JAPAN INTERNATIONAL COOPERATION AGENCY
REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

BASIC DESIGN STUDY REPORT

ON

THE PROJECT FOR THE REHABILITATION

OF

THE BALARA WATER TREATMENT PLANT

IN

THE REPUBLIC OF THE PHILIPPINES

JANUARY, 1994

NIPPON JOGESUIDO SEKKEI CO., LTD.

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PREFACE

In response to a request from the Government of the Republic of the Philippines, the Government of Japan decided to conduct a basic design study on the Project for the Rehabilitation of the Balara Water Treatment Plant and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to the Philippines a study team headed by Mr. Fumio Kikuchi, Deputy Director, Consultant Contract Division, Procurement Department, JICA, and constituted by members of Nippon Jogesuido Sekkei Co., Ltd. from August 4 to September 2, 1993.

The team held discussions with the officials concerned of the Government of the Philippines, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to the Philippines in order to discuss a draft report, and as this result, the present report was finalized.

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

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

January, 1994

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

January, 1994

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

We are pleased to submit to you the basic design study report on "the Project for the Rehabilitation of the Balara Water Treatment Plant" in the Republic of the Philippines.

This study was conducted by the Nippon Jogesuido Sekkei Co., Ltd., under a contract to JICA, during the period August 2, 1993 to January 6, 1994. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of the Philippines, and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

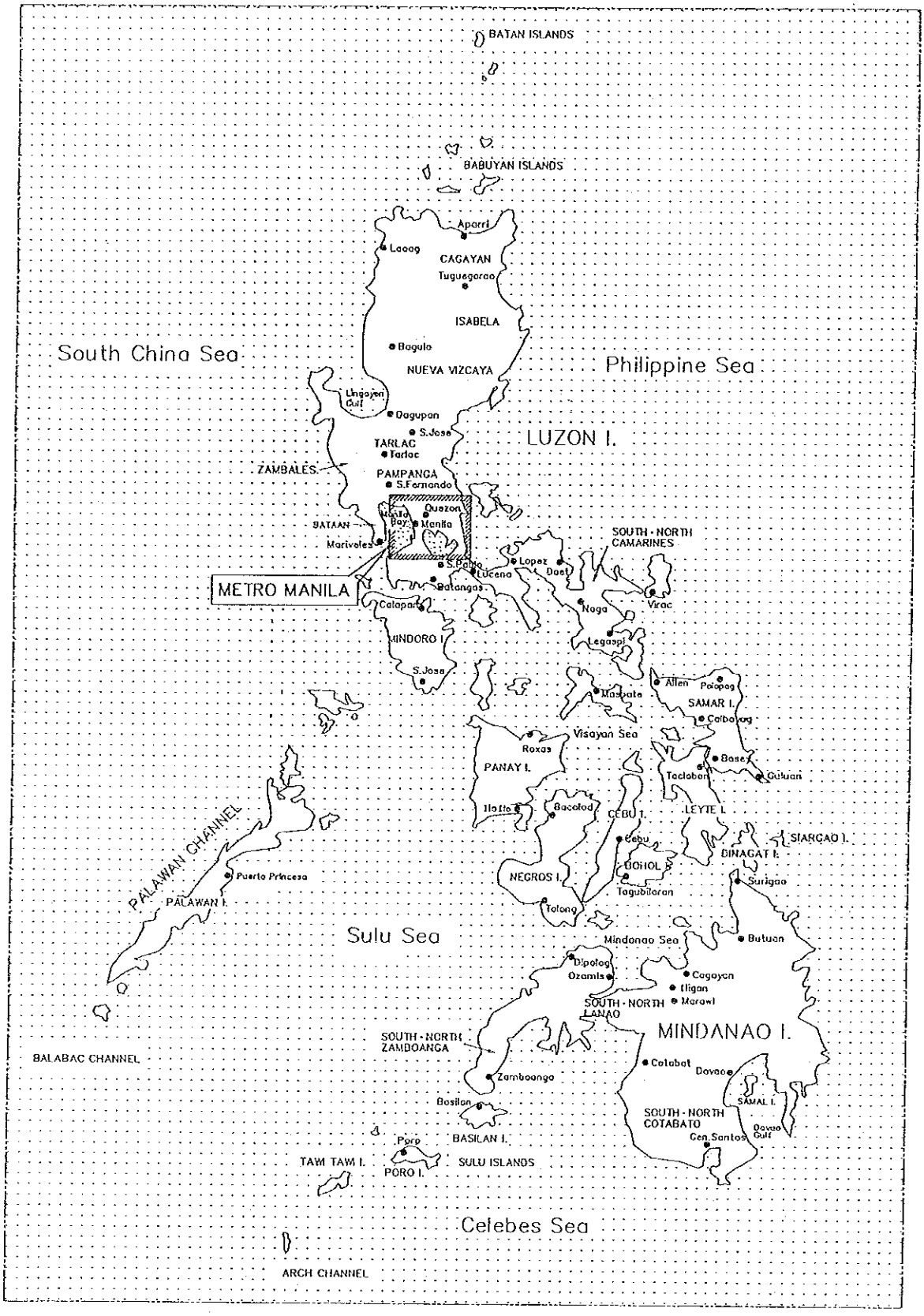
We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs, and the Ministry of Health and Welfare. We would also like to express our gratitude to the officials concerned of the Metropolitan Waterworks and Sewerage System, the JICA Philippine office and the Embassy of Japan in the Philippines for their cooperation and assistance throughout our field survey.

Finally, we hope that this report will contribute to further promotion of the project.

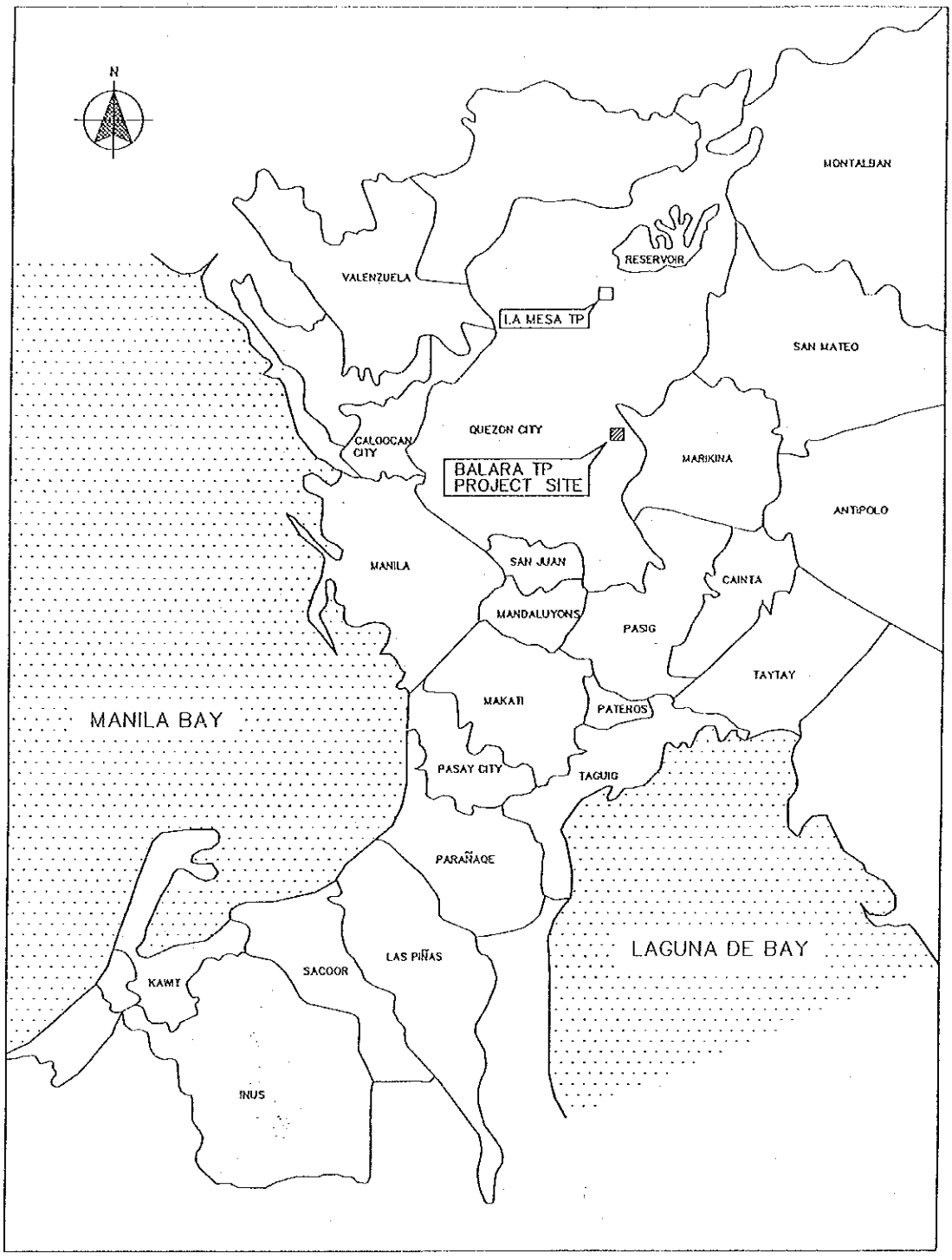
Very truly yours,

Y. Sato

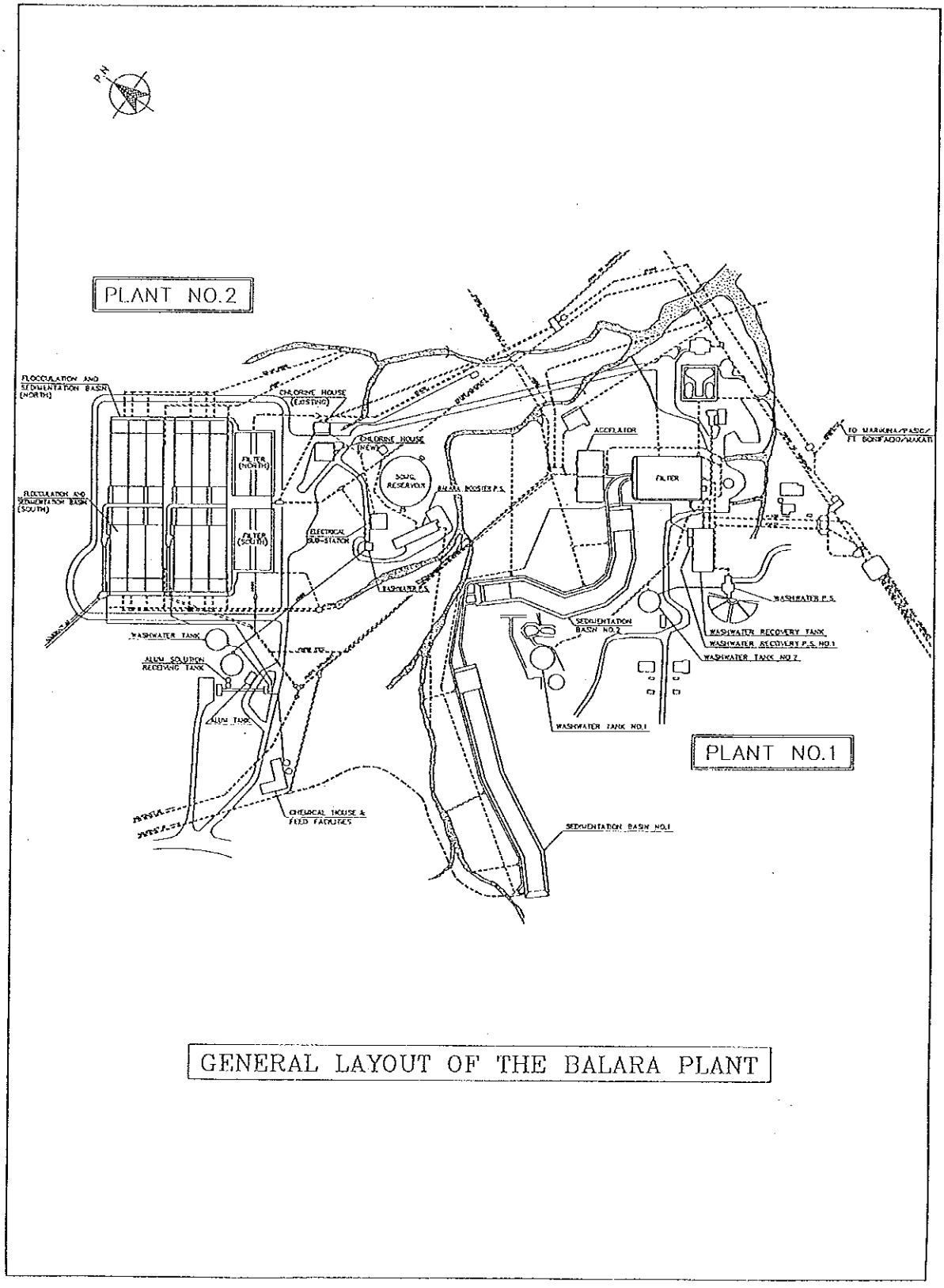
Yoshihiko Sato
Project Manager,
Basic design study team on
the Project for the Rehabilitation
of the Balara Water Treatment Plant.
Nippon Jogesuido Sekkei Co., Ltd.



THE REPUBLIC OF THE PHILIPPINES



LOCATION MAP OF THE PROJECT SITE



GENERAL LAYOUT OF THE BALARA PLANT

SUMMARY

SUMMARY

The Metropolitan Waterworks and Sewerage System (MWSS) provides for the potable water supply requirements and manages for the sewerage systems of Metro Manila, an area exceeding 1,800 sq. km, comprising 4 cities and 13 municipalities as well as one city and 19 municipalities adjacent to it. The MWSS is responsible for the planning, design, construction, operation and maintenance of the water supply and sewerage dispose systems for the Greater Metro Manila Area utilizing its revenues, borrowed funds and government capital contribution.

In Metro Manila, the water supply situation poses problems of greater variety and dimensions. Its population steadily increases every year, exerting mounting pressure on the capacity of the water supply. In 1991, the Angat Water Supply Optimization Project (AWSOP) was brought about to alleviate the present difficulties and to increase the MWSS's ability to serve Metro Manila's growing water demand. It was determined in the AWSOP that the population of Metro Manila is expected to reach 11.15 million by the year 2000 and that water demand is projected to be 3.8 million cubic meters by 1996. As of 1993, only about 63 % of the area's present population had access to piped water supply systems, a ratio that will be unsupportable without intervention.

To address the current short fall, and to provide for the additional water supply requirements due to population growth, several major projects and programs are being undertaken. The AWSOP is a large-scale effort which is connected to a number of core projects intended to have a major impact on the MWSS's operations, such as the Manila Water Supply Rehabilitation Projects I and II, as well as a number of smaller-scale projects which address related issues, such as the Study for the Groundwater Development in Metro Manila. A key part of the AWSOP is the rehabilitation of the Balara Water Treatment Plant. This project will maximize the capability of the water system in conjunction with the new developments/improvements. The Plant is one of the two huge water treatment plants in Metro Manila and it is rapidly deteriorating.

The Balara Water Treatment Plant treats an average of 1.35 million cu.m/d of water which is then supplied to around 6 million residents of the area. The

Plant has two plant systems, namely; Plant No.1, and Plant No.2 which were constructed in 1935 and 1958, respectively. The Plant has a combined designed production capacity of 1.6 million cu.m/d. The present supply has dropped considerably due to plant deterioration and operating difficulties. Likewise, the quality of water produced in the Plant deteriorates and oftentimes does not meet the requirements of the National Drinking Water Standards. At present, the plant is a vital component of the water supply system since it accounts for about 60% of the total water supply production for the Metro Manila Area.

The need to rehabilitate the Plant in order to optimize efforts for efficient operations and adequate maintenance has been recognized by the MWSS. However, due to budgetary and technical constraints, the MWSS could not address this necessity.

Thus, the Government of the Philippines (GOP) sought the assistance of the Government of Japan (GOJ) to undertake the rehabilitation of the Balara Water Treatment Plant to ensure treated water of acceptable quality, and to facilitate a technology transfer for ensuring the proper operation and maintenance of the Plant.

In response to this request, the GOJ decided to conduct a feasibility and a basic design study to assess the contents of the request and conducted field surveys and tested to determine the optimum rehabilitation plan for the Balara Water Treatment Plant. The Japan International Cooperation Agency (JICA) sent to the Philippines a Feasibility Study Team twice during August, 1991 to February, 1992; and a Basic Design Study Team from August 4, to September 2, 1993.

Both studies reaffirmed the request of the GOP and the urgency and importance of providing safe and stable water to the populace of the Metro Manila Area.

The Balara Treatment Plant Rehabilitation Project aims to rehabilitate the facilities and equipment of the Plant in order to restore it to its design capacity and to improve the treated water quality to meet the National Drinking Water Standards. The proposed rehabilitation plan consists of the improvement of treatment process and the replacement of the deteriorated

facilities and equipment.

Table 1 shows the list of equipment and facilities to be rehabilitated.

The MWSS will be the responsible agency in the implementation of the Project, an attached agency of the Department of Public Works and Highways (DPWH). The material procurement plan takes into consideration the Philippine and Japanese procurement method. Materials to be procured locally are cement, reinforcing rods, and aggregate and bricks. Materials to be procured in Japan are pumps, water treatment facilities and equipment, PVC pipes, valves, instruments, electrical equipment, laboratory and special maintenance tools and plywood forms.

The project period will entail a total of 27 months with an estimated 8 months allocated to Exchange of Notes, Detailed Design, Bidding, and Contract Agreement and the remaining 19 months to construction activities such as manufacturing, inspection, shipping, installation/construction, test run, and training.

The major direct effects of the Plant operation resulting from the implementation of the Project are:

1. Proper and trouble-free distribution of raw water to Plants No.1 and No.2.
2. Improvement of the coagulation/flocculation/sedimentation processes.
3. Improvement of the filtration process.
4. Appropriate chemical feeding rates.
5. Improvement of the treated water quality and the treatment capacity of the Plant.

In general, the Project is in concurrence with the National Plan and the Water Supply, Sewerage and Sanitation Master Plan, and it is expected to supply potable water to more than 6 million residents in Metro Manila and the surrounding area. In addition, the Project will contribute to develop the industrial sector and to the improvement of the living and health conditions of the residents of the Metro Manila Area by upgrading the delivery of water supply services. However, to maximize Projects effects and benefits, the following steps should be undertaken:

1. Before Project Implementation

a. Secure necessary budget for the portion of Project to be implemented by the MWSS.

b. Organize a promotion committee for the Project to ensure smooth cooperation regarding the Project.

c. Make efforts in public relations regarding consumers who have overhead tanks or underground sumps on their property to improve the sanitary conditions of the distributed water so as to avoid contamination.

2. During Project Implementation

a. Implement expansion projects for the water distribution systems to accelerate Project effects.

b. Organize a Project Team on exclusively a full-time basis for the project to take part in the detailed design period as well as in the construction period.

3. After Project Implementation

a. Improve collection efficiency of water revenues which is where the budget for O&M will come from.

b. Secure a budgetary scheme for future rehabilitation works of the Plant.

c. Implement preventive O&M regularly.

d. Secure a budgetary scheme sufficient for O&M.

e. Implement training for the officials concerned with O&M.

f. Develop institutional and supervisory responsibility for the facilities and equipment.

g. Implement raw water source control in order to secure good quality raw water for the application of the existing treatment process.

h. Secure appropriate storerooms to keep spare parts and tools purchased under the Grant Aid at the Balara Plant.

PLANT No. 1 REHABILITATION PLAN

No	Facilities	Rehabilitation	Quantity	Specification
1.	Aqueduct No. 1 & 2	Replacement of gates	4 gates	Nominal dim. (approx) W 2,200mm x D 2,200mm
2.	Rapid Mixer	Replacement of rapid mixers	2 units	Type : Vertical type mixer
3.	Flocculation Basin	Replacement of flocculators	24 units	Type : Vertical type mixer
4.	Sedimentation Basin	Construction of baffle walls	L.S.	R.C.
		Construction of launders	L.S.	R.C.
5.	Accelator	(1)Replacement of driving unit	2 units	Worm gear type reduction gear
		(2)Replacement of sludge withdrawal device	2 sets	Sludge withdrawal valve : 8 units Emergency gate valve : 2 units
		(3)Replacement of corroded part material	1 L.S.	Material : SS400
6.	Filtration	(1)Replacement of Venturi pipe	10 units	Diameter : 500mm
		(2)Replacement of penstock seat		
		(3)Replacement of flow regulating valve	10 units	Type : Electric type butterfly valve Diameter : 500mm
		(4)Replacement of main backwash valve	1 unit	Type : Electric type butterfly valve Diameter : 800mm
		(5)Replacement of main surface wash valve	1 unit	Type : Electric type butterfly valve Diameter : 450mm
7.	Washwater	(1)Replacement of wash-water pump	2 units	Type : Horizontal type centrifugal pump Delivery : 7.3m^3/min Head : 23m
8.	Washwater-recovery	(1)Replacement of washwater recovery pump	3 units	Type : Horizontal type centrifugal pump Delivery : 3.6m^3/min Head : 15m
		(2)Construction of a pump room	1 room	Concrete block structure
		(3)Change of return pipe line for wash-water recovery	1 unit	Material : Steel pipe

PLANT No.2 REHABILITATION PLAN

No	Facilities	Rehabilitation	Quantity	Specification
1.	Flocculation Basin	(1)Flocculator	108 units	Type : Vertical type mixer
		(2)Construction of a new control panel room	1 room	Concrete block structure
		(3)Structure of baffle walls	1 set	Reinforced concrete structure
2.	Sedimentation Basin	(1)Replacement of supports for sludge drain valve	12 gates	Spindle supports only
		(2)Replacement of flushing pump	2 units	Type : Horizontal type centrifugal pump Delivery : 0.8m^3/min Head : 20m
		(3)Construction of launders	L.S.	R.C.
3.	Filtration	(1)Replacement of Venturi tube	20 units	Diameter : 500mm
		(2)Replacement of penstock seat		
		(3)Rate of flow controller	20 units	Type : Electric type butterfly valve Diameter : 500mm
		(4)Replacement of main surface wash valve	1 unit	Type : Electric type butterfly valve Diameter : 450mm
		(5)Replacement of main backwash valve	1 unit	Type : Electric type butterfly valve Diameter : 1,000mm
4.	Washwater	(1)Replacement of Wash-water pump	3 units	Type : Horizontal type centrifugal pump Delivery : 7.3m^3/min Head : 23m

CHEMICAL DOSING FACILITIES REHABILITATION PLAN

No	Facilities	Rehabilitation	Quantity	Specification
1.	Alum	(1)Replacement of feeder	6 units	Type : Bucket feed type Delivery : 10,20 l/min
2.	Polymer	(1)Replacement of feeder	5 units	Type : Diaphragm pump Delivery : 1,3 l/min
3.	Chlorinator	(1)Replacement of chlorinator	4 units	Type : Manual regulating type Capacity : 150kg/hr.
		(2)Replacement of evaporator	2 units	Type : Water bath type Capacity : 150kg/hr.
		(3)Replacement of chlorine leakage detector	3 sets	Type : Dispersing type
		(4)Replacement of exhaust fan	3 units	Type : Exhaust fan
		(5)Replacement of chlorine booster pump	3 units	Type : Horizontal type centrifugal pump Delivery : 2.0m^3/min Head : 40m
		(6)Replacement of weighing scale	2 units	Type : Loadcell type Capacity : 2 tons

ELECTRICAL/INSTRUMENTATION FACILITIES REHABILITATION PLAN

No.	Facilities	Rehabilitation	Quantity	Specification
1.	Switching station & substation	(1)34.5KV switching station	1 pc.	Load disconnect switch 3phase 34.5KV, 200A, manual operation type
			1 pc.	Earth device 3phase, 34.5KV, manual operation type
		(2)Transformer	3 pcs.	1phase, oil immersed type 250K VA, 2.4KV/480-240V
2.	Plant No.1 Motor control operation panel	(1) a.Sedimentation basin No. 1 MCC	1 unit	Indoor single front type 3phase 460V
		b.Local switch box	13 pcs.	Post type
		(2) a.Sedimentation basin No.2 MCC	1 unit	Indoor single front type 3phase 460V
		b.Local switch box	13 pcs.	Post type
		(3) a.Accelator MCC	1 unit	Indoor single front type 3phase 460V
		b.Local switch box	2 pcs.	Post type
		(4) a.Filter MCC	1 unit	Indoor single front type 3phase 460V
		b.Local switch box	10 pcs.	Post type
		c.Local control panel	1 pc.	Indoor standing type
		(5) a.Washwater pump MCC	1 unit	Indoor single front type 3phase 460V
		b.Washwater pump house distribution	1 pc.	Indoor self-supporting enclosed type 3phase 460V
		(6) a.Washwater recovery pump MCC	1 unit	Indoor single front type 3phase 460V
3.	Plant No.2 Motor Control/ Operation Panel	(1) a.Sedimentation basic MCC	1 unit	Indoor double front type 3phase 460V
		b.Local switch box	110 pcs.	Post type
		c.Low tension main switch panel	1 pc.	Outdoor wall mounted type
		(2) a.Filter MCC	1 unit	Indoor single front type 3phase 460V
		b.Local switch box	20 pcs.	Post type
		c.Local control panel	2 pcs.	Indoor standing type
		d.Low tension main switch panel	1 pc.	Outdoor wall mounted type
		(3) a.Washwater pump MCC	1 unit	Indoor single front type 3phase 460V
		b.Low tension main switch panel	1 pc.	Outdoor wall mounted type
		(4) a.Chlorination MCC	1 unit	Indoor single mounted type 3phase 460V
		b.Local switch box	3 pcs.	Post type
		c.Low tension main switch panel	1 pc.	Outdoor wall mounted type

ELECTRICAL/INSTRUMENTATION FACILITIES REHABILITATION PLAN

No.	Facilities	Rehabilitation	Quantity	Specification
		(5) a.Polymer pump MCC	1 unit	Indoor single front type 3phase 460V
		b.Local switch box	5 pcs.	Post type
4.	Instrumentation facilities	(1) Flow meter accelator		by MWSS
		(2) Main surface wash flow meter	2 units	Differential pressure transmitter
		(3) Main backwash flow meter	2 units	Differential pressure transmitter
		(4) Flow meter for parshall flume		by MWSS
		(5) Flow meter for Plant No.1 sedimentation basins		by MWSS
		(6) Flow Meter for distribution		by MWSS
		(7) Loss of head meter	30 units	
		(8) Level meter for washwater tank	2 units	Submerged type
		(9) Alum storage tank level meter	5 units	Float type
5.	Lighting facilities		L.S.	Arrester
6.	Generator			Unnecessary

OTHERS

No.	Facilities	Rehabilitation	Quantity	Specification
1.	Laboratory equipment		L.S.	Conductivity meter, Jar tester, etc.
2.	Testing equipment		L.S.	Grounding ohmmeter, etc.

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LIST OF ABBREVIATIONS

The following abbreviations have been adopted in this report.

Philippine Government Organization

DA	Deputy Administrator
DPWH	Department of Public Works & Highways
EMB	Environment Management Bureau
MWSS	Metropolitan Waterworks and Sewerage System
LWUA	Local Water Utilities Administration
PMO-RWS	Project Management Office-Rural Water Supply
MM	Metro Manila
Wds	Water Districts
RWSAs	Rural Water Supply and Sanitation Associations
MWD	Metropolitan Water District
NAWASA	National Waterworks and Sewerage Authority
NEDA	National Economic and Development Authority
NPC	National Power Corporation
NSO	National Statistics Office
PHO	Public Health Office

Other Organizations

ADB	Asian Development Bank
AWSOP	Angat Water Supply Optimization Project
IBRD	International Bank for Reconstruction and Development
ICC	Investment Coordination Committee
JICA	Japan International Cooperation Agency
MMWDP	Metro Manila Water Distribution Project
MWSRP I	Manila Water Supply Rehabilitation Project I
MWSRP II	Manila Water Supply Rehabilitation Project II
MTPIP	1992 Philippine Medium-Term Public Investment Program
OECF	Overseas Economic Cooperation Fund

Technical Terms

ANCI	American National Standard Institute

ECC	Environmental Compliance Certificate
EIS	Environmental Impact Statement
GNP	Gross National Product
JEC	Japan Electrotechnical Committee
JMA	Japan Manufacturer's Association
JIS	Japan Industrial Standard
MSA	MWSS Service Area
NCR	National Capital Region
NEMA	National Manufacturer's Association
O&M	Operation and Maintenance
pH	pH Value
PVC	Polyvinyl Chloride

Units of Measurement

°C	degree Celsius	Temperature Unit
cm	centimeter	Length Unit
cu.m	cubic meter	Volume Unit
cu.m/d	cubic meter per day	Flow Rate
cu.m/min	cubic meter per minute	Flow Rate
cu.m/s	cubic meter per second	Flow Rate
cu.m/sq.m/d	cubic meter per square meter per day	Surface Loading
cu.m/m/d	cubic meter per meter per day	Overflow Rate
d	day	Time Unit
g	gram	Weight or Mass Unit
ha	hectare	Area Unit
h	hour	Time Unit
HP	horsepower	Power Unit
Hz	hertz (cycle per second)	Frequency Unit
kg	kilogram	Weight Unit
km	kilometer	Length Unit
kV	kilovolt	Electrical Potential Unit
kW	kilowatt	Power Unit
kWh	kilowatt-hour	Energy Unit
l	liter	Volume Unit
m	meter	Length Unit

mm	millimeter	Length Unit
m/sec	meter per second	Velocity Unity
Ml/d	million liter per day	Flow Rate
mg	milligram	Weight or Mass Unit
mg/l	milligram per liter	Density Unit
rpm	revolution per minute	Angular Velocity
s	second	Time Unit
sq.km	square kilometer	Unit Measurement of Area
sq.m	square meter	Area Unit
yr	year	Time Unit

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

The Balara Water Treatment Plant (hereinafter referred to as "the Plant")is one of the two huge treatment plants in Metro Manila (hereinafter referred to as "MM"), treating an average of 1.35 million cu.m/d of water that is supplied to more than six million residents of the area.

The Plant has two plant systems namely; Plant No. 1 and Plant No. 2 which were constructed in 1935 and 1958, respectively. The Plant has a combined designed production capacity of 1.6 million cu.m/d. The present water supply has dropped considerably due to the deterioration of the facilities/equipment which are also superannuated, and difficulties are encountered in operating the Plant efficiently. The quality of water produced in the plant has also deteriorated and does not always meet the requirements of the National Standards for Drinking Water Standard. Yet, the Plant presently performs a vital role in the water supply system since it accounts for about 60% of the total production for MM.

The Metropolitan Waterworks and Sewerage System (hereinafter referred to as "MWSS"), the official water supply agency for MM an attached agency of the Department of Public Works and Highways (hereinafter referred to as "DPWH") of the Government of the Philippines (hereinafter referred to as "GOP"), is optimizing efforts for efficient operations and adequate maintenance of the Plant. However, due to budgetary and technical constraints, MWSS could not cope with the necessities.

Consequently, the MWSS through the GOP requested the Japanese Government's assistance by means of the Grant Aid Programme to rehabilitate the Plant. The Balara Treatment Plant Rehabilitation Project (hereinafter referred to as "the Project") aims:

i) to produce an acceptable quality of treated water; and
ii) to facilitate a technology transfer to reduce the operation and maintenance problems of the Plant

In response to the request from the GOP, the Government of Japan conducted a Feasibility Study on the Project and entrusted the study to the Japanese

International Cooperation Agency (hereinafter referred to as "JICA").

From the discussions with the MWSS officials concerned and as a result of the feasibility study in 1992, the Project is deemed urgent. Immediate assistance from the Government of Japan through Grant-Aid is necessary to rehabilitate the Plant in order to ensure a safe and stable water supply for the residents of MM.

Following the Feasibility Study, JICA sent to the Philippines a Basic Design Study Team (hereinafter referred to as "the Study Team") headed by Mr. Fumio Kikuchi from August 4 to September 2, 1993.

Based on the Feasibility Study of 1992 and the update of its results, the Study Team conducted a field survey and held detailed discussions with the MWSS. The field survey has the following objectives:

i) to clarify the details of the Project requested by the GOP;
ii) to examine and assess the technical and economic viability of the Project;
iii) to make a general layout and design; and
iv) to estimate the cost of the Project and prepare the schedule required for the implementation of construction.

The study activities included:

i) Discussions on the scope of the present study;
ii) Confirmation of the appropriateness, necessity and priority of the Project in the National Development Plan (or Sectoral Development Plan);
iii) Study on the present water supply situation;
iv) Confirmation of the responsible/executing organization of the proposed Project (administration plan, operation plan, budgetary plan, staff training plan, etc.);
v) Confirmation and clarification of related projects, if any, content, function, service, completion time, maintenance system, etc. of the Project should be clarified;
vi) Geographical survey of the Project site (weather conditions, humidity, soil condition, etc.);

vii) Investigation of the existing facilities within the proposed Project area;

viii) Collection and analysis of data;

ix) Study of local construction conditions ; and

x) Study of local transportation conditions.

CHAPTER 2

BACKGROUND OF THE PROJECT

CHAPTER 2 BACKGROUND OF THE PROJECT

2.1 Water Supply in the Republic of the Philippines

The coverage of the entire country by the water supply agencies has been organized into separate areas of responsibilities. The MWSS covers the MM area and its fringes; the Local Water Utilities Administration (hereinafter referred to as "LWUA") covers cities and municipalities outside the MWSS service area with population of 20,000 and up, and the DPWH, through the Project Management Office-Rural Water Supply (hereinafter referred to as "PMO-RWS") covers the areas not covered by both the MWSS and LWUA. The MWSS organization chart is shown in Figure 2.1.1.

The MWSS provides for the potable water supply requirements and sewerage systems of MM comprising four cities and 13 municipalities plus one city and 19 other municipalities adjacent to it. It is responsible for the planning, design, construction, operation and maintenance of water supply and sewerage disposal systems by utilizing its revenues, borrowed funds and government capital contribution.

The LWUA, on the other hand, is a specialized lending institution for the promotion, development and financing of local water utilities. Its chief concern is the provision of loans to Water Districts (WDs) for the development of water systems under concessionary terms based on their potential for development and continued viability. The LWUA extends engineering services to WDs and also promotes the organization of Rural Water Supply and Sanitation Associations (RWSAs) and provides institutional, technical and financial assistance for the construction, operation and maintenance of these rural water supply systems.

These implementation agencies involved in water supply provide three levels of water service, namely: Level I or point source; Level II or communal faucet system; and Level III or individual house connections or waterworks system.

Level I is generally a protected well or spring with no distribution system. Level II is generally intended for rural areas where houses are clustered densely enough to justify a simple piped distribution system with public

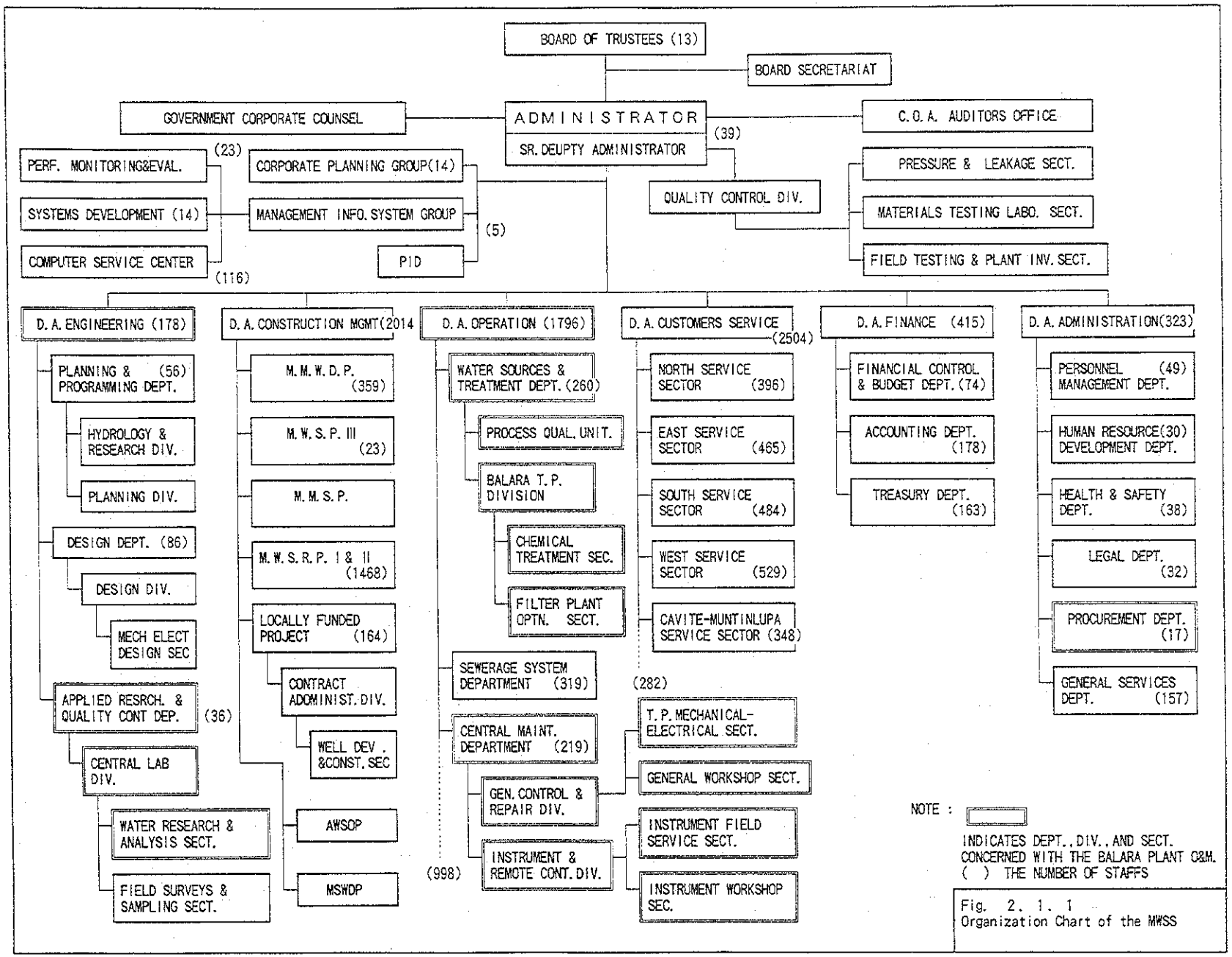


Fig. 2. 1. 1
Organization Chart of the MWSS

standpipes. Level III water supply service refers to a pipe system with individual house connections.

Based on available figure from the DPWH, MWSS, and LWUA as of the end of 1987, on the existing water supply coverage per geographic location is shown in Table 2.1.1.

Table 2.1.1 Existing Water Supply Coverage (As of end of 1987)

Classification	Total Population	Population Served						Unserved Population	
		Level I			Level II&III				
		Nos.	Pop.	%	Nos.	Pop.	%	Pop.	%
Urban Population									
Metro Manila	8.16M		0.17M	2	2	6.84M	84	1.15M	14
Other Urban	15.37M	9,000	2.70M	18	2,114	5.68M	37	6.99M	45
Rural Population	33.83M	667,808	15.38M	46	3,232	5.40M	16	13.05M	38
Total	57.36M	667,808	18.25M	32	5,348	17.92M	31	21.19M	37

Notes: 1) Source:DPWH, MWSS, LWUA

2) Excluding the 303,443 population in the towns of Rizal

About 63% of the total population of the country had access to water supply systems. The service area coverage included 86% in MM and its adjoining area, 55% in other urban areas, and 62% in the rural areas. The rest of the population or approximately 37% are still dependent on water from open dug wells, rainwater cisterns, lakes, and streams, majority of which were of doubtful quality.

To improve this situation of water supply for both urban and rural areas, the GOP has set investment requirements and service coverage as shown in Table 2.1.2 in the "Water Supply, Sewerage and Sanitation Master Plan from 1988 to 2000", aiming at the provision of reliable and safe water supply that are easily accessible to the majority of the households within the shortest time practicable in a cost effective manner.

The investment considers the development of the point sources of water supply systems in the rural areas and the acceleration of improvement or rehabilitation of water supply in addition to the expansion of water treat-

ment plants in the urban areas and its fringes.

Table 2.1.2 Investment Requirements and Service Coverage(1988-2000)

Classification	Investment Requirements	Population Served
1. Metro Manila and its Contiguous Areas	44,381.06M	97%
2. Other Urban Areas	11,282.00M	95%
3. Rural Areas	10,630.21M	93%
Total	66,293.27M	94%

Note : unit in Peso

2.2 Water Supply in Metro Manila

The water supply system for MM was established in 1882 through the assistance of Don Francisco Carriedo's fund. At that time, the water was taken from the Santolan area on the Marikina River by pumps, transmitted to a reservoir in San Juan, and then conveyed by gravity to the City of Manila through a 650mm diameter distribution pipeline.

The system was strengthened gradually, and in 1919, a new organization was set up and named the Metropolitan Water District (MWD) by virtue of Republic Act No. 2832. This body was tasked to take charge of the water supply of the City of Manila and the adjacent 14 municipalities.

Further in 1955, the MWD was reorganized as the National Waterworks and Sewerage Authority (NAWASA) to accelerate the restoration of devastated facilities.

In 1971, the NAWASA was dissolved and two water-related organizations were created namely; the MWSS and the LWUA. The MWSS was created by Republic Act No. 6234 - "An Act Creating the Metropolitan Waterworks and Sewerage System and Dissolving the National Waterworks and Sewerage Authority, and for other Purposes". Currently, the MWSS is responsible for 37 service areas as shown in Table 2.2.1.

The organization of the MWSS is shown in Figure 2.1.1. The Board of Trustees is the "policy-making" body composed of ten members including a Board Secretary. The law stipulates that the Secretary of the Department of Public Works and Highways (DPWH) is the ex-officio chairman unless the

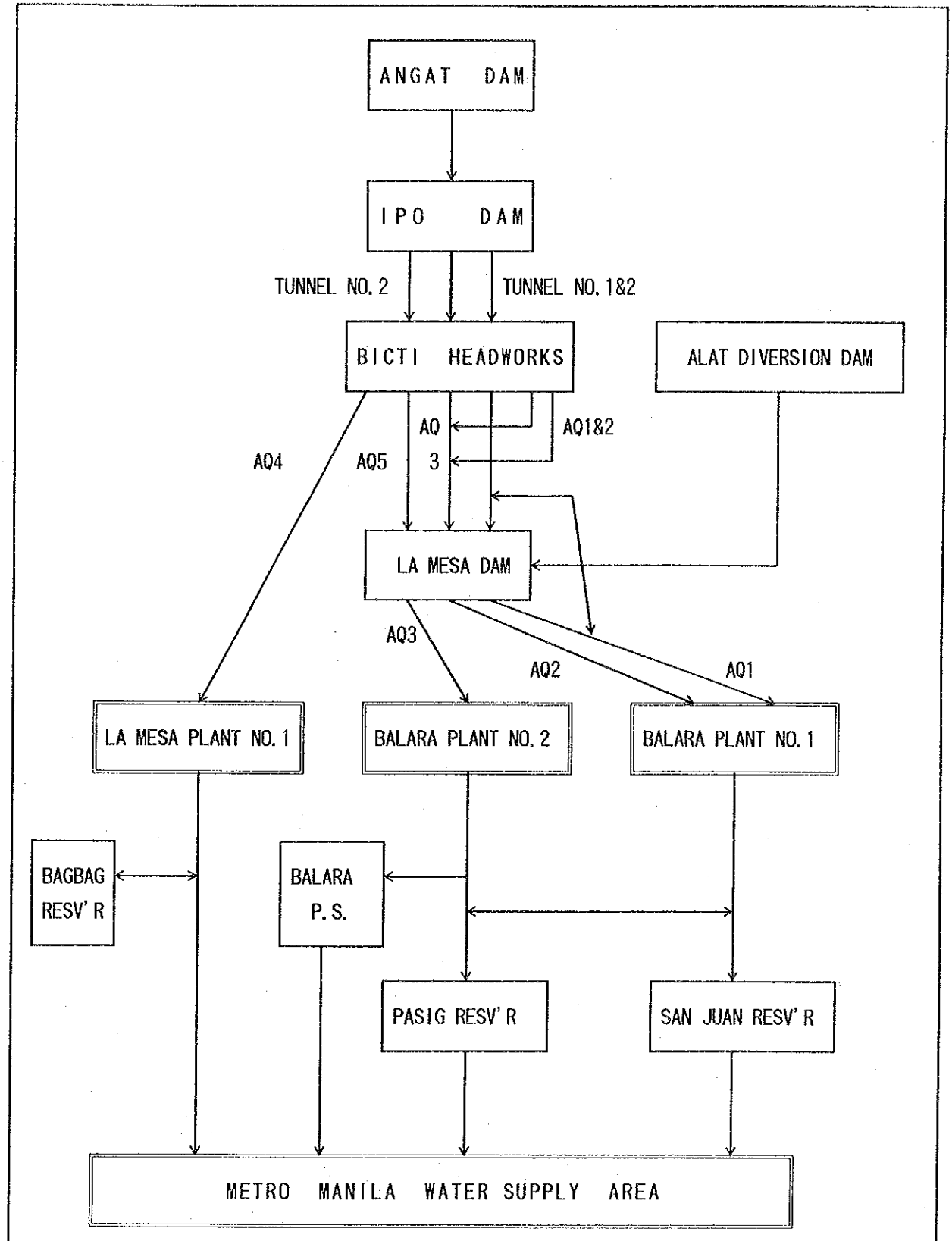


FIG. 2. 2. 1
ANGAT-NOVALICHES WATER SUPPLY SYSTEM

Table 2.2.1 Service Areas

City/Municipality		
NCR	CAVITE	RIZAL
1. Manila	18. Bacoor	24. Angono
2. Pasay	19. Cavite City	25. Antipolo
3. Quezon	20. Imus	26. Baras
4. Caloocan	21. Kawit	27. Binangonan
5. Las Pinas	22. Noveleta	28. Cainta
6. Makati	23. Rosario	29. Cardona
7. Malabon		30. Jala-Jala
8. Mandaluyong		31. Morong
9. Marikina		32. Pililla
10. Muntinlupa		33. Montalban
11. Navotas		34. San Mateo
12. Paranaque		35. Tanay
13. Pasig		36. Taytay
14. Pateros		37. Teresa
15. San Juan		
16. Taguig		
17. Valenzuela		

President of the Philippines appoints another person as Chairman. The Administrator of the MWSS acts as the Vice-Chairman. The law further stipulates that the Undersecretary (for Construction) of the Department of Public Works and Highways is the concurrent Administrator, unless another person is appointed by the President of the Philippines. Six members of the Board are appointed by the President and one comes from the Government Corporate Counsel and acts as the legal adviser of the Board.

One Senior Deputy Administrator and six Deputy Administrators act as the support staff of the Administrator.

The total number of MWSS employees is placed at 8,416 as of August 31, 1993. Of the total, 4,584 are permanent employees while the rest are casual/contractual employees.

The present raw water sources of the MWSS are surface water and groundwater which contribute 96.3% and 3.7% of the supply, respectively. Surface water, the major water source, comes from the Angat and Ipo Dams. These two facilities comprise the Angat-Novaliches Water Supply System. The system is characterized as a gravity fed water flow consisting of the sources flowing into the treatment plant through the Angat Dam, the Ipo Dam, the Bicti headworks, and the La Mesa Dam. Consequently, it is channeled to the Plant

and the La Mesa Water Treatment Plant No. 1. After treatment, it is distributed to MM through 15 distribution reservoirs. A schematic diagram of the Angat-Novaliches Water Supply Systems is shown in Figure 2.2.1. Groundwater sources consist of 3,000 wells, which are mostly privately owned. The MWSS manages only 220 wells, 120 of which are presently operational. Well water is delivered to the consumers after chlorination.

The MWSS supplies potable water to MM through two large water treatment plants - the Plant and the La Mesa Plant, with the Angat-Novaliches Water Supply System as the source. The Plant and the La Mesa Plant have a current design capacity of 1.6 and 1.5 million cu.m/d, respectively or a total capacity of 3.1 million cu.m/d.

Statistics relative to the total population and the percentage of served population of MM during the period from 1984 to 1991 are shown in Table 2.2.2. As of Sept. 1993, the number of population directly served by the MWSS was estimated at 6.61 million or 63% of population under the MWSS water supply area.

Table 2.2.2 Water Services of the MWSS in Recent Years

Year	Population under MWSS Million)	Connection 1000 (End of Period)	Population served (Directly) Million	Population served (Indirectly) Million (40% NRW)	Ratio of Population Served Directly (%)
1989	8.71	627,312	5.01	2.40	58
1990	9.00	667,818	5.51	2.65	30
1991	9.20	701,019	5.87	3.02	64
1992	9.09	-	6.19	-	68
1993	10.55	-	6.61	-	63

2.3 Outline of Water Supply Sector Programs

The Philippine Medium Term Development Plan formulated by the National Economic Development Authority (hereinafter referred to as "NEDA"), specifically the infrastructure sector wherein water supply is a sub-sector, acknowledges the necessity of providing adequate and potable water to the people. Water supply is one of the priority support facilities for the productive sectors that will act as catalysts of development.

As a policy, the Philippine Medium Term Development Plan adopts the following strategies:

i) Ensure provision of adequate funds for required capital investment and O&M;
ii) Strictly implement maintenance and rehabilitation programs;
iii) Adjust fees and charges to recover costs incurred in the provision of infrastructure services;
iv) Give priority to appropriate sanitation infrastructure facilities, namely; toilets, water supply and sewerage in MM and other urban centers, especially in depressed major areas;
v) Strengthen local technical and financial capacity for project implementation and service management through a broad-based training program and organizational and fiscal reform.

In accordance with this strategy, the MWSS has undertaken four projects, namely; (1) the Angat Water Supply Optimization Project (AWSOP) which is co-financed by IBRD, ADB and OECF; (2) the Manila Water Supply Rehabilitation Project I and II; (3) Metro Manila Water Distribution Project; and (4) the Study for the Groundwater Development in MM by JICA. The first four are on-going projects, while the remaining one has been completed.

Given these projects, the need for the immediate rehabilitation of the Plant, which is one of the two huge water treatment plants in Manila and rapidly deteriorating, is felt even more.

In MM, the water supply situation poses problems of greater variety and greater dimensions. For a nation whose population tends to gravitate and concentrate in big cities and other urban centers, Metro Manila's population steadily increases every year, exerting added pressure on the capacity of the water supply. As of September, 1993, only about 63% of area's present population had access to piped water supply systems.

In order to combat the current shortfall and to provide for the additional water supply requirements due to population growth, several projects and programs are being undertaken.

2.4 Circumstances and Contents of the Request

The Plant performs a vital role in the water supply system since it accounts for about 60% of the total water production for MM. The facilities/equipment of the Plant, however, are superannuated and difficulties have been encountered in trying to operate the Plant efficiently.

In 1991, JICA was commissioned by the Japanese Government to conduct a Feasibility Study on the "Balara Treatment Plant Rehabilitation". This Project is consistent with the national plan and policies on Water Resources Development. The objective of the study is to formulate the rehabilitation plan for the existing Plant while taking into consideration restoration of production capacity and improvement of the treated water quality. After a detailed evaluation, it was recommended that the GOP through the MWSS proceed with the implementation of the detailed design as soon as possible considering the urgency of the rehabilitation work required to cope with the advancing stage of deterioration of the existing facilities. Above all, the provision for safe potable water to the 9 million residents of MM cannot be undermined.

Under these circumstances, the Government of the Philippines, given its financial constraints and the urgent need to undertake the Plant rehabilitation, requested the Japanese Government for assistance. In response to the GOP's request, the Japanese Government decided to conduct a basic design study on the Rehabilitation of Balara Water Treatment Plant. JICA sent to the Philippines a basic design study team from August 4 to September 2, 1993.

The contents of the request made by the Government of the Philippines included the following:

1) Mechanical Equipment for Plant No. 1
   a. Aqueduct No. 1 & 2
      Replacement of four (4) units of headstocks
   b. Rapid mixers
      Replacement of two (2) units of rapid mixers
   c. Flocculators
      Provision of two (2) units of flocculators as spare.
   d. Accelators

Replacement of two (2) sets of sludge blow-off equipment, including valves

e. Filters

Replacement of ten (10) units of venturi tubes and ten (10) units each of sheet for inlet and drain penstocks

f. Washwater pumps

Replacement of three (3) units of washwater pumps

g. Washwater recovery pumps

Replacement of three (3) units of washwater recovery pumps

2) Mechanical Equipment for Plant No. 2

a. Flocculators

Replacement of driving unit chains, sprockets, and bearings for flocculators

b. Sedimentation equipment

Replacement of shaft support for drain penstocks and two (2) units of flushing pumps

c. Filters

Replacement of 20 units each of sheets for inlet and drain penstocks

d. Washwater pumps

Replacement of three (3) units of pumps

3) Mechanical Equipment for Chemical Dose

a. Alum dose equipment

Replacement of one (1) unit of feeder as spare.

b. Chlorine dose equipment

Replacement of four (4) units of chlorinators, two (2) units of evaporators, three (3) units of chlorine leak detectors, three (3) units of exhaust fans, one (1) unit of hoist, three (3) units of chlorine booster pumps, and dosing pipelines (3 lines)

c. Chlorine house

Repair of roof and extension of chlorine storage house/generator room

d. Polymer dose equipment

Replacement of five (5) units of feeders

4) Electrical Equipment for Plant No. 1

a. Motor control panels

Replacement of those panels for accelerators, washwater pumps, and recovery pumps

b. Distribution panels

Replacement of washwater pump panels

5) Electrical Equipment for Plant No. 2

a. Motor control panels

Replacement of those panels for flocculators, washwater pumps and recovery pumps

b. Distribution panels

Replacement of distribution panels for filter building

6) Electrical Equipment for Chemical Dose

a. Starter switch

Replacement of starter switch for chlorine booster pump

7) Instrumentation Equipment

a. Flow meter

- Replacement of those flow meters for accelators (2 units), and parshall flume (2 units)
- Installation of flow meters for settling basins of Plant No. 1 and sedimentation effluents of Plant No. 2

b. Level meter

Replacement of those level meters for washwater tanks and alum tanks

c. Loss of head devices for all filters

Replacement of 30 units of loss of head devices

d. Rate of flow control devices for all filters

Replacement of 30 units of rate of flow control devices including modification

e. Instrument panel

Replacement and installation of new instrument panel for supervision (2 panels)

8) Miscellaneous

a. Miscellaneous

Replacement of the plant lab. equipment and the central lab.

equipment

b. Lightning facilities
   Installation of new lightning rod devices for all buildings

c. Generator for chlorine house
   Installation of generator

d. Testing equipment
   Provision of testing equipment

These requests by the GOP were based on the findings of the Feasibility Study conducted by JICA in 1992 which concluded that the provision of a safe and stable supply of water to the populace is of utmost importance, particularly in MM.

The rehabilitation of the Plant, one of two large water treatment plants providing water to 60% of the MWSS service area is therefore urgently required. The capacity (nominal) to be rehabilitated in the proposed project is 1.6 million cu.m/d thus restoring the capacity modified in the project of 1981.

CHAPTER 3

OUTLINE OF THE PROJECT

CHAPTER 3 OUTLINE OF THE PROJECT

3.1 Objectives

Based on the results of the study on "Angat Water Supply Optimization Project", the MWSS prepared in 1991 a "Comprehensive Expansion Development Plan" to cope with the growing demand for water of the metropolis. The population of MM is expected to reach 11.15 million by year 2000 and water demand is projected at 3.8 million cu.m by 1996.

There are two large water treatment plants in MM - the Plant and the La Mesa Plant, with the Angat-Novaliches Water Supply as the source. The Balara and La Mesa Plant have a current design capacity of 1.6 and 1.5 million cu.m/day, respectively. There are two plants comprising the Plant, namely: Plant No. 1 and Plant No. 2, which were constructed in 1935 and 1958, respectively. Both plants were rehabilitated in 1981, after which, no rehabilitation of any kind was undertaken.

With the deterioration of the facilities and equipment of the Plant, a serious problem is being encountered in the quality of water supplied to MM and the decrease of production capacity by 20 %.

The objective of this Project is to rehabilitate the facilities and equipment of the Plant in order to restore it to its designed capacity and improve the treated water quality to constantly meet the National Drinking Water Quality Standard. By so doing, the residents of MM can look forward to a safe and an adequate water supply.

3.2 Study and Examination of the Request

3.2.1 Necessity and Appropriateness of the Project

(1) Conformity with National Plan

The 1992 Philippine Medium-Term Public Investment Program (MTPIP) formulated by the NEDA acknowledges the necessity of providing adequate potable water to the people.

The program indicates that the delivery of infrastructure services proved to be inadequate during the Master Plan period 1987-1992 due to macroeconomic difficulties of the country. Water supply is then one of the priority and urgent support facilities for the productive sectors that will act as catalysts of development.

In the policy as shown in section 2.3 of chapter 2, the MTPIP stresses:

i) Encouragement of maintenance and rehabilitation of the existing facilities/equipment;
ii) Precedence for provision of adequate funds for O&M;
iii) Improvement of the water tariff collection;
iv) Promotion of sanitation infrastructure projects especially water supply sub-sector; and
v) Strengthening of institutional capacity by means of training.

Following the national plan, the "Water Supply, Sewerage and Sanitation Master Plan of the Philippines 1988-2000" addresses the following targets;

i) Encouragement of rehabilitation of the existing water supply facilities;
ii) Improvement of the Operation and Maintenance (O&M) activities; and
iii) Set-up the implementation of water supply development programs including expansion and improvement of the distribution facilities

The rehabilitation of the Plant is positively in conformity with the national plan and the master plan, which is one specific project geared towards the achievement of the goals and objectives of the plans. This Project will ensure the provision of a safe and stable water supply that will conform to the National Standard for Drinking Water set by the GOP. Hence, the rehabilitation project is consistent and vital part of the national plan.

(2) Socio-Economic Aspect

The present population of the Philippines is estimated at 65 million with about 9 million residing in MM, 17 million in other urban areas and the

other 39 million in the rural areas.

The Plant serves approximately 60% of the MWSS service area population or seven million people, which is approximately 10% of the Philippine population, covering the whole of MM and 3.2% of Region IV with a total area of 1,800 sq.m. The MWSS service area is composed of five cities and thirty two municipalities with a combined population of approximately 12 million. Therefore the Project is very vital with 60% of 6.61 million persons to benefit from it.

(3) Technical Aspect

The existing Plant No.1 and No.2 were constructed 58 years ago and 35 years ago, respectively and they were modified and upgraded in 1981. However, after the modification they have not been rehabilitated sufficiently. Consequently most of the facilities/equipment are very superannuated and instrumentation have mostly broken down. The production capacity is decreased to 1.35 million cu.m/d in 1992. The treated water quality deteriorates and does not always meet to the National Standard for Drinking Water.

To cope with these serious situation of the Plant, large scale rehabilitation of the existing facilities/equipment is urgently required. By means of thorough rehabilitation, water productivity of the Plant will be improved to the nominal treatment capacity of 1.6 million cu.m/day, a good 20%(200,000 cu.m/day) higher than the present production capacity. The quality of water is also bound to improve, thereby complying with the Philippine Standard for Drinking Water. This marked improvement in water quality will result in a substantial improvement of the health and sanitation conditions in MM.

3.2.2 Implementation and Management Plan

(1) Organizational Continuity

The Project will be implemented by the MWSS. Specifically, the operation and maintenance of the Plant is officially under the Deputy Administrator (hereinafter referred to as "DA") for Operations. (See Fig. 2.1.1 Organization Chart of the MWSS). To operate and maintain the Plant, two other departments, the Procurement department in the processing of purchase orders

under the D.A. for Administration and the Applied Research and the Quality Control Department in the entire water quality control under the D.A. for Engineering are involved.

In spite of this complicated organizational setup, mutual cooperation is maintained, although difficulty is foreseen as the institutional scale shall be expanded. The existing treatment plant has been operated and maintained by skillful operators.The facilities were observed to be operated and maintained adequately despite the lack of spare parts, testing equipment, and insufficient instrumentation. The facilities and its premises are clean and well maintained. Moreover, a training program will be implemented to enhance O&M capability of the staff during the construction period of the Project. After rehabilitation, some treatment processes which may have been causing operational problems are to be improved. The Plant is then expected to improve with the assistance of the trained personnel and the replacement of the deteriorated facilities and equipment.

Judging from the above, the MWSS has the technical, organizational and institutional capability to undertake and continue the implementation of the proposed Project.

(2) Financial Continuity

The provision for safe and reliable supply of water is needed by the people and the industries of MM. The Plant is, therefore, a critical factor because of the importance that potable water supply has on the health and well-being of the population. The Plant must then be well operated and maintained in order for it to achieve its mission.

Securing necessary funds to achieve preventive O&M, the MWSS has set sufficient O&M budget covering such expenses as personnel, electricity, chemical, repair and maintenance as shown in Table 3.2.1, however, these have been realigned or reduced to the minimum to give priority to other important project. These difficulties are largely attributed to the setbacks inflicted by the string of natural calamities such as earthquake and typhoons that hit the country during the latter half of 1990, which redirected focus of substantial investments to the rehabilitation and restoration of damaged existing facilities. To cope with this problems, the GOP addresses in the

National Plan the assurance of the provision of adequate funds for required O&M budget.

From the financial viewpoint, the minimum budget required for O & M of the plant is estimated at around 120 million pesos after completion of the project. Therefore, it can be concluded that the MWSS is capable of implementing the proposed project.

Table 3.2.1 O&M Budget for the Plant

Years	Budget	Year	Budget
1989	62,054	1994	136,894
1990	164,264	1995	118,798
1991	150,600	1996	130,505
1992	103,747		
1993	128,953		

Source:MWSS Unit:1,000Pesos

3.2.3 Similar Projects and Projects Financed by Foreign Institutions

In MM, there are several ongoing projects under the water supply sector related to transmission, distribution, and/or water services as follows:

(1) Angat Water supply Optimization Project (AWSOP)

This project aimed to increase the supply capacity of the system. The AWSOP came into the picture as an interim project prior to the implementation of Manila Water Supply Project III (MWSP III). It is expected that after the completion of the project, the MWSS would receive additional water rights from Angat Reservoir by as much as 15 cu.m/s. Under this project, it is also intended that an available flow of at least 9 cu.m/s from the adjacent Umiray River would be diverted to the Angat Reservoir. The project will benefit 3.8 million customers.

The project entailed an estimated investment cost of around 8.8 billion Pesos and is expected to be completed by 1996.

The Angat Water Supply Optimization Project I (AWSOP I) is a major component of the comprehensive water supply development project for the system dependent on the Angat Reservoir Source. It is projected to harness an additional

15 cu.m/s from the Angat dam, after the initial usage of the National Power Corporation to generate power and subsequent diversion to irrigation system. The AWSOP I is composed of two major components, a transmission tunnel and an auxiliary power plant. According to the "1992 ANNUAL REPORT OF MWSS", under contract T-3 for the Ipo-Bicti Transmission Tunnel No. 3, the completion of the tunnel was pegged at 33.81%, while the overall accomplishment for the whole project including the tunnel and the power plant was pegged at 13.77%.

This Project, therefore, is in harmony with the proposed Project and will ensure a continuous and adequate water supply for MM.

(2) Study on the Metro Manila Groundwater Development Project

This study started in August of 1990 with JICA assistance in response to the request of the Philippine Government. The study area covers the MWSS Service Area composed of five cities and 32 municipalities.

The study intends to achieve the following four objectives:

a) To formulate a plan for the rehabilitation, operation, maintenance and development of the MWSS supervised wells in the MWSS Service Area
b) To evaluate the groundwater resource potential and formulate a groundwater development plan in Antipolo
c) to study a solution or remedial measure and preventive scheme for the areas with intense saline water intrusion.
d) to formulate a plan for the establishment of a groundwater monitoring system in MM.

This particular project is also geared towards the achievement of a national purpose -- to supply safe water to an expanded service area of MM.

(3) Manila Water Supply Rehabilitation Project I (MWSRP I)

This is a completed project which covers 56 zones (887.2 sq.km) of the MWSS service area at an estimated cost of 1,832.01 million Pesos. Its goals were to reduce non-revenue water, replace 150 km of tertiary lines, install 280

public faucets, construct 50km of new tertiary lines, replace 108,000 house service connections and relocate 12,000 water meters. The project was also targeted to recover 80,000cu.m/d of unaccounted-for water.

Again, this project is in conformity to the plan to supply safe water to the general populace.

(4) Manila Water Supply Rehabilitation Project II (MWSRP II)

With the same objectives as that of the MWSRP I, the MWSRP II was introduced and scheduled to be completed within five year period (1988-1993) at an estimated cost of 1,675 million Pesos. This project covers another 90 sq.km within the 52 zones and 7 subdivisions not covered by the MWSRP I. It aims to further recover 344,000 cu.m/d of unaccounted-for water benefiting anew the 2.7 million people of the South Eastern part of MM. The project will replace 100 kms of tertiary lines, install 285 public faucets and replace 87,000 water meters.

According to the "1992 ANNUAL REPORT OF MWSS", as of the end of the year 1990, the total volume of recovered water from the three completed zones (ZR-22, 44 and 66) was 6,347 cu.m/d, while the total volume measured from 38 zones was 390,170 cu.m with an average of 58.16%. Under this project, the total number of house service connections completed was 8,133, serving an equivalent 65,064 persons. Total length of pipeline laid during the year was 70.4km. Overall project completion was pegged at 85.37%.

All the above projects are in conformity with and necessary to the government's national plan of supplying a safe and adequate water supply to MM to ensure public health.

3.2.4 Project Component

The proposed rehabilitation plan consists of the improvement of treatment process and the replacement of deteriorated facilities and equipment as shown in Table 3.2.2.

The reduction of weir loading rate of launders to be constructed in the sedimentation basins will minimize the floc carry-over to the filters. The

change of washwater recovery schedule Plant No. 1 will contribute to the stable operation of the sedimentation basins of the Plant.

Table 3.2.2 Components of the Project Requested

	Rehabilitation		Description
A.	Improvement of the existing water treatment process	i)	Improvement of sedimentation effects -Construction of launders
		ii)	Control of filtration rate -Replacement of effluent valves
		iii)	Appropriateness of Chemical feed rate -Measurement of treatment cap.
B.	Replacement of deteriorated facilities/ equipment	i)	Restore the function of facilities/equipment by replacement

3.2.5 Requested Rehabilitation Plan

The rehabilitation plan shows the technical urgency and the economic viability of the Project. Table 3.2.3 presents the summary of the rehabilitation plan by the MWSS. In Table 3.2.3, identification "A" means the improvement of the existing water treatment while identification "B" means the replacement of deteriorated facilities and equipment. Likewise the words "Added", "Del", and "Original" mean alteration as follows:

Added	:	Request added to the original
Del	:	Request deleted from the original
Original	:	As requested

Table 3.2.3 Requested Rehabilitation Plan for Plant No. 1&2
Mechanical Facilities/Equipment

Item	Facilities/Equipment	Identification	Alteration	Remarks
<Plant No.1>				
1.	Aqueduct No. 1 & 2			
	a. Gates	A	Added	Deterioration
2.	Rapid Mixer			
	a. Mixers	B	Added	Ditto
3.	Flocculator			
	a. Flocculators	A	Added	Ditto
4.	Sedimentation			
	a. Baffle wall	A	Added	Construction
	b. Launder	A	Added	Construction
5.	Accelator			
	a. Driving units	B	Added	Ditto
	b. Sludge blow-off equipment	B	Original	Out of order
	c. Metal parts	B	Added	Corroded
6.	Filter			
	a. Venturi meters	B	Original	Out of order
	b. Inlet gate's sheets		Del	Negligible leakage
	c. Effluent valves	B	Added	Out of order
	d. Main surfacewash valve	A	Added	Deterioration
	e. Main backwash valve	A	Added	Ditto
7.	Washwater Pump			
	a. Pumps	B	Original	Ditto
8.	Washwater Recovery Pump			
	a. Pumps	B	Original	Ditto
	b. Reconstruction of pump house	A	Added	Adjustment for new pumps
	c. Return pipe extension	A	Added	
<Plant No.2>				
9.	Flocculator			
	a. Flocculators	A	Added	Deterioration
	b. Construction of panel room	A	Added	Adjustment for new panels
	c. Baffle wall	A	Added	Construction
10.	Sedimentation Equipment			
	a. Shaft support for drain penstock	B	Original	Deterioration
	b. Flushing pumps	B	Ditto	Ditto
	c. Launder	A	Added	Construction
11.	Filter			
	a. Venturi meters	B	Original	Out of order

Table 3.2.4 Requested Rehabilitation Plan for the Chemical Dosage Facilities/Equipment

Item	Facilities/Equipment	Identification	Alteration	Remarks
	b. Inlet gate's sheets		Del	Negligible leakage
	c. Effluent valves	B	Added	Out of order
	d. Main surfacewash valve	A	Added	Deterioration
	e. Main backwash valve	A	Added	Ditto
12.	Washwater Pump			
	a. Pumps	B	Original	Ditto
13.	Alum			
	a. Feeders	B	Original	Deterioration
14.	Chlorine			
	a. Chlorinators	B	Ditto	Ditto
	b. Evaporators	B	Ditto	Ditto
	c. Leak detectors	B	Ditto	Ditto
	d. Weighing scale	B	Added	Ditto
	e. Exhaust fans	B	Ditto	Ditto
	f. Booster pumps	B	Ditto	Ditto
15.	Polymer			
	a. Feeders	B	Ditto	Deterioration

Table 3.2.5 Requested Rehabilitation Plan for the Electrical/ Instrumentation Facilities/Equipment(1/2)

Item	Facilities/Equipment	Identification	Alteration	Remarks
16.	Power Receiving			
	a. Switching station	A	Added	34.5 kv
17.	Motor Control Panel			
	Plant No.1			
	a. Sed. basin No.1&2	A	Added	Mech. portion replacement
	b. Accelators	A	Original	Ditto
	c. Filters	A	Added	Ditto
	d. Washwater pumps	A	Original	Ditto
	e. Recovery pumps	A	Ditto	Ditto
	Plant No.2			
	f. Flocculators	A	Ditto	Ditto
	g. Filters	A	Ditto	Ditto
	h. Washwater pumps	A	Ditto	Ditto
	i. Chlorinator	B	Ditto	Ditto
	j. Polymer (including starter)	A	Added	Ditto
18.	Instrumentation			
	a. Accelator inflow		Del	To be provided by MWSS
	b. Plant No.1&2 Surfacewash flow	B	Added	Deterioration

Table 3.2.5 Requested Rehabilitation Plan for the Electrical/ Instrumentation Facilities/Equipment(2/2)

Item	Facilities/Equipment	Identification	Alteration	Remarks
c.	Plant No.1&2 Backwash flow	B	Added	Deterioration
d.	Plant No.2 parshall flume		Del	To be provided by MWSS
e.	Plant No.1 sedimentation inflow		Del	To be provided by MWSS
f.	Plant No.2 distribution flow		Del	To be provided by MWSS
g.	Loss of head of filter	B	Original	
h.	Plant No.1&2 washwater tanks	A	Ditto	
i.	Alum storage tank level meter	A	Ditto	
j.	Rate of flow device	B	Ditto	
19.	Lightning Facilities	A	Ditto	Install arresters
20.	Generator for Chlorination		Del	

Table 3.2.6 Requested Rehabilitation Plan for the Others

Item	Facilities/Equipment	Identification	Alteration	Remarks
21.	Water Quality Control			
a.	Analytical equipment	A	Added	Deterioration
22.	Testing Equipment			
a.	Testing equipment	A	Original	

3.2.6 Basic Principle for Project Implementation

The project is urgently needed by the GOP in order to meet the goals of its National Plan. It has been found to be feasible with respect to the socio-economic, financial, and technical aspects of the Project. The GOP has the organizational, institutional, and technical capability for implementing the project. This Project, therefore, meets the requirements for funding under the government of Japan's Grant Aid Programme after considering the benefits that the Project will generate for the population of MM.

Therefore, the implementation of the Project under Japan's Grant Aid Programme is deemed to be appropriate. The Basic Design for the Project has been prepared for inclusion under this Programme.

The Project will provide for the needed facilities and equipment in accordance with the schedule as shown in Table 3.2.3, 3.2.4, and 3.2.5. However, the success of the Project is in the proper operation and maintenance of these facilities and equipment, depending upon a comprehensive preventive maintenance program. The MWSS is required, therefore, to come up with an appropriate operation and maintenance system for the continuous operation of the Plant, together with sufficient budget allocation for the Plant upon completion of the Project.

3.3 Project Description

3.3.1 Executing Agency and Operational Structure

The operation and maintenance of the Plant is under the Deputy Administrator for Operations. The following are the Deputy Administrators, Departments, Divisions and Sections concerned with the O&M of the Plant.

(1) Plant Manpower

The number of staff and their positions are presented in Table 3.3.1.

Table 3.3.1 Staff Number and Position (1/2) *

1.	Chemical Treatment Section	1 - Utilities Services Chief 1 - Supervising Chemist 5 - Sr. Water Resources Facilities Technician 16 - Water Resources Facilities Technician
2.	Filter Plant Operation Section	1 - Utilities Services Chief 1 - Supervision Water Utilities Management Officer 4 - Sr. Water Utilities Mgmt Officer 1 - Plant Equipment Operator B 3 - Sr. Water Facilities Technician 9 - Water Resources Facilities Technician 11 - Plant Equipment Operator A 1 - Clerk-Processor A
3.	Instrumentation Field Services Section	1 - Utilities Services Chief 1 - Utilities Services Officer A 1 - Utilities Services Officer B 4 - Instrumentation Technician A (40% of above personnel performs the Balara Plant Maintenance)
4.	Treatment Plants Mechanical-Electrical Section	1 - Utilities Services Chief 1 - Supvg. Utilities Services Officer 3 - Sr. Plant Mechanic 1 - Sr. Plant Electrician 1 - Water Maintenance Foreman 1 - Property Officer B 3 - Plant Mechanic A 4 - Plant Electrician A 3 - Sr. Water Maintenance A 1 - Sr. Water Maintenance B 1 - Driver Mechanic B (65% of above personnel performs the Balara Plant Maintenance)
5.	Process Quality Unit	1 - Chief Chemist 1 - Principal Chemist 1 - Environmental Specialist 1 - Sr. Water Resources Facilities Tech'n 1 - Water Resources Facilities Technician 1 - Clerk/Processor A 1 - Sr. Water Resources Facilities Tech'n 2 - Plant Helper B 1 - Driver
6.	Water Research and Analysis Section	1 - Chief Chemist 1 - Supervising Chemist 3 - Senior Chemist 1 - Sr. Environmental Specialist 1 - Quality Control Inspector 1 - Water Resource Technician

Table 3.3.1 Staff Number and Position (2/2)

7.	Field Survey and Sampling Section	1 - Principal Engineer B 1 - Principal Engineer C 2 - Supervising Engineer B 2 - Sr. Engineer B 3 - Engineering Assistant B 1 - Driver
8.	Instrumentation Workshop and Other Services Section	1 - Utilities Services Chief 2 - Utilities Services Office A 1 - Sr. Instrument Technician 1 - Sr. Plant Electrician 1 - Sr. Electronic Communication System Technician 1 - Supvg. Electronic Communication System Technician 1 - Sr. Instrument Technician 1 - Utilities Services Officer B (5% of above personnel perform the Balara Plant maintenance)
9.	General Workshop	22 - Personnel (5% of above personnel perform the Balara Plant maintenance)

* (Filled Positions Only)

3.3.2 Project Plan

In conclusion, the Project involves the following:

a) the improvement of the existing process; and

b) the replacement of the deteriorated facilities and equipment

In the preparation of the Project Plan, the existing facilities such as concrete structures and piping which are still functional should continue to be utilized effectively. The construction methods and schedule should be determined so as to ascertain the period for the implementation of the Project.

The main portion of facilities/equipment to be rehabilitated are itemized as follows:

<Plant No.1>

i) Replacement of the intake gate facilities

ii) Replacement of coagulation and flocculation facilities/equipment

iii) Replacement of sedimentation facilities/equipment
iv) Replacement of filtration facilities/equipment
v) Replacement washwater recovery facilities/equipment
vi) Replacement of electrical facilities/equipment
vii) Replacement of instrumentation facilities/equipment
viii) Replacement of electrical/instrumentation facilities/equipment related to the replacement of mechanical items

<Plant No. 2>
i) Replacement of coagulation and flocculation facilities/equipment
ii) Replacement of sedimentation facilities/equipment
iii) Replacement of filtration facilities/equipment
iv) Replacement of electrical facilities/equipment
v) Replacement of instrumentation facilities/equipment
vi) Replacement of electrical/instrumentation facilities/equipment related to the replacement of mechanical items

<Chemicals>
i) Replacement of alum dose facilities/equipment
ii) Replacement of polymer dose facilities/equipment
iii) Replacement of chlorination facilities/equipment
iv) Replacement of electrical/instrumentation facilities/equipment related to the replacement of mechanical items

<Electrical/Instrumentation>
i) Provision of power receiving station
ii) Replacement of those motor control panels which are to be replaced due to their deterioration and/or system improvement
iii) Replacement of distribution panels
iv) Replacement of flow meters
v) Replacement of level meters
vi) Provision of instrument panels
vii) Improvement of lightning system

<Miscellaneous>
i) Provision of water quality analysis equipment
ii) Provision of testing equipment

3.3.3 Location and Condition of Project Site

The Plant is located at 50m to 75m above sea level in an undulating topography in Quezon City, Metropolitan Manila. The service area of the Plant with an elevation of 40-200m is situated in the southern part of the Luzon Central Plain East Side Hill. The East Side Hill ranges in the north-south direction of the eastern side of the Luzon Central Plain also extends from Pallanyan to Laguna de Bay. To the west of Balara service area, the Marikina River flows from North to South, down to the Pasig River turning at a right angle direction and pouring to the Manila Bay.

The Project site has access to fully developed infrastructure facilities and organized utilities, like the following:

Air Transportation	:	The Ninoy Aquino International Airport
Marine Transportation	:	The Manila Port
Inland Transportation	:	Various
Electricity	:	MERALCO

There is no problem related to construction on the location and condition of the Project site.

3.3.4 Outline of Facilities and Equipment

After a thorough examination of the rehabilitation plan requested by the MWSS, the following facilities and equipment will be rehabilitated and included in the Project.

(1) Mechanical equipment for Plant No. 1

a. Aqueduct No. 1 and 2
   Replacement of four (4) units of gates

b. Rapid mixers
   Replacement of two (2) units of rapid mixers

c. Flocculators
   Replacement of twenty four (24) units of flocculators

d. Sedimentation basins
   Excavation of sludge discharge creek by the MWSS

e. Accelators

Replacement of two (2) sets of driving units and sludge blow-off equipment, including valves and repainting for corroded parts and construction of the compressor room, and repair of pump house by the MWSS

f. Filters

- Replacement of ten (10) units of venturi tubes, ten (10) units of effluent valves, one (1) unit of main surfacewash valve, and one (1) unit of main backwash valve and construction of over-flow pit and the valve pit for the main surfacewash and backwash valves
- Replacement of surfacewash piping in the ten filters by the MWSS

g. Washwater pumps

Replacement of two (2) units of washwater pumps and repair of the pump house by the MWSS

h. Washwater recovery pumps

Replacement of three (3) units of washwater recovery pumps and construction of the pump house

i. Launders/baffle Walls

Construction of required numbers of launders/baffle walls in the sedimentation basins

(2) Mechanical equipment for Plant No. 2

a. Flocculators

Replacement of one hundred eight (108) units of flocculators and construction of necessary baffle walls in the sedimentation tanks and the control panel house

b. Sedimentation equipment

Replacement of shaft support for drain penstocks and two (2) units of flushing pumps and reinforcement of foundation of inflow headstocks by the MWSS

c. Filters

- Replacement of twenty (20) units of venturi tubes,twenty (20) units of effluent valves, one (1) unit of main surfacewash valve, and one (1) unit of main backwash valve and construction of over-flow pit and the valve pit for the main surfacewash and backwash valves
- Replacement of surfacewash piping in the twenty filters by the

MWSS

d. Washwater pumps

Replacement of three (3) units of pumps and repair of the pump house by the MWSS

e. Launders

Construction of required numbers of launders in the sedimentation basins

(3) Mechanical equipment for chemical dose

a. Alum dose equipment

Replacement of six (6) units of feeders

b. Chlorine dose equipment

Replacement of four (4) units of chlorinators, two (2) units of evaporators, three (3) units of chlorine leak detectors, three (3) units of exhaust fans, three (3) units of chlorine booster pumps, two (2) units of weighing scale, and dosing pipeline (3 lines)

c. Polymer dose equipment

Replacement of five (5) units of feeders

(4) Electrical equipment for Plant No. 1

a. Motor control panels

Replacement of those panels for flocculators, accelators, filters, washwater pumps, and recovery pumps

b. Distribution panels

Replacement of distribution panels for washwater pump building

c. Lighting panel

Modification of interior devices and installation of new meters on panel at settling basin Nos. 1 & 2, filter building, and washwater recovery pump by the MWSS

(5) Electrical equipment for Plant No. 2

a. Motor control panels

Replacement of those panels for flocculators, filters, and wash water pumps

(6) Electrical Equipment for Chemical dose

a. Motor Control Panel

Replacement of panels for chlorine facilities

(7) Instrumentation equipment

a. Flow meter

- Surfacewash flow for Plant No.1 & 2
- Backwash flow for Plant No.1 & 2

b. Level meter

Replacement of those level meters for the washwater tanks and alum storage tanks

c. Loss of head devices for all filters

Replacement of thirty (30) units of loss of head devices

d. Rate of flow control devices for all filters

Replacement of thirty (30) units of rate of flow control devices including modification

e. Instrument panel

Replacement and installation of new instrument panel for supervision (2 panels)

(8) Miscellaneous

a. Miscellaneous

Provision of the plant lab. equipment and the central lab. equipment

b. Lightning facilities

Provision of arresters in panels

c. Testing equipment

Provision of testing equipment

d. Installation of a switching station at 34.5 kv receiving point including transformer

e. Replacement of wooden poles for 34.5kv O/H distribution(24pcs) by the MWSS

f. Replacement of O/H wires by the MWSS

g. Replacement and improvement of illumination by the MWSS

h. Replacement of street lighting by the MWSS

3.3.5 Operation and Maintenance Plan

The JICA Basic Design Study Team discussed with MWSS officials the future operation and maintenance after the completion of the Project during field survey in August, 1993 . In the course of discussions, the MWSS side was in

overall agreement with the opinion and recommendations from JICA, recognizing the importance of institutional strengthening and securing necessary funds. Consequently, the MWSS agreed that it will take necessary measures to bear O&M cost of those facilities/equipment to be rehabilitated under the Project.

Described hereunder are the major problems on operation and maintenance for the Plant and the corresponding findings/recommendations.

(1) Problems on organization at present

i. No senior staff who assist the department manager of the Water Sources & Treatment Department(WSTD) exclusively are provided.

ii. Reeducation of middle management staff who are in charge of O&M for the Plant, and strengthening of closer cooperation between O&M and Labo. staff are necessary.

(2) Proposed improvement

i. To make clear and precise the rule on positions and duties regarding the WSTD. Staff who assist the department manger exclusively may be provided, if it is necessary.
ii. Key points on the proper O&M of the replaced/newly installed facilities/equipment should be made known to all of the staff, especially about renewed chemical dosing system. Also, much closer cooperation between O&M staff and Lab. staff, on day-to-day water treatment procedure, is recommended.

(3) Problems on maintenance and repair at present

i. Less preventive maintenance, and repairs are done only when troubles arise.
ii. There is no carefully planned rules of transaction when an imported equipment gets troubles or becomes out of order, or come to the end of its life.
iii. In procuring necessary spare parts for defective facilities/equipment, it takes too long time to implement proper O&M due to numer-

ous complex procedures.

(4) Proposed countermeasures

i. To prepare a manual on O&M, and strengthen the on-the job training, and let all the staff in every section and every position to understand the importance of preventive maintenance.

ii. To prepare a mid-term to long- term plan to ensure necessary budget for repair/rehabilitation, and move forward from outbreak-basis maintenance.

iii. To prepare a detailed and precise ledger of facilities/equipment on which every necessary data, such as year of construction/installation, specifications, dimensions, record of repair and etc.

iv. In addition to above, it is recommended that the original drawings of the equipment and facilities should be kept in an appropriate cabinet at the Plant. Also it is recommended to prepare reduced size drawings compiled in book form, say A-2 size, for staff's ready reference.

(5) Maintenance and repair cost after the completion of this project

Taking consideration into the last five years escalation of O&M costs including personnel expenditure, repair cost, chemical cost, and power cost, the O&M cost in 1996 when the Project would be commissioned is expected to be lower than that of the MWSS's budget plan as show in Table 3.2.1. However, qualitatively it can be said as following;

i. As a result of rehabilitation of intake facilities, an increase in water revenue will be expected by maximizing/stabilizing intake water volume.

ii. By reducing water used in the plant (backwash water for the filters and drain water from sedimentation basins), and less leakage water from valves and pipes will also contribute to reduced unaccounted-for water.

iii. With the replacement of mixers and flocculators and the construction of launders at the end of the sedimentation basins, it is expected that filter run will be longer than before , resulting in reduced backwash water per hour, and thereby reducing unaccounted

for water.

iv. With the rehabilitation and improvement of chemical dosing systems, it is expected that the wastage of chemicals is eliminated.

v. Improvement of electric facilities (development of protection systems, etc.) will greatly reduce the possibility of accident regarding electrical system, and as a result avoid major and expensive repair costs.

3.4 Technical Cooperation

(1) Past Records for Technical Cooperation

Dispatch of experts in the water supply sector has been extended three times between the Philippines and Japan as a technical cooperation scheme of the Japanese Government as shown in Table 3.4.1. Last two technical cooperation were implemented successfully and presently a expert on water distribution management is carrying out technical transfer in the field of water distribution management.

Table 3.4.1 Past records for Dispatch of Experts

Period	Subject
1) June, 1989 - June, 1991	Water Distribution Management
2) June, 1991 - June, 1993	Ditto
3) June, 1993 - Present	Ditto

(2) Necessity of Technical Cooperation

After the implementation of the Project, circumstances of water supply in MM will be remarkably improved especially in view point of facility arrangement. In corroboration with that, human resources should be developed to utilize the Plant effectively through overall training on the water supply. The effects derived from the progress of water supply technology will be extended not only to the Plant but also the La Mesa Plant Nos. 1 & 2 which perform a vital role in water supply system of MM.

Therefore, technical cooperation in provision of training course and dispatch of Japanese experts especially in the fields of water supply planning, water purification, water quality control, and management could produce synergic effects in combination with the Project.

CHAPTER 4

BASIC DESIGN

CHAPTER 4 BASIC DESIGN

4.1 Design Policies

The basic design is carried out based on the following design policies.

(1) The scope of the rehabilitation works is to be limited within the facilities/equipment in the Plant that presently have problems relating to the quality of the treated water and restoration of the designed capacity.

(2) The existing structures and equipment are to be utilised as much as possible.

(3) The treatment capacity to be applied is the original design capacity.

(4) Water quality for the treated water is to conform to the Philippine drinking water standard.

(5) The operational methods to be employed are on-site, manual type, except for the case where automatic operation is required for safety reasons.

(6) The facilities/equipment are to be of types that are able to run continuously except during periods of power shut-down.

(7) The metric system is to be adopted in all the design works, while the yard-pound system may be included, if necessary.

(8) The standards for design to be adopted are Japan Industrial Standard (JIS), Standards of the Japan Manufacturer's Association (JMA) and Standard of Japan Electrotechnical Committee(JEC) and also in accordance with the Philippine Electrical Code requirements. American National Standard Institute (ANSI), National Electrical Manufacturer's Association (NEMA), British Standard (BS) and Deutsche Industrie Norm (DIN) that are used in the existing facilities/equipment are to be adopted if necessary.

(9) The types of facilities and construction methods are to be selected so as to minimize and shorten water interruption time during the execution of the Project.

(10) The facilities and raw materials as well as the manpower for the construction are to be procured from the local market in the Philippines as much as possible.

4.2 Study and Examination of Design Conditions

4.2.1 Aims and Methods of the Rehabilitation

The scope of the design is to rehabilitate the facilities/equipment in which problems have been identified through this study as mentioned in the previous chapters. Targets of the improvement of each facilities/equipment are given as follows:

(1) Intake

To ensure the intake capacity for the designed treatment amount, the existing facilities/equipment which are deteriorated and/or malfunctioning are to be replaced.

(2) Coagulation and Sedimentation

To improve the floc formation, sedimentation , and the sludge withdrawal so as to reduce the turbidity loading to the filtration process, the existing facilities/equipment that are deteriorated and/or malfunctioning are to be replaced and launders are to be constructed at the end of the sedimentation basins.

(3) Filtration

To improve the quality of treated water in compliance with the Philippine drinking water standard and to produce a stable water, the existing facilities/equipment which are deteriorated and/or malfunctioning are to be replaced.

(4) Chemical Dose

To control the chemical dosing to the required rate, the existing facilities/equipment which are deteriorated and/or malfunctioning are to be replaced.

(5) Chlorination

To ensure effective disinfection of the filtered water, new chlorination facilities/equipment are to be installed in the new chlorination building.

(6) Power Supply

To ensure the stable operation of mechanical facilities/equipment which leads to reliable water service, the existing facilities/equipment which are deteriorated and/or malfunctioning are to be replaced.

(7) Instrumentation

To measure the amount of water in order to monitor the operation rate and to control chemical and chlorine dosing rate, the existing facilities/equipment which are out of order or malfunctioning are to be replaced.

4.2.2 Design Conditions

The following design conditions are adopted in the rehabilitation plan:

(1) General Condition

The following environmental condition is applied to the design of the rehabilitation project.

Ambient temperature	Max.	35°C
	Avg.	28
	Min.	22
Humidity	Max.	100%
	Avg.	80
	Min.	65

(2) Treatment Capacity

Based on a series of discussions between the MWSS and the Study Team, the following treatment capacity is applied as nominal design capacity in the design of facilities/equipment.

Design capacity of the Plants;

Settling basins No.1 and No.2	:	280,000 cu.m/day
		(140,000 cu.m/d each)
Accelators	:	190,000 cu.m/day
		(95,000 cu.m/d each)
Plant No.2 (12 sed. basins)	:	1,130,000 cu.m/d

(3) Treated Water Quality

The applied treated water quality standard is to conform to the Philippines drinking water standard as shown in Table 4.2.1.

Table 4.2.1 Design Treated Water Quality Standard

Characteristics	Maximum Permissible Level	Japan Level
Turbidity	5 NTU	2o
Color	5 units	5
Odor	Unobjectionable	Unobjectionable
Taste	Unobjectionable	Unobjectionable
Total Solids	500 mg/l	500 mg/l
pH	6.5 - 8.5	5.8 - 8.6
Total Coliforms	Not detected	Not detected

(4) Applied Chemicals

Based on the field survey, chemicals shown in Table 4.2.2 are applied.

(5) Power Receiving Capacity

The following power source is to be adopted:

a. Receiving Voltage

AC three-phase three-wire system, 34,500 V, 60 Hz

b. Distribution Voltage

High Voltage:

AC three-phase three-wire system, 34,500 V, 60Hz

AC three-phase three-wire system, 2,400 V, 60Hz (For Booster Pumps)

Low Voltage:

AC three-phase four-wire system 480/240, 60Hz

c. Motors

High Voltage (For Booster Pumps):

AC three-phase three-wire system, 2,400V, 60Hz

Low Voltage:

AC three-phase three-wire system, 460V, 60Hz

d. Control circuit voltage

AC 120V

e. Instrumentation circuit voltage

AC 120V

Signal transmission system

DC 4-20mA, 1-5V

f. Lighting and Receptacle

AC 240/120V

Table 4.2.2 Characteristics and Dosage of Chemicals

Description		Alum	Anion	Cation	Chlorine	
Characteristics	Purity (%)	8	2.75	2.75	99.5	
Solution Concentration		10	10	10	100	
Dose (mg/l)	Max.	45	0.2	0.2	Pre	3
					Mid	1
					Post	1.35
	Ave.	16.34	0.06	0.09	Pre	0.7
					Mid	0.5
					Post	1.15
	Min.	10	0.03	0.03	Pre	-
					Mid	-
					Min	-

4.3 Basic Plan

4.3.1 System Design

(1) Design Capacity

Flow Diagram of the Balara Water Treatment Plant is shown in Fig. 4.3.1. Design Capacity for each treatment process is shown in Table 4.3.1.

Table 4.3.1. Design Capacity

Plant	Sedimentation Facilities	Design Capacity (m^3/Day)
No.1	Sedimentation Basin No.1	140,000
	Sedimentation Basin No.2	140,000
	Accelerator	190,000
	Sub-total	470,000
No.2	Sedimentation Basin (Southern Line) (Northern Line)	1,130,000
	Total	1,600,000

(2) Design Calculation

<Plant No.1>

I. Flocculation Basins No.1, No.2

II. Sedimentation Basins No.1, No.2

III. Filters

IV. Washwater Pumps

V. Washwater Recovery Pumps

<Plant No.2>

I. Flocculation Basins

II. Sedimentation Basins

III. Filters

IV. Washwater Pumps

<Chemical Dosing Facilities>

I. Alum Dosing Facilities

II. Polymer Dosing Facilities

III. Chlorination Facilities

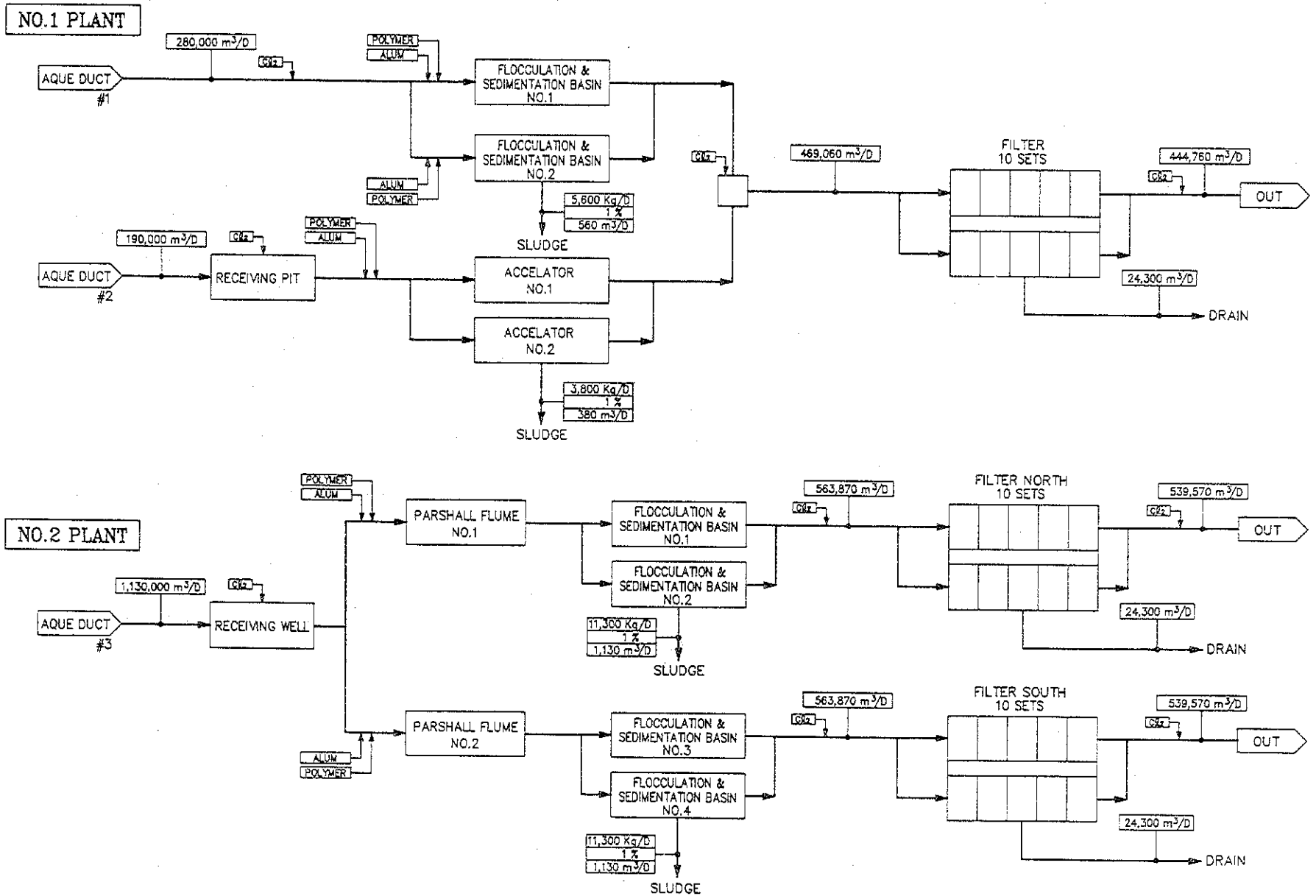


Fig.4.3.1

FLOW DIAGRAM OF THE BALARA WATER TREATMENT PLANT

I. Flocculation Basins No.1, No.2

i) Treatment Capacity

No.1 140,000 m3/day (5,833m^3/hr, 97m^3/min)

No.2 140,000 m3/day (5,833m^3/hr, 97m^3/min)

ii) Number of Basins and Dimensions

a. Number of basins: 2 basins (No.1, No.2)

b. Dimensions : No.1 W 21.25m(lower-part 15.25m) x L24.0m x D 5.0(water depth 4.5m)

: No.2 W 21.25m(lower-part 15.25m) x L24.0m x D 5.0(water depth 4.5m)

c. Treatment Capacity: No.1 1,971m^3

No.2 1,971m^3

iii) Calculation

a. Detention Time : No.1 1,971m^3 / 97m^3/min = 20 min

No.2 1,971m^3 / 97m^3/min = 20 min

II. Sedimentation Basins No.1, No.2

1) Sedimentation Basins No.1, No.2

i) Treatment Capacity

No.1 140,000 m^3/day (5,833m^3/hr, 97m^3/min)

No.2 140,000 m3/day (5,833m^3/hr, 97m^3/min)

ii) Number of Basins and Dimensions

a. Number of basins : 2 basins (No.1, No.2)

b. Dimensions : No.1 W 21.25m(lower-part 15.25m) x L 190.92m x D 5.0(water depth 4.5m)

: No.2 W 21.25m(lower-part 15.25m) x L 199.39m x D 5.0(water depth 4.5m)

c. Treatment Capacity: No.1 15,680m^3

No.2 16,375m^3

d. Surface Area : No.1 4,057m^2

No.2 4,237m^2

e. Sectional Area : No.1 $82m^2$

No.2 $82m^2$

iii) Calculation

a. Detention Time : No.1 $15,680m^3$ / $5,833m^3$/hr = 2.7 hr

No.2 $16,375m^3$ / $5,833m^3$/hr = 2.8 hr

b. Surface Loading

No.1 $97m^3$/min / $4,057m^3$ x 1,000 = 23.9mm/min

No.2 $97m^3$/min / $4,237m^3$ x 1,000 = 22.9mm/min

c. Mean Passing Velocity

No.1 $97m^3$/min / $82m^2$ = 1.2m/min

No.2 $97m^3$/min / $82m^2$ = 1.2m/min

d. Weir Loading rate

The present weir loading rate is obtained as follows;

No.1 $140,000m^3$/day / 23.25m = $6,021m^3$/m/day

No.2 $140,000m^3$/day / 23.25m = $6,021m^3$/m/day

To reduce the weir loading rate to $400m^3$/m/day, new launders with a total length of 175m are to be constructed ;

(17.5m/pc. x 10pcs/basin)

No.1 $140,000m^3$/day / (17.5 x 2 x 10) = $400m^3$/m/day

No.2 $140,000m^3$/day / (17.5 x 2 x 10) = $400m^3$/m/day

2) Accelator

i) Treatment Capacity

190,000 m^3/day ($7,917m^3$/hr, $132m^3$/min)

ii) Number of Basins and Dimensions

a. Number of basin : 2 basins

b. Dimensions : No.1 W 29.56m x L 29.56m x D 7.1(water depth 4.8m)

c. Capacity : For mixing and reaction

$1,300m^3$/basin

For clarification

$4,224m^3$/basin

d. Surface Area : $718.8m^2$

iii) Calculation

a. Detention Time :

$4,224m^3$ / $7,917m^3/hr$ / 2 basins = 1.06 hr

b. Surface Loading

$132m^3/min$ / 2 basins / $718.8m^2$ x 1,000 = 92mm/min

III. Filters

1) Treatment Capacity

469,060 m^3/day ($19,544m^3/hr$, $326m^3/min$)

2) Number and Dimensions

a. Number of filters : 10 filters

b. Dimensions : W 5.3m x L 15.3m x 2 tanks(per basin)

c. Filtration Area : W 5.3m x L 15.3m x 2 tanks = $162m^2$/basin

3) Filtration Rate

a. In case of 10 filters operated :

$469,060m^3/day$ / ($162m^2$ x 10 basins) = 290m/day

b. In case of one filter backwashing(9 filters operated):

$469,060m^3/day$ / ($162m^2$ x 9 basins) = 322m/day

4) Backwash Water Amount

i) Conditions

a. Number of filter basin : 10 basins

b. Ares of basin : 162m2/basin

c. Surfacewash : $0.2m^3/m^2/min$ x 3min/each

d. Backwash : $0.6m^3/m^2/min$ x 8min/each

e. Frequency of backwash : one time/basin/day

ii) Backwash Water Amount

Backwash Water Amount = 10 basins x $162m^2$/basin x ($0.2m^3/m^2/min$ x 3min+$0.6m^3/m^2/min$ x 8min/each) x one time/basin/day = $8,750m^3/day$

5) Available Backwash Water Amount

Available backwash water amount is obtained by the backwash pipe diameter (ϕ 900mm) and effective head(8.57m) as follows:

$Q = A\ v$

where, Velocity v is ;

$v = (2gH/(1+\alpha L/d))^{\frac{1}{2}}$

where,

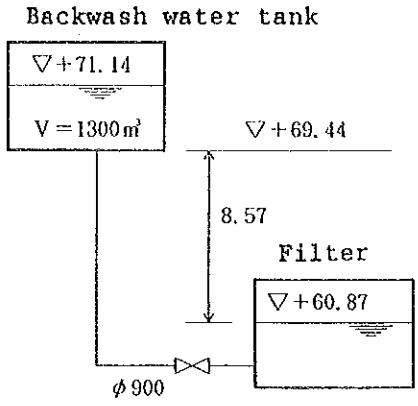
g : acceleration of gravity ($9.8m/sec^2$)

H : available head (8.57m)

α : coefficient (0.02)

L : length of pipeline (200m)

d : pipe diameter (0.9m)



Available backwash water amount is ;

$$Q = \frac{\pi \times 0.9^2}{4} \times 5.6 = 3.6m^3/sec \quad \text{--> } 214m^3/min$$

Therefore, possible backwash rate per unit filter area is obtained as follows :

$214m^3/min/162m^2 = 1.3m^3/m^2/min > 0.6 + 0.2 = 0.8m^3/m^2/min$

This result satisfies the water quantity required for backwash 0.6 $m^3/m^2/min$ plus surface wash $0.2m^3/m^2/min$.

IV. Washing Water Pumps

1) Required Amount

Required Amount : $8,750m^3/day$ ($6.1m^3/min$)

2) Lifting Head

a. Actual head : $H^1 = 71.14m - 56.6m = 14.54m$

b. Pipe loss : $H^2 = 5m$

c. Total head : $H = H^1 + H^2 = 14.54 + 5 = 19.54m$

3) Washwater Pump

Considering the inter-changeability with those of the Plant No.2 pumps, the washwater pumps are determined as follows:

Number : 2 units (one for standby)

Delivery capacity : $7.3m^3/min$

Lifting Head : 23m

V. Washwater Recovery Pump

1) Required Amount

Required Amount : 8,750m^3/day (6.1m^3/min)

2) Lifting Head

a. Actual head : H^1 = 61.6m - 52.2m = 9.4m

b. Pipe loss : H^2 = 5m

c. Total head : H = H^1 + H^2 = 9.4 + 5 = 14.4m

3) Washwater Recovery Pump

Considering an 20% allowance of the capacity, the washwater recovery pumps are determined as follows :

Number : 3 units (one for standby)

Delivery Capacity : 3.6m^3/min

Lifting Head : 15m

<Plant No.2>

I. Flocculation Basins

i) Treatment Capacity

1,130,000m^3/day (47,084m^3/h, 784.7m^3/min)

ii) Number and Dimensions

a. Number : 12 Basins

b. Dimensions : W 16.62m x L 19.25m x D 4.99 ~ 6.02m
(effective depth 5m)

c. Capacity : 1,321m^3/basin(15,852m^3 in total)

iii) Calculation

a. Detention Time

1,321m^3/basin x 12basins / 784.7m^3/min = 20.2min

II. Sedimentation Basins

i) Treatment Capacity

1,130,000 m^3/day (47,083m^3/hr, 785m^3/min)

ii) Number of Basins and Dimensions

a. Number of basins : 12 basins

b. Dimensions : W 18.3m x L 68.5m x D. 6.77~7.68m
(water depth 5.03m)

c. Treatment Capacity : 6,305m^3/basin

d. Surface Area : 1,253m^2/basin

e. Sectional area : 92m^2/basin

iii) Calculation

a. Detention Time :

6,305m^3 x 12 basins / 47,083m^3/hr = 1.6h

b. Surface Loading :

785m^3/min / 12basins / 1,253m^3 x 1,000 = 52.2mm/min

c. Mean Passing Velocity

785m^3/min / 12basins / 92m^2 = 0.71m/min

d. Weir Loading Rate

Present weir loading is obtained as follows;

1,130,000m^3/day / {(16.52+16.62 x 2) x 4)} = 5,677m^3/m/day

To reduce the weir loading rate to 400m^3/m/day, new launders with a total length of 1416 m to be constructed.

1,130,000m^3/day / 1416m / 2 = 400m^3/m/day

III. Filters

1) Treatment Capacity

1,127,740 m^3/day (46,989m^3/hr, 783m^3/min)

2) Number and Dimensions

a. Number of filters : 20 filters

b. Dimensions/filter : W 5.3m x L 15.3m x 2 tanks(per filter)

c. Filtration Area : W 5.3m x L 15.3m x 2 tanks = 162m^2

3) Filtration Rate

a. Normal operation(20 filters to be operated):

1,127,740m^3/day / (162m^2 x 20 filters) = 348m/day

b. Under backwashed (19 filters to be operated):

1,127,740m^3/day / (162m^2 x 19 basins) = 366m/day

4) Backwash Water Amount

i) Conditions

a. Number of basins : 20 filters

b. Ares of filter : $162m^2$/filter

c. Surfacewash : $0.2m^3/m^2$ min x 3 min/each

d. Backwash : $0.6m^3/m^2$/min x 8min/each

e. Frequency of backwash : once a day/filter

ii) Backwash Water Amount

Backwash Water Amount = 20 filters x $162m^2$/filter x ($0.2m^3/m^2$/min x 3min + $0.6m^3/m^2$/min x 8min/each) once a day/filter = $17,500m^3$/day

5) Available Backwash Water Amount

Available backwash water amount is obtained as follows;

$Q = A\ v$

where, Velocity v is ;

$v=\{2gH/(1+\alpha L/d)\}^{\frac{1}{2}}$

where,

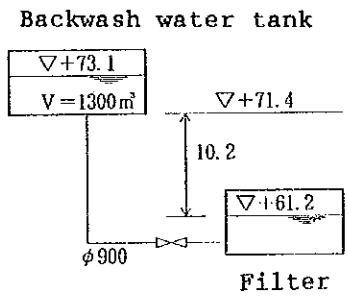
g : acceleration of gravity ($9.8m/sec^2$)

H : available head (10.2m)

α : coefficient (0.02)

L : length of pipeline (150m)

d : pipe diameter (0.9m)



Available backwash water is ;

$$Q = \frac{\pi \times 0.9^2}{4} \times 4.5 = 4.3m^3/sec \rightarrow 259m^3/min$$

Therefore, possible backwash amount is obtained as follows:

$259m^3/min$ / $162m^2$ = $1.6m^3/m^2/min$

This satisfies the water amount required backwash 0.6 $m^3/m^2/min$, surface wash $0.2m^3/m^2/min$.

IV. Washwater Pumps

1) Required Amount

Required Amount : $17,500m^3$/day ($12.2m^3/min$)

2) Lifting Head

a. Actual head : H^1 = 73.10m - 51.15m = 17.85m

b. Pipe loss : H^2 = 5m

c. Total head : H = H^1 + H^2 = 17.85 + 5 = 22.85m

3) Washwater Pump

Considering an allowance as much as 20% of the capacity, the washwater pump is determined as follows:

Number : 3 units (one for standby)

Delivery Capacity : 7.3m^3/min

Lifting Head : 23m

<Chemical Dosing Facilities>

I. Alum Dosing Facilities

1) Dosage :

Maximum : 45.0 mg/l

Mean : 16.34 mg/l

Minimum : 10.00 mg/l

2) Feeding Rate :

<Plant No.1>

i) Sedimentation Basins No.1, No.2

$$q = 140{,}000m^3/day \times A \times \frac{1}{B} \times 10^{-6}$$

A : Dosage 45mg/l
B : Specific Gravity 1.32

$$= 140{,}000 \times 45 \times \frac{1}{1.32} \times 10^{-6} = 4.8m^3/day(3.3\ l/min)$$

ii) Accelator

$$q = 190{,}000m^3/day \times A \times \frac{1}{B} \times 10^{-6}$$

A : Dosage 45mg/l
B : Specific Gravity 1.32

$$= 190{,}000 \times 45 \times 1/1.32 \times 10^{-6} = 6.5m^3/day(4.5\ l/min)$$

<Plant No.2>

i) Sedimentation Basins (South), (North)

$$q = 565{,}000 m^3/day \times A \times \frac{1}{B} \times 10^{-6}$$

A : Dosage 45mg/l
B : Specific Gravity 1.32

$$= 565{,}000 \times 45 \times \frac{1}{1.32} \times 10^{-6} = 19.3 m^3/day (19.3\ l/min)$$

The feeding rate is summarized as follows:

Plant	Dosing Point	Feeding rate (l/min)		
		Maximum	Mean	Minimum
No.1	Sedimentation No.1	3.3	1.2	0.7
	Sedimentation No.2	3.3	1.2	0.7
	Accelator	4.5	1.6	1.0
No.2	Sedimentation (South)	13.4	4.9	3.0
	Sedimentation (North)	13.4	4.9	3.0
	Total	37.9	13.8	8.4

4) Feeder :

Numbers : 6 units (one for standby)

Type : Rotary Type Rated Feeder

Capacity :

Plant	Dosing Point	Capacity (l/min)
No.1	Sedimentation No.1	10
	Sedimentation No.2	10
	Accelator	10
No.2	Sedimentation (South)	20
	Sedimentation (North)	20

5) Alum Storage Tank :

i) Number and Dimensions

a. Number : 5 tanks

b. Dimensions : W 6m x L 5m x H 5m

c. Capacity : 120m^3 (effective)

ii) Available Period

Available period by using 5 storage tanks at the mean feeding rate is as follows:

120m3 x 5 tanks / 24.8m3/day = 24.2 days

II. Polymer Dosing Facilities

1) Dosage

	Anion	Cation
Maximum	0.20 mg/l	0.20 mg/l
Mean	0.06 mg/l	0.09 mg/l
Minimum	0.03 mg/l	0.03 mg/l

2) Feeding Rate (Anion, Cation)

<Plant No.1>

i) Sedimentation Basin No.1, No.2

$$q = 280{,}000\text{m}^3/\text{day} \times A \times \frac{100}{B} \times \frac{1}{C} \times 10^{-6}$$

A : Dosage (0.20mg/l)

B : Solution concentration (2.75%)

C : Specific Gravity : (1.0)

$$= 280{,}000 \times 0.20 \times \frac{100}{2.75} \times \frac{1}{C} 10\text{-}6 = 2.04\text{m}^3/\text{day}(1.4\ \text{l/min})$$

ii) Accelator

$$q = 190{,}000\text{m}^3/\text{day} \times A \times \frac{100}{B} \times \frac{1}{C} \times 10^{-6}$$

A : Dosage (0.20mg/l)

B : Solution concentration(2.75%)

C : Specific Gravity (1.0)

$$= 190,000 \times 0.20 \times \frac{100}{2.75} \times \frac{1}{C} \times 10^{-6} = 1.4 m^3/day (0.9\ l/min)$$

<Plant No.2>

i) Sedimentation Basins (South, North)

$$q = 565,000 m^3/day \times A \times \frac{100}{B} \times \frac{1}{C} \times 10^{-6}$$

A : Dosage (0.25mg/l)

B : Solution concentration (2.75%)

C : Specific Gravity (1.0)

$$= 565,000 \times 0.20 \times \frac{100}{2.75} \times \frac{1}{1.0} \times 10^{-6} = 4.1 m^3/day (2.9\ l/min)$$

The feeding rate is summarized as follows:

Plant	Dosing Point	Feeding rate (l/min)					
		Max.	Mean	Min.	Max.	Mean	Min.
No.1	Sedimentation No.1 & 2	0.67	0.20	0.20	0.67	0.20	0.20
	Accelator	0.91	0.27	0.27	0.91	0.27	0.27
No.2	Sedimentation (South)	2.70	0.81	0.80	2.70	0.81	0.80
	Sedimentation (North)	2.70	0.81	0.80	2.70	0.81	0.80
	Total	7.65	2.09	2.27	7.65	2.09	2.27

4) Feeder :

Number : 5 units (one for standby)

Type : Diaphragm type Metering Pump

Capacity :

Plant	Dosing Point	Capacity (l/min)
No.1	Sedimentation No.1 & 2	1.0
	Accelator	1.0
No.2	Sedimentation (South)	3.0
	Sedimentation (North)	3.0

5) Polymer Solution Tank :

i) Numbers and Dimensions

a. Number : 4 tanks

b. Dimensions : c 1.7m x H 2.0m

c. Capacity : 3.6m^3 (effective)

ii) Available Period

The available period by using 5 storage tanks at the mean feeding rate is as follows:

3.6m^3 x 4 tanks / 3.0m^3/day = 4.8 days

III. Chlorination Facilities

1) Treatment Capacity

Plant	Dosing Point	Treatment capacity (m^3/day)
No.1	Aqueduct (Pre-chlorine Cl 1)	280,000
	Accelator (Pre-chlorine Cl 2)	190,000
	After Sedimentation (Medium-chlorine Cl 3)	469,060
	After Filtration) (Post-chlorine Cl 4)	444,760
No.2	Receiving Well (Pre-chlorine Cl 5)	1,130,000
	After Sedimentation (Medium-chlorine Cl 6)	563,870
	After Sedimentation) (Medium-chlorine Cl 7)	563,870
	After Filtration (Medium-chlorine Cl 8)	539,570
	After Filtration (Medium-chlorine Cl 9)	539,570

2) Dosage

	Pre-chlorine	Medium-chlorine	Post-chlorine
Maximum	3.0mg/l	1.0mg/l	1.35mg/l
Mean	0.7mg/l	0.5mg/l	1.15mg/l

3) Dosing Point

As per the next page attached.

4) Feeding Rate

$q = Q \times A \times 1/24$

Where, Q : Treatment capacity

A : Feeding rate

The results of the calculation are summarized as follows:

i) Pre-Chlorine

Plant	Feeding point	Feeding Rate (kg/hr)	
		Maximum	Mean
No.1	Cl - 1	35.0	8.2
	Cl - 2	23.8	5.6
No.2	Cl - 5	141.3	33.0
Total		200.1	46.8

ii) Medium-Chlorine

Plant	Feeding point	Feeding Rate (kg/hr)	
		Maximum	Mean
No.1	Cl - 3	19.5	9.8
No.2	Cl - 6	23.5	11.8
	Cl - 7	23.5	11.8
Total		66.5	33.4

iii) Post-Chlorine

Plant	Feeding point	Feeding Rate (kg/hr)	
		Maximum	Mean
No.1	Cl - 4	25.0	21.3
No.2	Cl - 8	30.4	25.9
	Cl - 9	30.4	25.9
Total		85.8	73.1

Consumption by Plant

		Plant No.1	Plant No.2	Total
Pre-chlorine	Maximum	58.8	141.3	200.1
	Mean	13.8	33.0	46.8
Medium-chlorine	Maximum	19.5	47.0	66.5
	Mean	9.8	23.6	33.4
Post-chlorine	Maximum	25.0	60.8	85.8
	Mean	21.3	51.8	73.1
Total	Maximum	103.3	249.1	352.4
	Mean	44.9	108.4	153.3

5) Chlorinator

Number : 4 units (one for standby)

Capacity : 150kg/hr (same as the existing ones)

6) Water Supply Pressure Pump

From the quantity required by the ejector,

400 l/min x 8 units + 800 l/min x 1 unit = 4,000 l/min

Required pressure is more than 3.5kg/cm^2, and the number of pump is 2.0m^2/min x 40m x 3 units (one for standby).

4.3.2 Design of Replacement of Major Existing Facilities

Based on the field survey conducted from August 4 to September 2, 1993, of which results are shown in the Appendix, the following is the detailed design of the replacement of major existing facilities/equipment.

I. Aqueduct

a. Gate

Due to deterioration and malfunction, the existing four out of five gates are to be replaced by the following gates:

Number	: 4 gates
Type	: Steel plate make, rectangular type gate
Nominal size	: W 2,200mm (approx.)x H 2,200mm(approx.)
Working Pressure	: 3 m Aq.(approx.)

II. Plant No.1 Mechanical Facilities/Equipment

(1) Rapid Mixing

a. Rapid Mixer

Due to deterioration, defective vibration is observed. The existing mixers are to be replaced by the following mixers.

Number	: 2 units (one each for NO.1 & No.2 basin)
Type	: Vertical type mixer

(2) Flocculation Basin

a. Flocculator

Three out of 12 flocculators in the flocculation basin No.1 and 5 out of 12 flocculators in the flocculator basin No.2 are out of order. The other flocculators are remarkably deteriorated. All of the existing flocculators are to be replaced by the following flocculators:

Numbers : 24 units (12 units each for No.1 & No.2 basin)
Type : Vertical type mixer

(3) Sedimentation Basin

a. Baffle Wall and Launder

The following concrete structures are to be constructed to improve hydraulic conditions of the sedimentation basins.

i) Baffle wall

Number : L.S. (for No.2 basin)
Structure : Reinforced concrete

ii) Baffle wall

Number : L.S.
Structure : Reinforced concrete

iii) Launder

Number : 20 pcs. (10 pcs. each for No.1 & No.2 basins)
Structure : Reinforced concrete

(4) Accelators

Two units of accelators were constructed 35 years ago. Due to deterioration, the existing driving units and sludge withdrawal device are to be replaced by the following equipment.

a. Driving Unit

Number : 2 units
Type : Worm-gear type reduction gear

b. Sludge Withdrawal Device

i) Sludge Withdrawal Valve

Number : 8 units
Type : air operation type diaphragm valve
Size : 150mm

ii) Sludge Withdrawal Gate Valve

Number : 8 units
Type : Manual operation type gate valve
Size : 150mm

iii) Quick Operation Valve

Number : 2 units
Type : Manual operation type, outer screw gate valve
Size : 150mm

c. Metal Parts

Corroded metal parts will be painted or replaced by new members.

(5) Filters

a. Flow Control Valve

Due to deterioration, the existing flow control valves, which are hydraulically operated butterfly valves, are to be replaced by the following valves.

Number : 10 units
Type : Electric operation type butterfly valve
Size : 500mm

b. Main Backwash Valve

The butterfly valve which controls the backwash rate is impossible to be operated due to deterioration. The existing valve is to be replaced by the following valve.

Number : 1 unit
Type-Form : Electric operation type, butterfly valve

Nominal Size : 800mm

c. Main Surfacewash Valve

Due to deterioration, the existing surfacewash valve, which are hydraulically operated butterfly valves, is to be replaced by the following valves.

Number : 1 unit
Type : Electric operation type butterfly valve
Size : 450mm

d. Venturi Tube

Due to deterioration, the existing venturi tubes are to be replaced by the following.

Number : 10 units
Size : 500mm
Measuring range : 0 ~ 47,000m^3/day

(6) Pump Facilities

a. Washwater Pump

Due to aging, the existing pumps are to be replaced by the following pumps. Taking into considerations easy O&M, both pump specifications for Plant No.1 and No.2 shall be the same.

Number : 2 units (one for standby)
Type : Horizontal type centrifugal pump
Capacity : 7.3m^3/min
Lifting head : 23m

b. Washwater Recovery Pump

Due to aging, the existing pumps are to be replaced by the following pumps. The pump room is to be constructed according to the required space for the new pumps.

Number : 3 units (one for standby)

Type : Horizontal type centrifugal pump
Capacity : 3.6m^3/min
Lifting head : 15m

III. Plant No.2 Mechanical Facilities/Equipment

(1) Flocculation Basin

a. Flocculator

Due to deterioration and malfunction, the existing flocculators are to be replaced by the following. The concrete slab is to be constructed for the installation of the flocculators.

Number : 108 units (9 units/basin x 12 basins)
Type : Vertical mixer

b. Baffle Walls

For the improvement of floc formation effect, the baffle walls are to be constructed.

i) Baffle Walls (A)

Number : 12 walls (1 wall/basin) x 12 basins
Structure : Reinforced concrete

ii) Baffle Walls (B)

Number : 24 walls (2 walls/basin) x 12 basins
Structure : Reinforced concrete

(2) Sedimentation Basin

a. Drain Penstock Support

Due to aging, the existing supports for the sludge withdrawal valves, which are corroded, are to be replaced.

Number : 12 sets
Material : Steel

b. Flushing Pump

Due to aging, the existing pumps are to be replaced by the following pumps.

Number : 2 units (one for standby)
Type : Horizontal type centrifugal pump
Capacity : 0.8m^3/min
Lifting head : 20m

c. Baffle and Launder

The baffle wall and launders are to be constructed in the sedimentation basin to improve the settling effect.

i) Baffle Wall

Number : 12 walls (1 wall/basin) x 12 basins
Structure : Reinforced concrete

ii) Launder

Number : 108 pcs. (9 pcs./basin x 12 basins)
Structure : Reinforced concrete

(3) Filter

a. Flow Control Valve

Due to deterioration, the existing valves are to be replaced by the following valves.

Number : 20 units
Type : Electric operation type butterfly valve
Size : 500mm

b. Main Backwash Valve

Due to deterioration, the existing valve is to be replaced by the following valve.

Number : 1 unit
Type : Electric operation type butterfly valve
Size : 1,000mm

c. Main Surfacewash Valve

Due to deterioration, the existing valve is to be replaced by the following valve.

Number : 1 unit
Type : Electric operation type butterfly valve
Size : 450mm

d. Venturi Tube

Due to deterioration, the existing venturi tubes are to be replaced by the following:

Number : 20 units
Size : 500mm
Measuring range : 0 ~ 56,500m^2/day

(4) Pump Facilities

a. Washwater Pump

Due to aging, the existing pumps are to be replaced in the following pumps.

Number : 3 units (one for standby)
Type : Horizontal type centrifugal pump
Capacity : 7.3m^3/min
Lifting head : 23m

IV. Chemical Dosing Facilities/Equipment

(1) Alum Dosing Equipment

a. Feeder (6 units)

Due to deterioration, the existing feeders are to be replaced by the

following:

Number : 6 units (one for standby)
Type : Rotodip type
Capacity : 10 l/min x 3 units, 20 l/min x 3 units

(2) Polymer Dosing Equipment

a. Feeder

Due to deterioration, the existing feeders are to be replaced by the following:

Number : 5 units (one for standby)
Type : Diaphragm pump
Capacity : 3 l/min x 3 units, 1 l/min x 2 units

(3) Chlorination Equipment

New chlorine equipment are to be installed in the newly constructed chlorination building which was constructed by the MWSS. The existing chlorine dosing equipment will be operated until the new equipment is in place.

a. Chlorinator

The existing two out of four chlorinator units are out of order, and the other two units in operation are badly deteriorated. All the chlorinators are to be replaced by the following:

Number : 4 units (one for standby)
Type : Manual Regulating type
Capacity : 150kg/hr

b. Evaporator

The existing evaporators, which are out of order, are to be replaced by the following:

Number : 2 units
Type : Warm water type

Capacity : 150kg/hr

c. Chlorine Gas Leakage Detector

The existing detectors, which are out of order, are to be replaced by the following:

Number : 3 sets

d. Exhaust Fan

Exhaust fans are to be installed in the new chlorination building.

Number : 3 units
Type : Exhaust fan

e. Booster Pump

In connection with the replacement of the existing chlorinators, the following pumps are to be installed.

Number : 3 units (one for standby)
Type : Horizontal type centrifugal pump
Capacity : 2.0m^3/min
Lifting Head : 40m

f. Weighing Scale

The existing weighing scales, which are out of order, are to be replaced.

Number : 2 units
Type : Loadcell type
Capacity : 2 tons

g.Piping

In connection with the relocation of the chlorination building, related valves and piping are to be installed to connect the new chlorination facilities and the old chlorine distribution pipe.

V. Switching Station Facilities & Substation

(1) 34.5KV Switching Station

In order to improve O&M for the distribution wiring (overhead wiring; about 1200m length), a switching station is to be constructed at 34.5KV receiving point.

1 unit: 3 phase load disconnection switch 34.5KV, 60HZ, 200A, manual operation type
1 set : Grounding device, 3 phase, 34.5KV, manual operation type
1 set : Wooden pole, insulator, protection fence

(2) Substation

In connection with the increase of electrical load by the increase of flocculation units in the Plant No.2, the existing transformer No.1 will be replaced by the following.

3 units:Transformer, 1 phase, oil immersed type, 250KVA, 2.4KV/480-240V

VI. Electrical Facilities/Equipment

< Plant No.1 Electrical Facilities/Equipment >

(1) Flocculation & Sedimentation Basin No.1 Control Center

In connection with the replacement of mechanical portion, the existing deteriorated control panels are to be replaced by the following control center.

a. 1 set : Indoor single-sided control center, 3 phase, 460V
Load for;
1 unit : Rapid mixer
12 units: Flocculators
1 set : Molded case circuit breakers

b. 13 units : Post type switch box,

Operation for;
1 unit : Rapid mixer
12 units : Flocculators

(2) Flocculation & Sedimentation Basin No.2 Control Center

In connection with the replacement of mechanical portion, the existing deteriorated control panels are to be replaced by the following control center units.

a. 1 set : Indoor single-sided control center, 3 phase, 460v
Load for;
1 unit : Rapid mixer
12 units : Flocculators
1 set : Molded case circuit breakers
b. 13 units : Post type switch box
Operation for:
1 unit : Rapid mixer
12 units : Flocculators

(3) Accelator Control Center

Due to aging, the existing control panels are to be replaced by the following panels.

a. 1 set : Indoor single-sided control center, 3 phase, 460v
Load for;
2 units : Accelators
2 units : Compressors
1 set : Sludge drain valve sequence (magnet valve; air operated valve x 8)
1 set : Molded case circuit breakers
b. 2 units : Post type switch box
Operation for;
2 units : Accelators

(4) Filter Control Center

In connection with the replacement of the existing air operated effluent valves with a electrically operated type, the following control center is to be installed.

a. 1 set : Indoor single-sided control center, 3 phase, 460v
Load for;
1 unit : Main surface wash valve
2 units : Main backwash valves
10 units : Purified water flow regulating valves
1 set : Molded case circuit breakers

b. 10 units: Post type switch box
Operation for;
1 set : Filtered water flow regulating valve and regulator

c. 1 panel : Indoor stand type, site control panel
Operation for;
1 unit : Main surface wash valve
1 unit : Main backwash valves
1 set : Main surface wash and main backwash flow meter

(5) Washwater Pump Control Center

Due to deterioration, the existing control center is to be replaced by the following control center.

1 set : Indoor single-sided control center, 3 phase, 460V
Load for;
2 units: Washwater pumps
1 set : Purchased electricity-Existing private power generator change over circuit
1 set : Molded case circuit breakers

(6) Washwater Pump Room Distribution Panel

Due to deterioration, the existing control panels are to be replaced by the following panels.

1 panel : Indoor self-stand closed type, 3 phase, 240-120V
1 unit : Molded case circuit breakers
3 poles, 400AF
2 units : Molded case circuit breakers
3 poles, 225AF
5 units : Molded case circuit breakers
2 poles, 100AF

(7) Washwater Recovery Pump Control Center

In connection with the replacement of mechanical portion, the existing panels are to be replaced by the following control center. The existing pump house is to be constructed according to the size of new pumps.

1 set : Indoor single-sided control center, 3 phase, 460V
Load for;
3 units : Washwater recovery pumps
1 set : Molded case circuit breakers

< Plant No.2 Electrical Facilities/Equipment >

(1) Flocculation & Sedimentation Basin Control Center

In connection with the replacement of mechanical portion, the existing deteriorated control center is to be replaced by the following . The existing control center house is to be reconstructed according to the necessary dimensions of new electrical facilities.

a. 1 set : Indoor double-sided type control center, 3 phase, 460V
Load for;
108 units : Flocculators
2 units : Flushing pumps
1 unit : Molded case circuit breakers
b. 110 units: Post type, site switch box
Operation for;
108 units : Flocculators
2 units : Flushing pumps
c. 1 panel : Low tension main switch panel

(2) Filter Control Center

In connection with the replacement of the existing air operated effluent valves with a electrically operated type, the following control center is to be installed.

a. 1 set : Indoor single-sided control center, 3 phase, 460V
composed of 2 pairs
Load for;
20 units : Washing water flow regulating valve
1 unit : Main surface wash valve
1 unit : Main backwash valve
1 set : Molded case circuit breakers

b. 20 units: Post type site switch box
Operation for;
1 set : Filtration water flow regulating valve and regulator

c. 2 panels: Indoor stand type site control panel
Operation for;
1 set : Main surface wash valve
1 set : Main backwash valve
1 set : Main surface wash and main backwash flow indicator

d. 1 unit : Low tension main switch panel

(3) Washwater Pump Control Center

Due to deterioration, the existing control center is to be replaced by the following:

a. 1 set : Indoor single-sided control center, 3 phase, 460V
Load for;
3 units : Washwater pumps

b. 1 unit : Low tension main switch panel

< Electrical Facilities/Equipment for Chemical Dosing Facilities >

(1) Chlorination Facilities Control Center

In connection with the replacement of the existing chlorination facilities, a new control center for the chlorination facilities is to be installed.

a. 1 set : Indoor single-sided type control center, 3 phase, 460V
Load for;
3 units : Booster pumps
3 units : Exhaust fans
2 units : Evaporators
1 set : Molded case circuit breakers

b. 3 units : Post type, site switch box
Operation for;
3 units : Booster pumps

c. 1 unit : Low tension main switch panel

(2) Polymer Dose Facilities Control Center

In connection with the replacement of the mechanical portion, the existing panels are to be replaced by the following control center.

a. 1 set : Indoor single-sided type control center, 3 phase, 460V
Load for;
5 units : Polymer dose pump
1 set : Molded case circuit breakers

b. 5 sets : Post type, site switch box
Load for;
5 units : Polymer dose pump

VI. Instrumentation Facilities

< Plant No.1 Instrumentation Facilities >

(1) Filtration Basin Instrumentation Facilities

Due to aging and deterioration, the existing instrumentation facilities/equipment are to be replaced by the following: A new instrument

panel is to be provided to install all electronic regulating meters in the panel.

a. Main surface wash flow meter

Number : 1 set, 1 set consists of;

1 unit : Differential pressure transmitter with indicator

1 unit : Electronic regulator

1 unit : Indicator (mounted on the site operation panel in the operation room for the filtration basin) The existing orifice are functional and are to be reused.

b. Main backwash flow meter

Number : 1 set, 1 set consists of;

1 unit : Differential pressure transmitter with indicator

1 unit : Electronic regulator

1 unit : Indicator (mounted on the site operation panel in the operation room for the filtration basin)

The existing Venturi tubes are functional and are to be reused.

c. Loss of head meter

Number : 10 sets, 1 set consists of;

1 unit : Differential pressure transmitter, capillary tube type, with indicator

d. Filtration rate of flow meter

Number : 10 sets, 1 set consists of;

1 unit : Differential pressure transmitter, capillary tube type, with indicator

1 unit : Electronic regulator

1 unit : Filtration flow main setting point instrument (1 unit/10 sets common)

1 set : Square root calculator, electric positioner, (or such device as placed inside the above instrument)

The existing Venturi tubes are functional and are to

be reused.

e. Filtration basin instrumentation panel

1 set : Indoor self-stand closed type, single phase

1 set : Instrument electric source circuit, and its stabilizing electric source

1 set : Space enough to fix extra instruments as follows;
Filtration flow regulator, filtration flow main setting point instrument, main surface wash water flow meter, main backwash water flow meter, washing water tank level gauge.

(2) Washwater Tank Level Gauge

The water level gauges, which are out of order, are to be replaced by the following:

Number : 1 set, 1 set consists of;

1 unit : Submerged type water level gauge, (or equivalent)

2 units: Indicators (mounted on the instrument panel in the washing water pump room for the filtration basin)

< Plant No.2 Instrumentation Facilities/ Equipment >

(1) Filter Instrumentation Facilities

The instrumentation facilities, which are out of order, are to be replaced by the following: A new instrument panel is to be provided to install all electronic regulating meters in the panel.

a. Main surface wash water flow meter

Number : 1 set, 1 set consist of;

1 unit : Differential pressure transmitter with indicator

1 unit : Electronic regulator

1 unit : Indicator (mounted on the site operation panel in the operation room for the filtration basin)

The existing Orifice are functional and are to be reused.

b. Main backwash flow meter

Number : 1 set, 1 set is consisted of;

1 unit : Differential pressure transmitter with indicator

1 unit : Electronic regulator

1 unit : Indicator (mounted on the site operation panel in the operation room for the filtration basin)

The existing Venturi tubes are functional and are to be reused, and the work for the drive regulating valve shall be executed by the mechanical side.

c. Loss of head meter

Number : 20 sets, 1 set is consisted of;

1 unit : Differential pressure transmitter, capillary tube type, with indicator

d. Filtration rate of flow meter

Number : 20 sets, 1 set is consisted of;

1 unit : Differential pressure transmitter, capillary tube type, with indicator

1 unit : Electronic regulator

1 unit : Filtration water flow main setting point instrument (1 unit/20 sets common)

1 set : Square root calculator, electric positioner, (or such device as placed inside the above instruments)

e. Filter instrumentation panel

1 set : Indoor self-stand closed type, single phase, 240-120V composed of 2 pairs

1 set : Instrument electric source circuit, and its stabilizing electric source

1 set : Space enough to fix extra instruments as follows;

Filtration water flow meter, filtration water flow main setting point instrument, main surface wash water flow meter, main backwash water meter, washing water level gauge.

(2) Washwater Tank Level Meter

The water level gauges, which are out of order, and are to be replaced by the following:

Number : 1 set, 1 set consists of;
1 unit : Submerged type water level gauge, (or equivalent)
2 units: Indicators (mounted on the instrument panel for the filtration basin, in the washwater pump room)

< Chemical Dosing Instrumentation Facilities >

(1) Alum Tank Level Gauge

The liquid level gauges, which are out of order, are to be replaced by the following:

Number : 5 sets, 1 set consists of;
1 unit : Float type liquid level gauge (with site indicator)
1 unit : Indicator

(2) Instrumentation Panel for the Chemical Facilities/Equipment

A new instrumentation panel is to be installed for monitoring the aforesaid alum tank liquid level in the chemical room.

Number : 1 panel : Indoor wall-hang type, single phase, 240-120V
1 set : Space enough to fix a liquid level gauge