9.2.2 Optimum System

The table below shows the optimum technical system for Panama District in 2015, which summarizing the discussion so far.

Table 9-5: Outline of Optimum System

Item	Outline
Collection service coverage	100%
Separate collection ratio	50%
Separation item	2 items (recyclable and non-recyclable)
Collection method	Normal vehicle collection (compactor track)
Transfer transport system	installation of two transfer station and/or site
Recycling system	Material Recovery Facility
Final disposal system	Sanitary landfill with leachate treatment system in Cerro Patacon

10 The Master Plan

10.1 Outline of the Master Plan

10.1.1 Goals

The principal goal of the Master Plan is to establish a sound Solid Waste Management System by the target year 2015 in Municipality of Panama, where the population and major economic activities of the country are centered.

The Master Plan aims to:

promote the citizens' well-being;

implement sustainable SWM; and

contribute to environmental conservation.

The goals in practice of the Master Plan are as follows:

The improvement of public health and the reduction of health hazards in and around the city is a primary task of SWM, in order to promote the citizens' well-being.

As implementation of sustainable SWM services is the duty and mandate of the DIMAUD, the DIMAUD should expedite:

- cost-effective SWM by continuous technical improvement;
- cost-effective SWM by continuous legal/institutional improvement; and
- cost-effective SWM by continuous administrative improvement of DIMAUD.

As the environmental conservation through SWM is today's requirement, DIMAUD should expedite the following:

- encouragement of further citizens' environmental awareness on waste minimization,
- promotion of environmental conservation through "reduction", "recycling" and "recovery" of waste, and
- operation of solid waste processing and disposal facilities without polluting the environment.

In other words, well-being of citizens will be indirectly achieved by providing cost-effective SWM services. Meanwhile, a **"beneficiary-pays-principle (under which recipients pay for the services)"** has to take root in the citizens' values. These will improve the

cost-consciousness of the citizens and induce **"waste minimization at source"** by each citizen, and it consequently will also contribute to the environmental conservation.

Meanwhile, as part of the goal of the M/P (citizens' well-being), well-being of all those who work for SWM should also be reminded in the formulation of the M/P.

10.1.2 Target Year

In accordance with the S/W of the Study, the target year for master plan is set up as follows:

Master Plan: Year 2015

Strategic actions to achieve the goals and targets should be, in practice, introduced step by step towards the target year 2015. Therefore, it is recommended to divide the period up to the target year into three phases.

Phase 1: **Short term improvement (2003 to 2005)**

Phase 2: **Medium term improvement (2006 to 2010)**

Phase 3: **Long term improvement (2010 to 2015)**

10.1.3 Policies

In order to lead implementation of the M/P to the goals, policies of the M/P are formed as follows.

Policy 1: Elimination of waste from the living environment, in order to preserve citizens' health

Policy 2: Establishment of appropriate final disposal system

Policy 3: Encouragement of waste minimization

10.1.4 Targets

a. Policies and Targets

Under the policies, clear and concrete targets to be achieved are set up. Policies and targets of the M/P are summarized below.

Table 10-1: Policy and Target of the Master Plan

Policies	Targets
Elimination of waste from the living environment	• Keeping up waste collection coverage • Improving waste collection coverage
Establishment of appropriate final disposal system	• Improving the operation at Cerro Patacon • Ensuring final disposal capacity by 2015
Encouragement of waste minimization	• Keeping down waste generation rate (waste generation amount per capita) • Introducing separate collection system

b. Target Figures

Target figures for the major components that constitute SWM were set as indicated in the table below.

Table 10-2: Target Figures of the Master Plan

Phase Target year	Present (2001 to 2002)	Phase 1 2005	Phase 2 2010	Phase 3 2015
Population	725,866/744,448	807,868	944,573	1,132,726
Waste generation rate				
Household waste (g/person/day)	589.8	590		
Commercial				
Restaurant (g/employee/day)	6,373	6,373		
Others (g/employee/day)	1,918	1,918		
Institutional waste (g/employee/day)	201	201		
Market waste (g/employee/day)	4,178	4,178		
Waste generation amount (ton/day)	1,025	1,102.0	1,262.9	1,443.6
Waste collection service coverage (%)	92	98	100 (2006)	100
Waste collection amount (ton/day)	965	1,065.3	1,231.2	1,408.3
Separate collection ratio (%)	0	0	16.5	50.0
Separate collection amount (ton/day)	0	0	63.3	222

c. Strategies

Strategies to attain the targets are summarized in the table below.

Table 10-3: Strategy for the Master Plan

Policies	Elimination of waste from the living environment	Establishment of appropriate final disposal system	Encouragement of waste minimization
Target	Keeping up waste collection coverage Improving waste collection coverage	Improving the operation at Cerro Patacon Ensuring final disposal capacity by 2015	Keeping down waste generation rate Introducing separate collection system
Technical system	Management of basic data Improvement of collection efficiency Improvement of street sweeping Expansion of collection area	Improvement of current landfill operation Expansion of landfill at Cerro Patacon final disposal site	Education program for waste minimization and recycling Establishing recycle market mechanisms
Management system	Improvement of DIAMUD's management Cooperation with Juntas Comunales and Juntas Locales Improvement of the private sector participation		
Legal and institutional system	Preparation of municipal regulations on solid waste management Establishment of a committee regarding MSWM Establishment of policy on waste minimization and resource conservation		
Issues to be considered	Social consideration (Waste-pickers, employees of DIMAUD, the poor) Environmental consideration (final disposal site, clandestine/illegal dumping, Lake Alajuela, Panama Bay)		

10.1.5 Outline of the Master Plan

Table 10-4 shows contents of the master plan.

Table 10-4: Outline of the Master Plan

Item			Present (2002)	Phase 1(2005)	Phase 2 (2010)	Phase 3 (2015)
General information						
	Population (Panama)		744,448	807,868	944,574	1,132,726
	Service coverage (%)		92	98	100 (2006)	100
Waste generation amount (ton/day)						
	Total (ton/day)		1,025	1,102	1,263	1,444
	Household waste		439	476	557	669
	Commercial, institutions and industries		421	459	534	596
	Market waste		24	24	24	24
	Bulky waste		12	14	19	26
	Street sweeping waste		8	8	8	8
	Hospital waste		20	20	20	20
	Demolition waste		96	96	96	96
	Sewage		5	5	5	5
	Potential recyclable waste		293	328	385	444
	Non-recyclable waste		732	774	909	1,047
Discharge and storage						
	Discharge manner	Separate	0 %	0 %	16.5%	50%
		Mixed	0 %	0 %	83.5%	50%
	Discharge amount (ton/day)	Total	965	1,065	1,231	1,408
		Separate	0	0	63	222
		Mixed	965	1,065	1,168	1,186
	Recycling amount (ton/day)		0	0	27	94
Collection and transport						
	Collection system		Collection vehicle	Collection vehicle	Collection vehicle	Collection vehicle
	Transport system		Collection vehicle	Collection vehicle and transfer station	Collection vehicle and transfer station	Collection vehicle and transfer station
Facilities						
	Transfer station		-	Installation and operation	Operation	Operation
	Material Recovery Facility		-	-	Installation, operation, expansion	
Final disposal						
	Final disposal site		Cerro Patacon	Cerro Patacon	Cerro Patacon	Cerro Patacon
	Landfill		Sanitary landfill and control dumping	Sanitary landfill		
	Disposals amount (ton/day)	Panama	965.0	1,065.3	1,204.0	1,314.1
		San Miguelito	216.7	250.0	320.3	393.5
		Arraijan	27.4	39.0	70.5	122.8
		Total	1,209.1	1,354.3	1,594.8	1,830.4

10.1.6 Proposed Improvement Measures

Proposed improvement measures corresponding to the strategies, which are contents of the M/P, are shown in the tables below.

Table 10-5: Proposed Improvement Measures (1)

Strategies		Contents (Proposed Improvement Measures)
Collection System and Transport System	Basic Database Establishment and Maintenance	Basic database, which is necessary for planning, implementation, monitoring, evaluation and revision of collection system, is established and maintained. 1) Preparation of collection area and route map acquisition and update of maps clarification of collection areas and routes on the maps 2) Establishment of methods of information gathering, accumulation, analysis and evaluation establishment of methods of gathering, accumulation, analysis and evaluation of the weighbridge's data at Cerro Patacon Final Disposal Site preparation of manual of T&M survey preparation of a form of daily working report
	Improvement of Collection Efficiency	1) Definition of collection areas and routes definition of collection areas according to Corregimientos definition of collection routes according to Corregimientos definition of roads and public spaces for sweeping (manual, mechanical) 2) Establishment of collection work standards loadage per trip by vehicle type nos. of personnel per vehicle type nos. of working shifts collection methods for each type of discharger or area collection amount (ton/vehicle/hour, ton/worker/hour) 3) Improvement of corresponding measures to emergency and supervision of vehicles equipping radio on vehicle equipping GPS on vehicle 4) Improvement of street sweeping 5) Improvement of vehicle maintenance preparation of maintenance program keeping up and improving mechanics' capability (employment of qualified person, training program) examination of maintenance method (maintenance contract, lease contract, etc.)
	Expansion of Collection Area (measures coping with the expanding urbanized areas to the north and east)	1) Examination of transfer transport examination of transfer type (setting large containers, construction of transfer station) planning of transfer transport (cooperation with Corregimientos, introduction of the private sector) 2) Introduction of transfer transport designing of transfer station construction of transfer station 3) Demarcation of collection works clarification of roles of Corregimientos in collection works (e.g. collection by DIMAUD and transport by Corregimientos) examination of possible roles in collection works for introduction of the private sectors
	Special collection for ICIs	Establishment of a special collection system for ICIs waste

Table 10-6: Proposed Improvement Measures (2)

Strategies		Contents (Proposed Improvement Measures)
Final Disposal	Improvement of Current Landfill Operation Measures	1) Establishment of information gathering, accumulation, analysis and evaluation waste amount brought into Cerro Patacon (weighbridge's data) settlement of landfill (by topographic survey) amount of soil used estimation and planning of soil acquisition (by topographic survey) environmental information (leachate, landfill gas) waste amount and composition survey manual 2) Establishment of standards for landfill works will keep quality of landfill operation 3) Improvement of safety of waste-pickers' works consultation with waste-pickers establishment of rules with waste-pickers registration of waste-pickers (issuing identification card to waste-picker) 4) Improvement of leachate treatment installation of pumps to raise up leachate to the lagoon 5) Improvement of landfill gas treatment 6) Urgent improvement of medical waste disposal method separation from general waste disposal operation
	Ensuring final disposal capacity by 2015	In order to ensure the appropriate final disposal in the municipality, it is recommended to take the following measures. Currying out survey, planning, designing of facilities for ensuring final disposal capacity within the Cerro Patacon site (Feasibility Study) Implementation of the above plan
Waste Minimization and Resource Conservation	Waste minimization and resource conservation cannot be overcome only by technical system. It is needless to say that a comprehensive approach, increasing citizens' awareness on environment, introduction of economic incentives, laws and regulations to facilitate, and so forth, is necessary. Such comprehensive approach is dealt with in the improvement of institutional system later.	
	Education Program for Encouraging Waste Minimization and Recycling	1) Preparation of education program for schools preparation of education program preparation of education materials training on teachers 2) Experimental implementation of the education program is for examining validity of the program 3) Implementation of the education program will be conducted by the Panamanian side 4) Preparation of education program for communities preparation of education program preparation of education materials training on community leaders or NGO 5) Experimental implementation of the education program is for examining validity of the program 6) Implementation of the education program will be conducted by the Panamanian side
	Waste Separation /Material Recovery	1) Planning of experimental separate collection/material recovery system 2) Implementation of the experimental separate collection/material recovery system separate discharge at public institutions and/or schools placement of recipient for cans, bottles at supermarkets collection of separated materials 3) Analysis and evaluation of the experiment 4) Examination of introduction of waste minimization and recycling system materials subject to separate collection necessary facilities

Table 10-7: Proposed Improvement Measures (3)

Strategies		Contents (Proposed Improvement Measures)
Improvement of Management System	• In order to function the proposed technical system, it is crucial to improve the implementation system.	
	Improvement of DIMAUD's Management	1) Establishment of Management Indicators contains In order to establishing a management tool, use of indicators is recommendable. The following are measures to be taken. • Adjustment the accounting system to technical component (e.g. collection, transport, final disposal, etc.) • Establishment of management indicators (application of CEPIS/COSEPRE System) • Establishment of methods to monitor and evaluate with the indicators • Experimental introduction of the above system • Evaluation of the experiment • Introduction of the system 2) Establishment of Management Information System In order to realize efficient and effective management, it is very important to exchange information vertically and horizontally in the organization. The following are recommendable measures to facilitate such communication. • Clarification of information to be exchanged (e.g. weighbridge's data, management indicators) • Establishment of rules to exchange the information (e.g. from which section to which section) • Establishment of tools for exchanging the information (e.g. document form, computer network) 3) Human Resource Development In order to keep up and increase capability of an organization, human resource development is necessary. The following measures are recommendable to take. • Organizing "Executing Unit" • Technology transfer to "Executing Unit" preparation of manual of site surveys planning methods use of the management indicators use of the management information system • Preparation of training program of personnel • Implementation of training 4) Improvement of tariff system In order to improve the present tariff system, it is recommended to take the following measures. • Examination of tariff collection method (direct, combination with water supply/electricity, etc.) • Examination of tariff rate (WTP, ATP) • Improvement of tariff system (simplifying tariff categories of ICIs "institutions, commercial and industries") • Improvement of tariff collection rate from ICIs preparation of list of ICIs establishment of tariff collection method •

Table 10-8: Proposed Improvement Measures (4)

Strategies		Contents (Proposed Improvement Measures)
Improvement of Implementation System	Cooperation with Corregimientos	In order to establish communication with citizens, it is recommendable to establish cooperation with Corregimientos that have closer relationship with citizens. 1)Establishment of rules for cooperation with Corregimientos • for conveying information from DIMAUD to residents through Corregimientos such as collection day and time, separate collection • for conveying information from residents to DIMAUD through Corregimientos such as collection service quality
	Efficient Use of the Private Sector	The private sector has potential resources, such as human resource and equipment, which is to be useful in MSWM. In order to use such resources in MSWM appropriately, it is recommended to take the following measures. Examination of contract and supervision manner with the private sector Registration of qualified private companies for collection service and disposal works Introduction of the private sector in MSWM
Improvement of legal and institutional system	In order to function MSWM appropriately, legal and institutional system that give regulatory framework is also very important.	
	Municipal Regulations on SWM	In order to maximize citizens' benefit and make policy on MSWM firmly, the following measures are recommendable to take. • Preparation of municipal regulations on SWM • Enforcement of the municipal regulations
	Establishment of a Committee regarding MSWM	In order to construct a consensus on MSWM, it is recommendable to set up a committee consisting of various types of stakeholders. Establishment of a committee on MSWM (members from Panama Municipality, DIMAUD, Corregimientos)
	Establishment of Policy on Waste Minimization and Resource Conservation	The followings are recommendable to establish policy on waste minimization and resource conservation. • 1) Suggestion for policy establishment • economic incentives (e.g. deposit system for cans and bottles, tariff system imposing more on large dischargers, etc.) • laws or regulations • education (e.g. establishment of environmental curriculum in the compulsory education) • recycling in factories • waste exchange within industries • 2)Establishment of policy on waste minimization and resource conservation

10.1.7 Future Waste Stream

Future waste stream shows Figure 10-1,Figure 10-2 and Figure 10-3.

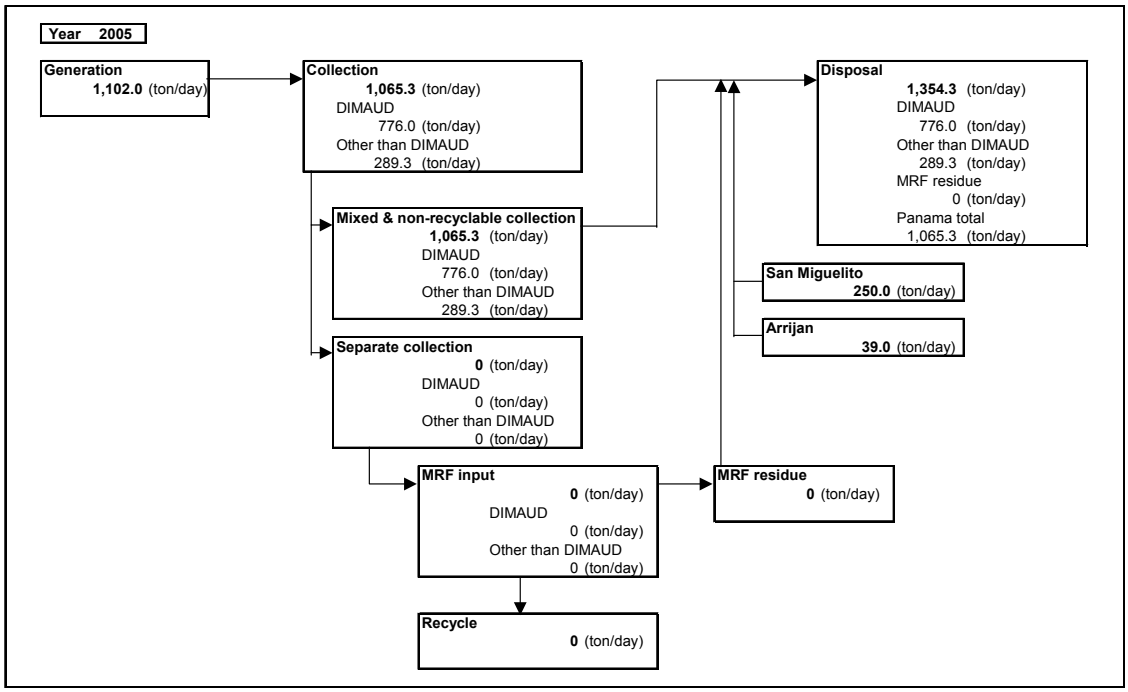

Figure 10-1: Waste Stream in 2005

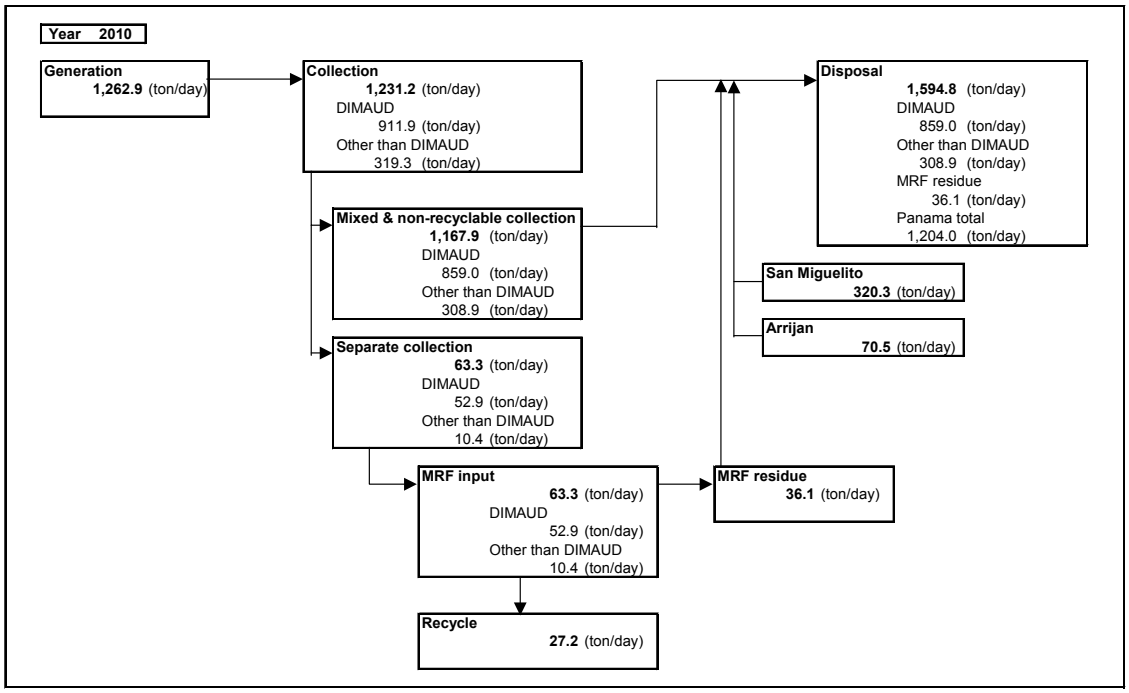

Figure 10-2: Waste Stream in 2010

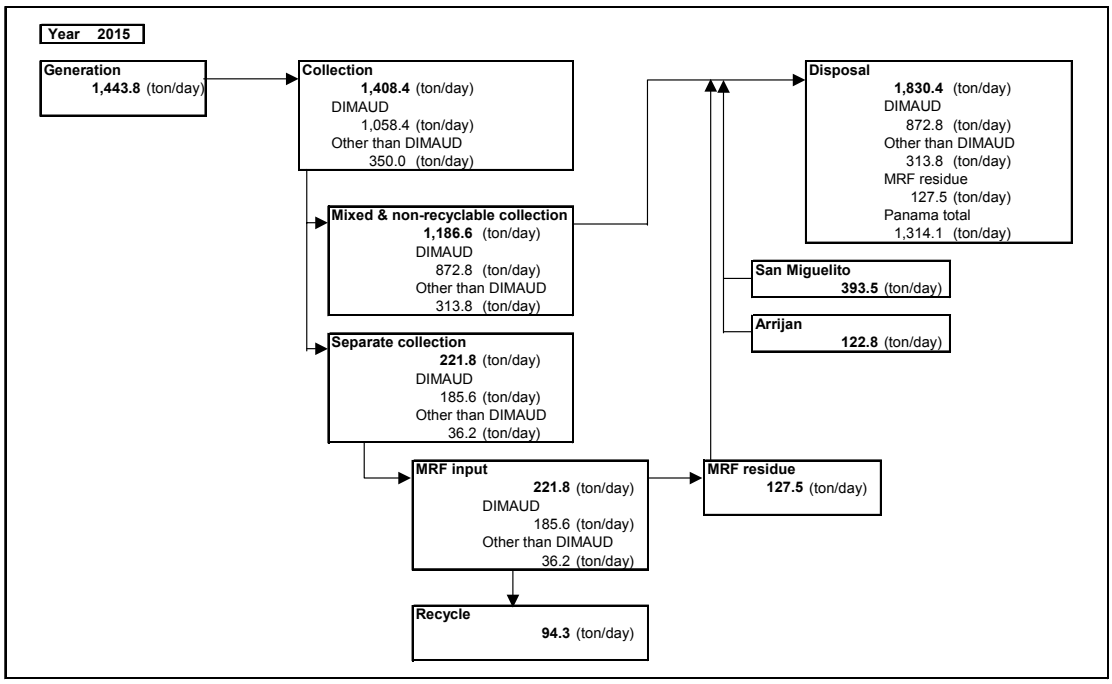

Figure 10-3: Waste Stream in 2015

10.2 Phased Implementation Plan

a. Overall Implementation Plan

The following table presents recommendable timing of implementation of the proposed improvement measures.

Table 10-9: Phased Implementation

Contents of the master Plan	Implementation Schedule				Remarks
	Urgent	Short	Mid	Long	
	2002	03-05	06-10	11-15	
Increase the waste collection service coverage	■	■	■		
Improvement/Establishment of Technical System					
Improvement Storage and discharge system					
Planning	■				
Implementation		■	■	■	
Collection System					
Basic Database Establishment and Maintenance					
Planning	■				
Implementation		■			
Improvement of Collection Efficiency					
Planning	■				
Implementation		■	■	■	
Introduction of separate collection					
Planning & preparation		■			
Implementation			■	■	

Contents of the master Plan	Implementation Schedule				Remarks
	Urgent	Short	Mid	Long	
	2002	03-05	06-10	11-15	
Transfer transport system					
Planning	■				
Implementation		■			
Final Disposal					
Improvement of Current Landfill Operation					
Planning	■				
Implementation		■	■	■	
Ensuring final disposal capacity by 2015					
Planning	■	■			
Implementation			■	■	
Waste Minimization and Resource Conservation					
Education Program for Encouraging Waste Minimization and Recycling					
Planning	■				
Implementation		■	■	■	
Material Recovery					
Planning	■	■			
Implementation			■	■	
Improvement of Implementation System					
Improvement of DIMAUD's Management					
Establishment of Management Indicators					
Planning	■				
Implementation		■	■	■	
Establishment of Management Information System					
Planning	■				
Implementation		■	■	■	
Human Resource Development					
Planning	■				
Implementation		■	■	■	
Improvement of tariff system					
Planning	■				
Implementation		■			
Cooperation with Corregimientos					
Planning	■				
Implementation		■	■	■	
Efficient Use of the Private Sector					
Planning	■				
Implementation		■	■	■	
Improvement of legal and institutional system					
Municipal Regulations on SWM					
Planning	■				
Implementation		■	■	■	
Establishment of Committee regarding MSWM					
Planning	■				
Implementation		■	■	■	
Establishment of Policy on Waste Minimization and Resource Conservation					
Planning	■				
Implementation		■	■	■	

b. Implementation plan of major components

Table 10-10 : Implementation plan

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Collection system														
Separate collection	Preparation				Operation									
Transfer system														
Tocumen			Const.	Operation										
MRF (Cerro Patacon)														
25 ton/day					Const.	Operation								
40 ton/day							Const.	Operation						
60 ton/day									Const.	Operation				
60 ton/day											Const.	Operation		
37 ton/day													Const.	Ope.
Landfill (Cerro Patacon)														
Etapa 2	Existing site													
Etapa 3 (new landfill site)														
Phase 1				Const.	Operation									
Phase 2						Const.	Operation							
Phase 3								Const.	Operation					
Phase 4										Const.	Operation			

10.3 Project Cost Estimation

Overall costs of the M/P are shown below.

Table 10-11: Overall Cost (New Facilities)

unit : U$1,000

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Overall costs															
Investment															
Separate Collection	0	0	0	0	0	89	179	268	178	355	355	356	533	534	2,847
Transfer station	0	67	3,106	0	0	1,876	0	0	0	0	0	0	0	0	5,049
Tractor (300-350hp)	0	0	0	356	89	89	89	0	0	89	356	178	89	178	1,513
Trailer (85 yd3, 20 ton)	0	0	0	326	54	54	163	0	0	54	326	109	54	217	1,357
MRF (Cerro Patacon)	0	0	0	20	800	32	1,292	47	1,937	47	1,937	21	873	0	7,006
Landfill (Cerro Patacon)	0	0	141	9,541	306	20,706	341	23,041	8	508	0	0	0	0	54,592
Total	**0**	**67**	**3,247**	**10,243**	**1,249**	**22,846**	**2,064**	**23,356**	**2,123**	**1,053**	**2,974**	**664**	**1,549**	**929**	**72,364**
Operation and maintenance															
Separate Collection	0	0	0	0	0	206	418	625	418	831	831	831	1,242	1,249	6,651
Transfer station	0	0	0	211	211	211	270	270	270	270	270	270	270	270	2,793
Tractor (300-350hp)	0	0	0	122	152	183	213	213	213	244	244	274	274	305	2,437
Trailer (85 yd3, 20 ton)	0	0	0	7	8	9	12	12	12	13	13	14	14	16	130
MRF (Cerro Patacon)	0	0	0	0	0	40	40	105	105	202	204	301	301	345	1,643
Landfill (Cerro Patacon)	0	0	0	2,946	2,946	2,946	2,946	2,946	2,946	2,946	3,604	3,604	3,604	3,604	35,038
Total	**0**	**0**	**0**	3,286	3,317	3,595	3,899	4,171	3,964	4,506	5,166	5,294	5,705	5,789	48,692
Investment and O&M total															
Total	0	67	3,247	13,529	4,566	26,441	5,963	27,527	6,087	5,559	8,140	5,958	7,254	6,718	121,056

Table 10-12: Total Overall Cost

Unit : U$1,000

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Investment															
New item	0	67	3,247	10,243	1,249	22,846	2,064	23,356	2,123	1,053	2,974	664	1,549	929	72,364
Current landfill	0	10,500	2,800	1,800	0	0	0	0	0	0	0	0	0	0	15,100
Investment total	**0**	**10,567**	**6,047**	**12,043**	**1,249**	**22,846**	**2,064**	**23,356**	**2,123**	**1,053**	**2,974**	**664**	**1,549**	**929**	**87,464**
O&M															
New item	0	0	0	3,286	3,317	3,595	3,899	4,171	3,964	4,506	5,166	5,294	5,705	5,789	48,692
Current landfill leachate treatment	0	2,742	2,848	3,146	1,711	180	180	180	180	180	180	180	180	180	12,067
O&M total	**0**	**2,742**	**2,848**	**6,432**	**5,028**	**3,775**	**4,079**	**4,351**	**4,144**	**4,686**	**5,346**	**5,474**	**5,885**	**5,969**	**60,759**
Total	**0**	**13,309**	**8,895**	**18,475**	**6,277**	**26,621**	**6,143**	**27,707**	**6,267**	**5,739**	**8,320**	**6,138**	**7,434**	**6,898**	**148,223**

a. Concession

The cost presented so far is for a case where DIAMUD would procure funds, construct and operate the facilities. It was found in the case that large deficits would happen in a cash flow when investments concentrate. Therefore, this section considers carrying out some components of the M/P under concession contract in order to overcome the deficits. Three cases of concession are analyzed as shown in Table 10-13.

Table 10-13: Examination on Cases for Concession

	Landfill	Transfer system	MRF
Case 0	DIMAUD direct	DIMAUD direct	DIMAUD direct
Case 1	Concession	DIMAUD direct	DIMAUD direct
Case 2	Concession	Concession	DIMAUD direct
Case 3	Concession	Concession	Concession

Table 10-14: Cost Comparison

Unit: U$ 1,000

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total	Unit cost (U$/landfill ton)
Case 0 (DIMAUD Direct operation)	33,527	29,896	40,343	30,740	50,423	30,707	53,101	32,516	32,902	36,425	35,259	37,600	38,180	481,619	65.611
Case 1	28,220	32,350	31,494	34,762	35,898	36,808	36,787	39,490	39,651	43,302	42,440	45,089	45,997	492,288	67.065
Case 2	28,153	29,244	31,381	35,235	34,538	37,194	37,501	40,283	40,354	43,556	43,152	46,045	46,774	493,410	67.218
Case 3	28,153	29,244	31,361	34,435	34,585	36,107	37,727	38,889	41,039	42,649	44,382	46,759	48,695	494,025	67.301

10.4 Evaluation of Master Plan

10.4.1 Technical Evaluation

Practicability of the components proposed in the M/P will be evaluated from a view point of technical level of the present Panama municipality.

The major components proposed in the M/P are;

- Introduction of Separate Collection
- Introduction of Transfer and Transport System
- Installation of Material Recovery Facility (MRF)
- Expansion of landfill

a. Separate Collection

The separate collection proposed in the M/P was initiated in this study as a pilot project. After five years of a preparation period, from 2002 to 2006, full-scale implementation will start in 2007 aiming at about 50% separate collection rate in 2015, the target year of the M/P.

Collection system generally needs to be modified for introduction of separate collection. The M/P suggests no introduction of new technology but to change frequency and timing of collection. Therefore, from a technical point of view, the introduction of separate collection is considered practicable.

b. Transfer Transport System

Currently, waste transport is conducted regardless of the distance from the Final Disposal Site by collection vehicles. The M/P proposes installation of a transfer station at the East of Panama District, which covers Tocumen, Pacora and San Martin. To improve the transport efficiency, $85yd^3$ trailers will be installed.

$85yd^3$ trailers will be the first case in the waste management in Panama District. However, such trailers and tractors are often used in the private sector for transporting merchandises and others. Therefore, operation and maintenance will not encounter serious problems in a technical viewpoint.

Type of transfer station proposed in the M/P is direct dump station, which does not employ complicated machines such as compactors. Then, it is easy to operate and maintain. Therefore, it can be said that this type of transfer station is appropriate for the first-time introduction.

c. Material Recovery Facility (MRF)

The first MRF is planed to start operation from 2007. Since the facility will be a simple structure with combination of conveyers and magnetic separators, technologically the facility could be installed immediately without serious problems. However, success of MRF depends on soft components rather that hard ones such as facility construction and O&M. The soft components are, for instance, the way to improve impurity rate of collected materials which are transported to the MRF and how to provide the recovered materials to the market and so on. To practice and assure these soft components, the M/P proposes a period of about five years before the operation of the facility.

Judging from this long preparation period and the technical level of Panama municipality, the introduction of this facility is considered practicable.

d. Expansion of landfill

The present landfill of Cerro Patacon has liner system and leachate treatment facilities. All these facilities were planned, designed and implemented by the Panama municipality. Therefore, it is considered that the Panama municipality has enough knowledge and experience for expansion of the landfill and other related constructions.

Meanwhile, there were problems in landfill management such as excessive use of cover soil and landfilling methods etc. Some of problems have been improved through the Landfill Operation Improvement Pilot Project that has left variable data and experiences to operate the sanitary landfill properly.

Consequently, it can be said that the final disposal system will be improved with the plans and designs provided by the M/P and based on the experiences obtained through the pilot project.

10.4.2 Financial Evaluation

a. Financial Analysis

Several Financial Options for implementing the M/P are analyzed herewith. Those options are the following.

- Directly by DIMAUD without borrowed funds
- Directly by DIMAUD with borrowed funds,
- Concession (Landfill)
- Concession (Landfill and Transfer & Transport)
- Concession (Landfill, Transfer & Transport and Material Recovery Facility)

a.1 Directly by DIMAUD without borrowed funds

As a pre-requisite, DIMAUD will have to implement the increase in income from commercial firms using the volume-based tariff, and the cost reduction resulting from improvement in the collection service. In addition, DIMAUD will have to find a way to cover the large cash flow deficits of $3.9 million in 2003, $3.1 million in 2005, $10.6 million in 2007 and $10.9 million in 2009.

Table 10-15: DIMAUD Direct Implementation of M/P without Borrowed Funds

Year	Total Income ($million)	Total Cost ($million)	Cash Flow ($million)
2003	29.7	33.5	-3.9
2004	33.8	29.9	3.9
2005	37.3	40.3	-3.1
2006	38.4	30.7	7.7
2007	39.8	50.4	-10.6
2008	41.0	30.7	10.3
2009	42.1	53.1	-10.9
2010	43.4	32.5	10.9
2011	44.7	32.9	11.8
2012	46.0	36.4	9.6
2013	47.4	35.3	12.2
2014	48.9	37.6	11.3
2015	50.5	38.2	12.3
Total	543.1	481.6	61.5

a.2 Directly by DIMAUD with borrowed funds

To overcome the large cash flow deficits in some years, an international soft loan can be considered for financing the Master Plan under DIMAUD direct operation. Financing terms and conditions for the Master Plan are set with careful considerations.

The required costs planned in the Master Plan amount to $105.8 million between 2003 and 2015. Assuming 70% is financed with borrowed funds, DIMAUD needs to borrow about $74.0 million between 2003 and 2015, but in addition should prepare around $31.8 million of own funds as counterpart funds for the Master Plan implementation. Assuming an interest rate of1.8% and repayment over 25 years with 7 years grace period, repayment amount is estimated at $96.6 Million, as summarized below.

Table 10-16: Financing M/P with Borrowed Funds

Item	Implementation	Repayment
Interest Rate	1.8%	1.8%
Repayment Period		25 years of disbursement: 2010-2039
Grace Period		7 years: 2003-2009
Implementation	13 years: 2003-2015	
Required Costs	$105.8 million	
Borrowed Funds	$74.0 million	$96.6 million
Own Funds	$31.8 million	

a.3 Concession

Concession option was considered separately for each component activity and its corresponding cost (Sanitary Landfill, Transfer & Transport, and Materials Recovery Facility).

a.3.1 Concession of Sanitary Landfill

By operating only Sanitary Landfill under concession, cash flow would be positive in every year, and the resulting financial balance over the planning period would amount to $31.6 million.

Table 10-17: Master Plan under Concession of Sanitary Landfill

Year	Income ($million)	Cost ($million)			Cash Flow ($million)
		DIMAUD	Concession	Total	
2003	28.5	20.3	7.9	28.2	0.27
2004	32.6	24.1	8.2	32.4	0.26
2005	36.0	22.9	8.6	31.5	4.5
2006	37.1	25.8	9.0	34.8	2.3
2007	38.5	26.6	9.3	36.0	2.5
2008	39.5	27.2	9.6	36.8	2.7
2009	40.7	26.9	9.9	36.8	3.9
2010	41.9	29.4	10.1	39.5	2.4
2011	43.1	29.3	10.4	39.7	3.5
2012	44.4	32.6	10.7	43.3	1.1
2013	45.8	31.5	11.0	42.4	3.3
2014	47.2	33.8	11.3	45.1	2.1
2015	48.7	34.4	11.6	46.0	2.7
Total	523.9	364.8	127.5	492.3	31.6

a.3.2 Concession of Sanitary Landfill and Transfer and Transport

Concession of Sanitary Landfill (SL) and Transfer & Transport (TT) is estimated to result in positive cash flow in every year of the implementation period, and the resulting financial balance over the planning period would amount to $30.5 million.

Table 10-18: Master Plan under Concession of Sanitary Landfill and Transfer & Transport

Year	Income ($million)	Cost ($million)			Cash Flow ($million)
		DIMAUD	Concession	Total	
2003	28.5	20.2	7.9	28.2	0.3
2004	32.6	21.0	8.2	29.2	3.4
2005	36.0	21.9	9.5	31.4	4.6
2006	37.1	25.3	10.0	35.2	1.9
2007	38.5	24.2	10.4	34.5	3.9
2008	39.5	26.5	10.7	37.2	2.4
2009	40.7	26.4	11.1	37.5	3.2
2010	41.9	28.9	11.4	40.3	1.6
2011	43.1	28.6	11.8	40.4	2.8
2012	44.4	31.4	12.1	43.6	0.9
2013	45.8	30.6	12.5	43.2	2.6
2014	47.2	33.1	12.9	46.0	1.1
2015	48.7	33.4	13.4	46.8	1.9
Total	523.9	351.5	141.9	493.4	30.5

a.3.3 Concession of Sanitary Landfill, Transfer & Transport, and MRF

And finally, concession of Sanitary Landfill (SL), Transfer & Transport (TT) and Materials Recovery Facility (MRF) is estimated to result in a small negative cash flow of $32,000 in 2014, and the resulting financial balance over the planning period would amount to $29.9 million.

Table 10-19: Master Plan under Concession of Sanitary Landfill, Transfer & Transport and MRF

Year	Income ($million)	Cost ($million)			Cash Flow ($million)
		DIMAUD	Concession	Total	
2003	28.5	20.2	7.9	28.2	0.3
2004	32.6	21.0	8.2	29.2	3.4
2005	36.0	21.9	9.5	31.4	4.7
2006	37.1	24.5	10.0	34.4	2.7
2007	38.5	24.1	10.5	34.6	3.9
2008	39.5	25.2	10.9	36.1	3.4
2009	40.7	26.3	11.4	37.7	3.0
2010	41.9	26.9	12.0	38.9	3.0
2011	43.1	28.3	12.7	41.0	2.1
2012	44.4	29.3	13.4	42.6	1.8
2013	45.8	30.3	14.1	44.4	1.4
2014	47.2	31.9	14.8	46.8	0.4
2015	48.7	33.1	15.6	48.7	-0.03
Total	523.9	342.9	151.1	494.0	29.9

All concession options would result in positive cash flow in all but one year of the planning period under the option in which concession is considered for landfill, transfer station and materials recovery facility. It can be seen that the appeal of concession is the possibility of overcoming large negative cash flows that would occur under direct DIMAUD operation.

b. Burden of SW Service Fee on Household Income

The World Bank estimates the share of solid waste expenses in the household budget to be around 0.7% to 1.7%, which are generally regarded as the range of **Ability to Pay (ATP)** of households for solid waste services.

The following table shows that the burden of SW service cost on household income is lower under concession, thereby confirming that the service is affordable for the residents of Panama District.

Table 10-20: Burden of Solid Waste Service Cost on Household Income with M/P under Concession

Year	Base Data		Landfill		Landfill & TT		Landfill, TT, MRF	
	Minim. Wages ($/month)	Hhold. Income ($/month)	Avg.SW Cost ($/month)	Cost/Income (%)	Avg.SW Cost ($/month)	Cost/Income (%)	Avg.SW Cost ($/month)	Cost/Income (%)
2003	269	1,136	6.93	0.61	6.92	0.61	6.92	0.61
2004	269	1,136	7.73	0.68	6.99	0.62	6.99	0.62
2005	285	1,204	7.32	0.61	7.29	0.61	7.29	0.61
2006	285	1,204	7.84	0.65	7.95	0.66	7.77	0.65
2007	302	1,277	7.86	0.62	7.56	0.59	7.57	0.59
2008	302	1,277	7.81	0.61	7.90	0.62	7.66	0.60
2009	320	1,353	7.56	0.56	7.71	0.57	7.75	0.57
2010	320	1,353	7.85	0.58	8.01	0.59	7.73	0.57
2011	340	1,434	7.61	0.53	7.75	0.54	7.88	0.55
2012	340	1,434	8.03	0.56	8.07	0.56	7.91	0.55
2013	360	1,520	7.59	0.50	7.72	0.51	7.94	0.52
2014	360	1,520	7.77	0.51	7.93	0.52	8.05	0.53
2015	382	1,612	7.62	0.47	7.75	0.48	8.07	0.50

TT: Transfer & Transport
MRF: Materials Recovery Facility

c. Financial Evaluation

Financial evaluation consisted of calculating the financial internal rate of return, and then conducting sensitivity analysis.

c.1 Financial Internal Rate of Return (FIRR)

Implementation of the Master Plan between 2003 and 2015 would give a positive financial balance of $61.5 million for the period, resulting in a financial internal rate of return (FIRR) of 47.5%. The high FIRR should be viewed with caution because it is extremely sensitive to variations in income. If government subsidy is eliminated as income source, the FIRR would

go down to 17.8%. And if government subsidy plus income from landfill are eliminated, FIRR would go down to 7.4%.

Posing still greater problems, large cash flow deficits are expected in some years: around $3.9 million in 2003, $3.1 million in 2005, $10.6 million in 2007 and $10.9 million in 2009.

c.2 Sensitivity Analysis

Sensitivity analysis was conducted by assuming a 10% reduction in total income, a 10% increase in total cost, and a simultaneous 5% reduction in total income and 5% increase in total cost. Results are summarized in the following table.

Table 10-21: Sensitivity Analysis

Cases	FIRR
Base Case	47.5%
Income reduction: -10%	3.4%
Cost Increase: +10%	5.8%
Income reduction: -5% and Cost Increase: +5%	4.6%

10.4.3 Economic Evaluation

The investment plan proposed in the M/P is practicable for DIMAUD and is expected to mitigate aggravation of urban sanitation and improve urban environment and social welfare through the effective MSWM.

Quantitative economic evaluation of the M/P is conducted by calculating Economic Internal Rate of Return (EIRR) and Benefit-Cost Ratio with the following benefit and cost.

- Willingness to Pay of U$6.07/household/month, which obtained through the Public Opinion Survey (POS), is regarded as benefit of the M/P.
- Amount, which is obtained by deducting 5% of tax from the existing and new costs required for the M/P, is assumed as cost.

Implementation of the M/P will bring about the following cost reductions.

- Cost reduction in the collection and transport works with introduction of the Transfer and Transport System
- Cost reduction in the collection works: the collection improvement pilot project proved that 21% of cost reduction in the collection works would be achievable, which is equivalent to 9.66% of the whole MSWM costs of DIMAUD in year 2001.

In this economic evaluation, three cases where the above cost reductions are considered or not considered (See Table 10-22) are analyzed as presented in the following.

Table 10-22: Study Case in Economic Evaluation

	Cost	Benefit
Case 1	Existing cost + incremental cost	Willingness to pay (U$ 77.02/ton)
Case 2	(Existing cost + incremental cost) – (saving cost by T/S system)	
Case 3	(Existing cost + incremental cost) – (save cost by T/S system + cost reduction of collection system)	

Table 10-23: EIRR and B/C

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	EIRR	B/C
Case 1	-5,052	-683	-9,822	465	-17,234	2,282	-18,235	2,197	2,682	190	2,250	965	1,455	-26.32%	0.919
Case 2	-5,052	-683	-9,637	667	-17,017	2,513	-17,988	2,460	2,962	489	2,568	1,303	1,815	-23.18%	0.925
Case 3	**-2,679**	**1,771**	**-7,097**	**3,309**	**-14,306**	**5,279**	**-15,163**	**5,331**	**5,884**	**3,460**	**5,592**	**4,380**	**4,948**	**0.47%**	**1.002**

As the results show, the benefit-cost rate slightly exceeds 1.0 and EIRR barely becomes positive in the Case 3 where the Transfer and Transport System is introduced and the collection improvement is carried out as proposed in the M/P.

Consequently, it is evaluated that the M/P is economically feasible and upgrades the urban environment as well as improve the efficiency of MSWM carried out by DIMAUD.

10.4.4 Overall Evaluation

The validity of the M/P was evaluated from technical, financial, economical, institutional, social and environmental viewpoints.

The proposed technical system will be effective to achieve the M/P's goal, or Establishment of Sound Solid Waste Management in the Panama District, through i) Elimination of waste from the living environment, in order to preserve citizens' health, ii) Establishment of appropriate final disposal system, and iii) Encouragement of waste minimization. The collection improvement and the establishment of the transfer and transport system will ensure the elimination of waste from the living environment. Improvement of the existing landfill operation and the new landfill development will guarantee the establishment of appropriate final disposal system. And, the separate collection, MRF and the environmental education will make sure the waste minimization. Technologies proposed here have well taken into account the degree of technical level and acceptability of the Panama District.

However, it is true that the proposed technical system will require higher technical capabilities and management abilities. In order to cope with this matter, technology transfer was carried out during the Study through various activities such as implementation of pilot

projects and joint formulation of the M/P. Besides, the Municipal Ordinance prepared during the study will be a firm foundation where service providers (DIMAUD and the private sector), clients (citizens and business entities) and supervisors (MINSA and Municipality) can participate positively and act properly in the MSWM. Responsibilities and tasks set for each department and units of DIMAUD will orient them to the M/P's goal.

Financial analysis found that the implementation of the M/P would cause large deficits in cash flow of DIMAUD in some years, although the financial situation would be positive in total. Then, it was clarified that concession contract of major components, such as Landfill, Transfer and Transport and MRF, to the private sector could overcome such large deficits. Such concession means effective use of assets of the private sector to the public. Furthermore, economic analysis clarified that the M/P will bring about benefits to the whole citizens of Panama District.

As the M/P is a kind of environment improvement projects, it will of course contribute to improvement of environmental quality of the Panama District. The environment education proposed in the M/P will take for a certain time to harvest its fruits. However, it is clear that it will bring about waste minimization and citizens' consciousness-raising on MSWM, then, it will ensure sustainability of provision of a Sound MSWM in the Panama District.

Consequently, it is evaluated that the M/P's goal will bring benefit for the citizens of the Panama District, besides for the global environment from a viewpoint of resource conservation, and the proposed measures in the M/P are effective, efficient and sustainable to achieve the goal.

11 Feasibility Study and Pre-feasibility Study for Priority Projects

11.1 Outline of the Projects

11.1.1 Target

It is indispensable to secure a final disposal site for a sound Solid Waste Management. There is a plan to expand the existing landfill, or Etapa 2 in the Cerro Patacon Landfill. The part to be expanded is called Phase 4 of Etapa 2 and will have a capacity of 1,800,000 m^3. The Phase 4 will be full by the beginning of 2006. Then, another new landfill will be necessary. Therefore, a feasibility study is conducted under the scheme of the Study for a new landfill, or Cerro Patacon Etapa 3, to be operated between 2006 and 2015.

It has also been sought to improve efficiency of transport in the eastern area (Tocumen, Pacora and San Martin) and northern area (Chilibre) where the distances to the Cerro Patacon Landfill exceed 40 km (a round trip). Therefore, aiming at improve the efficiency of the transport, a pre-feasibility study of transfer and transport systems in the areas were carried out.

11.2 Preliminary Design of Technical System

11.2.1 Final Disposal Project

a. Location and Area

a.1 Location

Cerro Patacon site is located about 5km to the northwest of the city center; from the locality off Bethanaia along the Cerro Patacon Avenue. It has paved access road and electrical power supply.

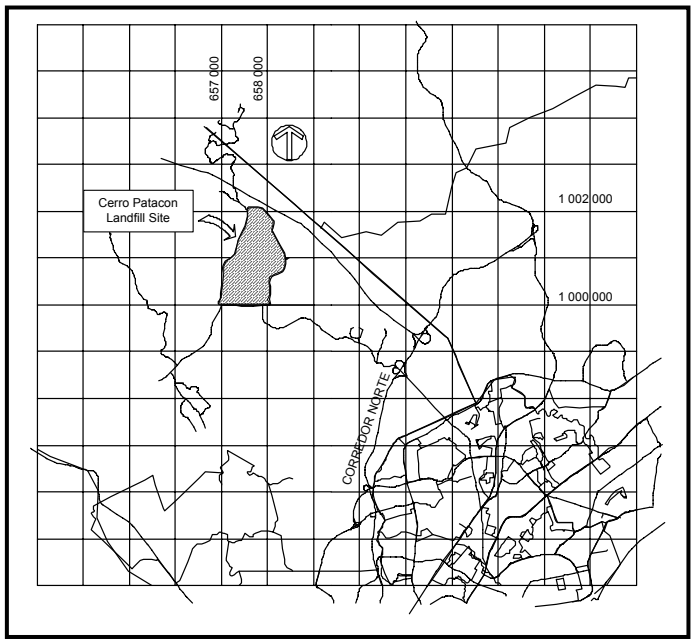

Figure 11-1: Location Map of Cerro Patacon

a.2 Project Site

The project site is in the Cerro Patacon Landfill that has an area of 130 ha. Besides, 9 ha will be added with the new landfill development, Etapa 3. Profile of the project site is as follows.

- The maximum height: 106 m
- The minimum height: 43 m
- Area: about 28ha
-

There is a small hill at the north and a shallow valley at the south in the project site. Around the project site, there is a hill at the north, the existing landfill (Etapa I) at the south, a river at the east and other existing landfill (Etapa II) at the west.

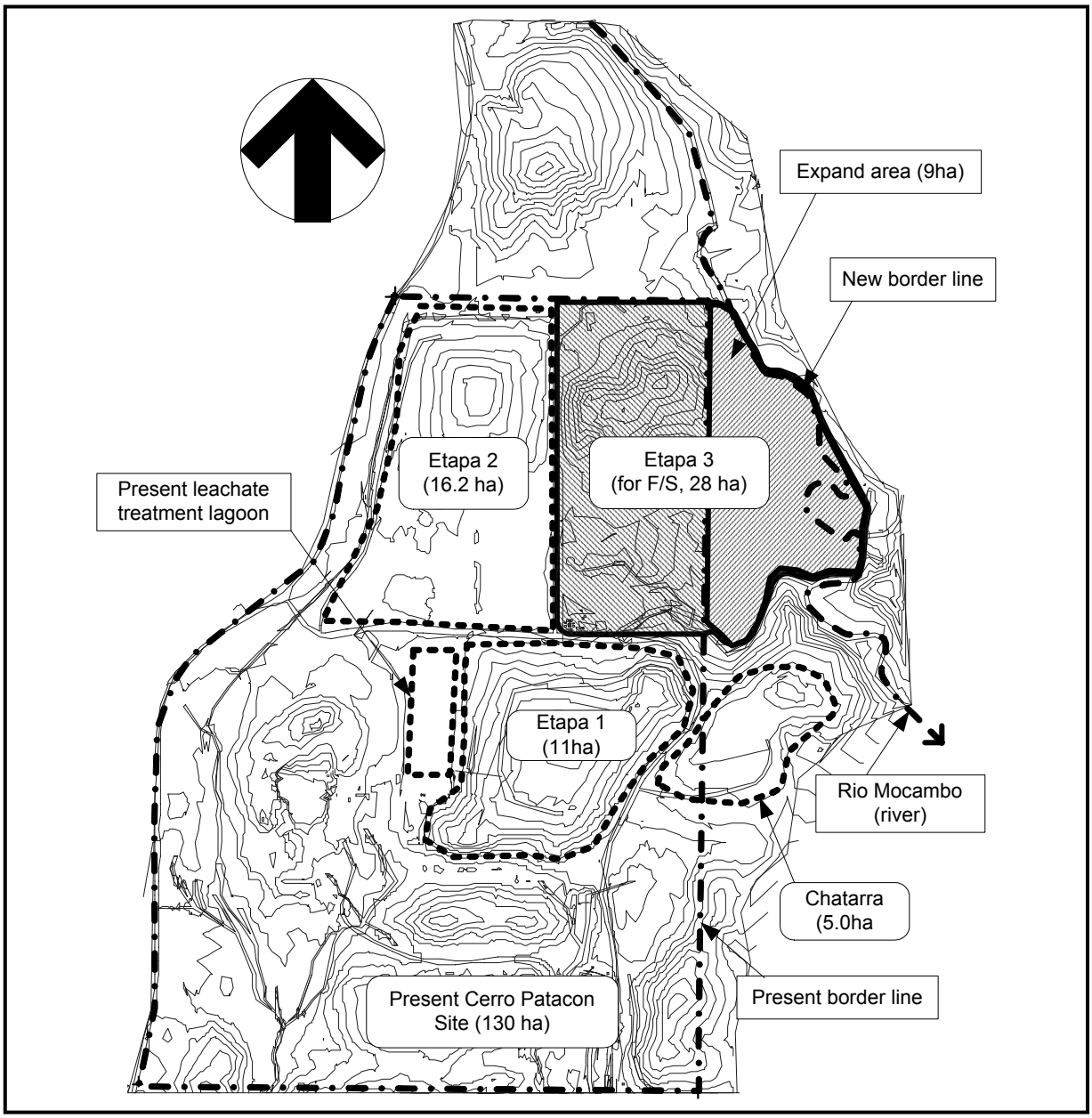

Figure 11-2: Project Site

b. Outline of Projects

Table 11-1 shows the outline of the final disposal project.

Table 11-1: Outline of the Final Disposal Project (Feasibility Study)

Items	Facilities				
	Overall	Phase 1	Phase 2	Phase 3	Phase 4
Construction site	Cerro Patacon Area				
Construction period	-	2005 to early 2006	2007 to early 2008	2009 to early 2010	2011
Operation period	2006 to 2015	early 2006 to early 2008	early 2008 to early 2010	early 2010 to end of 2011	2012 to 2015
Area	Site area :28 ha Filling area : 20.4 ha	6.9 ha	6.5 ha	6.3 ha	20.4 ha
Landfill waste	Municipal waste				
Landfill capacity	6,400,000 m^3	1,300,000m^3	1,200,000m^3	1,100,000m^3	2,800,000m^3
Access	Existing road and internal road Length of internal road : 2,570 m	Length of internal road : 1,300 m	Length of internal road : 800m	Length of internal road : 470m	-
Waste transport control facilities	Gate : 2 (existing), Weighbridge : 2 (existing), Car washing : 1 (existing), Site office :1, Work shop :1				
Leachate management	**Seepage control works**: installation of 1.5 mm HDPE synthetic liner with 10 mm geotextile (under and upper of synthetic liner), installation of soil layer for protection of synthetic liner				
	Collection and treatment system				
	Collection pipe: 6,690m(dia. 200 to 900mm)	2,070 m	2,020m	1,830m	770m
	Treatment system Regulation pond : 24,000 m^3,Treatment capacity : 800 m^3/day (oxidation ditch with chemical sedimentation, sand filtration and activated carbon absorption) Intake water quality : BOD 10,000 mg/l, COD 18,000 mg/l, Org-N 200 mg/l, NH_3-N 200 mg/l, P 30mg/l Treated water quality ; BOD 35 mg/l, COD 100 mg/l, Org-N 10 mg/l, NH_3-N 3 mg/l, P 5mg/l (comply the ANAM discharge limit)				
Landfill gas management	Gas ventilation pipe (PVC 200 mm) : 92 nos.	23 nos.	22 nos.	21 nos.	26 nos.
Rain water management	Trapezoidal lined ditch (wide 800 to 1,700 mm): 2,300 m and daily cover soil	1,190 m	700 m	410 m	-
Landfill operation	Cell method with compaction, daily soil cover thickness15cm, final soil cover thickness 60cm				
Aesthetic design	Daily soil cover				
Closure and post-closure	Final soil cover 60 cm Greening by seeding the final cover with grass				

c. Cost Estimation

Overall cost for new landfill shows below table.

Table 11-2: Overall Cost

unit : U$ 1,000

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Landfill site													
Investment													
Design & supervision	66	66	306	306	341	341	8	8					1,442
Construction		4,400		20,400		22,700		500					48,000
O&M		2,811	2,811	2,811	2,811	2,811	2,811	2,811	3,469	3,469	3,469	3,469	33,553
Total	**66**	**7,277**	**3,117**	**23,517**	**3,152**	**25,852**	**2,819**	**3,319**	**3,469**	**3,469**	**3,469**	**3,469**	**82,995**
Leachate treatment													
Investment													
Design & supervision	75	75											150
Construction		5,000											5,000
O&M		135	135	135	135	135	135	135	135	135	135	135	1,485
Total	**75**	**5,210**	**135**	**135**	**135**	**135**	**135**	**135**	**135**	**135**	**135**	**135**	**6,635**
Overall cost													
Investment total	141	9,541	306	20,706	341	23,041	8	508	0	0	0	0	54,592
O & M total	0	2,946	2,946	2,946	2,946	2,946	2,946	2,946	3,604	3,604	3,604	3,604	35,038
Total	**141**	**12,487**	**3,252**	**23,652**	**3,287**	**25,987**	**2,954**	**3,454**	**3,604**	**3,604**	**3,604**	**3,604**	**89,630**

11.2.2 Pre-feasibility Study on Transfer and Transport System

a. Consideration of Necessity of Transfer and Transport System

East

- The break-even analysis showed that the transfer and transport system (composed by a Transfer Station of 570 tons/day and tractor-trailers of 65 m^3 capacities) is financially feasible compared to the conventional transport system executed by 12.2 m^3 or 15.3 m^3 compactor trucks.
- Consequently, the Transfer and Transport system composed by a Transfer Station of 570 tons/day and tractor-trailers of 65 m^3 capacities is recommended to be implemented for the Eastern Sector formed by Tocumen, Pacora, and San Martin.

North

- The break-even analysis showed that the proposed Transfer and Transport system which is composed of Roll-off/Roll-on trucks and 22.9 m^3 containers is not feasible if it is compared to compactor trucks of 12.2 m^3 and compactor trucks of 15.3 m^3 which are currently used in Quebrada Ancha and Chilibre Centro. Moreover, the current collection amount in the routes mentioned previously is only 7 tons/day.

- Consequently, it is not recommendable at this moment to introduce a Transfer and Transport system to service the North. However, an evaluation of the variables that lead to the former conclusion (population growth, enforcement of urban development regulations, etc.) should be done in the future in order to determine if there has been any change in this regard and to define the necessity of introducing a Transfer and Transport system.

b. Outline of the Project of Transfer and Transport System in the East

b.1 Target Areas

The project of Transfer and Transport System in the East covers the following corregimientos.

- Tocumen
- Pacora
- San Martin

b.2 Recommended Location and Scale of Transfer Station

It is recommended to place the transfer station in the area along the Pan American Highway in Pacora corregimiento.

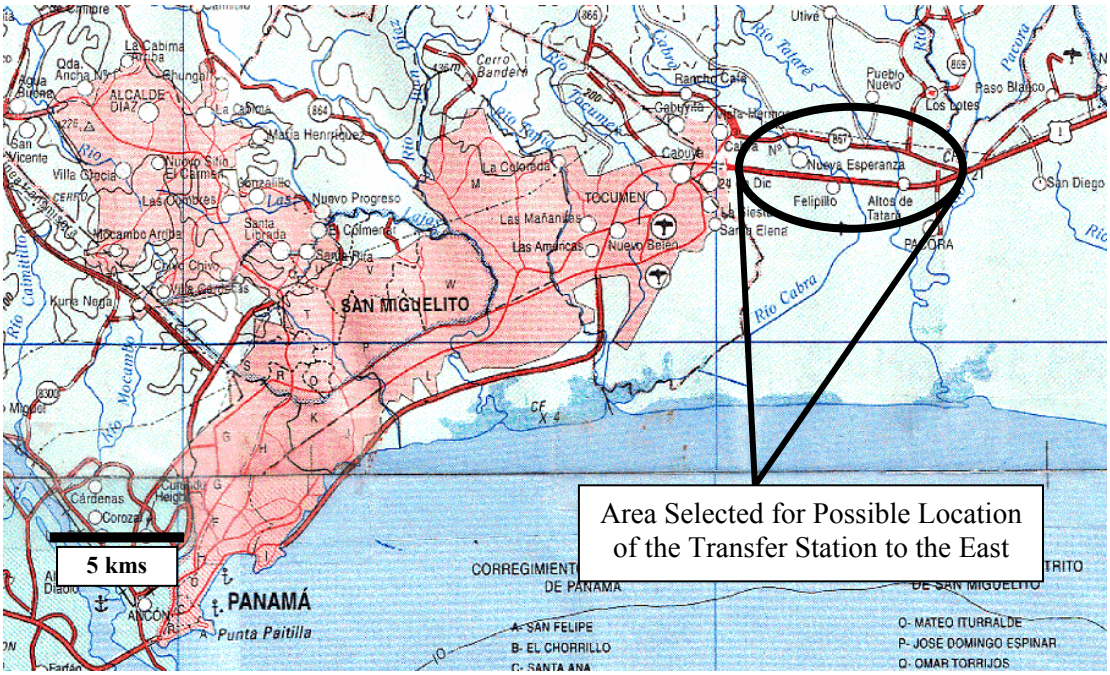

Figure 11-3: Recommended Location of Transfer Station in the East

b.3 Outline of the Project

The project is outlined in Table 11-3.

Table 11-3: Outline of the Project

Item	Specification
Transfer station	Type: Direct dump station Capacity:600 ton/day in total (First phase; 300 ton/day, Second phase; 300 ton/day
Transport equipment	Tractor: 300-350 Hp Trailer: payload 20 ton, 65 m^3 (85 yd^3) with hydraulic ejector blade
Collection equipment	Compactor: 12.2 m^3 (16 yd^3) compactor truck

Table 11-4: Outline of the Transfer and Transport Project (Pre-feasibility Study)

Items	Facilities		
	Overall	Phase 1	Phase 2
Construction site	Possibly along the American Highway in Pacora Corregimiento (the site will be looked for later by DIMAUD)		
Construction period	-	2004	2007
Operation period	From 2005 (economic life of the transfer station is assumed as 20 years)	From 2005	From 2008
Site area	5 ha	-	-
Target Waste	Municipal waste generated from Tocumen, Pacora and San Martin corregimientos		
Facilities	Direct dump station		
Platform	2,500 m^2	1,250 m^2	1,250 m^2
Hopper	4 units	2 units	2 units
Weighbridge	2 units	1 unit	1 unit
Others	Office, workshop, fence, gate, car washer, buffer zone		
Transport Equipment	Tractor-trailer (20 ton); 17 units of tractor and 25 units of trailer are to be purchased in total between 2005 and 2015.		
Collection Vehicle	16 yd^3 (12.2m^3) compactor truck; 67 units are to be purchased in total between 2005 and 2015.		

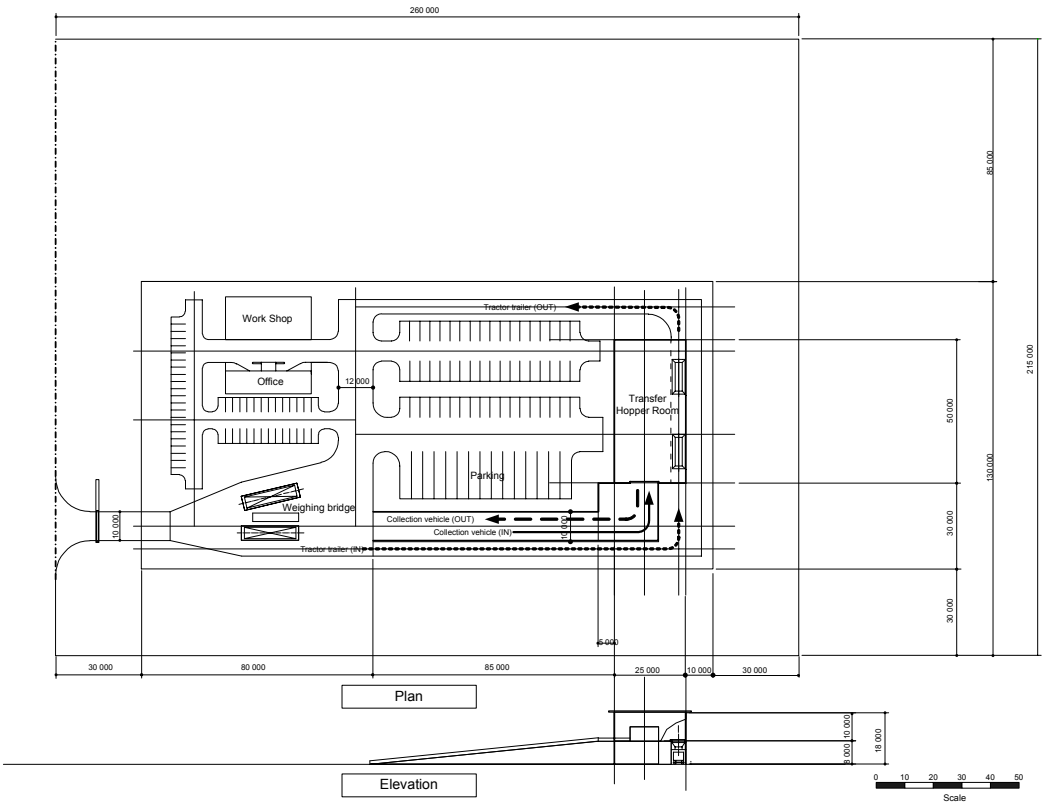

Figure 11-4: Plan of Transfer Station (Phase I, 300 ton/day)

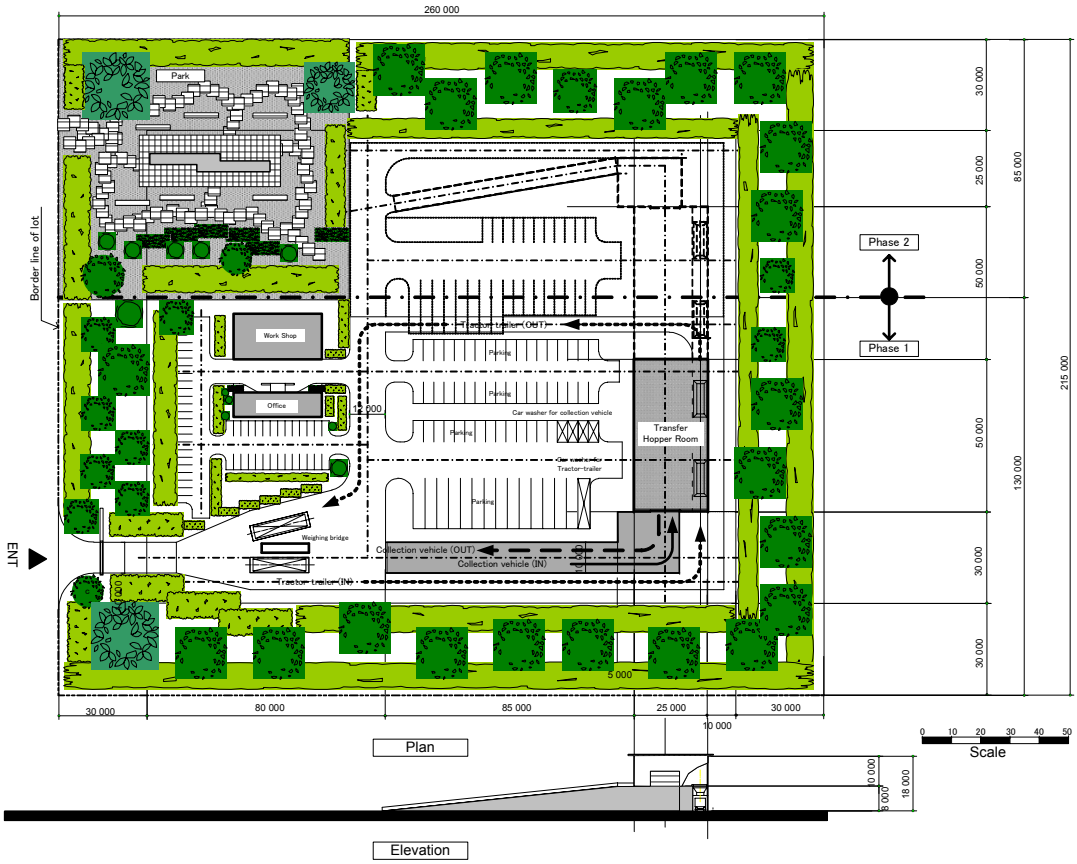

Figure 11-5: Plan of Transfer Station (Phase II, 600 ton/day)

c. Cost Estimation

Table 11-5 shows overall costs required for the transport ant transport system.

Table 11-5: Overall Cost of the Transfer and Transport System in the East

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
1. Transfer station														
Design and supervision	67	67	0	0	55	0	0	0	0	0	0	0	0	189
Capital	0	3,039	0	0	1,821	0	0	0	0	0	0	0	0	4,860
O&M	0	0	211	211	211	270	270	270	270	270	270	270	270	2,793
Total	67	3,106	211	211	2,087	270	270	270	270	270	270	270	270	7,842
2. Transport														
Capital			682	143	143	252	0	0	143	682	287	143	395	2,870
O&M			129	160	192	225	225	225	257	257	288	288	321	2,567
Total			811	303	335	477	225	225	400	939	575	431	716	5,437
3.3 Collection														
Capital			978	623	178	89	89	1,156	800	267	267	178	1,334	5,959
O&M			604	989	1,099	1,153	1,208	1,319	1,428	1,484	1,593	1,648	1,759	14,284
Total			1,582	1,612	1,277	1,242	1,297	2,475	2,228	1,751	1,860	1,826	3,093	20,243
3.4 Total Cost	67	3,106	2,604	2,126	3,699	1,989	1,792	2,970	2,898	2,960	2,705	2,527	4,079	33,522

11.3 Institutional Plan

The results of the financial evaluation of the M/P tell that it is appropriate to consign the project subject to the Feasibility Study and Pre-feasibility Study to the private sector under concession contract. Therefore, this institutional plan will examine conditions of the concession contract and provide a guideline to prepare a Terms of Reference (TOR).

11.4 Financial Analysis

Financial analysis was conducted for the Sanitary Landfill, the subject of feasibility study, and for the Transfer & Transport, the subject of pre-feasibility study. The purpose of this analysis was to assess the financial viability of the said activities from the standpoint of a possible concessionaire. Accordingly, income from the concessionaire standpoint was assumed to be equivalent to the concession cost for DIMAUD. The cost under consideration included investment plus operation & maintenance costs.

1. Sanitary Landfill

Under conditions explained above, the resulting financial internal rate of return (FIRR) would be 5.2%. The sensitivity analysis showed that a 10% income reduction would lower FIRR to –1.0%, while a 10% cost increase would lower FIRR to –0.4%. A simultaneous 5% income drop and a 5% cost increase would change FIRR to –0.7%.

2. Transfer & Transport

Under conditions explained above, the resulting financial internal rate of return (FIRR) would be 3.5%. The sensitivity analysis showed that a 10% income reduction would make FIRR negative lowering it to -1.1%, while a 10% cost increase would lower FIRR to –0.6%. A simultaneous 5% income drop and a 5% cost increase would change FIRR to –0.8%.

3. Sanitary Landfill plus Transfer & Transport

When sanitary landfill plus transfer & transport were considered under joint concession, the resulting financial internal rate of return (FIRR) would be 4.9%. The sensitivity analysis showed that a 10% income reduction would lower FIRR to –1.0%, while a 10% cost increase would lower FIRR to –0.5%. A simultaneous 5% income drop and a 5% cost increase would change FIRR to –0.7%.

Table 11-6: Financial Analysis of Feasibility Study

Cases	FIRR Sanitary Landfill (%)	FIRR Transfer & Transport (%)	FIRR LF, T&T (%)
Base	5.2	3.5	4.9
Income reduction: -10%	-1.0	-1.1	-1.0
Cost increase: +10%	-0.4	-0.6	-0.5
Income: -5% & Cost: +5%	-0.7	-0.8	-0.7

11.5 Environmental Impact Assessment

11.5.1 Scope of EIA Work

a. Contents of EIA

Process of the EIA employed in the Study consists of Initial Environmental Examination (IEE) and detailed EIA. As for the Final Disposal System, both the IEE and the detailed EIA were conducted. Meanwhile, only the IEE was carried out for the Transport and Transfer System, as any specific site has not been proposed.

Contents	Final Disposal System (Feasibility Study)	Transfer and Transport System (Pre-feasibility Study)
IEE	○	○
Detailed EIA	○	-

b. Scope of the detailed EIA Work

A whole EIA process usually includes public participation in decision-making. Consultation with the public is responsibility to a project proposer, and also this is out of the scope of the Study. The Study will prepare technical information that is required for the EIA process. Then, it is sought that the Panamanian side will conduct a whole process of the EIA with the information, if such EIA is required to carry out the project.

11.5.2 Initial Environmental Examination

Results of the scoping were shown in Table 11-7. It was carried out based on JICA Guideline, where words used in the table has the following meanings.

- Activities 'During Construction' include land acquisition, land occupation, use of construction equipment and traffic of construction tracks.
- Activities 'During Operation' include traffic of waste trailers and operations of the facility.
- Evaluation of possible environmental impact is expressed by ranks from A to D.
    - Rank A; Serious impacts might be caused.
    - Rank B; Some impacts might be caused.

- Rank C; Extent of impact is unknown because information is lacking and/or it depends on project location.
- Rank D; There is little or no impact.

Table 11-7: Results of Scoping

Evaluation Items	Possible Cause and Effect		Landfill Expansion (Cerro Patacon Final Disposal Site)		Transfer Stations (unknown)	
	During Construction	During Operation	Rank	Reasons	Rank	Reasons
Social Environment						
Resettlement	Resettlement of people living in the proposed site or on the access route		D	There are no permanent dwellings in the site.	D	Sites have not been identified but required areas are small.
Economic Activities	Disturbance of economic activities		D	Area is already used for solid waste disposal. Further disturbance of economic activity is not expected.	D	Location of sites is flexible so economic impacts can be minimized.
Transport	Increase in traffic and accidents	Increase in traffic and accidents	D	Area is already used for landfill operations	B	Near the locations there will be a change in traffic pattern.
Public Facilities	Impacts on schools, hospitals, etc. by traffic and noise	Impacts on schools, hospitals, etc. by traffic and noise	D	Area is already used for landfill operations.	C	Although potential sites have not been identified, impacts may not be serious, as required areas are small.
Division of Community	Geographical separation of community or interruption of communication		D	Area is already used for landfill operations.	D	Required areas are relatively small.
Historical Heritage/ Cultural properties	Loss and/or devaluation of heritage or cultural properties-- archeological remains, or historical assets	Devaluation of such properties by disposal trucks passing nearby	C	There is a potential that archeological remains would be found, because such discovery is common in the region.	D	Required areas are relatively small and increase in traffic should not be as significant
Water Rights/ Access Rights	Obstruction of water or common access rights		D	Area is already used for landfill operation	D	Required areas are relatively small and should not cause obstructions.
Public Health		Degradation of public health due to wastes fallen from trucks, existence of wastes in an area or proliferation of vermin	B	Although soil cover has been applied to avoid waste littering, the landfill operation is still associated with some littering.	B	Waste removal and cleansing of area should be done according to a strict schedule to avoid impacts.
Waste (from the project)	Generation of construction waste and debris		D	Minimal waste to be generated and disposed of on site	D	Wastes should be transported to landfill
Accident/Risks		Landfill gas explosion, refuse fires, landslides, lateral pressure on land, traffic accident	B	Hazardous wastes need to be controlled to avoid chemical reactions. Landfill design and practice, such as waste covering, should minimize risks. A due distance from physical structures should be kept.	B	Traffic of collection vehicles need to be controlled to avoid traffic accidents both in and out of the site.
Natural Environment						
Topography and Geology	Change in valuable topography and geology due to excavation	Change in valuable topography due to operations	C	Excavation works are required to obtain soil for covering waste.	D	Required areas are relatively small and modifications to topography would not be significant
Soil Erosion	Increase in soil erosion due to land preparation and/or deforestation	Increase in soil erosion during operation	B	Torrential rains can cause erosion of exposed soil	C	Torrential rains can cause erosion of exposed soil, but required areas are relatively small.

Evaluation Items	Possible Cause and Effect		Landfill Expansion (Cerro Patacon Final Disposal Site)		Transfer Stations (unknown)	
	During Construction	During Operation	Rank	Reasons	Rank	Reasons
Groundwater		Change in quality and level of groundwater due to leachate	B	Groundwater hydrology should be understood and a monitoring program should be conducted. It should be noted that the former landfill area may cause groundwater pollution, because there is only a clay liner which might not prevent leachate from leaking into the ground..	B	Control of liquids from wastes and washing areas need to be strictly followed.
Hydrological Conditions	Changes in river discharge and riverbed condition	Changes in river discharge and riverbed condition due to inflow from the site	B	Effluents might reach bigger water bodies, even if creeks are diverted. A monitoring program should be established.	B	Control of liquids from wastes and washing areas need to be strictly followed.
Coastal Zone	Impacts on Coastal Environment	Impacts on Coastal Environment	D	Area is far from Coastal zone	D	Required areas are small and will probably be far from coastal zone.
Fauna and Flora	Obstruction of natural species and extinction of them due to loss of habitat		B	A national park is near the landfill and will animals sometimes cross the area	D	Required areas are too small to cause a major impact on flora or fauna
Meteorology	Changes in temperature or winds	Changes in temperature or winds	D	The scale of the project is not large enough to cause any change in meteorology.	D	The scale of the project is not large enough to cause any change in meteorology.
Landscape/ Aesthetics	Change in landscape	Decrease in aesthetic value due to landfill	B/A	Landfill work will result in a change in landscape	C	Even though required areas are small, they could impact aesthetics
Pollution						
Air Pollution	Deterioration of air quality due to the increased traffic	Deterioration of air quality due to the increased traffic and dust from wastes delivered by trucks, landfill gases, and smoke from operation	B	Landfill should be properly operated to avoid fires, explosions, and control of gases needs to be considered	B	Traffic in areas selected can be expected to increase.
Water Pollution	Deterioration of water quality of surface or ground water due to silt or debris from land preparation	Deterioration of water quality of surface or ground water due to silt and leachate from the site	B	Soil and leachate control measures as well as monitoring need to be established.	B	Control of liquids from wastes and washing area need to be strictly followed.
Soil Contamination		Contamination of soil due to leakage of leachate	B	Leachate control measures need to be established and followed.	B	Control of liquids from wastes and washing areas need to be strictly followed.
Noise and Vibration	Noise and vibration caused by the construction operation	Noise and vibration caused by the operation	D	Sites are distant from major population areas.	B	Traffic and noises will increase near areas selected.
Land Subsidence	Land subsidence due to the land deformation.		D	Subsidence would be limited to selected areas, as the ground of the site is firm.	D	Required areas are too small to cause major subsidence problems.
Offensive Odor		Odor caused by wastes during operation	B	Wastes should be covered by soil.	B	Odors could become disturbing if removal is not conducted on schedule.

11.5.3 Environmental Impact Assessment of the Final Disposal System

a. Environmental Impact and Evaluation

Summary of environmental impact cause by landfill development and evaluation shows below.

Table 11-8: Summary of Impact and Evaluation

Item 1	Item 2	Evaluation
Socioeconomic Environment	Resettlement	No or insignificant impact.
	Economic Activities	There is an impact on economic activities of the waste-pickers and junk dealers.
	Transport	No further impact
	Public Facilities	No impact
	Division of Community	No impact
	Historical Heritage/ Cultural proper	There might be historical heritage
	Water Rights/ Access Rights	No impact
	Public Health	Expected impacts are controllable and large benefits to the public health should be brought
	Waste (from the project)	Negative and long-term impacts could be anticipated, but they will be well controllable.
	Accident/Risks	Negative and long-term impacts could be anticipated, but they will be well controllable.
Natural Environment	Topography and Geology	Long-term impacts could be anticipated, but they will be well controllable.
	Soil Erosion	Negative impacts could be anticipated, but they will be well controllable.
	Groundwater	Negative and long-term impacts could be anticipated, but they will be well controllable.
	Hydrological Conditions	Positive impact on water flow of river
	Coastal Zone	No impact
	Flora and Fauna	Negative and short/mid-term impacts could be anticipated, but they will be remedied at the end.
	Meteorology	No impact.
	Landscape/ Aesthetics	Positive impact in a long-term.
Pollution	Air Pollution	Insignificant negative impacts anticipated, but prevented by control.
	Water Pollution	Negative and possibly long-term impacts anticipated but to be well controlled.
	Soil Contamination	Negative and possibly long-term impacts anticipated but to be well controlled.
	Noise and Vibration	Insignificant negative impact anticipated, but controlled
	Land Subsidence	No impact
	Offensive Odor	Negative impact on limited recipients (site workers) and to be minimized with care.

b. Countermeasures

Summary of countermeasures shows below.

Table 11-9: Summary of Countermeasures

Countermeasures	Effects	Ensured by
Control of Waste Access	Prevention of landfill of unintended waste	Instruction to the workers.
Control of Vehicle Flow	Avoiding congestion of collection vehicles and traffic accidents	Supervision over vehicle movement and instruction to the drivers.
Signboards	Minimizing risks.	Inspection of signboards
Daily Soil Cover	Prevention of odor emission, control of noxious vermin and pathogens, and control of rainfall infiltration.	Supervision of qualified engineers over operation and scheduled supply of material.
Impermeabilization	Prevention of groundwater intrusion into the waste, groundwater and soil contamination with leachate and migration of landfill gas.	Inspection of liner quality, supervision of qualified engineers over secured implementation and water quality monitoring.
Leachate Treatment	Prevention of surface water contamination.	Supervision of qualified engineers over design, construction, secured implementation and water quality monitoring.
Landfill Gas Control	Prevention of unexpected landfill gas migration	Supervision of qualified engineers over design and construction of ventilation wells and monitoring of wells' function.
Reforestation	Avoidance of loss of cover soil, increase in green area, and introduction of a new habitat for wildlife.	Supervision of experienced personnel over reforestation planning and implementation.
Access Control	Avoidance of accidents.	Instruction to the workers and site supervisors.
Safety Surveillance	Prevention of risk for the workers	Instruction to the workers and site supervisors.

c. Monitoring Program

The monitoring program is shown in Table 11-10.

Table 11-10: Monitoring Program

Subject	Monitoring item	Frequency (per year)
Settlement	Elevation of lift(s)	1
Landfill gas	Temperature	2
	CH_4	2
	CO_2	2
	N_2	2
	O_2	2

Monitoring item	Frequency (per year)		
	Leachate	Groundwater	Effluent
Temperature	2	1	1
Color	2	1	1
pH	2	1	1
BOD_5	2	1	1
COD	2	1	1
T-N	2	1	1
T-P	2	1	1
Cl^-	2	1	1
CN	1	1	1
Cd	1	1	1
Cu	1	1	1
Pb	1	1	1
Cr^{+6}	1	1	1
Hg	1	1	1
As	1	1	1

d. Conclusion

In conclusion, the impact as a result of the character of recipients and the type of activities is, therefore, not significantly negative but could be even beneficial for the environment and people, and highly positive for the society.

11.6 Project Evaluation

This section evaluates viability of the priority projects, the Final Disposal Project and the Transfer and Transport Project, from technical, institutional, social, environmental, financial and economic viewpoints.

11.6.1 Technical Evaluation

Technical evaluation herewith gives an assessment whether or not these priority projects are technically practicable, with reference to the present technical capabilities of DIMAUD and technology transfer carried out through the Study.

a. Final Disposal Project

The present landfill of Cerro Patacon has liner system and leachate treatment facilities. All these facilities have been planned, designed and operated by DIMAUD (formerly DIMA) and private companies in the Panama District.

This project will be implemented by the private sector under concession contract. In this situation, roles of DIMAUD are to manage the contract and supervise the operation in order to secure proper final disposal. Knowledge and experiences in construction and operation of sanitary landfill are required for acting these roles. DIAMUD has learned such knowledge and experiences so far through construction and operation of Etapa 1 and 2. Besides, the Landfill Operation Improvement Pilot Project well transferred technologies regarding landfill operation to DIMAUD.

Consequently, it is evaluated that the society of the Panama District has enough capability to design and construct sanitary landfill facilities, and DIMAUD will be able to ensure proper operation of sanitary landfill with their capabilities.

b. Transfer and Transport Project

A transfer station will be constructed in the east of the Panama District, then 85yd^3 tractor and trailer will be employed as waste transport equipment, i.e., the project consists of the transfer station and transport. Introduction of this transfer and transport system will be the first case in the Panama District.

Therefore, the construction of the transfer station will of course be the first case. However, ordinary construction materials and general-purpose construction equipment can set up the transfer station. The construction situation in the Panama District well proves its capability to be able to do so.

85yd^3 trailers, which has about 20 ton of maximum loading capacity, will be installed for the first time in the waste management in Panama District. However, 20ton class trailers and tractors are widely used in other physical distributions and their know-how will be applied to O&M of the 85yd^3 trailers.

Therefore, the Transfer Transport System is judged practicable considering the present technical level of the society of Panama District.

11.6.2 Institutional Evaluation

DIMAUD will be required to manage and supervise concession contract(s) with the private company for implementation of the priority projects. Therefore, the Study provides a guideline to prepare appropriate TOR for the contract(s).

Meanwhile, the M/P gives a concrete direction with various plans and suggestions to strengthen its capability (Institutional Capacity Building).

Consequently, it is evaluated that DIMAUD will be able to implement the priority projects with the institutional plan proposed in the M/P and the TORs.

11.6.3 Social Evaluation

a. Final Disposal Project

It is thought that the project would take away means of living from the waste-pickers and environmental impacts on the neighbouring communities.

The issue of waste-pickers is inevitable for modernization of MSWM. DIMAUD and organizations concerned should take measures not to increase the number of waste-pickers and to create job opportunities. MRF proposed in the M/P may give job opportunities to the waste-pickers where they can get away from the illegal waste picking on the landfill, and move to legal material recovery works with better conditions and improved social positions.

The conceptual design of the priority projects was formulated with taking into account mitigation measures proposed in the EIA against anticipated environmental impacts. Therefore, environmental impacts on the neighboring communities will be enough mitigated.

b. Transfer and Transport Project

The Transfer and Transport Project may cause negative environmental impacts on communities around the transfer station and positive impacts induced by efficient use of collection vehicles.

Regarding the negative impacts, selecting appropriate site and setting up sufficient buffer zone will mitigate them.

Efficient use of collection vehicles will bring about improvement of collection service such as periodical and punctual waste collection, and improve working conditions of workers such as reduction of working hours.

11.6.4 Environmental Evaluation

a. Final Disposal Project

The EIA evaluated that the project has a potential to cause negative environmental impacts, however, such negative impacts can be minimized by environmentally appropriate design, construction and operation with taking into account the proposed countermeasures. Meanwhile for the whole Panama District, the project bring about positive environmental impacts.

b. Transfer and Transport Project

EIA is not carried out for the project, because a site for the transfer station is not confirmed. However, Initial Environmental Examination was carried out, which provides information of potential environmental impacts caused by introduction of a general transfer and transport system.

The environmental impacts that may be caused by the project will be minimized with environmentally appropriate design, construction and operation with taking into account issues pointed out by the IEE.

11.6.5 Financial Evaluation

It was found that large deficits in DIMAUD's cash flow would happen in case that the priority projects are carried out directly by DIMAUD. Then, it was recommended for consigning the implementation of the priority projects to the private sector under concession contract in order to overcome the financial deficits.

From a viewpoint of DIMAUD, it was evaluated in the M/P that such concession contract would be financially feasible. The financial analysis conducted in the F/S also concluded that the concession contract would be financially feasible for contractor(s) as shown in Table 11-11.

Table 11-11: Results of Financial Analysis

Case	FIRR (%)
Landfill	5.2
Transfer transport system	3.5
Landfill and Transfer transport system	4.9

The FIRRs in the table do not exceed annual interests set by commercial banks in Panama, that is about 9.5%. However, those FIRRs are over 1.8% of annual interest used in the Study, which takes into consideration risks on interest rates set by international financial institutions, such as LIBOR.

Consequently, it is evaluated that the implementation of the priority projects will be financially feasible under concession contract. International tender should be held, in which private companies that are capable to procure the international fund can participate.

11.6.6 Economic Evaluation

Willingness to Pay (WTP) of the citizens to MSWM obtained from POS is considered as benefit, as well as for the economic evaluation of the M/P.

a. Final Disposal Project

Table 11-12 presents 1.215 of Benefit-Cost Ratio (B/C) and 8.9% of Economic Internal Rate of Return (EIRR) resulted from calculation with the benefit and costs required for the project. Consequently, it is evaluated that the project will be economically feasible.

Table 11-12: Cost and Benefit (Final Disposal Project)

		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Cost	Investment (Exc. TAX 5%)	134	9,087	291	19,720	325	21,944	8	484	0	0	0	0	51,993
	O & M	0	2,946	2,946	2,946	2,946	2,946	2,946	2,946	3,604	3,604	3,604	3,604	35,038
	Total	134	12,033	3,237	22,666	3,271	24,890	2,954	3,430	3,604	3,604	3,604	3,604	87,031
Benefit	Disposal amount (ton/year)	0	0	262,276	535,966	551,004	567,393	582,102	597,943	613,930	631,414	649,189	668,096	
	Willingness to pay (U$1,000)	0	0	4,899	10,012	10,293	10,599	10,874	11,170	11,468	11,795	12,127	12,480	105,717
	Balance	-134	-12,033	1,662	-12,654	7,022	-14,291	7,920	7,740	7,864	8,191	8,523	8,876	
													EIRR	**8.9%**
													B/C	**1.215**

b. Transfer and Transport Project

Table 11-13 presents 1.251 of Benefit-Cost Ratio (B/C) and 17.5% of Economic Internal Rate of Return (EIRR) resulted from calculation with the benefit and costs required for the project. Consequently, it is evaluated that the project will be economically feasible.

Table 11-13: Cost and Benefit (Transfer and Transport Project)

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Waste amount (1000ton)			57	78	105	111	117	126	135	144	153	162	171	1,359
Cost (U$1000)														
Invest (ex. 5% tax)	64	2951	1577	728	2087	324	85	1098	896	902	526	305	1643	13,186
O&M	0	0	944	1,360	1,502	1,648	1,703	1,814	1,955	2,011	2,151	2,206	2,350	19,644
Total	64	2,951	2,521	2,088	3,589	1,972	1,788	2,912	2,851	2,913	2,677	2,511	3,993	32,830
Benefit (U$1000)														
WTP			1,723	2,358	3,174	3,356	3,537	3,809	4,081	4,353	4,625	4,897	5,169	41,083
Balance	-64	-2,951	-798	270	-415	1,384	1,749	897	1,230	1,440	1,948	2,386	1,176	8,253
													EIRR	17.5%
													B/C	1.251

11.6.7 Total Evaluation

As mentioned so far, it is concluded that the implementation of the priority projects will be feasible from technical, institutional, social, environmental, financial and economical viewpoints.

It should be noted that SWM should be considered as a total system. Achieving balance among SWM components is crucial, e.g., between collection and intermediate treatment, and technical system and institutional system.

In order to make the implementation of the priority projects viable, there are two important issues. The first one is to maintain the financial state of DIMAUD soundly, which can be

achieved through income increase by the special collection service for ICI and cost reduction in collection works by employing the knowledge and experiences obtained in the pilot project. The second one is to appropriately supervise the concession contract(s) with the private sector, which can be attained by strengthened institutional capacity of DIMAUD with experiences and knowledge obtained through the pilot projects and the institutional plan proposed in the M/P

Consequently, it can be said that implementation of the proposed improvement measures in the M/P integrally will ensure the viability of the priority projects.

12 Conclusions and Recommendations

12.1 Conclusions

1. Present Situation

Panama District, which has a population of about 744,000 as of 2002, is kept clean. The results of Public Opinion Survey (POS) curried out in the Study clarified that about 70% of the citizens (very satisfied 31%, satisfied 39%) are satisfied with the present Solid Waste Management. This is considered due to efforts of DIMAUD (Municipal Bureau for Urban and Household Cleansing) and organizations/persons concerned, and is highly appreciated.

However, large costs are required for waste collection and street sweeping in order to maintain the city cleanly. It is difficult to say that such works are efficient. If the inefficient works lower collection service quality in the future, the citizens' satisfaction would also lower; the citizens who answered "satisfied," would change "not satisfied."

About 1,200 ton of waste is disposed of at Cerro Patacon Landfill everyday. 80% of it is from Panama District. Medical and industrial wastes are included in the waste brought in. The waste is compacted by heavy equipment, but daily cover soil is not practiced strictly. Furthermore, there are many waste-pickers working inside the landfill, then, it reduces the landfill operation efficiency.

Meanwhile, large quantity of waste from business establishments is assumed as household waste and applied the tariff for household, i.e., waste collection fee per unit of those wastes are same or lower than of household. This is against the Polluter-Pay-Principle (PPP), as well as it reduces DIMAUD's revenue and makes its management unstable.

2. Master Plan

The principal goal of the Master Plan is to establish a sound Solid Waste Management System by the target year 2015 in Panama District, which practically aims to promote the citizens' well-being, to implement sustainable SWM and to contribute to environmental conservation.

Maintenance and improvement of the city's cleanliness and establishment of cost-effective SWM will lead to promotion of the citizens' well-being. Sustainable SWM will be established through Institutional Capacity Building (ICB). And, encouragement of waste reduction, reuse and recycling with environmental education will contribute to environmental conservation.

These issues are not achieved by only DIMAUD's effots. Those can be realized under where the citizens and the SWM executing bodies cooperate each other. The Municipal Ordinance proposed in the Study defines responsibilities and roles of actors, such as dischargers, DIMAUD and the private sector. It is expected that the actors will cooperate each other under the legal framework set by the Municipal Ordinance in order to realize the Sound SWM. For encouraging cooperation from the citizens, it is crucial to carry out educational campaign such as environmental education. Educational methods/skills and materials transferred to the Panamanian side through implementation of the Environmental Education Pilot Project will secure expansion of environmental education and its effectiveness after the Study.

As for the waste collection work, it is important to improve its efficiency without reduction of the service quality. The Collection Improvement Pilot Project transferred skills and knowledge how to do so. It is expected that DIAMUD will expand the pilot project to other areas based on the experience.

As for the final disposal, DIMAUD can improve the landfill operation by adapting cell methods transferred to them through the Landfill Operation Improvement Pilot Project.

At present, hazardous waste is mixed with non-hazardous municipal waste. Facilities to deal with hazardous waste are required to dispose of such mixed waste properly. In this case, costs per ton of waste for construction and O&M of such facilities will surely be much higher than facilities for non-hazardous waste. Then, such costly facilities are not recommendable. In principle, generators should appropriately dispose of their hazardous waste by themselves. However, taking into account the present situation, it is recommendable to properly separate the hazardous waste and to set up a facility for only hazardous waste in the Cerro Patacon Final Disposal Site apart from the proposed landfill for non-hazardous waste.

The issue of waste-pickers is typical in developing and intermediately developed countries. This is usually solved by economic growth that creates job opportunities and by efforts of organizations and persons concerned, but it takes for a long period. Measures that should be taken against this issue in Panama are to control waste-pickers activities hampering the landfill operation and to establish rules of waste picking with taking into account their safety.

As for leachate from the landfill, the existing treatment system cannot meet with the standard set by ANAM, then, the M/P recommends a methods that suites to it.

In views of PPP and DIMAUD's management state, origins and amounts of wastes from business establishments should be clarified and appropriate tariff should be applied for the wastes. In this case, the business establishments need to pay more than before. In order to

induce them to do so, a special collection service that meets with their needs shall be provided.

3. Feasibility Study

Out of the projects and improvement measures proposed in the M/P, the Final Disposal Project and the Transfer and Transport Project are selected as the priority projects for the Feasibility Study and the Pre-feasibility Study from viewpoints of importance and urgency.

It was evaluated that those priority projects would not cause serious technical and social problems. However, it was found that large deficits would happen in the DIMAUD's cash flow, if the priority projects are implemented directly by DIMAUD. Then, the Study recommends to make good use of the private sector in a scheme of concession contract. Open market rates in Panama are considerably high, about 9.5% annually. However, some international banking institutions provide lower interest rates. For example, JBIC, or Japan Bank for International Cooperation, has a financing scheme named as Overseas Investment Loans, which lends money at lower interest rates, e.g., LIBOR plus 0.4 to 0.5%, to Japanese companies or joint ventures of Japanese and local companies. Consequently, it is recommendable to hold an international tender, in which foreign and/or joint companies including from Japan can participate, in order to make DIAMUD's cash flow stable for provision of sound SWM.

4. Cost-Benefit Ratio

1.002 of Cost-Benefit Ratio was obtained by dividing WTP of the citizens for SWM by the total costs for implementation of the all project proposed in the M/P (inc. cost reduction), as shown in the table below.

Total Cost (Cost, U$1,000)	Willingness to Pay (Benefit, U$1,000)	Benefit / Cost
438,206	438,905	1.002

Consequently, it can be said that the society of Panama will be able to bear the costs incurred by implementation of the M/P during 2003 and 2015 as well as achievement of the M/Ps goal.

12.2 Recommendations

1. DIMAUD´s Vision and Mission

The population of the District deserves a Great City; that is the vision of the Mayor´s office and the Municipality. DIMAUD´s vision forms part of standards of life that is being pursued and has the purpose to recover the nickname of "golden cup" for Panama City which used to distinguish this city due to the ornate and cleansing of its roads and public areas.

Within this vision, DIMAUD has a mission that is to implement a sustainable solid waste management to promote the well-being of citizens through the protection of their health and the preservation of the environment.

The Master Plan submitted to the authorities proposes various improvement measures. Of course, DIMAUD will be able to fulfill its mission through implementation of the M/P.

The execution and successful finalization of the M/P depends on the degree of willingness of the Panamanian side, especially DIMAUD.

2. SWM: a public service

A public service should be effective and also efficient. Effectiveness is linked to the attainment of objectives and efficiency is linked to the results.

The main objectives of DIMAUD are linked to two factors, i.e., health and the environment. Both of them are social goods which can be immediately deteriorated if SWM is ineffective. The costs of health service is extremely high for the society; and environmental deterioration is, in cases, irreversible. DIMAUD and competent institutions should join efforts under the principle that it is preferable to invest in public services than to pay the costs for negative externalities derived from deficient SWM.

Effectiveness of the service should be measured based on how diseases linked to deficient solid waste management are being controlled, the preservation of the environment, and better use of the natural resources.

A healthy city has a clean city image. We are going on the right path.

3. Service sustainability: a need

If we are already effective; now, we should be efficient. The M/P could be a guide if the proposed decisions are taken. As a public service which should be provided along the time with quality and efficient costs, it is necessary to structure SWM service with a long term vision. The M/P has a target year set as 2015.

4. Institution

The city is a kind of organizations in which the citizens conduct their activities. Every organization needs “rules of game”, i.e., institutions.

The current legislative period of the Honorable Municipal Council is considering a project of legislation which has, as main purpose, the regulation of the relations between the Municipality, its clients and the private sector. It is necessary that the service has a normative which regulates its operation. It will be the first step to establish responsibilities, duties, and rights of the main actors. Subsequently, the normative could be perfected through the experience attained.

If all actors fulfill their responsibilities, the health and the environment will be protected. At this point, the effective coordination among the competent authorities is of vital importance.

5. Organization

The M/P incorporates a proposal to adjust the organizational structure of DIMAUD. The adjustments are directed to obtain as much synergy as possible among the different administrative units. If we keep in mind that DIMAUD has a social mission to satisfy and objectives to attain, it is necessary that all activities are directed to satisfy that mission and to attain those objectives. As a result, teamwork will be strengthened a matter of course.

The top management has decided to initiate these adjustments which should be permanently evaluated in the face of the operational changes that are also being proposed. Readjustments should be implemented as they are needed.

The experience obtained through the adjustment of the organizational structure will be highly valuable to evaluate the possibility to create a new municipal enterprise for Solid Waste Management for the District. The proposed structure in the M/P corresponds to a kind of enterprise structures. An organization of this type would strengthen the sustainability of the service because it would incorporate long-term planning. Additionally, technical, organizational, and financial capacities can be integrated. A successful example which can be analyzed is the case of the Urban Planning and Research Institute of Curitiba Municipality. This is a municipal enterprise which is world-famous. This way, independence from politics can be attained.

6. Planning

The M/P incorporates planning as a routine task during the development of DIMAUD´s activities. It is necessary to know the direction, the means, and the cost.

Establishment of the Executive Unit would be highly beneficial to plan the attainment of the objectives defined for the entity and the strategies of the top management. The M/P provides a detailed listing of activities to be undertaken by the Executive Unit.

It should be emphasized the need to assign a personnel having enough knowledge and experiences in the SWM sector on a full time basis to integrate various activities assigned to the Executive Unit. The results of the service provision will be linked to the performance of this team.

DIMAUD´s Executive Unit will only be the second unit formed under JICA´s SWM Studies. It is highly recommendable to create a network of executive units on solid waste management which would interact between them. The first unit successfully working is the Planning Office for the Metropolitan Area of San Salvador (OPAMSS).

Monitoring and control of management is a tool for the sustainability of the service. The top management has decided to organize an administrative unit for the control of management as proposed in the M/P. The JICA Study has equipped this unit and the personnel have received training material. The following step would be establish an accounting system which is able to clarify costs of respective activities. With the previous activity, management indicators such as collection cost per ton of waste will be prepared which would be sent to the appointed officers.

Every customer service activity should be personalized. The characteristic of the SWM service requires an active participation of the client in particular and of the public in general. Success in providing the service largely depends on an effective coordination and support between the different actors: DIMAUD and its clients. The M/P introduces a policy of customer service which should be implemented and intensified.

Consequently, the top management has decided to organize an administrative unit for Customer Attention which is formed by S.O.C.I.O., Public Relations and Quality Control sections. The activities to be developed are diverse, but complementary. Teamwork is fundamental i.e., an effective coordination will be of vital importance.

On DIMAUD´s part, the communication system in solid waste management has been organized by creating an administrative unit for customer service. Additionally, the 800ASEO service has been expanded and improved. Now, S.O.C.I.O should be strengthened to complement the communication system.

S.O.C.I.O should promote the constitution of the Committees for Cleansing and Ornate. The Honorable Representatives of the Corregimiento in the District should be informed about the

results which are being obtained in Juan Diaz and Rio Abajo corregimientos in order to include these experiences in their respective corregimientos.

7. Minimization

The Panama District should conduct every effort to encourage waste minimization which is one of the main policies of the M/P.

In this effort, all actors should participate: the customer, the commerce, the industries, the NGO´s, the public entities. All of them should receive DIMAUD´s message: to minimize waste generation.

In order to attain this objective of the policy, DIMAUD should continue the education campaign that initiated in some schools in the Environmental Education Pilot Project. Excellent educational materials are available which should be used rationally and should be reproduced whenever it is necessary. The materials should be delivered to all schools in the District. The goal is to promote public participation in waste minimization activities.

Several schools have joined the recycling program "Cumple tu papel". The program should reinitiate at the beginning of the next school year (2003). DIMAUD should support, strengthen, and expand this program as a manner to promote minimization and education to preserve the environment and conservation of the natural resources.

The private sector should assume its responsibility on generating large amount of waste. This practice is transforming a private cost into a social cost. "Polluters Pay Principle are not well practiced in the Panamanian environmental arrangement. The participation of the private sector is of vital importance to stop the continuous waste generation increment.

The multi-national companies which operate in Panama could transfer their experience, procedures, and practices to minimize solid wastes which are implemented in their respective countries and can become true allies in this crusade. It is necessary to convoke them and motivate their interest.

8. Operations

The operation of the services is the most important activity conducted by DIMAUD. The effectiveness in their performance is a parameter which serves to qualify DIMAUD. However, it is necessary to attain efficiency in the service in order to make SWM sustainable.

The M/P proposes to adjust the organizational structure of DIMAUD in order to improve the efficiency through the integration of all the operations into a single administrative unit: the Operations Department. DIMAUD´s top management has considered convenient this proposal and it has been approved.

It is expected for the Operations Department to achieve a better quality in service and a significant reduction in costs, i.e., to do more with less costs.

9. Collection and Maintenance

During the year 2001, the collection service represented 53% of total expenditures. The Collection Improvement Pilot Project showed that efficiency levels, which are competitive in the Latin-American market, can be attained. The direct costs of labor and associated to vehicle were reduced in about 21% which represents approximately 10% of total collection costs.

Currently, the improvement of two routes has initiated by making use of the Manual of Procedures to Optimize the Routes in the pilot project. If this improvement practice is expanded to the other routes, around of U$.1.4 millions/year could be saved.

Now, DIMAUD has a digitalized map which could be used for planning and optimization of collection routes.

The top management of DIMAUD has decided to organize a Collection Special Service for ICI's (for institutional, commercial, and industrial clients). The wastes collected by DIMAUD from ICI's clients represent about 50% of the total amount of solid wastes.

The participation of ICI's clients in the total income of DIMAUD could increase if the service meets with needs of ICI's.

The M/P includes a strategic procedure to implement this special collection service and DIMAUD could and should initiate procedures to organize it and provide it.

The maintenance activities are linked to the collection activities. The procedures that are used for maintenance should follow necessarily the instructions provided by the manufacturer. The formalities for the procurement of spare parts should be simplified to a minimum.

10. Street Sweeping

With taking into account the present situation, mechanical street sweeping should be incorporated in the roads in the future.

The deployment of waste bins for pedestrians along the roads is part of a program to provide the city with urban furniture which should contribute to keep clean the roads and public areas. This deployment should be continued with taking into consideration DIMAUD's technical input to improve the street sweeping performance.

11. Transfer

DIMAUD should implement the Transfer and Transport Project. The pre-feasibility study should be taken as a base for this purpose. As a priority and due to the urbanization process, the Municipality should consider the acquisition of land which will be necessary for a transfer station.

12. Final Disposal

The M/P has given a significant importance to the final disposal.

The plan to give in concession to the private sector the sanitary landfill operation should be proceeded by taking as a base the M/P feasibility study.

However, some limitations have been detected during the concession process. Among these limitations, there are land ownership issues, San Miguelito Municipality solid waste discharge, and extraction of materials in the operation areas. In order to have a high participation of bidders, it is convenient that those limitations have been overcome at the beginning of the bidding process.

13. Commercialization

The clients database should be completed and updated with the tools provided by General Controller Office (the District database and digitalized map).

The identification of ICI´s clients should be prioritized in order to initiate the Special Collection Service for ICI´s.

The 800ASEO system should be expanded and strengthened. This system will be of great value to support a telephone marketing program which is directed to the new service for ICI´s clients. In the M/P, a scheme is presented which will serve to develop this telephone marketing program to support the activities by the Commercialization Department.

14. Finances

A cash flow projected until 2015 is presented in the M/P. DIMAUD should continue working with these figures and should adjust them to the variations which might occur in the financial sector. Fund requirements should be foreseen well in advance.

The new Management Unit should provide information about the performance of the entity. Management indicators should be used to monitor the performance levels. The efficiency levels projected can be attained if any deviation from them is corrected on time as they occur.

15. Human Resources

The adjustment of the administrative structure which was approved requires an extensive training program. The need to provide training has been detailed in the description of every administrative unit. A continuous training program is essential to achieve an improvement in the performance of the human resources in the whole entity.

The worker should be protected from labor accidents and professional diseases. Coordination with Caja del Seguro Social (Social Security Institution) is essential in occupational health, and medical and emotional attention.

The self-esteem of workers should be developed through a well structured program. A day dedicated to the cleansing workers should be established as an important sign of appreciation from the city to the workers.

16. Organizational Environment

The approval of the Cleansing Regulation (Municipal Ordinance), the definition of objectives for the entity, the adjustment of the organizational structure, and the implementation of the Master Plan requires an extensive and detailed explanation to all members of the working community in DIMAUD.

It is necessary to generate a team work spirit in order to increment the synergy and improve the performance. Similarly, a policy to recognize the work done and to provide incentives and rewards for the workers should improve the organizational environment.

Last Words

We thank the municipality and DIMAUD authorities, as well as the technical and operative personnel who work in those entities because they have helped us to conduct and finalize successfully, in a joint effort, this Study.

We acknowledge the Panamanian C/P for their permanent support and interest in this endeavor.

The learning experiences acquired in this new way to conduct and develop the technical assistance will be of great value for us in future undertakings.