

**BASIC DESIGN STUDY REPORT  
ON  
CONSTRUCTION PROJECT  
OF  
SEWAGE DISPOSAL TREATMENT FACILITIES  
IN  
BAGUIO CITY  
REPUBLIC OF THE PHILIPPINES**

MAY 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

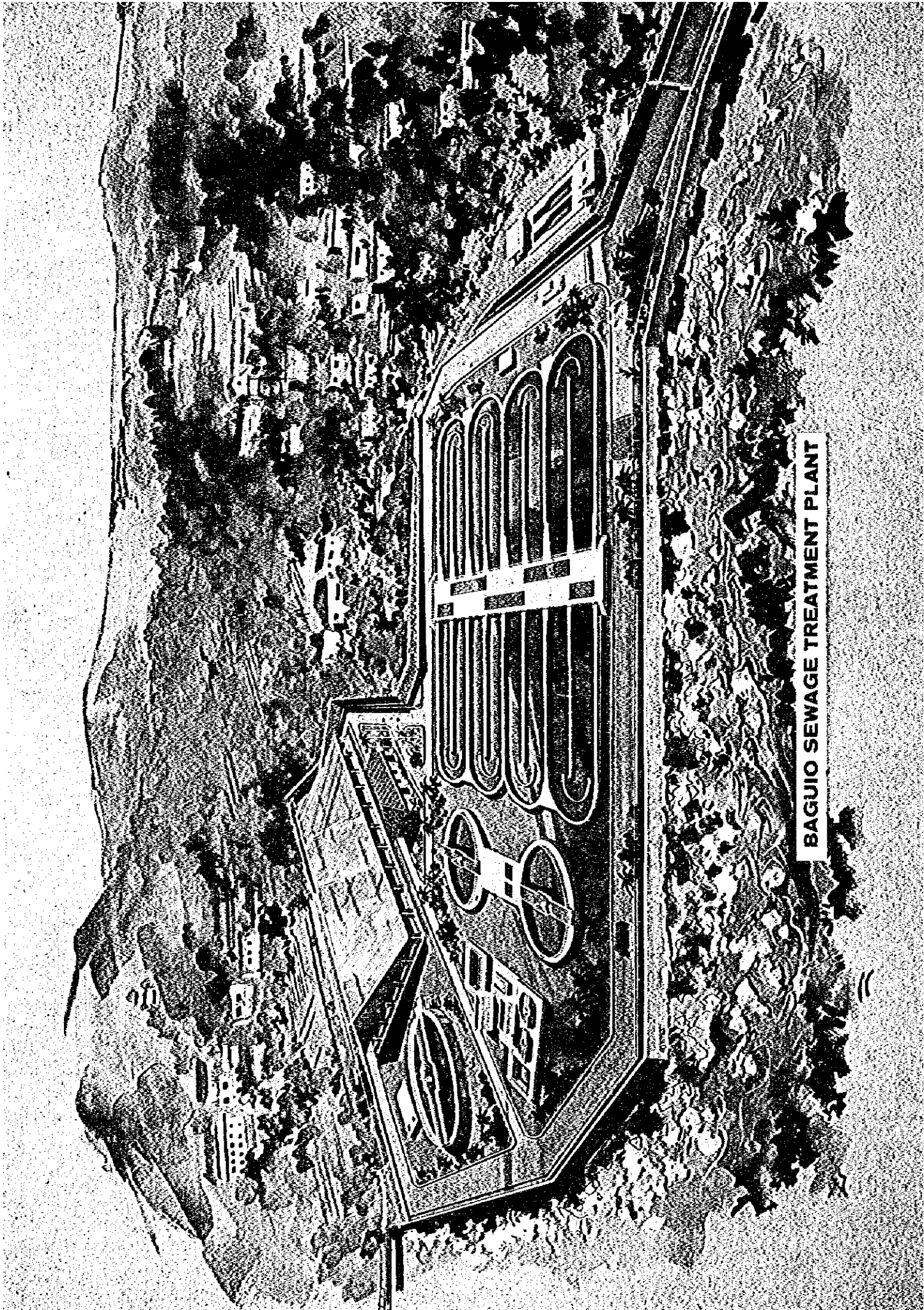


**BASIC DESIGN STUDY REPORT  
ON  
CONSTRUCTION PROJECT  
OF  
SEWAGE DISPOSAL TREATMENT FACILITIES  
IN  
BAGUIO CITY  
REPUBLIC OF THE PHILIPPINES**

**MAY 1984**

**JAPAN INTERNATIONAL COOPERATION AGENCY**

国際協力事業団	
受入 月日 '84.11.13	118
	61.8
登録No. 10828	GRB



BAGUIO SEWAGE TREATMENT PLANT



## PREFACE

In response to the request of the Government of the Republic of the Philippines, the Government of Japan decided to conduct a Basic Design Study, on the Construction Project of Sewage Disposal Treatment Facilities in Baguio and entrusted the study to the Japan International Cooperation Agency (JICA). The JICA sent to the Philippines a study team headed by Mr. Tatsuo Murayama, Public Sewerage Div., City Bureau, Ministry of Construction, from 8th February to 1st March, 1984.

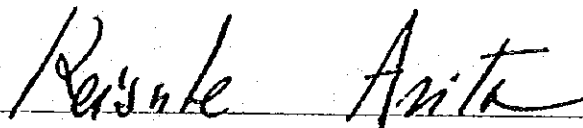
The team had discussions with the officials concerned of the Government of the Philippines and conducted a field survey in Baguio.

After the team returned to Japan, further studies were made and the present report has been prepared.

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

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

May, 1984



Keisuke Arita

President

Japan International Cooperation Agency

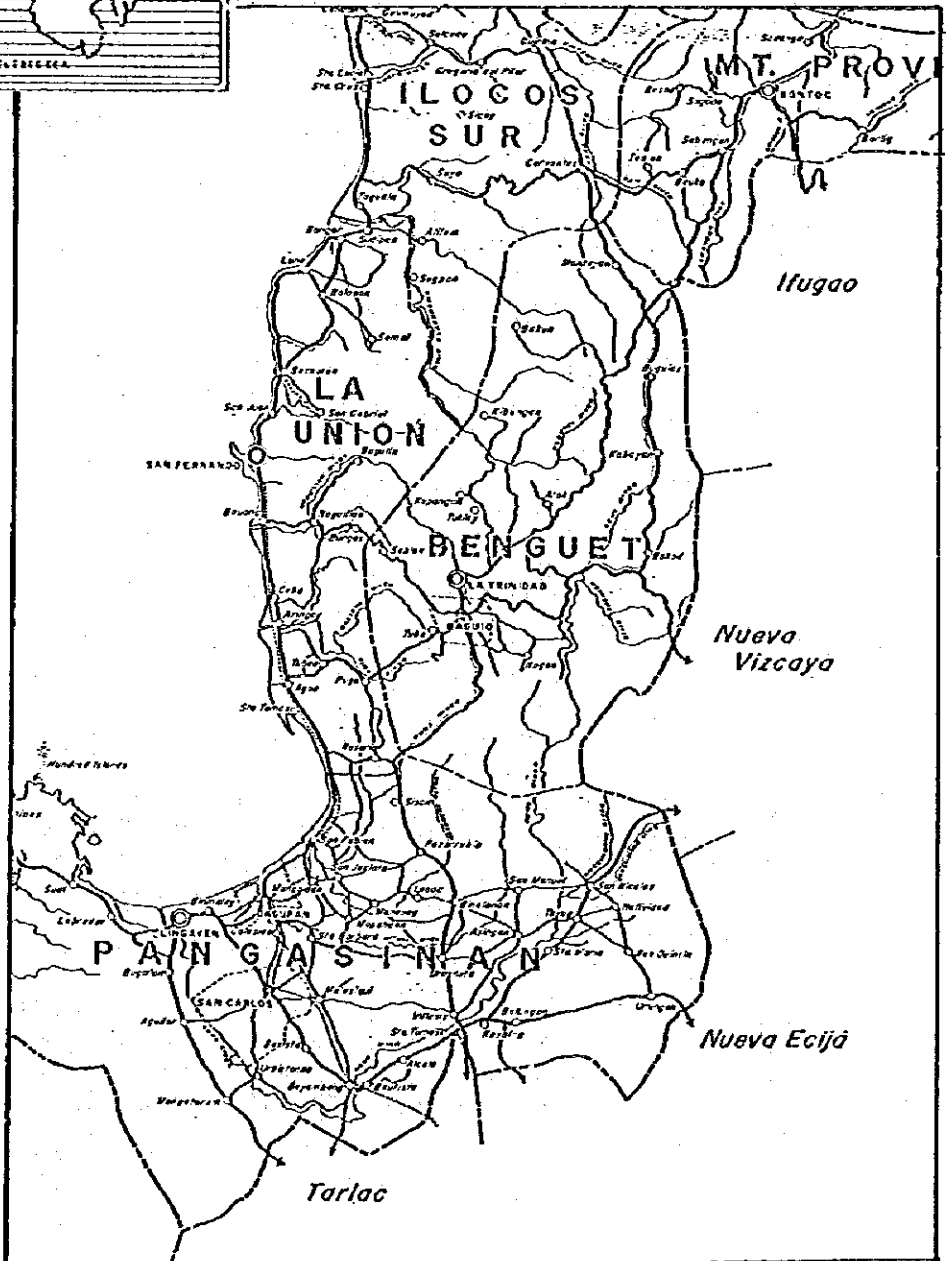




THE REPUBLIC OF THE PHILIPPINES



## LOCATION MAP





# TABLE OF CONTENTS

	<u>Page</u>
PREFACE	
TABLE OF CONTENTS	I
LIST OF TABLES	IV
LIST OF FIGURES	VI
ABBREVIATIONS	VII
S U M M A R Y . . . . .	1
CHAPTER 1            INTRODUCTION . . . . .	5
CHAPTER 2            BACKGROUND OF THE PROJECT	
2-1                General Conditions of Water Supply and Sewerage Systems in the Philippines . . . . .	9
2-1-1            Basic Plan . . . . .	9
2-1-2            Present Status of Water Supply and Sewerage Systems .	10
2-2                Socio-Economic Conditions of Baguio City . . . . .	12
2-2-1            General Conditions of Socio-Economy . . . . .	12
2-2-2            Industry and Education . . . . .	14
2-2-3            Drainage System and Wastewater Treatment. . . . .	17
2-3                Socio-Economic Conditions of La Trinidad. . . . .	21
CHAPTER 3            STUDY OF FUNDAMENTALS FOR DESIGN OF THE SEWAGE TREATMENT PLANT	
3-1                The Present and Future Land Use in Baguio City. . . . .	25
3-2                Present and Future Population of Baguio City . . . . .	29
3-2-1            Number of and Increases in Permanent Residents . . . . .	29
3-2-2            Prediction of Permanent of the City . . . . .	30
3-2-3            Transient Students . . . . .	30
3-2-4            Visitors . . . . .	31
3-3                Present and Future Water Supply of Baguio City . . . . .	31
3-3-1            Current Water Supply . . . . .	31
3-3-2            Water Supply by Service Zone . . . . .	32
3-3-3            Average Water Consumption Per Capita Per Day . . . . .	35
3-3-4            Monthly Fluctuation of Water Consumption in Baguio City. . . . .	36

		<u>Page</u>
3-4	Subject Area for Sewage Treatment and Present Water Consumption in the Area . . . . .	37
3-5	Water Pollution and Sanitary Conditions in Baguio City . . . . .	45
3-5-1	Situation of Existing Sewerage System . . . . .	45
3-5-2	Situation of Existing Sewers and Creeks Based on the Field Survey . . . . .	49
3-5-3	Water Pollution in the Subject Area . . . . .	51
3-5-4	Present Situation of Water Body into which Effluent will be Discharged . . . . .	62
3-6	Design Sewage Flow and Quality . . . . .	70
3-6-1	Present Water Consumption and Served Population in the Balili River Basin . . . . .	72
3-6-2	Population Increase from 1983 to 1986 . . . . .	72
3-6-3	Ratio of Planned Population Served by the Sewerage System to Total Predicted Population in the Balili River Basin . . . . .	73
3-6-4	Study of Related Factors to Estimate Design Flow . . . . .	73
3-6-5	Design Flow . . . . .	74
3-6-6	Quality of Sewage Treatment Plant Influent . . . . .	75
 CHAPTER 4            BASIC DESIGN		
4-1	Location of Proposed Construction Site and its Surrounding Area . . . . .	77
4-1-1	Location and Climatological Conditions . . . . .	77
4-1-2	Surrounding Conditions at Planned Construction Site . . . . .	78
4-1-3	Infrastructures . . . . .	81
4-2	Sewage Treatment Facilities . . . . .	83
4-2-1	Initial Plan and Situation of Existing Facilities . . . . .	83
4-2-2	Selection of Alternatives . . . . .	94
4-2-3	Comparison of Alternatives . . . . .	97
4-2-4	Outline of the Sewage Treatment Plant . . . . .	122
4-3	Basic Design Drawings . . . . .	131
 CHAPTER 5            PROJECT IMPLEMENTATION		
5-1	Organization . . . . .	153
5-2	Scope of Construction Work . . . . .	154
5-3	Overall Implementation Schedule . . . . .	157

	<u>Page</u>
CHAPTER 6 OPERATION AND MAINTENANCE . . . . .	159
6-1 Management of Facilities . . . . .	159
6-2 Operation Organization . . . . .	159
6-3 Cost for Operation and Maintenance . . . . .	159
6-4 Operation Program . . . . .	160
6-5 Laboratory Equipment . . . . .	166
CHAPTER 7 PROJECT EVALUATION . . . . .	171
7-1 Diminution of Contamination of Water Quality of Balili River and its Effect . . . . .	171
7-2 Study on the Capacity of the Facility . . . . .	172
CHAPTER 8 CONCLUSIONS AND RECOMMENDATIONS	
8-1 Comments on the Required Measures Concerning the Existing Sewer System . . . . .	173
APPENDICES	
Appendix 1 Officials Concerned, Itinerary of Study Team, and Minutes of Discussion	
1-1 Philippine Government and Baguio City Officials Concerned . . . . .	177
1-2 Japanese Basic Design Study Team . . . . .	178
1-3 Site Investigation for Confirmation of Basic Design . . . . .	192
Appendix 2 Results of Field Measurement . . . . .	197
Appendix 3 Capacity Calculation Sheet for Baguio Sewage Treatment Plant	
3-1 Outline of Plan . . . . .	209
3-2 Sewage Treatment Facilities . . . . .	211
3-3 Sludge Treatment Facilities . . . . .	215
Appendix 4 Profile of Planned Main Sewer . . . . .	217

# LIST OF TABLES

## CHAPTER 2

		<u>Page</u>
2-1	Water Supply Service Ratio in the Philippines (1980) . . .	10
2-2	Labor Force Plan of Baguio City . . . . .	14
2-3	Industries of Baguio City . . . . .	15
2-4	Average Household Expenditure in Baguio City (1980) . . .	16
2-5	Public Utility Charges in Baguio City (monthly rate) . . .	17
2-6	Sanitary Treatment at Households in Baguio City (1983) . . . . .	19
2-7	Record of Incidence and Mortality of Water Borne Diseases in Baguio and the Philippines . . . . .	20
2-8	Disease Intelligence of La Trinidad, 1982 . . . . .	23
2-9	Leading Causes of Infant Morbidity, La Trinidad, 1982 . . .	23
2-10	Leading Causes of Infant Mortality, La Trinidad, 1982 . . .	24

## CHAPTER 3

3-1	Present Land Use in Baguio City . . . . .	25
3-2	Baguio City Population Growth Rate . . . . .	29
3-3	Future Permanent Residents of Baguio City . . . . .	30
3-4	Water Consumption by Service Zone, Dec. 1983 . . . . .	32
3-5	Estimated Served Population and Per Capita Water Consumption by Service Zone . . . . .	36
3-6	Monthly Fluctuation in Water Consumption . . . . .	37
3-7	Districts in the Served Area in the Balili River Basin . . .	41
3-8	Daily Average Water Consumption and Estimated Served Population in the Subject Area (Dec. 1983) . . . . .	45
3-9	Result of Examination of Sewage Quality . . . . .	59
3-10	Result of Field Measurement and Sewage Examination . . . .	66

## CHAPTER 4

4-1	Outline of Main Facilities . . . . .	88
4-2	Operational Characteristics of Various Treatment Process . . . . .	96
4-3	Principle and Characteristics of Various Treatment Processes . . . . .	98
4-4	Performance Example of Conventional Activated Sludge Process. . . . .	101
4-5	Performance Example of Extended Aeration Process . . . .	103
4-6	Performance Example of Oxidation Ditch Process . . . . .	105
4-7	Performance Example of High-Rate Trickling Filter Process . . . . .	107
4-8	Performance Example of Rotating Biological Reactor Process . . . . .	109
4-9	Operational Characteristics of the Alternative Processes . . . . .	111

	<u>Page</u>
4-10	Estimation of Energy Requirement and Electrical Cost . . . . . 117
4-11	Energy Requirement (Case I and II - High-Rate Trickling Filter Process) . . . . . 118
4-12	Energy Requirement (Case III - Oxidation Ditch Process) . . . . . 119
4-13	Comparison of Annual Maintenance and Operational Cost . . 121
4-14	Outline of Main Facilities . . . . . 127
4-15	Content of Major Maintenance Work . . . . . 131

APPENDIX 2

2-1	Estimation of Daily Flow of the River . . . . . 200
2-2	Data Sheet for Measurement of Flow Velocity and Water Level . . . . . 202
2-3	Water Sampling and Field Measurement Points . . . . . 205
2-4	Water Quality Analysis, Baguio City . . . . . 208

# LIST OF FIGURES

## CHAPTER 2

		<u>Page</u>
2-1	Toilet Facilities at Filipino Households . . . . .	11
2-2	Trends in the Domestic Product by Major Industry Contribution, Baguio . . . . .	13

## CHAPTER 3

3-1	Present Land Use Pattern of Baguio City . . . . .	27
3-2	Baguio City Water District Water Service Zones . . . . .	33
3-3	Subject Area for Sewage Treatment . . . . .	39
3-4	Relationship between Subject Area and Water Service Zones . . . . .	43
3-5	Main Sewer Systems and Subdivision of Subject Area . . . . .	47
3-6	Location of Observed Points (No. 8 to No. 10) . . . . .	50
3-7	Observed Points of Sewerage Manholes and Creeks . . . . .	53
3-8	Field Measurement and Water Sampling Points . . . . .	57
3-9	Variation of Flow Rate in Balili River . . . . .	64
3-10	Water Sampling Points along Balili River . . . . .	65
3-11	Interrelation between BOD and ORP . . . . .	69
3-12	Flow Chart to Estimate Design Flow . . . . .	71

## CHAPTER 4

4-1	Location of Baguio City . . . . .	77
4-2	Monthly Average Rainfall in Baguio City (1978-1982) . . . . .	79
4-3	Monthly Average Atmospheric Temperature in Baguio City (1978-1982) . . . . .	79
4-4	Planned Construction Site . . . . .	80
4-5	Flow Sheet for Treatment of Initial Plan . . . . .	84
4-6	Initial Layout Plan . . . . .	85
4-7	Hydraulic Profile for Sewage Treatment Facilities of Initial Plan . . . . .	86
4-8	Hydraulic Profile for Sludge Treatment Facilities of Initial Plan . . . . .	87
4-9	Return Method of Recirculation . . . . .	90
4-10	Bypass . . . . .	90
4-11	Disinfection Tank . . . . .	92
4-12	Layout Plan using High-Rate Trickling Filter Method . . . . .	113
4-13	Layout Plan for Oxidation Ditch Process . . . . .	114
4-14	Flow Sheet for Treatment . . . . .	125
4-15	Hydraulic Profile . . . . .	126
4-16	General Layout . . . . .	132
4-17	Grit Chamber . . . . .	133
4-18	Primary Sedimentation Tank . . . . .	134
4-19	Oxidation Ditch . . . . .	135



	<u>Page</u>	
4-20	Final Sedimentation Tank . . . . .	136
4-21	Disinfection Tank . . . . .	137
4-22	Sludge Thickener & Sludge Storage Tank . . . . .	138
4-23	Sludge Drying Bed . . . . .	139
4-24	Administrative Quarter . . . . .	140
4-25	Mechanical Equipment Flow Sheet Plan . . . . .	141
4-26	Mechanical Equipment Layout Plan (1)-1 (Horizontal Aerator) . . . . .	142
4-27	Mechanical Equipment Layout Plan (1)-2 (Vertical Aerator) . . . . .	143
4-28	Mechanical Equipment Layout Plan (2) . . . . .	144
4-29	Single Line Diagram . . . . .	145
4-30	Power Distribution Plan . . . . .	146
4-31	Roadway . . . . .	147
4-32	Drainage Plan . . . . .	148
4-33	Box Culvert . . . . .	149
4-34	Gutter & Roadway . . . . .	150
4-35	Bank Protection & Retaining Wall . . . . .	151
 CHAPTER 5		
5-1	Organization for Project Implementation . . . . .	154
5-2	Overall Project Implementation Schedule . . . . .	157
 CHAPTER 6		
6-1	Flow Diagram of the Operation System . . . . .	169
 CHAPTER 8		
8-1	Possible Route of New Main Sewer . . . . .	175
 APPENDIX 2		
2-1	Cross Section of the River . . . . .	198
2-2	Variation of Water Level and Flow Velocity . . . . .	201
2-3	Daily Variation of Flow Rate . . . . .	201
2-4	Water Sampling and Field Measurement Points . . . . .	204
2-5	Relationship Between the Two Selected Points . . . . .	206
 APPENDIX 4		
4-1	Profile of Planned Main Sewer Case 1 . . . . .	217
4-2	Profile of Planned Main Sewer Case 2 . . . . .	218

# ABBREVIATIONS

BENECO	-	Benguet Electric Corporation
BOD	-	Biochemical Oxygen Demand
BWD	-	Baguio Water District
COD	-	Chemical Oxygen Demand
DO	-	Dissolved Oxygen
DIV.	-	Division
EPA	-	U.S. Environmental Protection Agency
GL	-	Ground Level
JICA	-	Japan International Cooperation Agency
JSWA	-	Japan Sewage Works Agency
LWUA	-	Local Water Utilities Administration
MPWH	-	Ministry of Public Works and Highways
NPC	-	National Power Corporation
ODA	-	Official Development Assistance
ORP	-	Oxidation-reduction Potential
pH	-	Hydrogen ion concentration, showing degree of acidic or alkaline of medium
PILTEL	-	Philippine Telephone Corporation
RC	-	Reinforced Concrete Pipe
SS	-	Suspended Solid
Temp.	-	Temperature
WL	-	Water Level

## ABBREVIATION FOR MEASUREMENTS

mm	-	millimeter
cm	-	centimeter
m	-	meter
km	-	kilometer
m <sup>2</sup>	-	square meter
ha	-	hectare
km <sup>2</sup>	-	square kilometer
m <sup>3</sup> , cu.m	-	cubic meter

$m^3/day$	-	cubic meter per day
$m^3/m^2/day$	-	cubic meter per square meter per day
$m^3/month$	-	cubic meter per month
$m^3/sec$	-	cubic meter per second
kg	-	kilogram
$kg/m^3/day$	-	kilogram cubic meter per day
ton	-	metric ton
l	-	liter
sec, s	-	second
min	-	minutes
hr	-	hour
hrs	-	hours
mon	-	month
yr	-	year
kW	-	kilowatt
kWh	-	kilowatt-hour
kWh/day	-	kilowatt-hour per day
HP	-	horse power
MGD	-	million gallon per day
Lit./cap./day	-	liter per capita per day
mg/l	-	milligram per liter
mV	-	milli volt
ppm	-	parts per million
C, °C	-	centigrade of temperature unit
kV	-	kilo volt
MV	-	mega volt
GWR	-	giga watt hour
$N/cm^3$	-	Number per cubic centimeter
MPN	-	Most Probable Number
MVA	-	Mega Volt Ampere
No.	-	number
l.s. (L.S.)	-	lump sum
%	-	percentage
¥	-	Japanese Yen
₱	-	Philippine Peso
MP	-	Million Peso
\$	-	US Dollar



## SUMMARY



## SUMMARY

The city of Baguio, the "summer capital of the Philippines", with its highland characteristics, favorable climate and natural features has undergone rapid development. In contrast to this remarkable economic development, there has been observed the delay or insufficiency in areas of infrastructure implementation under the city's urban development plan. In particular, in the field of public sewerage system, attention should be drawn to the fact that wastewater is being discharged untreated into rivers owing to the absence of treatment facilities in the city, resulting in the water pollution of these rivers.

The Balili River, which flows northward from Baguio City, is utilized to supply part of the water by means of deep wells to La Trinidad and for irrigation in the vegetable farms. In line with the rapid urban development of Baguio City, water pollution in rivers due to direct discharge of untreated wastewater has become worse year by year. In La Trinidad, located downstream from Baguio, damage to vegetable cultivation and public hygiene has increased to the point where it became so serious a problem that the people appealed to the courts requesting immediate countermeasures be taken up by Baguio City. The latter has drawn up a plan to construct the necessary sewage treatment facilities to solve the said problem in good time, and has requested the Japanese Government through its national government to provide cooperation and assistance.

In response to the request from the Philippine Government, the Japanese Government despatched a basic design study team through the Japan International Cooperation Agency (JICA) from February to March 1984. The study team has performed the confirmation on the background and details of the requested plan for cooperation and assistance submitted by the Philippine Government; the field surveys necessary to determine the appropriate capacity of sewage treatment facilities and to develop the optimum design of treatment processes; and, has held discussions

repeatedly with officials concerned. Those basic items agreed upon through the discussions are contained in the minutes of discussions.

Major subjects discussed are as follows:

As to the proposed service area of the public sewerage system, it has been agreed to cover such areas being installed with sewer pipelines in the Balili River basin. The population of the subject area has had to be estimated from the present water supply amount as a practical procedure since an accurate figure is not available even from population statistics owing to the presence of long-stay visitors.

The water supply amount in the subject area is estimated to be some 11,000 cu.m/day based on the number of faucets. This figure is equivalent to approximately 79 percent of the total supply amount in the city (daily average: 13,900 cu.m/day) excluding water being supplied to the Baguio City Export Processing Zone.

The target year of this plan has been set for 1986, which is expected to be the time of coming into operation of the sewage treatment facilities, and the population in the target year has been considered to be 12 percent above the present population.

As to the planned sewage flow, it is agreed that 70 percent of households being connected to the water supply pipelines in the subject area shall be regarded to be potential beneficiaries of the public sewerage system, although Baguio City initially presented the said sewage flow as 3 MGD (approximately 11,350 cu.m/day). Based on this agreement, the planned sewage flow is estimated to be some 8,600 cu.m/day (2.27 MGD).

For selection of sewage treatment method, constructive opinions from both the Japanese and Philippine sides have been presented and discussed. The criteria for evaluation and selection of the most appropriate treatment method have been established to ensure: (1) ease of



operation and maintenance; (2) high treatment efficiency and stability of treated wastewater quality; (3) low running costs; and (4) freedom from secondary public nuisance by implementation of treatment facilities. As a result of evaluation and discussion, the oxidation ditch process has been selected.

As to utilization of abandoned facilities in the proposed construction site, it has been agreed to preserve the primary sedimentation tank and to remove, as necessary, other facilities.

The basic design of treatment facilities has been developed paying due consideration to reflect the agreement settled down with the Philippine officials. Principle approaches to the basic design are; (1) to employ, so far as possible, two series of treatment facilities to cope with suspension of plant operation for inspection and repair of facilities and standby facilities/equipment necessary for emergency bypassing of wastewater and for operation and maintenance; (2) to locate all the facilities within the proposed construction site; (3) to ensure ease of operation and maintenance; (4) to minimize running costs by means of effective facilities design and of operating plan; (5) to minimize any secondary public nuisance. This basic design also includes access roads, which, in compliance with the agreement, are to be constructed at the expense of Philippine Government.

The construction of treatment facilities based on this plan is considered to be carried out by the Japanese Grant-in-Aid Assistance for the periods of 4.0 months in detailed design, for the period of 2 months in bidding & contract awarding and 16 months in construction work including technical advice during test running.

The executing agency of this plan is the Local Water Utilities Administration (LWUA). Under the general coordination and administration of the LWUA, the necessary organization for project implementation has been established together with the allocation of respective local funds. Moreover, Baguio City will be primarily responsible for

operation and maintenance of facilities, while the LWUA will provide Baguio City with necessary technical advisement.

Upon completion of this plan, water pollution in the Balili River being caused by wastewater inflow from Baguio City will be significantly reduced; and the damage to the people and economy of La Trinidad will then be removed. These events will go beyond being a problem limited to one provincial city, to contribute significantly to an improvement in understanding of the Filipino people of the importance of public hygiene in their country. Needless to say, Japan itself has already confronted similar bitter experiences and has been aware of the importance of the conservation of the natural environment. Based on these experiences and a deep understanding of the present situation of the Philippines, if this technical cooperation with Japan is materialized through the implementation of the proposed plan, a resultant goodwill and friendship between both countries can be expected.

## CHAPTER 1



## CHAPTER I INTRODUCTION

The city of Baguio is located in the central highlands of Benguet Province, 208 km north of Manila in the northwest of Luzon Island. Baguio City has an area of 48.9 sq.km, and an altitude which varies from 1,300 m to 1,600 m; the city proper being on a plateau at an altitude of 1,400 m. The city is famous as a summer capital of the Philippines, welcoming sightseers not only from other parts of the Philippines, but also from abroad, with a peak season population approximately two times that of its 130,000 permanent residents.

In spite of the city's remarkable economic development, there have been noticeable delays or shortcomings in some areas of infrastructure implementation under the city's urban development plan. Concerning the public sewerage system, almost all of the wastewater discharged in the city is flowing into rivers without any treatment owing to the absence of public sewage treatment facilities. Thus, water pollution is occurring in the area.

The Balili River, which rises in and flows northwards from Baguio City, is the largest of four rivers in the city. La Trinidad, in marked contrast to Baguio, which is located in a hilly area, is the next municipality downriver and has extensive cultivated fields. This area, formerly known as the salad bowl of the Philippines before, is however named as a toilet bowl of Baguio City now because of the utilization of polluted water in Balili River for the irrigation. The more, there are areas where drinking water supply sources depend on wells in the Balili River Basin and problems on public hygiene are then issued from.

Given these background conditions, Baguio City has planned to construct public sewage treatment facilities to improve of the aquatic environment in the rivers and for an upgrading of public hygiene in the area, and has turned to Japan through the Government of the Philippines for necessary assistance.

The Government of Japan, in response to the request from the Government of the Philippines, dispatched a preliminary survey team on May 30, 1983 for 10 days through the Japan International Cooperation Agency, to confirm the details of the said request and to investigate the background of the proposed plan.

Based on the results of this preliminary survey, a basic design study was programmed for the proposed project. The basic design study team, headed by Mr. Tetsuo Murayama<sup>1/</sup>, was dispatched for 23 days from February 8 to March 1, 1984. The study team has conducted discussions with officials of the Government of the Philippines and of the City of Baguio and various surveys necessary to carry out further study on the details of the proposed plan and to develop basic design of the proposed plan.

Major subjects of discussions and surveys are as follows:

- (1) Discussions to confirm the details of the request of the Philippine Government
  - 1) Objectives of the plan
  - 2) Discussions and agreement on the basic concept of the plan
- (2) Investigation on water pollution in rivers, water quality research, and existing wastewater (nightsoil) treatment facilities for justifying the objectives and basic concept of the plan
- (3) Investigation at the proposed construction site and its surrounding areas
- (4) Discussions on the capacity and function of the treatment facilities

---

<sup>1/</sup> Mr. Tetsuo Murayama; Deputy Manager of Public Sewerage Division, Sewerage and Sewage Purification Department, City Bureau, Ministry of Construction.

- (5) Explanation of the system of the Japanese Grant Aid Assistance and discussions on the areas of cooperation to be covered by each Government, the executing agency, and the operation and maintenance of treatment facilities.
- (6) Investigation on the existing sewer system and recommendations on improvement/reconstruction.
- (7) Investigation on the local conditions of raw materials, labor force, equipment for construction, and so on.

Based on the results of above-mentioned field works, the minutes of discussions on the agreed fundamental items were signed by the study team leader and the officials concerned in the Philippines on March 18, 1984.

The study team continued discussions and investigations for further details based on the agreed minutes of discussions.

This report contains results of these discussions and investigations, and details of the proposed plan. The composition of the basic design team and its itinerary and agreed minutes of discussions are as per attached.





## CHAPTER 2



## CHAPTER 2 BACKGROUND OF THE PROJECT

### 2-1 General Conditions of Water supply and Sewerage Systems in the Philippines

#### 2-1-1 Basic Plan

The Philippine Government has set forth "the Integrated Water Supply Program, 1980-2000" and "the Rural Water Supply and Sanitation Master Plan" focusing on the development and improvement of water supply and environmental sanitation facilities, in compliance with the "International Water Supply and Sanitation Decade Program" launched at the General Meeting of the United Nations in 1980. The former is a long-term program with objectives for deployment of water supply systems, while the latter is mid-term program from 1981 to 1990 aiming at upgrading the living environment in rural areas through the implementation of water supply and sanitation facilities.

The executing agencies of these programs are; the Local Water Utilities Administration (LWUA) for areas with 20,000 population or more, the Ministry of Public Works and Highways (MPWH) for areas with less than 20,000 population.

According to the former program, service ratio of water supply in the country is planned to reach 93 % including wells, by 1990. While all households in rural areas are planned to have septic tanks, those in rural areas are to be equipped with water-sealed toilets. Especially during 1981 to 1990, which is a period of the said water decade being promoted by the United Nations, various projects and manpower development programs are planned under the assistance from international lending agencies and ODA from developed countries. However, considerable delays have been observed in these projects and their completions are not foreseeable in the near future.

In the field of sewerage system development, there are some cities which have public sewer systems; however, no public sewage treatment facilities exist except in the areas of the export processing zones, U.S. military camps, and so on. Sewerage facilities in Manila, for example, consist of a grit chamber and screening equipment and almost no wastewater treatment is undertaken. The sewage is then discharged into Manila Bay. In provincial areas, no detailed plans for construction of such treatment facilities are envisaged.

2-1-2 Present Status of Water Supply and Sewerage Systems

(1) Water Supply System

The water supply service ratio in the Philippines was 43 % in 1980. Classification by area and water supply level are presented in Table 2-1.

Table 2-1 Water Supply Service Ratio in the Philippines (1980)

Service Level	Metro-politan Manila	Provincial Cities (more than 20,000 pop.)	Rural Areas (less than 20,000 pop.)	Philippines
Level I	2 %	17 %	33 %	26 %
Level II	6 %	0 %	0 %	1 %
Level III	74 %	38 %	0 %	16 %
Not Served	18 %	45 %	67 %	57 %

The service levels presented in the above table are defined in the Philippines to indicate levels of water supply systems as follows:

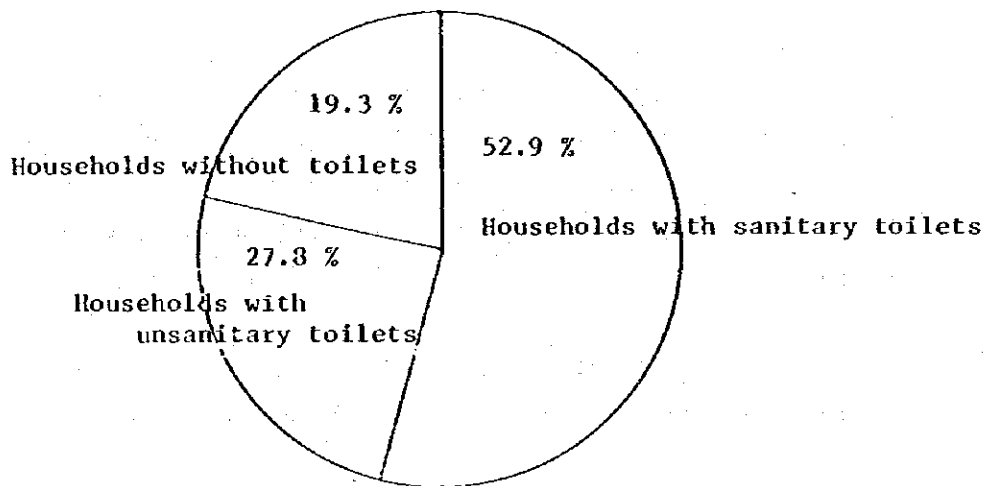
- Level I : Wells equipped with hand pumps
- Level II : Communal faucet system
- Level III : Individual house connection system

(2) Sanitary Conditions

In the Philippines, the implementation of sanitary facilities is not yet sufficient. The aforementioned program has therefore pointed out the necessity of further effort for the preventive medicine and health care for promoting social and economic development in the country.

There are various types of toilet facilities reflecting local economies and living customs in the Philippines. Among the country's 7 million households, those which use flush toilets with septic tanks account for 10.8 percent; flush toilets connected to public sewers, 1.4 percent; water-sealed toilets, 37.8 percent; sanitary privies, 2.9 percent; open pit privies, 6.4 percent; and antipolo type toilets, 16.6 percent. Provisions of these toilet facilities are shown in Figure 2-1.

Fig. 2-1 Toilet Facilities at Filipino Households



As shown in this figure, households with sanitary and unsanitary toilets account for 52.9 and 27.8 percent, respectively, leaving 19.3 percent of households without toilet facilities.

## 2-2 Socio-Economic Conditions of Baguio City

### 2-2-1 General Conditions of Socio-Economy

Baguio City, with a present population of some 130,000 has shown remarkable development, utilizing its features as a highland town over the last 80 years, having had a population of approximately 500 at the beginning of the 20th century.

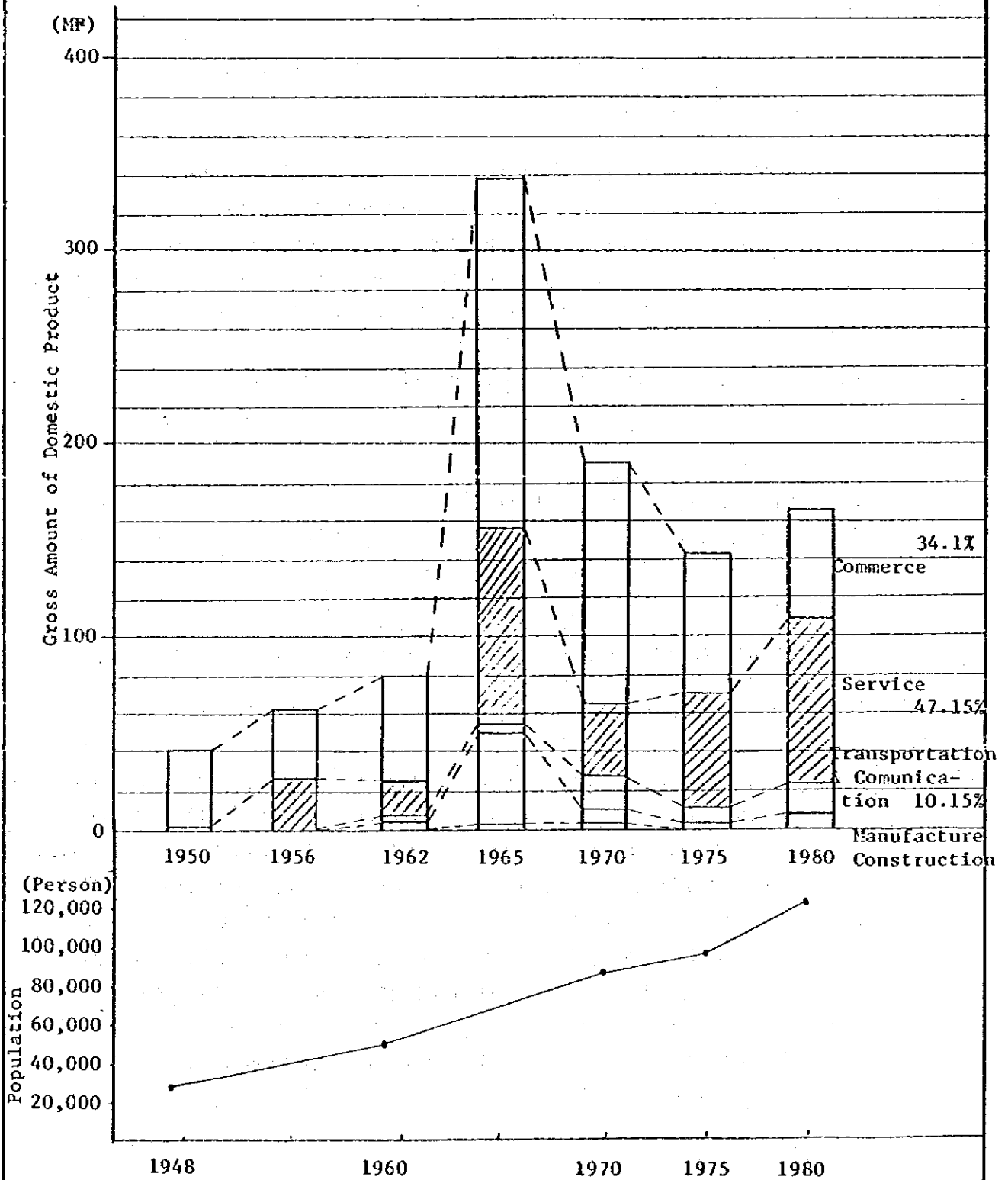
As a famous resort, the major industry of the city is, needless to say, services and commerce. Gross production of the city due to these two sectors registered more than 80 percent of the total. Figure 2-2 presents historical changes over the last 30 years in population and gross production by major industries in Baguio City. Up to 1970, commercial industries have been in the first place, while service industries have been developing rapidly in contrast to the decline in commerce. Shares of major industries in 1980 are: service, 47.15 %; commerce and industry, 34.1 %; transportation and communication, 10.15 %; manufacturing, 6.1 %; and 2.5 % for construction and others.

As stated above, Baguio City has shown rapid development in commercial fields in connection with population increases and service industries. Investment in public utilities, on the other hand, lags behind the city's development at present. Areas where investment is required include, among others, urban infrastructures, especially for a public sewerage system.

Baguio City is therefore implementing an Integrated Program for 1983 to 1987. Major objectives of this program are to:

- (1) implement roads and bridges;
- (2) improve public market and construct satellite markets around the city;
- (3) implement sanitary sewers and stormwater drainages;
- (4) construct a slaughterhouse;
- (5) strengthen housing and public services.

Fig. 2-2 Trends in the Domestic Product by Major Industry Contribution, Baguio



Source: Economic Base Study, City Planning Staff Baguio, 1973 & 1980

2-2-2 Industry and Education

(1) Population and Employment

Present and future labor force and employment in Baguio City is shown in Table 2-2.

The ratio of employed labor force to the total labor force at age of 15 years and over registered 40.11 percent in 1980 which is slightly higher than the 37 percent national average. The actual employment ratio is supposed to be much greater than the above as young people are going on to higher grades in schools.

Table 2-2 Labor Force Plan of Baguio City

I t e m	Base Year (1980)	Plan	
		1983	1985
Total Population	119,516	130,079	137,427
Labor Force	76,318	83,063	87,755
Employed	30,611	33,317	35,199
Unemployed	45,707	49,746	52,656

Source: City Project Development Staff, 1980

(2) Enterprises

The total number of enterprises in Baguio City was counted at 4,568 in 1980. Some 2,428 enterprises, or 53.15 percent of the total number, are wholesale and retail enterprises; followed by the 11.63 percent of commercial, storage and personal service enterprises; 6.00 percent for manufacturing; 1.43 percent for financial and real estate; and 0.62 percent for transportation and communication services. Power, gas and water supply services, which are influenced by the investment in public utilities, account for 0.08 percent. A classification by type of industry is shown in Table 2-3.



There are 64 hotels and lodgings for sightseers. Although their capacities (number of beds, etc.) are not given, the total number of single and family rooms is reported to be 2,313.

Table 2-3 Industries of Baguio City

Classification	No. of Enterprises	Percentage
Agriculture, forestry, hunting & fishing	2	0.03
Mining & Quarrying	5	0.08
Manufacturing	274	6.00
Electricity, gas & water supply	4	0.08
Construction	5	0.11
Wholesale & retail	2,428	53.15
Transport, storage & communication	28	0.62
Commerce & personal services	531	11.63
Finance & real estate	65	1.43
Not classified	1,227	26.86
<b>T O T A L</b>	<b>4,568</b>	<b>100.00</b>

(3) Education

Baguio City is famous not only as summer resort, but also as an "educational city". Consequently, there are various universities, colleges and other professional schools accepting numerous students from outside the city. The overall registered student population for 1981 to 1982 was 76,393, approximately 50 percent of which were university/college students, 27.5 percent were elementary schools and 22.5 percent were high schools, respectively.

Other statistics reveal that 26 percent of university/college students were members of families residing in the city, while the remaining 74 percent, or approximately 30,000 students, were from outside the city.

(4) Income and Expenditure

The overall personal income of the people of Baguio City was 144.5 million Pesos (approximately 2.5 billion Yen) in 1980 (Socio-Economic Profile, Baguio, 1980). This is equivalent to 1,325.46 Pesos per permanent resident or 7,820.20 Pesos per household (approximately 135,000 Yen).

On the other hand, overall expenditure amounted to 228.2 million Pesos (approximately 3.9 billion Yen); equivalent to 12,350 Pesos per household (approximately 215,000 Yen). A breakdown of average household expenditure is shown in Table 2-4.

Table 2-4 Average Household Expenditure in Baguio City (1980)

I t e m	Expenditures (Pesos)	Percentage
Food & beverages	6,400	51.8
Housing	1,840	14.9
Clothes	720	5.8
Education	590	4.8
Fuel, light & water	560	4.5
Gifts & contributions	490	4.0
Recreation	370	3.0
Household furnishing & equipment	250	2.0
Medical care	210	1.7
Other	920	7.5
<b>T O T A L</b>	<b>12,350</b>	<b>100.00</b>

Among others, 51.8 percent of total expenditure was for food and beverages, followed by 14.9 percent for housing, 5.8 percent for

clothes, and 4.8 percent for education. Fuel, light and water (fuel, electricity, water supply and public sewerage system for those in the served area) accounted for 4.5 percent.

A composition of public utility charges in the city is shown in Table 2-5.

Table 2-5 Public Utility Charges in Baguio City (monthly rate)

I t e m	Basic Charge	Excess Charge
Electricity (15 kwh)	16.05 Pesos	1.06 Pesos/kwh
Water (10 cu.m)	26.00 "	2.60 Pesos/cu.m
Sewerage	8.40 "	----

Electricity and water supply services are based on the basic and excess charges by use of current/water meters. The figures shown in Table 2-5 are therefore charges for consumption per meter, and not per family. According to the collected data and reports, these meters were installed for each 1.5 to 2.0 households. In addition, charges for public sewerage system are collected from approximately 7,000 households being connected to public sewer systems.

### 2-2-3 Drainage System and Wastewater Treatment

#### (1) Drainage System

A noteworthy feature of the land development in Baguio City was that, because of the terrain, the road network was constructed first and stormwater drainage was then planned to fit in with this. According to city records, public sewer pipe laying was begun in the 1940s and there is a total of 58 km.

The surface water in Baguio City flows through a dendritic drainage system which is divided into four major systems as follows:

Baguio-La Trinidad drainage system comprising the Balili River and Asintuba drainage system comprising the Asintuba River which both flow northwards out of Baguio; Agno drainage system and Bued drainage system comprising the Bued River which both flow southwards out of Baguio.

As to the sanitary drainage, two different types of wastewater drainage are presently employed corresponding to the natural topography in the area. One is the separate sewer system draining wastewater and stormwater individually. The other is the combined sewer system draining such waters together along the same waterway.

The sanitary drainage system in Baguio City, known as the public sewerage system, is almost entirely within the Baguio-La Trinidad drainage system among the existing four drainages. Wastewater being discharged at the commercial center of the city and at the densely populated area is removed through the said sanitary drainage system. However, due to absence of wastewater treatment and disposal facilities in this system, such wastewater has been directed into Balili River without treatment, causing major pollution in the river.

## (2) Wastewater and Nightsoil Treatment and Disposal

The existing conditions of sanitary treatment at all of the 26,810 households in Baguio City are shown in Table 2-6.

Table 2-6 Sanitary Treatment at Households in Baguio City (1983)

Treatment Method	No. of Households	Percentage
Public sewerage system	9,568	35.7
Flush toilets with septic tank	4,448	16.6
Water-sealed toilets	11,807	44.0
Open pit privies	987	3.7
T O T A L	26,810	100.0

As shown in the above, almost all the households have sanitary flush toilets. However, the water-sealed toilets, the most common means of excreta disposal, are designed as ground infiltration type open pit for water flushing (including flushing by means of water in a bucket). If maintenance is insufficient, it will not work sanitarilly.

### (3) Public Hygiene

A record of historical incidence of water-borne diseases and related mortality in Baguio City is presented along with comparative data on the national average in Table 2-7. As is clearly defined in this table, dysentery, gastro-enteritis and infectious hepatitis show remarkably high rates of occurrence.

The 1979 LWUA report<sup>1/</sup> on sewerage systems and sanitary facilities noted that the reason for the high incidences was: degradation of sewerage systems and sanitary facilities; lack of residents' understanding on the importance of public hygiene; and insufficiency of drinking water supply.

Table 2-7 Record of Incidence and Mortality of Water Borne Diseases in Baguio and the Philippines

	1973		1974		1975		1976		1977		Average	
	Baguio	R.P.	Baguio	R.P.	Baguio	R.P.	Baguio	R.P.	Baguio	R.P.	Baguio	R.P.
<u>Incidence</u>												
Cholera	-	7.3	-	5.1	-	-	-	-	-	-	-	-
Dysentery	270.40	59.5	284.65	56.8	241.28	47.5	151.76	-	210.75	-	271.76	-
Gastro- enteritis	4,857.00	689.0	3,998.50	592.0	3,404.94	476.2	2,327.00	-	2,013.00	-	3,300.00	-
Infectious hepatitis	137.77	16.8	123.12	14.4	153.67	10.4	128.27	-	143.10	-	137.18	-
Typhoid	10.28	12.1	48.26	9.1	240.49	7.3	102.07	-	39.89	-	88.20	-
Polio- myelitis	1.02	-	0.96	-	0.00	-	0.00	-	0.00	-	0.00	-
<u>Mortality</u>												
Cholera	-	-	-	-	-	-	-	-	-	-	-	-
Dysentery	1.02	0.90	3.93	0.86	2.99	1.94	0.90	-	0.86	-	1.94	-
Gastro- enteritis	51.40	45.00	21.66	36.60	17.96	27.80	10.84	-	10.40	-	22.45	-
Infectious hepatitis	0.00	1.40	0.98	1.50	2.99	1.50	0.00	-	0.86	-	0.97	-
Typhoid	0.00	1.50	0.98	1.40	0.99	1.40	0.00	-	0.86	-	0.56	-
Polio- myelitis	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-

## 2-3 Socio-Economic Conditions of La Trinidad

### (1) General Conditions of Socio-Economy

The city of La Trinidad is a garden city of some 30,000 for the Balili River, downstream from Baguio City, and is affected by the water pollution caused by discharge of untreated wastewater from the latter. La Trinidad is also the provincial capital of Benguet.

The total land area of this city is 56.6 sq.km, of which approximately 80 percent is devoted to agriculture, where 90 percent of the city's total population is employed. Major agricultural products include rice, vegetables, and raising of pigs and poultry. The area is famous for its tableland vegetables, supplying not only the surrounding municipalities, but also the metropolitan area.

### (2) Affects of Water Pollution

In La Trinidad, drinking water sources depend on springs and deep wells. A report prepared by La Trinidad Municipal Health Office pointed out that water quality at deep wells constructed near the Balili River is affected by polluted water from the river, and incidences of diarrhea, paratuberculosis, dysentery, amoebiasis and colitis, as well as typhoid fever, are observed.

---

1/ Pre-Feasibility Study Report of the Sewerage and Sanitation Systems, Baguio City; 1979

In agriculture, the major industry in La Trinidad, water from the Balili River is utilized for irrigation. An ill fame, that of the frequent occurrence of water-borne diseases being closely related to water pollution in the Balili River, triggered a serious decline in the economy of the area due to poor marketability of vegetables grown in this area.

Conditions on public hygiene are shown in Tables 2-8 to 2-10. When these data are compared with those previously presented for Baguio City and the Philippines, it can be seen that quite high incidences exist in La Trinidad, although they are less than those of Baguio City.



Table 2-8 Disease Intelligence of La Trinidad, 1982

<u>NOTIFIABLE DISEASES</u>	<u>No.</u>	<u>Rate/10,000 Population</u>
1. Bronchitis	276	93.79
2. Gastroenteritis and Colitis	93	31.60
3. Influenza	63	21.40
4. Tuberculosis	59	20.05
5. Pneumonia	44	14.95
6. Dysentery (all Forms)	37	12.57
7. Gonococcal Infection	8	2.71
8. Measles	5	1.69
9. Infections Hepatitis	2	0.67
10. Chiken Pox	1	0.33
11. Tetanus	1	0.33

Table 2-9 Leading Causes of Infant Morbidity, La Trinidad, 1982

<u>Cases</u>	<u>No.</u>	<u>Rate/10,000 Livebirth</u>
1. U R I	185	120.96
2. Bronchitis	30	57.60
3. Diarrhea	33	38.01
4. Dermatitis	15	17.28
5. Bronchopneumonia	13	14.97
6. Otitis Media	3	3.45
7. Scabies	3	3.45
8. Malnutrition	3	3.45

Table 2-10 Leading Causes of Infant Mortality, La Trinidad, 1982

<u>Cases</u>	<u>No.</u>	<u>Rate/10,000 Livebirth</u>
1. Bronchopneumonia	6	69.12
2. Placental Insufficiency	4	46.08
3. Respiratory Distress	2	23.04
4. Pneumonia	2	23.04
5. Sepsis Neonaturum	1	11.52
6. Congenital Alvelectasis	1	11.52
7. Diarrhea	1	11.52