PHOTOGRAPHIC DATA SHEET	PN-AAJ-353	AP10-0000-G732

Water supply, provincial urban areas; feasibility study, summary report

4. CORPORATE AUTHORS (101)

Camp Dresser & McKee International, Inc.

6. DOCUMENT DATE (110)	7. NUMBER OF PAGES (120)	8. ARC NUMBER (170)
1976	49p.	RP628.1.C186c

9. REFERENCE ORGANIZATION (130)

CDM

10. SUPPLEMENTARY NOTES (500)

11. ABSTRACT (950)

12. DESCRIPTORS (920)

Water supply
Feasibility
Water services
Philippines
Urban areas
Municipal engineering
Water management
Municipalities

13. PROJECT NUMBER (150)

492026000

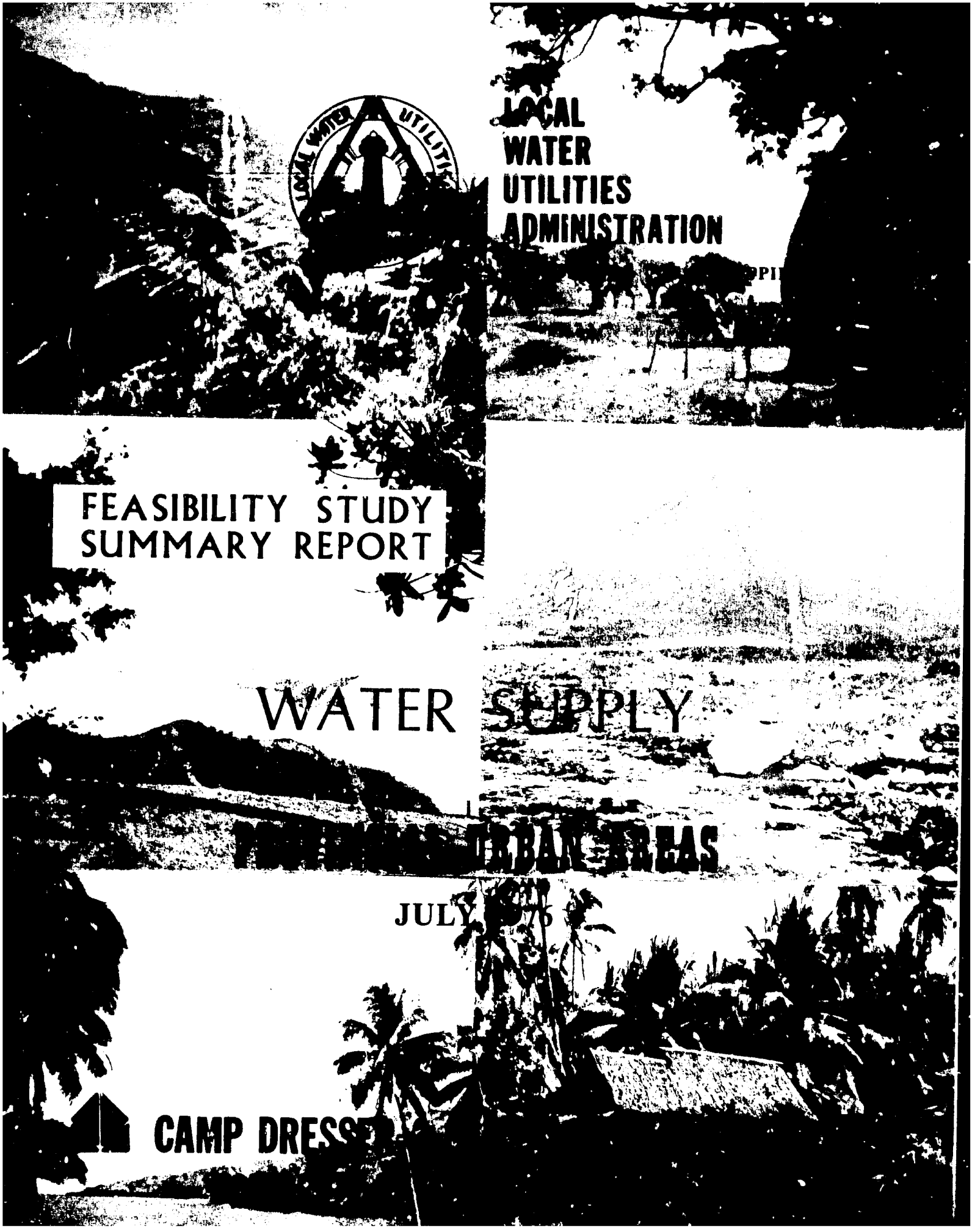
14. CONTRACT NO.(140)

AID-492-1281-T

15. CONTRACT TYPE (140)

16. TYPE OF DOCUMENT (160)

41



LOCAL WATER UTILITIES ADMINISTRATION

FEASIBILITY STUDY SUMMARY REPORT

WATER SUPPLY

URBAN AREAS

JULY 1976

CAMP DRESSER

CAMP DRESSER & McKEE INTERNATIONAL INC.

CONSULTING ENVIRONMENTAL ENGINEERS

ONE CENTER PLAZA BOSTON, MA 02108 TEL. 617 742-5151 CABLE: CAMDRES

Local Address:
PHILCAMCON BLDG., SEVENTH FLOOR
ORTIGAS AVENUE
PASIG, RIZAL
REPUBLIC OF THE PHILIPPINES
TEL. 70-11-76
70-11-77

Please Reply To:
CAMP DRESSER & McKEE INTERNATIONAL INC.
P.O. BOX 1231, MCC MAKATI, RIZAL
REPUBLIC OF THE PHILIPPINES

August 2, 1976

Mr. Carlos C. Leaño, Jr.
General Manager
Local Water Utilities Administration
5th Floor, Philcamcon Bldg.
Ortigas Ave., Pasig, Rizal
Republic of the Philippines

Subject: Summary Report - Feasibility Studies for Water Supply of Philippine Provincial Urban Areas

Dear Mr. Leaño:

In accordance with the contract between Local Water Utilities Administration (LWUA) and Camp Dresser & McKee International Inc., dated 14 October 1974, we take pleasure in submitting this summary report.

This summary report presents the highlights of the feasibility studies for water supply for the urban areas of Ozamiz, Dast, Butuan, Zamboanga, Cebu, Lucena, Lipa, Tarlac, Cabanatuan and San Fernando (La Union). The studies involve over eight per cent of all people living in provincial urban areas of the Philippines. This report also includes the summary findings on prefeasibility surveys of 131 communities served by 110 waterwork systems. This portion of the study constitutes about one-third of all cities/municipalities with existing waterworks in the Philippines.

We wish to extend our thanks to the LWUA Board, all the members of the LWUA staff, our counterpart engineers from DCCD Engineering Corporation, the water districts' staffs and the officials of various agencies of the Government of the Philippines, who so generously assisted us during the course of our study.

Very truly yours,

CAMP DRESSER & McKEE INTERNATIONAL INC.

LEONARDO V. GUTIERREZ, JR.
Project Manager

PAUL W. FRESNDIVILLE
Principal-In-Charge

"Feasibility Studies for Water Supply of Philippine Provincial Urban Areas"

TABLE OF CONTENTS

		Page
Findings		1
Recommendations - Technical		1
Recommendations - Institutional		2
Introduction	(Figure A)	3
Existing Data/Facilities		3
Resulting Inadequacies	(Table 1)	4
Planning Criteria		5
Design Criteria	(Table 2)	6
Cost & Economic Criteria		6
Ability-to-Pay Issue		8
Alternative Studies		9
Recommended Plan(s)	(Table 3)	10
Benefits of the Water Supply Project		13
Environmental Statement	(Table 4)	13
Sewerage/Drainage Concepts		15
Monitoring of Water Quality/Flows		17
Updating the Water Supply Plan		17
Economic/Financial Analysis	(Table 5)	17
Appendix I Prefeasibility Studies for 100 Cities		I-1
II Recommended Plan(s)		II-1

Findings

1. Existing waterworks facilities of provincial urban areas of the Philippines are inadequate and unreliable. The water produced is unsafe for human consumption. The facilities are generally in rundown condition and in constant disrepair. Field tests show that most water distribution systems have old and inadequately sized pipes with considerably reduced capacities resulting in low pressures and marginal fire-fighting capabilities.

2. Water sources, both surface and groundwater, are available and in most cases plentiful, but water-handling facilities such as impoundments, reservoirs, intake structures, transmission mains, treatment plants, storage facilities, and distribution piping have to be planned, engineered, and constructed to convey the water to the demand centers.

3. Water demand will increase exponentially as urban population grows, accompanied by increases in the standard of living/opportunity.

4. Implementation of well-planned and properly-engineered water supply systems is feasible, both from the technical and the economic/financial viewpoints.

5. Quantifiable economic benefits exceed the known costs of the water supply projects. The non-quantifiable benefits are also significant. Therefore, economic analysis of the implementation of improved and adequate water supply systems is substantially more favorable than financial analysis would indicate.

6. The recommended plan may be implemented through well-defined series of construction stages. These staged programs are considered financially viable, provided water rates are set on the basis of the consumers' "ability to pay". In certain cases, the water rate structure may be designed to provide some form of subsidy to lower income groups.

7. The local capability to plan, design, construct, manage and operate efficiently improved water supply systems will have to be strengthened to keep up with the increasing demand for such expertise.

Recommendations - Technical

1. The logical and economical development of waterworks facilities must be based on a comprehensive long-range planning process. The planning process must take into account alternative studies, economic optimization of the selected plan, and the citizen's "ability-to-pay".

2. Approximately two-thirds of the water produced in existing water supply system is not sold or billed against water consumers. Such unaccounted-for-water is due mostly to leakage and wastage in the transmission and distribution system. A comprehensive leakage and wastage survey must be conducted preparatory to a corrective leakage/wastage program.

3. All existing flat-rate connections must be converted into metered connections as expeditiously as possible. Meters should be installed first on unmetered large-demand connections, where pressures are high and eventually where demand and pressures are low. An effective meter repair and preventive maintenance

program should be initiated as soon as possible.

4. A routine water measurement and sampling program at the sites of proposed and existing water sources and within the existing distribution system must be initiated. Bacteriological, chemical and physical testing of these water samples should be performed so that corrective measures may be made to safeguard public health of the water consumers.

5. A continuous disinfection program must be initiated and enforced to safeguard the entire water distribution system on a 24-hour daily basis.

6. A physical inventory and survey of all existing water supply and drainage/sewerage systems and all connections to private premises must be conducted. An inventory of all private wells, septic tanks and private drainage systems to complete as-built drawings will be included in this task.

7. A flexible and enforceable plumbing code must be adopted, to complement proposed water supply facility improvements, to eliminate water supply/drainage cross-connections, and to minimize potential (future) wastewater/drainage problems.

8. A hydrological and meteorological data collection and monitoring program must be initiated by establishing stream, spring, rainfall and evaporation gaging stations and by measuring water levels and volumetric discharges at existing and proposed well fields.

Recommendations - Institutional

1. The legal basis for the development of existing and new water sources must be established. Guidelines for the implementation and enforcement of policies such as water allocation should be established.

2. Water rates have traditionally been so low that, in most cases, even operational costs are not even covered by collected revenue. Water rates must be increased to realistic levels to cover amortization of capital expenses and operational cost. Associated with this water rate increase is the need to socialize the pricing structure, e.g., a stepped-up rate structure. Low-income water users should be billed on their "ability-to-pay", with high-income consumers, industries and commercial establishments subsidizing the low-income groups.

3. There is a serious need to upgrade and train personnel involved in the planning, design, construction, management and operation of water supply systems. Therefore, improvements to the engineering, management and maintenance procedures should be implemented in anticipation of future requirements that will be imposed by funding agencies and the water district's demands.

4. After the physical inventory is completed (Item 6, Technical Recommendations) a water audit task force should be organized within the water district to monitor/inspect premises and to detect/minimize leakage wastage and meter tampering. Such task force should be granted police powers in protecting the water resources of the community.

5. To encourage early provision of water service and to help low-income house-

holds, a revolving fund for service connections should be established within the water district.

Introduction

Presidential Decree No. 198 issued on May 25, 1973, seeks to establish, operate and develop reliable, adequate and economically viable water supply and wastewater disposal systems. The Local Water Utilities Administration (LWUA) was formally organized on September 18, 1973 to implement the objectives and provisions of this decree.

LWUA has been actively encouraging the formation of independent, locally controlled public water districts in provincial urban areas. This step is designed to ensure safe and sufficient potable water supply by the district and its operation on a business-like basis. LWUA is currently engaged in developing feasibility studies of several provincial urban areas, prefeasibility studies of cities/municipalities, as well as, project and facility implementation programs resulting from such studies.

The feasibility studies included in this paper are financed from proceeds of a loan to the Government of the Republic of the Philippines from the United States of America through the Agency for International Development. These feasibility studies cover over eight per cent of people living in provincial urban areas of the Philippines.

The project consists of four parts:

1. Preparing water supply master plan and feasibility studies for ten provincial urban areas of the Philippines, initially Cebu, Zamboanga, Butuan, Ozamiz, and Dast (see Figure A);

2. Developing a methodology of conducting these studies through weekly training seminars of LWUA engineers;

3. Applying this training methodology, using LWUA trainees, in the preparation of master plans and feasibility studies for the second five areas, namely: Tarlac, Cabanatuan, San Fernando-La Union, Lucena and Lipa; and

4. Assisting LWUA in long-range planning by developing selection criteria, applying these criteria to 100 cities and conducting prefeasibility surveys and data collection on these cities/municipalities. (Refer to Appendix I.)

The training of counterpart LWUA and local consulting (DCCD Engineering Corporation) personnel is an important element in the conduct of such studies.

Existing Data/Facilities

Hydrologic and hydrogeologic information is scarce and insufficient to make accurate assessment of the future potential surface and groundwater resources. Therefore, the safe yield studies of streams and underground aquifers have been based on short-term field work supplemented by broad estimates and tempered largely by engineering judgement.

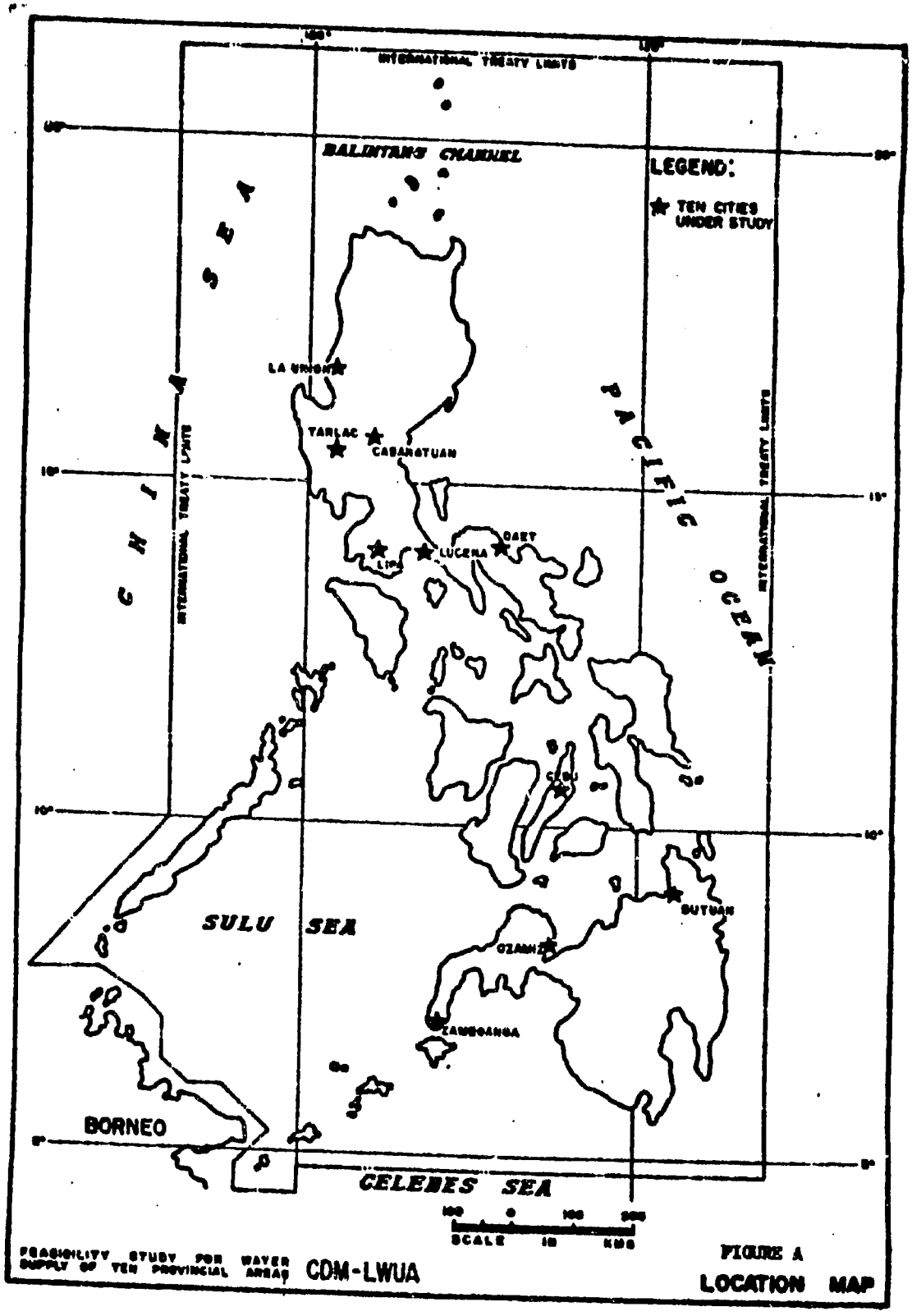


FIGURE A
LOCATION MAP

The existing waterworks facilities of the urban areas are inadequately designed and improperly operated. They are generally rundown and in constant disrepair. Field tests show that most distribution systems have old pipes with considerably reduced carrying capacities resulting in low pressures and marginal fire-fighting capabilities in these areas. Operational personnel are mostly untrained and inadequately compensated. There is evidence of widespread wastage of the water through leakage from old, corroded pipe mains, and careless use by the average householder. Wastage is associated with and encouraged by unmetered (flat rate) water connections. Water rates have traditionally been so low that in most cases operational costs of substandard facilities are not even covered by collected revenues.

Resulting Inadequacies

Most deficiencies in the ten water districts studied are similar: water shortage; system age; water unaccountability; inadequate disinfection; and unreliable service.

The water shortage affects the system pressures, fire-fighting potential, and consumption patterns. Because water must be rationed, pressures fluctuate over a wide range and often become negative. The negative pressures increase the possibility of contaminated water entering the distribution system. Areas receiving no water are extremely vulnerable to fires. Many water district customers must modify their consumption patterns because of water rationing. Some get water only during night-time hours and others only during day-time hours. Such service strains any goodwill developed between consumers and the water district. Unserved households are, in the best of circumstances, sub-users obtaining their water from dwellings connected to the distribution system. These unserved households must pay water vendors rates (up to 5-7 times) greater than water district rates.

More than two-thirds of the water produced is neither sold nor billed against the water consumers. Leakage and wastage comprise more than half of the water produced. House connections without meters or with non-functioning meters are billed on a flat-rate basis - a situation which encourages the wasting of water. (See Table 1.)

At best, delivered water is of questionable quality and unsafe bacteriologically. The water supply system generally includes numerous opportunities for cross-connections with polluted water from drains/sewers.

TABLE 1

WATER ACCOUNTABILITY
(As a Percentage of Water Production)

City Of	Accounted-For-Water			Unaccounted-For-Water				
	Metered Billing	Flat-Rate Billing	Total	Underestimated Flat-Rate Use	Wastage	Leakage	Other	Total
Ozamis	33	4	37	9	13	35	6	63
Dast	3	25	28	5	31	30	6	72
Butuan	7	26	33	5	31	23	8	67
Zamboanga	20	20	40	9	29	15	7	60
Cebu	17	14	31	11	26	25	7	69
Lucena	0	17	17	17	33	26	7	83
Lipa	0	21	21	7	29	36	7	79
Tarlac	5	41	46	0	35	10	9	54
Cabanatuan	16	31	47	7	30	10	6	53
San Fernando	17	4	21	3	7	62	7	79

Planning Criteria

The following criteria were used as guidelines for the feasibility studies:

1. Regional Approach: Planning of facilities was made on a regional basis, taking into account the short-term district boundaries and the logical long-term service areas beyond present district or political boundaries.

2. Source of Water: Groundwater and surface water were given equal emphasis as potential sources of water.

3. Self-Sufficiency: The recommended plan was based on a system which would provide the highest quality of water service within the "ability-to-pay" of the customers.

4. Conservation: Selection of alternative plans considered water, power, chemicals, and foreign exchange as a valuable resource which must be conserved to the best extent possible.

5. Stage Development: The long-range implementation program for source, transmission and treatment facilities was based on several construction stages/phases to satisfy projected requirements for a specific design year:

Stage/Phase	Implementation/Construction Period	Target Design Year
Early Action	1976-78	
Stage I	1977-90	1990
Phase I-A	1977-82	1986
Phase I-B	1982-86	
Phase I-C	1986-90	
Stage II	1990-2000	2000
Phase II-A	1990-95	
Phase II-B	1995-2000	

6. **Alternative Plan Screening and Selection:** From an array of identified plan alternatives, an interim plan was selected on the basis of least (present worth) cost and other non-economic parameters. The selected (interim) plan was tested for economic/financial feasibility.

7. **Skilled Manpower Shortage:** The recommended plan recognizes, in the short term, the apparent shortage in skilled, technical and managerial expertise. Emphasis was given on the need for district personnel training and certification.

8. **Water Quality:** The feasibility study identifies present and future water quality problems and includes recommendations towards providing water supply that is safe, healthful and wholesome. It develops conceptually long-range water quality management plans to conserve the integrity of this valuable resource.

Design Criteria

Average per capita domestic water consumption for each of the ten project areas was estimated with the use of field data and available records of past and present water use. Per capita domestic use was increased each year to account for projected economic growth within the community (see Table 2).

Commercial and institutional water demands were estimated as a percentage of the domestic demand. Where no reliable records were available, a unit demand of five cum/day/ha (gross) was used.

There are currently few or almost no heavy and/or "wet" industries in the provincial areas studied. Projection of future industrial water demand was based on land zoning plans, where available.

Maximum daily and maximum hourly demands were estimated from field data and available records. On the basis of an evaluation of variations in water use observed in one of the study areas, the following ratios were adopted for this study:

Relationship of Flow	Ratio
Maximum Daily to Average Daily Demand	1.20:1.00
Maximum Hourly to Average Daily Demand	1.50:1.00 - 1.75:1.00

A review of the available records and consumption patterns indicates that the present unaccounted-for-water is high, amounting to 50-80 per cent or more of the water production. For preliminary design purposes, it has been assumed that unaccounted-for-water would be reduced gradually as positive improvements are added to the water system. By the year 2000, unaccounted-for-water would be about 20 per cent or even less.

Cost and Economic Criteria

The opportunity cost of capital or discount rate used in this feasibility study is 12 per cent. The discount rate was utilized for economic screening of the technically viable alternatives.

Projections indicate a general price escalation rate of 10-12 per cent for

TABLE 2

AVERAGE DAILY WATER
DEMAND AND SUPPLY REQUIREMENT (cumd)

Category of Water Use	Ozamiz			Dapitan			Butuan			Zamboanga			Cebu		
Yr.	1980	1990	2000	1980	1990	2000	1980	1990	2000	1980	1990	2000	1985	1990	2000
Domestic	3,230	7,050	13,900	5,760	12,640	25,500	4,000	11,080	22,800	8,800	16,600	27,600	68,200	94,000	168,000
Commercial/Institutional	390*	850*	1,700*	690*	1,520*	3,060*	400	1,100	2,300	2,200	2,600	3,000	6,800	9,400	17,000
Industrial							100	560	2,100	500	1,100	2,000	3,600	7,600	12,000
Accounted-for-Water	3,620	7,900	15,600	6,450	14,160	28,560	4,500	12,700	27,200	11,500	20,300	32,600	78,600	111,000	197,000
(Equivalent, lpcd)	(134)	(149)	(168)	(134)	(149)	(168)	(135)	(133)	(179)	(158)	(163)	(177)	(170)	(183)	(205)
Unaccounted-for-Water	2,[illegible]	3,400	3,900	4,300	6,070	7,140	1,900	4,200	6,800	7,700	8,700	8,200	23,700	37,000	49,000
(Equivalent, lpcd)	[illegible]	(64)	(42)	(89)	(64)	(42)	(58)	(50)	(45)	(105)	(70)	(45)	(73)	(61)	(51)
Grand Total	6,[illegible]	11,300	19,500	10,800	20,200	35,700	6,400	16,900	34,000	19,200	29,000	40,800	112,300	148,000	246,000

	Cabanatuan			La Union			Lucena			Lipa			Tarlac		
Yr.	1985	1990	2000	1985	1990	2000	1985	1990	2000	1985	1990	2000	1985	1990	2000
Domestic	8,300	13,200	22,600	4,260	8,000	19,600	9,800	15,400	26,900	3,900	7,200	12,900	8,300	12,300	21,300
Commercial/Institutional	1,[illegible]00*	2,400*	3,600*	900	1,320	2,400	1,500	2,000	2,700	600*	1,100*	2,000*	1,700*	2,200*	3,400*
Industrial				660	950	1,400	650	1,000	1,700						
Air Base										1,750	1,800	1,850			
Accounted-for-Water	11,200	15,600	26,200	5,820	10,270	23,400	11,950	18,400	31,300	6,250	10,100	16,750	10,000	14,500	24,700
(Equivalent, lpcd)	(160)	(165)	(180)	(188)	(184)	(188)	(166)	(174)	(186)	(202)	(189)	(188)	(159)	(165)	(180)
Unaccounted-for-Water	3,700	4,400	6,600	1,930	2,830	5,900	5,150	5,000	7,800	1,500	2,400	3,700	3,300	4,100	6,200
(Equivalent, lpcd)	(53)	(47)	(45)	(62)	(51)	(48)	(71)	(47)	(46)	(48)	(47)	(42)	(53)	(47)	(45)
Grand Total	14,900	20,000	32,800	7,750	13,100	29,300	17,100	23,400	39,100	7,750	12,500	20,450	13,300	18,600	30,900

*Industrial demand is included.

the period 1976 through 1980; 8-10 per cent for the period 1981-85; and 6-8 per cent for the period 1986-90.

For the purposes of cost estimating, a construction cost index (CCI) for water supply projects has been developed, with 1965 as the base year (CCI=100). Unit costs for the water supply feasibility studies have been projected to July 1976 price levels (CCI=384). Construction cost curves have been developed for in-place costs of pipelines, deep wells, water treatment plants, pump stations, and storage reservoirs and used for estimating the relative cost magnitudes of alternative water supply plans.

Ability-to-Pay Issue

Presidential Decree No. 198 stipulates that water district must be financially self-sufficient. In the past, most water systems have not been able to generate sufficient revenues to cover even just the operation and maintenance expenses due to various factors including poor pricing schemes, defective collection system and inadequate consumer promotion. The major reason that has been pointed out, however, is that the consumers being served by the water district have such low incomes and hence, they are not in a financial position to pay the full costs of the system. Therefore, before a water system is improved and expanded, the "ability-to-pay" of the population targeted to be served must first be ascertained.

Since water districts are not expected to be extended government subsidy, this has significantly simplified the analysis of the factors affecting "ability-to-pay". The factors that affect "ability-to-pay" are the annual income of families covered by the water district; percentage of their income allocated to water supply; average per capita water use; and the cost of water per unit volume.

In March 1975, an informal survey was conducted among Water District General Managers to help gather data needed for the "ability-to-pay" studies. Questionnaires were distributed to 15 water districts covering provincial areas that differed in size, location and economic conditions.

The answers given by the general managers of the 15 water districts are summarized as follows:

1) Though 10 of the water districts were revenue-producing prior to the change in management of the water district, 13 imposed increased water rates upon takeover.

2) Water consumers generally accepted the increase after some explanations justifying it. Only five received formal complaints about the increased rates while eight received formal complaints about the poor quality of water supply.

3) Ten had difficulty in the collection of water bills primarily due to dissatisfaction of consumers to the water service.

4) Assuming that capital and service improvements were made, the general managers indicated they could increase their rates by as low as 25 per cent and as high as 447 per cent for the average and below average households.

A formal survey was conducted in April and May, 1975 in the City of Lipa and the Municipality of Tanauan. These pilot areas were selected because (a) they are at present experiencing water supply problems, (b) the income level of their families is similar to that of the national income figure, and (c) they are near Manila, only about two hours away by bus.

The survey covered 556 families, classified into four income groups. Approximately 28 per cent came from the low-income class (below ₱220/month); 55 per cent from the middle income (₱221-₱750/month); 12 per cent from the upper middle income (₱751-₱1,500/month); and five per cent from the high-income group (above ₱1,500).

The table below presents the highlights and pertinent findings of the survey:

ESTIMATED ABILITY-TO-PAY BY INCOME GROUPING

					Weighted Average
Income Group	< ₱220	₱221-750	₱751-1500	> ₱1500	
% Distribution	28%	55%	12%	5%	
Probable "Ability-to-Pay" on Basis of Improved Service	₱13.50	₱24.50	₱37.00	₱67.50	₱25.00/mo
Estimated Monthly Average Income	₱220	₱660	₱1,000	₱2,700	₱600/household
"Ability-to-Pay" Divided by Average Income	6.1%	3.7%	3.7%	2.5%	3.7%

The foregoing table indicates that the low-income group may be able to pay a maximum of ₱13.50 a month for water (about 6.1 per cent of their average income). In the extreme end, the high-income group may be able to pay a maximum of ₱67.50 a month for water (only 2.5 per cent of their average income). This disparity in the percentage of income allocated to water by the two income groups may well be the best argument for a socialized price structure.

The probable maximum "ability-to-pay" of the average household in the pilot area is about ₱25.00 per month.*

Alternative Studies

Several alternatives on water sources, source development, water treatment, transmission and distribution of treated water were identified for each of the ten provincial urban areas. These alternatives were evaluated and screened, using economic and non-economic techniques.

Alternative analysis of the water source(s) for the long-range program is primarily based on the least present worth cost alternative, tempered by non-economic parameters such as socio-political, environmental and other considerations.

---

*This figure includes appropriate allowances for the respondents' understating their income or unwillingness to pay and the increase in amount they are willing to pay as a result of improved services.

The water quality tests performed on samples taken from spring and well sources indicate, in general, that most of the physical and chemical quality parameters are within "permissible" and/or /excessive" limits as defined in the Philippine Drinking Water Standards.

For groundwater and spring sources, disinfection will be the only treatment needed. Disinfection ensures safety of the water delivered to the consumers. Various disinfecting chemicals (chlorine, iodine, bromine, oxidising agents) and processes (ozonation, ultra-violet radiation) were examined in this study. Chlorination, which is a universal disinfecting process for municipal water supplies, has a long history of successful application, and has been determined to be the most practicable disinfection process. In three cases (where surface water is the primary source) complete treatment is recommended. The treatment process consist of chemical flocculation, coagulation, sedimentation, multi-media rapid sand filtration and chlorination.

Major distribution alternatives for the areas are concerned with pressure zones, feeder mains, storage facilities and internal distribution network (service mains).

Important considerations with respect to distribution storage are location, elevation, and staging of required volume. The alternative for feeder mains includes the location or routes, sizes, spacing in the network, and construction staging. The alignments for future feeder mains have been chosen along existing and planned road and street rights-of-way. As much as possible, the feeder mains have been looped to avoid dead-end service areas, minimize the number of customers affected by line shut-off, and provide adequate pressure during maximum demand periods as the water can be supplied from more than one direction. Two-hundred mm has been taken as the minimum diameter of feeder mains and 1,000 m as the maximum spacing. The timing of construction of the feeder mains took into account the attainable level of growth in the distribution system, with priority given to areas having higher densities of potential customers.

Alternative studies on the internal network systems considered service both with and without fire protection. Other considerations included minimum pressures in the system, minimum pipe sizes, valve location and spacing, and type, location, and spacing of fire hydrants.

Alternatives available to counteract future (and present) water shortages include: (1) reuse of wastewater, (2) desalting, (3) precipitation augmentation, (4) land management, and (5) dual plumbing system. Except for land management, the above alternatives would have little or no applicability in the study area in the immediate future in view of economic and other factors unique to the study area.

Recommended Plan(s)

The recommended plans for the ten provincial urban areas include:

(a) Maximum use of existing facilities.

(b) Interim improvements that may be implemented by the district (with or without LWUA financing).

(c) Reinforcement and expansion of the transmission and distribution facilities, including pipelines, valves, pressure control chambers,

chlorination stations and storage tanks (with LWUA financing).

(d) Expansion of internal distribution piping, and installation of new metered service connections (with LWUA financing).

For the long-range plan (to year 2000), the principal water sources will be:

Principal Water Source	No. of Cities	Name of City of Urban Area
Springs	3	Osamis, Laoag, Lucena
Groundwater Wells	5	Butuan, Lipa, Tarlac, Cabanatuan, San Fernando
Surface Water	2	Zamboanga, Cebu

The long-range plan has been divided into five construction stages with the following summarized data (see Table 3):

	Total/Average for Ten Urban Areas
Total Project Costs (₱ x 10^6)	2,282.1
Project Costs for Phase I-A (₱ x 10^6)	806.3
Total Served Population (Year 2000), millions	2.222
Total Served Population (1986), millions	1.000
Average Cost per Year 2000 Resident, Pesos	1,026.9
Average Cost per Year 1986 Resident, Pesos	805.7

The per capita project costs of upgrading the existing systems to provide at least 1986 needs range from ₱334 to ₱1,045. Based on the assumption that the water district has to be financially self-sufficient, water rates for the initial three-year period (1978-80) would be ₱0.75 - ₱1.60/cum. With social pricing the resulting water rates correspond to about three to five per cent of the income of the low-income groups; and about 2½ to 5½ per cent of that of the average-income groups without social pricing (see Table 5).

General details of the recommended plan(s) are shown in Appendix II.

Prior to the implementation of the Phase I-A Program, a list of early action works has been drafted for each urban area. The early action program includes easily implementable steps in planning and administration; land acquisition and data collection; and operational improvements. Of importance are:

- strengthening the legal basis for development of water sources;
- initiating improvements to e management, engineering and maintenance procedures;
- land and right-of-way acquisition for proposed improvements;

TABLE 3

SUMMARY SHEET
TRI-AREA FEASIBILITY STUDY

	OLANGO	BAIK	BUTUAN	SAMBOANGA	CEBU	LUCENA	LIPA	TARLAC	[illegible]	[illegible]	TOTAL
Area (ha) Served											
Present	170	380	60	1,020	1,060	360	190	275	390	275	[illegible]
Future (Year 2000)	750	1,580	1,325	2,100	2,660	1,470	860	1,140	1,130	1,155	[illegible]
Population (1000)											
1980	85.5	143.0	124.8	132.0	635.1	129.5	72.6	115.5	108.2	98.0	1,644.2
1990	118.4	188.0	166.3	178.0	865.4	171.2	96.0	148.9	148.4	134.9	2,217.3
2000	154.0	248.0	209.6	230.0	1,129.3	222.6	121.8	190.8	190.1	179.1	2,875.3
Served Population (1000)											
1980	26.9	46.0	33.2	73.0	350.0	63.5	20.4	23.0	34.5	30.2	[illegible]
1990	53.0	95.0	83.3	125.0	470.0	105.9	53.4	97.5	94.3	55.6	1,[illegible]
2000	93.0	170.0	151.5	184.0	960.0	167.8	88.7	137.1	1[illegible]	124.2	2,[illegible]
Maximum-Day Demand (cmm)											
1980	7,200	13,000	7,700	23,000	135,000	16,400	6,200	7,400	12,300	5,000	[illegible]
1990	13,600	24,200	20,300	34,800	178,000	28,100	15,000	22,300	24,000	15,[illegible]	[illegible]
2000	23,400	42,800	40,800	49,000	295,000	46,900	24,500	37,100	39,400	35,[illegible]	[illegible]
Existing Facilities											
Source	Springs	Springs	Wells	Surface water	Mostly wells, some surface water	Springs some surface water	Springs groundwater wells	Groundwater wells	Groundwater wells	Surface water	
Treatment	None	None	Intermittent	Partial	Partial	Intermittent	Intermittent, partial	None	None	Partial	
Water Quality											
Wells	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Good	Good	
Springs	Good	Good	n/a	n/a	Fair	Good	Fair	n/a	n/a	Good	
Surface Water	Needs treatment	Needs treatment	Needs treatment	Needs treatment	Needs treatment	Needs treatment	Needs treatment	Needs treatment	Needs treatment	Needs treatment	
Long-Range Plan											
Source	Highland springs	Highland springs	Wells	Surface water	Impounded surface water	Highland springs	Groundwater wells, springs	Groundwater wells	Groundwater wells	Infiltration wells	
Treatment	Disinfection	Disinfection	Disinfection	Complete	Complete	Disinfection	Disinfection	Disinfection	Disinfection	Disinfection	
Project Cost (P x 10^6)											
Overall	79.7	192.7	163.0	156.3	1,238.8	110.5	54.6	80.5	93.3	112.8	[illegible]
Phase I-A	23.0	48.6	33.9	43.5	520.1	37.5	14.0	25.2	29.2	31.3	[illegible]
1986 Served Population	42,560	76,200	43,260	104,200	422,000	78,900	35,500	67,300	74,900	35,900	[illegible]
Per Capita Cost	P 540	P 637	P 535	P 417	P1,232	P 475	P 394	P 374	P 390	P 872	
Economic Benefit/ Cost Ratio	1.16:1	1.16:1	1.27:1	1.64:1	1.25:1	1.86:1	1.88:1	1.55:1	1.48:1	1.35:1	
Internal Economic Rate of Return*						24%	22%	20%	21%	16%	
Resulting Water Rates(P)	1.00/cmm	1.10/cmm	1.60/cmm	1.20/cmm	1.60/cmm	0.80/cmm	1.00/cmm	1.00/cmm	0.75/cmm	1.25/cmm	
Initial Borrowing Required (P x 10^6)	31.1	87.7	45.5	56.5	757.5	56.5	22.0	37.8	46.9	44.5	

*This additional method of calculating the relationship between economic benefits and costs was applied only to the second five study areas.

- routine collection of hydrologic and meteorological data;
- conversion of all* service connections to metered services;
- leakage survey and appropriate repairs to pipelines and valves; and
- acquisition of selected office and system equipment.
- cleaning and lining encrusted pipes;
- provision of disinfection facilities (chlorination);
- installation of water analysis and testing facilities.

Benefits of the Water Supply Project

The establishment of a water supply system in a community will necessarily bring about health benefits to the population. Undoubtedly, the provision of safe, potable water to the population is a prerequisite for the maintenance of minimum health standards. These health benefits are ordinarily manifested in the following:

1. A significant reduction in the incidence of waterborne diseases such as cholera, dysentery, gastro-enteritis, and typhoid/paratyphoid. As a result, there will be a decrease in the amount of time lost by income earners who are afflicted with such diseases.

2. A subsequent reduction in premature deaths due to the lower incidence of waterborne diseases.

3. A corresponding reduction in medical expenses due to lower incidence of waterborne diseases.

The water supply project will generate other benefits as shown in Table 4. This table indicates the implication of having (with) or not having (without) the water supply project.

Other benefits (that are quantifiable)resulting from the water supply project are:

1. increase in land values

2. personal satisfaction

3. reduction in fire damages

4. reduction in fire insurance costs

Environmental Statement

To provide basic water supply, the project will involve the installation of deep and/or shallow wells; diversion or intake structure; treatment facilities; distribution system storage facilities; pumps, valves and other machi-

---

*Economic analysis shows a benefit/cost ratio which justifies total metering of service connections.

TABLE 4

Benefitem	"Without" Project	"With" Project
1. Water Adequacy	will continue to become in short supply; service will be intermittent and unreliable.	supply will be adequate at continuous pressure.
2. Water Quality	will continue to provide unsafe water and water-borne diseases will continuously be a threat.	supply will be safe, wholesome and healthful.
3. Personal Hygiene of Served Population	because of current water shortage, personal cleanliness is expected to range from marginal to lacking.	will enhance personal hygiene and overall appearance and cleanliness of the population.
4. Personal Satisfaction	will be minimal; significant time spent in fetching water.	releases time for other productive activities; provides "modernization" benefits; enhances self-reliance.
5. Employment Benefits	no improvement.	will provide short and long-term employment benefits.
6. Fire Protection and Fire Insurance	no improvement; area vulnerable to extensive fire damage because of water shortage; no reduction in insurance because the level of fire risks will remain essentially the same.	will improve the fire-fighting capabilities of the area; reduction in fire insurance cost since availability of water with adequate pressure will reduce fire risks.
7. Water-Using Industries in Area	no inducement to industries which use water as a primary or secondary input to locate in the area.	water-using industries will be encouraged to expand facilities, or relocate in the area.
8. Local Tourism	non-availability of piped potable water and poor sanitation facilities will be a deterrent to local tourism.	availability of water, if accompanied by sanitation program, will help boost local tourism.
9. Development of Areas Adjacent to Core City Area into Housing Subdivisions	no impetus to the development of areas adjacent to core city since not much economic activity can occur without adequate water supply.	will help spur the development of areas adjacent to core city into housing subdivisions because water supply availability somehow enhances standard of living.
10. Wastage of Water - a Valuable Natural Resource	wasteful consumption of water will continue because of the absence of safeguards to check its use.	undertaking of metering programs and adoption of new realistic water rates will definitely minimise water wastage.
11. Land Values	market value of land will remain at present levels except for effect of inflation.	will increase land values by at least 20 per cent since water availability is a major consideration in market values of land.

nery; customer meters and fire hydrants; and a network of pipelines along streets, roads, highways and other rights-of-way (generally following normal routes of transport) specifically acquired for these purposes. Each component of the project, as it is constructed, will have a local environmental effect in terms of land use, construction activities, and final aesthetics. In the sense of a treatment plant's use of chemicals and power, and in the use of power for pumping water, there will be the wider environmental effect of depleting natural resources.

Probable adverse environmental effects consist of: soil erosion and noise during construction aesthetics; increase in wastewater; and increase in migration to urban areas. On the other hand, benefits from public health enhancement and other factors will be derived from the project.

The probable environmental effects are tabulated as follows:

Probable Environmental Effects

Item	Term	Positive	Negative	Solution
Soil Erosion	Short		✓	Tight construction specifications
Dust	Short		✓	"
Noise - construction	Short		✓	"
Noise - operational	Long		✓	Proper design
Aesthetics	Long	✓		"
Increase in Wastewater	Long		Unavoidable	Solve sewage problem
Impoundment	Long	✓✓	✓	Careful design
Migration	Long	✓	✓	Careful planning
Resource Use	Long/Short		Unavoidable	

The evaluation of the short-and long-term effects, both beneficial and adverse, indicate that:

1. Careful design and construction will minimize environmental disturbances while these will also create aesthetic and culturally pleasing conditions under which man can develop his most desirable potentialities.

2. The recommended plan will enhance public health, improve the quality of life in the community, and guide its long-term growth and productivity.

3. The peso costs and the short-term adverse effects are offset by the long-term benefits. When compared to the general benefits, particularly those of the health aspects and social uplift, the amount of upset is relatively minor.

4. The commitment of resources is small compared with the anticipated benefits. Resource use is necessary in the construction and operation of a water supply system, but the overall benefits show the overwhelming advantage of carrying on with the project.

Sewerage/Drainage Concepts

With the exception of the core city area of Zamboanga, none of the ten

urban areas have central sanitary sewage (wastewater) collection and disposal systems. Generally, septic tanks are used in the larger houses and establishments. The effluents from the septic tanks are piped to leaching pits, or overflow into the nearest drainage ditches. The latter practice results in grossly polluted open drains and gives rise to offensive and unaesthetic conditions, particularly during the dry season.

As the water supply problem is resolved, wastewater quantities will increase. Consequently, related public health and aesthetic problems will also increase. The additional volumes of wastewater that improved waterworks will generate are anticipated to be disposed of through the same means being used throughout the Philippines, i.e., septic tanks, cesspools, and through surface drains in ditches or gutters. In terms of being a burden to the existing surface drainage facilities, or causing flooding, wastewater is insignificant by comparison with run-off from even a minor rainstorm, although minor revisions to surface drainage facilities may be necessary to prevent unsightly or undesirable accumulations.

There are no current provisions for wastewater collection, treatment or disposal on a nationwide basis. While knowledgeable officials recognize this problem must be addressed in the future, there are no formal plans to meet the requirement at present. If left unattended and unresolved, unsatisfactory disposal of wastewater could present an additional hazard to public health, and could conceivably produce an adverse visual effect on the environment. The potable water system will not be in danger of contamination from the wastewater since, assuming proper installation and operation of the new improved distribution systems, the water supply will be under sufficient constant pressure to prevent infiltration. In fact, the incidence of waterborne diseases should decline since many present water systems are subject to contamination by infiltration owing to occasional negative pressures on distribution systems.

In the Philippines, wastewater has not been given the significance or priority it enjoys in more developed countries. In the contemplation and order of priorities, local decision makers consider basic water supply and distribution to be far more important than sewage disposal and at this point are simply unwilling to consider investing an equal amount, and possibly more, of capital funds in sewerage as in waterworks improvements. In the highly urbanized coastal areas* such as Manila, Cebu and Zamboanga, the order of priority appears to be water supply, drainage/flood control and then wastewater disposal.

Therefore, as soon as the first-phase of the water supply program is underway, appropriate steps should be taken by the water district towards the satisfactory solution of the anticipated wastewater problem.

---

*In the Philippines, only Manila and Zamboanga have some form of wastewater disposal system. At present Manila is basically served by an antiquated sewage disposal system designed to serve 220,000 (Metro Manila is now about five million in population). Practically all other liquid wastewater is transported to natural drainage systems through open ditches, gutters, canals, etc. Yet there is no evidence of intolerable or unacceptable public health conditions as a result. Zamboanga has a system which was built in 1913 and has had no significant improvements since then. It serves about 20 per cent of the core city area.

The initial effort should be directed in developing a comprehensive sewerage/drainage feasibility study. This study must address the issue of whether a combined or a separate system should be provided.

In the meantime, an inventory of existing facilities and collection of pertinent data and information should be conducted in preparation for the sewerage/drainage feasibility study. These activities will include a house-to-house survey of wastewater and toilet facilities and compilation of available and as-built drawings of the storm drains and canals.

Monitoring of Water Quality and Flows

To provide accurate and reliable data for operation and planning/detailed design of future facilities, it is imperative that water quality and flow of the proposed water sources such as springs be monitored. Flow data from the springs may be taken monthly, except during the dry months when flow data should be done on a bi-weekly basis. Monitoring activities should be coordinated and the water district or its consultants should update and review the monitoring program as the goals and the needs of the study area change.

Updating the Water Supply Master Plan

After the water supply master plan has been adopted and initially implemented, it will be necessary to undertake a program for continuously updating and keeping the plan current. Plan updating should take place at least once every five years, or sooner if significant changes occur. Updating is required to assess the effectiveness of the current plan, the benefits gained, the actual costs, the problems encountered, and to provide overall review, refinement, and direction for the future.

Economic/Financial Feasibility

The recommended improvements of the water supply system will bring about numerous economic benefits to the study area. Economic feasibility studies show that the benefits exceed the economic costs associated with the development and operation of the water supply system. The economic benefits that will be derived from an improved, upgraded, and expanded water system can be classified into quantifiable and non-quantifiable. Quantifiable benefits are those which can be expressed in monetary terms while non-quantifiable benefits are intangible but real, and are extremely difficult to express in monetary terms. Significant non-quantifiable benefits are improved standard of living and economic linkages.

The economic cost of the proposed water supply system is the sum of all expenditures required to realize project objectives and benefits. Costs include (1) capital expenditure costs, (2) annual costs.

One method of determining the economic feasibility of a water supply project is by comparing the present value of the benefits likely to be derived and the present value of the costs. The results can be expressed as a ratio called the benefit-cost ratio. The project is considered feasible if the ratio is equal to or greater than one to one. Another method utilizes the internal economic rate of return (IERR). The IERR is the discount rate at which the present value of the benefit stream equals the present value of the cost stream. If the calculated IERR exceeds the adopted or national discount rate (12 per cent in this particular study), then the project is considered economical. Both methods

were used in the economic analysis.

The financial feasibility analyses made for the study establish a detailed set of guidelines that the water district management may use in making crucial decisions during the initial years. A plan was developed to indicate the manner and the time funds would be used to operate and maintain the system; implement the program; establish reserve funds; and retire the indebtedness. Water rates have been developed on the basis that the system will be financially self-supporting. These water rates appear to be within the "ability-to-pay" of the average householder in the district (see Table 5).

Funds from revenues derived from the operations of the water district can be devoted to financing developmental costs to the extent that the revenues exceed annual cash requirements for all purposes. Funds may be borrowed by the water district for development. From the district's point of view, LWUA is the primary, if not the only, realistic source of funds. LWUA borrows both local and foreign currencies at varying terms and lends them to water district.

Funds required to cover development costs have been determined in the financial study. Also included in the financial analyses are (1) water district assets and depreciation forecasts, (2) annual depreciation expenses, (3) revolving fund for service connections, (4) debt service requirements, (5) revenue unit forecasts, (6) water rates determination, (7) revenue forecasts, (8) feasibility of charges, (9) external borrowing required, (10) projections of financial statements, (11) cash flow statements, and (12) other financial statements.

TABLE 5
FINANCIAL ANALYSIS

		Misamis	Daet	Butuan	Zamboanga	Cebu	Lucena	Lipa	Tarlac	Cabanatuan	La Union	[illegible]
Without Social Pricing	Average Water Rate (₱/cum)	1.00	1.10	1.60	1.20	1.60	0.80	1.00	1.00	0.75	1.25	
	Monthly Cost/Average Household[1] (₱/mo.)	24.00	26.40	38.40	28.80	38.40	19.20	24.00	24.00	18.00	30.00	25.00
	Percentage of Income[2] (%)	3.40	3.80	5.50	4.10	5.50	2.70	3.40	3.40	2.57	4.28	3.7
With Social Pricing	Socialized: 0-15 cum	0.75	0.80	0.80	0.80	0.80	0.60	0.75	0.75	0.50	0.80	
	Water Rate (₱/cum): 15-30 "	1.35	1.50	2.75	1.65	2.75	1.10	1.35	1.35	1.10	1.85	
	Rate (₱/cum): 31-40 "	1.95	2.30	4.60	3.50	4.60	1.50	1.95	1.95	1.70	3.10	
	(₱/cum): Above 40 cum	2.55	2.95	6.35	4.50	6.35	1.90	2.55	2.55	2.30	4.70	
	Monthly Cost/Below Average Household[3] (₱/mo)	12.60	13.50	14.75	13.65	14.75	10.10	12.60	12.60	8.60	13.85	13.50
	Percentage of Income[4] (%)	4.2	4.5	4.9	4.6	4.9	3.4	4.2	4.2	2.9	4.6	4.5

1/ Based on water use 24 cum/mo.

2/ Based on average income ₱700/mo (1976 levels).

3/ Based on water use 16 cum/mo.

4/ Based on household income ₱300/mo (1976 levels).

PREFEASIBILITY STUDIES FOR 100 CITIES

Conducted over a period of eight months, prefeasibility surveys and data collection were performed on 131 cities served by 110 water systems. (These constitute about one-third of all cities/municipalities with existing waterworks and with a population of 30,000 or more in the Philippines.)

The study found that 65 of these water systems were suitable as capital assistance projects for "complete" water supply improvements and that an additional 16 were suitable as projects for "partial" improvement. Data on these water systems are summarized below:

	Complete[1] Projects	Partial[2] Projects
Number of Systems	65	16
Construction Cost[3] of Improvements, Pesos	₱ 273,635,000	₱ 79,304,000
Foreign Exchange Component, Dollars	$ 9,948,000	$ 3,979,000
Estimated Total Population Served by 1983	1,940,000	415,000
Average Population Served	30,000	26,000
Average Construction Cost Per Project, Pesos	₱ 4,210,000	₱ 4,956,000
Average Foreign Exchange, Dollars	$ 153,000	$ 249,000
Average Construction[4] Cost Per 1983 Resident, Pesos	₱ 141	₱ 191

The survey found that 65 water systems, projected to be serving almost two million people by 1983, can be raised to the desired standard at an estimated cost of ₱273,635,000. Sixteen additional water systems projected to be serving 415,000 people by 1983 can be materially improved at an

---

1/ Defined as those that are "feasible" from the technical and economic criteria and are recommended for capital assistance immediately.

2/ Partially feasible based on certain criteria. Capital assistance may be provided on a selective basis.

3/ Does not include other costs such as land purchase, engineering services, legal and administrative costs, interest during construction and contingencies.

4/ Not "project" cost.

estimated cost of ₱79,304,000.

The study further found that 48 of the 110 water systems require special technical studies. Most of these required studies relate to groundwater investigations. Fifteen of them were for water systems included among the 65 systems recommended as capital assistance projects, and five were for systems among the "partial" capital assistance projects.

Needed improvements which cost relatively little but would make a relatively big difference in the water supplied were classified as emergency works. The survey found such emergency works advisable in 58 water systems. Most such works are in the category of broken pumps, or engines which go out of order frequently, or leaking transmission lines, etc.

Twenty-nine waterworks were considered not suitable for capital assistance based on available information.* Only in about half a dozen of the 110 systems are the people not seriously inconvenienced for lack of water. In the great majority of the systems either pressures are low (or non-existent) a large part of the day, or much of the town area is not served, or the available water is unevenly distributed, or there just is not enough. Forty-three systems were classed as having low pressures throughout the system ("low pressure" will not reach the second floor), 49 were classed as having low pressure in part of the system and good pressure in part, and only 13 were classed as having good pressure throughout. Forty-eight were classed as having water pressures throughout the 24 hours, 35 had water pressure in the pipes from 12 to 23 hours, 14 from four to 12 hours, four from two to four hours daily, and five systems usually had pressure in the pipes less than two hours each day. Even these figures tend to make the situation look better than it is. In half a dozen instances the 24-hour supply occurs because a very inadequate spring or highland source feeds the system 24 hours a day, so that there is not enough water although there is some water throughout the day.

Other cities appear to have adequate water or even excessive water, for each authorized connection. Here also, the figures are often misleading. In a number of towns, the unauthorized connections are numerous. In one town they were estimated at 250 per cent of the authorized connections. Leaks and other losses of water are generally excessive. Discussions with both officials and consumers indicate that the consuming public needs more water. If it appears from the figures that the supply should be nearly adequate for consumers, this may be untrue as usually there is much loss or improper use or both.

In the opinion of the surveyors, two findings do indicate the true situation. One is the overall per capita supply of 91 liters per day, about 24 gallons, half a reasonable amount if there was little loss and waste and if the water was equitably distributed, which is generally not the case. The other is that only 25 per cent of the households in the water service area have connections to the pipe system.

---

* For purposes of this study, a project is not suitable for capital assistance if (a) the source of required additional water was not apparent and/or (b) if the construction cost of initial (1983) requirements substantially exceeds ₱200/capita.

The quality of the water supplied definitely needs improvement in a number of towns. At least four have muddy water in the pipes after a rain. Thirteen sources in use are rather saline.

Data on bacteriological quality are scarce, but it appears that the great majority of the supplies cannot meet the bacteriological standards prescribed by the Philippine Government. Unfortunately the bacteriological tests made do not distinguish between a real hazard which may cause an epidemic of typhoid fever or cholera and some incidental dust-borne contamination unlikely to have public health significance. Public health officers know that many water systems regularly fail the bacteriological tests. They also know that public health will be improved if more people drink piped water. Forty-four water systems made some effort to disinfect the water at source by chlorinating. In four instances the chlorination was judged to be somewhat effective most of the time. In the other forty water systems, chlorination was judged to be generally ineffective.

OZAMIZ

RECOMMENDED PLAN

Source

The long-term supply of the Ozamiz-Clarin service area of the MCWD will be derived from the present Talibaksan and Cocok Spring sources, and from the Regina, Bitoon and Lower Dalingap Springs.

The Cocok, Regina and Bitoon Springs will be developed during the first construction phase (1977-82). Certain improvements to the Talibaksan Spring facilities will also be made during this phase. These sources will provide a minimum combined yield of approximately 10,400 cumd which is adequate to meet the projected demand of the water district until 1986. Subsequent source development, which must be completed by 1986, will tap the Lower Dalingap Spring to provide additional capacity to meet the water demand at least until the year 2000.

Transmission

Transmission lines for the long-term improvement plan will total 47 km ranging in size from 100 mm to 350 mm. These will connect the spring sources, storage tanks, and the distribution systems of Ozamiz and Clarin. During the first construction phase, about 15.2 km of 150 to 250 mm pipes will be installed.

Treatment

The only treatment that will be required for the Ozamiz-Clarin water supply is disinfection by chlorination and it is recommended that this be constructed in the early action program. Chlorination facilities will be installed at two points, one to serve the Cocok and Regina Springs and the other to treat the flow from the Talibaksan, Bitoon and Lower Dalingap Springs.

Storage

Three storage tanks will be provided in three construction phases. The first tank will be a 1,900 cum ground storage tank to be built during the first construction phase. The tank will be constructed in Barrio Sogatic at a ground elevation of about 67 meters. It will receive the flow from the Talibaksan and Bitoon Springs and will serve both Ozamiz City and Clarin. The second tank will be a 700 cum ground storage facility on the Ozamiz City distribution system. This tank, to be built in Barrio Kalabayan at a ground elevation of 63 m, will provide additional supply during peak demand periods and will help maintain uniform pressures in the fringe areas of the distribution system near Ozamiz City.

The third tank is a 900 cum storage tank. It will be located at the site of the first storage tank in Barrio Segatic, unless future demand conditions indicate that it would be preferable to build it at another site in Ozamis or Clarin.

Distribution

A total of 41 km of distribution mains ranging in size from 150 mm to 200 mm will be constructed in the long-term plan. About 5.2 km of 150 mm and 200 mm pipes and 18 valves will be installed during the first construction phase. Of the total pipe length for the first phase, 1.2 km of 150 mm pipes will be installed in Clarin and the rest in Ozamis City. The distribution systems of Clarin and Ozamis City will be connected during the second construction phase by a 6 km long, 150 mm line along the National Road. Some distribution mains to reinforce earlier mains will be installed during later construction phases.

Internal Network

Internal network piping (service mains) will be installed to reinforce the existing distribution system and to extend the water service to new areas. It is projected that by the year 2000, some 750 ha will be served by the water system. Of this area, 190 ha will be served directly from transmission and distribution mains and 560 ha will be served from the internal network system.

During the first construction phase, internal network piping will reinforce the network in 30 ha of the present service area and will include installing 17 fire hydrants in the same area. An additional 100 ha will receive internal network piping, 85 ha in and around the Ozamis City poblacion and 15 ha in the Clarin poblacion. Some 8.9 km of 100 mm pipes and 3.2 km of 150 mm pipes will be installed.

Service Connection

The long-term construction program for service connections involves a total of 12,550 connections by the year 2000. Some 1,500 new connections and replacements for 200 existing connections are scheduled to be installed during the first construction phase. Metering all service connections is a goal of the water district.

Other Facilities

The existing offices and facilities for the administration and operation of the MOWD are housed in rented and overcrowded premises. In addition, the district does not have facilities for the testing and repair of customer water meters, and for water sampling and analyses. To provide for the necessary facilities/space, a new administration building will be provided in the first construction phase. The water analysis laboratory will be expanded in a later construction phase.

Capital Cost Summary[1]

Construction Stage/Phase	Construction Period	Construction Cost (₱)	Total Project Cost (₱)	Foreign Exchange Component (US$)
Early Action	1976-78	₱ 594,000	₱ 683,000	$ 44,000
I-A	1977-82	16,232,000	23,006,000	774,000
I-B	1982-86	4,785,000	6,522,000	180,000
I-C	1986-90	7,572,000	10,591,000	416,000
II-A	1984-95[2]	15,143,000	21,401,000	773,000
II-B	1992-2000	12,412,000	17,464,000	548,000
TOTAL		₱ 56,738,000	₱ 79,667,000	$2,735,000

[1] All costs are based on July 1976 prices. Based on ₱7.00 to $1.00.

[2] Each construction phase is generally about 4 to 5 years. However, a major exception to this is Stage II which begins in 1984 and ends in 1995 since the development of the Lower Dalingap Spring must be implemented in 1984-86. Because this additional source will provide water supply to satisfy demands in Ozamiz and Clarin until year 2000, the cost of the development of this source has been included in the Stage II program.

DRAFT

RECOMMENDED PLAN

Source Development

Future sources of supply of the CNWD will be the existing Boro Boro, Magana and Lugui Spring sources, which are planned to be improved during the initial construction phase, and later on the Malubay, Banban, Balane, Alinao, Vargas and Bungcay Springs. The existing Boro Boro, Magana and Lugui Springs, have an estimated combined capacity of 13,900 cumd and will be adequate to meet the system water demands until 1981 by which year the Malubay Spring must be fully developed. The Malubay Spring will provide an additional capacity of about 6,900 cumd, thereby increasing total source capacity to approximately 21,000 cumd. This total capacity will be adequate until 1988.

The Banban and Balane Springs, scheduled to be developed in 1987-88, will increase the total supply to approximately 30,000 cumd, which will be sufficient until 1994. After 1994, the additional flow required until 1999-2000 will be obtained from the Alinao, Vargas and Bungcay Springs. These springs will provide an additional capacity of 11,700 cumd bringing total source capacity to 41,900 cumd.

Storage

Six storage facilities are planned to be constructed in the long-term improvement program. Two tanks will be initially built, one to serve the Labo service area and the other to serve the other municipalities. The Labo tank will be a 400-cum ground tank constructed between Barrio Tulay na Lupa and Labo, approximately 3 km from Labo and at a ground elevation of 37 m - 40 m. Water from the Boro Boro-Magana-Lugui-Malubay systems will discharge into this facility before delivery to Labo. The second tank, referred to as San Vicente Source Storage Tank No. 1, is a 1,100 cum storage tank to be built about 2 km west of San Vicente, also at ground elevation 37 m - 40 m. This tank will also receive flow from the Boro Boro-Magana-Lugui-Malubay spring supplies.

During the third construction phase, a third source storage tank (San Vicente Source Storage Tank No. 2) will be constructed near San Vicente, also at elevation 37 m to 40 m. This third tank will have a capacity of 1,700 cum and will be designed to receive the flow from five or more additional springs proposed to be tapped in the future.

Other tanks to be constructed are distribution storage facilities. One tank will be designed to serve the Labo service area and will be located north of Labo. It will have a volume of 400 cum and a maximum water level elevation of 40 meters. The other two tanks, to be built in separate construction phases, will be located in Barrio Padaguit and will have maximum water level elevations of 40 meters. The first tank will have an operational volume of 1,800 cum; the second, 1,000 cum.

Water Treatment

Disinfection by chlorination will be the only treatment required for the water from the existing and proposed sources. Three chlorination stations will be established near the Labo Source Storage Tank and the San Vicente Source Storage Tanks No. 1 and 2. Each chlorination station will be equipped with two chlorinators, one unit serving as stand-by.

Transmission and Distribution Mains

A total of 132.5 km of transmission and distribution mains ranging in size from 100 mm to 600 mm is required for the long-term improvement plan. During the first construction phase, about 32 km of pipeline ranging in diameter from 200 mm to 600 mm will be installed. About 9.4 km of this total pipe length will be 200 mm to 350 mm transmission lines from the proposed spring sources to the source storage tanks.

Internal Network

Internal network piping will be installed to reinforce existing distribution systems and to extend water service to new areas. It is projected that by the year 2000, some 1,580 ha will be served by the water district. Two-hundred forty (240) ha of this area will be served directly from transmission and distribution mains and 1,340 ha will be served by the internal network systems.

During the first construction phase, the existing internal network in 80 ha of the Daet service area will be reinforced and provided with fire protection service. The internal networks in the other municipalities do not require immediate reinforcement. Also, water service will be extended to 160 ha in Daet and Mercedes. Approximately 100 ha in the fringe area of Daet and 60 ha in Mercedes will be served. The area in Mercedes will also be provided with fire protection.

The long-term construction program involves a total of 28,000 service connections by the year 2000. It is estimated that the district will have 4,000 connections by 1978. Some 2,400 new connections are planned to be installed during the period 1978-82, bringing the total number of services to 6,400 by the end of this construction period.

Capital Cost Summary*

Construction Stage/Phase	Construction Period	Construction Cost (₱)	Total Project Cost (₱)	Foreign Exchange Component (US$)
Early Action Works	1976-78	₱ 1,426,000	₱ 1,640,000	$ 161,300
I-A	1977-82	31,446,000	48,574,000	2,284,600
I-B	1982-86	15,432,000	23,840,000	685,600
I-C	1985-90	28,343,000	41,055,000	1,691,300
II-A	1990-95	39,691,000	58,333,000	2,389,800
II-B	1995-2000	12,430,000	19,221,000	579,500
TOTALS		₱128,768,000	₱192,663,000	$7,792,100

*All costs are based on July 1976 prices.

METRO CEBU

RECOMMENDED PLAN

Source Development

The long-term supply of the MCWD will be derived from the Balamban and Mananga Rivers. During the first construction period, Balamban River will be developed.

An 82-m high dam, located near Barrio Lusaran, will be constructed to regulate the Balamban River flows to an estimated potential safe yield of 138,000 cumd, which is expected to be adequate until 1993. Additional supply to meet projected year 2000 water demands will be derived from the Mananga River which is scheduled to be developed in the fourth construction period.

The selected dam site on the Balamban River appears to be suitable for construction of either a rockfill or a concrete dam. The project will also include upstream and downstream cofferdams, a diversion tunnel, a chute-type spillway, access roads, and raw water system consisting of a reinforced concrete intake tower and transmission line to the Talamban Water Treatment Plant.

The Mananga River source development facilities will include a 96-m high dam located 1.5 km north of Barrio Jaclupan to regulate the Mananga River flows to provide an estimated potential safe yield of 83,400 cumd. Other facilities will be similar to those recommended for the Balamban River development.

Raw Water Transmission Line

Raw water transmission lines will deliver raw water from the surface sources to their respective treatment plants. A total of 29.1 km of transmission line ranging in size from 600 to 2,500 mm will be needed.

The initial transmission line will consist of a 7.6 km long, 2,500-mm diameter concrete-lined tunnel and a 7.7-km long, 1,000-mm diameter pipeline. However, the transmission pipeline will be adequate only until 1988, thus a 7.7-km long, 600-mm diameter pipeline and will be constructed during third construction period to reinforce the line.

For the Mananga River system, the raw water transmission line will consist of a 6.1-km long, 1,000-mm diameter pipeline.

Water Treatment Plants

Complete treatment will be required for both the Balamban and Mananga River waters. The proposed treatment plants are conventional-type and will employ, as a minimum, coagulation, flocculation, sedimentation, filtration and disinfection.

The treatment plant for the Balamban River supply will be located near Barrio Talamban and will have an ultimate design plant capacity of 166,000 cumd. The initial facilities for a 120,000-cumd capacity will be installed during the first

construction period and will include a chemical building and an administrative building. These building facilities will be designed and constructed to be adequate for the full capacity of the treatment plant. Expansion will be implemented during the fourth construction period.

The treatment plant and facilities for the Mananga River supply will be similar in design concept to those recommended for the Balamban system. Design capacity of the plant is 100,000 cumd.

Treated Water Transmission Facilities

Treated water transmission lines will convey water from treatment plants to the distribution system or storage facilities. A total of approximately 85 km of transmission mains ranging in size from 200 to 1,400 mm will be needed in the long-term improvement program. About 33 km of 250 to 1,400-mm pipes will be installed during the first construction period. These facilities will include the line from the Talamban treatment plant to Cebu and the Tisa storage tank, the line from the plant to Mandaue and Lapu-Lapu, and the line to Consolacion, Liloan and Mandaue.

Storage Facilities

Six new storage facilities with a total volume of 60,600 cum will be provided in four construction phases at the two treatment plants and Tisa. Five of these tanks will have operational ranges varying from three and seven meters and overflow elevations at 70 meters. Initially, a 20,000-cum ground storage tank with a seven-meter operational range will be located between elevations 63-70 m at Tisa.

The sixth storage tank will be installed during the last construction period. This will have a capacity of 600 cum and an overflow elevation at 100 m to serve the high area in Talamban. The existing Betania storage tank will also be improved.

Booster Pumping Facilities

Two booster pumping stations are needed in the long-term plan for the MCWD system. One pumping station will serve the Guadalupe-Lahug area; the other will serve the high area at Talamban.

The Guadalupe-Lahug booster zone will encompass the area in Barrios Guadalupe and Lahug between ground elevations 40 and 90 meters. The pump station for this zone will be installed during the second construction period and will have a capacity of 4,000 cumd. It will be connected to the existing Betania storage tank through a network of 150-200 mm distribution mains. A reinforced concrete cover will be provided for the Betania storage tank to protect the water from contamination. The capacity of the pumping station will be increased to 5,000 cumd in the fourth period with the installation of additional pumping units.

The pumping station for the Talamban booster zone will be of 4,000 cumd capacity and will be constructed in the last construction period.

Distribution Mains

A total of 153 km of distribution mains ranging in size from 150 to 450 mm will be installed. Initial improvements to the feeder system, consisting of about 29 km of 150-400 mm pipe, will be concentrated in the central area of Cebu City, the core city areas of Mandaue and Lapu-Lapu and in Consolacion, Liloan and Compostela.

Internal Network

Internal network piping will be installed to reinforce existing internal networks and to extend the water service to new areas. It is projected that by the year 2000, some 5,050 ha will be served by the water system. Of this area, 1,330 ha will be served directly from transmission and distribution mains and 3,720 ha will be served from the internal network systems.

During the initial construction period, 630 ha of existing internal networks in the cities of Cebu and Mandaue will be reinforced. This will cover the entire network serving Mandaue and an area in the older portion of Cebu City and its high-value commercial and institutional district bounded by distribution mains to be installed during the same period. New areas to be provided with internal network include 100 ha in Cebu City and 40 ha each in the central parts of Lapu-Lapu City and Consolacion, a total of 180 ha. About 60 km of 100 and 150-mm pipes and some 251 commercial-type fire hydrants will be installed. The areas to be covered by fire protection will be limited to 300 ha in the core city of Cebu, 100 ha in Mandaue, 30 ha in Lapu-Lapu and 10 ha in Consolacion.

Service Connections

The long-term program involves the installation of 119,700 new service connections in MCWD. Of this number, 7,700 connections will be installed during the early action and interim improvement programs. Some 17,000 new connections are to be installed and about 2,000 existing service connections will be replaced during the first construction period. All services will be metered.

Other Facilities

The building being rented for the administration of the MCWD will rapidly become inadequate for the expanded water system and increasing number of customers. A new administrative building at the Talamban Water Treatment Plant is included in the first construction period and will house a proposed water analysis laboratory, new and appropriate meter testing and repair equipment, and general shop and storage facilities. The existing water analysis laboratory will be transferred to the new administrative building. Both the water analysis laboratory and meter testing/repair shop will be expanded during the fourth construction period.

Capital Cost Summary*

Construction Phase	Construction Period	Construction Cost (₱ x 1,000)	Project Cost (₱ x 1,000) Local Component	Foreign Exchange Component	Total
Early Action Works	1976	5,060	3,555	2,264	5,819
Interim Improvements	1976 - 78	16,360	9,557	11,138	20,695
I-A	1978 - 82	399,175	330,360	189,746	520,106
I-B	1982 - 87	38,795	24,055	26,492	50,547
I-C	1986 - 89	69,553	46,199	44,426	90,625
II-A	1989 - 94	379,627	312,830	181,805	494,635
II-B	1995 - 2000	43,272	26,566	29,815	56,381
Total		951,842	753,122	485,686	1,238,808

*All costs are based on July 1976 prices.

ZAMBOANGA

RECOMMENDED PLAN

Interim Improvements

About 3,600 m of 150-mm pipes are recommended to be cleaned and lined. The significant portion of these pipes are within the core city area.

Source Development

The future source of supply of the ZCWD will be the Tumaga River. The expected yield of this river is sufficient to meet projected maximum daily demands until the year 2000, without construction of a major dam. However, it is recommended that a permanent diversion dam be constructed to replace the existing dam of loosely packed cobblestones. Analyses have indicated that the best site for this new dam is approximately 300 m upstream of the existing dam. The proposed dam, approximately 27 m long and 2.3 m high, will be of reinforced concrete and will be constructed during the first construction period (1977-1982). Additional source facilities include a new intake structure and fine screen/grit removal chamber.

Raw Water Transmission Lines

Transmission facilities for conveying raw water from the Tumaga River diversion to treatment works at Pasonanca Park will consist of two pipelines. The first pipeline, to be constructed during the first construction period, is 600 mm in diameter and approximately 4 km long. It will be laid along the east side of the Tumaga River. This transmission main will have a capacity of 29,800 cumd and will be adequate until 1986. Operation of the first transmission main will permit dewatering and inspection of the existing 750 mm transmission main. The second transmission main will be 500 mm in diameter and about 3 km long, and will provide additional capacity for the projected year 2000 maximum daily demand. It is planned to thread this pipeline into the existing water transmission line. The second pipeline must be operational by 1986.

Water Treatment

Complete water treatment, consisting of chemical coagulation, sedimentation, filtration and chlorination, will be provided for the Zamboanga City supply as is required for water obtained from surface sources. Alterations and additions will be made, during the first construction phase, to the existing treatment plant in Pasonanca Park. The plant will be converted to a conventional complete treatment plant. Upon completion, the plant will have a capacity of approximately 32,700 cumd, which is adequate to meet maximum daily demands until 1988. Plant expansion which should be completed by 1988, will bring the total treatment capacity to 49,000 cumd, the year 2000 projected maximum daily demand.

Storage

Storage facilities are planned to be constructed at two sites: (1) at the treatment plant site in Pasonance Park and (2) at Barrio Cabatangan. A total of 7,400 cum storage will be provided, divided equally between the two sites. Initial construction, which will be during the third construction phase in 1986-90, will provide 1,850 cum storage at each site. Both storage tanks will be built at elevation 45-52 m.

Treated Water Transmission Facilities

Treated water transmission lines will deliver water from the treatment plant to the distribution system or storage tanks. A total of 16.2 km of new transmission mains ranging in size from 250 mm to 600 mm is required for the long-term improvement plan. Only 3.2 km of 300-mm pipe will be installed during the first construction phase.

Distribution Mains

A total of 68 km of distribution mains ranging in size from 150 mm to 350 mm will be constructed. About 18.2 km of pipe and 42 valves will be installed during the first construction phase. The initial improvements are largely for the purpose of improving the water service in the eastern and western extremities of the present system.

Internal Network

Internal network piping (service mains) will be installed to reinforce the existing distribution system and to extend the water service to new areas. It is projected that by the year 2000, some 2,100 ha in and around the Zamboanga City poblacion will be served by the water system. Of this area, 840 ha will be served directly from distribution (feeder) mains and 1,260 ha will be served from the internal network system. One-thousand two-hundred sixty (1,260) ha with internal network piping will have fire protection service.

During the first construction phase, internal network piping will reinforce the network, including installation of fire hydrants, in 80 ha of the present service area. This 80-ha area is located in the downtown high-value commercial district. New internal network piping will be installed in an additional 150 hectares.

Service Connections

The long-term program for involves a total of 23,200 service connections by the year 2000. Some 2,700 new connections are scheduled to be installed during the first construction phase, bringing the total number of services to 10,500 by the end of this construction period. All services will be metered.

Pipe Cleaning and Lining

In addition to the distribution system piping that should be cleaned and lined during the Interim Improvement Program, it is recommended that about 5.3 km of 200 mm lines installed between 1912 and 1920 be cleaned and lined as field tests have indicated reduced carrying capacity of these pipelines. This work is planned for implementation during the second construction phase, 1982-86. Also, about 8 km of 150-mm pipes installed between 1931 and 1940 should be cleaned and lined in 1990-95.

Other Facilities

The existing ZCWD office building, which presently houses the entire administrative staff, meter repair shop and other facilities, is very crowded. It is recommended that this existing building be designated for use only by the General Manager and Customer Service staff, and a new building for the water meter testing and repair shop, a new water analysis laboratory, and for general storage be constructed in the first construction phase. Both meter testing/repair shop and water analysis laboratory are planned to be expanded in 1990-1995.

Capital Cost Summary*

Construction Stage/Phase	Construction Period	Construction Cost (₱)	Total Project Cost (₱)	Foreign Exchange Component (US$)
Early Action	1976-78	₱ 646,000	₱ 743,000	$ 52,000
Interim Improvements	1977-79	311,000	358,000	8,000
I-A	1978-82	30,671,000	43,532,000	2,186,000
I-B	1982-86	14,983,000	20,779,000	829,000
I-C	1986-90	30,486,000	43,182,000	1,626,000
II-A	1990-95	17,271,000	24,023,000	938,000
II-B	1995-2000	17,051,000	23,667,000	731,000
TOTALS		₱111,419,000	₱156,284,000	$6,370,000

*All costs are based on July 1976 prices.

BUTUAN

RECOMMENDED PLAN

Interim Improvements

The main interim improvement which must be completed by 1977 is the overhaul or replacement of the existing pumpset in the Bonbon deep well. This will provide a groundwater supply of 1,000 cumd or more into the existing transmission line at an operating pressure such that the line will carry the well and reservoir waters simultaneously. An additional deep well should be drilled in the same vicinity as a stand-by or supplementary source and as an eventual replacement because the production rate of the existing well appears to be declining gradually.

Source Development

As a result of studies of alternative supply sources, a long-term groundwater supply by induced infiltration wells tapping the surface gravels of the Taguibo River Valley to the northeast of the City Proper has been found to be the most economical and practical for the study area. A total of 20 wells will be constructed in Taguibo for the long-term improvement plan. Based on preliminary field observations, it has been assumed that the wells will have 250 mm casing, depth of approximately 50 m, and spaced approximately 400 m apart. Each well will be equipped with a diesel engine-driven well pump capable of delivering 2,200 cumd at a total head of 80 meters. Six wells (five production wells plus one stand-by) will be constructed during the initial construction phase. During two separate subsequent construction phases, six wells and eight wells will be added, respectively.

Transmission Facilities

Transmission lines to be constructed for the long-term improvement plan will total 53.0 km ranging in size from 300 mm to 450 mm. These lines will connect the well sources and storage tanks to the distribution system. About 11.3 km of 300 mm to 400 mm mains will be installed during the first construction phase to transmit the flows from the Taguibo wells.

Water Treatment

The only treatment that will be required for the Taguibo deep well water supply is disinfection by chlorination. Chlorination facilities will be installed at five points. Two stations will serve the first six wells and the other three will treat the flow from the later additional wells. Chlorination is also recommended for the surface water and well sources at Bonbon. The chlorination stations for the Bonbon supply are recommended to be constructed in the Early Action and Interim Improvement Programs.

Storage

Two storage tanks will be provided in two construction phases. The first tank will be a 2,500-cum ground storage tank to be constructed during the second construction phase (1982-86) near Bonbon at a ground elevation of 28-35 meters.

It will be connected by a 300-mm line to the transmission line from the Taguibo wells. The second tank will also be a 2,500-cum ground storage facility. It will be built at the same location as the first tank and will likewise be connected to a later-stage transmission line from Taguibo.

Distribution Mains

A total of 58.1 km of distribution mains and 107 valves ranging in size from 150 mm to 300 mm will be installed. About 10 km of 150 mm to 250-mm pipe and 19 valves will be installed during the first phase of construction scheduled for 1977-82. The initial improvements will be concentrated in the core city and densely populated areas of Butuan City.

Internal Network

Internal network piping (service mains) will be installed to reinforce the existing distribution system and to extend the water service to new areas. It is projected that by the year 2000, some 1,325 ha in and around the Butuan City poblacion will be served by the water system. Of this area, 300 ha will be served directly from transmission and distribution mains and 1,025 ha will be served from the internal network system. All areas with internal network piping will have fire protection service.

During the first construction phase, internal network piping will reinforce the existing network, including installation of fire hydrants, in 40 ha of the present service area. An additional 160 ha within the core city will also receive internal network piping but without fire protection service. Installation of fire hydrants in new service areas is deferred until succeeding or later-construction phases.

Service Connections

The long-term construction program for service connections involves a total of 22,500 connections by the year 2000. Some 3,000 new connections are scheduled to be installed during the first construction phase, bringing the total number of services to about 3,500 by the end of this construction period. All services will be metered.

Other Facilities

The existing offices and facilities for the administration and operation of the BCWD are housed in rented and overcrowded premises. In addition, the district does not have facilities for the testing and repair of water meters, and for water sampling and analyses.

Capital Cost Summary*

Construction Stage/Phase	Period	Construction Cost (₱)	Total Project Cost (₱)	Foreign Exchange Component (US $)
Early Action		₱ 569,000	₱ 654,000	$ 55,000
Interim Improvements		248,000	285,000	19,000
I-A	1977-82	22,986,000	33,868,000	1,586,000
I-B	1982-86	28,230,000	41,855,000	1,881,000
I-C	1986-90	12,152,000	15,521,000	511,000
II-A	1990-95	34,069,000	51,551,000	2,455,000
II-B	1995-2000	12,127,000	19,216,000	589,000
TOTALS		₱110,381,000	₱162,950,000	$7,096,000

*All costs are based on July 1976 prices.

LIPA

RECOMMENDED PLAN

Source

The long-term water supply for the LCWD will be derived primarily from groundwater wells. The service area will have three pressure zones served by a total of 21 wells of which nine, five and four operational wells are planned to serve Pressure Zones 1, 2 and 3, respectively. Each pressure zone will be provided with a stand-by well. Interconnections among the three pressure zones will be kept normally closed and will be opened only during emergency situations.

Construction of the new wells will be done in three stages and will follow as closely as possible the growth and expansion of the service area. The following criteria have been established, based on the available limited well data, for the well construction: (1) well spacing, 2 km in each aquifer, (2) well depth, 100 m in the upper aquifer and 200 m in the lower aquifer, (3) size of casing, 200 mm, (4) average yield from one well, 1,300 cumd, (5) pumping water level, 45 m for the upper aquifer and 135 m for the lower aquifer.

Transmission/Distribution

The transmission/distribution facilities for the long-term improvement program of LCWD will include approximately 47.3 km of pipelines ranging in size from 100 to 250 millimeters. These will serve to connect the well sources (and existing ones) with the proposed storage tanks and the internal network of the LCWD. During the first construction period, about 15.6 km of pipelines ranging in size from 100 mm to 200 mm will be installed.

Treatment

The only treatment proposed for the water supplied to the LCWD system is disinfection by chlorination. Chlorination facilities will be provided for each of the additional wells constructed in every phase.

Storage

The ultimate storage requirement in Lipa is 2,800 cum, with 1,400 cum to be provided in the first construction stage and additional 1,400 cum to be provided in the second construction stage. The existing storage tank in the poblacion is recommended to be kept as emergency storage and the Fernando Air Base storage facilities should be restored and kept in service. In the first construction phase, the storage tank in the poblacion will be utilized and the storage tank at the Fernando Air Base will be renovated. During second construction period, the required 1,400-cum storage will be provided through a 1,000-cum storage tank, located in Barrio Balintawak at an elevation range of 335-340 m and through another 400-cum storage tank in Barrio Tibig at elevation range of 362-365 meters.

Internal Network

Internal network piping will be installed to reinforce the existing distribution system and to extend water service to new areas. Existing internal network

systems for approximately 140 ha will be reinforced by 1990. New service areas will be provided with internal network covering 40 ha, 70 ha and 125 ha by 1982, 1986 and 1990, respectively, in the first stage of the long-term construction program. Hence, it is projected that by the year 2000 approximately 680 ha of service area will be covered by internal network piping.

Service Connection

The long-term construction program for service connections involves a total of 14,600 additional connections through the year 2000. During the first construction phase 2,050 new connections are scheduled to be installed. Metering all service connections is a goal of the water district.

Other Facilities

The LCWD presently occupies a small office space within the compound of the Lipa City Engineering Department. The existing office is not adequate for proper operation and management of the district. To provide for the necessary facilities and space, a new administrative building will be built in the first construction phase. This office complex will include an administrative area and functional space for laboratory, meter shop, storage, garage and parking which are, in general, needed for efficient operation of a water district.

Capital Cost Summary*

Construction Phase	Construction Period	Construction Cost (₱ x 1,000)	Project Cost (₱ x 1,000) Local	FEC	Total
Early Action Works	1977-78	983	461	726	1,187
I-A	1978-82	10,774	7,340	6,700	14,040
I-B	1982-86	8,365	5,762	5,210	10,972
I-C	1986-90	5,262	3,344	3,512	6,856
II-A	1990-1995	10,517	7,355	6,427	13,782
II-B	1995-2000	5,927	3,877	3,846	7,723
TOTAL		41,828	28,139	26,421	54,560

*All costs are based on July 1976 prices.

LUCENA-PAGBILAO-TAYABAS

RECOMMENDED PLAN

Source

The long-term water supply for the LPTWD will be derived primarily from the May-it Spring. Expansion of the existing collection facilities at May-it Spring will include miscellaneous site works, construction of an additional collection chamber, construction of a valve/metering chamber and construction of approximately 1.5 km of gravel-surfaced access road. These facilities will be constructed during the first construction phase and will not require additional expansion during the study period. These facilities will provide the projected demands in Lucena and Pagbilao until the year 2000.

The existing Ibia, Lalo Grande, Lalo Pequeño and Dapdap "A" and "B" spring facilities will supply water to Tayabas, and will not require additional works except for the construction of approximately 2.0 km of access road. These springs will provide sufficient flows to meet system demands in Tayabas until approximately 1995, at which time the Dapdap "C", "D" and "E" Springs will be developed to provide the additional 1,650 cumd required to meet projected year 2000 demands.

Transmission

The transmission facilities for the long-term improvement program in the LPTWD will include approximately 21.6 km of pipelines ranging in size from 200 to 700 millimeters. They will serve to connect the spring sources with the proposed storage tanks and distribution systems of Lucena, Pagbilao and Tayabas. During the first phase of construction approximately 17.7 km of pipelines (with all required appurtenances) ranging in size from 200 to 700 mm, will be constructed.

Treatment

The only treatment proposed for the water supplied to the LPTWD systems is disinfection by chlorination. All chlorination facilities required for projected year 2000 flows will be provided during the Early Action Program except those for the May-it Spring supply which will be augmented with larger-capacity facilities during the first construction phase.

Storage

The ultimate storage requirement in Pagbilao is 900 cum, with 500 cum to be provided in the first construction phase and 400 cum to be provided by 1992. Both storage tanks will be constructed at an elevation of 70 m, approximately 1.5 km from Pagbilao along the Pagbilao-Tayabas Road.

The year 2000 storage requirement for Tayabas will be provided in two stages, 700 cum to be provided in the first construction phase and an additional 500 cum to be provided by 1992. Each of these storage tanks will be located at an elevation of 230 m approximately 1.0 km from Tayabas along the road to the northwest of Tayabas.

The storage requirement for Lucena will be located at two sites - Isabang and Tengko. Economic comparisons of various alternatives have led to the provision of 70 per cent of the Lucena storage requirement at the Tengko site. First-phase construction will consist only of providing covers for the existing tanks. In about 1992, the entire projected year 2000 storage requirement at Tengko (3,500 cum) will be included in the new tank to be constructed at that time. The balance of the Lucena storage requirement will be located at Isabang, at an elevation of 70 meters.

Distribution

The total construction program for the study period includes approximately 60 km of pipelines ranging in size from 150 to 250 millimeters. The first phase of construction includes approximately 13.4 km of pipelines ranging in size from 150 to 250 millimeters.

Internal Network

Internal network piping will be installed to reinforce the existing distribution system and to extend water service to new areas. Existing internal network systems for approximately 300 ha will be reinforced by 1985. New service areas will be provided with internal network covering 205, 460 and 855 ha by 1985, 1990 and 2000, respectively. Hence, it is projected that by the year 2000 approximately 1,155 ha of service area will be covered by internal network piping. An additional 315 ha served directly from transmission and distribution mains will increase the year 2000 service area to approximately 1,470 hectares.

Service Connection

The long-term construction program for service connections involves a total of 24,900 additional connections by the year 2000. During the first construction phase, 3,050 new connections are scheduled to be installed. Metering all service connections is a goal of the water district.

Other Facilities

The existing administrative and operations facilities of the LPTWD consist solely of the existing office in Lucena, which is owned by the LPTWD but located on land owned by the Provincial Government. In addition, the district does not have facilities for the testing and repair of customer water meters, and for water sampling and analyses. To provide for the necessary facilities and space, a new administration building will be built in the first construction phase. Additional revenue offices for Tayabas and Pagbilao may be constructed at a later stage.

Capital Cost Summary*

Construction Period	Construction Cost (₱1,000)	Cost in Thousand Pesos		
		Local	FEC	Total
Early Action Program (1976-78)	1,692.0	821.0	1,222.0	2,043.0
Phase I-A (1978-82)	28,772.4	17,311.7	20,177.3	37,489.0
Phase I-B (1982-86)	11,273.1	7,047.8	7,640.5	14,688.3
Phase I-C (1986-90)	12,618.7	7,858.4	8,583.2	16,441.6
Phase II-A (1990-95)	21,068.9	13,369.8	14,081.8	27,451.6
Phase II-B (1995-2000)	9,487.6	5,980.3	6,381.6	12,361.9
TOTAL	84,912.7	52,389.0	58,086.4	110,475.4

*All costs are based on July 1976 prices.

TARLAC

RECOMMENDED PLAN

Source

The long-term water supply for the TWD will be derived mainly from deep well sources. The service area will have two pressure zones served by a total of 11 new wells, of which eight wells are planned to serve Pressure Zone 1. Interconnections between the two pressure zones will be kept normally closed and will be opened only during emergency situations.

Construction of the new wells will be done in three stages and will follow as closely as possible the growth and expansion of the service area. The following criteria have been established based on the available limited well data, for the well construction: (1) well spacing, 2 km; (2) well depth, 200 m; (3) diameter of casing, 300 mm; (4) average yield of one well, 3,800 cumd; (5) pumping water level, 65 meters. Four new wells are to be constructed during the initial construction period.

Treatment

The only treatment proposed for the water supply of TWD is disinfection by chlorination. Each deep well will be equipped with chlorinating facilities which will be installed adjacent to it.

Storage

Five reservoirs will be constructed, three for Pressure Zone 1 and two for Pressure Zone 2. All reservoirs will be located at the higher ground elevations southwest of the population.

For Pressure Zone 1, the ultimate storage requirement is 3,300 cum. This volume will be provided at two sites in three construction phases. Initially, a 6,300-cum standpipe (2,100 cum operational volume) will be built near the provincial hospital. During two separate subsequent construction phases, a 700-cum ground level tank and a 1,500-cum standpipe will be added. All storage tanks will have an operating range of five meters, overflow elevation of 70 m above mean sea level, and an automatic or manual flow control device.

For Pressure Zone 2, with an ultimate storage requirement of 1,100 cum, a 2,400-cum (600 cum operational volume) standpipe will be constructed in 1978-80 at Barrio San Jose Urquico. A second standpipe with 2,000-cum total volume (500 cum operational) will be built at the same site in 1990-92. Both tanks will have a five-meter operating range and overflow elevation of 90 meters.

Distribution Mains

The existing distribution mains of TWD will require reinforcement and expansion throughout the study period. The total construction program for the study period includes approximately 66 km of distribution mains ranging in size from 150 to 450 millimeters. The first construction phase requires about 13 km of mains ranging in size from 200 to 450 millimeters.

Internal Network

Internal network piping will be installed to replace existing pipes that are undersized or badly corroded to reinforce the distribution system and to extend water service to new areas. The existing internal network systems in 230 ha will be completely reinforced by 1990. New areas that will be provided with internal network will cover 120 ha in the first construction period and will total 415 ha in 1990 and 610 ha by the year 2000. Additional 300 ha will be served directly from distribution mains, increasing the year 2000 area served to 1,140 hectares.

Service Connections

The long-term construction program includes a total of 23,200 additional service connections through the year 2000. During the first construction phase 4,900 new connections are scheduled to be installed and 200 existing connections will be replaced. Metering all service connections is a goal of the water district.

Other Facilities

The existing administrative and operations facilities of the TWD consist of a rented central office in a local commercial building, an improvised field located beneath the existing TWD elevated storage tank and a small wooden shop. The district does not have facilities for testing and repair of water meters, and for water sampling and anaysis. To provide for the necessary facilities/space, a new administrative building will be provided in the first construction phase.

Because of the similar needs of the Cabanatuan City and Tarlac Water Districts, the relatively short distance between them, the relatively high capital cost of laboratory facilities and the relative scarcity of experienced laboratory personnel, only one laboratory will be constructed to serve both water districts. This laboratory will be built in Tarlac.

Capital Cost Summary*

Construction Phase	Construction Period	Construction Cost(₱1,000)	Cost in Thousand Pesos		
			Local	FEC	Total
Early Action Works	1977-1978	1,305	690	886	1,576
Phase I-A	1978-1982	19,353	13,928	11,289	25,217
Phase I-B	1982-1986	12,027	7,951	7,727	15,678
Phase I-C	1986-1990	5,779	3,603	3,927	7,530
Phase II-A	1990-1995	14,513	9,763	9,155	18,918
Phase II-B	1995-2000	8,894	5,727	5,862	11,589
TOTAL		61,871	41,662	38,846	80,508

*All costs are based on July 1976 prices.

CABANATUAN

RECOMMENDED PLAN

Source

The long-term water supply for the CCWD will be derived mainly from deep well sources. The service area will have two pressure zones served by a total of 16 new wells, of which 14 wells are planned to serve Pressure Zone 1. Because of the recommended well spacing of one to two kilometers, two wells will be needed in Pressure Zone 2, although the water demand in this pressure zone is very small. Excess water from Pressure Zone 2 will be transferred to Pressure Zone 1 through a pressure-regulating valve.

Construction of the new wells will be done in five stages and will follow as closely as possible the growth and expansion of the service area. The following criteria have been established based on the available limited well data, for the well construction: (1) minimum well spacing, 1 to 2 km; (2) well depth, 300 m; (3) diameter of casing, 300 mm; (4) average yield of one well, 2,600 cumd; (5) pumping water level, 30 meters. Six new wells are planned to be constructed during the first construction phase.

Treatment

The only treatment proposed for the water supply of CCWD is disinfection by chlorination. Each deep well will be equipped with chlorinating facilities which will be installed adjacent to it.

Storage

For Pressure Zone 1, the ultimate storage requirement is 4,800 cum. This volume will be provided at three sites in two construction phases. Two storage facilities will be provided during the first construction phase. In 1978-80 a 4,600-cum standpipe (1,200 cum operational volume) will be built in Barrio Bantug Bulale. The second facility will also be a standpipe with 5,300-cum volume (1,200 cum operational volume) to be built in 1980-82 in the poblacion. Both storage tanks will have an operating range of five meters, overflow elevation of 70 m above mean sea level, and will be equipped with double-acting altitude valves for flow control.

For Pressure Zone 2, with an ultimate storage requirement of only 100 cum, a 400-cum (100 cum operational volume) standpipe will be constructed in 1995-97 in Barrio Bangad. The tank will have an overflow elevation of 60 m and will be equipped with a double-acting altitude valve.

Distribution Mains

The existing distribution system of CCWD will require reinforcement and expansion throughout the study period. The total construction program for the study period includes approximately 54.4 km of distribution mains ranging in size from 150 to 250 millimeters. The first construction phase requires about 13.2 km of mains ranging in size from 150 to 250 millimeters.

Internal Network

Internal network piping will be installed to replace existing pipes that are undersized or badly corroded, to reinforce the distribution system and to extend water service to new areas. Initially, the internal network over a 200-ha portion of the existing service area between the Cagayan Valley Road and Mabao Creek and in Barrio Aduas will be reinforced. The existing internal network systems in 340 ha will be completely reinforced by 1990. New areas that will be provided with internal network will cover about 100 ha in the first construction phase and will total 350 ha in 1990 and 570 ha by the year 2000. An additional 220 ha will be served directly from distribution mains, increasing the year 2000 area served to 1,130 hectares.

Service Connections

The long-term construction program involves a total of 22,950 additional service connections through the year 2000. During the first construction phase 4,550 new connections will be installed and 600 existing connections will be replaced. Metering all service connections is a goal of the water district.

Other Facilities

The existing administrative and operations facilities of the CCWD is housed in a rented central office in a local commercial building. The district does not have facilities for testing and repair of water meters, and for water sampling and analyses. To provide for the necessary space and facilities, a new administration building will be built in the first construction phase. However, a regional laboratory, to be built in Tarlac, will take care of the water analyses for the CCWD and other water districts in the area.

Capital Cost Summary*

Construction Period	Construction Cost (₱1,000)	Project Cost (₱1,000)		
		Local	FEC	Total
Early Action Program (1977-78)	1,077	437	863	1,300
Phase I-A (1978-82)	21,960	18,046	11,184	29,230
Phase I-B (1982-86)	13,225	10,078	7,477	17,555
Phase I-C (1986-90)	9,416	6,482	5,797	12,279
Phase II-A (1990-1995)	14,734	11,088	8,125	19,213
Phase II-B (1995-2000)	10,523	7,402	6,319	13,721
TOTAL	70,935	53,533	39,765	93,298

*All costs are based on July 1976 prices.

LA UNION

RECOMMENDED PLAN

Source

The long-term water supply for the LUWD will require a total of 25 infiltration wells, of which 17 wells will be in the Bauang system and eight wells in the Baroro system. The infiltration wells for the Bauang system will be constructed in four stages, the first of which will involve five wells. The following criteria have been established based on limited available data, for construction of the Bauang infiltration wells: (1) well spacing, 100-150 m; (2) well depth, 50 m; (3) diameter of casing, 250 mm; (4) average yield from one well, 2,000 cumd; and (5) pumping water level, 20 meters.

For the Baroro system, the infiltration wells will be constructed in three stages. Criteria established for construction of the Baroro wells are: (1) well spacing, 250-300 m; (2) depth, 40 m; (3) diameter of casing, 200 mm; (4) average yield from one well, 1,000 cumd; and (5) pumping water level, 20 meters. Three wells, two operational and one standby, will be constructed during the first construction phase.

Treatment

The only treatment recommended for the infiltration well water is disinfection by chlorination. Separate facilities will be provided for each system.

Transmission Facilities

The proposed transmission facilities for the long-term improvement plan in the LUWD will require approximately 34.2 km pipes ranging in size from 200 to 500 mm for the Bauang system and about 24.1 km of 200 and 300-mm pipes for the Baroro system. During the first construction phase, approximately 21.6 km of 200 to 500-mm transmission pipelines will be constructed. About 15.2 km of this total length will be installed for the Bauang system and about 6.4 km for the Baroro system.

Distribution Mains

The total construction program for distribution mains includes approximately 31.87 km of pipelines ranging in size from 150-mm to 300-mm for the Bauang system and approximately 11.80 km of 200 and 300-mm pipes for the Baroro system. Initially, about 4.45 km of 200 and 250-mm distribution mains will be required for the Bauang system service area and about 0.60 km of 150-mm pipe for the Baroro system.

Storage

Five storage tanks will be constructed at five different sites in the recommended long-term LUWD water system. Three tanks with a total storage capacity of 4,200 cum will be provided for the Bauang system. The remaining two tanks will be for the Baroro system and will have a total operational volume of 900 cum.

The existing 450-cum storage tank in San Fernando will be retained. The existing 150-cum storage facility in San Juan will be abandoned because its overflow elevation (66 m) is significantly higher than the long-term HGL of 60 meters.

Booster Pumping Station

Only one booster pumping station is required in the future LUWD water system. This is a 2,000-cumd capacity pumping station to be built during the last construction

period, at the junction of the Bunang and Barero systems. The booster pumping station will be needed during the dry periods to transfer water from the Bunang system to the Barero system.

Internal Network

Internal network piping will be installed to reinforce the existing internal networks in 160-ha area of San Fernando and 25-ha area of San Juan and to extend water service to new areas. By the year 2000, a total of 805 ha (including existing 185 ha) will have internal network piping. Additional 350 ha served directly from transmission and distribution mains will increase the year 2000 service area to approximately 1,155 hectares.

Service Connections

The long-term construction program includes a total of 20,350 additional service connections through the year 2000. During the first construction phase, 1,500 new connections are scheduled to be installed and 200 existing connections will be replaced. Metering all service connections is a goal of the water district.

Other Facilities

At present, the LUWD occupies a small provincial government-owned office building which is not adequate for proper and efficient operation and management of the district. It is recommended that a new office complex be constructed for the LUWD in San Fernando during the first construction phase. This office complex will include an administrative area and functional spaces for water analysis laboratory, meter repair and plumbing shops, storage, garage and parking.

Capital Cost Summary*

Construction Phase	Construction Period	Construction Cost (₱1,000)	Project Cost (₱1,000) Local	FEC	Total
Early Action Works	1977-78	943	624	515	1,139
I-A	1978-82	24,016	16,003	15,288	31,291
I-B	1982-86	7,670	5,324	4,671	9,995
I-C	1986-90	5,221	3,177	3,625	6,802
II-A	1990-95	35,046	22,189	23,576	45,765
II-B	1995-2000	13,696	8,975	8,875	17,850
Total		86,592	56,292	56,550	112,842

*Based on July 1976 prices