JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MINISTRY OF PUBLIC WORKS
REPUBLIC OF INDONESIA

The Study on the Solid Waste Management Improvement for Surabaya City in The Republic of Indonesia

FINAL REPORT

Volume 2

SUMMARY

May 1993

Pacific Consultants International
EX Corporation

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All the Rupiah amounts including the projects costs shown in this report are indicated in 1992 price unless otherwise indicated. Those amounts are estimated partly based upon the foreign prices by applying dominant 1992 currency exchange rates, i.e.: US $ 1 = Rp 2,000 = ¥125 (¥1 = Rp 16).

PREFACE

In response to a request from the Government of the Republic of Indonesia, the Government of Japan decided to conduct the Master Plan Study and Feasibility Study on Solid Waste Management Improvement for Surabaya City and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Indonesia a study team headed by Mr. Kihachiro Urushibata, Pacific Consultants International (PCI), and composed of members from PCI and EX Corporation, three times between February 1992 and February 1993.

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

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

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

May, 1993

Kensuke Yanagiya

Kensuke YANAGIYA
President
Japan International Cooperation Agency

STUDY ON THE SOLID WASTE
MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

Mr. Kensuke YANAGIYA
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

Dear Sir,

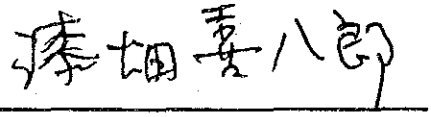
We are pleased to submit to you the final report entitled "THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY". This report has been prepared by the Study Team in accordance with the contract signed on 17 January 1992 and 1 October 1992 between the Japan International Cooperation Agency and Pacific Consultants International.

The report examines the existing conditions of solid waste management in Surabaya, and presents a master plan for its improvement and the results of a feasibility study on the priority projects selected through the master plan.

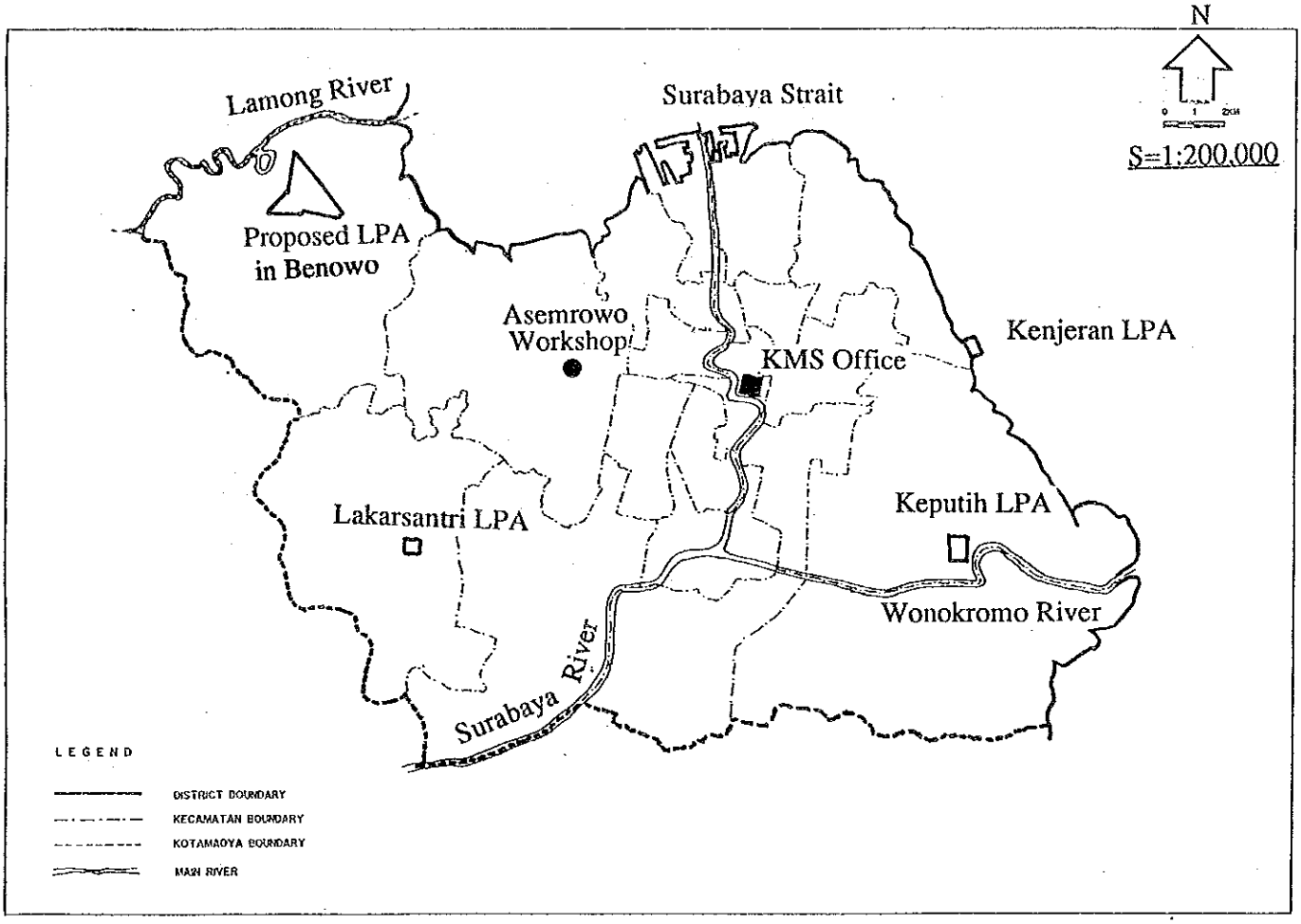
The report consists of the Summary, Main Report, Supporting Reports, Data Book and Drawings. The Summary summarizes the results of all studies. The Main Report contains background conditions, overall sanitation and solid waste management plan, urgent improvement project, conclusions and recommendations. The Supporting Reports include technical details.

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

Yours faithfully,



Kihachiro URUSHIBATA
Team Leader

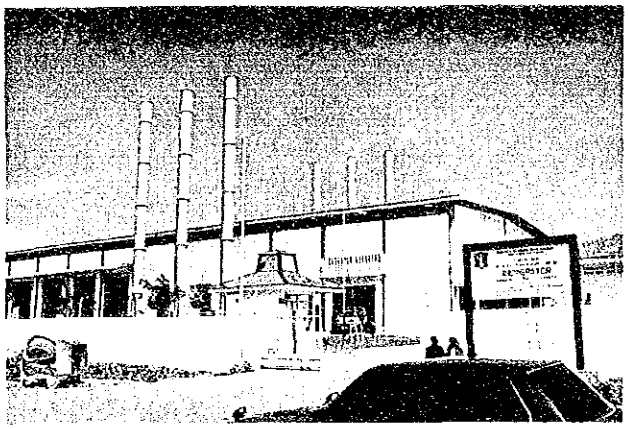


Location of SWM Facilities in Surabaya

KMS: Municipal Government of Surabaya

LPA: Final Disposal Site

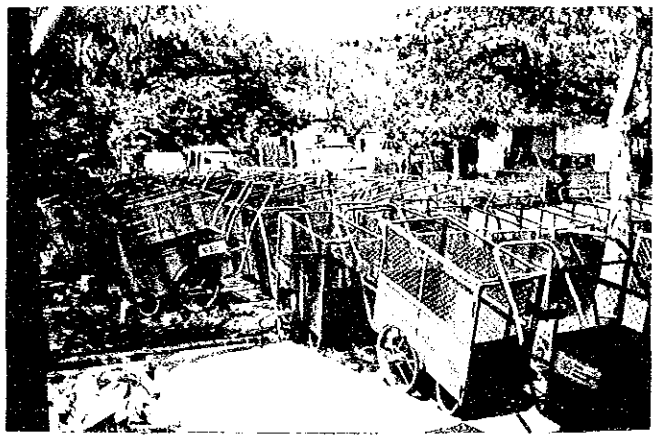
Photos of SWM Facilities Used in Surabaya



Incineration Plant in Keputih

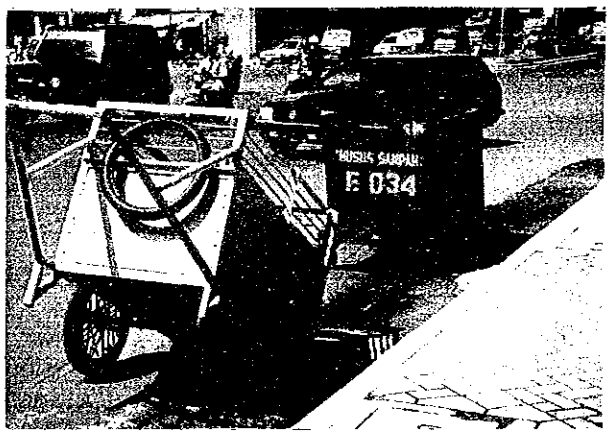
Inside the Plant (Garbage Pit)

A Typical Depo (Manyar Kertoarjo)



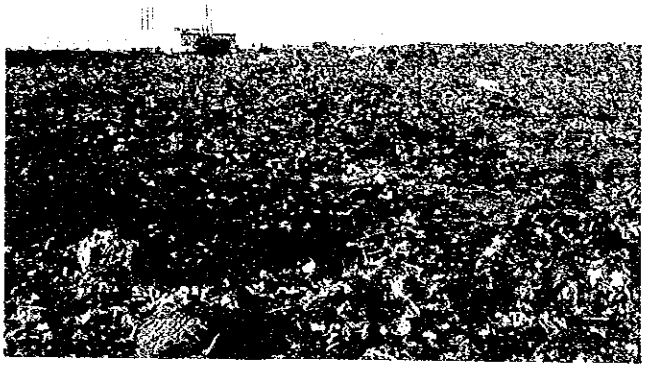
Asemrowo Workshop (Cart Stockyard)

A Typical LPS (Sido Kapasan)

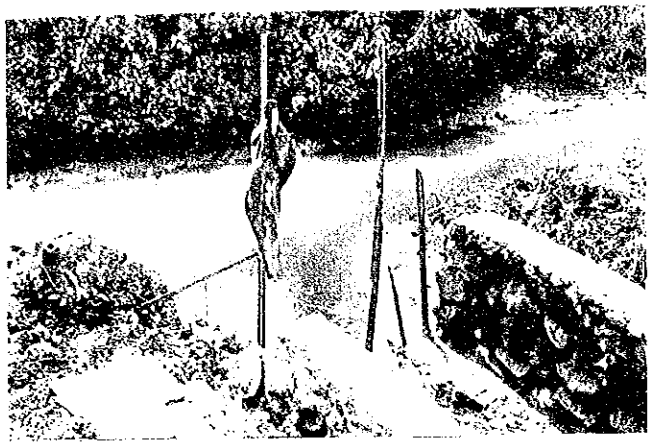


Handcart and 1m^3 Container

Kenjeran LPA

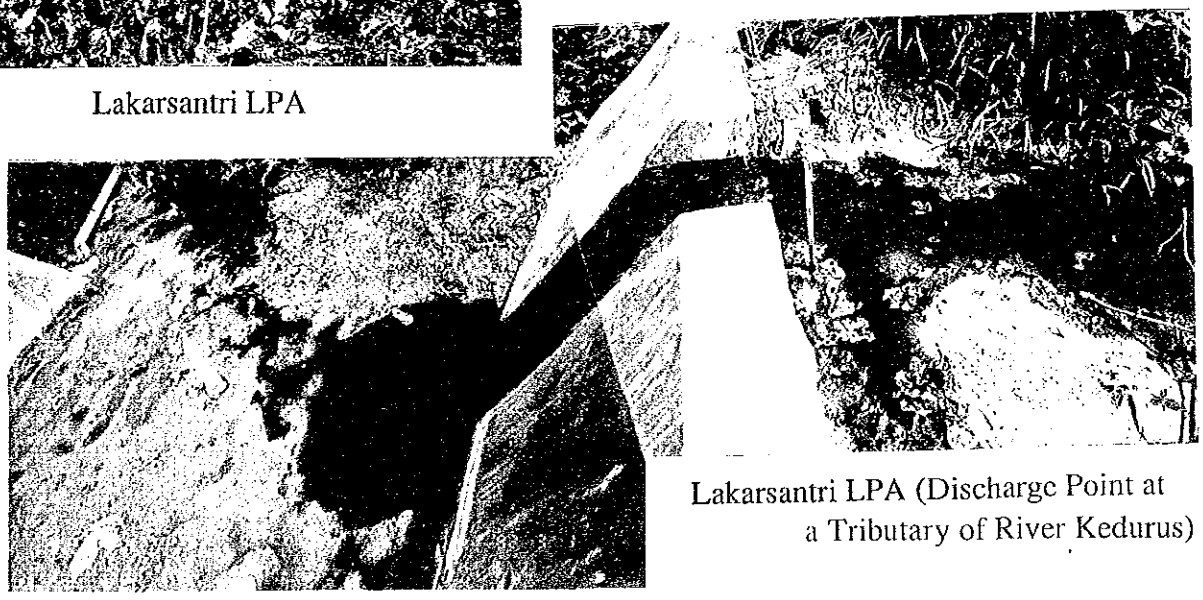


Keputih LPA

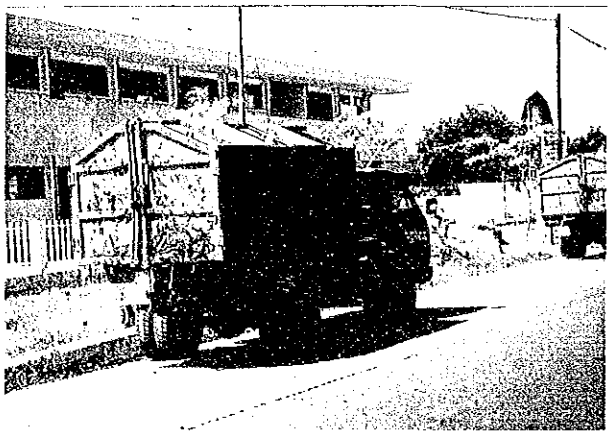


Keputih LPA (Discharge Point at River Pojokan Semampir)

Lakarsantri LPA



Lakarsantri LPA (Discharge Point at a Tributary of River Kedurus)

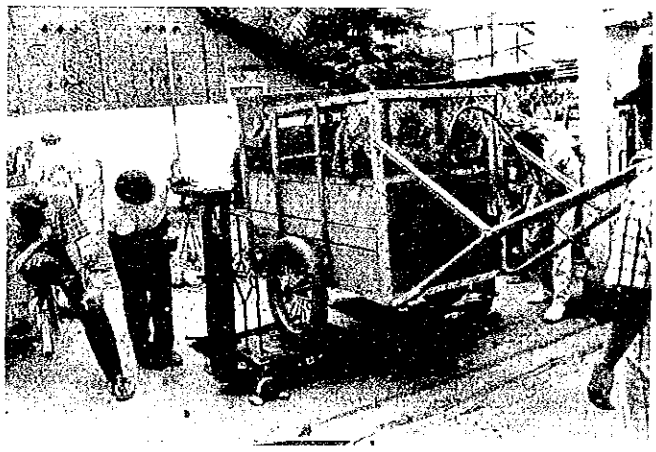


Haulage Vehicle of Container Type

Haulage Vehicle of Open Body Type

Waste Quality Survey (Sampling and Mixing)

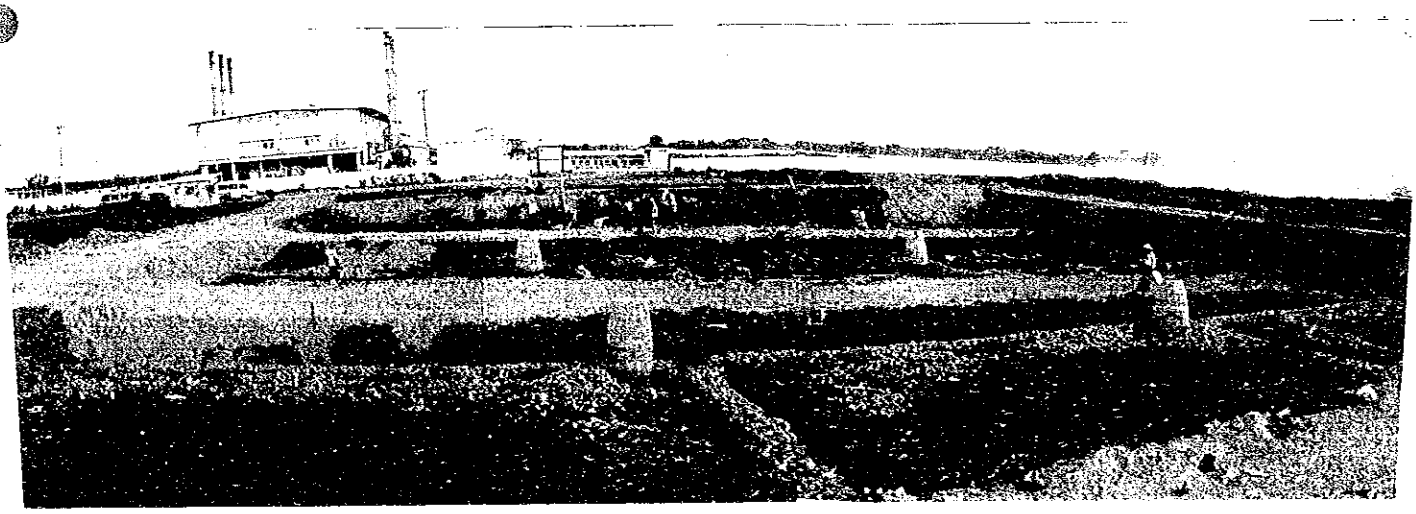
Recycling Activity near a Depo



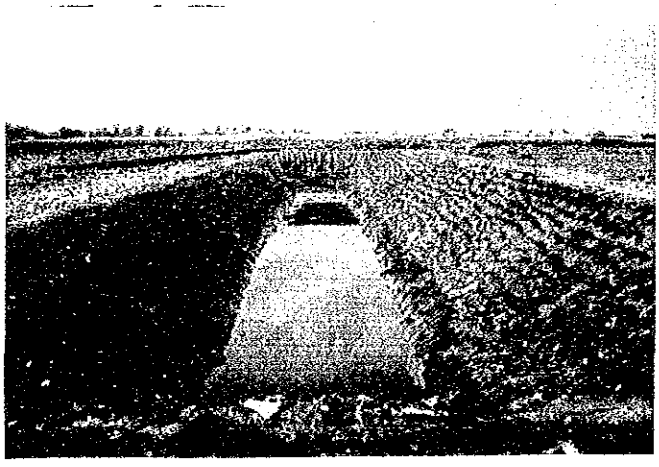
Waste Amount Survey (Weighing Handcart for Per-capita Waste Generation)

Wate Amount Survey (Weighing for Specific Weight)

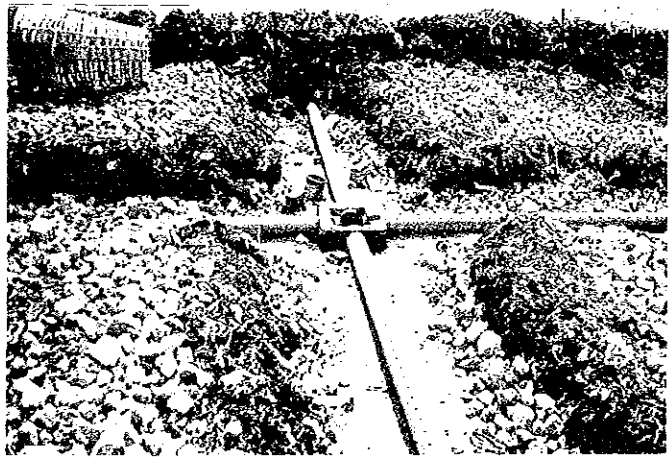
Planned Landfill Site in Benowo



Sanitary Landfill Test in Keputih (Preparation of Underdrain and Gas Vent)



Sanitary Landfill Test (Retention Pond)



Sanitary Landfill Test (Underdrain)

Contents

Abbreviations & English Translations

(in alphabetical order)

1.	ADIPURA	:	Noble City Award, an award presented by the Central Government to the local government for their efforts in sustainable improvement of the overall urban environmental quality.
2.	AMDAL	:	Environmental Impact Assessment Sytem.
3.	ANDAL	:	Environmental Impact Analysis.
4.	BAPEDAL	:	Environmental Impact Control agency.
5.	BAPPEDA	:	Local Development Planning Agency.
6.	BAPPENAS	:	National Development Planning Agency.
7.	Bina Marga	:	Directorate General of Highways, a name of a directorate general under the Ministry of Public Works.
8.	Biro KLH	:	Provincial Bureau of KLH.
9.	BPPT	:	Technology Study and Application Agency.
10.	Cabang	:	Branch office for sanitary management at District Level.
11.	Camat	:	Chief of District.
12.	Cipta Karya	:	Directorate General of Human Settlements, a directorate general under the Ministry of Public Works.
13.	CBD	:	Central Business District.
14.	Depo	:	Waste transfer station with an administrative office.
15.	Dinas Kebersihan	:	Cleansing Department.
16.	Dinas Marga	:	Road Department.
17.	IUIDP	:	Integrated Urban Infrastructure Development Project.
18.	JATIM	:	East Jawa Province.
19.	JKT	:	Jakarta.
20.	KA ANDAL	:	Terms of Reference of ANDAL.
21.	Kampung	:	Unplanned low-income residential area naturally originated from villages and inhabited by people migrated from rural areas.
22.	Kecamatan	:	District, an administrative area.
23.	Kelurahan	:	Sub-District, an administrative area.
24.	KLH	:	Ministry of Population and Environment.
25.	KMS	:	Surabaya Municipality; Surabaya Municipal Government.
26.	LPA	:	Final Disposal Site.
27.	LPS	:	open-dumping waste transfer station without administration office (literally means temporary disposal site).
28.	Lurah	:	Chief of Sub-District.
29.	MCK	:	Public facilities for taking shower, washing, and toilet.

30.	Pasar	:	Traditional market.
31.	Pasukan Kuning	:	"Yellow Troop" (waste collection workers and street sweepers).
32.	PDAM	:	Water Supply Municipal Company.
33.	PEL	:	Preliminary Environmental Evaluation Report.
34.	Perda	:	Municipal Regulation.
35.	PIL	:	Preliminary Environmental Information Report.
36.	PLN	:	State Electric Company
37.	Rayon	:	Working area of each Assistant to the Mayor.
38.	RT	:	Neigbourhood Unit.
39.	RW	:	Community Unit.
40.	SBY	:	Surabaya.
41.	SEL	:	Environmental Evaluation Study.
42.	SMA	:	Surabaya Metropolitan Area.
43.	SUDP	:	Surabaya Urban Development Plan.
44.	SWM	:	Solid Waste Management.

Summary
of
The Study on the Solid Waste Management Improvement for Surabaya

1. STUDY BACKGROUND, PURPOSE AND ORGANIZATION

Background: The City of Surabaya (KMS) has made remarkable improvements on solid waste management (SWM) over the past decade through the execution of the Solid Waste Improvement Program (SWIP). KMS plans to make further improvements on SWM through the implementation of the Surabaya Urban Development Program (SUDP) during 1993/94 -1998/99.

Under the above-described situation, the Ministry of Public Works, the Republic of Indonesia requested the Government of Japan to conduct a study on the solid waste management improvement for Surabaya City. The current study has been executed based upon the Scope of Work for the Study, and the Minutes of Meeting signed by both Cipta Karya, the Ministry of Public Works, and JICA on 19th March 1991.

SUDP Solid Waste Management Sector Report was prepared by P.T. Indulexco in association with Mott MacDonald International and P.T. Persada Adhi Cipta. The report contains useful recommendations and plans. The SUDP Solid Waste Management Sector Plan was fully reviewed by the JICA Study Team. As a result, the Study Team utilized all parts of the plan that do not need further modifications.

However, the Study Team made additions and modifications to the plan wherever necessary to strengthen the spirit of the original plan. Major addition and modifications in the feasibility studies are shown below.

Major Additions :
1. Construction of the sanitary landfill site (LPA) in Benowo (west part of Surabaya).
2. Improvement of Asemrowo Workshop

Major Modifications : Types of waste haulage trucks (as shown in the table below.)

	Equipment Recommended by the JICA Study Team	Equipment Recommended in the Original SUDP SWM Plan
1. For haulage of waste from Depo/LPS	a. 14 m^3 containers & Arm-roll trucks of 14 GVW chassis with single rear axle, and b. 8 m^3 containers & Arm-roll trucks of 7 GVW chassis with single rear axle GVW: Gross Vehicle Weight	a. 16 m^3 containers & Arm-roll trucks with 10 GVW chassis uprated from 7 GVW by adding an additional rear axle.
2. For haulage of waste from small containers placed on roadsides	No procurement. (KMS will use contractors for hauling this type of waste.)	Front End Loader (FEL) Compactor trucks with 17 m^3 capacity and 10 GVW chassis uprated from 7 GVW by adding an additional rear axle.

It is expected that those modifications and additions will be fully reflected during the implementation of the actual SUDP.

Purpose of the Study: The purposes of the current study are as follows:

1. Formulation of a Master Plan for the improvement of solid waste management in Surabaya for the period 1993 - 2010. (Shown in Part 2 of the main report)
2. Feasibility study of priority project (identified in the Master Plan) which are to be implemented during the SUDP implementation period 1992/93 -1998/99. (Shown in Parts 3 of the main report)

Organization of the Study: The Study has been jointly executed by both the JICA Study Team and the Indonesian Counterparts in close consultation with the Steering and Technical Committees as well as the JICA Advisory Committee. Members of these committees are shown in Appendix 1.

Reports: The Study reports consist of the following reports:

Volume 1 : Main Report,
Volume 2 : Summary,
Volume 3 : Supporting Report 1 for Master Plan,
Volume 4 : Supporting Report 2 for Feasibility Study, and
Volume 5 : Data Book.
Volume 6 : Drawings

2. PRESENT SOLID WASTE MANAGEMENT CONDITIONS IN SURABAYA

1) General

Surabaya is one of the cleanest cities in Indonesia. The City of Surabaya was awarded with Adipura 5 times so far since the establishment of the Award in 1985. (Adipura is an award given by the Central Government to local government that was judged as the best in the urban environmental sanitation management.) The City of Surabaya was also awarded with AGA KHAN Award in 1986, UNEP Award in 1990, and UNCED Award in 1992, and HABITAT Award from the United Nations in 1992.

The acquisition of those awards is attributable to the remarkable efforts of both the city authority (KMS) and the citizens. The administrators of KMS are very keen in the environmental cleanliness. The citizens' participation in the sanitary management is very active as shown below:

1. Local communities, RT/RW, take the responsibility for collection and transfer of waste from households to the nearest transfer stations called Depo or LPS. (small transfer station or temporary disposal site)

2. The citizens pay monthly sanitary retribution charge to Surabaya Municipal Government (KMS) as service charge for hauling waste from Depo/LPS to LPA (final disposal sites) as well as for street and other public facilities cleaning.

3. The citizens donate some sanitary equipment and facilities such as small containers to KMS.

4. The citizens carry out mass voluntary cleaning of public places occasionally.

2) Strong and Weak Points of the SWM in Surabaya

Solid waste management service comprises of two major services, i.e., 1) Collection and haulage & 2) Treatment and disposal. In Surabaya, it is considered that the former is rather satisfactory, while the latter has much to be improved.

A strong advantage in the waste collection and haulage in Surabaya is that there are as many as 168 Depo or LPS in Surabaya (58 Depo and 110 LPS), which are very good from the efficiency view point. Another superior aspect is that the local communities take the responsibility for waste collection. This system enables the local

communities to choose appropriate level of services that match with the level of their income and priority.

On the other hand, the waste disposal method practiced in Surabaya is not so impressive. KMS has been still practicing an open dumping method that causes environmental problems, while, on the other hand, KMS uses an extremely costly treatment method (an incinerator) for a small part (17%) of the waste disposed of by KMS although this incinerator may provide both Surabaya and Indonesia with valuable experience as it is the first solid waste incinerator of this scale introduced in Indonesia.

3) Responsibility of Solid Waste Management (SWM)

The responsibilities of the solid waste management (SWM) are shared by the local communities, KMS and waste generators. The local communities called RT/RW perform a great role in the solid waste management in Surabaya. They are directly responsible for the collection of solid waste, and for the transfer of collected waste to the nearest transfer stations that are locally called Depo or LPS, while the city authority (KMS) takes the responsibility for haulage from Depo or LPS to LPA, disposal of municipal solid waste, and for street sweeping as well as for the disposal of night soil sludge. Generators of hazardous solid waste are responsible for disposal of their waste.

Type of SWM Services and Responsible Bodies

Type of Solid Waste	Types of SWM Services	Responsible Body
A. Household waste & Non-hazardous commercial and industrial waste which is less than 2.5 m^3/day per generator	1. Waste Collection and Transfer to Depo/LPS	Local communities (RT/RW)
	2. Haulage to LPA (final disposal sites)	KMS (Cleansing Dept.)
	3. Treatment & Disposal	KMS (Cleansing Dept.)
B. Market Waste & Other non-hazardous commercial & industrial waste that is 2.5 m^3/day or more per generator	4. Collection and Haulage	Generators & KMS
	5. Disposal	KMS (Cleansing Dept.)
C. Hazardous waste	6. Collection, Haulage & Disposal	Generators
D. Street waste	7. Collection (Street sweeping), Haulage & Disposal	KMS (Cleansing Dept.)
E. Night soil sludge	8. Collection and Haulage	Residents (Service users)
	9. Treatment and Disposal	KMS (Cleansing Dept.)

4) Waste Generation

It is estimated that the waste generation amount in Surabaya is 1,626 ton/day on average, of which details are shown in the following table.

Generation Sources	Average Waste Amount (ton/day)
1. Household:	1,108 (68 %)
2. Market:	258 (16 %)
3. Commercial & Industrial waste:	177 (11 %)
4. Street & open space:	83* (5 %)*
Total:	1,626 (100 %)

* The waste amount of "Street & open space" partly include waste discharged from households located nearby street waste containers.

5) Waste Collection and Disposal

Of the generated 1,626 ton/day of waste, 1,116 ton/day (69 %) is either collected and disposed properly or recycled as shown below.

	Average Waste Amount (ton/day)
1. Either collected and disposed properly or recycled:	1,116 (69 %)
1.1 Collected and disposed properly:	936 (58 %)
1.2 Recycled:	180 (11 %)
2. Collected but disposed at unofficial places:	261 (16 %)
3. Not collected:	249 (15 %)
Total:	1,626 (100 %)

6) Manpower Involved in SWM

It is estimated that the local communities (RT/RW) use about 10,500 workers in total to collect waste and transfer it to Depo and LPS. Number of KMS employees involved in the solid waste management services is about 1,700, of which 1,060 are street sweepers. In addition, KMS uses 5 waste haulage contractors (which use 113 workers in total for the service), and 25 street sweeping contractors (which use 404 sweepers). The total number of persons involved in solid waste management services in Surabaya is estimated to be about 13,000, which corresponds to about 0.5 % of the population (about 2.5 million) in Surabaya. In addition, there are over 3,000 scavengers engaged in the recycling activities.

7) Money Used for SWM

It is estimated that the local communities (RT/RW) spend about Rp 8.5 billion/year for waste collection and transfer to Depo/LPS. KMS uses about Rp 11.5 billion/year for solid waste management in fiscal year 1992/93. Of KMS's SWM expenditure Rp 11.5 billion, Rp 4 billion is funded by the SWM fee (called Sanitary Retribution)

paid directly by the citizens, while the remaining Rp 7.5 billion is covered by various kinds of taxes and other sources.

Total SWM expenditure in Surabaya is Rp 20 billion (Rp 8.5 billion + Rp 11.5 billion), which corresponds to 0.5 % of the gross regional product (GRP) of Surabaya recorded in 1990. The per capita SWM expenditure is estimated to be about Rp 8,000/person/year (Rp 20 billion divided by 2.5 million persons) or Rp 40,000/household/year (Rp 20 billion divided by 0.5 million households) on average.

8) KMS's Major SWM Facilities and Equipment

KMS's major facilities and equipment used for SWM are shown below.

a. Haulage Equipment

(1) Vehicles

- Arm-roll container trucks:	43 units
- Rear End Loader (REL)Trucks:	15 units
- Open trucks:	6 units
- Mechanical road sweepers:	3 units
- TOTAL:	67 units

Note: Arm-roll trucks are used to haul waste-filled large containers from Depo/LPS to LPA, while REL trucks collect waste from small containers.

(2) Containers

- Large containers (6 m^3, 10 m^3 & 12 m^3):	260 units
- Small containers (0.6 m^3 and 1.0 m^3):	436 units
- TOTAL:	696 units

Note: Large containers are placed in Depo and LPS, while small containers are placed mainly on the streets.

(3) Depo and LPS

- Depo:	58
- LPS	110
- TOTAL:	168

b. Treatment Facility: - Incineration Plant (capacity: 200 ton/day): 1

c. Final Disposal Facility

(1) Final Disposal Sites (LPA): 3

Note:
1. The LPA in Lakarsantri and Keputih are owned by KMS, while the LPA in Kenjeran belongs to a private company.
2. There are several places in Surabaya that are used as unofficial final disposal sites including the one in Asemrowo.

(2) Heavy Equipment (currently used)

- Bulldozer:	5 units
- Wheel loader	1 unit

d. Workshop: 1 (Asemrowo)

3. MASTER PLAN

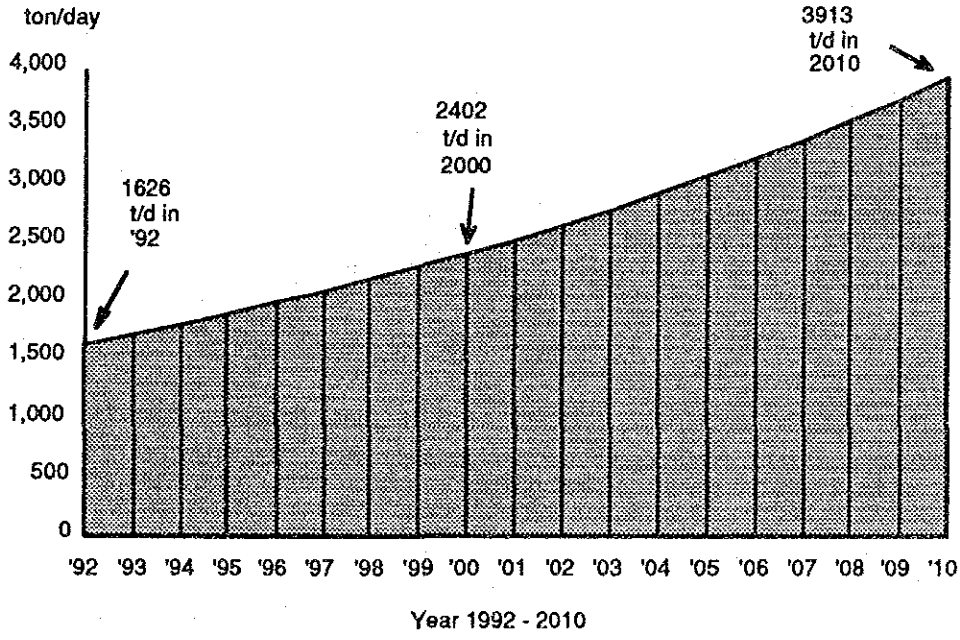
1) Waste Generation

Estimation of Waste Quantity in Tonnage

In Surabaya and most other cities in Indonesia, waste quantities are expressed in cubic meter (m3). However, waste quantities expressed in cubic meter are misleading without specifying bulk density of waste, which changes greatly depending on phases of waste flow. Therefore, JICA Study Team has attempted to estimate waste quantity in tonnage based upon the field survey.

The present waste generation amount is estimated to be 1,626 ton/day approximately based upon the current survey.

The Study Team assumes that the future waste generation will increase at an annual average rate of 5% for the period 1992 - 2010 taking into account the past economic growth in Surabaya, the future population, and increases in amounts of waste hauled by KMS during the past several years.



Projection of the Future Waste Generation Amount in Surabaya 1992-2010

The Current and the Future Waste Generation

	Waste Generation Amount Projected	Per Capita Waste Generation
1992	1,626 ton/day (100%)	634 gram/day (100%)
2000	2,402 ton/day (148%)	820 gram/day (129%)
2010	3,913 ton/day (241%)	1,157 gram/day (182%)

The projected increases (5 %/year) in the future waste generation may be decomposed into two main factors : 1) population increase that is projected at about 1.6 %/year, and 2) per capita waste generation increase that is estimated at about 3.4 %/year on average for the period 1992-2010.

2) Responsibility for Solid Waste Management

Municipal solid waste management consists of such activities as waste collection, haulage, treatment and disposal, and street sweeping. Responsible bodies for respective activities will be as shown below.

SWM Activities and Responsible Bodies

Solid Waste Management Activities	Responsible Bodies
1. Collection & Transfer to Depo/LPS	
1.1 Waste of large amount (2.5 m^3 or more each day) - Collection & direct haulage to LPA	Waste generators
1.2 Hospital waste	KMS
1.3 Household and all other waste	Local communities (RT/RW)
2. Haulage from Depo/LPS to LPA	
2.1 Haulage of large amount waste (2.5 m^3 or more each day)	Waste generators
2.2 All other waste	KMS
3. Treatment and Disposal	KMS

Waste Collection

Like many other cities of Indonesia, local communities (RT/RW), in Surabaya, is responsible for collection of waste, and transfer to Depo or LPS. In principle, unless socio-economic conditions of Surabaya changes substantially, this system should be maintained in the future in view of the following advantages:

(1) People can choose level of collection service suitable to their needs and financial capacity.

(2) Beneficiary Pay Principle (BPP) can be best realized.

(3) The local people can supervise waste activities of collection workers.

(4) In addition, it is easy for RT/RW to cope with increases in waste discharge volume, for example, by increasing the number of Pasukan Kuning (collection workers), handcarts, etc.

(5) Waste collection services of RT/RW create the employment opportunity for many people.

The current waste collection is carried out by using workers and handcarts. In the future, however, it might be more feasible to use capital intensive methods (trucks) owning to the future upgrading of the economic standard. In such case, it might be difficult for each local community to manage the waste collection because the collection with trucks require technical know-how in the selection, operation and maintenance of trucks. It may be more suitable for KMS to take over the responsibility of waste collection.

3) Target Service Level

At present, 58 % of the waste generated in Surabaya is collected, hauled to and disposed of at official LPA by either KMS or waste generators. 11 % is recycled. In other words, 69 % of the waste generated in Surabaya is either recycled or properly managed.

Target Level of Waste Collection and Haulage

Unit: Ton/day

Year	Waste to be Collected, Hauled to & Disposed at Official LPA by either KMS or Waste Generators (1)	Waste to be Recycled through Waste Pickers before being Hauled to LPA (2)	Waste either Recycled or Properly Managed (1) + (2) = (3)	Waste to be Generated (4)
1992	936 t/d (58 %)	180 t/d (11 %)	1,116 t/d (69 %)	1,626 t/d (100 %)
1995	1,244 t/d (66 %)	207 t/d (11 %)	1,451 t/d (77 %)	1,882 t/d (100 %)
2000	1,906 t/d (79 %)	264 t/d (11 %)	2,170 t/d (90 %)	2,402 t/d (100 %)
2010	3,270 t/d (84 %)	430 t/d (11 %)	3,700 t/d (95 %)	3,913 t/d (100 %)

Note: Figures in parenthesis show percentages to total waste generation.

As shown in Table 1 hereto-attached it is planned that KMS will increase the service level of collection, haulage, and disposal so that waste to be either recycled or properly managed will increase as follows: 77 % in 1995, 90 % in 2000, and 95 % in 2010 through various actions explained in Item 4).

Target Service Level in terms of Population: According to the information given by Kelurahan and Kecamatan offices, 81 % of the population in Surabaya receive waste collection and haulage services at present. The target coverage in terms of population will gradually increase, and it will reach 90 % in 2000, and 95 % in 2010.

4) Master Plan Goals, Targets, and Major Means to Achieve the Goals

Master Plan goals, targets and major means to achieve the goals are summarized in the following table.

Master Plan Goals, Targets and Major Means to Achieve the Goals

Master Plan Goals and Targets	Major Means to Achieve Goals
A. DISPOSAL	
1. Introduction of sanitary landfill	1) Construction of a new landfill site in the western part of Surabaya.
1.1 Construction of two (2) sanitary landfill sites; one in Benowo, the other in the east part of Surabaya. (Sanitary landfill is the most appropriate disposal method for Surabaya from environmental and economic view points. Two (2) LPA [sanitary landfill] are necessary in order to save haulage costs. Haulage cost with only one (1) LPA in Benowo will be 2.2 times larger than the case with two (2) LPA.)	a. Acquisition of land with an area of about 40 ha in Benowo by 1994. (The location is shown in the front page map.) b. Construction of the 1st phase landfill site by 1996. c. Acquisition of additional land with an area of about 110 ha by 2002. d. Construction of the 2nd phase landfill site by 2004.
1.2 Improvement of existing landfill sites.	2) Construction of a new landfill site in the eastern part of Surabaya. a. Acquisition of land with an areas of about 14 ha in the east by 1995, 31 ha by 1999 and 75 ha by 2005. b. Staged construction of landfill site by 1996, 2000 and 2006. 3) Acquisition of land adjacent to the site. 4) Installation of facilities for improvement.

B. HAULAGE	
2. Increases of the service coverage	
2.1 Complete elimination of "waste that is collected by RT/RW but not hauled to official LPA" by 2000 through KMS' provision of waste haulage service for all areas where RT/RW collect garbage.	5) Provision of Depo and LPS for all Kelurahan. 6) Provision of small containers where Depo or LPS may not be placed.
2.2 Reduction of non-collected waste from the current 15 % of generated waste to 5 % by 2010.	7) Grant of handcarts to low-income RT/RW.
3. Increases of efficiency of waste haulage	8) Use of more contractors. Haulage of waste from small containers with compactor trucks should be fully contracted out. 9) Use of larger containers (14 m^3). 10) Reduction of crew of arm-roll trucks from the current 2 (1 driver & 1 assistant) to 1 driver by 2000.
4. Upgrading of sanitary conditions of Depo/LPS	11) Rehabilitation of Depo/LPS (provision of drainage, piped water, trees, etc.) 12) Complete containerization of Depo/LPS. (to provide container for all Depo & LPS.)
C. STREET SWEEPING	
5. Increases of the efficiency of street sweeping	13) Reduction of street sweeping frequency wherever possible. 14) More use of contractors.

D. VEHICLE MAINTENANCE **6. Strengthening of vehicle maintenance**	15) Introduction of daily checking of vehicles. 16) Introduction of regular maintenance and repair. 17) Quick procurement of adequate spare parts. 18) Removal of abandoned vehicles and containers from the Asemrowo workshop. 19) Remodeling and improvement of the Asemrowo workshop. 20) Construction of a new garage, in the new East LPA, with facilities for car washing and minor repairs.
E. INSTITUTION **7. Saving of SWM Costs** 7.1 Shift of waste haulage responsibility from KMS to generators of large waste amount (2.5 m^3 or more each day). The target is to increase share of the self-haulage from the current 8 % to 25 % of the total waste generation amount by 2000, which corresponds to nearly all waste of large amount waste generators. 7.2 Use of more contractors. The policy is that KMS will keep the amount of waste to be hauled by KMS' direct operation at the current level (621 ton/day), and contractors should haul all the remaining and incremental waste in the future. As a result, the rate of usage of contractors will increase to the current 30% to about 75% by 2010 in terms of rate of waste amount hauled by contractors relative to total waste hauled by KMS and contractors.	21) To make necessary legal arrangements. 22) To apply the law, at first, to major waste generators including the Market (Pasar) Authority. 23) Increases in the rates of contract price. 24) Application of longer contract period - at least one (1) year. 25) To use waste weight-based contract, which would provide contractors with incentive to haul more waste. 26) To make contractors responsible for provision of small containers as well, which would lead to increases in placement of containers and service coverage under the arrangement shown in Item 25 above. 27) To sell or lease KMS' used vehicles if accepted by contractors.

8. Improvement of fee revenue	28) Increases of the sanitary retribution rates. 29) Use of PLN' (electric company) tariff collection points. 30) Application of volume-based fee rates to business waste.
9. Institutional Strengthening	
9.1 Privatization	31) Establishment of an independent cleansing authority (Perusahaan Daerah Kebersihan Surabaya).
9.2 Reorganization	32) Formation of a Disposal Section responsible for planning and operation of waste disposal.
F. WASTE AMOUNT REDUCTION	
10. Control of waste generation	33) Promotion for the reduction of weight of agricultural products coming into markets by such means as removing nutshell of agricultural products before transportation
11. Resources recycling	34) Supports of scavengers. The target is to increase the waste recycling amounts so that it will be constant at 11 % in terms of share to the total waste generation in Surabaya.
G. INCINERATION	
12. Improvement of the operation and facilities of the existing incinerator.	35) To select more suitable waste, and take measures to keep waste drier in the pit. 36) To install air-preheater to promote drying process of waste in the furnace.
13. Effective use of the incinerator	37) Use of the incinerator for incineration of medical waste (already implemented).

5) Necessity for Construction of New Disposal Site (LPA) in the East Part of Surabaya

As shown in Item 1.2 of the table above, it is strongly recommended that KMS should construct LPA not only in Benowo (west part of Surabaya) but also in the east part of Surabaya in order to save the future costs of waste haulage.

A comparative study was made with respect to the following two cases in order to find the cost difference.

Case A : 2 LPA are available: one in the west (Benowo) and the other in the east part of Surabaya.

Case B : Only one LPA is available in the west (Benowo)

Conclusion

As can be seen from the following table, Case B with one LPA in Benowo is 2.2 times costlier than the Case A. Annual average cost difference (KMS' expected saving by having LPA in the east part of Surabaya) is estimated to be Rp 6,425 million/year on average throughout the years 1992 -2010. Such difference is too large to ignore.

Summary of the Comparison of the Two Cases

	Case A	Case B	Difference between the 2 Cases
1. Average Trips to be made per truck per day	7.7 trips/truck/d	3.4 trips/truck/d	4.2 trips/truck/d
2. Estimated Average Unit Haulage Cost per Ton	Rp 10,000/ton	Rp 22,000/ton	Rp 12,000
3. Annual Average Haulage Cost throughout Years 1992 -2010	Rp 5,355 million per year	Rp11,780 million per year	Rp 6,425 million per year
4. Cost Index (Case A=100)	100	220	120

Furthermore, due to the future development in the east part of Surabaya, it is expected that the waste generation amount will increase faster in the east part of Surabaya than in the rest of Surabaya. Then, the real difference in the future may be even greater than the estimated Rp 6,425 million/year.

According to KMS officials, a land use plan is already determined for the east part of Surabaya. Development priority of different sectors should be carefully determined. In doing so, it should be noted that land after completion of landfill can be used for residential, commercial, industrial and other purposes, while it is difficult to reverse the development process (use land for non-landfill purposes at first, and later use it for landfill purpose).

It is very strongly recommended that KMS should make all efforts to obtain a land in the east part of Surabaya, and construct a LPA before the existing LPA in Keputih is exhausted, which will happen in 1997 at the latest.

6) Type of Waste to be Disposed of By KMS

It is planned that KMS will provide solid waste disposal services for the same types of waste as currently disposed of by KMS as listed below:

a. Household waste
b. Commercial and industrial waste excluding hazardous waste
c. Street waste of the roads for which KMS is responsible for street sweeping
d. Hospital waste (to be collected separately and incinerated.)
e. Sludge and sand generated in the human waste treatment facility
f. Incineration ash (This could be used as cover material in LPA.)

All other types of waste should be disposed by generators of the waste.

Disposal of Hazardous Industrial Waste

All the hazardous industrial waste will be disposed at "Centralized Hazardous and Toxic Waste Treatment Facility in GKS Region" planned by the Central Government.

7) Methods of Disposal

The following three alternative methods were evaluated from economic and environmental view points in order to find appropriateness of applicability of these alternatives as a major means of waste disposal in Surabaya.

Alternative 1. Sanitary landfill
Alternative 2. Sea reclamation
Alternative 3. Incineration

Unit Costs and Evaluation of the Disposal Alternatives

	ALT. 1 Sanitary Landfill	ALT. 2 Sea Reclamation	ALT. 3 Incineration
1. Land cost (Rp/ton)	3,300	0	0
2. Construction (Rp/ton)	7,930	15,500	50,200
3. Operation/maintenance (Rp/ton)	4,330	4,620	56,830
4. Total (1+ 2 + 3) (Rp/ton)	15,560	20,120	107,030
5. Land Value Created (Rp/ton)	6,600	3,300	0
6. Net Cost (4 - 5) (Rp/ton)	8,960	16,820	107,030
7. Cost Index (ALT.1 = 1)	1	2	12
8. Cost Evaluation	A	B	D
9. Environmental Soundness	A	B	A
10. Overall Evaluation	A	B	C

Notes: 1. The breakdown of the above-estimated costs are shown in the Volume 3 : Supporting Report 1.
2. The grades are explained in the table below:

GRADES	COST	ENVIRONMENTAL SOUNDNESS
A	Low cost	Sound
B	Reasonable	Need further assessment before making a decision
C	Costly	Risky
D	Very costly	Not sound

<u>Conclusion</u>

a. The sanitary landfill is evaluated to be the most appropriate disposal method from both economic and environmental view points, and, therefore, KMS should apply it as a major means of waste disposal provided that land is available for sanitary landfill.

- Most Appropriate Alternative: Alt. 1 Sanitary Landfill
- Second Best Alternative: Alt. 2 Sea Reclamation
- Third Best Alternative: Alt. 3 Incineration

b. The availability of land largely depends of the amount of KMS's land acquisition efforts. In many cases, the availability also importantly depends on acquisition prices or amounts of compensation offered to people who would be affected.

c. If the land acquisition proved impossible, KMS should seriously consider the application of the sea reclamation method, before jumping into the incineration option.

d. The incineration option is the last option which KMS may inevitably have to choose if neither the sanitary landfill nor sea reclamation are applicable due to the difficulty in the acquisition of land or seashore areas. It should be noted that the use of costly incinerators, under the KMS's limited budget, may affect the speed and degree of the development and improvements of other sectors and services.

e. Policy for Renewal of the Existing Incinerator in Surabaya

The existing incinerator of Surabaya serves as a sort of pilot incinerator for Indonesia. The experience gained through the operation of the existing incinerator is useful not only for Surabaya but also for Indonesia in making future improvements on the incinerators to better suit to Indonesian conditions, and also in deciding the future policy and plan for incineration and disposal at both central and municipal government level.

The past experience in Japan and other countries shows that it would take ten years or more for countries to modify incinerators so as to suit them to the local conditions. It also takes time to train manpower needed for the operation and maintenance of incinerators. It cannot be expected that any municipality would operate incinerators effectively and efficiently right after the introduction of them.

Because the experience of Surabaya in the incineration can be shared by the country as a whole, it might be rational for the central government to provide KMS with subsidies for the incinerator though it is entirely up to the policy of the Indonesian government how much priority be given to the gaining of such experience.

Whether or not KMS should renew the existing incinerator in the future depends on the availability of the central government's financial support. Renewal of the incinerator in the future without obtaining financial supports from the central government would impose abnormally large financial burdens on KMS, which would affect appropriate resource allocation among sectors that need development funds.

8) Five (5) Disposal Options

As discussed in the previous section, the sanitary landfill is the best for KMS as a major disposal method if land is available.

Through the discussions with KMS officials, JICA Study Team strongly recommended that KMS should construct two (2) LPA: one in Benowo, west part of Surabaya, and the other in the east part of Surabaya.

KMS expressed that 1) it is likely that KMS will construct a LPA in Benowo, 2) KMS however may not be able to construct a LPA in the east part of Surabaya as it is difficult for KMS to acquire necessary land there.

Considering this situation, and based upon KMS' request, this Section presents and evaluates five (5) disposal options that may be available for KMS.

Five (5) Disposal Options

Option 1. 2 LPA are available, i.e., one in Benowo, the other in the east part of Surabaya.

Option 2. 2 LPA are available, i.e., one in Benowo, and the other (sea reclamation) in the east part of Surabaya.

Option 3. 1 LPA in Benowo, and Incinerators in the east part of Surabaya (Keputih) are available.

Option 4. 1 LPA in Benowo, and further expansion of the Benowo LPA are available.

Option 5. 2 LPA are available, i.e., one in Benowo, the other in the neighboring cities such as Sidoarjo or Gresik.

(The order of the above options follows the preference of KMS officials.)

Evaluation of the Disposal Options

The five disposal options are evaluated as shown in the table below.

Comparison of Unit Haulage and Disposal Costs of the Five (5) Options

Unit: Rupiah per ton

Disposal Options	Unit Haulage Cost (1)	Unit Disposal Cost (2)	Total Unit Cost (1) + (2) = (3)	Low Cost Ranking (4)
1. Opt. 1 (1 LPA in Benowo & 1 LPA in the east)	10,000	8,960	18,960 (100)	1
2. Opt. 2 (1 LPA in Benowo & Sea Reclamation in the East)	10,000	12,890	22,890 (121)	2
3. Opt. 3 (1 LPA in Benowo & Incinerators in Keputih)	10,000	58,000	68,000 (359)	5
4. Opt. 4 (1 LPA in Benowo & further Expansion of it)	22,000	8,960	30,960 (163)	3
5. Opt. 5 (1 LPA in Benowo & 1 LPA outside Surabaya)	30,000	8,960	38,960 (205)	4

Note: Figures in parenthesis ( ) show cost indices with the cost of Option 1 being 100.

Major Assumptions Used for The Cost Estimation

1. 50 % of waste will be hauled to and disposed at LPA in Benowo, and the remaining 50 % will be hauled to and disposed at other place and by other means as indicated.

2. Waste will be hauled by arm-roll trucks and large containers from Depo and LPS. (Refer to Part 2 Section 3.6 Table 2.3-8 for assumptions used for estimation of costs of haulage.)

Comments

1. Option 1 (two sanitary landfill) is the most recommendable. However, if it is not possible for KMS to choose Option 1 (two sanitary landfill), Option 2 (one LPA in Benowo, and the other (sea reclamation) in the east part) is the second best.

2. Option 2 is followed by Option 4 (LPA in Benowo and further expansion of Benowo LPA), which is then followed by Option 5 (1 LPA in Benowo, and the other outside Surabaya).

3. Option 3 (with Incinerators in Keputih) is the most expensive, and the least recommendable.

9) Expected Benefits Deriving from the Implementation of the Master Plan

Expected benefits deriving from the successful implementation of the master plan is summarized below.

1. Continued obtainment of Adipura Award, which would contribute to increases of the citizens' pride and the social coherence.

2. Achievement of higher standard of environmental sanitation and cleanliness in the city of Surabaya through the improvement of the KMS' capacity and means of the solid waste management.

   a. Increases of coverage of solid waste management (SWM) service through the procurement of adequate trucks, containers and handcarts, and also through the construction of additional Depo and LPS. As a result, waste neither recycled nor properly disposed would decrease from the current 31 % of the total waste generation amount to 10 % in 2000, and 5 % in 2010.

   b. Reduction of negative environmental impacts on the citizens living around Depo or LPS through rehabilitation of Depo and LPS and containerization of Depo and LPS.

   c. Improvement of waste disposal standard from the current open dumping to the sanitary landfill, which would contribute to the substantial reduction of the following risks.

      (1) Pollution of water body with waste leachate
      (2) Pollution of surrounding area with waste
      (3) Diffusion of offensive odor

3. SWM Cost Saving

It is estimated that the implementation of the master plan will bring about Rp 42.3 billion (Rp 2,352 million/year on average) during the master plan period 1993 - 2010 as shown in the table below.

Means to Save SWM Costs and Expected Amount of Saving

Means to Save SWM Costs	Amount of cost to be Saved during the Master Plan Period	Remarks
1. Shift of the waste haulage responsibility from KMS to those that generate waste of 2.5 m^3 or more each day. [The target is to increase the waste to be hauled by waste generators from the current 8 % to 25 % of the total waste generation by 2000.]	Rp 19.0 billion (Rp 1,055 million/year on average)	Unit average cost of haulage of waste from Depo/LPS (Rp 7,000/ton) x cumulative incremental waste to be hauled by waste generators under this policy during the master plan period (2,719,162 ton) = Rp 19.0 billion
2. More use of contractors for waste haulage [The target is to increase the use of contractors from the current 30 % to 73 % by 2010 in terms of waste haulage amount.]	Rp 13.5 billion (Rp 750 million/year on average)	Average unit saving or cost difference between contractors and KMS' direct haulage cost (Rp 4,811/ton) x cumulative incremental waste to be hauled by contractors under the policy of more use of contractors during the master plan (2,814,697 ton) = Rp 13.5 billion
3. Use of larger containers (8 m^3 & 14 m^3) and compatible trucks instead of the existing smaller containers (6 m^3, 10 m^3, 12 m^3).	Rp 2.2 billion (Rp 124 million/year on average)	Average unit cost difference between the planned equipment and the existing one (Rp 700/ton) x cumulative waste to be hauled from Depo/LPS during the master plan period by KMS' own equipment (3,179,880 ton) = Rp 2.2 billion
4. More use of contractors for street sweeping Target is to reduce KMS' direct street sweeping to about 25 % from the current 50 % in terms of sweeping length of road side and berm (not street length)	Rp 7.6 billion (Rp 423 million/year on average)	Average cost saving or difference between KMS' direct operation and contractors (Rp 6,436/km/day) x Sweeping length to be contracted out (180 km/day x 365 days/year) x 18 years = Rp 7.6 billion
Total (1+2+3+4)	Rp 42.3 billion (Rp 2,352 million/year on average)	

4. Net Fee Revenue Increases

The net fee revenue will increase by about 10 %/year on average in real term through the implementation of 1) increases of rates of the sanitary retribution, 2) introduction of new collection method with the use of PLN tariff collection points as points of collection of the sanitary retribution, 3) gradual application of volume-based rates of the sanitary retribution to business establishments that discharge less than 2.5 m^3 per day.

4. RESULTS OF FEASIBILITY STUDY

Outline

1) Feasibility Study Project Components

The JICA Study Team has carried out a feasibility study for the SWM improvement project that comprises of the following four (4) components that are recognized as important and urgent ones by both KMS officials and the Study Team through the Master Plan study.

Component 1. Procurement of haulage vehicles, containers and handcarts
Component 2. Construction of sanitary landfill site in Benowo
Component 3. Construction and rehabilitation of Depo/LPS and Improvement of Asemrowo Workshop
Component 4. Procurement of heavy equipment (bulldozers, etc.) to be used at LPA

Note: Locations of Benowo and Asemrowo are shown in the front page map.

Of the above-shown components, components 1, 3 (construction and rehabilitation of Depo/LPS only), and 4 were already studied by a local consulting firm and its associate foreign consultants.

The JICA Study Team has reviewed the previous study, utilized the study and planning outputs that do not need revisions, but modified some of the outputs that were found necessary after discussions with KMS officials. In addition, the Study Team carried out a feasibility study for some new components, i.e., Construction of sanitary landfill site in Benowo, and Improvement of Asemrowo workshop. The reasons for inclusion of those additional components in the feasibility study are as follows:

Construction of sanitary landfill in Benowo: This component was not included in the previous study just because KMS had not decided on a location of site for the sanitary landfill during the previous study period. However, KMS, during the current JICA Study, decided that an area in Benowo should be the site location. Therefore, it was made possible to include this component in the current study.

Improvement of Asemrowo Workshop: This component was newly added to the current study through the discussion with the KMS officials because of the strong needs for the improvement of the maintenance of waste haulage vehicles that directly affects the efficiency of waste haulage.

Imporatance and Urgency of the Project

The importance and urgency of implementing the project comprising of the above four (4) components could be understood by knowing that conditions that 1) most of KMS' waste haulage trucks need replacement now or within a few years. (KMS' newest waste haulage vehicles are those purchased in 1988.), 2) the existing landfill sites (LPA) will be exhausted within three (3) years, 3) waste haulage coverage and efficiency cannot be improved without improvement of Depo/LPS and maintenance facility (Asemrowo workshop), and 4) heavy equipment is an essential equipment needed for operation of sanitary landfill.

2) Agency Responsible for the Project Implementation

KMS will be responsible for the implementation of the project. The Cleansing Department in KMS will be the major department in charge of the project execution.

3) Period of Project Implementation

KMS will implement the projects during the seven (7) financial years 1992/93 - 1998/99. It is anticipated that KMS would actually commence the implementation in 1993/94 as the project preparation would be completed in 1993.

4) Implementation Schedule and Program

The project implementation schedule is shown below. Types and quantities of equipment to be procured and works to be constructed are summarized in Table 3.

Implementation Program of F/S Project

Project Component	Fiscal Year					
	93/94	94/95	95/96	96/97	97/98	98/99
1. Procurement of Waste Haulage Vehicles, Containers, & Handcarts						
1.1 Vehicles						
1.2 Containers						
1.3 Handcarts						
2. Construction of Sanitary Landfill Site in Benowo						
3. Construction and Rehabilitation of Depo/LPS & Improvement of Asemrowo Workshop						
4. Procurement of Heavy Equipment						

5) F/S Project Expenditures and Other Expenditures

A total F/S project expenditure is estimated to be Rp 41,783.7 million including the value added tax of which the investments will amount to Rp 33,581.2 million, and the operation and maintenance costs will amount to Rp 8,202.5 million. (See table below.)

Annual investment amounts and operation and maintenance costs are shown in Tables 4 and 5.

Other Expenditures

In addition to the F/S project costs, there will be other expenditures needed for operation and maintenance of the existing trucks, containers, LPA, incinerator, street sweeping and administration as well as construction of the proposed sanitary landfill in the east part of Surabaya.

The sum of those expenditures are estimated to be Rp 97,856 million in 1992 price during the F/S project period 1992/93 - 1998/99. Refer to Table 6 for details of the non-F/S project expenditures.

The sum of total F/S project expenditures and other expenditures will be Rp 139, 639.7 million. See table below.

Summary of Feasibility Study (F/S) Project & Other Expenditures

Unit: Million Rupiah in 1992 price

Project Components	Investment (1)	Operation & Maintenance (2)	Total (1) + (2) = (3)
A. F/S Project Expenditures	6,644.4	5,275.7	11,920.1
1. Procurement of waste haulage vehicles, containers, and handcarts			
2. Construction of sanitary landfill site in Benowo	23,434.0	2,049.0	25,483.0
3. Construction and rehabilitation of Depo/LPS & Improvement of Asemrowo Workshop	1,607.8	160.8	1,768.6
4. Procurement of heavy Equipment	1,895.0	717.0	2,612.0
Total	33,581.2	8,202.5	41,783.7 (30%)
B. Other Expenditures	12,208.0	85,648.0	97,856.0 (70 %)
C. Total (A + B)	45,789.2	93,850.5	139,639.7 (100 %)

6) Sources of Finance

a. Sources of Finance of F/S Projects

It is expected that all the F/S project components (except for operation, maintenance and land purchase costs) will be financed by a bi-lateral aid organization with the scheme of soft loan. The prime borrower will be the Government of Indonesia, through which KMS will acquire sub-loans on conditions that will be agreed between the Government of Indonesia and KMS.

b. Sources of Finance of Other Expenditures

KMS will finance all other expenditures except for those needed for construction of sanitary landfill in the east part of Surabaya, which will cost Rp 12,208 million (Land acquisition Rp 3,542 million + Construction Rp 8,666 million). The following table shows the total expenditures and sources of finance.

Total SWM Costs and Sources of Finance 1992/93 - 1998/99

Unit: Million Rupiah in 1992 price

	Investment (1)	Operation/ Maintenance (2)	Total (1) + (2) = (3)
1. The 4 F/S components	33,581.2	8,202.5	41,783.7 (30 %)
2. Other Expenditures	12,208.0	85,648.0	97,856.0 (70 %)
3. Total (1 + 2)	45,789.2	93,850.5	139,639.7 (100 %)
4. Bilateral Loan revenue	30,307.5	-	30,307.5 (22 %)
5. The Indonesian Government Loan	12,208.0	-	12,208.0 (19 %)
6. Net Expenditures [3 - (4 + 5)]	3,273.7	93,850.5	97,124.2 (69 %)
7. Net Revenue of the Sanitary Retribution	-	-	44,336.0 (31 %)
8. The Remaining to be Covered by the General KMS Budget (6 - 7)	-	-	52,788.2 (38 %)

Note : Item 4 Bi-lateral loan revenue (Rp 30,307.5 million) is estimated in the following manner: Rp 33,581.2 (Item 1) - Rp 243 million (Land purchase cost - See Table 4) - Rp 3,030.7 million (Estimated sum of the value added tax) = Rp 30,307.5 million. Sum of the value added tax is estimated as follows : (Rp 33,581.2 million - Rp 243 million) x 1/11 = Rp 3,030.7 million.

Note: A value 1/11 derives as follows; Value added tax (10%) ÷ (Original price 100% + Value added tax 10%) = 1/11

7) Economic and Financial Evaluation

a. Methods of Evaluation

There are the following two levels of financial and economic evaluation carried out in connection with the F/S project:

1) Evaluation of each F/S project component such as waste haulage equipment, sanitary landfill facility, etc.
2) Evaluation of F/S project as a whole

For the first level of the evaluation, the Least Cost Method (Principle) has been used that are generally applied for the evaluation of municipal SWM projects. The

reason for not using profitability indices such as the net present value, benefit-cost ratio, internal rate of return is that it is not possible to measure, in the monetary units, the direct benefits of the SWM services which is the improvement of cleanliness and sanitary conditions of the city.

For the second level of the evaluation, both KMS' and Surabaya citizens' financial burdens arising from the implementation of the F/S project and other expenditures were examined in terms of ratios of annual net SWM cash expenditures (Project expenditures minus loan revenues plus repayment of loans) relative to projected KMS budget and Gross Regional Product (GRP) of Surabaya respectively.

b. Evaluation

(1) Financial Evaluation of F/S Project Components

Through the application of the least cost method (principle), the least cost equipment and facilities were chosen given that the chosen equipment will perform required functions, and satisfy national regulations, standards and guidelines and other requirements as agreed by the Indonesian Side. The least cost equipment as chosen in the above manner is the most cost-effective equipment. Reasons for choosing specific waste haulage, equipment and disposal facilities are given in the relevant section that explain respective project components.

(2) Financial Evaluation of F/S Project as a Whole

Evaluation of KMS' Financial Burden

The estimated annual net cash expenditures (SWM expenditures minus the expected loan revenues plus loan repayments*) arising from both the four (4) F/S project components and all other expenditures will range from 9.1 % to 10.7 % of the projected KMS' total budget during the F/S project implementation period of 1992/93 - 1998/99 assuming that KMS' annual budget will grow at the same growth rates as recorded during the past 5 yeas (10.8 %/year in real term). The average ratio during the F/S project implementation period is 9.9 %, which is lower than the corresponding average ratio (about 11 %) during the past three (3) years. (Refer to Table 7.) The corresponding ratio after 1998/99 will be lower than those to be experienced during the F/S project implementation period as the KMS budget would increase faster than the rates of increases of the sum of the cash expenditures and loan repayments.

As a conclusion, the financial burden arising from the implementation of the F/S project will not be greater than what is currently experienced.

* Conditions of the Sub-loan from the Central Government to KMS is assumed as follows:

  1. Annual interest rate will be 10.5%
  2. There will be 10 years grace period during which only interest will be paid.
  3. Period of repayment of the principle will be 20 years from 2002.
  4. The bi-lateral loan will be made available to KMS through the Indonesian Government in Rupiah.

Economic Evaluation of Citizens' Financial Burden

At present, the annual sum of SWM expenditures spent by KMS and citizens community group (RT/RW) is about Rp 20 billion per year (Rp 12 billion by KMS and Rp 8 billion by RT/RW in 1992), which is about 0.5 % of the Gross Regional Product (GRP) of Surabaya, Rp 4,100 billion (1990).

Assuming that the KMS budget would grow at the same rate as recorded during the past five (5) years (10.8 %/year on average), and the GRP Surabaya will grow as fast as the KMS budget, the corresponding ratio of the annual net SWM expenditures relative to the GRP will decrease in the future as the ratios of such expenditures to KMS budget are expected to decrease.

As a conclusion, the implementation of the F/S project will not cause both KMS' and citizens' financial burden to increase in terms of ratio of net SWM cash expenditures relative to either KMS budget or GRP.

8) Project Justification

The F/S project comprising of the four (4) project components have been carefully prepared in order to improve KMS' s capacity and the means to manage solid waste. The F/S project has been planned to satisfy the following conditions and criteria.

1. All the national standards and guidelines with respect to solid waste management and environment.

2. Legal environmental assessment procedure (AMDAL)

A legal environmental assessment (ANDAL) was carried in connection with the construction of sanitary landfill in Benowo. The ANDAL executed was accepted and authorized by the Government of Indonesia. Refer to Appendix 2 : Notification of ANDAL Evaluation by the East Jawa AMDAL Commission.

3. Cost-effectiveness

In the preparation of the projects, the priority was given to the cost-effectiveness through the application of the least cost method as explained in Section 7). The equipment and the works planned are those that would perform required functions in safety and sanitary manner at the least costs.

4. Appropriateness of Sizes of the Project Cost

Appropriateness of the project costs is examined in terms of ratios of the net SWM each expenditures (including the F/S project expenditures and all other SWM expenditures) to the projected KMS budget and Gross Regional Product (GRP of Surabaya). The ratios during and after the F/S project period are expected to be not more than the current ratios as shown in Section 7). Therefore, it is judged that the financial burden arising from the implementation of the F/S project would be manageable for KMS and appropriate for the citizens of Surabaya.

F/S Project Component 1: Procurement of Waste Haulage Vehicles, Containers and Handcarts

The purpose of this study is to prepare a complete procurement plan of waste haulage vehicles, containers and handcarts for KMS to be procured during the SUDP (Surabaya Urban Development Projects) period of 7 years from 1992/93 through 1998/99.

1) Outline (Equipment to be Procured)

The proposed types and quantity of equipment to be procured are summarized in the table below. Total procurement cost is estimated to be Rp 6,644.4 million including value added tax (PPN) in 1992 price.

Summary of Procurement Plan of Waste Haulage Vehicles, Containers and Handcarts during 1992/93 - 1998/99

Equipment	Quantity (1)	Unit Price (1992 Price in Million Rupiah) (2)	Total Price (1992 Price in Million Rupiah) (3) = (1) x (2)
A. Waste Haulage Trucks (1 -3)			
1. Arm-roll trucks (7 GVW) for 8 m^3 containers	26	Rp 50.6 m.	Rp 1,315.6 m.
2. Arm-roll trucks (14 GVW) for 14 m^3 container	39	Rp 85.3 m.	Rp 3,326.7 m.
3. Open dump trucks	5	Rp 50.7 m.	Rp 253.5 m.
Sub-Total of Vehicles (1+2+3)	68	-	Rp 4,895.8 m
B. Containers (4 & 5)			
4. 8 m^3 containers	89	Rp 6.0 m.	Rp 534.0 m.
5. 14 m^3 containers	130	Rp 8.0 m.	Rp 1,040.0 m.
Sub-Total of Containers (4+5)	219	-	Rp 1,574.0 m.
C. Handcarts (6 & 7)			
6. 1.0 m^3 handcarts	256	Rp 0.48 m.	Rp 122.9 m.
7. 1.5 m^3 handcarts	94	Rp 0.55 m.	Rp 51.7 m
8. Sub-Total of Handcars	350	-	Rp 174.6 m
Total			Rp 6,644.4 m

Note: 1. The above prices include the value added tax (PNN).
2. It is planned that all the handcarts shown in the above table will be given to local communities (RT/RW) that are relatively low income, in order to support their waste collection activities.

See Figures 6 and 7or recommended types of trucks.

2) Reasons for Recommending 2 Sizes of Containers (8 m^3 and 14 m^3)

The particular capacity of the containers (8 m^3 and 14 m^3) are selected based on the following criteria and conditions:

1. Cost-effectiveness
2. Capacity of the recommended chassis (7 GVW and 14 GVW) that have been chosen based upon operational reliability)
3. Road regulation that restricts dimensions of trucks and freight
4. Sizes of and access to the existing Depo and LPS

Unit Procurement Cost of Truck and Container Per Ton of Waste

Container and Truck System	Unit Procurement Cost
1. Recommended 14 m^3 Container & Truck System	Rp 2,313/ton (100)
1. Current 12 m^3 Container & Truck System	Rp 2,557/ton (111)
1. Recommended 8 m^3 Container & Truck System	Rp 2,630/ton (114)
1. Current 10 m^3 Container & Truck System	Rp 2,995/ton (129)
1. Current 6 m^3 Container & Truck System	Rp 3,385/ton (146)

Comment on 16 m3 Containers: The haulage system with 16 m3 containers as recommended by the IUIDP Sector Report might be more cheaper. However, it is considered that they would be too large, and would not simultaneously satisfy both the road regulation that restricts on the dimensions of trucks and freight, and the structural requirement (If the height of containers is higher than a certain height, the truck with the waste container would not be stable as the gravity center becomes higher than it should be.)

3) Reasons for Recommending 14 GVW Chassis for 14 m^3 Containers

In Indonesia, two kinds of chassis, i.e., 7 GVW chassis and 14 GVW chassis are available. The IUIDP Solid Waste Sector Report recommended, in view of its low cost, 10 GVW chassis uprated from 7 GVW by providing 1 additional rear axle. However, the current study cannot recommend the 10 GVW chassis uprated from 7 GVW chassis due to the reasons shown below unless KMS produces a prototype, and verifies its operational reliability through the test operation.

a. There is no guarantee that the uprated 10 GVW chassis satisfactorily performs its function.

b. Due to the augmented payload, troubles may occur to brake system and driving system such as engine, transmission, because they remain unchanged.

c. There is an uncertainty as to durability. Durability may become shorter than regular chassis. In addition, it may require higher maintenance costs than regular chassis.

4) Policy, Target, Conditions, and Assumptions for Planning

The procurement plan is prepared based upon the policy and targets as explained in the Master Plan. Quantity of equipment is decided on the following conditions.

a. KMS will haul a constant amount of waste, 621 ton/day (equivalent to the current average waste amount hauled by KMS' own trucks) throughout the Master Plan period.

b. All the remaining and incremental waste will be hauled by contractors.

c. The future waste haulage service with compactor trucks and small containers will be contracted out to contractors. Therefore, KMS will not purchase compactor tracks serving for small containers.

5) Feasibility Study of a Large Transfer Station for Waste Haulage to the Planned Disposal Site (LPA) in Benowo

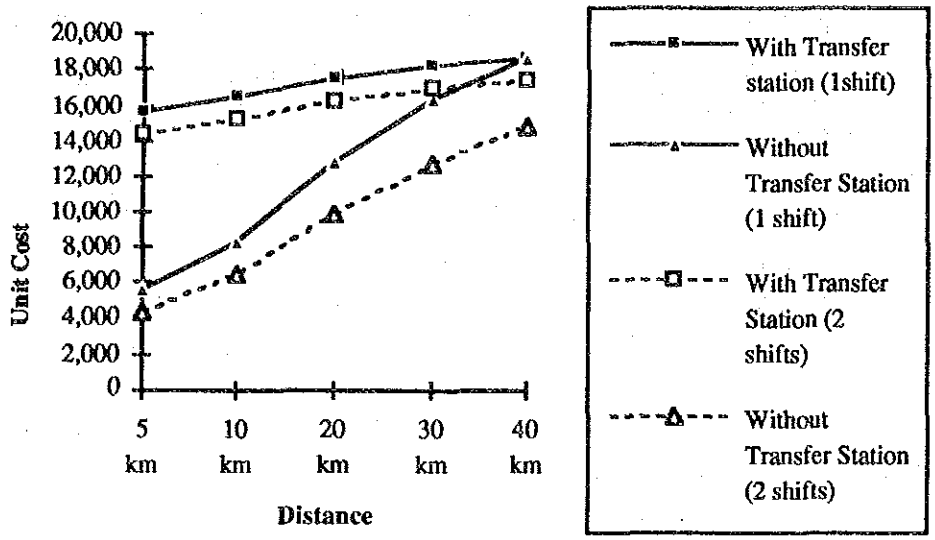
The planned future LPA in Benowo is located further than the existing LPA in Keputih or Lakarsantri. (Locations are shown on the front page map.) The JICA Study Team has made a comparative study of the haulage costs with or without a large transfer station in order to know whether or not a transfer station is necessary. Conclusions are as follows:

1. Under the existing haulage system of Surabaya where there are many Depo & LPS, a large transfer station is not necessary if a final disposal site (LPA) is located within 40 km from collection areas. (See the figure on the next page.)

2. The above conclusion means that construction of any large transfer stations is not feasible, and therefore not advisable if a LPA is located in Surabaya.

3. A transfer station might be necessary if a LPA is constructed outside Surabaya such as Sidoarjo.

4. The KMS's existing haulage system with Depo and LPS is efficient as Depo and LPS serve as mini-transfer stations.



Comparison of Haulage Cost With and Without a Transfer Station

6) Container Placement Plan

A field survey was conducted to prepare a container placement plan to determine as to where containers (either 8 m3 or 14 m3) should be placed. In principle, 14 m^3 containers will be placed in Depo/LPS that have adequate space. It should be noted that some Depo and LPS need either expansion or relocation for placing containers. A complete container placement plan is shown in the Main Report Part 3 Section 2.4.

Space Requirement for Placement of Containers

	Conditions for Placement of 14 m^3 Containers	Conditions for Placement of 8 m^3 Containers
1. Length of Depo/LPS	13 m minimum	11 m minimum
2. Width of Depo/LPS	3 m minimum	2.5 m minimum
3. Width of Entrance	4 m minimum	4 m minimum
4. Turning Space for Trucks	10 m radius minimum for turning	9 m radius minimum for turning

Number of the Existing Depo and LPS to be Placed with Containers

	Depo & LPS to be Placed with 14 m^3 Containers	Depo & LPS to be Placed with 8 m^3 Containers	Number of Depo & LPS that Need either Expansion or Relocation
1. Depo	42	11	0
2. LPS	40	61	6
3. Total (1+2)	82	72	6

F/S Project Component 2: Construction of Sanitary Landfill Site in Benowo

1) Outline of the Proposed Facility

It was decided that a new landfill site should be located in Kecamatan Benowo, the western part of Surabaya City, by the competent officials of KMS including Mayor of the city on November 28, 1992. The whole site has an area of about 150 ha. It was also decided that a western most part of this area would be used as the first sanitary landfill construction site. A feasibility study was conducted for this construcion. The site has an area of approximately 47 ha. Area allocation for facilities is planned as follows giving due consideration to both cost effectiveness and environmental soundness.

Total Area	46.9 ha	100%
Dumping Area	36.9 ha	78%
(Net Area)	(32.2 ha)	(75%)
Retention Pond	2.2 ha	5%
Paved Road	2.6 ha	6%
Administrative Facility	0.3 ha	0.6%
Rainwater Discharge	0.2 ha	0.4%
Miscellaneous	4.7 ha	10%

2) Circumstances of the Project Site

The planned landfill site is located in the following natural conditions.

- 10 to 15 km away from the central part of the city.
- Exists on an alluvium plain that belongs to the River Lamong.
- 5 km away from the estuary of the said river.
- Altitude ranges from 2 to 3 m above sea level.
- Tributaries in and around the site belong to tidal compartment and they contain salty water.
- Surface soil consists of soft silty clay classified as alluvium deposit.
- Surface soil, with a depth of about 10 m, can be regarded as impermeable but compressible by consolidation.

The conditions of the neighboring community is summarized below.

- Most part of the surrounding area is occupied with salt farm or fish pond as shown in Fig. 10.

- The nearest houses (20) are located 300 m away from the entrance of the planned landfill site.
- Four villages are located at the downstream of tribultaries that flow through the planned landfill site.
- These villages have no piped waster, so drinking water is supplied by PDAM tank lorry and stored in a communal reservoir installed in each village.
- There is no permanent residence, amid the salt farm, however, some temporary huts for seasonal laborers of salt farm are scattered.

3) Basic Consideration of Facility Design

To design a landfill site, the technical guideline issued by Directorate of Environmental Sanitation, CIPTA KARYA, was referred to. The guideline explains several negative impacts that may be caused by landfill operation, and at the same time suggests mitigation measures against each impact. First of all, the design of planned landfill site in Benowo followed the relevant recommendations of this guideline as long as the guideline shows circumstances similar to the planned site. Besides this guideline, the following factors were taken into consideration:

a. Environmental protection
b. Construction cost and operation
c. Future land use

a. Environmental Protection : Surrounding water body is mostly used for salt production or fishery. On the contrary, ground water is not utilized in the neighboring villages located along the lower reaches of the tribularies flowing through the planned site due to salinity of the groundwater. Then the fundamental subject in environmental protection is water quality of the surface water.

Considering the circumstances of the site, the water in the site should be controlled to prevent pollution of the surrounding water body in the manner shown below :

a. Enclose the leachate within the site
b. Reduce the leachate by recirculation and evaporation
c. Lower the porewater pressure by underdrain
d. Collect the rainwater that has not touched the garbage separately from the leachate and discharge

Waste pile generates inflammable gases during decomposition process and the gases sometimes cause spontaneous fire. Therefore it is planned that the ventilation facility will be introduced to obtain the following effects of ventilation.

a. Facilitate the aerobic decomposition by supplying air into the garbage layer
b. Shorten the necessary time for stabilizing the layer that results in the subsidence of the surface.
c. Disperse the inflammable gases safely

Another major protection subject is prevention of overflow of garbage out of site as is commonly observed in the existing landfill sites. For this purpose, it is planned that the landfill operation will be conducted within an enclosure dike. Waste surface is also covered with some stable material periodically and finally covered with soil with sufficient thickness.

b. Construction Cost and Operation : The sanitary landfill facilities consist of various sub-systems. As shown below, the Study Team has given a priority to the selection of the most cost-effective systems of the least cost that fulfill required functions.

a. Use of Steel Sheet Pile for Reinforcement of Foundation of Dike

The total construction cost turned out to be costlier than initially thought because the site is covered with soft clay, and it is necessary to reinforce the foundation of dike by driving either steel sheet pile or steel pipes into the clay soil to the depth of 10 m. As a matter of fact, the cost of the reinforcement of the soft clay foundation shares 40 % of the total construction cost of the planned LPA.

As a result of the cost comparison, the use of steel sheet pile is recommended and adopted for the plan because the other method (use of steel pipes) is more than 60 % costlier than the former.

b. Leachate Treatment

There are the following two methods for leachate treatment: 1) leachate recirculation system, and 2) mechanical treatment. The JICA Study recommend the former because the latter is more than 12 times costlier than the former, and the former requires much less and easier maintenance services.

The unit disposal cost (about Rp 12,000/ton max.) of the planned sanitary landfill in Benowo ie still less than one seventh (1/7) of the unit waste incineration cost of the existing incineration (estimated to be about Rp 85,600/ton).

c. Future Land Use : The planned site is involved in a comprehensive development plan called "Rencana Detail Tata Ruang Kota Tambak Osowilangon". Considering this situation, it is planned that the landfill facilities will meet requirements for the planned future land use.

For instance, the facilities are planned to secure dynamic stability from the beginning of operation stage and to secure the earlier stabilization against the decomposition process. Besides this measure, the final soil cover is planned to have sufficient thickness to enable the tree planting on it.

4) Structure and Function of Facility

Planned facilities for the new landfill site consists of the following components, and their layout plan is shown in Fig. 11.

Major Component of Landfill Site

Type	Function and Dimension
a. Access Road	a. Connect the planned site with AMD road b. 10 m wide, 500 m long with buffer zone
b. Leachate Control Facility (See Fig. 12)	a. Consists of collection facility, reservoir and recirculation facility b. Collection facility is composed of horizontal and vertical drain with cobble and PVC pipe c. Recirculation facility is driven by electric power
c. Rainwater Drainage	a. Consists of collection and discharge facility b. Discharge point is selected on the River Sememi c. Capacity is 5 m^3/s that corresponds to a rainfall of 80 mm/h
d. Enclosure Dike	a. Made of soil with sheet pile foundation b. Placed along the boundary of the site to limit the range of dumping area c. Two layer with the height of 3 m and 4 m
e. Divider Dike	a. Made of aged waste in principle b. Limit the range of dumping area c. Placed on the boundary of the partition for the demarcation of annual operation

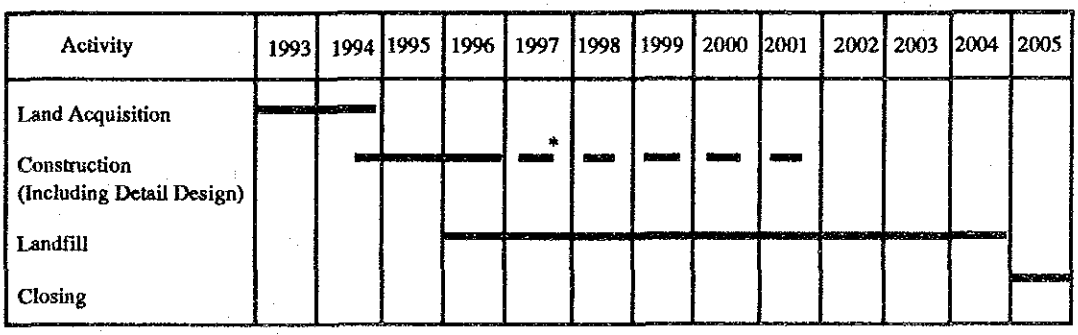
f. Landfill Area	a. Installed on-site road, underdrain for leachate and gas vent according to the progress of the landfill operation b. Divide the whole area of 37 ha into 3 zones Zone 1 12 ha (south) Zone 2 13 ha (center) Zone 3 12 ha (north) c. Final height of garbage layer is 9 m with 1 m soil cover
g. Gas Vent	a. Made of Cobble contained in bamboo cage for gas ventilation and recirculation water b. Installed vertically through the garbage layer and cover soil c. Connected with the under drain at each level
h. Administrative Facility	a. Consists of building and other miscellaneous facilities (Heavy equipment maintenance, Vehicle washing, Vehicle weighing etc.) b. Supposed to be occupied by full time staffs

5) Implementation Schedule of the project

a. Construction of Facility : It is forecasted that the critical time when the existing landfill site is exhausted will be the year 1996. It is necessary to prepare the new landfill site by the year before such critical time at the latest. This means KMS should have the additional capacity of landfill by the end of 1995 with the minimum capacity that meets the demand expected in the next year.

The construction should be continued thereafter according to the annual landfill amount expected in the successive years.

Schedule for Construction of Benowo Landfill Site



Note : * Broken lines mean the installation of underdrain and gas vent.

The planned landfill site for the Feasibility Study is expected to expand to northeastern direction along high tension lines up to Surabaya-Gresik Toll Road. In the course of expansion, it is desirable to keep the landfill point away from the said high tension lines and the toll road in order to protect them against the deformation

of ground surface. Therefore, the retention ponds for each stage of landfill site will be placed along the northern boundary as buffer zone.

b. Landfill Operation : It is estimated that the landfill operation duration will be 9 years based on the simulation for allocation of landfill demand. The whole operation period is divided into three stages with the height of 3 m respectively.

To maintain an environmentally sound condition, it is necessary to control area of working face where waste is unloaded every day. The standard cycle time to form a cell is one week. Covering is planned to be carried out once a week just after finishing unloading and shaping of the cell. The thicknes of cover layer is planned to be 10 to 20 cm for the intermediate cover and 1 m for the final.

6) Project Cost

a. Investment Cost : Total investment amount is estimated at about Rp. 25.6 billion including the value added tax as shown below.

Investment Schedule

(unit : Rp million)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Initial	18,335	3,692	0	0	0	0	0	0	0	0	22,027
Additional Construction Cost	0	1	1	1,405	1,000	1,113	2	2	2	57	3,583
Total	18,335	3,693	1	1,405	1,000	1,113	2	2	2	57	25,610

b. Operation and Maintenance (O & M) Cost : This cost is classified into two (2) types, namely 1) costs of operation and maintenance for heavy equipment including salary of employees, and 2) costs for application of cover material.

Operation and Maintenance Cost

(unit : Rp million)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
O & M of Heavy Equipment	0	353	353	353	353	353	353	353	353	353
Cover Soil Application	0	330	330	330	330	330	330	600	600	600
Total	0	683	683	683	683	683	683	953	953	953

The operation and maintenance cost is estimated at about Rp 683 million /year including sanitary operation for the first six (6) years and Rp 953 million/year for the

last three (3) years. Unit costs are estimated to be about Rp 2,100/ton for the first six (6) years, and about Rp 2,900/ton for the last three (3) years, which are higher than the present unit operation and maintenance cost by 25% and 75% respectively mainly due to the application cost of cover material.

7) Environmental Impact Assessment (EIA)

a. Procedure of Assessment

An Environmental Impact Assessment (EIA) was carried out in accordance with the laws and regulations of Indonesia including related standards and by-laws. The EIA and its appraisal were conducted under the control of the AMDAL Commission consisting of the Central AMDAL Commission of Cipta Karya and the Local AMDAL Commission of East Java Provincial Government.

The ANDAL was carried out with steps of impact identification, data collection, impact forecasting and suggestion of mitigation measures, and impact assessment based on the Terms of Reference (KA ANDAL) approved by the Local AMDAL Commission.

b. Results of Assessment

A detailed assessment of the project impact was carried out, and an ANDAL report was submitted to the Local Commission of AMDAL for its approval. The commission finally concluded that the project is considered to be environmentally sound in terms of natural and social conditions. At the same time, the executing agency is requested to pay attention to the following issues and to take necessary measures to mitigate such negative effects that may be caused by the project implementation.

1. The leachate should be handled by constructing leachate retention ponds to control its limited state.

2. The necessary measures should be taken to handle the air pollution problems such as dust, noise, offensive odor and gasses. Such measures will include the followings.

   - Spray water on access roads close to the neighboring communities
   - Cover the freight of vehicles with canvas or plastic sheet

- Proceed with no activities at night
- Provide a green belt as a buffer zone around the landfill site
- Cover the waste layer with soil as soon as possible
- Diffuse gasses safely through ventilation network

3. The negative impacts on the social culture of local society which may be caused by the operation of the new disposal site should be mitigated.

4. The countermeasures to keep the aesthetic environment of the surrounding society in good condition should be taken as required.

5. The measures should be taken to mitigate the traffic congestion caused by waste haulage trucks.

Following the approval of ANDAL, the Commission requested that an Environmental Management Plan (RKL) and an Environmental Monitoring Plan (RPL) should be prepared by the project proponent (KMS), and submitted to the Commission.

F/S Project Component 3: Construction and Rehabilitation of Depo/LPS and Improvement of Asemrowo Workshop

1) Background, Purpose and Outline of the Project

a. Construction of New Depo and LPS : At present, KMS has 58 Depo and 102 LPS in Surabaya which serve as small transfer stations. (A Depo has a small administrative office stationed with an officer, while LPS does not have such office.)

The existing Depo and LPS is not sufficient in number at present. In principle, a Kelurahan should be provided with either a Depo or LPS. In view of the future increases in population and waste amount, it is considered necessary to construct new Depo and LPS.

It is planned 24 Depo and 12 LPS will be constructed during the 4 years period 1994/95 - 1997/98. Total construction cost is estimated to be Rp 1,157 million approximately in 1992 price. See Fig. 13 for location of Depo and LPS planned.

The priority is given to Kelurahan with higher population density in the selection of the Kelurahan where new Depo or LPS are constructed, as well as in the determination of time order of construction.

b. Rehabilitation of the Existing Depo and LPS : Some of the existing Depo and LPS need rehabilitation with respect to the following facilities:

1. Wall
2. Office building
3. Drainage
4. Gate
5. Floor
6. Water pipes and Electricity equipment
7. Enlargement of entrance
8. Expansion of area

In addition, tree planting around Depo and LPS is advisable as it is effective to make them look nicer. KMS should identify suitable kinds of trees.

It is planned that 30 Depo and 34 LPS will be rehabilitated during the planned 4 years period 1994/95 - 1997/98. In addition, it is planned that tree will be planned for 90 % of Depo and LPS during the period. Total cost of the rehabilitation is estimated to be Rp 184 million.

c. Improvements of Asemrowo Workshop : In order to improve the vehicle maintenance capacity of Asemrowo Workshop, the following construction and procurement is planned.

1. Remodeling of the Workshop
2. Procurement of tools and equipment for maintenance and repair

2) Plans for Construction and Rehabilitation of Depo/LPS

A plan for Depo/LPS construction and rehabilitation and improvement of Asemrowo is shown in the main report Part 3 Chapter 4 which explains where (in which Kelurahan) new Depo and LPS should be constructed, and which Depo and LPS need rehabilitation.

Land Acquisition

Of the 24 Depo and 12 LPS to be constructed, it is identified that KMS should purchase land for construction of nine (9) Depo as shown in the table below. Land for other Depo and LPS is either owned by KMS or can possibly be made available for KMS free of charge.

Land Acquisition for Construction of New Depo and LPS

Land Status	Depo	LPS
1. Number of Depo & LPS to be constructed	24	12
2. Number of Depo & LPS of which land is owned by KMS	10	1
3. Number of Depo & LPS of which land belongs to other persons or organizations, but can possibly be made available for KMS' use free of charge	5	11
4. Number of Depo & LPS of which land must be purchased (1 - 2 - 3)	9	0

3) Plan for Improvement of Asemrowo Workshop

This plan have the following two components:

1) Remodeling of the Workshop
2) Procurement of tools and equipment for maintenance and repair

a. Remodeling of the Workshop : A main idea of the remodeling is to divide the workshop into two parts; maintenance area on the east side of the workshop, and car parking area on the west side. Fig. 14 shows the remodeling plan.

Needless to mention, removal of abandoned trucks is the prerequisite for carrying out the remodeling. Remodeling works include the following:

1) Construction of a fuel pump station
2) Pavement of vehicle passage
3) Remodeling of the building

b. Procurement of Tools and Equipment for Maintenance and Repair : Asemrowo Workshop is not equipped with adequate tools and equipment for maintenance and repairs. For example, the Workshop does not have equipment such as gauges that are needed for measuring the accuracy and appropriateness of repairs and adjustments made.

The equipment and tool recommended are basic ones necessary for carrying out proper and effective maintenance and repairs. The equipment to be purchased are shown in the main report Part 3 Chapter 4.

Although most of the listed equipment are relatively simple and easy to use, the adequate training on the usage of those equipment should be provided.

4) Investments Needed

The total cost needed for the implementation of the programs is estimated to be about Rp 1,608 million in 1992 price as shown below:

1) Construction of new Depo (24) and LPS (12):	Rp 1,157,100,000
2) Rehabilitation of the existing Depo (30) and LPS (34);	Rp 183,735,000
3) Improvement of Asemrowo Workshop:	Rp 267,004,180
Total:	Rp 1,607,839,180

F/S Project Component 4: Procurement of Heavy Equipment

Heavy equipment is used for operation of landfill in final disposal sites (LPA). At present, KMS have 7 bulldozers, 2 compactors and 1 wheel-loader.

Of the 7 bulldozers, only one bulldozer is considered in good conditions, 5 of them are seriously damaged. Most of the damages occurred to the undercarriage. Some of the damaged bulldozers can be operational through overhaul, but some are not worthwhile to overhaul. It is necessary to replace them with new ones. A new bulldozer is also needed for the planned LPA in Benowo.

Types, quantities and cost of heavy equipment to be procured or overhauled during the SUDP period are shown in the table below.

Unit: Rupiah in 1992 price

Equipment	Unit Price (1)	Quantity (2)	Costs (1) x (2) = (3)
1. New bulldozer to be used in Keputih LPA	Rp 300,000,000	3	Rp 900,000,000
2. Rotary screen	Rp 15,000,000	1	Rp 15,000,000
3. Bulldozer overhaul	Rp 100,000,000	4	Rp 400,000,000
4. Landfill compactor overhaul	Rp 100,000,000	2	Rp 200,000,000
5. Wheeled loader overhaul	Rp 50,000,000	1	Rp 50,000,000
6. New bulldozers to be used in Benowo LPA	Rp 300,000,000	1	Rp 300,000,000
7. New excavator to be used in Benowo LPA	Rp 230,000,000	1	Rp 230,000,000
Total	-	13	Rp 1,895,000,000

Note: 1. The above prices include the value added tax (PPN).
2. Item 7 (new excavator) will be used mainly for loading cover materials into open dump trucks in Benowo LPA.

The above items 1 - 5 will be used for the LPA in Keputih, while items 6 and 7 will be used for the planned LPA in Benowo. The former items (1 - 5) are identical with a plan contained in the Addendum (July 1991) to IUIDP Solid Waste Management Sector Report.

5. RECOMMENDATIONS

This part presents major recommendations deriving from the current study.

1) Construction of 2 Disposal sites (LPA) in Benowo and the East Part of Surabaya

KMS should construct two (2) LPA; one in Benowo and the other in the east part of Surabaya as planned and shown in this report. The construction of 2 (two sites) would enable KMS to save waste haulage costs by over Rp 6.4 billion/year on average throughout the master plan period from 1993 to 2010. The waste haulage cost under the case with only one LPA in Benowo would be 2.2 times costlier than the case with the 2 LPA.

2) Application of Sanitary Landfill

KMS should apply the sanitary landfill. The open dumping, though cheaper than the sanitary landfill, would not be suitable to the City of Surabaya that has won honorable Adipura 5 times and a few other international environmental awards. From both environmental and economic view points, the sanitary landfill is the most appropriate waste disposal method for KMS among other methods including open dumping, sea reclamation, incineration, composting. It is estimated that the cost of the sanitary landfill is about one twelfth (1/12) of the incineration cost and a half of the sea reclamation cost.

3) Acquisition of Land for Sanitary Landfill in Benowo and East Part of Surabaya

It is crucial for KMS to acquire a land (150 ha in total) in Benowo; about 40 ha by 1994 and the remaining 110 ha by 2002 both in order to construct sanitary landfill sites as planned. It is also necessary for KMS to acquire land (120 ha in total) in the east part of Surabaya; 14 ha by 1995, 31 ha by 1999, and 75 ha by 2005.

4) Increase of Waste Haulage Coverage

KMS should do the following in order to increase waste haulage coverage:

a. Provide all Keluranhan with Depo and LPS

b. Provide small containers where Depo or LPS cannot be placed.
c. Provide low-income RT/RW with handcarts.
d. Rehabilitate some Depo and LPS as planned.

5) Increase of Waste Haulage Efficiency

KMS should do the following in order to increase waste haulage efficiency:

a. Use more contractors.
b. Use larger containers (14 m3 and 8 m3).
c. Provide all Depo and LPS with containers.
d. Improve vehicle maintenance through
   (1) Introduction of daily checking of vehicles and of regular maintenance and repair,
   (2) Quicker procurement of adequate spare parts,
   (3) Removal of abandoned vehicles and containers from Asemrowo workshop,
   (4) Remodeling and improvement of Asemrowo workshop.
e. Reduce crew of arm-roll trucks from the current 2 (1 drivers & 1 assistant) to 1 driver.

6) Increase of Efficiency of Street Sweeping

KMS should do the following in order to increase the efficiency of street sweeping:

a. Reduce sweeping frequency wherever possible.
b. Use more contractors.

7) Shift of Waste Haulage Responsibility from KMS to Generators of Large Waste Amount

It is recommended for KMS to transfer the waste haulage responsibility from KMS to generators of large waste amount (2.5 m^3 or more each day) in order to save costs. KMS would be able to save over Rp one billion/year on average throughout the master plan period from 1993 to 2010 if it shifted the responsibility as planned (A proposed target is to gradually increase the self-hauled-waste from the current 8 % to 25 % of the total waste generation by 2000.)

8) Increase of Use of Contractors for Waste Haulage and Street Sweeping

It is recommended that KMS will increase the use of contractors for both waste haulage and street sweeping in order to save costs. KMS would be able to save 1,173 million/year on average throughout the master plan period from 1993 to 2010 if it increased the use of contractors as planned. A policy is that KMS will haul a constant waste amount same as the current level, while all the remaining and incremental waste should be hauled by contractors. As a result, the ratio of waste hauled by contractors would increase from the current 30 % to 73 % by 2010 in terms of waste haulage amount. A target of street sweeping is to increase contractors' sweeping service from the current 50 % to 75 % by 2000 in terms of length of streets swept.

9) Regular Revision of Rates of the Sanitary Retribution

It is recommended that KMS will revise rates of the sanitary retribution every three (3) years, and increase the revenue of the retribution so as to increase the cost recovery ratio. The current ratio is as low as 27 %. A proposed target cost recovery ratio is 44 % in 2000, and 54 % in 2010.

10) Use of PLN' (electric company) Tariff Collection Points

It is recommended that KMS would use PLN' tariff collection points as collection points of the sanitary retribution. Through the use of PLN' tariff collection points, the revenue of the sanitary retribution would substantially increase because 1) number of payers will increase, and 2) the handling charges paid by KMS will decrease to 5 % of the gross revenue from the current average of 15 %. At present, KMS pays 26 % of the sanitary retribution revenue collected through RT/RW to RT/RW and persons involved in the collection of the retribution, and 10 % of the retribution collected through the Municipal Water Authority (PDAM) to PDAM as handling charges related to the fee collection.

11) Application of Volume-Based Fee Rates to Business Waste

At present, the rates of the sanitary retribution does not depend on the volume of waste discharged. It is recommended to apply volume-based fee rate to business waste like the Municipal Cleansing Company (PDK) of Bandung. The application of this method would 1) enable KMS to increase revenue of the sanitary retribution, and 2) provide business establishments an incentive to reduce waste generation volume, which are good from environmental view point.

12) Waste Amount Reduction

KMS should do the following:

a. Promotion for the reduction of weight of agricultural products coming into markets by such means as removing nutshell of agricultural products before bringing them into the city
b. Supports of scavengers. A proposed target is to increase the waste recycling amounts so that it will be constant at 11 % in terms of share to the total waste generation in Surabaya

13) Establishment of an Independent Cleansing Authority (Perusahaan Daerah Kebersihan Surabaya - PDKS)

It is recommended that KMS will establish an independent cleansing authority like PDK Bangdung. Through the establishment of such authority, the SWM service efficiency (cost effectiveness) would increase, and cost recovery ratio will increase. It is important to realize that even after establishment of the authority, KMS' supports of the authority are required in the such areas as 1) law enforcement and 2) finance.

14) Establishment of a Disposal Section

It is recommended that the existing cleansing department of KMS would be reorganized so as to establish a disposal section specializing in the planning and operation of waste disposal, which are increasingly important.

15) Government' Financial Assistance for KMS in Construction of Sanitary Landfill

Land acquisition for LPA is not easy job for most local governments including Surabaya. They are also hesitant in constructing a sanitary landfill which is a few times costlier than the open dumping. However, the sanitary landfill is necessary in order to meet the sanitary standard shown in the national guideline, and to avoid the environmental pollution problems that would become more and more serious in the future. It makes sense for the Central government to provide local governments with financial assistance (grant or low-interest loans) to promote construction of sanitary landfill.