Name	Use
Topo. Survey Equipment	Topographic survey required for rehabilitation and extension of a sewer system.
DO Meter	In-situ analysis of Dissolved Oxygen (DO)
BOD Bottle	BOD analysis
Automatic Buret	Titration of reagents used in various water quality analysis
Computer	Calculation and billing of sewage fee

4.3.5 Operation and Maintenance

The sewerage system of the City consists of the sewer system and the sewage treatment plant. The sewer system further consist of sewers, manholes, house inlets, house connections, etc. As these facilities are closely related to daily life, appropriate operation and maintenance of the system shall be strictly enforced.

There is a need to maintain the system properly to secure sufficient flow capacity, to prevent damages caused by other works on the facilities, to prevent accidents originating from damaged facilities, and to prolong the actual life of sewers.

Maintenance work consists of the inspection, cleaning, repair and rehabilitation, protection and safeguarding, measures for and restoration work due to disasters and accidents, monitoring of pretreatment facilities and house connections, and etc.

a) Inspection

Regular inspection is conducted to check flow condition and deposits in sewers to ensure the normal functioning of the facilities. Damages on the system and its general condition shall also be looked into to prevent accidents. These inspections shall have to be conducted regularly and findings recorded.

Items to be inspected at each facility are as follows:

Sewer

- Condition of flow and deposit
- Existence of ground subsidence
- Existence of damage
- Condition of groundwater intrusion
- Existence of harmful sewage inflow and poisonous gas

Manhole

- Condition of manhole cover
- Inside condition

Inlet and House Connection

- Condition of inlet and existence of deposit
- Existence of blockade and damage in house connection

It is recommended that inspections be conducted at least once a year. However, frequency shall be based on the condition of the area and facilities.

Intake Facility in the River

- Piling condition of earth and sand at weir
- Piling condition of garbage at weir
- Condition of damage to weir
- Piling condition of garbage at screen
- Condition of opening and closing of intake gate

As some people living along the river/creeks have a custom to dump garbage into the river, it is necessary to check the piling condition of garbage around the intake facility everyday in dry season and once a week in rainy season. The opening degree of the intake gate shall be determined

taking account of the sewage flow at the treatment plant and the gate shall be closed during the heavy or long rain.

b) Cleaning

As sewer pipes are sometimes blocked by settled grit and the like, cleaning shall be conducted frequently. It is advisable to conduct cleaning based on the yearly work plan which reflects the findings in inspection. The cleaning plan including details of work and work period shall be made considering the traffic condition, and the condition of deposit. It is recommended that cleaning be conducted at least once in two years.

When garbage is piled around the intake facility, it may cause damage to the screen and inflow of garbage into a sewer, therefore the removal of garbage should be done everyday especially around the screen in dry season. As the weir is buried with earth and sand at the end of rainy season, those should be removed at the beginning of dry season so as to keep the function of the intake facility.

c) Repair and Rehabilitation

Repair and rehabilitation shall be executed immediately after finding the cause of damage to the facility or should a decline in efficiency be found at the time of inspection and cleaning. Before implementation, traffic condition, road condition, buried structures, sewage flow, sewer condition in upstream and downstream, and other conditions shall be examined, and a work plan established based on it.

d) Protection and Safeguarding

There are many cases wherein sewerage facilities are damaged by nearby excavation work, and it should not be disregarded accordingly. Precautionary measures shall have to be undertaken to prevent accidents and to safeguard the facilities.

When construction work other than sewage works is executed near the sewerage facility, maintenance work of the facility is sometimes hindered in various ways causing damage to facility with the lost of ground or

construction machinery, and blocking of the sewer with the inflow of construction materials such as cement mortar due to carelessness.

Sufficient attention must therefore be given to nearby excavation work more specifically, driving of piles and sheet-piles. These can sometimes cause accidents such as a road cave-ins. It is therefore necessary that before any work of such origin is to be done, permission from the person in-charge of the system shall have to be given. Precautionary measures shall be adopted to prevent future damage.

The papers to be presented for approval shall include the project name, work period, and work location, relation to the sewerage facility (distance, depth, etc.) and any other information relevant to the request.

Some precautionary measures to be adopted include conducting a pre-meeting on safeguard work, monitoring patrol over the area, establishing disaster prevention system and confirmation of submitted documents.

e) Restoration Work Due to Disasters and Accidents

As sewer pipes do not immediately show any signs of damage, finding it is apt to be delayed. In case pinpointing is delayed, damage is neglected, or repair is poorly done, the earth and sand surrounding the sewer pipe flows into it, and may cause big accidents such as road cave-ins or damage to neighboring buried structures.

f) Monitoring of Pretreatment Facilities

The sewerage system conveys and treats not only the domestic sewage but industrial wastewater as well. However, if the amount of industrial wastewater becomes too much or its quality becomes worse, it may cause damage to the system and lessen its efficiency, lessen the treatment efficiency of the sewage treatment plant and make it difficult to maintain the quality of the treated water within the standard.

It is recommended that the sewerage system administration require those who are discharging industrial wastewater to install the necessary pretreatment facilities to maintain the quality of wastewater to be dis-

charged to the sewerage system. The details of this facility shall be examined and a modification of the plan is to be done if necessary. To properly operate the facility, regular water quality analysis shall be required, reports prepared, site inspection conducted, investigation on discharged sewage done and operation and maintenance training undertaken.

g) House Connection

The sewerage system consists of the sewer system and the sewage treatment plant. However, the sewerage system is not completely achieved without the house connections to convey the domestic sewage into sewers without delay.

Thus, sufficient considerations on the planning, construction and maintenance of house connection (including flush toilets) shall be given same as that of the sewerage system.

4.3.6 Financial Considerations

a) Operation and Maintenance Cost

The substructure and number of personnel of sewerage division as shown in Figure 4-3-2 are assumed as indicated in Figure 4-3-5.

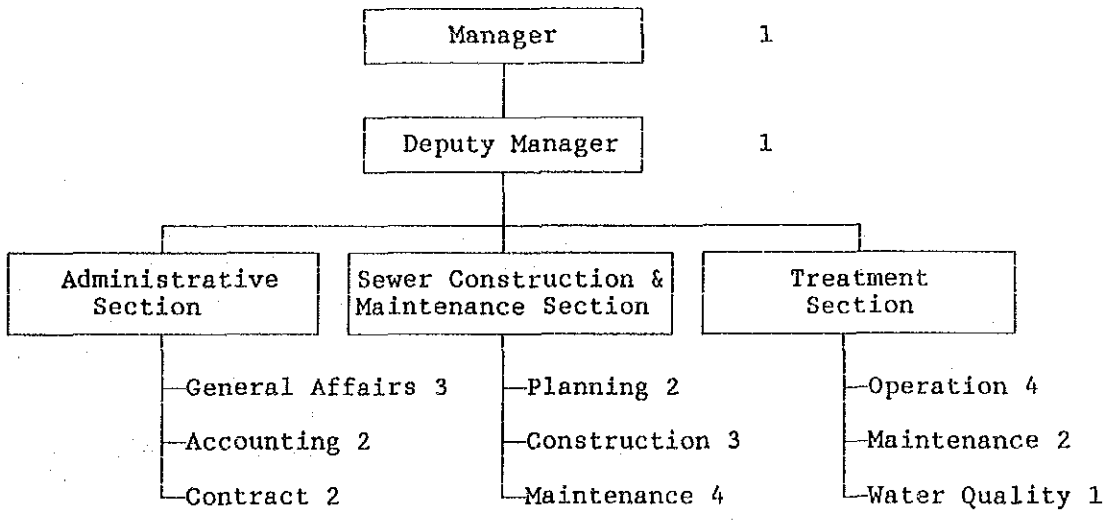


Figure 4-3-5 Organization and Number of Personnel for Management of Sewerage System

1) Personnel Expenses

Average salary is assumed to be ₱3,000/month.

Personnel Expenses
= 26 x ₱3,000/month x 12 months/year = ₱936,000/year

2) Chemical Cost

Disinfectant to be used is chlorine, the amount of which is computed as follows:

Dosing rate : 3 mg/l
Cost : ₱27/kg
Chemicals Cost = 8,400 cu.m/day x 3 mg/l x ₱27/kg x 365 days
= ₱248,346/year

3) Power Cost

Power Cost is estimated at ₱1,977,897 per year based on Table 4-3-2.

4) Repair Cost

Repair cost is estimated at ₱200,000/year

5) Office Running Cost

Office running cost is estimated at ₱60,000/year

6) Commission Charge to BWD

11% of total amount of Item a) to e) is ₱376,447/year
Commission Charge is assumed to be 10% of Collected Sewerage Fee.

As a result, total operation and maintenance cost per annum will be ₱3,798,690 or ₱316,558/month.

Table 4-3-2 Estimation of Power Cost

Facility	Machinery	Rated	Output	No.	Actual Amount	Power
Grit Chamber	Coarse Screen	1.5	1	1.5	1.5x24x0.7	25.2
	Discharge Pump	2.2	1	2.2	2.2x24x0.3	15.8
Primary Sedimentation Tank	Sludge Collector	1.5	1	1,5	1,5x24x0.8	28.8
	Sludge Pump	4.5	2(1)	4.5	4.5x24x0.3	32.4
Oxidation Ditch	Aerator	18.5	8	148	8.5x6.5x24	1,326.0
Final Sedimentation Tank	Sludge Collector	0.75	2	1.5	1,5x24x0.8	28.8
	No.1 Sludge Return Pump	7.5	2	15	15x24x0.75	270.0
	NO.2 Sludge Return Pump	3.7	4	14.8	14.8x24x0.75	266.4
	Excess Sludge Pump	2.2	2	4.4	4.4x24x0.3	31.7
Sludge Thickener	Sludge Collector	0.7	2	1.4	1.4x24x0.3	10.1
	Drain Valve	0.2	2	0.4	0.4x24x0.3	2.9
Sludge Storage Tank	Agitator	2.2	1	2.2	2.2x24x0.8	42.2
	Drain Pump	2.2	2(1)	2.2	2.2x24x0.3	15.8
Chlorine Contact Chamber	Pump	5.5	1	5.5	5.5x24x0.3	39.6
Drainage	Pump	1.5	2(1)	1.5	1.5x24x0.3	10.8
		5.5	1(1)	5.5	5.5x24x0.3	39.6
Sub-total				212.1		2,186.1
Lighting		15.6		15.6	15.6x24x0.3	112.3
Total				227.7		2,298.4

Therefore: Demand charge = 227.7 kw x ₱25.2/kw/month x 12 months/year
= ₱68,856/year

Energy Charge = 2,298 kwh/day x ₱2.276/kwh x 365 days/year
= ₱1,909,041/year

Total = ₱1,977,897/year

b) Sewerage Fee Determination

Revenues of the BCG amount to 62 to 65 million pesos per annum,

(Table 4-3-3) and the maintenance cost of engineering services was estimated at ₱ 800,000. Consequently, it will be difficult to maintain the sewerage system without collection of sewerage fee.

On the assumption that the number of connections is 10,000, the monthly sewerage fee per connection will be 31.6 pesos and the sewerage fee per cu.m of sewage is ₱1.24.

₱316,558/month/10,000 connections = ₱31.6/month/connection

₱3,798,690/year/(8,400 cu.m/day x 365 days) = ₱1.24/cu.m

For reference, the average monthly water charge per connection was ₱147 and water charge per cu.m of water was ₱4.67 in 1988.

₱31,092,788.57/year/(17,589 connections x 12 months/year)
= ₱147/cu.m

₱31,092,788.57/year/6,659,836 cu.m/year = ₱4.67/cu.m

Average family income of the city was ₱70,719/year or ₱5,893/month, and the ratio of the sewerage fee to household expenses will be 0.54% (refer to Table 3-1-10).

The BCG had four (4) hydroelectric plants in Assin and Kennon, the management and operation of which was entrusted and turned over to the BWD on November 22, 1975 and on June 21, 1976. In this connection, the BCG concluded the agreement with the BWD in which the BWD was responsible for power supply to the BCG. By the provisions that the BWD shall supply 150,000 kwh per month to the City for the year 1986 thereafter during lifetime of this Agreement in Article 7, and that this Agreement shall have a term of 25 years commencing from the execution of the same and shall be subject to renewal for another 25 years by mutual agreement of the parties in Article 15, the BCG has a right to receive power supply from the BWD by August 31, 2006 and by August 31, 2031 by mutual agreement of both parties.

The power consumption at the sewage treatment plant is expected at approximately 71,000 kwh per month under the condition of full operation. If the power supplied by the BWD is predominantly allocated to sewerage

division in the BCG, the expenditure for sewage works will be cut to the half and the burden of the residents will be incidentally alleviated thereby.

Table 4-3-3 Distribution of Revenues and Expenditures of BCG

Item	1987 Amount	1987 Percent	1988 Amount	1988 Percent
Revenue				
Tax Revenue	39,453,524.88	61.6	35,789,985.91	57.3
Operating & Miscellaneous Revenue	13,452,006.76	21.6	16,615,515.04	26.6
Capital Revenue	198,140.36	0.3	157,923.95	0.2
Grants	863,265.00	1.3	2,171,394.53	3.5
Surplus Reg.	10,131,820.08	15.8	7,772,283.35	12.4
Total	64,098,757.08	100.0	62,507,102.78	100.0
Expenditures				
General Public Services			25,203,166.14	48.7
Education, Culture and Sports			4,004,465.54	7.7
Health, Nutrition and Population Control			11,563,779.31	22.4
Economic Services			--	--
Engineering Services (General Administration)			2,021,569.80	4.2
Engineering Services (Construction)			3,356,707.50	6.5
Engineering Services (Maintenance)			810,266.48	1.6
Other Social Services			4,269,385.86	8.3
Other Purposes			300,000,00	0.6
Total			51,709,340.63	100.0

Municipal Ordinance No. 636, implemented in August 13, 1975, fixed sewerage fees by type and by scale.

For private residences and apartments:

a. Occupied by 1 or 2 families	₱2.50
b. Occupied by 3 families	₱3.75
c. Occupied by 4 families	₱5.00
d. Occupied by 5 families	₱6.25
e. Occupied by 6 families	₱7.50
f. Occupied by more than 6 families, per family in excess of 6 families	₱1.00

For hotels and condominiums:

a. With 25 rooms or less	₱20.00
b. With 26 to 50 rooms	₱25.00
c. With 51 to 75 rooms	₱30.00
d. With 76 to 100 rooms	₱40.00

Considering the above mentioned unit cost, it will be hard to maintain the sewage works in the future using the above rating system.

Therefore, it is necessary to transfer the sewerage fee rate system to a meter-rate system.

The BCG has reviewed to revise the sewage tariff and two alternatives were in consideration therein as shown below.

(1) To increase the sewage fee tree times (flat rate system)
(2) to define the sewage fee to be 19% of water charge (meter-rate-system)

The conclusion was that Alternative 1 brought the deficit, while Alternative 2 the profit to the BCG. As the water rate is higher for commercial use than for domestic use, residents shares 87% in the number of connections and 62% in water consumption but 52% in sewage fee to be collected.

The financial internal rates of return (FIRR) are 3.07% before depreciation and 3.01% after depreciation, however sewage charges are ₱ 1.9/cu.m in the former and ₱6.4/cu.m in the latter in 2010 (See Tables 8 and 9 in Appendix 6) as shown below. The depreciation periods are set at 30 to 50 years per facility.

Case	Sewage Charge in 1993	Rate of Increase Per annum	Sewage Charge in 2010	FIRR
Before Depreciation	₱1.0/cu.m	3.0%	₱1.9/cu.m	3.07%
After Depreciation	₱4.0/cu.m	3.0%	₱6.4/cu.m	3.01%

CHAPTER 5
BASIC DESIGN

CHAPTER 5 BASIC DESIGN CONSIDERATIONS

5.1 Design Policy

a) Natural Condition

The project area has a much undulation and declined to the BSTP in general. Thus, it is possible to convey the sewage to the BSTP by gravity. However, roads does not always exist along creeks, consequently in case the sewer is installed under the road, the depth of the sewer will be deep so that the installation work become difficult. In that case, the solution of problem can be obtained by the installation of sewer in rivers/creeks. The sewage discharged from the areas located on the place lower than roads is difficult to be collected by the sewer installed under roads so that the sewer will also be installed in rivers/creeks for these areas.

b) Socio-Economic Condition

After the completion of this Project, the BSTP is expected to be operated with its full capacity, and also the cost of operation and maintenance will be expensive accordingly. Thus, the sewer system is planned to be only in gravity flow as stated above, and no pumping facility will be installed. If a pumping station is constructed, various works become necessary such as removal of screenings, inspection on mechanical and electrical equipment, measures against power cut and so on.

c) Local Construction Condition

The most important construction material in the Project is sewer pipes. In the existing sewer system, the reinforced concrete pipes are used for underground sections, and the cast iron pipes and steel pipes are used for exposed or bridged sections. At the time of the selection of pipe materials, use of local made products will be considered with high priority.

However if its quality is poor, use of the pipe materials of good durability will be considered instead. The special equipment and con-

struction materials that is not available in the Philippines are considered to be imported from Japan.

d) Construction Method and Period

Ordinary method in the Philippines is applied to the construction of work of the facility.

Consultation with the administration of rivers will be taken for the installation of structures in rivers/creeks to lessen the influence to rivers to a minimum. Sufficient safety measures against flooding will be also taken.

As to construction period, 2-phased construction is expected to be implemented because of slow work progress during rainy season due to the world famous heavy rain in Baguio and traffic congestion caused by the construction work.

5.2 Design Fundamentals

a) Design Sewage Flow

Design sewage flow adopted shall be the maximum hourly sewage flow and sewer pipe diameters shall have a 100% additional capacity as calculated for the system.

b) Sewage Flow Calculation

As shown below, the flowing capacity of each sewer to receive the design sewage flow is calculated by multiplying the sewer's sectional area by average velocity in a sewer which is given by Manning formula. In case of a circular pipe, the flowing capacity is decided by the sewer size and slope. Velocity and slope of a sewer shall follow the rule as stated in c). The results of calculation is shown in Appendix 5.

$$Q = A \times V$$

$$V = (1/n) \times R^{2/3} \times I^{1/2}$$

Where:

			Circular Pipe
Q	=	flow quantity (cu.m/sec)	
A	=	flow area (sq.m)	= $\pi D^2/4$
V	=	flow velocity (m/sec)	
n	=	coefficient of roughness	= 0.013
R	=	hydraulic radius (m)	= D/4
I	=	inclination of energy grade line	
D	=	diameter (m)	

c) Sewage Flow Velocity

As a general rule, velocity of sewage flow shall be 0.6 m/sec minimum to 3.0 m/sec maximum. However, some cases may require a deviation from this rule such as for steep slope sections to avoid an increase in construction cost as a result of an equal increase in the number of manholes to be constructed.

d) Pipe Materials

Reinforced concrete pipes with socket joints shall be used for buried sections, polyvinyl chloride pipes encased with concrete for exposed sections and fiber-reinforced plastic pipes for elevated sections.

e) Pipe Installation

A minimum earth cover of 1.2 m depth shall be adopted and earth pressure and loads should exceed the maximum bearing capacity of the sewer pipe, concrete or reinforced concrete encasement will be provided to protect the pipe from external pressure. Pipes shall have sandbedding in principle. Pipe connections shall be as follows:

- Water surface connection or pipe top connection shall be adopted for changes in pipe diameter at junctions of two pipes.

- In cases of steep slopes, sewer pipes shall be installed parallel to the ground slope regardless of changes in pipe diameter.

- The angle between centers of two pipes at a junction shall not

exceed 60°, and the radius of the curved sewer junction shall be more than 5 times its inner diameter.

f) Manholes

Manholes shall be installed at the upper ends, at changes in alignment, grade, diameter or invert level, at the junctions of sewers and at places necessary for maintenance. Manholes may be installed even on straight sections at maximum intervals of 50 m for 300 mm diameters or less and at 75 m intervals for 600 mm diameters or less.

Manhole covers shall be of reinforced concrete. The manhole riser and manhole cone (manhole wall) shall be made of pre-cast concrete sections and the manhole base of cast-in-place concrete, with invert provided for a smooth connection of pipes. Table 5-2-1 lists the types of manhole to be used in the Project.

Table 5-2-1 Type of Manhole

Type	Structure	Use
No. 1	Circular, Inner dia. 90cm	Upper end, Middle point of sewers less than 600 mm, Junction point of sewers less than 450 mm
No. 2	Circular, Inner dia. 120cm	Middle point of sewers less than 900 mm, Junction point of sewers less than 600 mm

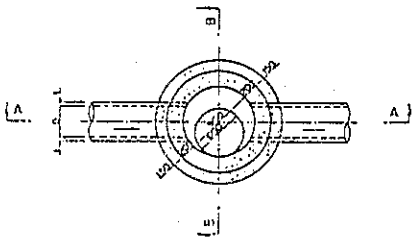
5.3 Basic Design

Based on the above design fundamentals, the planned sewers to be constructed, standard manhole and sewer installation plan in creeks are shown in Figures 4-3-3, 5-3-1 and 5-3-2, respectively.

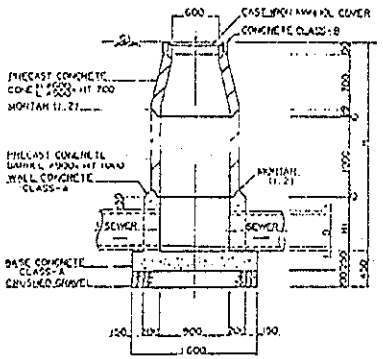
TYPE-1 MANHOLE

SCALE 1:30

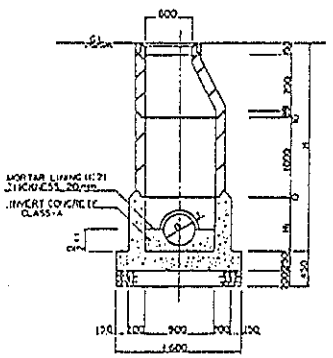
PLAN



A-A SECTION



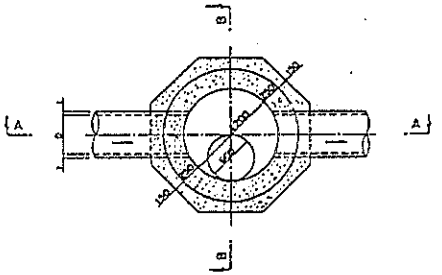
B-B SECTION



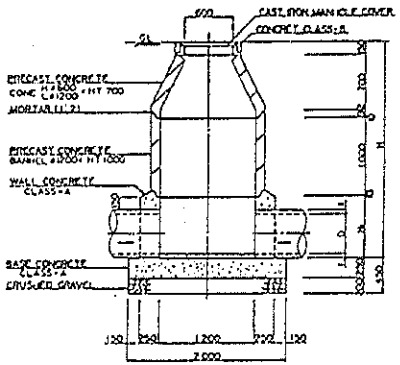
TYPE-2 MANHOLE

SCALE 1:30

PLAN



A-A SECTION



B-B SECTION

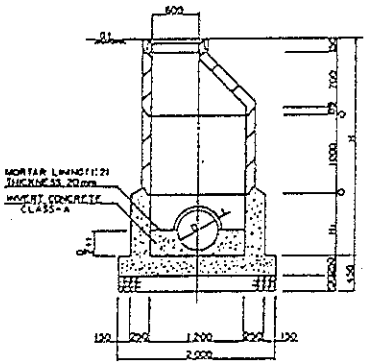
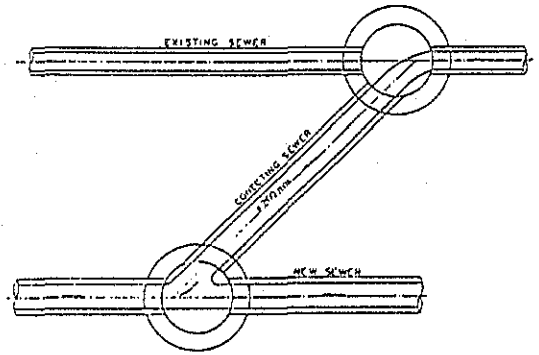
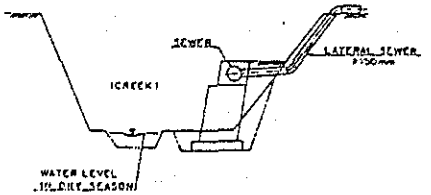


Figure 5-2-1 Plan of Manholes

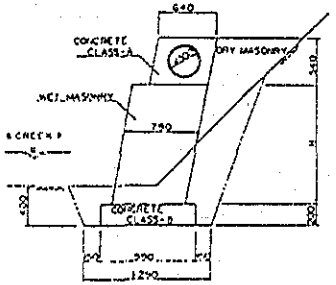
TYPICAL METHOD OF CONECTION
BETWEEN EXISTING SEWER AND NEW SEWER
SCALE 1:20



TYPICAL METHOD OF LATERAL SEWER
CONECTION IN CREEK
SCALE 1:N



SEWER LAYING IN CREEK
SCALE 1:25



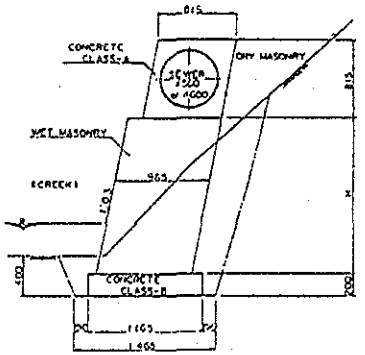


Figure 5-2-2 Sewer Installation Plan in Creeks

5.4 Project Implementation Plan

5.4.1 Construction Considerations

Construction work for drainage pipes have been done in the Philippines for years. The work itself is the same for sewerage as that for drainage except that the former shall carry sewage and the latter, stormwater. For the Project, most of the sewers are to be installed under roads and the rest on creeks.

a) Road Portion

- Construction work on the roads are apt to lead to traffic congestion due to the narrow widths of the roads. The contractor must discuss the construction period and method with the agencies concerned, decide whether traffic will be stopped half or fully, and detours done, and place sign boards at entrances to the particular road for the convenience of drivers and pedestrians.

- April and December being the peak season of tourists, construction works must not be undertaken in the Business Section and Burnham Park during those months.

- Since M. Roxas Road makes a steep ascent (approximately 18m) to Aurora Hill near Brookside, M. Roxas Main escapes into Pacdal Creek and M. Roxas Creek and then returns to M. Roxas Road at the place where elevation has gone down. In this section where M. Roxas Main returns to M. Roxas Road, the sewer will run at 10.3 m up from the riverbed, since the elevations of creek have also gone down.

- The roads run northwards in the City to join La Trinidad Road opposite the sewage treatment plant. Since new sewers shall run on these road, it is recommended not to construct M. Roxas Main, Magsaysay Main and Ferguson Main at the same time.

- To maintain the detour, construction work must not be done on parallel roads, for example, Harrison Road and Session Road, or Abanao and Kayan at the same time and Kayan Road specifically must be done nighttime.

- Since construction works will bring about much inconvenience to residents along the roads, the understanding and cooperation of residents must be obtained through the City Mayor and Barangay Captains.

- The BCG agreed to restore the demolished pavement for pipe installation to the original form within the excavation area. The contractor is required to do the work in such a manner not to expand the excavation area and not to damage a pavement unconcerned with pipe installation.

b) Creek Portion

- Baguio City is famous for heavy rains and the river immediately rises during these times. Therefore, it is recommended that sewers in the creeks be constructed in the dry season. Beforehand, the contractor must collect information on the river condition during past heavy rains and take precautionary measures.

- As the creeks are mostly natural formations, explosion work might have to be resorted to remove the big boulders and to excavate the area. Care should be taken to ensure that no harm will come to the nearby residents and workers.

- Houses are located on both sides of the creeks. There is a need to construct temporary roads for transporting materials and equipment. In view thereof the approval and coordination of the residents must be acquired.

5.4.2 Construction Method and Period

The construction of the sewers will be by the open-cut method, a special method to be introduced locally. The works shall be undertaken separately for road and creek portions. The river portion shall be constructed in the dry season, while the road portion may be done in the wet season considering climatological conditions in the area. However, work with deep excavation will also be done in the dry season on the road.

Regarding the demolition of a pavement for pipe installation, the pavement shall be restored to the original form within the excavation area. The concrete pavement will be restored so as to keep the integral construction as a concrete slab by placing the reinforcing bar at the concrete joints.

The Construction work shall be divided into two stages as it is expected that work progress will be delayed by heavy rains and traffic congestion. The first stage will be contracted by the end of March 1992 and the whole work will be completed by the end of February 1994 with all construction works undertaken by a Japanese contractor.

5.4.3 Construction Supervision

Taking into account the nature of works, one Japanese civil engineer will be assigned at the site to supervise construction to be assisted by two local civil engineers employed in the Philippines.

Consultations with government officials shall be observed to eliminate any possible conflicts that may arise upon the construction of works.

The supervisory engineer shall issue construction orders and adopt measures necessary to avoid traffic congestion and to provide safety at the construction site.

The new sewers will run parallel to existing sewers which may have house connections on one or both sides. In such cases, the supervisory engineer will decide whether such house connections shall be reconnected

to new sewers or the profile of new sewers shall be changed.

Since Baguio is most frequently visited by typhoons, the engineer shall determine beforehand safety measures to be undertaken should such case happen.

5.4.4 Procurement Plan

The materials and equipment to be utilized for the Project will be procured in the Philippines as much as possible. However, should problems arise in availability, quality, quantity and delivery time of materials, such may be imported from Japan. The materials and equipment to be imported from Japan shall be shipped from Yokohama to Manila and then transported to Baguio by trucks.

Local materials to be used include sand, gravel, crusher run, cement, steel bars, structural steel, concrete pipes, reinforced concrete pipes, lumber, plywood, concrete block, dynamite, manhole cover, manhole cone block, manhole rising block, gasoline, diesel oil, fuel, etc. Foreign materials include polyvinyl chloride pipes and fiber-reinforced plastic pipes and manholes.

Major construction equipment do not pose any problem as they are readily available by lease in the Philippines.

5.4.5 Implementation Schedule

The Project shall include the preparation of the detailed design, prequalification of bidders, bidding for the construction works, procurement of materials and equipment and finally, construction.

Japanese Consultants shall sign a contract for detailed design and construction supervision with the Philippine Government and, after approval of the contract by the Japanese Government, will start the detailed design and preparation of drawings, specifications and tender documents.

Bidders shall be prequalified and then invited to bid on the

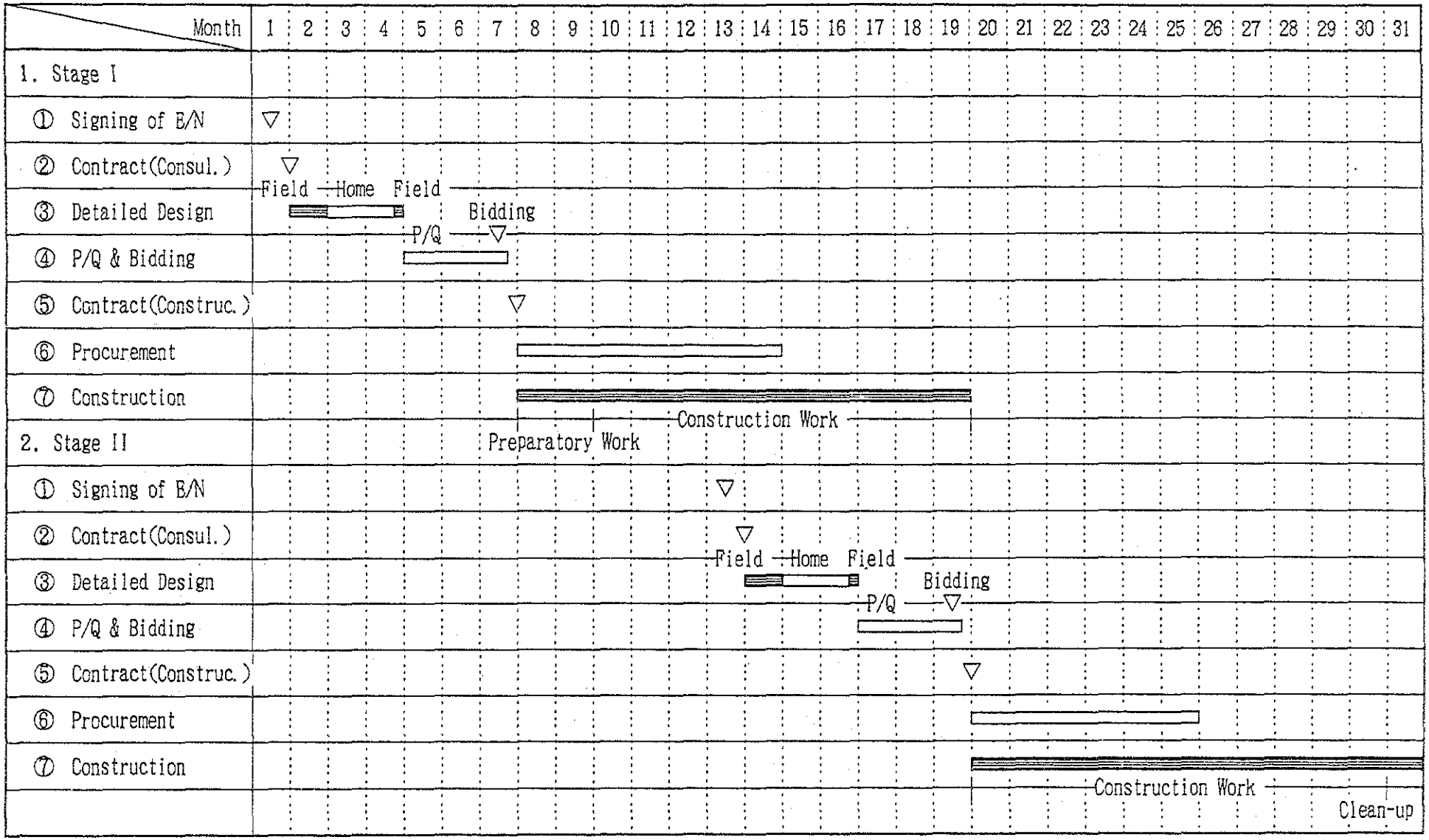
Project. The successful bidder after evaluation of bids has been done will make a contract with the Philippine Government for construction and thereafter commence work after approval of the contract by the Japanese Government.

Detailed design period is three months and construction is twelve months in each stage. The construction period includes that for manufacturing and transportation of materials and equipment. The whole implementation schedule is shown in Figure 5-4-1.

5.4.6 Share of Cost

The total project cost comprise of the consulting fees for detailed design and construction supervision, direct and indirect cost for construction and equipment procurement cost. The cost necessary for the construction of sewers as previously mentioned shall be borne by the GOJ including consulting fees and equipment procurement cost. All else shall be borne by the GOP including services of local counterparts, which is estimated at 0.4 million pesos, and land expropriation, if any, as well as operation and management cost for sewerage facilities after completion of the Project, which is estimated at 3.8 million pesos per annum.

Figure 5-4-1 Implementation Plan



CHAPTER 6
CONCLUSION AND RECOMMENDATIONS

CHAPTER 6 CONCLUSION AND RECOMMENDATION

The objective of this study is to clarify and confirm the background and scope of works of the proposed Project and to determine its appropriateness for implementation through the Grant-Aid Program.

After a detailed evaluation of the existing sewerage system of Baguio City, the Study Team hereby recommends the implementation of the Project in view of the following:

- Operation of the Baguio Sewage Treatment Plant shall be maximized making full use of its original designed capacity.

- Water pollution of the Balili River will be greatly alleviated since 8,600 cu.m/day of the 12,000 cu.m/day sewage generated in the Balili River basin will be collected by the rehabilitated sewer system and about 64% BOD loading caused by sewage will be reduced by treatment.

- La Trinidad Area downstream of Baguio City can again utilize the Balili River for irrigation after water quality has been greatly improved.

- Offensive odor and appearance of the river environment caused by sewage leaking from existing sewers shall be eliminated.

- Standard of living of the residents particularly those living near broken sewers shall be greatly improved.

- Baguio City shall become the first urban center with a complete municipal sewerage system which other future system could be patterned after.

- Knowledge of the proper operation and maintenance of sewerage systems could be derived from training to be provided for by the Project.

To maximize the benefits of the Project, the Study Team further recommends that the following be undertaken:

- It is desirable that JICA will dispatch a short-term expert to Baguio to advise and instruct the proposed staff on the establishment of a new management system, operation and maintenance of sewage treatment plant and rehabilitation of existing sewer not included in the Project.

- The BCG shall establish a complete garbage collection system as early as possible since garbage dumping is a main source of river pollution which reduces the benefits to be derived from the Project.

APPENDICES

APPENDIX 1 MEMBER OF STUDY TEAM

1. Basic Design

Name	Assignment	Position
Mr. Kenichi Osako	Team Leader	Manager, Facility Planning Div., Planning Dept., Sewerage Bureau, Tokyo Metropolitan Government
Mr. Takahiro Ikari	Coordinator	Grant Aid Division, Bureau of Economic Cooperation, Ministry of Foreign Affairs
Mr. Ikuo Miwa	Planning of Sewer System	Nippon Jogesuido Sekkei Co., Ltd. (NJS Consultants)
Mr. Tetsuo Yanagida	Earthquake Damage Analyst	-ditto-

2. Discussion on Draft Final Report

Name	Assignment	Position
Mr. Kenichi Osako	Team Leader	-mentioned above-
Mr. Ikuo Miwa	Planning of Sewer System	-mentioned above-
Mr. Tetsuo Yanagida	Earthquake Damage Analyst	-mentioned above-

APPENDIX 2 SCHEDULE OF STUDY TEAM

1. Field Survey (July 29 to August 9, 1991)

Date	Activities
July 29 Mon.	Arrival in Manila
	Courtesy call to JICA and EOJ
30 Tue.	Courtesy call to LWUA
	Visit to Philippine Tiles Corporation
31 Wed.	Move to Baguio
	Survey in Baguio City
August 1 Thu.	Discussion with the BWD and BCG
	Survey on Earthquake Damage
2 Fri.	Preparation of Minutes Draft at the BWD
	Explanation of Minutes Draft to the BCG
	Survey on Sewerage Facilities
3 Sat.	Survey on Sewerage Facilities
4 Sun.	Data Arrangement
5 Mon.	Visit to Sto. Thomas Reservoir
	Discussion with the BCG
	Survey on Sewerage Facilities
	Signing of Minutes (Team and BWD)
6 Tue.	Data Collection at the City Hall
	Survey on Sewerage Facilities
	Signing of Mimutes (BCG)
7 Wed.	Move to Manila
	Report to EOJ
8 Thu.	Signing of Minutes (LWUA)
	Report to JICA
9 Fri.	Arrival in Tokyo

2. Discussion on Draft Final Report (October 4 to 11, 1991)

Date	Activities
October 4 Fri.	Arrival in Manila
	Courtesy Call to LWUA, JICA and EOJ
5 Sat.	Move to Baguio
6 Sun.	Survey in Baguio City
7 Mon.	Explanation of Draft Final Report to the BCG and BWD
	Preparation of Minutes Draft
8 Tue.	Signing of Minutes (Team, BCG and BWD)
9 Wed.	Move to Manila
10 Thu.	Signing of Minutes (LWUA)
	Report to JICA and EOJ
11 Fri.	Arrival in Tokyo

APPENDIX 3 LOCAL AGENCIES AND OFFICIALS MET WITH

Philippine Side

Local Water Utilities Administration (LWUA)

Mr. Armando C. Lizaso	Administrator
Mr. Billy C. Berisario Jr.	Manager
Mr. Emmanuel B. Malicdem	Manager, System Rehabilitation and Interim Improvement Division
Mr. Alfredo B. Espino	Project Manager

Baguio City Government (BCG)

Mr. Jaime R. Bugnosen	City Mayor
Mr. Antonio Tabora	Vice City Mayor
Mr. Ricardo L. Panlilio	Councilar
Mr. Lito M. Pagnilinan	Councilar
Mr. Leonardo T. dela Cruz	City Administrator
Mr. Teodoro G. Barrozo	City Engineer
Mr. Leo C. Bernardez Jr.	Civil Engineer
Ms. Catherine A. Buccat	Senior Safety Engineer

Baguio Water District (BWD)

Atty. Moises P. Cating	Chairman, Board of Directors
Mr. Juan R. Zarate, Jr.	Director
Mr. Stephan M. Hamada	Director
Ms. Teresita P. De Guzman	General Manager
Mr. Albert Buen P. Arenas	Manager, Engineering Division

Japanese Side

Embassy of Japan (EOJ)

Mr. Takuya Ikeda	First Secretary

Japan International Cooperation Agency, Philippine Office (JICA)

Mr. Masataka Iijima	Resident Representative
Mr. Kenji Matsumoto	Asst. Resident Representative

APPENDIX 4 MINUTES OF DISCUSSIONS

1. Field Survey (August 8, 1991)

2. Discussion on Draft Final Report (October 10, 1991)

MINUTES OF DISCUSSIONS

THE BAGUIO SEWER SYSTEM REHABILITATION PROJECT
IN
THE REPUBLIC OF THE PHILIPPINES

BASIC DESIGN STUDY

Based on the results of the Basic Design Study, the Japan International Cooperation Agency (JICA) decided to conduct a supplementary Basic Design Study on the Baguio Sewer System Rehabilitation Project (hereinafter referred to as "the Project").

JICA sent to the Republic of the Philippines a study team, which is headed by Mr. Kenichi Osako, Manager of Facility Planning Division, Sewerage Bureau, Tokyo Metropolitan Government. The team stayed in the country from July 30 to August 8, 1991.

The team held discussions with the concerned officials of the Government of the Philippines including the Mayor and other city officials of Baguio and Officers of LWUA and Baguio Water District and conducted a field survey of the study area.

In the course of discussions and field survey, both parties have confirmed the main items described on the attached sheets. The team will proceed to perform further works and prepare the supplementary Basic Design Study report.

Baguio, August 8, 1991

KENICHI OSAKO
Leader
Basic Design Study Team
JICA

LOCAL WATER UTILITIES ADMINISTRATION

MOISES F. GUTIERREZ
Chairman
Baguio Water District

JAIME R. BUGNOSEN
Mayor
Baguio City

ATTACHMENT

1. Objective

The objective of the Project is to rehabilitate the existing sewer system in Baguio City by constructing new trunk sewer network to be connected to the existing sewer system.

2. Project Site

Baguio City

3. Executing Agency

Local Water Utilities Administration

4. Items requested by the Government of the Philippines

After discussions with the Basic Design Study Team, the following items were finally requested by the Philippines side.

(1) Construction of a new trunk sewer network as planned in the previous Basic Design Study (Refer to Figure attached hereto)

(2) Provision of survey instrument

(3) Provision of (analytical instrument for measuring water quality) and laboratory wares

(4) Other items which will be decided upon after further studies

5. Japan's Grant Aid System

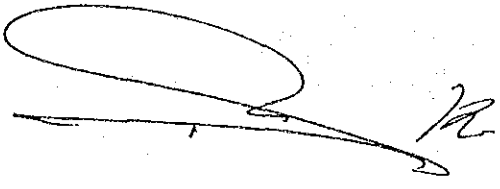
(1) The Republic of the Philippines has understood the system of Japanese Grant Aid as explained by the team.

(2) The Government of the Philippines will take necessary measures, described in Annex II for the smooth implementation of the Project, if the Grant aid Assistance by the Government of Japan is extended to the Project.

6. Schedule of the Study

(1) JICA will prepare the draft report in English and dispatch a mission in order to explain its contents around October, 1991.

(2) If the contents of the report is accepted in principle by the Philippines side, JICA will complete the final report and submit it to the Government of the Philippines by November, 1991.



7. Others

(1) After completion of the Project, the Local Water Utilities Administration, shall transfer the sewerage facilities to the Baguio City Government and the Baguio City Government shall manage, operate and maintain the sewerage system.

(2) The Baguio City Government and the Baguio Water District have reconfirmed that there is no change in Article 9 of the Minutes of Discussion agreed among agencies concerned including the Local Water Utilities Administration and the Japan International Cooperation Agency on July 13, 1990. (Refer to attached minutes).

(3) The Baguio City Government and the Baguio Water District agreed to conclude the detailed agreement for billing and collection sewage fees before end of September 1991, the time when the supplementary Basic Design Team would visint Baguio City for discussion of the Draft on Final Report of the Basic Design.

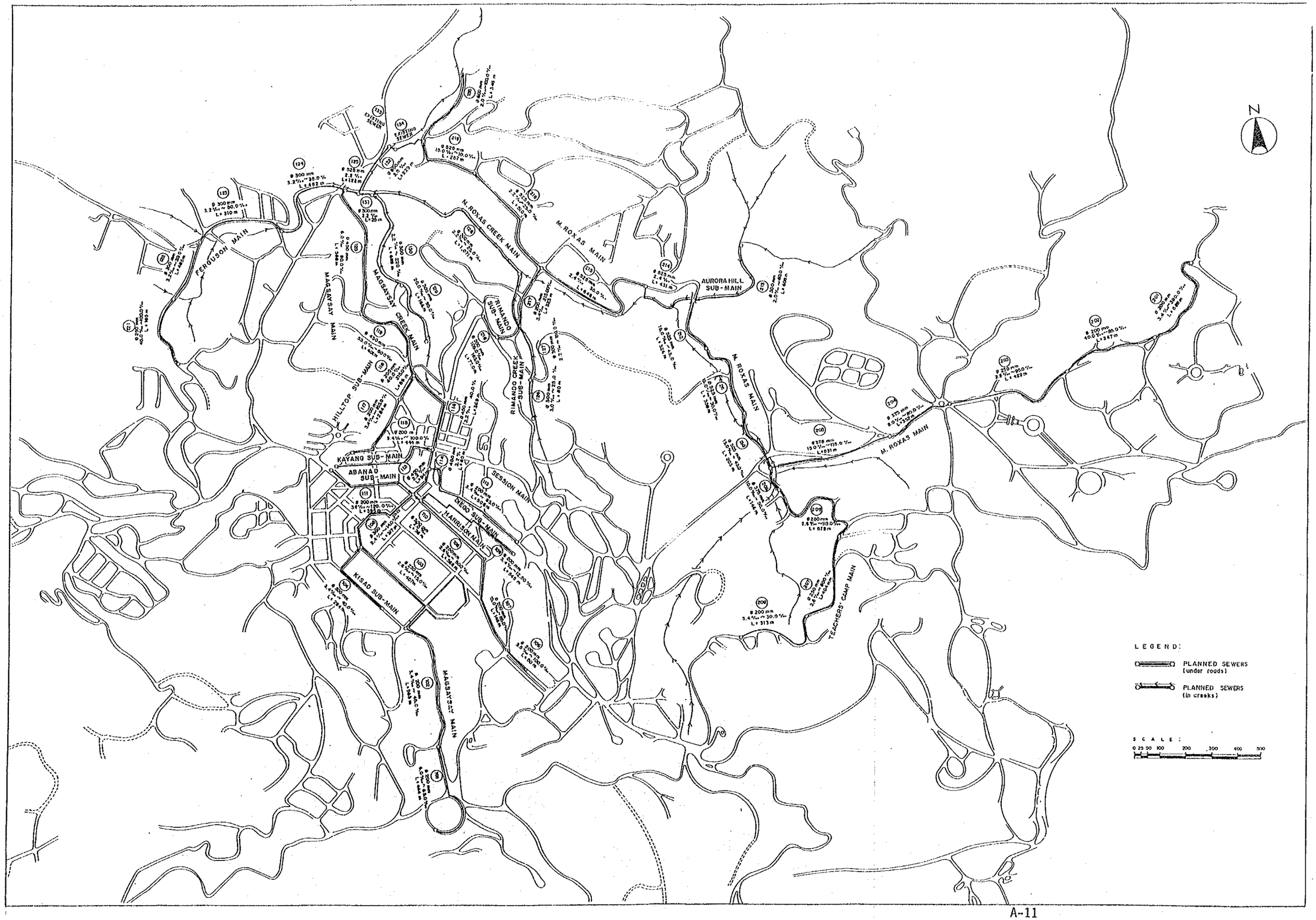
(4) The City Government agreed to establish an independent unit to manage, operate and maintain the sewerage system.

(5) The City Government shall maintain a separate book of accounts for the sewerage system; All net collections or payments in connection with the said sewerage system would be given to the City Treasurer of Baguio by the B&D, its collecting agent. That the aforementioned collection or payment turned over to the Treasurer of the City of Baguio should exclusively be used for the operation and maintenance of the sewerage system.

REFERENCE

Necessary measures to be taken by each government in case Japan's Grant Aid is executed.

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1.	To secure land		*
2.	To clear, level and reclaim the site when needed		*
3.	To construct sewers including manholes		*
	1) Lines indicated in Figure attached hereto	*	
	2) Lines not indicated in Figure attached hereto		*
4.	To provide furniture and equipment		
	1) General furniture		*
	2) Project equipment	*	
5.	To bear the following commissions to the Japanese foreign exchange bank for the banking services based upon the B/A		
	1) Advising commission of A/P		*
	2) Payment commission		*
6.	To ensure unloading and customs clearance at port of disembarkation in recipient country		
	1) Marine (Air) transportation of the products from Japan to the recipient country	*	
	2) Tax exemption and custom clearance of the products at the port of disembarkation		*
	3) Internal transportation from the port of disembarkation to the project site	*	
7.	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.		*
8.	To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contracts.		*
9.	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant.		*
10.	To bear all the expenses, other than those to be borne by the Grant, necessary for construction of the facilities as well as for the transportation and installation of the equipment.		*


N
FERGUSON MAIN
MAGSAYSAY MAIN
MAGSAYSAY CREEK MAIN
HILLTOP SUB-MAIN
KAYANG SUB-MAIN
ABANAO SUB-MAIN
N. ROXAS CREEK MAIN
RIMANDO SUB-MAIN
RIMANDO CREEK SUB-MAIN
SESSION MAIN
DIEGO SUB-MAIN
HARRISON MAIN
KISAD SUB-MAIN
MAGSAYSAY MAIN
N. ROXAS MAIN
AURORA HILL SUB-MAIN
N. ROXAS MAIN
TEACHERS' CAMP MAIN
EXISTING SEWER
EXISTING SEWER
LEGEND:
PLANNED SEWERS (under roads)
PLANNED SEWERS (in creeks)
SCALE:
0 25 50 100 200 300 400 500

MINUTES OF DISCUSSIONS

ON

THE BASIC DESIGN STUDY ON THE PROJECT

FOR

THE BAGUIO SEWER SYSTEM REHABILITATION PROJECT

IN

THE REPUBLIC OF THE PHILIPPINES
(CONSULTATION ON DRAFT REPORT)

In August 1991, the Japan International Cooperation Agency (JICA) dispatched a basic design study team on the Baguio Sewer System Rehabilitation Project (hereinafter referred to as "the Project") to the Republic of the Philippines, and through discussions, field survey and technical examination on the results in Japan, has prepared a draft report on the study.

In order to explain and consult with Philippine side on the content of the report, JICA sent a team to the Republic of the Philippines which was headed by Mr. Kenichi Osako, Manager of Facilities Planning Division, Sewerage Bureau, Tokyo Metropolitan Government and scheduled to stay in the country from October 4 to October 11, 1991.

As a result of discussions, both parties confirmed the main items as described on the attached sheets.

Baguio, October 11, 1991

Kenichi Osako
Leader
Draft Report Explanation Team
JICA

Armando C. Lizaso
Administrator
Local Water Utilities
Administration

Moises P. Cating
Chairman
Baguio Water District

Jaime R. Bugnosen
M a y o r
Baguio City

Jose N. Ricafrente, Jr.
Chairman, LWUA

ATTACHMENT

1. Components of Draft Report

The Government of the Philippines, has agreed and accepted in principle the components of the Draft Report proposed by the team.

2. Japan's Grant Aid System

(1) The Government of the Philippines, has understood the system of Japan's Grant Aid as explained by the team.

(2) The Government of the Philippines, will take the necessary measures, described in Annex I, for smooth implementation of the Project on condition that the Grant Aid assistance by the Government of Japan is extended to the Project.

3. Further Schedule

The team will make the Final Report in accordance with the confirmed items, and send it to the Government of the Philippines, by November 1991.

4. Others

(1) After completion of the Project, the Local Water Utilities Administration, shall transfer the sewerage facilities to the Baguio City Government and the Baguio City Government shall manage, operate and maintain the sewerage system.

(2) The Baguio City Government and the Baguio Water District have reconfirmed that there is no change in Article 9 of the Minutes of Discussion agreed among agencies concerned including the Local Water Utilities Administration and the Japan International Cooperation Agency on July 13, 1990. (Refer to attached Minutes.)

(3) The City Government agreed to establish an independent unit to manage, operate and maintain the sewerage system. For this purpose a management committee composed of Mr. Leonardo S. dela Cruz, Chairman; Atty. Moises P. Cating, Member; and Atty. Juan D. Hernandez, Member was organized.

(4) The City Government shall maintain a separate book of accounts for the sewerage system; All net collections of payments in connection with the said sewerage system will be remitted to the City Treasurer of Baguio

by the BWD. Collections or payments turned over to the Treasurer of the City of Baguio should exclusively be used for the operation and maintenance of the sewerage system.

(5) The City Government reported that the agreement for billing and collection of sewage fee was concluded between the City Government and the Baguio Water District as attached hereto.

(6) The City Government agreed to allow excavation of concrete pavements for the sewer installation works. The concrete pavements destroyed shall be restored by the contractor in accordance with the hereto attached sketch, marked Annex "A" based on Philippine standards and specification with the supervision of the City Engineer's Office.

(7) As a counterpart of the City Government of Baguio for the implementation of the Project, the City Government shall shoulder the Engineering costs of LWUA. A detailed agreement will be finalized between LWUA and the City Government before the start of the Project.

ANNEX 1

Necessary measures to be taken by the Government of the Philippines in case of Japan's Grant Aid is extended.

1. To establish an executing agency responsible for implementation of the Project and to allocate adequate number of personnel and budget necessary for the implementation of the Project.

2. To bear commissions to the Japanese foreign exchange bank for the banking services upon the Banking Arrangements.

3. To exempt taxes and to take necessary measures for customs clearance of the materials and equipment brought for the project at the port of disembarkation.

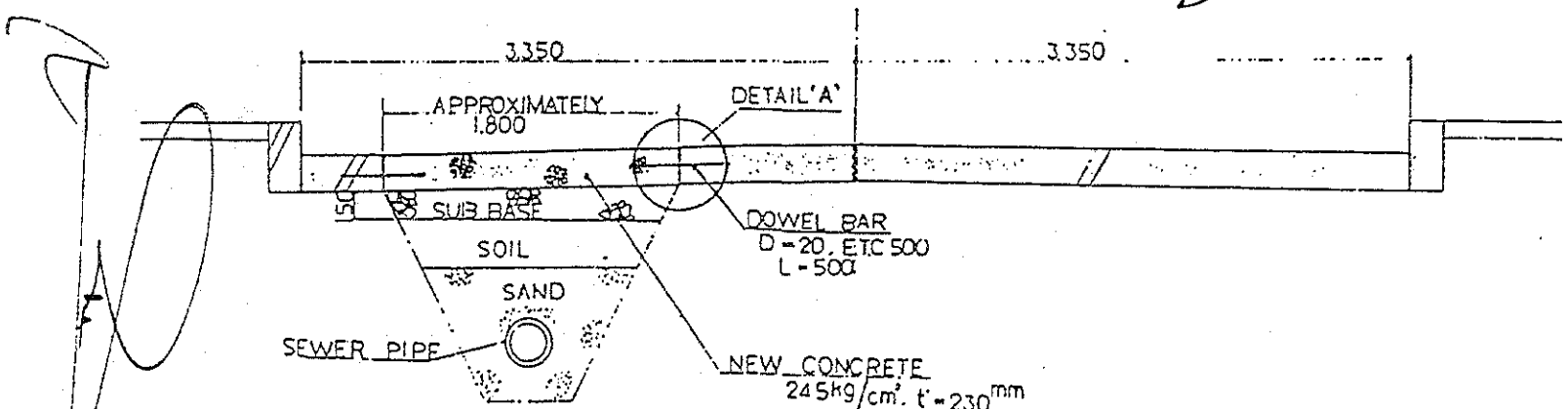
4. To accord Japanese Nationals whose services may be required in connection with the supply of products and the services under the verified contract such facilities as may be necessary for their entry in the Philippines, and stay therein for the performance of their work.

5. To maintain and use properly and effectively the facilities constructed and equipment purchased under the Grant.

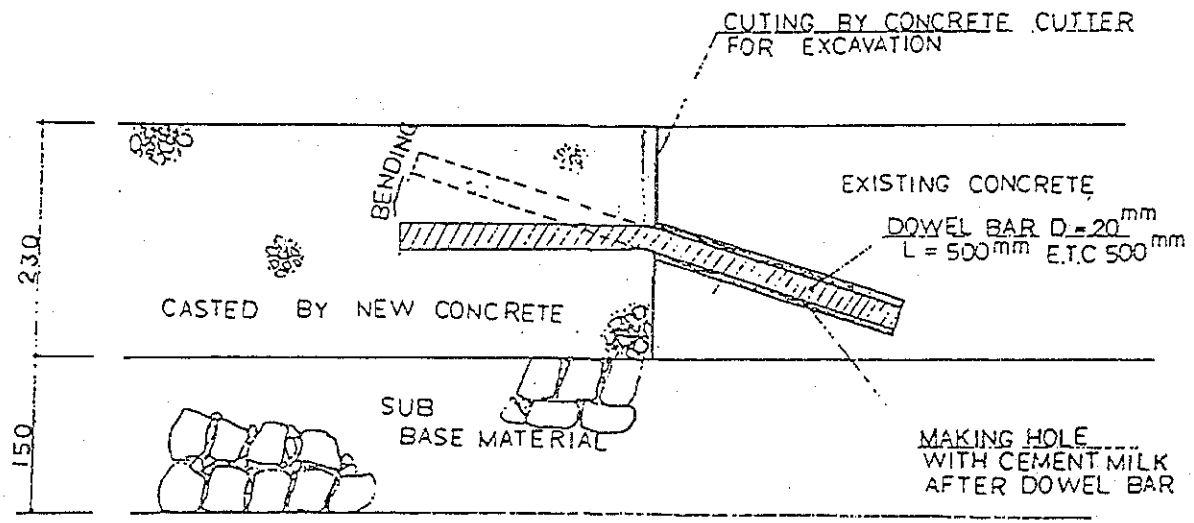
6. To bear all the expenses, including V.A.T. (value added tax) and the application of building construction permit other than those to be borne by the Grant, necessary for construction of the facilities as well as for the transportation and the installation of the equipment.

ANNEX "A"

TYPICAL SECTION



DETAIL 'A'



MEMORANDUM OF AGREEMENT

KNOW ALL MEN BY THESE PRESENTS:

This AGREEMENT, made and entered into by and between:

The CITY OF BAGUIO, a public corporation organized existing by virtue of and under the laws of the Republic of the Philippines , represented herein by its Mayor, JAIME R. BUGNOSEN, of legal age, married, Filipino and a resident of Baguio City, hereinafter referred to as the CITY;

- a n d -

The BAGUIO WATER DISTRICT., a corporation duly organized under Presidential Decree 198 as amended by PD 768 with its principal business address at Utility Road, Baguio City, represented herein by ATTY. MOISES P. CATING, Chairman of the Board of Directors, of legal age, married, Filipino citizen and a resident of Baguio City, hereinafter referred to as B W D.

W I T N E S S E T H

Resolution No. 92, series of 1990 approved that proposed contract between the City of Baguio and the Baguio Water District on joint management, operation and administration of the Baguio Sewerage System;

That, the parties herein hereby agree, stipulate and covenant, as they hereby agreed, stipulated, covenanted as follows:

1. The CITY shall remain the owner of the sewerage system including the Sewerage Treatment Plant;

2. That the CITY shall manage, operate, administer the Sewerage System and maintain the same in good condition at all times;

3. That the billing and collection of sewerage fees shall be done by BWD, except fees which accrued before the signing and effectivity of this management contract;

4. That a public hearing to fix the sewerage fees shall be conducted by the CITY in coordination with the BWD;

5. That all collections must be deposited in a separate fund to be jointly managed by both parties in accordance with auditing rules and regulations;

6. That the salaries of employees and the cost of maintenance and operation shall come from the fund and that 10% of the gross collection of sewerage and other fees related thereto shall be paid to BWD for handling fee and the rest of the income shall go to the City of Baguio; however in the event that the income derived from operation is not enough, the CITY shall assume the payment of the difference between the salaries and wages of the city employees working with the system and the income derived from it; and

7. This contract supersedes and cancels the temporary agreement dated December 27, 1989, which was signed by the parties and was approved per Resolution No. 347-89;

That the rehabilitation of the sewer lines is scheduled to commence in March 1992;

WHEREFORE, both parties have agreed to the foregoing terms and conditions the City of Baguio and Baguio Water District hereby affixed their signatures this _____ day of October, 1991, in the City of Baguio, Philippines.

CITY OF BAGUIO

by:

JAIME R. BUGNOSEN
City Mayor

BAGUIO WATER DISTRICT

by:

MOISES P. CATING
Chairman, Board of Director

Witnesses:

LEONARDO S. DELA CRUZ
City Administrator, Baguio

TERESITA DE GUZMAN
Manager, B W D

Republic of the Philippines
OFFICE OF THE MAYOR
Baguio City

ADMINISTRATIVE ORDER NO._____
Series of 1991

WHEREAS, in the meeting with the LWUA, JICA, BWD and the City of Baguio, it was agreed upon that the City Administrator shall be designated Project Coordinator for Baguio City re the Sewerage System Rehabilitation Project;

WHEREAS, there is now need to designate the coordinator to enable him to now start performing his duties;

NOW, THEREFORE, I, JAIME R. BUGNOSEN, City Mayor of Baguio by virtue of the powers vested in me by law, do hereby promulgate:

1. The designation of LEONARDO S. DELA CRUZ, City Administrator as the Project Coordinator for the project: Rehabilitation of the Baguio Sewerage System Rehabilitation;

2. All coordination functions with the LWUA, BWD, and the City of Baguio shall be done through the Coordinator.

DONE this _____ day of October, 1991, in the City of Baguio, Philippines.

JAIME R. BUGNOSEN
City Mayor

/jnc

APPENDIX 5 CONDITIONS FOR CALCULATIONS

1. Design Flow

- Capacity of each sewer is decided based on the maximum hourly sanitary sewage flow.
  (Total: 16,800 cu.m/day)

  -Sanitary sewage flow is divided into two categories based on the sewage volume.

- Sanitary sewage flow derived from each big discharge is allotted to the particular sewer based on his location and sewage volume.
  (Total: 5,415 cu.m/day)

- Sanitary sewage flow derived from small dischargers is allotted to each sewers in proportion to its tributary area
  (Total: 16,800 - 5,415 = 11,385 cu.m/day)

2. Sewer

- The minimum size of sewers is 200 mm in diameter for the road portion but 300 mm for the creek portion to facilitate the connection work from factories, offices and houses.

- The pipe materials are concrete or reinforced concrete pipes for the road portion and polyvinyl chloride pipes for the creek portion.

- The coefficient of roughness is 0.013 for Manning's Formula.

- Each pipe has 100% allowance to the design sanitary sewage flow.

Computations for A Sanitary Sewer System

Pipe No.	Downstream Pipe No.	Small Tributary Area Each ha	Small Tributary Area Cumulative ha	① Volume of Sewage m³/day	Big Each m³/day	Big ② Cumulative m³/day	Maximum Volume of Sewage ③=①+② m³/day	Maximum Volume of Sewage m³/sec	Design Profile Size mm	Slopes ‰	Length m	Velocity m/sec	Capacity m³/sec	Remarks
101		10 1	10 1	147	336	336	483	0.006	⊙200	(3.4) 6.0～85	444	(0.609)	(0.019)	
102		7 4	17 5	254	—	336	590	0.007	⊙200	3.4～45	583	0.609	0.019	
103		14 8	32 3	469	—	336	805	0.009	⊙250	2.6～15	457	0.618	0.030	
	105													
104		8 7	8 7	126	138	138	264	0.003	⊙200	3.4～40	294	0.609	0.019	
105		15 6	56 6	822	199	673	1.495	0.017	⊙300	2.4～14	317	0.670	0.047	
	112													
106		6 6	6 6	96	—	—	96	0.001	⊙200	(3.4) 35～100	150	(0.609)	(0.019)	
107		14 8	21 4	311	303	303	614	0.007	⊙200	(3.4) 15～85	146	(0.609)	(0.019)	
108		14 3	35 7	519	193	496	1.015	0.012	⊙250	2.6～50	368	0.618	0.030	
	110													
109		3 1	3 1	45	274	274	319	0.004	⊙200	3.4～125	545	0.609	0.019	
110		0 1	38 9	565	—	771	1.336	0.015	⊙300	2.0	39	0.612	0.043	
	112													
111		5 6	5 6	81	207	207	288	0.003	⊙200	3.4～120	395	0.609	0.019	
112		0 6	101 7	1.477	6	1.656	3.133	0.036	⊙450	2.2	94	0.841	0.134	
	114													
113		6 7	6 7	97	237	237	334	0.004	⊙200	3.4～95	508	0.609	0.019	
114		0 4	108 8	1.580	26	1.920	3.500	0.041	⊙450	2.2	80	0.841	0.134	
	116													
		108 8												

Note : Figures in parentheses show the minimum velocity and capacity

Computations for A Sanitary Sewer System

Pipe No.	Downstream Pipe No.	Small Tributary Area Each ha	Small Tributary Area Cumulative ha	① Volume of Sewage m³/day	Big Each m³/day	Big ② Cumulative m³/day	Maximum Volume of Sewage ③=①+② m³/day	m³/sec	Design Profile Size mm	Slopes ‰	Length m	Velocity m/sec	Capacity m³/sec	Remarks
115		3.0	3.0	44	127	127	171	0.002	⊙200	3.4～100	444	0.609	0.019	
116		8.9	120.7	1.754	271	2.318	4.072	0.047	⊙450	2.2～40	389	0.841	0.134	
	119													
117		4.3	4.3	63	6	6	69	0.001	⊙200	(3.4) 40～155	240	0.609	0.019	
118		2.4	6.7	97	——	6	103	0.001	⊙200	(3.4) 40～315	69	(0.609)	(0.019)	
119		6.0	133.4	1.937	18	2.343	4.280	0.050	⊙450	(2.2) 55～80	401	(0.841)	(0.134)	
120		6.0	139.4	2.025	34	2.376	4.401	0.051	⊙450	(2.2) 6.0～80	568	(0.841)	(0.134)	
	125													
121		62.7	62.7	911	244	244	1.155	0.013	⊙250	(3.2) 45～100	165	(0.685)	(0.034)	
122		4.8	67.5	981	40	283	1.264	0.015	⊙300	3.2～20	485	0.774	0.055	
123		12.3	79.8	1.159	20	303	1.462	0.017	⊙300	3.2～50	310	0.774	0.055	
124		20.4	100.2	1.456	69	372	1.828	0.021	⊙300	3.2～35	462	0.774	0.055	
125		27.5	267.1	3.880	149	2.897	6.777	0.078	⊙525	2.2	122	0.932	0.202	
	132													
126		43.5	43.5	632	153	153	785	0.009	⊙300	(2.2) 3.0～25	80	(0.642)	(0.045)	CREEK
127		8.7	52.2	758	——	153	911	0.011	⊙300	2.2～150	1.049	0.642	0.045	CREEK
128		37.5	89.7	1.303	20	173	1.476	0.017	⊙300	2.2～25	1.071	0.642	0.045	CREEK
	131													
129		8.1	8.1	118	213	213	331	0.004	⊙300	(2.2) 20～95	166	(0.642)	(0.045)	CREEK
130		7.9	16.0	232	17	230	462	0.005	⊙300	2.2～220	689	0.642	0.045	CREEK
		264.0												

Note : Figures in parentheses show the minimum velocity and capacity

Computations for A Sanitary Sewer System

Pipe No.	Downstream Pipe No.	Small Tributary Area Each (ha)	Small Tributary Area Cumulative (ha)	Small ① Volume of Sewage (m³/day)	Big Each (m³/day)	Big ② Cumulative (m³/day)	Maximum Volume of Sewage ②−①+② (m³/day)	Maximum Volume of Sewage ②−①+② (m³/sec)	Design Profile Size (mm)	Slopes (‰)	Length (m)	Velocity (m/sec)	Capacity (m³/sec)	Remarks
131		0.6	106.3	1.544	—	403	1.947	0.023	⊙300	2.2	25	0.642	0.045	CREEK
132		22.0	395.4	5.743	162	3.463	9.206	0.107	⊙600	2.0	229	0.971	0.275	CREEK
133		0.0	395.4	5.743	—	3.463	9.206	0.107	⊙400	(10.6)	—	(1.704)	(0.214)	EXISTING WATER BRIDGE
134		1.8	397.2	5.769	11	3.473	9.242	0.107	⊙600	(1.2)	—	(0.757)	(0.214)	EXISTING SEWER
	135													
201		9.6	9.6	139	54	54	193	0.002	⊙200	3.4~390	588	0.609	0.019	
202		5.6	15.2	221	—	54	275	0.003	⊙200	(3.4) 40~85	347	(0.609)	(0.019)	
203		39.6	54.8	796	365	418	1.214	0.014	⊙250	2.6~95	469	0.618	0.030	
204		46.5	101.3	1.472	142	561	2.033	0.024	⊙375	(1.6) 8~80	352	(0.635)	(0.070)	
205		3.7	105.0	1.525	—	561	2.086	0.024	⊙375	(1.6) 15~115	531	(0.635)	(0.070)	
	210													
206		11.8	11.8	172	359	359	531	0.006	⊙200	3.4~30	313	0.609	0.019	
207		9.2	21.0	305	34	392	697	0.008	⊙250	2.6~80	404	0.618	0.030	
208		4.5	25.5	371	18	411	782	0.009	⊙250	2.6~115	579	0.618	0.030	
209		107.2	132.7	1.927	541	951	2.878	0.033	⊙375	(2.4) 10~50	146	(0.778)	(0.086)	
210		17.5	255.2	3.707	107	1.619	5.326	0.062	⊙525	(2.4) 15~45	203	(0.973)	(0.211)	
211		22.7	277.9	4.036	—	1.619	5.655	0.065	⊙525	(2.4) 15~30	359	(0.973)	(0.211)	
212		2.6	280.5	4.075	—	1.619	5.694	0.066	⊙525	(2.4) 15~45	326	(0.973)	(0.211)	
	214													
213		39.6	39.6	575	5	5	580	0.007	⊙300	2.0~60	608	0.612	0.043	CREEK
		344.5												

Note : Figures in parentheses show the minimum velocity and capacity

Computations for A Sanitary Sewer System

Pipe No.	Downstream Pipe No.	Small			Big		Maximum Volume of Sewage ③=①+②		Design Profile					Remarks
		Tributary Area		① Volume of Sewage	Each	② Cumulative			Size	Slopes	Length	Velocity	Capacity	
		Each	Cumulative											
		ha	ha	m³/day	m³/day	m³/day	m³/day	m³/sec	mm	‰	m	m/sec	m³/sec	
214		16 9	337 0	4.895	34	1.658	6.553	0.076	⊙525	2.4	431	0.973	0.211	
215		8 7	345 7	5.022	6	1.664	6.686	0.077	⊙525	2.4~35	648	0.973	0.211	
	218													
216		4 2	4 2	61	14	14	75	0.001	⊙200	(3.4) 105~165	77	(0.609)	(0.019)	
217		11 0	15 2	221	199	213	434	0.005	⊙200	3.4~215	323	0.609	0.019	
218		15 6	376 5	5.469	38	1.915	7.384	0.085	⊙525	2.4~25	510	0.973	0.211	
219		6 5	383 0	5.563	26	1.941	7.504	0.087	⊙525	(2.4) 15~100	257	(0.973)	(0.211)	
135		3 6	783 8	11.385	—	5.415	16.800	0.194	⊙600	2.0~100	346	0.971	0.275	
	STP													
		66 5												

Note: Figures in parentheses show the minimum velocity and capacity

APPENDIX 6 DATA

Table 1 Projectd Population by Barangay

BARANGAY	1980	1985	1989	1990	1991	1992	1993	1994	1995	2000	SEWERAGE AREA Coverage (%)	1989	1992
BAGUIO CITY	119,009	137,426	152,166	183,102	186,947	190,873	194,881	198,974	203,152	206,504		72,577	80,151
ABANAO-ZANDUETA CHUGUM-OTEK	653	754	835	272	278	284	289	296	302	307	100	835	284
ALFONSO O. TABORA	1,254	1,448	1,604	1,647	1,682	1,717	1,753	1,790	1,827	1,858	100	1,604	1,717
AMBIONG	705	814	902	600	613	625	639	652	666	677	0	0	0
ASIN ROAD	1,081	1,248	1,382	2,081	2,125	2,169	2,215	2,261	2,309	2,347	0	0	0
ATOK TRAIL	345	398	441	471	481	491	501	512	523	531	0	0	0
AURORA HILL NORTH CENTRAL	463	535	592	389	397	406	414	423	432	439	100	592	406
AURORA HILL SOUTH CENTRAL	906	1,046	1,159	1,087	1,110	1,133	1,157	1,181	1,206	1,226	100	1,159	1,133
A. BONIFACIO-CAGUIOA-RIMANDO	857	990	1,096	1,631	1,665	1,700	1,736	1,772	1,810	1,839	100	1,096	1,700
BAGONG LIPUNAN	443	512	567	375	383	391	399	408	416	423	100	567	391
BAGUIO GEN. HOSPITAL COMP.	653	754	835	712	727	742	758	774	790	803	100	835	742
BAKAKENG CENTRAL	839	969	1,073	1,663	1,698	1,734	1,770	1,807	1,845	1,876	0	0	0
BAKAKENG NORTE	715	826	914	2,431	2,482	2,534	2,587	2,642	2,697	2,742	0	0	0
BALSIGAN	1,006	1,162	1,287	2,009	2,051	2,094	2,138	2,183	2,229	2,266	100	1,287	2,094
BAYAN PARK VILLAGE	751	867	960	892	911	930	949	969	990	1,006	100	960	930
BROOKES POINT	322	372	412	1,168	1,193	1,218	1,243	1,269	1,296	1,317	100	412	1,218
BROOKSIDE	2,590	2,991	3,312	2,350	2,399	2,450	2,501	2,554	2,607	2,650	100	3,312	2,450
CABINET HILL-TEACHER'S CAMP	1,239	1,431	1,584	2,437	2,488	2,540	2,594	2,648	2,704	2,748	100	1,584	2,540
CAMDAS SUBDIVISION	1,403	1,620	1,794	1,369	1,398	1,427	1,457	1,488	1,519	1,544	0	0	0
CAMP 7	1,134	1,309	1,450	2,890	2,951	3,013	3,076	3,141	3,206	3,259	0	0	0
CAMP 8	867	1,001	1,109	1,636	1,670	1,705	1,741	1,778	1,815	1,845	0	0	0
CAMP ALLEN	730	843	934	1,684	1,719	1,755	1,792	1,830	1,868	1,899	100	934	1,755
CAMPO FILIPINO	1,502	1,734	1,921	1,506	1,538	1,570	1,603	1,637	1,671	1,698	100	1,921	1,570
CARINO-PALMA	1,231	1,422	1,574	1,306	1,333	1,361	1,390	1,419	1,449	1,473	0	0	0
CITY CAMP CENTRAL	1,597	1,844	2,042	1,747	1,784	1,821	1,859	1,898	1,938	1,970	0	0	0
CITY CAMP PROPER	2,032	2,346	2,599	2,107	2,151	2,196	2,243	2,290	2,338	2,376	0	0	0
COUNTRY CLUB	1,350	1,559	1,726	1,413	1,443	1,473	1,504	1,535	1,568	1,594	0	0	0
CRESENCIA VILLAGE	1,260	1,455	1,611	1,452	1,482	1,514	1,545	1,578	1,611	1,638	100	1,611	1,514
DEPT. OF PUBLIC SERVICES	877	1,013	1,122	968	988	1,009	1,030	1,052	1,074	1,092	100	1,122	1,009
DIZON SUBDIVISION	952	1,099	1,217	1,480	1,511	1,543	1,575	1,608	1,642	1,669	0	0	0
DOMINICAN HILL-MIRADOR	544	628	696	1,563	1,596	1,629	1,664	1,698	1,734	1,763	0	0	0
DONTOGAN	684	790	875	1,253	1,279	1,306	1,334	1,362	1,390	1,413	0	0	0
EAST BAYAN PARK	347	401	444	694	709	723	739	754	770	783	20	89	145
EAST MODERN SITE	2,051	2,368	2,623	1,995	2,037	2,080	2,123	2,168	2,213	2,250	100	2,623	2,080
EAST QUIRINO HILL	628	725	803	1,273	1,300	1,327	1,355	1,383	1,412	1,436	0	0	0
ENGINEER'S HILL	1,491	1,722	1,907	2,389	2,439	2,490	2,543	2,595	2,651	2,694	100	1,907	2,490
FAIRVIEW	998	1,152	1,276	4,277	4,367	4,459	4,552	4,648	4,745	4,824	50	638	2,229
FERDINAND	701	809	896	1,024	1,046	1,067	1,090	1,113	1,136	1,155	0	0	0
FORT DEL PILAR	2,093	2,417	2,677	2,993	3,056	3,120	3,186	3,252	3,321	3,376	0	0	0
GABRIELA SILANG	1,067	1,232	1,365	1,927	1,967	2,009	2,051	2,094	2,138	2,173	0	0	0
GIBRALTAR	1,210	1,397	1,547	3,030	3,094	3,159	3,225	3,293	3,362	3,417	70	1,083	2,211
GREEN WATER VILLAGE	774	894	990	930	950	969	990	1,011	1,032	1,049	0	0	0
GUISAD CENTRAL	985	1,137	1,260	1,597	1,631	1,665	1,700	1,735	1,772	1,801	0	0	0
GUISAD SURONG	1,068	1,233	1,366	1,229	1,255	1,281	1,308	1,336	1,364	1,386	0	0	0
HAPPY HOLLOW	316	365	404	591	603	616	629	642	656	667	0	0	0
HAPPY HOMES-LUCBAN	1,249	1,442	1,597	1,593	1,626	1,661	1,695	1,731	1,767	1,797	0	0	0
HARRISON-CLAUDIO CARANTES	310	358	369	39	40	41	42	42	43	44	100	369	41
HILLSIDE	934	1,079	1,194	1,246	1,272	1,299	1,326	1,354	1,382	1,405	0	0	0
HOLY GHOST EXTENSION	1,296	1,497	1,657	2,224	2,271	2,318	2,367	2,417	2,468	2,508	100	1,657	2,318
HOLY GHOST PROPER	1,597	1,844	2,042	1,621	1,655	1,690	1,725	1,762	1,799	1,828	100	2,042	1,690
HONEYMOON-HOLY	1,292	1,492	1,652	2,415	2,466	2,517	2,570	2,624	2,679	2,724	100	1,652	2,517

Table 1 Projectd Population by Barangay

BARANGAY	1980	1985	1989	1990	1991	1992	1993	1994	1995	2000	SEWERAGE AREA Coverage (%)	1989	1992
BAGUIO CITY	119,009	137,426	152,166	183,102	186,947	190,873	194,881	198,974	203,152	206,504		72,577	80,151
IMELDA R. MARCOS	535	618	684	657	671	685	699	714	729	741	0	0	0
IMELDA VILLAGE	562	649	719	1,416	1,446	1,476	1,507	1,539	1,571	1,597	100	719	1,476
IRISAN	1,797	2,075	2,298	8,375	8,551	8,730	8,914	9,101	9,292	9,445	0	0	0
KABAYANIHAN	545	629	697	586	598	611	624	637	650	661	100	697	611
KAGITINGAN	605	699	774	483	493	503	514	525	536	545	100	774	503
KAYANG EXTENSION	1,045	1,207	1,336	1,037	1,059	1,081	1,104	1,127	1,151	1,170	100	1,336	1,081
KAYANG-HILLTOP	1,235	1,426	1,579	997	1,018	1,039	1,061	1,083	1,106	1,124	100	1,579	1,039
KIAS	1,123	1,297	1,436	1,506	1,538	1,570	1,603	1,637	1,671	1,698	0	0	0
LEGARDA-BURNHAM	905	1,045	1,157	1,088	1,111	1,134	1,158	1,182	1,207	1,227	100	1,157	1,134
LOAKAN PROPER	874	1,009	1,118	2,622	2,677	2,733	2,791	2,849	2,909	2,957	0	0	0
LOAKAN-APUGAN	424	490	542	886	905	924	943	963	983	999	0	0	0
LOAKAN-LIWANAG	653	754	835	1,146	1,170	1,195	1,220	1,245	1,271	1,292	100	835	1,195
LOPEZ JAENA	712	822	911	961	981	1,002	1,023	1,044	1,066	1,084	100	911	1,002
LOURDES SUBDIVISION EXT.	532	614	680	597	610	622	635	649	662	673	0	0	0
LOURDES SUBDIVISION PROPER	380	439	486	515	526	537	548	560	571	581	0	0	0
LOWER BOKAWKAN	908	1,049	1,161	1,342	1,370	1,399	1,428	1,458	1,489	1,514	100	1,161	1,399
LOWER DAGSIAN	379	438	485	489	499	510	520	531	543	551	0	0	0
LOWER GENERAL LUNA	253	292	324	497	507	518	529	540	551	561	100	324	518
LOWER LOURDES SUBD.	162	187	207	242	247	252	258	263	268	273	0	0	0
LOWER MAGSAYSAY	768	887	982	982	1,003	1,024	1,045	1,067	1,090	1,108	100	982	1,024
LOWER QUIRINO HILL	653	754	835	1,314	1,342	1,370	1,399	1,428	1,458	1,482	0	0	0
LOWER QUIRINO-MAGSAYSAY	1,435	1,657	1,835	2,344	2,393	2,443	2,495	2,547	2,601	2,644	0	0	0
LOWER ROCK QUARRY	1,082	1,249	1,384	1,484	1,515	1,547	1,579	1,613	1,647	1,674	0	0	0
LUALHATI	684	790	875	687	701	716	731	747	762	775	100	875	716
LUCNAB	455	525	582	513	524	535	546	557	569	579	0	0	0
MALCOLM SQUARE	283	327	362	105	107	109	112	114	116	118	100	362	109
MALVAR-SGT. FLORESCA	656	758	839	732	747	763	779	795	812	826	100	839	763
MANUEL ROXAS-TEACHER'S CAMP	489	565	625	410	419	427	436	446	455	462	100	625	427
MARCOVILLE	682	788	872	741	757	772	789	805	822	836	0	0	0
MIDDLE QUEZON HILL SUBD.	1,173	1,355	1,500	2,171	2,217	2,263	2,311	2,359	2,409	2,448	100	1,500	2,263
MIDDLE QUIRINO HILL	599	692	766	1,552	1,585	1,618	1,652	1,687	1,722	1,750	0	0	0
MIDDLE ROCK QUARRY	1,072	1,238	1,371	1,251	1,277	1,304	1,331	1,359	1,388	1,411	0	0	0
MILITARY CUT-OFF	1,311	1,514	1,677	1,333	1,361	1,390	1,419	1,449	1,479	1,503	0	0	0
MINES VIEW PARK	441	509	564	1,210	1,235	1,261	1,288	1,315	1,342	1,365	20	113	252
NEW LUCBAN	2,004	2,314	2,563	3,405	3,477	3,550	3,624	3,700	3,778	3,840	100	2,563	3,550
NORTH SANITARY CAMP	375	433	480	708	723	738	754	769	786	798	0	0	0
OUTLOOK DRIVE	554	640	708	985	1,006	1,027	1,048	1,070	1,093	1,111	0	0	0
PACDAL	2,269	2,620	2,902	3,515	3,589	3,664	3,741	3,820	3,900	3,964	30	871	1,099
PADRE BURGOS	815	941	1,042	2,065	2,108	2,153	2,198	2,244	2,291	2,329	100	1,042	2,153
PADRE ZAMORA	1,858	2,146	2,376	1,577	1,610	1,644	1,678	1,714	1,750	1,779	100	2,376	1,644
PHIL-AM	373	431	477	453	463	472	482	492	503	511	100	477	472
PINGET	1,281	1,479	1,638	3,158	3,224	3,292	3,361	3,432	3,504	3,562	0	0	0
PINSAO PILOT PROJECT	1,484	1,714	1,698	2,291	2,339	2,388	2,438	2,490	2,542	2,584	0	0	0
PINSAO(PROPER)	613	708	784	1,607	1,641	1,675	1,710	1,746	1,783	1,812	0	0	0
PRIVATE ROAD MAGSAYSAY				621	634	647	661	675	689	700	0	0	0
PUCSUSAN	296	342	379	264	270	275	281	287	293	298	0	0	0
PULIWES	879	1,015	1,124	1,667	1,702	1,738	1,774	1,812	1,850	1,880	0	0	0
QUEEN OF PEACE	1,326	1,531	1,696	2,181	2,227	2,274	2,321	2,370	2,420	2,460	0	0	0
QUEZON HILL PROPER	668	771	854	735	750	766	782	799	815	829	100	854	766
RIZAL MONUMENT	428	494	547	361	369	376	384	392	401	407	100	547	376

Table 1 Projectd Population by Barangay

BARANGAY	1980	1985	1989	1990	1991	1992	1993	1994	1995	2000	SEWERAGE AREA		
											Coverage (%)	1989	1992
BAGUIO CITY	119,009	137,426	152,166	183,102	186,947	190,873	194,881	198,974	203,152	206,504		72,577	80,151
SAINT JOSEPH VILLAGE	1,373	1,585	1,756	2,603	2,658	2,713	2,770	2,829	2,888	2,936	70	1,229	1,899
SALUD MITRA	1,314	1,517	1,680	1,497	1,528	1,561	1,593	1,627	1,661	1,688	100	1,680	1,561
SAN ANTONIO VILLAGE	964	1,113	1,233	1,167	1,192	1,217	1,242	1,268	1,295	1,316	0	0	0
SAN LUIS	1,318	1,522	1,686	1,607	1,641	1,675	1,710	1,746	1,783	1,812	40	674	670
SAN ROQUE	577	666	738	508	519	530	541	552	564	573	0	0	0
SAN VICENTE	1,536	1,774	1,964	2,137	2,182	2,228	2,274	2,322	2,371	2,410	0	0	0
SANTA ESCOLASTICA VILLAGE	930	1,074	1,189	1,372	1,401	1,430	1,460	1,491	1,522	1,547	0	0	0
SANTO ROSARIO	846	977	1,082	1,170	1,195	1,220	1,245	1,271	1,298	1,320	0	0	0
SANTO TOMAS PROPER	790	912	1,010	1,215	1,241	1,267	1,293	1,320	1,348	1,370	0	0	0
SANTO TOMAS SCHOOL AREA	304	351	389	532	543	555	566	578	590	600	0	0	0
SCOUT BARRIO	1,205	1,391	1,541	1,422	1,452	1,482	1,513	1,545	1,578	1,604	0	0	0
SESSION ROAD	329	380	421	353	360	368	376	384	392	398	100	421	368
SLAUGHTER COMPOUND	1,631	1,883	2,086	1,608	1,642	1,676	1,711	1,747	1,784	1,814	100	2,086	1,676
SLU-SVP HOUSING VILLAGE	838	968	1,072	1,780	1,817	1,856	1,895	1,934	1,975	2,008	0	0	0
SOUTH DRIVE	180	208	230	284	290	296	302	309	315	320	100	230	296
SOUTH SANITARY CAMP	1,234	1,425	1,578	1,667	1,702	1,738	1,774	1,812	1,850	1,880	40	631	695
TECOCORA ALONZO	1,236	1,427	1,581	1,511	1,543	1,575	1,608	1,642	1,676	1,704	100	1,581	1,575
TRANCOVILLE	2,041	2,357	2,610	2,294	2,342	2,391	2,442	2,493	2,545	2,587	100	2,610	2,391
UPPER DAGSIAN	353	408	451	551	563	574	586	599	611	621	0	0	0
UPPER GENERAL LUNA	1,013	1,170	1,295	1,343	1,371	1,400	1,429	1,459	1,490	1,515	100	1,295	1,400
UPPER MAGSAYSAY	410	473	524	230	235	240	245	250	255	259	100	524	240
UPPER MARKET SUBDIVISION	541	625	692	363	371	378	386	394	403	409	100	692	378
UPPER QUEZON HILL	1,157	1,336	1,480	2,034	2,077	2,120	2,165	2,210	2,257	2,294	90	1,332	1,908
UPPER QUIRINO-MAGSAYSAY	1,416	1,635	1,811	2,527	2,580	2,634	2,690	2,746	2,804	2,850	0	0	0
UPPER ROCK QUARRY	1,032	1,192	1,320	1,779	1,816	1,855	1,893	1,933	1,974	2,006	0	0	0
VICTORIA VILLAGE	668	771	854	1,400	1,429	1,459	1,490	1,521	1,553	1,579	30	256	438
WEST BAYAN PARK	470	543	601	662	676	690	705	719	734	747	100	601	690
WEST MODERN SITE	1,036	1,196	1,325	1,168	1,193	1,218	1,243	1,269	1,296	1,317	100	1,325	1,218
WEST QUIRINO HILL	240	277	307	778	794	811	828	845	863	877	0	0	0

Table 2 Number of Connections by Zone (1979-1989)

Zone	1979 Ave.	1979 Share (%)	1980 Ave.	1980 Share (%)	1981 Ave.	1981 Share (%)	1982 Ave.	1982 Share (%)	1983 Ave.	1983 Share (%)	1984 Ave.	1984 Share (%)	1985 Ave.	1985 Share (%)	1986 Ave.	1986 Share (%)	1987 Ave.	1987 Share (%)	1988 Ave.	1988 Share (%)	1989 Ave.	1989 Share (%)	Growth Rate 1989/1979 (%)
1	380	3.93	377	3.58	392	3.52	420	3.36	435	3.19	435	3.04	428	2.89	449	2.82	432	2.65	429	2.47	416	2.33	109
2	465	4.81	489	4.65	510	4.58	650	5.20	682	5.00	688	4.81	693	4.70	721	4.69	747	4.58	776	4.46	784	4.40	169
3	331	3.43	382	3.63	401	3.60	506	4.07	671	4.92	783	5.47	822	5.58	941	6.12	1,073	6.58	1,297	7.46	1,379	7.73	417
4	398	4.12	423	4.02	439	3.95	462	3.70	482	3.54	485	3.38	506	3.43	521	3.39	539	3.31	555	3.19	579	3.25	145
5	441	4.56	475	4.52	549	4.93	644	5.16	723	5.30	850	5.94	880	5.97	887	5.77	995	6.10	1,049	6.03	1,080	6.06	245
Sub-Total	2,015	20.86	2,146	20.41	2,291	20.59	2,684	21.49	2,993	21.95	3,241	22.64	3,327	22.57	3,519	22.89	3,786	23.22	4,106	23.50	4,238	23.77	210
6	542	5.61	592	5.63	635	5.71	687	5.34	776	5.71	843	5.89	835	5.67	783	5.09	763	4.68	913	5.25	786	4.41	145
7	325	3.36	351	3.34	351	3.15	509	4.08	513	3.76	511	3.57	519	3.52	581	3.78	566	3.47	595	3.42	618	3.47	190
8	542	5.61	626	5.95	671	6.03	745	5.97	858	6.29	952	6.65	1,038	7.04	1,153	7.50	1,329	8.15	1,470	8.45	1,542	8.65	285
9	477	4.94	506	4.81	535	4.81	583	4.67	629	4.61	648	4.53	678	4.60	725	4.72	758	4.65	793	4.56	840	4.71	176
10	463	4.79	481	4.57	529	4.75	581	4.73	622	4.56	660	4.61	658	4.47	659	4.29	680	4.23	708	4.06	738	4.08	159
Sub-Total	2,349	24.31	2,560	24.40	2,721	24.46	3,005	24.70	3,400	24.94	3,814	25.25	3,728	25.30	3,901	25.38	4,197	25.19	4,477	25.74	4,516	25.33	192
11	673	6.97	727	6.91	750	6.81	813	6.51	894	6.56	927	6.48	991	6.72	985	6.41	1,012	6.58	1,125	6.47	1,200	6.73	178
12	239	2.47	281	2.67	275	2.47	283	2.27	310	2.27	328	2.28	313	2.12	308	2.00	325	1.98	334	1.92	345	1.93	144
13	623	6.45	635	6.04	637	5.73	684	5.48	724	5.31	743	5.18	742	5.03	754	4.90	780	4.78	805	4.63	813	4.56	130
14	440	4.55	480	4.59	495	4.45	536	4.30	588	4.31	619	4.32	640	4.34	632	4.11	658	4.02	678	3.90	697	3.91	158
15	661	6.83	711	6.70	737	6.62	803	6.43	853	6.26	904	6.32	926	6.30	985	6.43	1,031	6.32	1,059	6.09	1,059	5.94	165
Sub-Total	2,616	27.08	2,837	26.98	2,902	26.08	3,119	24.98	3,368	24.71	3,521	24.60	3,620	24.56	3,668	23.86	3,864	23.70	4,001	23.00	4,114	23.07	157
16	705	7.30	756	7.02	770	6.92	747	5.98	771	5.65	802	5.60	788	5.35	832	5.41	861	5.28	895	5.15	918	5.15	130
17	458	4.82	480	4.59	513	4.61	694	5.56	758	5.54	785	5.34	805	5.46	838	5.46	884	5.42	930	5.35	962	5.40	208
18	558	5.76	614	5.84	639	5.74	695	5.57	734	5.38	730	5.10	742	5.03	753	4.90	809	4.96	855	4.92	870	4.88	156
19	405	4.19	443	4.21	470	4.28	541	4.33	620	4.55	735	5.10	815	5.53	877	5.70	948	5.80	1,023	5.88	1,069	6.00	264
20	549	5.68	690	6.56	814	7.32	913	7.31	992	7.28	899	6.33	912	6.19	984	6.40	1,045	6.41	1,108	6.37	1,138	6.38	207
Sub-Total	2,681	27.75	2,988	28.22	3,212	28.87	3,590	28.75	3,873	28.40	3,938	27.51	4,062	27.56	4,285	27.87	4,545	27.88	4,811	27.66	4,957	27.80	185
Delivery	0	0.00	0	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	
Hauling	0	0.00	0	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0.03	
Total	9,661	100.00	10,517	100.01	11,126	100.00	12,486	100.00	13,635	100.00	14,314	100.00	14,738	99.99	15,373	100.00	16,302	99.99	17,395	100.00	17,830	100.00	185

Table 3 Number of Connections by Zone (1989)

Zone	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Share (%)	Sewerage Area (%)	
1	428	422	430	432	423	427	422	422	421	415	419	416	2.33	100	416
2	778	778	780	790	784	782	787	787	786	765	783	784	4.40	100	784
3	1,312	1,327	1,347	1,355	1,352	1,352	1,376	1,372	1,373	1,360	1,379	1,378	7.73	0	0
4	557	562	569	575	571	571	577	576	575	575	578	579	3.25	100	579
5	1,054	1,054	1,063	1,081	1,075	1,084	1,081	1,077	1,083	1,083	1,076	1,080	6.06	90	972
Sub-Total	4,129	4,143	4,189	4,233	4,205	4,216	4,243	4,234	4,238	4,198	4,235	4,238	23.77		2,751
6	791	789	791	795	796	798	799	790	790	785	791	786	4.41	100	786
7	603	607	614	616	622	622	628	619	627	625	616	618	3.47	90	556
8	1,487	1,505	1,532	1,543	1,542	1,549	1,555	1,560	1,552	1,545	1,547	1,542	8.65	0	0
9	805	802	806	812	813	816	822	826	833	829	835	840	4.71	0	0
10	708	714	715	720	720	724	725	699	699	725	724	730	4.08	0	0
Sub-Total	4,394	4,417	4,458	4,486	4,493	4,509	4,529	4,494	4,501	4,509	4,513	4,516	25.33		1,342
11	1,139	1,152	1,172	1,178	1,181	1,187	1,187	1,180	1,184	1,186	1,181	1,200	6.73	10	120
12	334	334	340	342	342	344	345	346	345	345	348	345	1.93	100	345
13	810	803	806	809	804	813	814	806	816	813	818	813	4.56	100	813
14	677	693	684	686	677	693	696	687	700	701	701	697	3.91	80	558
15	1,038	1,034	1,045	1,051	1,034	1,049	1,054	1,053	1,057	1,052	1,056	1,059	5.94	100	1059
Sub-Total	3,998	4,006	4,050	4,069	4,038	4,086	4,096	4,072	4,102	4,097	4,104	4,114	23.07		2,895
16	901	906	909	910	917	926	928	921	930	927	927	918	5.15	70	643
17	934	937	938	948	949	954	957	949	953	951	962	962	5.40	70	673
18	854	859	865	864	870	862	880	869	877	872	872	870	4.88	100	870
19	1,039	1,058	1,063	1,069	1,069	1,079	1,077	1,055	1,064	1,062	1,073	1,069	6.00	90	962
20	1,121	1,124	1,135	1,136	1,140	1,140	1,148	1,127	1,136	1,125	1,131	1,138	6.38	20	220
Sub-Total	4,849	4,884	4,911	4,927	4,945	4,961	4,990	4,921	4,960	4,937	4,965	4,957	27.80		3,370
Delivery													0.00		
Hauling	4	5	7	9	9	9	6	7	5	5	4	5	0.03		
Total	17,374	17,455	17,615	17,724	17,690	17,781	17,864	17,728	17,806	17,746	17,823	17,830	100.00		10,364

Table 4 : Inflow of Sewage Treatment Plant (April 1990 - March 1991) (Unit: cu. m/d)

Date	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar
1	3,307.70	620.20	3,477.30	4,637.82	661.20	3,789.63	624.30	1,770.72	1,977.70	2,839.40	1,121.82	1,025.40
2	3,202.60	630.80	2,769.20	4,637.82	0.00	3,789.63	624.30	1,770.72	752.90	3,009.40	1,121.82	1,025.40
3	3,110.50	852.90	352.90	4,637.82	0.00	3,789.63	1,032.50	1,770.72	979.20	2,995.40	1,121.82	1,025.40
4	3,502.40	845.50	940.55	4,637.82	0.00	0.00	3,638.10	1,770.72	1,021.90	2,344.30	1,121.82	1,025.40
5	3,502.40	216.50	940.55	4,737.10	0.00	0.00	5,795.02	1,770.72	897.30	2,833.80	1,121.82	1,025.40
6	3,502.40	643.70	1,884.20	5,662.23	0.00	0.00	5,795.02	1,770.72	1,200.20	2,777.40	1,200.50	1,025.40
7	3,502.40	632.50	1,247.22	5,662.23	0.00	0.00	5,795.02	1,770.72	1,521.00	3,019.70	1,200.50	1,025.40
8	3,502.40	541.50	1,247.22	5,662.23	0.00	0.00	5,795.02	1,770.72	1,092.90	2,097.30	1,200.50	1,025.40
9	3,502.40	913.20	1,247.22	6,450.30	0.00	0.00	4,796.20	1,770.72	1,009.20	2,334.10	1,200.50	1,025.40
10	3,502.40	362.30	1,247.22	5,076.00	3,603.57	0.00	2,388.60	1,770.72	1,222.70	3,124.00	1,200.50	1,025.40
11	3,622.40	310.30	1,247.22	3,805.00	3,603.57	0.00	2,388.60	1,770.72	1,019.60	3,124.30	1,200.50	1,025.40
12	3,998.90	1,488.50	3,229.00	2,340.28	3,603.57	0.00	9,814.40	1,770.72	982.70	9,182.08	1,200.50	1,025.40
13	3,384.44	434.55	3,229.00	2,340.28	4,587.10	0.00	5,171.84	1,324.23	991.40	9,182.08	1,200.50	1,025.40
14	3,384.44	434.55	3,184.10	2,340.28	2,764.00	0.00	5,171.84	1,324.23	1,201.30	9,182.08	1,200.50	1,025.40
15	3,384.44	2,656.30	3,184.10	2,340.28	3,146.70	0.00	5,171.84	1,324.23	1,109.80	9,182.08	1,200.50	1,025.40
16	3,384.44	812.20	3,313.77	2,340.28	3,798.24	0.00	5,171.84	2,019.60	1,692.90	9,182.08	1,200.50	1,025.40
17	3,384.44	475.20	3,313.77	2,400.81	3,798.24	0.00	5,171.84	1,921.30	1,301.30	9,182.08	1,200.50	1,025.40
18	3,526.70	1,282.10	3,313.77	2,400.81	3,798.24	0.00	5,791.00	505.52	992.10	9,182.08	1,200.50	1,025.40
19	3,028.20	713.67	3,161.30	2,400.81	3,798.24	0.00	5,791.00	505.52	1,550.90	9,182.08	1,200.50	1,025.40
20	2,987.10	713.67	2,571.20	2,400.81	3,798.24	0.00	5,791.00	505.52	1,302.70	9,182.08	1,200.50	1,025.40
21	2,991.47	713.67	5,861.10 *1/	2,400.81	8,460.10	0.00	8,726.20	505.52	1,730.20	9,182.08	1,200.50	1,025.40
22	2,991.47	122.10	1,390.00	2,400.81	5,867.80	0.00	5,550.70	4,201.00	1,785.60	1,206.50	1,200.50	1,025.40
23	2,991.47	409.40	2,482.47	2,400.81	5,867.80	0.00	6,130.10	4,201.00	1,920.70	848.40	1,200.50	1,025.40
24	2,991.47	341.30	2,482.47	2,400.81	5,867.80	0.00	0.00	4,220.60	1,890.40	1,109.60	1,200.50	1,025.40
25	2,991.47	854.20	2,482.47	2,400.81	3,789.63	0.00	0.00	1,930.20	1,902.60	1,200.90	1,200.50	1,025.40
26	2,991.47	3,929.00	2,482.47	3,601.22	3,789.63	0.00	0.00	2,101.30	2,236.70	1,466.35	1,200.50	1,025.40
27	3,527.40	735.00	9,663.00 *1/	3,601.22	3,789.63	0.00	0.00	2,199.10	2,300.90	1,466.35	1,200.50	1,025.40
28	3,004.70	735.00	5,414.00 *1/	3,601.22	3,789.63	0.00	0.00	1,992.70	2,203.50	1,333.20	1,200.50	1,025.40
29	3,436.90	2,768.00	3,880.90	3,601.22	3,789.63	0.00	0.00	2,624.50	1,982.50	1,333.20		1,025.40
30	3,859.30	2,768.00	8,425.60 *1/	3,601.22	3,789.63	0.00	1,760.65	2,229.70	2,007.60	1,333.20		1,025.40
31		282.10		3,601.22	3,789.63		1,760.65		2,680.20	1,333.20		1,025.40
Total	100,000.22	29,237.91	89,665.29	110,522.38	93,551.82	11,368.89	115,647.58	56,884.41	46,460.60	134,950.80	33,220.60	31,787.40
Average (cu. m/d)	3,333.34	943.16	2,988.84	3,565.24	4,067.47	3,789.63	4,625.90	1,896.15	1,498.73	4,353.25	1,186.45	1,059.58

*1/ Due to heavy rain.

Table 5 : Power Consumption of Sewage Treatment Plant (April 1990 - March 1991) (Unit: kwh/d)

Date	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar
1	708.00	715.00	654.00	732.75	719.00	555.20	652.00	894.00	780.00	770.00	600.00	788.06
2	820.00	715.00	1,354.00	732.75	675.86	555.20	652.00	894.00	780.00	790.00	600.00	788.06
3	772.00	715.00	581.00	732.75	675.86	555.20	430.00	894.00	780.00	760.00	600.00	788.06
4	920.28	715.00	546.00	732.75	675.86	751.00	787.00	894.00	780.00	800.00	600.00	788.06
5	920.28	715.00	546.00	766.00	675.86	898.00	780.25	894.00	780.00	780.00	600.00	788.06
6	920.28	715.00	692.00	561.00	675.86	553.00	780.25	894.00	780.00	770.00	557.04	788.06
7	920.28	301.00	694.40	561.00	675.86	994.00	780.25	894.00	780.00	790.00	557.04	788.06
8	920.28	344.00	694.40	561.00	675.86	732.00	780.25	894.00	780.00	780.00	557.04	788.06
9	920.28	562.00	694.40	1,027.00	735.00	730.20	724.00	894.00	770.00	901.00	557.04	788.06
10	920.28	656.00	694.40	771.00	760.33	730.20	361.00	894.00	790.00	701.00	557.04	788.06
11	841.00	730.00	694.40	802.00	760.33	730.20	361.00	894.00	780.00	701.00	557.04	788.06
12	681.00	510.00	805.50	678.00	760.33	730.20	1,502.00	894.00	780.00	736.10	557.04	788.06
13	887.40	677.00	805.50	678.00	837.00	730.20	722.80	520.67	780.00	736.10	557.04	788.06
14	887.40	677.00	733.00	678.00	702.00	550.50	722.80	520.67	780.00	736.10	557.04	788.06
15	887.40	640.00	733.00	678.00	794.00	550.50	722.80	520.67	780.00	736.10	557.04	788.06
16	887.40	880.00	785.33	678.00	442.00	706.00	722.80	1,502.00	790.00	736.10	557.04	788.06
17	887.40	520.00	785.33	0.00	442.00	702.00	722.80	716.00	770.00	736.10	557.04	788.06
18	712.00	780.00	785.33	0.00	442.00	820.00	722.00	190.25	780.00	736.10	557.04	788.06
19	850.00	595.33	693.00	0.00	442.00	628.86	722.00	190.25	770.00	736.10	557.04	788.06
20	463.00	595.33	660.00	0.00	442.00	628.86	722.00	190.25	790.00	736.10	557.04	788.06
21	793.17	595.33	737.00	0.00	746.00	628.86	791.00	190.25	780.00	736.10	557.04	788.06
22	793.17	674.00	771.00	0.00	720.67	628.86	730.00	1,541.50	780.00	603.00	557.04	788.06
23	793.17	701.00	345.75	0.00	720.67	628.86	490.00	1,541.50	790.00	785.00	557.04	788.06
24	793.17	618.00	345.75	0.00	720.67	628.86	767.00	1,383.00	770.00	751.00	557.04	788.06
25	793.17	731.00	345.75	0.00	555.20	628.86	767.00	780.00	780.00	850.00	557.04	788.06
26	793.17	766.00	345.75	687.00	555.20	752.00	767.00	780.00	780.00	760.00	557.04	788.06
27	715.00	752.00	401.00	687.00	555.20	752.00	767.00	780.00	780.00	760.00	557.04	788.06
28	715.00	657.67	818.00	687.00	555.20	752.00	767.00	780.00	780.00	722.75	557.04	788.06
29	715.00	657.67	562.00	687.00	555.20	611.00	767.00	780.00	780.00	722.75		788.06
30	715.00	657.67	958.00	687.00	555.20	611.00	785.00	780.00	780.00	722.75		788.06
31		601.00		687.00	555.20		785.00		780.00	722.75		788.06
Total	24,344.98	20,169.00	20,260.99	15,492.00	19,803.42	20,453.62	22,553.00	24,415.01	24,180.00	23,304.00	15,811.92	24,429.86
Average (kwh/d)	811.50	650.61	675.37	704.18	638.82	681.79	727.52	813.83	780.00	751.74	564.71	788.06

fname:powcon90

Table 6 : Unit Power Consumption of Sewage Treatment Plant (April 1990 - March 1991) (Unit: kwh/cu m sewage)

Date	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar
1	0.21	1.15	0.19	0.16	1.09	0.15	1.04	0.50	0.39	0.27	0.53	0.77
2	0.26	1.13	0.49	0.16	0.00	0.15	1.04	0.50	1.04	0.26	0.53	0.77
3	0.25	0.84	1.65	0.16	0.00	0.15	0.42	0.50	0.80	0.25	0.53	0.77
4	0.26	0.85	0.58	0.16	0.00	0.00	0.22	0.50	0.76	0.34	0.53	0.77
5	0.26	3.30	0.58	0.16	0.00	0.00	0.13	0.50	0.87	0.28	0.53	0.77
6	0.26	1.11	0.37	0.10	0.00	0.00	0.13	0.50	0.65	0.28	0.46	0.77
7	0.26	0.48	0.56	0.10	0.00	0.00	0.13	0.50	0.51	0.26	0.46	0.77
8	0.26	0.64	0.56	0.10	0.00	0.00	0.13	0.50	0.71	0.37	0.46	0.77
9	0.26	0.62	0.56	0.16	0.00	0.00	0.15	0.50	0.76	0.39	0.46	0.77
10	0.26	1.81	0.56	0.15	0.21	0.00	0.15	0.50	0.65	0.22	0.46	0.77
11	0.23	2.35	0.56	0.21	0.21	0.00	0.15	0.50	0.77	0.22	0.46	0.77
12	0.17	0.34	0.25	0.29	0.21	0.00	0.15	0.50	0.79	0.08	0.46	0.77
13	0.26	1.56	0.25	0.29	0.18	0.00	0.14	0.39	0.79	0.08	0.46	0.77
14	0.26	1.56	0.23	0.29	0.25	0.00	0.14	0.39	0.65	0.08	0.46	0.77
15	0.26	0.24	0.23	0.29	0.25	0.00	0.14	0.39	0.70	0.08	0.46	0.77
16	0.26	1.08	0.24	0.29	0.12	0.00	0.14	0.74	0.47	0.08	0.46	0.77
17	0.26	1.09	0.24	0.00	0.12	0.00	0.14	0.37	0.59	0.08	0.46	0.77
18	0.20	0.61	0.24	0.00	0.12	0.00	0.12	0.38	0.79	0.08	0.46	0.77
19	0.28	0.83	0.22	0.00	0.12	0.00	0.12	0.38	0.50	0.08	0.46	0.77
20	0.15	0.83	0.26	0.00	0.12	0.00	0.12	0.38	0.61	0.08	0.46	0.77
21	0.27	0.83	0.13	0.00	0.09	0.00	0.09	0.38	0.45	0.08	0.46	0.77
22	0.27	5.52	0.55	0.00	0.12	0.00	0.13	0.37	0.44	0.50	0.46	0.77
23	0.27	1.71	0.14	0.00	0.12	0.00	0.08	0.37	0.41	0.93	0.46	0.77
24	0.27	1.81	0.14	0.00	0.12	0.00	0.00	0.33	0.41	0.68	0.46	0.77
25	0.27	0.86	0.14	0.00	0.15	0.00	0.00	0.40	0.41	0.71	0.46	0.77
26	0.27	0.19	0.14	0.19	0.15	0.00	0.00	0.37	0.35	0.52	0.46	0.77
27	0.20	1.02	0.04	0.19	0.15	0.00	0.00	0.35	0.34	0.52	0.46	0.77
28	0.24	0.89	0.15	0.19	0.15	0.00	0.00	0.39	0.35	0.54	0.46	0.77
29	0.21	0.24	0.14	0.19	0.15	0.00	0.00	0.30	0.39	0.54		0.77
30	0.19	0.24	0.11	0.19	0.15	0.00	0.45	0.35	0.39	0.54		0.77
31		2.13		0.19	0.15		0.45		0.29	0.54		0.77
Total	7.33	37.88	10.47	4.21	4.47	0.44	6.13	13.09	18.02	9.97	13.35	23.82
Average(kwh/d)	0.24	1.22	0.35	0.19	0.19	0.15	0.25	0.44	0.58	0.32	0.48	0.79

fname:unit90
8/16/91

Table 7 : Results of Water Quality Analysis at Sewage Treatment Plant (November 1990 - April 1991)

Date	Time	Raw Sewage							Treated Sewage							Oxidation Ditch Mixed Liquor					Eff.
1991		SS (mg/l)	T-COD (mg/l)	S-COD (mg/l)	pH	Trans	T-BOD (mg/l)	S-BOD (mg/l)	SS (mg/l)	T-COD (mg/l)	S-COD (mg/l)	pH	Trans	T-BOD (mg/l)	S-BOD (mg/l)	pH	SV	SVI	MLSS (mg/l)	Temp.	Re. Cl (mg/l)
Nov. 2	1:45 P.M.	230.00			7.35	2.75			4.00			7.10	30 +			7.15			1,680.00		
Nov. 3	8:50 A.M.				7.55	3.25						7.15	30 +			7.25					
Nov. 4	8:45 A.M.				7.55	3.25						7.00	30 +			7.20					
Nov. 5	8:25 A.M.				7.75	2.75						6.65	30 +			7.15	8.00				
Nov. 6	8:50 A.M.		201.60	165.76	7.60	2.25				13.87	13.07	7.05	30 +			7.25	8.50				
Nov. 7	8:25 A.M.	160.00			7.60	2.75			10.00			7.15	30 +			7.25	9.00		2,670.00		
Nov. 11	4:30 P.M.				7.55	2.75						7.10	30 +			7.10					
Nov. 12	9:00 A.M.				7.55	2.24						6.95	30 +			6.95	9.00				
Nov. 15	8:45 A.M.				7.50	3.00						7.05	30 +			7.10					
Nov. 19	9:40 A.M.				7.65	2.75						7.15	30 +			7.05					
Nov. 22	8:40 A.M.		201.60	103.04	7.80	2.25				20.26	2.38	6.95	30 +			6.85	9.00				
Nov. 23	9:00 A.M.	560.00			7.65	2.00			9.00			6.80	30 +			6.85			2,950.00		
Dec. 7			186.60	73.92	7.65	3.00				18.66	9.33	7.10	30 +			6.80	10.00				
Dec. 22	4:30 P.M.		126.93	98.56	7.50	2.50				17.06	19.60	7.25	30 +			6.90	8.00				
1991																					
Jan. 3	12:30 A.M.	720.00	291.20	112.00	7.35	2.75			20.00	12.80	10.73	7.00	30 +			7.15			3,240.00		
Jan. 4	9:05 A.M.				7.75	2.50	346.44	190.16				7.05	30 +	9.60	4.77	7.10					
Jan. 9	1:45 P.M.	250.00	119.46	67.20	7.45	2.50			16.67	17.06	13.07	6.80	30 +			6.95			4,360.00		
Jan. 10	9:30 A.M.				7.65	2.75						6.75	30 +			6.80	14.50				
Jan. 11	8:45 A.M.				7.85	2.25	275.90	168.73				6.80	30 +	10.93	8.17	6.85					
Jan. 16	1:00 P.M.	220.00	128.00	81.60	7.45	2.25			10.00	17.14	16.50	6.90	30 +			6.75			3,600.00		
Jan. 17	9:00 A.M.				7.95	2.00	299.59	175.73				6.85	30 +	14.73	8.22	6.95	11.00				
Jan. 22	4:00 P.M.		128.00	72.00	7.40	2.50				17.14	9.00	6.95	30 +			6.90	9.00				
Jan. 24	10:00 A.M.	490.00			7.60	2.00	280.42	132.02	16.00			6.95	30 +	14.88	5.43	7.65	14.00		4,100.00		
Jan. 29	1:15 P.M.	210.00	208.00	81.60	7.55				16.00	12.00	15.50	7.05	30 +			7.05	14.00		4,800.00		
Jan. 31	1:35 P.M.		136.00	91.20	7.45							5.70	15.00	7.05		7.05	14.00				
Feb. 1	1:20 P.M.				7.60	2.60	272.73	184.91				7.20	30 +	17.45	8.84	7.25					
Feb. 5	1:00 P.M.		152.00	100.80	7.50	2.25				12.57	20.00	7.15	30 +			7.15	13.50				
Feb. 12	12:45 A.M.	310.00			7.50	2.25	154.13	60.44	8.00			7.25	30 +	14.59	15.87	7.25	15.00		4,900.00		
Feb. 13	12:30 A.M.				7.65	3.00						7.25	30 +			7.30					
Feb. 14	8:45 A.M.		194.13	107.52	7.80	2.00				14.93	15.23	7.20	30 +			7.30	14.00				
Feb. 19	9:25 A.M.	530.00	238.93	112.00	7.85	2.25			16.00	16.00	14.47	7.15	30 +			7.05			5,150.00		
Feb. 21	8:40 A.M.				7.85	2.00	328.10	141.36				7.05	30 +	16.36	8.27	7.15	15.50				
Feb. 26	1:50 P.M.		134.40	76.16	7.50	2.25				25.72	21.62	7.25	30 +								
Mar. 1	8:10 A.M.	730.00			7.95	2.00	229.04	157.46	20.00			7.00	30 +	11.09	4.83	6.85	16.50		5,266.70		
Mar. 7	9:00 A.M.	470.00			7.55	2.50	230.94	157.80	22.00			6.95	30 +	6.35	5.33	6.90	16.50		5,366.70		
Mar. 14	1:40 P.M.	320.00			7.50	2.25	232.73	154.52	6.00			6.95	30 +	5.23	4.27	6.65	17.00		5,550.00		
Apr. 2	9:45 A.M.															6.65	16.00				
Apr. 4	9:20 A.M.															6.90	15.00				
Apr. 5	9:15 A.M.				7.70							6.80				6.80	17.50				
Apr. 8	9:45 A.M.		16.80	57.60	7.80	2.50				16.89	8.00	6.75	30 +			6.75	16.50				
Apr. 9	9:30 A.M.				7.90	2.40						6.90	30 +			6.75	17.00				
Apr. 10	9:45 A.M.	360.00			7.50	2.40			38.67			6.95	30 +			7.00	19.00		4,200.00		
Apr. 11	9:30 A.M.				7.80	2.40	298.19	196.51				6.80	30 +	1.92		6.80	16.00				
Apr. 12	9:45 A.M.				7.90	2.70						6.60	30 +			6.70	16.50				
Apr. 16	9:15 A.M.				7.60							6.50				6.40	12.50				
Apr. 17	10:00 A.M.				7.80	2.40						6.75	30 +			7.00	12.50				
Apr. 18	9:45 A.M.				7.60	2.42						6.50	30 +			6.40	13.00				
Apr. 19	9:30 A.M.				7.80	2.40						6.75	30 +			6.40	12.00				
Apr. 22					7.80	3.50						6.60	30 +			6.70	11.00				
Apr. 24					7.60	2.30						6.80	30 +			6.80	15.00				
Apr. 25					7.90	2.50						7.10	30 +			6.80	17.00				
Apr. 26					7.90	2.50						6.70	30 +			6.90	17.00				
Apr. 29					7.80	2.00						6.90	30 +			7.00	14.00				
Apr. 30					7.80	2.45										7.00	14.00				
No. of Samples		14	15	15	52	48	11	11	14	14	14	51	49	12	10	53	38		14		
Maximum		730.00	291.20	165.76	7.95	3.50	346.44	196.51	38.67	25.72	21.62	7.25	30 +	17.45	15.87	7.65	19.00		5550.00		
Minimum		160.00	16.80	57.60	7.35	2.00	154.13	60.44	4.00	12.00	2.38	5.70	15.00	1.92	4.27	6.40	8.00		1680.00		
Average		296.11	123.18	70.05		2.20	184.26	107.48	11.57	12.22	9.92		30 +	7.66	4.93	6.31	12.03		3119.63		

Table 8 Financial Internal Rate of Return before Depreciation

Unit: Peso

YEAR	Cost						Total Cost	Benefit	Net Benefit	Sewerage Inflow (Year)	Sewerage Charge (P/cu.m)
	Personnel	Chemical	Power	Repair	Other	Depreciation					
1990	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	600,000	-2,828,141	3,024,000	0.2
1991	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	907,200	-2,520,941	3,024,000	0.3
1992	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	1,512,000	-1,916,141	3,024,000	0.5
1993	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	2,419,200	-1,008,941	3,024,000	0.8
1994	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	3,024,000	-404,141	3,024,000	1.0
1995	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	3,144,960	-283,181	3,024,000	1.0
1996	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	3,270,758	-157,383	3,024,000	1.1
1997	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	3,401,589	-26,552	3,024,000	1.1
1998	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	3,537,652	109,511	3,024,000	1.2
1999	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	3,679,158	251,017	3,024,000	1.2
2000	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	3,826,325	398,184	3,024,000	1.3
2001	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	3,979,378	551,237	3,024,000	1.3
2002	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	4,138,553	710,412	3,024,000	1.4
2003	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	4,304,095	875,954	3,024,000	1.4
2004	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	4,476,259	1,048,118	3,024,000	1.5
2005	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	4,655,309	1,227,168	3,024,000	1.5
2006	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	4,841,521	1,413,380	3,024,000	1.6
2007	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	5,035,182	1,607,041	3,024,000	1.7
2008	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	5,236,590	1,808,449	3,024,000	1.7
2009	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	5,446,053	2,017,912	3,024,000	1.8
2010	936,000	254,259	1,977,882	200,000	60,000	0	3,428,141	5,663,895	2,235,754	3,024,000	1.9
TOTAL	19,656,000	5,339,439	41,535,522	4,200,000	1,260,000	0	71,990,961	77,099,677	5,108,716	63,504,000	

FIRR = 3.07%

Table 9 Financial Internal Rate of Return after Depreciation

Unit: Peso

YEAR	Cost						Total Cost	Benefit	Net Benefit	Sewerage Inflow (Year)	Sewerage Charge (P/cu.m)
	Personnel	Chemical	Power	Repair	Other	Depreciation					
1990	936,000	254,259	1,977,882	200,000	60,000	7,056,716	10,484,857	600,000	-9,884,857	3,024,000	0.2
1991	936,000	254,259	1,977,882	200,000	60,000	7,056,716	10,484,857	3,024,000	-7,460,857	3,024,000	1.0
1992	936,000	254,259	1,977,882	200,000	60,000	7,056,716	10,484,857	6,048,000	-4,436,857	3,024,000	2.0
1993	936,000	254,259	1,977,882	200,000	60,000	7,056,716	10,484,857	9,072,000	-1,412,857	3,024,000	3.0
1994	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	12,096,000	-1,188,260	3,024,000	4.0
1995	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	12,458,880	-825,380	3,024,000	4.1
1996	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	12,832,646	-451,614	3,024,000	4.2
1997	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	13,217,626	-66,635	3,024,000	4.4
1998	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	13,614,155	329,894	3,024,000	4.5
1999	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	14,022,579	738,319	3,024,000	4.6
2000	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	14,443,257	1,158,996	3,024,000	4.8
2001	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	14,876,554	1,592,294	3,024,000	4.9
2002	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	15,322,851	2,038,591	3,024,000	5.1
2003	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	15,782,536	2,498,276	3,024,000	5.2
2004	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	16,256,013	2,971,752	3,024,000	5.4
2005	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	16,743,693	3,459,432	3,024,000	5.5
2006	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	17,246,004	3,961,743	3,024,000	5.7
2007	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	17,763,384	4,479,123	3,024,000	5.9
2008	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	18,296,285	5,012,025	3,024,000	6.1
2009	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	18,845,174	5,560,913	3,024,000	6.2
2010	936,000	254,259	1,977,882	200,000	60,000	9,856,119	13,284,260	19,410,529	6,126,269	3,024,000	6.4
TOTAL	19,656,000	5,339,439	41,535,522	4,200,000	1,260,000	195,780,896	267,771,857	281,972,165	14,200,309	63,504,000	

FIRR = 3.01%

IN THE REPUBLIC OF THE PHILIPPINES (SUPPLEMENTARY STUDY)

NOVEMBER, 1991 JAPAN INTERNATIONAL COOPERATION AGENCY