BIBLIOGRAPHIC DATA SHEET	1. CONTROL NUMBER PN-AAK-218	2. SUBJECT CLASSIFICATION (695) AP10-0000-G792

3. TITLE AND SUBTITLE (240) Water supply: Misamis Occidental Water District; feasibility study, summary final report

4. PERSONAL AUTHORS (100)

5. CORPORATE AUTHORS (101)

Camp Dresser & McKee Intl., Inc.

6. DOCUMENT DATE (110) 1976	7. NUMBER OF PAGES (120) 45p.	8. ARC NUMBER (170)

9. REFERENCE ORGANIZATION (130) CDM

10. SUPPLEMENTARY NOTES (500)

~~(Volume I, 193p.: PN-AAK-216~~

11. ABSTRACT (950)

(Volume I, text, 193p.: PN-AAK-216; Volume II, appendices, 217p.: PN-AAK-217)

12. DESCRIPTORS (920)		13. PROJECT NUMBER (150)	
Philippines	cost analysis	492026400	
water resources	design criteria	14. CONTRACT NO. (140)	15. CONTRACT TYPE (140)
water supply	water management	unknown	
urban areas	public utilities	16. TYPE OF DOCUMENT (160)	
feasibility	engineering		

AID 590-7 (10-79)

PN-AAK-218

LOCAL WATER UTILITIES ADMINISTRATION

REPUBLIC OF THE PHILIPPINES

FEASIBILITY STUDY SUMMARY FINAL REPORT

WATER SUPPLY

MISAMIS OCCIDENTAL WATER DISTRICT

JANUARY 1976

CAMP DRESSER & McKEE INTERNATIONAL INC.

CONSULTING ENVIRONMENTAL ENGINEERS

CAMP DRESSER & McKEE INTERNATIONAL INC.

CONSULTING ENVIRONMENTAL ENGINEERS

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

Local Address:
PHILCOMCEN 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 1251, MCC MAKATI, RIZAL
REPUBLIC OF THE PHILIPPINES

16 January 1976

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

Subject: Final Report – Feasibility Study for Water Supply - Misamis Occidental Water District (MOWD)

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 report.

This report is presented in two parts: the Summary Final Report which provides the brief highlights of the study, and the Technical Final Report which provides the detailed analysis and support information.

Extensive improvements and additions to the present water supply system are needed to overcome current deficiencies and to meet future requirements. The recommended plan is the result of alternative studies and cost optimization work. While the cost of the recommended long-range water system facilities is substantial, we consider it within the people's ability-to-pay.

We wish to extend our thanks to the LWUA Board, all the members of the LWUA staff, our counterpart engineers from DCCD, the MOWD staff 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. PRENDIVILLE
Principal-in-Charge

PREFACE

This water supply feasibility study and similar studies for nine other provincial urban areas have been undertaken by Camp Dresser & McKee International Inc. for the Local Water Utilities Administration (LWUA) of the Republic of the Philippines. The studies have been financed from proceeds of a loan to the Philippine Government by the United States of America through the Agency for International Development (AID).

The project consists of four parts:

1. Preparing water supply master plans and feasibility studies for ten urban (provincial) areas of the Philippines, initially: Cebu, Zamboanga, Butuan, Ozamiz, and Daet;

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

3. Applying the training methodology by employing LWUA trainees in the preparation of master plans and feasibility studies for the Second Five Cities, 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/municipalities and conducting pre-feasibility studies on 20 to 60 of the 100 cities/municipalities.

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

The work officially started 9 December 1974. Camp Dresser & McKee International Inc. maintained an average staff of six U.S. engineers and 35 Filipino personnel in the Philippines for the studies of the ten provincial urban areas. Some assistance was also provided by personnel of the respective water districts during the course of the studies.

This is a brief summary of the findings and recommendations that have resulted from the studies. This summary is based on the technical and economic/financial studies contained in the Interim Report for the Misamis Occidental Water District (Volume I and Volume II), Addendum to the Interim Report, Methodology Manual on Water Supply Feasibility Studies and the Technical Final Report:

The following have contributed significantly to the development of this Final Report:

A. Ulvi Gulbey, Chief Engineer
Gilbert S. Nicolson, Sanitary Engineer
Eugene Rumph, Hydrologist
James De Young Water Supply Engineer
James Fort, Distribution Engineer
John Burgh, Groundwater Engineer
Mario Zabat, Counterpart Chief Engineer
Reynaldo Florendo, Sanitary Engineer
Delia Castañeda, Technical Writer/Economist
Lourdes de Guzman, Technical Writer
Manuel Yoingco, Economist
Wilfredo Sevilleja, Professional Engineer
Violeta Galicinao, MOWD General Manager

LIST OF ABBREVIATIONS

Agencies

BCWD	Butuan City Water District
CDM	Camp Dresser & McKee International, Inc.
CNWD	Camarines Norte Water District
DCCD	Design Consultation Construction and Development Engineering Corporation
EDF	Economic Development Foundation
LWUA	Local Water Utilities Administration
MCWD	Metropolitan Cebu Water District
MOWD	Misamis Occidental Water District
MWSS	Metropolitan Waterworks and Sewerage System (formerly National Waterworks and Sewerage Authority or NWASA)
NEDA	National Economic Development Authority
NIA	National Irrigation Administration
NWRC	National Water Resources Council
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration (formerly Weather Bureau)
ZCWD	Zamboanga City Water District

Units

AC	asbestos cement
CCI	centrifugal cast iron
CI	cast iron
CLCI	cement-lined cast iron
cum	cubic meter
cumd	cubic meter per day
cum/mo	cubic meter per month
GI	galvanized iron
GS	galvanized steel
ha	hectare
HGL	hydraulic grade line
hr	hour
km	kilometer
lpcd	liter per capita per day
m	meter
mg/l	milligram per liter
mo	month
%	per cent
₱	Philippine peso
pH	logarithm (base 10) of the reciprocal of the hydrogen ion concentration in water, moles per liter.
PVC	polyvinyl chloride
RU	revenue unit
sqkm	square kilometer
$	United States dollar
yr	year

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

*A foldout of Figure IX-2 is appended in the envelope attached to the back of the report.

I. INTRODUCTION

Description of the Study Area

The study area[1], which covers about 4,245 ha in Ozamiz City and Clarin, lies along Iligan Bay and Panguil Bay in the eastern part of the Province of Misamis Occidental in the Island of Mindanao, Republic of the Philippines (Figure III–I). Ozamiz City is one of three cities of the province. Clarin is located about 6 km north of Ozamiz City.

A portion of Ozamiz City is served by a public water supply system. Clarin has no public water system.

The economy of the study area is dominated by agriculture. Ozamiz City is developing into a trade center in the northern Mindanao region and a popular tourist spot.

The combined 1970 Census population of Ozamiz City and Clarin was 82,400, 64,600 in Ozamiz City and 17,800 in Clarin. The estimated 1970 population of the Ozamiz City water service area was about 61,000. Of this number, only about 23 per cent were served by the water system.

The present service area[2] is approximately 165 ha in and around the Ozamiz City Poblacion[3]. The future area that will be served by the water system is projected to increase to about 290 ha by 1980, 510 ha in 1990, and 750 ha by the year 2000, and will cover both Ozamiz City and Clarin.

[1]The study area encompasses the area which has been considered in the projections of gross population and land use pattern. Study area limits have been determined after a careful review of development or zoning plans, physical limits and public facility projects in the region.

[2]The service area represents sections of the study area, which are currently served or intended to be served by the municipal water system. The served population projections relate to the service area.

[3]The poblacion also known as city or town proper is defined by pre-established political boundaries. It is determined by the location of the city or municipal hall. Ordinarily, the poblacion consists of the plaza or public square (which forms the central part), the public market, schools, churches, commercial and residential blocks.

Local Water Utilities Administration

The Local Water Utilities Administration was created to implement the objectives and provisions of Presidential Decree No. 198 dated May 25, 1973. This decree seeks to establish, operate, maintain and develop reliable, adequate and economically viable water supply and wastewater disposal systems. LWUA potentially covers urban areas throughout the country except Metropolitan Manila, which is served by the Metropolitan Waterworks and Sewerage System (MWSS).

LWUA was formally organized on September 18, 1973 under the National Economic Development Authority (NEDA). When Presidential Decree No. 768 was issued on August 15, 1975, however, LWUA was placed directly under the Office of the President. On December 11, 1975, LWUA was transferred from the Office of the President to the Department of Public Works, Transportation and Communication by virtue of Letter of Implementation No. 31.

One of LWUA's primary activities is to encourage the formation of independent, locally controlled public water districts in provincial urban areas. LWUA may provide financial, training and technical assistance to local water systems. However, only organized water districts which have complied with LWUA requirements and have been issued a Conditional Certificate of Conformance (CCC) by LWUA are qualified for financial assistance. As of October 15, 1975, 19 out of 27 officially organized water districts, have been issued CCC's. The Misamis Occidental Water District (MOWD) is one of the districts which have been issued CCC's.

The MOWD was originally formed on July 13, 1973 but its jurisdiction or membership was finally defined on July 17, 1974. The District covers Ozamiz City and Clarin in the south and Oroquieta City and Calamba in the northern part of Misamis Occidental Province. This study is confined only to the Ozamiz-Clarin area.

Present Facilities

MOWD assumed responsibility of supplying water to Ozamiz City and Clarin in 1973. The water system of Ozamiz City was formerly owned and operated by the provincial government of Misamis Occidental.

Ozamiz City's existing water system was originally constructed in 1941. At that time the system included a groundwater spring source, a storage tank, a hypochlorinator, and transmission and distribution piping. Minor improvements were made in later years to the supply intake, transmission and distribution facilities.

A schematic diagram of the existing Ozamiz City water system is shown in Figure IV-2. At present, the system has two sources of supply: Talibaksan Spring and Cocok Spring. The Talibaksan Spring is a gravity supply. Source facilities include a 1,500 cum open storage tank. The Cocok facility consists of a diesel engine-driven, vertical turbine pump mounted on top of a casing enclosing the spring. The water from these two sources is disinfected by injecting chlorine gas directly, without regulation, into the transmission lines from the sources to the Ozamiz distribution system. A deep well source, the Catadman Well, which was constructed in 1967, was taken out of service in 1971 and its pump was transferred to the Cocok Spring. Talibaksan and Cocok Springs produce about 3,100 cumd and 300 cumd, respectively, and serve an estimated present (1975) population of 17,500.

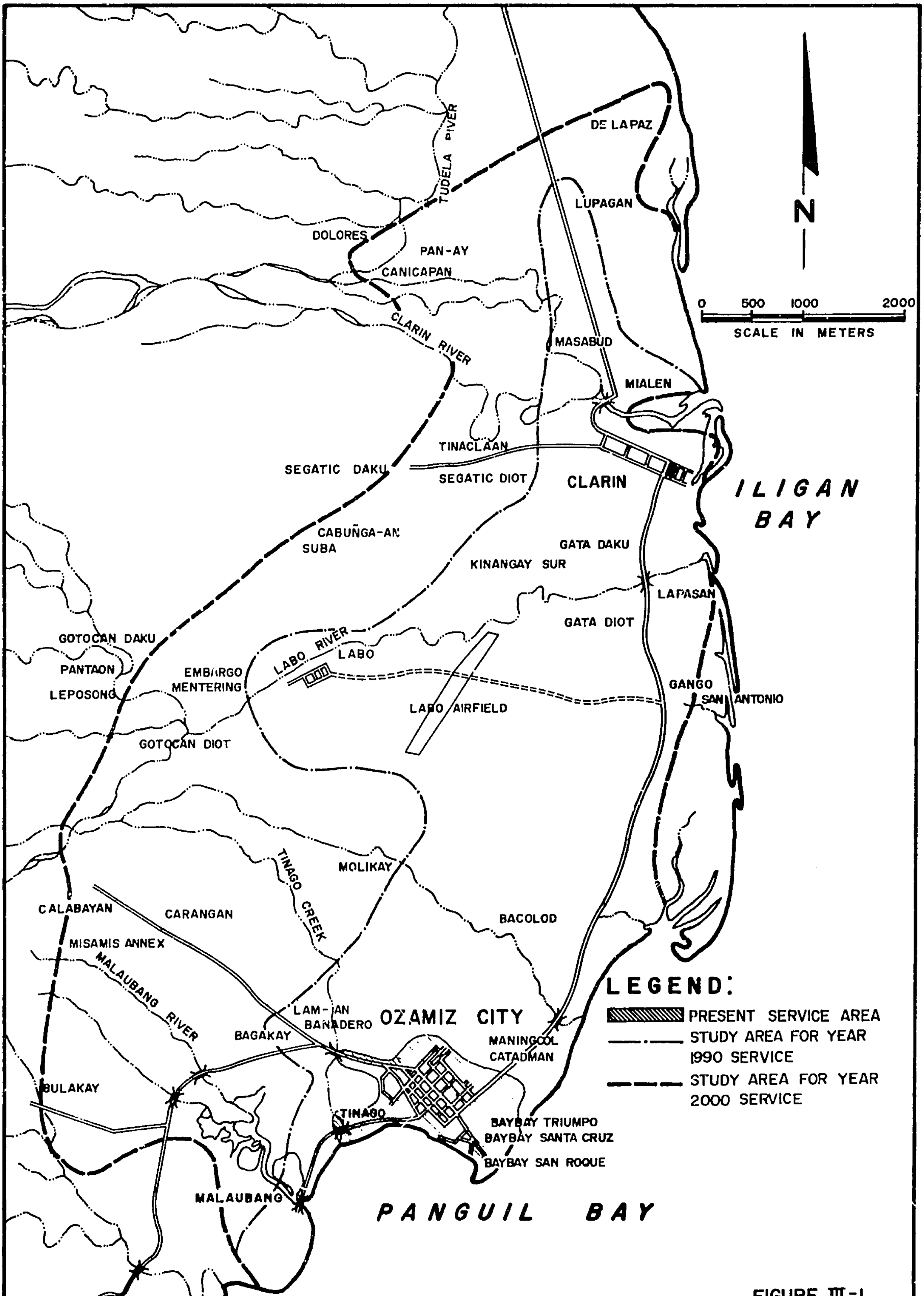
The present distribution system piping totals 12.8 kilometers. The original distribution piping constructed in the 1940's consisted almost entirely of 100 mm and 150 mm pipes. At present, 27 per cent of the piping is 75 mm in diameter or smaller. The distribution system includes 31 valves and 26 fire hydrants. There are no distribution storage facilities; the only storage is the open tank near Talibaksan Spring. As of May 1975, the Ozamiz water system had 1,624 service connections, of which 1,452 were metered. Of the metered services, 256 had non-functioning meters.

Deficiencies of the Existing Water System

The present system and level of service of the MOWD in Ozamiz City are unsatisfactory and suffer from many deficiencies. The effective yield from the present water sources is inadequate to satisfy present demands. The capacity of the transmission main from Talibaksan is insufficient to deliver the full spring flow with adequate residual pressure. The Cocok pump station is of temporary construction and cannot utilize the full capacity of the spring source and associated transmission line. Operation of the pump station is intermittent. The source storage tank at Talibaksan is open, thereby providing opportunities for contamination of the stored water. Existing chlorination equipment and practices are inadequate.

Water pressures in the distribution system are low, ranging from 0 to 6 m. Water must be rationed during night-time hours to conserve water in the storage tank. There are 26 fire hydrants in the system but because of low pressures prevailing in the system, fire-fighting capabilities are severely limited. Potential for cross-connections in the distribution system is significant.

Water accountability is poor, with accounted-for-water (billed water) estimated at only 37 per cent of total water production. Unaccounted-for-water which is 63 per cent of production includes: 35 per cent, leakage; 13 per cent, wastage at flat rate connections; 9 per cent, water loss due to low consumption rate used as basis for billing flat rate connections; and 6 per cent, water loss due to public use, meter under-registration and unauthorized use (illegal connections). However, because of good management, the MOWD collects sufficient revenues to cover operating expenses. This is accomplished through emphasis on metering consumption and eliminating non-paying concessionaires.



FEASIBILITY STUDY FOR WATER SUPPLY OF TEN PROVINCIAL AREAS

CDM-LWUA

FIGURE III-1
STUDY AREA MAP

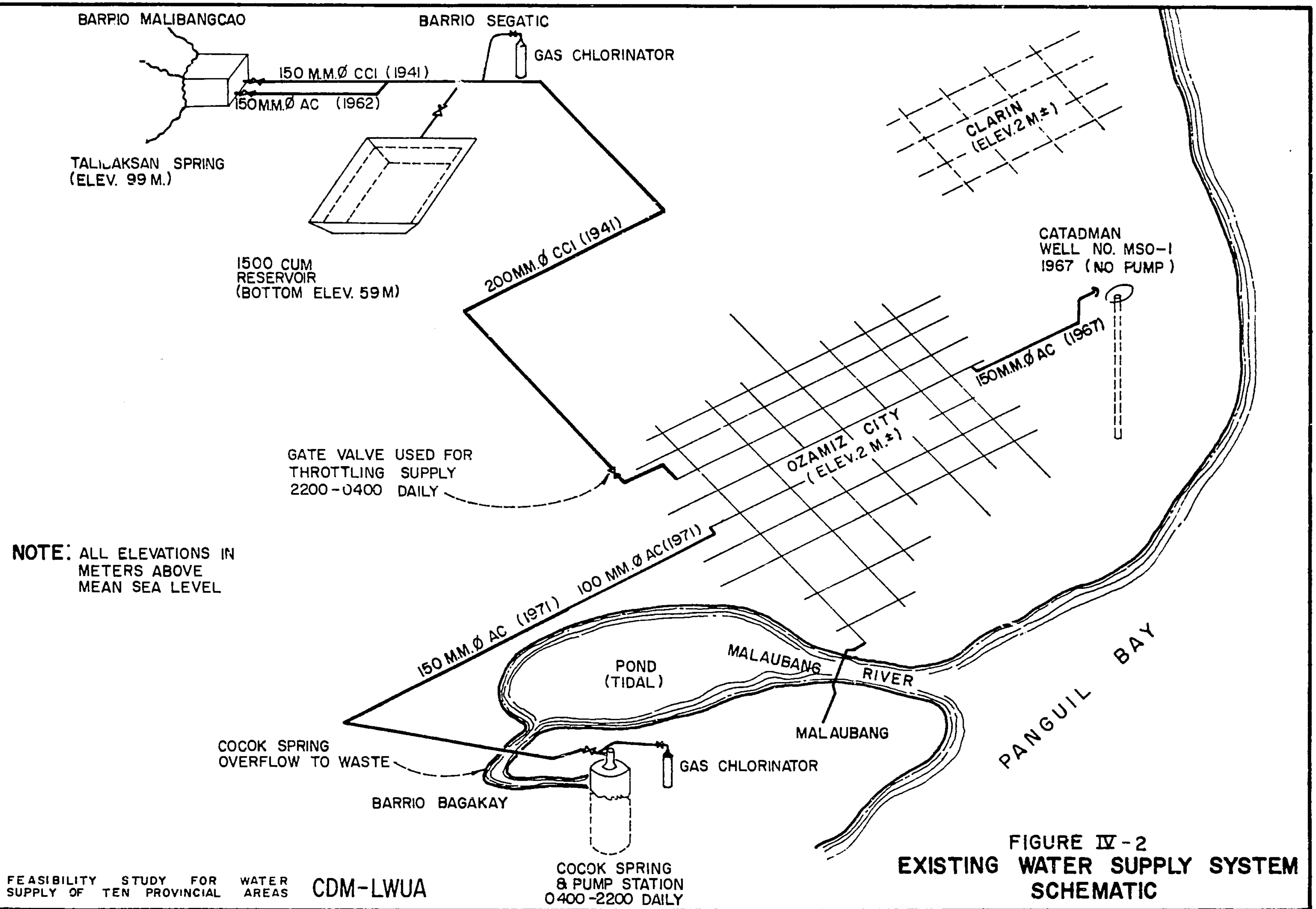


FIGURE IV-2
EXISTING WATER SUPPLY SYSTEM SCHEMATIC

2. STUDY CRITERIA

The planning, design, and economic criteria used in the feasibility studies have been established from studies of local conditions, accepted practices, standards and methods in the Philippines and abroad. These criteria, together with unit cost estimates specifically prepared for the studies, were employed to evaluate and compare the various alternatives identified and developed during the course of the studies.

Planning Criteria

This water supply feasibility study has been guided by the following planning criteria (not in order of importance):

1. *Regional Approach:* Planning of facilities was made on a regional basis, taking into account the short-term district boundaries and the long-term logical 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 consumers.

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

5. *Stage Development:* The long-range program would be implemented in stages to satisfy projected requirements of a specific design year.

6. *Alternative Plan Screening and Selection:* From an array of identified plan alternatives, the recommended plan was selected on the basis of least (present worth) cost and other non-economic parameters. The selected 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 has developed conceptually long-range water quality management plans to conserve the integrity of this valuable resource.

Design Criteria

Average per capita domestic water consumption in the study area has been estimated with the use of field data and available records of past and present water use as well as those from similar cities. Per capita domestic use has been increased each year to account for projected economic growth within the community.

Commercial and institutional water demands have been estimated as percentages of the domestic demand. Where no reliable records were available, a unit demand of 5 cum/day/ha (gross) has been used.

There are currently few or almost no heavy and/or "wet" industries in the study area. Projection of future industrial water demand has been based on land zoning plans, where available.

Maximum – day and peak-hour demands have been estimated from field data and available records.

A review of the available records and consumption patterns indicates that the present unaccounted-for-water is high, amounting to 50 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.

Criteria and guidelines for planning and design of waterworks facilities are discussed in detail in Volume II of the Technical Final Report and Chapter 10 of the Methodology Manual.

Economic Criteria

Discount Rate. 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.

Inflationary Trends. From 1959 to 1969, the Philippines experienced an average inflation of 5 per cent per annum. The pace of inflation from 1969 to the present, however, has been at least double that of the inflationary period after 1962. Price control policies failed to suppress the spiralling prices. In most recent years before 1973, external factors apparently played a relatively small role in the price increases. By contrast, the large price increases in 1973 were attributable to external factors i.e., the oil energy crisis and raw material shortages.

NEDA foresees that the government can effectively combat inflationary tendencies in the economy so much so that inflation rate could be brought down to about 12 to 18 per cent for fiscal year 1975. A 12 to 18 per cent rate of increase per year may sound optimistic given recent experiences, but possibly, this can be achieved. The rate of inflation in industrial countries is expected to decline from 15 to 10 per cent. Commodity prices after posting substantial increases are expected to drop.

Projections made in this feasibility study indicate a general price escalation rate of 12 per cent for the period 1976 through 1980; 10 per cent for the period 1981-85; and 8 per cent for the period 1986-90. These are subject to the following conditions:

- o no major changes in the structure and stability of international political relations;
- o no significant changes in production technology as to reduce dependence on oil;
- o no dramatic increases in the price of energy originating from the cartel countries;
- o the government will not retrench (i. e., fight inflation at the price of the recession that goes with it) as forecasted;
- o no significant oil discoveries in the country; and
- o no internal political upheavals of significant proportions.

Basis of Cost Estimates

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 plant, pump stations, and storage reservoirs and used for estimating the relative cost magnitudes of alternative water supply plans. Escalation factors used in calculating the capital cost of recommended improvements are tabulated as follows:

Year	Escalation Factor
1976	1.00
1977	1.12
1978	1.25
1979	1.40
1980	1.57
1981	1.73
1982	1.90

3. POPULATION AND WATER DEMAND PROJECTIONS

Total Population

The projected (year 2000) service area had an estimated population of 60,700 in 1970. Over the 1960-70 decade, the population grew at an average rate of 3.35 per cent per year.

The population projections of the present and future service areas show a consistently increasing trend (Figure VI-1). From 1970 to 2000, the study area population is estimated to increase by 1 1/2 times - from 60,700 in 1970 to 154,000 in the year 2000. The population growth rate, however, will show a declining trend. From 1970 to 1980, the average annual growth rate will be 3.5 per cent. This is expected to drop to 3.3 per cent during the next decade and to 2.7 per cent from 1990 to the year 2000.

Served Population

The estimated population served in Ozamiz and Clarin (Figure VI-1) by the public water system in 1970 was 14,100 or 23 per cent of the total study area population. The population to be served by the Water District will likewise increase during the study period. However, not all people living within the delineated service area are expected to be served by the Water District. The projected population to be served by the year 2000 is 93,000 or 60 per cent of the total study area population.

Present Water Use

The current water demands of Ozamiz City were analyzed to provide data for estimating future water requirements. For this purpose, data were obtained from records of the Water District, and through field investigation, measurement and interviews with concessionaires.

A study of a three-month average consumption of six metered connections in Ozamiz City indicated an average domestic consumption of 83 lpcd for connections without auxiliary supply, 47 lpcd for connections with auxiliary supply, and an average of 68 lpcd for both categories. Many concessionaries make use of auxiliary water supply because of the inadequate and unreliable service. It is probable that the domestic per capita consumption would be higher if the system had good pressures and sufficient supply.

Current commercial, institutional and industrial water demands have been difficult to estimate because of coincident domestic water consumption. The commercial demand has been assumed to be a percentage of the domestic demand amounting, for Ozamiz City, to 5-8 per cent or 4-6 ipcd. Institutional and industrial consumption each is estimated at 1 lpcd. Thus, the combined commercial, institutional and industrial water demand is 6-8 lpcd.

The present accounted-for-water of the Ozamiz City water system, defined as the sum of the metered water consumption and inferred water consumption at flat rate connections, is very low, only 37 per cent of the total production. Unaccounted-for-water (63 per cent of total production), which is water lost as far as revenue to the Water District is concerned, is estimated to be 122 lpcd. Part of the unaccounted-for-water (28 lpcd) is consumed at flat rate connections due to underestimation of flat rate use and at metered connections due to meter under-registration.

Projected Water Demand

In estimating the probable future water requirements of the study area, it was assumed that there would be increasing economic growth in the area concurrent with a pricing policy for water and a public relations program of the Water District that would discourage wasteful and extravagant water use.

The present total consumption in Ozamiz City is estimated to be 100 lpcd, of which 72 lpcd is accounted for and 28 lpcd is estimated unrecorded use. It is believed that the present domestic consumption would approach 115 lpcd if adequate supply and pressures are available. This unit domestic water demand has been adopted for 1975. For purposes of projection, it was assumed that the domestic demand would increase in the order of 1 per cent per year compounded annually. Based on these figures, the projected per capita domestic water demands are 120 lpcd, 133 lpcd, and 150 lpcd for 1980, 1990 and year 2000, respectively.

The future combined commercial, institutional and industrial demand is estimated to be 12 per cent of the domestic demand. All concessionaires are assumed to have metered connections by 1980, and, therefore, the projections for domestic, commercial, institutional and industrial demands will be accounted-for-water. Unaccounted-for-water, which at present (1975) is 63 per cent of the water production is primarily due to leakage and water wastage (48°/o) and secondarily to unrecorded consumption (15°/o). The unaccounted-for-water is expected to be reduced to 40 per cent in 1980, 30 per cent in 1990 and finally 20 per cent in the year 2000 through a program of metering flat rate connections, replacing non-functioning meters, leakage surveys and elimination, and replacement of defective service connections.

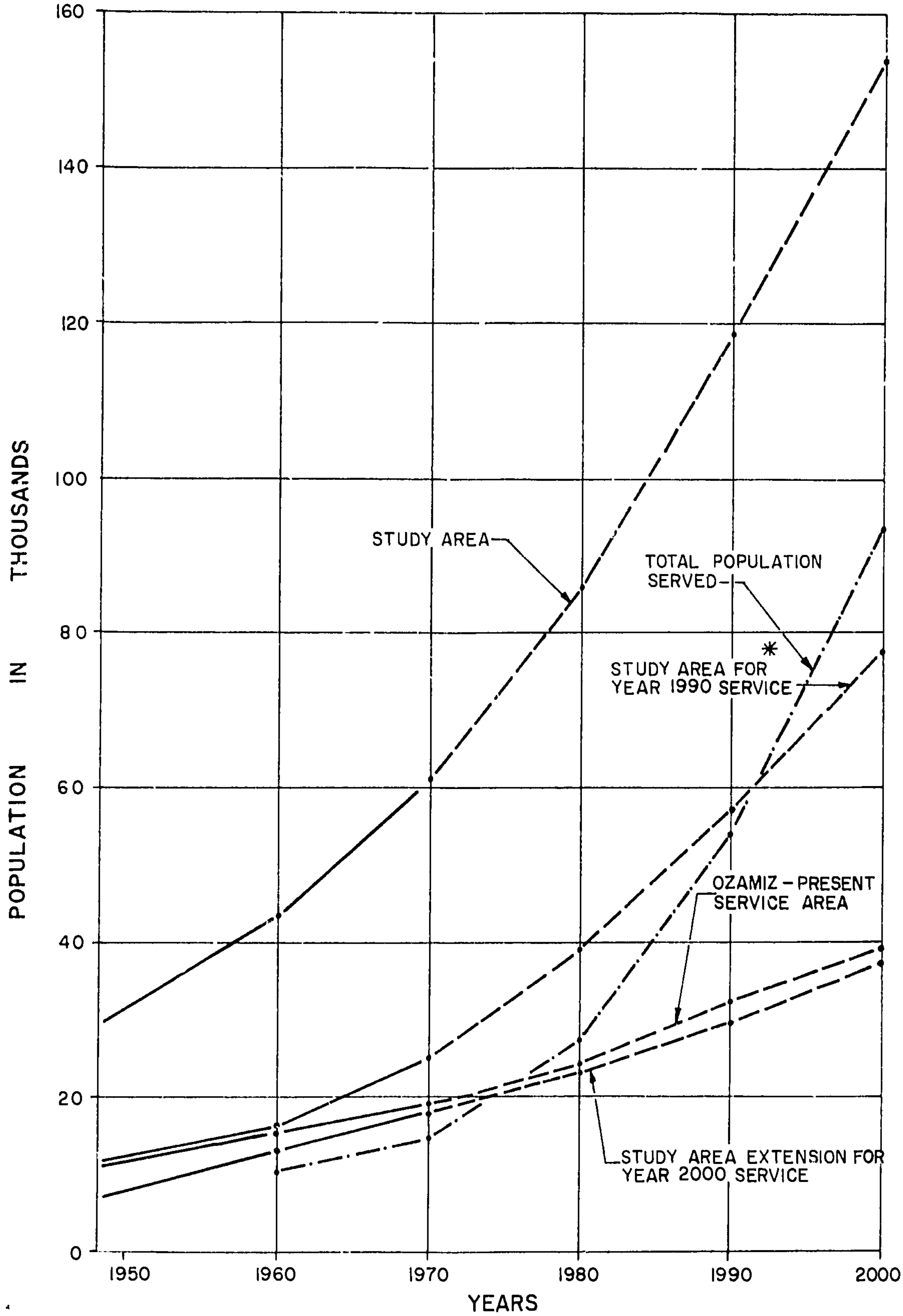
On the basis of the future population to be served and the above projections, the average water demand of the service area will increase from the current (1975) 3,400 cumd to 19,500 cumd by the year 2000 (Tables 1 and 2).

TABLE 1
AVERAGE UNIT CONSUMPTION AND SUPPLY REQUIREMENT
MISAMIS OCCIDENTAL WATER DISTRICT

Item/Year	1975	1980[4]	1990	2000
Domestic, lpcd	65	120	133	150
Commercial/Institutional/Industrial				
(°/o of Domestic)	(10)	(12)	(12)	(12)
Equivalent, lpcd	7	14	16	18
Sub-total, lpcd	72	134	149	168
Unaccounted-For-Water				
(°/o Production)	63	40	30	20
Equivalent, lpcd	122	89	64	42
Leakage, lpcd	69	62	44	25
Unrecorded Use[5], lpcd	53	27	20	17
Total Unit Supply Requirement	194	223	213	210

[4]1980 figures do not have any practical meaning as construction Phase I – A would still be underway.

[5]Unrecorded use represents additional consumption in the study area. For 1975, the unrecorded use includes underestimated flat rate use, wastage at flat rate connections and other uses. The projected unrecorded use consists of other uses – public use, meter under-registration, and unauthorized use.



* EXCLUDING PRESENT SERVICE AREA

FIGURE VI - 1
MISAMIS OCCIDENTAL WATER DISTRICT
POPULATION PROJECTIONS

TABLE 2
AVERAGE DAILY WATER DEMAND AND SUPPLY REQUIREMENT PROJECTIONS (cumd)

Item/Year	1975	1980*	1990	2000
Domestic	1,140	3,230	7,050	13,900
Commercial/Institutional/Industrial	120	390	850	1,700
Sub–Total	1,260	3,620	7,900	15,600
Unaccounted-for-Water	2,140	2,380	3,400	3,900
Total	3,400	6,000	11,300	19,500

Variation in Water Demand

For any given year, water use on any one day may be either equal to or greater or less than the average for the year. During the dry season, for example, there will be one day during which more water will be used than on any other day. The water used on this day is referred to as the maximum-day water demand. Water use also varies from hour to hour throughout the 24-hour day, with one hour showing the maximum rate of use. The rate of water consumption on this hour is referred to as the peak-hour demand.

For the Ozamiz-Clarin service area, there are no reasonably accurate and reliable records of water use from which the relationships between maximum demands and average demands may be determined. On the basis of an evaluation of variations in water use in communities similar to the study area, however, the following ratios were adopted for this study:

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

*1980 figures do not have practical meaning as construction Phase I-A would still be underway.

4. ALTERNATIVES CONSIDERED

Several alternatives on water sources, source development, water treatment, and transmission and distribution of treated water were identified and investigated. From these studies, the recommended plan discussed hereafter was evolved.

Water Source Alternatives

Springs, wells and rivers are the possible sources of water supply for the Ozamiz-Clarin service areas. All these sources were studied and evaluated.

Springs are abundant in the study area. The present supply of the Ozamiz City water system is derived from two springs, Talibaksan and Cocok Springs. In addition to the present spring sources, four other springs were located and investigated, namely: Bitoon, Regina, Upper Dalingap and Lower Dalingap Springs.

Aquifer systems in the area identified from geologic cross-sections and logs of existing wells are a water table aquifer about 10 to 30 m thick and a sand and gravel artesian aquifer overlain by a clay aquaclude of varying thickness. Few wells are drilled into the water table aquifer because of poor water from this aquifer. Water from the water table aquifer is reported to contain hydrogen sulfide.

Numerous wells are drilled into the artesian aquifer because of better water quality and possible free-flowing water. However, well and aquifer parameters derived from data on existing wells indicate it is unlikely that large-capacity production wells can be constructed in this aquifer. There is evidence that the piezometric level in the artesian aquifer and the yields of existing wells are rapidly declining. This situation has resulted from overpumping through uncontrolled proliferation of wells. The continuing decline in piezometric head in the artesian aquifer is very undesirable because pumping will be necessary when wells will no longer be free-flowing. A combination of low piezometric head and pumping may cause saline water intrusion and consequent deterioration of water quality.

With respect to surface water, there are only two perennial water sources of significant size passing through or near the study area: the Labo River and the Clarin River. Other small streams in the coastal plain are either ephemeral or, as in the case of those streams within the Ozamiz City Poblacion, are sluggish waterways grossly polluted with wastewater. Both the Clarin and Labo Rivers have been developed for irrigation by the National Irrigation Administration (NIA), with the construction of low diversion structures. At present, there is no appreciable storage impoundment upstream of the control works in either river.

The full potential of the Labo River is utilized by the NIA in the driest critical months, thus, substantial storage would be needed if both existing NIA requirements and long-term municipal water supplies for Ozamiz and Clarin were to be sustained by this source.

In the case of the Clarin River, available flow records indicate that both the NIA and year 2000 water demands of the study area could not be fully satisfied simultaneously. Thus a water rights conflict may arise in the distant future.

Source Development and Transmission Alternatives

Based on the analysis of the potential water resources in the study area, springs are clearly the preferable sources for the long-term supply of Ozamiz and Clarin. Plans for three alternative combinations of the Talibaksan, Cocok, Regina, Bitoon, Lower Dalingap and Upper Dalingap Springs were developed and studied for stage development. Except for Cocok and Regina Springs, all the spring supplies will be by gravity flow. Flow measurements made in this study during the period February to May 1975 showed that these springs could yield about 38,600 cumd, which is significantly more than the estimated maximum day demand of 23,400 cumd for the year 2000.

Water transmission alternatives are related to the source alternatives and were, therefore, included in the economic analysis of the source development schemes.

Water Quality and Treatment

Analysis of water samples collected from the proposed spring sources indicated that the physical and chemical quality parameters were within acceptable limits, except for slightly excessive iron (0.55 mg/l) in Cocok Spring water. On the assumption that this slight excess of iron from only one of the proposed sources would be acceptable, disinfection will be the only treatment needed. Disinfection ensures safety of the water delivered to the consumers.

Various disinfecting chemicals (chlorine, iodine, bromine, oxidizing agents) and processes (ozonation, ultra-violet radiation) were examined in this study. Chlorination, which is a universal disinfecting process for municipal water supplies and has a long history of successful application, has been determined to be the most practicable disinfection treatment process for the MOWD supply.

Distribution System Alternatives

Major distribution alternatives for the Ozamiz-Clarin service area are concerned with feeder mains, storage facilities, and internal distribution network (service mains).

Important considerations with respect to storage are location, elevation, and staging of required volume. Seven storage schemes were studied for the selected source development plan. Economic and qualitative analysis showed that providing the required storage at two sites, in Barrio Segatic and Barrio Kalabayan, is the most advantageous and practical alternative. In this scheme, 80 per cent of the storage volume would be provided in Barrio Segatic and the remaining 20 per cent in Barrio Kalabayan.

The alternative for feeder mains includes the locations 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 (200) mm has been taken as the minimum diameter of feeder mains and 1,000 m, 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.

Water Resources Conservation Measures

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.

5. RECOMMENDED PLAN

An integrated water supply system utilizing springs as water sources is recommended for the Ozamiz City and Clarin service areas. The long-term improvement program would be implemented in five construction phases of 4 to 5 years each. Prior to the initial construction phase, an "Early Action" program must be undertaken.

The schedule for implementation of the recommended program is given below:

Stage/Phase	Implementation/Construction Period
Early Action	1976–78
Stage I	1977–90
Phase I-A	1977-82
Phase I-B	1982–86
Phase I-C	1986-90
Stage II	1984–2000
Phase II-A	1984–95
Phase II-B	1992-2000

Early Action Program

The Early Action Program includes easily implementable steps in planning and administration; land acquisition and data collection; and operational improvements. The detailed 'Early Action' Program is presented in the Technical Final Report. Of importance are:

- o strengthening the legal basis for development of water sources;
- o initiating improvements to the management, engineering and maintenance procedures;
- o land acquisition of sites for proposed improvements;
- o routine collection of hydrologic and meteorological data;
- o conversion of all service connections to metered services;
- o leakage survey and appropriate repairs to pipelines and valves; and
- o acquisition of selected office and system equipment.

Source Development

The long-term supply of the Ozamiz-Clarin service area of the MOWD 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 (Figure IX-1). 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. Figure IX-2 shows the recommended source, transmission and storage facilities.

Transmission Lines

Transmission lines for the long-term improvement plan will total 47 km ranging in size from 100 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.

Water Treatment

The only treatment that will be required for the Ozamiz-Clarin water supply is disinfection and it is recommended that this be accomplished by chlorination. 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. The chlorination stations are recommended to be constructed in the Early Action Program which should be implemented before the initial phase of the long-term improvement program.

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 Segatic at a ground elevation of about 67 m. 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 Ozamiz or Clarin.

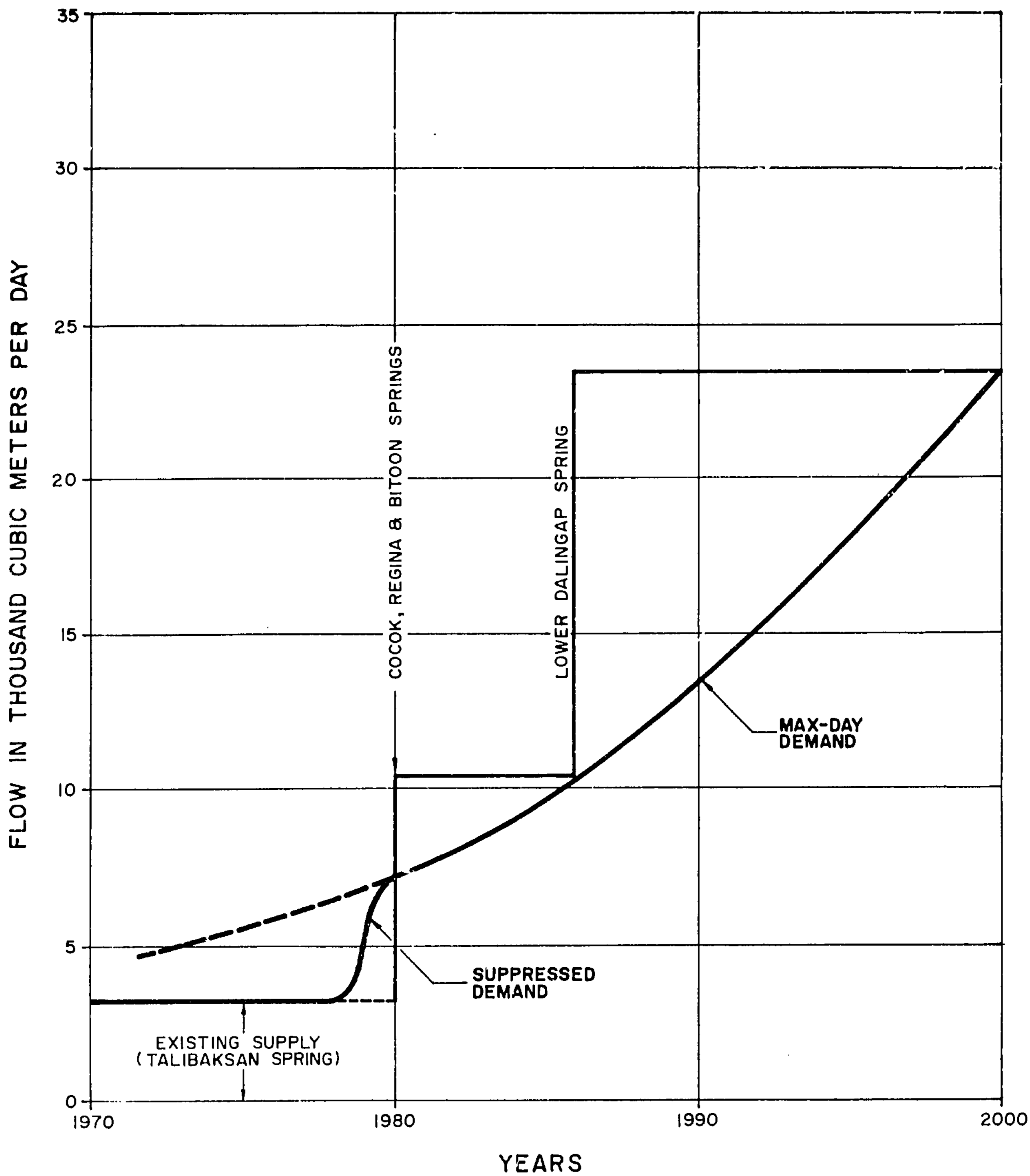
Distribution Mains

The recommended long-term plan for distribution mains (feeder mains) is shown in Figure IX-3. A total of 41 km of distribution mains ranging in size from 150 to 200 mm will be constructed. 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 Ozamiz City. The distribution systems of Clarin and Ozamiz City will be connected during the second construction phase by a 6 km long, 150 mm line along the National Road. Some distribution 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 net-

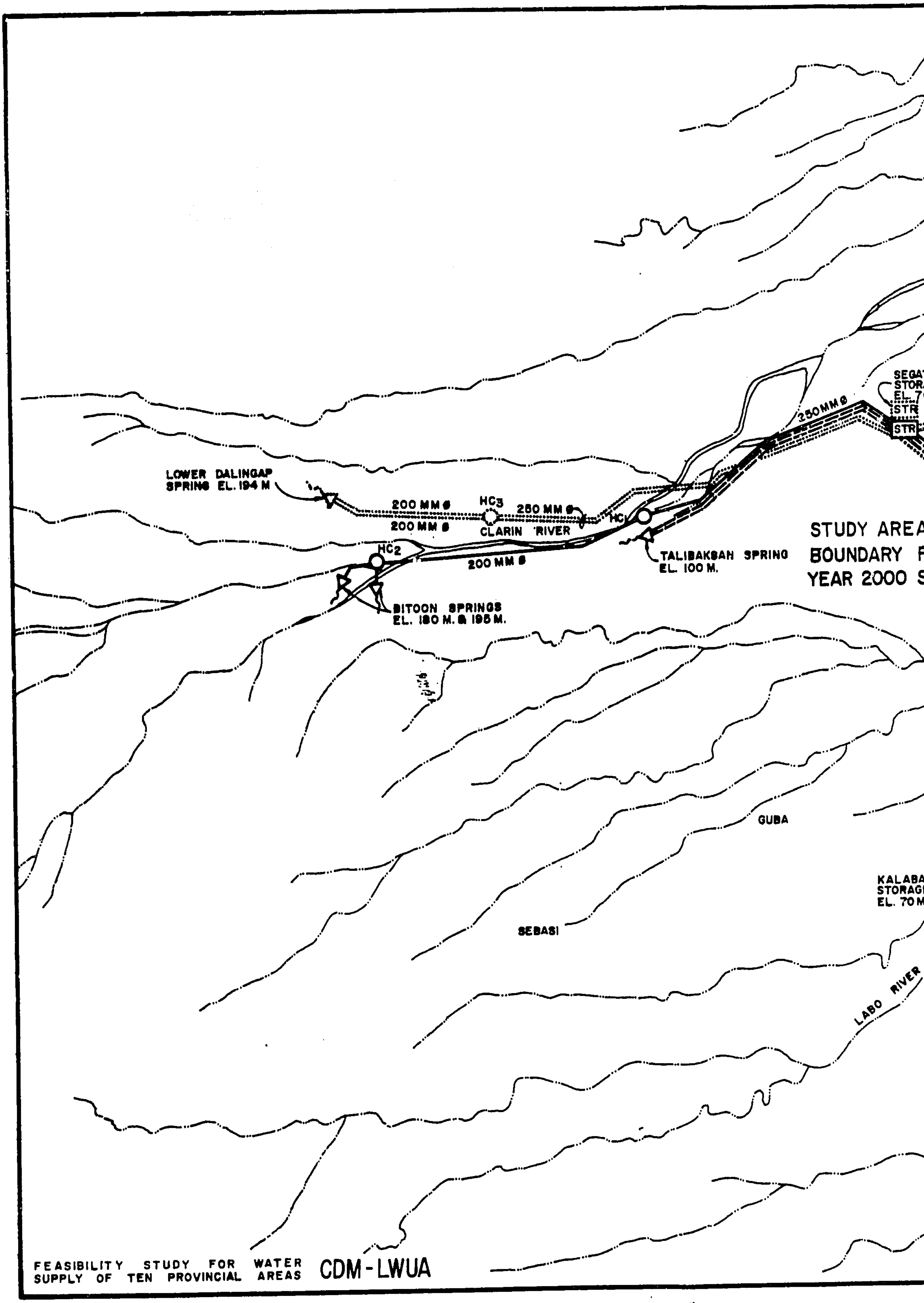


FEASIBILITY STUDY FOR WATER SUPPLY OF TEN PROVINCIAL AREAS

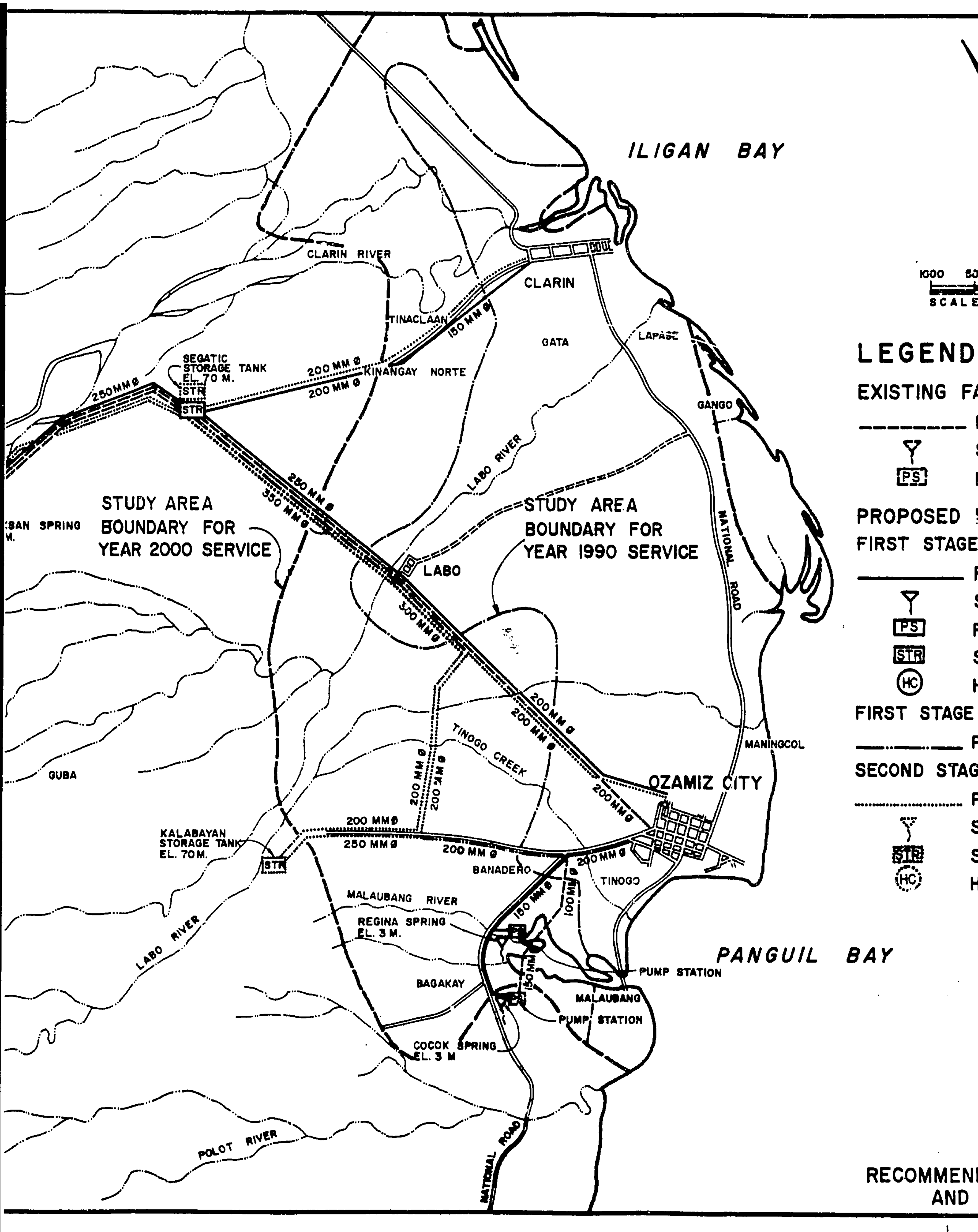
CDM-LWUA

FIGURE IX-1

WATER SUPPLY-DEMAND CHART


LOWER DALINGAP SPRING EL. 194 M
200 MM Ø
200 MM Ø
HC3
CLARIN RIVER
250 MM Ø
HC1
HC2
200 MM Ø
250 MM Ø
STR
STR
TALIBAKSAN SPRING EL. 100 M.
BITOON SPRINGS EL. 180 M. & 195 M.
STUDY AREA
BOUNDARY
YEAR 2000
GUBA
SEBASI
LABO RIVER
FEASIBILITY STUDY FOR WATER SUPPLY OF TEN PROVINCIAL AREAS
CDM-LWUA

F IX-2 a



ILIGAN BAY
CLARIN RIVER
CLARIN
TINACLAAN
150 MM Ø
GATA
LAPASE
SEGATIC
STORAGE TANK
EL. 70 M.
STR
250MM Ø
200 MM Ø
KINANGAY NORTE
200 MM Ø
GANGO
LABO RIVER
250 MM Ø
350 MM Ø
STUDY AREA
BOUNDARY FOR
YEAR 2000 SERVICE
STUDY AREA
BOUNDARY FOR
YEAR 1990 SERVICE
NATIONAL ROAD
LABO
300 MM Ø
200 MM Ø
200 MM Ø
TINOGO CREEK
MANINGCOL
GUBA
200 MM Ø
200 MM Ø
200 MM Ø
OZAMIZ CITY
200 MM Ø
KALABAYAN
STORAGE TANK
EL. 70M.
250 MM Ø
200 MM Ø
200 MM Ø
BANADERO
TINOGO
150 MM Ø
100 MM Ø
MALAUBANG RIVER
REGINA SPRING
EL. 3 M.
LABO RIVER
PANGUIL BAY
PUMP STATION
BAGAKAY
150 MM
MALAUBANG
PUMP STATION
COCOK SPRING
EL. 3 M
POLOT RIVER
NATIONAL ROAD
1000
SCALE
LEGEND
EXISTING FA
PS
PROPOSED
FIRST STAGE
PS
STR
HC
FIRST STAGE
SECOND STAG
STR
HC
RECOMMEN
AND

b

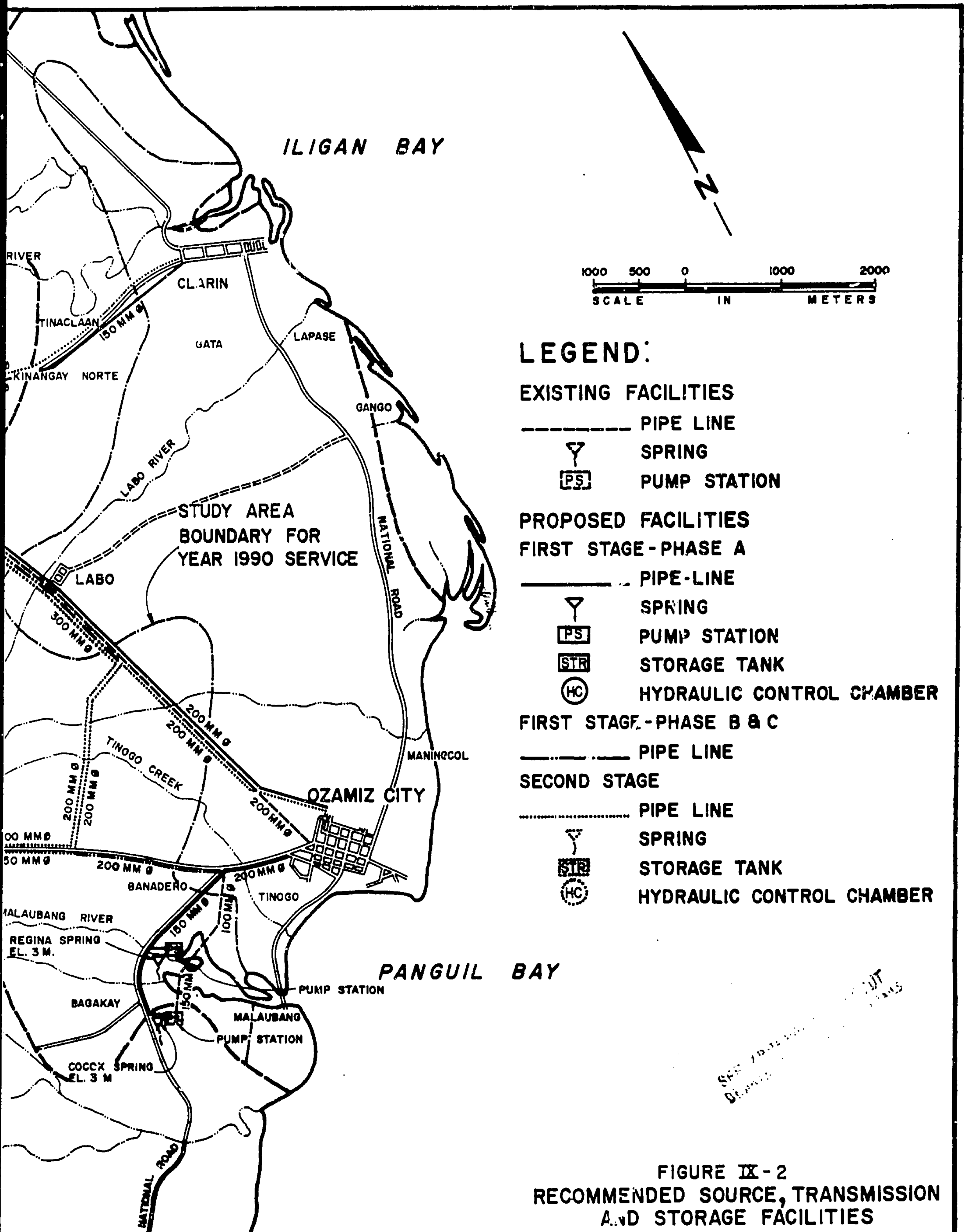
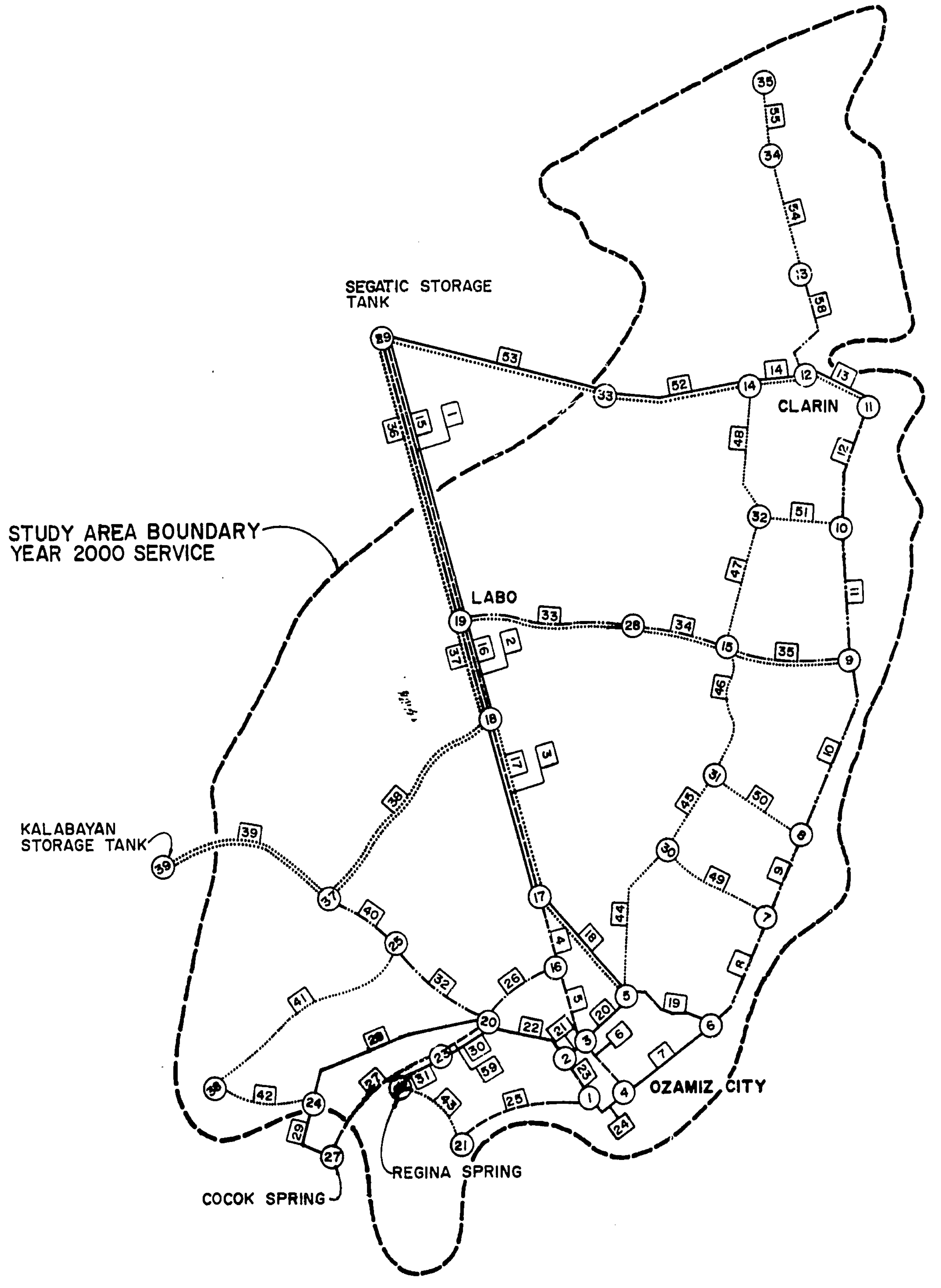


FIGURE IX - 2
RECOMMENDED SOURCE, TRANSMISSION AND STORAGE FACILITIES



FUTURE

FEASIBILITY STUDY FOR WATER SUPPLY OF TEN PROVINCIAL AREAS CDM-LWUA

F IX-3 d

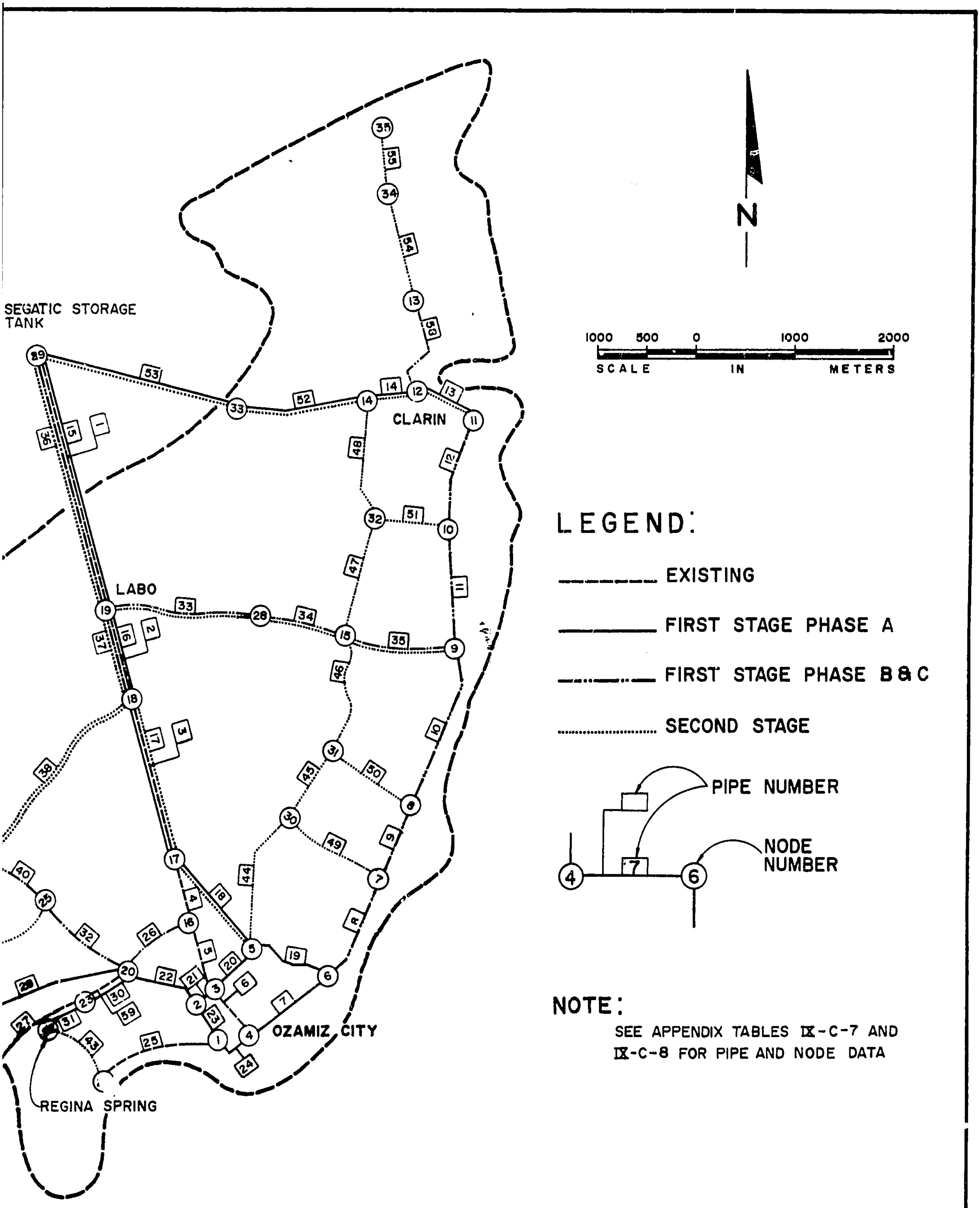


FIGURE IX-3
FUTURE TRANSMISSION LINES & FEEDER MAINS
SCHEMATIC PLAN

LWUA

e

work piping 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 Ozamiz 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 Connections

Service connections or service lines are the facilities that convey the water from the distribution system to the customer's premises. A service line will normally include the following main components: (1) a valved connection to the public water main (corporation cock or stop), (2) a pipeline, usually of small diameter (13 mm to 50 mm) from the corporation cock to the customer's property, (3) a valve accessible to the water utility for shutting off water service, and (4) a water meter. Every service connection will be equipped with a water meter in order to discourage water wastage and obtain an accurate basis for billing. Piping beyond the meter is considered part of the plumbing system of the household or building.

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.

Summary of Water System Improvements

The main features of the recommended long-term water supply improvement program for the projected service area are summarized in Table 3 and shown in Figures IX -2 and IX-3. A brief description of the works involved for each component facility is given in the preceding sections.

Capital Cost Summary

The capital costs for each phase of construction, including the "Early Action Works", are summarized in Table 4. The total project cost shown in the table includes the construction cost of facilities, engineering and contingencies, land and easement costs, administrative and legal fees, and interest during construction. Land costs for all proposed facilities are included in the "Early Action Works" costs. The foreign exchange component of the total project cost includes the costs of direct and/or indirect import items.

A breakdown of the Phase I-A costs is given in Table 5. All costs shown in Tables 4 and 5 are based on projected July 1976 unit prices. Escalated Phase I-A costs are shown in Table 6.

Staff Requirements

Personnel of various categories will be needed to operate and maintain the water system properly and efficiently. Projections until 1981-82 for the staff are shown in Table 7.

Annual Operation and Maintenance Costs

Annual operation and maintenance costs are expenses incurred for personnel, power, chemicals, maintenance, repayments of past loans, and miscellaneous expenses. Estimates of the annual operation and maintenance costs of the Water District are given in Tables 8 and 9. The annual costs do not include repayment of the debt to be incurred for construction of the proposed facilities. Repayment costs are included in the financial analysis to determine the future water rates.

TABLE 3

SUMMARY OF PROPOSED WATER SUPPLY IMPROVEMENTS

	Construction Phase					
	I–A	I–B	I–C	II–A	II–B	Overall
Source Improvement	Talibaksan Spring					
Source Development	Cocok, Regina and Bitoon Springs	Lower Dalingap Spring				
Transmission Lines						
Diameter, mm	150-250		350	200-250	200-300	100-350
	15.2		3.6	14.1	14.00	46.9
Water Treatment[6]						
Storage						
Number	1			1	1	3
Capacity, cum	1,900			700	900	3,500
Location	Bo. Segatic			Bo. Kalabayan	Bo. Segatic	
Distribution Mains						
Diameter, mm	150-200	150	150-200	150-200	150	150-200
Total Length, km	5.2	6.0	7.4	16.2	6.3	41.1
Internal Network						
Reinforcement of Existing Area, ha	30	30				60
Extension, ha	100	100	100	95	95	490
Service Connections						
Replace Existing Connections	200	300	400	724		1,624
New Connections	1,500	1,500	1,500	3,100	3,100	10,700
Other Facilities	Adm. Building Water Meter Shop Water Laboratory					

TABLE 4

CAPITAL COST SUMMARY[7]

Construction Stage/Phase	Construction Period	Construction Cost (P)	Total Project Cost (P)	Foreign Exchange Component[8] (US$)
Early Action	1976–78	₱ 594,000	₱ 683,000	$ 44,000
I–A	1977–82	16,232,000	23,006,000	744,000
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	15,143,000	21,401,000	773,000
II–B	1992–2000	12,412,000	17,464,000	548,000
Totals		₱56,738,000	₱79,667,000	$2,735,000

[6] Chlorinators to be installed during Early Action Phase.

[7] All costs are based on July 1976 prices.

[8] Based on ₱7.00 to $1.00

TABLE 5

COST SUMMARY OF CONSTRUCTION
STAGE I PHASE A (1977–82)

(Based on July 1976 Prices)

Item	Construction Period[9]	Construction Cost (₱)	Foreign Exchange Component[10] (US$)
Source Development			
Cocok and Regina Springs	1977–78	₱ 1,616,000	$100,000
Talibaksan Spring	1978–79	33,000	
Bitoon Spring	1979–80	543,000	
Transmission Lines[11]			
Cocok to Ozamiz City	1977–78	1,364,000	44,300
Talibaksan Spring	1978–79	1,491,000	56,000
Bitoon Spring	1979–80	958,000	36,000
Storage Tank to Clarin	1978–79	1,116,000	40,200
Storage Tank to Ozamiz City	1980–81	2,746,000	102,900
Storage Tank	1978–79	930,000	
Distribution Mains	1978–82	1,551,000	52,000
Internal Network[12]	1978–82	2,418,000	66,000
Service Connections[12]	1977–82	832,000	24,000
Administration Building	1977–78	304,000	
Meter Repair Facilities	1977–78	168,000	20,000
Laboratory Equipment	1977–78	162,000	19,000
Sub-Total		₱16,232,000	$560,400
Engineering and Contingencies at 25%		3,247,000	118,000
at 15%		488,000	14,000
Sub-Total		₱19,967,000	$692,000
Land[13]			
Administrative and Legal Fees at 3%		599,000	
Sub-Total		₱20,566,000	$692,000
Interest During Construction at 12%		2,440,000	82,000
TOTAL		₱23,006,000	$774,000

---

9 From mid-year to mid-year.

10 Based on ₱7.00 to $1.00.

11 Include hydraulic control chambers.

12 Engineering and contingencies are computed at 15%.

13 Included in Early Action Works.

TABLE 6

COST SUMMARY OF CONSTRUCTION STAGE I PHASE A (1977 – 82)

(Escalated From July 1976 Prices)

Items		1977 Construction		1978 Construction		1979 Construction		1980 Construction		1981 Construction		1982 Construction		TOTAL Construction	
		Cost (₱)	FEC ($)	Cost (₱)	FEC ($)	Cost (₱)	FEC ($)	Cost (₱)	FEC ($)	Cost (₱)	FEC ($)	Cost (₱)	FEC ($)	Cost (₱)	FEC ($)
Source Development															
Cocok and Regina Springs	1977–78	905	62	1,010	69										
Talibaksan Spring	1978–79			20		24									
Bitoon Spring	1979–80					379		427							
Transmission Lines															
Cocok to Ozamiz City	1977–78	764	25	853	28									1,9175	131
Talibaksan Spring	1978–79			931	35	1,044	39							44	
Bitoon Spring	1979–80					671	25							806	
Storage Tank to Clarin	1978–79			698	25	781	28	752	28						
Storage Tank to Ozamiz City	1980–81													1,617	53
														1,975	74
Storage Tank	1978–79			581		651		2,156	81	2,375	89			1,423	53
														1,479	53
Distribution Mains	1978–82			243	8	543	18	609	20	671	22				
Internal Network	1978–82			378	10	847	23	950	26	1,047	29			4.531	170
Service Connections	1978–82			130	4	291	8	326	9	360	10			1.232	
Administration Building	1977–78	170		190								367	12	2.433	80
												572	16	3,794	104
Meter Repair Facilities	1977–78	94	11	105	13							198	6	1,305	37
														360	
Laboratory Equipment	1977–78	91	11	101	12									199	24
														192	23
Sub–total		2,024	109	5,240	204	5,231	141	5,220	164	4,453	150	1.137	34	23,305	802
Contingencies		304	16	735	30	671	18	655	21	527	19	94	3	2.986	106
Construction Cost		2,328	125	5,975	234	5,902	159	5,87[illegible]	185	4,980	169	1,231	37	26,291	908
Engineering, Administration, Legal Services and Interest During Construction		591	27	1,522	50	1,510	35	1,505	40	1,279	37	320	8	6,727	197
Total		2,919	152	7,497	284	7,412	184	7,380	225	6,259	206	1,551	45	33,018	1,105

TABLE 7
PROPOSED STAFFING PLAN

Organization Unit	1976–77 Number of Positions	1978–79 Number of Positions	1981–82 Number of Positions
General Manager's Office	1	2	2
Administrative Division	9	7	7
Office of the Chief Engineer	2	3	3
Production Division	8	8	8
Construction and Maintenance Division	8	7	8
Commercial Division	15	19	19
Total	43	46	47

TABLE 8
ANNUAL OPERATION AND MAINTENANCE COSTS[14]
(Based on 1976 Cost Levels)

Item	Annual Costs (₱) 1980	1990	2000
1. Source Facilities	₱283,000	₱304,000	₱319,000
2. Water Treatment	18,000	34,000	58,000
3. Storage, Transmission and Distribution	73,000	167,000	253,000
4. Water District Personnel and Administration	308,000	354,000	442,000
5. Miscellaneous	45,000	87,000	123,000
Total	₱727,000	₱946,000	₱1,195,000

[14]Exclude annual payments on capital loan, which are to be made for proposed improvements.

TABLE 9

ANNUAL OPERATION AND MAINTENANCE COST
(Escalated From July 1976 Prices)
₱ x 1000

	Item	Annual Costs 1980	1990	2000
1.	Source Facilities/Storage, Transmission and Distribution [15]	₱ 501	₱1,564	₱5,634
2.	Water Treatment	28	126	571
3.	Water District Personnel and Administration	444	1,340	4,353
4.	Miscellaneous	72	323	1,211
	Total	₱1,045	₱3,353	₱11,769

6. ECONOMIC FEASIBILITY

The recommended improvements to 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.

Economic Benefits

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.

The quantifiable benefits that have been identified and for which monetary values have been determined are increase in land values, health, personal satisfaction, employment generation (temporary and permanent), fire protection, and reduction in fire insurance costs. A summary of the quantifiable benefits is shown in Table 10. Significant non-quantifiable benefits are improved standard of living and economic linkages.

Economic Costs

The total cost of the proposed water supply system is the sum of all expenditures required to realize project objectives and benefits. Costs have been divided into (1) capital expenditure costs, (2) annual costs, and (3) depreciation costs. In the computation of these costs, it has been assumed that the escalation rate due to inflation would be decreasing in the following manner: 12 per cent from 1976 to 1980, 10 per cent from 1981 to 1986, and 8 per cent from 1987 to 1990. A summary of the economic costs is shown in Table 10.

Benefit-Cost Ratio

One method of determining the eco-

[15] Maintenance and power costs.

nomic 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. This approach has been used in the present project.

The benefit-cost ratio for the proposed water system for the MOWD is 1.16:1. The project, therefore, is economically feasible. It should be noted, however, that the actual benefits will be greater than what the ratio represents because the non-quantifiable benefits are not included in the economic analysis.

TABLE 10
ECONOMIC BENEFITS AND COSTS

Benefits [16] (in million pesos):	**₱55.027**
Increase in Land Values	
Health	
Personal Satisfaction	
Employment Generation	
Fire Protection	
Reduction in Insurance Costs	
Costs [16] (in million pesos):	**₱47.596**
Capital Expenditures [17]	
Annual Operating	
Depreciation	
Benefit – Cost Ratio:	**1.16:1**

7. FINANCIAL FEASIBILITY

The financial feasibility analyses made for the study established a detailed set of guidelines that the Water District management may use in making crucial decisions during the next few years. A plan was developed to indicate the manner and the time funds will 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.

Development Costs

The cost estimates of the facilities needed to improve and expand water services of the District over the development planning period were based on the projected July 1976 unit prices. To account for the effects of inflation, capital cost estimates have been escalated on a year by year and item by item basis. Escalation factors derived from the projected or assumed inflationary trends were used.

Operating and Maintenance Costs

This cost analysis covers cash expenses required to keep the system operating and adequately maintained and includes personnel, salaries, power, chemicals, maintenance, rental and other miscellaneous expenses. A staffing schedule and the associated costs were developed for the MOWD water system. Projections were also made for the other operating and maintenance expenses.

Financing Policies

Major potential sources of funds which can be utilized by the District are (1) operating sources, (2) non-operating sources, and (3) reserve funds. Non-operating sources include loans, charges and assessments, and grants or credits.

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.

[16] All discounted at 12 per cent.

[17] Foreign exchange cost and skilled labor cost were adjusted by 'shadow pricing'.

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 needed funds to the Water District.

Charges and assessments consist of payments made by new customers and benefiting property owners for the costs of specific portions of the facilities being developed.

Credit available to the Water District may include funds that the national government may advance during the early years of the development at little or no interest to assist the local utility in building its financial capacity. It may also be possible to obtain outright grants from the national government. In addition, LWUA has also access to loan funds on concessionary terms and is thus able to relend funds at rates that may be lower than market rates. This in itself is a "grant" available to the local Water District.

Reserve requirements are tied directly to obtaining development loans from LWUA. They are considered funds required to support capital development.

Revolving Fund for Service Connections

The cost analysis for service connections in this study assumes the establishment of a revolving fund. Cost of the connection will be shared by the customer and the Water District. The customer will pay for the cost of the water meter and two-thirds of the cost of the rest of the service line. The District will bear the remaining one-third of the cost.

Based on 1976 price levels, the estimated cost of a 12 mm service connection is ₱366 and that of the water meter, ₱190. Thus, the cost chargeable to the customer is ₱434 (1976 price level).

To assist new customers in financing service connection charges, it will be necessary to provide working capital for a revolving fund. LWUA has a current policy which provides for service connection costs to be payable at ₱5.00 per month over a 10-year period. It is proposed that this rate be increased to ₱5.65 per month to cover the increase in the cost of the meters. Net inflow funds will be required over a period of 10 years to build sufficient income to support the annual cost of connections.

Funds Required to Support Capital Development

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) annual cash requirements, (6) revenue unit forecasts, (7) water rates determination, (8) revenue forecasts, (9) feasibility of charges, (10) external borrowing required, (11) projections of financial statements, (12) cash flow statements, and (13) other financial statements. Detailed data are presented in the Technical Final Report. The following have been derived from the financial studies.

1. The recommended plan for the first construction phase (Phase I-A) of MOWD is financially feasible. Borrowing for that period would be ₱31.08 million.

2. External borrowing would still be necessary for the second construction phase (Phase I-B).

3. Revenues are adequate for most years assuming some flexibility is taken on setting up the reserve fund and depreciation expense.

4. The cash flow analysis shows adequate working capital. Positive net cumulative cash balance is realized immediately.

5. The proposed water rates to effect self-sufficiency are as follows:

1976–78	₱1.00/cum
1979–81	1.90
1982–84	2.50
1985–87	3.20
1988–90	4.50

Cash Flow and Other Financial Statements

The cash flow statement (sources and application of funds statement) provides an indication of the adequacy of working capital. It is generally not sufficient to cover cash outlays with revenues in equal amounts because of the tendency of cash receipts to lag behind the cash outlays. Also, an organization that is expanding operations, conducting a capital development program and generally increasing its level of activities will need increasing quantities of working capital.

Table 11 presents the cash flow statement until 1982 for the study area. As can be seen, a potential net decrease is expected in 1981. However, net positive cash balance is achieved yearly from the very start even if "cash" at the beginning of 1976 is only ₱20,000.

The Balance Sheet and Rate of Return are shown in Tables 12 and 13, respectively.

8. IMPLEMENTATION PLAN

Implementation Schedule

The recommended water supply improvements and facilities may be implemented in increments or stages. The following is the proposed schedule for implementation of the Early Action and Phase I-A improvements:

Final Report Submission	January	1976
LWUA/ADB Loan Negotiation	December	1975
Select Design Engineer	May	1976
Start Final Design	July	1976
Complete Early Action Works	December	1976
Complete Final Design: Prequalify Contractor	December	1977
Open Bids	March	1978
Complete Phase I-A Works:		
Source Development		1979
Transmission Facilities		1979
Administration Building		1979
Distribution Mains		1981
Internal Network		1981
Service Connections		1981

Cash Outflow from 1976 to 1982

Estimates of funding requirements are important information in the implementation of the recommended water system improvements. The projected cash outflows of MOWD for Phase I-A design and construction (1976-1982) are listed in the following table. This includes local costs and foreign exchange components.

	Project Cost	Local Cost	Foreign Exchange Component[18]	
Year	₱ x 10^6	₱ x 10^6	₱ x 10^6	\$ x 10^3
1976	1.222	.743	.479	68.43
1977	2.617	1.798	.819	117.00
1978	6.136	4.575	1.561	223.00
1979	8.262	6.299	1.963	280.43
1980	6.515	4.862	1.653	236.14
1981	3.748	2.873	.875	125.00
1982	1.521	1.162	.359	51.29
Total	30.021	22.312	7.709	1,101.29

[18] Dollar costs are based on ₱7.00 to \$1.00.

TABLE 11

PROJECTED SOURCES AND APPLICATION OF FUNDS
MISAMIS OCCIDENTAL WATER DISTRICT
(₱ x 1000)

Source of Funds	1976	1977	1978	1979	1980	1981	1982[19]
Net Income (Before Interest)	358	532	497	1,739	1,577	1,555	2,974
Depreciation	26	32	81	164	283	544	634
Increase in Current Liability	5	5	31	9	76	17	(10)
Total Internal Sources	389	569	609	1,912	1,936	2,116	3,598
Long-Term Debt	1,222	2,654	6,173	8,170	6,393	4,066	2,402
Capital Contributions		25	33	113	146	182	221
Total External Sources	1,222	2,679	6,206	8,283	6,539	4,248	2,623
Total Sources	1,611	3,248	6,815	10,195	8,475	6,364	6,221
Application of Funds							
Investment in Utility Plant	1,222	2,679	6,206	8,283	6,539	4,248	2,623
Interest on Debt		110	349	904	1,640	2,215	2,564
Principal Repayment						185	185
Total Capital Charges	1,222	2,789	6,555	9,187	8,179	6,648	5,372
Increase in Current Assets	109	77	50	411	119	91	359
Total Application	1,331	2,866	6,605	9,598	8,298	6,739	5,731
Net Increase (Decrease)	280	382	210	597	177	(375)	490
Cash at Beginning of Period	20	300	682	892	1,489	1,666	1,291
Cash at End of Period	300	682	892	1,489	1,666	1,291	1,781

[19] 1982 includes portion of Stage I Phase B.

TABLE 12
PROJECTED BALANCE SHEET
MISAMIS OCCIDENTAL WATER DISTRICT
(₱ x 1000)

Assets Fixed Assets	1976	1977	1978	1979	1980	1981	1982
Gross Value of Fixed Assets	1,437	2,763	6,088	11,365	17,592	29,902	32,510
Less: Accumulated Depreciation	311	328	394	543	811	1,340	1,959
Net Value of Fixed Assets	1,126	2,435	5,694	10,822	16,781	28,562	30,551
Work in Process	585	1,923	4,789	7,780	8,077		
Total Fixed Assets	1,711	4,358	10,483	18,602	24,858	28,562	30,551
Current Assets							
Cash	300	682	892	1,489	1,666	1,291	1,781
Accounts Receivable	173	223	271	613	706	785	1,143
Less: Provision for Uncollectibles	(3)	(2)	(3)	(12)	(7)	(8)	(23)
Inventories	1	27	30	108	129	142	158
Total Current Assets	471	930	1,190	2,198	2,494	2,210	3,059
Total Assets	2,182	5,288	11,673	20,800	27,352	30,772	33,610
Equity & Liabilities **Equity**							
Government Construction	549	549	549	549	549	549	549
Capital Contributions		25	58	171	317	499	720
Reserves	21	48	81	155	240	428	702
Unappropriated Retained Earnings	337	732	847	1,608	1,460	612	748
Total Equity	907	1,354	1,535	2,483	2,566	2,088	2,719
Long-Term Debt							
Long-term Loans (Less Current Maturities	1,222	3,876	10,049	18,219	24,427	28,308	30,525
Current Liabilities							
Accounts Payable	53	58	89	98	174	191	181
Current Maturities of Long-Term Debt					185	185	185
Total Current Liabilities	53	58	89	98	359	376	366
Total Equity & Liabilities	2,182	5,288	11,673	20,800	27,352	30,772	33,610

TABLE 13

FORECASTED RATE OF RETURN ON NET FIXED ASSETS IN SERVICE
(₱ x 1,000,000)

Item	1976	1977	1978	1979	1980	1981	1982
Average Net Fixed Assets in Service	.82	1.78	4.06	8.26	13.80	22.67	29.56
Net Operating Income	.36	.53	.49	1.72	1.55	1.51	2.90
Rate of Return (%)	43.9	29.7	12.1	20.8	11.2	6.7	9.8

Sewerage/Drainage Concepts

Both Ozamiz City and Clarin do not have central sanitary sewage collection and disposal systems. In both communities, 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.

As the water supply problem is resolved, wastewater quantities will increase. Consequently, related public health and aesthetic problems will also increase. 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.

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, and should include oceanographic studies relative to marine disposal of wastewaters into the Iligan and Panguil Bays.

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 spring sources 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-monthly basis. Monitoring activities should be coordinated with LWUA and the National Water Resources Council. The Water District and its consultants should update and review the monitoring program as the goals and the needs of 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 5 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.