

4. Implementation of Pilot Projects

During the study work in Honduras, the following four pilot projects were conducted to verify the feasibility of the technical system proposed in the M/P, introduce SWM techniques, and collect necessary data and information. The aim and the activities of the each pilot project are introduced with pictures in Appendix.

- 1) Campaign for Raising Awareness on Solid Waste Issues
- 2) Experiment on the Implementation of the Best Collection System for Marginal Areas
- 3) Experiment on the Improvement of Existing Final Disposal
- 4) Improvement of the Managerial Capability of the Cleansing Section

4.1 Campaign for Raising Awareness on Solid Waste Issues

a. Outline of the Project

This pilot project aimed to strengthen the education program on solid waste issues in the "Alcaldia Mobile³" campaign, currently conducted by the AMDC to focus on the improvement of sanitation.

The campaign primarily focuses on making the public aware of the potential hazards of solid waste, the necessity of proper solid waste management, the responsibility of both the citizens and the AMDC, and the required manner of public participation.

b. Findings

- a) The execution of the campaign project and the presentation of educational panels and films could open the eyes of the people to the environmental problems that currently prevail. The majority of community leaders and residents participated and cooperated fully during the campaign project.
- b) The experiment made the people realize how dirty their towns are and how important appropriate solid waste disposal is. The continuation of the sanitary education programs will further motivate the people to continually keep their towns clean and beautiful.
- c) Many people understand that the conduct of the campaign and sanitary education programs would significantly contribute to solving current environmental and health problems, as these programs are instrumental to the proper conduct of waste collection and disposal services. This is why the residents were considerably grateful for the conduct of the pilot projects.
- d) The method of community education on solid waste used for the experiment was found to be very effective in San Martin, Ayestas and Tres de Mayo. Aside from slight modifications in accordance with town/city characteristics, the method is considered applicable to many areas and other cities in Honduras as well.

³ It means "mobile municipality".

4.2 Experiment on the Implementation of the Best Collection System for Marginal Areas

a. Outline of the Project

This experiment aimed to investigate the applicability of the container collection system for marginal areas where collection services are currently insufficient or not provided. Communal containers were placed in the project areas and collected periodically.

This experiment also included the implementation of clean-up operations in marginal areas to prevent illegal dumping and to improve public attitudes.

b. Findings

- a) The residents basically understood the container collection system, thanks mainly to the instructions given in the workshops. There was no more waste discharge in illegal dumpsites (A1 & A2) after the cleansing activities.
- b) The campaign project, clean-up operations, and the collection experiment, carried out in the pilot project areas, helped to promote SWM improvement in other neighboring *colonias*, such as Zapote Norte west of Tres de Mayo, that requested the AMDC to provide equipment and a container for cleansing activities. The clean-up operation of Zapote Norte which took place on August 8, was carried out by the initiative of the residents, with the AMDC providing the cleansing equipment and the container.
- c) Although there was a time constraint, it was possible to confirm, through the evaluation of the proposed objectives, that the experimental collection system were successful. The results were promising as residents in beneficiary areas were highly cooperative. Further, public motivation in the project areas spread to other neighboring *colonias*, that undertook their own clean-up operations with the help of the AMDC. The residents efforts are highly commendable and are seen as an invaluable achievement of this experiment.

4.3 Experiment on the Improvement of Existing Final Disposal

a. Outline of the Project

This experiment aims to improve the sanitary level of the final disposal site through the partial improvement of the site, by demonstrating landfill technology and on the job training of staff on proper sanitary landfill operation methods.

b. Findings

- a) Implementation of the on-the-job training of AMDC staff and the installation of essential sanitary landfill facilities were very successful. AMDC's engineer quickly grasped all of the concepts that were explained to him, and attained the respect of fellow landfill staff and scavengers. His ability to manage, however, is greatly hindered by poor facilities.

- b) Equipment operators are skilled and after only a few days of instruction and trials, sanitary landfilling methods were being carried out smoothly and in a professional manner.
- c) The installation of basic facilities was done without problems and all were operating as planned at the end of the pilot project stage.
- d) Scavengers cooperated and understood that the changes being made were also in their interests.
- e) Even though every one was made clearly aware of the importance of sanitary landfilling methods and understood how to implement them. Once the experiment was over and the study team left, sanitary landfilling immediately ceased and the landfill staff reverted back to the previous landfilling methods. Because of institutional problems the AMDC administration is not supplying a sufficient amount of fuel for the bulldozers to continue applying the methods learnt.
- f) Scavenging activities are again not being controlled. Frequent change is discouraging and confusing to them. Because constant supervision and assistance is necessary for the scavengers to gain confidence in the newly introduced methods.
- g) Even though the condition of the disposal site markedly improved through the implementation of this experiment, sustained improvement is vital. And sustained improvement can only occur with institutional reform thus ensuring the provision of spare parts and fuel, the coordinating the use of landfill equipment, support for the proper management of the site and scavengers, and planning of future disposal activities.

4.4 Improvement of the Managerial Capability of the Cleansing Section

a. Outline of the Project

This pilot project focuses mainly on the improvement of record keeping, cost control, and cost analysis systems by using computers. It also includes training staff on management methods by using computers.

b. Findings

- a) The SWM program for computer proved that the present record keeping system is unreliable because considerable data were found to be inconsistent. It can conclude that the improvement of basic information should go together with the improvement of management system.
- b) Some of AMDC staff have realized the importance of monitoring the performance with the data.

5. Feasibility Study for the Priority Projects

5.1 Outline of the Priority Projects

a. Targets of the First Priority Projects

The SWM master plan covers all proposed projects to be conducted from 1999 until 2010, while the priority projects covers only from 1999 until 2002 and aim at:

- a) Improvement of Institutional System;
- b) Preliminary Design for the Improvement and Overall Development of the Existing Disposal Site; and
- c) Improvement of Collection and Haulage System;

Table 12 shows the targets for the priority projects.

Table 12: Target for the Priority Projects

Items	unit	1998	1999	2000	2001	2002	2003
A. Main Targets							
Collection Rate	%	64%	64%	64%	72%	72%	72%
Recycling Rate	%	3%	3%	3%	4%	4%	4%
Street Swept Length	km	180	180	180	180	190	190
Final Disposal		Level 1		Level 2			
B. Detailed Targets							
1. Waste Generation Amount		481	514	550	586	626	667
Residential Waste	t/d	318	342	367	392	419	447
Non-residential Waste	t/d	134	144	155	166	177	190
Street Sweeping Waste	t/d	28	28	28	28	30	30
2. Waste Collection Amount		309	330	352	422	451	480
Collection of Residential Waste	t/d	213	229	246	294	314	336
Collection of Non-Residential Waste	t/d	67	72	77	99	106	114
Collection of Street Sweeping Waste	t/d	28	28	28	28	30	30
Direct Haulage	t/d	27	29	31	33	35	38
On-site Disposal	t/d	19	21	22	24	25	27
Recycling	t/d	0	7	8	10	10	11
Uncollected	t/d	-126	-128	-137	-98	-104	-111
3. Service Rate		64%	64%	64%	72%	72%	72%
High Income Residents	%	90%	90%	90%	100%	100%	100%
Middle Income Residents	%	70%	70%	70%	80%	80%	80%
Low Income Residents	%	50%	50%	50%	55%	55%	55%
4. Service Population							
4.1 Service Population		543,270	565,568	588,781	685,868	714,392	744,099
High Income Residents	t/d	152,795	154,848	156,825	176,353	178,350	180,232
Middle Income Residents	t/d	178,260	194,552	211,851	263,099	285,360	308,969
Low Income Residents	t/d	212,215	216,169	220,105	246,417	250,681	254,899
4.2 Unserved Population		305,589	316,754	328,323	267,389	276,443	285,796
High Income Residents	t/d	16,977	17,205	17,425	0	0	0
Middle Income Residents	t/d	76,397	83,379	90,793	65,775	71,340	77,242
Low Income Residents	t/d	212,215	216,169	220,105	201,614	205,103	208,554
5. Final Disposal Amount		353	358	382	454	485	517
Municipal Waste	t/d	343	347	370	442	472	503
Others	t/d	10	11	12	12	13	14

Table 13: Contents of the Priority Projects

System	Description																																
1. Institutional System																																	
1.1 Administration & Organization	1) In 1999, the Solid Waste Management Executing Unit (SWEU), which will be a temporary organization directly linked to the Mayor's office, will be established. 2) In 2000, the Municipal Cleansing Corporation (MCC) which is a Solid Waste Management Autonomous Entity will be established. The AMDC shall hold at least 51% of whole capital of the MCC.																																
1.2 Financial System																																	
1.2.1 Waste Fee Collection System	In 2001, the joint billing of waste collection fees and electricity charges will begin.																																
1.2.2 Waste Collection Fee	1) Residential waste collection fee: (unit: Lps/month/house) <table><tr><td></td><td>2001</td><td>2003</td></tr><tr><td>high-income group:</td><td>Lps. 63</td><td>Lps. 70</td></tr><tr><td>middle-income group:</td><td>Lps. 22</td><td>Lps. 33</td></tr><tr><td>low-income group:</td><td>Lps. 11</td><td>Lps. 18</td></tr></table> 2) Non-residential waste collection will be charged according to their annual turnover according to the proposed fee table. <table><tr><td>Annual business income</td><td>Fee Rate</td></tr><tr><td>more than Lps.4,000,000</td><td>Lps. 500 /establishment/month</td></tr><tr><td>Lps.3,000,001-4,000,000</td><td>Lps. 450 /establishment/month</td></tr><tr><td>Lps.2,000,001-3,000,000</td><td>Lps. 400 /establishment/month</td></tr><tr><td>Lps.1,000,001-2,000,000</td><td>Lps. 250 /establishment/month</td></tr><tr><td>Lps.500,001-1,000,000</td><td>Lps. 200 /establishment/month</td></tr><tr><td>Lps.300,001-500,000</td><td>Lps. 150 /establishment/month</td></tr><tr><td>Lps.100,001-300,000</td><td>Lps. 100 /establishment/month</td></tr><tr><td>Lps.50,001-100,000</td><td>Lps. 75 /establishment/month</td></tr><tr><td>up to Lps.50,000</td><td>Lps. 50 /establishment/month</td></tr></table> 3) Collection service rate for large discharger: Lps. 480/ton in 2001 4) Direct haulage rate: Lps. 50/ton in 2001		2001	2003	high-income group:	Lps. 63	Lps. 70	middle-income group:	Lps. 22	Lps. 33	low-income group:	Lps. 11	Lps. 18	Annual business income	Fee Rate	more than Lps.4,000,000	Lps. 500 /establishment/month	Lps.3,000,001-4,000,000	Lps. 450 /establishment/month	Lps.2,000,001-3,000,000	Lps. 400 /establishment/month	Lps.1,000,001-2,000,000	Lps. 250 /establishment/month	Lps.500,001-1,000,000	Lps. 200 /establishment/month	Lps.300,001-500,000	Lps. 150 /establishment/month	Lps.100,001-300,000	Lps. 100 /establishment/month	Lps.50,001-100,000	Lps. 75 /establishment/month	up to Lps.50,000	Lps. 50 /establishment/month
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1.3 Management System	1) The MCC's accounting, financing, planning, monitoring and supervision capabilities will be improved. 2) The involvement of private sector will be gradually extended in the SWM services. Contract A: Collection and Haulage of Municipal Solid Waste (MSW) in the City's Urban Areas Contract B: Collection and Haulage of Municipal Solid Waste in the City's Marginal Areas 3) The operation of collection and haulage service will be gradually shifted to from the public sector to the private sector. In that process the MCC will directly operate at least 25% of the collection and haulage works. 4) The MCC will hold an open bid so that proceedings are transparent to the general public. 5) The MCC limits the amount to be collected in one contract area to less than 50 tons/day. 6) The contract rate of collection and haulage work will be kept at less than Lps. 300 per ton.																																

2. Technical System																																																	
2.1 Collection and Haulage	1) The proposed proportion of waste collection amount for AMDC's or MCC's direct operation and contractors' operation are as follows. <div>unit: ton/day</div> <table><tr><td></td><td>1999</td><td>2000</td><td>2001</td><td>2002</td><td>2003</td></tr><tr><td>AMDC</td><td>230</td><td>252</td><td>222</td><td>251</td><td>280</td></tr><tr><td>Contractors</td><td>100</td><td>100</td><td>200</td><td>200</td><td>200</td></tr><tr><td>total</td><td>330</td><td>352</td><td>422</td><td>451</td><td>480</td></tr></table>		1999	2000	2001	2002	2003	AMDC	230	252	222	251	280	Contractors	100	100	200	200	200	total	330	352	422	451	480																								
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	2) Planned Number of Collection Vehicles to be owned by the MCC. <table><tr><td></td><td>1999</td><td>2000</td><td>2001</td><td>2002</td><td>2003</td></tr><tr><td>15m³ compactor</td><td>11</td><td>11</td><td>10</td><td>10</td><td>10</td></tr><tr><td>13m³ compactor</td><td>9</td><td>9</td><td>0</td><td>0</td><td>0</td></tr><tr><td>8m³ compactor</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr><tr><td>12m³ dump truck</td><td>10</td><td>10</td><td>0</td><td>5</td><td>5</td></tr><tr><td>5.5m³ hoist truck</td><td>1</td><td>1</td><td>0</td><td>9</td><td>9</td></tr><tr><td>10m³ armroll truck</td><td>1</td><td>1</td><td>0</td><td>0</td><td>9</td></tr><tr><td>Leased 6m³ dump truck</td><td>0</td><td>3</td><td>29</td><td>16</td><td>8</td></tr></table>		1999	2000	2001	2002	2003	15m ³ compactor	11	11	10	10	10	13m ³ compactor	9	9	0	0	0	8m ³ compactor	0	0	0	0	3	12m ³ dump truck	10	10	0	5	5	5.5m ³ hoist truck	1	1	0	9	9	10m ³ armroll truck	1	1	0	0	9	Leased 6m ³ dump truck	0	3	29	16	8
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3) Procurement Schedule (unit: nos) <table><tr><td></td><td>1999</td><td>2000</td><td>2001</td><td>2002</td></tr><tr><td>15m³ compactor</td><td>0</td><td>10</td><td>0</td><td>0</td></tr><tr><td>8m³ compactor</td><td>0</td><td>0</td><td>0</td><td>3</td></tr><tr><td>12m³ dump truck</td><td>0</td><td>0</td><td>5</td><td>0</td></tr><tr><td>5.5m³ hoist truck</td><td>0</td><td>0</td><td>9</td><td>0</td></tr><tr><td>10m³ armroll truck</td><td>0</td><td>0</td><td>0</td><td>9</td></tr><tr><td>5.5m³ container</td><td>0</td><td>0</td><td>90</td><td>0</td></tr><tr><td>10m³ container</td><td>0</td><td>0</td><td>0</td><td>90</td></tr></table>		1999	2000	2001	2002	15m ³ compactor	0	10	0	0	8m ³ compactor	0	0	0	3	12m ³ dump truck	0	0	5	0	5.5m ³ hoist truck	0	0	9	0	10m ³ armroll truck	0	0	0	9	5.5m ³ container	0	0	90	0	10m ³ container	0	0	0	90									
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2.2 Street sweeping system	1)The present street sweeping work is mainly conducted manually and is deemed to be an appropriate method until 2010 due to cheap labor costs and inferior road conditions that would hamper mechanical street sweeping equipment. Therefore, this system basically would be maintained until 2010. 2)Following improvement measures will be executed. a) Economic utilization of micro-enterprises b) To install more litter boxes along streets c) To increase the number of collection points d) To use a new type of cart to carry litter collected e) To set up site offices with space																																																
2.3 Final disposal	1) Existing Final Disposal Site a) In 1999, the following facilities will be constructed in order to improve the existing disposal site: weighbridge; leachate circulation system; gas vents; fence; site office; green buffer zone; garage; etc. b) The cooperation of scavengers will be encouraged.																																																
	2) New Final Disposal Site a) In 2001, the committee for selection of a new disposal site will be established. b) In 2002, the new site will be decided. c) In 2003 a preliminary design and EIA for the new disposal site will be done.																																																

5.2 Improvement of Institutional System

As the improvement of the institutional system is a priority issue concerning the improvement of the present SWM system, its reform shall be conducted in two stages. The first stage targets immediate improvements, and the second stage aims for full-scale improvement.

First Stage: Immediate Improvement Plan

"Establishment of a Solid Waste Management Executing Unit"

Description:

An SWM Executing Unit, a temporary organization directly linked to the Mayor's office, will be established immediately. The SWM Executing Unit will have the same functions as the present Cleansing Department, however, its hierarchy level will be raised to much a higher level than the present Cleansing Department.

This improvement aims at the following.

- Urgent improvement of the SWM system's efficiency with minimal changes in the administering of the present organizational system.
- Execution of necessary preparations for the establishment of an autonomous entity to undertake solid waste management.

Schedule: In early 1999

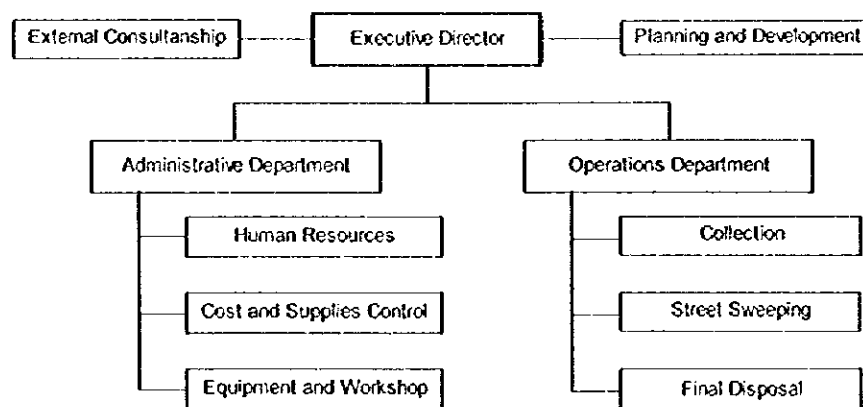


Figure 8: "1st Stage" Organizational Chart of SWM Executing Unit

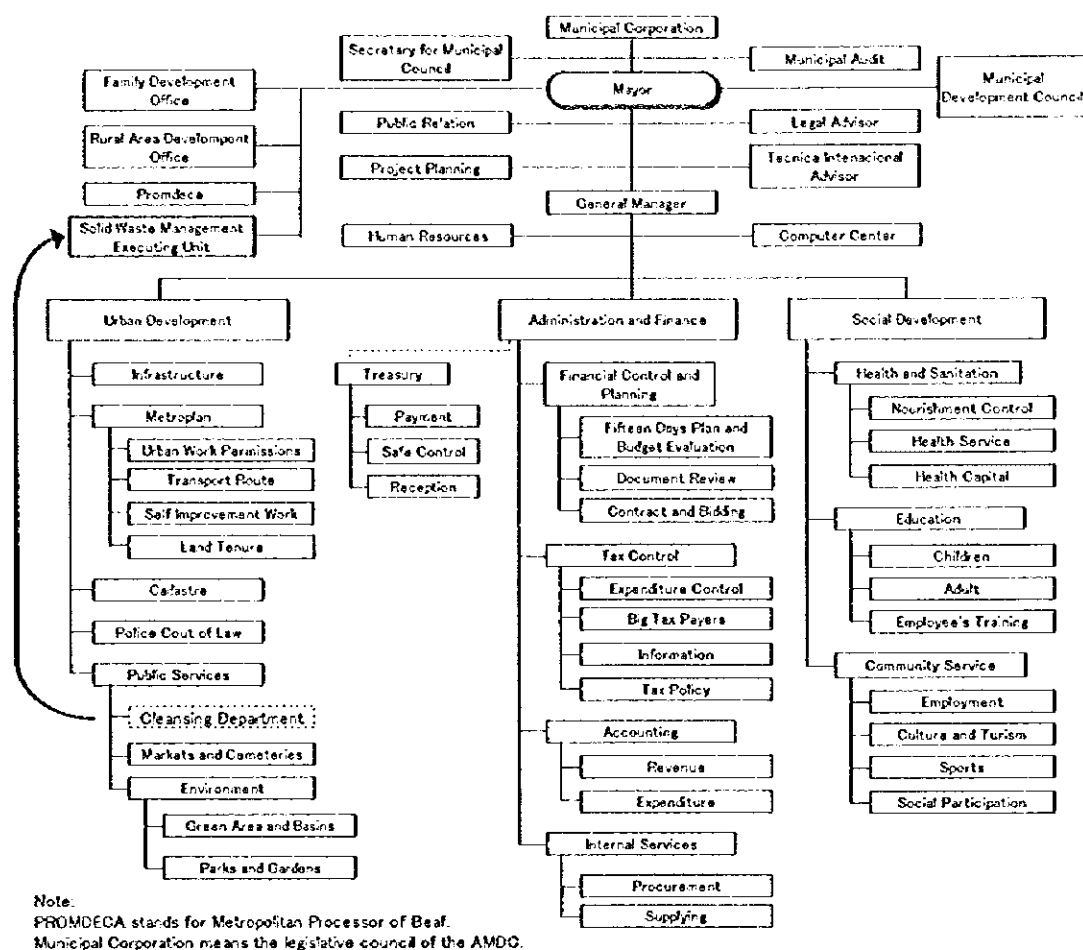


Figure 9: "1st Stage" Proposed Hierarchy Level of SWM Executing Unit

Second Stage: Full-scale Improvement Plan

"Establishment of a Solid Waste Management Autonomous Entity"

Description:

An autonomous entity with complete administrative and financial autonomy, for the purpose of having an integral management of municipal SWM in the Central District, will be established.

Objective:

- To halt and reverse environmental deterioration caused by the provision of waste services.
- To rehabilitate, to renew, and to expand the infrastructure.
- To guarantee service quality with appropriate controls.
- To improve and to simplify contacts with clients.
- To contribute to the recovery of the environment.

Schedule: Before 2001

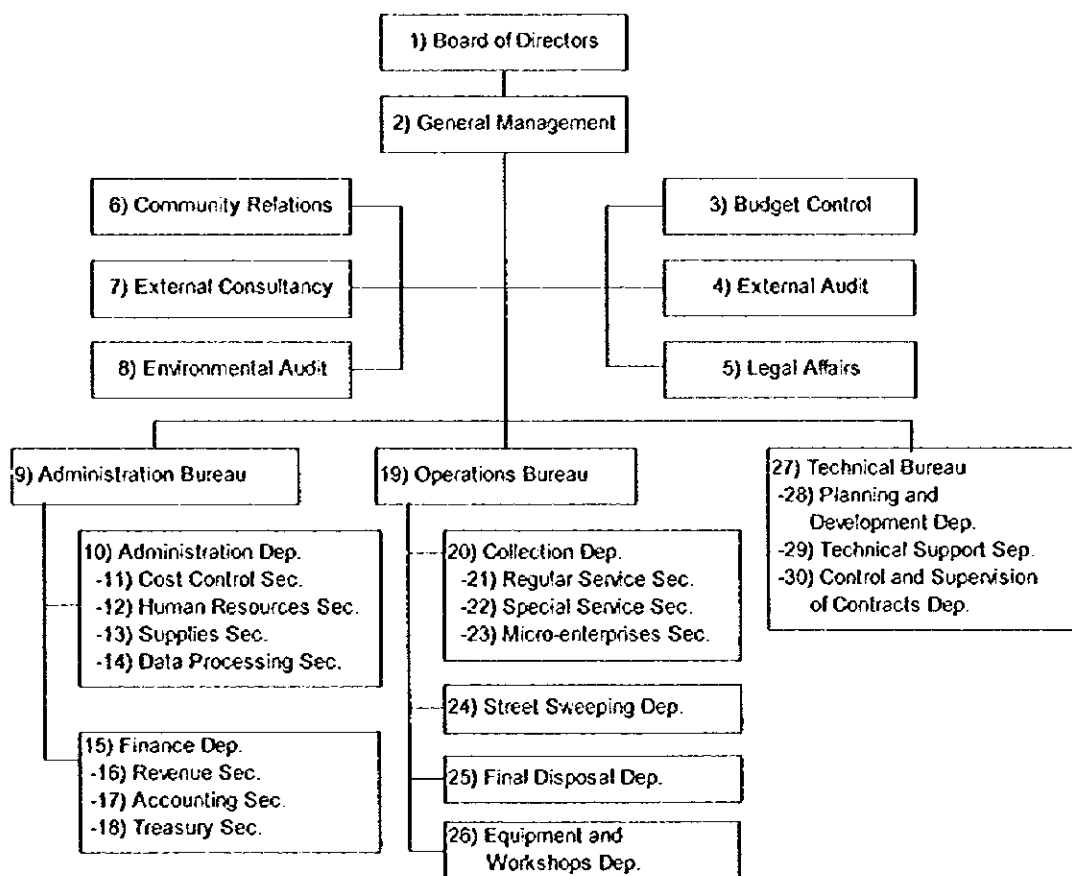


Figure 10: "2nd Stage" Organizational Structure of SWM Autonomous Entity

5.2.1 Proposal for the Scheme for Private Sector Participation

The following points constitute the basis for the scheme for private participation

Figure 11: Work Schedule for Private Sector Participation

	Activity	1999	2000	after 2001
A Pre-conditions				
1	Establishment of an Executing Unit (SWEU)	Immediately done Strengthen its activities. Negotiations for a new institution	Establishment of an autonomous institution	Strengthening an autonomous institution
2	Design for collection and haulage	Terms of Reference Contracting and execution	Strengthening planning and development	Strengthening planning and development
3	Design for a street sweeping system	Terms of Reference Contracting and execution	Strengthening planning and development	Strengthening planning and development
4	Design for the rehabilitation and the operation of a sanitary landfill	Terms of Reference Contracting and Execution	Strengthening planning and development	Strengthening planning and development
5	Equipment and workshops strengthening	Request for technical assistance Training and equipment provision	Training and equipment provision	Preventive maintenance is done by the institution. Corrective maintenance is contracted out.
6	Revenue control system	Agreement with ENEE	Identify the total No. of clients and improve revenues.	Establishment of a fee system
7.	Monitoring and supervision system	Select personnel	Training and initiates functions	High professional level
B Private Sector Participation				
1	Contract A: Collection and haulage for urban areas		Bidding Foundations. First bidding will be for 25%	Gradually expand the involvement of the private sector's scope
2	Contract B: Collection and haulage for marginal areas	Begin promotion of community organizations	Expand coverage for primary and secondary collection	Coverage expansion continues.
3	Contract C: Street sweeping operations	Training for micro-entrepreneurs	Contract out all manual sweeping operation	Micro-entrepreneurs should be successful
4	Contract D: Sanitary landfill operations			
	Existing landfill site	Operation improvement. Weighbridge installation.	Contract out operation services. Initiate rehabilitation	Correct operations. sanitary landfill is rehabilitated. Ecological park
	Future landfill site		Identify appropriate sites for a new sanitary landfill	New sanitary landfill constructed (2006)

5.3 Preliminary Design for the Improvement and Overall Development of the Existing Disposal Site

a. Landfill Site Utilization Plan

Table 14 and Figure 12 show the landfilling sequence plan so as to utilize the whole reserve capacity of the disposal site which is 2,440,000 m³ effectively.

Table 14: Landfilling Plan by Sections

Area	Period Filled	Area (m ²)	Average landfill height	Available space (m ³)
A ₁	2005-6	40,000	20	800,000
A ₂	2000	20,000	12	240,000
B ₁	2000-4	84,000	12	1,008,000
B ₂	1998-1999	27,000	16	432,000
C	-	30,000	no further filling	-
Z	-	116,460	no further filling	-
Totals		317,460	60	2,440,000

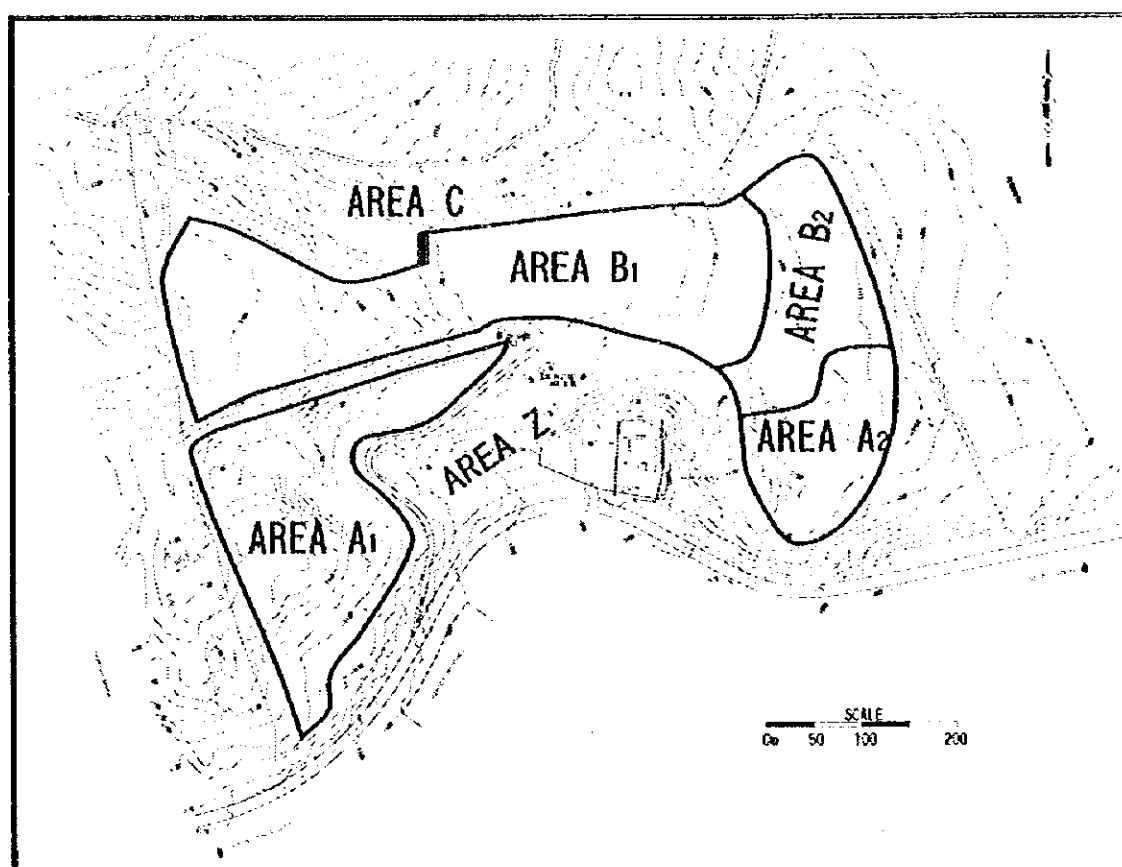


Figure 12: Division of Disposal Site

b. Required Landfill Equipment

Table 15 shows the required quantities of landfill equipment.

Table 15: Required Landfill Equipment

Equipment	1999	2000	2001	2002	2003
D7 bulldozer	3	3(3)	3	4(1)	4
Wheel loader	1	1(1)	1	1	1
Dump truck	3	3(3)	3	3	3
Pick up	1	1(1)	1	1	1
Water tanker	1	1(1)	1	1	1
Motor grader	-	-	-	-	-

P: Equipment is hired for periodic use.

Numbers in parenthesis represent numbers acquired.

c. Quantity of the Landfill Improvement Work to be done in 1999

Table 16 shows the main facilities to be constructed in the priority project.

Table 16: Work Quantify of Facility Improvement

	Description	unit	Quantity
A	landfill controlled 2 m high chain mesh fence	m	2,000
B	leachate recirculation leachate pump, head=40 m, 10 hp pump house 2 x 2 x 2m concrete steel pipe, dia. 50 mm heavy duty flexible hose, dia. 50 mm install 3 phase power line install 50 KVA transformer dam core, low permeability clay	unit unit m m km unit m ³	2 2 200 750 2 1 400
C	gas vents gas vents 1m x 1m x 3m sections	sections	220
D	surface drainage surface drains, open concrete culvert reinforced	m m	500 50
E	additional equipment portable pump, gasoline motor fire extinguisher	unit unit	2 3
F	buffer zone trees and shrubs for buffer zone	seedlings	6,000
G	Improvements to Olancho Road road pavement caution signs road markings	m ² sign m	90 6 600
H	site administration		
H.1	office building (reinf conc and block construction) change rooms (reinf conc and block construction) parking asphalt paving footpath, 1.5 m wide, 75mm, reinf concrete	m ² m ² m ² m ³	120 50 525 12
H.2	truck scale pitless type truck scale, incl electronic read out, printer, transport, installation, conc ramp and base control room	set m ²	1 24
H.3	water and sewage water tank, capacity 10m3, reinf conc, 3 x 2 x 1.75m, wall t = 150mm septic tank, 1.5 x 1.2 x 1.5 m, t=0.10m french drains, 100 PVC perforated pipe "FHIS" type latrine	m ³ m ³ m unit	6 1 120 3
H.4	garage garage reinforced concrete 150 mm	m ² m ³	225 37
H.5	lighting	global	1

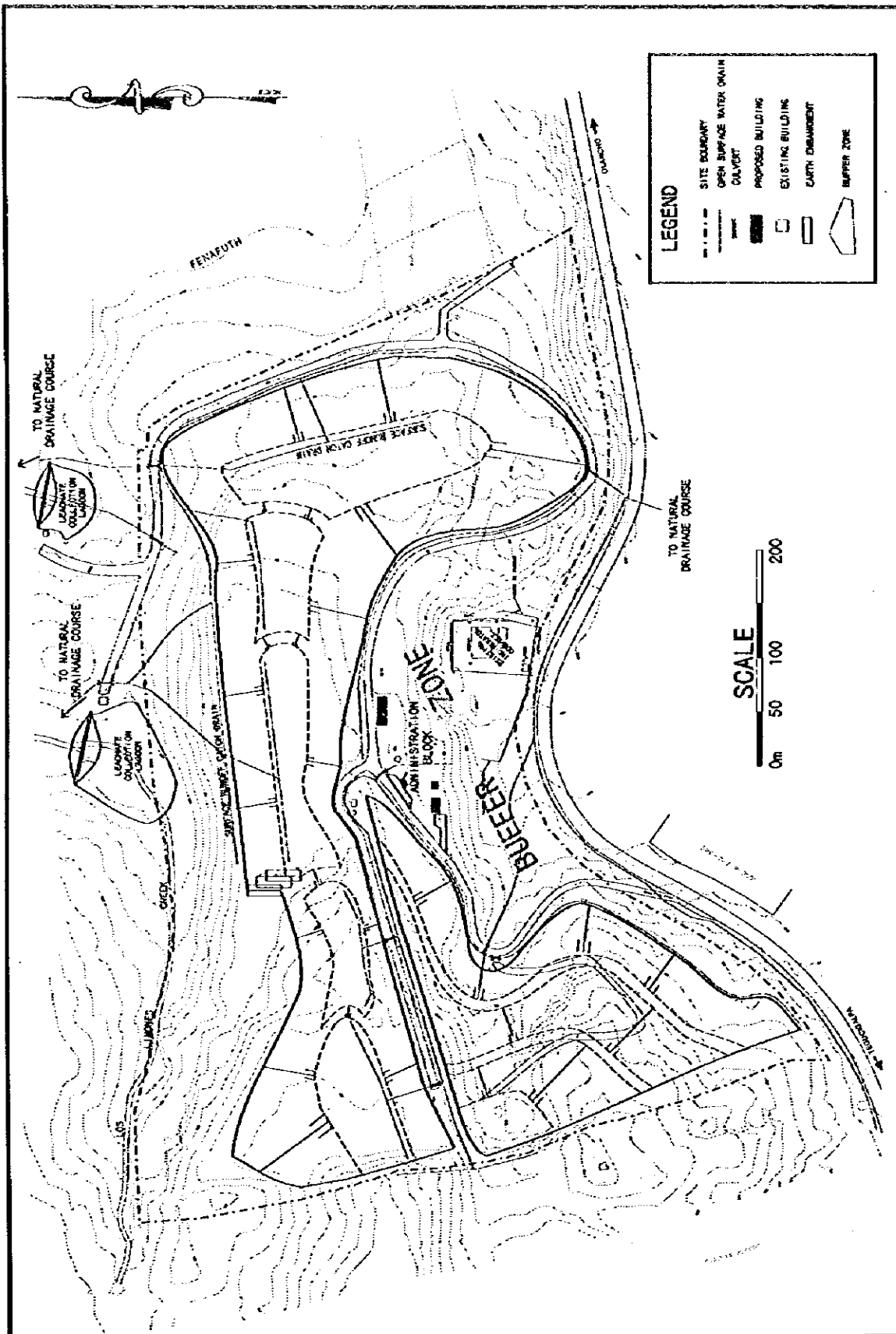


Figure 13: Layout Plan of Improved Disposal Site

5.4 Improvement of the Collection and Haulage System

a. Proposed Collection Equipment

The following waste collection equipment were selected.

Type of equipment	Area
15 m ³ compactor	high and middle income residential areas,
13 m ³ compactor	high and middle income residential areas,
8 m ³ compactor	old city center
12 m ³ dump truck	low income residential areas
5.5 m ³ container truck	marginal areas, collection station for street sweeping waste
10 m ³ container truck	marginal areas, collection station for street sweeping waste
6 m ³ leased truck	low income residential areas, adjustment for required number of equipment

b. Plan of Expanding the Private Sector's Involvement to Collection Work

The concept of work allocation to the public sector's direct operation and the private sector was set up as follows.

Type	Assignment	Examples
Direct Operation	Problematic areas	a) where roads are narrow, traffic is congested and difficult for passing b) where infrastructure, especially roads, is poor
Contracting-out	Standard areas	Standard residential areas

Table 17 shows the rate of the direct operation work and the contracting-out work which was supposed for priority project planning.

Table 17: Planned Rate of Direct Operation and Contracting Out Works

Category	Items	unit	1999	2000	2001	2002	after 2003
Collection	Direct operation	ton/day	230	252	222	251	280
Amount	Contracting-out	ton/day	100	100	200	200	200
	Total collection amount	ton/day	330	352	422	451	480
Rate	Direct operation	%	70%	72%	53%	56%	58%
	Contracting-out	%	30%	28%	47%	44%	42%

c. Planned Number of Equipment to be Directly Operated

Table 18 shows the planned number of equipment to be directly operated by the SWEU or the MCC.

Table 18: Planned Number of Equipment to be Directly Operated

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
15m ³ compactor	11	11	10	10	10	10	10	10	10	10	10	10
13m ³ compactor	9	9	0	0	0	0	0	0	0	0	0	0
8m ³ compactor	0	0	0	0	3	3	3	3	3	3	3	3
12m ³ dump truck	10	10	0	5	5	5	5	5	5	5	5	5
5.5m ³ hoist truck	1	1	0	9	9	9	9	9	9	9	9	9
10m ³ armroll truck	1	1	0	0	9	9	9	9	9	9	9	9
5.5m ³ container	11	11	0	90	90	90	90	90	90	90	90	90
10m ³ container	13	13	0	0	90	90	90	90	90	90	90	90
Rental truck	0	3	29	16	8	8	8	8	8	8	8	8

5.5 Priority Projects Cost

5.5.1 Final Disposal

a. Investment

Table 19 shows the investment schedule for the final disposal.

Table 19: Investment Schedule for Final Disposal

unit: 1000 Lps

items	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Equipment												
Bulldozer, 210Hp	0	8,884	0	2,961	0	0	0	8,884	0	2,961	0	0
Wheel loader, 150Hp	0	891	0	0	0	0	0	891	0	0	0	0
Dump truck, 10tons	0	1,733	0	0	0	0	0	1,733	0	0	0	0
Water tanker	0	422	0	0	0	0	0	422	0	0	0	0
Pickup	0	234	0	0	0	0	0	234	0	0	0	0
Facilities Improvement	6,332	1,128	1,158	808	1,403	2,458	1,620	1,879	1,614	1,562	1,628	1,617

b. O & M Cost

Table 20 shows the required O & M cost for final disposal. The required O & M cost after 2003 will be constant.

Table 20: O & M Cost for Final Disposal

unit: 1000 Lps

Category	Items	1999	2000	2001	2002	after 2003 annually
Diesel	Bulldozer, 210Hp	726	726	726	726	968
	Wheel loader, 150Hp	145	145	145	145	145
	Dump truck, 10tons	145	145	145	145	145
	Water tanker	0	19	19	19	19
	Pickup	0	19	19	19	19
Lubricant	15% of diesel	152	158	158	158	195
Spareparts	10% of basic price	921	973	973	973	1,210
Repair	5% of basic price	460	487	487	487	605
Labor	Manager	132	132	132	132	132
	Assistant Manager	116	116	231	231	231
	Operator	231	297	297	297	330
	Truckscale operator	66	66	66	66	66
	Worker	330	330	330	396	396
	Security guards	99	99	99	99	99
	total	3,525	3,714	3,830	3,896	4,563
Miscellaneous	10% of direct O&M cost	352	371	383	390	456
Rental	Motor grader	120	120	120	120	120
Total O&M		3,997	4,205	4,333	4,405	5,139

5.5.2 Collection and Haulage

a. Investment Schedule of Equipment

Table 21 shows the investment schedule for waste collection equipment

Table 21: Investment Schedule for Waste Collection Equipment

Equipment	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
unit: 1000Lps												
15m ³ compactor	0	10,503	0	0	0	0	0	0	10,503	0	0	0
8m ³ compactor	0	0	0	2,080	0	0	0	0	0	0	2,080	0
12m ³ dump truck	0	0	3,466	0	0	0	0	0	0	3,466	0	0
8m ³ hoist truck	0	0	6,239	0	0	0	0	0	0	6,239	0	0
10m ³ armroll truck	0	0	0	7,940	0	0	0	0	0	0	7,940	0
5.5m ³ container	0	0	1,512	0	0	0	0	0	0	1,512	0	0
10m ³ container	0	0	0	3,528	0	0	0	0	0	0	3,528	0
Total	0	10,503	11,216	13,547	0	0	0	0	10,503	11,216	13,547	0

b. Operation and Maintenance Cost

Table 22 shows the required cost for operation and maintenance. This table contains the required cost for the contracting-out work.

Table 22: Required Cost for Operation and Maintenance

Items	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
unit: 1000Lps												
Direct Operation												
15m ³ compactor	4,345	4,345	3,950	3,950	3,950	3,950	3,950	3,950	3,950	3,950	3,950	3,950
13m ³ compactor	4,230	4,230	0	0	0	0	0	0	0	0	0	0
8m ³ compactor	0	0	0	0	885	885	885	885	885	885	885	885
12m ³ dump truck	1,074	1,074	0	1,790	1,790	1,790	1,790	1,790	1,790	1,790	1,790	1,790
5.5m ³ hoist truck	226	226	0	2,034	2,034	2,034	2,034	2,034	2,034	2,034	2,034	2,034
10m ³ armroll truck	253	253	0	0	2,277	2,277	2,277	2,277	2,277	2,277	2,277	2,277
5.5m ³ container	9	9	0	76	76	76	76	76	76	76	76	76
10m ³ container	25	25	0	0	176	176	176	176	176	176	176	176
Rental truck	0	1,404	13,572	7,488	3,744	3,744	3,744	3,744	3,744	3,744	3,744	3,744
Sub-Total	10,163	11,567	17,522	15,338	14,932	14,932	14,932	14,932	14,932	14,932	14,932	14,932
Contracting out												
Sub-total	10,950	10,950	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900
Total O&M Cost	21,113	22,517	39,422	37,238	36,832	36,832	36,832	36,832	36,832	36,832	36,832	36,832

5.5.3 Overall Cost for the Priority Projects

Table 23 shows the whole cost for the priority projects.

Table 23: Project Cost Summary of the Priority Projects

Items	Category	1999	2000	2001	2002	2003	2003- 2010
Collection & Haulage	Investment	0	10,503	11,216	13,547	-	35,266
	O & M	10,163	11,567	17,522	15,338	14,932	104,524
	Contract out	10,950	10,950	21,900	21,900	21,900	153,300
Street Sweeping	Investment	0	656	0	0	-	656
	O & M	2,840	2,840	3,316	3,500	3,500	24,503
	Contract out	6,730	6,730	6,730	7,104	7,104	49,727
Final Disposal	Investment	6,332	12,164	0	2,961	-	17,005
	O & M	3,997	5,334	5,491	5,214	6,542	46,470
General Expense	OM	2,550	2,961	4,739	4,329	4,495	31,589
Total	Investment	6,332	23,323	11,216	16,509	-	52,927
	O & M	19,550	22,702	31,069	28,381	29,470	207,086
	Contract out	17,680	17,680	28,630	29,004	29,004	203,027
	Total	43,562	63,705	70,915	73,894	58,474	463,041

6. Project Evaluation

6.1 Technical Evaluation

The technical system proposed in the priority projects and the master plan is essentially the same as the present system consisting of waste collection, haulage, and disposal. It will not include any major processing or treatment system except on-site composting, that does not require complex technology. This technical system would be suitable because it is consistent with the institutional requirements for the area, identified in the main report, and also with the main SWM objectives, i.e., improvement of sanitary conditions and prevention of negative environmental impacts posed by the implementation of SWM works.

a. Collection and Haulage

All proposed collection and haulage systems, including the compactor truck system, the hoist truck and container system, the arm-roll truck and container system, and the dump truck system, have been used in the Central District for over four years. Their previous exemplary performance records have proved that they are appropriate for the Central District in terms of the waste quality, the topographical features, the climate, the existing skills, etc. As of August 1998, all collection vehicles granted by the Japanese Government in 1993, i.e., 12 compactors, 10 dump trucks, 1 hoist truck, 1 arm-roll truck, are still operable except one compactor, which was written off in a traffic accident. This implies that there are no technical problems predicted in the proposed collection and haulage system.

A collection system using large communal containers is currently used as collection points for street sweeping waste. The master plan proposes to apply this system for marginal areas so that residents living in inaccessible areas can carry their waste to containers. Whether the operation of this proposal will be a success depends on the neighborhood's cooperation and the accessibility of container trucks. The applicability of this system has been demonstrated through the implementation of this system in the pilot project, as a part of this study, in Colonia San Martin, Tres de Mar and Ayestas. The pilot project demonstrated that a hoist truck for a 5.5 m³ container can access relatively broad areas in marginal districts where road conditions are very poor. Therefore, in order to minimize the costs, the master plan proposes a combination of hoist trucks (for 5.5 m³ containers) and arm-roll trucks (for 10 m³ containers) as the collection and transportation system for marginal areas in order to minimize the cost.

The container system requires special attention because its improper use would affect the entire SWM system. If containers are used in residential or commercial areas, people may discharge their waste generated through business activities into them. This not only will increase the discharge amount of residential waste, but will also introduce industrial waste, such as construction waste, into the residential waste flow. Also this will lead to the loss of opportunity to earn special waste fees for large amount dischargers and for direct haulage. The container system will also encourage people to discharge more waste because it is very convenient for them to use these containers. Because it is essential to control the possible negative impacts of this

system, the master plan proposes the container system only for marginal areas, where residents can supervise the containers, and for collection points for street sweeping wastes, carefully supervised by the authority responsible for SWM.

b. Final Disposal

The master plan proposes immediate soil coverage and re-circulation of leachate in the existing disposal site as main technical improvements. The reasons why immediate soil coverage is not carried out at present, in spite of soil and equipment availability, are: 1) scavengers disturb the soil coverage works; 2) lack of funds to purchase enough diesel for landfill equipment; 3) lack of awareness on final disposal methods; and 4) lack of technical knowledge.

The institutional master plan proposes a solution for the second cause in detail. For the first, the third, and the fourth causes, possible solutions were, as a part of pilot projects in this study, demonstrated in the on-the-job training programs, the raising awareness campaign, and the improvement of scavenger management. The AMDC and the MCC is required to expand these experiences and to develop an appropriate system in line with the institutional master plan, carrying on the learning process to solve these problems over executing the final disposal operation.

c. Maintenance Workshop

The repairing capacity of the Cleansing Department's workshop has improved through repairing machinery granted in 1993 by the Japanese Government. The fact that all collection vehicles granted in 1993, except one compactor, are still operable as of August 1998 -- after four years and eight months -- has proved that its repairing capacity is sufficiently adequate.

The existing problems of repair works (long repair period) is attributed to the inappropriate administrative system. The institutional master plan proposes to solve these problems in detail.

d. Human Resources

The total number of people required for SWM works in 2010 will be more than double the current number. The master plan, therefore, proposes to extend the involvement of the private sector to control the number of employees required by the MCC; the aim is to maintain the Cleansing Department's present level of SWM employees.

The master plan proposes to shift the public sector's role in SWM works from actual physical engagement to control and supervision. The institutional master plan, therefore, proposes an education plan to train the required staff.

6.2 Social Evaluation

Since the master plan would pose various social impacts, it was evaluated in terms of intangible social impacts as listed below.

Negative Impacts:

- Loss of livelihood for scavengers.
- Loss of employment for staff currently employed at the Cleansing Department initiated by the expansion of the private sector's involvement.
- Rise in the waste collection fee rates.
- Uneven wealth distribution caused by the expansion of the private sector's involvement.

Positive Impacts:

- Improvements in public health and sanitary conditions.
- Prevention of flooding.
- Promotion of foreign investment and tourism.
- Increase in land value.

a. Mitigation Measures to Predicted Negative Impacts

a.1 Loss of Livelihood for Scavengers

The master plan proposes to prohibit the entry of unauthorized persons into a disposal site in 2008 to improve the sanitary and environmental conditions of disposal sites. If this is enforced suddenly, this will abruptly deprive the scavengers, who work in a disposal site, of their livelihood. The master plan proposes to take a few measures to minimize this kind of social impact prior to the entry restrictions. The first step is to introduce a recycling system at generation sources, which aims at diverting the current predominantly informal recycling activities to the formal recycling activities. The second step is to establish a manual sorting plant to be placed near a disposal site; this will create job opportunities for scavengers who will be employed as sorting workers.

a.2 Loss of Employment for Staff Currently Employed at the Cleansing Department initiated by the Expansion of the Private Sector's Involvement

The expansion of private sector's participation into the SWM works would reduce the role of the public sector and its work load. It would result in unemployment for some of the current Cleansing Department employees if the private sector's participation is expanded without a proper program.

The master plan proposes the MCC to retain the capacities to conduct some SWM operations directly. For collection and haulage, the master plan proposes the MCC to retain the capacity to do at least 25% of the entire collection and haulage works. The proposed required collection and haulage capacity for the MCC until 2010 is around 250 ton/day, almost same as the present capacity of the Cleansing Department. Therefore, the expansion of the private sector's participation will not result in layoffs for the present employees.

For street sweeping, the private sector has already become involved in street sweeping work since March 1998. As of August 1998, there were about 100 workers, employed

by the Cleansing Department, and about 300 workers, employed by micro-enterprises that are contractors to the Cleansing Department. The master plan proposes the MCC to retain the capacity to undertake 20% of the entire street sweeping. The required number of street sweepers employed by the MCC will then be 95 persons in 1999. Therefore, the impact will be negligible.

a.3 Rise in the Waste Collection Fee Rates

The master plan proposes to raise the present waste collection fee rate because the increase of the revenue for SWM works is the top priority issue in the master plan. Although this would increase the financial burden on citizens, the master plan, to minimize negative impacts, has taken the following considerations into account.

- a) To introduce the cross-subsidy mechanism (i.e., the affluent pay for the less well off).
- b) To keep the proposed rate below the amount that people are willing to pay (WTP).
- c) To keep the proposed rate below 1.0% of the resident's income.

Table 24 compares these amounts.

Table 24: Proposed Waste Collection Fee Rate for Residential Waste

unit: Lps/month/household

Income Level Group	Proposed Rate	Willingness to Pay	1.0% of Income
High Income Residents	70	40	69
Middle Income Residents	33	30	32
Low Income Residents	18	20	20

The master plan proposes the rate for high income residents to be higher than the amount they are willing to pay because it was deemed that they can afford to pay more as the WTP is far below 1% of the average income.

a.4 Uneven Wealth Distribution caused by the Expansion of the Private Sector's Involvement

Without careful consideration, further participation of the private sector would affect the distribution of wealth by creating a monopoly. For instance, because of previous experiences in SWM works and exemplary performance records, one company could be awarded more than one contract by the MCC. Also, if the contract requirements are stringent or demand that the contractor has a large amount of resources to enter the bid, it could become increasingly difficult for small and medium operators to enter the competition fairly. The outcome of both these hypothetical cases is a monopoly and a wealth distribution biased toward only a few companies that are rich and successful.

Therefore, the master plan proposes to restrict the size of each collection and haulage contract to 50 ton/day to give micro-enterprises more opportunities to enter the competition.

b. Predicted Positive Impacts

b.1 Improvements in Public Health and Sanitary Conditions

The implementation of the project will bring various benefits. Poor collection or disposal practices encourage the breeding of insects, rodents, and pathogens that can cause and transmit diseases, particularly several diseases found in the tropical cluster: viral encephalitis; trypanosomiasis; and Bancroftian filariasis. Since the master plan intends to mitigate the effect of such diseases by the elimination of waste heaps and the introduction of sanitary landfills with proper facilities, considerable improvements in public health and in disposal sites can be anticipated; conditions in nearby illegal dumping sites are also assumed to improve considerably.

The number of people who will benefit from refuse collection services by the implementation of the project is approximately 600,000.

b.2 Prevention of Flooding

Inadequate collection and transport of wastes may also clog open drains, creating breeding grounds for malaria and dengue-transmitting mosquitoes, or causing floods in rainy seasons, which may increase the chance of human contact with pathogen-infected feces contained in the waste. The master plan will significantly mitigate the dangers these situations may bring about through the promotion of regular road sweeping services.

b.3 Promotion of Investment and Tourism

In addition to the above-mentioned health effects, proper collection, transport and disposal of wastes shall provide the Central District with a favorable environment for the promotion of foreign investment and tourism. Since the Central District is the capital of Honduras, the improvement of its environment will enhance its image and eventually contribute to attracting more investors and tourists to the area.

b.4 Increase in Land Value

Well-managed waste disposal services also improve the living environment which result in increased land values. A study on the relationship between the living environment and land value suggests that, other factors held constant, housing values with distance from a landfill rise at an average rate of 6.2 % a mile within a two-mile radius of the landfill, presumably because the environmental and aesthetic problems associated with living near a landfill diminish as distance from it increases⁴. Thus, the master plan, with the proper sanitary landfilling measures, increases the land value around the present illegal dumping sites and the disposal site.

⁴ Beede, D.N. and Bloom, D.E. 1995, *The Economics of Municipal Solid Waste*, The World Bank

6.3 Environmental Evaluation

Table 25 summarizes the impacts that are predicted to occur with the implementation of the SWM master plan.

Table 25: Summary of the SWM Master Plan Environmental Evaluation

Project	Components	Positive Impacts	Negative Impacts
Increase in Waste Collection Rate	Waste Collection	<ul style="list-style-type: none"> • Improvement of sanitation and cleanliness ⇒ Mortality and morbidity ⇒ Promotion of tourism ⇒ Promotion of business • Improvement in air quality • Improvement in water quality • Removal of offensive odor • Improvement in aesthetic conditions • Reduction of public nuisance • Less contributors to global warming • Creation of job opportunities 	<ul style="list-style-type: none"> • Air pollution • Noise pollution
	Haulage	<ul style="list-style-type: none"> • Creation of job opportunities 	<ul style="list-style-type: none"> • Increase of traffic ⇒ Air pollution ⇒ Global warming ⇒ Traffic accidents ⇒ Congestion of traffic ⇒ Consumption of fossil fuel
Improvement of the Disposal Site	Landfilling	<ul style="list-style-type: none"> • Improvement of sanitation • Reduction of landfill gas ⇒ Less air pollution ⇒ Less contributors to global warming • Reduction of leachate ⇒ Less water pollution • Improvement in aesthetic conditions • Increase of land price • Reduction of public nuisance • Creation of job opportunities 	<ul style="list-style-type: none"> • Increase of equipment ⇒ Air pollution ⇒ Noise ⇒ Vibration ⇒ Consumption of fossil fuel

The improvement of collection rate will generate various significant positive impacts on the waste catchment area. These impacts will outnumber the negative impacts that will result from an increase in the use of waste collection vehicles.

As for the improvement of the final disposal, it will significantly mitigate the existing negative impacts. This benefit will outnumber the negative impacts that will result from an increase in the use of heavy landfill equipment.

6.4 Financial Evaluation

6.4.1 Financial Evaluation of the SWM Master Plan

a. Conditions for Financial Evaluation

Table 26: Condition for the Master Plan's Financial Evaluation

Evaluation Period	12 years, from 1999 until 2010
Executing Body	<p>a) The AMDC's SWEU will be the executing unit starting from 1999. After 2001, the Municipal Cleansing Corporation (MCC) will be the executing body.</p> <p>b) The MCC will commission private contractors to execute some of the work.</p>
Investment Plan	<p>a) Collection and Haulage New equipment will be acquired in 2001, 2004 and 2008, and the investment necessary for the purchase of these equipment is included in the expenses calculated for the previous fiscal years.</p> <p>b) Street Sweeping One 4 ton truck, for transporting MCC street sweepers, will be operated in 2001; more trucks will be operated in 2009.</p> <p>c) Final Disposal In 1999, the final disposal site will be improved, so it can be used until 2006. In 2004, the land for the new disposal site will be acquired and construction work will be completed in 2006.</p> <p>d) Recycling In 2004, one 4 ton truck, used to carry recycled waste to middle men, will be operated; more trucks will be purchased in 2008. In 2004, recycling of some wastes will begin by putting containers at public areas and supermarkets (high-income areas). In 2008, recycling of some wastes will begin by putting containers at elementary schools (middle-income areas). In 2007, the semi-mechanical sorting plant for the recovery of valuable items will be constructed near the new disposal site.</p>
Salvage Value	The salvage value of equipment for collection, haulage, landfilling, street sweeping and recycling equipment, and a disposal site in 2011 were taken into account.
Cut-off Rate	Based on the interest rate of IDB for loans, the cut-off rate was established at 12% per annum.
Interest Rate	<p>a) Long Term Loan</p> <ul style="list-style-type: none"> It is assumed that a long term loan will cover 80% of the investment required in 2000. The assumed interest rate is 8.5% per annum. The repayment period is 10 years, of which the grace period is 2 years. <p>b) Short Term Loan</p> <ul style="list-style-type: none"> The assumption is that a short term loan will cover the finance required temporarily. The assumed interest rate is 12.5% per annum.
Inflation	The present value (1998) is used for the financial evaluation

b. Cases for Financial Evaluation

For the financial evaluation, the various cases of the waste fee collection system, the waste fee collection rates, the waste collection fee system, and basic socio-economic parameters were assumed and four cases were formulated.

Table 27: Cases to be Examined for the Master Plan's Financial Evaluation

Case	Main Systems	Description																
1	<ul style="list-style-type: none">• Present waste fee collection system• Present waste fee tariff	<p>1)Waste fee collection system</p> <ul style="list-style-type: none">• Residential waste: Joint billing with fixed property tax• Business waste: Joint billing with business income tax <p>2)Waste fee collection rate</p> <ul style="list-style-type: none">• Residential waste: from 48.7% in 1998 to 90% in 2010• Business waste: from 73.8% in 1998 to 90% in 2010 <p>3)Revenue Potential</p> <p>a) Residential waste:</p> <ul style="list-style-type: none">• The number of household is proportional to the population.• Fixed property values is reviewed every 5 years. <p>b) Business waste:</p> <ul style="list-style-type: none">• The revenue is proportional to changes in GRDP.																
2	<ul style="list-style-type: none">• Joint billing of waste collection fees and electricity charges from 2001• Present waste fee tariff	<p>1)Waste fee collection system</p> <p>Joint billing of waste collection fees and electricity charges will begin from 2001</p> <p>2)Waste fee collection rate</p> <p>The collection rate for residential waste and business waste collection fees will increase to 90%.</p> <p>3)Revenue Potential</p> <p>The conditions are same as in Case 1.</p>																
3	<ul style="list-style-type: none">• Joint billing of waste collection fee and electricity charges from 2001• New waste fee system A	<p>1)Waste fee collection system</p> <p>Joint billing of waste collection fees and electricity charges will begin from 2001</p> <p>2)Waste fee collection rate</p> <p>The collection rate for residential waste and business waste collection fees will increase to 90%.</p> <p>3)Waste collection fee system</p> <p>From 2001, the system will be changed as follows:</p> <p>a) Residential waste:</p> <p>High-income group: Lps. 70/month/house (175% of WTP)</p> <p>Middle-income group: Lps. 33/month/house (110% of WTP)</p> <p>Low-income group: Lps. 18/month/house (90% of WTP)</p> <p>b)Business waste collection fee will be charged according to their annual turnover.</p> <p>c)Large scale dischargers will be charged according to the discharge amount.</p> <p>Collection service: Lps. 480/ton</p> <p>d)Direct hauliers will be charged according to the haulage amount.</p> <p>Direct haulage: Lps. 50/ton</p> <p>4)Revenue Potential</p> <p>The conditions are same as in Case 1.</p>																
4	<ul style="list-style-type: none">• Joint billing of waste collection fee and electricity charges from 2001• New waste fee system B	<p>1)The difference between Case 3 and Case 4 is the proposed waste collection fee. In Case 4, the waste collection fee is raised in a few stages.</p> <p>2)Waste collection fee system</p> <p>a) Residential waste (unit:Lps/month/house)</p> <table><thead><tr><th></th><th>2001</th><th>2003</th><th>2008</th></tr></thead><tbody><tr><td>high-income group</td><td>Lps. 63</td><td>Lps. 70</td><td>Lps. 80</td></tr><tr><td>middle-income group:</td><td>Lps. 22</td><td>Lps. 33</td><td>Lps. 36</td></tr><tr><td>low-income group:</td><td>Lps. 11</td><td>Lps. 18</td><td>Lps. 20</td></tr></tbody></table> <p>b) Large scale dischargers: Lps. 480/ton Lps. 480/ton Lps. 530/ton</p> <p>c) Direct haulage: Lps. 50/ton Lps. 50/ton Lps. 55/ton</p>		2001	2003	2008	high-income group	Lps. 63	Lps. 70	Lps. 80	middle-income group:	Lps. 22	Lps. 33	Lps. 36	low-income group:	Lps. 11	Lps. 18	Lps. 20
	2001	2003	2008															
high-income group	Lps. 63	Lps. 70	Lps. 80															
middle-income group:	Lps. 22	Lps. 33	Lps. 36															
low-income group:	Lps. 11	Lps. 18	Lps. 20															

c. SWM Costs, Waste Collection Amounts and Disposal Amounts in the Master Plan

Table 28 summarizes the estimated SWM costs, waste collection amount and disposal amount for the master plan until 2010 for the financial evaluation.

Table 28: Estimated SWM Costs and Waste Amount

unit: Lps/ton

Item	1997*	1999 to 2000 average**	2001 to 2007 average	2008 to 2010 average
Collection & Haulage***	83.6	175.4	263.1	266.7
Street Sweeping	N.A.	920.2	974.2	975.0
Final Disposal	5.5	37.9	45.8	38.4
Recycling	0	0	261.7	290.2
Others	N.A.	N.A.	N.A.	N.A.
Total SWM Works	130.2	290.8	362.0	350.7

Note:

*: Excludes depreciation.

** : Includes depreciation of investment for improvement of disposal site.

***: Includes the cost for contracting out.

d. Financial Internal Rate of Return (FIRR) and Financial Balance

Table 29 shows the FIRRs and the NPVs at a 12% discount rate for the four hypothetical revenue cases.

Table 29: Result of FIRRs for 4 Cases

Case	Description	FIRR (%)	Discount rate = 12.0%	
			Revenue over Expenditure	NPV* (R - E) (1000Lps)
Case 1	• Present waste fee collection system • Present waste fee rates	N.A.	0.7191	-128,683
Case 2	• Joint billing of waste collection fees and electricity charges from 2001 • Present waste fee rates	N.A.	0.8188	-85,965
Case 3	• Joint billing of waste collection fees and electricity charges from 2001 • New waste fee system A	22.8	1.0413	19,826
Case 4	• Joint billing of waste collection fees and electricity charges from 2001 • New waste fee system B	17.2	1.0264	12,679

Note: NPV stands for Net Present Value.

For Case 1 and Case 2, the net present values calculated based on a discount rate of 12.0% (opportunity costs) are negative and therefore indicate that the master plan will be financially unfeasible. The inference is that the waste collection fee system must be changed.

For Case 3 and Case 4, the FIRRs imply that the master plan will be financially feasible, because they exceed the cut off rate of 12.0%.

Figure 14 shows that although the profit and loss between 1999 and 2001 will be negative, it will be positive after 2002 and the internal reserves will reach Lps. 68 million in 2010, which will be enough for the required investment. Therefore, it implies that Case 4 will make the master plan financially sustainable.

The conclusion is that Case 4 will be more acceptable to the citizens than Case 3.

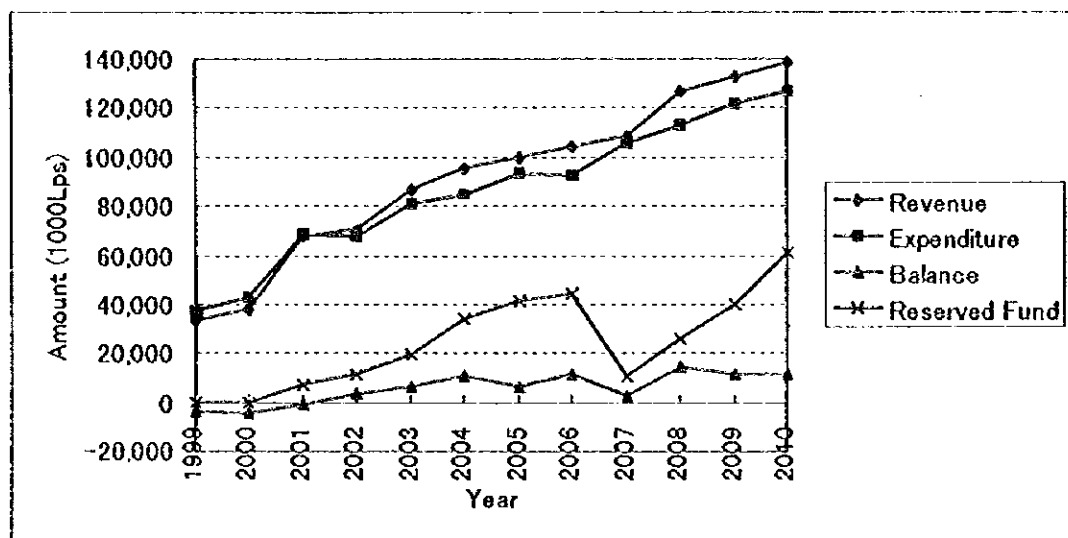


Figure 14: Cash Flow Diagram for Case 4

e. Conclusion of the Financial Evaluation

The financial evaluation concluded that theoretically both Case 3 and Case 4 will make the master plan financially feasible. The financial evaluation of the two cases revealed the following requirements:

- The waste fee collection rate must be increased to 90% by introducing the joint billing of waste fees and electricity charges.
- The new waste collection fee system, proposed in the master plan, must be introduced.

If the above requirements are satisfied, even though the waste fee rates gradually rise as in Case 4, the master plan will be financially feasible because the FIRR will be 17.2%.

6.4.2 Financial Evaluation of the Priority Projects

a. Conditions for Financial Evaluation

Table 30: Condition for the Priority Projects' Financial Evaluation

Evaluation Period	The performance of projects to be invested from 1999 to 2002 is evaluated for 12 years, from 1999 until 2010
Executing Body	<p>a) The AMDC's SWEU will be the executing unit starting from 1999. After 2001, the Municipal Cleansing Corporation (MCC) will be the executing body.</p> <p>b) The MCC will commission private contractors to execute some of the work.</p>
Investment Plan	<p>a) Collection and Haulage The operation of new equipment will start between 2001 and 2003, and the investment necessary for the purchase of these equipment is included in the expenses calculated for the fiscal year before these years. The investment for replacement are included after seven years.</p> <p>b) Street Sweeping In 2001, one 4 ton truck, for transporting MCC street sweepers, will be purchased; it will be replaced in 2008.</p> <p>c) Final Disposal In 1999, the final disposal site will be improved, so it can be used until 2006. In 2004, the land for the new disposal site will be acquired and construction work will be completed in 2006. In 2000 and 2002, new landfill equipment will be purchased and they will be replaced after six years.</p> <p>d) Recycling is not included in the priority projects.</p>
Salvage Value	The salvage value of equipment for collection, haulage, landfilling, street sweeping and recycling equipment, and a disposal site in 2011 were taken into account.
Cut-off Rate	Based on the interest rate of IDB for loans, the cut-off rate was established at 12% per annum.
Interest Rate	<p>a) Long Term Loan</p> <ul style="list-style-type: none"> It is assumed that a long term loan will cover 80% of the investment required in 2000. The assumed interest rate is 8.5% per annum. The repayment period is 10 years, of which the grace period is 2 years. <p>b) Short Term Loan</p> <ul style="list-style-type: none"> The assumption is that a short term loan will cover the finance required temporarily. The assumed interest rate is 12.5% per annum.
Inflation	The present value (1998) is used for the financial evaluation

b. Cases for Financial Evaluation

The financial evaluation for the master plan found that the introduction of the joint billing of waste collection fees and electricity charges will be essential to ensure a sustainable SWM. Therefore, for the priority projects' financial evaluation, the various cases shown for the waste fee collection rates, the waste collection fee system, and basic socio-economic parameters were assumed; three cases were formulated.

Table 31: Cases to be Examined for the Priority Projects' Financial Evaluation

Case	Main Systems	Description																
1	<ul style="list-style-type: none">Joint billing of waste collection fees and electricity charges from 2001Present waste fee tariff	<p>1)Waste fee collection system Joint billing of waste collection fees and electricity charges will begin from 2001</p> <p>2)Waste fee collection rate The collection rates for residential and business waste collection fees will increase to 90%.</p> <p>3)Revenue Potential</p> <p>a) Residential waste:</p> <ul style="list-style-type: none">The number of household is proportional to the population.Fixed property values is reviewed every 5 years. <p>b) Business waste:</p> <ul style="list-style-type: none">The revenue is proportional to changes in GRDP.																
2	<ul style="list-style-type: none">Joint billing of waste collection fee and electricity charges from 2001New waste fee system A	<p>1)Waste fee collection system Joint billing of waste collection fees and electricity charges will begin from 2001</p> <p>2)Waste fee collection rate The collection rates for residential and business waste collection fees will increase to 90%.</p> <p>3)Waste collection fee system It will be changed to the following system from 2001.</p> <p>a) Residential waste:</p> <p>High-income G.: Lps. 70/month/house (175% of WTP) Middle-income G.: Lps. 33/month/house (110% of WTP) Low-income G.: Lps. 18/month/house (90% of WTP)</p> <p>b)Business waste collection fee will be charged according to their annual turnover.</p> <p>c)Large scale dischargers will be charged according to the discharge amount.</p> <p>Collection service: Lps. 480/ton</p> <p>d)Direct hauliers will be charged according to the haulage amount.</p> <p>Direct haulage: Lps. 50/ton</p> <p>4)Revenue Potential The conditions are same as in Case 1.</p>																
3	<ul style="list-style-type: none">Joint billing of waste collection fee and electricity charges from 2001New waste fee system B	<p>1)The difference between Case 2 and Case 3 is the proposed waste collection fee. In Case 3, the waste collection fee is raised in a few stages.</p> <p>2)Waste collection fee system</p> <p>a) Residential waste (unit:Lps/month/house)</p> <table><thead><tr><th></th><th>2001</th><th>2003</th><th>2008</th></tr></thead><tbody><tr><td>high-income group</td><td>Lps. 63</td><td>Lps. 70</td><td>Lps. 80</td></tr><tr><td>middle-income group:</td><td>Lps. 22</td><td>Lps. 33</td><td>Lps. 36</td></tr><tr><td>low-income group:</td><td>Lps. 11</td><td>Lps. 18</td><td>Lps. 20</td></tr></tbody></table> <p>b) Large scale dischargers: Lps. 480/ton Lps. 480/ton Lps. 530/ton</p> <p>d) Direct haulage: Lps. 50/ton Lps. 50/ton Lps. 55/ton</p>		2001	2003	2008	high-income group	Lps. 63	Lps. 70	Lps. 80	middle-income group:	Lps. 22	Lps. 33	Lps. 36	low-income group:	Lps. 11	Lps. 18	Lps. 20
	2001	2003	2008															
high-income group	Lps. 63	Lps. 70	Lps. 80															
middle-income group:	Lps. 22	Lps. 33	Lps. 36															
low-income group:	Lps. 11	Lps. 18	Lps. 20															

c. SWM Costs, Waste Collection Amount and Disposal Amount in the Priority Projects

Table 32 summarizes the estimated SWM costs, waste collection amount and disposal amount for the priority projects until 2010 for the financial evaluation.

Table 32: Estimated SWM Costs and Waste Amount for the Priority Projects

unit: Lps/ton

Items	1999-2000 average	2001- 2003 average	1999-2003 average
Collection & Haulage*	175.4	249.4	224.6
Street Sweeping*	920.2	974.6	953.3
Final Disposal	37.9	49.9	45.9
Administration etc.	N.A.	N.A.	N.A.
Total SWM Works	290.8	366.5	341.0

Note:

*: Includes the cost for contracting out.

d. Financial Internal Rate of Return (FIRR) and Financial Balance

Table 33 shows the FIRRs and the NPVs calculated based on a 12% discount rate for the three hypothetical revenue cases.

Table 33: Result of FIRRs for 3 Cases

Case	Description	FIRR (%)	Discount rate = 12.0%	
			Revenue over Expenditure	NPV* (R - E) (1000Lps)
Case 1	<ul style="list-style-type: none"> Joint billing of waste collection fees and electricity charges from 2001 Present waste fee rates 	-0.1	0.9240	-30.240
Case 2	<ul style="list-style-type: none"> Joint billing of waste collection fees and electricity charges from 2001 New waste fee system A 	32.2	1.1047	42.069
Case 3	<ul style="list-style-type: none"> Joint billing of waste collection fees and electricity charges from 2001 New waste fee system B 	23.0	1.0674	27.016

Note: NPV stands for Net Present Value.

For Case 1, the net present values, calculated based on a discount rate of 12.0% (opportunity costs) are negative and therefore indicate that priority projects will be financially unfeasible. The inference is that the waste collection fee system must be changed.

For Case 2, the FIRR implies that the priority projects will be financially feasible, because it will reach 32.2%, widely exceeding the cut off rate of 12.0%.

For Case 3 it will introduce the transitional raise of waste collection fee system, the FIRR also implies that the priority projects will be financially feasible, because it will reach 23.0%, still exceeding the cut off rate of 12.0%.

Figure 15 shows that although the profit and loss between 1999 and 2001 will be negative, it will be positive after 2002 and more than Lps. 12 million will be gained annually after 2003. Case 3 will make the priority projects financially sustainable because internal reserves will reach Lps. 18 million in 2003.

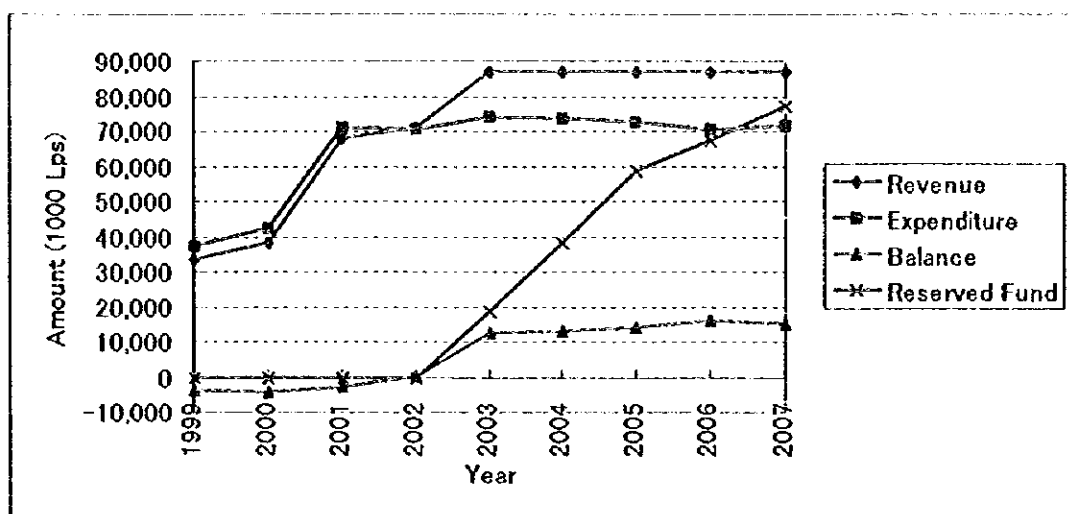


Figure 15: Cash Flow Diagram for Case 3

c. Conclusion of the Financial Evaluation

The financial evaluation concluded that theoretically both Case 2 and Case 3 will make the priority projects financially feasible. The financial evaluation of the two cases revealed the following requirements:

- The waste fee collection rate must be increased to 90% by introducing the joint billing of waste fees and electricity charges.
- The new waste collection fee system, proposed in the master plan, must be introduced.

If the above requirements are satisfied, even though the waste fee rates gradually increase as in Case 3, the priority projects will be financially feasible because the FIRR will be 23%.

6.5 Economic Evaluation

6.5.1 The Economic Evaluation Method

The economic evaluation aims to examine the viability of the project in macroeconomic terms. As it is difficult to quantify the benefits obtained through the implementation of SWM projects (although various approaches have been tried), some of the benefits are only quantified in general. For the purpose of this economic evaluation the WTP data, obtained through the public opinion survey, is the economic benefit of this project.

Generally, the WTP amount increases with income growth and the promotion of environmental education and awareness. Looking at the present situation, however, there is a tendency that the WTP amount is inversely proportional to the income level. As the potential benefits associated with disposal site improvement affect only the immediate neighbors, the general WTP of residents are less likely to increase.

Taking these factors into account, the economic internal return (EIRR) was calculated based on the following conditions.

- a) For 1999, only investment was included.
- b) It was assumed that the WTP will increase in proportion to the GRDP per capita and reach in 2003 to the level of willingness to pay obtained by the survey.
- c) As the study did not survey the WTP for non-residential waste, expenses for waste services paid out by non-residential sources in 1997 was used. In other words, it was assumed that non-residential sources will expend annually Lps. 263/ton until 2010.
- d) The conversion factors were used to calculate the economic costs in order to take factors, such as internal transfer of taxes, unemployment rate, etc., into account.
- e) The book values of equipment for 2011, to be procured by the MCC, were included.

6.5.2 Economic Evaluation of the Master Plan

a. Economic Internal Rate of Return (EIRR)

The EIRR of the master plan, calculated based on the above benefits and costs, was 16.1%, which is over the cut off rate.

b. Qualitative Evaluation

The master plan projects will improve the sanitary and working conditions in the existing disposal site, leading to the improvement of the surrounding environment and social acceptability of the disposal site.

Expanding waste collection services into marginal areas will reduce the number of disease-carrying vermin, especially mosquitoes that transmit the virus which causes dengue fever.

The secondary effects will be the increase in job opportunities and the introduction of sanitary landfilling technologies to other Honduran cities.

Recycling will contribute to resource recovery and natural conservation, and also to reduction of illegal dumping as side effect.

These effects, which are too difficult to be quantified, would far outweigh the quantifiable benefits.

6.5.3 Economic Evaluation of the Priority Projects

The EIRR calculated for the priority projects is greater than the master plan's EIRR at 18.6%.

7. Conclusions and Recommendations

7.1 Conclusions

a. Amount of municipal solid waste generated and the waste stream

- 1) As of 1998, approximately 481 ton of municipal solid waste is generated each day in the Central District. This figure includes the overall municipal waste generation rate of 566 g/cap/day and residential waste generation rate of 375 g/cap/day.
- 2) Based on the assumption that the collection rate is 64%, 289 ton is collected per day if waste is collected everyday. In reality, however, Saturday is a half-day and there are no collection services on Sunday, so the actual daily collection amount is 368 ton/day. Further, dischargers haul 23 ton of waste to the disposal site, most of which is commercial waste.
- 3) The final disposal amount is approximately 343 ton/day: 333 ton/day of municipal waste, and 10 ton/day of industrial waste and medical waste.
- 4) The on-site disposal amount is approximately 20 ton/day and the amount recycled at generation sources is approximately 4 ton/day.
- 5) The uncollected waste amount is approximately 114 ton/day.
- 6) The present waste generation amount is estimated to double (1,053 ton/day) in relation to the forecast population increase, that is from 0.85 million in 1998 to 1.35 million in 2010. These waste problems are predicted to worsen by 2010 if no countermeasures are taken. Therefore, an appropriate municipal solid waste management system must be established urgently.

b. Technical System

- 1) At present, the most common SWM technical system in the Central District is rudimentary, composed only of collection and haulage of waste and final disposal systems. This system is basically appropriate for the Central District as long as the acquisition of land for the disposal site is financially and socially unproblematic.
- 2) As nature conservation is a global issue, such concept should be gradually incorporated into the solid waste management. As a long term plan, the Central District should gradually introduce both a recycling system and a waste minimization system; however, long term solutions must not affect the financial sustainability of the cleansing work.
- 3) The present collection and haulage system, i.e., the compactor collection system and the container collection system, functions adequately, but the efficiency of the dump truck collection system was poorer in comparison. Therefore, the use of dump trucks for waste collection should be avoided.
- 4) The introduction of a waste transfer system will not be necessary until 2006, when the reserve capacity of the present disposal site expires, because the current disposal site is located only 6.5km from the center of the city.

- 5) Areas that do not receive collection services are frequently low income residential areas where lack of a frequent service has left unhygienic conditions, that are often blamed for outbreaks of dengue fever. The expansion of a regular waste collection service, therefore, should be a continuous endeavor.
- 6) In areas where collection vehicles are inaccessible due to the poor road conditions and topographical features, the point collection system with communal containers, that obliges beneficiaries to bring their waste to points accessible to collection vehicles, should be adopted. One of the pilot projects conducted during the study found that residents' are willing to cooperate with primary collection (i.e. taking their wastes to the collection points) as long as environmental education and public motivation is promoted sufficiently.
- 7) The present disposal site is 31.7 hectares, of which only 12 hectares are currently used for landfilling. Even though the final waste disposal amount is predicted to increase in future, the site has the capacity to receive waste generated in the Central District until 2006. The present disposal site has a favorable natural condition in terms of environmental protection and haulage of waste. The sanitary condition can easily be enhanced by improving some facilities, training staff in operation techniques, and raising awareness among the municipalities' staff and citizens. Therefore, the best option is considered to be the utilization of the existing disposal site, for as long as possible, providing the landfill operation level is improved.
- 8) Planning and construction of a new final disposal site should proceed deliberately while the existing disposal site has a reserve.
- 9) At present, recycling activities rely mainly on scavengers operating at the disposal site and in towns and on the collection workers' sorting work. Although both activities contribute to recycling, they are informal and thus impose negative impacts on the present solid waste management system. These negative impacts will grow if no proper countermeasures are taken. It is, therefore, necessary for the governmental organizations – as a long term objective – to be gradually involved in recycling to shift the trends from an informal activity to a formal activity.

c. Institutional System

- 1) At present, the AMDC spends Lps. 130 per ton for the management of municipal solid waste. The minimum SWM unit cost to materialize the appropriate level of SWM in the Central District is approximately Lps. 360 per ton. Therefore it is essential to establish a sufficient revenue source to cover both the costs and the improvements in the present technical system.
- 2) The collection rates of the present waste fees, charged jointly with the fixed property tax for residential waste and with the business income tax for business waste, are low. Its improvement cannot be expected to be done immediately, nor can an increase in revenue from waste collection fees be expected. The financial evaluation concluded that the present waste fee collection system will be unable to financially sustain the SWM works. Therefore, a new joint billing system, where waste fee bills are issued with the electricity statement, should be introduced, as electricity charges have a high collection rate and have more registered users.

- 3) Since the present waste collection fee system is related to the fixed property tax, residents who are tenants do not have to pay waste collection fees. This situation also restricts the number of service recipients issued a statement; those who feel that the present system is unfair are unwilling to pay their waste fee. Therefore, the present system should be improved so that it is fair to the majority of service recipients.
- 4) The position of the AMDC's Cleansing Department, an executing body responsible for SWM, is under the Public Service Division in the Urban Development Bureau. The very limited authority held by the Cleansing Department restricts its ability to quickly make important decisions. Therefore, the organization responsible for SWM works needs to have a higher profile.
- 5) With every political transition, experienced staff at the AMDC are replaced by new officials; this has left the current Cleansing Department officials with very little experience in technological and administrative processes. There has been two drastic changes in the organization system in the five year period between 1993 and 1998, thus undermining the Cleansing Department's capacity to provide effective waste services. It is imperative that the authority responsible for SWM is made stable in order to improve its administrative capabilities.
- 6) With the continuous urban expansion, the amount of SWM works is becoming more intricate and overwhelming; it has reached a point where it is both physically and financially difficult for the AMDC to effectively manage on their own. Therefore the private sector's financial and technical capabilities must be introduced into the SWM system. In addition, the AMDC should encourage the public to become involved in SWM works through environmental education, public campaigns, etc.; the public should be made aware of their responsibility in supporting SWM. In order to achieve the goal in the master plan, the AMDC should effectively promote and coordinate the participation of both the private sector and citizens.

d. Cost Summary of the Priority Projects

The cost for the priority projects covers the investment from 1999 to 2002 and the O & M costs from 1999 to 2010.

Table 34: Project Cost Summary of the Priority Projects

		unit: 10 ³ Lps					
		1999	2000	2001	2002	2003	2003-2010
Collection & Haulage	Investment	0	10,503	11,216	13,547	-	35,266
	O & M	10,163	11,567	17,522	15,338	14,932	104,524
	Contract out	10,950	10,950	21,900	21,900	21,900	153,300
Street Sweeping	Investment	0	656	0	0	-	656
	O & M	2,840	2,840	3,316	3,500	3,500	24,503
	Contract out	6,730	6,730	6,730	7,104	7,104	49,727
Disposal Site	Investment	6,332	12,164	0	2,961	-	17,005
	O & M	3,997	5,334	5,491	5,214	6,542	46,470
General Expense	O & M	2,550	2,961	4,739	4,329	4,495	31,589
Total	Investment	6,332	23,323	11,216	16,509	-	52,927
	O & M	19,550	22,702	31,069	28,381	29,470	207,086
	Contract out	17,680	17,680	28,630	29,004	29,004	203,027
	Total	43,562	63,705	70,915	73,894	58,474	463,041

e. Project Evaluation

e.1 The SWM Master Plan

The financial evaluation concluded that the master plan will be financially feasible if, from 2001, the waste collection fees and electricity charges are jointly billed and if the new waste fee system is introduced.

If the waste fee system A is introduced in 2001, the FIRR will be 22.8%. Even though the waste fee rates gradually rise as in the system B, the master plan will be financially feasible because the FIRR will be 17.2%.

e.2 Priority Projects

The financial evaluation concluded that the priority projects will be financially feasible if, from 2001, the waste collection fees and electricity charges are jointly billed and if the new waste fee system is introduced.

If the waste fee system A is introduced in 2001, the FIRR will be 32.2%. Even though the waste fee rates gradually rise as in the system B, the priority projects will be financially feasible because the FIRR will be 23.0%.

7.2 Recommendations

a. Implementation of the Master Plan

The master plan is assessed to be feasible from technical, social, environmental, financial, and economic viewpoints. Therefore, the AMDC should implement this master plan based on the strategies proposed in this study.

In the master plan, the improvement of the institutional system is given priority, followed by technical improvements in general.

b. The Improvement of the Institutional System

The master plan proposes basic strategies to achieve the goals for 2010 based on future projections, made by taking the current actual situation of the Central District into account. There will, however, be unforeseen matters when the master plan is executed, often caused by socioeconomic changes, among others. To achieve the goal, in the event of such uncertainties, it is essential for a sound institutional system, which can tackle these matters, to be in place. In addition, most problems, at present, are attributed to the inadequate institutional system. Therefore, the improvement of institutional system is given a priority.

- 1) An SWM Executing Unit, a temporary organization directly linked to the Mayor's office, will be established in early 1999. The SWM Executing Unit will have the same functions as the present Cleansing Department, however, its hierarchy level will be raised to much a higher level than the present Cleansing Department so that it can immediately take appropriate actions. This measure will strengthen the Cleansing Department effectively with the minimum organizational change.
- 2) The SWM Executing Unit will efficiently carry out solid waste management works in preparation for: the establishment of the municipal cleansing corporation (MCC); the introduction of the new waste fee collection system; and the expansion of contracting out services and training staff.
- 3) The fully autonomous MCC will be established by 2001, and will be responsible for municipal solid waste management in the Central District.
- 4) In 2001, the new waste fee collection system will be introduced to collect waste fees together with the electricity charges.
- 5) The waste collection fee system, to be introduced in 2001, are shown below.

Waste Collection Fee	Descriptions
Residential Waste Collection Fee	Three different rates according to the resident's income bracket
Business Waste Collection Fee	Ten different rates according to the sales income bracket
Large Discharger Waste Collection Fee	Based on the weight of waste discharged
Direct Haulage Fee	Based on the weight of waste received at the disposal sites

- 6) The private sector's involvement in collection and haulage works will be gradually expanded after the establishment of the MCC, the introduction of the new joint billing system, and the introduction of the new waste fee rates. In order to minimize the cost for contracting out, while creating a climate for fair competition, the following measures should be taken when selecting the competitors. Other works, such as final disposal, will be gradually commissioned to private sectors following the contracting out of collection and haulage works.
 - i) The MCC holds an open bid so that the process is transparent to the general public.
 - ii) The MCC limits the amount to be collected in one contract area to less than 50 ton/day.

- iii) The MCC directly operates at least 25% of the entire collection and haulage works.
- 7) The MCC, in collaboration with the AMDC, should actively carry out a campaign to raise public awareness and initiate a hygiene education program to promote cooperation with SWM; the sensitivity analysis in the financial evaluation revealed the importance of such education programs for the master plan to succeed. Solid waste education materials, such as books and videos, and other campaign goods, such as posters, stickers, and 'Limpin' (the campaign mascot), all proved to be a success during the study. In the future, these and other similar materials should be effectively used by the waste management authorities to promote public awareness.
- 8) The MCC should provide training for those engaged in solid waste management and create a human resource development plan to improve their employees' basic skills.

c. Improvement of Technical System

- 1) The waste management authorities should implement the following measures to prepare for the expansion of contracting out SWM operations.
 - i) Produce a collection area map, where each collection area has a discharge amount of approximately 50 ton/day.
 - ii) Improve its finances, its capacity to plan both SWM and contract forms, and its monitoring and supervision capabilities.
 - iii) Provide facilities and tools, such as a weighbridge, required to monitor and supervise contractors.
- 2) Where collection vehicles can access the discharge points, compactors will be used, and where collection vehicles cannot access discharge points the containers will be used to provide waste collection services.
- 3) The areas given priority for waste collection services are as follows.
 - i) City center.
 - ii) High and middle income residential areas.
 - iii) Low income residential areas in the city.
 - iv) Low income residential areas on the outskirts of the city.
- 4) The construction and operation of recycling facilities by public waste authorities usually require additional funding. Therefore, the master plan does not propose the construction and operation of both recycling facilities and processing facilities, but the following measures may be carried out after the institutional system undergoes complete reform.
 - i) Promotion of on-site composting.
 - ii) Separate collection at collection points for recycling waste.
 - iii) Provide funding for a sorting company, which will provide scavengers with job opportunities, before entry restrictions are enforced at the disposal site.

- 5) Taking into account the high unemployment rate, narrow and steep roads, and road congestion, street sweeping shall be manually carried out in the Central District except for some sections of the trunk roads.
- 6) The study provided various basic data, such as the waste generation amount and the waste composition, for proper solid waste management. The AMDC and the MCC should effectively utilize these data to manage solid wastes. The SW authorities should continue to accumulate basic data, such as differences in daily and seasonal waste amount, so that this plan may be re-examined in the future.
- 7) The responsible authorities for solid waste collect residential waste, business waste and large scale dischargers' waste but not construction waste and liquid waste.
- 8) The public final disposal site receives residential waste, business waste, non-hazardous waste, treated medical waste and non-hazardous construction waste but not liquid waste.

8. Proposed Medical and Industrial Waste Management Policies

8.1 Medical Solid Waste Management Policies

a. Improvement of Institutional System and Formulation of Guidelines

a.1 Improvement of Institutional System

The AMDC proposes the need to review the roles, tasks, responsibilities, and powers of the Central Government, the municipalities, and the institutions discharging medical waste in order to establish an agreeable institutional system.

a.2 Formulation of Guidelines

In order to enable the government to devise a medical SWM plan, a medical SWM guideline in line with the Sanitary Code will be prepared as soon as possible.

b. Formulation of the Medical SWM Master Plan

A medical SWM master plan that covers a financial plan, institutional plan, training plan, and technical plan will be formulated.

c. Educational Programs

When the medical SW guidelines are enforced, an educational program will be held for the staff of medical institutions, to promote source segregation and proper storage of infectious and non-infectious wastes.

8.2 Industrial Solid Waste Management (ISWM) Policies

a. Improvement of Institutional and Administrative Systems

a.1 Improvement of Institutional System

The AMDC proposes the need to review the roles, tasks, responsibilities, and powers of the Central Government, the municipalities, and the institutions discharging industrial waste in order to establish an agreeable institutional system. An administrative structure that will ensure the formulation of an institutional system will be established.

The number of staff in charge of ISWM will be increased by reforming the existing administrative structure. Technical training will be given to these staff.

a.2 Inventory System

A classification system for industrial solid wastes will be established to distinguish hazardous wastes from non-hazardous wastes.

The responsible organizations for ISWM will produce an inventory system that incorporates data on the characteristics, amount, treatment and discharge methods of industrial waste generated. These data will be periodically updated.

a.3 Introduction of Economic Incentives

Waste discharge legislation that provides economic incentives to dischargers should be introduced, to assist in minimizing ISW discharge and to control pollution.

b. Technical Assistance

Through technical assistance, administrative officers will gain technical knowledge (in discharge, treatment, recycling, and disposal methods, etc.), correct information, and will work towards the development of appropriate technologies. The administration will transfer technical information and know-how to dischargers through various schemes.

c. Waste Producers

Waste producers should find the most appropriate technical measures in line with the principle that the treatment and disposal of waste they produce is their responsibility.

The administrative organization will assist waste producers in the construction and operation of a sanitary landfill and treatment system.

Appendix

Record of Pilot Projects Implementation

During the second study work in Honduras, the following four pilot projects were carried out to verify the feasibility of the technical system proposed in the M/P, introduce SWM techniques, and collect necessary data and information. The aim and the activities of the each pilot project are introduced with pictures in the following pages.

- 1) Campaign for Raising Awareness on Solid Waste Issues
- 2) Experimental Implementation of the Best Collection System for Marginal Areas
- 3) Experimental Improvement of the Existing Final Disposal Site
- 4) Improvement of the Managerial Capabilities of the Cleansing Department

1. Campaign for Raising Awareness on Solid Waste Issues

This pilot project was intended to reinforce the waste education program within the "Mobile Municipality" campaign being carried out by the municipality to promote sanitary improvement.

This mobile municipality campaign commenced in February 1998 and was carried out twice a month in poor areas, i.e., marginal areas surrounding the city where sanitary facilities are of poor standards.

The campaign started with clean-up operations involving resident participation followed by health care activities carried out in a tent, especially set up for the campaign. The health care activities were performed with the cooperation and participation of the residents, and included: vaccinations and medical check ups for children, vaccinations of pets against rabies, distribution of family planning materials and sanitary education pamphlets, and haircutting. Cultural shows (musical shows and plays), games, and soccer competitions were also held.

These activities were held with the close cooperation and the voluntary participation of the residents. The medical staff of local health centers assisted the health care activities, while cultural shows were held with the cooperation and participation of primary school students.

The pilot project focused on informing the public of the potential hazards of solid waste, the necessity of proper solid waste management, responsibilities of the residents and the municipalities, and the required manner of public participation.

In addition, the following were especially carried out to reinforce the waste education program:

1. Logo contest to select the campaign logo
2. Production of stickers (large: 5,000, small: 10,000) bearing the selected campaign logo
3. Production of posters (3,000)
4. Production of waste education panels (10)
5. Production of waste education texts (10,000 copies)
6. Production and set up of campaign banners (30)
7. Production of waste education videos
8. Implementation of educational programs on SWM
9. Site visits to the pilot project areas before and after execution of pilot projects

Pilot Project (1) Campaign for Raising Awareness on Solid Waste Issues

(1) Logo Contest to Select the Campaign Logo

To ensure a sustainable clean-up campaign, the planning and implementation were not left entirely to the municipality alone. The voluntary participation of the residents was considered of great importance. With this in mind, an advertisement was placed in a local newspaper to invite participants. The winning logo is shown to the right.



(2) Stickers bearing the campaign logo (large: 5,000, small: 10,000)

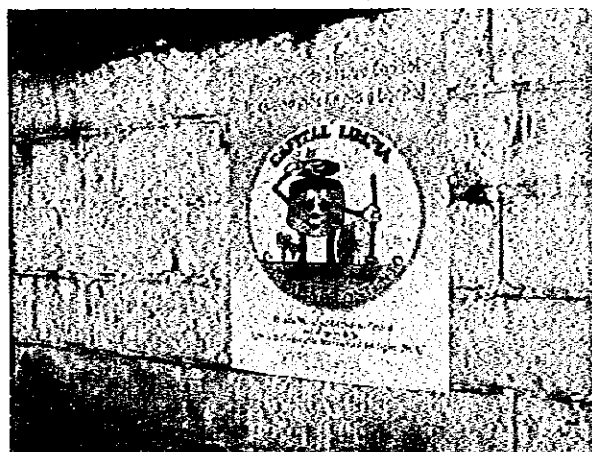
The stickers were pasted onto the municipal vehicles, and to make the campaign more effective and to enhance the students' awareness of solid waste problems, the students were asked to distribute the stickers to vehicles at the intersection.



Students explaining the campaign to drivers and sticking the campaign stickers onto the vehicles, after the driver has given them permission to do so.

(3) Posters(3,000)

To stimulate the interest of the residents in the clean-up campaign, 3,000 posters were displayed on public facilities where they can be seen by many.



A poster pasted onto a street corner

(4) Educational Panels (10)

Educational panels were designed according to the following concepts: a) the problems wastes incur, b) the present solid waste management conditions, c) the things the public can do to help. Pictures and photos were used to attract the attention of children and adults alike, and to facilitate understanding.



Educational panels set up at the sanitary campaign site

Pilot Project (I) Campaign for Raising Awareness on Solid Waste Issues

(5) Educational Texts (10,000)

Comic books briefly illustrating the adverse impacts of improper waste disposal on the public and the environment were produced. These were used in the trial lesson on SWM in primary schools, and distributed to the residents by governmental agencies.



(6) Campaign Banners (30)

Banners (30) bearing the campaign logo were set up in 30 designated places. The picture to the right shows the campaign banner set up at the central park of Tegucigalpa which is usually full of passers-by.



(7) Educational Video

An educational video was produced; the counterpart managed the whole work, e.g., script writing, acting, shooting, etc., using JICA's video camera. Through this project, the municipal staff proved that they are capable of independently producing educational videos.



Counterparts editing and dubbing the educational video they produced for the campaign

(8) Educational Programs on SWM

A trial lesson was conducted for 110 students from three primary schools in the marginal areas of Tegucigalpa. The educational texts produced by the counterpart and the study team were used. Discussions were held on prevailing waste problems to raise awareness, as well as on what the students can do to help solve these problems themselves.



Study team member Masaharu Kina giving a lecture in Spanish on waste problems using the educational panels

Pilot Project (I) Campaign for Raising Awareness on Solid Waste Issues

(9) Site Visits to the Pilot Project Areas Before and After Execution of Pilot Project

A total of about 30 people representing the counterpart agency, steering committee, agencies related to waste management, Ministry of International Cooperation (SETCO), the residents, the press, etc., visited the sites prior to and after the implementation of the pilot project. The visit made the representatives realize the seriousness of the problems incurred by improper waste handling and the great improvement achieved as a result of the pilot projects.



Final disposal site (Before)



Final disposal site (After)



San Martin/Ayestas area (Before)



San Martin/Ayestas area (After)



Site visit to the final disposal site
(Prior to the pilot project)



Site visit to the San Martin/Ayestas area
(After the pilot project)

2. Experiment on the Implementation of the Best Collection System for Marginal Areas

This pilot project was intended to determine the applicability of the container collection system in marginal areas where collection services are unsatisfactory or not provided at all.

For this pilot project, 5.5m³ and 10m³ public containers were manufactured and installed in the project area. Municipal container trucks were used to periodically collect the waste. Educational programs and clean-up operations were also simultaneously carried out to motivate the residents to further participate in the implementation of the container collection system.

This pilot project was implemented in San Martín/Ayestas and Tres de Mayo. Although both *colonias* are located comparatively close to the city center, they have poor infrastructure and consist of low-income residential areas. Due to unsatisfactory waste collection services in these *colonias*, wastes are illegally dumped resulting in the creation of an unsanitary living environment. In contrast with other marginal areas, the number of residents suffering with dengue fever was also observed to be high in these two *colonias*.

In this pilot project, public containers were installed in illegal dumpsites of the pilot project areas to urge the residents to discharge their wastes into the containers. To do so, however, it is imperative to first clear the illegal dumpsites of wastes. Nonetheless, if the removal of these wastes is to be carried out by the municipality alone, illegal dumping activities are highly likely to recur. Municipalities can only do so much to prevent such activities from becoming widespread. To successfully eliminate such activities, therefore, residents should be made to feel attached to their area, be proud of it and have a strong sense of duty to keep it clean by monitoring the waste disposal activities of those who feel otherwise. With this as a premise, the illegal dumpsites were cleared of wastes mainly with the help of the residents, assuming of course that having them clean the area themselves would make them refrain from illegally dumping wastes at the area again. The municipalities and the study team carried out public educational programs that would educate the residents on the importance of sanitation and raise awareness on waste issues, and provided the residents with the tools and vehicles for the clean-up operations.

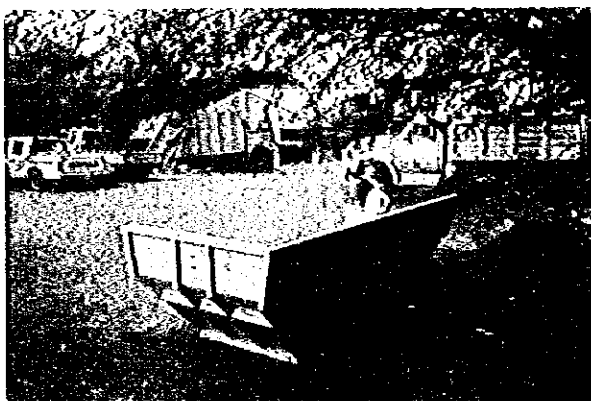
The following activities were carried out in this pilot project.

1. Manufacture of containers (three 5.5m³ and two 10m³)
2. Public education activities
3. Production of leaflets (to encourage public participation in clean-up operations)

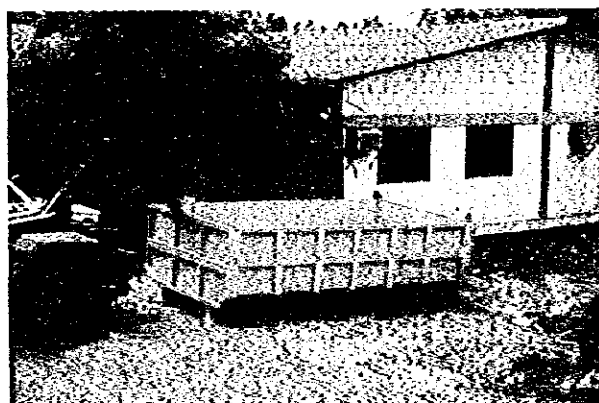
Pilot Project (2): Experiment on the Implementation of the Best Collection System for Marginal Areas

(1) Manufacture of containers (three 5.5m³ and two 10m³)

Although light, containers are quite spacious and are therefore expensive to ship, as shipment costs are calculated by space covered. To avoid such exorbitant expenses, the containers for the pilot project were manufactured locally. The existence of a factory with the proper technology to produce containers of good quality in the central district of Tegucigalpa was confirmed.



5.5m³ waste container



10m³ waste container

(2) Public education activities

The municipal staff and the study team held talks with the residents in a community hall and a health center within the project areas as a means of enhancing public awareness on waste problems. The talks focused on the seriousness of sanitary problems generated by wastes and the present illegal dumping conditions, and encouraged the residents to determine ways to solve these issues.



(3) Production of leaflets

In order to encourage public participation in clean-up operations, leaflets with the campaign logo were produced and distributed.

Pilot Project (2): Experiment on the Implementation of the Best Collection System for Marginal Areas

(4) Clean-up Operations

Illegally dumped wastes at the designated collection station were cleared with the voluntary participation of the residents. Cleaning the area themselves is assumed to cultivate within the residents a feeling of attachment to their environment, and encourage the discharge of wastes into the containers to be installed. The number of residents who voluntarily participated in the clean-up operations of illegal dumpsites totaled over 100 for each clean-up operation. Including participants in the street-sweeping activities, each clean-up operation had a total of over 500 participants.



San Martin/Ayestas (Before the clean-up operation)
The foul smell and the flies were a constant nuisance to surrounding residents.



San Martin/Ayestas (After the clean-up operation)
With the participation of the residents, the area was cleared of wastes.

(5) Container Collection System

The roads leading to the areas designated for the containers are unpaved, narrow and sloped. Although the use of a container truck was considered quite dangerous, a 5.5m³ container truck built for such bad roads was proven to make container collection and haulage possible. With residents from other areas coming all the way to discharge their wastes, the installed containers were immediately filled up. The non-recurrence of illegal dumping activities in areas surrounding the container collection points was attributed to the effective implementation of public education activities.



Billboards bearing the following messages were set up: No illegal dumping! Let us throw our waste into the containers!



The residents abided by the regulations and made sure they disposed their wastes into the containers.

3. Experiment on the Improvement of the Existing Final Disposal Site

By demonstrating landfill techniques, conducting hands-on-training on sanitary landfill methods, improving sanitary conditions through scavenger participation, and partially improving the disposal site, this pilot project aimed to:

1. Partially improve the sanitary level of the final disposal site
2. Confirm the suitability of the technical system of the final disposal proposed in the master plan
3. Motivate the residents and the municipal staff

The present final disposal site has sufficient supply of cover soil, and is equipped with the necessary landfilling equipment provided by the Japanese government. Realistically, therefore, there should be no difficulty in speedily covering the wastes and keeping the disposal site sanitary to a certain degree. The fact that this is not carried out is attributed to problems in the technical aspects, i.e., technical ineptness, lack of knowledge and interest in sanitary landfill techniques, as well as the financial aspects of running the disposal site. Another impediment is the existence of scavengers in the disposal site.

To solve these technical problems, this pilot project covered the following:

1. Facility Improvement
 - a) Erection of gates, fences and construction of a guardhouse (security improvements)
 - b) Pavement of approach road (improve the landscape by reducing dust and litter, and reduce the vehicle breakdowns)
 - c) Installation of a net fence to prevent waste from scattering
 - d) Construction of a slope in the section completely landfilled, and turfing or planting of shrubbery (landscape improvement)
 - e) Manufacture and use of movable net fence to prevent waste from scattering
 - f) Installation of gas removal facilities
2. Demonstration of landfill techniques & hands-on-training of Cleansing Department staff on proper sanitary landfill methods.
3. Improving sanitary conditions through scavenger participation
 - a) Formulation of final disposal site operation regulations with scavenger participation
 - b) Issuing entry permits to the site for scavengers
 - c) Vaccinations for tetanus and hepatitis B

Pilot Project (3) Experiment on the Improvement of the Existing Final Disposal Site

(1) Facility Improvement

a) Erection of gates, fences, and construction of a guardhouse (improvement of security facilities)

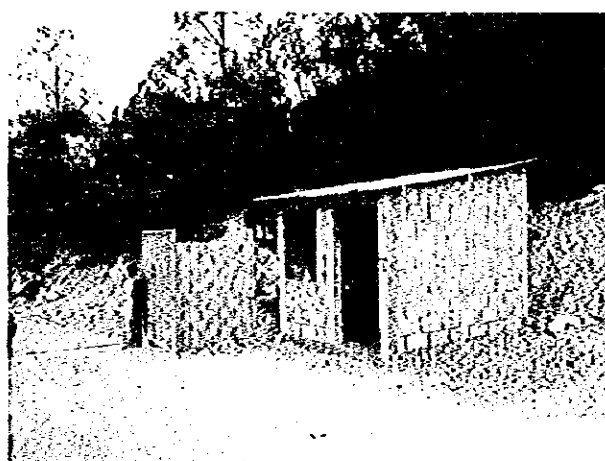
The absence of security facilities made it possible for just about anybody to enter the site. Controlling entry to the site would be the first step toward sanitary landfilling. Although fencing the entire site is desirable, only the area close to the entrance was fenced in the pilot project. Other improvements carried out to control entry to the site included the erection of a gate, construction of a guardhouse, and the installation of "Unauthorized Persons Keep Out!" sign.



Entrance to the final disposal site (Before the pilot project)



The gate constructed at the entrance to the final disposal site



Guardhouse constructed at the site entrance

b) Pavement of Approach Road

The unpaved condition of the approach road generates dust, and the road is also littered with a lot of wastes. Since the road is visible from the public highway, such unsanitary condition does not render a good view of the site. Hence 300m of this approach road was paved to improve the landscape, eliminate dusty conditions, and to a certain degree indirectly reduce vehicular breakdowns.



Paving of the approach road

Pilot Project (3) Experiment on the Improvement of the Existing Final Disposal Site



Final disposal site (Before improvement)



Final disposal site (After improvement)



c) Installation of a net fence to prevent waste scattering

Since the disposal site is located on high grounds, strong winds scatter the wastes. The deteriorating condition of the landscape due to waste scattering is a serious environmental problem in the disposal site. To improve the landscape, a net fence was installed at one section of the shoulder of the slope of the landfill site.

d) Construction of a slope in the section completely landfilled, and turfing or planting of shrubbery

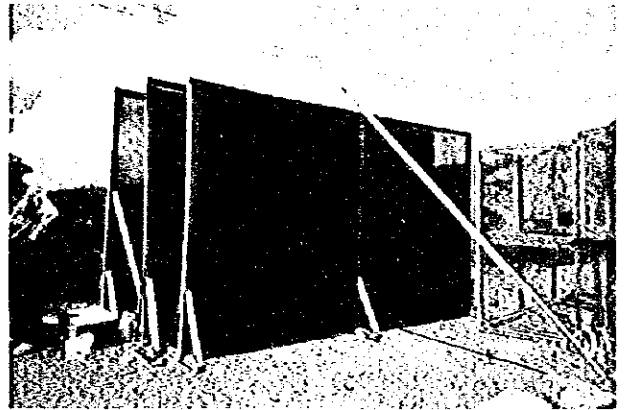
Because the finishing touches to the slope of the landfilled section were not carried out, wastes scattered and the slope eroded, resulting in unsightly conditions. To improve these conditions, slope protection works, i.e., finishing touches on one section of the slope, turfing, and planting of shrubbery, were carried out.



Pilot Project (3) Experiment on the Improvement of the Existing Final Disposal Site

e) Manufacture and use of a movable net fence to prevent waste scattering

To minimize waste scattering at the landfill section, net fences that can be moved from one landfill section to another, depending on which section is being used, were made and installed.



(f) Installation of gas removal facilities

To speedily remove, dissolve and stabilize gases generated by the covered wastes, and to prevent explosions in the site, gas removal facilities were installed.



Pilot Project (3) Experiment on the Improvement of the Existing Final Disposal Site

(2) Demonstration of landfill techniques & hands-on-training on sanitary landfill methods

Guidance on proper landfill methods was extended on site using municipal vehicles.



Sanitary landfill training yard



54 trucks of waste were hauled to the sanitary landfill training yard.



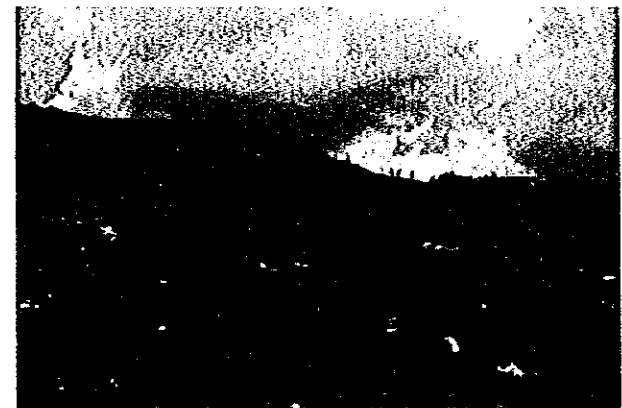
Immediately after discharge, waste was leveled off with a bulldozer.



Waste was immediately covered.



First sanitary landfill layer was completed.



After the sanitary landfill operation was completed, there were no visible signs of waste buried below.

Pilot Project (3) Experiment on the Improvement of the Existing Final Disposal Site

(3) Improving Sanitary Conditions through Scavenger Participation

The existence of many scavengers in the site incurs various problems. They hamper the speedy covering of wastes and create fires that spread over the site when they burn copper wires for the recovery of copper. The unsanitary state of the disposal site also endangers their health. Driving the scavengers off the disposal site would be an ideal solution to these problems. This, however, is easier said than done. The recovery of valuable materials is the only source of income for many of the scavengers, most of who, for various reasons, are unable to enter the traditional labor market.

Given such conditions, long-term and short-term improvement plans were proposed in the M/P. The long-term plan entailed the creation of job opportunities outside of the disposal site for the scavengers to facilitate their removal from the final disposal site. The short-term plan entails the improvement of the disposal site on the premise that scavengers are working at the disposal site, and its feasibility was analyzed in the pilot project.

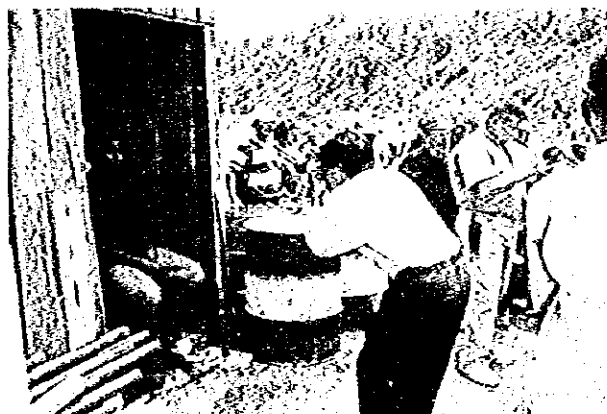


(a) Formulation of final disposal site operation regulations with scavenger participation

Through Project Cycle Management (PCM) workshop, it was confirmed that the scavengers themselves are strongly aware of the problems in the disposal site environment. Although their cooperation is essential to the improvement of sanitary conditions, it is common knowledge that most scavengers hate adhering to rules. Regulations were, therefore, formulated with their active participation to ensure effective enforcement.

(b) Issuing entry permits to the final disposal site for scavengers

One of the regulations agreed upon by the scavengers is the restriction of site entry to entry permit holders. To execute this regulation, the Social Development Department of the municipality issued permits to the scavengers. The permits bear the picture of the permit holder.



(c) Vaccinations for tetanus and hepatitis B

To reduce the risk of scavengers catching serious diseases, they were vaccinated against tetanus and hepatitis B. These series of considerations are expected to improve the relationship between the scavengers and the municipality into one that is based on trust and cooperation.

4. Improvement of the Managerial Capability of the Cleansing Department

This pilot project was intended to introduce methods of effectively using the various data that have been collected, teach the importance of proper management, and assist the staff in being able to analyze potential problems.

Operation and maintenance are extremely essential in solid waste management services. To highly ensure the sustainability of the SWM services, it is very important to shift the management mentality to a level that would at least take the following items into consideration:

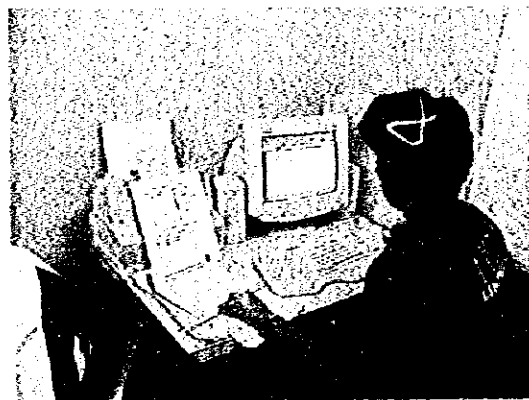
- a) The amount of waste collected by each collection vehicle the previous month
- b) The costs incurred the previous month in the collection of each ton of waste
- c) Cost breakdowns

The following were implemented under this pilot project:

- a) Establishment of a final disposal amount database
- b) Establishment of waste collection amount database per collection vehicle
- c) Establishment of a database on fuel, lubricants and spare parts expenses per collection vehicle
- d) Introduction of the use of computers for solid waste data management.



The Study Team supervising the management program operation methods.



Cleansing Department staff entering data into the computer.





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