社会開発協力部報告書

No. 8

LOCAL WATER UTILITIES ADMINISTRATION

MASTER PLAN AND FEASIBILITY STUDY OF THE LOCAL WATER SUPPLY PROJECTS IN THE REPUBLIC OF THE PHILIPPINES

DARAGA WATER DISTRICT

JUNE 1982

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request of the Government of the Republic of the Philippines, the Japanese Government decided to cooperate in formulating a master plan and making a feasibility study on the Local Water Supply Project and entrusted the work to the Japan International Cooperation Agency (JICA).

The JICA sent to the Philippines a survey team from 28 June 1981 to 27 December 1981. The team exchanged views with the officials concerned of the Government of the Philippines and conducted field surveys in the Ilocos Norte Province (Laoag City, Bacarra Municipality, Pasquin Municipality, Vintar Municipality and Paoay Municipality), the Albay Province (Legaspi City and Daraga Municipality) and the Bohol Province (Tagbilaran City). After the team returned to Japan, further studies were made and the present report has been prepared.

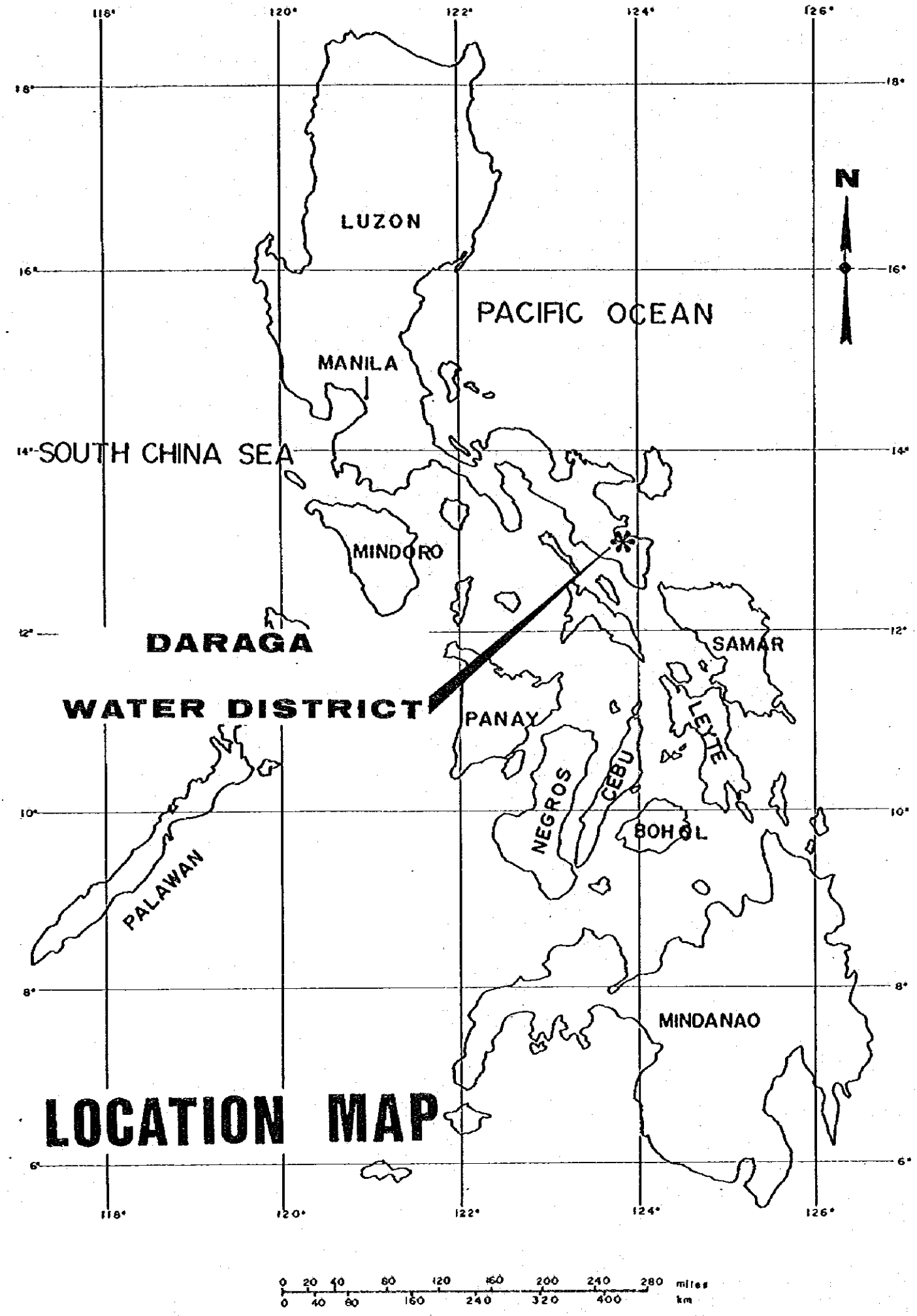
I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Republic of the Philippines for their close cooperation extended to the team.

June, 1982

Keisuke Arita

Keisuke Arita
President
Japan International
Cooperation Agency


118°
120°
122°
124°
126°
18°
16°
14°
12°
10°
8°
6°
N
LUZON
PACIFIC OCEAN
MANILA
SOUTH CHINA SEA
MINDORO
DARAGA
WATER DISTRICT
SAMAR
PANAY
LEYTE
NEGROS
CEBU
BOHOL
PALAWAN
MINDANAO
LOCATION MAP
0 20 40 80 120 160 200 240 280 miles
0 40 80 160 240 320 400 km

LIST OF CONTENTS

PART THREE: FEASIBILITY STUDY

APPENDIXES

ABBREVIATIONS

GOP	- the Government of the Republic of the Philippines
GOJ	- the Government of Japan
JICA	- the Japan International Cooperation Agency
LWUA	- the Local Water Utilities Administration
WD	- Water District
WTC	- willingness-to-connect
BPWS	- the Bohol Provincial Waterworks System
APWS	- the Albay Provincial Waterworks System
INMW	- the Ilocos Norte Metropolitan Waterworks
NEDA	- National Economic Development Authority
NCSO	- National Census and Statistics Office
BCGS	- Bureau of Coast and Geodetic Survey
NIA	- National Irrigation Administration
PAGASA	- Philippine Atmospheric, Geophysical and Astronomical Services Administration
NWRC	- National Water Resources Council
DPWTC	- Department of Public Works, Transportation and Communications
MPW	- Ministry of Public Works
mm	- millimeters
cm	- centimeters
m	- meters
km	- kilometers
cm^2, sq cm	- square centimeters
m^2, sq m	- square meters
km^2, sq km	- square kilometers
m^3, cu m	- cubic meters
cm/sec	- centimeters per second
m/sec	- meters per second
m^3/sec	- cubic meters per second
m^3/min, cu m/min	- cubic meters per minute

m^3/h, cu m/h	- cubic meter per hour
m^3/day, cu m/day	- cubic meters per day
l/sec	- liters per second
l/min	- liters per minute
l/c/d	- liters per capita per day
kg/cm^2, kg/sq cm	- kilograms per square centimeter
ha	- hectare
%	- percents
°C	- degrees centigrade
mg/l	- miligrams per liter
FTU	- function turbidity unit
pH	- potential of Hydrogen
ppm	- parts per million
mm/year	- millimeters per year
hp	- horse - power
rpm	- revolutions per minute
V	- volt
A	- ampere
kWh	- kilowatt-hour
kVA	- kilovolt-ampere
MVA	- mega volt-ampere
kW	- kilowatt
PVC	- polyvinyl chloride pipe
ACP	- asbestos cement pipe
CIP	- cast iron pipe
DIP	- ductile iron pipe
GSP	- galvanized steel pipe
SP	- steel pipe
Fig	- Figure

Currency Equivalent

US$1.00 = ₱7.80 (Philippine Peso)

Fiscal Year Period

from Jan. 1 to Dec. 31

SUMMARY

I. General

1.1 Physical and Socioeconomic Conditions

The Water District consists of Daraga poblacion and surrounding barangays. The poblacion lies on the alluvial plain developed by the Yawa River, and the built-up area of the poblacion adjoins with Old Albay of Legaspi City. The barangays are scattered on the mountain foot of Volcano Mayon. Major features of the District are as follows.

(1)	Location:	Southeast of the Luzon Island in the Philippines; 500 km away from Manila
(2)	Topography:	Alluvial plain, sea coast and Mt. Mayon (2,462 m)
(3)	Climate:	Tropical climate with plentiful precipitation and high temperature Rainfall: 3,260 mm/year Not much variable temperature throughout the day and the year (Average = 27.0°C)
(4)	Population:	73,213 in 1980, with 3.0% annual growth rate
(5)	Socio-Economic Conditions:	Identified as a commercial, trading center and educational center Dialect: Bicol (98%) Religion: Roman Catholic (98%) Public Water Supply: Existing, however poorly supplying Sewerage System: Not existing Electricity: 40% in electrification Transportation: One airport, one railway and highways

1.2 Existing Water Supply

Until the formation of the Water District in October, 1981, this District had been served by the waterworks of the Provincial Government including Legaspi City. Main water sources of the said waterworks are located in the District. Therefore, the District is to supply water in bulk to the Legaspi City Water District until the completion of the project of the latter. Water supply conditions are far from satisfactory because of overall deterioration of the existing facilities and some damages thereof by the mudflow caused by the heavy rain in 1981. Features of the water supply of the District are as follows.

(1)	System:	Started in 1920's with Banadero Spring and in 1930's with Budiao Spring. Presently managed by Daraga Water District.
(2)	Water Source:	Two major springs of Budiao and Sanadero
(3)	Distribution System:	19,865 m of distribution mains with diameters of 200 - 50 mm No regulating reservoirs
(4)	Present Water Use:	Maximum supply = 2,080 cu m/day from Budiao Spring Served Population = 17,900 Service Connections = Total 1,229 including 1,125 domestic connections
(5)	Water Rate	Peso 11.00 per month for domestic (Minimum charge for the first 20 cu m)

II. Master Plan

A period from the present up to the year 2010 was taken for the design period of the master plan of Daraga Water District water supply. Served population was planned to gradually increase from the present served population 17,900 (24% of total population) to 67,806 (55%) at the end of the design period. Based on the served population, future water demand was projected.

Potential water sources to meet the projected water demand were investigated in and around the project area, including springs and riverbed water. Riverbed water of the Yawa River in addition to the existing spring was selected for future use.

The whole master plan period was divided into three Phases I, II and III. Phase I covers a period up to the year 1987 and plans to increase the supply capacity by rehabilitation of the water sources and some improvement of transmission facilities. Phase II covers a period up to the year 1993 after Phase I, and plans to increase the supply capacity by improvement of the transmission facilities. The rest period is Phase III.

Major figures and work items are tabulated below.

(1)	Target Year:	Phase I	= 1987
		Phase II	= 1993
		Phase III	= 2010
(2)	Service Area:	Present	: 400 ha
		1987	: 680 ha
		1993	: 1,480 ha
		2010	: 1,850 ha
(3)	Population Projection:	Present	: 73,210
		1987	: 85,850
		1993	: 94,980
		2010	: 122,340

(4) Served Population:

Present	:	17,900 (24%)
1987	:	23,270 (27%)
1993	:	39,240 (41%)
2010	:	67,806 (55%)

(5) Water Demand:

Present	:	1,720 cu m/day
1987	:	5,203 cu m/day
1993	:	7,608 cu m/day
2010	:	15,811 cu m/day

(6) Water Sources:

Present	:	4 springs
1987	:	"
1993	:	"
2010	:	4 springs + Riverbed water

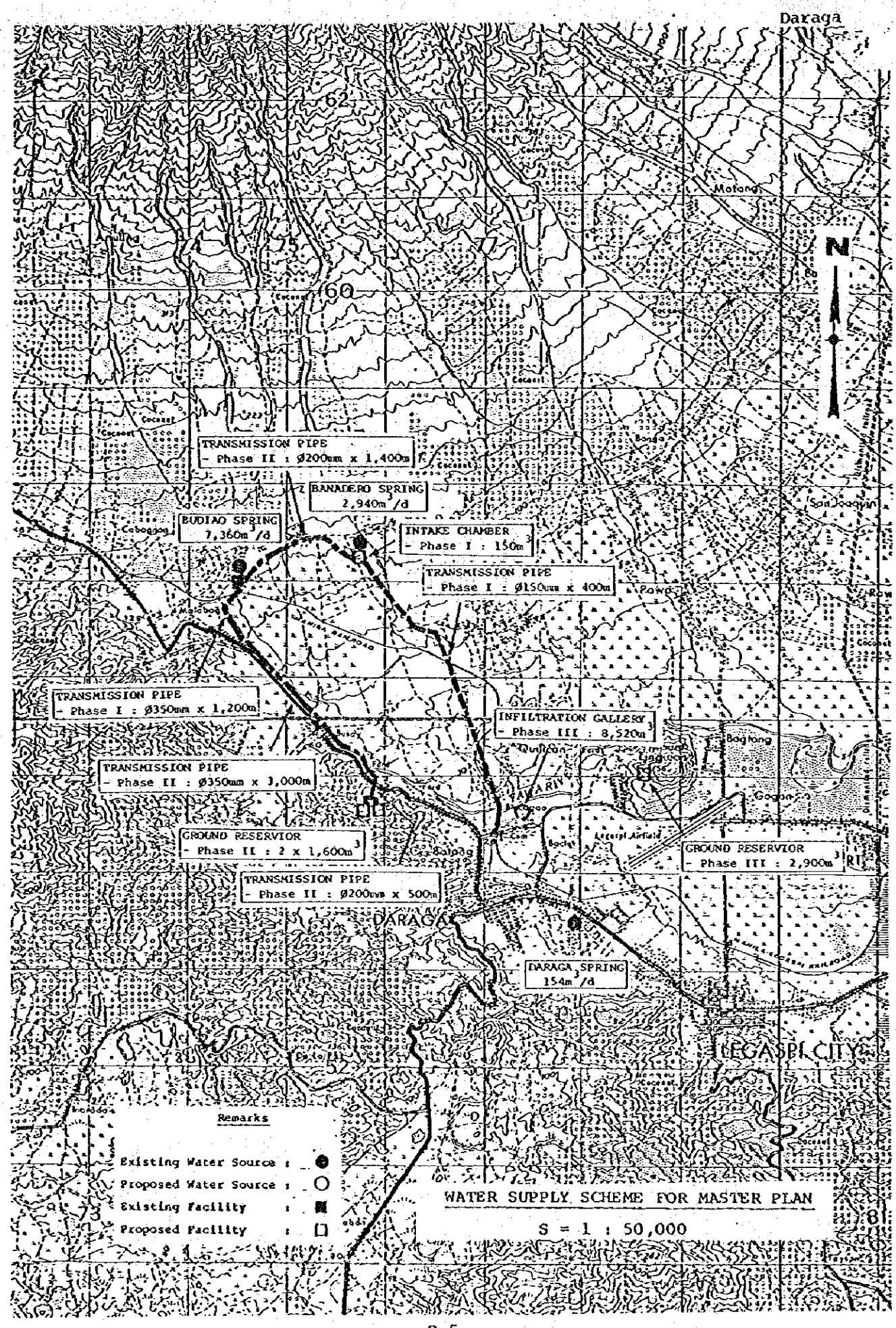
(7) Facilities to be Constructed:

See page 6.

(8) Project Cost:

	Phase I	Phase II	Phase III
Foreign	$0.58 M	$ 2.12M	$ 2.77M
Local	$0.38 M	$1.40 M	$ 1.72M
Total	$0.96 M	$ 3.52M	$ 4.49M

(Costs as of July 1981: Not including price escalation)


Daraga
N
TRANSMISSION PIPE
- Phase II : Ø200mm x 1,400m
BANADERO SPRING
2,940m³/d
BUDIAO SPRING
7,360m³/d
INTAKE CHAMBER
- Phase I : 150m³
TRANSMISSION PIPE
- Phase I : Ø150mm x 400m
TRANSMISSION PIPE
- Phase I : Ø350mm x 1,200m
INFILTRATION GALLERY
- Phase III : 8,520m³
TRANSMISSION PIPE
- Phase II : Ø350mm x 3,000m
GROUND RESERVIOR
- Phase II : 2 x 1,600m³
GROUND RESERVIOR
- Phase III : 2,900m³
TRANSMISSION PIPE
- Phase II : Ø200mm x 500m
DARAGA
DARAGA SPRING
154m³/d
LEGASPI CITY
Remarks
Existing Water Source :
Proposed Water Source :
Existing Facility :
Proposed Facility :
WATER SUPPLY SCHEME FOR MASTER PLAN
S = 1 : 50,000

Facilities to be Constructed

Phase I	Phase II	Phase III
i) Budiao/Banadero System a. Transmission pipeline of a part of Budiao System b. Bulk meters c. Chlorinators d. Daraga Spring System ii) Others a. Expansion of distribution pipelines b. Water meters c. Fire hydrants	i) Budiao/Bunadero System a. Transmission pipeline from Banadero Spring to Budiao Spring b. Transmission pipeline from Budiao to new reservoir c. Reservoir d. Pumps at Banadero Spring e. Chlorinators ii) Others a. Expansion of distribution pipelines b. Water meters c. Fire hydrants	i) Infiltration Gallery System a. Infiltration gallery b. Reservoir c. Transmission pipeline from the gallery to the reservoir d. Bulk meters e. Chlorinators ii) Others a. Expansion of distribution pipelines b. Water meters c. Fire hydrants

III. Feasibility Study

Feasibility study was carried out for two potential cases: Case 1 study was made on the Phase I project, and Case 2 study on the combined project of Phases I and II. The Phase I project places emphasis on rehabilitation of the existing water sources and partial replacement of the transmission line. The Phase II project intends to lay a connection line from Banadero to Budiao and replace part of the existing transmission line, in addition to construction of a reservoir.

The results of the above study indicate that both projects are feasible. The only difference is that the Case 2 is to given a government subsidy of 20% of the total project cost.

(1) Implementation Schedule:

Phase I : 1982 - 1985
Phase II : 1982 - 1988

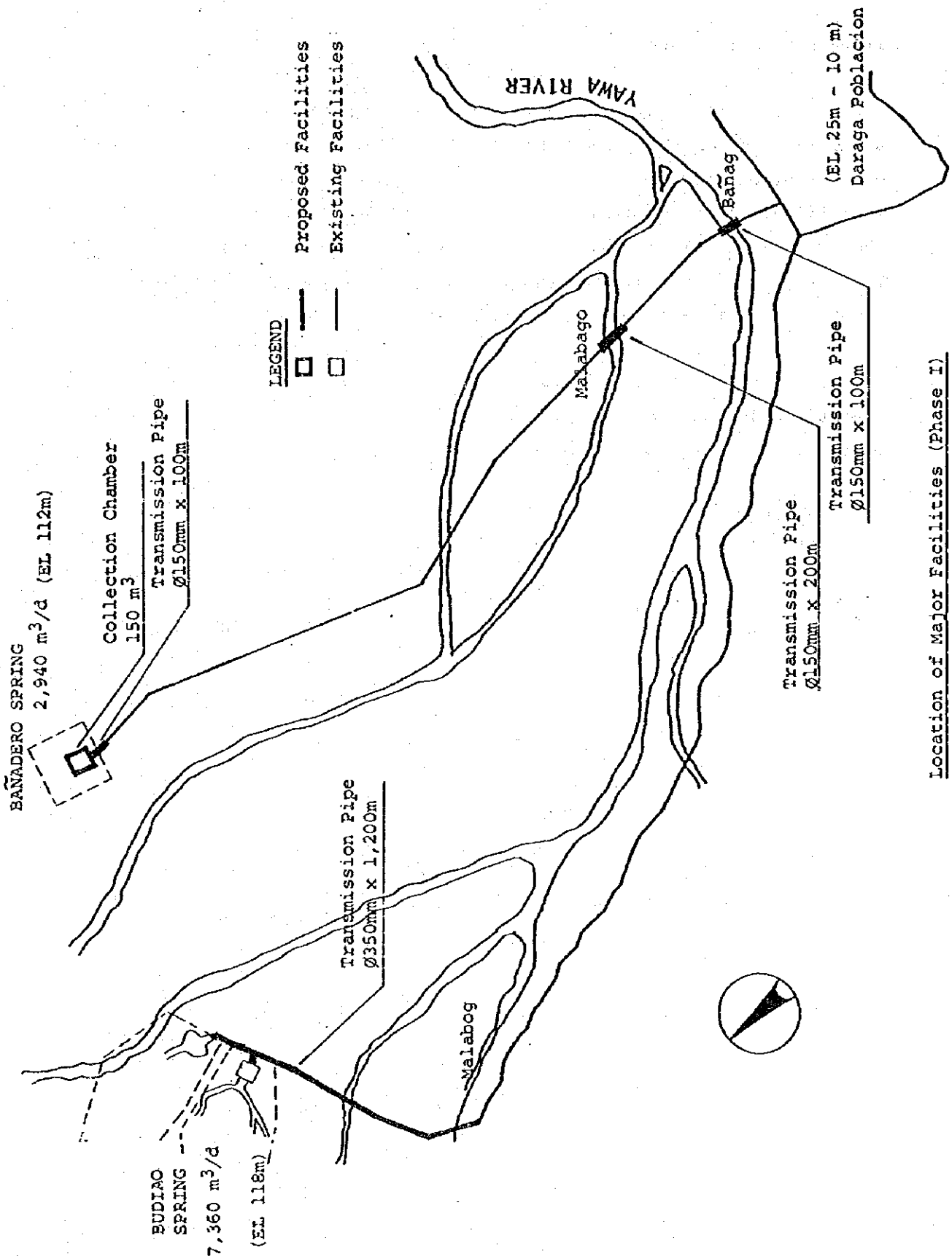
(2) Project Costs:

	Phase I	Phase I + II
Foreign	$0.91 M	$3.84 M
Local	$0.60 M	$2.67 M
Total	$1.51 M	$6.51 M

(Costs including price escalation according to implementation schedule)

(3) Financial Feasibility:

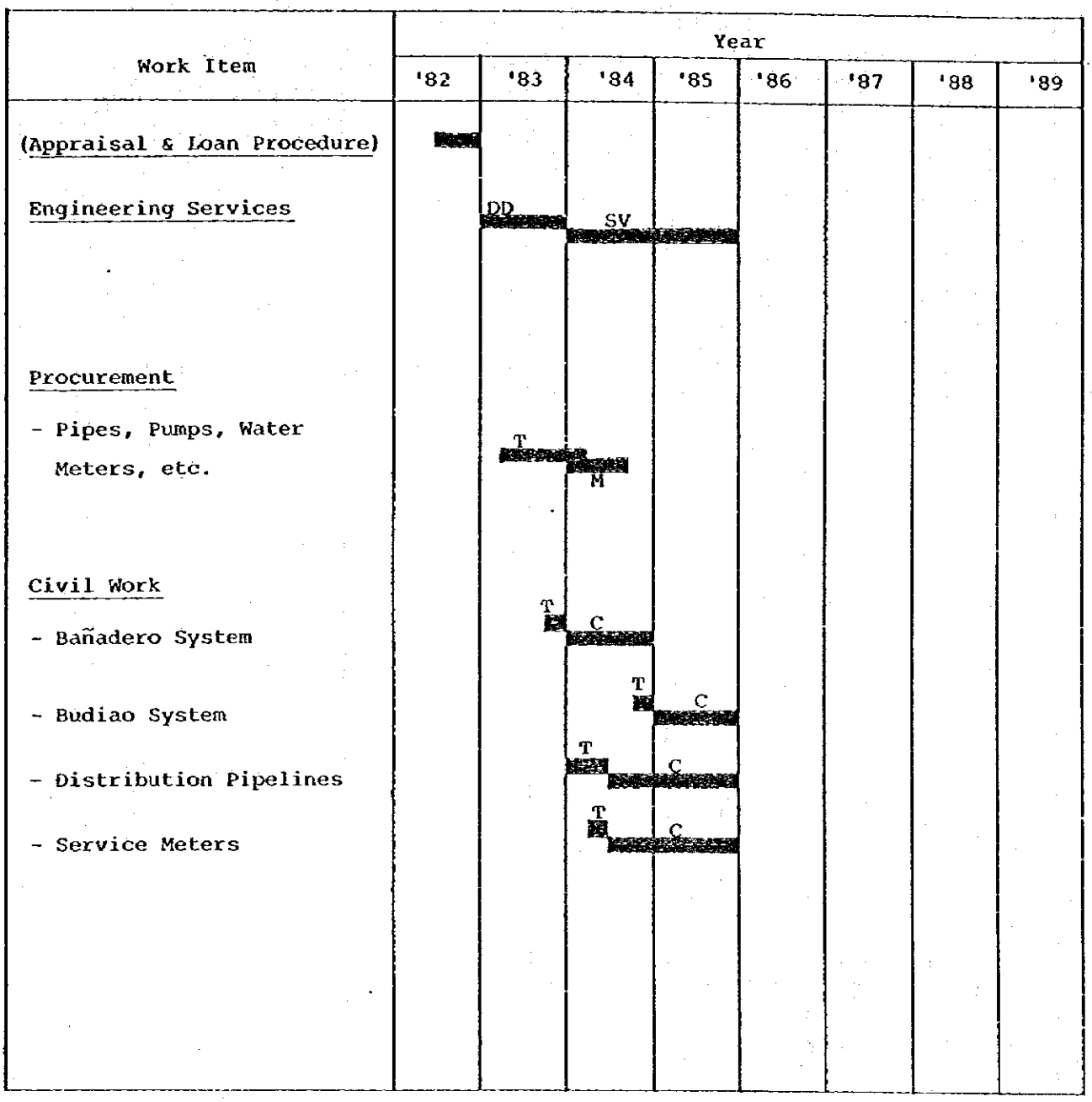
Phase I : Feasible
Phase I + II : Feasible with government subsidy of 20% of total investment cost



Location of Major Facilities (Phase I)

Construction Schedule for Phase I

(Target Year: 1987)



Note: DD = Detailed Design
SV = Supervision of Construction
T = Tendering Procedure (Advertisement/Tendering/Evaluation/Award)
M = Manufacturing & Shipping
C = Construction/Installation

Construction Cost for Phase I

(Target Year: 1987)

Note: - Unit = One Thousand Pesos = '000 Pesos
- Prices as of 1st July 1981
- Foreign Exchange Rate: US $ 1.00 = Peso 7.80

Work Items	Cost		
	Total Cost	Foreign Currency Component	Local Currency Component
A. Banadero System	1,030	396	634
B. Budiao System	1,723	1,028	695
C. Reinforcement/Expansion of Distribution Pipelines	1,665	1,115	550
D. Equipment	1,457	1,063	394
Sub Total	5,875	3,602	2,273
Detailed Design Cost (10.5%)	617	378	239
Supervision Cost (3.5 %)	206	126	80
Land Cost	100	-	100
Total	6,798	4,106	2,692
Physical Contingency (10 %)	680	411	269
Total	7,478	4,517	2,961
Price Contingency	4,311	2,592	1,719
Grand Total (Project Cost)	11,789	7,109	4,680
	(Equivalent to US$1.51 M)	(Equivalent to US$0.91 M)	(Equivalent to US$ 0.60M)

Water Rate Schedule
(Phase I)

DOMESTIC AND GOVERNMENTAL SERVICE CONNECTIONS, 1/2"

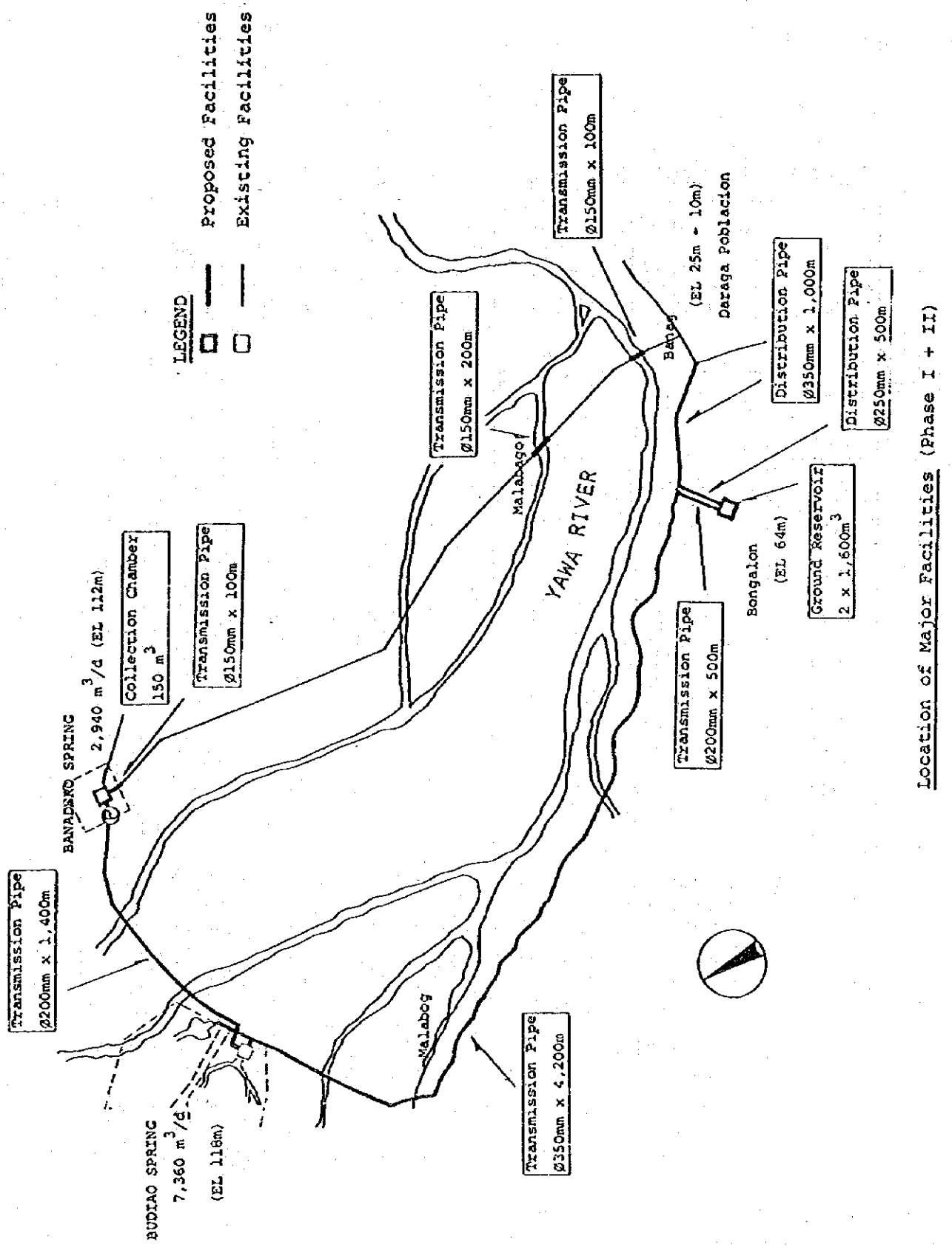
Year	First 10 m^3 1/	Charge for Each Added m^3 2/			Charge 3/ per Revenue Unit
		11-20	21-45	over 45	
1981	17.50	0.84	0.98	1.19	0.70
1982	17.50	0.84	0.98	1.19	0.70
1983	26.00	1.25	1.46	1.77	1.04
1984	26.00	1.25	1.46	1.77	1.04
1985	26.00	1.25	1.46	1.77	1.04
1986	28.50	1.37	1.60	1.94	1.14
1987	28.50	1.37	1.60	1.94	1.14
1988	34.00	1.63	1.90	2.31	1.36
1989	34.00	1.63	1.90	2.31	1.36
1990	42.00	2.02	2.35	2.86	1.68
1991	42.00	2.02	2.35	2.86	1.68
1992	50.75	2.44	2.84	3.45	2.03
1993	50.75	2.44	2.84	3.45	2.03

Note: 1/ To obtain charge per m^3 for the first 10 m^3 classified by connection size, multiply R.U. charge shown in 3/ above by the following connection size factors.

Domestic : 1.0 for 3/8"; 2.5 for 1/2"; 4.0 for 3/4"; 8 for 1"
Commerical: 5.0 for 1/2"; 8.0 for 3/4"; 16.0 for 1"; 40.0 for 1 1/2"

2/ To obtain charge for each added m^3, multiply R.U. charges shown in 3/ by the following block factors.

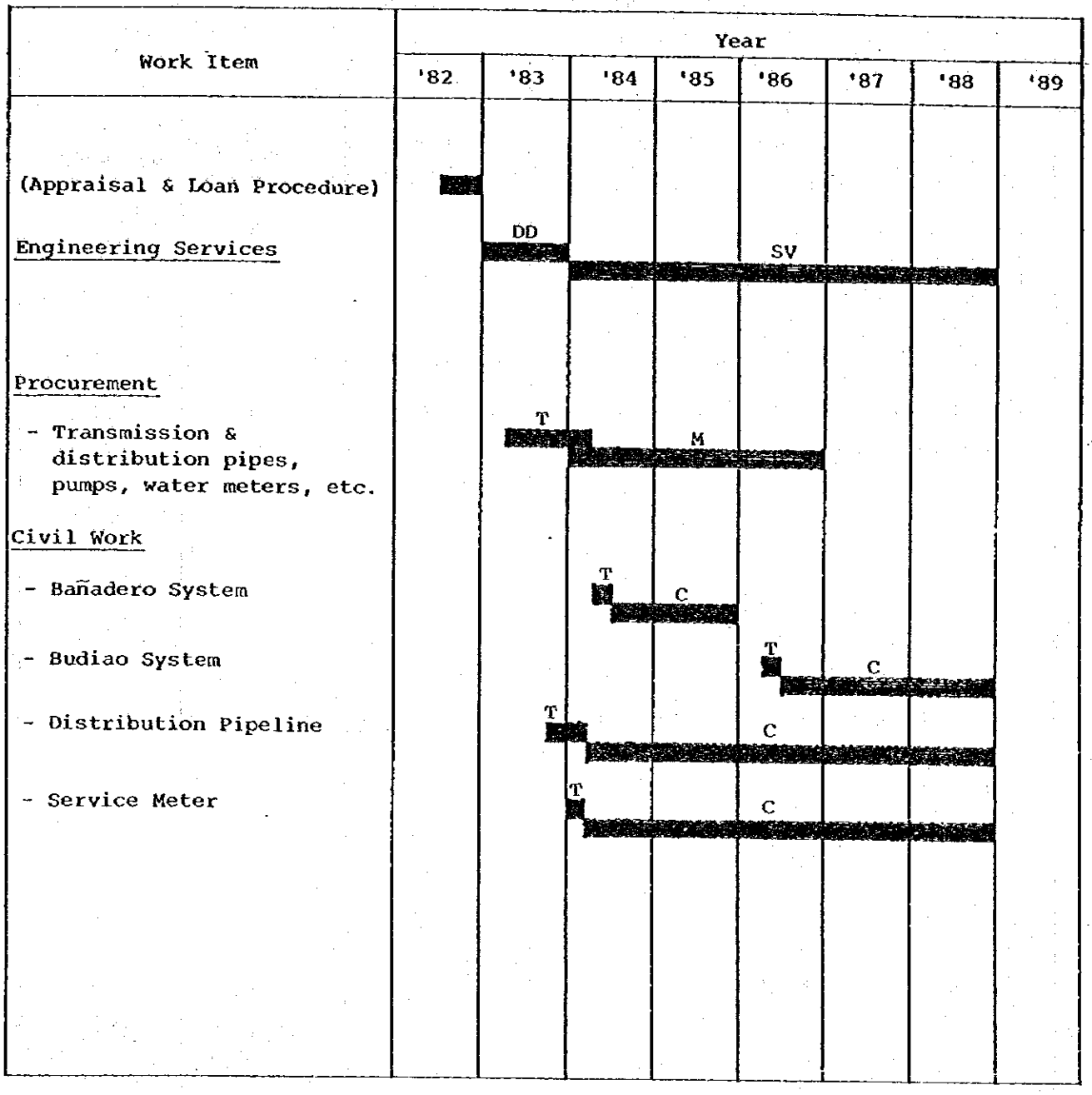
Domestic : 1.2 for 11-20 m^3; 1.4 for 21-45 m^3; 1.7 for over 45 m^3
Commercial: 2.4 for 21-45 m^3; 2.8 for 46-100 m^3; 3.4 for over 100 m^3



Location of Major Facilities (Phase I + II)

Construction Schedule for Phase I + II

(Target Year: 1993)



Note: DD = Detailed Design
SV = Supervision of Construction
T = Tendering Procedure (Advertisement/Tendering/Evaluation/Award)
M = Manufacturing & Shipping
C = Construction/Installation

Project Cost for Phase I + II

(Target Year: 1993)

Note: - Unit = One Thousand Pesos = '000 Pesos
- Prices as of 1st July 1981
- Foreign Exchange Rate: US $ 1.00 = Peso 7.80

Work Items	Cost		
	Total Cost	Foreign Currency Component	Local Currency Component
A. Banadero System	2,824	1,530	1,294
B. Budiao System	9,695	5,210	4,485
C. Reinforcement/Expansion of Distribution Pipelines	4,633	3,105	1,528
D. Equipment	5,662	4,249	1,413
Sub Total	22,814	14,094	8,720
Detailed Design Cost (10.5%)	2,396	1,480	916
Supervision Cost (3.5 %)	798	493	305
Land Cost	156	-	156
Total	26,164	16,067	10,097
Physical Contingency (10 %)	2,617	1,607	1,010
Total	28,781	17,674	11,107
Price Contingency	21,987	12,273	9,714
Grand Total (Project Cost)	50,768	29,947	20,821
	(Equivalent to US$6.51 M)	(Equivalent to US$3.84 M)	(Equivalent to US$2.67 M)

RECOMMENDATIONS

1. Implementation of the Project

The water supply Master Plan proposed a long term development program up to the year of 2010, and recommended its implementation by stages, namely, Phase I up to 1987, Phase II up to 1993, and Phase III up to the final target year 2010.

In accordance with the above recommendation, the present feasibility study was made with regard to two cases, i.e., Case 1 for Phase I project, of which the major intention is to maximize use of the existing facilities, together with urgent improvements and reinforcement works, and Case 2 for a combined project to Phase I and II, which includes, in addition to the Phase I works, development of a new water source/s and pipeline extension works.

The results of the study of the two cases indicate that both cases are technically and financially feasible, meeting satisfactorily the basic requirements concerning loan ceiling, water rate and consumers' paying ability. Case 2, however, is based on the given conditions that a national subsidy equivalent to 20% of the total project cost will be provided to the project.

As regards implementing the water supply development project, it is desirable to consider the Case 2 project, because it can meet the water requirement over a medium term future, contributing to the unimpeded social development of the community concerned. Decision of the implementation must be made solely depending on the national policy. If case 1 should be selected for implementation, the Phase II project should, needless to say, follow immediately the Phase I project.

2. Technical Recommendations

1) Periodic Review of Master Plan

In preparing and drawing out the present water supply master plan and feasibility study some assumptions were inevitably made owing to insufficiency of necessary data, and furthermore, the projected development of the area, together with water consumption, may possibly differ from the actual future development. Therefore, review and revision of the present report is recommended from time to time as required, at least once every five years after the commencement of the operation of Phase I or before implementation of the subsequent phases.

2) Population and Water Demand

Population growth may be influenced by changes in the social conditions and industrial development in the area, and water demand will be affected accordingly. Therefore, population, both total and served, and water demand should be continuously reviewed, and in addition the categorized water demand should be calculated. It is advisable to revise the projected figures in the master plan according to the above review.

3) Water Loss and Metering

Loss of water from the water supply system means insufficient operation and maintenance of resources and loss of revenue to the district. To maintain sound management and self-sustaining Water District, loss of water must be prevented by all means. Loss of water can be known by the metering of water production and consumption, and, by analyzing the results of metering, causes of and remedies for such loss can be established. Installation and maintenance of meters, on account of this, is essential for production points and all consumers' connections.

4) Future Merger of the Two Water Districts

The water demand in the short term can be met, as planned in the present master plan, by springs rather closely located to the two water districts, namely Daraga WD and Legaspi City WD. The water demand in the long term projection, however, has to be met by more costly developments of water sources on a large scale. In order to attain the least cost system construction and management of the water supply in the means concerned, it is most desirable for the two water districts to merge as early as practicable.

5) Safety and Palatability of Water

The existing water supply system of the Daraga WD has chlorination equipments to disinfect the water to supply. To insure the safety of tap water, chlorination has to be constantly conducted, but the existing equipment is not necessarily well attended to satisfy this purpose. Some improvement is required.

6) Arrangement for Transition Period

It was only recently that the two water districts, Daraga and Legaspi City, were formed and the operation of the water supply facilities and management of the water supply business were started on an independent basis. However, until completion of the water source facilities of the Legaspi City Water District, the bulk supply from the Daraga water system must be continued. In this connection, even the necessary works are included in Phase I implementation, the following technical arrangement is recommended to be executed as soon as possible.

i. To rehabilitate Banadero Spring system to supply the available water from the spring.

ii. To make full use of the Daraga Spring at the campus of the B.U. pilot elementary school.

7) Improvement of Plumbing System

Since the water pressure has been extremely low so far, most of the plumbing system have been built in an abnormal way, namely, corporation cocks are fitted at the bottom of pipe, or pumps are installed onto the main, or private storage tanks and pumps are provided to plumbing systems. When the water pressure is heightened to the normal level by the project, all these devices will become causes for water loss. Therefore, all the plumbing systems must be checked and irregular devices be taken away. On the other hand, when there is an application for connection to the main, the design must be checked before execution so as to make sure the design is made in accordance with normal practice.

8) Measures to be Immediately Taken

Reduction of leakage and wastage is the most effective measure to substantially increase water supply. As water shortage in the served area is presently very acute, it is recommended, that the newly formed water district, should concentrate its effort on reduction of leakage and wastage even before the proposed project is started. Water thus saved can alleviate the suffering of the customers from water shortage, and may in addition be supplied to new customers. Besides, the financial position of the water district will be accordingly improved.

At present, leakage and wastage from the plumbing systems account for more than half that of the whole water supply system. Therefore, to maximize the results of the leakage abatement activities, all existing service systems should be inspected, and all leaks thereof be repaired.

Further, to discourage wasteful use of water, all the connections should be metered. If required, fund necessary for metering should be borrowed on a short term basis, though the cost for meter procurement and installation is provided in the present project cost.

9) Riverbed Observation

It is recommended to study the long-period seasonal movement of the riverbed of the Yawa, although the present planning selected a site for infiltration gallery which is considered to hardly be affected by flow, before construction and thereafter, in order to keep the original function of infiltration gallery to be installed.

10) Riverbed Water Quality

Although the riverbed water has presently good quality suitable for drinking, it may undergo changes in the future when more population concentrate along the river. Against such probable pollution of the river water, and further riverbed water, the following is recommended.

(1) To observe the variation of the riverwater quality by regular sampling and analysis.
(2) To observe the variation of the riverbed water quality after the commencement of the infiltration gallery operation.
(3) To watch the siting of factories which may discharge wastewater.
(4) To record the increase of population in the river basin.

When any sign of undesirable pollution is noticed, measures must be taken against wastewater with harmful quality, or for installation of a sewerage system, or addition of treatment processes to riverbed water, such as chlorination plus sand filtration method.

11) Water Right

Intake of water for water supply from water sources, such as springs and riverbed water, and construction of facilities for such water intake should be authorized/approved by authorities in charge in compliance with relevant laws and regulations. It is, therefore, recommended that formal procedures for such authorization/approval be taken before the implementation of the present project.

PART ONE: GENERAL

1. Introduction

1.1 Authorization

The present report on water supply master plan and feasibility study is prepared in accordance with the terms of reference of the Contract for the Engineering Services (the work) made between the Japan International Cooperation Agency (JICA) and Nihon Suido Consultants, Co., Ltd. (the Consultant) on June 22, 1981. The work was earlier requested by the Government of the Philippines to the Government of Japan, and the latter decided to undertake the work through JICA within the frame of the international cooperation program. With regard to execution of the present work, the leading agency of the Government of the Philippines is the Local Water Utilities Administration (LWUA).

1.2 Objective and Scope

The objective of the work is to establish a comprehensive water supply plan for the Daraga Water District (Study area) for a long term period up to the year of 2010, including preparation of a project having a highest priority for immediate implementation. The project, with such priority, will be studied with regard to its feasibility in the aspects both technical and financial in PART THREE.

The Scope of the master plan covers:

1) Data collection and analysis
2) Establishment of the target year for planning,
3) Definition of served area for planning,
4) Estimation of population,
5) Estimation of water demand,

6) Study of present status of waterworks,
7) Study of water source,
8) Planning of water supply system,
9) Rough estimation of costs for construction, operation and maintenance,
10) Preparation of implementation schedule,
11) Study of Interim Program,
12) Socio-economic study, and
13) Studies of organization, operation and management plan.

The scope of the feasibility study covers:

1) Definition of the target year,
2) Definition of project area,
3) Estimation of population to be served,
4) Estimation of the water demand,
5) Study of improvement of existing facilities,
6) Study of water source,
7) Study of required facilities and layout of facilities,
8) Study of design criteria,
9) Preliminary design,
10) Preparation of construction schedule,
11) Study of construction materials and labour force and study of construction ability of local contractors,
12) Preparation of construction method and procurement method of materials and equipments,
13) Estimation of costs for construction, operation and maintenance,
14) Estimation of benefits,
15) Financial analysis,
16) Studies of organization, operation and management plan, and
17) Preparation of Implementation program.

1.3 Terminology

The following words and terms in the present report mean as set forth below:

(a) Water District - local water district formed pursuant to the Provincial Water Utilities Act.
(b) Rural Waterworks Association - a rural waterworks association organized pursuant to the Executive Order No. 577.
(c) Level I system - developed point source, such as artesian well or protected spring, generally suited for clusters of around 15 households for a shallow well and 50 households for a deep well.
(d) Level II system - Level I plus a system of communal faucets, generally suited for more dense clusters of around 100 households.
(e) Level III system - system of individual house connections.
(f) Point Source - generally a protected well or a spring with no distribution system, which has a distance to the farthest user of no more than 250 m.
(g) Poblacion - an urbanized area in a city/town
(h) Barangay - a political unit or community in a city/town, however "Barangay" in this Report refers to that which is located outside of a poblacion.

1.4 Compilation of the Report

The existing water supply system was formerly owned and operated by the Albay Provincial Waterworks System and covers most of three poblacions of Daraga, Old Albay and Legaspi Port, and some barangays along the transmission lines. However, two water districts, one for the Municipality of Daraga and the other for the City of Legaspi, were formed in October 1981, the water supply system has been split into two systems under separate ownership and management, although the facilities have physically some connections. Real separation of the existing system can be achieved only when the plan are implemented to a large extent. Taking into account these circumstances, Part One: General of the present report will describe the general conditions and the water supply systems of the Provincial Waterworks area immediately before the formation of the two water districts, Legaspi City and Daraga, and Appendices covering all studies and investigations performed in the same area will be attached.

2. Present Conditions of the Study Area

2.1 Natural Conditions

2.1.1 Location

The study area consisting of the City of Legaspi and the Municipality of Daraga is located in the southeast of the Albay Province along the seacoast. The area is about 500 km away from Manila, and is linked with the latter by highway, railroad and airway. In addition, there is a good seaport, which connects with other ports in the country for transportation of goods. The City of Legaspi is the capital of the Province and forms a center of local administration, education and commerce.

2.1.2 Topography

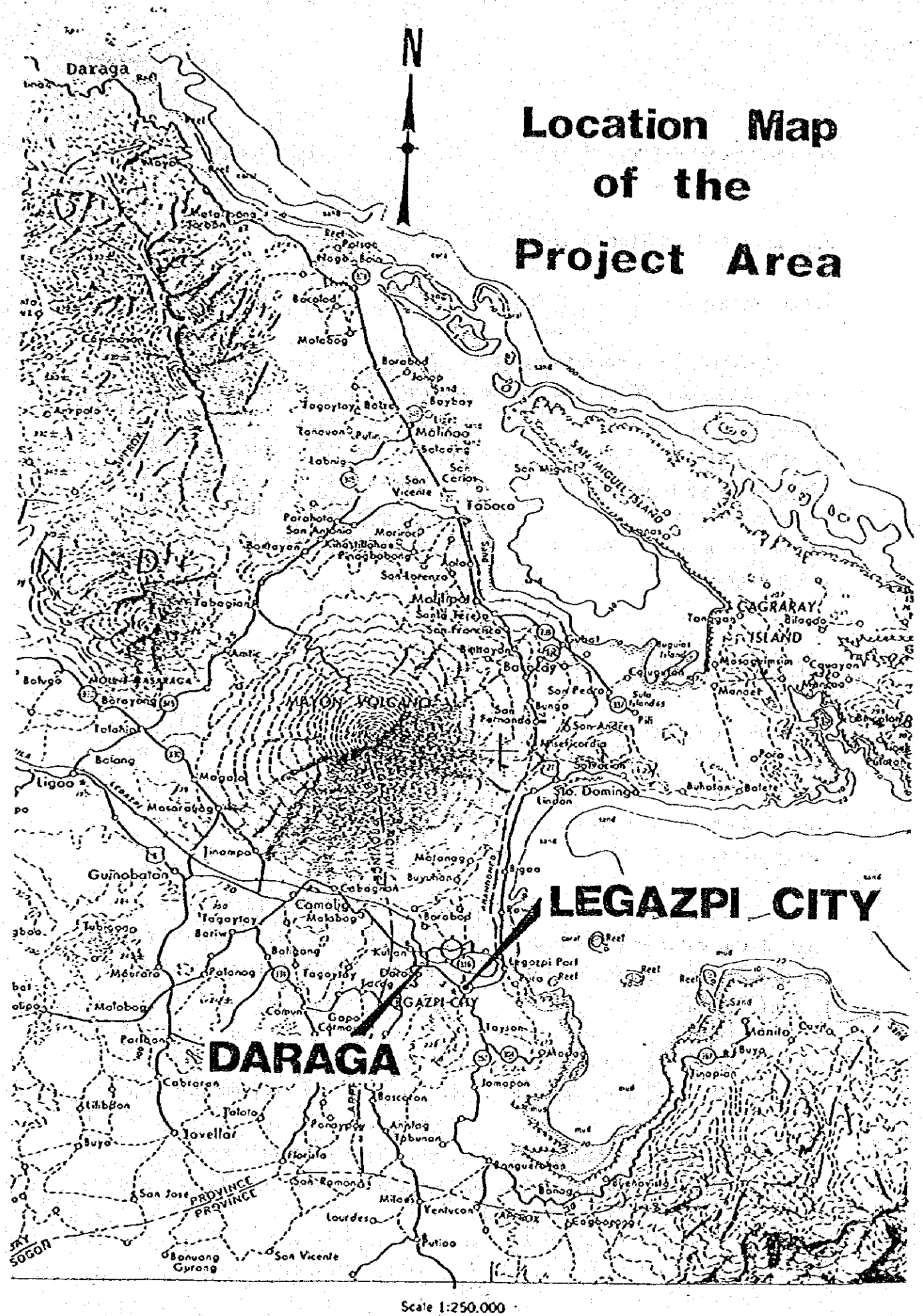
The study area includes mountains, an alluvial plain and the seacoast. An outstanding one of the mountains is the active volcano Mt. Mayon with an elevation of 2,462 m above sea level, which rises in the north of the area. Its gently sloped foot spreads into the study area, and to the sea on the east.

The Yawa River, which flows from west to east along the southern end of the volcano foot, has developed an alluvial plain. The built-up areas of the Daraga municipality and the Legaspi city are situated in this plain.

In the center of the plain and on the south bank of the Yawa River, there is Mt. Linguion, 165 m high, which is an old extinct volcano.

In the south of the study area, the lower Catabrean mountains stretch toward far south beyond the boundary of the area.

Location Map of the Project Area



Three poblacions, Daraga, Old Albay and Legaspi Port, are in the plain with fairly dense population. The last named poblacion has a seaport, constructed taking advantage of the favorably shaped seacoast.

2.1.3 Geology

Geologically, the study area has three distinct areas, i.e., the Mt. Mayon, the alluvial plain and the lower Catabrean mountanous areas.

The Mt. Mayon area comprises lava flows, andesite, scoria and volcanic ash in the higher portion of the mountain slope, and mud-flows in addition to the above in the lower portion. The latter portion is predominantly covered with mud-flows, forming the gentle and smooth slope of the vast mountain skirts.

The alluvial plain has formations consisting of lapilli, volcanic sand ash, and clay. All these originate from the eruptions of Mt. Mayon and the formations of the lower mountains. The alluvial plain has been formed by the Yawa River with the transported material.

The lower mountainous area is formed of the Daraga formation, which consists of lava flows, agglomerates, volcanic breccia, tuff with interbeds of conglomerates, sand and shale.

2.1.4 Climate

The study area belongs to the tropical climate zone, with plentiful precipitation all through the year and high temperature. The period from November to January, in particular, is prominent in rainfall having a maximum monthly average of 415.3 mm, and the period from February to October has a high monthly average of 223.4 mm. The annual average rainfall is 3,256.4 mm (normal 1951-70), which is higher than that of the whole country, 2,500 mm. The area has no definite dry season.

Daraga

The temperature is generally high and not much variable through the day and the year. The annual mean temperature is 27.0°C.

The area is situated on the typhoon belt and in the latter half of the year it is rather frequently hit by typhoons. Tropical depressions pass the area bringing abundant rains during the high rainfall months.

Table 1.2.1 Climate Record, Legaspi City

(Period: 1951 - 1970, Normal)
Source of Data: Annual Climatological River (PAGASA, March 1980)

Month	Rainfall (mm)	Rainy Days	Relative Humidity (%)
January	301.5	22	84
February	176.1	17	82
March	207.5	17	82
April	172.6	17	82
May	182.1	14	82
June	205.3	16	82
July	229.8	19	84
August	282.8	20	85
September	247.2	20	85
October	307.2	20	85
November	478.2	21	85
December	466.2	23	85
Annual	3,256.4	226	84

2.2 Population

The Population Census conducted in May 1980 registered a population of 98,787 for Legaspi City and that of 73,213 for Daraga; or an increase of 10,409 persons over the 1975 censual figures of 88,378 for Legaspi City and an increase of 9,948 persons for Daraga.

Table 1.2.2 (1) Past Population Trend: Legaspi City (1970 - 1980)

Barangay	Population			Average Annual Growth Rates (%)		
	1970	1975	1980	1970-75	1975-80	1970-80
LEGASPI PORT DISTRICT						
1. Arimbay	1,422	1,653	1,817	3.1	1.9	2.5
2. Bagon Abre	460	558	745	3.9	6.0	4.9
3. Bigaa	2,816	3,036	3,262	1.5	1.4	1.5
4. Buyuan	1,463	1,934	2,117	5.7	1.8	3.8
5. Dap-dap	1,714	1,447	1,911	-3.4	5.7	1.1
6. Dita	532	634	724	3.6	2.7	3.1
7. Gogon	2,259	1,585	2,770	-7.3	11.8	2.1
8. Legaspi City Proper (u)	35,911	19,694	19,291	-	-0.4	-
9. Padang	901	996	1,450	2.0	7.8	4.9
10. Puro	2,154	2,639	3,069	4.1	3.1	3.6
11. Rawis	1,783	2,163	2,381	3.9	1.9	2.9
12. San Joaquin	785	905	1,105	2.9	4.1	3.5
13. San Roque	4,137	3,106	3,234	-5.9	0.8	-2.5
14. Tamadyan	482	576	611	3.6	1.2	2.4
Sub-Total	57,179	40,926	44,487	-	1.7	-
Note: (u) Urban						
ALBAY DISTRICT						
1. Bagacay	885	826	904	-1.4	1.8	0.2
2. Banquerohan	2,588	2,354	2,671	-1.9	2.6	0.3
3. Bariis	1,352	1,490	1,611	2.0	1.6	1.8
4. Bogna	2,463	2,580	2,946	0.9	2.7	1.8
5. Bogtong	1,496	1,707	1,974	2.7	2.9	2.8
6. Buenavista	352	403	530	2.7	5.6	4.2

- to be continued -

Table 1.2.2 (2) Past Population Trend: Legaspi City
(1970 - 1980)

Barangay	Population			Average Annual Growth Rates (%)		
	1970	1975	1980	1970-75	1975-80	1970-80
7. Cagbacong	1,619	1,705	2,045	1.0	3.7	2.4
8. Poblacion (u)		18,030	21,530	-	3.6	-
9. Cruzada	1,410	1,507	1,760	1.3	3.2	2.2
10. Estanza	1,533	1,683	1,927	1.9	2.7	2.3
11. Homapon	2,014	2,249	2,378	2.2	1.1	1.7
12. Imalnod	811	902	944	2.1	0.9	1.5
13. Mabini	625	841	937	6.1	2.2	4.1
14. Maritawa	828	1,020	1,282	4.3	4.7	4.5
15. Maslog	2,568	2,701	2,682	1.0	-0.1	0.4
16. Pawa	2,049	2,196	2,323	1.4	1.1	1.3
17. San Francisco	1,132	1,157	1,457	0.4	4.7	2.6
18. Taysan	3,186	4,101	4,399	5.2	1.4	3.3
Sub-Total	26,911	47,452	54,300	-	2.7	-
T O T A L	84,090	88,378	98,787	1.00	2.3	1.62

Note: (u) Urban

Table 1.2.3 (1) Past Population Trend: Daraga Municipality (1970 - 1980)

Barangay	Population			Average Annual Growth Rates (%)		
	1970	1975	1980	1970-75	1975-80	1970-80
1. Alcala	1,503	1,607	1,768	1.3	1.9	1.6
2. Alobo	439	536	581	4.1	1.6	2.8
3. Anislag	2,218	2,448	2,819	2.0	2.9	2.4
4. Bagumbayan	951	1,121	1,280	3.3	2.7	3.0
5. Balinad	1,031	1,190	1,331	2.9	1.1	2.6
6. Banadero	917	1,070	1,158	3.1	1.6	2.4
7. Banag	1,268	1,314	1,775	0.7	6.2	3.4
8. Bascaran	1,608	1,698	2,241	1.1	5.7	3.4
9. Bigao	675	731	657	1.6	-2.2	-0.3
10. Binitayan	1,144	1,579	2,323	6.7	8.0	7.3
11. Bognalon	463	539	610	3.1	2.5	2.8
12. Budiao	985	1,218	1,417	4.3	3.1	3.7
13. Burgos	729	778	831	1.3	1.3	1.3
14. Busay	748	985	1,228	5.7	4.5	5.1
15. Canarom	543	520	587	-0.9	2.6	0.8
16. Culiat	576	780	861	6.3	2.0	4.1
17. De la Paz	444	426	482	-0.8	2.5	0.8
18. Dinoronan	368	407	386	2.0	-1.1	0.5
19. Gabawan	871	971	1,223	2.2	4.7	3.5
20. Gapo	1,240	1,591	1,520	5.1	-0.9	2.1
21. Ibaugan	317	382	447	3.8	3.2	3.5
22. Inarado	968	1,129	1,193	3.1	1.1	2.1
23. Kidaco	337	410	512	4.0	4.5	4.3
24. Kilicao	1,775	1,696	2,182	-0.9	5.2	2.1
25. Kimantong	1,176	1,252	1,527	1.3	4.1	2.6
26. Kinawitan	462	421	421	1.9	0	1.9
27. Kiwalo	571	656	709	2.8	1.6	2.2

- to be continued -

Table 1.2.3 (2) Past Population Trend: Daraga Municipality (1970 - 1980)

Barangay	Population			Average Annual Growth Rates (%)		
	1970	1975	1980	1970-75	1975-80	1970-80
28. Lacag	1,702	1,846	2,037	1.6	2.0	1.8
29. Mabini	443	509	611	2.8	3.7	3.3
30. Malabog	2,255	2,413	2,579	1.4	1.3	1.4
31. Melobago	395	423	495	1.4	3.2	2.3
32. Maopi	697	861	874	4.3	0.3	2.3
33. Maropoy	2,348	2,535	3,161	1.5	4.5	3.0
34. Matong	549	468	839	-3.2	12.4	4.3
35. Mayon	850	990	992	3.1	-	1.6
36. Mi-Isi	443	475	731	1.4	9.0	5.1
37. Nabasan	540	656	637	4.0	-0.6	1.7
38. Namantao	915	955	1,111	0.9	3.1	2.0
39. Pancan	670	593	638	-2.5	1.5	-0.5
40. Penafrancia	992	1,028	1,301	0.7	4.8	2.7
41. Poblacion	(4,389)	4,011	3,956	-1.8	-0.3	-1.0
42. Sagpan	3,545	3,577	4,696	0.2	5.6	2.9
43. Salvacion	1,161	1,311	1,780	2.5	6.3	4.4
44. San Rafael	217	216	306	-	7.2	3.5
45. San Ramon	1,363	1,369	1,373	-	-	0.1
46. San Roque	3,123	3,732	3,852	3.6	0.6	2.0
47. San Vicente Grande	891	779	758	-2.7	-0.5	-1.6
48. San Vicente Pequeno	132	181	192	6.5	1.2	3.8
49. Sipi	1,187	1,843	2,192	9.2	3.5	6.3
50. Tabon-tabon	827	930	1,058	2.4	2.6	2.5
51. Tagas	1,757	2,259	2,902	5.2	5.1	5.1
52. Talahib	683	694	732	0.3	1.1	0.7
53. Willamermosa	1,035	1,156	1,340	2.2	3.0	2.6
T O T A L	58,335	63,265	73,213	1.63	2.96	2.30

These increases in terms of average annual growth are 2.3 percent for Legaspi City and 3.0 percent for Daraga.

The population in Legaspi City is distributed among 69 barangays in which 40,821 or 41 percent of the total is concentrated in urban areas while 57,966 or 59 percent is living in rural areas.

In Daraga, the urban population concentrated in the poblacion and the five neighboring barangays is estimated to be 25,889 or 35 percent of Daraga total population with the rural area population being 47,324 or 65 percetn of the total.

Populations both for Legaspi City and Daraga classified by barangay and their past trends, 1970 - 1980, are shown in Tables 1.2.2 and 1.2.3.

2.3 Socio-Economic Conditions

The study area consists of the City of Legaspi and the Municipality of Daraga. From the socio-economic point of view, Legaspi City and Daraga can be observed as one area. This is particularly true in the field of economic activities. They are both basically agricultural. In trade and commerce, Legaspi City and Daraga are complementing each other, as they serve their combined population and residents of the surrounding areas as well. The study area is becoming the commercial center of the Albay Province.

Manufacturing industries in the study area are of the small-scaled cottage type, with exception only of the Legaspi Oil Company and the Isalog Pulp and Paper Mill.

The household income in the study area remains considerably low, and nearly 80 percent of the urban households and 75 percent of the rural households are producing nearly one-fourth of the food they consume in order to cover the shortage of their monthly income.

Bicol is spoken by 98 percent of the population in the study area, and 99.3 percent of the people in Daraga and 96.5 percent of Legazenos are Roman Catholic.

Males and females are almost the same in number in the study area. More than half of the population in the area are under 20 years old.

The education level in the study area is high, reflecting the fact that the area is the educational center of the Bicol Region.

The dwelling conditions in the study area are, though improving, still poor with more than 70 percent of dwelling units roofed with nipa.

The transportation system in the study area includes one airport, one seaport and one railway line. The area, in addition, is served by a number of buslines and spot-to-spot jeepney transportation. The pavement ratio of the study area's roads is considerably high compared with other municipalities.

There have been proposed 18 communal irrigation systems in the study area but so far only one project is on-going.

The study area is being served by a provincial water supply system, though its service is not so satisfactory.

Electric power is being supplied by a semi-government entity, with an energization of 39.1 percent.

In the past five years, 1976 to 1980, Gastro-Enteritis, a typical water-borne disease, ranked 7th in the causes of both morbidity and mortality in Legaspi City. In Daraga, it ranked also 7th in the causes of mortality and 10th in the causes of morbidity.

The study area has 12 hospitals whose total bed capacity amounts to 861. The ratio of the households with flush-type and water-sealed toilets amounts to 50.2 percent in Legaspi City and 41.0 percent in Daraga.

For details, please refer to Appendix 5.

3. Existing Water Supply

3.1 General

The major existing water supply system in the study area is the water works system that was formerly owned and operated by the Provincial Government. The system serves three poblacions, Daraga, Old Albay and Legaspi Port. In addition, there are Level II systems in some barangays which are located far away from the poblacions. Further, there are a number of Level I systems, scattered in the three poblancions and barangays.

As regards the Level III system, details of which are dealt with in the following sections with a view to preparing most realistic water supply master plan, the present water supply conditions are far from satisfactory, due to deterioration of the water supply facilities and damages to water sources and transmission systems by the latest flood. Most of the served area has no water in the day time, and even in areas where water is available for 24 hours a day the water pressure is too low for use.

3.2 Water Sources

The water sources currently used by Level III, II and I systems in the study area are springs, deep wells and shallow wells, as shown in Table 1.3.1. Water quality of major water sources and drinking water quality standard in the Philippines are shown in Appendix 1. Details of which are summarized below.

(1) Springs

Springs are very widely used for water supply in the study area. Main supply sources of the Albay Provincial Waterworks System are also springs, namely Budiao I, Budiao II, Banadero and Daraga Springs. Most

Table 1.3.1 Conditions of Existing Water Sources

Name of Source	Kind of Source	Level	Production (cu m/d)	Place	Odor Intensity 1/	Color (Unit)
Budiao I	Spring	III	3,600 2/	Daraga	0	0
Budiao II	Spring	III	3,760 2/	Daraga	0	0
Banadero	Spring	III	2,940 2/	Daraga	1	0
Daraga	Spring	III	154 2/	Daraga	1	10
Camp Ibalon	Deepwell	III	109 2/	Legaspi	3	15
Bogtong	Spring	II	850 3/	Legaspi	1	0
Salbacion	Spring	II	-	Daraga	0	0
Tinapian	Spring	II	5,180 3/	Manito	0	0
Lacag	Spring	II	260 3/	Daraga	0	0
Buyoan	Spring	I	7,230 3/	Legaspi	0	0
Tinago	Deepwell	I	35 3/	Legaspi	4	20
Malabog	Spring	I	-	Daraga	2	0
Bicol	Deepwell	Private	-	Daraga	4	8
Binato	Deepwell	Private	-	Legaspi	5	40
Imperial St.	Shallowwell	Private	-	Legaspi	0	0
Daraga	Shallowwell	Private	-	Daraga	0	0
Curuzada	Shallowwell	Private	-	Legaspi	4	0

Note

1/

Odor Intensity	Description of Odor
0	Non
1	Barely perceptible
2	Perceptible
3	Easily perceptible
4	Strong
5	Intense

2/ According to data obtained from the Provincial Waterworks

3/ Measured by the Team

of the springs in the study area are located at the foot of Mt. Mayon, and the yield of each of these springs is fairly large. Their characteristics are that 1) they are located at high elevations, about 100 m or more above sea level, 2) their yields vary according to seasons, and 3) the water quality of the springs at the foot of that mountain is generally good, having few bacteria and little odor, low concentrations of dissolved matters and turbidity.

Other springs located at Mt. Linguion and the lower mountains are not much in yield, and some of them have odor of hydrogen sulfide.

(2) Deep Wells

Some deep wells have been sunk in the poblacion area for use by Level II and I systems and sometimes for private use. Almost all of the deep well water has very poor quality as shown in Table 1.3.1 and Appendix 1, having strong odor of hydrogen sulfide and high value of color, which may derive from the characteristics of the formations ejected from the volcano. Removal of odor and color is not practically recommendable. (Refer to Appendix 1)

(3) Shallow Wells

Shallow wells are used mostly for private domestic use. They have rather good quality compared with that of the deep wells as shown in Table 1.3.1 and Appendix 1.

3.3 Distribution System

The existing distribution system of Level III, of which water sources are mentioned in Table 1.3.1 in the foregoing section is composed of mainly two systems of Budiao and Banadero springs. The system does not, in a precise meaning, have a transmission system, but the pipeline between the intake and the entrance at the poblacion of Daraga will be termed transmission line, and the networks covering the three poblacions of Daraga, Old Albay and Legaspi Port will be called distribution system, for convenience of description. The system is illustrated in Figs. 1.3.2, 1.3.3. and 1.3.4.

(1) Budiao Spring System

The Budiao spring system serves, by gravity, mainly the two poblacions of Daraga and Old Albay through the transmission line, 200 mm in diameter and 5 km in length, consisting of ACP and CIP, constructed in 1960. This system has been reinforced with a spring located in the Daraga poblacion and a deep well sunk near Camp Ibalon. Production of the above two sources is being pumped directly into the distribution networks. Even with this enforcement, water is insufficient and water pressure in both transmission and distribution lines is extremely low.

Presently; the water intake at the spring is less than 3,900 cu m/day, which is the calculated carrying capacity of the pipeline, against the yield 7,360 cu m/day, as reported in Appendix 6.

(2) Bañadero Spring System

The Bañadero spring system serves, by gravity, the poblacions of Legaspi Port through the transmission line and a distribution main laid on the north side of the served area. The transmission line is 150 mm in diameter, 4 km in length and of ACP, constructed in 1970. This system is currently out of service because of serious damage by a typhoon in June 1981.

Water intake at the spring is none at present. The capacity of the pipeline is estimated at 2,200 cu m/day against the recorded yield 2,940 cu m/day.

(3) Distribution Networks

First distribution pipelines were installed in 1927 and since then extensions of pipelines were made in 1950's and 1970's. Pipe materials are of cast iron, steel, asbestos cement and galvanized iron. (Refer to Table 1.3.2.)

There are several public faucets on the Budiao transmission pipeline and in the poblacion; they are presently used by neighboring people. Fire hydrants were installed in 1930's, however, they are not sufficient

in numbers and their actual function is in doubt. Air valves and blow-off branches are equipped to some extent.

Supply conditions are from satisfactory, and Old Albay and Legaspi Port, in particular, have no water during daytime. Some consumers take water by pump from the main during night time as water pressure is very low. As described in Appendix 3, water pressure recording was made only in the Daraga area for the above reason.

As regards leakage, visible leaks on the ground surface are very rare, but this fact leads to suspicion that invisible underground leaks may exist. To ascertain actual conditions of the existing pipelines, some representative spots were dug to inspect the soil and the conditions of pipe corrosion. Major findings of the investigation were that pH of the soil was generally higher than 7, sulfate concentrations ranged from 91 ppm to 182 ppm, and chloride contents were in a range of 0.7 ppm to 16.9 ppm. Exterior surface of the laid pipe had encrustations, but pittings of the pip wall were not detected.

From the above conditions, as well as the results of water analysis, leaks may, it is concluded, be attributable to the aging of the pipelines and the poor maintenance of all the facilities; it may not be caused by soil corrosiveness.

Table 1.3.2 Existing Distribution Pipeline

Diameter (mm)	Length (m)			Material
	Legaspi	Darage	Total	
200	2,405	5,125	7,530	CCI, ACP SP
175	3,500	5,000	8,500	SP
150	8,360	4,375	12,735	CCI, ACP
100	8,638	2,515	11,153	CCI, ACP
75	4,632	2,850	8,255	ACP, GI
50	1,043			GI
Total	28,308	19,865	48,173	

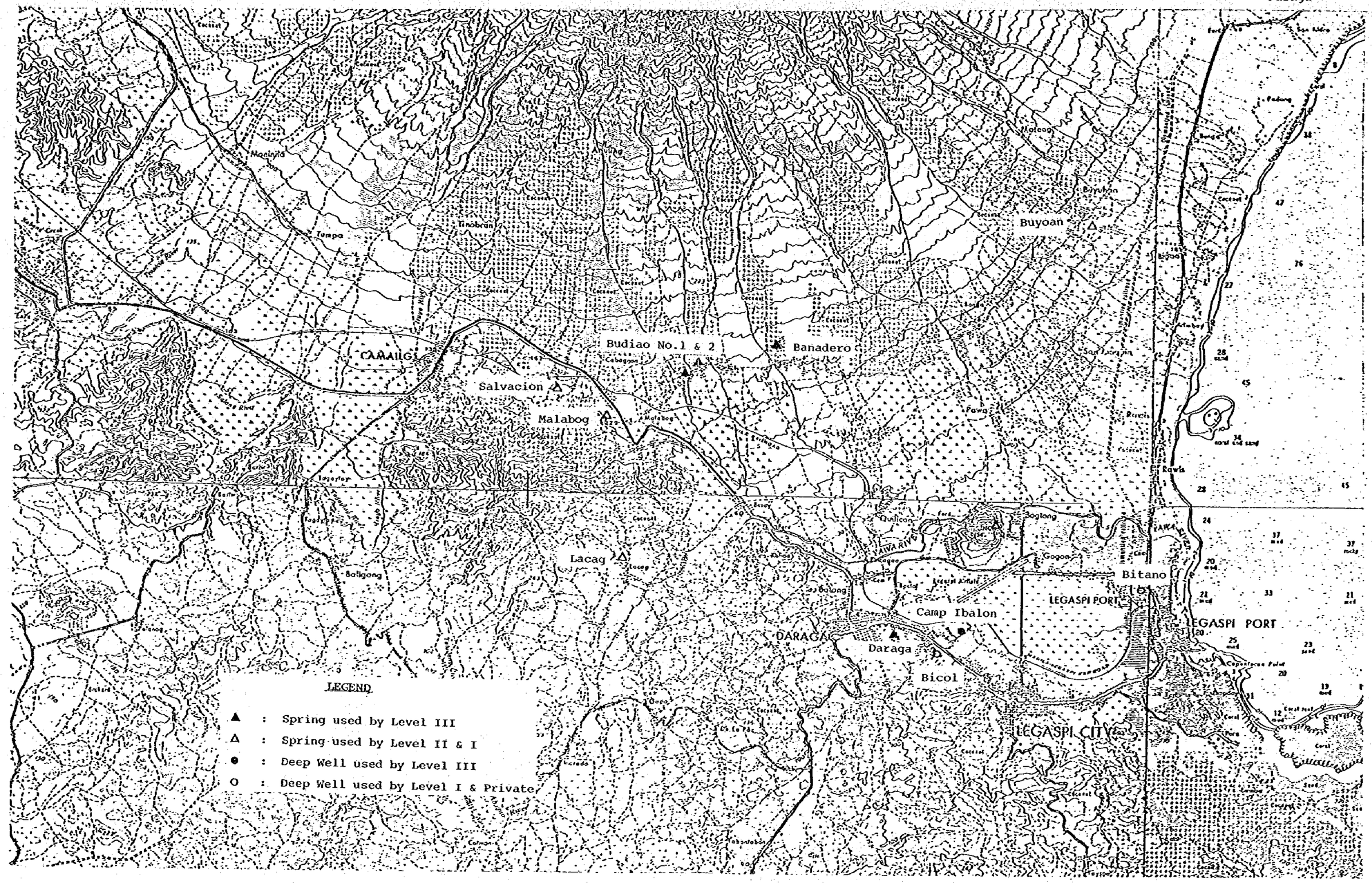


Fig 1.3.1 Location of Existing Water Sources

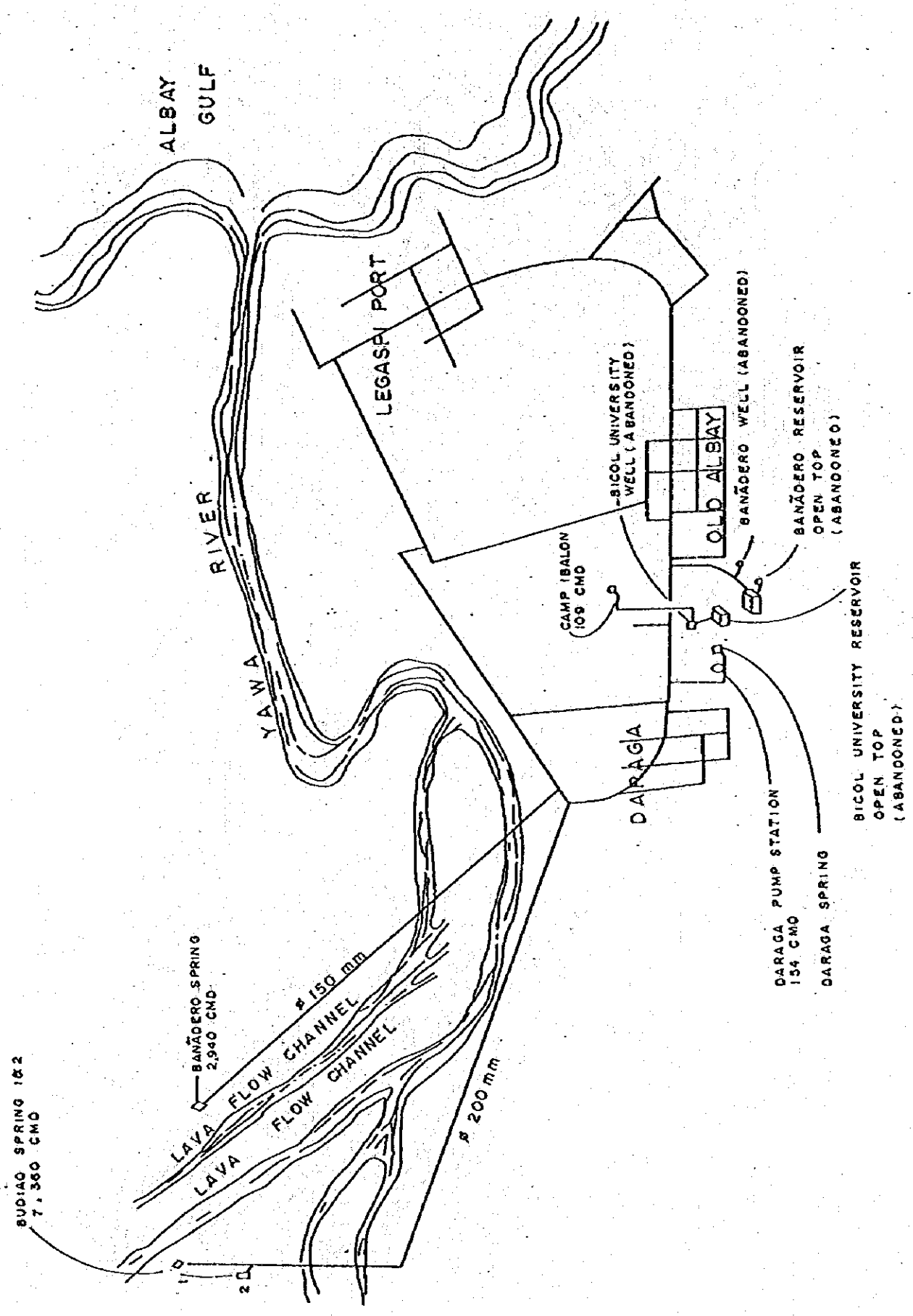


Fig 1.3.2 Existing Water Supply System

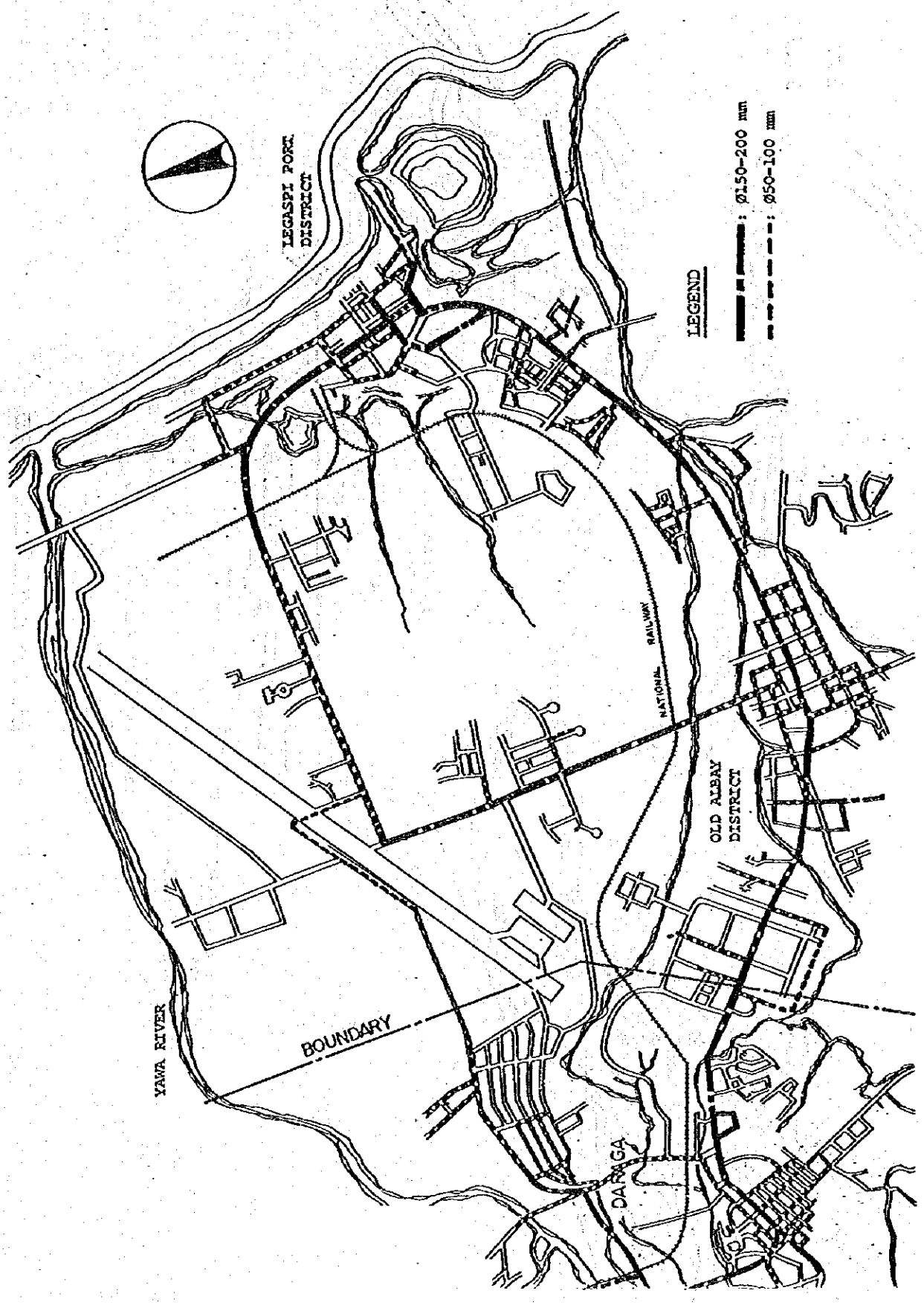


Fig 1.3.3 Existing Distribution Network (Legaspi)

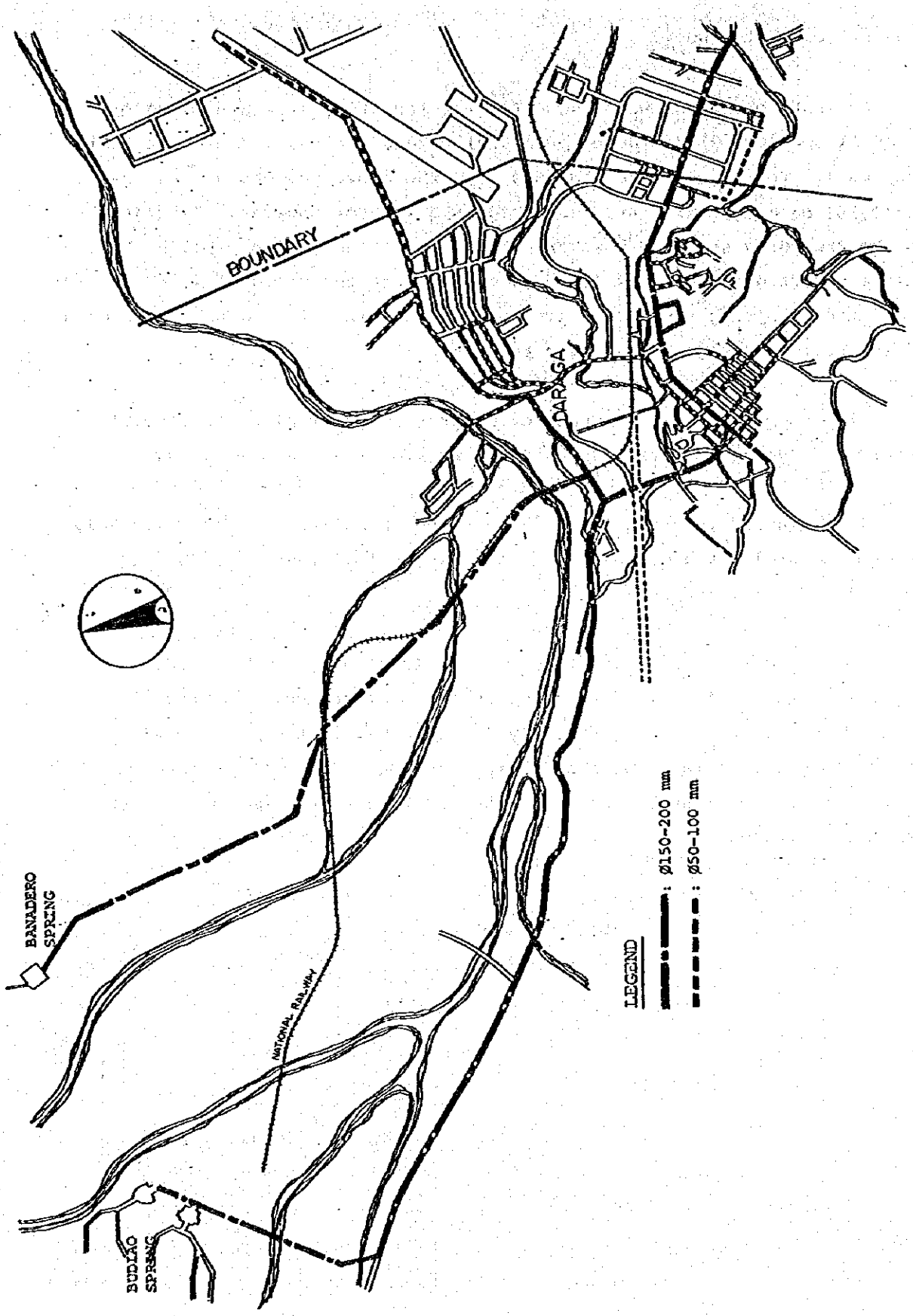


Fig 1.3.4 Existing Distribution Network (Daraga)

3.4 Present Water Use

Present sources of water supplies for the study area are 1) Budiao I and II springs, 2) Banadero spring, 3) Daraga spring, and 4) Camp Ibalon deep well. Total production amounts from the above sources are estimated as 10,563 cu m/d,details are described in 3.2 Water Sources. As stated in the preceding section, however, the Budiao transmission pipeline has only a carrying capacity of 3,900 cu m/d against the yield of 7,360 cu m/d The Banadero spring system has not been functioning since June 1981 because of the serious damage caused by a typhoon.

At present the total amount of water supply for Albay Provincial Waterworks System is estimated as 4,163 cu m/d at a maximum basis.

According to the APWS office, the served population is approximately 36,500 in total which may be split into two as 18,600 and 17,900 for Legaspi and Daraga respectively.

The present service connections are 1,405 and 1,229 for Legaspi and Daraga respectively. Out of the above total connections, the metered service connections are only 115 or 8 per cent of the total and 186 or 15 per cent in Legaspi and Daraga respectively. The breakdown of service connections by use categories in Legaspi and Daraga is shown in a table below.

Table 1.3.3 Present Service Connections

Use Category	Legaspi	Daraga
Domestic	1,184	1,125
Commercial	151	81
Industrial	5	12
Institutional	27	5
Public stand pipes	38	6
Total	1,405	1,229

Total Legaspi and Daraga 2,634

System loss and leakage are not obtainable from the balance of supply and consumption due to the shortage of supply and the very low pressure in the system, which is causing a suppressed supply conditions for the consumer.

3.5 Present Water Rates

3.5.1 Procedure for Determining Water Rates

The original establishment of water rates and their changes are recommended by the Waterworks Superintendent through the Provincial Treasurer to the Provincial Governor. Based on the initiative of the Provincial Governor, the Sangguniang Panlalawigan (Provincial Board) deliberates upon and approves the recommended water rates. A public hearing is sometime conducted by the Sangguniang Panlalawigan for this purpose.

3.5.2 Present Schedule of Water Rates

The present water rates were approved in 1977. As shown in Table 1.3.4, the minimum water rates are ₱11.00 for domestic consumption; ₱19.00 for commercial; and ₱23.00 for industrial consumption.

3.5.3 Billing and Disconnection

Water bills are rendered monthly to consumers by bill collectors. The bills are then paid within a period of five days. Disconnection is usually ordered for delinquent consumers who fail to pay the water bills after the period of five days.

Table 1.3.4 Present Schedule of Water Rates

1. Flat Rate

Domestic	- ₱11.00 for the first faucet, plus ₱3.00 for each additional faucet or outlet
Commercial	- ₱19.00 for the first faucet, plus ₱4.00 each additional faucet or outlet
Industrial	- ₱23.00 for the first faucet, plus ₱5.00 for each additional faucet or outlet

2. Meter Rate

Domestic	- ₱11.00 minimum charge for the first 20 cu m.
	₱ 0.30 per cu m. for the first additional 10 cu m.
	₱ 0.20 per cu m. for the first additional 20 cu m.
	₱ 0.15 per cu m. for all additional consumption
Commercial	- ₱19.00 minimum charge for the first 20 cu m.
	- ₱ 0.40 per cu m. for the first additional 20 cu m.
	- ₱ 0.30 per cu m. for the first additional 40 cu m.
	- ₱ 0.20 per cu m. for the first additional 60 cu m.
	- ₱ 0.15 per cu m. for all additional consumption
Industrial	- ₱23.00 minimum charge for the first 20 cu m.
	- ₱ 0.50 per cu m. for the first additional 30 cu m.
	- ₱ 0.40 per cu m. for the first additional 40 cu m.
	- ₱ 0.30 per cu m. for the first additional 60 cu m.
	- ₱ 0.20 per cu m. for the first additional 80 cu m.
	- ₱ 0.15 per cu m. for all additional consumption

Source of Data: Albay Provincial Waterworks System.

3.6 Present Institutional Water Supply Practice 1/

3.6.1 Responsible Agency

The Albay Provincial Waterworks is owned and operated by the Provincial Government of Albay. Its Superintendent and other staff members are all Provincial Government Officials and employees.

3.6.2 Policy-making Function

The policy-making function relating to water supply and the implementation of those policies are carried out by the Provincial Governor, subject to the resolution or approval of the Sangguniang Panlalawigan (Provincial Board).

Remarks: 1/ As described in Part One: 1.4 Compilation of the Report, the existing water supply system was formerly owned and operated by the Albay Provincial Waterworks System; two water districts, one for Legaspi City and the other for the municipality of Daraga, were formed in October 1981. The former water supply system has been split into two systems under the separate ownership and management; institutional development of the two districts is in process of organization now under the assistance of LWUA. Taking into account these circumstances, this section will treat the institutional water supply practice of the Albay Provincial Waterworks System that is the situation just before the formation of the two water districts.

3.6.3 Direct Responsibility

The direct responsibility for important tasks such as the preparation and execution of annual budgets for the Waterworks and recommendation of changes in water rates is placed in the Provincial Treasurer. In these important matters, the role of the Waterworks Superintendent is indirect and limited to the presentation of necessary reference data to the Provincial Treasurer.

3.6.4 Accounting and Finance

The accounting of the Waterworks is not separated from that of the Provincial Government, and the income and expenditures of the Waterworks are accounted as part of the Provincial income and expenditures. The expenditures of the Waterworks System consist of "personal service", "maintenance and other operating expenses", and "capital outlay", which are subdivided into 15 items. These expenses and outlays are financed by collected water rates, other consumers contributions and provincial government subsidies. Tables 1.3.5 and 1.3.6 show the income and expenditures of the Waterworks for 1979 and 1980 and its budget for 1981. The annual surplus or deficit is not carried over to the following fiscal term, but is incorporated into the surplus or deficit of the Provincial Government accounts. The Provincial Audit audits the accounts.

3.6.5 Relationship with Consumers

The relationship of the Waterworks with the consumers is governed by the Provincial Tax Code and the Contract on Water Services which is made between the Provincial Government and each consumer.

3.6.6 Organization

The staff of the Waterworks is organized as shown in Fig 1.3.5, and consists of the superintendent and other 39 staff members, who are grouped into two divisions, i.e., "Technical Division" and "Administrative Division".

3.6.7 Office Procedures

The description of the assignments to each staff member is given by the Provincial Governor but the functional relationship among the staff members is not clear enough to show the chains of command. Delegation of authority and inter-division communication are being done at the discretion of each staff member in charge. The Waterworks has no written office procedures and no manuals for the maintenance and operation of the water supply facilities.

3.6.8 Personnel Management

The Waterworks has no established system of recruitment. The Waterworks Superintendent recommends placements and promotions of the personnel to the Provincial Governor. The Waterworks has no programs for personnel training. New-comers are usually trained by senior staff members on the job.

Table 1.3.5 Statement of Income and Expenses
(1979 - 1980)

Republic of the Philippines
PROVINCE OF ALBAY
LEGAZPI
Office of the Provincial Treasurer

August 17, 1981

The Provincial Waterworks Superintendent
Legazpi City

S i r :

In connection with your letter dated August 10, 1981 hereunder is the Statement of Income and Expenses for the period 1979-1980:

	1979	1980
INCOME:		
Water Fees Collections	P 334,728.23	P 332,982.67
EXPENSES:		
Salaries & Wages	P 200,076.89	P 230,456.60
Life & Retirement Cont.	9,958.23	11,155.53
Medicare Contributions	1,696.52	1,877.26
State Insurance	1,622.09	1,597.70
Living Allowance	12,700.00	11,650.00
Travel & Transportation	15,915.80	13,525.80
Supplies & Materials	48,459.05	38,734.41
Gasoline & Spare Parts	38,568.57	48,138.85
Communication	958.09	1,005.43
Repair & Equipment	855.00	928.00
Other Services	300.00	63.26
Capital Outlay	48,164.60	-
Total	P 379,248.49	P 364,124.72

Very truly yours,

HICANOR MIRANDA
Asst. Provincial Treasurer
For and in the absence of the
Provincial Treasurer

Local Budget Preparation Form No. 152

PROGRAM APPROPRIATION AND OBLIGATIONS BY OBJECTS

Program: Water Management Service

Title/Department: Provincial Waterworks

ALBAY
Province

APPROPRIATION LANGUAGE

Page No. 109

OBJECT OF EXPENDITURES	Past Year 79 (Actual)	Current Year 80 (Estimate)	Budget Year 81
Obligations by Objects of Expenditures by Projects:			
Water Management Services			
I. Personal Services			
a. Salaries	P 208,[illegible]	P 294,501.00	P 116,[illegible]
b. Insurance Contributions	9,952.[illegible]	27,978.00	11,[illegible]
c. Retirement Contributions	1,[illegible]	3,225.00	1,[illegible]
d. Medicare Contributions	1,[illegible]	2,946.00	[illegible]
e. State Insurance	1,[illegible]	19,440.00	[illegible]
f. Living Allowance	[illegible]		[illegible]
Sub-Total	[illegible]	P 3[illegible],090.00	P 14[illegible]
II. Maintenance & Other Operating Expenditures:			
a. Travel & transportation	P 15,[illegible]	P 11,000.00	P 6,[illegible]
b. Supplies & Materials	4[illegible],[illegible].05	44,000.00	10,[illegible]
c. Gasoline & Spare Parts	3[illegible].57	35,000.00	1[illegible]
d. Freight	-	-	-
e. Repair of Equipment	[illegible].00	2,000.00	1,[illegible]
f. Illumination	-	-	-
g. Communication	[illegible].00	440.00	[illegible]
h. Other Services	300.00	16,500.00	[illegible]
i. Representation Allowance	-	-	-
Sub-Total	P 9[illegible].31	P 107,140.00	P 3[illegible].00
Capital Outlay			
a. Equipment	P 6,889.00	P -	P -
Sub-Total	P 6,889.00	P -	P -
T O T A L	P 337,972.89	P 453,230.00	P 185,119.00

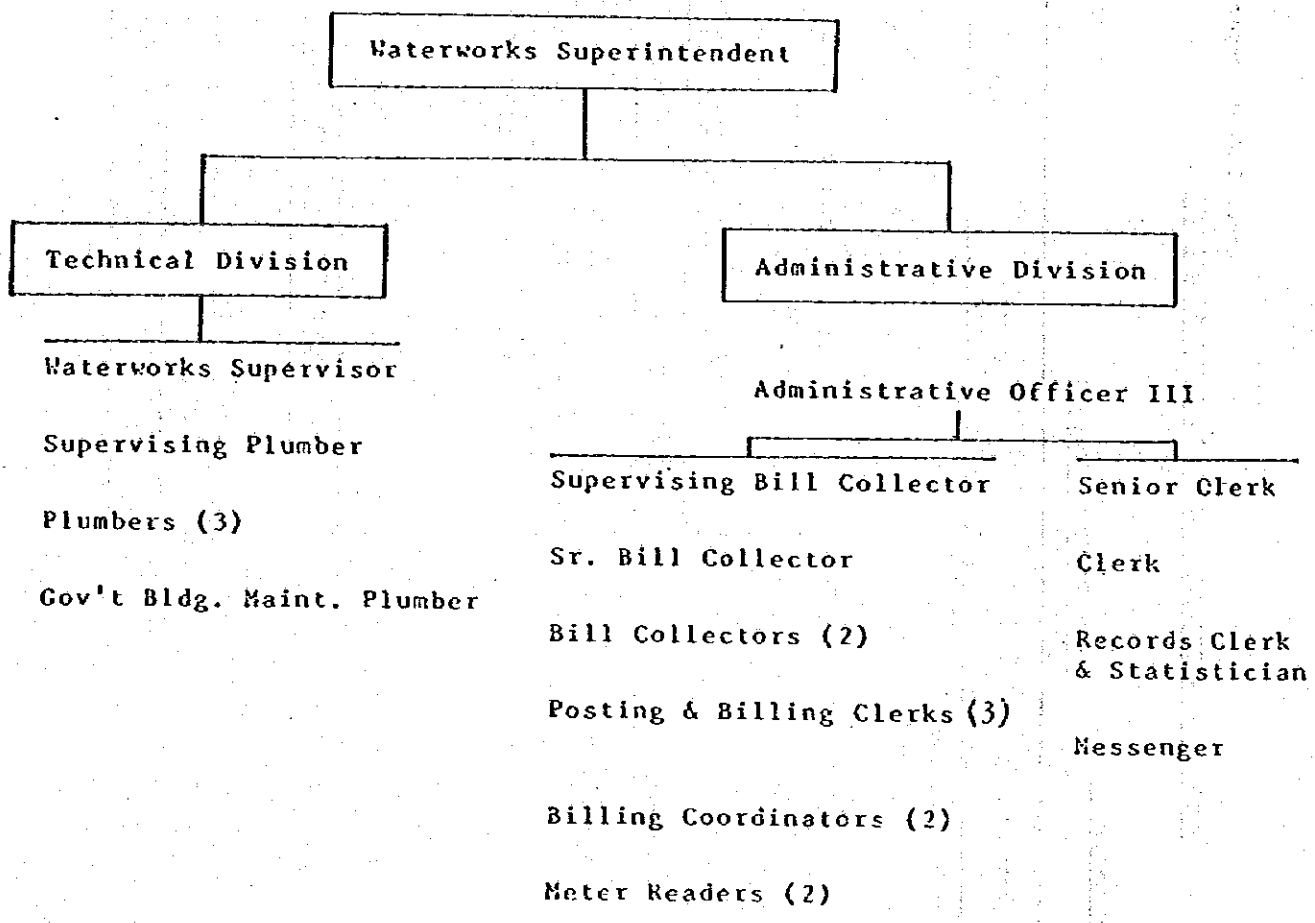
Table 1.3.6 Budget Alaby Provincial Waterworks System (1981)

Daraga

Fig. 1.3.5 Organization Chart

of

Albay Provincial Waterworks



PART TWO: MASTER PLAN

1. General
2. Target Year and Served Area
3. Projection of Population and Water Demand
4. Water Sources
5. Proposed Water Supply System
6. Cost Estimate
7. Implementation Schedule
8. Organization and Management

Daraga

1. General

This Part discusses and draws out a water supply master plan for the Daraga Water District newly formed taking over most of the water supply system formerly owned and operated by the Albay Metropolitan Waterworks System. The master plan will treat the Level III system as a mainstay of water supply in the District.

The master plan will project the needs for water supply over a long range future and present a water supply system to meet the growing water demand. Means and ways to cope with the chronically existent and near future water requirement, in particular, will be dealt with fairly in detail. Based thereon, the feasibility of a project covering a short range future, which is essential for implementation thereof, will be studied in the following Part Three.

Since this District has inevitably to continue supplying water to the Legaspi City Water District, also newly formed, until the new water source system of the latter is completed, the master plan will take into due consideration the implementation schedule of construction work including the arrangement necessary for the transition period.

2. Target Year and Served Area

2.1 Target Year

(a) Phase I

Basically the purpose of this Phase project is to satisfy the present water requirement which has not been met in recent years due to deterioration of the water supply facilities, by rehabilitation, improvement and some additional works, within as short a period as possible.

Taking into account the work volume, financial constraints and the required time for foreign financing, six years time is considered optimal. As illustrated in Fig 2.7.1, the Phase I project will require about four and a half years from the commencement of the master planning and feasibility study until completion of the construction works, that is, the completion is at the end of 1985. Therefore, the target year, which is defined as the year when the designed supply capacity equals to the water demand, must be at least a few years ahead of 1985. And during the period between the completion of the work and the target year, preparation for the succeeding Phase II project must be made. As is known from the barchart in the figure, 2 years for this period is a most realistic solution, not giving much inconvenience to the consumers, nor making the construction cost of Phase I unbearably high. After all considered as above, the target year of Phase I is proposed as 1987.

(b) Phase II

Major purpose of this Phase project is to provide water for all consumers of the served area which is realized in the previous Phase and for additional population in the thereafter extended built-up area, and to upgrade the level of consumption in accordance with the improvement of the whole national living standard.

For this Phase, six years time is also considered appropriate from the same standpoint as Phase I. Therefore, the target year is proposed as 1993.

(c) Phase III

Long range planning of public facilities in the Philippines 1/ is currently being made with the year of 2010 as the target year. As water supply is one of the public utilities, the said year is employed as the target year of the present master planning.

Remarks: 1/ The LWUA's recent project, Water Supply of Ten Provincial Areas (5th Package), also aims to prepare a Master Plan upto the year 2010.

2.2 Served Area

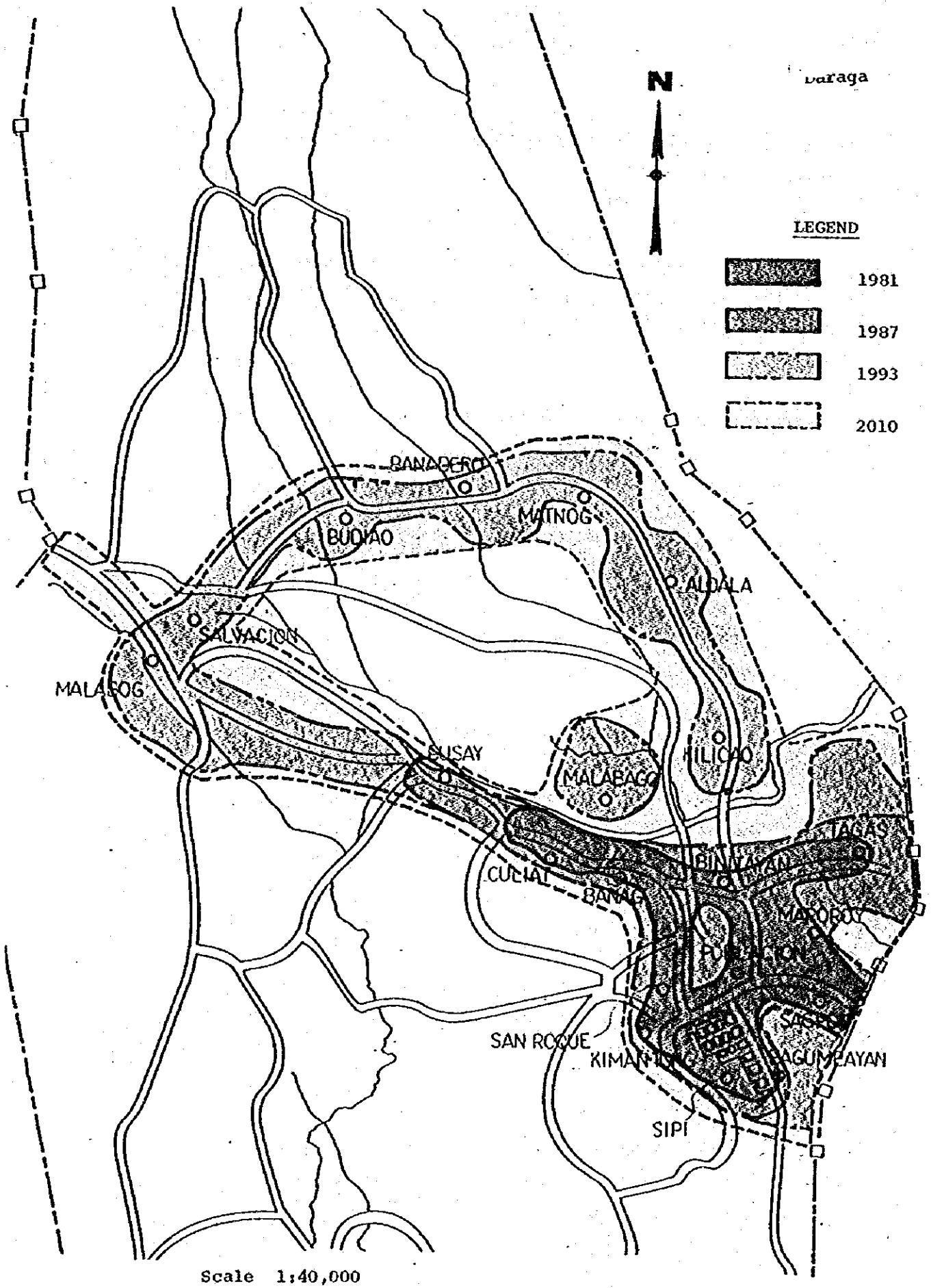
The Local Water District Law stipulates that a water district, when formed, covers all the municipal or city area, but on the other hand the Executive Order 577 (an order concerning formation of RWA/s) allows that Level I and II systems be constructed and maintained in the area of the water district in consideration of economy and early realization of water supply services.

Served area, for which water supply is being planned by the present master plan is, in accordance with the intention of the above Law and Executive Order, delineated to confine such an area to the existing built-up area for the short term plan, and to the anticipated built-up area as the final served area for the long range plan.

General topography, natural barriers, and zoning plans are also concidered in determining served area limits by each phase. Based on technical, topographic, and socio-economic consideration, the served area boundaries for different phases of program implementation are determined as follows, and shown in Fig 2.2.1.

1. Present Served Area- the area presently served by existing system, 400 ha approximately.
2. Phase I Served Area- the reinforcement and the extention of present served area, where minimum investment is required but maximum number of persons can be served to create a high impact/effectiveness on the consumers in the WD. The Phase I served area is extended approximately by 280 ha totaling to 680 ha.
3. Phase II Served Area- further extension of served area into 1,480 ha, taking into account the extent of development within the design year of 1993 in the WD.
4. Master Plan Served Area- the total area within the WD jurisdiction where service can be provided technically and financially. In this study, the main objective is to

provide water service to the maximum number of persons within the area in the Master Plan period. The expanded served area is 1,850 ha in total in the year 2010.



Scale 1:40,000

0 1km 2km

Fig 2.2.1 Served Area

3. Projection of Population and Water Demand

3.1 Population Projection

To estimate the study area population which is one of the basic factors of water requirement, the past census made by the National Census and Statistics Office (NCSO) is used as the most reliable demographic data.

The total study area population is projected on the basis of separate projections for barangays both in the city core or poblacion and rural areas within the study area. The method of past trend extrapolation is applied for population projection of such "micro-economic" areas of barangays in this study.

The procedure or the methodology of population projection for this study is included in Appendix 7. Based on the said methodology, population projections for the study area have been worked out.

Population trends indicate that the population in the study area would increase from 73,213 in 1980 to 122,340 in the year 2010. The projected population by the design year is tabulated in Table 2.3.1 and graphically shown in Fig. 2.3.1. Population projections by barangay are shown in Table 2.3.2.

The high and low growth of population projections in the study area have been made separately from the adopted one. Regarding the high projection, the high series of NEDA-POPCOM projection[1/] is introduced as a useful data for the high population projection. While, the low growth of population in the study area is projected as shown in Table 2.3.3.

Remarks: 1/ Population Dimension of Planning, III Population Projection of Cities and Municipalities in the Philippines 1970 - 2000.

The population in the served area is projected by design year based on the served area which is discussed in the preceding section of 2.2 Served Area. The population in the served area is shown in Table 2.3.4.

The coverage of served population for the master plan has been projected based on the above population in the served area taking account of the willingness-to-connect (WTC) of the projected consumers and future improvement of the consumers living standard.

The average percentage of WTC in the Phase II project area is 53%, which is obtained by a market research made in this study. Based on the market study the percentage of WTC of the urban and rural areas for future planning is projected as shown below:

Average Percentage of WTC

	1987	1993	2010
Urban Area	70	80	100
Rural Area	20	54	80

The served population which is estimated approximately 17,900 or 24% of the total population in 1980 would increases to 23,270 or 27% in 1987, 39,240 or 41% in 1993, and 67,806 or 55% in 2010, respectively. The served population by design year is shown in Table 2.3.5 and graphically shown in Fig. 2.3.2. The served population by barangay is shown in Table 2.3.6.

Note: As the results of projection of population served, percentage of population served to total population would not reach high value. This is due to following characteristics of scattered barangays of this area which would not been included in the served area because of economic reason.

Characteristics of these barangays:

1) Population density is rather low,
2) Distance from poblacion is far, and/or
3) Topographical elevation is rather high.

Table 2.3.1 Daraga WD Population Projection

	1980	1987	1993	2010
1. Urban	25,889	31,038	34,531	44,846
2. Rural	47,324	54,808	60,452	77,494
Total	73,213	85,846	94,983	122,340
Average annual increase (%)	2.3	1.7	1.5	

Table 2.3.3 Daraga WD High and Low Growth Population Projection

	1980 T.P	A.G.R (%)	1987 T.P	A.G.R (%)	1993 T.P	A.G.R (%)	2010 T.P
1. High Projection	77,449	3.2	96,580	3.3	117,350	3.1	197,190
2. Medium Projection	73,213	2.3	85,846	1.7	94,983	1.5	122,340
3. Low Projection	73,213	2.07	84,500	1.36	91,630	1.2	112,230

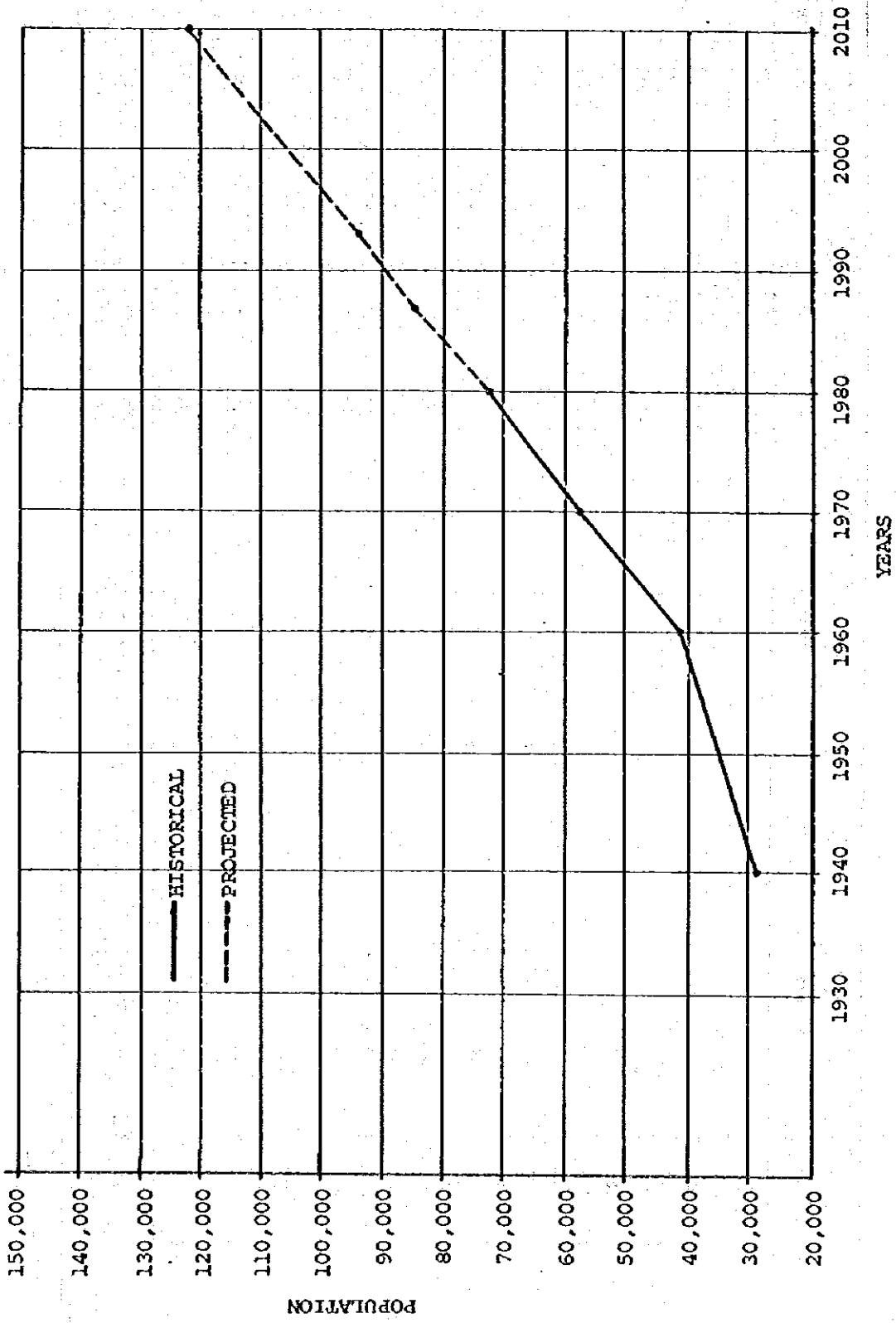


Fig 2.3.1 Population Projection

Table 2.3.2 Population Projection by Barangay

Barangay	Area (ha)	1980 Population	1980 Population Density	1980 - 1987 Ave. Annual Growth Rate (%)	1987 Population	1987 Population Density	1987 - 1993 Ave. Annual Growth Rate (%)	1993 Population	1993 Population Density	1993 - 2010 Ave. Annual Growth Rate (%)	2010 Population	2010 Population Density
1. Alcala	114	1,768	15.5	1.6	1,976	17.3	1.6	2,173	19.1	1.5	2,783	24.4
2. Alobo	214	581	2.7	2.5	691	3.2	2.0	794	3.7	1.7	1,057	4.9
3. Anislas	223	2,819	12.6	2.4	3,328	14.9	2.0	3,748	16.8	1.7	4,992	22.4
4. Bagumbayon (u)	44	1,280	29.1	2.4	1,552	34.6	2.0	1,714	39.0	1.7	2,283	51.9
5. Balinad	72	1,331	18.5	2.0	1,529	21.2	1.7	1,692	23.5	1.5	2,179	30.3
6. Banadero	128	1,158	9.0	2.0	1,330	10.4	1.7	1,472	11.5	1.5	1,896	14.8
7. Banag	103	1,775	17.2	3.0	2,183	21.2	2.2	2,487	24.1	2.0	3,481	33.8
8. Bascaran	170	2,241	13.2	3.0	2,756	16.2	2.0	3,103	18.3	1.7	4,133	24.3
9. Bigao	809	657	0.8	0	657	0.8	0	657	0.8	0	657	0.8
10. Binitayan (u)	181	2,323	12.8	7.3	3,804	21.0	2.5	4,411	24.4	2.0	6,175	34.1
11. Bognalon	191	610	3.2	2.5	752	3.8	2.0	816	4.3	1.7	1,087	5.7
12. Budiao	292	1,417	4.9	3.0	1,743	6.0	2.0	1,963	6.7	1.7	2,614	9.0
13. Burgos	128	831	6.5	1.3	910	7.1	1.5	966	7.5	1.5	1,282	10.0
14. Busay	189	1,228	6.5	4.0	1,616	8.6	2.5	1,874	9.9	2.0	2,623	13.9
15. Canarom	227	587	2.6	0.8	621	2.7	0.5	640	2.8	0.5	697	3.1
16. Culiat	122	861	7.1	3.0	1,059	8.7	2.0	1,193	9.8	1.7	1,589	13.0
17. De La Paz	74	482	6.5	0.5	510	6.9	0.5	525	7.1	0.5	571	7.7
18. Dinoronan	92	386	4.2	0	400	4.3	0	400	4.3	0	400	4.3
19. Gabawan	67	1,223	18.3	3.0	1,504	22.4	2.0	1,694	25.3	1.7	2,256	33.7
20. Gapo	328	1,520	4.6	1.0	1,630	5.0	0.5	1,680	5.1	0.5	1,829	5.6
21. Ibangan	1,112	447	0.4	3.0	550	0.5	2.0	619	0.6	1.7	824	0.7
22. Inarado	153	1,193	7.8	1.5	1,324	8.7	1.5	1,448	9.5	1.5	1,865	12.2
23. Kidaco	153	512	3.3	3.0	630	4.1	2.0	709	4.6	1.7	944	6.2
24. Kilicao	109	2,182	20.0	2.1	2,524	23.2	1.7	2,793	25.6	1.5	3,597	33.0
25. Kimontong (u)	36	1,527	42.4	2.6	1,828	50.8	2.0	2,059	58.2	1.7	2,742	76.2

Barangay	Area (ha)	1980 Population	1980 Population Density	1980 - 1987 Ave. Annual Growth Rate (%)	1987 Population	1987 Population Density	1987 - 1993 Ave. Annual Growth Rate (%)	1993 Population	1993 Population Density	1993 - 2010 Ave. Annual Growth Rate (%)	2010 Population	2010 Population Density
26. Kinawitan	187	421	2.3	1.0	451	2.4	1.5	493	2.6	1.5	635	3.4
27. Kiwalo	63	709	11.3	2.0	814	12.9	1.7	901	14.3	1.5	1,161	18.4
28. Lacag	143	2,037	14.2	1.8	2,308	16.1	1.0	2,450	17.1	1.0	2,902	20.3
29. Mabini	172	611	3.6	3.0	751	4.4	2.0	846	4.9	1.7	1,127	6.6
30. Malaboc	185	2,579	13.9	1.4	2,643	15.4	1.5	3,109	16.8	1.5	4,004	21.6
31. Malabago	278	495	1.8	2.3	580	2.1	2.0	653	2.3	1.7	870	3.1
32. Maopi	133	874	6.6	1.0	937	7.0	1.0	995	7.5	1.0	1,178	8.9
33. Maropoy (u)	32	3,161	98.8	3.0	3,888	121.5	2.0	4,378	136.8	1.7	5,831	182.2
34. Matong	185	839	4.5	3.0	1,032	5.6	2.0	1,269	6.9	1.7	1,690	9.1
35. Mayon	263	992	3.8	1.6	1,109	4.2	1.5	1,213	4.6	1.5	1,562	5.9
36. Mi-Isi	1,366	731	0.5	4.0	962	0.7	2.5	1,116	0.8	2.5	1,562	1.1
37. Nabasan	292	637	2.2	1.0	683	2.3	0.5	704	2.4	0.5	766	2.6
38. Namantao	164	1,111	6.8	2.0	1,276	7.8	1.7	1,412	8.6	1.7	1,881	11.5
39. Pancan	189	638	3.4	0	638	3.4	0	638	3.4	0	638	3.4
40. Penafrancia	124	1,301	10.5	2.7	1,568	12.6	2.0	1,766	14.2	1.7	2,352	19.0
41. Poblacion Ilowod	90	3,956	44.0	0	3,956	44.0	0	3,956	44.0	0	3,956	44.0
42. Market Area (u)												
43. Sagpon (u)	65	4,696	72.2	2.0	5,395	83.0	2.0	6,076	93.5	1.7	8,092	124.5
44. Salvacion	149	1,780	11.9	3.0	2,189	14.7	2.5	2,539	17.0	2.5	3,554	23.9
45. San Rafael	141	306	2.2	3.0	376	2.7	2.0	423	3.0	1.7	563	4.0
46. San Ramon	244	1,373	5.6	0	1,373	5.6	0	1,373	5.6	0	1,373	5.6
47. San Roque (u)	34	3,852	113.3	1.0	4,130	121.5	1.0	4,381	128.9	1.0	5,188	152.6
48. San Vicente Grande	145	758	5.2	0	758	5.2	0	758	5.2	0	758	5.2
49. San Vicente Requeno	69	192	2.8	2.0	221	3.2	1.7	245	3.6	1.5	316	4.6
50. Sipi (u)	55	2,192	39.9	3.0	2,696	49.0	2.5	3,127	56.9	2.0	4,378	79.6

Barangay	Area (ha)	1980 Population	1980 Population Density	1980 - 1987 Ave. Annual Growth Rate (%)	1987 Population	1987 Population Density	1987 - 1993 Ave. Annual Growth Rate (%)	1993 Population	1993 Population Density	1993 - 2010 Ave. Annual Growth Rate (%)	2010 Population	2010 Population Density
51. Tabon-Tabon	271	1,058	3.9	2.5	1,258	4.6	2.0	1,417	5.2	1.7	1,887	7.0
52. Tagao (u)	69	2,902	42.1	4.0	3,819	55.3	2.5	4,429	64.2	2.5	6,201	89.9
53. Talahib	206	732	3.6	0.7	769	3.7	0.5	792	3.8	0.5	862	4.2
54. Villa Hermosa	1,355	1,341	1.0	2.6	1,604	1.2	2.0	1,806	1.3	1.7	2,405	1.8
T O T A L	12,000	73,213	6.1	2.3	85,846	7.2	1.7	94,983	7.9	1.5	122,340	10.2

Note: (u) : Urban

Table 2.3.4 Projected Population in The Served Area in Daraga W/D

	1980			1987			1993			2010		
	T.P	P.S.A	%	T.P	P.S.A	%	T.P	P.S.A	%	T.P	P.S.A	%
Urban area	25,889	25,889	100	31,038	31,038	100	34,531	34,531	100	44,846	44,846	100
Rural area	47,324	6,443	14	54,808	7,701	14	50,452	21,531	36	77,494	28,701	37
Total	73,213	32,332	44	85,846	38,739	45	94,983	56,062	59	122,340	73,547	50

Remarks: T.P - Total population in the study area

P.S.A - Population in the served area

% - per cent of the total population (P.S.A/T.P x 100)

Table 2.3.5 Projected Served Population in Daraga W/D

	1980			1987			1993			2010		
	P.S.A	S.P	%	P.S.A	S.P	%	P.S.A	S.P	%	P.S.A	S.P	%
Urban area	25,889	16,900	65	31,038	21,730	70	34,531	27,610	80	44,846	44,846	100
Rural area	6,443	1,000	16	7,701	1,540	20	21,531	11,630	54	28,701	22,960	80
Total	32,332	17,900	55	38,739	23,270	57	56,062	39,240	70	73,547	67,806	92

Remarks: P.S.A - Population in the served area
S.P - Served population
% - per cent of the P.S.A (S.P/P.S.A x 100)

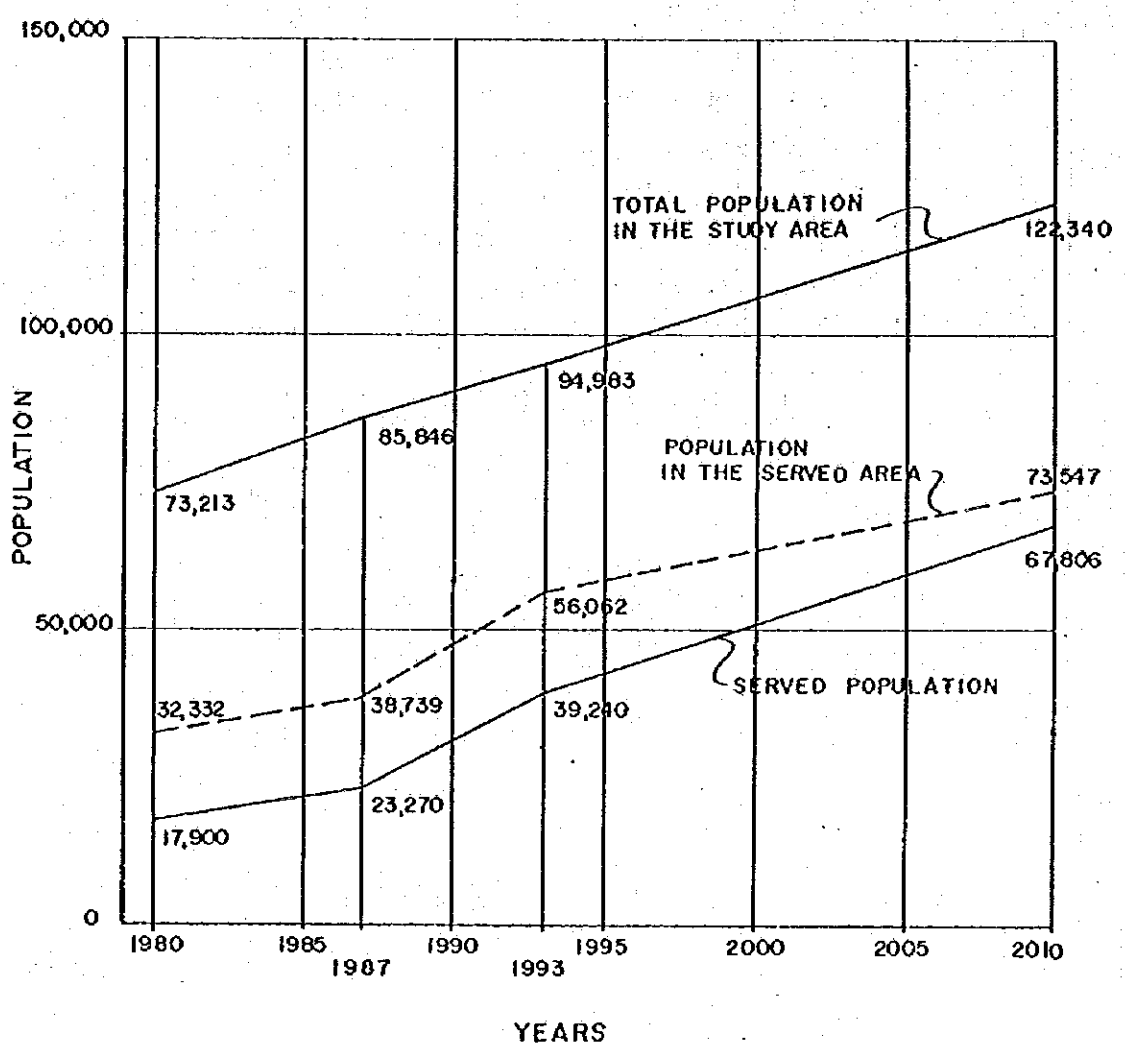


Fig 2.3.2 Served Population

Table 2.3.6 Served Population and Served Area

Barrangay	1980-Present Served Area				1987-Served Area (Phase I Program)				1993-Served Area (Phase II Program)				2010-Served Area (Phase III Program)			
	S.P	% T.P	S.A (ha)	P.D (p/ha)	S.P	% T.P	S.A (ha)	P.D (p/ha)	S.P	% T.P	S.A (ha)	P.D (p/ha)	S.P	% T.P	S.A (ha)	P.D (p/ha)
Urban Area																
Poblacion					2,770	70	90	30.8	3,160	80	90	35.1	3,956	100	90	44
Sagpon					3,780	70	60	63	4,860	80	60	81	8,092	100	60	134.9
Sipi					1,890	70	50	37.8	2,500	80	50	50	4,378	100	50	87.6
Kimantong					1,280	70	30	42.7	1,650	80	30	55	2,742	100	30	91.4
San Roque	16,900	65	400	42.3	2,890	70	30	96.3	3,500	80	30	116.7	5,188	100	30	172.9
Bagumbayon					1,070	70	40	26.8	1,370	80	40	34.3	2,283	100	40	57
Binitayan					2,660	70	180	14.8	3,530	80	180	19.6	6,175	100	180	34.3
Maroroy					2,720	70	30	90.7	3,500	80	30	116.7	5,831	100	30	194.4
Tagas					2,670	70	60	44.5	3,540	80	60	59	6,201	100	60	103
Rural Area																
Malabog					570	20	40	14.3	1,870	60	90	20.8	3,200	80	130	24.6
Busay	1,000	16	-	-	320	20	40	8	1,120	60	90	12.4	2,100	80	130	16.2
Culiat					210	20	20	10.5	720	60	60	12	1,270	80	80	15.9
Banag					440	20	20	22	1,490	60	50	29.8	2,780	80	70	39.7
Budiao									980	50	150	6.5	2,090	80	210	10
Banadero									740	50	60	12.3	1,520	80	80	19
Malobago									330	50	140	2.4	700	80	200	3.5
Kilicao									1,400	50	50	28	2,880	80	70	41.1
Alcala									1,080	50	60	18	2,230	80	80	27.9
Matnog									630	50	90	7	1,350	80	130	10.4
Salvacion									1,270	50	70	18	2,840	80	100	28.4
Total	17,900		400		23,270		680		39,240		1,480		67,806		1,850	
Average				44.8				34.2				26.5				36.7

Remarks: S.P - Served population
% T.P - Per cent to the total population
S.A - Served area in hectare
P.D - Served population density, persons per hectare

3.2 Water Demand

Water demand projection in this section is undertaken to obtain a basis for a long range water supply plan until the Master Plan target year 2010. The water demand projection years are 1987, 1993 and 2010 conforming to the design years of this study. The water demand projections for this study are worked out based on the concept or the methodology indicated in the Procedure of Projection of Population and Water Demand in Appendix 7.

Water demand projections have been made separately for domestic, commercial and industrial, and institutional demands, and for unaccounted-for-water. The categories of water use adopted herein are those presently prescribed in the LWUA's methodology manual.

The average unit consumption figure, which is the amount of water required to satisfactorily supply to all consumers on a continuous 24-hour basis, was developed for each of urban and rural demand areas. The unit consumption figures are qualified as theoretical since there is insufficient data available to develop accurate unit consumptions. The theoretical unit consumption figures are therefore subject to careful review and adjustment after the First Phase program is completed and consumers have an adequate continuous supply of water.

Summary of water demand projections by the design year and category of water use are shown in Table 2.3.7. Served population and average day water demand by demand area are shown in Table 2.3.8. Based on the design criteria for planning, included in Appendix 6, maximum day water demands and peak hour water demands are calcurated and shown in Table 2.3.9.

Table 2.3.7

Daraga WD Average Day Water Demand in Urban Area
(In m^3/day)

Use Category \ Year	1987	1993	2010
Domestic	2,934	4,086	7,848
Commercial and Industrial	369	663	2,242
Institutional	43	83	179
Accounted-for-water	3,346	4,832	10,269
Unaccounted-for-water	1,717	1,601	2,557
Total	5,063	6,433	12,826
Population Served	21,730	27,610	44,846
Per Capita Use(lpcd)	233	233	286

Daraga WD Average Day Water Demand in Rural Area
(In m^3/day)

Use Category \ Year	1987	1993	2010
Domestic	106	907	2,296
Commercial and Industrial	-	-	-
Institutional	3	35	92
Accounted-for-water	109	942	2,388
Unaccounted-for-water	31	233	597
Total	140	1,175	2,985
Population Served	1,540	11,630	22,960
Per Capita Use(lpcd)	91	101	130

Table 2.3.8 Served Population and Average Day Water Demand

	1981			1987			1993			2010		
	S.P	lpcd	A.D (m^3/day)	S.P	lpcd	A.D (m^3/day)	S.P	lpcd	A.D (m^3/day)	S.P	lpcd	A.D (m^3/day)
Daraga												
Urban	16,900	-	-	21,730	233	5,063	27,610	233	6,433	44,846	286	12,826
rural	-	-	-	1,540	91	140	11,630	101	1,175	22,960	130	2,985
Total	17,900	(96)	1,720	22,270	234	5,203	39,240	194	7,608	67,806	233	15,811

Remarks: S.P - Served population
lpcd - litters per capita per day
A.D - Average day demand in cu m/day.

Table 2.3.9 Fluctuations in Water Demand (In m^3/day)

Water District	1981			1987			1993			2010		
	A.D	M.D	P.H	A.D	M.D	P.H	A.D	M.D	P.H	A.D	M.D	P.H
Daraga	1,720	2,080	-	5,203	6,244	7,805	7,608	9,130	11,412	15,810	18,972	23,715

Remarks: A.D - Average day demand

M.D - Maximum day demand = A.D x 1.2

P.H - Peak hour demand - A.D x 1.5

4. Water Sources

This section discusses water sources to be used for the water district in accordance with the projected water demand and based on the conditions of the existing water sources, described in the previous PART. Potential water sources and water demand in the master plan period are shown in Table 2.4.1, and water sources for each phase project are shown in Fig 2.4.1.

4.1 Phase I

Water demand in Phase I is 6,244 cu m/day as shown in Table 2.4.1. The existing water sources in Daraga, namely, Budiao I and II, Banadero and Daraga springs, have an yield of 10,454 cu m/day in total. Against the above yield, present distribution is estimated to be in a range from 2,000 to 3,000 cu m/day due to the damage by the recent flood and deterioration of the facilities. To meet the demand of the district, therefore, repair of the damaged parts and rehabilitation of the facilities are indispensable and included in Phase I project.

4.2 Phase II

In this Phase, the total yield of the existing water sources still meets the projected water demand. However, for full utilization of the yield, some works of transmission pipelines and storage facilities are required.

4.3 Phase III

Water demand in Phase III, up to the year 2010, reaches 18,972 cu m/day which is about twofold that of Phase II. Therefore, an additional water source for 8,518 cu m/day is required. Riverbed water of the Yawa River will be developed to meet the above demand.

As regards the development of riverbed water of the Yawa River, the Legaspi City Water District has a similar plan. For economy of the construction work, it is recommendable that the water source development be carried out under a joint venture of the two districts.

Table 2.4.1 Water Sources for Master Plan Period

Phase	Existing (1980)	Phase I (1987)	Phase II (1993)	Phase III (2010)
Population Served	17,900	22,270	39,240	67,806
Water demand (cu m/day)	2,080	6,244	9,130	18,972
Existing water source and capacity (cu m/day)	4 springs 10,454	4 springs 10,454	4 springs 10,454	4 springs 10,454
New requirement (cu m/day)	-	Not needed	Not needed	8,518
Additional source	-	-	-	Riverbed water 1/

1/ Some shallow wells dug on the riverbed and outcrops of riverbed water which are being used by inhabitants nearby have good water quality, not requiring treatment for domestic use.

Note (1): Use of groundwater to be taken by deep wells in this area is not recommended in this study because of the defect of water quality. Deep groundwater in the area is found to contain odor and color; both to unpermissible extents. They are due to geological conditions influenced by eruptions of active Mayon volcano.

Odor contained in the groundwater can be removed by simple aeration method: however, to remove color requires complicated treatment processes which are not practicable for public water supply, such as rapid sand filtration method plus activated carbon treatment.

(Above consideration is based on the study results of existing deep wells, depths of which are less than 70 m. From the view point of geological and hydrogeological conditions, groundwater deeper than 70 m is also considered to contain odor and color.) (Please refer to Appendix 4.)

Note (2): Location of the infiltration gallery on the Yawa River should be placed on the right bank of the river; between upstream site of Isalog Pulp & Paper Mill and downstream of the conjunction point of two branch streams.

Note (3): Banadero Spring Water
Water of Banadero Spring Water source contains sulphate more than permissible level (Refer to Appendix 1.). If simple measurement can solve the sulphate problem, Banadero Spring source is recommended to be used, since it is already existing. The simple way is to mix the water with other water source which does not contain the sulphate.
Sulphate (SO_4^{--}) can not be removed by ordinary treatment methods; except ion-exchange method which is considered unpractical to the public water supply, economically and rechnically. It is, therefore, recommended that Banadero Spring water be mixed with good water of Budiao Spring water nearby, provided that the sulphate concentration of the Banadero Spring water would not changeable so much in the future. People living nearby Banadero Spring will be supplied with the mixed water.
Regarding deposit on the pipe walls due to the existence of the sulphate, it would be hardly developed, since Langelier's saturation index relresents chemical stabilization is calculated as minus (-) 0.51 which means undersaturation of the water.

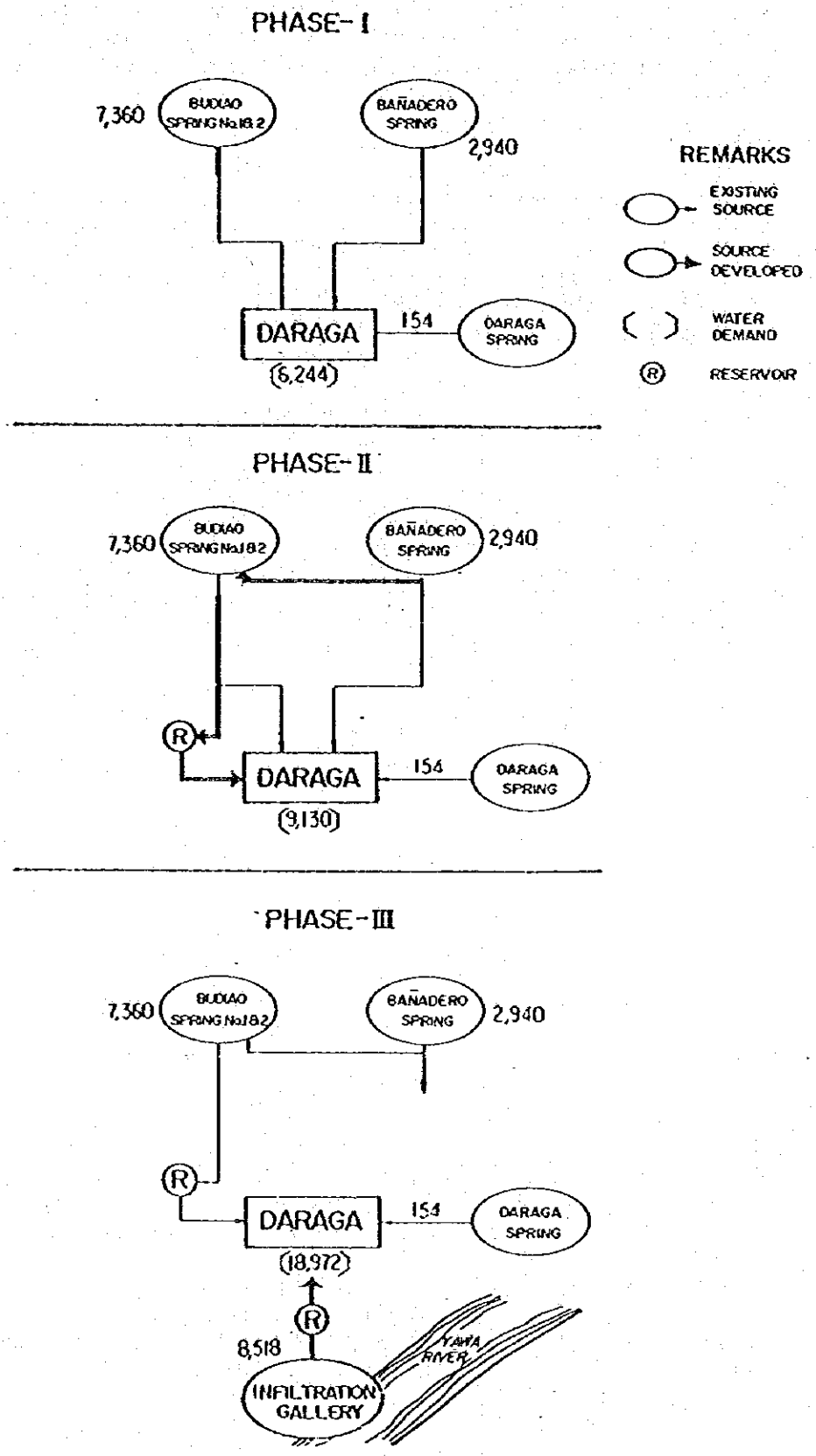


Fig 2.4.1 Water Sources in Each Phase

5. Proposed Water Supply System

5.1 General

The water supply system to be provided for the water district is planned hereunder based on the present conditions of the existing water supply system, the projected water demand and available water sources, so far described. Design criteria to be used for the planning are prepared as presented in Appendix 6, which are worked out taking into account the Technical Standard Manual prepared by LWUA.

5.2 Basic Concept of Planning

In Phase I, the goal of the project is placed on remedy of the current extremely poor water supply conditions in the district. To attain the goal, it is essential to rehabilitate the existing transmission pipelines of Budiao and Banadero. By the above project, continuous supply to the Legaspi City Water District will be assured as well.

In Phase II, the water demand of the district outgrows the water supply capacity obtained by both the reinforcement of the Budiao spring system and the repair of the Banadero spring system. Therefore, to utilize the full yield of the Banadero spring, the yield will be delivered to Budiao, and this transmission system will be strengthened so as to accommodate the two spring yield.

In Phase III, the incremental water demand in the phase will be met by developing riverbed water of the Yawa River.

The above approach to meeting future requirements is presented in Fig 2.5.1. As illustrated, only maximum day demands will be met from the sources; peak hour demands will be furnished by additional supply from the proposed storage facilities.

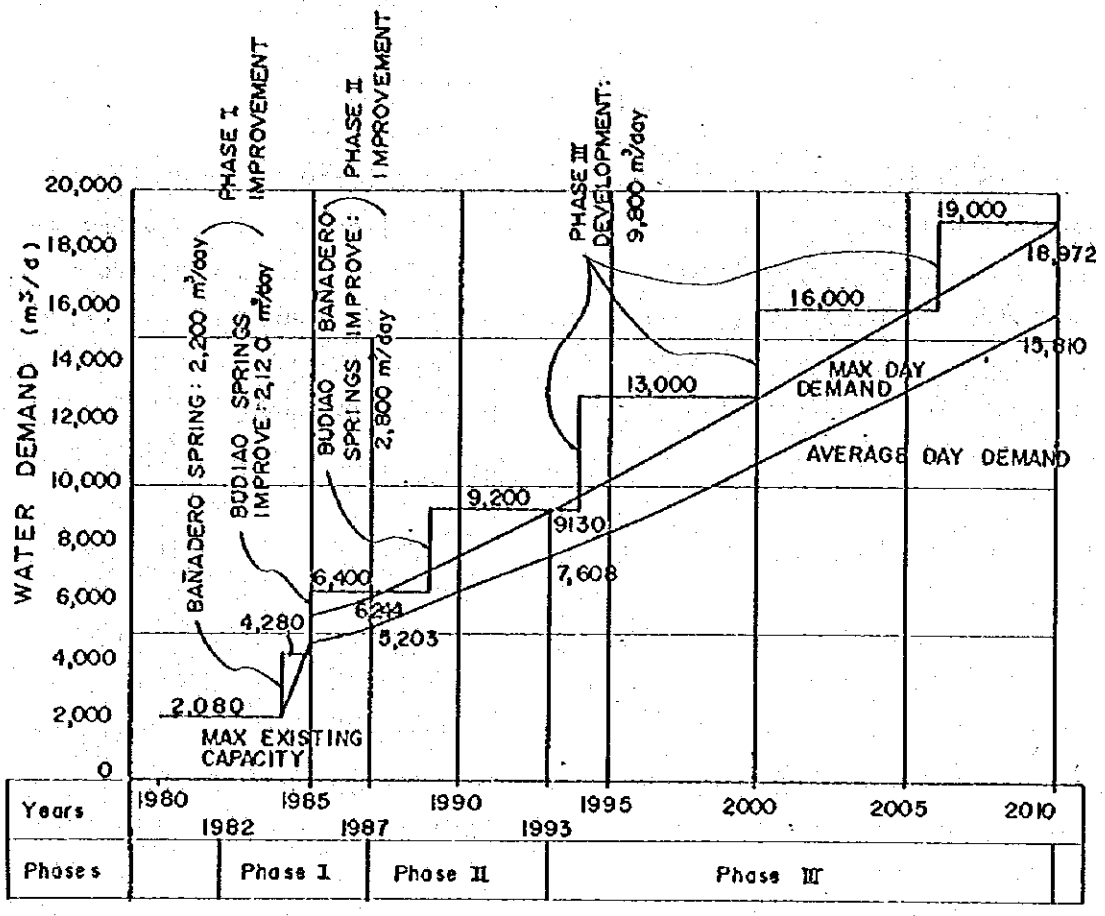


Fig 2.5.1 Water Demand vs. Sources

5.3 Works of Each Phase

Works to be executed in accordance with the basic concept of planning described in the previous section are presented in Table 2.5.1, together with water demand and supply capacity to be added in each phase. Major works are outlined in the following.

(a) Phase I

Essential works of this Phase are rehabilitation of the existing transmission pipelines. The upstream portion of the Budiao transmission line will be replaced. Other major works are reinforcement of the distribution mains and installation of bulk meters and a chlorinator. All service connections will be equipped with meters.

(b) Phase II

To Increase the supply capacity, an additional transmission pipeline will be installed along the Budiao transmission line, and further most of the yield of Banadero spring will be delivered to the collection tank of Budiao spring with a new pipeline. Part of the Banadero spring yield will be distributed in barangays in the water source area. The reservoir will accommodate the production of the Budiao spring diverting from the existing transmission line. For this work, some piping works are required to connect the reservoir and the transmission line and to connect the reservoir and existing distribution networks in Daraga. Secondary distribution mains will be extended as required.

(c) Phase III

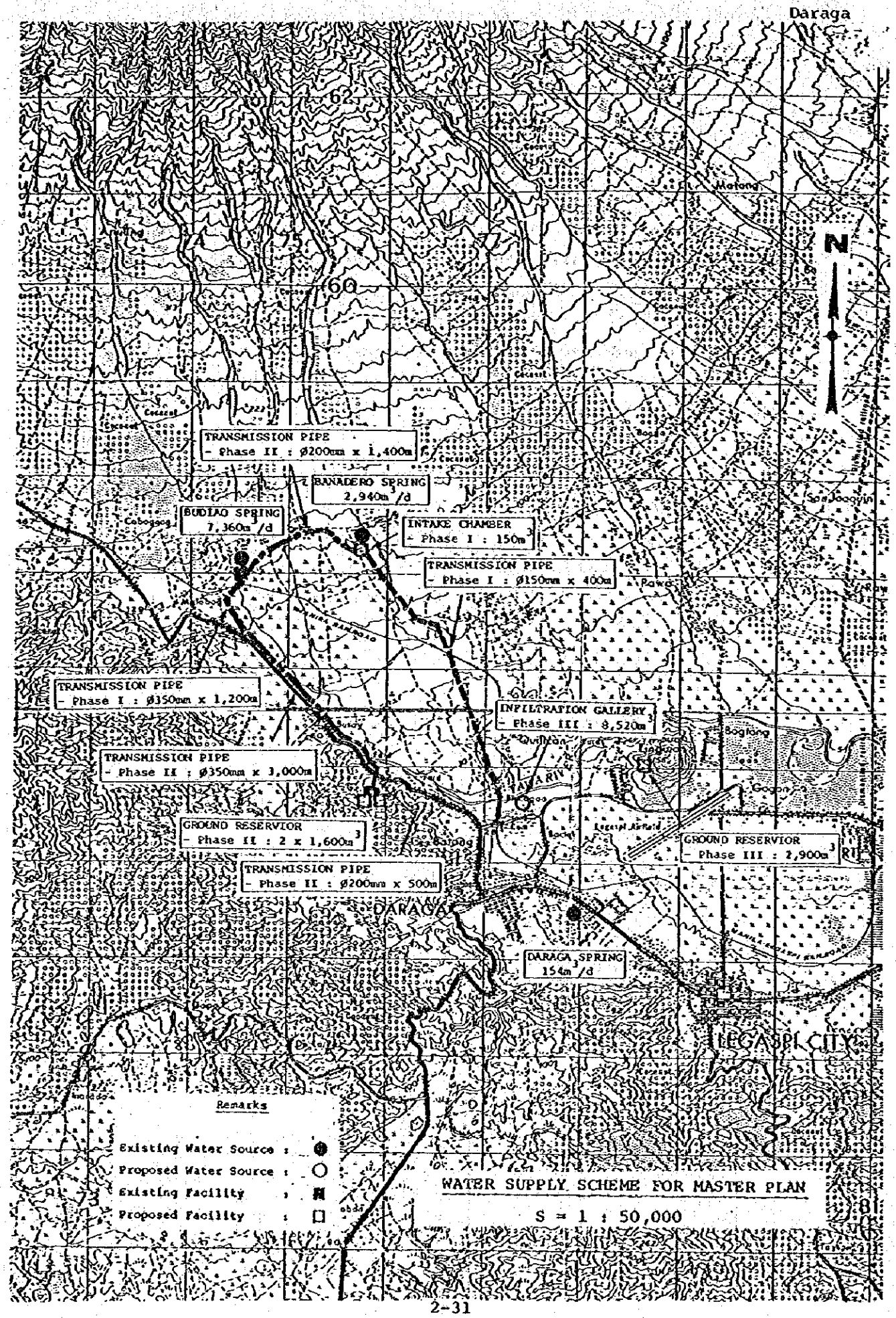
In this phase, the incremental water demand will be met by riverbed water of the Yawa River complete with construction of all necessary facilities.

Table 2.5.1 Description of Necessary Works in Each Phase

Unit: cu m/d

	Phase I (1987)	Phase II (1993)	Phase III (2010)
Water Demand	6,244	9,130	18,972
Source Capacity	10,454	10,454	10,454
Needed Additional Capacity	0	0	8,518
Necessary Works	(1) Buidao, Banadero System a. T/P[1/] of a part of Budiao b. Five bulk meters c. Chlorinator (2) Daraga Spring System Bulk meter (3) Others a. Expansion of distribution pipelines b. Water meters c. Fire hydrants	(1) Budiao, Banadero System a. T/P from Banadero spring to Budiao Spring b. T/P from Budiao to the new reservoir c. Reservoir d. Pumps at Banadero Spring e. Chlorinator (2) Others a. Expansion of distribution pipelines b. Water Meters c. Fire hydrants	(1) Infiltration Gallery System a. Infiltration gallery b. Reservoir c. T/P from the gallery to the reservoir d. Two bulk meters e. Chlorinator (2) Others a. Expansion of distribution pipelines b. Water meters c. Fire hydrants

1/ Transmission pipeline


Daraga
N
TRANSMISSION PIPE
- Phase II : Ø200mm x 1,400m
BANADERO SPRING
2,940m³/d
BUDIAO SPRING
7,360m³/d
INTAKE CHAMBER
- Phase I : 150m³
TRANSMISSION PIPE
- Phase I : Ø150mm x 400m
TRANSMISSION PIPE
- Phase I : Ø350mm x 1,200m
INFILTRATION GALLERY
- Phase III : 8,520m³
TRANSMISSION PIPE
- Phase II : Ø350mm x 3,000m
GROUND RESERVIOR
- Phase II : 2 x 1,600m³
GROUND RESERVIOR
- Phase III : 2,900m³
TRANSMISSION PIPE
- Phase II : Ø200mm x 500m
DARAGA
DARAGA SPRING
154m³/d
LEGASPI CITY
Remarks
Existing Water Source :
Proposed Water Source :
Existing Facility :
Proposed Facility :
WATER SUPPLY SCHEME FOR MASTER PLAN
S = 1 : 50,000

6. Cost Estimate

Summary of the project costs of Master Plan are shown in Table 2.6.1, 2.6.2 and 2.6.3. The costs are broken down into foreign and local currency components. Cost for engineering and physical contingency are allowed in addition to the construction costs.

Conditions and assumptions on which the estimation is carried out are as below, and cost data relating to the estimation are attached to the Report as Appendix 8.

1) All of costs and prices presented in the Table are as of July 1981.
2) Unit costs, as far as available, are taken from the list of costs prepared by LWUA[1/].
3) Unit costs not included in the above list are current prices in the market.
4) Some of the unit costs of LWUA are modified so as to fit for the present project.
5) Local currency portion for the above includes costs for handling, storage and local transportation.
6) Engineering costs are assumed as following percentages of the basic construction cost:
   - For feasibility study = 2.5%,
   - For detailed design = 10.5%, and
   - For construction supervision = 3.5%
7) Physical contingency is allowed by 10 percent of the basic construction cost and engineering cost.
8) Foreign currency exchange rate applied is: US$1.00 = ₱7.80.

1/ Addendum to Methodology Manual, 1981.

Table 2.6.1 Project Cost of Phase I

Note: - Unit = One Thousand Pesos = '000 Pesos
- Prices as of 1st July 1981
- Foreign Exchange Rate: US $ 1.00 = Peso 7.80

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
A. Banadero System				
a) Intake Facilities	150 m^3 x 1	700	175	525
b) Transmission Pipeline	ø150 mm x 400 m	330	221	109
B. Budiao System				
a) Transmission Pipeline	ø350 mm x 1,200 m	1,423	953	470
b) Transmission Outlet Construction		300	75	225
C. Distribution Pipeline	ø200 mm x 1,000 m	390	261	129
	ø150 mm x 1,000 m	275	184	91
	ø100 mm x 2,000 m	360	241	119
	ø 75 mm x 2,000 m	240	161	79
	ø 50 mm x 5,000 m	400	268	132
D. Other Equipment				
a) Service Meters	ø13 mm x 1,233	802	618	184
b) Bulk Meters	ø350 mm x 1 ø200 mm x 1 ø150 mm x 2	50	40	10
c) Valves	ø200 mm - ø75 mm, 20 pcs	120	88	32
d) Fire Hydrant	30 pcs	202	133	69

- to be continued -

Daraga

Note: - Unit = One Thousand Pesos = '000 Pesos
- Prices as of 1st July 1981
- Foreign Exchange Rate: US $ 1.00 = Peso 7.80

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
e) Chlorinators	2 units	20	18	2
f) Vehicles	2 units	140	70	70
g) Spareparts		123	96	27
Sub Total		5,875	3,602	2,273
Feasibility Study Cost (2.5%)		-	-	-
Detailed Design Cost (10.5%)		617	378	239
Supervision Cost (3.5%)		206	126	80
Land Cost		100	0	100
Sub Total		6,798	4,106	2,692
Physical Contingency (10%)		680	411	269
Total		7,478	4,517	2,961
Equivalent to US $		0.96 M	0.58 M	0.38 M

Table 2.6.2 Project Cost of Phase II

Note: - Unit = One Thousand Pesos = '000 Pesos
- Prices as of 1st July 1981
- Foreign Exchange Rate: US $ 1.00 = Peso 7.80

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
A. Budiao System				
a) Transmission Pipeline	ø350 mm x 3,000 m	3,555	2,382	1,173
	ø200 mm x 500 m	294	197	97
b) Ground Reservoir	1,600 m^3 x 2	3,060	765	2,295
c) Distribution Pipeline	ø350 mm x 1,000 m	790	529	261
	ø250 mm x 500 m	573	384	189
B. Banadero System				
a) Pumping Facility		972	583	389
b) Transmission Pipeline	ø200 mm x 1,400 m	822	551	271
C. Distribution Pipe	ø300 mm x 1,200 m	780	523	257
	ø200 mm x 400 m	156	105	51
	ø150 mm x 1,160 m	319	214	105
	ø100 mm x 3,300 m	594	398	196
	ø 75 mm x 3,300 m	396	265	131
	ø 50 mm x41,600 m	3,328	2,230	1,098
D. Other Equipment				
a) Service Meter	ø13 mm x 5,779	3,756	2,892	864
b) Bulk Meter	ø350 mm x 1	52	42	10
	ø300 mm x 1			
	ø250 mm x 3			
c) Valve	ø300 mm - ø75 mm, 32 pcs	192	140	52

- to be continued -

Note: - Unit = One Thousand Pesos = '000 Pesos
- Prices as of 1st July 1981
- Foreign Exchange Rate: US $ 1.00 = Peso 7.80

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
d) Fire Hydrant	38 pcs	254	168	86
e) Chlorinator	1 set	10	9	1
f) Vehicle	1 unit	70	35	35
g) Spareparts		281	219	62
E. Administrative Building		650	130	520
F. Operation Center		490	176	314
Sub Total		21,394	12,937	8,457
Feasibility Study Cost (2.5%)		535	321	214
Detailed Design Cost (10.5%)		2,246	1,348	898
Supervision Cost (3.5%)		749	449	300
Land Cost		56	-	56
Sub Total		24,980	15,055	9,925
Physical Contingency (10%)		2,498	1,506	992
Total		27,478	16,561	10,917
Equivalent to US $		3.52 M	2.12 M	1.40 M

Table 2.6.3 Project Cost of Phase III

Note: - Unit = One Thousand Pesos = '000 Pesos
- Prices as of 1st July 1981
- Foreign Exchange Rate: US $ 1.00 = Peso 7.80

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
A. Infiltration Gallery System				
a) Infiltration Gallery	ø1,000 x 450 m	1,800	450	1,350
b) Intake Pump Station	98.6 l/s, H=60 m	1,417	850	567
c) Transmission Pipe	ø300 x 3,200 m	3,120	2,090	1,030
d) Ground Reservoir	2,900 m^3 x 1	2,236	559	1,677
B. Distribution Pipe	ø350 mm x 1,500m	1,185	794	391
	ø300 mm x 4,000m	2,600	1,742	858
	ø200 mm x 5,000m	1,950	1,307	643
	ø100 mm x 3,000m	540	362	178
	ø 75 mm x 10,000m	1,200	804	396
	ø 50 mm x 65,000m	5,200	3,484	1,716
C. Other Equipment				
a) Service Meter	ø13 mm x 6,500 pcs	4,225	3,253	972
b) Bulk Meter	ø350 mm x 1 pc	20	16	4
	ø300 mm x 1			
c) Valve	297 pcs	811	592	219
d) Fire Hydrant	70 pcs	504	333	171
e) Chlorinator	1 unit	10	9	1

- to be continued -

Daraga

Note: - Unit = One Thousand Pesos = '000 Pesos
- Prices as of 1st July 1981
- Foreign Exchange Rate: US $ 1.00 = Peso 7.80

Work Item	Description	Cost		
		Total Cost	Foreign Currency Component	Local Currency Component
f) Vehicle	2 cars	140	70	70
g) Spareparts		310	242	68
Sub Total		27,268	16,957	10,311
Feasibility Study Cost (2.5%)		682	409	273
Detailed Design Cost (10.5%)		2,863	1,718	1,145
Supervision Cost (3.5%)		954	572	382
Land Cost		104	-	104
Sub Total		31,871	19,656	12,215
Physical Contingency (10%)		3,187	1,966	1,221
Total		35,058	21,622	13,436
Equivalent to US $		4.49 M	2.77 M	1.72 M

7. Implementation Schedule

In accordance with the target years set forth in Section 2 and in consideration of works described in Section 5, the implementation schedule of the whole project of the master plan is worked out and shown in Fig 2.7.1. Major points to be noted about the implementation schedule are as follows.

7.1 Phase I

1) The period from present up to the commissioning of the completed facilities is estimated based on the detailed time elements of individual work items.

2) The period between the above commissioning and the target year is set so that actual data on water supply planning factors can be collected.

3) Start of engineering works for Phase II project is placed just after the commissioning and before the target year, so that the planning of the Phase II project can be made employing actual data and the construction of the said project can be commenced as early as possible.

7.2 Phases II and III

1) Commissioning of the Phase II facilities is scheduled two years after the Phase I target year. It may result in slight shortage of the supply capacity. But, depending on the actual development of the supply conditions, the time of commissioning can be advanced to some extent, or a small cut of maximum day demand may be tolerated by the consumers.

2) Implementation of the Phase III project is planned in a similar way to Phase II. All explanations above are applicable to this phase as well.

Fig 2.7.1 Implementation Schedule