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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

DIRECTORATE GENERAL OF HUMAN SETTLEMENTS (CIPTA KARYA)
MINISTRY OF PUBLIC WORKS (PU)
GOVERNMENT OF INDONESIA

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

FINAL REPORT

MAIN REPORT

PART II FEASIBILITY STUDY

MARCH 1996

PACIFIC CONSULTANTS INTERNATIONAL, TOKYO
YACHIYO ENGINEERING CO., LTD., TOKYO

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FOR

THE CITY OF UJUNG PANDANG

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In this report project cost is estimated at June 1995 price and at an exchange rate of 1 US$ = Rp. 2,250 (= ¥100)

PREFACE

In response to a request from the Government of the Republic of Indonesia, the Government of Japan decided to conduct a master plan and feasibility study on wastewater and solid waste management for the city of Ujung Pandang and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Indonesia a study team headed by Mr. Ryuji Yanai of Pacific Consultants International (PCI) five times between June 1994 and February 1996.

The team held discussions with the officials concerned of the Government of Indonesia, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

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 Indonesia for their close cooperation extended to the team.

March 1996

藤田公郎

Kimio Fujita
President
Japan International Cooperation Agency

MASTER PLAN AND FEASIBILITY STUDY
ON
WASTEWATER AND SOLID WASTE MANAGEMENT
FOR
THE CITY OF UJUNG PANDANG

March 1996

Mr. Kimio Fujita
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

Dear Sir,

We are pleased to submit herewith the final report entitled "MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG". This report has been prepared by the Study Team in accordance with the contract signed on 14 June 1994, 24 April 1995 and 1 November 1995 between the Japan International Cooperation Agency and Pacific Consultants International in association with Yachiyo Engineering Co., Ltd.

The report, based on the results of analysis of existing condition of wastewater and solid waste management in Ujung Pandang, presents a master plan and feasibility study of wastewater and solid waste management, and an alternative study for wastewater management. The report consists of Executive Summary, Main Report and Supporting Report. The Executive Summary briefly illustrates the findings of the entire Study. The Main Report, in three (3) parts, presents the master plan (Part I), feasibility study (Part II) and alternative study (Part III). The Supporting Report describes in details the technical aspects of the master plan and feasibility study. Moreover, the relevant data and drawings are compiled as the Data Book & Drawing.

All members of the Study Team wish to express grateful acknowledgment to the personnel of your Agency, Advisory Committee, Ministry of Foreign Affairs, Ministry of Construction, Ministry of Health and Welfare and Embassy of Japan in Indonesia, and also to officials and individuals of the Government of Indonesia for their assistance extended to the Study Team. The Study Team sincerely hopes that the results of this study will contribute to the socio-economic development and environmental sanitation improvement in Ujung Pandang, the gateway to East Indonesia.

Yours faithfully,

Ryuji Yanai
Team Leader

SUMMARY

1. Introduction

This is a Summary of the feasibility study for wastewater and solid waste management (Part II of Main Report), conducted for the priority projects as identified by the master plan in the Municipality of Ujung Pandang (KMUP). The Study Area of master plan is shown in *Fig. 1.*

The objectives of the entire study and the relevant reports in which they are dealt with are as follows:

- To formulate a master plan for the improvement of wastewater and solid waste management until the year 2015 in KMUP (Part I of Main Report)
- To conduct a feasibility study for the priority projects, until the year 2005, as identified by the master plan (This Report)
- To conduct an alternative study for wastewater management (Part III of Main Report)

2. Feasibility Study of Wastewater Management

The projects of feasibility study of wastewater management as identified by the master plan are categorized into three (3) major components of sanitation improvement project, sewerage development project and pilot project.

2.1 Sanitation Improvement Project

Sanitation improvement project consists of two (2) project components, namely, provision of accessible basic sanitation facilities in slum areas and improvement of septage management. These projects are slated for urgent implementation until the year 2000.

(1) Sanitation improvement for slum area

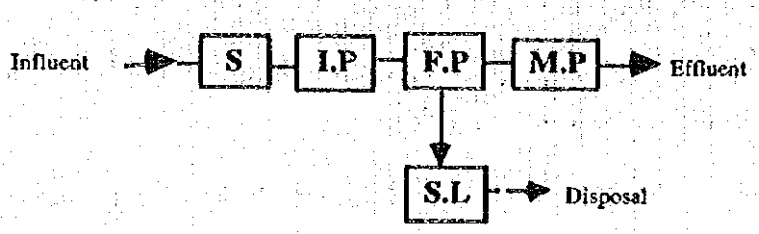
Project work includes rehabilitation of 59 malfunctioned public toilets and construction of 66 SMS (B)/public toilets, basically to be accomplished until the year 1998.

(2) Improvement of septage management

Project work includes procurement of vacuum trucks on regular basis in conformity with the quantity of generated septage until the year 2015 and improvement of the access road to the existing Antang septage treatment plant to be accomplished until the year 1998.

2.2 Sewerage Development Project

Sewerage Development Project is comprised of three (3) sewerage projects shown in *Fig. 2.* Stabilization pond is applied as the treatment system for all the proposed sewerage systems. The flow diagram of the stabilization pond treatment process adopted is shown below.



S	:	Screen
I.P	:	Inflow Pump
F.P	:	Facultative Pond
M.P	:	Maturation Pond (minimum of two ponds in series)
S.L	:	Sludge Lagoon (minimum of two cells)

The collection system is comprised of a combination small scale sewers, ordinary sewers and interceptor sewers. Small scale sewer is applied as the tertiary sewer prior to house connection sewer when the width between the front of houses and road is at least 3m, or the road has pedestrian walkway of at least 1m width. Interceptor sewers with no direct house connection is used in areas of poor accessibility and congested areas.

Project work of each sewerage system is described below.

(1) Northern sewerage system

Northern sewerage system will cover the northern part of the Priority Area with its treatment facility located at Lembo. The capacity of Lembo wastewater treatment plant (WTP) is very limited and consequently this plant will be abandoned with the expansion of service area according to the Master Plan.

The significant features are as follows.

Service area	:	73 ha
Design population	:	22,900 persons in the year 2005
Design inflow to WTP	:	5,500 m^3/day

(2) Central sewerage system

Central sewerage system will cover the central part of the Priority Area with its treatment facility located at Pampang.

The significant features are as follows.

Service area	:	435 ha
Design population	:	130,600 persons in the year 2005
Design inflow to WTP	:	28,600 m^3/day

(3) Southern sewerage system

Southern sewerage system will cover the southern part of the Priority Area with its treatment facility located at Maccini Sombala.

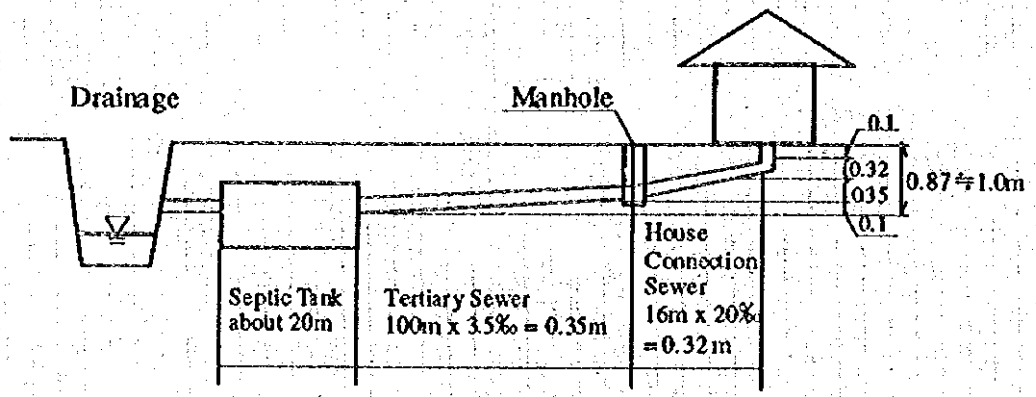
The significant features are as follows.

Service area	:	162 ha
Design population	:	70,800 persons in the year 2005
Design inflow to WTP	:	11,000 m^3/day

2.3 Pilot Project

Pilot project, which aims to demonstrate SMS (B/G), is planned at six (6) potential sites shown in *Fig. 2*. Among six (6) potential sites, Losari site is planned with package wastewater treatment plant (PWTP) and remaining sites with septic tank.

Typical profile of SMS (B/G) is shown below.



The above typical profile assumes a service area of about 1 ~ 2 ha.

2.4 Project Cost

The total investment cost of the entire Feasibility Study projects of wastewater management is estimated to be Rp. 76.35 billion. The relevant annual O/M cost in the year 2005 is estimated to be Rp. 2.45 billion/year. The cost breakdown is shown below (price and physical contingencies are not included).

Project Item	Project component	Served population (persons)	Investment cost (Rp.billion)	Annual O/M cost (Rp.billion)
Sanitary Improvement Project	Rehabilitation of malfunctioning public toilet	15,950	0.03	0.41
	Provision of SMS(B)/public toilet	7,260	0.33	0.13
	Procurement of vacuum trucks	1,363,000	1.54	0.77
	Improvement of Antang access road		0.54	
Sewerage Development Project	Provision of LMS (north)	22,900	6.91	0.14
	Provision of CSS (central)	130,600	40.31	0.81
	Provision of CSS (south)	70,800	8.46	0.17
Pilot Project	Provision of SMS (B/G) using septic tank	2,068	1.53	0.01
	Provision of SMS (B/G) using PWTP	935	0.74	0.01
Sub total			60.39	2.45
Land Acquisition			8.16	
Administration			1.11	
Engineering service			6.68	
Total			**76.35**	**2.45**

3. Feasibility Study of Solid Waste Management

The feasibility projects of solid waste management as identified by the master plan are comprised of four (4) major components. They are improvement of collection and transport of solid waste, improvement of street sweeping and ditch cleansing, expansion of Tamanagapa final solid waste disposal site and the construction of initial stage (Phase 1) of Samata final solid waste disposal site.

3.1 Improvement of Collection and Transport

Improvement of collection and transport is comprised of procurement plan of required equipment and operation plan.

(1) Procurement plan

Procurement plan has been prepared considering the normal conditions applied in obtaining foreign loan.

Procurement schedule is determined as follows.

Equipment	1998	2000	2001	Total Procurement
1. Armroll	32	8	25	65
2. Tipper large (6 m^3)	14	35	21	70
3. Tipper small (3 m^3)	6	2	0	8
4. Container	311	83	127	521
5. Hand cart	429	429	0	858

(2) Operation plan

Primary collection using hand carts will be limited to areas where such service is absolutely necessary. About 420 hand carts with their workers have been included in the project for this purpose. In line with the present KMUP policy, the haul container system will be gradually expanded to cover 60% of the collected waste by the year 2005 (at present about 30%).

3.2 Improvement of Street Sweeping and Ditch Cleansing

Introduction of mechanical sweeper is proposed for street sweeping to improve work efficiency. In total three (3) mechanical sweepers shall be introduced, starting in 1998.

For improving ditch cleansing and working conditions two (2) backhoes and dump trucks will be introduced.

3.3 Expansion of Tamangapa Disposal Site

According to the Master Plan, Tamangapa disposal site will be used until the year 2001 and expanded up to 32 hectare as a semi-sanitary landfill site. Necessary facilities for upgrading to semi-sanitary landfill are as follows.

- Leachate collection pipe
- Leachate circulation system
- Leachate discharge facility
- Gas removal facility

Design conditions for the expansion of Tamangapa disposal site are given below.

a.	Landfill area	:	32 hectares
b.	Landfill height	:	15 m (include covering soil)
c.	Landfill capacity	:	1,520,000 ton
d.	Period of usage	:	until the year 2001 (six years)
e.	Landfill method	:	Semi-sanitary landfill
f.	Service area	:	whole area of KMUP
g.	Waste amount to be collected	:	571 ton/day in the year 2000

3.4 Construction of Samata Disposal Site Phase I

According to the Master Plan, Samata disposal site will be constructed as an inter-municipal disposal site, for the waste generated from KMUP and Kabupaten Gowa in consideration of the MINASAMAUPA concept. For Samata final disposal site sanitary landfill, which would require complete leachate treatment facility, is proposed.

Design conditions for the construction of Samata disposal site are given below.

a.	Landfill area	:	65 hectares
b.	Landfill height	:	15 m (include covering soil)
c.	Landfill capacity	:	3,540,000 ton
d.	Period of usage (Phase I)	:	2002 ~ 2012 (10 years)
e.	Landfill method	:	Sanitary landfill
f.	Service area	:	whole area of KMUP and Sungguminasa area of Kabupaten Gowa
g.	Waste amount to be collected	:	774 ton/day in the year 2005

3.5 Other Activities

For the purpose to expand the collection service in suburban area, Panakkukang branch office shall be constructed and the operation of this branch office shall be started in the year 2000. Two (2) hectare of land shall be kept for the necessary facilities of this branch office, such as office building, parking lot etc., and in consideration of future development of solid waste management facilities such as incineration plant, recycling facilities, and so on, additional two (2) hectare of land shall be secured at the same time.

The Panakkukang branch office would function mainly as the depot of the collection vehicles and administrative base for the waste collection service.

To improve the institution frame of SWM, PD Kebersihan shall be established with a staff of 859 persons. Contract - out of waste collection and transport in the six(6) old Kecawetan shall be introduced. Tariff levels shall be continuously reviewed to maintain a strong financial base for the SWM activity.

3.6 Project Cost

The total investment cost of the entire Feasibility Study projects of solid waste management is estimated to be Rp. 50.38 billion. The relevant annual O/M cost in the year 2005 is estimated to be Rp. 7.66 billion/year. The cost breakdown is shown below (price and physical contingencies are not included).

Project component	Investment cost (Rp.billion)	O&M cost (Rp.billion)
Collection	11.03	5.17
Street sweeping	0.89	0.46
Ditch cleansing	0.34	0.12
Final Disposal Site	23.36	1.91
Office	1.98	0
Sub total	37.59	7.66
Land acquisition	7.29	
Administration	0.78	
Engineering service	4.71	
Total	**50.38**	**7.66**

4. Project Evaluation

4.1 Institutional Evaluation

4.1.1 Wastewater Management

For the responsible organization of wastewater management sector, amalgamation with PDAM is proposed. The organization structure of PDAM is accepted as it is and the amalgamation of a wastewater management institution will be accomplished.

The minimal number of personnel and scale of the organization are studied in detail enough to institutionally be implementable for providing 90% of the population with the service of on-site sanitation and 15% with that of off-site sewerage system. That is, 5% of the population will be furnished with the dual services of on and off-site systems for a certain period (interceptor service population).

The Study on PDAM with a wastewater management institution of KMUP in 2005 is evaluated as institutionally feasible. The organization chart is shown in *Fig. 3.*

4.1.2 Solid Waste Management

PD Kebersihan of KMUP in 2005 (with 1,508 personnel) can be evaluated as follows.

a. Good, compared to the Dinas Kebersihan KMUP in 1994. The present Dinas Kebersihan of KMUP will require 1,911 persons in 2005, should it operates as it does at present.

b. Not always good, compared to Bandung PD Kebersihan in 1994. Compared as 1,508 persons against 1,424 persons, 84 persons in excess.

c. Not good, compared to the contents of the M/P. The number of 134 persons exceeds the level of the M/P.

As a conclusion, proposed organization of solid waste management is acceptable because of the reason as evaluated above in (a.). The organization chart is shown in *Fig. 4.*

4.2 Pricing and Tariff Structure

Provided that the maximum amount payable for the tariffs accrued to the sanitation services concerned are generally accepted at 1 percent, 0.75 percent and 2 percent of disposable income which accounts for 90 percent of the total income for sewerage, septage management, and solid waste management, respectively, willingness to pay are summarized as follows.

Willingness to Pay (Rp./month)

	Low income residents	Middle income residents	High income residents	Business and public entities
Sewerage	1,440	3,040	6,400	1,186,000
Septage Management	1,080	2,280	4,800	890,000
Solid Waste	2,880	6,080	12,800	2,373,000

Considering affordability of the beneficiaries associated with the project scope, the tariff structure in compliance with the policy of full cost recovery for the whole project components will be infeasible with the highly excessive pricing level in terms of people's affordability, or willingness to pay.

The proposed tariff structure that covers the total operation and maintenance (O/M) cost and the construction cost of house connection for the sewerage sub-component will be addressed in tandem with those tariff to meet the total cost recovery accruable to the septage management and solid waste management services. The proposed tariff structure is as follows.

Proposed Monthly Tariff

	Low income (Rp./HH)	Middle income (Rp./HH)	High Income (Rp./HH)	Small comm. (Rp./m^2)	Large comm. (Rp./m^2)	Public Inst. (Rp./m^2)
Sewerage (Rp.)	1,115.3	3,345.8	8,364.6	95.1	608.9	149.5
Septage (Rp.)	119.0	357.0	892.4	503	375.4	92.1
Solid Waste(Rp.)	872.5	1,963.2	4,417.2	401.6	1,715.0	526.2

All the tariff indicated above rest below or near the neighborhood of willingness to pay for households. Hence, it would be acceptable to assess the project scope to be affordable. As for business entities, the monthly weighted average tariff of Rp.172.1/m^2 would be feasible considering the average willingness to pay for sewerage services provided be about Rp.100,000 per month and the average floor area of business entities in the city is most likely be less than 580 m^2.

4.3 Financial Analysis

Financial viability of the Project has been established by estimating a financial internal rate of return (FIRR).

The benefits comprise tariff revenues as borne out by the provision of sewerage, desludging and solid waste management services attributable to the investments during the fiscal years from 1997 to 2000 for the sewerage and desludging component, and up to the year 2001 for the solid waste component. In addition, capital works charge which leads to the city revenue at Rp.10,000 /m^2 up to the year 2005 and Rp.20,000 /m^2 onwards is taken into account.

The FIRR of the investment plan with all costs and benefits expressed as per 1995 price level, is estimated at 10.5% and 12.7% for the wastewater and the solid waste sub-sectors, respectively. With the current opportunity cost of capital standing at around 8 to 10%, the FIRRs for the projects are to exceed the real cost of project capital, thereby making it possible to evaluate the projects as financially viable.

4.4 Economic Analysis

Economic analysis of the projects under the study has been quantitatively carried out wherever possible while taking into account a number of economic, social and environmental benefits accrued. The economic internal rates of return (EIRR) has been expeditiously estimated with the marginal cost-based tariff and the shadow priced project costs.

EIRR on the Project as a whole works out to 11.7%, with 10.8% and 12.9% for the wastewater and solid waste sub-components, respectively. Thus, the Project with those sub-projects altogether is substantially viable and acceptable, while the currently estimated opportunity cost of capital which stands at around 10% is taken into account.

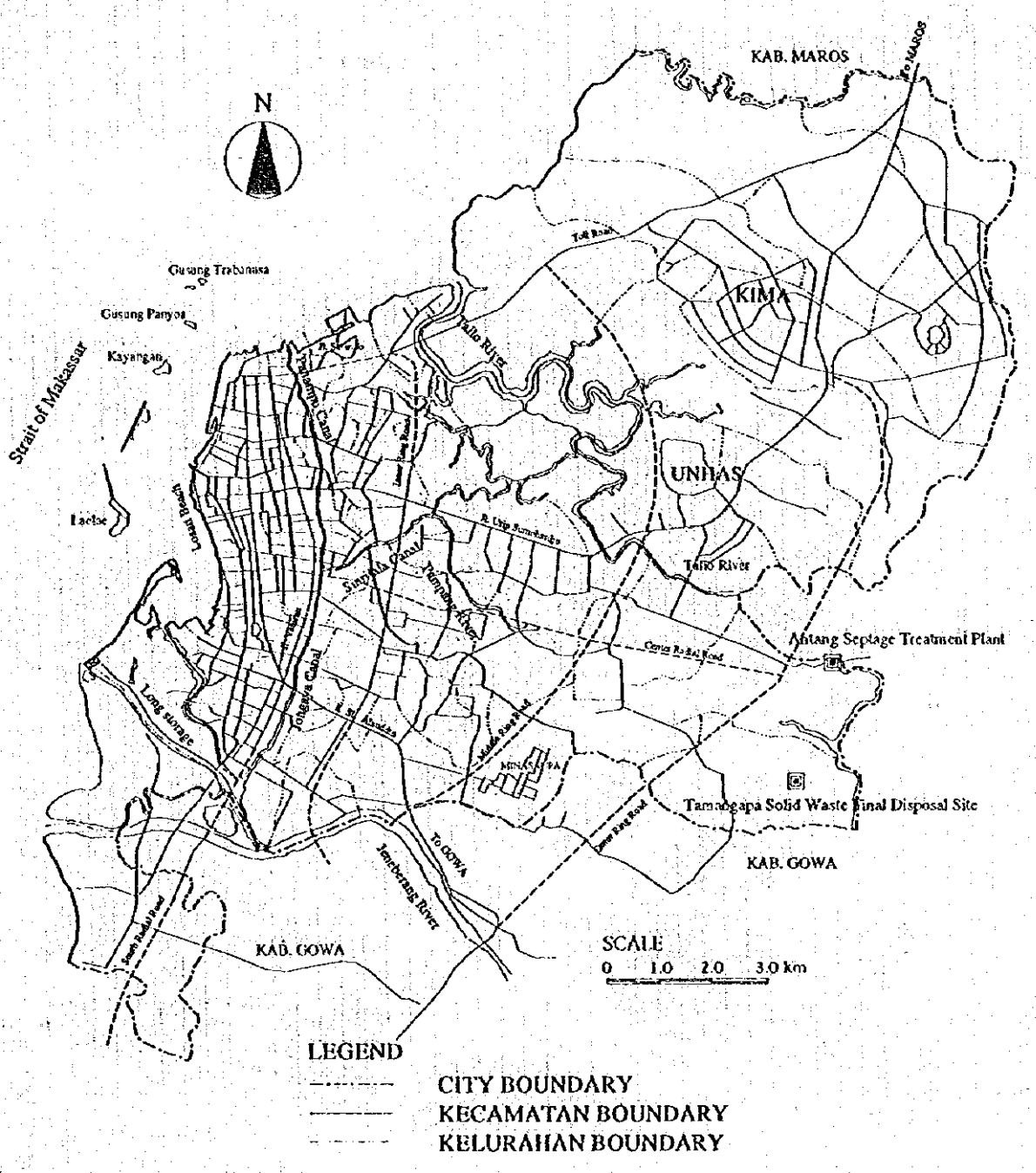


FIG. 1 Study Area of Master Plan

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

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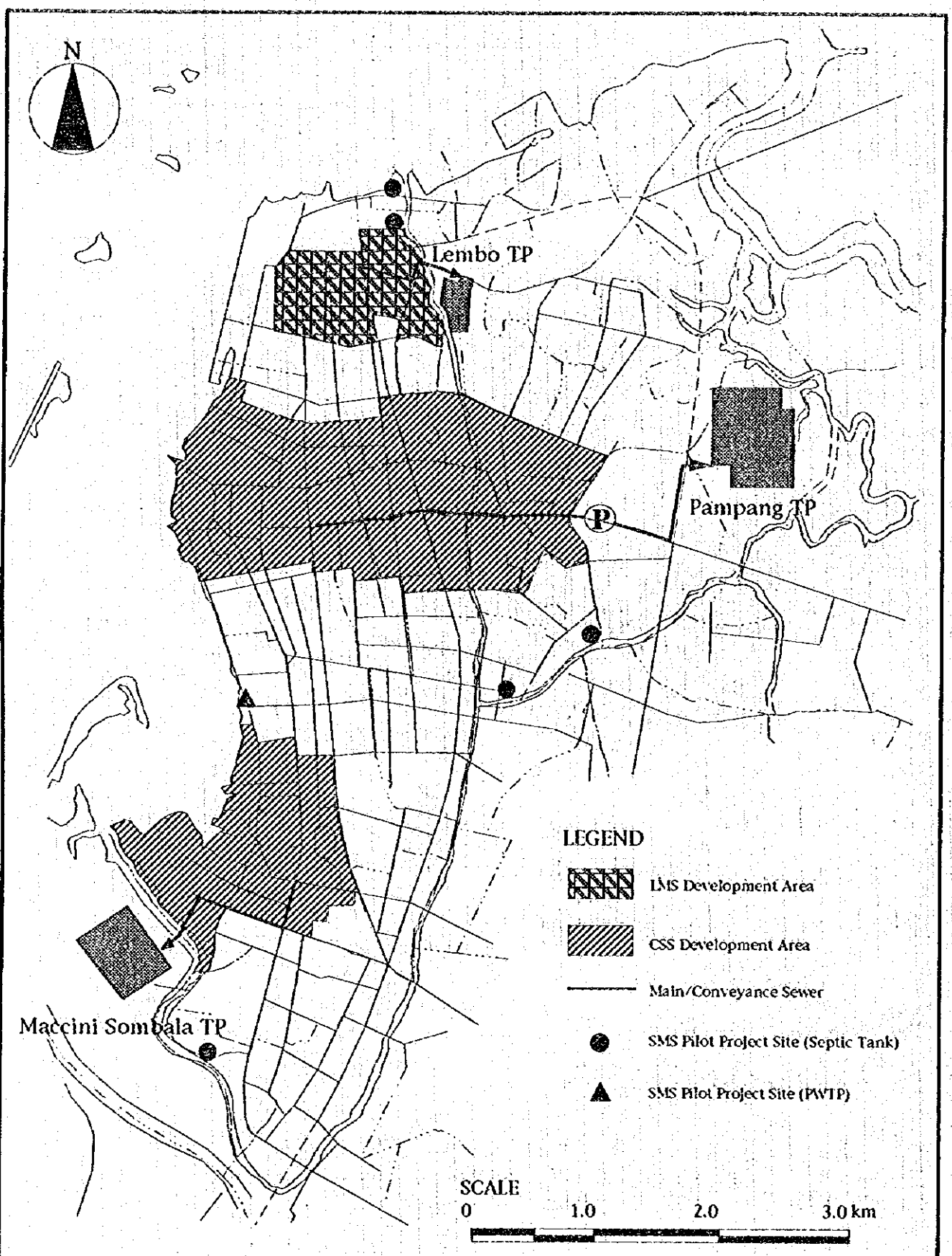

FIG. 2	LMS/CSS Development Plan until 2005 and SMS Pilot Project Sites

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

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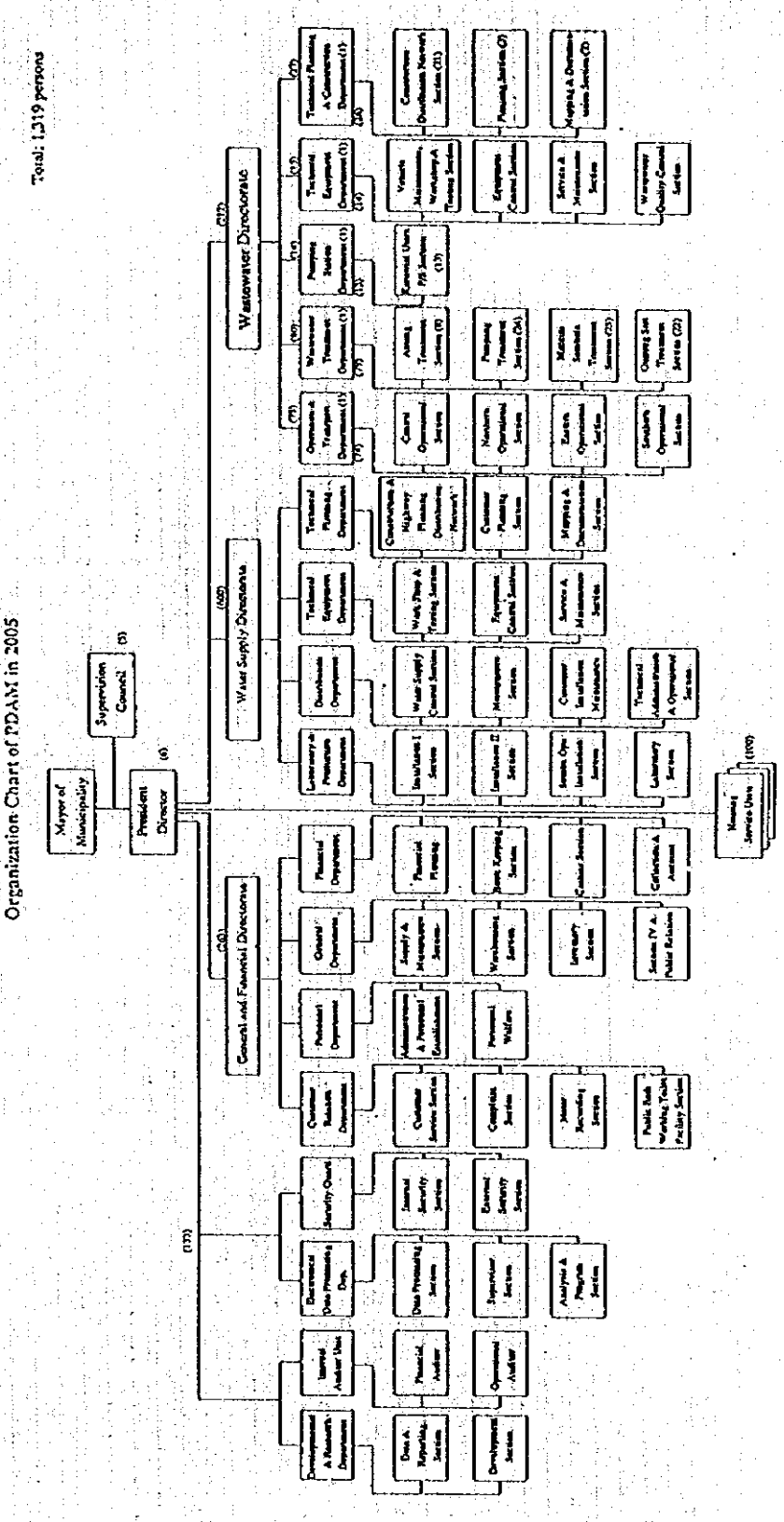

FIG. 3 | Organization Chart of PDAM in 2005

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

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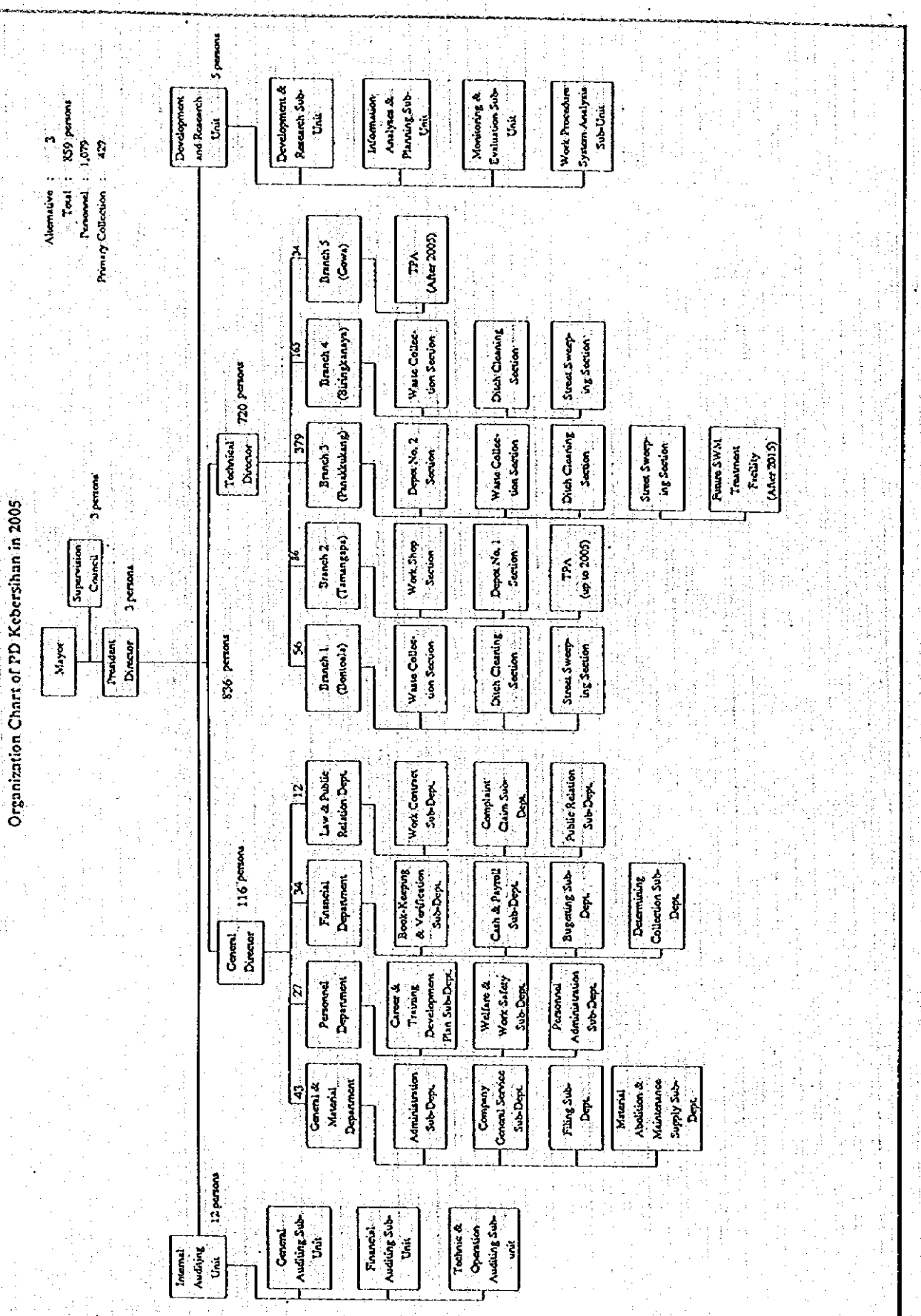

FIG. 4 Organization Chart of PD Kebersihan in 2005

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

JICA A.D.1995

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ABBREVIATIONS AND ACRONYMS

(in alphabetical order)

1. ADIPURA	:	Evaluation system of the city cleanliness
2. AMDAL	:	Environmental impact assessment process
3. ANDAL	:	Environmental impact assessment study
4. APBD	:	Annual local government development budget
5. APBN	:	Annual central government development budget
6. BANDES	:	Village aid plan
7. BAPEDAL	:	Environmental impact control agency
8. BAPPEDA	:	Local development planning agency
9. BAPPENAS	:	National development planning agency
10. DIP	:	Budget proposal for project
11. DK	:	Dinas Kebersihan (Cleansing department)
12. IUIDP	:	Integrated Urban Infrastructure Development Program
13. KANWIL	:	Provincial branch of department of central government
14. KIP	:	Kampung Improvement Program
15. KMUP	:	The Municipality (city) of Ujung Pandang
16. LKMD	:	Village social activity group
17. MINASAMAUPA	:	Ujung Pandang, Maros and Gowa metropolitan area
18. PERUMNAS	:	Public housing authority
19. PD	:	Regional enterprise
20. PDAM	:	Local government water supply enterprise
21. PKK	:	Woman's education plan

22. PLN	:	State electricity enterprise
23. PLP	:	Environmental sanitation division
24. PU	:	(Ministry of) Public works
25. PUSKESMAS	:	Public Health Center
26. RDTRK	:	Land arrangement plan
27. REPELITA	:	Five-year development plan
28. SLA	:	Subsidiary Loan Agreement
29. SOP	:	Standard Operation Procedure
30. SWM	:	Solid Waste Management
31. TPA	:	Final disposal site
32. TPS	:	Temporary disposal site
34. UNHAS	:	Hasanuddin University
35. WWM	:	Wastewater Management

DEFINITION OF TECHNICAL TERMS

A. Wastewater Management

1. On-site System	:	The system treating wastewater within each building lot.
2. Off-site System	:	The system collecting and treating wastewater from multiple number of building lots.
3. Package Wastewater Treatment Plant (PWTP)	:	The compact blackwater and graywater treatment system which can obtain high BOD removal efficiency. The popular treatment processes of this system are an anaerobic filter-contact aeration process and separate contact aeration process.
4. Small Modular System (B)	:	The system consisting of collection system, septic tank and leaching bed to collect and treat black water from about 20 households.
5. Small Modular System (B/G)	:	The off-site system that serves about 1 RT (250 people) with collection and treatment system for both blackwater and graywater. The treatment system will be abandoned after integration into conventional sewerage system.
6. Large Modular System	:	The off-site system that serves about 10,000 ~ 50,000 people with collection and treatment system for both blackwater and graywater. The treatment system will be abandoned after integration into conventional sewerage system.

7. Developer Modular System : The off-site system with collection and treatment system for both blackwater and graywater covering a housing complex constructed by developer.

8. Small Scale Sewer : The separate collection system from each household to main sewer constructed under foot path or housing lot at a shallow depth less than 1.0 m.

9. Interceptor Sewer : The collection system that receives gray water from road side ditch during dry weather.

B. Solid Waste Management

1. Primary Collection : Solid waste collection from houses and transport to communal stations or TPS using hand cart or small satellite vehicle.

2. Secondary Collection : Solid waste collection from communal stations and generator premises and transport to final disposal site or intermediate treatment facilities.

3. Semi-sanitary Landfill : The solid waste disposal system which requires leachate collection, re-circulation and pre-treatment (aeration) facility and gas removal facility in addition to the necessary facilities of control landfill.

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1. Objective of Study

Three prime objectives of this JICA study are as follows :

1) Formulate a Master Plan of Wastewater and Solid Waste Management, for the entire administrative region of the Municipality of Ujung Pandang (Kotamadya Ujung Pandang - KMUP), with an area of about 176 sq. km. The target year of the Master Plan is until year 2015 (next 20 years).

2) Identify feasibility study projects, with due consideration to economic and financial constraints, of Wastewater and Solid Waste Management and to conduct the preliminary design of facilities, targeting the initial ten (10) year period, until the year 2005, in the objective area of KMUP.

3) To conduct an alternative study for wastewater management for identifying and evaluating alternative wastewater management strategies as stopgap measure, until the implementation of feasibility project, in the event the implementation is delayed due to unforeseen circumstances.

The Study Area would cover the KMUP and its surroundings as appropriate.

1.2 Wastewater Management Master Plan

The master plan of wastewater management (year 2015) is shown in *Fig.*1.1. Its major components are delineated below.

1) Of the whole master plan area of KMUP (Area : 176 sq. km), an area of about 30% (Area : 56 sq. km), covering the existing and future urban area in the year 2015, is planned for centralized sewerage system development by the year 2015. Population and population density of this area by 2015 is respectively, 1,341,000 and 241 person/ha.

2) The remaining 70% of the non-urban area of KMUP (Area : 120 sq. km) would continue to be served principally with simple individual on-site sanitation systems of septic tank/leaching pit. Population and population density of this remaining area by 2015 is respectively, 859,000 and 72 person/ha.

3) In the whole objective area of KMUP (Study Area) all newly developing housing complexes, irrespective of their location, shall provide their own communal wastewater treatment system, to treat together both blackwater and graywater. A secondary treatment level will be targeted as the effluent quality.

It is noted that the non-urban area of simple on-site system (120 sq. km) is divided into area suited for leaching pit and not suited for leaching pit (hence septic tank is suited), based on the groundwater table level, under the critical condition of rainy season.

Area suited for leaching pit is an area where the critical groundwater table level is not less than 4 m, and vice versa for an area not suited for leaching pit.

1.3 Solid Waste Management Master Plan

(1) Framework of master plan

The future population of KMUP is estimated to be 2.2 million in the year 2015. Target of collection service ratio is set to provide 95% of total population providing the service to the area that have population density more than 50 person/ha.

Solid waste amount is estimated based on future population and unit generation rate obtained in this study. Solid waste amount in 2015 is estimated to be 1,640 ton/day including industry waste and around three (3) times of present amount. Also solid waste amount collected in Maros and Gowa will be 82.3 ton/day (service population 152,400) and 85.5 ton/day (service population 158,400) respectively.

Future solid waste composition is predicted based on general tendency of change. Characteristics of solid waste in Ujung Pandang are:

i. High content of putrescible matter

ii. Low non-combustible content such as metal and glass

iii. High moisture content specially in wet season

iv. Low lower calorific value specially in wet season

(2) Target and strategies

The level of environmental improvement concerning solid waste management are set at the following three (3) levels

i. ML (Minimum level)

To collect solid waste within a service area on a regular basis (at least once a week) and disposal at control landfill site

ii. CL (Comfortable level)

To collect solid waste within a service area on a regular basis (more than twice a week) and disposal at sanitary landfill site

iii. AL (Amenity level)

To collect solid waste within the city area on a regular basis and to treat adequately then dispose of.

This master plan set the target level at CL because environmental improvement is require not only in solid waste management sector but also in the waste water management sector and this improvement shall be achieved within financial constrains. Following should be basic policy for solid waste management.

i. Expanded and more efficient collection service

ii. Prohibition of open dumping and disposal by sanitary landfill method

iii. Promotion of solid waste volume reduction

iv. Strengthening responsible organization; Dinas Kebersihan

v. Sustain a solid waste management financial base

vi. Strengthen public education and citizens participation concerning solid waste management

vii. Introduction and promotion of private sector participation

(3) Alternatives studied and selected

Type of collection vehicle to be used and collection system to be employed in KMUP is compared considering location of final disposal site at present and future. Proposed system in the Master Plan summarized as follows.

Items	Phase I (up to year 2005)	Phase II (2006-2015)
Collection vehicle to be used	a. Arm-roll truck 6 cu.m b. Dump truck 6 cu.m	a. Arm-roll truck 6 cu.m b. Dump truck 6 cu.m c. Compactor truck 10 cu.m
Collection system	a. Hauled container system (with/without handcart) b. Door to door and calling system c. Station (packed waste) and TPS	a. Hauled container system (with/without handcart) b. Door to door and calling system c. Station (packed waste)
Discharge	Packed by plastic bin or bag (door to door, calling and open station system) Unpacked (hauled container system)	Packed by plastic bin or bag (door to door, calling and open station system) Unpacked (hauled container system)

KMUP, Maros and Gowa have a concept of Minasamaupa as an greater municipality. Intermediate treatment and final disposal system of this area is studied because land acquisition of future final disposal site is difficult within KMUP. It is proposed to have at least two final disposal site in this area to avoid heavy burden of transportation cost. Then following six (6) alternatives of intermediate treatment and final disposal of solid waste in 2015 were studied including the case of introduction of transferstation and incineration plant.

After comparison of six (6) alternatives, Alternative 1 that all collected waste shall be disposal of in Gowa is selected because it is most economical alternative. Therefore, solid waste management of Minasamaupa will have two (2) final disposal site, one in Gowa as an inter-municipal disposal site and another one in Maros. System to be employed in Gowa shall be sanitary landfill but Maros may be control landfill system.

(4) Implementation program of Master Plan

The Master plan period is divided into two (2) phases and each phase is further divided into two (2) 5-year period stages. Implementation program to achieve the Target of Master Plan is shown in *Table* 1.1.

1.4 Study Reports

This is the Part II of the Main Report, that describes the project components of the Feasibility Study of wastewater and solid waste management.

Master Plan of wastewater and solid waste management is compiled separately as the Part I of the Main Report.

The composition of the entire reports of the Study is as follows:

(1) Main Report (English version)

Part I : Master Plan of wastewater and solid waste management
Part II : Feasibility Study of wastewater and solid waste management (This Report)
Paart III : Alternative Study for Wastewater Manageement

(2) Executive Summary Report (English and Indonesian version)

Presents the summary of the entire Study

(3) Supporting Report (English version)

Describes in details the technical aspects of the master plan and feasibility studies on a sectored basis

(4) Data Book (English version)

Compiles the basic data/information used in the Study and the relevant drawings

Table 1.1 Implementation Schedule of Solid Waste Management

	1995-2000	Phase I 2001-2005	2006-2010	Phase II 2011-1015
Collection	a. Continuation of existing improvement plan - Hauled container system - Night shift collection b. Expansion of collection service to 85% - Procurement of collection vehicle and container - Introduction of new discharge method - Improvement of TPS	a. Expansion of collection service to 90% - Procurement of collection vehicle and container - Improvement of TPS - Expansion of new discharge method	a. Expansion of collection service to 93% - Procurement of collection vehicle and container - Introduction of compactor truck - Improvement of TPS	a. Expansion of collection service to 95% - Procurement of collection vehicle and container
Intermediate treatment	a. Pilot project for small incineration plan and composting			(a. Introduction of incineration plant if economically possible)
Final disposal	a. Expansion of Tamangapa disposal site - Construction - Procurement of equipment b. Start of construction of Desa Samata Disposal site (c. Improvement of KIMA)	a. Construction of Desa Samata. disposal site and operation	a. Operation of Desa Samata disposal site - Procurement of heavy equipment	a. Expansion of Desa Samata disposal site
Street sweeping and ditch cleansing	a. Procurement of equipment b. Procurement of equipment		a. Procurement of mechanical sweeper	
Privatization and other activity	a. Preparation of privatization a. Study and research	a. Introduction of contract out (Old city area, 30% of collection) b. Construction of branch office	a. Expansion of contract out to new housing estate (40%)	a. Expansion of contract out (50% of collection)
Organization	a. Preparation for establishment of PD Kebersihan b. Preparation for inter-municipal operation of disposal site	a. Establishment of PD Kebersihan b. Establishment of Inter-municipal operation of disposal site		
Fee collection	a. Introduction of new fee collection system b. Introduction of new tariff for commercial waste	a. Revise of tariff	a. Revise of tariff	a. Revise of tariff
Campaign	a. Campaign for proper discharge	a. Campaign for proper discharge	a. Campaign for proper discharge	a. Campaign for proper discharge

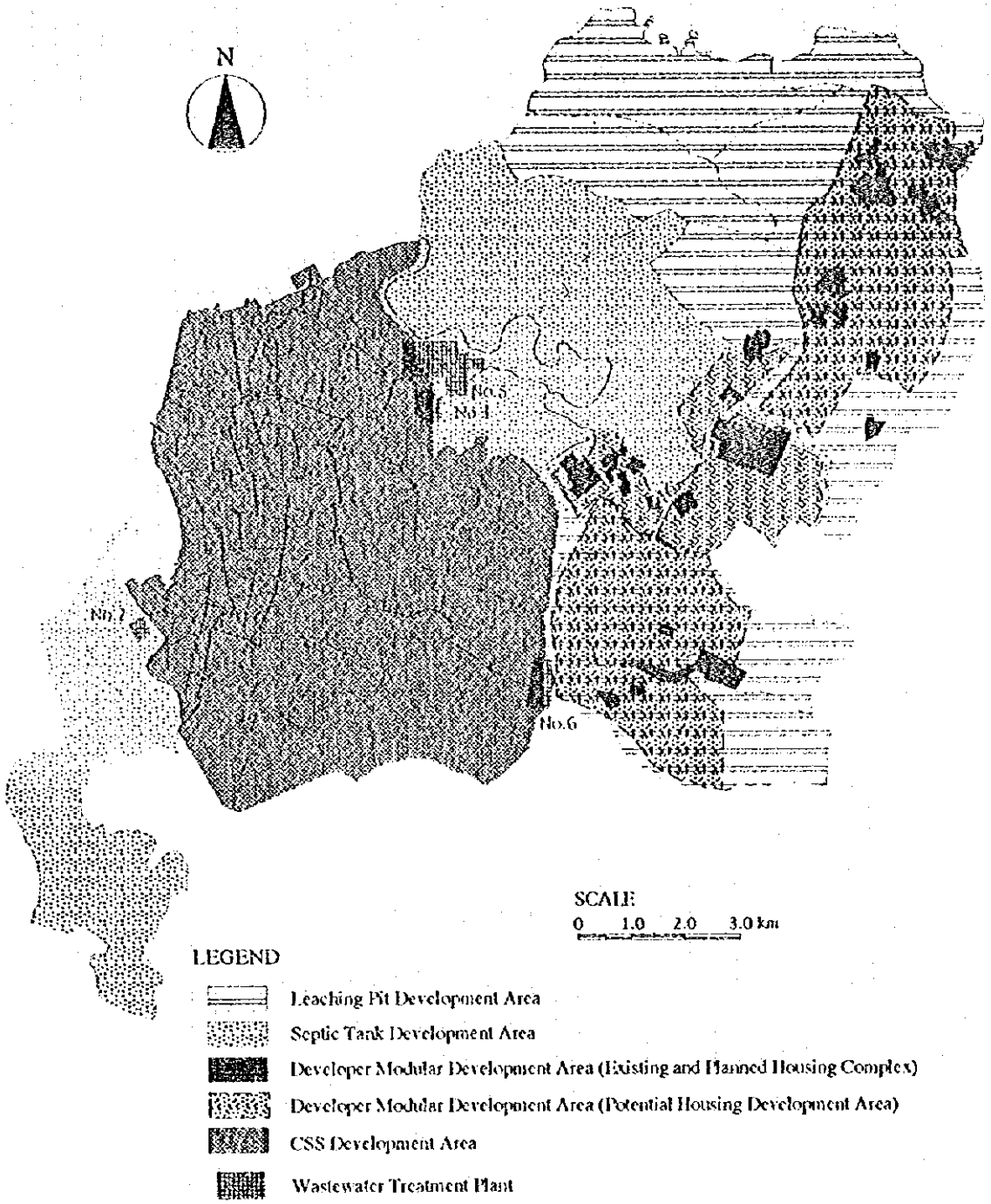


FIG. 1.1	Master Plan of Wastewater Management in 2015

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

JICA A.D.1995

CHAPTER 2

FACILITY PLAN OF WASTEWATER MANAGEMENT

CHAPTER 2 FACILITY PLAN OF WASTEWATER MANAGEMENT

2.1 Planning Frame

The location of priority area, that covers the highly urbanized old town area and its surroundings, along with the identified project components of feasibility study, based on the Master Plan until the year 2015 delineated in Part I of Main Report, are shown in *Fig.* 2.1.

The basic planning frame of the priority area with respect to population, population density and wastewater and pollution load generation as delineated between existing and planning frame (until the feasibility target year of 2005) is tabulated below.

Planning Frame of Priority Area (Area : 2542 ha)

Item	Existing Condition	Planning Frame (2005)
Population	587,800	725,300
Population density (person/ha)	231	285
Wastewater generation (m^3/d)	45,200	119,100
Pollution load generation (kg/d)	13,900	27,820

2.2 Project Components

The project components of wastewater management for feasibility study until the year 2005 is comprised of both on-site sanitation improvement as well as off-site sewerage development including pilot projects. These projects are categorized into three (3) major project components as follows.

- Sanitation improvement project
- Sewerage development project
- Pilot project

The facility plan of each of these three (3) major project components are described in the subsequent sections.

2.3 Sanitation Improvement Project

The Sanitation Improvement Project is comprised of two (2) project components, namely, provision of accessible basic sanitation (toilet) facility in slum areas, as the basic sanitation improvement measure, and improvement of

septage management. These projects are slated for urgent implementation until the year 2000.

2.3.1 Sanitation improvement for slum area

The project works include both rehabilitation of existing, but malfunctioning pubic toilets (MCK) and the provision of new public toilets.

It is emphasized that both the rehabilitation and provision of new public toilets is subjected to the condition that a responsible organization to ensure proper operation and maintenance of a system, comprising of intended users of the system (public toilet), shall be established, as the prerequisite.

(1) Rehabilitation of malfunctioned public toilets (MCK)

At present, based on survey conducted by the Study Team, there exists a total of 204 public toilets (MCK) in the Study Area. Most of these public toilets are located in slum areas. Moreover 59 of these public toilets malfunctioned.

The proposed urgent project that would be accomplished until the year 1998 includes the rehabilitation of these 59 malfunctioned public toilets (MCK).

(2) Provision of new public toilets (MCK)

As the means of elimination of population with no access to sanitation facility (toilet) a total of 66 public toilets (MCK) will be constructed, in principle, until the year 1998 in slum areas.

Number of these new public toilets according to the respective Kelurahans are shown in *Table* 2.1. Selection of these Kelurahans for the provision of new public toilets (MCK) was made based on interview survey conducted by the Study Team, targeting the heads of Kelurahan (Lurahs).

Typical public toilet (MCK) proposed as new sanitation facility is shown in *Fig.* 2.2. One public toilet is intended to serve 20 households.

It is noted that communal septic tank, denoted as small modular system treating blackwater (SMS (B)), instead of public toilet (MCK) is strongly

recommended, provided the following conditions are satisfied at a selected location.

1) Intended slum residents have their own toilets, but with no treatment, or they have the willingness and affordability to construct ones own toilet. In other words, provision of ones own toilet could be guaranteed.

2) The proposed location of the communal septic tank, which shall be provided with leaching field as far as the local conditions permit, is topographically favorable, so that the wastewater (toilet waste/blackwater) from all the intended houses could be conveyed through pipes by gravity to the septic tank.

3) An agreement could be reached with the intended slum residents concerning the financing and layout alignment of conveyance pipes from household toilets to septic tank.

It is recommended that every effort shall be made to the provision of SMS (B) (communal septic tank) instead of public toilet (MCK). This is due to the fact that users of SMS (B) can enjoy the convenience of having their own private toilets in the housing lots, thereby ensuring the effectiveness of the usage of provided facility.

2.3.2 Improvement of septage management

The project works of septage management improvement is comprised of two (2) segments. They are as follows.

(1) Procurement of additional vacuum trucks on regular basis conforming the variation in the quantity of desludging with time, until the entire planning frame of Master Plan up to the year 2015.

(2) Improvement of the access road to the existing Antang septage treatment plant, as the urgent project to be accomplished until the year 1998.

1) Procurement of additional vacuum trucks

It is proposed to improve the management of desludging service from the present practice of user request based desludging (request system) to planned desludging at regular interval (visit system).

Accordingly, the requirement of vacuum trucks is estimated based on the following basic assumptions.

i) Rate of septage accumulation is 18 liter/person/year, assuming only blackwater is treated in an on-site facility (septic tank/leacling pit).

ii) Capacity of typical septic tank/leaching pit of a household is $1m^3$.

iii) Number of inhabitants in a typical household is 5.5 persons on an average.

iv) An on-site facility will be desludged completely once the accumulation of septage reached 50% of the capacity of the facility ($0.5\ m^3$).

v) Capacity of a vacuum truck is $3\ m^3$, same as the present ones.

vi) Operational service level of a vacuum truck on an average is 9 households/day.

vii) Annual working days of vacuum trucks are 260 days (5 day work week).

viii) Stand-by allowance of vacuum trucks is 20%.

Under the above basic assumptions, the requirement of vacuum trucks for desluding service for the whole study area is estimated as tabulated below.

Requirement of vacuum trucks (1995 ~ 2015)

capacity of truck : $3m^3$

Year	1995	2000	2005	2010	2015
Total population	1,090,000	1,270,000	1,520,000	1,870,000	2,200,000
Population of desludging	1,090,000	1,122,800	1,363,000	1,088,000	859,000
Quantity of desludging (m^3/annum)	39,780	42,120	49,140	39,780	32,760
No. of vacuum trucks	20	22	25	20	17

As evident from the above table, the required vacuum trucks of $3m^3$ capacity in 1995 becomes 20, which is much higher than existing vacuum trucks under operation of only four (4). It is also noted that the above estimation is valid only if the existing desludging system, the request system is altered to visit system of regular desludging.

Accordingly, it is assumed that the implementation of visit system could be fully implemented by the year 2006. Then a more realistic procurement plan of vacuum trucks, so that the number of trucks in operation by the year 2006 becomes 25 is proposed as shown below. This procurement plan assumes a depreciation period of 5 years for vacuum trucks.

The proposed procurement plan for new vacuum trucks on annual basis (1995~2015) is tabulate below.

Year	New trucks/annum	Total No. of Trucks
1995~1996	0 (4 : Existing trucks)	0
1997~2001	3	15
2002~2006	5	25
2007~2011	4	20
2012	3	3
2013	4	4
2014~2015	3	6
Grand Total (Until the year 2015)		73

Conforming the above procurement plan, the number of vacuum trucks in operation on an annual basis separated between the initial ten (10) year period and final ten (10) year period, until the year 2015 is shown below.

Vacuum Trucks in Operation - (1995~2005)

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
No. of Trucks	4	4	6	8	10	12	15	17	19	21	23

Vacuum Trucks in Operation - (2006~2015)

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
No. of Trucks	25	24	23	22	21	20	19	19	18	17

It is noted that the above number of vacuum trucks in operation is computed on the assumption that the existing four (4) trucks would

depreciate one by one from the year 1997, thereby being phased out completely with new trucks by the year 2000.

2) Improvement of access road to Antang STP

The final 1.8 km length of the access road to the Antang septage treatment plant (STP) remains unpaved. This makes the access of vacuum trucks to the STP very cumbersome.

Accordingly this 1.8 km length of the access road, shown in *Fig.* 2.3, will be improved to asphalt type pavement as an urgent project until the year 1988.

It is noted that until the year 2000, Antang STP will be the only system available for the receipt of desludged septage. However, from the year 2001, three (3) wastewater treatment plants, located at Lembo, Pampang and Maccini Sombala will commence operation, in accordance with the sewerage development project delineated in the subsequent section.

Of these three (3) wastewater treatment plants, the two (2) treatment plants of conventional sewerage system, Pampang and Maccini Sombala treatment plants would receive desludged septage as well.

Accordingly, since the year 2001 a total of three (3) treatment plants would be available for treatment of desludged septage.

The proposed wastewater treatment plant at Gunung Sari, planned for operation by the year 2016, is not considered for the receipt of desludged septage, since its commencement of operation is beyond the planning frame of Master Plan (2015).

Demarcation of service area among the three (3) treatment plants, for the receipt of desludged septage since the year 2001, is proposed as given below. This demarcation is made so that the distance of hauling and transportation of desludging vacuum trucks could be optimized.

i) Antang septage treatment plant
The service areas are Kec. Bringkanaya and the nearer area of Kec. Panakkukang.

ii) Pampang wastewater treatment plant
The service areas are Kec. Tallo, nearer area of Kec. Panakkukang, Kec. Ujung Tanah, Kec. Wajo, Kec. Bontoala, Kec. Makassar and Kec. Ujung Pandang.

iii) Maccini Sombala treatment plant
The service areas are Kec. Mariso, Kec. Mamajang and Kec. Tamalate.

2.3.3 Project cost

(1) Basic sanitation for slum area

1) Rehabilitation of malfunctioned public toilets (MCK)

Unit construction cost of public toilet is 5million Rp.

There are 59 malfunctioned public toilets to be repaired.

The unit repair cost is estimated at 10 % of the unit construction cost. Accordingly, total rehabilitation cost becomes 30 million Rp.

2) Provision of new public toilets (MCK)

A total of 66 public toilets will be constructed (ref. *Table* 2.1). The total construction cost becomes 330 million Rp.

3) Operation and maintenance cost

Appropriate organization is required for public toilets to maintain good function of the system. Construction and repair of the mentioned public toilets will be commenced after the organization system is ascertained.

The organization is responsible for both operation and maintenance(O/M) and collection of user charge. The cost of O/M include caretaker wage, desludging cost, repair cost and others. User charge would cover a portion of O/M cost. The remaining would be paid by public sector as a cross subsidy.

Typical O/M cost of an MCK(public toilet) and the relevant revenue from users, including the required contribution from public sector as O/M subsidy, are given below.

O/M cost	for caretaker(5am ~ 11pm)	= 150,000 Rp/month
	Key holder at night (11pm ~ 5am)	= 30,000 Rp/month
	Repair cost/desludging	= 10,000 Rp/month
	sub-total	= 190,000 Rp/month

Relevant revenue

Condition		
No. of users	20 households x 5.5 person/household = 110 person	
Fee charge	5 Rp/person/day	
Revenue	110 x 1 x 5	= 550 Rp/day
	550 Rp/day x 30	= 16,500 Rp/month

Balance = -173,500 Rp/month

= 2 million Rp/year

Outlay of household

5.5 x 1 x 5	= 27.5 Rp/day/H.
55 x 30	= 825 Rp/month/H.
	= 800 Rp/month/H.

The tariff of public toilet users is about 800 Rp/month/household. Such a tariff system is considered affordable for a typical slum household.

The subsidy of operation and maintenance for one (1) public toilet is 2million Rp/year/MCK.

Total number of public toilets is 270.

The required annual subsidy of operation and maintenance of public toilets becomes 540 million Rp.

(2) Improvement of septage management

1) Procurement of vacuum trucks and desludging

Investment cost for the procurement of 20 vacuum trucks until the year 2002 is 1,540 million Rp.

Annual O/M cost that includes operation and maintenance including depreciation of vacuum trucks and personnel expenditure is 766 million Rp in 2005.

2) Improvement of access road to Antang STP

About 1.8 km length of the final access road to Antang STP requires improvement (ref. *Fig.* 2.3).

The unit construction cost of road improvement is 50,000 Rp./m^2

The cost of road improvement becomes 540 million Rp.

3) Adequate operation and maintenance (O/M) at Antang STP

The level of staffing in the Antang septage treatment plant (STP) at present, is very inadequate for effective O/M of the STP. About 8 staff including director, workers and security personnel are proposed for proper O/M of Antang STP. The annual O/M cost of 766 million Rp in 2005, mentioned above, includes this personnel requirement of Antang STP.

2.4 Sewerage Development Project

2.4.1 Basic considerations

The three (3) sewerage project components of feasibility study are northern sewerage system, central sewerage system and southern sewerage system.

The present and planned population in the year 2005 and the corresponding quantity of wastewater and pollution load generation (as BOD), including the design inflow to the respective treatment plants, for each of these three (3) sewerage systems, are shown in *Table* 2.2.

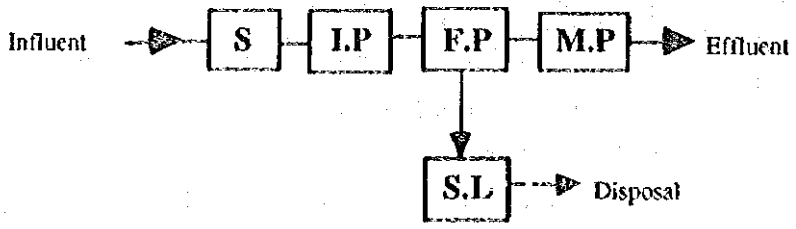
The significant features common to all three (3) sewerage systems are given below.

(1) The collection system is comprised of a combination small scale sewers, ordinary sewers and interceptor sewers. Small scale sewer is applied as the tertiary sewer prior to house connection sewer when the width between the front of houses and road is at least 3m, or the road has pedestrian walkway of at least 1m width. Interceptor sewers with no

direct house connection is used in areas of poor accessibility and congested areas like slum areas.

(2) Stabilization (Oxidation) pond system consisting of facultative pond followed with maturation pond is adopted as the simple wastewater treatment system. Important advantages of stabilization pond are the ease and economics of construction, operation and maintenance and the insignificance of mechanical and electrical installations.

The flow diagram of the stabilization pond treatment process adopted is shown below.



S : Screen
I.P : Inflow Pump
F.P : Facultative Pond
M.P : Maturation Pond (minimum of two ponds in series)
S.L : Sludge Lagoon (minimum of two cells)

The capacity of treatment facilities of pond system are determined based on the following considerations;

(1) Facultative pond

The capacity of pond isdetermined to satisfy both the required effluent BOD of 50mg/l and the allowable surface BOD loading of 380 kg/day/ha.

(2) Maturation pond

The capacity of ponds are determined to satisfy the required treated effluent quality as fecal coliforms of 2000 cells/100ml as per the river water quality standards of DKI, Jakarta.

(3) Sludge lagoon

The capacity of lagoons are determined based on an annual per capita sludge accumulation of 40 liter.

2.4.2 Northern sewerage system

Large scale modular sewerage development is planned in the northern part of the priority area with its treatment plant at Lembo. This is a temporary system, and planned to be incorporated into the Central Sewerage System with its treatment plant in Pampang, as per the master plan, in future.

The sewerage service area is 73 ha. The design population served in 2005 is 22,900 persons. The design inflow to the treatment plant is 5,500m^3/day (ref. *Table* 2.2).

The total length of collection sewer network is about 2700m, with its diameter in the range of 350 ~ 700 mm. The earth covering depth is mostly in the range of 2 ~ 4 m.

There is no lift pump in the collection system. In other words the collected wastewater is conveyed through gravity only up to the treatment plant.

The proposed treatment plant site is a wetland (swampy area), located near Canal Panampu in Kel. Lembo of Kec. Tallo. The area of treatment plant is about 6 ha.

The influent wastewater quality to treatment plant is estimated as 210 mg/l in BOD5, while the effluent water quality requirement is 30 mg/l as BOD5.

The design capacities of treatment facilities are summarized below.

(1) Inflow pump station

The inflow pump station of treatment plant consists of initial bar screen followed with the pump facilities.

Pump type :	Vertical Axial Centrifuge Pump
The design hydraulic pump head:	5.8 m

(2) Stabilization pond treatment system

1) Facultative pond

Detention time : 8.2 day
Effective depth : 1.5 m
Effective dimension of ponds (2 No. ponds in parallel):
250 m(L) x 65 m(W) x 1.5 m(D) x 2 set

2) Maturation pond

Detention time : 3.16 day
Effective depth : 1.5 m
Effective dimension of ponds (2 sets in parallel)
82 m(L) x 29 m(W) x 1.5 m(D) x 2 set x 3 pond series

Sludge treatment facility is not installed in this treatment plant. When necessary, sludge removal in the facultative pond shall be executed by vacuum truck and transported for treatment in the Pampang treatment plant of central sewerage system.

The layout of treatment facilities designed is shown in *Fig.* 2.4.

2.4.3 Central sewerage system

Conventional sewerage development for central area is planned in the central part of the priority area with its treatment plant at Pampang.

The sewerage service area is 435 ha and the design poplation served in 2005 is 130,600 persons. The design inflow to the treatment plant is 28,600m^3/day (ref. *Table* 2.2).

The total length of collection sewer network is about 11870 m, with its diameter in the range of 350 ~ 1100 mm. The earth covering depth is mostly in the range of 2 ~ 6 m.

There is one lift pump station in the collection system located in Kel. Karuwisi Utara (Kebun Binatang, Jl. Urip Sumaharjo). The pump facility proposed is comprised of four (4) units (2 units each of 300 kw and 400 kw).

The proposed treatment plant site is fish pond area, located near Sinasara river in Kel. Pampang of Kec. Panakkukang. The area of treatment plant is 44 ha.

The influent wastewater quality to treatment plant is estimated as 220 mg/l in BOD5, while the effluent water quality requirement is 30 mg/l as BOD5.

The design capacities of treatment facilities are summarized below.

(1) Inflow pump station

The inflow pump station of treatment plant consists of initial bar screen followed with the pump facilities.

Pump type :	Vertical Axial Centrifuge Pump
The design hydraulic pump head:	8.6 m

(2) Stabilization pond treatment system

1) Facultative pond

Detention time :	8.0 day
Effective depth :	1.5 m

Effective dimension of ponds (6 No. ponds in parallel)
320 m(L) x 85 m(W) x 1.5 m(D) x 6 sets

2) Maturation pond

Detention time :	6.1 day
Effective depth :	1.5 m

Effective dimension of ponds (12 sets in parallel)
130 m(L) x 42 m(W) x 1.5 m(D) x 12 set x2 pond series

3) Sludge lagoon

Annual sludge accumulation:	5230 m^3/annum
Depth of sludge storage:	2.0 m
Effective dimension:	30 m(L) x 42 m(W) x 2 m(D) x 3 ponds

The layout of treatment facilities designed is shown in *Fig.* 2.5.

2.4.4 Southern sewerage system

Conventional sewerage development for southern area is planned in the southern part of the priority area with its treatment plant at Maccini Sambala.

The sewerage service area is 162 ha and the design population served in 2005 is 70,800 persons. The design inflow to the treatment plant is 11,000 m^3/day (ref. *Table* 2.2).

The total length of collection sewer network is about 5,580 m, with its diameter in the range of 350 ~ 800 mm. The earth covering depth is mostly in the range of 2 ~ 4 m.

There is no lift pump facility in the collection system, similar to that of the northern sewerage system.

The proposed treatment plant site is fish pond area, located near Jongaya Canal in Kel. Maccini Sombala of Kec. Tamalate.

The influent wastewater quality to treatment plant is estimated as 220 mg/l in BOD5, while the effluent water quality requirement is 30 mg/l as BOD5.

The design capacities of treatment facilities are summarized below.

(1) Inflow pump station

The inflow pump station of treatment plant consists of initial bar screen followed with the pump facilities.

Pump type :	Vertical Axial Centrifuge Pump
The design hydraulic pump head:	6.9 m

(2) Stabilization pond treatment system

1) Facultative pond

Detention time :	11.5 day
Effective depth :	1.5 m

Effective dimension of ponds (4 No. ponds in parallel)

265 m(L) x 85 m(W) x 1.5 m(D) x 4 sets

2) Maturation pond

Detention time :	6.3 day
Effective depth :	1.5 m

Effective dimension of ponds (8 sets in parallel)

80 m(L) x 42 m(W) x 1.5 m(D) x 8 set x 2pond series

3) Sludge lagoon

Annual sludge accumulation: 2800 m^3/annum
Depth of sludge storage : 2.0 m
Effective dimension: 20 m(L) x 30 m(W) x 2 m(D) x 3 ponds

The layout of treatment facilities designed is shown in *Fig.* 2.6.

2.4.5 Project cost

(1) Basis of cost estimation

Based on the facility plans of sewerage development, the project costs are estimated under the following condition.

1) All base costs are expressed under the economic conditions that prevailed in August, 1995.

2) Overhead is assumed at 20 % of the total cost of equipment and civil works and incorporated in the direct construction cost.

3) Engineering service and administration costs are assumed respectively at 12 % and 2 % of the total direct construction cost.

(2) Unit construction cost

Three items of unit construction cost were used for the estimation of the sewerage project cost. They are the unit construction cost with respect to sewer network, pump station and treatment plant.

(3) Sewerage construction cost

The total construction cost of sewerage development projects of feasibility study (2005) is estimated below.

The project components are northern sewerage system, central sewerage system and southern sewerage system (ref. *Fig.* 2.1). The cost of relevant project components are given below.

1) House connection sewer and tertiary/secondary sewer

Total construction cost of house connection sewer and tertiary/secondary sewer is estimated at 12,184 million Rp. and 26,832 million Rp., respectively.

2) Main sewer

Total construction cost of main sewer is estimated at 9,369 million Rp.

3) Pump station

Total construction cost of pump station at Karuwisi Utara is estimated at 1,939 million Rp.

4) Treatment plant

Total construction cost of all three (3) treatment plants is estimated at 5,359 million Rp.

5) Land acquisition cost

Total land acquisition cost is estimated at 8,160 million Rp.

6) Total construction cost

The total construction cost of sewerage development project of feasibility study becomes 71,639 million Rp.

The breakdown of cost is shown in *Table* 2.3.

(4) Operation and maintenance (O/M) cost

O/M cost of sewerage system consist of sewer line maintenance cost, pump station maintenance cost, treatment plant maintenance cost and personnel expenditure.

Total operation and maintenance (O/M) cost is assumed to be 2% of direct construction cost.

Annual O/M cost of feasibility sewerage project is estimated at 1,114 million Rp.

2.5 Pilot Project

2.5.1 Project components

In principle, about 60 to 90 households comprising about 300 to 500 people in one(1) to two (2) hectare is planned to be served with small modular system treating together both blackwater and graywater (SMS(B/G)), conveyed through sewer collection system to wastewater treatment plant.

In comparison to large modular system or conventional sewerage system, small modular system (B/G) could quickly realize the project benefit, though the service area would be limited.

However, due to the absence of demonstrated practicability of such a system in Indonesia, introduction of the system shall be first conducted as a pilot project. The result will be studied both technically and managerially including operation and maintenance aspects. If it could be well organized and operated successfully, introduction of a SMS(B/G) on a wider scale could be promoted.

This system is planned as simple system for sanitation improvement. Accordingly, in principle, the system is designed without pump facility and septic tank as the treatment system. Service area and the site of treatment system are constrained to meet these conditions. In addition to the service area limitation of 2 ha, space of at least about 10 m x 20 m (200m2) for septic tank and drainage depth of at least 1 meter below ground level should be permissible near the space for the septic tank.

The above conditions are necessary to ensure a smooth gravitational flow throughout the system. Available sites to satisfy these conditions are very limited due to flat topography and low ground elevation of the priority area (old city of Ujung Pandang).

Still, six (6) potential sites are selected for this pilot project as tabulated below (ref. *Fig.*2.1).

No	Treatment site	Treatment Process	Service Area (ha)	Served Household (No)	Kelurahan	Kecamatan
1	Field near canal	Septic tank	1.2	77	Sambung Jawa	Mamajang
2	Puskesmas / Mardekaya	Septic tank	1.3	92	Bara-Baraya Selatan	Makassar
3	SD / Kip Bara-Baraya II	Septic tank	1.5	75	Bara-Baraya Timur	Makassar
4	SD / Neg. Bertingkat Tabaringan SD / Inp. Tabaingan	Septic tank	1.8	62	Totake	Ujung Tanah
5	Field at harbor	Septic tank	1.3	70	Gusung	Ujung Tanah
6	Tamang Safari	Package wastewater treatment plant (PWTP)	5.2	170	Losari	Ujung Pandang

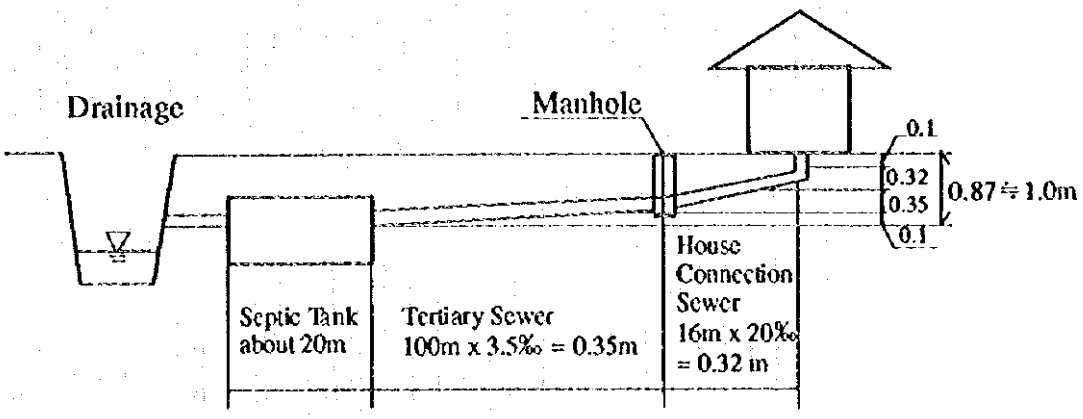
It is noted that among to above six (6) sites, Losari site is planned with package wastewater treatment plant (PWTP) instead of septic tank. Losari is a high income residential area and the treatment plant is planned to be placed at Tamang Safari Park. The treated effluent (to a secondary treatment level) can be reused at the park for irrigation or other non portable uses.

It would serve as a good demonstration (advertisement) for not only wastewater treatment but also reuse of treated wastewater (integrated wastewater management).

It is also noted that due to the provision of PWTP, that requires elaborate management in comparison to septic tank, the service area is much larger (5.2 ha). Moreover, inflow pump facility is provided at the location of PWTP (Tamang Safari Park).

In principle small scale sewer system at shallow depth is planned as collection system. If external loading is anticipated, reinforcement of pipes or installation of pipes at deeper depth shall be considered.

Typical profile of the small scale sewerage system (SMS (B/G)) is shown below.



The above typical profile assumes a service area of about one (1) to two (2) ha.

2.5.2 Project facilities

The design layout of the one (1) septic tank based SMS planned at Totake is shown in *Fig.* 2.7.

The design layout of PWTP based SMS planned at Losari is shown in *Fig.* 2.8. The PWTP proposed is shown in *Fig.* 2.9.

It is emphasized that the organization in charge of O/M(operation and maintenance) shall be ascertained with agreement before the implementation of this pilot project. Moreover, service charge of beneficiary shall be determined, and agreed upon.

2.5.3 Project cost

(1) Construction cost

The total construction cost of all five (5) septic tank based pilot projects is estimated at 1,020 million Rp.

The construction cost of package wastewater treatment plant (PWTP) based pilot project at Losari is estimated at 739 million Rp.

Accordingly the total pilot project cost becomes 1,759 million Rp.

Moreover, wider SMS(B/G) project is assumed to start after the O/M of the above pilot project is confirmed to be feasible. Under such an assumption, additional budget for further construction of five (5) septic

tank based SMS (B/G) is allocated. This budget allocation assumes 250 people will be served in a service area of one (1) hectare.

Construction cost of these additional five(5) units of the SMS(B/G) is estimated at 509 million Rp.

(2) Operation and maintenance cost

The total operation and maintenance (O/M) cost of five (5) septic tank based pilot projects is estimated at 11 million Rp./annum and that of PWTP based pilot project at 8 million Rp./annum.

2.6 Feasibility Project Cost

The total construction cost of the entire feasibility projects of wastewater management is estimated to be 76,346 million Rp. The relevant annual O/M cost in the year 2005 is estimated to be 2,445 million Rp./annum. The details are summarized in *Table* 2.4

Table 2.1 Proposed Public Toilets (MCK) According to Kelurahan

No.	Kecamatan	Code No.	Kelurahan	No. of Proposed MCK
1	MARISO			
		121	Mattoanging	1
		131	Banto Rannu	1
Sub Total				2
2	MAMAJANG			
		211	Parang	1
		221	Mamajang Luar	1
		222	Bonto Biraeng	1
		241	Sambung Jawa	5
		243	Tamparan Keke	3
Sub Total				11
3	MAKASSAR			
		312	Maricaya Baru	1
		323	Bara-Baraya Timur	2
		331	Maradekaya	1
		332	Maradekaya Utara	2
		342	Barona	1
		352	Maccini Parang	2
		353	Maccini Gusung	1
Sub Total				10
4	U. PANDANG			
Sub Total				0
5	WAJO			
		512	Ende'h	1
Sub Total				1
6	BONTOALA			
		641	Layang	3
Sub Total				3
7	TALLO			
		721	Rappo Jawa	3
		731	Rappo Kalling	12
		741	Tallo	4
		742	Buloa	2
		761	Pannampu	4
		762	Lembo	9
Sub Total				34
8	U. TANAH			
		811	Ujung Tanah	2
		822	Totake	1
Sub Total				3
9	PANAKKUKANG			
		943	Sinri Jala	2
Sub Total				2
10	TAMALATE			
Sub Total				0
11	BIRINGKANAYA			
Sub Total				0
Total				66

Source : JICA Survey in 1994,1995

Table 2.2 Basic Design Information of Sewerage Development Plan

Sewerage System	Service Area (ha)	Existing condition			Planning Condition (year 2005)					
		Population (person)	Wastewater Generation (cu.m/day)	Poltion Load Generation (kg BOD/day)	Served Population (person)	Wastewater Generation (cu.m/day)	Groundwater infiltration (10%) (cu.m/day)	Design Inflow (cu.m/day)	Pollution Load Generation (kg BOD/day)	Design Inflow BOD (mg/l)
Northern Seweragw System	73	21,127	2169	612	22,900	5,000	500	5,500	1,133	210
Central Sewerage System	435	107,159	9552	2,791	130,600	26,000	2,600	28,600	5,815	200
Southern Sewerage System	162	57,639	3958	1,251	70,800	10,100	1,000	11,100	2,394	220
Total	670	185,925	15,679	4,654	224,300	41,100	4,100	45,200	9,342	210

Table 2.3 Total Construction Cost of Sewerage Development Project

F/S Construction Cost during from 1996 to 2005

Items			Northern area	Central area	Southern area	Total
Treatment plant site			Lembo	Pampang	Maccini Sombala	
Wastewater Management System			Large modular system	conventional sewerage system	conventional sewerage system	
Served area		(ha)	73	435	162	670
Served Population		(person)	22,900	130,600	70,800	224,300
Population density		(person/ha)	314	300	437	335
Design Flow (Day average)		(cu.m/day)	5,500	28,600	11,100	45,200
Direct Construction Costs	House connection sewer	(million Rp.)	1,644	9,223	1,317	12,184
	Tertiary/secondary sewer	(million Rp.)	3,456	19,616	3,760	26,832
	Main & Conveyance Sewer	(million Rp.)	1,072	6,295	2,002	9,369
	Pump Station	(million Rp.)	0	1,939	0	1,939
	Treatment Plant	(million Rp.)	735	3,241	1,383	5,359
	Total (A)	(million Rp.)	6,907	40,314	8,462	55,683
Land Acquisition Cost		(million Rp.)	2,580	3,140	2,440	8,160
Administration Cost	A x 2%	(million Rp.)	138	806	169	1,114
Engineering Cost	A x 12%	(million Rp.)	829	4,838	1,015	6,682
Total		(million Rp.)	10,454	49,098	12,086	71,639
		us$/people	208	171	78	145

	Ratio of civil works and Equipment					
Pipe cost/civil works		(million Rp.)	6,172	35,134	7,079	48,385
Pump cost		(million Rp.)	0	1,939	0	1,939
Civil works	30%	(million Rp.)	0	582	0	582
Equip.	70%	(million Rp.)	0	1,357	0	1,357
Treatment cost		(million Rp.)	735	3,241	1,383	5,359
Civil works	30%	(million Rp.)	221	972	415	1,608
Equip.	70%	(million Rp.)	515	2,269	968	3,752
Civil works		(million Rp.)	6,393	36,688	7,494	50,575
Equipment		(million Rp.)	515	3,626	968	5,109
Total		(million Rp.)	6,908	40,314	8,462	55,684

O/M	A x 2%	(M. Rp/year)	138	806	169	1,114

Table 2.4 Total Cost of F/S Project

Project Item	Quantity (pcs)	Served population (people)	Investment cost (million Rp.)	O/M cost (million Rp./year)
Rehabilitation of Malfunctioning MCKs	204(59) present total no. (malfun. no.)	15,950	30	408
Provision of new MCKs	66	7,260	330	132
Procurement of vacuum tracks for desludging improvement	20	1,363,000	1,540	766
Improvement of Antang STP access road	(1,800m x 6m) 10,800m2		540	
Sub-total of Sanitary Improvement Project			2,440	1,306
Provision of SMS(B/G) as pilot project				
Septic tanks	5	2,068	1,020	11
PWTP	1	935	739	8
Provision of SMS(B/G) (for 250p) as wider project				
Septic tank	5	1,250	509	7
Sub-total of Pilot Project, SMS(B/G)		4,253	2,268	26
Provision of LMS(north)	1	22,900	10,454	138
Provision of CSS(central)	1	130,600	49,098	806
Provision of CSS(south)	1	70,800	12,086	169
Sub-total of Sewerage Development Project		224,300	71,638	1,113
Total of F/S Project		1,614,763	76,346	2,445

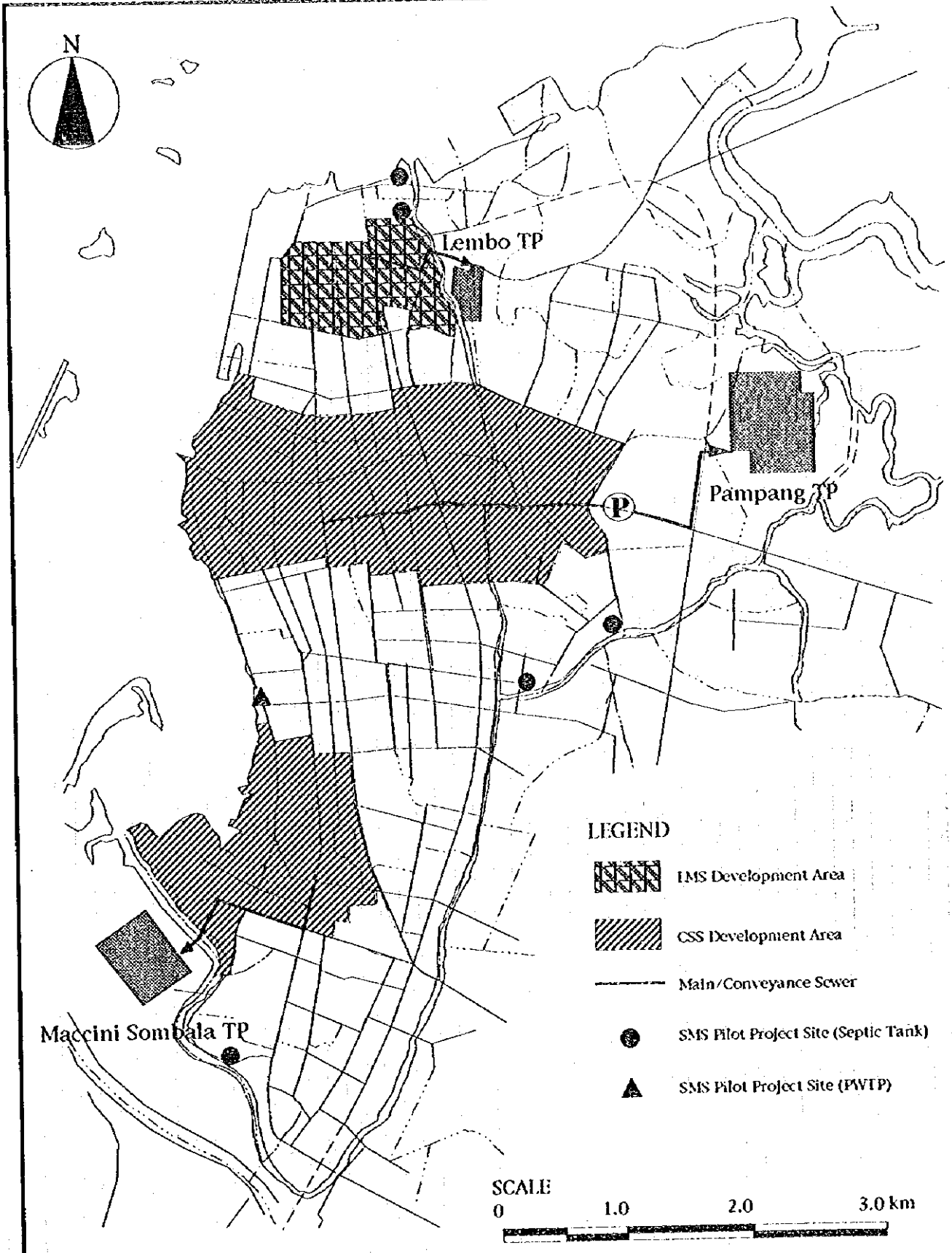


FIG. 2.1 LMS/CSS Development Plan until 2005 and SMS Pilot Project Sites

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

JICA A.D.1995

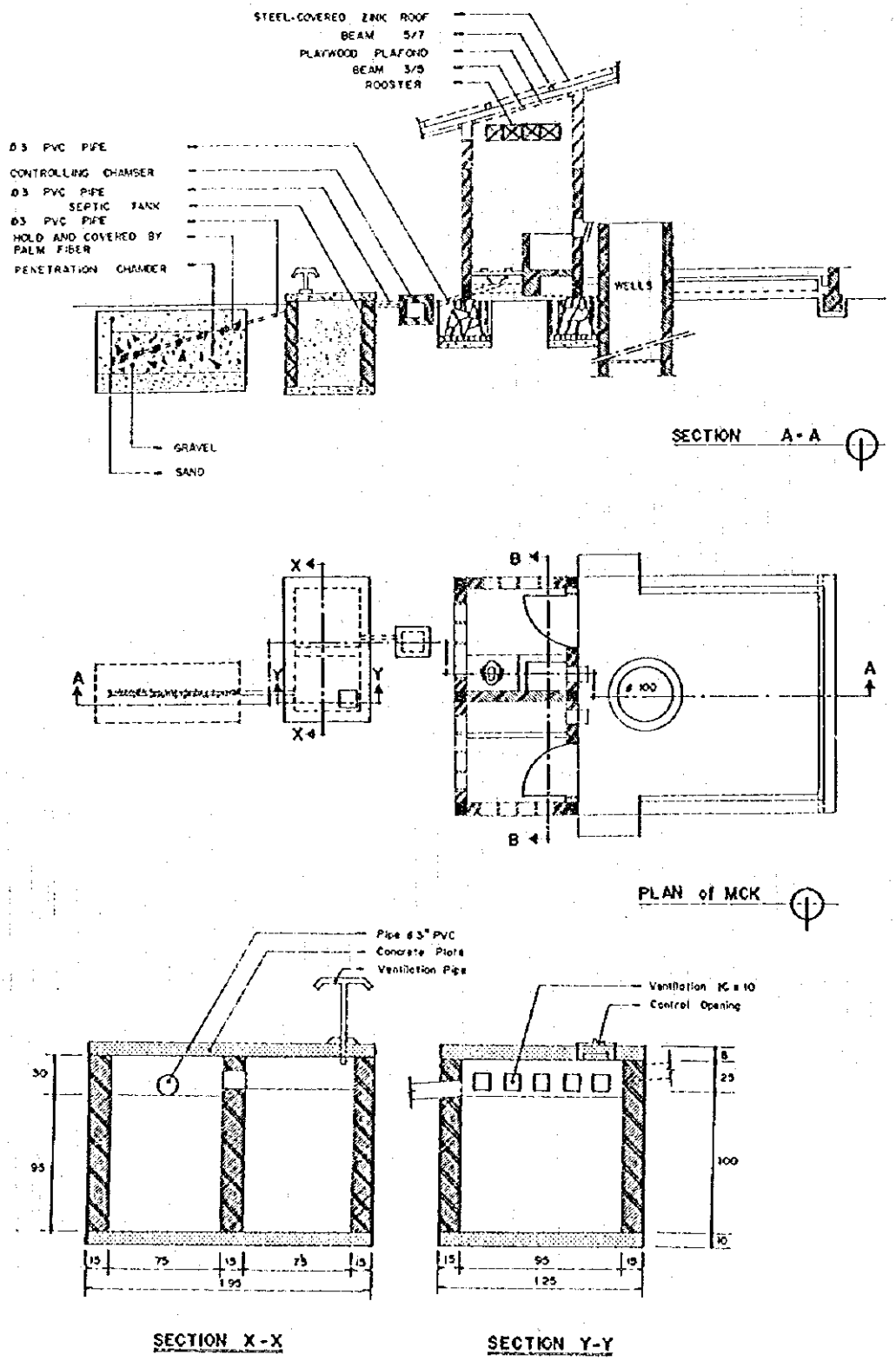


FIG. 2.2 Typical Public Toilet (MCK)

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

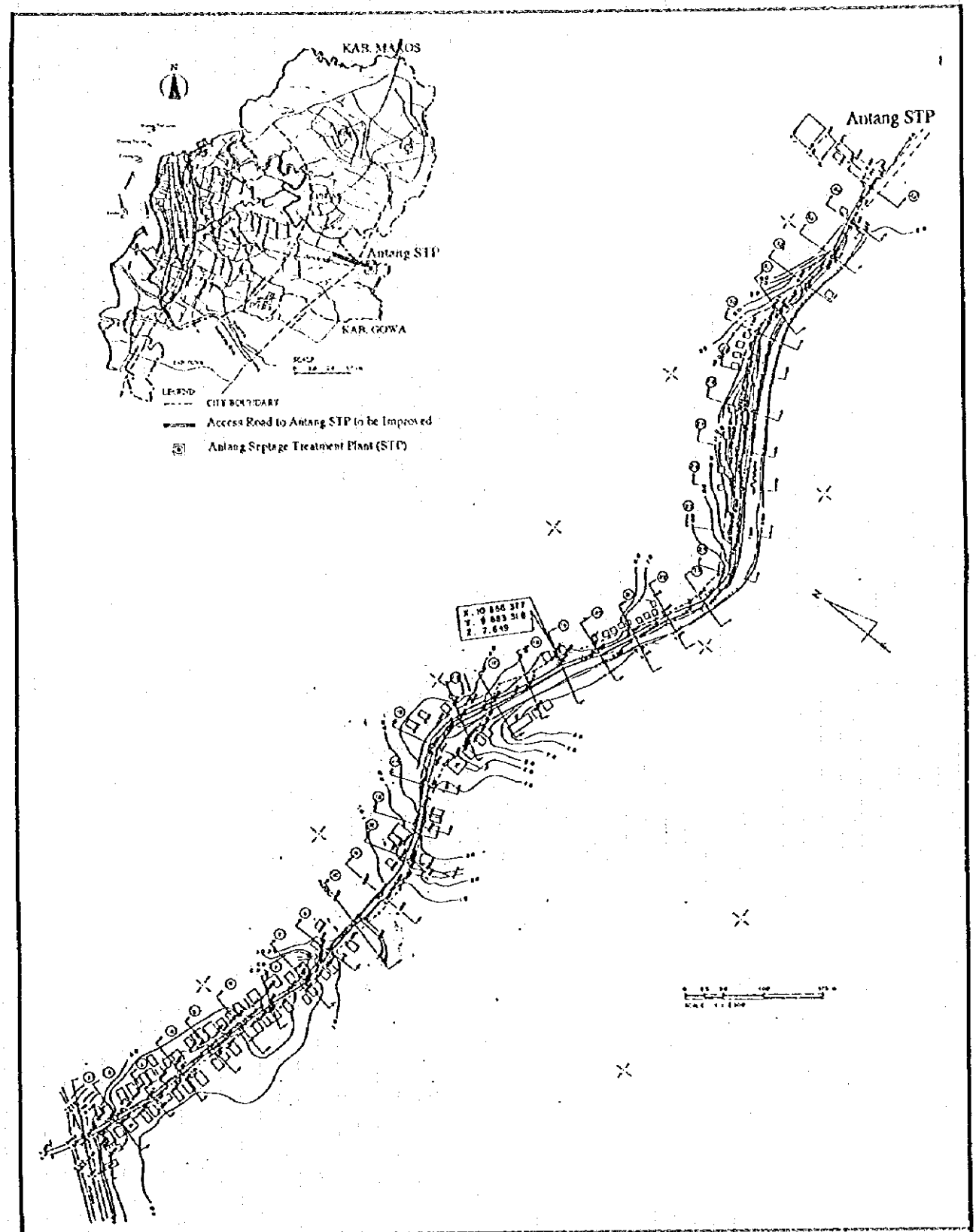


FIG. 2.3 Access Road to Antang STP for Improvement

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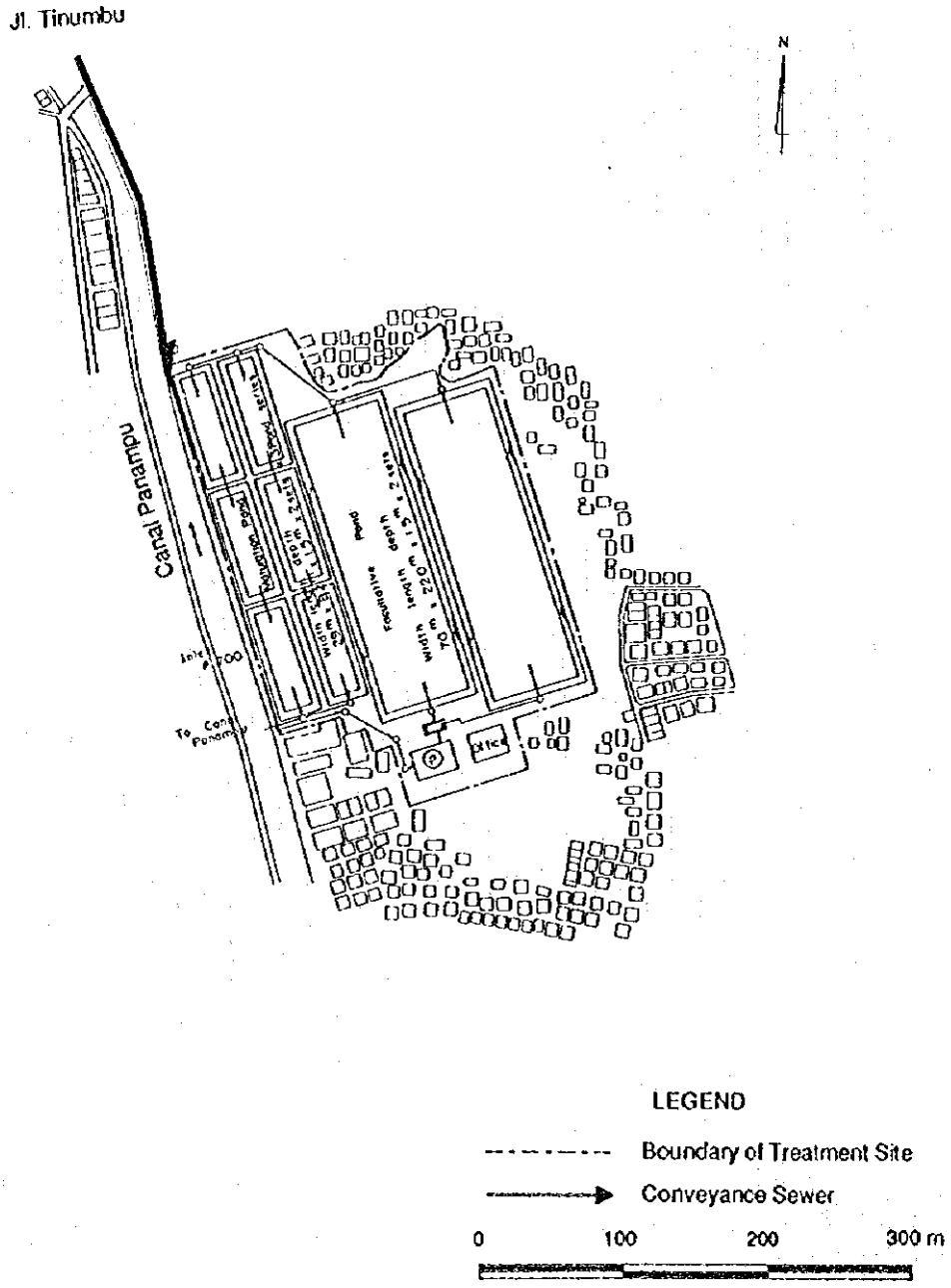

FIG. 2.4 Layout of Lembo Treatment Plant

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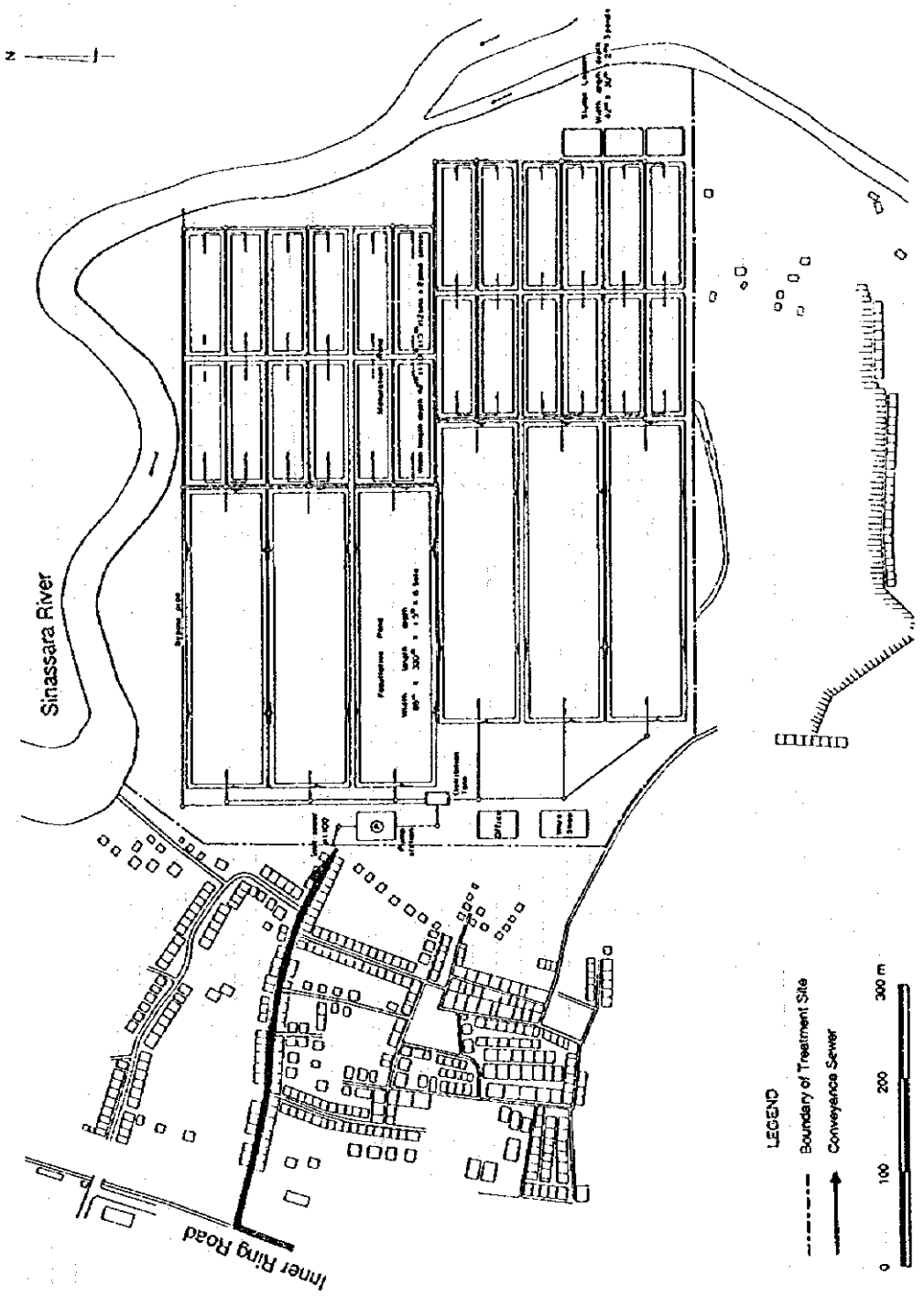

FIG. 2.5	Layout of Pampang Treatment Plant

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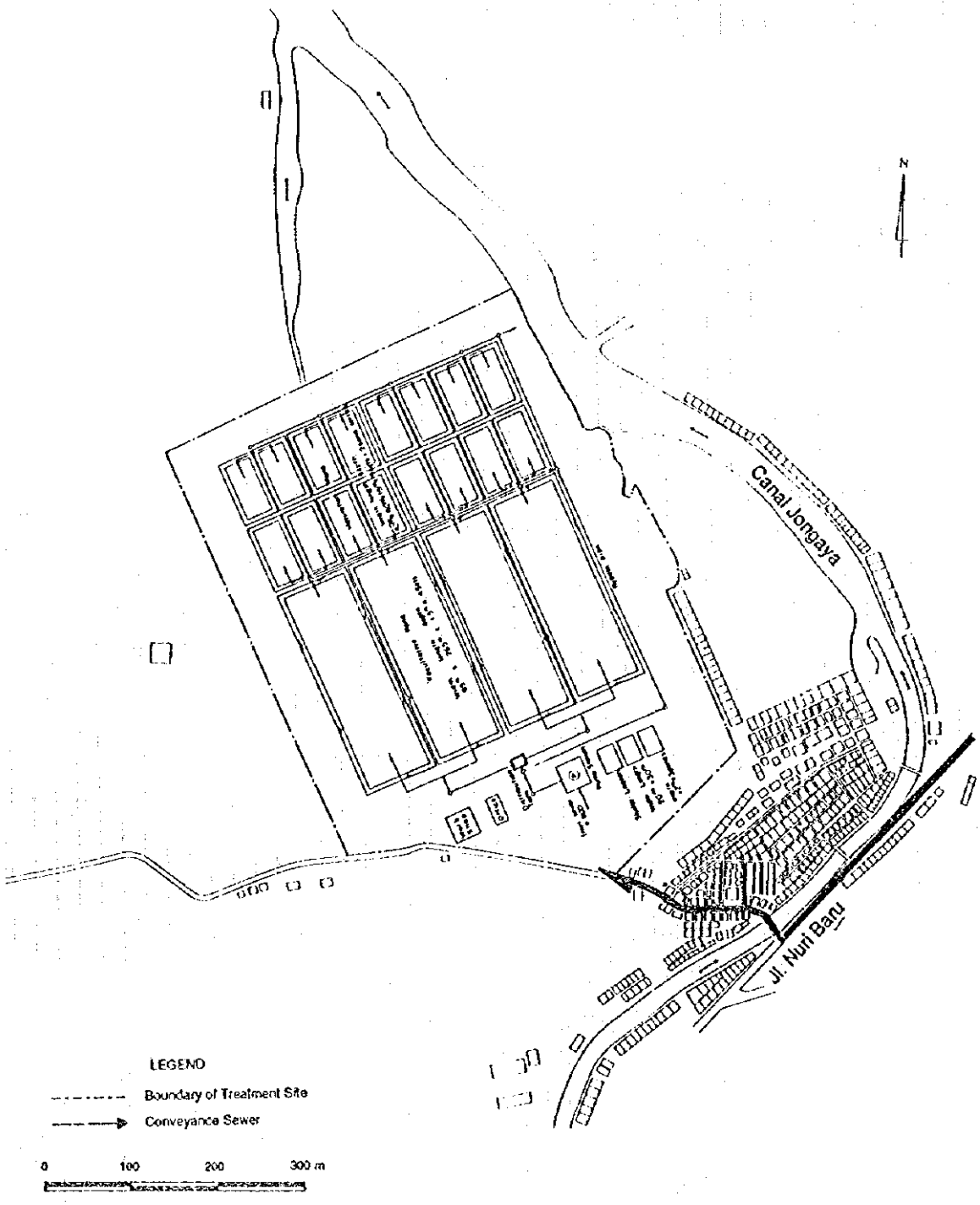

FIG. 2.6 Layout of Maccini Sombala Treatment Plant

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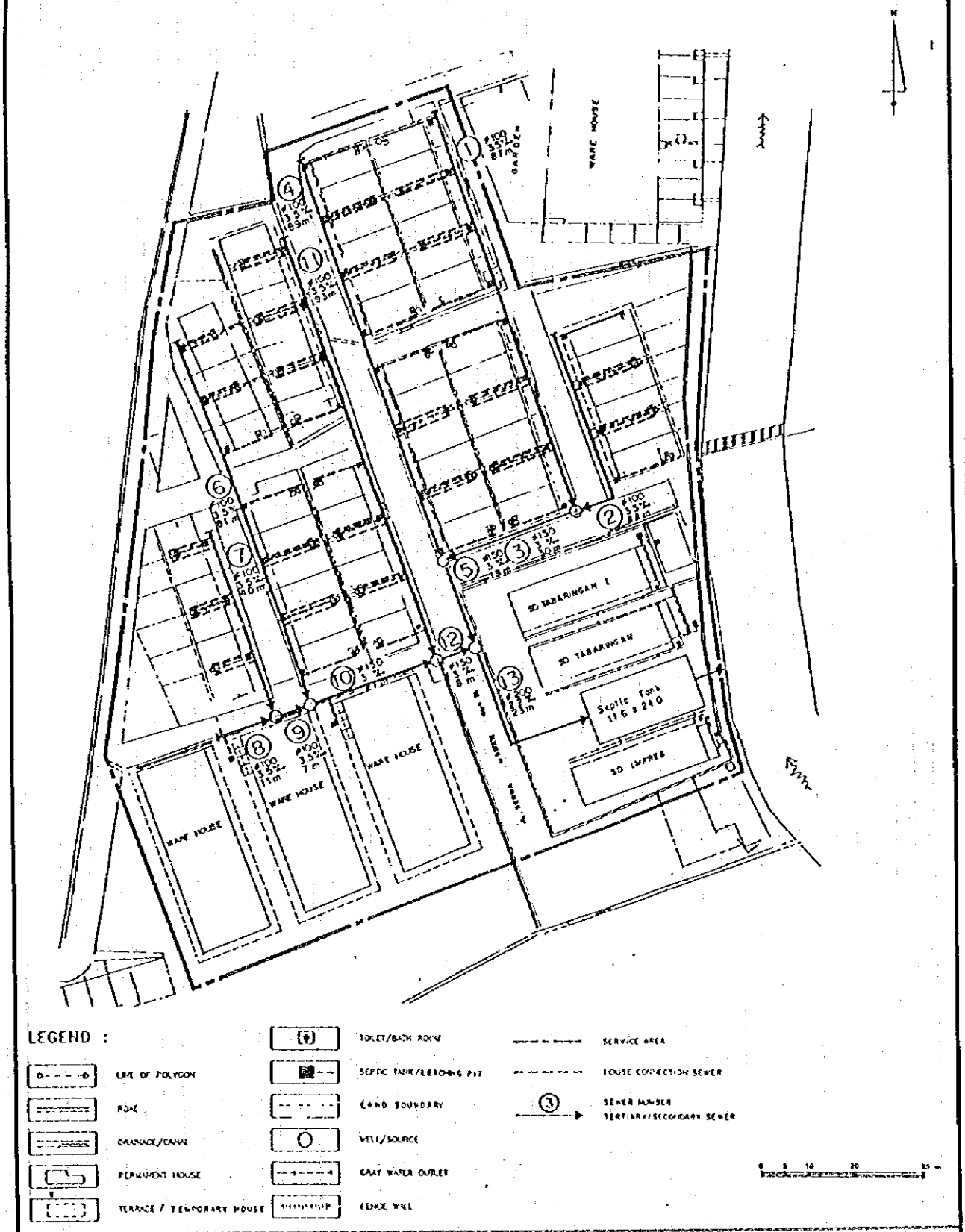

FIG. 2.7 Layout of SMS(B/G) at Totake

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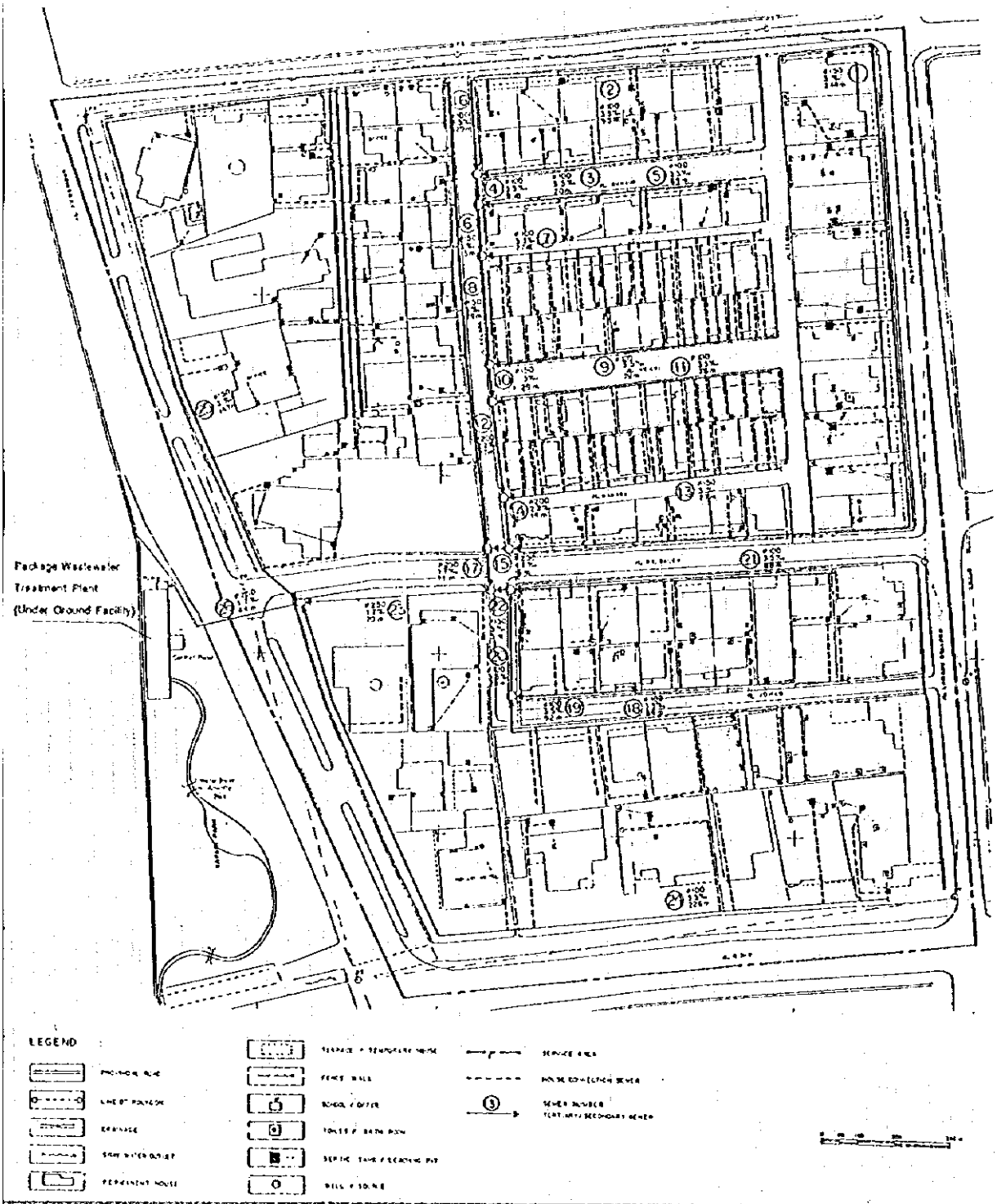

FIG. 2.8 Layout of SMS(B/G) at Losari

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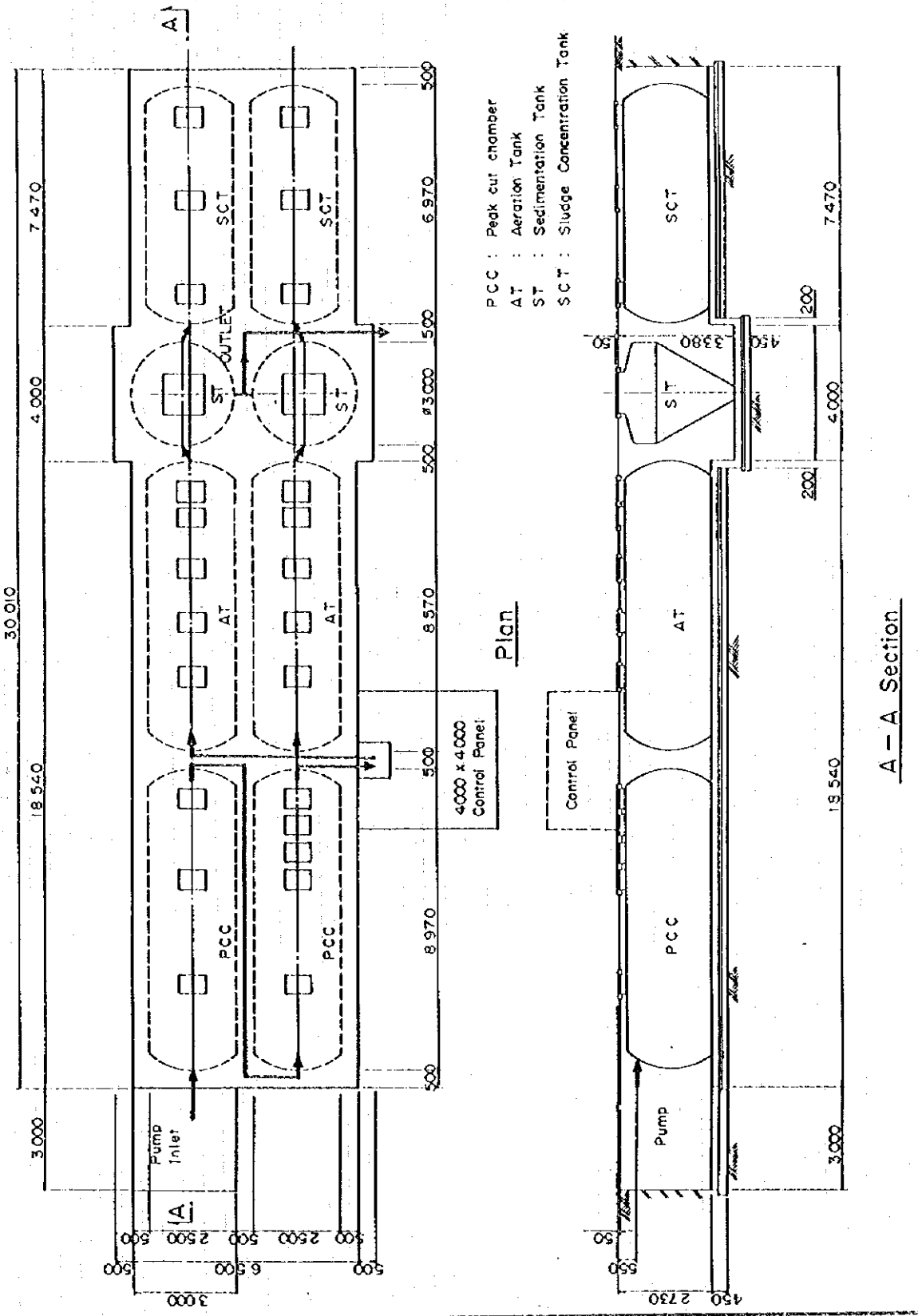

FIG. 2.9 Package Wastewater Treatment Plant at Losari

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