

3.3.2 Master Plan Concepts

a. Institutional, Organizational, and Financial System Reform

a.1 Institutional System

- 1) The private sector's participation will be expanded.
- 2) The current cleansing status will be upgraded.

a.2 Organizational System

- 1) The executing agency of solid waste management will become autonomous, creating a Municipal Cleansing Corporation (MCC), to bring about more flexibility and stability.
- 2) A self-supporting accounting system will be established so that revenue from the waste collection fee is apportioned to only solid waste management works.

a.3 Financial System

- 1) The new waste fee system will be based on the most appropriate combination of the following concepts.
 - Polluter-pays-principle (waste dischargers pay the SWM cost).
 - Cross-subsidy mechanism (the affluent pay for the less well off).
 - Minimization of the waste fee collection costs.
 - Strong enforceability of the collection system.
 - Different service levels in accordance with the amount of collection fee paid.
- 2) A disposal fee will be imposed on direct waste hauliers.

a.4 Management System

- 1) The AMDC's new Solid Waste Management Executing Unit (SWEU), created during the first phase of the institutional reform program, will be required to have a sound managerial capability to control the participation of the private sector. The management capability of the SWEU, especially regarding cost control, financial planning, technical planning, contracting, monitoring and supervision works, will be improved compared to the current Cleansing Department.
- 2) Accountability and transparency of solid waste management practices will be established in the SWEU.

a.5 Education and Raising Awareness

When raising public awareness through education and encouragement of social participation, the following should be considered.

- 1) Inform the citizens on:
 - Environmental problems and health problems related to SWM.
 - Changes in the organization structure, the responsibilities, and legal powers of the organization.

- Existing legislation; explaining penalties and punitive measures to transgressors and the enforcement procedures.
 - Duties and responsibilities of the citizens, including the waste collection fee and the methods of payment.
 - Procedures to submit complaints to the authorities.
- 2) Institutionalize the municipal education program on sanitation: "Mobile Municipality" as a means to promote social participation in the improvement of public health through clean-up campaigns, cultural activities, and provision of primary medical services to residents (e.g., ante- and postnatal care, immunization programs, dental check-ups, etc.).
 - 3) Education programs for school students and local groups through effective use of existing resources.

Public education cannot proceed if the human resources responsible for SWM do not have a sufficient information base with which they can teach the general public. The master plan proposes a human resource training program, consisting of three training courses.

- Public Affairs
- Operations
- Support Services

b. Technical System

b.1 Storage and Discharge

- 1) The type of containers used will be regulated.
- 2) A separate discharge system for recyclable and non-recyclable wastes will be introduced.

b.2 Collection and Haulage

- 1) Areas given a priority for waste collection services are as follows.
 1. City center.
 2. High and middle income residential areas.
 3. Low income residential areas in the city limits.
 4. Low income residential areas in the outskirts of the city.
- 2) The compactor truck collection system will be extended.
- 3) In problematic areas, the dump truck system, the arm-roll container system, the hoist truck container systems, etc., will be appropriately adapted depending on the conditions in each area.
- 4) In problematic areas, primary collection will be provided by micro-enterprises or community based organizations (CBOs) and secondary collection by the AMDC. The AMDC will promote primary collection activities, however, all costs incurred for this service will be shouldered directly by the users.

b.3 Processing, Treatment and Recycling

- 1) No major processing or treatment plants for solid waste will be introduced.
- 2) Recycling activities will be promoted by the AMDC's SWEU and carried out mainly by the private sector. The SWEU will not participate in recycling activities directly.

b.4 Street Sweeping

- 1) All street sweeping work will be carried out manually.
- 2) An appropriate collection and transportation system for street waste will be introduced.

b.5 Final Disposal

- 1) The sanitary level of the existing disposal site will be improved to minimize the negative impacts on the environment.
- 2) The whole area of the existing final disposal site will be fully utilized, in order to continue its operation for as long as possible.
- 3) The control of scavengers will be reinforced; they will be prohibited from continuing their activities at the disposal site by 2010, without ensuing considerable social impacts.

b.6 Maintenance System

- 1) Only preventive and daily maintenance as well as repair services, that cannot be done at private workshops, will be conducted by the AMDC's workshop. The rest will be undertaken by the private sector.

3.4 The SWM Master Plan

System	Description																																														
1. Institutional System																																															
1.1 Administration & Organization	<p>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.</p> <p>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.</p>																																														
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	<p>1) In 1999, the new business waste collection fee tariff is put into effect. As shown below, the tariff is based on annual turnover which is outlined in the proposed fee table.</p> <table border="1"> <thead> <tr> <th>Annual Business Income</th> <th>Fee Rate (establishment/month)</th> </tr> </thead> <tbody> <tr> <td>Up to Lps 50,000.00.</td> <td>Lps 40.00</td> </tr> <tr> <td>Lps.50,000.01 - 100,000.00</td> <td>Lps.80.00</td> </tr> <tr> <td>Lps.100,000.01 - 300,000.00</td> <td>Lps.125.00</td> </tr> <tr> <td>Lps.300,000.01 - 600,000.00</td> <td>Lps.180.00</td> </tr> <tr> <td>Lps.600,000.01 - 1,000,000.00</td> <td>Lps.240.00</td> </tr> <tr> <td>Lps.1,000,000.01 - 2,000,000.00</td> <td>Lps.325.00</td> </tr> <tr> <td>Lps.2,000,000.01 - 5,000,000.00</td> <td>Lps.500.00</td> </tr> <tr> <td>Lps.5,000,000.01 - 10,000,000.00</td> <td>Lps.700.00</td> </tr> <tr> <td>Lps.10,000,000.01 - 15,000,000.00</td> <td>Lps.800.00</td> </tr> <tr> <td>Lps.15,000,000.01 - 20,000,000.00</td> <td>Lps.1,000.00</td> </tr> <tr> <td>Lps.20,000,000.01 - 30,000,000.00</td> <td>Lps.1,300.00</td> </tr> <tr> <td>Lps.30,000,000.01 - 40,000,000.00</td> <td>Lps.1,500.00</td> </tr> <tr> <td>Lps.40,000,000.01 - 60,000,000.00</td> <td>Lps.1,600.00</td> </tr> <tr> <td>more than Lps.60,000,000.01</td> <td>Lps.1,800.00</td> </tr> </tbody> </table> <p>2) In 2001, other new waste collection fee systems will be introduced.</p> <p>a. Residential waste collection fee: (unit:Lps/month/house)</p> <table border="1"> <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. Collection service rate for large discharger:</p> <p>Lps. 480/ton in 2001 Lps. 530/ton in 2008</p> <p>c. Direct haulage rate:</p> <p>Lps. 50/ton in 2001 Lps. 55/ton in 2008</p>	Annual Business Income	Fee Rate (establishment/month)	Up to Lps 50,000.00.	Lps 40.00	Lps.50,000.01 - 100,000.00	Lps.80.00	Lps.100,000.01 - 300,000.00	Lps.125.00	Lps.300,000.01 - 600,000.00	Lps.180.00	Lps.600,000.01 - 1,000,000.00	Lps.240.00	Lps.1,000,000.01 - 2,000,000.00	Lps.325.00	Lps.2,000,000.01 - 5,000,000.00	Lps.500.00	Lps.5,000,000.01 - 10,000,000.00	Lps.700.00	Lps.10,000,000.01 - 15,000,000.00	Lps.800.00	Lps.15,000,000.01 - 20,000,000.00	Lps.1,000.00	Lps.20,000,000.01 - 30,000,000.00	Lps.1,300.00	Lps.30,000,000.01 - 40,000,000.00	Lps.1,500.00	Lps.40,000,000.01 - 60,000,000.00	Lps.1,600.00	more than Lps.60,000,000.01	Lps.1,800.00		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
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1.3 Management System	<p>1) The MCC's accounting, financing, planning, monitoring and supervision capabilities will be improved.</p> <p>2) The involvement of private sector will be gradually extended in the SWM services.</p> <p>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.</p> <p>4) The MCC will hold an open bid so that proceedings are transparent to the general public.</p> <p>5) The MCC limits the amount to be collected in one contract area to less than 50 tons/day.</p> <p>6) The contract rate of collection and haulage work will be kept at less than Lps. 300 per ton after 2000.</p>																																														

2. Technical System																																																																						
2.1 Discharge and Storage	<p>1) The MCC will not bear any costs related to discharge and storage system except for the cost of communal containers.</p> <p>2) The MCC will promote people to use plastic bags or plastic containers for storage of waste.</p> <p>3) The separate discharge system will begin in adequate areas from 2008.</p>																																																																					
2.2 Collection and Haulage	<p>1) Executing body will be the AMDC's SWEU from 1999 to 2000, and after 2001 the executing agency will be the MCC.</p> <p>2) The private sector's involvement will be gradually extended, but the MCC will directly operate at least 25% of the entire collection and haulage works. M/P proposes the collection work allocation as follows.</p> <p style="text-align: right;">unit: ton/day</p> <table border="1"> <thead> <tr> <th>Type of operators</th> <th>1999</th> <th>2001</th> <th>2004</th> <th>2006</th> <th>2008</th> <th>2009</th> </tr> </thead> <tbody> <tr> <td>Direct operation</td> <td>228</td> <td>217</td> <td>254</td> <td>233</td> <td>273</td> <td>223</td> </tr> <tr> <td>Contractor's operation</td> <td>100</td> <td>200</td> <td>300</td> <td>400</td> <td>500</td> <td>600</td> </tr> </tbody> </table> <p>3) Collection Frequency City center and high income residential areas: three times a week Other areas: twice a week</p> <p>4) Type of Equipment</p> <table border="1"> <thead> <tr> <th>Area</th> <th>Collection Equipment</th> <th>Method</th> </tr> </thead> <tbody> <tr> <td>Standard residential areas</td> <td>15m³ Compactor truck</td> <td>Curb collection</td> </tr> <tr> <td>Commercial areas</td> <td>15m³ Compactor truck</td> <td>Curb collection</td> </tr> <tr> <td>Busy commercial areas</td> <td>8m³ Compactor truck</td> <td>Curb collection</td> </tr> <tr> <td>Marginal areas</td> <td>5.5 - to 10 m³ container</td> <td>Point collection</td> </tr> <tr> <td>Street waste</td> <td>5.5 - to 10 m³ container</td> <td>Point collection</td> </tr> </tbody> </table> <p>5) Type of Equipment unit: nos</p> <table border="1"> <thead> <tr> <th>Type of equipment</th> <th>1999</th> <th>from 2001 to 2010</th> </tr> </thead> <tbody> <tr> <td>15m³ compactor truck</td> <td>11</td> <td>15</td> </tr> <tr> <td>13m³ compactor truck</td> <td>9</td> <td>0</td> </tr> <tr> <td>8m³ compactor truck</td> <td>0</td> <td>3</td> </tr> <tr> <td>12m³ dump truck</td> <td>10</td> <td>7</td> </tr> <tr> <td>5.5 m³ hoist truck</td> <td>1</td> <td>5</td> </tr> <tr> <td>10 m³ armroll truck</td> <td>1</td> <td>5</td> </tr> <tr> <td>5.5 m³ containers</td> <td>10</td> <td>50</td> </tr> <tr> <td>10 m³ containers</td> <td>12</td> <td>50</td> </tr> <tr> <td>Leased 6 m³ dump truck</td> <td>0</td> <td>vary from 0 to 8</td> </tr> </tbody> </table>	Type of operators	1999	2001	2004	2006	2008	2009	Direct operation	228	217	254	233	273	223	Contractor's operation	100	200	300	400	500	600	Area	Collection Equipment	Method	Standard residential areas	15m ³ Compactor truck	Curb collection	Commercial areas	15m ³ Compactor truck	Curb collection	Busy commercial areas	8m ³ Compactor truck	Curb collection	Marginal areas	5.5 - to 10 m ³ container	Point collection	Street waste	5.5 - to 10 m ³ container	Point collection	Type of equipment	1999	from 2001 to 2010	15m ³ compactor truck	11	15	13m ³ compactor truck	9	0	8m ³ compactor truck	0	3	12m ³ dump truck	10	7	5.5 m ³ hoist truck	1	5	10 m ³ armroll truck	1	5	5.5 m ³ containers	10	50	10 m ³ containers	12	50	Leased 6 m ³ dump truck	0	vary from 0 to 8
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2.3 Processing, treatment, recycling	<p>1) Basic Policy</p> <p>a) Neither major processing nor treatment plants for municipal solid waste, to be operated by the MCC, will be introduced provided that acquisition of a landfill site and its operation do not impose too much effort on the proposed waste management authority.</p> <p>b) The AMDC's SWEU will promote recycling activities by encouraging the participation of the private sector and avoid direct involvement in the execution of recycling activities.</p> <p>c) A separate discharge system will be firstly introduced in the high income residential areas, where more recyclable materials are included in the generated wastes, and gradually expanded to the middle and low income residential areas.</p> <p>2) Implementation Plan</p> <p>a) In 2004, the first recycling program that recyclable waste is collected at markets and public square will be implemented.</p> <p>b) In 2008, the second recycling program that recyclable waste is collected at schools will be implemented.</p> <p>c) In 2007, the recycling company will be jointly established by the AMDC and the private sector. This company will have a manual sorting plant near</p>																																																																					

	<p>the new disposal site and start its operation by employing scavengers in 2008.</p> <p>d) In 2008, the MCC will prohibit private people to enter the disposal site.</p> <p>e) In 2008, the MCC will start the separate collection officially.</p>
2.4 Street sweeping system	<p>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.</p> <p>2) Following improvement measures will be executed.</p> <ul style="list-style-type: none"> 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
2.5 Final disposal	<p>1) Existing Final Disposal Site</p> <ul style="list-style-type: none"> a) In 1999, conditions in the existing disposal site will be improved in order to improve the sanitary level. b) Scavengers cooperation and participation will be encouraged. <p>2) New Final Disposal Site</p> <ul style="list-style-type: none"> a) In 1999, the F/S study, EIA study, official selection of the site, land acquisition, detailed design and contractor selection will be conducted. b) In 2000, the new final disposal site will be constructed. c) In 2001, the operation of the new disposal site will commence. <p>3) Final Disposal Site for the Next Term</p> <ul style="list-style-type: none"> a) In 2008, the site selection will start. b) In 2011, the construction of the new final disposal site will commence. c) In 2012, the operation of the following new disposal site will start.
2.6 Operation and maintenance	<p>Employing a large number of people is risky and is also difficult to maintain the level of management required, so it is recommended that the private sector participates in SWM works in order to reduce the burden and work load on the authority responsible for SWM.</p>
2.7 Hygiene education	<p>1) Hygiene education in Alcardia Mobile Campaign will be reinforced.</p> <p>2) School education will be conducted by using the textbook "Basura", the video on solid waste, etc.</p>

3.5 SWM Project Cost

a. Total Cost from 1999 to 2010

Table 18: Summary of the Costs Involved in SWM Works

unit: 10⁶ Lps.

Activities	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1 Administration												
1.1 Institutional, Organizational and Financial Reform												
Institutional reform												
To improve the financial system												
Organizational reform												
Improvement of managerial capability												
1.2 Hygiene Education												
To operate the mobile municipality campaign												
To conduct hygiene education at school												
To start education on recycling												
1.3 General administrative work												
Cost: Operation and Maintenance Cost	2.8	2.9	3.9	3.9	4.4	4.2	4.9	4.3	4.8	5.0	4.9	5.3
Total Cost	2.8	2.9	3.9	3.9	4.4	4.2	4.9	4.3	4.8	5.0	4.9	5.3
2 Collection and Haulage System												
Detailed design on collection vehicles (1st phase)												
Arrangement of financial source (1st phase)												
Procurement of collection vehicles (1st phase)												
Operation of vehicles procured at the 1st phase												
Detailed design on collection vehicles (2nd phase)												
Arrangement of financial source (2nd phase)												
Procurement of collection vehicles (2nd phase)												
Operation of vehicles procured at the 2nd phase												
Cost: Investment	0.0	40.9	0.0	0.0	0.0	0.0	0.0	0.0	40.9	0.0	0.0	0.0
Operation and Maintenance Cost	11.0	11.5	12.7	12.7	14.6	12.7	15.5	12.7	14.6	14.6	12.7	14.6
Contracting Out	13.8	13.8	21.9	21.9	21.9	32.9	32.9	43.8	43.8	54.8	65.7	65.7
Total Cost	24.8	66.2	34.6	34.6	34.6	45.6	49.4	56.5	99.3	69.4	78.4	80.3
3 Recycling System												
Preparation for recycling point collection (1st phase)												
Recycling point collection (1st phase) start												
Preparation for recycling point collection (2nd phase)												
Recycling point collection (2nd phase) start												
Establishment of a recycling company by MCG and private sector												
Construction of a sorting plant												
Separate collection by MCG start												
Recycling company start operation												
Cost: Investment	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	2.7	0.7	0.0	0.0
Operation and Maintenance Cost	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5	1.0	1.0	1.0
Total Cost	0.0	0.0	0.0	0.0	1.6	0.5	0.5	0.5	3.2	1.7	1.0	1.0
4 Street Sweeping System												
To increase litter boxes along the streets												
To increase the number of collection points												
To introduce a new type of carts for carrying litters collected												
To set up site offices												
To operate it in the new method												
Cost: Investment	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.4	0.0	0.0
Operation and Maintenance Cost	2.8	2.8	3.3	3.5	3.5	3.5	3.7	3.9	4.1	4.2	4.4	4.6
Contracting Out	6.7	6.7	6.7	7.1	7.1	7.1	7.5	7.9	8.2	8.6	9.0	9.3
Total Cost	9.6	10.4	10.0	10.6	10.6	10.6	11.2	11.7	13.1	13.2	13.4	14.0
5 Final Disposal System												
Existing Disposal Site												
Improvement of the existing disposal site												
Operation												
New Disposal Site												
F/S, EIA, Detailed design, Land acquisition, Bidding												
Construction												
Operation												
Following Disposal Site												
Siting a new disposal site												
F/S, EIA, Detailed design, Land acquisition, Bidding												
Cost: Investment	3.7	42.4	0.0	3.7	1.2	0.0	13.4	7.8	0.7	7.4	0.7	4.7
Operation and Maintenance Cost	5.0	5.2	5.6	5.7	6.6	8.8	6.8	6.9	7.8	8.0	9.0	9.0
Total Cost	8.7	47.6	5.6	9.4	7.8	6.8	20.2	14.7	8.5	15.4	9.7	13.7
Cost: Investment	3.7	84.1	0.0	3.7	2.8	0.0	13.4	7.8	45.1	8.4	0.7	4.7
Operation and Maintenance Cost	21.7	22.5	25.5	25.8	29.1	27.7	32.4	28.3	31.8	32.8	32.0	34.4
Contracting Out	20.6	20.6	28.6	29.0	29.0	40.0	40.3	51.7	52.0	63.3	74.7	75.0
Total Cost	45.9	127.2	54.2	58.5	60.8	67.7	86.1	87.7	128.9	104.6	107.4	114.2

b. Cost Analysis

Table 19: Estimated Unit SWM Costs

Item	unit: Lps/ton			
	1997*	1999 to 2000 average**	2001 to 2007 average	2008 to 2010 average
Collection & Haulage***	83.6	203.9	257.3	272.2
Street Sweeping***	N.A.	920.2	976.2	977.2
Final Disposal	5.5	40.2	62.9	49.7
Recycling	0	0	278.6	314.1
Others	N.A.	N.A.	N.A.	N.A.
Total SWM Works	130.2	321.3	376.7	368.3

Note:

- *: This excludes depreciation.
- ** : This includes depreciation for final disposal site.
- ***: This includes the contracting-out cost.

The unit cost of the collection and haulage works is broken down as follows.

Direct operation costs: Lps. 210.17 per ton

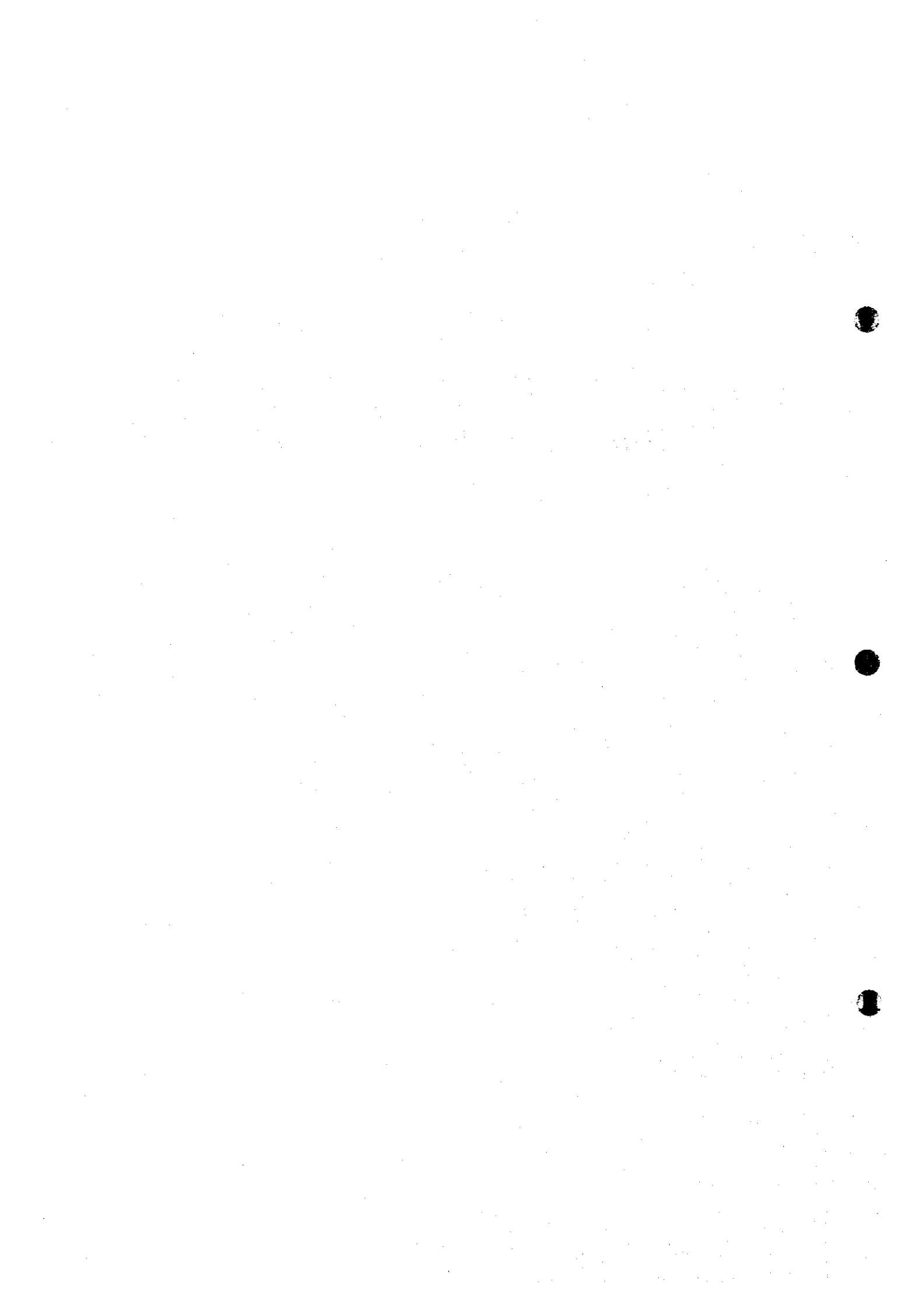
Contracting out price: Lps. 379.0 per ton in 1999 and 2000

Lps. 300.0 per after 2000

The costs for the proposed waste management authorities to directly operate collection and haulage works (Lps. 210.17 per ton) exclude the administration cost and the financial cost, while their contracting out price exclude only the administration cost and include a profit.

Chapter 4

Implementation of Pilot Projects



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 Mobile⁶" 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.

⁶ 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 commedable 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.

Chapter 5

*Feasibility Study for
the Revised Priority Projects*

5. Feasibility Study for the Revised 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 20 shows the targets for the priority projects.

Table 20: Target for the Priority Projects

Items	unit	1999	2000	2001	2002	2003
A. Main Targets						
Collection Rate	%	64%	64%	72%	72%	72%
Recycling Rate	%	3%	3%	4%	4%	4%
Street Swept Length	km	180	180	180	190	190
Final Disposal		Level 1		Level 2.5		
B. Detailed Targets						
1. Waste Generation Amount		512	541	579	621	662
Residential Waste	t/d	340	360	387	415	443
Non-residential Waste	t/d	143	152	163	176	188
Street Sweeping Waste	t/d	28	28	28	30	30
2. Waste Collection Amount		328	346	417	447	476
Collection of Residential Waste	t/d	228	242	290	312	333
Collection of Non-Residential Waste	t/d	72	76	98	106	113
Collection of Street Sweeping Waste	t/d	28	28	28	30	30
Direct Haulage	t/d	29	30	33	35	38
On-site Disposal	t/d	21	22	23	25	27
Recycling	t/d	7	8	9	10	11
Uncollected	t/d	-127	-135	-96	-103	-110
3. Service Rate		64%	64%	72%	72%	72%
High Income Residents	%	90%	90%	100%	100%	100%
Middle Income Residents	%	70%	70%	80%	80%	80%
Low Income Residents	%	50%	50%	55%	55%	55%
4. Service Population						
4.1 Service Population		565,568	588,781	685,868	714,392	744,099
High Income Residents	t/d	154,848	156,825	176,353	178,350	180,232
Middle Income Residents	t/d	194,552	211,851	263,099	285,360	308,969
Low Income Residents	t/d	216,169	220,105	246,417	250,681	254,899
4.2 Unserved Population		316,754	328,323	267,389	276,443	285,796
High Income Residents	t/d	17,205	17,425	0	0	0
Middle Income Residents	t/d	83,379	90,793	65,775	71,340	77,242
Low Income Residents	t/d	216,169	220,105	201,614	205,103	208,554
5. Final Disposal Amount		356	376	449	481	513
Municipal Waste	t/d	345	364	436	468	499
Others	t/d	11	11	12	13	14

Table 21: Contents of the Priority Projects

System	Description																																										
1. Institutional System																																											
1.1 Administration & Organization	<p>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.</p> <p>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.</p>																																										
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	<p>1) Residential waste collection fee: (unit: Lps/month/house)</p> <table border="1"> <thead> <tr> <th></th> <th>2001</th> <th>2003</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>2) Non-residential waste collection will be charged according to their annual turnover according to the proposed fee table.</p> <table border="1"> <thead> <tr> <th>Annual business income</th> <th>Fee Rate (establishment/month)</th> </tr> </thead> <tbody> <tr> <td>Up to Lps 50,000.00.</td> <td>Lps. 40.00</td> </tr> <tr> <td>Lps. 50,000.01 - 100,000.00</td> <td>Lps. 80.00</td> </tr> <tr> <td>Lps. 100,000.01 - 300,000.00</td> <td>Lps. 125.00</td> </tr> <tr> <td>Lps. 300,000.01 - 600,000.00</td> <td>Lps. 180.00</td> </tr> <tr> <td>Lps. 600,000.01 - 1,000,000.00</td> <td>Lps. 240.00</td> </tr> <tr> <td>Lps. 1,000,000.01 - 2,000,000.00</td> <td>Lps. 325.00</td> </tr> <tr> <td>Lps. 2,000,000.01 - 5,000,000.00</td> <td>Lps. 500.00</td> </tr> <tr> <td>Lps. 5,000,000.01 - 10,000,000.00</td> <td>Lps. 700.00</td> </tr> <tr> <td>Lps. 10,000,000.01 - 15,000,000.00</td> <td>Lps. 800.00</td> </tr> <tr> <td>Lps. 15,000,000.01 - 20,000,000.00</td> <td>Lps. 1,000.00</td> </tr> <tr> <td>Lps. 20,000,000.01 - 30,000,000.00</td> <td>Lps. 1,300.00</td> </tr> <tr> <td>Lps. 30,000,000.01 - 40,000,000.00</td> <td>Lps. 1,500.00</td> </tr> <tr> <td>Lps. 40,000,000.01 - 60,000,000.00</td> <td>Lps. 1,600.00</td> </tr> <tr> <td>more than Lps. 60,000,000.01</td> <td>Lps. 1,800.00</td> </tr> </tbody> </table> <p>3) Collection service rate for large discharger: Lps. 480/ton in 2001</p> <p>4) Direct haulage rate: Lps. 50/ton in 2001</p>		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 (establishment/month)	Up to Lps 50,000.00.	Lps. 40.00	Lps. 50,000.01 - 100,000.00	Lps. 80.00	Lps. 100,000.01 - 300,000.00	Lps. 125.00	Lps. 300,000.01 - 600,000.00	Lps. 180.00	Lps. 600,000.01 - 1,000,000.00	Lps. 240.00	Lps. 1,000,000.01 - 2,000,000.00	Lps. 325.00	Lps. 2,000,000.01 - 5,000,000.00	Lps. 500.00	Lps. 5,000,000.01 - 10,000,000.00	Lps. 700.00	Lps. 10,000,000.01 - 15,000,000.00	Lps. 800.00	Lps. 15,000,000.01 - 20,000,000.00	Lps. 1,000.00	Lps. 20,000,000.01 - 30,000,000.00	Lps. 1,300.00	Lps. 30,000,000.01 - 40,000,000.00	Lps. 1,500.00	Lps. 40,000,000.01 - 60,000,000.00	Lps. 1,600.00	more than Lps. 60,000,000.01	Lps. 1,800.00
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more than Lps. 60,000,000.01	Lps. 1,800.00																																										
1.3 Management System	<p>1) The MCC's accounting, financing, planning, monitoring and supervision capabilities will be improved.</p> <p>2) The involvement of private sector will be gradually extended in the SWM services.</p> <p style="padding-left: 40px;">Contract A: Collection and Haulage of Municipal Solid Waste (MSW) in the City's Urban Areas</p> <p style="padding-left: 40px;">Contract B: Collection and Haulage of Municipal Solid Waste in the City's Marginal Areas</p> <p>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.</p> <p>4) The MCC will hold an open bid so that proceedings are transparent to the general public.</p> <p>5) The MCC limits the amount to be collected in one contract area to less than 50 tons/day.</p> <p>6) The contract rate of collection and haulage work will be kept at less than Lps. 300 per ton after 2000.</p>																																										

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. unit: ton/day																																															
	<table border="1"> <thead> <tr> <th></th> <th>1999</th> <th>2000</th> <th>2001</th> <th>2002</th> <th>2003</th> </tr> </thead> <tbody> <tr> <td>AMDC</td> <td>228</td> <td>246</td> <td>217</td> <td>247</td> <td>276</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>328</td> <td>346</td> <td>417</td> <td>447</td> <td>476</td> </tr> </tbody> </table>		1999	2000	2001	2002	2003	AMDC	228	246	217	247	276	Contractors	100	100	200	200	200	total	328	346	417	447	476																							
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2) Planned Number of Collection Vehicles to be owned by the MCC.																																																
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2.2 Street sweeping system	3) Procurement Schedule (unit: nos)																																															
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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 existing disposal site sanitary will be improved in order to improve the sanitary level. b) The cooperation of scavengers will be promoted.																																															
	2) New Final Disposal Site																																															
	In 1999: a) A preliminary design and feasibility study will be conducted. b) The new site will be officially decided. c) The environmental impact assessment will be conducted. d) Neighborhood consensus will be obtained. e) The required land will be acquired. f) The detailed design and tender documents will be prepared. g) The financial source will be secured.																																															
In 2000: a) A contractor will be selected by a bid. b) A new disposal site will be constructed.																																																
In 2001: a) The operation of the new disposal site will start.																																																

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

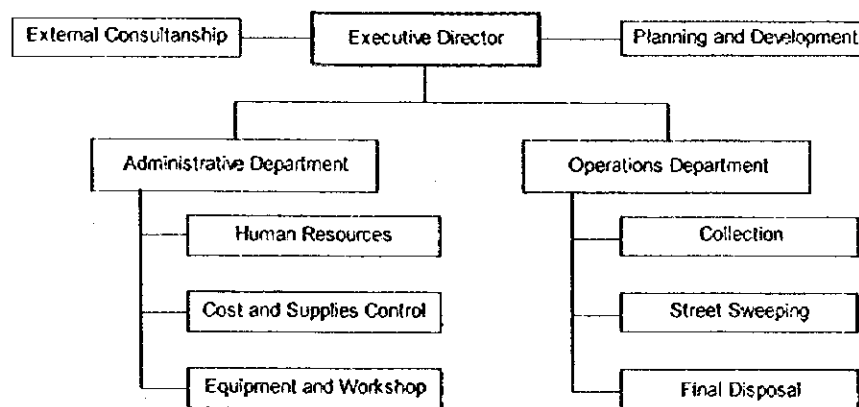


Figure 9: "1st Stage" Organizational Chart of SWM Executing Unit

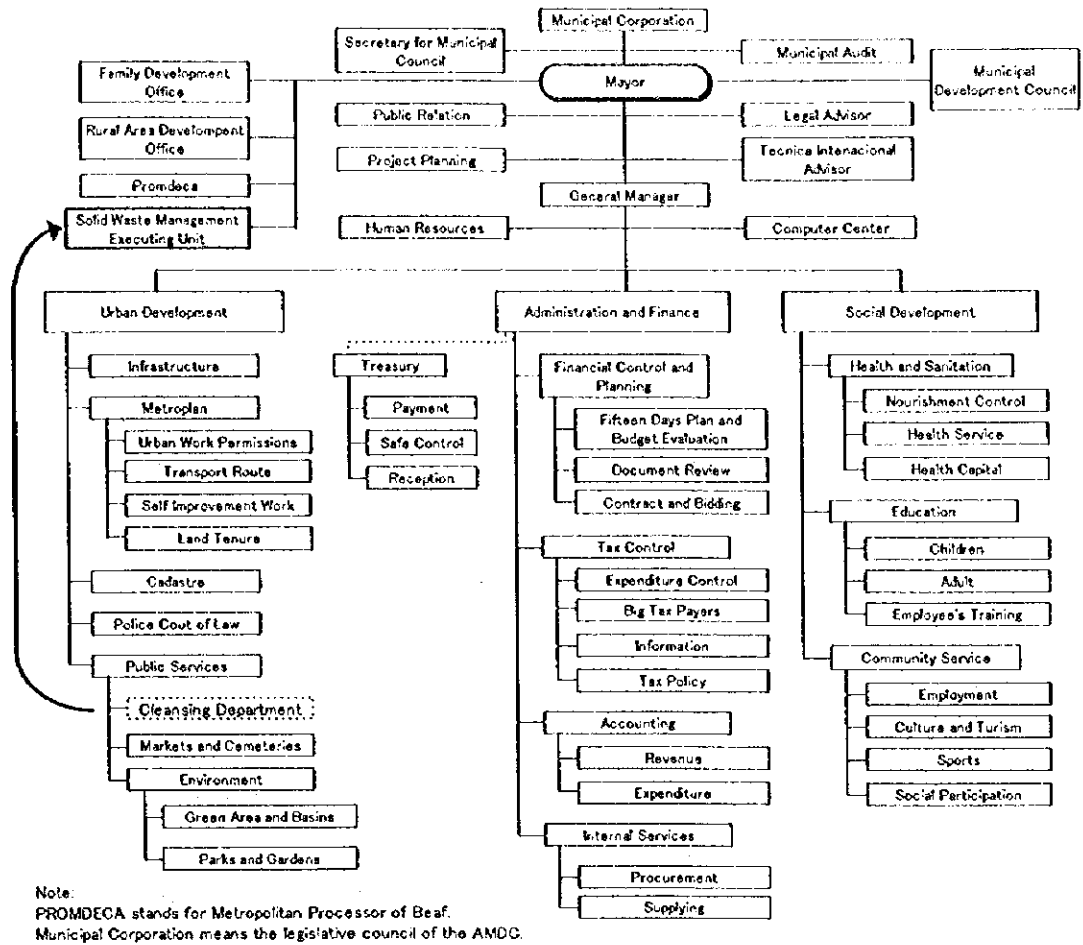


Figure 10: "1st Stage" Proposed Hierarchy Level of SWM Executing Unit

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

Justification:

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 fact some services have already been contracted out to the private sector.

There are, however, some discrepancies between the private sector's objective and the government's objective in SWM. The private sector's aim in SWM is more profit oriented, whereas the municipality strives to provide citizens with sanitary conditions and achieve aesthetic conditions, environmental protection, and conservation of natural resources, etc. Therefore, the municipality must retain its function in order to control the private sector's activities properly so that the master plan targets are achieved.

On the other hand, there are many problems with a direct municipal operation (see Chapter 12 for details). Because an autonomous entity is not bound by the same administrative restrictions that are at the root of the problems faced by public waste services, financial stability for the new autonomous entity – achieved through the billing of services – will become a reality.

Autonomous entities are gaining popularity in other Latin American countries, as management decisions – especially concerning personnel appointments and setting of fees – are not swayed by political intervention.

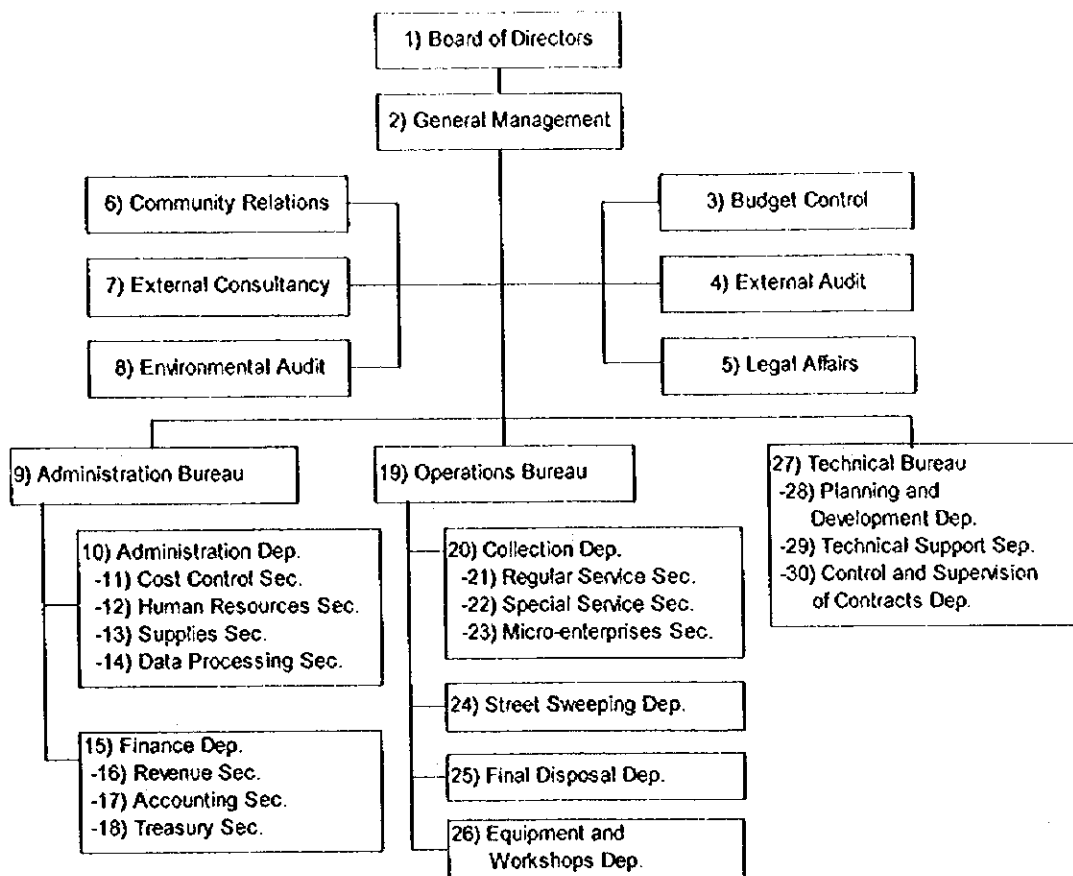


Figure 11: "2nd Stage" Organizational Structure of SWM Autonomous Entity

5.2.1 Proposal for the Scheme for Private Sector Participation

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

Figure 12: 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 New Disposal Site

5.3.1 Site Selection

Since the remained life year of the existing disposal site has been reduced by receiving huge amount of hurricane waste, the AMDC conducted the site selection study by itself. The following six sites were assessed.

- 1) Barrio Ingles
- 2) Lake Pedregal
- 3) Kilometer 7 on the Danli road
- 4) Santa Rosa
- 5) Adjacent to existing final disposal site
- 6) Lake Pedregal via Santa Anita Cemetery Road

Summarizing the AMDC report: Sites 1, 2, and 3 have problems regarding existing transport routes and accessibility. Sites 1 and 2 are aesthetically attractive and hence better suited to future urban development. While site 4 is possibly suitable as a disposal site, it is not owned by the AMDC and there has been strong resistance to selling the property by the existing owners and locals. The report concluded that the remaining two sites (5 and 6) are the most suitable, with site 5 being their first preference.

Because the site 5's topography is suitable for the management of leachate and landfill gas, and because existing environmental impacts are to some degree already understood and managed by AMDC staff and accepted by locals, the AMDC informed the Study Team that the team shall execute surveys for this site as a new disposal site. The Study Team conducted the preliminary design and the preliminary cost estimation on this site for future final disposal after confirming the site suitable for final disposal.

5.3.2 Site Location

Figure 13 shown on the location map. Located at KM 7 on the Olancho Highway, the new disposal site abuts the northern and western boundaries of the existing disposal site.

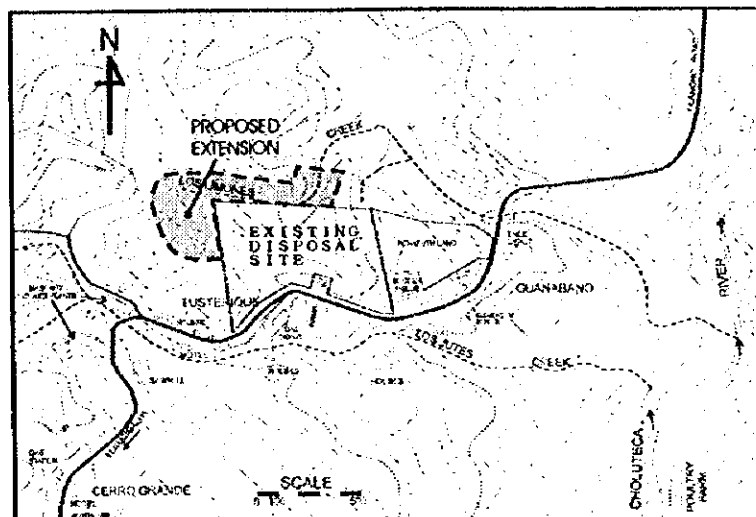


Figure 13: Location Map of New Disposal Site

5.3.3 Condition of Site and Surrounding Areas

a. Topography

According to the topographical survey carried out for the Revised Master Plan the total area necessary for the establishment of the new disposal site is about 30 hectares (including landfill, buffer zone, and leachate treatment facilities). The new disposal site is a valley that forms the upper portion of the Los Limones Valley. The upstream part of the site is flatter and wider than the downstream end, which is deeper and narrower because of landfilling of the existing disposal site on one side and a narrow ridge on the other. This topography is favorable for the construction of a disposal site).

However caution is advised in regard to the steep northern slope of the existing landfill. It is between 30° and 40° from the horizontal, rises up over 50 m in some areas, and is poorly stabilized. Generally MSW landfilling slopes are kept to less than 20° and should consist of well compacted layers. The current condition is dangerous, and some slope failures have occurred.

b. Access

Access is possible using the existing disposal site's asphalt paved access road. The road remains in excellent condition in spite of the extraordinary heavy rains and runoff, and the dramatic increase in traffic, resulting from Hurricane Mitch. This, however, ends several hundred meters short of the existing disposal site and must be extended to the new filling areas.

Access is also possible from behind the new site, from the Villa Lena Road. This route could be used during construction of the new site. However, it is strongly recommended that this route not be used because of the potential to increase environmental damage.

c. Hydrological conditions

Currently surface water flows and leachate from the existing disposal site flow into the Los Limones Creek and then into the Choluteca River, approximately 2 km downstream. As mentioned in the master plan the Choluteca is already heavily polluted as a result of untreated wastewater from urban areas of the DC flowing directly into the river.

The incline of the Los Limones Creek in the area of the new site is in the order of 8% to 20%. Because of the small catchment area and the steep incline the creek rarely contains runoff from rainfall. There are, however, seasonal flows of leachate emanating from the landfill.

Because of its proximity, the permeability of the soil is assumed to be the same as within the existing disposal site. Interstratified layers of highly permeable weathered rhyolite and tuffs of low to medium permeability predominate.

Many residents surrounding the disposal site obtain drinking water from community faucets from two deep wells located approximately 600 meters to the west and southwest of the existing landfill in the valley of the Los Jutes Creek. Both wells are 110m deep and produce about 10 liters per minute (SANAA).

The limit of the proposed landfill is about 600m from these wells. The new disposal site is in the same catchment as the existing disposal site. The new landfill is located at a similar elevation to the existing landfill so the new landfilling is not expected to impact these wells. Water quality tests undertaken by CESSCO (Center for Studies and Control of Contaminants) show no clear indication that wells in the general southwest direction of the existing disposal site are contaminated by the existing landfill.

Analysis (CESSCO and Study Team testing) of wells and lagoons and road cuttings between the Choluteca River and the disposal site clearly indicate contamination by the existing disposal site and therefore it is determined that shallow groundwater flows toward the river, i.e., easterly, from the existing disposal site.

However, water quality tests are infrequent and not always for the contaminants that should be tested for. Furthermore, it is impossible to determine flow directions at the depths of the existing wells without further investigations. Groundwater sometimes flows very slowly, so even though the landfill was established 20 years ago, water may not have reached the wells yet.

d. Landfilling space

Because of Hurricane Mitch an extra 300,000m³ of waste (250,000 in 1998 and 50,000 in 1999)⁷ is deposited at the existing landfill. The revised table showing remaining landfilling capacity (1999-2010) is shown below (Table 22).

Table 22: Disposal Site Space Requirements

Year	MSW Received	Compacted waste (D=0.8)	Hurricane waste	Cumulated Compacted Waste	Cover Soil Required	Cumulated Cover Soil	Required Capacity
	tons/year	m ³	m ³	m ³	m ³	m ³	m ³
1999	131,000	163,750	50,000	213,750	24,563	24,563	238,313
2000	139,000	173,750	-	387,500	26,063	50,625	438,125
2001	166,000	207,500	-	595,000	31,125	81,750	676,750
2002	177,000	221,250	-	816,250	33,188	114,938	931,188
2003	189,000	236,250	-	1,052,500	35,438	150,375	1,202,875
2004	219,000	273,750	-	1,326,250	41,063	191,438	1,517,688
2005	235,000	293,750	-	1,620,000	44,063	235,500	1,855,500
2006	250,000	312,500	-	1,932,500	46,875	282,375	2,214,875
2007	266,000	332,500	-	2,265,000	49,875	332,250	2,597,250
2008	303,000	378,750	-	2,643,750	56,813	389,063	3,032,813
2009	323,000	403,750	-	3,047,500	60,563	449,625	3,497,125
2010	344,000	430,000	-	3,477,500	64,500	514,125	3,991,625

The required capacity of the overall disposal site, from the beginning of 1999 to the end of 2010, is therefore assumed to equal 4 million cubic meters. In addition to the 185,400m³ of landfill space filled in 1998 resulting from the disposal of MSW, a further 250,000m³ of hurricane derived waste was dumped at the existing disposal site. It is therefore estimated that 435,400 m³ was landfilled in 1998, so the space available at the beginning of 1999 is estimated to be 1 million cubic meters.

The landfilling space of the new disposal site was estimated by taking cross sections at 100m intervals through the proposed new landfill. It was found that a total of 3.6 million cubic meters of space is available in the new disposal site.

⁷ Based on new topographic survey data and UNDP field studies and visual estimates.

Summing the available space of the existing disposal site and that available at the new disposal site it is estimated that 4.6 million m³ of space is available. From Table 22 it can be approximated that this is sufficient to last beyond 2010 and, by extrapolation, to near the end of 2011.

e. Soil Conditions

Geological surveys carried out for the master plan determined that approximately eighty percent of the soil (weathered rhyolite and tuffs) can be used for cover soil. The remaining rock, 20%, can be used for the construction of leachate drains and for slope stabilization works.

Soil is available from three sources within the area of the existing and new disposal site:

- existing borrow areas (A₁ and A₂)
- hurricane waste
- borrow areas of the new disposal site (C₁, C₂, and D)

According to the Revised master plan, approximately 330,000 m³ of soil remained at the beginning of 1998 in the existing disposal site's borrow areas, and an estimated 24,200m³ of soil was consumed in 1998. So therefore it is calculated that 305,800m³ of soil remained in the existing disposal site at the beginning of 1999.

Hurricane waste is another potential source of soil. It is estimated, by site inspection, that 50% of the amount deposited at the existing disposal site is suitable, therefore a further 150,000m³ of soil is available.

Within the area of the new disposal site there are two potential borrow sites: 1) excavations from the slopes of the new landfilling areas (C₁ and C₂), earthwork volume calculations carried out for the revised Master Plan, estimated that 536,000m³ potentially exists in these areas; and 2) from the hill to the west of the existing site (D), where 656,000m³ was calculated to exist. Of the total 1.19 million m³ available, 953,600m³ (80%) is soil suitable for cover soil and the construction of embankments.

Therefore, in total 1.4 million cubic meters of soil is, therefore, available within the entire site. According to Table 22, this is well in excess of the amount necessary.

In regard to which areas should be exploited first, soil should be taken first from areas where the least impact on the natural environment will result. Therefore hurricane waste and soil within areas C1 and C2 should be used first. After these sources have been exhausted, areas A1, A2, and D should be used.

f. Local Residents

Within the boundaries of the proposed site there are 4 households. These houses are structures of adobe (mud brick) construction. According to locals they have been there for 10 to 15 years. The land surrounding their properties is well fenced though no cattle were spotted during the several trips taken to the site by the study team, neither is a significant portion of this land currently under cultivation. The adults in these either work in Tegucigalpa or scavenge at the landfill.

Although ownership is not clear, resettling these people should be done with sensitivity, respecting their dignity and providing compensation where necessary to compensate for building a new home and other necessary expenses.

In addition to these households there are three households located within 200 meters of the proposed new boundaries. Development activities should be sensitive to their needs, and access to their properties not hindered.

5.3.4 Proposed Design Concept

When designing a new landfill there are various system alternatives that must be considered. These system alternatives are summarized by the following:

- final disposal method
- landfill structure
- level of sanitary landfill development

a. Final Disposal Method

Basically there are three final disposal methods: 1) open dumping, 2) controlled tipping, and 3) sanitary landfilling.

While operators of the existing disposal site attempt to cover the MSW with soil, large sections remain uncovered for long periods of time due to poor filling techniques and high machine downtimes. Therefore the method currently employed by AMDC operators at the final disposal site is described as controlled tipping with irregular and insufficient application of cover soil.

Considering the environmental advantages of sanitary landfilling and the fact that the operators are partially using this method, it is proposed, as demonstrated in the Master Plan, that cover soil application be improved (mainly by implementing the cell method) in order to achieve sanitary landfilling.

b. Landfill Structure

Basically five types of landfill structures exist.

Type	Description
anaerobic landfill	Most leachate generated is not drained, landfill layers are constantly being built up to achieve anaerobic conditions. The quality of leachate is very poor, resulting in bad odors and the propagation of disease carrying insects and vermin.
anaerobic sanitary landfill	Cover soil is applied over each layer of waste thereby preventing bad odors and landfill fires, as well as mitigating the propagation of insects to a certain extent. Leachate and gas problems, however, remain. Similarly to the anaerobic landfill model, the landfill layers maintain anaerobic conditions.
improved anaerobic sanitary landfill	In addition to regular cover soil, this structure is constructed with a leachate drain at the base of the of the landfill. Leachate's quality is improved and anaerobic conditions are maintained.
semi-aerobic sanitary landfill	Leachate quality is further improved with better drainage. More drainage pipes and vents stimulate natural ventilation, achieving aerobic conditions in the landfill layers and consequently accelerating solid waste composition.
aerobic sanitary landfill	In addition to the drainage pipes used in semi-aerobic landfills, air is forced into the landfill through injection pipes, thereby accelerating solid waste decomposition and stabilizing and improving leachate quality.

The existing landfilling method is categorized under anaerobic sanitary landfill. Taking into account the conditions of the proposed site and the existing management, etc., the semi-aerobic landfill model is proposed for the new landfill. The major factors that influenced this decision are set out below:

Factor	Advantages of Semi-Aerobic System
Landfill gas composition	Less methane (CH ₄) will be generated than with an anaerobic system. Because CH ₄ gas is not planned to be exploited as a fuel, it is preferable to reduce its production as it may cause fires and explosions. Landfill gas from a semi-aerobic system contains less volatile gases than aerobic systems.
Leachate quality	Overall leachate quality is better than anaerobic systems
Landfill operation	Operation and maintenance is simple
Investment	The semi-aerobic system is inexpensive because large investments are not necessary for air blowers. Leachate treatment costs are less than anaerobic systems

c. Level of Sanitary Landfill Development

The sanitary landfill development and operation levels are classified as:

Level 1: Controlled Tipping

Level 2: Sanitary Landfill with Embankment and Daily Soil Covering

Level 3: Sanitary Landfill with Leachate Cycling System with impermeable lining.

Level 4: Sanitary Landfill with Leachate Treatment System with impermeable lining

Because of improved environmental conditions, ease of operation, and relatively low investment cost, the middle of Level 2 and Level 3 type landfill (with no liner) is proposed for the new disposal site. No landfill liner is proposed because of the high investment cost (it would roughly double the investment cost), difficulty of maintenance, and the low benefit.

The adjacent existing disposal site is not lined and leachate either seeps into the ground or flows into the Los Limones Creek and flows into the heavily polluted Choluteca River. The area effected by leachate is small and the locals are coping by collecting water from other sources. Improved landfilling techniques and leachate collection and cycling will be more beneficial in reducing the impact of leachate.

5.3.5 Preliminary design

The following outlines the factors of the preliminary design that are considered for preparing the cost estimate⁸.

a. Geometrical design

A canyon/depression method landfill is planned.

Benching of the valley floor increases the stability of the landfill, i.e., prevents longitudinal sliding of the landfill.

⁸ A more detailed description of many of the facilities discussed here is in Chap. 15 of the Annex.

Cutting (1:1) the north wall of area C₂ and both walls of C₁ provide cover soil and increase the filling capacity.

Embankments provide further stability of the landfill. The embankments (No.1 and No.2) are approximately 10 meters high with 1:2 terraced slopes. The embankments are constructed from select material obtained by excavating the north wall.

Landfilling slopes are terraced every 5 to 10 m to provide stability against slope failure and surface drainage

b. Access roads

The access road is extended in two sections. A 6m wide asphalt pavement (plus 1m wide shoulders) is constructed from where the existing access road ends, along the route shown on Figure 19.

From the point where the new asphalt road ends is a gravel surfaced access road winding down to the floor of the new landfill. The gravel access road connects the filling area with the temporary soil stock piling area in Area C₁.

The asphalt road's route passes over compacted waste so additional work is necessary to stabilize the sub-base; using soil excavated in the disposal site.

Asphalt access road = 500m long x 6m wide + 1 m shoulders

Gravel access road = 450m long x 8m wide

c. Leachate collection and cycling

Two types of leachate collection drains: a larger capacity central main collector and a smaller capacity lateral collectors. The leachate drains consist of 40 to 100mm cobbles enclosed in geotextile layer.

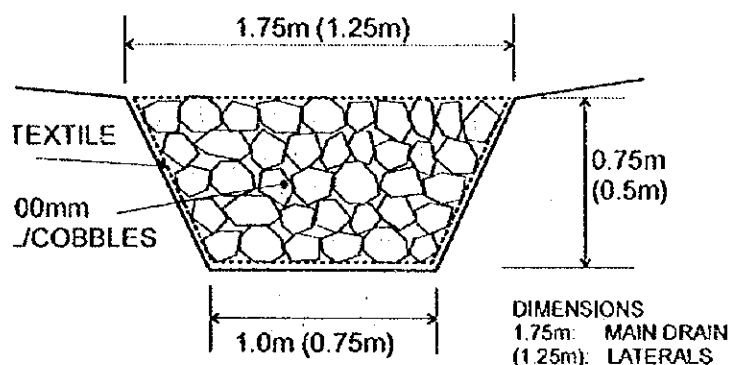


Figure 14: Leachate Collection Drains - Cross Sections

The leachate drains are connected to the landfill gas vents to improve the circulation of air and drainage of leachate.

A leachate holding lagoon is constructed on the downstream side of embankment No. 1. The capacity of the leachate holding lagoon was calculated assuming that the maximum amount generated in one day can be contained. From the Master Plan (Annex Chap. 15) in September the maximum amount of leachate is potentially

generated (i.e., 92 mm/m²). The total area of landfill generating leachate that is potentially caught in the holding lagoon is areas B₁, C₁, and C₂ (22.3 ha in total).

Leachate lagoon holding capacity:

$$0.092 \text{ m/m}^2 \times 223,000 \text{ m}^2 \div 30 \text{ days} = 684 \text{ m}^3$$

A 1 l/s, 100-meter head electric motor driven pump is used to cycle collected leachate held in the lagoon. The leachate is pumped up through a flexible 38 mm hose into vents, or sprayed over the filled areas to evaporate. The hose is moved often between gas vents and spraying, therefore the discharge should be small enough as to be manually managed, thus 1 l/s is selected as the maximum flowrate.

d. Landfill gas extraction

Landfill gas is extracted from the landfill using two types of vents: 1) free-standing vents are proposed as described in the Annex, and 2) wall-resting vents. Installation of both type of vents is considered an operation and maintenance cost.

Landfill gas vents are installed at approximately 50-meter intervals positioned as shown on Figure 19. More vents are located near the center of the new landfill where the thickness of the waste is greatest.

e. Cover soil

A layer of no less than 150 mm of cover soil is placed daily over the compacted waste, as described in the cell method (see Chap. 15 of Annex).

A 600 mm final layer will be constructed as detailed in the Master Plan

f. Surface water diversion

Upstream surface runoff is diverted around the filling area with a catch drain on the terraced cutting.

g. Truck scale

A 60-ton truck scale is proposed instead of the 30-ton model proposed for the original Master Plan. The change is because of the recent increase and the expected further increase in the number of private MSW waste collection companies. It can not be predicted what size haulage vehicles will be used in the future.

Also as described in the Master Plan a control room and corresponding digital recording equipment (i.e. PC and printer) is necessary

The truck scale is to be placed on natural terrain and located as shown on Figure 16 for the duration of the Master Plan.

h. Garage/workshop

The 250 m² garage is large enough to securely park 6 vehicles and a stockroom with essential tools, spare parts, lubricants, etc., to keep the vehicles operating.

i. Security fence

A 1000m long 2.5-meter high chain mesh security fence is installed to prevent scavengers, waste dumpers, and animals (cattle, horses, dogs, etc.) accessing from the western areas and to reduce wind blown litter spoiling neighboring areas.

j. Monitoring facilities

Two piezometers are proposed adjacent to the western boundary to monitor ground water flows towards the existing drinking water supply wells. An average depth of 100m and PVC pipe, diameter 100 mm.

In accordance with the monitoring program described in Chap. 15 of the Annex, samples are taken once or twice per year (more frequently if any suspicion). Because of their infrequent use the wells are equipped with a hand drawn bailer.

k. Closure

Closure is as described in Chap. 15 of the Annex. A final cover layer and vegetative layer will be placed. Surface runoff drains installed to divert runoff. Trees, shrubs, and grasses planted to reduce erosion and beautify the area.

5.3.6 Development sequence

a. Stage 1 Development

The new disposal site is developed in two stages. Stage 1 includes the excavation of the first two benches and cutting from the north side of C₂. Material from the excavations is used for the construction of embankments 1 and 2. The remaining soil is stockpiled for use as cover material. Rock is removed and used for slope stabilization or in the leachate drain.

The main leachate drain is constructed to embankment No. 2. Lateral drains are constructed in the first two benches. The leachate holding lagoon and cycling pump and

An asphalt access road is constructed from the existing access road to embankment No. 2. A gravel access road is constructed from embankment No. 2 winding down to the landfilling area.

The truck scale, garage/workshop, security fence, and piezometers are installed during this stage.

b. Stage 2 Development

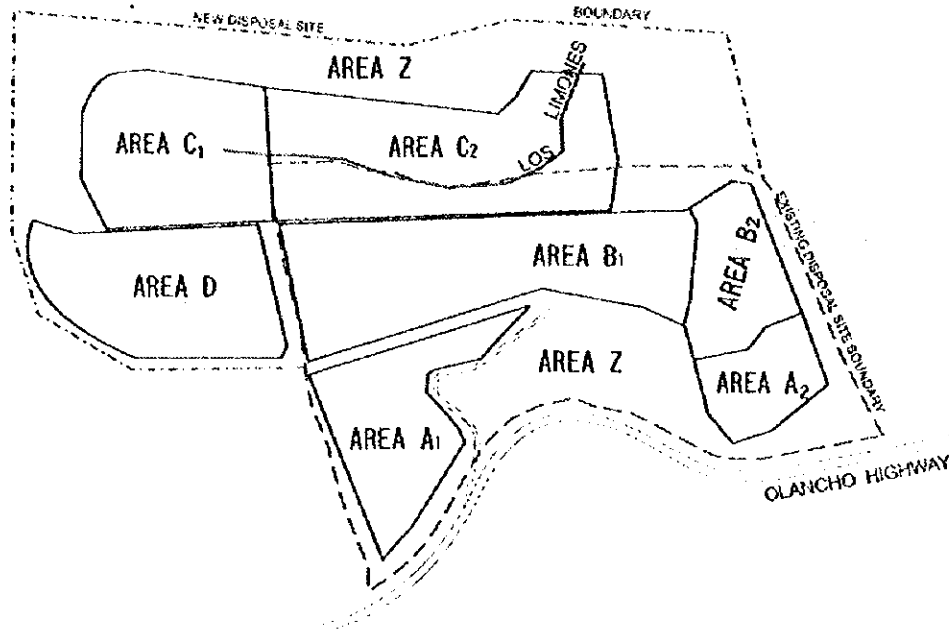
The completion of the main leachate drain is undertaken during this stage. In addition to the extension of the gravel access road for the landfilling of Area C₁

c. Other Development

Other excavation of sides and benching is carried out by landfill operators and is considered an operation cost. As is the installation of subsequent lateral leachate collection drains and landfill gas vents

5.3.7 Landfilling sequence

The divisions of the overall disposal site have been modified from those described in the original Master Plan to include the areas of the new disposal site.



Modified Division of Landfill

The areas are classified as shown below.

Table 23: Land-Use

Area	Land-Use	Area (ha)
A ₁	cover soil	4.0
A ₂	cover soil	2.0
B ₁	waste disposal	8.4
B ₂	waste disposal	2.7
C ₁	waste disposal/cover soil	6.8
C ₂	waste disposal/cover soil	7.1
D	cover soil	5.3
Z	buffer zone/administration/other	25.4

Filling of areas B1 and B2 will continue until the first stage of C₂ is ready. C₂ is expected to be constructed in 2000 and brought into operation in early 2001. Then filling of C₂ will immediately begin.

Filling begins from the lower end of the new site and proceeds toward the higher end so as to provide support for the north slope of the existing landfill. Filling from low to high also provides the benefit of always filling on top of deposited waste thus increasing the strength and compaction of the landfill.

This method usually has the draw back that upstream surface water has to be carefully managed. So upstream non-contaminated runoff should be diverted. However, the

upstream catchment is relatively small so the amount of runoff will not cause major problems.

5.4 Environmental Consideration

Main issues that should be closely analyzed in an EIA are:

- underground drinking water supplies
- surface water
- neighboring residents
- scavengers working at the current site
- air pollution (smoke, dust, and odors)
- native flora and fauna

A new disposal site that is planned and operated in order to produce minimal environment impacts will provide a strong positive effect on the environment of areas neighboring the existing disposal site.

An environmental impact assessment (EIA) must be undertaken prior to the detail design for the new disposal site. Even though the impact of a properly constructed and operated disposal site is likely to be positive, an EIA is important as it will provide a means of assessing the overall environmental impact of current and future disposal activities in a comprehensive and systematic manner.

5.4.1 Equipment for Final Disposal

Table 24 shows the required number of equipment for final disposal.

Table 24: Final Disposal Equipment Plan

type of equipment	unit: nos				
	1999	2000	2001	2002	2003
Bulldozer, 210 Hp	3	3(3)	3	3	4
Backhoe, 0.7m ³	0	(1)	1	1	1
Wheel loader	1	1(1)	1	1	1
Dump truck	3	3(3)	3	3	3
Pickup	1	1(1)	1	1	1
Water tanker	1	1(1)	1	1	1
Motor grader	Rental	Rental	Rental	Rental	Rental

Note: () shows the number of equipment to be purchased.

5.4.2 Preliminary Cost Estimation

a. Investment

a.1 Construction Cost

Table 25: Construction Cost for the First Phase

Code	Description	unit	Unit Rate 1000Lps	Quantity	Amount (1000Lps)	
					1999	2000
1	Preparation					
11	EIA	L.S.	139	1	139	-
12	Detailed Design	L.S.	1,392	1	1,392	-
13	Land Acquisition	ha	72,384	30	2,172	-
14	Compensation	nos.	34.8	4	-	139
2	Construction		0			
21	Access Road					
211	Asphalt paved road	m	2,088	500	-	1,044
212	Gravel road	m	0,529	350	-	185
213	Earthwork	m ³	0,056	124,000	-	6,904
22	Embankment		0			0
221	Embankment 1	m ³	0,056	60,000	-	3,341
222	Embankment 2	m ³	0,056	15,000	-	835
23	Leachate treatment system		0			0
231	Subsoil leachate collection drain for main	m	0,960	500	-	480
232	Subsoil leachate collection drain for branch	m	0,320	200	-	64
233	Leachate cycling	set	139,200	1	-	139
234	Leachate lagoon	m ³	0,056	850	-	47
235	Leachate lagoon lining	m ²	0,139	800	-	111
24	Culvert	m ³	3,480	50	-	174
25	Security fence, 2.5m high	m	0,139	1,000	-	139
26	Piezometer	L.S.	27,840	1	-	28
27	Garage	m ²	1,392	250	-	348
28	Truckscale, capacity=60 tons	L.S.	626,400	1	-	626
29	Miscellaneous	L.S.		1	0	1,428
	Direct cost	L.S.		1	3,703	15,710
	Indirect cost (30% of direct cost)	L.S.		1	0	4,713
	Total construction cost	L.S.		1	0	20,423
	Contingency (10%)	L.S.		1	0	2,042
	Tax (12%)	L.S.		1	0	2,451
	Total				3,703	24,916

a.2 Equipment for Final Disposal

Table 26 shows the investment schedule of equipment for final disposal.

Table 26: Investment Schedule of Equipment for Final Disposal

Category	Items	Unit	Unit rate	1999	2000	2001	2002
Quantity	Bulldozer, 210 Hp	nos.	0	0	3	0	1
	Backhoe, 0.7m ³	nos.	0	0	1	0	0
	Wheel loader	nos.	0	0	1	0	0
	Dump truck	nos.	0	0	3	0	0
	Water tanker	nos.	0	0	1	0	0
	Pickup	nos.	0	0	1	0	0
	Investment	Bulldozer, 210 Hp	10 ³ Lps	3,689	0	11,068	0
Backhoe, 0.7m ³		10 ³ Lps	2,337	0	2,337	0	0
Wheel loader		10 ³ Lps	1,110	0	1,110	0	0
Dump truck		10 ³ Lps	720	0	2,159	0	0
Water tanker		10 ³ Lps	526	0	526	0	0
Pickup		10 ³ Lps	292	0	292	0	0
Total					0	17,491	0

b. Operation and Maintenance Cost

Table 27 shows the operation and maintenance cost for final disposal. The annual cost after 2002 is constant.

Table 27: O & M Cost for Final Disposal

Category	Items	1999	2000	2001	2002	2003
Diesel	Bulldozer, 210 Hp	738	738	738	738	738
	Backhoe, 0.7m ³	0	0	148	148	148
	Wheel loader	148	148	148	148	148
	Dump truck	148	148	148	148	148
	Water tanker	0	20	20	20	20
	Pickup	0	20	20	20	20
	Total		1,033	1,073	1,220	1,220
Lubricant	15% of diesel	155	161	183	183	183
Spare parts	10% of basic price	1,147	1,212	1,212	1,212	1,212
Repair by private	5% of basic price	573	606	606	606	606
Labor	Manager	132	132	132	132	132
	Assistant manager	116	116	231	231	231
	Operator	231	297	330	330	330
	Truckscale operator	66	66	66	66	66
	General worker	330	330	330	396	396
	Security guard	99	99	99	99	99
Material	Gas vent	87	92	110	118	126
Utility service	Electricity	200	200	200	200	200
	Water supply	200	200	200	200	200
Others	10% of direct O&M cost	492	517	563	570	570
Rental	Motor grader	120	120	120	120	120
Total		4,982	5,222	5,605	5,685	5,693

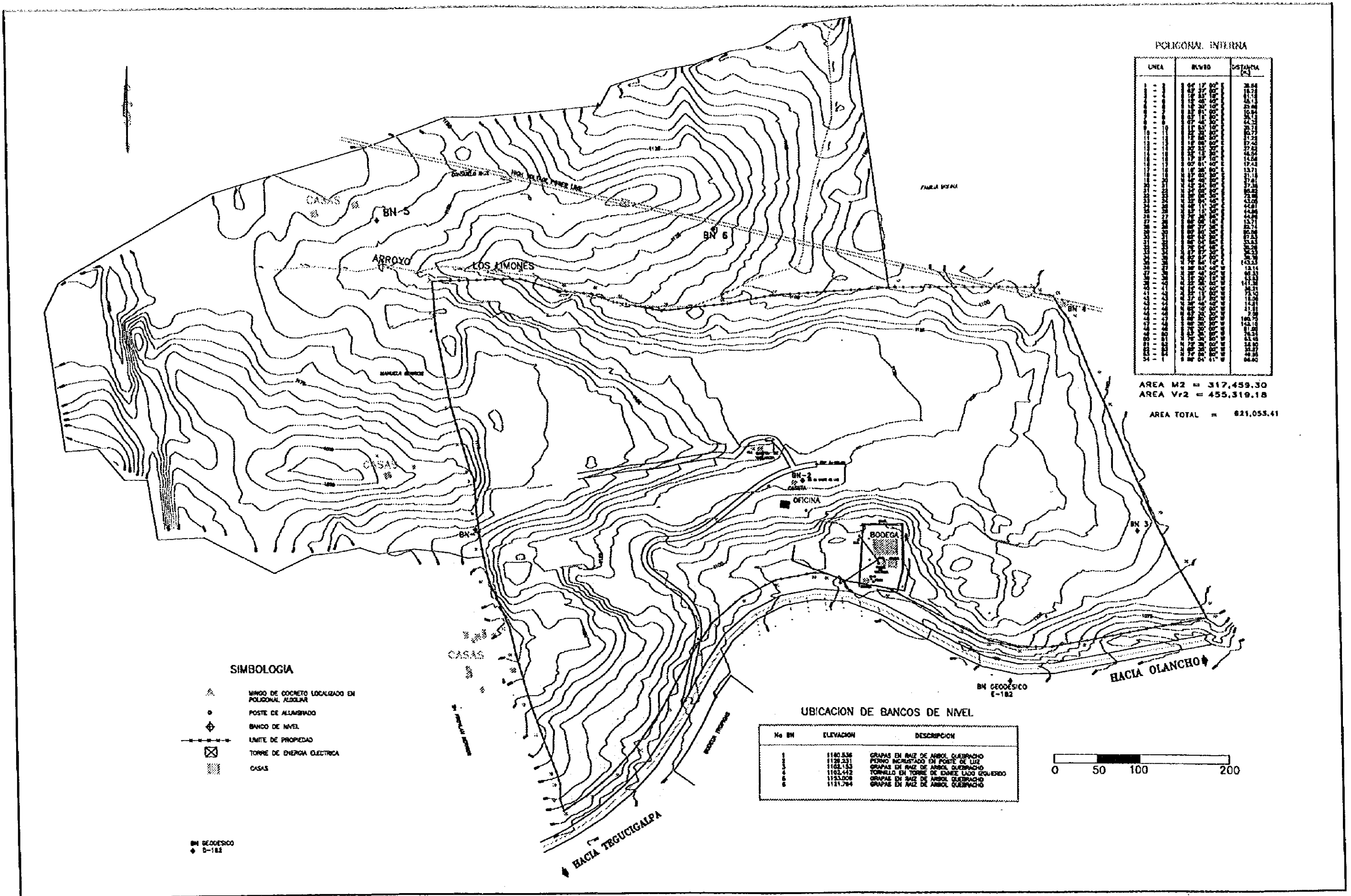


Figure 15: Topographical Map of New Site

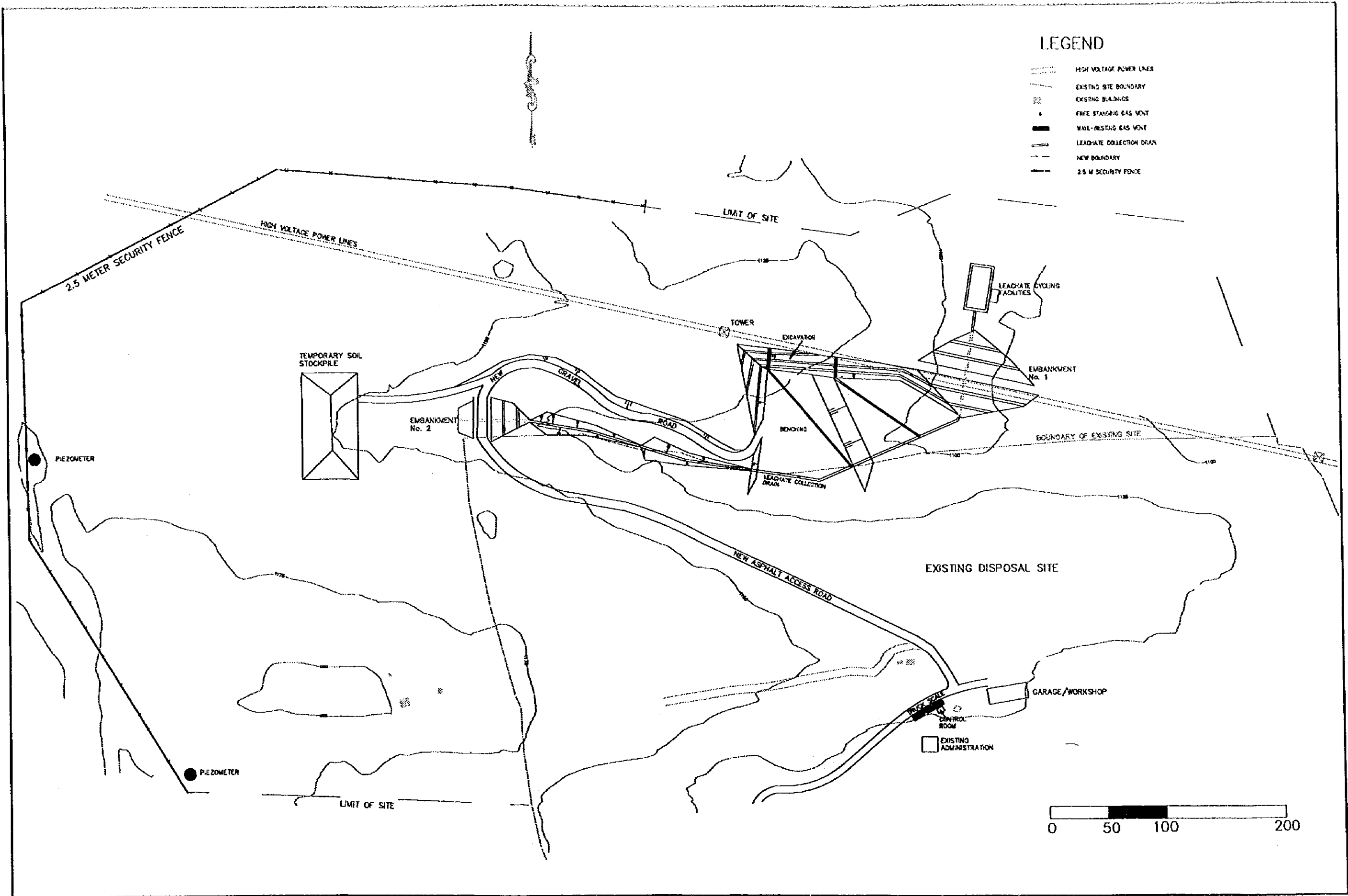


Figure 16: Stage 1 Development Plan

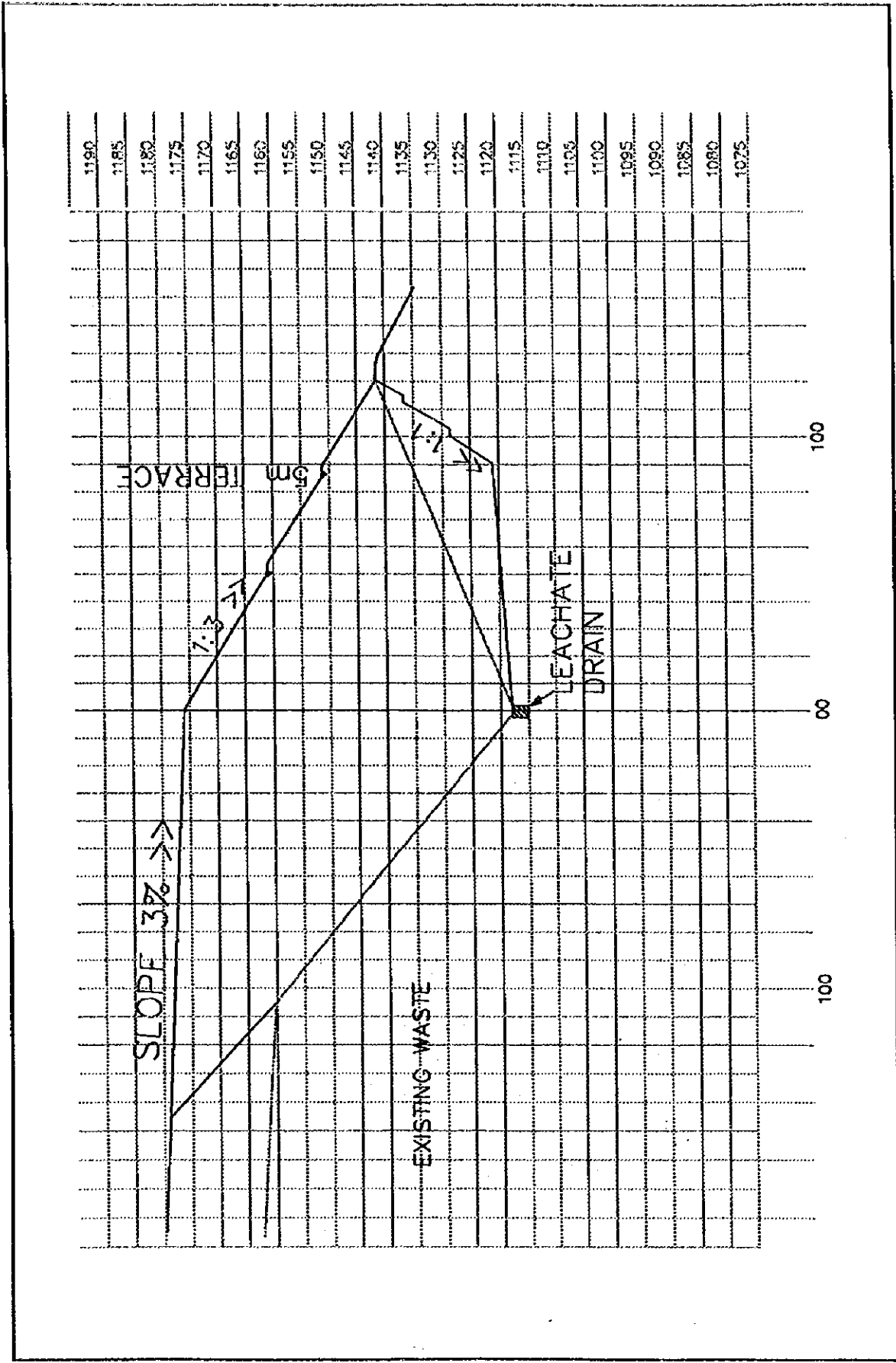
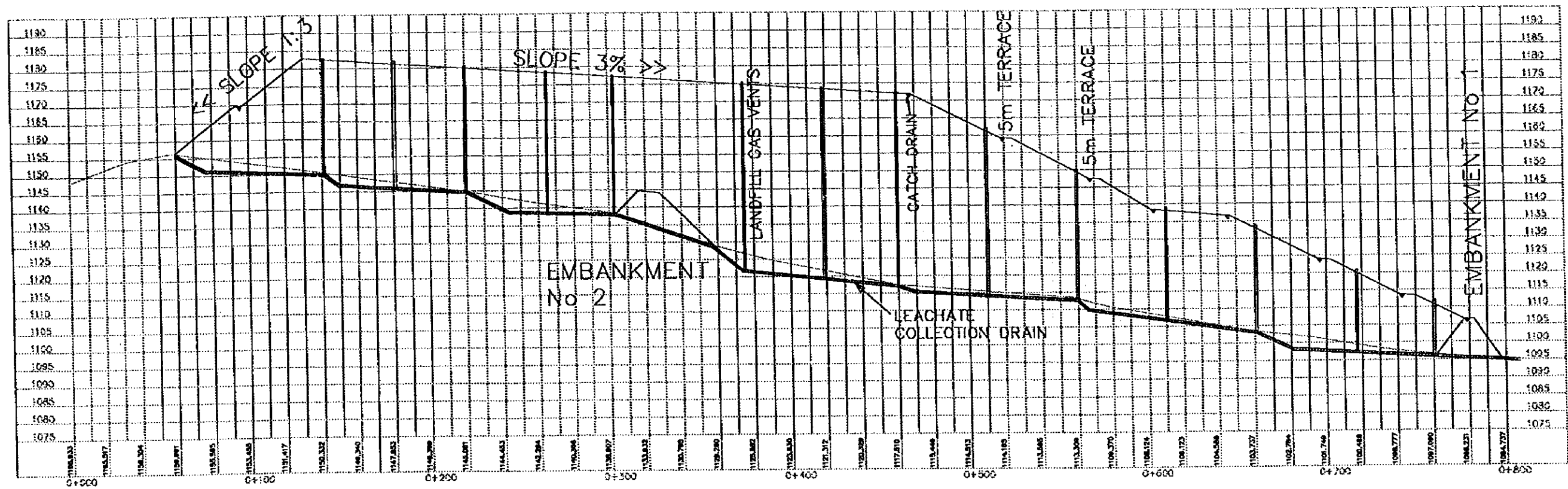


Figure 17: Typical Section Through New Landfill



SCALES:
 1M = 100M HOR
 1M = 500M VER

Figure 18: Profile of New Landfill

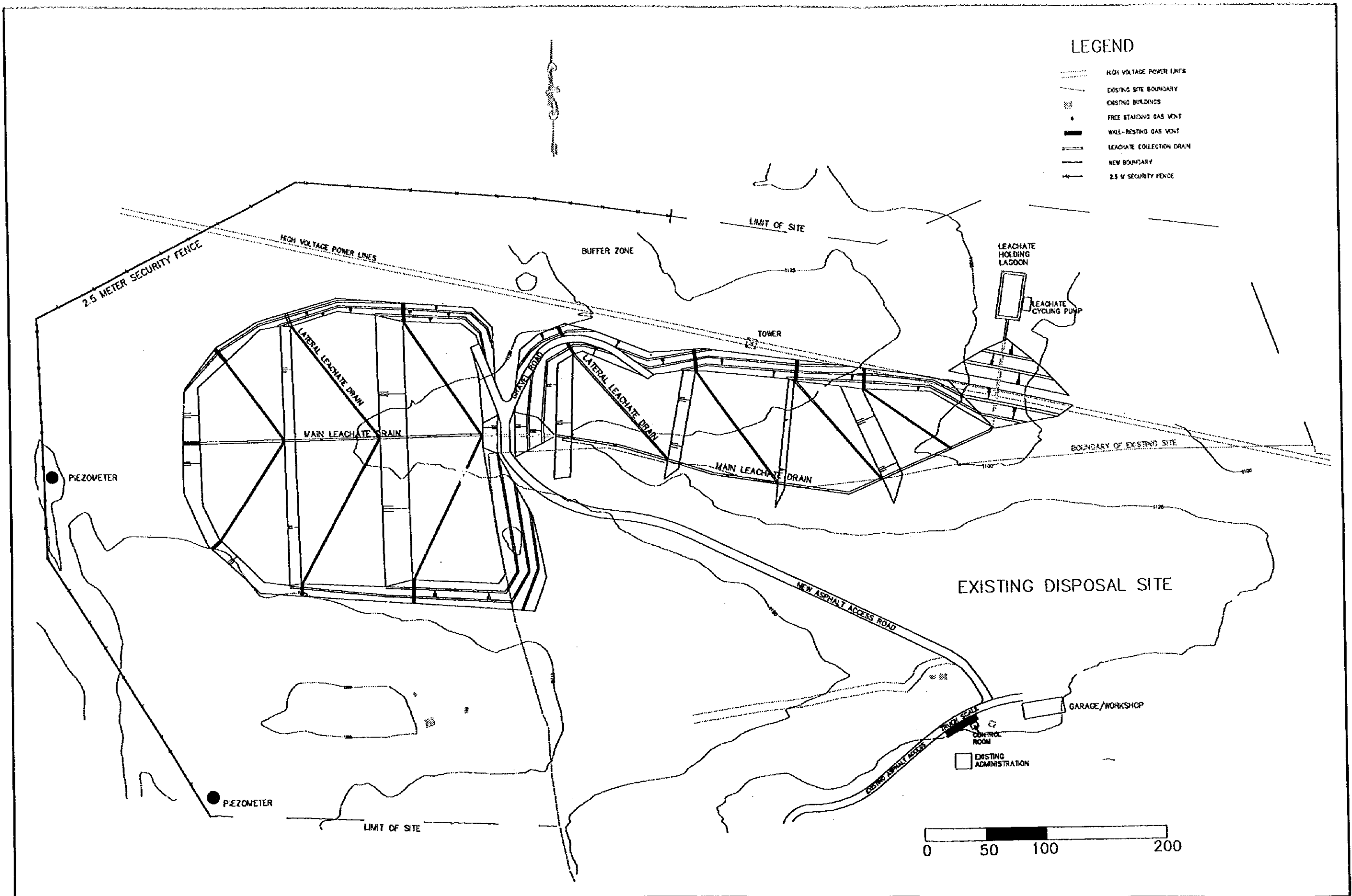


Figure 19: New Disposal Site Facilities Plan

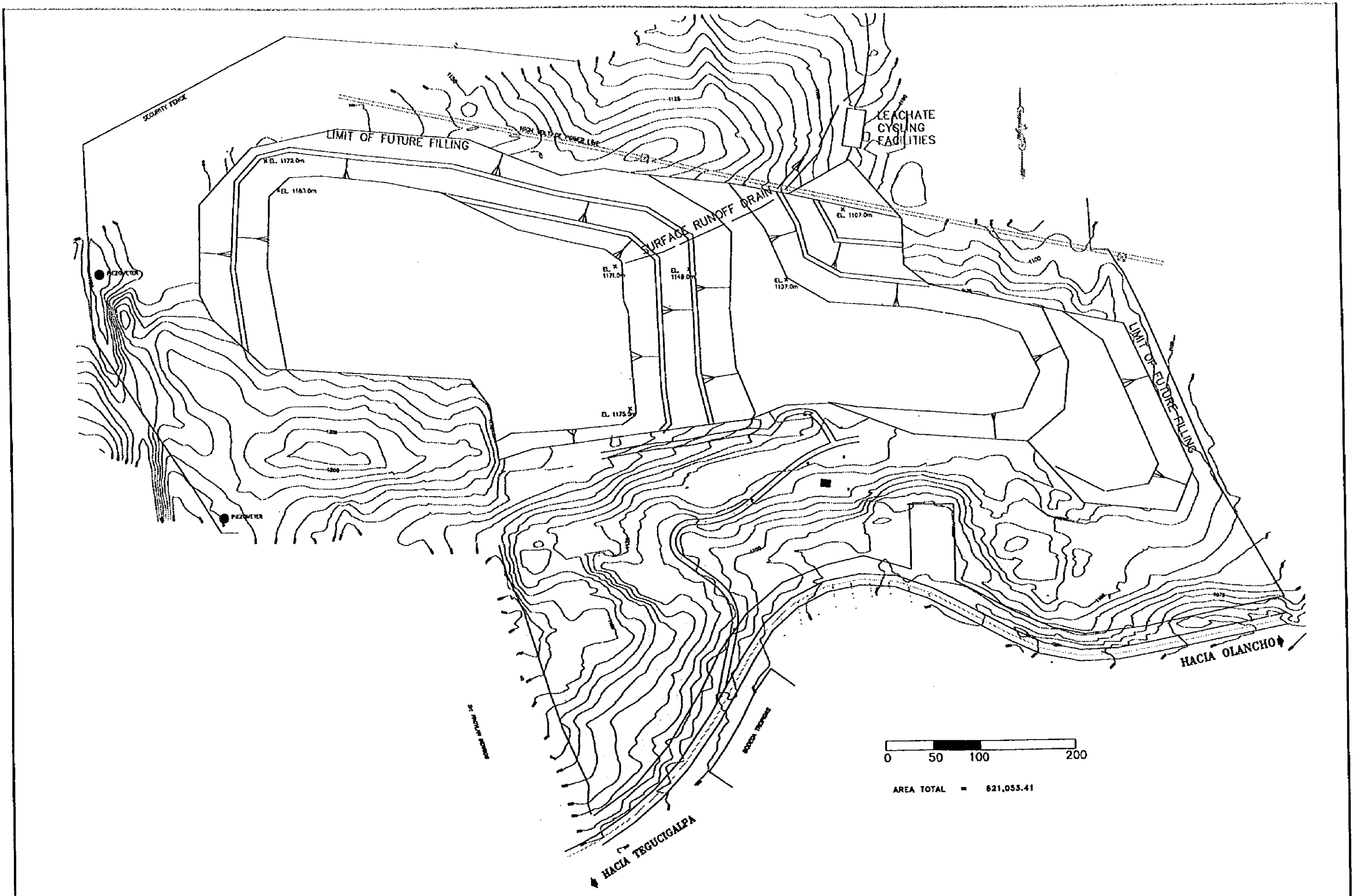


Figure 20: Final Closure Plan of Disposal Site

5.5 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 28 shows the rate of the direct operation work and the contracting-out work which was supposed for revised priority project planning.

Table 28: Planned Rate of Direct Operation and Contracting Out Works

Category	Items	unit	1999	2000	2001	2002	after 2003
Collection Amount	Direct operation	ton/day	228	246	217	247	276
	Contracting-out	ton/day	100	100	200	200	200
	Total collection amount	ton/day	328	346	417	447	476
Rate	Direct operation	%	70%	71%	52%	55%	58%
	Contracting-out	%	30%	29%	48%	45%	42%

c. Planned Number of Equipment to be Directly Operated

Table 29 shows the planned number of equipment to be directly operated by the SWEU or the MCC.

Table 29: Planned Number of Equipment to be Directly Operated

	Unit	1999	2000	2001	2002	After 2002
15m ³ compactor	Unit	11	11	15	15	15
13m ³ compactor	Unit	9	9	0	0	0
8m ³ compactor	Unit	0	0	3	3	3
12m ³ dump truck	Unit	10	10	7	7	7
5.5m ³ hoist truck	Unit	1	1	5	5	5
10m ³ armroll truck	Unit	1	1	5	5	5
5.5m ³ container	Nos.	11	11	50	50	50
10m ³ container	Nos.	13	13	50	50	50
6 ton Rental truck	Unit	0	1	0	0	4

5.6 Revised Priority Projects Cost

5.6.1 Final Disposal

a. Investment

Table 30 shows the investment schedule for the final disposal.

Table 30: Investment Schedule for Final Disposal

items	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
unit: 1000 Lps												
Equipment												
Bulldozer, 210Hp	0	11,068	0	3,689	0	0	11,068	3,689	0	7,379	0	0
0.7m ³ Backhoe	0	2,337	0	0	0	0	2,337	0	0	0	0	0
Wheel loader, 150Hp	0	1,110	0	0	0	0	0	1,110	0	0	0	0
Dump truck, 10tons	0	2,159	0	0	720	0	0	2,159	720	0	720	0
Water tanker	0	526	0	0	0	0	0	526	0	0	0	0
Pickup	0	292	0	0	0	0	0	292	0	0	0	0
Facilities Improvement	3,703	24,916	0	0	0	467	0	0	0	0	0	0

b. O & M Cost

Table 31 shows the required O & M cost for final disposal. The required O & M cost after 2003 will be constant.

Table 31: O & M Cost for Final Disposal

Category	Items	1999	2000	2001	2002	after 2003 annually
Diesel	Bulldozer, 210Hp	738	738	738	738	738
	0.7 m ³ Backhoe	0	0	148	148	148
	Wheel loader, 150Hp	148	148	148	148	148
	Dump truck, 10tons	148	148	148	148	148
	Water tanker	0	20	20	20	20
	Pickup	0	20	20	20	20
Lubricant		155	161	183	183	183
Spareparts		1,147	1,212	1,212	1,212	1,212
Repair		573	606	606	606	606
Labor	Manager	132	132	132	132	132
	Assistant Manager	116	116	231	231	231
	Operator	231	297	330	330	330
	Truckscale operator	66	66	66	66	66
	Worker	330	330	330	396	396
	Security guards	99	99	99	99	99
Material cost	Gas removal facility	87	92	110	118	126
Utilities	Electricity	200	200	200	200	200
	Water	200	200	200	200	200
Miscellaneous		492	517	563	570	570
Rental	Motor grader	120	120	120	120	120
Total		4,982	5,222	5,605	5,685	5,693

5.6.2 Collection and Haulage

a. Investment Schedule of Equipment

Table 32 shows the investment schedule for waste collection equipment

Table 32: Investment Schedule for Waste Collection Equipment

Equipment	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
15m ³ compactor	0	19,627	0	0	0	0	0	0	19,627	0	0	0
8m ³ compactor	0	2,591	0	0	0	0	0	0	2,591	0	0	0
12m ³ dump truck	0	6,045	0	0	0	0	0	0	6,045	0	0	0
8m ³ hoist truck	0	4,318	0	0	0	0	0	0	4,318	0	0	0
10m ³ armroll truck	0	5,496	0	0	0	0	0	0	5,496	0	0	0
5.5m ³ container	0	840	0	0	0	0	0	0	840	0	0	0
10m ³ container	0	1,960	0	0	0	0	0	0	1,960	0	0	0
Total	0	40,876	0	0	0	0	0	0	40,876	0	0	0

unit:1000Lps

b. Operation and Maintenance Cost

Table 33 shows the required cost for operation and maintenance. This table contains the required cost for the contracting-out work.

Table 33: Required Cost for Operation and Maintenance

Items	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Direct Operation												
15m ³ compactor	4,675	4,675	6,375	6,375	6,375	6,375	6,375	6,375	6,375	6,375	6,375	6,375
13m ³ compactor	4,662	4,662	0	0	0	0	0	0	0	0	0	0
8m ³ compactor	0	0	945	945	945	945	945	945	945	945	945	945
12m ³ dump truck	1,134	1,134	2,646	2,646	2,646	2,646	2,646	2,646	2,646	2,646	2,646	2,646
5.5m ³ hoist truck	246	246	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230	1,230
10m ³ armroll truck	277	277	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385	1,385
5.5m ³ container	9	9	42	42	42	42	42	42	42	42	42	42
10m ³ container	25	25	98	98	98	98	98	98	98	98	98	98
6 ton Rental truck	0	468	0	0	1,872	1,872	1,872	1,872	1,872	1,872	1,872	1,872
Sub-Total	11,029	11,497	12,721	12,721	14,593	14,593	14,593	14,593	14,593	14,593	14,593	14,593
Contracting out	13,834	13,834	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900
Sub-total	13,834	13,834	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900
Total O&M Cost	24,862	25,330	34,621	34,621	36,493	36,493	36,493	36,493	36,493	36,493	36,493	36,493

unit:1000Lps

5.6.3 Overall Cost for the Revised Priority Projects

Table 34 shows the whole cost for the revised priority projects.

Table 34: Project Cost Summary of the Revised Priority Projects

Category	Items	1999	2000	2001	2002	2003	2004-2010
Collection & Haulage	Investment	0	40,876	0	0	0	40,876
	O & M	11,029	11,497	12,721	12,721	14,593	102,151
	Contract out	13,834	13,834	21,900	21,900	21,900	153,300
Street Sweeping	Investment	0	818	0	0	0	1,227
	O & M	2,840	2,840	3,316	3,500	3,500	28,371
	Contract out	6,730	6,730	6,730	7,104	7,104	57,579
Disposal Site	Investment	3,703	42,408	0	3,689	720	30,466
	O & M	4,982	5,222	5,605	5,685	5,693	39,852
General Expense	O & M	2,828	2,934	3,896	3,943	4,282	30,667
Total	Investment	3,703	84,102	0	3,689	720	72,570
	O & M	21,679	22,493	25,538	25,850	28,068	201,042
	Contract out	20,564	20,564	28,630	29,004	29,004	210,879
	Total	45,946	127,158	54,168	58,543	57,792	484,490

unit: 10³ Lps

Chapter 6

Project Evaluation

6. Project Evaluation

6.1 Technical Evaluation

The technical system proposed in the revised priority projects and the revised 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 revised 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 revised 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

revised 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 revised 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 35 compares these amounts.

Table 35: 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 increases⁹. Thus, the master plan, with the proper sanitary landfilling measures, increases the land value around the present illegal dumping sites and the disposal site.

⁹ Beede, D.N. and Bloom, D.E. 1995, *The Economics of Municipal Solid Waste*, The World Bank

6.3 Environmental Evaluation

Table 36 summarizes the impacts that are predicted to occur with the implementation of the SWM master plan.

Table 36: 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 Revised Master Plan

a. Conditions for Financial Evaluation

Table 37: Condition for the Revised 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 sanitary will be generally improved. In 2000, the new disposal site will be constructed. In 2009, the arrangement for the following disposal site will start.</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 (1)</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) Long Term Loan (2) Assuming USD 500,000 from IDB loan for this.</p> <ul style="list-style-type: none"> • The repayment period is 40 years, of which the grace period is 10 years. • The interest rate during the grace period is 1.0% per annum. • The interest rate during the grace period is 2.0% per annum. <p>c) 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.

The fact that the new business waste collection fee tariff, which was put into effect in January 1999, will be taken into account for every case.

The following financial effects due to Mitch for 1999 and 2000 are assumed:

- The revenue from residential waste collection fee will decrease by 1.5%.
- The revenue from the business waste collection fee will decrease by 15%.

Table 38: Cases to be Examined for the Revised 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> <ul style="list-style-type: none"> High-income group: Lps. 70/month/house (175% of WTP) Middle-income group: Lps. 33/month/house (110% of WTP) Low-income group: Lps. 18/month/house (90% of WTP) <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> <ul style="list-style-type: none"> Collection service: Lps. 480/ton <p>d) Direct hauliers will be charged according to the haulage amount.</p> <ul style="list-style-type: none"> Direct haulage: Lps. 50/ton <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 	<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>

Case	Main Systems	Description
	fee and electricity charges from 2001	2) Waste collection fee system a) Residential waste (unit:Lps/month/house) 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 b) Large scale dischargers: Lps. 480/ton Lps. 480/ton Lps. 530/ton c) Direct haulage: Lps. 50/ton Lps. 50/ton Lps. 55/ton
	♦ New waste fee system B	

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

Table 39 summarizes the estimated SWM costs, waste collection amount and disposal amount for the revised master plan until 2010 for the financial evaluation.

Table 39: Estimated SWM Costs and Waste Amount

Item	1997*	1999 to 2000 average**	2001 to 2007 average	2008 to 2010 average
Collection & Haulage***	83.6	203.9	257.3	272.2
Street Sweeping	N.A.	920.2	976.2	977.2
Final Disposal	5.5	40.2	62.9	49.7
Recycling	0	0	278.6	314.1
Others	N.A.	N.A.	N.A.	N.A.
Total SWM Works	130.2	321.3	376.7	368.3

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

Table 40: Result of FIRRs for 4 Cases

Case	Description	FIRR (%)	Discount rate = 12.0%	
			Revenue over Expenditure	NPV* (R - E) (1000Lps)
Case 1	<ul style="list-style-type: none"> • Present waste fee collection system • Present waste fee rates 	N.A.	0.6646	-152,818
Case 2	<ul style="list-style-type: none"> • Joint billing of waste collection fees and electricity charges from 2001 • Present waste fee rates 	N.A.	0.7591	-110,130
Case 3	<ul style="list-style-type: none"> • Joint billing of waste collection fees and electricity charges from 2001 • New waste fee system A 	15.4	0.9910	8,075
Case 4	<ul style="list-style-type: none"> • Joint billing of waste collection fees and electricity charges from 2001 • New waste fee system B 	12.1	0.9760	324

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 revised 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 FIRR's imply that the revised master plan will be financially feasible, because they exceed the cut off rate of 12.0%.

Figure 21 shows that although the profit and loss between 1999 and 2002 will be negative, it will be positive after 2002 and the internal reserves will reach Lps. 34 million in 2010, which will be enough for the required investment. Therefore, it implies that Case 4 will make the revised master plan financially sustainable.

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

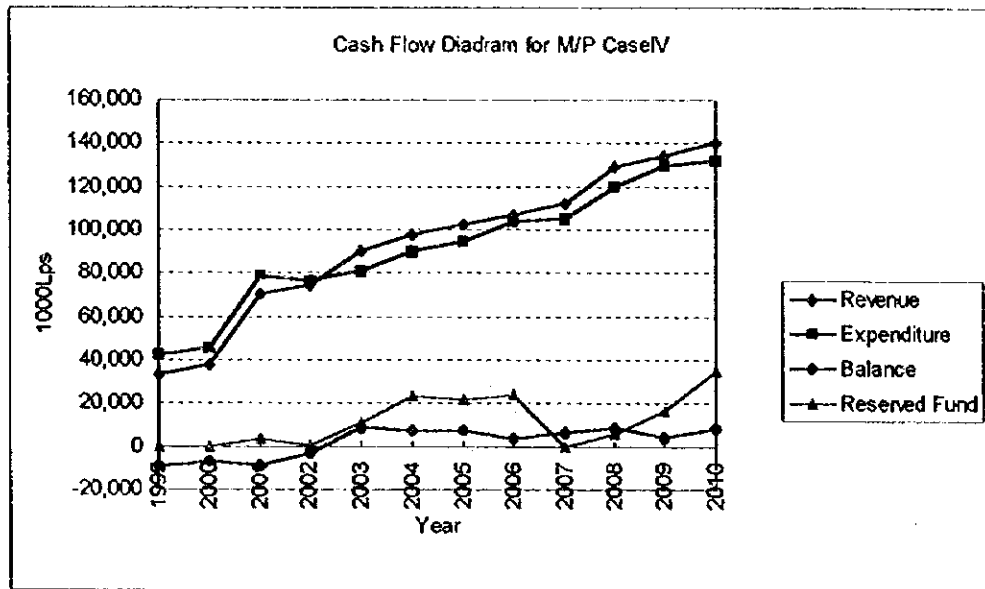


Figure 21: Cash Flow Diagram for Case 4

e. Conclusion of the Financial Evaluation

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

- a) The waste fee collection rate must be increased to 90% by introducing the joint billing of waste fees and electricity charges.
- b) The new waste collection fee system, proposed in the revised master plan, must be introduced from 2001.

If the above requirements are satisfied, even though the waste fee rates gradually rise as in Case 4, the revised master plan will be financially feasible because the FIRR will be 12.1% which is greater than the cut off rate.

6.4.2 Financial Evaluation of the Revised Priority Projects

a. Conditions for Financial Evaluation

Table 41: Condition for the Revised 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 sanitary will be generally improved. In 2000, the new disposal site will be constructed. 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 revised 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 (1)</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) Long Term Loan (2) Assuming USD 500,000 from IDB loan for this.</p> <ul style="list-style-type: none"> • The repayment period is 40 years, of which the grace period is 10 years. • The interest rate during the grace period is 1.0% per annum. • The interest rate during the grace period is 2.0% per annum. <p>c) 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 revised 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 revised 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 42: Cases to be Examined for the Revised 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 2001 Present 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 2001 New 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. Collection service: Lps. 480/ton</p> <p>d) Direct hauliers will be charged according to the haulage amount. 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 2001 New 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 border="1"> <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 Revised Priority Projects

Table 43 summarizes the estimated SWM costs, waste collection amount and disposal amount for the revised priority projects until 2010 for the financial evaluation.

Table 43: Estimated SWM Costs and Waste Amount for the Revised Priority Projects

	1997*	1999~2000 Average**	2001~2007 Average	2008~2010 Average
Collection & Haulage***	83.6	203.9	257.3	272.2
Street Sweeping	N.A.	920.2	976.2	977.2
Final Disposal	5.5	40.2	62.9	49.7
Recycling	0	0	278.8	314.1
Administration etc.	N.A.	N.A.	N.A.	N.A.
Total SWM Works	130.2	321.3	376.7	368.3

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 44 shows the FIRR and the NPVs calculated based on a 12% discount rate for the three hypothetical revenue cases.

Table 44: 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 	N.A.	0.7966	-75,691
Case 2	<ul style="list-style-type: none"> Joint billing of waste collection fees and electricity charges from 2001 New waste fee system A 	28.3	1.1135	59,702
Case 3	<ul style="list-style-type: none"> Joint billing of waste collection fees and electricity charges from 2001 New waste fee system B 	13.8	0.9906	5,722

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 revised 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 revised priority projects will be financially feasible, because it will reach 28.3%, widely exceeding the cut off rate of 12.0%.

For Case 3 that will introduce the transitional raise of waste collection fee system, the FIRR also implies that the revised priority projects will be financially feasible, because it will reach 13.8%, still exceeding the cut off rate of 12.0%.

Figure 22 shows that although the profit and loss between 1999 and 2002 will be negative, it will be positive after 2003 and more than Lps. 7 million will be gained annually after 2003. Case 3 will make the revised priority projects financially sustainable because internal reserves will reach Lps. 11 million in 2003.

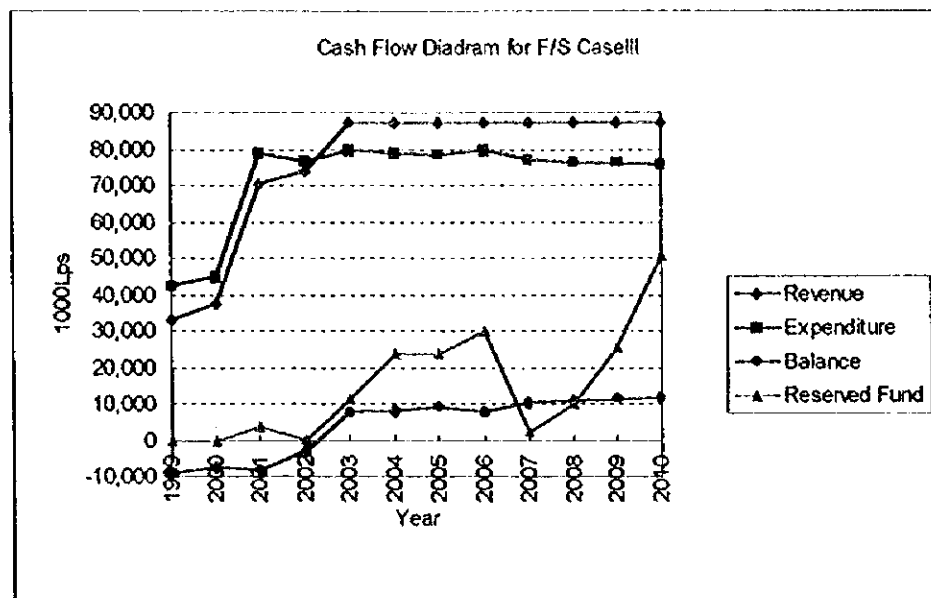


Figure 22: Cash Flow Diagram for Case 3

e. Conclusion of the Financial Evaluation

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

- a) The waste fee collection rate must be increased to 90% by introducing the joint billing of waste fees and electricity charges.
- b) The new waste collection fee system, proposed in the revised master plan, must be introduced in 2001.

If the above requirements are satisfied, even though the waste fee rates gradually increase as in Case 3, the revised priority projects will be financially feasible because the FIRR will be 13.8%.

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 Revised Master Plan

a. Economic Internal Rate of Return (EIRR)

The EIRR of the revised master plan, calculated based on the above benefits and costs, was 2.2%, which is below the cut off rate. This seems due to that the business people's assumed willingness to pay is too low.

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 Revised Priority Projects

Although the EIRR calculated for the revised priority projects is slightly greater than the revised master plan's EIRR at 5.7%, it is still below the cut off rate. Therefore the environmental education and promotion campaign for the environmental protection is a important issue.