

- 3) **Pump station**  
Total construction cost of pump stations in the sewer collection systems becomes 4,515 million Rp.  
The cost breakdown is shown in *Table 5.39*
- 4) **Treatment plant**  
Total construction cost of treatment plants becomes 56,795 million Rp.  
The cost breakdown is shown in *Table 5.40*.
- 5) **Land acquisition cost**  
Total land acquisition cost becomes 16,300 million Rp.  
The cost breakdown is shown in *Table 5.41*.
- 6) **Total sewerage development cost (Master Plan)**  
The total construction cost of sewerage development until the year 2015 becomes 541,804 million Rp.  
The cost breakdown is shown in *Table 5.42*.

#### 5.2.4 Operation and maintenance cost

O/M cost of sewerage system consist of sewer line maintenance cost, pump station maintenance cost, treatment plant maintenance cost and personnel expenditure. The breakdown of total O/M cost is shown in *Table 5.43*. O/M cost of each pump station is also shown in *Table 5.39*. Personnel expenditure is related with number of employees. The number of employees is estimated referring to relationship between design flow and number of employees of Japanese wastewater bureau.

Ratio of the calculated O/M cost to direct construction cost becomes 1.3 % and 1.5 % for F/S and M/P respectively. Considering previous JICA sewerage development studies in Indonesia, the ratio of 2 % seems to be recommendable. Accordingly, total operation and maintenance (O/M) cost is assumed to be 2% of direct construction cost.

Annual O/M cost of feasibility sewerage project becomes 1,114 million and that of master plan sewerage project becomes 9,219 million Rp.

### 5.3 Pilot Project

Pilot project consists of small modular system (SMS(B/G)) with treatment systems of septic tank (5 locations) and package wastewater treatment plant (PWTP-1

location) as delineated in Section 4.5.

### 5.3.1 Construction cost of treatment plant

#### (1) Unit construction cost of septic tank

Unit construction cost of septic tank for SMS(B/G) is as follows,

$$C = (1 \text{ million Rp} / 5.5) \times P^{0.97}$$

C : Construction cost of septic tank

P : No. of users

The construction cost of septic tank at three (3) locations of Sambung Jawa, Bara-Baraya Selatan and Totake is shown in *Table 5.44*.

#### (2) Unit construction cost of package wastewater treatment plant (PWTP)

Unit construction cost of package wastewater treatment plant shown in *Fig. 5.45* is 177us\$/people. The price is based on the PWTP price in Malaysia.

The construction cost of package wastewater treatment plant becomes 364 million Rp. as shown in *Table 5.44* (177us\$ x 2200 Rp/us\$ x 170 households x 5.5).

### 5.3.2 Construction cost of collection sewer

Collection system is designed for four (4) pilot project sites of Sambung Jawa, Bara-Baraya Selatan, Totake and Losari.

The relevant construction cost of collection sewer is shown in *Table 5.44*.

### 5.3.3 Total construction cost of pilot project

The total construction cost of the three (3) septic tank based pilot projects (Sambung Jawa, Bara-Baraya Selatan and Totake) becomes 612 million Rp. (ref. *Table 5.44*).

Based on this, the total construction cost of all five (5) septic tank based pilot projects is estimated as 1,020 million Rp.

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

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

#### 5.3.4 Construction cost of wider project of SMS(B/G)

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.

Unit construction cost of septic tank for 250 people is 38.5 million Rp.

Construction cost of collection sewer with small scale sewer system per hectare becomes 63 million Rp.

Accordingly, construction cost of one(1) unit of SMS(B/G) becomes 101.5 million Rp.

Total construction cost of five(5) unit of the SMS(B/G) becomes 509 million Rp.

#### 5.3.5 Operation and maintenance

##### (1) SMS(B/G) using septic tank

###### Unit desludging cost

Desludging cost is estimated to be 3,000Rp/person/year assuming annual per capita sludge accumulation of 40 liter and desludging frequency of 5 year.

###### Unit sewer O/M cost

The unit O/M cost of sewer is estimated as 2000 Rp./person/year

Total unit O/M cost becomes 5,000 Rp/person/year

###### Total O/M cost

The total population served is 2,068 persons Accordingly, total O/M cost of five septic tank based pilot projects becomes 11 million Rp./annum.

##### (2) SMS(B/G) using package wastewater treatment plant (PWTP)

###### Unit desludging cost

Unit desludging cost is estimated at 3,000Rp/person/year (similar to septic tank).

###### Unit sewer O/M cost

The unit O/M cost of sewer is 2000 Rp./person/year.

###### Unit PWTP O/M cost

The unit PWTP O/M cost that includes electricity charge, cleaning and others is determined as 3000 Rp/person/year.

Unit total O/M cost becomes 8,000 Rp/person/year.

Total O/M cost

Total cost of O/M for a service population of 935 persons becomes 8 million Rp/year.

#### **5.4 Total Cost of Feasibility Project**

The total construction cost of the entire feasibility projects of wastewater management is estimated to be 76,346 million Rp. The annual O/M cost in the year 2005 is estimated to be 2,445 million Rp/annum. The details are summarized in *Table 5.45*

#### **5.5 Total Cost of Master Plan**

The total construction cost of the master plan (2015), that includes the cost of feasibility projects as the initial project components until the year 2005, is estimated at 551,286 million Rp.

However, assuming that newly developing housing complexes could provide their own secondary/tertiary sewers in the developer modular system dominated south-eastern service area (ref *Fig. 5.26 ~ Fig. 5.28*), the total construction cost of master plan (2015) by public sector becomes 483,689 million Rp. This amounts to a reduction in investment cost of about 67,600 million Rp., by public sector (government).

The annual O/M cost in the year 2015 is estimated at 9,219 million Rp. The details are summarized in *Table 5.46*.

## **6. Implementation Programme**

### **6.1 Implementation Schedule of Feasibility Study**

The significant project components of wastewater management, for as the feasibility project, to be accomplished until the year 2005 are as follows :

1. Rehabilitation and construction and of public toilets (MCK)
2. Improvement of access road to Antang septage treatment plant
3. Procurement of additional vacuum trucks
4. Development of northern sewerage system
5. Development of central sewerage system
6. Development of southern sewerage system
7. Implementation of pilot project

The proposed implementation schedule for the feasibility projects of wastewater management, including the project cost, is shown in *Fig. 5.46*.

### **6.2 Implementation Schedule of Master Plan**

The implementation schedule of Master Plan for the initial ten (10) year period from 1996 to 2005 is the same as that of feasibility projects shown in *Fig. 5.46*.

Accordingly, the implementation schedule of Master Plan separated between that of the initial ten (10) year period (feasibility projects) and the entire twenty (20) year period of Master Plan is shown in *Fig. 5.47*.

It is noted that the major project works to be accomplished by public sector during the last ten (10) year period (2006 ~ 2015) of the Master Plan is the expansion of sewerage development, so that about 30% of the Study Area (5,564 ha) will be covered with conventional sewerage system (CSS), as shown in *Fig. 5.25*.

### **6.3 Extension to Master Plan**

The sewerage development planned as the feasibility projects until the year 2005, as shown in *Fig. 5.21*, will be expanded to become the sewerage development conforming to that of master plan until the year 2015, as shown in *Fig. 5.25*, by adopting the following expansion methodology during the last ten (10) year period (2006 ~ 2015) of the Master Plan.

- (1) The northern sewerage system of feasibility study described in Section 4.4.3 (ref. Fig. 5.22) with its treatment plant at Lembo (large modular system (LMS)), will be integrated with the central sewerage system with its treatment plant at Pampang (ref. Section 4.4.4) until the year 2015.

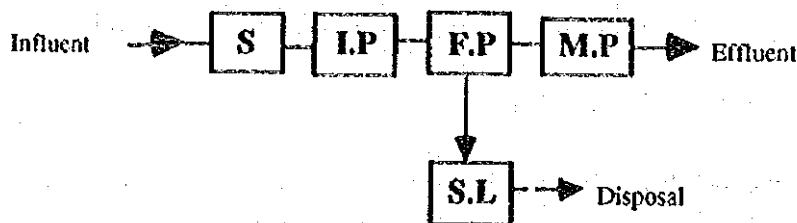
With this integration the Lembo treatment plant operation will be terminated, and the treatment plant site would be relieved for other urban uses. Still, a lift pump facility needs to be provided at this location.

- (2) Expansion of sewerage service areas for both the Pampang treatment plant and Maccini Sombala treatment plant will be done utilizing independent sewer collection networks. The capacity of collection sewer network pipes for the feasibility projects is determined based on such conditions. In other words the sewer network pipes of feasibility projects until the year 2005, in principle, are designed to convey the wastewater generated within the respective service areas only.
- (3) The treatment plants that would require expansion of capacity to cope with the increased wastewater inflow from the feasibility project stage (until the year 2005) to the final master plan stage (until the year 2015), are the two (2) treatment plants located at Pampang and Maccini Sombala.

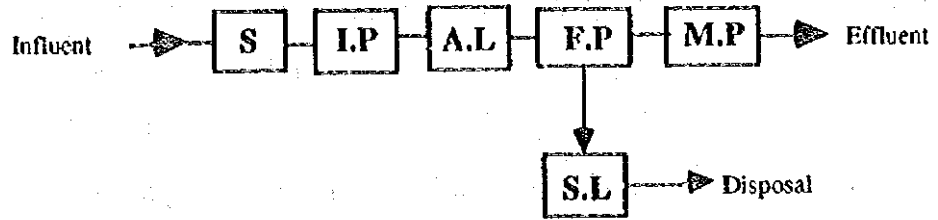
Such expansion of treatment capacity would be accomplished by upgrading the treatment system from that of stabilization pond (until the year 2005) to aerated lagoon (by the year 2015).

The flow diagrams of both these treatment systems are shown below for illustrative purpose.

1) Treatment flow diagram-feasibility project (2005)



2) Treatment flow diagram-master plan (2015)



- S : Screen
- I.P : Inflow Pump
- A.L : Aerated Lagoon
- F.P : Facultative Pond
- M.P : Maturation Pond
- S.L : Sludge Lagoon

## **7. Supplementary Study**

### **7.1 Survey of Septic Tanks**

The existing domestic on-site system in the study area are utilized to treat blackwater only, while the graywater is discharged to drainage with no treatment.

To treat disposed blackwater in the study area, leaching pit systems are installed at most of households. It is to be noted that there exists no clear distinction between leaching pit and septic tank in Indonesia. The leaching pit system is suitable for treatment/disposal of blackwater in this study area, because of;

- Low costs (construction, operation and maintenance)
- Simple operation and maintenance
- Low sludge production

However, the leaching pit system may contaminate groundwater in the following condition;

- High population density area (high rate of installed of leaching pit systems)
- High groundwater level

Therefore, the leaching pit system is not suitable in the central area of Ujung Pandang city situated on a flat area. For the alternative disposal system in the central area, septic tank system can be proposed from following view points;

- Low cost of construction and operation/maintenance.
- Simple operation/maintenance

There are not enough data about the septic tank in the study area at present, because of;

- few septic tanks are available in the study area.
- most septic tanks were installed just recently.

Consequently, it is necessary to survey the existing conditions of septic tanks in the study area, in order to find out;



- Useful system in unsuitable area of leaching pit system.
- Effective treatment plant at the small modular system.

JICA Study Team conducted a questionnaire and sampling survey to evaluate the septic tank under existing condition. The survey works and results are shown as below.

**(1) Contents of Survey**

This survey consists of two (2) items as below;

- Technical evaluation of septic tank
- Survey of communal septic tank system

Technical evaluation of septic tank consists of the survey as follows;

- a) Selection of objective septic tank
- b) Field survey of existing conditions
- c) Function survey ( water quality and quantity)

The survey of communal septic tank system consists of items as follows;

- a) Selection of objective area
- b) Field survey of existing condition
- c) Questionnaire survey for users of communal system

**(2) Results of Survey**

**1) Technical evaluation of septic tank**

- a) The objective septic tank

Selection of objective septic tank is selected based on criteria as below.

- The septic tank is seal up type.
- utilized to treat for blackwater from individual residence or community
- Septic tank was installed after 1 year.

Based on above criteria, three septic tank system are selected as following.

No.1 - Individual septic tank system in Kel. Mangasa, Kec. Tamalate

No.2 - Community septic tank of Rumah Susun in Kel. Lette, Kec. Mariso

No.3 - Community septic tank in Kel. Pannambungan, Kec. Mariso

Location of these septic tank systems are shown in *Fig. 5.48*.

b) Existing conditions of septic tank systems

According to the field survey and questionnaire survey, description of existing condition each septic tank system are shown as follows.

No.1 - Individual septic tank system

< septic tank >

Installation	:	the year of 1969
Dimension of septic tank	:	2.3 m(L) x 1.3 m(W) x 1.8 m(D)
Partition of septic tank	;	3 parts
Total volume of tank	:	2.6 m <sup>3</sup>
System	:	Septic tank with leaching bed

(The septic tank is show in *Fig. 5.49(1)*)

< User >

Number of user	:	8 persons ( one family)
House type	:	one-storied house with garden/garage (a company house for its employee)
Opration/maintenance	:	a caretaker of company
the past records of O/M	:	No O/M (No desludging)
water source	:	PDAM

No.2 - Community septic tank system at Rumah Susun

< septic tank >

Installation	:	the year of 1993
Dimension of septic tank	:	2.6 m(L) x 1.3 m(W) x 1.7 m(D)
Partition of septic tank	;	2 parts
Total volume of tank	:	2.2 m <sup>3</sup>
System	:	Septic tank (discharge to ditch)

(The septic tank is shown in *Fig. 5.49(2)*)

< User >

Number of user	:	57 persons ( 16 households)
House type	:	flat house (for low income groups)
Operation/maintenance the past records of O/M	:	unknown (in principle, Kelrahan office) No O/M (No desludging)
water source	:	PDAM

No.3 - Community septic tank system in RW-V, Kel. Pannambungan, Kec. Mariso

< septic tank >

Installation	:	January. 1994
Dimension of septic tank	:	2.5 m(L) x 1.6 m(W) x 2.2 m(D)
Partition of septic tank	:	3 parts
Total volume of tank	:	3.9 m <sup>3</sup>
System	:	Septic tank (discharge to ditch) (The septic tank is show in <i>Fig. 5.49(3)</i> )

< User >

Number of user	:	59 persons ( 10 households)
House type	:	one-storied house (almost house are semi-permanent)
Operation/maintenance the past records of O/M	:	Community of user No O/M (No desludging)
water source	:	PDAM and Well

c) Function survey ( water quality and quantity)

This survey consists of tow (2) items as below.

i) Measurement of discharged water volume

The whole discharged water from a septic tank was collected by a large bucket for 24 hours, and the volume of discharged water was measured for seven (7) days.

ii) Analysis of discharged water quality

The water sample was taken for analysis from the all discharged water for 24 hours (above mentioned). This is a composite sample for 24 hours and analysis parameters are as below;

pH, BOD, COD, SS, Fecal Coliforms

iii) Results of function survey

Results of measurement of discharged water volume and analysis of discharged water quality survey are shown in *Table 5.47*. Based on the results, function of septic tank is follows;

- Effluent water volume ranges from 10.3 lcd to 13.2 lcd with an average of 11.9 lcd in three septic tank systems.
- Effluent Suspended Solids ranges from 760 mg/l to 2200 mg/l with an average of 1600 mg/l in three septic tank systems.
- Effluent BOD ranges from 200 mg/l to 280 mg/l with an average of 250 mg/l.
- Effluent Fecal Coliforms ranges from  $1.8 \times 10^5/100\text{ml}$  from  $2.6 \times 10^5/100\text{ml}$  with an average of  $2.6 \times 10^5/100\text{ml}$ .
- BOD removal efficiency ranges from 69 % to 75 % with an average of 73 % in three (3) septic tank systems. (BOD removal efficiency is shown in *Table 5.48*)

No.1 - Individual septic tank system

range : 51 % - 86 %                      average : 74 %

No.2 - Community septic tank system at Rumah Susun

range : 57 % - 77 %                      average : 69 %

No.3 -Community septic tank system Kel. Pannambungan

range : 59 % - 91 %                      average : 75 %

2) Survey of communal septic tank system

a) Selection of objective area

Four (4) communal septic tank systems were installed by PLP at RW-A, B, E and F in Kel. Pannambungan, Kec. Mariso. But, communal system at WR-B of them is no operation.

This survey is conducted for three (3) communal systems, and objective communal systems are shown in *Fig. 5.50*.

b) Existing Condition

The objective area of this survey, which is at RW-V and RW-VIII in Kel. Pannambungan, Kec. Mariso, is a part of slum area in Ujung Pandang, this area is characterized with aspects as follows;

- Housing condition in the area is one-storied house, no garden and semi-temporary or temporary house.
- Lack of infrastructure for living condition as example of road, Drainage system, water supply and sanitation.
- Especially, lack of sanitary facilities is a significant problem. According to the results of sanitary facilities survey, the condition of sanitary facilities in this area is as follow;

area	sanitary facilities with treatment	sanitary facilities without treatment	NO sanitary facilities
RW-V	42 %	24 %	34 %
RW-VIII	14 %	22 %	64 %
Average	28 %	23 %	49 %

(source : Results of survey are shown in *Table 5.49*. JICA, 1995, )

- Number of communal system user

Communal system	Number of user	Number of household
RW - A	59 persons	10 households
RW - B	16 persons	2 households
RW - F	23 persons	2 households
Total	98 persons	14 households

- Condition of communal septic tank

Communal system (RW - A)	:	good condition No desludging as yet
Communal system (RW - B)	:	Few connected household Lack of operation/maintenance Discharge pipe is damaged

Communal system (RW - AF) : Few connected household  
Lack of operation/maintenance  
Discharge pipe is damaged

c) Questionnaire survey for User of communal system

Results of Questionnaire survey for User of communal system are shown in *Table 5.50*. Results of questionnaire Survey are summarized as below.

Communal septic tank (RW - A)

- Users of Communal system are satisfied with sarinity condition.
- Operation / maintenance of communal system are managed by user's community.

Communal septic tank (RW - B)

- Order problem from communal septic tank was occurred
- Condition of efflent discharge is bad ( topographical problem)
- The neighbor request to connect with communal system.
- The present user are not satisfied, because of the flow of toilet wastewater is not enough
- Two users cut off connection with communal system by reason of topographical problem in the past one year

Communal septic tank (RW - F)

- The same condition as communal septic tank (RW - B)

(3) Conclusion

Based on the above results of survey, knowledge is acquire for septic tank system.

- Function of septic tank for BOD removal in the treatment of blackwater is roughly estimated at about 70 % for BOD removal effeciency. Effluent BOD and efflent fecal coliform is BOD. 250 mg/l and  $2 \times 10^5$  /100ml, respectively.
- It is necessary to consider based on pollution load density for application of septic tank system in unsuitable area of leaching pit system.

- Application of septic tank system for treatment plant at the small modular system is unknown as yet. It is necessary to investigate by pilot plant .
- The low income groups in slum area which is lack of snitary facilities, request to connect with communal system
- It is necessary to solve problems for communal, which are shown as below;
  - i) to make clear of topographical condition
  - ii) to make sure of gradient of collection and discharged pipe in design
  - iii) if pipe position is upper than ground level, protection pipe shall be constructed.

## **7.2 Database for On-site Sanitation Facilities**

### **7.2.1 Objective**

The objective of this survey is to conduct a pilot study to establish the facility management system for on-site sanitation facilities. And for this purpose required data to construct database which include type of toilet, type of treatment of toilet wastewater, and condition of its operation and maintenance, etc. is collected from all households within the survey area.

At the same time, the objective of this survey includes establishment the methodology to design a GIS (Geographic Information System) which interlocks above mentioned database. Considering that main component of O&M of on-site facilities is desludging service using vihecles, GIS has a potential to be a strong supporting tool.

After achieving above mentioned objectives, final goal of this survey is to transfer the methodology to Dinas Kebersihan, the responsible organization of on-site sanitation system, for the purpose of strengthening their autonomous development.

### **7.2.2 Survey Area**

The survey area covers following three (3) Kelurahan.

#### **(1) Kelurahan Barabaraya Selatan, Kecamatan Makassar**

Total population	: 6,543 persons
Number of household	: 738 households

Area : 15.4 ha  
Average income level : low

(2) Kelurahan Mardekaya Selatan, Kecamatan Makassar

Total population : 3,137 persons  
Number of household : 339 households  
Area : 13.5 ha  
Average income level : middle

(3) Kelurahan Losari, Kecamatan Ujung Pandang

Total population : 3,508 persons  
Number of household : 418 households  
Area : 27.2 ha  
Average income level : high

Location of survey area is shown in *Fig. 5.51*.

### 7.2.3 Result of the survey

Total number of collected data is 1,511 and its breakdown is 754 from Kelurahan Barabaraya Selatan, 338 from Kelurahan Mardekaya Selatan and 418 from Kelurahan Losari. The questionnaire is as follows.

- Q1. Address
- Q2. Name
- Q3. Family size
- Q4. Type of water supply
  - a. house connection
  - b. public tap
  - c. well water
  - d. house connection + well
  - e. public tap + well
- Q5. Average monthly water charge
  - a. less than Rp.5,000



- b. Rp.5,000~Rp.10,000
- c. Rp.10,000~Rp.20,000
- d. Rp.20,000~Rp.50,000
- e. more than Rp.50,000

**Q6. Type of toilet**

- a. individual toilet with pour flushing
- b. individual toilet with western flushing
- c. MCK
- d. no toilet
- e. neighbor's toilet
- f. others

**Q7. Type of on-site facility**

- a. leaching pit
- b. septic tank with leaching
- c. septic tank without leaching (effluent directly flow to ditch or canal)
- d. directly flow to ditch or canal
- e. others

**Q8. Condition of on-site facilities**

- a. very good
- b. little bit smelling
- c. sometimes clogging
- d. bad

**Q9. When did you construct on-site facility?**

- a. 1993~1995
- b. 1991~1993
- c. 1986~1990
- d. 1981~1985
- e. 1971~1980
- f. earlier than 1970

**Q10. How much did it cost to construct?**

- a. less than Rp.100,000
- b. Rp.100,000~Rp.250,000
- c. Rp.250,000~Rp.500,000
- d. Rp.500,000~Rp.1,000,000
- e. Rp.1,000,000~Rp.2,000,000

- f. Rp.2,000,000~Rp.5,000,000
- g. more than Rp.5,000,000

Q11. When did you desludge last time?

- a. 1994
- b. 1993
- c. 1992
- d. 1991
- e. 1990
- f. earlier than 1989

Q12. When did you desludge two times before?

- a. 1993~1994
- b. 1991~1992
- c. 1989~1990
- d. 1987~1988
- e. 1984~1986
- f. earlier than 1983

Q13. How much did you pay as a desludging fee per time?

- a. less than Rp.5,000
- b. Rp.5,000~Rp.7,500
- c. Rp.7,500~Rp.10,000
- d. Rp.10,000~Rp.15,000
- e. Rp.15,000~Rp.25,000
- f. Rp.25,000~Rp.50,000
- g. more than Rp.50,000

Q14. Type of ownership of the house

- a. own house
- b. rented house

Q15. Size of the house

- a. less than 10 m<sup>2</sup>
- b. 10 ~20 m<sup>2</sup>
- c. 20 ~50 m<sup>2</sup>
- d. 50 ~100 m<sup>2</sup>
- e. 100 ~200 m<sup>2</sup>
- f. more than 200 m<sup>2</sup>

Q16. Number of floor

- a. 1F
- b. 2F
- c. 3F
- d. more than 4F

Q17. Type of house (*Surveyor shall decide*)

- a. permanent
- b. semi-permanent
- c. temporary

Q18. How much do you earn per month per household?

- a. less than Rp.50,000
- b. Rp.50,000~Rp.100,000
- c. Rp.100,000~Rp.200,000
- d. Rp.200,000~Rp.500,000
- e. Rp.500,000~Rp.1,000,000
- f. Rp.1,000,000~Rp.2,000,000
- g. more than Rp.2,000,000

Q19. How much will you pay for eliminating wastewater from your living environment per month?

- a. less than Rp.1,000
- b. Rp.1,000~Rp.5,000
- c. Rp.5,000~Rp.10,000
- d. Rp.10,000~Rp.20,000
- e. Rp.20,000~Rp.30,000
- f. Rp.30,000~Rp.50,000
- g. more than Rp.50,000

Q20. How much will you pay for improving solid waste collection service per month?

- a. less than Rp.1,000
- b. Rp.1,000~Rp.5,000
- c. Rp.5,000~Rp.10,000
- d. Rp.10,000~Rp.20,000
- e. Rp.20,000~Rp.30,000
- f. Rp.30,000~Rp.50,000
- g. more than Rp.50,000

The result of collected data are shown below.

No.	Question	Kel. Losari							Kel. Mardekaya Sel.							Kel. Barabaraya Sel.						
		a.	b.	c.	d.	e.	f.	g.	a.	b.	c.	d.	e.	f.	g.	a.	b.	c.	d.	e.	f.	g.
4	Type of water supply	12	0	1	35	6		46	24	33	19	23	1		0	19	16	7	58			0
5	Average monthly water charge	60	33	4	2	1		0	31	39	18	9	3		0	53	40	5	1	1		0
6	Type of toilet	47	48		4	1		0	76	20	2		2		0	77	3	6	4	1		9
7	Type of on-site facility	1	95	1	3			0	8	88	1	2	1		0	4	84	6	3	3		0
8	Condition of on-site facility	94	2	1	3			0	92	6	1	1			0	83	6	6	5			0
9	Construction year	2	2	12	5	10	69	0	13	3	20	18	18	28	0	18	9	23	36	12	2	0
10	Construction cost	54	25	8	6	4	3	0	56	37	4	1	1	1	0	73	24	2	1			0
11	Last desludging	8	2	2	1	3	13	71	16	7	2	1	2	9	63	7	2	1	1	2	1	86
12	Year of desludging two times before	2	1	1	2	3	16	75	2	5	4	4	2	5	78	2	2	2	2	1	1	90
13	Desludging fee per time	1	2	5	8	8	10	66	1	2	5	5	18	2	67	1	2	2	8	2		85
14	Type of ownership of house	75	13	12				0	74	19	7				0	80	18	2				0
15	Size of house			3	34	29	34	0	9	10	24	33	15	9	0	2	6	54	35	3		0
16	Number of floor	51	44	5				0	67	29	4				0	52	45	2	1			0
17	Type of house	88	12					0	63	37					0	20	44	36				0
18	Monthly income per household	1	5	30	30	12	12	10	1	15	37	37	9		1	4	30	42	21	3		0
19	Willingness to pay for eliminating wastewater	56	40	4				0	61	33	6				0	94	6					0
20	Willingness to pay for solid waste collection	43	44	11	1	1		0	50	46	4				0	76	24					0

Concerning GIS, base maps which show all households (scale 1: 1,000) have been revised by field surveyors to delineate existing condition of survey area. The extend of revision for each Kelurahan is summarized as follows.

Kelurahan	extend of revision	
	Buildings	Road
Barabaraya Selatan	65%	25%
Mardekaya Selatan	35%	none
Losari	35%	none

Revised base map has been digitized completely.

Table 5.1 (1) Existing Condition of Public Toilets (MCK) According to Kelurahan

No.	Kecamatan Code No.	Kelurahan	Existing condition				
			No. of MCK	Condition		O/M organization	
				Good	Not good	Exist	Not exist
<b>1</b>	<b>MARISO</b>						
	121	Mattoanging	1		1	1	
	131	Banto Rannu	1		1	1	
	150	Lette	2	1	1	2	
	160	Pannambungan	1	1		1	
		Sub Total	5	2	3	5	
<b>2</b>	<b>MAMAJANG</b>						
	211	Parang	2	2		2	
	222	Bonto Biraeng	1	1		1	
	223	Labung Baji	1	1		1	
	231	Mamajang Dalam	1	1		1	
	232	Mandala	2	2		2	
	241	Sambung Jawa	2		2		2
	250	Maricaya Selatan	2	1	1	2	
		Sub Total	11	8	3	9	2
<b>3</b>	<b>MAKASSAR</b>						
	312	Maricaya Baru	3	3		3	
	321	Bara-Baraya	15	5	10	15	
	324	Bara-Baraya Selatan	6	6		6	
	331	Maradekaya	4	2	2	4	
	342	Barona	3	2	1		3
	352	Maccini Parang	1		1		1
	353	Maccini Gusung	1	1			1
		Sub Total	33	19	14	28	5
<b>4</b>	<b>U. PANDANG</b>						
	412	Bulo Gading	1	1		1	
	413	Lae-Lae	1	1		1	
	421	Maloku	1	1		1	
	441	Pisang Selatan	2	2		2	
		Sub Total	5	5		5	
<b>5</b>	<b>WAJO</b>						
	512	Endeh	3	2	1	3	
		Sub Total	3	2	1	3	
<b>6</b>	<b>BONTOALA</b>						
	612	Bontoala Tua	2	1	1	2	
	621	Gaddong	1	1		1	
	622	Bontala Parang	4	3	1	4	
	642	Bunga Ejaya	2	1	1	2	
	660	Baraya	2	2		2	
	670	Parang Layang	2	2		2	
		Sub Total	13	10	3	13	
<b>7</b>	<b>TALLO</b>						
	711	Kalukuang	1	1		1	
	722	Wala-Walaya	2		2		2
	731	Reppo Kalling	12	9	3	12	
	751	Kaluku Bodoa	9	6	3	9	
	752	Suwangga	4	1	3		4
	761	Pannampu	4	3	1		4
	762	Lembo	4	3	1	4	
		Sub Total	36	23	13	26	10

Table 5.1 (2) Existing Condition of Public Toilets (MCK) According to Kelurahan

No.	Kecamatan	Kelurahan	Existing condition				
			No. of MCK	Condition		O/M organization	
				Good	Not good	Exist	Not exist
8	U. TANAH						
	812	Tamalabba	17	17		17	
	822	Totake	2	2		2	
	830	Gusung	1	1		1	
	841	Cambaya	3	3		3	
	852	Pattingalloang Baru	3		3		3
	860	Barrang Lompo	2	2		2	
	870	Barrang Caddi	1	1		1	
	880	Kodingareng	3	3			3
		Sub Total	32	29	3	26	6
9	PANAKKUKANG						
	912	Pampang	8	3	5		8
	942	Karuwisi Utara	3		3	3	
		Sub Total	11	3	8	3	8
10	TAMALATB						
	1011	Mangasa	4	2	2		4
	1022	Karonrung	2	1	1	2	
	1023	Banta-Bantaeng	8	2	6	8	
	1031	Jongaya	2	1	1	2	
	1033	Bungaya	1		1		1
	1041	Maccini Sombela	13	13		13	
	1042	Parang Tambung	3	3		3	
	1051	Barombong	12	12		12	
	1052	Tanjung Merdeka	5	5		5	
		Sub Total	50	39	11	45	5
11	BIRINGKANAYA						
	1111	Tamalanrea	3	3		3	
	1113	Tamalanrea Indah	2	2		2	
		Sub Total	5	5		5	
		Total	204	145	59	168	36

Source : JICA Survey in 1994,1995

Table 5.2 Desludging Frequency of Vacuum Trucks (1992 - 1993)

Yera	Tank Truck No.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total
1992	No.1	69	46	35	41	18	22	18	35	51	57	55	53	500
	No.2	67	39	41	27	8	16	29	23	49	65	73	64	501
	No.3	65	47	26	36	18	13	43	29	40	65	5	32	419
	No.4	64	33	34	54	27	20	19	37	65	71	56	47	527
	No.5	0	0	0	0	0	0	0	0	0	0	0	0	0
	No.6	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	265	165	136	158	71	71	109	124	205	258	189	196	1,947
1993	No.1	64	43	32	38	16	21	16	33	48	53	51	56	471
	No.2	65	38	40	26	7	16	28	22	48	63	71	65	489
	No.3	66	46	26	36	18	13	42	29	39	64	5	32	416
	No.4	62	32	33	52	26	18	18	36	63	68	55	46	509
	No.5	0	0	0	0	0	0	0	0	0	0	0	0	0
	No.6	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	257	159	131	152	67	68	104	120	198	248	182	199	1,885

Source : DINAS KEBERSIHAN

Table 5.3 Preliminary Evaluation of Collection System

	Const. cost	O/M cost	Business of const.	Easiness of O/M	Reliability	Cost Recovery
Ordinary Sewer	△	△	△	○	○	○
Small Bore Sewer	○	○	○	○	×	○
Shallow Sewer	○	△	○	△	△	○
Small Scale Sewer	○	○	○	○	○	○
Pressured Sewer	○	△	△	×	△	○
Vacuum Sewer	○	△	△	×	△	○
Interceptor Sewer	◎	◎	○	○	○	×

Note: ◎ -- very good : ○ -- good : △ -- fair : × -- bad



Table 5.4 Preliminary Evaluation of Treatment System

	Const. cost	O/M cost	Groundwater Pollution	Ease of const.	Ease of O/M	Required space	Effluent quality
Leaching Pit	⊙	⊙	×	⊙	⊙	⊙	⊙
Septic Tank	○	○	⊙	○	○	⊙	△
Septic Tank with Leaching Pit	○	○	×	○	○	⊙	⊙
Septic Tank with Leaching Field	○	○	○	○	○	×	⊙
Septic Tank with Upflow Filter	○	○	⊙	○	○	⊙	△
Imhoff Tank	○	○	⊙	△	○	⊙	△
Anaerobic Filter	△	○	⊙	△	○	⊙	○
UASB	△	○	⊙	×	△	⊙	○
Anaerobic Aerobic Contact Process	×	△	⊙	△	×	⊙	⊙
Trickling Filter	△	○	⊙	△	△	△	○
Rotating Biological Contractor	△	○	⊙	△	△	○	○
Stabilization Pond	⊙	⊙	⊙	⊙	⊙	×	⊙
Aerated Lagoon	○	○	⊙	○	○	△	⊙
Activated Sludge Process	×	×	⊙	×	×	⊙	⊙
Step Aeration	×	×	⊙	×	×	⊙	⊙
Pure Oxygen Activated Sludge Process	×	×	⊙	×	×	⊙	⊙
Contact Stabilization	×	×	⊙	×	×	⊙	⊙
Extended Aeration	△	△	⊙	△	○	⊙	⊙
Oxidation Ditch	△	△	⊙	△	○	⊙	⊙

Note : ⊙ - very good ; ○ - good ; △ - fair ; × - bad

Table 5.5 Result of Water Consumption Survey

With House Connection

Sample	User (persons)	Tap Water (l/d)	Well Water (l/d)	Unit Consumption (lcd)
D1/2	5	600		120
D1/3	8	2,333	150	310
D1/4	7	600	500	157
D1/5	6	1,233	50	214
D1/6	3	500		167
D2/1	8	1,067		133
D2/3	11	1,500	750	205
D2/5	10	1,067		107
D2/6	5	1,100	750	370
D3/4	6	500		83
D3/6	9	900		100
D3/7	9	853		95
D4/1	9	800	600	156
D4/3	4	833	150	246
D4/4	9	700	200	100
D4/5	8	633		79
D4/6	5	767		153
D5/1	6	967	250	203
D5/3	11	967	400	124
D5/5	7	600		86
D5/6	7	667	250	131
D6/1	4	533		133
D6/2	7	1,167		167
D6/3	6	600		100
D6/5	7	1,200		171
D7/3	7	333		48
D8/1	2	333		167
D8/2	2	433		217
D8/3	2	900		450
D8/4	5	667		133
D8/6	4	1,933		483
D9/1	12	1,667		139
Total	211	28,953	4,050	156

Without House Connection

Sample	User (persons)	Public Tap (l/d)	Well Water (l/d)	Unit Consumption (lcd)
D2/2	5	75	1,200	255
D3/5	5		420	84
D5/2	6	75	400	79
D5/4	10	50	450	50
D7/1	5	100		20
D7/2	5	200		40
D7/4	9	240	50	32
D7/5	9	120	70	21
D7/6	4	120		30
D7/7	5	120		24
D9/2	5	120		24
D9/3	6	180		30
D9/4	10	500		50
D9/5	3	120		40
D9/6	8	200		25
D9/7	8	200		25
Total	103	2,420	2,590	49

Table 5.6 Present and Future Per Capita Domestic Water Consumption

Unit : lcd

		Present (1992)	Year 2005	Year 2015
With House Connection	Toilet	3	8	14
	Others	153	207	216
	Total	156	215	230
Without House Connection	Toilet	3	3	3
	Others	46	46	46
	Total	49	49	49

Source : JICA Study Team

Table 5.7 Water Supply for Commercial, Institutional and Industrial Uses

Unit : m<sup>3</sup>/d

		1991	1992	1993
Commercial	Small Scale	2,083	2,882	2,736
	Large Scale	790	897	921
	Total	2,873	3,779	3,657
Institutional	Public Social	1,333	1,743	1,795
	Special Social	105	181	245
	Government	1,471	2,009	2,060
	Total	2,909	3,933	4,100
Industrial	Small Scale	58	85	54
	Large Scale	626	712	781
	Inside KIMA	300	340	390
	Outsede KIMA	386	457	445

Source : PDAM

Table 5.8 Present Wastewater Generation by Kelurahan in 1992 (1/2)

Name of Kecamatan	Code No.	Wastewater Generation (m3/d)					
		Blackwater	Graywater	Commercial	Institutional	Industrial	Total
MARISO	111	14	302	51	17	0	384
	112	26	539	6	36	0	607
	121	15	310	18	59	0	402
	122	13	275	6	9	3	307
	131	14	292	0	0	0	306
	132	12	256	13	14	4	300
	140	26	539	1	0	2	568
	150	25	521	6	0	4	556
	160	33	698	23	12	7	773
	Mamajang	211	20	433	9	0	0
212		15	312	13	0	0	340
213		19	417	1	2	0	439
221		13	289	23	17	0	343
222		14	294	0	20	0	328
223		7	142	13	10	0	172
231		13	269	29	4	0	314
232		11	240	6	0	0	258
241		25	546	1	19	0	592
242		20	422	10	0	3	455
243		19	416	0	10	19	465
244		20	422	1	5	2	450
250		20	431	37	16	0	505
MAKASSAR		311	26	517	15	23	0
	312	20	414	54	0	0	488
	321	25	504	23	16	0	567
	322	24	485	19	0	0	528
	323	19	382	0	5	0	406
	324	25	504	0	0	0	529
	331	13	270	18	16	1	318
	332	12	251	23	13	1	301
	333	13	254	60	0	0	327
	341	23	474	54	20	4	575
	342	25	496	8	9	1	538
	351	25	505	1	2	1	534
	352	22	447	31	15	1	513
	353	25	499	0	12	1	535
	UJUNG PANDANG	411	9	238	13	55	4
412		11	296	28	30	0	365
413		5	133	4	13	0	154
421		12	318	22	1	2	354
422		11	293	11	38	0	354
431		10	260	24	43	3	339
432		9	254	97	29	0	390
441		18	482	31	1	2	534
442		19	510	1	0	0	531
450		18	488	37	30	3	576
WAJO		511	21	582	305	47	6
	512	18	515	91	21	4	649
	521	9	249	82	32	2	373
	522	16	456	40	12	0	524
	531	24	673	85	15	0	798
	532	17	465	70	7	1	560
	541	21	599	263	8	0	892
	542	15	434	83	2	7	541
	BONTOALA	611	9	232	13	0	0
612		13	351	42	0	0	407
621		17	456	28	12	0	513
622		14	380	20	11	0	425
631		16	422	45	4	0	487
632		14	368	22	1	0	405
641		28	752	3	1	0	783
642		20	522	0	12	0	553
651		17	459	36	5	3	520
652		20	539	56	51	9	675
660		19	520	0	6	0	546
670		18	475	37	2	0	532

Table 5.8 Present Wastewater Generation by Kelurahan in 1992 (2/2)

Name of Kecamatan	Code No.	Wastewater Generation (m3/d)					Total
		Blackwater	Graywater	Commercial	Institutional	Industrial	
TAILO	711	18	370	15	2	0	405
	712	16	319	23	2	0	360
	721	24	484	6	16	11	541
	722	33	637	0	0	0	690
	731	29	587	0	13	0	629
	732	22	443	0	2	0	466
	741	20	396	0	5	10	431
	742	17	334	54	29	9	442
	751	35	698	59	31	30	852
	752	23	465	9	14	4	513
	753	17	340	0	0	3	360
	761	38	766	1	4	0	809
	762	27	540	0	9	0	576
	763	31	623	0	0	0	654
	770	3	52	0	1	0	56
UJUNG TANAH	811	9	183	80	26	0	298
	812	13	267	10	76	0	366
	821	18	372	14	0	0	404
	822	10	199	71	6	0	287
	830	11	228	18	12	0	268
	841	15	317	77	41	0	451
	842	11	235	6	8	0	262
	851	14	298	3	2	5	321
	852	12	245	1	3	9	271
	860	10	219	0	0	0	230
	870	10	210	0	0	0	220
	880	11	235	0	0	0	247
PANAKKURANG	911	31	694	59	21	9	814
	912	30	663	19	51	26	789
	913	38	863	5	0	0	907
	914	42	953	3	0	0	998
	915	30	684	96	103	23	936
	916	34	769	0	1	0	804
	921	30	682	107	74	0	894
	922	15	341	0	41	0	397
	931	25	569	0	41	0	636
	932	14	322	0	34	0	371
	941	32	722	11	11	0	777
	942	22	506	11	5	5	549
	943	13	287	0	0	0	300
	951	30	677	3	0	0	710
	952	20	443	6	107	12	588
953	35	776	0	3	2	816	
954	35	795	0	0	0	830	
TAMALATE	1011	30	621	176	49	0	877
	1012	69	1,429	97	79	0	1,674
	1013	28	587	0	93	0	709
	1021	20	411	0	0	0	432
	1022	26	547	0	46	0	619
	1023	37	771	0	35	0	843
	1024	32	661	0	7	0	700
	1025	30	620	0	64	0	714
	1026	28	573	0	0	0	601
	1027	29	602	0	0	0	632
	1028	27	564	0	18	0	609
	1029	20	413	0	5	0	439
	1031	41	838	156	0	0	1,034
	1032	36	742	147	26	0	951
	1033	43	928	9	9	0	991
	1041	23	479	102	0	0	604
	1042	42	859	0	41	68	1,010
1043	32	654	0	52	57	795	
1061	26	529	0	204	0	759	
1082	13	271	0	0	0	284	
BIRINGKANAYA	1111	32	741	23	54	0	850
	1112	19	453	0	0	25	498
	1113	25	593	13	245	9	886
	1121	24	365	13	76	0	678
	1122	13	342	20	64	0	441
	1123	20	454	19	117	22	642
	1131	21	494	15	194	19	743
	1132	12	276	0	226	0	514
	1141	13	352	0	68	0	435
	1142	24	533	18	389	0	983
	1151	14	323	15	103	0	455
	1152	13	309	26	0	0	348
Total		3,001	66,488	3,779	3,933	457	77,657

Table 5.9 Estimated Wastewater Generation by Kelurahan in 2005 (1/2)

Name of Kecamatan	Code No.	Wastewater Generation (m <sup>3</sup> /d)					Total
		Blackwater	Graywater	Commercial	Institutional	Industrial	
MARISO	111	37	850	146	68	0	1,101
	112	65	1,502	21	148	0	1,735
	121	46	1,061	58	246	0	1,412
	122	39	903	21	39	3	1,004
	131	30	695	19	0	0	744
	132	29	664	41	58	3	796
	140	47	1,092	3	0	1	1,145
	150	48	1,104	21	7	3	1,182
	160	76	1,757	74	54	5	1,966
Mamajang	211	39	900	25	0	0	964
	212	28	645	35	0	0	708
	213	37	843	3	8	0	891
	221	34	789	64	74	0	962
	222	30	692	0	87	0	810
	223	15	348	35	43	0	441
	231	34	775	83	16	0	908
	232	28	651	19	0	0	698
	241	50	1,156	3	80	0	1,291
	242	39	900	29	0	2	970
	243	44	1,014	0	44	15	1,116
	244	38	876	3	22	2	941
	250	42	974	105	69	0	1,391
MAKASSAR	311	79	1,963	40	93	0	2,376
	312	64	1,580	141	0	0	1,785
	321	75	1,841	60	64	0	2,040
	322	62	1,535	50	0	0	1,647
	323	53	1,309	0	20	0	1,382
	324	57	1,414	0	0	0	1,472
	331	43	1,056	47	68	1	1,214
	332	38	929	60	55	0	1,083
	333	40	991	158	0	0	1,189
	341	74	1,830	141	82	3	2,130
	342	63	1,545	20	38	1	1,667
	351	63	1,558	3	6	1	1,631
	352	64	1,585	81	63	0	1,793
	353	70	1,737	0	47	0	1,855
UJUNG PANDANG	411	27	688	35	232	2	983
	412	30	766	76	126	0	993
	413	13	332	10	53	0	408
	421	29	748	59	5	1	842
	422	30	767	32	162	0	991
	431	30	764	68	179	2	1,042
	432	35	887	261	123	0	1,306
	441	42	1,063	82	3	1	1,191
	442	48	1,213	3	2	0	1,265
	450	48	1,234	103	127	1	1,514
WAJO	511	52	1,313	834	189	5	2,393
	512	42	1,068	253	84	3	1,451
	521	22	557	228	129	2	937
	522	36	915	110	47	0	1,108
	531	53	1,357	240	61	0	1,711
	532	37	939	205	28	1	1,210
	541	50	1,272	727	34	0	2,084
	542	35	890	250	8	6	1,189
BONTOALA	611	22	525	34	2	0	582
	612	34	812	111	0	0	956
	621	44	1,065	74	50	0	1,233
	622	37	887	54	45	0	1,023
	631	41	984	117	18	0	1,160
	632	34	831	57	5	0	927
	641	62	1,491	7	3	0	1,563
	642	49	1,180	0	50	0	1,279
	651	49	1,171	94	23	2	1,339
	652	78	1,876	148	212	6	2,320
	660	48	1,150	0	26	0	1,224
	670	45	1,076	97	8	0	1,226

Table 5.9 Estimated Wastewater Generation by Kelurahan in 2005 (2/2)

Name of Kecamatan	Code No.	Wastewater Generation (m3/d)					Total	
		Blackwater	Graywater	Commercial	Institutional	Industrial		
TALLO	711	40	878	73	9	0	999	
	712	33	766	89	7	0	896	
	721	70	1,556	49	75	11	1,761	
	722	44	974	0	0	0	1,018	
	731	70	1,547	0	61	0	1,678	
	732	36	795	0	7	0	838	
	741	33	719	0	23	11	785	
	742	77	1,710	251	133	10	2,181	
	751	85	1,872	274	141	31	2,403	
	752	65	1,429	42	65	4	1,605	
	753	36	795	0	2	3	836	
	761	82	1,805	3	18	0	1,911	
	762	62	1,378	0	41	0	1,482	
	763	53	1,172	0	2	0	1,228	
	770	36	799	0	6	0	841	
	URUNG TANAH	811	37	833	270	113	0	1,254
		812	32	714	34	323	0	1,104
821		24	535	48	2	0	609	
822		31	688	239	27	0	984	
830		36	798	60	49	0	943	
841		56	1,358	258	177	0	1,750	
842		21	476	22	34	0	555	
851		21	473	9	6	4	516	
852		17	369	5	15	7	413	
860		11	247	0	2	0	260	
870		11	239	0	2	0	251	
880		12	266	0	0	0	278	
PANAKKUKANG		911	92	2,072	426	164	5	2,759
	912	95	2,127	113	213	33	2,581	
	913	82	1,846	103	38	0	2,068	
	914	75	1,677	22	2	0	1,776	
	915	92	2,063	698	573	25	3,450	
	916	71	1,586	57	22	0	1,735	
	921	132	2,969	762	423	0	4,287	
	922	127	2,850	57	233	0	3,267	
	931	120	2,706	19	238	0	3,083	
	932	52	1,166	19	193	0	1,432	
	941	65	1,459	197	63	0	1,785	
	942	48	1,083	197	30	6	1,367	
	943	21	469	19	0	0	509	
	951	65	1,452	22	2	0	1,541	
	952	80	1,796	57	579	13	2,525	
	953	74	1,659	38	26	2	1,799	
	954	76	1,704	38	26	0	1,844	
TAMALATIB	1011	142	3,271	807	237	0	4,462	
	1012	342	7,891	359	472	0	9,061	
	1013	80	1,851	57	388	0	2,376	
	1021	48	1,104	28	29	0	1,209	
	1022	99	2,284	123	291	0	2,797	
	1023	98	2,270	57	179	0	2,604	
	1024	79	1,818	57	82	0	2,035	
	1025	110	2,546	47	254	0	2,957	
	1026	58	1,347	9	2	0	1,418	
	1027	63	1,443	19	2	0	1,527	
	1028	99	2,292	57	94	0	2,547	
	1029	46	1,054	19	28	0	1,146	
	1031	84	1,932	425	0	0	2,440	
	1032	122	2,822	450	121	0	3,515	
	1033	94	2,174	50	33	0	2,351	
	1041	50	1,156	338	64	0	1,808	
	1042	149	3,429	0	216	58	3,851	
	1043	124	2,853	0	225	49	3,251	
	1051	243	5,399	95	947	0	6,884	
1052	27	654	683	134	0	1,479		
BIRINGKANAYA	1111	77	1,567	354	239	0	2,257	
	1112	52	1,046	190	0	30	1,317	
	1113	55	1,116	155	1,118	26	2,471	
	1121	57	1,064	534	333	0	1,984	
	1122	43	869	114	279	0	1,365	
	1123	97	1,963	280	514	26	2,879	
	1131	64	1,306	203	848	30	2,452	
	1132	66	1,342	190	947	0	2,545	
	1141	108	2,129	95	299	0	2,628	
	1142	78	1,582	443	1,702	0	3,805	
	1151	47	947	203	406	0	1,603	
	1152	46	942	403	37	0	1,428	
	<b>Total</b>		<b>8,361</b>	<b>192,314</b>	<b>17,601</b>	<b>18,319</b>	<b>457</b>	<b>237,052</b>

Table 5.10 Estimated Wastewater Generation by Kelurahan In 2015 (1/2)

Name of Kecamatan	Code No.	Wastewater Generation (m3/d)					Total
		Blackwater	Graywater	Commercial	Institutional	Industrial	
MARISO	111	65	1,004	183	98	0	1,350
	112	113	1,747	28	214	0	2,101
	121	90	1,393	79	363	0	1,925
	122	68	1,047	28	58	2	1,203
	131	54	825	40	0	0	918
	132	50	772	56	85	2	964
	140	76	1,171	4	0	1	1,252
	150	77	1,192	28	18	2	1,317
	160	129	1,983	99	82	3	2,297
	Mamajang	211	68	1,043	32	0	0
212		47	732	44	0	0	823
213		59	910	4	13	0	986
221		60	918	79	113	0	1,168
222		52	806	0	131	0	992
223		27	411	44	62	0	544
231		64	993	103	25	0	1,185
232		48	744	24	0	0	816
241		87	1,340	4	120	0	1,551
242		67	1,039	36	0	1	1,144
243		77	1,182	0	65	11	1,335
244		65	1,004	4	33	1	1,107
250		73	1,121	131	102	0	1,427
MAKASSAR	311	141	2,174	48	136	0	2,499
	312	114	1,753	167	0	0	2,034
	321	136	2,103	72	94	0	2,404
	322	111	1,706	60	0	0	1,876
	323	94	1,452	0	29	0	1,575
	324	100	1,540	0	0	0	1,640
	331	79	1,212	56	98	0	1,445
	332	67	1,035	72	80	0	1,254
	333	76	1,166	187	0	0	1,429
	341	135	2,082	167	120	1	2,506
	342	117	1,798	24	56	0	1,995
	351	116	1,789	4	9	0	1,919
	352	116	1,785	95	91	0	2,088
	353	125	1,922	0	69	0	2,116
	UJUNG PANDANG	411	58	889	44	343	0
412		53	820	91	189	0	1,154
413		22	343	12	78	0	455
421		50	764	72	9	0	894
422		57	880	40	241	0	1,217
431		77	1,184	83	265	0	1,610
432		85	1,307	314	183	0	1,888
441		75	1,152	99	4	0	1,330
442		66	1,025	4	2	0	1,098
450		83	1,281	127	189	0	1,681
WAJO		511	88	1,357	1,018	272	4
	512	65	995	314	120	3	1,497
	521	37	571	282	185	1	1,076
	522	53	815	135	67	0	1,070
	531	79	1,217	298	87	0	1,682
	532	55	844	262	40	1	1,202
	541	79	1,222	894	49	0	2,244
	542	53	817	326	11	5	1,212
BONTOALA	611	37	572	40	2	0	651
	612	58	890	131	0	0	1,078
	621	76	1,168	87	74	0	1,405
	622	63	973	64	67	0	1,166
	631	70	1,078	139	27	0	1,314
	632	59	911	68	7	0	1,014
	641	106	1,633	8	4	0	1,751
	642	84	1,293	0	74	0	1,453
	651	83	1,285	111	33	2	1,515
	652	134	2,060	175	312	5	2,686
	660	82	1,269	0	38	0	1,390
	670	77	1,188	115	11	0	1,391



Table 5.10 Estimated Wastewater Generation by Kelurahan in 2015 (2/2)

Name of Kecamatan	Code No.	Wastewater Generation (m <sup>3</sup> /d)					Total	
		Blackwater	Graywater	Commercial	Institutional	Industrial		
TALLO	711	63	973	113	13	0	1,166	
	712	33	831	131	11	0	1,048	
	721	118	1,826	87	118	12	2,162	
	722	62	956	0	0	0	1,018	
	731	118	1,814	0	96	0	2,028	
	732	52	805	0	11	0	868	
	741	51	793	0	36	11	891	
	742	136	2,097	397	209	10	2,850	
	751	147	2,262	433	221	32	3,055	
	752	105	1,616	68	102	4	1,895	
	753	58	894	0	2	3	958	
	761	130	2,005	8	29	0	2,172	
	762	100	1,535	0	65	0	1,699	
	763	83	1,304	0	2	0	1,390	
	770	118	1,812	0	9	0	1,938	
	UJUNG TANAH	811	111	1,708	374	169	0	2,362
		812	82	1,237	48	483	0	1,869
821		40	621	68	2	0	731	
822		86	1,318	330	40	0	1,774	
830		100	1,536	83	74	0	1,793	
841		162	2,501	358	263	0	3,286	
842		47	729	32	51	0	860	
851		40	612	12	9	4	676	
852		29	447	8	22	6	513	
860		13	199	0	2	0	214	
870		13	194	0	2	0	209	
880		14	213	0	0	0	227	
PANAKKUKANG		911	233	3,624	751	323	2	4,935
	912	329	5,064	191	314	39	5,937	
	913	159	2,448	203	94	0	2,904	
	914	114	1,753	40	4	0	1,911	
	915	258	3,972	1,232	994	27	6,482	
	916	115	1,774	119	51	0	2,059	
	921	389	5,894	1,339	744	0	8,467	
	922	438	6,750	119	410	0	7,717	
	931	424	6,532	40	419	0	7,415	
	932	202	3,119	40	343	0	3,704	
	941	102	1,571	386	111	0	2,170	
	942	93	1,434	386	53	6	1,973	
	943	28	437	40	0	0	505	
	951	116	1,781	40	4	0	1,941	
	952	356	5,482	103	991	14	6,946	
953	170	2,624	79	53	2	2,929		
954	228	3,315	79	67	0	3,890		
TAMALATE	1011	259	4,000	1,268	383	0	5,910	
	1012	664	10,230	521	846	0	12,261	
	1013	146	2,243	119	568	0	3,076	
	1021	87	1,348	60	71	0	1,566	
	1022	179	2,756	258	535	0	3,727	
	1023	178	2,737	119	301	0	3,334	
	1024	143	2,200	119	176	0	2,638	
	1025	201	3,091	99	359	0	3,790	
	1026	106	1,628	20	4	0	1,753	
	1027	114	1,758	40	4	0	1,916	
	1028	179	2,763	119	158	0	3,227	
	1029	83	1,278	40	47	0	1,447	
	1031	151	2,324	317	0	0	2,991	
	1032	220	3,390	392	192	0	4,394	
	1033	171	2,629	83	45	0	2,927	
	1041	93	1,427	882	160	0	2,562	
	1042	168	4,126	0	363	51	4,808	
	1043	222	3,429	0	341	43	4,035	
1051	497	7,658	199	1,493	0	9,846		
1052	47	727	1,431	339	0	2,543		
BIRINGKANAYA	1111	386	5,941	688	363	0	7,377	
	1112	226	3,472	597	0	33	4,128	
	1113	142	2,179	294	1,744	39	4,398	
	1121	119	1,827	1,089	306	0	3,340	
	1122	194	2,987	191	423	0	3,795	
	1123	602	9,276	341	782	29	11,230	
	1131	324	4,994	390	1,390	39	7,036	
	1132	463	7,132	397	1,394	0	9,409	
	1141	386	5,949	199	454	0	6,989	
	1142	319	4,919	886	2,586	0	8,711	
	1151	202	3,113	390	372	0	4,278	
	1152	213	3,283	783	91	0	4,374	
	Total		18,576	286,290	27,823	28,959	457	362,105

Table 5.11 Result of Pollution Load Survey

Unit : lcd

Category	Sample	Quantity of Wastewater (l/day)	BOD Load Generation (g/day)	Water Quality (mgBOD/l)	Description
Domestic	Dom 1	163	24	147	High Income
	Dom 2	232	25	108	
	Dom 3	143	35	244	
	Dom 4	139	33	237	Middle Income
	Dom 5	176	24	136	
	Dom 6	125	20	160	
	Dom 7	38	12	316	Low Income
	Dom 8	167	26	155	
	Dom 9	50	8	160	
		<b>Average</b>	<b>137</b>	<b>23</b>	<b>168</b>
Commercial	Com 1	18,648	5,544	297	Department Store
	Com 2	207	9	44	Book Store, etc.
	Com 3	20,736	4,977	240	Department Store
	<b>Average</b>	<b>13,197</b>	<b>3,510</b>	<b>266</b>	
Market	Market 1	5,000	279	55.8	Traditional Market
	Market 2	14,330	1,056	73.7	Supermarket
	<b>Average</b>	<b>9,665</b>	<b>668</b>	<b>69</b>	
Institutinal	Inst 1	1,500	175	117	
	Inst 2	2,000	319	160	
	<b>Average</b>	<b>1,750</b>	<b>247</b>	<b>142</b>	

Source : JICA Study Team

Table 5.12 Industrial Wastewater Quality

Category	Unit Wastewater Generation* (ℓ/day/million Rp./year)	Water Quality (mgBOD/ℓ)
1. Food, Beverage	2.30	1,800
2. Textile	0.46	190
3. Wood, Wood Products	0.69	140
4. Paper, Paper Products	0.69	960
5. Industrial Chemicals	2.30	760
6. Non-metalic Mineral	6.21	280
7. Iron and Steel Basic	6.21	280
8. Fabricated Mineral Products, Machinery and Equipment	6.21	280
9. Others	2.30	110

Source : Jakarta Sewerage Project, JICA 1991

\*) Unit wastewater generation is modified based on the existing condition of the Study Area.

Table 5.13 Present Industrial Sales Amount and Water Quality of Industrial Wastewater

Category	Sales Amount (million Rp./year)	Wastewater Generation (m <sup>3</sup> /day)	BOD Load Generation (kg/day)	Water Quality (mgBOD/ℓ)
1. Food, Beverage	195,766	450	810.0	1,800
2. Textile	3,112	1	0.2	190
3. Wood, Wood Products	81,665	56	7.8	140
4. Paper, Paper Products	3,916	3	2.9	960
5. Industrial Chemicals	11,493	26	19.8	760
6. Non-metalic Mineral	1,594	10	2.8	280
7. Iron and Steel Basic	35,233	219	61.3	280
8. Fabricated Mineral Products, Machinery and Equipment	4,157	26	7.3	280
9. Others	390	1	0.1	110
Total	337,326	792	912.2	1,152

Source : JICA Study Team

Table 5.14 Present Pollution Load Generation by Kelurahan in 1992 (1/2)

Name of Kecamatan	Code No.	Pollution Load Generation (kgBOD/d)					Total	
		Blackwater	Graywater	Commercial	Institutional	Industrial		
MARISO	111	50	51	14	2	0	117	
	112	69	91	2	5	0	187	
	121	51	52	5	8	0	117	
	122	46	46	2	1	4	99	
	131	48	49	0	0	0	97	
	132	42	43	3	2	5	96	
	140	89	91	0	0	2	183	
	150	86	88	2	0	4	180	
	160	116	118	6	2	8	249	
	Mamajang	211	71	73	2	0	0	146
212		51	53	3	0	0	107	
213		68	70	0	0	0	139	
221		47	49	6	2	0	105	
222		48	50	0	3	0	100	
223		23	24	3	1	0	52	
231		44	45	8	1	0	97	
232		39	40	2	0	0	81	
241		89	92	0	3	0	184	
242		69	71	3	0	3	146	
243		68	70	0	1	22	161	
244		69	71	0	1	3	143	
250		70	73	10	2	0	155	
MAKASSAR		311	90	87	4	3	0	184
		312	72	70	14	0	0	156
	321	87	85	6	2	0	181	
	322	84	82	5	0	0	171	
	323	66	64	0	3	0	131	
	324	87	85	0	0	1	173	
	331	47	45	5	2	1	100	
	332	44	42	6	2	1	95	
	333	44	43	16	0	1	103	
	341	82	80	14	3	5	184	
	342	86	84	2	1	1	174	
	351	88	85	0	0	1	174	
	352	77	75	8	2	1	164	
	353	86	84	0	2	1	173	
	UJUNG PANDANG	411	31	40	3	8	4	86
412		38	50	7	4	0	100	
413		17	22	1	2	0	42	
421		41	54	6	0	2	103	
422		38	49	3	5	0	96	
431		34	44	6	6	4	94	
432		33	43	26	4	0	106	
441		63	81	8	0	3	155	
442		66	86	0	0	0	153	
450		63	82	10	4	4	163	
WAJO		511	72	98	81	7	6	265
	512	64	87	24	3	5	182	
	521	31	42	22	5	2	101	
	522	57	77	11	2	1	146	
	531	84	113	23	2	1	222	
	532	58	78	19	1	1	157	
	541	74	101	70	1	0	247	
	542	54	73	22	0	8	157	
	BONTOALA	611	30	39	3	0	0	73
612		46	59	11	0	0	116	
621		60	77	7	2	0	146	
622		50	64	5	2	0	121	
631		55	71	12	1	0	139	
632		48	62	6	0	0	116	
641		99	127	1	0	0	226	
642		69	88	0	2	0	158	
651		60	77	10	1	4	151	
652		71	91	15	7	10	193	
660		68	88	0	1	0	157	
670		62	80	10	0	0	152	

Table 5.14 Present Pollution Load Generation by Kelurahan in 1992 (2/2)

Name of Kecamatan	Code No.	Pollution Load Generation (kgBOD/d)					Total
		Blackwater	Graywater	Commercial	Institutional	Industrial	
TALLO	711	63	62	4	0	0	131
	712	56	54	6	0	0	116
	721	85	81	2	2	12	182
	722	113	111	0	0	0	226
	731	103	99	0	2	0	203
	732	77	75	0	0	0	152
	741	69	67	0	1	12	149
	742	58	56	14	4	11	144
	751	122	118	16	4	34	294
	752	81	78	2	2	4	168
	753	39	57	0	0	3	120
	761	134	129	0	1	0	264
	762	94	91	0	1	0	187
	763	109	105	0	0	0	214
	770	9	9	0	0	0	18
	UJUNG TANAH	811	31	31	21	4	0
812		45	45	3	11	0	103
821		62	63	4	0	0	129
822		33	34	19	1	0	87
830		38	38	5	2	0	83
841		53	53	20	6	0	133
842		39	40	2	1	0	82
851		50	50	1	0	5	106
852		41	41	0	0	10	93
860		37	37	0	0	0	73
870		35	35	0	0	0	71
880		39	40	0	0	0	79
PANAKKUKANG		911	108	117	16	3	10
	912	104	112	5	7	29	257
	913	155	145	1	0	0	281
	914	149	160	1	0	0	310
	915	107	115	25	15	27	289
	916	120	130	0	0	0	250
	921	106	115	29	11	0	260
	922	33	37	0	6	0	116
	931	89	96	0	6	0	190
	932	50	54	0	5	0	109
	941	113	122	3	2	0	239
	942	79	85	3	1	6	174
	943	45	48	0	0	0	93
	951	106	114	1	0	0	220
	952	69	75	2	15	13	174
953	121	131	0	0	2	254	
954	124	134	0	0	0	258	
TAMALATE	1011	108	108	47	7	0	264
	1012	242	241	26	11	0	520
	1013	99	99	0	13	0	212
	1021	70	69	0	0	0	139
	1022	93	92	0	6	0	191
	1023	131	130	0	5	0	265
	1024	112	111	0	1	0	224
	1025	108	104	0	9	0	219
	1026	97	96	0	0	0	194
	1027	102	101	0	0	0	204
	1028	96	95	0	3	0	193
	1029	70	70	0	1	0	140
	1031	142	141	41	0	0	323
	1032	126	125	39	4	0	294
	1033	157	156	7	1	0	317
	1041	81	81	27	0	0	189
	1042	146	145	0	6	18	315
	1043	111	110	0	7	66	294
1051	90	89	0	29	0	208	
1052	46	46	0	0	0	92	
BIRINGKANAYA	1111	111	123	6	8	0	249
	1112	68	76	0	0	29	173
	1113	89	100	3	35	11	237
	1121	84	95	3	11	0	194
	1122	51	58	3	9	0	123
	1123	69	78	3	17	23	194
	1131	74	83	4	28	22	210
	1132	41	47	0	32	0	120
	1141	53	59	0	10	0	121
	1142	83	93	3	53	0	236
	1151	48	54	4	13	0	121
	1152	46	52	7	0	0	105
	Total		10,503	11,196	1,000	558	526

Table 5.15 Estimated Pollution Load Generation by Kelurahan in 2005 (1/2)

Name of Kecamatan	Code No.	Pollution Load Generation (kgBOD/d)					Total
		Blackwater	Graywater	Commercial	Institutional	Industrial	
MARISO	111	71	143	39	10	0	262
	112	125	253	5	21	0	404
	121	88	179	16	35	0	317
	122	75	152	5	6	3	241
	131	58	117	5	0	0	180
	132	55	112	11	8	4	190
	140	91	184	1	0	2	277
	150	92	185	5	1	3	287
	160	146	296	20	8	6	474
	Mamajang	211	75	152	7	0	0
212		54	109	9	0	0	172
213		70	142	1	1	0	214
221		65	133	17	11	0	226
222		57	117	0	12	0	187
223		29	59	9	6	0	103
231		64	131	22	2	0	219
232		54	110	5	0	0	169
241		96	195	1	11	0	303
242		75	152	8	0	2	236
243		84	171	0	6	17	278
244		73	147	1	3	2	226
250		81	164	28	10	0	283
MAKASSAR		311	124	331	11	13	0
	312	99	266	37	0	0	403
	321	116	310	16	9	0	451
	322	97	258	13	0	0	369
	323	82	220	0	3	0	306
	324	89	238	0	0	0	328
	331	66	178	12	10	1	267
	332	59	157	16	8	0	239
	333	62	167	42	0	0	272
	341	115	308	37	12	3	476
	342	97	260	5	5	1	369
	351	98	262	1	1	1	363
	352	100	267	21	9	0	398
	353	109	292	0	7	0	409
UJUNG PANDANG	411	38	116	9	33	2	198
	412	42	129	20	18	0	209
	413	18	56	3	8	0	84
	421	41	126	16	1	1	184
	422	42	129	9	23	0	203
	431	42	129	18	25	2	216
	432	49	149	69	17	0	285
	441	58	179	22	0	1	261
	442	67	204	1	0	0	272
	450	68	208	27	18	2	323
WAJO	511	72	221	222	27	6	548
	512	59	180	67	12	4	322
	521	31	94	61	18	2	205
	522	50	154	29	7	0	241
	531	75	229	64	9	0	376
	532	52	158	55	4	1	269
	541	70	214	194	5	0	483
	542	49	150	67	1	7	273
BONTOALA	611	37	88	9	0	0	134
	612	57	137	29	0	0	223
	621	74	179	20	7	0	280
	622	62	149	14	6	0	232
	631	69	166	31	3	0	268
	632	58	140	15	1	0	214
	641	104	251	2	0	0	357
	642	82	199	0	7	0	288
	651	82	197	25	3	3	310
	652	131	318	39	30	7	523
	660	80	194	0	4	0	278
	670	75	181	26	1	0	283

Table 5.15 Estimated Pollution Load Generation by Kelurahan in 2005 (2/2)

Name of Kecamatan	Code No.	Pollution Load Generation (kgBOD/d)					Total	
		Blackwater	Graywater	Commercial	Institutional	Industrial		
TALLO	711	84	148	19	1	0	252	
	712	73	129	24	1	0	226	
	721	148	262	13	11	13	447	
	722	93	164	0	0	0	257	
	731	147	261	0	9	0	416	
	732	76	134	0	1	0	211	
	741	68	121	0	3	13	205	
	742	163	288	67	19	11	547	
	751	178	315	73	20	36	622	
	752	136	241	11	9	3	402	
	753	76	134	0	0	4	213	
	761	172	304	1	3	0	480	
	762	131	232	0	6	0	369	
	763	111	197	0	0	0	309	
	770	76	135	0	1	0	211	
	UIJUNG TANAH	811	77	140	72	16	0	305
		812	66	120	9	45	0	241
821		49	90	13	0	0	153	
822		64	116	64	4	0	247	
830		74	134	16	7	0	231	
841		116	212	69	25	0	422	
842		44	80	6	5	0	135	
851		44	80	2	1	5	132	
852		34	62	1	2	8	108	
860		23	42	0	0	0	65	
870		22	40	0	0	0	62	
880		23	43	0	0	0	69	
PANAKKUKANG		911	186	349	113	23	5	677
	912	191	358	30	30	38	648	
	913	166	311	27	5	0	509	
	914	151	282	6	0	0	439	
	915	185	347	186	81	29	829	
	916	143	267	15	3	0	428	
	921	267	500	203	60	0	1,030	
	922	256	480	15	33	0	784	
	931	243	456	5	34	0	738	
	932	105	196	5	28	0	334	
	941	131	246	52	9	0	438	
	942	97	183	52	4	7	344	
	943	42	79	5	0	0	126	
	951	130	245	6	0	0	381	
	952	161	302	15	82	15	576	
	953	149	279	10	4	2	445	
954	153	287	10	4	0	454		
TAMALATE	1011	269	552	215	34	0	1,069	
	1012	647	1,329	98	67	0	2,138	
	1013	152	312	15	55	0	534	
	1021	90	186	8	4	0	288	
	1022	187	385	33	41	0	645	
	1023	186	382	15	25	0	609	
	1024	149	306	15	12	0	482	
	1025	209	429	13	36	0	686	
	1026	110	227	3	0	0	340	
	1027	118	243	5	0	0	367	
	1028	188	386	15	13	0	602	
	1029	86	177	3	4	0	273	
	1031	158	325	113	0	0	597	
	1032	231	475	120	17	0	843	
	1033	178	366	13	5	0	562	
	1041	95	195	143	9	0	442	
	1042	281	577	0	31	67	956	
	1043	234	480	0	32	56	802	
	1051	459	943	25	135	0	1,562	
1052	52	107	182	19	0	359		
BIRINGKANAYA	1111	191	264	94	34	0	583	
	1112	127	176	50	0	35	388	
	1113	136	188	41	159	30	554	
	1121	130	179	142	47	0	498	
	1122	106	146	30	40	0	322	
	1123	239	331	74	73	30	747	
	1131	159	220	54	120	35	588	
	1132	163	226	50	134	0	574	
	1141	259	359	23	41	0	683	
	1142	193	266	118	242	0	818	
	1151	115	159	54	58	0	386	
	1152	115	159	107	5	0	386	
	Total		15,960	32,386	4,682	2,601	526	56,155

Table 5.16 Estimated Pollution Load Generation by Kelurahan in 2015 (1/2)

Name of Kecamatan	Code No.	Pollution Load Generation (kgBOD/d)					Total	
		Blackwater	Graywater	Commercial	Institutional	Industrial		
MARISO	111	74	169	49	14	0	305	
	112	128	293	7	30	0	460	
	121	102	234	21	52	0	409	
	122	77	176	7	8	3	271	
	131	61	139	11	0	0	210	
	132	57	130	15	12	4	217	
	140	86	197	1	0	2	285	
	150	88	200	7	3	3	301	
	160	146	333	26	12	6	523	
	Mamajang	211	77	173	8	0	0	260
212		54	123	12	0	0	188	
213		67	153	1	2	0	223	
221		67	154	21	16	0	259	
222		59	136	0	19	0	214	
223		30	69	12	9	0	120	
231		73	167	27	3	0	271	
232		55	125	6	0	0	186	
241		98	225	1	17	0	342	
242		76	173	10	0	2	263	
243		87	199	0	9	17	313	
244		74	169	1	3	2	250	
250		82	188	35	15	0	320	
MAKASSAR		311	123	363	13	19	0	523
		312	101	295	44	0	0	440
	321	121	353	19	13	0	507	
	322	98	287	16	0	0	401	
	323	84	244	0	4	0	332	
	324	89	259	0	0	0	348	
	331	70	204	15	14	1	303	
	332	60	174	19	11	0	265	
	333	67	196	50	0	0	313	
	341	120	350	44	17	3	535	
	342	104	302	6	8	1	421	
	351	103	301	1	1	1	407	
	352	103	300	25	13	0	442	
	353	111	323	0	10	0	444	
	UJUNG PANDANG	411	47	149	12	49	2	259
412		43	138	24	27	0	232	
413		18	58	3	11	0	90	
421		40	128	19	1	1	190	
422		46	148	11	34	0	239	
431		62	199	22	38	2	323	
432		69	220	84	26	0	398	
441		61	194	26	1	1	283	
442		34	172	1	0	0	228	
450		68	215	34	27	2	345	
WAJO	511	72	228	271	39	6	614	
	512	53	167	84	17	4	324	
	521	30	96	75	26	2	229	
	522	43	137	36	9	0	226	
	531	64	205	79	12	0	361	
	532	45	142	70	6	1	263	
	541	64	205	238	7	0	515	
	542	43	137	87	2	7	275	
BONTOALA	611	36	96	11	0	0	143	
	612	57	149	35	0	0	241	
	621	74	196	23	10	0	304	
	622	62	163	17	9	0	252	
	631	69	181	37	4	0	291	
	632	58	153	18	1	0	230	
	641	104	274	2	1	0	381	
	642	82	218	0	10	0	310	
	651	82	216	30	5	3	335	
	652	131	346	47	44	7	575	
	660	81	213	0	5	0	299	
	670	76	200	31	2	0	307	



Table 5.16 Estimated Pollution Load Generation by Kelurahan in 2015 (2/2)

Name of Kecamatan	Code No.	Pollution Load Generation (kgBOD/d)					Total
		Blackwater	Graywater	Commercial	Institutional	Industrial	
TALLO	711	84	164	31	2	0	280
	712	73	143	35	2	0	252
	721	157	307	23	17	13	516
	722	82	161	0	0	0	243
	731	156	305	0	14	0	474
	732	69	135	0	2	0	206
	741	68	133	0	5	13	219
	742	180	352	106	30	11	679
	751	194	380	115	31	36	756
	752	139	271	18	15	5	441
	753	77	150	0	0	4	231
	761	172	337	2	4	0	515
	762	132	258	0	9	0	399
	763	117	219	0	0	0	331
	770	155	304	0	1	0	461
UJUNG TANAH	811	146	287	99	24	0	557
	812	108	211	13	69	0	400
	821	53	104	18	0	0	176
	822	113	222	83	6	0	428
	830	132	258	22	10	0	422
	841	214	420	95	38	0	767
	842	63	123	8	7	0	201
	851	52	103	3	1	5	164
	852	38	75	2	3	8	127
	860	17	33	0	0	0	51
	870	17	33	0	0	0	50
	880	18	36	0	0	0	54
PANAKKURANG	911	298	609	200	46	5	1,158
	912	417	851	51	45	38	1,401
	913	201	411	54	13	0	680
	914	144	295	11	1	0	450
	915	327	667	328	141	29	1,492
	916	146	298	32	7	0	483
	921	493	1,007	356	106	0	1,962
	922	555	1,134	32	58	0	1,779
	931	538	1,097	11	59	0	1,705
	932	257	524	11	49	0	840
	941	129	264	103	16	0	512
	942	118	241	103	8	7	476
	943	36	73	11	0	0	120
	951	147	299	11	1	0	457
	952	451	921	27	141	15	1,555
	953	216	441	21	8	2	688
	954	289	591	21	9	0	910
TAMALATE	1011	301	672	337	54	0	1,365
	1012	770	1,719	139	120	0	2,747
	1013	169	377	32	81	0	658
	1021	101	228	16	10	0	354
	1022	207	463	69	76	0	815
	1023	206	460	32	43	0	740
	1024	166	370	31	25	0	592
	1025	233	519	26	51	0	829
	1026	123	274	5	1	0	402
	1027	132	295	11	1	0	439
	1028	208	464	32	22	0	727
	1029	96	215	11	7	0	328
	1031	175	390	137	0	0	702
	1032	255	570	158	27	0	1,009
	1033	198	442	22	6	0	668
	1041	107	240	235	23	0	605
	1042	311	693	0	52	67	1,122
	1043	238	576	0	48	56	939
	1051	576	1,287	53	212	0	2,128
	1052	55	122	381	48	0	605
BIRINGKANAYA	1111	643	998	183	52	0	1,876
	1112	376	583	106	0	35	1,099
	1113	236	366	78	248	30	958
	1121	198	307	290	72	0	866
	1122	323	502	51	60	0	936
	1123	1,004	1,538	144	111	30	2,847
	1131	541	839	104	183	35	1,701
	1132	774	1,203	106	198	0	2,279
	1141	644	999	53	65	0	1,761
	1142	532	826	236	367	0	1,962
	1151	337	523	104	81	0	1,045
	1152	356	552	208	13	0	1,129
Total		23,100	48,097	7,401	4,112	526	83,236

Table 5.17 Specific Pollution Load Discharge excl. Housing Bstate by Kelurahan in 2005 (1/2)

Kecamatan	Code No.	Area (ha)	Population in 2005	Area of Housing Estates (ha)	Population of Housing Estates	Pollution Load Discharge (kgBOD/day)			Specific Pollution Load Discharge (kgBOD/day/ha)	
						From Housing Estates	Remaining	Total		
Mariso	111	18	6,717	0	0	0	192	192	10.64	
	112	29	11,872	0	0	0	279	279	9.63	
	121	35	8,387	0	0	0	229	229	6.55	
	122	18	7,135	0	0	0	166	166	9.22	
	131	14	5,492	0	0	0	122	122	8.72	
	132	14	5,251	0	0	0	135	135	9.62	
	140	14	8,636	0	0	0	186	186	13.32	
	150	14	8,727	0	0	0	195	195	13.96	
	160	26	13,889	0	0	0	329	329	12.64	
Mamajang	211	14	7,114	0	0	0	158	158	11.31	
	212	10	5,098	0	0	0	118	118	11.80	
	213	12	6,667	0	0	0	144	144	12.00	
	221	18	6,236	0	0	0	160	160	8.91	
	222	16	5,474	0	0	0	129	129	8.06	
	223	8	2,751	0	0	0	74	74	9.26	
	231	18	6,130	0	0	0	155	155	8.61	
	232	12	5,348	0	0	0	115	115	9.55	
	241	28	9,142	0	0	0	207	207	7.40	
	242	17	7,118	0	0	0	162	162	9.50	
	243	31	8,012	0	0	0	194	194	6.25	
	244	14	6,922	0	0	0	153	153	10.96	
	250	27	7,703	0	0	0	202	202	7.48	
	Makassar	311	27	11,770	0	0	0	355	355	13.13
		312	20	9,474	0	0	0	304	304	15.18
321		19	11,038	0	0	0	335	335	17.65	
322		15	9,205	0	0	0	272	272	18.13	
323		13	7,852	0	0	0	223	223	17.18	
324		13	8,481	0	0	0	239	239	18.35	
331		15	6,331	0	0	0	201	201	13.37	
332		12	5,574	0	0	0	181	181	15.07	
333		13	5,942	0	0	0	209	209	16.09	
341		27	10,977	0	0	0	361	361	13.35	
342		16	9,268	0	0	0	272	272	16.98	
351		19	9,341	0	0	0	265	265	13.94	
352		19	9,507	0	0	0	298	298	15.67	
353		24	10,415	0	0	0	300	300	12.49	
Ujung Pandang		411	41	3,603	0	0	0	160	160	3.90
	412	28	4,010	0	0	0	167	167	5.97	
	413	16	1,737	0	0	0	66	66	4.13	
	421	17	3,916	0	0	0	143	143	8.43	
	422	23	4,017	0	0	0	161	161	6.99	
	431	32	4,001	0	0	0	174	174	5.43	
	432	43	4,646	0	0	0	236	236	5.49	
	441	21	5,569	0	0	0	203	203	9.65	
	442	12	6,352	0	0	0	205	205	17.11	
	450	30	6,465	0	0	0	255	255	8.49	
Wajo	511	53	6,879	0	0	0	476	476	8.97	
	512	23	5,594	0	0	0	263	263	11.44	
	521	22	2,917	0	0	0	175	175	7.94	
	522	13	4,795	0	0	0	190	190	14.65	
	531	20	7,108	0	0	0	301	301	15.07	
	532	15	4,919	0	0	0	218	218	14.51	
	541	35	6,663	0	0	0	413	413	11.79	
	542	18	4,663	0	0	0	224	224	12.46	
Bontoala	611	6	3,486	0	0	0	98	98	16.26	
	612	11	5,388	0	0	0	166	166	15.10	
	621	22	7,071	0	0	0	206	206	9.37	
	622	14	5,890	0	0	0	170	170	12.15	
	631	16	6,530	0	0	0	199	199	12.47	
	632	12	5,516	0	0	0	156	156	12.98	
	641	15	9,900	0	0	0	253	253	16.89	
	642	15	7,831	0	0	0	206	206	13.72	
	651	20	7,776	0	0	0	228	228	11.41	
	652	47	12,432	0	0	0	393	393	8.35	
	660	17	7,636	0	0	0	197	197	11.61	
Tallo	670	15	7,141	0	0	0	208	208	13.88	
	711	11	7,953	0	0	0	168	168	15.31	
	712	10	6,936	0	0	0	154	154	15.36	
	721	35	14,092	0	0	0	299	299	8.54	
	722	6	8,821	0	0	0	164	164	27.33	
	731	39	14,013	0	0	0	269	269	6.90	

Table 5.17 Specific Pollution Load Discharge excl. Housing Estate by Kelurahan in 2005 (2/2)

Kecamatan	Code No.	Area (ha)	Population in 2005	Area of Housing Estates (ha)	Population of Housing Estates	Pollution Load Discharge (kgBOD/day)			Specific Pollution Load Discharge (kgBOD/day/ha)	
						From Housing Estates	Remaining	Total		
Tallo	732	10	7,202	0	0	0	135	135	13.49	
	741	30	6,511	0	0	0	137	137	4.56	
	742	78	15,485	0	0	0	385	385	4.93	
	751	90	16,961	0	0	0	444	444	4.93	
	752	28	12,942	0	0	0	266	266	9.49	
	753	11	7,204	0	0	0	138	138	12.52	
	761	22	16,353	0	0	0	308	308	14.00	
	762	26	12,486	0	0	0	238	238	9.15	
	763	12	10,614	0	0	0	198	198	16.46	
	770	173	7,237	0	0	0	135	135	0.77	
Ujung Tanah	811	119	7,335	0	0	0	228	228	1.92	
	812	68	6,285	0	0	0	175	175	2.58	
	821	24	4,713	0	0	0	103	103	4.30	
	822	88	6,053	0	0	0	183	183	2.08	
	830	76	7,023	0	0	0	157	157	2.07	
	841	120	11,075	0	0	0	306	306	2.55	
	842	31	4,193	0	0	0	91	91	2.94	
	851	27	4,184	0	0	0	88	88	3.26	
	852	23	3,250	0	0	0	74	74	3.22	
	860	7	2,177	0	0	0	42	42	5.98	
	870	8	2,101	0	0	0	40	40	5.05	
	880	3	2,344	0	0	0	45	45	14.95	
	Panakkukang	911	188	17,735	0	0	0	491	491	2.61
912		370	18,202	0	0	0	457	457	1.23	
913		113	15,801	28	5,600	195	149	344	1.75	
914		70	14,353	23	6,900	240	48	289	1.03	
915		261	17,656	110	16,500	574	69	644	0.46	
916		70	13,578	51	6,630	231	55	285	2.87	
921		525	25,415	38	11,400	397	366	763	0.75	
922		638	24,393	70	14,000	487	41	528	0.07	
931		655	23,160	6	1,200	42	453	494	0.70	
932		271	9,983	24	4,800	167	62	229	0.23	
941		79	12,489	0	0	0	307	307	3.89	
942		70	9,284	0	0	0	246	246	3.52	
943		19	4,016	7	1,750	61	23	84	1.93	
951		153	12,427	0	0	0	251	251	1.64	
952		327	15,370	32	6,400	223	192	415	0.65	
953		125	14,198	35	7,000	244	52	295	0.58	
954		185	14,587	35	7,000	244	57	301	0.38	
Tamalate		1011	148	25,577	64	19,200	668	132	800	1.57
		1012	414	61,594	64	19,200	668	823	1,491	2.35
	1013	94	14,452	40	10,000	348	34	382	0.63	
	1021	34	8,614	14	4,200	146	51	197	2.57	
	1022	125	17,827	76	12,920	450	9	459	0.18	
	1023	79	17,719	50	11,500	400	23	423	0.78	
	1024	61	14,187	40	8,400	292	41	333	1.93	
	1025	89	19,870	31	9,300	324	154	477	2.65	
	1026	21	10,518	21	6,300	230	0	230	0.00	
	1027	26	11,265	26	7,800	248	0	248	0.00	
	1028	78	17,890	36	7,200	251	164	414	3.90	
	1029	22	8,225	22	6,600	186	0	186	0.00	
	1031	65	15,080	9	1,800	63	376	438	6.71	
	1032	82	22,028	52	15,600	543	69	612	2.31	
	1033	37	16,966	0	0	0	384	384	10.38	
	1041	286	9,026	0	0	0	347	347	1.21	
	1042	162	26,763	45	13,500	470	205	675	1.76	
1043	133	22,270	34	10,200	355	214	569	2.16		
1051	634	43,705	0	0	0	1,103	1,103	1.74		
1052	354	4,950	0	0	0	307	307	0.87		
Biringkanaya	1111	483	18,166	24	4,800	167	225	392	0.49	
	1112	274	12,123	35	7,000	244	18	261	0.07	
	1113	521	12,940	56	8,400	292	126	418	0.27	
	1121	527	12,341	33	6,600	230	139	369	0.28	
	1122	778	10,073	18	3,600	125	91	216	0.12	
	1123	811	22,755	30	6,000	209	299	508	0.38	
	1131	663	15,138	14	3,500	122	308	429	0.47	
	1132	671	15,563	17	4,200	146	265	411	0.40	
	1141	836	24,684	20	6,000	209	217	426	0.27	
	1142	745	18,336	0	0	0	626	626	0.84	
	1151	632	10,976	0	0	0	271	271	0.43	
	1152	1,065	10,920	0	0	0	271	271	0.25	
	<b>Total</b>		<b>17,577</b>	<b>1,520,000</b>	<b>1,330</b>	<b>303,000</b>	<b>10,489</b>	<b>29,707</b>	<b>40,195</b>	<b>1.83</b>

Table 5.18 Deviation from Mean of Each Data (1/2)

Code	Populaton Density (persons/ha)	Deviation from Mean	Public Land Use (%)	Deviation from Mean	Distance from WTP (m)	Deviation from Mean	Average Income Level (Rp.1,000/month)	Deviation from Mean
111	373	-0.07	49%	1.50	2,890	-0.12	166	-0.21
112	409	0.10	36%	0.71	2,010	0.47	230	0.39
121	240	-0.68	51%	1.58	600	1.41	65	-1.15
122	396	0.04	18%	-0.27	1,150	1.04	140	-0.45
131	392	0.02	5%	-1.03	600	1.41	125	-0.59
132	375	-0.06	36%	0.76	1,000	1.14	125	-0.59
140	617	1.07	1%	-1.27	1,100	1.07	210	0.21
150	623	1.10	4%	-1.07	1,330	0.92	220	0.30
160	534	0.68	19%	-0.22	1,840	0.58	230	0.39
211	508	0.56	5%	-1.03	1,790	0.62	118	-0.66
212	510	0.57	11%	-0.69	2,190	0.35	195	0.07
213	556	0.79	5%	-1.03	1,490	0.82	150	-0.36
221	346	-0.19	39%	0.90	2,980	-0.18	190	0.02
222	342	-0.21	36%	0.75	2,580	0.09	195	0.07
223	344	-0.20	49%	1.46	2,180	0.36	325	1.28
231	341	-0.21	20%	-0.17	2,620	0.06	126	-0.58
232	429	0.20	5%	-1.03	3,180	-0.31	200	0.11
241	327	-0.28	18%	-0.28	2,560	0.10	110	-0.73
242	419	0.15	5%	-1.01	1,670	0.70	130	-0.54
243	258	-0.60	9%	-0.78	1,770	0.63	125	-0.59
244	494	0.50	11%	-0.70	2,510	0.14	105	-0.78
250	285	-0.47	29%	0.33	3,590	-0.58	189	0.01
311	436	0.23	27%	0.22	4,420	-1.13	238	0.47
312	474	0.41	21%	-0.12	5,390	-1.78	160	-0.26
321	581	0.90	32%	0.49	3,880	-0.77	108	-0.75
322	614	1.06	10%	-0.74	3,530	-0.54	41	-1.38
323	604	1.01	10%	-0.74	3,450	-0.49	46	-1.33
324	652	1.23	0%	-1.31	4,190	-0.98	73	-1.08
331	422	0.16	39%	0.89	4,630	-1.27	106	-0.77
332	465	0.36	45%	1.25	4,370	-1.10	181	-0.07
333	457	0.33	36%	0.75	4,940	-1.48	150	-0.36
341	407	0.09	35%	0.69	4,200	-0.99	230	0.39
342	579	0.89	19%	-0.21	3,650	-0.62	194	0.06
351	492	0.49	3%	-1.16	3,370	-0.43	140	-0.45
352	500	0.53	34%	0.63	3,000	-0.19	60	-1.20
353	434	0.22	13%	-0.58	2,970	-0.17	142	-0.43
411	88	-1.39	39%	0.91	4,840	-1.41	450	2.46
412	143	-1.14	37%	0.78	5,710	-1.99	470	2.64
421	230	-0.73	13%	-0.58	5,610	-1.92	380	1.80
422	175	-0.99	49%	1.46	5,930	-2.14	380	1.80
431	125	-1.22	42%	1.05	5,870	-2.10	290	0.96
432	108	-1.30	37%	0.76	5,180	-1.64	290	0.96
441	265	-0.57	12%	-0.61	5,050	-1.55	295	1.00
442	529	0.66	2%	-1.21	4,680	-1.31	295	1.00
450	216	-0.80	37%	0.78	4,290	-1.05	350	1.52
511	130	-1.20	71%	2.73	5,340	-1.74	541	3.31
512	243	-0.67	57%	1.90	5,340	-1.74	300	1.05

Table 5.18 Deviation from Mean of Each Data (2/2)

Code	Population Density (persons/ha)	Deviation from Mean	Public Land Use (%)	Deviation from Mean	Distance from WTP (m)	Deviation from Mean	Average Income Level (Rp.1,000/month)	Deviation from Mean
521	133	-1.18	70%	2.64	2,200	0.34	405	2.03
522	369	-0.08	49%	1.45	1,710	0.67	380	1.80
531	355	-0.15	56%	1.84	1,120	1.06	285	0.91
532	328	-0.27	53%	1.72	1,370	0.90	40	-1.39
541	190	-0.92	69%	2.62	1,780	0.62	310	1.14
542	259	-0.60	45%	1.25	2,580	0.09	220	0.30
611	581	0.90	18%	-0.27	4,220	-1.00	265	0.72
612	490	0.48	30%	0.39	4,710	-1.33	260	0.67
621	321	-0.31	25%	0.11	4,100	-0.92	310	1.14
622	421	0.16	33%	0.56	4,780	-1.37	300	1.05
631	408	0.10	29%	0.36	3,700	-0.65	164	-0.22
632	460	0.34	17%	-0.36	3,450	-0.49	180	-0.07
641	660	1.27	3%	-1.16	820	1.26	100	-0.82
642	522	0.63	22%	-0.06	1,280	0.95	70	-1.11
651	389	0.01	22%	-0.09	2,920	-0.14	300	1.05
652	265	-0.57	39%	0.90	3,420	-0.47	301	1.06
660	449	0.29	10%	-0.74	4,360	-1.09	260	0.67
670	476	0.41	23%	-0.02	970	1.16	110	-0.73
711	723	1.56	32%	0.50	2,680	0.02	230	0.39
712	694	1.43	38%	0.85	2,440	0.18	88	-0.94
721	403	0.07	21%	-0.14	1,010	1.13	77	-1.04
722	1470	5.04	0%	-1.31	1,890	0.55	70	-1.11
731	359	-0.13	11%	-0.70	0	1.81	115	-0.68
732	720	1.55	5%	-1.03	810	1.27	50	-1.29
741	217	-0.79	5%	-1.01	2,470	0.16	170	-0.17
742	199	-0.88	24%	0.05	1,630	0.72	50	-1.29
751	188	-0.93	22%	-0.08	1,840	0.58	79	-1.02
752	462	0.35	23%	-0.03	2,000	0.48	117	-0.67
753	655	1.25	1%	-1.26	1,190	1.01	250	0.58
761	743	1.66	7%	-0.92	2,500	0.14	70	-1.11
762	480	0.43	11%	-0.67	2,580	0.09	200	0.11
763	885	2.32	1%	-1.26	1,380	0.89	184	-0.04
811	62	-1.51	13%	-0.58	1,680	0.69	224	0.34
812	92	-1.37	32%	0.49	1,380	0.89	125	-0.59
821	196	-0.89	7%	-0.91	1,180	1.02	270	0.77
822	69	-1.48	10%	-0.76	870	1.23	125	-0.59
830	92	-1.37	6%	-0.95	930	1.19	180	-0.07
841	92	-1.37	16%	-0.43	1,170	1.03	163	-0.23
842	135	-1.17	10%	-0.76	2,470	0.16	100	-0.82
851	155	-1.08	2%	-1.19	520	1.46	50	-1.29
852	141	-1.15	5%	-1.01	530	1.45	24	-1.54
941	158	-1.07	14%	-0.53	1,800	0.61	146	-0.39
942	133	-1.18	7%	-0.92	1,550	0.78	150	-0.36
943	211	-0.82	5%	-1.04	2,300	0.28	37	-1.41
1031	232	-0.72	19%	-0.22	2,960	-0.16	219	0.29
1033	459	0.34	10%	-0.77	1,920	0.53	80	-1.01

Table 5.19 Classification of Each Data

score	Population Density (persons/ha)	Public Land Use Ratio (%)	Distance from WTP (m)	Average Income Level (Rp/month/hh)
1	0~160	0~ 6	4,250~	0~ 85,000
2	160~250	6~13	3,600~4,250	85,000~120,000
3	250~340	13~20	3,100~3,600	120,000~170,000
4	340~430	20~26	2,400~3,100	170,000~205,000
5	430~520	26~33	1,800~2,400	205,000~250,000
6	520~590	33~40	1,200~1,800	250,000~290,000
7	590~680	40~45	800~1,200	290,000~330,000
8	680~790	45~55	400~ 800	330,000~400,000
9	790~870	55~60	0~ 400	400,000~440,000
10	870~	60~		440,000~

Table 5.20 Specific Pollution Load Discharge excl. Housing Estate by Kelurahan in 2015 (1/2)

Kecamatan	Code No.	Area (ha)	Population in 2015	Area of Housing Estates (ha)	Population of Housing Estates	Pollution Load Discharge (kgBOD/day)			Specific Pollution Load Discharge (kgBOD/day/ha)	
						From Housing Estates	Remaining	Total		
Mariso	111	18	7,029	0	0	0	231	231	12.85	
	112	29	12,222	0	0	0	331	331	11.42	
	121	35	9,745	0	0	0	307	307	8.76	
	122	18	7,327	0	0	0	194	194	10.80	
	131	14	5,774	0	0	0	149	149	10.66	
	132	14	5,401	0	0	0	160	160	11.44	
	140	14	8,194	0	0	0	199	199	14.24	
	150	14	8,342	0	0	0	213	213	15.23	
	160	26	13,878	0	0	0	377	377	14.49	
	211	14	7,298	0	0	0	184	184	13.12	
Mamajang	212	10	5,119	0	0	0	135	135	13.45	
	213	12	6,366	0	0	0	156	156	12.98	
	221	18	6,421	0	0	0	191	191	10.62	
	222	16	5,653	0	0	0	154	154	9.65	
	223	8	2,876	0	0	0	90	90	11.19	
	231	18	6,950	0	0	0	198	198	10.99	
	232	12	5,205	0	0	0	131	131	10.94	
	241	28	9,377	0	0	0	243	243	8.69	
	242	17	7,272	0	0	0	186	186	10.96	
	243	31	8,272	0	0	0	225	225	7.24	
	244	14	7,023	0	0	0	176	176	12.60	
	250	27	7,845	0	0	0	238	238	8.81	
	Makassar	311	27	11,945	0	0	0	397	397	14.72
		312	20	9,634	0	0	0	339	339	16.93
		321	19	11,554	0	0	0	386	386	20.30
322		15	9,373	0	0	0	302	302	20.16	
323		13	7,980	0	0	0	248	248	19.09	
324		13	8,459	0	0	0	259	259	19.92	
331		15	6,662	0	0	0	233	233	15.54	
332		12	5,688	0	0	0	205	205	17.07	
333		13	6,409	0	0	0	246	246	18.92	
341		27	11,442	0	0	0	414	414	15.35	
342		16	9,880	0	0	0	317	317	19.82	
351		19	9,832	0	0	0	304	304	15.98	
352		19	9,807	0	0	0	339	339	17.82	
353		24	10,560	0	0	0	333	333	13.88	
Ujung Pandang		411	41	4,468	0	0	0	212	212	5.16
	412	28	4,121	0	0	0	189	189	6.75	
	413	16	1,724	0	0	0	72	72	4.49	
	421	17	3,839	0	0	0	150	150	8.80	
	422	23	4,422	0	0	0	193	193	8.37	
	431	32	5,950	0	0	0	261	261	8.14	
	432	43	6,566	0	0	0	329	329	7.65	
	441	21	5,788	0	0	0	222	222	10.56	
	442	12	5,152	0	0	0	174	174	14.47	
	450	30	6,439	0	0	0	278	278	9.25	
Wajo	511	53	6,820	0	0	0	543	543	10.24	
	512	23	5,000	0	0	0	272	272	11.81	
	521	22	2,867	0	0	0	199	199	9.05	
	522	13	4,095	0	0	0	183	183	14.06	
	531	20	6,118	0	0	0	297	297	14.83	
	532	15	4,241	0	0	0	218	218	14.54	
	541	35	6,139	0	0	0	450	450	12.86	
	542	18	4,107	0	0	0	232	232	12.90	
Bontoala	611	6	3,468	0	0	0	107	107	17.84	
	612	11	5,391	0	0	0	184	184	16.76	
	621	22	7,079	0	0	0	230	230	10.45	
	622	14	5,895	0	0	0	190	190	13.56	
	631	16	6,534	0	0	0	222	222	13.87	
	632	12	5,520	0	0	0	172	172	14.33	
	641	15	9,895	0	0	0	277	277	18.47	
	642	15	7,849	0	0	0	228	228	15.20	
	651	20	7,786	0	0	0	253	253	12.65	
	652	47	12,487	0	0	0	444	444	9.43	
	660	17	7,693	0	0	0	219	219	12.86	
	670	15	7,199	0	0	0	232	232	15.45	
Tallo	711	11	7,936	0	0	0	196	196	17.84	
	712	10	6,943	0	0	0	179	179	17.94	
	721	33	14,905	0	0	0	360	360	10.28	
	722	6	7,804	0	0	0	161	161	26.77	
	731	39	14,812	0	0	0	318	318	8.16	

Table 5.20 Specific Pollution Load Discharge excl. Housing Estate by Kelurahan in 2015 (2/2)

Kecamatan	Code No.	Area (ha)	Population in 2015	Area of Housing Estates (ha)	Population of Housing Estates	Pollution Load Discharge (kgBOD/day)			Specific Pollution Load Discharge (kgBOD/day/ha)	
						From Housing Estates	Remaining	Total		
Tallo	732	10	6,568	0	0	0	137	137	13.68	
	741	30	6,471	0	0	0	151	151	5.03	
	742	78	17,120	0	0	0	499	499	6.40	
	751	90	18,467	0	0	0	562	562	6.25	
	752	28	13,192	0	0	0	309	309	11.02	
	753	11	7,299	0	0	0	154	154	14.00	
	761	22	16,367	0	0	0	343	343	15.59	
	762	26	12,531	0	0	0	267	267	10.27	
	763	12	10,641	0	0	0	219	219	18.28	
	770	175	14,789	0	0	0	306	306	1.75	
Ujung Tanah	811	119	13,942	0	0	0	410	410	3.45	
	812	68	10,258	0	0	0	292	292	4.30	
	821	24	5,069	0	0	0	123	123	5.11	
	822	88	10,763	0	0	0	315	315	3.58	
	830	76	12,542	0	0	0	291	291	3.83	
	841	120	20,415	0	0	0	553	553	4.61	
	842	31	5,954	0	0	0	138	138	4.46	
	851	27	4,994	0	0	0	112	112	4.14	
	852	23	3,651	0	0	0	89	89	3.86	
	860	7	1,621	0	0	0	34	34	4.81	
	870	8	1,583	0	0	0	33	33	4.11	
	880	3	1,742	0	0	0	36	36	11.95	
	Panakkukang	911	188	28,398	0	0	0	860	860	4.57
		912	370	39,689	89	24,920	905	80	984	0.28
913		113	19,188	38	8,550	310	168	479	2.24	
914		70	13,742	23	5,175	188	118	306	2.51	
915		261	31,126	110	24,750	898	267	1,165	1.77	
916		70	13,902	41	9,225	335	2	337	0.07	
921		525	46,976	154	38,388	1,393	76	1,469	0.20	
922		638	52,900	142	31,964	1,160	64	1,224	0.13	
931		655	51,194	102	22,842	829	338	1,167	0.61	
932		271	24,440	67	15,021	545	38	583	0.19	
941		79	12,312	0	0	0	382	382	4.84	
942		70	11,242	0	0	0	358	358	5.11	
943		19	3,422	7	1,575	57	27	84	2.23	
951		153	13,956	0	0	0	310	310	2.03	
952		327	42,962	63	14,117	512	592	1,104	2.24	
953		125	20,561	45	10,125	368	104	472	1.30	
954		185	27,550	46	10,404	378	244	621	1.76	
Tamalate		1011	148	28,672	119	26,874	976	88	1,064	3.09
	1012	414	73,335	124	31,620	1,148	830	1,977	2.86	
	1013	94	16,080	63	12,580	457	33	489	1.05	
	1021	34	9,662	20	4,533	165	88	252	6.47	
	1022	125	19,754	66	14,850	539	69	608	1.16	
	1023	79	19,617	79	15,800	574	0	574	0.00	
	1024	61	15,769	51	10,160	369	57	426	5.63	
	1025	89	22,159	31	6,975	253	343	597	5.92	
	1026	21	11,672	21	4,515	164	0	279	0.00	
	1027	26	12,603	26	3,900	142	0	307	0.00	
	1028	78	19,819	62	13,954	507	12	519	0.76	
	1029	22	9,159	22	3,300	120	0	232	0.00	
	1031	65	16,659	10	2,304	84	444	528	8.13	
	1032	82	24,303	82	12,300	446	0	754	0.00	
	1033	37	18,845	0	0	0	470	470	12.71	
	1041	286	10,228	21	4,725	172	326	497	1.23	
	1042	162	29,575	56	8,391	305	507	812	4.78	
	1043	133	24,578	50	7,503	272	408	680	4.92	
	1051	634	54,895	170	38,250	1,388	163	1,551	0.35	
	1052	354	5,208	38	8,550	310	240	551	0.76	
Biringkenaya	1111	483	61,246	106	31,800	1,154	78	1,233	0.21	
	1112	274	35,794	61	18,324	665	58	724	0.27	
	1113	521	22,461	50	11,354	412	310	722	0.66	
	1121	527	18,831	33	7,425	270	399	668	0.81	
	1122	778	30,793	18	4,050	147	466	613	0.61	
	1123	811	95,627	209	47,070	1,709	134	1,843	0.22	
	1131	663	51,483	93	21,006	763	398	1,161	0.70	
	1132	671	73,733	165	37,161	1,349	156	1,505	0.31	
	1141	836	61,330	43	12,040	437	680	1,117	0.86	
	1142	745	50,709	133	26,632	967	463	1,429	0.76	
	1151	632	32,096	0	0	0	708	708	1.12	
	1152	1,065	33,880	0	0	0	773	773	0.73	
<b>Total</b>		<b>17,577</b>	<b>2,200,000</b>	<b>2,950</b>	<b>665,000</b>	<b>24,140</b>	<b>35,336</b>	<b>60,136</b>	<b>2.42</b>	



Table 5.21 Basic Design Information of Sewerage Service Areas (Master Plan)

Sewerage Zone	Kil. Code No.	Area (Ha)	Population (persons)		Wastewater (cumacity)		Pollution Load Generation (kg-BOD/day)	
			Existing	2015	Existing	2015	Existing	2015
Northern Sewerage Zone	57	22	2,038	2,987	373	1,778	101	207
	58	13	5,195	4,085	584	1,970	223	214
	59	20	7,647	6,119	788	1,685	223	195
	60	16	5,265	4,241	580	1,252	175	242
	61	26	5,104	4,654	689	1,885	185	351
	62	9	2,485	2,054	271	466	79	126
	63	15	9,291	7,291	703	1,731	228	360
	64	15	6,607	7,489	543	1,453	198	302
	65	15	5,016	7,188	532	1,391	152	302
	66	12	10,794	10,641	654	1,390	214	331
	67	46	2,750	10,034	216	1,434	66	331
	68	119	2,780	13,942	296	2,542	86	501
	69	66	4,532	10,244	386	1,689	103	374
	70	47	5,544	5,060	404	1,774	179	407
	71	22	3,700	10,763	207	1,774	107	462
Central Sewerage Zone	72	11	6,123	2,866	405	1,166	131	260
	73	10	6,350	4,263	500	1,046	119	240
	74	35	6,071	1,700	541	2,182	152	503
	75	8	6,028	1,765	600	1,016	226	243
	76	39	9,703	14,674	638	2,028	203	448
	77	10	7,386	9,988	468	861	149	217
	78	30	9,911	5,671	571	861	149	454
	79	78	6,978	17,129	445	2,650	164	623
	80	11	6,648	13,192	515	1,895	126	453
	81	28	7,754	13,192	595	1,895	126	453
	82	11	5,672	7,289	398	2,172	204	313
	83	22	12,764	15,387	698	2,172	204	313
	84	26	9,016	13,521	578	1,699	167	358
	85	120	4,766	20,415	461	3,268	130	728
	Eastern Sewerage Zone	86	31	3,587	3,564	282	860	65
87		27	4,497	4,041	321	676	106	165
88		20	3,716	3,611	271	613	93	125
89		1,04	302,208	286,078	15,987	44,659	4,862	10,649
90		20	7,059	2,824	449	2,034	156	433
91		16	4,669	6,688	312	1,446	100	244
92		12	4,282	9,681	302	1,254	95	264
93		15	4,533	6,430	327	1,459	103	320
94		27	9,095	11,442	572	2,438	184	502
95		14	6,470	9,880	538	1,965	174	417
96		41	3,850	4,489	318	1,334	86	259
97		20	3,513	4,171	385	1,194	100	210
98		17	3,772	3,839	354	894	103	188
99		25	3,443	4,522	344	1,217	95	229
South-Eastern Sewerage Zone		100	19	1,849	3,270	203	946	76
	101	43	3,016	6,286	360	1,681	106	375
	102	21	5,728	5,788	534	1,330	156	270
	103	12	6,046	5,152	521	1,091	163	330
	104	30	5,703	4,439	476	1,661	143	304
	105	33	8,111	4,830	981	2,739	246	504
	106	20	3,648	5,002	444	1,407	140	303
	107	9	1,750	1,535	220	445	41	117
	108	9	3,867	2,053	270	658	78	127
	109	6	2,860	3,466	254	631	53	143
	110	11	4,374	5,291	407	1,078	116	208
	111	22	5,072	7,079	513	1,449	149	278
	112	14	4,725	5,895	425	1,158	121	214
	113	16	5,257	6,534	467	1,314	139	224
	114	12	4,546	5,500	405	1,044	134	227
Total	660	17	6,475	7,993	548	1,360	157	265
	661	19	6,949	11,554	549	2,408	181	500
	662	19	9,275	7,980	508	1,076	171	346
	663	13	6,525	7,980	468	1,575	175	346
	664	13	6,801	6,459	534	1,646	175	346
	665	19	7,623	9,532	534	1,919	174	406
	666	26	8,512	10,960	536	2,086	184	434
	667	20	5,709	7,786	520	1,515	173	441
	668	42	6,710	12,447	673	2,686	193	564
	669	78	11,364	12,312	777	2,170	238	456
	670	70	7,838	11,242	549	1,973	174	425
	671	667	211,942	202,480	17,444	57,638	5,205	11,947

Table 5.22 Estimation of Construction Cost (Collection Sewer)

Items	Unit Cost ( million./ha)	Service Area (ha)			Construction Costs ( Million Rp.)			
		Alternative - 1	Alternative - 2	Alternative - 3	Alternative - 1	Alternative - 2	Alternative - 3	
Collection Sewer	100	5,564			556,400			
Items	D (mm)	Unit Cost (1,000Rp./m)	Pipe Length ( m )			Construction Costs ( Million Rp.)		
			Alternative - 1	Alternative - 2	Alternative - 3	Alternative - 1	Alternative - 2	Alternative - 3
Main Sewer	350	260	31,396	35,307	34,525	8,163	9,180	8,977
	400	291	11,242	10,963	10,554	3,271	3,190	3,071
	450	321	7,546	11,407	10,688	2,422	3,662	3,431
	500	348	7,877	6,655	7,164	2,741	2,316	2,493
	600	414	14,426	12,285	11,096	5,972	5,086	4,594
	700	568	11,597	6,827	9,820	6,587	3,878	5,578
	800	635	6,328	6,294	7,500	4,018	3,997	4,763
	900	732	8,335	7,077	9,857	6,101	5,180	7,215
	1000	839	3,169	4,408	1,807	2,659	3,698	1,516
	1100	945	3,225	2,898	3,655	3,048	2,739	3,454
	1200	1,073	560	0	1,582	601	0	1,697
	1350	1,363	0	710	0	0	946	0
	1500	1,718	916	1,879	1,846	1,574	3,228	3,171
	1650	2,141	1,050	2,700	1,460	2,248	5,781	3,126
	1800	2,544	0	1,053	363	0	2,679	923
2000	3,234	1,770	0	0	5,724	0	0	
2100	4,002	313	0	0	1,253	0	0	
Total	-	109,750	110,463	111,917	55,129	55,560	54,009	
Total	-	-	-	-	611,529	611,960	610,409	

Table 5.23 Estimation of Construction Cost (Lift Pump)

Sewerage Development area		Pump capacity (cu.m/min.)	Construction Costs (million Rp.)
Alternative - 1	Northern zone	19.08	1,275
	Central zone	36.72	1,939
		19.68	1,301
	Southern zone	43.44	2,159
	E-southern zone	72.54	2,998
	Total	191.46	9,671
Alternative - 2	Northern zone	19.08	1,275
	Central zone	36.72	1,939
		19.68	1,301
	E-southern zone	72.54	2,998
	Total	148.02	7,512
Alternative - 3	Northern zone	19.08	1,275
	Central zone	36.72	1,939
		19.68	1,301
	Total	75.48	4,515

Table 5.24 Estimation of Construction Cost (Treatment Plant)

Alternatives	Sewerage zone	Design flow (cu.m/day)	Construction Cost (million Rp.)
Alternative- 1	Pampang T.P.	262,000	43,116
	total	262,000	43,116
Alternative- 2	Pampang T.P.	143,300	26,607
	Macchi Sombala T.P.	118,700	22,886
	total	262,000	49,493
Alternative- 3	Pampang T.P.	143,300	26,607
	Macchi Sombala T.P.	41,000	9,777
	Bagun Sari T.P.	77,700	16,306
	total	262,000	52,690

Table 5.25 Cost Estimation (summary)

Alternatives	Construction Costs ( billion Rp.)				O/M Cost (billion Rp./year)
	Collection Sewer	Lift Pump	Treatment plant	total	
Alternative - 1	611.5	9.7	43.1	664.3	13.3
Alternative - 2	612.0	7.5	49.5	669.0	13.4
Alternative - 3	610.4	4.5	52.7	667.6	13.4

Table 5.26 Proposed Public Toilets (MCK) According to Kelurahan

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

Source : JICA Survey in 1994,1995

Table 5.27 Basic Design Information of Sewerage Service Area

Sewerage System	Administrative Area		Service Area (ha)	Served Population (person)		Wastewater Generation (cu.m/day)		Pollution Load Generation (kg BOD/day)		
	Kec.	Kel.		Existing	2005	Existing	2005	Existing	2005	
Northern Sewerage System	522	Mamou	13	5,185	4,795	524	1,108	146	241	
	531	Wajo	20	7,647	7,108	798	1,711	222	376	
	532		15	5,285	4,919	560	1,210	157	269	
	822	Ujung Tanah	25	3,010	6,053	287	984	87	247	
		Total	73	21,127	22,875	2,169	5,013	612	1,133	
Central Sewerage System	341	Makassar	Larang Banggi	27	8,095	10,977	575	2,130	184	476
	342		Barona	16	8,470	9,268	538	1,667	174	369
	351		Maccini	19	8,626	9,341	534	1,631	86	198
	353	Ujung Pandang	Maccini Gusung	24	8,512	10,415	535	1,855	100	209
	411		Baru	41	2,823	3,603	318	983	163	323
	412		Bulo Gading	28	3,513	4,010	365	998	265	548
	450	Wajo	Pisang Utara	30	5,793	6,465	576	1,514	182	322
	511		Pattunuang	53	6,611	6,879	960	2,993	78	136
	512		Endeh	23	5,856	5,594	649	1,451	73	134
	542	Bontoala	Melayu Baru	9	2,467	2,331	270	594	116	223
	611		Bontoala	6	2,890	3,486	254	582	146	280
	612		Bontoala Tua	11	4,374	5,388	407	956	121	232
	621	Bontol	Gadong	22	5,672	7,071	513	1,293	139	268
	622		Bontala Parang	14	4,725	5,890	425	1,023	116	214
	631		Wajo Baru	16	5,257	6,530	487	1,160	157	278
632	Tompo Balang		12	4,582	5,516	405	927	174	363	
651	Mat. Baru		20	5,708	7,776	520	1,339	173	409	
652	Baraya	Timungan Lompoa	47	6,710	12,452	675	2,320	151	310	
660		Baraya	17	6,475	7,636	546	1,224	193	523	
		Total	435	107,159	130,628	9,552	25,980	2,791	5,815	
Southern Sewerage System	112	Mariso	Mario	29	8,680	11,872	607	1,735	187	404
	121		Mattoangng	35	4,996	8,387	402	1,412	117	317
	122		Kampung Buyang	18	4,424	7,135	307	1,004	99	241
	131	Mamaia	Banto Rianu	14	4,696	5,492	306	744	97	180
	140		Mariso	14	8,681	8,636	568	1,145	183	277
	150		Lette	14	8,388	8,727	556	1,182	180	287
	160	Mamaia	Pannambungan	26	11,234	13,889	773	1,966	249	474
	213		Pa'Batang	12	6,540	6,667	439	891	139	214
	Total	162	57,639	70,805	3,958	10,079	1,251	2,394		

Table 5.28 Length of Sewer Line by Diameter and by Earth Covering Depth

( Northern Sewerage System )

Diameter ( mm )	Earth Covering Depth				total
	0 - 2 m	2 - 4 m	4 - 6 m	6 - 8 m	
350	398				398
400		392			392
450		212			212
500		596			596
600		289			289
700		270	539		809
800					0
900					0
1000					0
1100					0
1200					0
Total	398	1759	539	0	2696

( Central Sewerage System )

Diameter ( mm )	Earth Covering Depth				total
	0 - 2 m	2 - 4 m	4 - 6 m	6 - 8 m	
350	750	2850			3600
400		900			900
450		300			300
500		760	180		940
600		70	1400		1470
700					0
800			420		420
900			810		810
1000			340		340
1100	2090	500	240	260	3090
1200					0
Total	2840	5380	3390	260	11870

( Southern Sewerage System )

Diameter ( mm )	Earth Covering Depth				total
	0 - 2 m	2 - 4 m	4 - 6 m	6 - 8 m	
350	840	1420			2260
400		500			500
450		630			630
500		410	390		800
600		200	500		700
700					0
800			690		690
900					0
1000					0
1100					0
1200					0
Total	840	3160	1580	0	5580

Table 5.29 Design of Treatment Plant - Lenbo

Basic Design Condition	Design Flow	5,600 cu.m/day
	Pollution Load Generation	1,133 kg-BOD/day
	Served Population	23,000 person

< Facultative Pond >

Required Surface Area by Effluent BOD	Design Inflow BOD	210 mg/l	
	Design Effluent BOD	30 mg/l	
	Design Depth	1.5 m	
	Design Temperature	25 C.	
	Required Surface Area	28,729 sq.m	
Required Surface Area by BOD Loading	Design BOD Loading	380 kg/day/ha	
	Required Surface Area	29,816 sq.m	
Proposed Facilities	Size of Pond	width	70 m
		length	220 m
		depth	1.5 m
		number of ponds	1 pond
		number of sets	2 sets
	Actual Surface Area	29,738 sq.m	
	Actual Volume	43,107 cu.m	
	Detention Time	7.8 day	

< Maturation Pond >

Design Condition	Number of Fecal Coliform in Inflow	40.0E+6 /100ml	
	Required Number of Fecal Coliform in Effluent	2.0E+3 /100 ml	
	Design Depth	1.5 m	
	First Order Rate Constant for Coliform Reduction	6.2	
Proposed Facilities (Maturation Pond -1)	Size of Pond	width	29 m
		length	82 m
		depth	1.5 m
		number of sets	2 sets
		Actual Surface Area	3,983 sq.m
		Actual Volume	5,975 cu.m
		Detention Time	1.1 day
Proposed Facilities (Maturation Pond -2)	Size of Pond	width	29 m
		length	82 m
		depth	1.5 m
		number of sets	2 sets
		Actual Surface Area	3,983 sq.m
		Actual Volume	5,975 cu.m
		Detention Time	1.1 day
Proposed Facilities (Maturation Pond -3)	Size of Pond	width	29 m
		length	82 m
		depth	1.5 m
		number of sets	2 sets
		Actual Surface Area	3,983 sq.m
		Actual Volume	5,975 cu.m
		Detention Time	1.1 day
Conformation	Actual Number of Fecal Coliform in Effluent	1,695 /100ml	

Table 5.30 Design of Treatment Plant - Pampang

Basic Design Condition	Design Flow	28,600 cu.m/day
	Pollution Load Generation	5,815 kg-BOD/day
	Served Population	130,600 person

< Facultative Pond >

Required Surface Area by Effluent BOD	Design Inflow BOD	200 mg/l	
	Design Effluent BOD	30 mg/l	
	Design Depth	1.5 m	
	Design Temperature	25 C.	
	Required Surface Area	141,093 sq.m	
Required Surface Area by BOD Loading	Design BOD Loading	380 kg/day/ha	
	Required Surface Area	153,026 sq.m	
Proposed Facilities	Size of Pond	width	85 m
		length	320 m
		depth	1.5 m
		number of ponds	1 pond
		number of sets	6 sets
	Actual Surface Area	154,530 sq.m	
	Actual Volume	231,795 cu.m	
Detention Time	8.1 day		

< Maturation Pond >

Design Condition	Number of Fecal Coliform In Inflow	40,000,000 /100ml	
	Required Number of Fecal Coliform In Effluent	2,000 /100 ml	
	Design Depth	1.5 m	
	First Order Rate Constant for Coliform Reduction	6.2	
Proposed Facilities (Maturation Pond -1)	Size of Pond	width	42 m
		length	130 m
		depth	1.5 m
		number of sets	12 sets
		Actual Surface Area	58,245 sq.m
		Actual Volume	87,368 cu.m
		Detention Time	3.1 day
Proposed Facilities (Maturation Pond -2)	Size of Pond	width	42 m
		length	130 m
		depth	1.5 m
		number of sets	12 sets
		Actual Surface Area	58,245 sq.m
		Actual Volume	87,368 cu.m
		Detention Time	3.1 day
Conformation	Actual Number of Fecal Coliform In Effluent	1,910 /100ml	

< Sludge Lagoon >

Design Condition	Unit Annual Sludge Accumulation	0.04 cu.m/per./year	
	Annual Accumulation of Sludge	5,224 cu.m/year	
	Design Depth	2 m	
	Required Surface Area	2,612 sq.m	
Proposed Facilities	Size of Pond	width	42 m
		length	30 m
		depth	2 m
		number of ponds	3 ponds
		Actual Surface Area	3,780 sq.m
		Actual Volume	7,560 cu.m



Table 5.31 Design of Treatment Plant - Maochl Sombala

Basic Design Condition	Design Flow	11,000 cu.m/day
	Pollution Load Generation	2,394 kg-BOD/day
	Served Population	70,800 person

< Facultative Pond >

Required Surface Area by Effluent BOD	Design Inflow BOD	220 mg/l	
	Design Effluent BOD	30 mg/l	
	Design Depth	1.5 m	
	Design Temperature	25 C.	
Required Surface Area by BOD Loading	Required Surface Area	60,651 sq.m	
	Design BOD Loading	380 kg/day/ha	
Proposed Facilities	Size of Pond	Required Surface Area	63,000 sq.m
		width	85 m
		length	265 m
		depth	1.5 m
		number of ponds	1 pond
	number of sets	4 sets	
	Actual Surface Area	85,112 sq.m	
	Actual Volume	127,668 cu.m	
Detention Time	11.6 day		

< Maturation Pond >

Design Condition	Number of Fecal Coliform In Inflow	40.0E+6 /100ml	
	Required Number of Fecal Coliform In Effluent	2.0E+3 /100 ml	
	Design Depth	1.5 m	
	First Order Rate Constant for Coliform Reduction	6.2	
Proposed Facilities (Maturation Pond -1)	Size of Pond	width	42 m
		length	80 m
		depth	1.5 m
		number of sets	8 sets
		Actual Surface Area	23,470 sq.m
		Actual Volume	35,205 cu.m
		Detention Time	3.2 day
Proposed Facilities (Maturation Pond -2)	Size of Pond	width	42 m
		length	80 m
		depth	1.5 m
		number of sets	8 sets
		Actual Surface Area	23,470 sq.m
		Actual Volume	35,205 cu.m
		Detention Time	3.2 day
Conformation	Actual Number of Fecal Coliform In Effluent	1,263 /100ml	

< Sludge Lagoon >

Design Condition	Unit Annual Sludge Accumulation	0.04 cu.m/per./year	
	Annual Accumulation of Sludge	2832 cu.m/year	
	Design Depth	2.0 m	
	Required Surface Area	1416 sq.m	
Proposed Facilities	Size of Pond	width	20 m
		length	30 m
		depth	2.0 m
		number of ponds	3 ponds
		Actual Surface Area	1800 sq.m
		Actual Volume	3600 cu.m

Table 5.32 Design Procedure of Septic Tank

Item	Calculation of Typical Septic Tank	Location of Septic Tank		
		Sambung Jawa	Totake	Bara-Baraya Selatan
Condition				
No. of users (NP)	250 people	425	342	506
Assumption				
Design inflow (Q)	215 l/hd/day	215	215	215
Sludge accumulation (S)	40 l/hd/year	40	40	40
Retention time at start-up	3 days	3	3	3
Factor of sludge V. rate prior to desludging (FS)	1/3 of empty tank V.	1/3	1/3	1/3
Desludging interval (n)	5.0 years	5.0	5.0	5.0
Tank Volume (V1)	$= 0.215 \text{ m}^3/\text{hd}/\text{d} \times 250 \text{ people} \times 3 \text{ d retention}$ 161.3 m <sup>3</sup>	274.1	220.6	326.4
Size of the tank				
Wide (m)	8.2 m	10.7	9.6	11.7
Long (m)	16.4 m	21.4	19.2	23.4
Depth (m)	1.2 m	1.2	1.2	1.2
Volume (m <sup>3</sup> )	161.4 m <sup>3</sup>	274.8	221.2	328.5
Tank volume (V2)	$= FS \times S/1000 \times n \times NP$ $= 3 \times 0.04 \text{ m}^3/\text{hd}/\text{y} \times 5 \text{ year} \times 250 \text{ people}$ 150.0 m <sup>3</sup>	255.0	205.2	303.6
Size of the tank				
Wide (m)	7.9 m	10.3	9.2	11.2
Long (m)	15.8 m	20.6	18.4	22.4
Depth (m)	1.2 m	1.2	1.2	1.2
Volume (m <sup>3</sup> )	149.8 m <sup>3</sup>	254.6	203.1	301.1
Retention time at start-up	$= V2 / (Q \times NP)$ $= 150 \text{ m}^3 / (0.215 \text{ m}^3/\text{hd}/\text{d} \times 250 \text{ people})$ 2.8 day	2.8	2.8	2.8
Size of the adopted tank (1.2 times of required net value)				
Wide (m)	9.9 m	12.9	11.6	14.1
Long (m)	20.0 m	26.0	24.0	29.0

Note

Larger septic tank size will be adopted, comparing V1 and V2.

Size ratio of septic tank is that wide to length is 1 to 2.

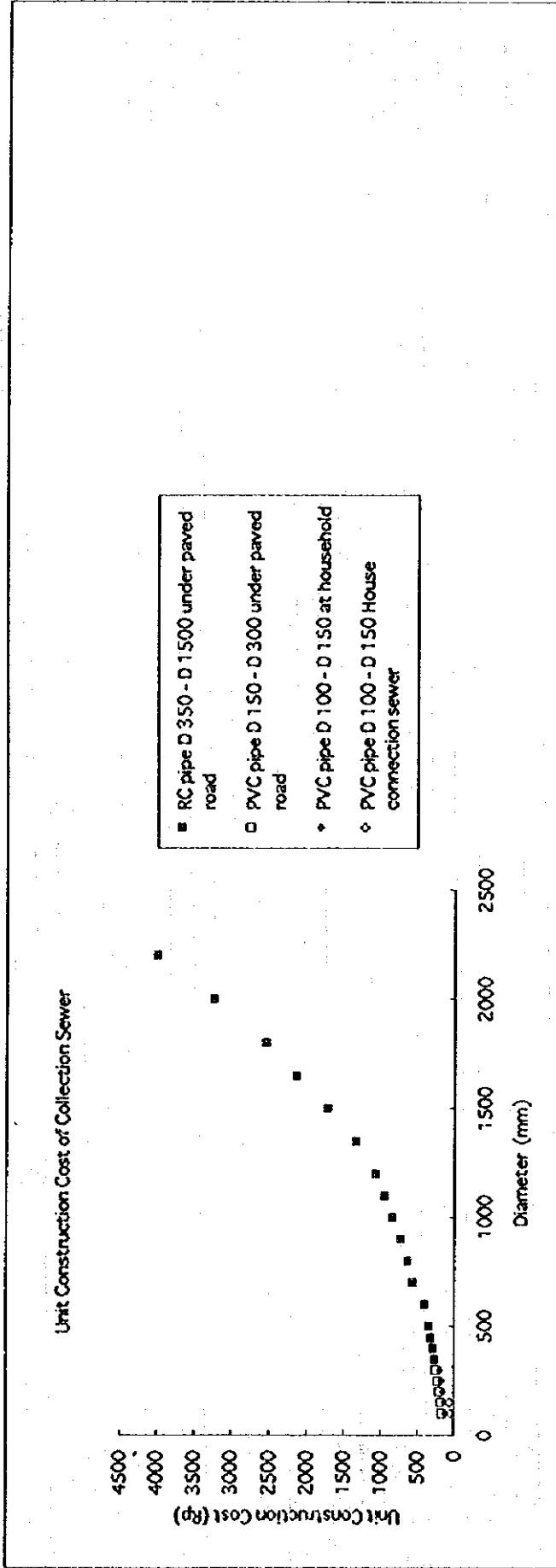
Table 5.33 Investment Cost and O/M Cost of Desludging Work

Investment Cost	Item	Unit Cost (x 1,000Rp)	1996		2000		2005		2010		2015		Remarks
			Qty	Amount (x 1,000Rp)	Qty	Amount (x 1,000Rp)	Qty	Amount (x 1,000Rp)	Qty	Amount (x 1,000Rp)	Qty	Amount (x 1,000Rp)	
1	Direct Cost												
	Sludge Collection Vehicles(A)	70,000	20	1,400,000	22	1,540,000	25	1,750,000	20	1,400,000	17	1,190,000	
2	Physical Contingency	A x 10%	ls	140,000	ls	154,000	ls	175,000	ls	140,000	ls	119,000	
	Total			1,540,000		1,694,000		1,925,000		1,540,000		1,309,000	
O/M Cost per anum													
Item	Unit Cost (x1,000Rp)	1996		2000		2005		2010		2015		Remarks	
		Qty	Amount (x 1,000Rp)	Qty	Amount (x 1,000Rp)	Qty	Amount (x 1,000Rp)	Qty	Amount (x 1,000Rp)	Qty	Amount (x 1,000Rp)		
1	Depreciation of vehicles	14,000	20	280,000	22	308,000	25	350,000	20	280,000	17	238,000	5years
2	Repair and Sparepart for car	1,000	20	20,000	22	22,000	25	25,000	20	20,000	17	17,000	
3	Fuel and Oil for car	2,000	20	40,000	22	44,000	25	50,000	20	40,000	17	34,000	
4	Equipment	440	62	27,280	74	32,560	83	36,520	68	29,920	59	25,960	for car personnels
5	Personel Expenditure(Admini.)	2,400	12	28,800	14	33,600	15	36,000	12	28,800	11	26,400	1 pers./Scars Pers.
6	Personel Expenditure(TPS)	2,400	2	4,800	8	19,200	8	19,200	8	19,200	8	19,200	2personel/TPS
7	Personel Expenditure(car)	2,400	60	144,000	66	158,400	75	180,000	60	144,000	51	122,400	3personel/car
	Sub Total (B)			544,880		617,760		696,720		561,920		482,960	
	Total			599,368		679,536		766,392		618,112		531,256	
	Desludging unit cost(Rp/people/year)			550		605		562		568		618	
	Desludging cost per month(Rp/H/m)			252		277		258		260		283	
	Desludging unit cost(Rp/m <sup>3</sup> )			15,067		16,133		15,596		15,538		16,217	
	No. of staff		74		88		98		80		70		

Based on present condition of Dinas Kebersihan

Table 5.24 Unit Construction Cost of Collection Sewer

Diameter (mm)	Unit : 1,000 Rp/meter																					
	100	150	200	250	300	350	400	450	500	600	700	800	900	1000	1100	1200	1350	1500	1650	1800	2000	2200
RC pipe D 350 - D 1500 under paved road						260	291	321	348	414	568	635	732	839	945	1073	1333	1718	2141	2544	3234	4002
PVC pipe D 150 - D 300 under paved road	165	182	205	226	251																	
PVC pipe D 100 - D 150 at household	119	134	152	170	192																	
PVC pipe D 100 - D 150 House connection sewer	52	65																				



Note : Refer to the subsequent Tables for breakdown on unit cost

Table S.35 (1) Breakdown of Collection Sewer Unit Cost

Work Item	Unit	Unit Cost	D 350mm		D 400mm		D 450mm		D 500mm		D 600mm		D 700mm		D 800mm		D 900mm		D 1000mm	
			Qty	(RP)	Qty	(RP)	Qty	(RP)	Qty	(RP)	Qty	(RP)	Qty	(RP)	Qty	(RP)	Qty	(RP)	Qty	(RP)
Excavation backhoe	m <sup>3</sup>	5,220	2.86	14,929	3.13	16,339	3.42	17,852	3.73	19,471	4.33	22,603	5	26,100	5.71	29,806	6.47	33,773	7.26	37,897
Excavation manpower	m <sup>3</sup>	1,470	0.24	353	0.26	382	0.28	412	0.30	441	0.34	500	0.38	559	0.42	617	0.46	676	0.50	735
Pipe	m	-	1.00	23,000	1.00	33,000	1.00	42,000	1.00	50,000	1.00	70,000	1.00	95,000	1.00	115,000	1.00	150,000	1.00	190,000
Pipe laying	m	-	1.00	3,615	1.00	4,055	1.00	4,436	1.00	4,802	1.00	5,548	1.00	6,369	1.00	7,059	1.00	7,805	1.00	8,589
Backfill, sand manpower	m <sup>3</sup>	12,189	0.45	5,485	0.51	6,216	0.56	6,826	0.62	7,557	0.74	9,020	0.86	10,483	1.00	12,189	1.15	14,017	1.31	15,968
Backfill, soil backhoe	m <sup>3</sup>	5,416	1.79	9,695	1.93	10,453	2.07	11,211	2.21	11,969	2.49	13,486	2.78	15,056	3.07	16,627	3.37	18,252	3.66	19,823
Pavement	m <sup>3</sup>	80,000	0.41	32,800	0.44	35,200	0.47	37,600	0.50	40,000	0.57	45,600	0.63	50,400	0.70	56,000	0.77	61,600	0.83	66,400
Manhole	m	-	1	40,000	1	40,000	1	40,000	1	40,000	1	40,000	1	40,000	1	40,000	1	40,000	1	40,000
Miscellaneous	100%	-	-	129,877	-	145,645	-	160,337	-	174,240	-	206,757	-	283,967	-	317,298	-	366,123	-	419,412
Total	-	-	-	259,754	-	291,290	-	320,674	-	348,480	-	413,514	-	567,934	-	634,596	-	732,246	-	838,824
Total(rounded)	-	-	-	260,000	-	291,000	-	321,000	-	348,000	-	414,000	-	568,000	-	635,000	-	732,000	-	839,000

Work Item	Unit	Unit Cost	D 1100mm		D 1200mm		D 1350mm		D 1500mm		D 1650mm		D 1800mm		D 2000mm		D 2200mm	
			Qty	(RP)	Qty	(RP)	Qty	(RP)	Qty	(RP)	Qty	(RP)	Qty	(RP)	Qty	(RP)	Qty	(RP)
Excavation backhoe	m <sup>3</sup>	5,220	8.02	41,864	8.84	46,145	10.07	52,565	11.94	62,327	13.32	69,530	14.73	76,891	17.13	89,419	19.51	101,842
Excavation manpower	m <sup>3</sup>	1,470	0.54	794	0.57	838	0.63	926	0.72	1,058	0.77	1,132	0.83	1,220	0.91	1,338	0.99	1,455
Pipe	m	-	1.00	230,000	1.00	280,000	1.00	390,000	1.00	550,000	1.00	740,000	1.00	920,000	1.00	1,230,000	1.00	1,580,000
Pipe laying	m	-	1.00	9,336	1.00	9,937	1.00	11,123	1.00	12,516	1.00	13,556	1.00	14,742	1.00	16,251	1.00	17,746
Backfill, sand manpower	m <sup>3</sup>	12,189	1.46	17,796	1.62	19,746	1.86	22,672	2.36	28,766	2.66	32,423	2.96	36,079	3.46	42,174	3.97	48,390
Backfill, soil backhoe	m <sup>3</sup>	5,416	3.93	21,285	4.22	22,856	4.62	25,022	5.26	28,488	5.66	30,655	6.05	32,767	6.68	36,179	7.27	39,374
Pavement	m <sup>3</sup>	80,000	0.89	71,200	0.96	76,800	1.05	84,000	1.20	96,000	1.29	103,200	1.38	110,400	1.52	121,600	1.65	132,000
Manhole	m	-	1	80,000	1	80,000	1	80,000	1	80,000	1	80,000	1	80,000	1	80,000	1	80,000
Miscellaneous	100%	-	-	472,275	-	536,322	-	666,308	-	859,155	-	1,070,496	-	1,272,099	-	1,616,961	-	2,000,807
Total	-	-	-	944,550	-	1,072,644	-	1,332,616	-	1,718,310	-	2,140,992	-	2,544,198	-	3,233,922	-	4,001,614
Total(rounded)	-	-	-	945,000	-	1,073,000	-	1,333,000	-	1,718,000	-	2,141,000	-	2,544,000	-	3,234,000	-	4,002,000

Note: Miscellaneous which is 100 % of direct cost is for sheathing works, water removal works and others.  
The above construction cost is calculated as the sewer is laid with 3 meter covering depth.

Table 5.35 (2) Breakdown of Collection Sewer Unit Cost

(PVC pipe D 150-D 300) under road

Work Item	Unit Cost	Unit	D 100mm		D 150mm		D 200mm		D 250mm		D 300mm	
			Q'ty	(RP)	Q'ty	(RP)	Q'ty	(RP)	Q'ty	(RP)	Q'ty	(RP)
Excavation backhoe	5,220	m <sup>3</sup>	1.29	6,734	1.47	7,673	1.66	8,665	1.85	9,657	2.05	10,701
Excavation manpower	1,470	m <sup>3</sup>	0.12	176	0.14	206	0.15	221	0.17	250	0.19	279
Pipe	-	m	1.00	8,000	1.00	13,000	1.00	20,000	1.00	27,000	1.00	35,000
Pipe laying	-	m	1.00	3,899	1.00	3,899	1.00	3,899	1.00	3,899	1.00	3,899
Backfill, sand manpower	12,189	m <sup>3</sup>	0.16	1,950	0.20	2,438	0.23	2,803	0.26	3,169	0.30	3,657
Backfill, soil backhoe	5,416	m <sup>3</sup>	0.91	4,929	1.02	5,524	1.14	6,174	1.25	6,770	1.36	7,366
Pavement	80,000	m <sup>3</sup>	0.21	16,800	0.23	18,400	0.26	20,800	0.28	22,400	0.31	24,800
Manhole	-	m	1	40,000	1	40,000	1	40,000	1	40,000	1	40,000
Miscellaneous	100%	-		82,488		91,140		102,562		113,145		125,702
Total				164,976		182,280		205,124		226,290		251,404
Total(round)				165,000		182,000		205,000		226,000		251,000

Note: Miscellaneous which is 100 % of direct cost is for sheathing works, water removal works and others.

The above construction cost is calculated as the sewer is laid with 3 meter covering depth.

Table 5.35 (3) Breakdown of Collection Sewer Unit Cost

Work Item	Unit Cost	Unit	D 100mm		D 150mm		D 200mm		D 250mm		D 300mm	
			Qty	(RP)	Qty	(RP)	Qty	(RP)	Qty	(RP)	Qty	(RP)
Excavation	5,220	m3	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
Excavation	1,470	m3	1.41	2,073	1.61	2,367	1.81	2,661	2.02	2,969	2.24	3,293
Pipe	-	m	1.00	8,000	1.00	13,000	1.00	20,000	1.00	27,000	1.00	35,000
Pipe laying	-	m	1.00	3,899	1.00	3,899	1.00	3,899	1.00	3,899	1.00	3,899
Backfill, sand	12,189	m3	0.16	1,950	0.20	2,438	0.23	2,803	0.26	3,169	0.30	3,657
Backfill, soil	1,549	m3	0.91	4,929	1.02	5,524	1.14	6,174	1.25	6,770	1.36	7,366
Pavement	80,000	m3	0.11	8,800	0.12	9,600	0.13	10,400	0.14	11,200	0.16	12,800
Manhole	-	m	1	30,000	1	30,000	1	30,000	1	30,000	1	30,000
Miscellaneous	100%	-		59,651		66,828		75,937		85,007		96,015
Total				119,302		133,656		151,874		170,014		192,030
Total(round)				119,000	0	134,000	0	152,000	0	170,000	0	192,000

Note : Miscellaneous which is 100 % of direct cost is for sheathing works, water removal works and others.

The above construction cost is calculated as the sewer is laid with 3 meter covering depth.

All earth work is conducted by man power. 50 % of normal pavement is not installed. Backfill (soil) is done by manpower.

Table 5.35 (4) Breakdown of Collectio Sewer Unit Cost

Work Item	Unit Cost	Unit	D 100mm		D 150mm	
			Q'ty	(RP)	Q'ty	(RP)
Excavation	5,220	m3	0.00	0	0.00	0
Excavation	1,470	m3	0.38	559	0.45	662
Pipe	-	m	1.00	8,000	1.00	13,000
Pipe laying	-	m	1.00	1,700	1.00	1,700
Backfill, sand	12,189	m3	0.24	2,925	0.29	3,535
Backfill	5,416	m3	0.00	0	0.00	0
Pavement	80,000	m3	0.11	8,800	0.12	9,600
Manhole	-	m	1	4,000	1	4,000
Miscellaneous	100%	-		25,984		32,497
Total				51,968		64,994
Total(round)				52,000	0	65,000

Note: Miscellaneous which is 100 % of direct cost is for sheathing works, water removal works and others.

The left construction cost is calculated as the sewer is laid with 0.5 meter covering depth.

All earth work is conducted by man power. Pavement is installed at 50 % of the unit length.



Table 5.36 Unit Construction Cost and Unit Length of House Connection and Tertiary/Secondary Sewer

No.	Name of site	Area (ha)	No. of house connections	House Density (H/ha)	Sewer Length						Unit Construction Cost					
					Ordinary Sewer			Small Scale Sewer			Ordinary Sewer			Small Scale Sewer		
					House connection (m/ha)	Tertiary/ secondary (m/ha)	Total (m/ha)	House connection (m/ha)	Tertiary/ secondary (m/ha)	Total (m/ha)	House connection (mRp/ha)	Tertiary/ secondary (mRp/ha)	Total (mRp/ha)	House connection (mRp/ha)	Tertiary/ secondary (mRp/ha)	Total (mRp/ha)
1	Totale	1.78	62	34.8	408	227	635	432	314	746	29	39	68	29	40	69
2	Losari	5.19	170	32.8	493	298	791	450	351	801	27	53	80	27	49	76
3	Berti	4.26	59	13.8	414	252	666	295	240	535	12	44	56	12	31	43
4	Sambung Jawa	1.24	77	62.1	647	531	1178				52	91	143			
5	Bera-Beraya Selatan	1.28	92	71.9	572	513	1085				60	91	151			
6	Pamnuang	1.88	86	45.7	877	967	1244				38	67	105			
	Total	15.63	546													
	Average	2.61	91	43.5	525	321	846	557	434	991	36	64	100	23	40	63

Table 5.37 (1) Construction Cost of House Connection and Tertiary/Secondary Sewer

Construction cost of F/S project  
F/S area Disposition at M/P area

Zone name of F/S	Northern area	Central area	Southern area	Total F/S area
Zone name of M/P	Northern, central, east central	Northern, central, east central	Southern	
Area (ha)	73	435	162	670

Land Use Ratio for Sewer System

Applied area	Means of sewer	(%)	(%)	(%)
A	Interceptor sewer (Ordinary, Tertiary S.) (Redeveloped/poor access area)	12.9	11.1	12.7
B	Interceptor sewer (Small S., Tertiary S.) (Ground area)	0	2.6	1.7
C	Small scale sewer	66.3	75.6	31.6
D	Ordinary sewer	20.8	10.6	2.3
E	None tertiary S. (Redeveloped area)	0	0	51.7
Total		100	100	100

Land Use Area for Sewer System

				unit : ha	
A	Interceptor sewer (Ordinary, Tertiary S.) (Redeveloped/poor access area)	9	48	21	78
B	Interceptor sewer (Small S., Tertiary S.) (Ground area)	0	11	3	14
C	Small scale sewer	48	329	51	428
D	Ordinary sewer	15	46	4	65
E	None tertiary S. (Redeveloped area)	0	0	84	84
Total		72	434	163	669

Construction Cost of House Connection and Tertiary/Secondary Sewer for F/S Project

Applied area	Means of sewer	Unit cost (mRp/ha)	Construction cost of house connection and tertiary/secondary sewer for each means (million Rp)				
			Northern area	Central area	Southern area	Total F/S area	
A	Interceptor sewer (Ordinary, Tertiary S.) (Redeveloped/poor access area)	64	576	3,072	1,344	4,992	
B	Interceptor sewer (Small S., Tertiary S.) (Ground area)	40	0	440	120	560	
C	Small scale sewer	House C.	23	1,104	7,567	1,173	9,844
		Tertiary S.	40	1,920	13,160	2,040	17,120
		Total	63	3,024	20,727	3,213	26,964
D	Ordinary sewer	House C.	36	540	1656	144	2,340
		Tertiary S.	64	960	2944	256	4,160
		Total	100	1500	4600	400	6,500
E	None tertiary S. (Redeveloped area)	0	0	0	0	0	
Total	House connection sewer		1,644	9,223	1,317	12,184	
	Tertiary/secondary sewer		3,456	19,616	3,760	26,832	
			5,100	28,839	5,077	39,016	

Table 5.37 (2) Construction Cost of House Connection and Tertiary/Secondary Sewer

Construction cost of M/P improvement of F/S project implementation

Service area by interceptore at poor access road and other area will be redeveloped with house connection sewer.  
 Redeveloped area at southern area will be installed small scale sewer system.

Land Use Area for Sewer System unit : ha

A	by Interceptor sewer (ordinary, tertiary S.) (Redeveloped/poor access area)	9	48	21	78
B	by Interceptor sewer (small S., tertiary S.) (ground area)	0	0	0	0
C	by Small scale sewer	0	0	0	0
D	by Ordinary sewer	0	0	0	0
B	None tertiary S. (Redeveloped area)	0	0	84	84
Total		9	48	105	162

Construction Cost of House Connection and Tertiary/Secondary Sewer for M/P Improvement of F/S project implementation

Applied area	Means of sewer	Unit cost (mRp/ha)	Construction cost of house connection and tertiary/secondary sewer for each means (million Rp)			
			Northern area	Central area	Southern area	Total F/S area
A	Interceptor sewer (Ordinary, Tertiary S.) (Redeveloped/poor access area)	36	324	1,728	756	2,808
B	Interceptor sewer (Small S., Tertiary S.) (Ground area)	40	0	0	0	0
C	Small scale sewer	House C.	0	0	0	0
		Tertiary S.	40	0	0	0
		Total	63	0	0	0
D	Ordinary sewer	House C.	0	0	0	0
		Tertiary S.	64	0	0	0
		Total	100	0	0	0
E	Install small scale sewer system	House connection	0	0	1,932	1,932
		Tertiary S.	40	0	0	3,360
		Total	63	0	0	5,292
Total	House connection sewer		0	0	1,932	1,932
	Tertiary/secondary sewer		324	1,728	4,116	6,168
			324	1,728	6,048	8,100

Table 5.37 (3) Construction Cost of House Connection and Tertiary/Secondary Sewer

Additional Construction cost of M/P out of F/S Sewerage Area  
F/S area Disposition at M/P area

Zone of M/P		Northern, central, east central	Southern	South eastern	Total
M/P Area	(ha)	2,851	571	2,142	5,564
F/S Area	(ha)	508	162	0	670
Remained area of M/P	(ha)	2,343	409	2,142	4,894

Land Use Ratio for Sewer System

Applied area	Means of sewer	M/P (%)
A	Interceptor sewer (Ordinary, Tertiary S.) (Redeveloped/poor access area)	0
B	Interceptor sewer (Small S., Tertiary S.) (Ground area)	2
C	Small scale sewer	64
D	Ordinary sewer	22
E	None tertiary S. (Redeveloped area)	12
Total		100

Land Use Area for Sewer System

		unit : ha			
A	Interceptor sewer (Ordinary, Tertiary S.) (Redeveloped/poor access area)	0	0	0	0
B	Interceptor sewer (Small S., Tertiary S.) (Ground area)	47	8	43	98
C	Small scale sewer	1,500	262	1,371	3,133
D	Ordinary sewer	515	90	471	1,076
E	None tertiary S. (Redeveloped area)	281	49	257	587
Total		2,343	409	2,142	4,894

Construction Cost of House Connection and Tertiary/Secondary Sewer for Additional M/P out of F/S Area

Applied area	Means of sewer	Unit cost (mRp/ha)	Construction cost of house connection and tertiary/secondary sewer for each means (million Rp)				
			Northern, central, east central	Southern	South eastern	Total	
A	Interceptor sewer (Ordinary, Tertiary S.) (Redeveloped/poor access area)	64	0	0	0	0	
B	Interceptor sewer (Small S., Tertiary S.) (Ground area)	40	1,880	320	1,720	3,920	
C	Small scale sewer	House C.	23	34,500	6,026	31,533	72,059
		Tertiary S.	40	60,000	10,480	54,840	125,320
		Total	63	94,500	16,506	86,373	197,379
D	Ordinary sewer	House C.	38	18,340	3,240	16,956	38,736
		Tertiary S.	64	32,960	5,760	30,144	68,864
		Total	100	51,300	9,000	47,100	107,600
E	None tertiary S. (Redeveloped area)	0	0	0	0	0	
Total	House connection		53,040	9,266	48,489	110,795	
	Tertiary/secondary		94,840	16,560	86,704	198,104	
			147,880	25,826	135,193	308,899	

Total Construction Cost for M/P consisting of Improvement of F/S and Additional M/P

Means of sewer	Construction cost of house connection and tertiary/secondary sewer for each means (million Rp)			
	Northern, central, east central	Southern	South eastern	Total
House connection	53,040	11,198	48,489	112,727
Tertiary/secondary	96,892	20,676	86,704	204,272
Total	149,932	31,874	135,193	316,999

Table 5.38 (1) Main Sewer Construction Cost

D (mm)	Unit Cost (1,000Rp./m)	Pipe Length ( m )			Construction Costs ( Million Rp. )				
		Northern area	Southern area	Central area	Total	Northern area	Southern area	Central area	Total
350	260	398	3,600	2,490	6,488	103.5	936.0	647.4	1,686.9
400	291	392	900	500	1,792	114.1	261.9	145.5	521.5
450	321	212	300	630	1,142	68.1	96.3	202.2	366.6
500	348	596	940	800	2,336	207.4	327.1	278.4	812.9
600	414	289	1,470	700	2,459	119.6	608.6	289.8	1,018.0
700	568	809	0	0	809	459.5	0.0	0.0	459.5
800	635	0	420	690	1,110	0.0	266.7	438.2	704.9
900	732	0	810	0	810	0.0	592.9	0.0	592.9
1000	839	0	340	0	340	0.0	285.3	0.0	285.3
1100	945	0	3,090	0	3,090	0.0	2,920.1	0.0	2,920.1
1200	1,073	0	0	0	0	0.0	0.0	0.0	0.0
1350	1,333	0	0	0	0	0.0	0.0	0.0	0.0
1500	1,718	0	0	0	0	0.0	0.0	0.0	0.0
1650	2,141	0	0	0	0	0.0	0.0	0.0	0.0
1800	2,544	0	0	0	0	0.0	0.0	0.0	0.0
2000	3,234	0	0	0	0	0.0	0.0	0.0	0.0
Total		2,696	11,870	5,810	20,376	1,072.2	6,294.9	2,001.5	9,368.6

Table 5.38 (2) Main Sewer Construction Cost

D (mm)	Unit Cost (1,000Rp/m)	Pipe Length (m)					Total	Construction Costs (Million Rp.)					Total		
		Northern, Central and N-Eastern Area		Southern area	S-Eastern area	Total		Northern, Central and N-Eastern Area		Southern area	S-Eastern area	Total			
		Northern area	Central area					N-Eastern area	Northern area					Central area	N-Eastern area
350	260	5,388	3,740	6,690	15,818	4,980	1,880	22,678	1,400.9	972.4	1,739.4	4,112.7	1,294.8	488.8	5,896.3
400	291	1,885	440	1,260	3,585	2,390	890	6,865	548.5	128.0	366.7	1,043.2	695.5	259.0	1,997.7
450	321	1,816	990	710	3,516	2,250	1,070	6,836	582.9	317.8	227.9	1,128.6	722.3	343.5	2,194.4
500	348	2,206	1,030	550	3,786	940	1,850	6,576	767.7	358.4	191.4	1,317.5	327.1	643.8	2,288.4
600	414	2,544	1,590	1,110	5,204	1,950	1,280	8,414	1,053.2	641.7	459.5	2,154.4	799.0	529.9	3,483.3
700	568	2,010	520	2,280	4,810	1,850	1,690	8,290	1,141.7	295.4	1,295.0	2,732.1	1,050.8	925.8	4,708.7
800	635	0	320	2,480	2,800	0	1,720	4,520	0.0	203.2	1,574.8	1,778.0	0.0	1,092.2	2,870.2
900	732	1,148	2,530	120	3,798	500	3,360	7,658	840.3	1,852.0	87.8	2,780.1	366.0	2,459.5	5,605.6
1000	899	1,287	0	0	1,287	690	0	1,977	1,079.8	0.0	0.0	1,079.8	378.9	0.0	1,658.7
1100	945	466	1,330	0	1,796	0	0	1,796	440.4	1,256.9	0.0	1,697.3	0.0	0.0	1,697.3
1200	1,073	0	0	0	0	0	590	590	0.0	0.0	0.0	0.0	0.0	633.1	633.1
1350	1,333	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1500	1,718	0	0	0	0	0	100	100	0.0	0.0	0.0	0.0	0.0	171.8	171.8
1650	2,141	0	500	0	500	0	0	500	0.0	1,070.5	0.0	1,070.5	0.0	0.0	1,070.5
1800	2,544	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	3,234	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	-	18,750	12,950	15,200	46,900	15,530	14,370	76,800	7,855.4	7,096.3	5,942.5	20,894.2	5,834.4	7,547.4	34,276.0

Table 5.39 Construction Cost and O/M Cost of Pump Station

Project	Zone Name	Pump capacity (cu.m/min.)	Construction Costs (million Rp.)	Operation and Maintenance			
				Unit Cost (Rp./kwh)	Generating Power (kw)	Generating Power (kwh)	O/M Cost (million Rp./annum)
F/S	Central	35.9	1,911	180	83	363,540	65
	Total		1,911	180		363,540	65
M/P	Northern	19.1	1,276	180	44	192,720	35
	Central 1	36.7	1,938	180	85	372,300	67
	Central 2	19.7	1,302	180	45	197,100	35
	Total		4,516	180		762,120	137

Conditions:

$$\text{Generating Power (kw)} = (0.163 \times H \times Q) \times S / E$$

1.15 (S) : Spare

0.65 (E) : Pump Efficiency

8 (H) : Head

$$\text{Generating Power (kwh)} = \text{Generating Power(kw)} / \text{FD} \times 24 \times 365$$

2 (FD) : Convert Factor to be Day Avarage Value

Table 5.40 Construction Cost of Treatment Plant

(1) For F/S Project  
Design Flow in 2005 for F/S

Sewerage Development Zone	Name of Treatment Plant	Service Area	Design Flow (m <sup>3</sup> /day)
		(ha)	2005
Northern	Lembo	73	5,500
Central	Pampang	435	28,600
Southern	Macciri Sombala	162	11,100
sub total		670	45,200

Construction cost of Wastewater Treatment Plant (TP) for F/S (Process : Stabilization Pond)

Sewerage Development Zone	Name of Treatment Plant	Service Area	TP Construction Cost (million Rp)
		(ha)	2005
Treatment Process			(1) S.P.
Northern	Lembo	73	735
Central	Pampang	435	3,241
Southern	Macciri Sombala	162	1,383
Sub total		670	5,359

(2) For M/P Project  
Design Flow in 2005, 2015 and the difference

Sewerage Development Zone	Name of Treatment Plant	Service Area (ha)	Design Flow (m <sup>3</sup> /day)		
			2005 (A)	2015 (A) - (B)	2015 (B)
	(Lembo)		5,500		
North, central and central east	Pampang	2,851	28,600	109,100	143,200
Southern	Macciri Sombala	571	11,100	29,900	41,000
Eastern south	Gunung Sari	2,142	0	77,700	77,700
Sub total		5,564	45,200	216,700	261,900

Construction Cost of TP for Above Design Flow (Process : Areated Lagoon)

Sewerage Development Zone	Name of Treatment Plant	Service Area (ha)	TP Construction Cost (million Rp)		
			2005 (2) A.L.	2015 (3) A.L.	2015 A.L.
Treatment Process			(2) A.L.	(3) A.L.	A.L.
Northern			735		
North, central and central east	Pampang	2,851	7,330	21,392	26,592
Southern	Macciri Sombala	571	3,438	7,595	9,777
Eastern south	Gunung Sari	2,142	0	16,306	16,306
Sub total		5,564	10,768	45,293	52,675

Construction Cost of TP for M/P (Process : Areated Lagoon)

Sewerage Development Zone	Name of Treatment Plant	Service Area (ha)	TP Construction Cost (million Rp)	
				2015 (3) + (2) - (1))
North, central and central east	Pampang	2,851		25,480
Southern	Macciri Sombala	571		9,650
Eastern south	Gunung Sari	2,142		16,306
Sub total		5,564		51,436

Unit Construction Cost of Treatment Plant

$$C = 10^{CI} \times Q^{C2}$$

C : Construction cost (million Rp.)

Q : Design flow (1,000m<sup>3</sup>/day)

Treatment Process	Coefficient	
	CI	C2
Stabilization Pond(SP)	2.2	0.9
Areated Lagoon(AL)	2.7	0.8



Table 5.41 Land Acquisition Cost

Land Acquisition Cost for F/S Project

Zone Name		Northern LMS	Central CSS		Southern CSS	Total
Items	unit	Lembo TP	Pampang TP	Karuwisi Utara Pump S.	Maccini Sombala TP	
Required Land Area	(ha)	6	44	1	29	80
Unit Land Price	(Rp/m <sup>2</sup> )	43,000	6,000	50,000	8,500	-
Land Price	(mRp)	2,580	2,640	500	2,440	8,160
Total Land Price	(mRp)	2,580	3,140		2,440	8,160

Land Acquisition Cost for M/P Final Facility (Figure of 2015 Sewerage Facility)

Zone Name		Central and northern Area				Southern Area	South-Eastern Area	Total
Items	unit	Pampang TP	Karuwisi Utara Pump S.	Bara-Baraya Utara Pump S.	Lembo Pump Station	Maccini Sombala TP	Gunung Sari TP	
Condition	-	half is bought in F/S	Bought in F/S		Bought in F/S	Bought in F/S		
Required land area	(ha)	88	1	1	1	29	50	170
Unit land price	(Rp/m <sup>2</sup> )	6,000	50,000	50,000	50,000	8,500	10,000	-
Land price	(mRp)	5,280	500	500	500	2,440	5,000	14,220
Total Land Price	(mRp)	6,780				2,440	5,000	14,220

Additional Land Acquisition Cost for M/P (from 2006 to 2015)

Zone Name		Central and northern Area				Southern Area	South-Eastern Area	Total
Items	unit	Pampang TP	Karuwisi Utara Pump S.	Bara-Baraya Utara Pump S.	Lembo Pump Station	Maccini Sombala TP	Gunung Sari TP	
Additional land price from F/S	(mRp)	2,640	0	500	-2,080	0	5,000	6,060
Estimated above price		2,640	0	500	0	0	5,000	8,140
Total Land Price	(mRp)	3,140				0	5,000	8,140

Total Land Acquisition Cost, Summation of F/S Cost and Add. Cost for M/P (from 1996 to 2015)

Zone Name		Central and northern Area				Southern Area	South-Eastern Area	Total
Items	unit	Pampang TP	Karuwisi Utara Pump S.	Bara-Baraya Utara Pump S.	Lembo Pump Station	Maccini Sombala TP	Gunung Sari TP	
Condition	-	half is bought in F/S	Bought in F/S		Bought in F/S	Bought in F/S		
Total Land Price	(mRp)	8,860				0	5,000	13,860

Table 5.42 (1) 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 Somba'a	
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
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