5. FEASIBILITY STUDY

5.1 Feasibility Study of Priority Projects

a. Contents of Priority Projects

The following are the priority projects selected for 2000 to achieve the targets of the Master Plan. A Feasibility Study was carried out on these priority projects.

- Improvement of the collection and public area cleansing system
- Construction of the new sanitary landfill site in Acahualinca
- Improvement of the present Los Cocos workshop
- Promotion of public awareness, cooperation and participation

b. Technical System of Priority Projects

The technical system of the priority projects are shown in the following tables (Refer to Table 5.1a,b,c,d).

Table 5.1a Project for the Improvement of the Collection and Public Area Cleansing System

Equipment	Required Number of Equipment	Remarks
Collection Service		
- Compactors (15.3m^3)	55	
- Compactors (15.3m^3) with lift	3	
- Hoist trucks for container (7.0m^3)	20	
- Containers (1.0m^3)	155	
- Containers (7.0m^3)	127	
- Dump trucks (8.0m^3)	6	equipment for collection route
- Wheel loaders (1.6m^3)	3	equipment for collection route
- Motor graders (130PS)	1	equipment for collection route
- Pickups	6	equipment for supervision
Public Area Cleansing Service		
- Compactors (15.3m^3) with lift	2	
- Hoist trucks for container (7.0m^3)	1	
- Containers (1.0m^3)	115	
- Containers (7.0m^3)	4	
- Pickups	2	equipment for supervision

Table 5.1b Outline of the Project for the Construction of the Sanitary Landfill Site in Acahualinca Landfill Site

Items	Contents				Remarks
a. Proposed Site	Acahualinca				
b. Landfill Area	18.8 ha.				Total area: 70.0 ha.
c. Capacity	2,600,000 m³				Total capacity: 9,800,000 ha.
d. Waste to be disposed			2000	2010	
	- Household waste	Area A	470.5	844.4	
		Area B	164.4	421.6	
	- Commercial waste	Res.	32.5	49.3	
		Others	0.4	0.4	
	- Market waste		33.3	50.4	
	- Institutional waste		2.8	2.8	
	- Hospital waste		8.1	12.3	
	- Street sweeping waste		17.1	17.1	
	- Park & Green waste		3.7	3.7	
	- Industrial waste		11.4	17.2	
	- Direct haulage		53.3	80.7	
	- Other waste		240.2	364.1	
	Total(ton/day)		1037.7	1865.1	
e. Life span	6 years (Phase I)				from 2000 to 2005
f. Landfill method	Sanitary landfill (level 3)				Leachate circulation system
i. Facilities					
- Main facilities	Enclosing dike, drainage system, access road				
- Environmental protection facilities	Buffer zone, gas removal facilities, leachate circulation and monitoring				
- Building and accessories	Office, garage, truck scale, parking				
j Equipment	Bulldozers (21 tons)	5			
	Landfill compactors (20 tons)	3			
	Wheel loaders (1.2m³)	1			
	Dump trucks (10m³)	2			
	Motor graders (130PS)	1			
	Wheel excavators (1.2m³)	1			
	Water tanks (5m³)	1			
	Pickups	2			
k. Personnel	31 persons				
l. Construction period	2 years				

Table 5.1c Outline of Project for the Improvement of Existing Los Cocos Workshop

Items	Contents	Remarks
a. Site	Present Los Cocos Workshop	
b. Area	3.05 ha.	Surveyed by JICA Study Team
c. Equipment to be maintained in 2000	Compactors: 60 Hoist trucks: 21 Dump trucks: 8 Water tanks: 1 Pickups, etc.: 12 Heavy equipment: 14 total 116 Containers (1.0m³): 270 Containers (7.0m³): 131	does not include present equipment
d. Facilities	(construction) - Pavement for maintenance work - Extension of maintenance buildings (installation of equipment) - Maintenance equipment	 approx. +300 m² approx. +570 m²
e. Maintenance Staff	- Administration: 3 - Mechanics: 18 - Vulcanization: 6 - Greasing: 6 - Electrical repair: 4 - Welding: 3 - Body repair: 3 Total 43	
f. Construction period	2 years	

Table 5.1d Outline of the Project for the Promotion of Public Awareness, Cooperation and Participation

Items	Contents	Remarks
a. Competent section	Public communications assistant	refer to the Institutional System
b. Facilities	- VIDEO sets: 7 - Station wagon: 1	includes one set to be installed on the station wagon
c. Education materials	- Production of education videos - Printing pamphlet	 for 184,000 families

c. Cost Estimate

ca. Investment Cost

The initial investment cost for the priority projects was estimated as shown in Table 5.1e. The investment period is for 2 years, from 1998 to 1999.

Table 5.1e Initial investment Costs for the Priority Projects

Priority Project	Main Contents	Initial Investment Cost	
1. Collection Improvement	Compactor truck (15.3m^3) : 10 units Hoist Truck (7m^3) : 21 units Compactor truck with container : 5 units Container (1m^3) :270 units Container (7m^3) :131 units	114.33	
2. Construction of ANPLS	Disposal site Construction (Phase I)	122.78	148.57
	Equipment (Bulldozer, Landfill Compactor, etc.)	25.79	
3. Improvement of Los Cocos Workshop	Construction of Building	8.84	11.50
	Equipment (Maintenance Machine etc.)	2.66	
4. Promotion of Public Participation	Equipment (Station Wagon, Video set)	0.68	
Total		275.08	

1) Costs based upon the price in January 1993

Table 5.1.f shows the annual investment plan according to priority project.

Table 5.1f Annual Investment Plan by Priority Project

(unit: C$million)

Priority Projects	1998	1999	2000	2001	2002	2003	2004
1. Collection Improvement	18.382	20.522	75.423	1.990	2.002	10.177	11.391
- Foreign portion Area B	15.774	19.029	0.000	1.716	1.649	6.631	6.530
- Foreign portion Area A & LGS	2.608	1.493	75.423	0.274	0.353	3.546	4.861
2. ANPLS Construction	71.619	76.959	0.000	0.000	0.000	48.636	46.591
- Foreign portion for construction	61.357	40.904	0.000	0.000	0.000	38.803	38.803
- Foreign portion for equipment	0.000	25.793	0.000	0.000	0.000	2.045	0.000
- Local portion for construction	10.262	10.262	0.000	0.000	0.000	7.788	7.788
3. Workshop Improvement	5.216	6.287	0.000	0.000	0.000	0.000	0.000
- Foreign portion for construction	4.774	3.182	0.000	0.000	0.000	0.000	0.000
- Foreign portion for equipment	0.000	2.663	0.000	0.000	0.000	0.000	0.000
- Local portion for construction	0.442	0.442	0.000	0.000	0.000	0.000	0.000
4. Public Promotion	0.680	0.000	0.000	0.110	0.000	0.000	0.150
- Foreign portion	0.680	0.000	0.000	0.110	0.000	0.000	0.150
5. Total	95.897	103.768	75.423	2.100	2.002	58.813	58.132
- Foreign portion	85.193	93.064	75.423	2.100	2.002	51.025	50.344
- Local portion	10.074	10.704	0.000	0.000	0.000	7.788	7.788

Priority Projects	2005	2006	2007	2008	2009	2010
1. Collection Improvement	20.703	26.091	29.247	19.056	19.458	4.161
- Foreign portion Area B	14.710	15.033	7.957	15.245	17.441	12.181
- Foreign portion Area A & LGS	5.993	11.058	21.290	3.811	2.017	1.980
2. ANPLS Construction	46.591	25.793	5.154	83.836	86.845	15.881
- Foreign portion for construction	38.803	0.000	0.000	65.980	65.980	65.980
- Foreign portion for equipment	0.000	25.793	5.154	0.000	3.009	2.045
- Local portion for construction	7.788	0.000	0.000	17.856	17.856	17.586
3. Workshop Improvement	0.000	0.540	0.000	0.000	0.000	0.000
- Foreign portion for construction	0.000	0.000	0.000	0.000	0.000	0.000
- Foreign portion for equipment	0.000	0.540	0.000	0.000	0.000	0.000
- Local portion for construction	0.000	0.000	0.000	0.000	0.000	0.000
4. Public Promotion	0.540	0.000	0.110	0.000	0.000	0.150
- Foreign portion	0.540	0.000	0.110	0.000	0.000	0.150
5. Total	67.834	52.424	34.511	102.892	106.303	100.192
- Foreign portion	60.046	52.424	34.511	85.036	88.447	82.336
- Local portion	7.788	0.000	0.000	17.856	17.856	17.856

cb. Operation & Maintenance (O&M) Cost

The **O&M** cost consists of the depreciation cost, fuel and lubricant cost, maintenance cost and personnel expenses, and is shown in Table 5.1g.

Table 5.1g O & M Cost of the Priority Projects

(Unit: million C$)

Project	2000	2005	2010
1. Improvement of Collection System	15.73	15.59	15.40
2. Construction of ANPLS	5.99	6.95	12.30
3. Improvement of Los Cocos Workshop	1.02	1.02	1.02
4. Promotion of Public Participation	0.67	0.71	0.74
Total Poeration and Maintenance Cost	23.41	24.27	29.46

d. Institutional System

da. Administration and Organization

daa. Administration

Solid waste management in Managua is a non-profit public service. Waste collection fees imposed on the beneficiaries are used to cover whatever expenses the service may incur. SWM will continue to be under the supervision of PCO, which will be strengthened and expanded to efficiently and effectively carry out services to the public. New sections will be organized in the PCO for the conduct of the following:

- Waste collection in Collection Area B
- Management and operation of ANPLS
- Supply of appropriate cleansing services and the regular maintenance of vehicles and equipment
- Supervision of private companies
- Street sweeping services
- Coordination with DEE, DEO, and other offices related to sanitary education programs
- Control of revenue and expenditure of cleansing service

dab. Organization

The organization of MSWM in Managua is as shown in Table 5.1.h.

Table 5.1h Municipal Solid Waste Management System

Responsible Institution	Organizational Role
National Government (MINSA,National Police)	- Legislation and Enforcement - Control of Illegal Dumping of Waste
Municipality (Dep.of Environmental Education, District Offices)	- Public Sanitary Education - Promotion of Sanitary Improvement - Property Tax Collection
Public Cleansing Office	- Waste Collection (Area B, Large Generation) - Street Sweeping - Final Disposal - Vehicle and Equipment Maintenance - Planning and Control - Fee Collection - Management of environmental education program
Concessionaires	- Waste Collection (Area A) - Fee Collection
Citizens	- Establishment of community organization for sanitation - Participation in public education program - Monitor the illegal dumping site in the area - Primary Collection (Area B) - Fees and Taxes Payment

In order to effectively achieve the proposed institutional system, a PCO organizational structure was made and proposed as shown in Figure 5.1a. This structure shall be fully operational by the year 2000 when priority projects are completed, with all positions occupied by appropriate public officials.

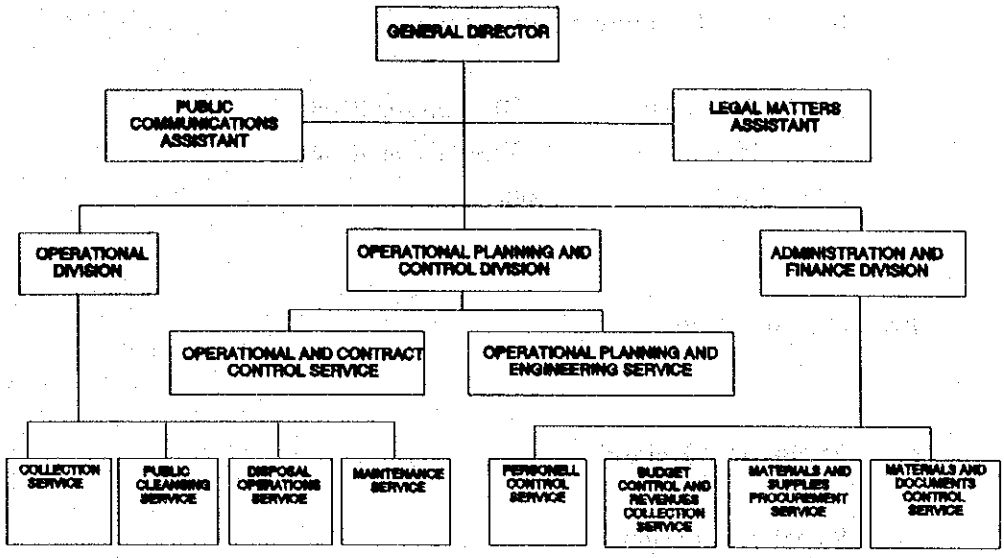

Figure 5.1a Proposed Organizational Chart of PCO

db. Privatization

The partial privatization of MSWM was proposed in consideration of ALMA's policy and the methods applied by the central government in the privatization of government enterprises.

- The collection, haulage and disposal services for solid waste in collection area A will be offered for privatization.

- Privatization of services in collection area A will be carried out by the following phases:

  2000 – 50% of the households will be covered by the privatized collection service

  2010 – 100% of the households will be covered by the privatized collection service

- The contract between private companies and ALMA obliges the former to use the collection and haulage vehicles and equipment of the latter for a monthly fee. Private companies are also required to pay ALMA for the license that would authorize them to carry out cleansing services.

- Private companies are required to pay waste tipping fees to ALMA, who in turn gives the following incentive:

for	2000–2004	A 60% discount rate
	2005–2009	A 30% discount rate
after	2010	None

5.2 Project Evaluation

a. Evaluation Method

aa. Social Evaluation

The social evaluation of each project was conducted considering its effects on employment, public health improvement, appropriateness of technology, etc.

ab. Environmental Evaluation

The environmental evaluation of each project, except for the promotion of public awareness, cooperation and participation, was carried out based on the items for assessment established in the "Matrix for Scoping" (Environmental Guidelines for Development Studies, Volume VI, Municipal Solid Waste Management, 1994, JICE).

ac. Economic and Financial Evaluation

The economic and financial evaluation methods by project applied in this study are shown in Table 5.2a.

Table 5.2a Economic and Financial Evaluation Methods by Project

Projects		Financial evaluation	Economic evaluation
1.	Improvement of Collection and Public Area Cleansing System	Quantitative evaluation	Quantitative evaluation Qualitative evaluation
2.	Construction of ANPLS	Quantitative evaluation	(Cost minimum) Qualitative
3.	Improvement of Los Cocos Workshop	to be evaluated along with the project for the improvement of collection and public area cleansing system	Quantitative evaluation Qualitative evaluation
4.	Promotion of Public Awareness, Cooperation and Participation	to be evaluated along with the project for the improvement of collection and public area cleansing system	Quantitative evaluation Qualitative evaluation
5.	Overall Evaluation	Continuity of the MSWM (financial burden of the municipality and citizens)	

aca. Financial Evaluation

The revenue and expenditure of the collection service were evaluated and outlined in Table 5.2b.

Table 5.2b Evaluation of Collection Service Revenue and Expenditure

Items	Sources	Execution Body	ALMA's Revenues	ALMA's Expenditures
Collection & Haulage	Collection Area A	ALMA	-Waste Fee	-Investment and O&M of Vehicles
		Private	-License Fee -Rental Fee -Tipping Fee (Partially)	-Investment and maintenance cost of Vehicles
	Collection Area B	ALMA	-Waste Fee (partially)	-Investment and O&M of Vehicles
	Large Generation Sources (LGS)	ALMA	-Waste Fee	-Investment and O&M of Vehicles
	Street Sweeping	ALMA	-(Property Tax)	-Investment and O&M of Vehicles
Final Disposal		ALMA	-Tipping Fee* (Collection Area A & LGS)	-Investment and O&M of Facilities, Vehicles and Equipment

* Tipping fee is included in the waste collection fees of Area A, large generation sources and companies; shops that carry out direct haulage are charged a fee at the disposal site.

acb. Economic Evaluation

Table 5.2c shows the Benefits and Costs by Priprity Project.

Table 5.2c Evaluation of the Project's Costs and Benefits

Items for Evaluation	Improvement of Collection Services and Public Area Cleansing System	Construction of ANPLS	Improvement of the Los Cocos Workshop	Promotion of Public Awareness, Cooperation and Participation
Benefits (B)	eliminates cost for the removal of illegally dumped waste		services offered by concessionaires are more efficient than municipality's and therefore helps curtail costs for O&M and investment	eliminates cost for street sweeping services *
	promotion of public participation		will help increase the efficiency of collection services in Area A	increase in the willingness to pay of Area B residents *
	improved living environment, improved public health and sanitation, attracts tourists, higher land market values	better sanitary environment, improved public health and sanitation, groundwater preservation, prevent waste scattering		reduction of drain cleansing fee, fee for disposal of illegally dumped waste, fee for the cleansing of streets and public and green area
Cost (C)	investment, O&M costs	investment, O&M costs	investment, O&M costs	preparation of pamphlets and videos, personnel costs, transportation costs, material costs

* Quantitative analysis.

Table 5.2d shows the factors used to convert financial costs to economic costs.

Table 5.2d Conversion Factor from Financial Cost to Economic Cost

Item	Conversion factor	Assumption
Import goods		
collection vehicles	85%	Custom duty 5%, domestic taxes 10%
video set	80%	Custom duty 10%, domestic taxes 10%
spare parts	90%	Custom duty 0%, domestic taxes 10%
light heavy oil	99%	Custom duty 1%, domestic taxes 0%
Labor		
unskilled	60%	Income level of semi-unemployed people
Equipment ownership cost	90%	Heavy equipment (imported goods) 60% Heavy oil 25%, personnel expenses (skilled) 15% (weighing average)

Note: Average Shadow Exchange Rate (SER) was estimated at 1.06 in 1991, 1.05 in 1992 despite the data available. SER was disregarded in the Study, because only almost 1.0 was calculated in 1994.

b. Project for the Improvement of Collection and Public Area Cleansing System

ba. Social Evaluation

Social evaluation is rather difficult to carry out, since most social benefits have strong psychological components that are sometimes impossible to measure. Qualitatively, the improvement of the collection system is feasible because of the above-mentioned benefits it will bring about.

bb. Environmental Evaluation

The improvement of the collection service will not have a significant influence on environmental impact components such as air, noise, vibration and bad odor usually resulting form the operation of collection vehicles.

bc. Economic and Financial Evaluation

bca. Economic Evaluation

i. Quantitative Evaluation

The curtailment of collection costs for illegally dumped waste along streets, parks and channels in area B will be considered as a tangible benefit of the collection improvement project.

- As a result of the comparison between the time spent on street cleansing and collection of illegally dumped waste, one fourth of the present unit cost for street cleansing is used to determine the unit benefit for the collection of waste dumped illegally: approximately 1.5 times more costly than the collection cost, inclusive of depreciation cost, in area B.

- The economic internal rate of return (EIRR) will be 24.1%, if the investment and O&M costs for new services necessary for the collection of illegally dumped wastes in area B are regarded as costs. This figure proves the economic feasibility of the project.

ii. Qualitative Evaluation

The following items are the subjects for qualitative evaluation:

- Improvement of public health
- Contribution to prevention of the generation of dengue fever, malaria, cholera etc., through the elimination of the waste heaping practice
- Promotion of public participation in cleansing services
- Promotion of tourism
  (through the sanitation and beautification of Managua)
- Rise in land costs
  (improvement of sanitary condition and beautification of the area will bring about rapid infrastructure improvement)

bcb. Financial Evaluation

Based on the "Beneficiary Pay Principle", the beneficiaries of the collection service should pay waste collection fees. The waste collection fees paid by the area A residents are partly used to cover up the collection service expenses in area B. Although the residents in area B are also required to pay, they can hardly do so. That is why the remaining amount is subsidized by fees collected form large generation sources, solvent residents in area A and ALMA.

R/E (Revenue/ Expenditure) will be 0.80 at a discount rate of 0% if initial investment costs are excluded in the revenues. Assuming that the initial investment costs will be subsidized by foreign entities and regarded as revenues, the Financial Internal Rate of Return (FIRR) will be 9.8%, and the project can be deemed financially feasible.

c. Project for the Construction of the Acahualinca Newly Proposed Landfill Site

ca. Social Evaluation

The quantitative evaluation of social benefits is rather difficult since most have strong psychological components that are sometimes impossible to measure. The construction of Acahualinca Newly Proposed Landfill Site is socially feasible, because it will also lead to the sanitation and beautification of the final disposal site.

cb. Environmental Evaluation

cba. Bad Odor

The effects of this priority project was qualitatively evaluated by studying wind direction to determine its effect on the proposed location of the leachate circulation pond, which is a bad odor source, and nearby residences or villages. The leachate circulation pond will be constructed at the northernmost part of the final disposal site. A residential area and a village can be found approximately 250 meters southeast and 600 meters south, respectively. The construction of the circulation pond in this site will hardly affect the said residents as the wind blows from the east.

cbb. Landscape

The effects of this project on the surrounding landscape was qualitatively evaluated with due consideration of the present land use in the vicinity of the proposed final disposal site.

Peninsula de Chiltepe is the only scenic spot near the proposed landfill site. The small hill within the proposed landfill site is used as waste covering and dike construction material. The disappearance of this hill after the disposal site is completed will hardly affect the surrounding landscape.

cc. Environmental Protection Measures

Although these activities are judged to have little impact on the surrounding environment, the following protection measures are necessary to further minimize whatever impacts they may bring about.

cca. Bad Odor

Although the generation of bad odor is inevitable it can be minimized by the proper operation of the leachate circulation system and avoidance of storing leachate for long periods of time.

ccb. Landscape

The following are the proposed environmental protection measures:

- Execution of daily covering of waste to restrict exposure of waste.
- Turfing or planting on the slope to create harmony with surrounding landscape.

cd. Economic and Financial Evaluation

cda. Economic Evaluation (Qualitative Evaluation)

The use of a sheet lining to upgrade the leachate treatment system will require additional expenses but will bring about the following advantages:

- Prevent contamination of Managua Lake
- Improve public health
- Preserve groundwater quality

The following effects are expected from daily waste covering activities and the construction of a buffer zone:

- Prevent waste scattering
- Sanitation of the disposal site's surrounding environment

The management and operation of the final disposal site under independent fund reserves would inevitably raise the tipping fee, which in turn would result from illegal waste dumping. Therefore, a new legislation should be formulated to prevent illegal dumping.

cdb. Financial Evaluation (Quantitative Evaluation)

If the foreign portion of the initial investment for the construction of the new landfill site is subsidized by foreign entities, the estimated FIRR would be 29.6%, thereby making the project financially feasible. If the project is financed by loans, however, the FIRR will only be 1.5%. Nevertheless the financial evaluation of the

operation of the ANPLS from 2011-2016, which took the construction of leachate treatment facilities (sanitary landfill level 4) into account, showed an R/E of 0.83, with a 0% discount rate.

A feasibility study should be carried out again concerning the operation of the final disposal site after 2011 to confirm or determine the feasibility of constructing treatment facilities.

d. Project for the Improvement of the Los Cocos Workshop

da. Social Evaluation

The outcome is rather difficult to evaluate quantitatively since most have strong psychological components that are sometimes immeasurable. Qualitatively, the improvement of the Los Cocos workshop is socially feasible because it will greatly contribute to the establishment of reliable collection services.

db. Environmental Evaluation

Conclusively, this project will not have a significant impact on the surrounding environment. Because the traffic volume increases when the amount of waste generation increases, the following environmental protection measures are proposed:

- To assign a traffic regulator at the entrance and exit of Los Cocos to ensure traffic safety;
- To educate vehicle drivers and heavy equipment operators on safe driving and proper equipment operation;
- To select equipment that has minimum effect on air pollution, noise generation and vibration.

dc. Economic and Financial Evaluation

dca. Economic Evaluation

i. Quantitative Evaluation

The improvement of the workshop will lengthen the life span and improve the operation rate of collection vehicles. The improvement of Los Cocos workshop is necessary to reduce the collection expenses of the private collection company. At the same time, it will guarantee an improved and reliable collection service.

The quantitative evaluation of the project for the improvement of the Los Cocos workshop indicates reduced investment and O&M costs which will help increase collection efficiency due to the privatization of services. The efficiency of collection services is said to improve gradually, through privatization, between 2000 and 2010. This improvement is expected to bring about C$6.0 million in 2010, 30% more than the 1994 figure. An EIRR of 12.5% was calculated using investment and O&M as expenditures, therefore the project is judged financially feasible.

ii. Qualitative Evaluation

The improvement of the Los Cocos workshop is expected to raise the efficiency of ALMA's collection vehicles and street sweeping services. Moreover, the provision of a collection service at regular intervals will increase the residents' willingness to pay.

dcb. Financial Evaluation

The calculated R/E until 2010 only amounted to 0.82 at a discount rate of 0%. The calculation was made assuming that investment is subsidized by foreign grant aid, which can be considered as revenue as well.

As previously discussed in the economic evaluation section, the improvement of the workshop is essential for the smooth operation of cleansing services in Managua. Therefore, this project is financially feasible when evaluated jointly with the collection and public area cleansing system improvement project.

e. Project for the Promotion of Public Awareness, Cooperation and Participation

ea. Social Evaluation

The public awareness, cooperation and participation promotion project is feasible socially because it is very important to the successful execution of the other three priority projects.

eb. Economic and Financial Evaluation

eba. Economic Evaluation

i. Quantitative Evaluation

The project for the promotion of resident participation and cooperation will curtail the cleansing costs as the amount of waste illegally dumped along streets, parks and channels will be reduced and collection services in Collection Area B will be efficiently carried out. It will also reduce the solid waste collection and disposal expenses through the reduction of waste discharge volume.

This project was also evaluated to increase the area B residents' willingness to pay as a direct result of the reduction of illegally dumped waste collection costs. The reduced amount of illegally dumped waste is equivalent to waste amount generated in a day for a span of four months. The implementation costs of the public promotion project is 0.8% (1 day/ 120 days) of the cost curtailed from illegally dumped waste collection service.

Considering the above benefits and costs for the preparation of promotion pamphlets and video programs, including personnel, transportation and material costs, the project is financially feasible with an EIRR of 34.0%.

ii. Qualitative Evaluation

Public participation and cooperation will be promoted in generation sources, including Area B, and is expected to have the following effects:

- Increase willingness to pay
- Promote recycling activities
- Attract tourists

ebb. Financial Evaluation

This project is impossible to evaluate financially because it does not have any direct revenues. Nevertheless, the implementation of this project is considered feasible when evaluated along with the collection service improvement and public area cleansing projects.

f. The Combined Overall Financial Evaluation of 3 Priority Projects

fa. Combined Overall Financial Evaluation of the 3 Projects Proposed for Area B

The improvement of collection services and Los Cocos workshop and the promotion of public participation and cooperation will be financially feasible if their initial investments are subsidized by foreign entities. Taking this assumption into account, the FIRR was calculated at 9.0%.

fb. Financial Evaluation of Private Companies for Concession

The FIRR of private companies is estimated at 7.7% considering that the cleansing service they will render will be 30% more efficient than ALMA and that they will be granted 60% and 30% tipping fee discounts for 2000–2004 and 2005–2009, respectively.

fc. Area A Financial Capability

The generation sources in Area A are financially capable of paying the imposed collection fees, which will also partly subsidize the cleansing service expenses in Area B. The collection fee until 2009 is estimated to be within 1% of the income of households in Area A.

The leachate treatment facilities will be upgraded to level 4 in the year 2010 for the new landfill site and will therefore, slightly raise the collection fees imposed on the residents. Therefore, it is necessary to review the projects' financial evaluation after 2011 as indicated in the financial evaluation for the ANPLS construction project.

fd. Municipal Financial Capability

If the initial investment cost is financed by subsidies from the central government or grant aid from foreign countries, part of the collection fee will be reserved internally as funds, which will enable ALMA to shoulder the budget for the second and third investments. Accordingly, ALMA's share in the cleansing service expenses will gradually decrease from C$19.2 in 2000 to 13.2 million in 2010. By 1998 and 2010, this cost will only cover 7.6% and 3.4% of ALMA's budget; the former is the highest amount to be ever appropriated for cleansing services by ALMA.

Conclusively, ALMA's self-sustainability regarding MSWM expenses has been

proven.

If a loan is used to cover most of the initial investment, ALMA will end up deep in debt, because instead of saving the waste collection fees for the 2nd and 3rd investments, they will be used to repay the loan. And since ALMA will have no reserves to finance the 2nd and 3rd investments it will be forced to obtain another loan, consequently owing the bank a total of C$ 300 million.

5.3 Implementation Plan

a. Project Executing Bodies

The 4 projects will be implemented by the following:

1.	**Improvement of Collection System:**	**ALMA**
2.	**Construction of the ANPLS:**	**ALMA**
3.	**Improvement of Los Cocos Workshop:**	**ALMA**
4.	**Public Promotion:**	**ALMA**

b. Implementation Schedule

The proposed implementation schedule of the 4 projects is shown in Figure 4.3a.

c. Financial Plan

ca. Financial Sources

Table 5.3a Financial Sources

(unit:C$million)

	1998	1999	2000	Total
Total Investment Required	95.89	103.77	75.42	275.08
Foreign Aid	85.19	93.07	-	178.26
Loan	-	-	75.42	75.42
Municipality	10.70	10.70	-	21.40

cb. Foreign Aid

Foreign aid will be necessary for the procurement of equipment listed in Table 5.3b and the construction of the ANPLS and workshop.

Table 5.3b Equipment and /or Construction Carried Out by Foreign Aid

Project	Equipment	Construction
1. Improvement of Collection Service and Public Area Cleansing	Collection Vehicles for Collection Area B	-
2. Construction of New Sanitary Landfill at Acahualinca	Heary Equipment for Disposal Dite Use	Disposal Site (for Phase I)
3. Improvement of the existing Los Cocos Workshop	Maintenance Wquipment for Workshop	Building of Workshop
4. Promotion of Public Acareness, Cooperation and Participation	Equipment of Promotion of Public Cooperation (Station Wogon, Eideo Set, etc.)	-

Foreign aid will also be used to cover the foreign currency portion required until 2000, when the new collection system commences.

cc. Loan

A loan will be made to cover the enormous cost involved in the procurement of equipment to be replaced in 2000 and equipment needed to cope with the increase in waste volume. On the other hand, private companies would find it difficult to obtain loans because they are still quite small. The loan condition was assumed as follows:

Repayment period	10 years
Arrival Interest	8 %

cd. ALMA

ALMA will cover all expenses within Nicaragua that would result from the import of equipment procured by foreign aid or loan. And ALMA will supply the budget equivalent to the local portion of the construction cost of the ANPLS and Los Cocos workshop.

Projects	1996	1997	1998	1999	2000
1. Collection Improvement					
1.1 Procurement of Equipment					
(1) Preparation					
(2) Detailed design					
(3) Tender					
(4) Manufacturing of equipment					
(5) Delivery of equipment					
(6) Operation					
Investment total			32.03	35.17	47.13
2. Construction of ANPLS					
2.1 Disposal Site Construction					
(1) Preparation					
(2) Land acquisition					
(3) Detailed design					
(4) Tender					
(5) Construction					
(6) Operation					
Sub-total			61.39	61.39	
2.2 Procurement of Equipment					
(1) Preparation					
(2) Detailed design					
(3) Tender					
(4) Manufacturing of equipment					
(5) Delivery of equipment					
(6) Operation					
Sub-total				25.79	
Investment cost total			61.39	87.18	

Figure 5.3a(1) Implementation Schedule (Unit : million C$)

Projects	1996	1997	1998	1999	2000
3. Improvement of Los Cocos Workshop					
3.1 Construction of Building					
(1) Preparation					
(2) Detailed design					
(3) Tender					
(4) Construction					
(5) Operation					
Sub-total			4.42	4.42	
3.2 Procurement of Equipment					
(1) Preparation					
(2) Detailed design					
(3) Tender					
(4) Manufacturimg of equipment					
(5) Installation of equipment					
(6) Operation					
Sub-total				2.66	
Total			4.42	7.08	
4. Promotion of Public Participation					
4.1 Procurement of Equipment					
(1) Preparation					
(2) Detailed design					
(3) Tender					
(4) Manufacturing of equipment					
(5) Delivery of euipment					
(6) Operation					
Total			0.68		

Figure 5.3a(2) Implementation Schedule (Unit : million C$)

6. GENERAL RECOMMENDATIONS FOR THE IMPROVEMENT OF MEDICAL SWM AND ISWM

6.1 Study on Medical SWM

a. Findings

aa. Government Organization and Collection Service

MINSA is the sole organization responsible for the management of medical wastes.

ab. Medical Waste Collection Service

There are no government organizations providing waste collection services to the medical institutions of Managua, forcing most of these institutions to burn refuse at their premises or dispose medical wastes at the final disposal site through municipal collection services. Furthermore, the staff of medical institutions are unaware of the importance of segregating medical waste from municipal solid waste, indirectly putting the health of collection workers and scavengers at the disposal site at risk as both wastes are collected, hauled and disposed at the Acahualinca landfill site.

ac. Incinerator Installation Program

EU approved the program for the installation of incinerators in ALMA for the treatment of Medical Waste in December 1993. MINSA completed the first detailed survey phase on the future establishment of an incineration system for one month, from November to December 1994, and conducted the second survey phase for another month in February of 1995.

ad. Necessity of Education Programs for the Staff of Medical Institutions

Although municipal collection services are theoretically provided only for refuse, the municipality also collects domestic waste mixed with medical waste. The mixed condition of the wastes only proves the negligence in the part of the waste producers. The use of incinerators to treat waste would extremely require waste segregation considering the consequences that could seriously result from non segregation.

A one month staff education program was carried out nationwide from January to February 1995 in accordance with the incinerator installation program.

b. General Recommendations on Medical SWM

MINSA will introduce the medical waste incineration system to all the medical institutions in Managua in December 1995. In accordance to this, education programs prepared by EU were carried out with the staff of medical institutions in November 1994.

The incineration of infectious waste can only be made possible if Medical Institutions abide by the collection system established for medical waste. ALMA and medical institutions should promote this system to ensure good sanitary conditions.

6.2 Study on the Present Industrial Solid Waste Management (ISWM)

a. Findings

aa. Laws and Regulations

Nicaragua has no laws on groundwater and environmental protection, and neither does it have water quality standards nor guidelines for the disposal of hazardous and industrial wastes. Although the Environmental Standards and Guidelines of international organizations like WHO and UNDP are being enforced in the country in lieu of national laws, they are not compelling enough to cope with the conditions prevailing in Nicaragua.

The laws and regulations in effect in Nicaragua are very lenient. Penalties or punishments are not imposed.

ab. Administration and Organization

Industrial waste management is associated with many government organizations. However, no particular investigations are carried out for the disposal or treatment of industrial wastes.

ac. Generation of ISW

ALMA states that the annual amount of industrial waste disposed at the Acahualinca disposal site totals 13,000 m^3. There are no data that would substantiate the figure however.

ad. Classification of Factories

Factories located in Managua are classified as either of the light industry category or factories of small scale enterprises.

ae. Collection and Haulage

ALMA provides collection and haulage services for the industrial wastes of factories but with the exclusion of hazardous and toxic wastes. The collection fee charged by ALMA to factories are based on their sales taxes. There are factories, however, who do not pay the collection fee.

af. Final Disposal

Industrial wastes are finally disposed of at the Acahualinca disposal site through the collection services of the municipality. On the other hand, the disposal methods of non-paying institutions are quite difficult to determine. Many are presumed to use the Acahualinca disposal site, while others are presumed to dump their wastes illegally along the roads on the east and south sides of the Managua International Airport (Augusto César Sandino).

b. General Recommendations

ba. Necessity of Further Survey

Although there are approximately 2,100 factories in Managua, the questionnaire survey could only be conducted on a limited number, due to time shortages and lack of a reliable list of factories. Since there are various kinds of factories that generate different kinds of waste of course, the survey should be conducted again after a complete list of existing factories is prepared.

bb. Laws and Regulations

A legislation which promotes economic incentivesshould be formulated to support efforts geared towards minimizing the production of industrial wastes and to promote the use of pollution control equipment.

The Environmental Impact Assessment should have its own legislations in order to define the precise role of the different government agencies involved in its implementation. Coordination shall be sought between MINSA, MARENA and ALMA when producing laws, regulations and guidelines regarding industrial waste,

bearing in mind the hierarchy of the laws, ordinances and guidelines, so to avoid conflicts on environmental legislation. The control and enforcement system to eliminate illegal dumping of ISW shall also be established urgently in cooperation with various agencies concerned.

bc. Administration and Organization

bca. Administrative Structure

An administrative structure which ensures a proper ISWM shall be established by clearly defining the roles of each organization concerned. Coordination shall also be sought between the different levels of government and the different governmental agencies, in the law enforcement activities related to industrial waste management. ALMA shall cooperate with the National Government authorities mainly on matters related to nuisances and hazards to the people that result from mismanagement of industrial wastes.

bcb. Plans and Technology

Guidelines and plans should be made with regards to industrial waste management to serve as a standard the enterprises have to comply with. It will be essential to review personnel disposition within the administration and organization and increase the staff responsible for industrial waste management, and then conduct necessary training courses.

Furthermore, the administration is required to have technical knowledge (in discharge, treatment, recycling, disposal methods, etc.), collect information and develop new techniques. The administration has to transfer technical information to enterprises and provide them with technical aid through subsidies and other schemes.

bd. Reduction at Generation Source and Recycling

Although the generation of ISW is not large, it is necessary to control the generation and discharge of waste, and to further reduce the amount through recycling. Enterprises should develop processes which would enable the treatment of industrial waste at generation source. It is necessary that enterprises examine the raw materials they use and take necessary steps that would mitigate environmental pollution caused by their waste.

In addition, all enterprises are required to plan the utilization of these recyclable materials and to increase the means for their use.

be. Generation of Waste

bea. Inventory System

Each factory shall submit to MARENA and ALMA information on the characteristics and amount of industrial waste they generate. The information can be used for the management of industrial waste. Inventory system is effective for supervising ISWM. Therefore, precise registration and continuous updating of inventories shall be implemented.

beb. Segregation of Hazardous Wastes

Dischargers should try to separate hazardous and non-hazardous wastes in order to reduce the amount of hazardous industrial solid wastes to be disposed of and facilitate waste reuse and recycling.

bf. Treatment and Disposal

Basic treatment and final disposal methods needed for industrial wastes are chemical treatment such as neutralization, oxidation and reduction, thermal treatment such as incineration, and the construction of a separate landfill site. The characteristics of industrial solid waste are so variable that it is necessary to find out the best treatment and final disposal alternatives from a technical and economic point of view.

In many cases the most convenient treatment and final disposal method is the construction of a separate landfill site, because the cost is relatively low. The central government may be requested to construct such facilities for the sake of environmental protection if it is very difficult for the private sector to acquire the land and funds necessary. An environmental impact assessment is necessary prior to the construction of an industrial waste disposal site.

bg. Supervision and Advice

Appropriate supervision and sound advises from the central government are most important to steadily implement industrial solid waste management. It is, therefore, important to primarily analyze and improve administrative capacity, then conduct inspection and give advises on the operation of the storage, transportation and final disposal of industrial solid wastes. In addition, the ISW shall be clearly defined by the central government (MARENA).

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

a. MSWM Master Plan

aa. Goal

The goal of the MSWM Master Plan is

Development and Realization of a Beautiful and Sanitary Environment in the City of Managua towards the 21st Century through Citizens' Participation and Establishment of Self-sustainable Solid Waste Management.

ab. Technical System

aba. Collection System

The following collection systems shall be provided in order to expand the collection area and supply effective collection service to the whole urban area in Managua City.

Area A: Curb collection system using compactor trucks

Area B: Container collection system using hoist trucks or bell collection system using compactor trucks

Large generation sources: Container collection system using hoist trucks or compactor trucks with container

abb Public Cleansing

Manual street sweeping and park green area cleansing should be implemented continuously in the Study Area to counter-act high unemployment ratio. Container collection is recommended for public cleansing to increase collection efficiency and maintain cleanliness.

abc. Construction of Sanitary Landfill in ANPLS (Acahualinca Newly Proposed Landfill Site)

The installation of water treatment facilities in ANPLS for leachate control is desirable, but because of the enormous capital it would require the following phased-measures for leachate control were proposed instead:

- Year 2000 - 2009: Sanitary Landfill Level 3
  - . leachate circulation system
  - . the installation of liners for seepage control
  - . the installation of leachate collection, circulation and monitoring facilities

- Year 2010: Sanitary Landfill Level 4
  - . leachate treatment system
  - . the installation of leachate treatment facilities

abd. Equipment Operation & Maintenance

The existing Los Cocos Workshop shall be improved in order to carry out preliminary maintenance of vehicles and equipment for cleansing services to be carried out by the Public Cleansing Office.

b. Institutional System

bd. Administration and Organization

ALMA will remain in charge of the Solid Waste Management activities through the PCO. The proposed new PCO organizational structure includes the following new roles:

- waste collection in Area B
- operation of ANPLS
- operation, management and periodic maintenance of vehicles and equipment for cleansing service
- supervision of private companies
- street sweeping service
- coordination of related departments on environmental education programs
- control of revenue and expenditure for cleansing service

bb. Privatization

The partial privatization of MSWM is proposed in accordance with the policies of the central government and the municipality, and is shown in Table 7.1a.

Table 7.1a Proposed Privatization System

Generation sources	Executing Agency	Revenue sources for ALMA
Collection Area A	Private (Concession)	-License Fee -Rental Fee -Tipping Fee
Collection Area B	ALMA	Waste Fee (partially)
Large Amount Waste Generation	ALMA	Waste Fee
Street Sweeping	ALMA	(Property Tax)
Direct Haulage	-	Tipping Fee

As a means of achieving the goal, the collection services in area A will be privatized in a phased-wise manner as shown below.

- 2000 - 50% of households in Collection Area A
- 2010 - 100% of households in Collection Area A
- The contract between private companies and ALMA obliges the former to use the collection and haulage vehicles and equipment of the latter for a monthly fee. Private companies are also required to pay ALMA for the license that would authorize them to carry out cleansing services.
- Private companies are required to pay waste tipping fees to ALMA, who in turn gives the following incentive:

for	2000-2004	a 60% discount rate
	2003-2009	a 30% discount rate
after	2010	None

bc. Legislation

The establishment of proper and sound legislations on Solid Waste Management is an urgent need in Managua, since there are no Sanitation Codes particularly dealing with this subject. The Public Cleansing Code shall basically define the different types of wastes produced in the city and determine the responsibility and means for storage, transportation, treatment and disposal by waste category. The Monitoring system for illegal dumping of waste, which was started under the supervision of MINSA, the national police and ALMA, is not carried out

adequately and effectively. Since it is very important for the sanitation and beautification of Managua city, it should be restructured with the roles and responsibilities of concerned government bodies clearly defined. The system should also be clear of its rules on violation.

bd. Training Program

Training programs should be organized to develop and hone the skills and capabilities of the personnel in all the department levels of PCO. These training programs should be operated in cooperation with INATEC. It would also be a good idea to send managers and engineers to training courses and seminars held in neighboring Latin American countries by the Pan American Health Organization or the Inter-American Environment and Sanitation Association.

be. Public Cooperation

In order to gain resident acceptance for the proposed solid waste management system, a public education program should be established. The program will involve activities promoting public cooperation and participation and will enlighten the public on sanitation.

Public cooperation will be achieved through the following:
- negotiate with residents through community organization
- offer a reliable solid waste management system
- sanitary education through community activities and school activities
- handle public complaints against solid waste management

At present, DEE is carrying out a sanitary education program. Sanitary education programs carried out in cooperation with related government agencies, i.e., PCO, DO, are usually successful in achieving public understanding and cooperation.

bf. Financial Plan

In order to secure an independent financial resource for the cleansing services in 2010 proposed in the Master Plan, the following should be considered:

i. Establishment of a "Beneficiary Pay Principle"

"Beneficiary Pay Principle" – beneficiaries of collection services pay ALMA waste fees in accordance with the fee for the final disposal of waste. Residents in collection area A pay waste fees to private companies, who pay ALMA rental fees for the use of vehicles and equipment for household waste collection and haulage.

These private companies also pay license fees based upon the service it was consigned to do by ALMA and waste tipping fees at the disposal site. ALMA collects tipping fees from the private companies which directly haul waste to the disposal site. ALMA collects waste fees from the residents in collection area B, based upon the "Beneficiary Pay Principle"; the bulk of the fee however is covered by large generation sources, residents of collection area A and ALMA itself due to the poor financial condition of area B residents.

ii. Imposition of fees in accordance with the economic standing of the residents

As mentioned previously, ALMA collects a part of the waste fee from the residents in collection area B based on the results of the survey on their "willingness to pay". Also, the waste fees collected from residents of area A are used not only to cover a portion of the required expenses for the collection service, but also to subsidize the expenses for services area B.

The Area A residents are considered capable of paying the imposed waste fee which is only within 1% of every household income within the area.

iii. Appropriation of funds from the general budget of the Municipality

To realize the priority projects by 2000, the initial investment cost should be covered by subsidies from the central government or grant aid from foreign countries. Accordingly this will gradually decrease ALMA's expenses from C$ 19.2 million in 2000 to 13.2 in 2010. From 7.6% in 1998, the highest figure ever, ALMA will only have to allocate 3.4% of its budget to cleansing service costs. These values prove ALMA's capability to finance the cleansing services.

The financial sources and money flow of the fee collection system are shown in Figure 7.1a. The fee tariff estimated for each waste generation source is shown in Table 7.1b.

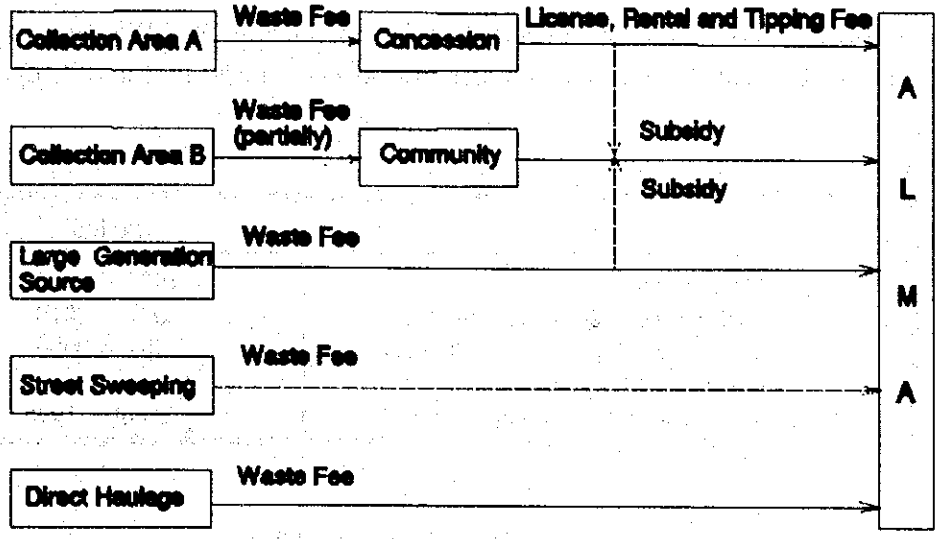

Figure 7.1a Financial Source and Money Flow of the Fee Collection System

Table 7.1b Fee Tariff

Description		1995	2000	2005	2010
Waste Fee *	Collection Area A (C$/month/household)				
	Residential (A)	64.3	140.8	161.9	191.1
	Residential (B)	23.8	52.1	59.9	70.7
	Traditional	10.0	21.9	25.2	29.7
	Popular	7.5	16.4	18.9	22.3
	Collection Area B (C$/month/household)				
	Bell Collection	2.00	4.38	6.50	8.00
	Container Collection	1.00	2.19	3.25	4.00
	Commercial & Companies (C$/ton)				
	Collection	175.1	612.2	655.1	741.3
Tipping Fee	Direct Haulage	2.7	99.2	99.2	112.3

* : Waste fee includes tipping fee

c. Phased Implementation Plan

The master plan shall cover a period of 15 years, from 1995 to 2010. Upon consideration of the limited resources of the municipality for SWM, the goal of the master plan shall be pursued in a stepwise manner (Refer to Table 7.1c).

Table 7.1c Target Years

Plan	Period
Master Plan	1995 – 2010
– Medium Term Improvement Plan	2001 – 2010
– Short Term Improvement Plan for Feasibility Study	1997 – 2000
– Immediate Improvement Plan	present – 1996

ca. Immediate Improvement Plan (present–1996)

Table 7.1d shows the concrete measures to be taken in order to attain the targets of the Immediate Improvement Plan.

Table 7.1d Concrete Measures to attain the Targets of the Immediate Improvement Plan

Targets (Improvement)	Concrete Measures
1. Technical Improvement 1.1 To improve collection efficiency	– By using data obtained from truck scale
1.2 To establish the system for collection area expansion	– Through organization of community association and promotional activities by the District Office – Establishment of waste fee collection system by community in squat areas
1.3 To establish the system for the sanitation of the area	– Through organization of community associations and promotional activities by the District Office; – Establishment of funds to improve area condition, i.e. roads and drains
1.4 To sanitize the present Acahualinca disposal site	– Construction of dike – Improvement of approach road – Transfer of techniques,i.e., daily waste covering, – construction of gas removal facility
1.5 To execute public education programs on sanitation	– Education program on sanitation using videos and booklets – Promotional activities by the District Office and Environmental Protection Head Office
2. Institutional Improvement 2.1 Set up a new section in PCO (Public Cleansing Office) to follow up pilot projects 2.2 Increase waste fee collection ratio 2.3 Commencement of planning and control processes 2.4 Establishment of a training program 2.5 Establishment of supervision structure for illegally dumped waste 2.6 Initiation of administrative improvement works	These activities can be carried out by the existing municipal staff, provided that training is supplied and proper support is given by the Managua municipal authorities.

cb. Short Term Improvement Plan (1997–2000)

cba. Selection of Priority Projects

The Master Plan consists of various projects and some will be selected as priority projects to be carried out in 2000. A Feasibility Study will be conducted on the priority projects shown below which have been selected by the Study Team and approved by the Coordinating Committee.

- Improvement of collection and public area cleansing system
- Construction of a sanitary landfill at the proposed site in Acahualinca
- Improvement of the present Los Cocos workshop for maintenance of cleansing equipment

- Promotion of public awareness, cooperation and participation

cbb. Feasibility Study of the Priority Projects

i. Priority Projects and Initial Investment Cost

The initial investment costs of the proposed projects were estimated as shown in Table 7.1e.

Table 7.1e Initial Investment Cost

Unit:C$ mill.

Projects	Main Contents of the Projects	Initial investment	
1.Collection Improvement	Compactor truck (15.3m³) :10 Units Hoist truck (7m³) :21 Units Compactor truck with container :5 Units Container (1m³) :270 Units Container (7m³) :131 Units		114.33
2.Construction of ANPLS	Construction (Phase I)	122.78	148.57
	Equipment (Bulldozer, Landfill compactor, etc.) :16 Units	25.79	
3.Improvement of Los Cocos	Construction	8.84	11.50
	Equipment (Maintenance machine etc.)	2.66	
4.Promotion of Public Education	Equipment (Station wagon, video set)		0.68

ii. Project Evaluation

- **Social Evaluation**

The impacts of the projects were determined in terms of the jobs they will create, improvement of public health and suitability of technology to the study area, in order to know whether they are socially feasible or not. Consequently, the 4 projects were feasible from a social view point.

- **Environmental Evaluation**

The environmental evaluation of each project, except for the promotion of public awareness, cooperation and participation, was carried out using the items for assessment set up in the "Matrix for Scoping" by JICA. Consequently, the 4 projects were feasible from an environmental view point.

– Economic and Financial Evaluation

The following shows the result of the economic and financial evaluation.

Table 7.1f Results of the Economic and Financial Evaluation of the Priority Projects

Project	Economic Evaluation			Financial Evaluation			
	Benefits (B)	Cost (C)	EIRR (%)	Revenue	Expenditure	FIRR by Project (%)	FIRR of 3 combined Projects
(1)Improvement of Collection and Public Area Cleansing System	Eliminates expenses for the removal of illegally dumped waste	Investment 1), O&M cost	24.1%	-Waste fee -License fee -Rental fee	Investment 1), O&M of vehicles	9.8	9.0
(2)Improvement of Existing Los Cocos Workshop	Curtailment of investment and O & M Costs as services of private concessionaires are more efficient than the municipality's	Investment 1), O&M cost	12.5%	-	Investment 1), O&M	-	
(3)Promotion of Public Awareness, Cooperation and Participation	Eliminates expenses for the removal of illegally dumped waste	Investment 1), O&M cost	34.0%	-	Investment 1), O&M	-	
(4)Construction of Proposed New Landfill Site	Eliminates expenses for the removal of illegally dumped waste	Investment 1), O&M cost	-	-Tipping fee	Investment 1), O&M of facilities, vehicles and equipment	29.6	

Note: 1)Foreign Currency Portion of Initial investment is assumed to be financed by foreign Subsidies.

– Overall Evaluation

The combined financial evaluation of the 3 projects [improvement of collection and public cleansing system, improvement of existing Los Cocos workshop and promotion of public awareness, cooperation and participation] These 3 projects was carried out due to the similarities in the nature of their activities. They are financially feasible because the calculated FIRR is 9.0%, assuming of course that the initial investment cost will be covered by subsidies from the central government or grant aid from foreign countries.

- **Financial Evaluation of Private Companies for Concession**

The private companies were financially evaluated under the following two assumptions:

* The management of the cleansing service by these concessionaires will be 30% more efficient than ALMA
* The concessionaires will be given tipping fee incentives

Incentive discount rate 2000–2004:	60%
Incentive discount rate 2005–2009:	30%

Under these assumptions, the FIRR of private companies is estimated at 7.7%. However, due to these assumptions, the privatization of the Public Cleansing Office (PCO) should be carried out with extreme care.

- **Financial Capability of Collection Area A**

The residents in collection area A are capable of paying the imposed collection fees. The collection fee is estimated to amount only to within 1% of every household income in collection area A, regardless of the fact that the amount shall partly subsidize the collection service expenses for area B.

- **Municipal Financial Capability**

If the foreign currency portion of the initial investment cost is financed by subsidies from the central government or grant aid from foreign countries, part of the income from collection can be kept as reserves which will enable ALMA to shoulder the budget for the second and third investments.

This is also assumed to gradually curtail the share of ALMA in the cleansing costs, from C$ 19.2 million in 2000 to C$ 13.2 million in 2010. Consequently, instead of appropriating 7.6% (1998)of its budget for cleansing costs, ALMA will only spend 3.4% in 2010. Conclusively, ALMA is proven financially capable of carrying out MSWM.

Using a loan to cover the initial investment cost will bury ALMA deep in financial debt as the collection fees will be used for repayment, thereby further obliging ALMA to obtain another loan for the second and third investment. This will incur a total debt of C$ 300 million. Conclusively, the initial investment cost should be covered through subsidies from the central government or grant aid from foreign entities.

bc. Medium Term Improvement Plan (2000–2010)

Table 7.1g shows the concrete measures for the attainment of the medium term improvement plan targets.

Table 7.1g Concrete Measures to attain the Targets of the Medium Term Improvement Plan

Targets	Concrete Measures
1.To attain 100% collection service	– Provision of cleansing equipment of good quality
2.To start sanitary landfill with leachate treatment (Level 4)	– Installation of leachate treatment facilities – Operation of sanitary landfill (Level 4)

bd. Phased Implementation Plan

The phased implementation plan to achieve the MSWM Master Plan for the Municipality of Managua is summarized and illustrated in Figures 3.3b and 3.3c.

7.2 Recommendations

a. Community Organization for Area Sanitation

The establishment of an organization in the community was proven to be necessary not only for the execution of collection services but for the sanitation of the squat areas as well.

In order to promote this activity, the section who shall be made responsible and at the same time constitute the present staff of PCO (Public Cleansing Office), DO (District Offices) and DEE (Department of Environmental Education) should be set up in the Municipality. The section will mainly have the following roles:

- Educate the community leader
- Execution of sanitary education program
- Coordinate with responsible municipal related offices

b. Leachate Treatment in ANPLS

The installation of leachate circulation system level 3 in ANPLS was proposed for 2000, while the leachate treatment facilities (level 4) was proposed for 2010. The main factor that contaminates the water quality of Managua lake is sewage water from the city.

The formulation of a Master Plan for the construction of a sewage system in Managua City commenced. In the plan, the Study Team recommends the construction of a sewage plant as the most cost effective means of treating leachate inflowing to the lake. It also recommends leachate treatment in the same plant. This combined utilization of the sewage plant will minimize the capital required for the improvement of waste quality flowing into Managua lake.

c. Acquisition of Proposed Landfill Site

The proposed landfill site is partly privately owned. Accordingly, the Study Team requested the Nicaraguan counterpart to carry out any means possible to acquire the land for ANPLS construction.

Based on the environmental study carried out by the Study Team, the proposed area is the most suitable area in Managua for the construction of the future landfill site, which should be as spacious as possible.

d. Composting

In the Study, the composting system was not introduced as a component of the optimum technical system of the Master Plan mainly because of a small market for compost products derived from MSW. Nevertheless, the Municipality experimented on the manual production of composts under the guidance of a Dutch expert. Composting is a very effective measure of MSW volume reduction and source recovery, a practice which consequently extends the life span of the final disposal site. Therefore, the Study Team recommended the continuous implementation of composting activities to the Municipality, regardless of its present state of unprofitability, in order to accumulate data necessary to eventually perpetuate the activity.

e. Recycling

The recycling system was not introduced as a component of the optimum technical system of the Master Plan mainly because of a limited market for recycled goods.

The MSWM system is also not adequately established yet for the introduction of recycling activities. Nevertheless, recycling is expected to play a very important role in the future MSWM with regard to the reduction of the amount of waste generated and conservation of natural resources. The Municipality, therefore, should promote recycling activities in cooperation with the central government.

f. Methane Gas Recovery

The recovery of methane gas in ANPLS is not included as a technical system component of the Master Plan mainly due to the reason stated hereafter.
The anaerobic condition of a landfill site usually produces methane gas, but deteriorates leachate quality. To improve leachate quality, a semi- aerobic landfill structure with a liner is proposed in the Master Plan.

A study on the production of gas in the present disposal site would necessitate investigations on the quality and quantity of gas produced, including test boring activities which are not included in the scope of the study.

g. Privatization

The municipality expressed the need to privatize MSWM in accordance with central government policies. Accordingly, the Study Team carried out studies to determine the most adequate and feasible privatization model in terms of curtailment of the Municipality's MSWM budget and the waste collection fee. The privatization process will require ALMA to carefully check the capacity of private companies which may participate in the competitive bidding of MSWM services. Bidding will be carried out to ensure highly efficient collection services and minimum municipal cost.

h. Financial Source

It would be difficult for ALMA to recover the entire cost to be spent on the priority projects with the waste collection and tipping fee and revenue from private concession. The investment costs should be subsidized by the central government therefore, or with donations from bilateral and multilateral agencies. ALMA must therefore strive to acquire such sources to successfully implement the projects. All of the four priority projects are indispensable to the master plan's realization, and were evaluated as financially feasible, ALMA was requested to rank these four projects in order of importance to determine which should be implemented first, in order to balance its finances which will be very reliant on foreign aid for the execution of these projects.