

10.4.6 Overall Cost

a. Implementation plan

Project implementation plan is shown below. The overall cost will be calculated based on this implementation plan.

Table 10-52 : 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			

b. Overall cost

Overall costs for new facilities, which include implementation of the separate collection and installation of facilities proposed in the M/P, are shown below.

Table 10-53 : Overall Cost (1)

unit : US\$1,000

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2,015	Total
Separate Collection															
Investment															
Purchase collection vehicle	0	0	0	0	0	89	179	268	178	355	355	356	533	534	2,847
Investment total	0	0	0	0	0	89	179	268	178	355	355	356	533	534	2,847
O&M	0	0	0	0	0	206	418	625	418	831	831	831	1,242	1,249	6,651
Total	0	0	0	0	0	295	597	893	596	1,186	1,186	1,187	1,775	1,783	9,498
Transfer system															
Investment															
Land acquisition			346												346
Design supervision &		67	67			55									189
Capital			2,693			1,821									4,514
Total	0	67	3,106	0	0	1,876	0	0	0	0	0	0	0	0	5,049
O & M				211	211	211	270	270	270	270	270	270	270	270	2,793
Total	0	67	3,106	211	211	2,087	270	270	270	270	270	270	270	270	7,842
Transport															
Tractor (300-350hp)				356	89	89	89	0	0	89	356	178	89	178	1,513
Trailer (85 yd ³ , 20 ton)				326	54	54	163	0	0	54	326	109	54	217	1,357
Investment total	0	0	0	682	143	143	252	0	0	143	682	287	143	395	2,870
O&M (w/o personnel)				66	82	99	115	115	115	132	132	148	148	165	1,317
Personnel				56	70	84	98	98	98	112	112	126	126	140	1,120
O&M (w/o personnel)				7	8	9	12	12	12	13	13	14	14	16	130
O&M total	0	0	0	129	160	192	225	225	225	257	257	288	288	321	2,567
Total	0	0	0	811	303	335	477	225	225	400	939	575	431	716	5,437
Transfer system total	0	67	3,106	1,022	514	2,422	747	495	495	670	1,209	845	701	986	13,279
MRF (Cerro Patacon)															
Investment															
Land acquisition					0										0
Design supervision &				20	20	32	32	47	47	47	47	21	21		334
Construction					150		252		378		378		171		1,329
Equipment					630		1,008		1,512		1,512		681		5,343
Total	0	0	0	20	800	32	1,292	47	1,937	47	1,937	21	873	0	7,006
O & M						40	40	105	105	202	204	301	301	345	1,643
Total	0	0	0	20	800	72	1,332	152	2,042	249	2,141	322	1,174	345	8,649

Table 10-54: Overall Cost (2)

unit : US\$1,000

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2,015	Total
Landfill (Cerro Patacon)															
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	0	0	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	0	0	75	5,210	135	135	135	135	135	135	135	135	135	135	6,635
Investment total	0	0	141	9,541	306	20,706	341	23,041	8	508	0	0	0	0	54,592
O & M total	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	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

Table 10-55: Overall Cost (3)

unit : US\$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

c. Total Overall Cost

Total overall costs, which include implementation of the separate collection, installation of facilities and improvement current landfill system proposed in the M/P, are shown below.

Table 10-56: Total Overall Cost

Unit : US\$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

d. Incremental Cost

The separate collection and the MRF are new projects. The required costs presented so far are incremental to the costs of the existing system.

However, there exists the final disposal system that requires a certain amount of costs at present. Therefore it is necessary to clarify incremental costs incurred by the new landfill project to analyze its validity from financial and economic aspects that will be carried out later. This incremental cost can be obtained by subtracting the cost required for the existing system (base cost) from the cost required for the new project.

Meanwhile, it is expected that the transfer and transport system will bring cost reduction in collection works. Therefore, incremental costs have to count such cost reduction.

This section presents incremental costs incurred by implementation of the Master Plan with taking into account the aforementioned.

d.1. Base Cost

Table 10-57 shows cost per ton of waste according to respective activities in 2001 based on the financial report of DIMAUD and the final disposal amount at the Cerro Patacon Landfill. The cost required for the existing landfill (base cost) is US\$ 6/ton.

Table 10-57: MSW Unit Cost in 2001

2001 disposal amount		433,027.62ton/year	
Item	2001 cost (U\$/year)	Unit cost for disposal amount (U\$/ton)	Share
Administrative	3,935,387.98	9.088	18.1%
Collection	10,090,778.29	23.303	46.4%
Maintenance	1,488,635.78	3.438	6.8%
Landfill	2,612,096.64	6.032	12.0%
Sweeping	3,047,337.99	7.037	14.0%
Landscaping	580,310.37	1.340	2.7%
Total	21,754,547.05	50.238	100.0%

d.2. Effect of Transfer and Transport System

Table 10-58 presents cost reduction by introduction of the transfer and transport system.

Table 10-58: Cost Effect of Transfer and Transport System

unit : US\$ 1,000

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	total
Without T&S system	0	0	0	2,687	1,962	2,649	2,300	3,838	3,000	3,672	3,127	4,735	3,896	4,596	36,462
With T&S system	0	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
Cost effect	0	67	3,106	-83	164	1,050	-311	-2,046	-30	-774	-167	-2,030	-1,369	-517	-2,940

Introduction of the Transfer and Transport System will bring cost reduction of US\$2,940,000 by year 2015. The system will operate from 2005. Between 2005 and 2015 the system will deal with about 1,390,000 ton of waste. That is, US\$2.116 per ton of waste is reduced. Based on these figures, Table 10-59 presents the cost reduction of each year.

Table 10-59: T/S handling Amount and Saving Cost

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
T/S handling amount (ton/year)	0	0	0	87,710	95,265	102,419	109,281	116,618	124,283	132,459	141,182	150,234	159,907	170,090	1,389,448
															Unit cost (U\$/ton)
Saving cost (US\$1,000)	0	0	0	-185	-202	-217	-231	-247	-263	-280	-299	-318	-338	-360	-2,940

d.3. Total Incremental Cost

Table 10-60 shows the total incremental cost incurred by implementation of the Master Plan. Table 10-61 presents incremental cost per ton of disposal waste. Both costs per total disposal amount and per disposal amount originating from only Panama District are shown as the Cerro Patacon Landfill receives waste originating from other than Panama District.

Table 10-60: Incremental Cost

unit : US\$1,000

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Total cost	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
Landfill base cost	0	-2,742	-2,848	-2,966	-1,531	-3,216	-3,306	-3,404	-3,493	-3,588	-3,684	-3,788	-3,895	-4,009	-42,470
Incremental cost (1)	0	10,567	6,047	15,509	4,746	23,405	2,837	24,303	2,774	2,151	4,636	2,350	3,539	2,889	105,753
Collection cost for T/S effect	0	0	0	-185	-202	-217	-231	-247	-263	-280	-299	-318	-338	-360	-2,940
Incremental cost (2)	0	10,567	6,047	15,324	4,544	23,188	2,606	24,056	2,511	1,871	4,337	2,032	3,201	2,529	102,813

Table 10-61: Unit Incremental Cost for Landfill Amount

unit : US\$/ton

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average
For whole disposal amount	0.00	23.12	12.74	31.37	9.17	43.67	5.15	42.83	4.77	3.60	7.55	3.72	5.45	4.32	13.59
For disposal amount from Panama	0.00	29.10	16.10	39.89	11.74	56.40	6.70	56.20	6.31	4.81	10.20	5.08	7.51	6.02	17.89

e. 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 10-62.

Table 10-62: Examine Case 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

e.1. Fund-raise Conditions

The required costs for the facilities construction presented so far include financial charges such as for borrowing money for a short term. However, financial charges that would be required to the private sector for financing for a long term is not included. Although conditionality for financing is depending on banking establishments, typical conditionality

for international financing affairs set by Japan Bank for International Cooperation (JBIC) is applied for the consideration herewith. The conditionality is shown in Table 10-63.

Table 10-63: Interest of JBIC Investment Credit

		Yen loan	Foreign currency loan	Loan amount
Annual interest rate	Normal	1.4 %	LIBOR + 0.4375%	60 to 70%
	Special	0.75 to 1.10%	LIBOR to LIBOR+0.25%	

LIBOR : 6 month rate of US\$ London International Bank Offer Rate

Meanwhile, LIBOR (London International Bank for Offer Rate) for 6 month financing in November 2002 was 1.43%. With this 1.43% and the table above, 1.68 to 1.8675% is obtained. Taking into account the interest rates of JBIC and LIBOR, the consideration will use 1.8% and borrowed money is set as 70% of necessary expenses. Table 10-64 summarize the conditionality employed in the consideration.

Table 10-64: Loan Conditions

Annual interest rate	1.8 %
Own fund	30 %
Borrowed	70 %

e.2. Borrowing and Repayment Plan

With the conditionality, repayment by a contractor to a bank and payment by DIMAUD to the contractor are presented in the following tables for each project, the Final Disposal System, Transfer and Transport System and Material Recovery Facility.

Table 10-65: Borrowing Condition for Landfill

Total cost (US\$ 1,000)	116,797
Own fund (US\$ 1,000)	35,039
Borrowed (US\$ 1,000)	81,758
Annual interest	1.8%

Table 10-66: Repayment Plan of Concessionaire for Landfill

Unit : US\$1,000

	Total	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Compound value	92,427	7,110	7,110	7,110	7,110	7,110	7,110	7,110	7,110	7,110	7,110	7,110	7,110	7,110
Capital	81,758	5,638	5,740	5,843	5,948	6,055	6,164	6,275	6,388	6,503	6,620	6,739	6,861	6,984
Interest charge	10,669	1,472	1,370	1,267	1,162	1,055	946	835	722	607	490	371	249	126
Outstanding amount	81,758	76,120	70,380	64,537	58,589	52,534	46,370	40,095	33,707	27,204	20,584	13,845	6,984	0
Total required fund	127,466													

Table 10-67: DIMAUD Repayment Plan for Landfill

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Landfill amount (ton/year)	456,980	474,719	494,320	517,424	535,966	551,004	567,393	582,102	597,943	613,930	631,414	649,189	668,096	7,340,480
DIMAUD payment (US\$ 1,000/year)	7,935	8,243	8,584	8,985	9,307	9,568	9,853	10,108	10,383	10,661	10,965	11,273	11,601	127,466

Table 10-68: Borrowing Condition for Transfer System

Total cost (US\$ 1,000)	13,279
Own fund (US\$ 1,000)	3,984
Borrowed (US\$ 1,000)	9,295
Annual interest	1.8%

Table 10-69: Repayment Plan of Concessionaire for Transfer System

Unit : US\$1,000

	Total	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Compound value	10,418	868	868	868	868	868	868	868	868	868	868	868	867
Capital	9,295	701	713	726	739	753	766	780	794	808	823	838	852
Interest charge	1,123	167	155	142	129	115	102	88	74	60	45	30	15
Outstanding amount	9,295	8,594	7,881	7,155	6,416	5,663	4,897	4,117	3,323	2,515	1,692	852	0
Total required fund	14,402												

Table 10-70: DIMAUD Repayment Plan for Transfer System

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Landfill amount (ton/year)	87,710	95,265	102,419	109,281	116,618	124,283	132,459	141,182	150,234	159,907	170,090	1,389,448
DIMAUD payment (US\$ 1,000/year)	909	987	1,062	1,133	1,209	1,288	1,373	1,463	1,557	1,657	1,763	14,401

Table 10-71: Borrowing Condition for MRF

Total cost (US\$ 1,000)	8,649
Own fund (US\$ 1,000)	2,595
Borrowed (US\$ 1,000)	6,054
Annual interest	1.8%

Table 10-72: Repayment Plan of Concessionaire for MRF

Unit : US\$1,000

	Total	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Compound value	6,669	667	667	667	667	667	667	667	667	667	666
Capital	6,054	558	568	578	589	599	610	621	632	644	654
Interest charge	615	109	99	89	78	68	57	46	35	23	12
Outstanding amount	6,054	5,496	4,928	4,350	3,761	3,162	2,552	1,931	1,299	653	0
Total required fund	9,264										

Table 10-73: DIMAUD Repayment Plan for MRF

	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Landfill amount (ton/year)	4,271	8,760	13,505	23,178	33,398	44,129	55,517	67,525	81,030	331,313
DIMAUD payment (US\$ 1,000/year)	119	245	378	648	934	1,234	1,552	1,888	2,266	9,264

e.3. Overall Cost

Required funds to DIMAUD for each case are summarized in the following tables.

Table 10-74: Case 1(Concession for Landfill)

Unit: US \$ 1,000

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Existing cost	20,218	21,001	21,868	24,463	23,802	24,564	25,394	26,249	27,163	28,105	29,121	30,166	31,282	333,396
DIMUD direct operation	67	3,106	1,042	1,314	2,789	2,676	1,540	3,133	2,105	4,536	2,354	3,650	3,114	31,426
Concession	7,935	8,243	8,584	8,985	9,307	9,568	9,853	10,108	10,383	10,661	10,965	11,273	11,601	127,466
New investment total	8,002	11,349	9,626	10,299	12,096	12,244	11,393	13,241	12,488	15,197	13,319	14,923	14,715	158,892
Total	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

Table 10-75: Case 2 (Concession for Landfill and Transfer System)

Unit: US \$ 1,000

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Existing cost	20,218	21,001	21,868	24,463	23,802	24,564	25,394	26,249	27,163	28,105	29,121	30,166	31,282	333,396
DIMUD direct operation	0	0	20	800	367	1,929	1,045	2,638	1,435	3,327	1,509	2,949	2,128	18,147
Concession	7,935	8,243	9,493	9,972	10,369	10,701	11,062	11,396	11,756	12,124	12,522	12,930	13,364	141,867
New investment total	7,935	8,243	9,513	10,772	10,736	12,630	12,107	14,034	13,191	15,451	14,031	15,879	15,492	160,014
Total	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

Table 10-76: Case 3 (Concession for Landfill, Transfer System and MRF)

Unit: US \$ 1,000

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Existing cost	20,218	21,001	21,868	24,463	23,802	24,564	25,394	26,249	27,163	28,105	29,121	30,166	31,282	333,396
DIMUD direct operation	0	0	0	0	295	597	893	596	1,186	1,186	1,187	1,775	1,783	9,498
Concession	7,935	8,243	9,493	9,972	10,488	10,946	11,440	12,044	12,690	13,358	14,074	14,818	15,630	151,131
New investment total	7,935	8,243	9,493	9,972	10,783	11,543	12,333	12,640	13,876	14,544	15,261	16,593	17,413	160,629
Total	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

Table 10-77: Overall Cost

Unit: US \$ 1,000

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total	Unit cost (US\$/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

10.5 Evaluation of Master Plan

10.5.1 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, 85yd³ trailers will be installed.

85yd³ 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 planned 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 than 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.

10.5.2 Financial Evaluation

This section describes results of the following financial considerations regarding the M/P.

1. Financial situation of DIMAUD without the M/P
2. Financial situation of DIMAUD with the M/P
3. Implementation options: for finding an option that achieves sound financial condition of DIMAUD
4. Burden of solid waste services on household income: for checking Ability to Pay of households for solid waste services

5. Financial viability: for confirming financial viability of the M/P with Financial Internal Rate of Return (FIRR) and sensitivity analysis.

a. Without Master Plan

Under “Without Master Plan” or “Do Nothing” case, cash flow was estimated on the basis of projections of 2001 and 2002 situations. Highly sensitive to variations in income and expenses, cash flow is estimated to become negative anytime within the planning period 2003-2015, probably around 2007. Sufficient attention should be paid to the fact that once the DIMAUD financial balance becomes negative, the situation gets worse every year, that is, the shortage of income over expenses widens year by year.

Table 10-78: Financial Situation without Master Plan

Year	Total Income (\$million)	Total Cost (\$million)	Cash Flow (\$million)
2003	24.4	23.0	1.4
2004	24.6	23.8	0.8
2005	25.3	24.8	0.5
2006	26.1	26.0	0.1
2007	27.0	27.0	-0.07
2008	27.7	27.9	-0.14
2009	28.6	28.8	-0.23
2010	29.4	29.7	-0.30
2011	30.4	30.8	-0.39
2012	31.3	31.8	-0.44
2013	32.4	32.9	-0.53
2014	33.5	34.1	-0.59
2015	34.6	35.3	-0.65
Total	375.4	375.9	-0.46

b. With Master Plan

The case “With Master Plan” incorporated the findings made during the Study.

b.1. Cost

i) Existing Cost

Cost of the existing system was projected on the basis of the 2001 and 2002 situations.

ii) Incremental Cost

Incremental Cost needed to implement the Master Plan was estimated at around \$105.8 million during the implementation period 2003-2015.

b.2. Income

Income was estimated by source.

i) Households

Income from households was estimated using the following data.

Population and family size

Population projection was made by the Study Team, and the family size of 4.4 resulted from the Public Opinion Survey.

Income Groups and Willingness to Pay (WTP)

The Public Opinion Survey determined low income households to comprise 43.0% of the population, middle income 46.6% and high income 10.4%. The revealed monthly WTP was \$4.16 for low income, \$7.09 for middle income, and \$9.43 for high income. Accordingly, the corresponding tariff used in the income estimation from households was \$5.00 for low income, \$7.20 for middle income, and \$10.30 for high income. Adjustments were made for coverage of solid waste service and collection/billing ratio.

ii) Commerce, Industry

Income from Commerce, Industry was estimated on the basis of data from waste amount and composition survey (WACS), and waste stream analysis, by applying the existing volume-based tariff of \$14.3 per cubic yard.

Commerce: 115.6 ton/day, density 60 kg/cubic meter

Industry: 159.6 ton/day, density 150 kg/cubic meter

Restaurant: 106.4 ton/day, density 200 kg/cubic meter

Assumption was that 70% of this group of clients would be served by DIMAUD, making adjustments for billing/collection ratio. Further, it was assumed that the special collection service charging the volume-based tariff would be implemented 70% in 2003, 90% in 2004 and 100% in 2005. Thereafter, the growth of income from this client group would be according to the growth rate of the economy.

iii) Institution

The 2002 situation was projected with \$50,000 to \$60,000 monthly increase already included in the 2003 budget of the Central Government, as a result of lobbying efforts made by the DIMAUD Commercial Department.

iv) Sanitary Landfill

Projection of the 2002 situation was used. The income potential of San Miguelito Municipality (over one million dollars a year) was left aside, due to the likelihood of a lengthy legal battle, if actions were taken to require San Miguelito Municipality to pay their share of final disposal fees.

v) Government Subsidy

Income from this source was estimated at the 2001 and 2002 level.

vi) Other Income

Projection of 2002 situation was used.

vii) Additional Income

Additional income was estimated as transport cost reduction resulting from the introduction of the transfer station, and the cost reduction resulting from improvement in the collection service.

b.3. Implementation Options

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)

i) 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 10-79: 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

ii) 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 the Master Plan with borrowed funds requires careful considerations of financing terms and conditions. On November 18, 2002, LIBOR was 1.43%, which adding some risk factors can go to 1.8%. Soft loans for very specific purposes could be found possibly at 1.8% interest rate, repayment over 25 years with 7 years grace period.

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 of 1.8% and repayment over 25 years with 7 years grace period, repayment amount is estimated at \$96.6 Million, as summarized below.

Table 10-80: 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	

International soft loans will have to be processed through diplomatic channels, and the required bureaucratic procedure will make it impossible to start implementation in 2003.

iii) Concession

Concession option was considered separately for each component activity and its corresponding cost (Sanitary Landfill, Transfer & Transport, and Materials Recovery Facility). “Separate Collection” was excluded from concession, as this activity will have to be always under direct DIMAUD operation. Cost specification by activity permitted analysis of concession of only one or more activities.

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. It is worth noting that the concession of the sanitary landfill eliminates as income source the final disposal fee that was charged to the difference between total waste disposed and the waste collected/ disposed by DIMAUD. Therefore, total income is less under concession than under direct DIMAUD operation.

Table 10-81: 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

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 10-82: 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

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 2015, and the resulting financial balance over the planning period would amount to \$29.9 million.

Table 10-83: 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.4. Requirements

Implementation of the Master Plan requires income increase and cost reduction.

Income requirements

The most important, and just about the only income increase that can be expected, is that from commercial/industrial firms, which requires the following:

- Passage of the Municipal Ordinance
- Implement special service for commercial/industrial firms

Cost requirements

Cost should be reduced by improving operations according to recommendations resulting from the Collection Improvement Experiment. Another important source of cost reduction would be payroll control by optimizing personnel.

c. Burden of SW Service Fee on Household Income

On the presumption of more than one wage earner per family, the household income was assumed to exceed the officially set minimum monthly wages of \$253.80. Therefore, the household income was estimated by multiplying the minimum salary by a factor of 1.5 for the low income group, 5 for the middle income group, and 12 for the high income group. This process made the household income levels consistent with the income range used in the POS. According to POS results, low income households were assumed to comprise 43.0%, middle income households 46.6% and high income households 10.4%. The combination of all these data and assumptions resulted in average household monthly income of \$1,072 in 2001 and 2002, going up to \$1,136 in 2003 and 2004.

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 burden of the SW service fee on household income was estimated as a ratio between the estimated cost of SW service per household, and the estimated average household income. For the 2002 situation, the following analysis can be made.

Table 10-84: Burden of Solid Waste Service Cost on Household Income, 2002

Item	Value
Total Estimated Cost in 2002	\$22,167,000
Percentage of waste from Households	51.2%
51.2% of Total Cost allocated to Households	\$11,349,504
Number of Households	169,193
51.2% of SW Cost allocated to Household sector in 2002	\$67.08
Estimated Average Household Yearly Income	\$12,864
Burden of SW Cost on Household Income: 51.2%	0.52%

According to the preceding table, the burden of SW cost was estimated as 0.52% of household income in 2002, if 51.2% of the Total Cost of SW service was distributed to households according to the percentage of waste generated by households. During the project period 2003-2015, and considering past increases in minimum wages, the household income was estimated to grow by 6% every two years, coinciding with the review of minimum wages.

The burden on household income was estimated as the ratio between the annual SW service cost per household, as per the 51.2% of waste generation attributed to households in the waste stream analysis, and the annual household income. The result can be summarized as follows.

Table 10-85: Burden of Solid Waste Service Cost on Household Income with M/P

Year	With Master Plan Case			
	Minimum wages (\$/month)	Household Income (\$/month)	Average SW Cost (\$/month)	Cost/Income (%)
2003	269	1,136	8.24	0.73
2004	269	1,136	7.15	0.63
2005	285	1,204	9.37	0.78
2006	285	1,204	6.94	0.58
2007	302	1,277	11.04	0.86
2008	302	1,277	6.52	0.51
2009	320	1,353	10.91	0.81
2010	320	1,353	6.46	0.48
2011	340	1,434	6.32	0.44
2012	340	1,434	6.75	0.47
2013	360	1,520	6.30	0.41
2014	360	1,520	6.48	0.43
2015	382	1,612	6.33	0.39

The above table shows that the cost of SW service per household is way below the upper limit of 1.7% of average household income. Consequently, it can be judged that the cost of SW service “With Master Plan” is within the Ability to Pay of households.

When the cost of SW service was based on the three cases of concession, the burden on household income was as shown in the following table.

Table 10-86: 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

The above table shows that the burden of SW service cost on household income is even lower under concession, thereby confirming that the service is affordable for the residents of Panama District. However, as there are income differentials among Corregimientos in the Panama District, the SW service affordability was checked for the households in Curundu and found to be affordable, as shown in the table below.

Table 10-87: Burden of Solid Waste Service Cost on Curundu Household Income (%)

Year	Master Plan	Concession		
		LF	LF,TT	LF,TT,MRF
2003	1.39	1.17	1.05	1.17
2004	1.21	1.31	1.07	1.18
2005	1.50	1.17	1.05	1.16
2006	1.11	1.25	1.15	1.27
2007	1.66	1.18	1.02	1.14
2008	0.98	1.17	1.07	1.19
2009	1.55	1.07	0.99	1.09
2010	0.92	1.11	1.03	1.14
2011	0.85	1.02	0.94	1.04
2012	0.90	1.07	0.98	1.08
2013	0.80	0.96	0.88	0.97
2014	0.82	0.98	0.91	1.00
2015	0.75	0.91	0.84	0.92

d. Financial Evaluation

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

d.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.

d.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 10-88: 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%

d.3. Conclusions

- The Master Plan can give attractive financial returns, but it is quite sensitive to variations in income and cost.
- It is more sensitive to variations in income: a 10% reduction in total income causes FIRR to go down from 47.5% to 3.4%
- A 10% increase in cost causes FIRR to go down from 47.5% to 5.8%.
- A simultaneous 5% income reduction and 5% cost increase cause FIRR to go down from 47.5% to 4.6%.
- The viability of the Master Plan hinges on achieving income increase and cost reduction. Income increase implies implementation of the volume-based tariff

applicable to commercial/industrial firms, while cost reduction depends heavily on improving collection efficiency.

10.5.3 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.

a. Willingness to Pay

The results of POS say that i) Willingness to Pay is U\$6.07/household/month and ii) average number of family members is 4.4 persons/house. Meanwhile, the Waste Amount and Composition Survey (WACS) obtains the waste generation amount as 590g/person/day. From these data, Willingness to Pay and waste generation amount per person per year can be obtained as U\$16.56 and 0.215 ton respectively as shown in the following.

$$U\$6.07 / household / month \div 4.4 person / household = U\$1.38 / person / month$$
$$U\$1.38 / person / month \times 12 month = U\$16.56 / yera / person$$

$$590g / person / day \times 365 days = 0.215 ton / year / person$$

Consequently, Willingness to Pay per ton of waste is obtained as U\$77.02/ton as follows.

$$U\$16.56 / year / person \div 0.215 ton / year / person = U\$77.02 / ton$$

b. Economic Evaluation

b.1. Method

The Willingness to Pay obtained by POS corresponds to benefit that is regarded to be brought about by the whole MSWM, not only by new projects/measures proposed in the M/P, as each component of MSWM achieves the benefit in total combination. Therefore, this economic evaluation subjects to the whole MSWM.

b.2. Cost

Investment costs for new projects proposed in the M/P is subtracted 5% of tax. Costs of O&M for the new projects and the existing activities are used as they are.

b.3. Benefit

As the whole MSMW of the Panama District is subject to this economic evaluation, it is regarded that economic benefit would be delivered to all beneficiaries of DIMAUD service, or all citizens and business entities in Panama District. Therefore, the value obtained by multiplying the Willingness to Pay per ton of waste by the whole waste amount generated from the Panama District is considered as the economic benefit.

b.4. Economic Evaluation

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 10-89) are analyzed as presented in the following.

Table 10-89: 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 10-90: Cost and Benefit

		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total	
Cost (US 1,000)	Investment	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	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	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	
	Existing cost	20,218	21,001	21,868	24,463	23,802	24,564	25,394	26,249	27,163	28,105	29,121	30,166	31,282	333,396	
	Investment (exc. tax 5%)	10,064	5,759	11,470	1,190	21,758	1,966	22,244	2,022	1,003	2,832	632	1,475	885	83,300	
	O & M	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 (Case 1)	33,024	29,608	39,770	30,681	49,335	30,609	51,989	32,415	32,852	36,283	35,227	37,526	38,136	477,455	
	Saving cost (T/S)	0	0	-185	-202	-217	-231	-247	-263	-280	-299	-318	-338	-360	-2,940	
	Total (Case 2)	33,024	29,608	39,585	30,479	49,118	30,378	51,742	32,152	32,572	35,984	34,909	37,188	37,776	474,515	
	Reduction cost (collection)	-2,373	-2,454	-2,540	-2,642	-2,711	-2,766	-2,825	-2,871	-2,922	-2,971	-3,024	-3,077	-3,133	-36,309	
	Total (Case 3)	30,651	27,154	37,045	27,837	46,407	27,612	48,917	29,281	29,650	33,013	31,885	34,111	34,643	438,206	
	Benefit	Waste amount - Panama (ton/year)	363,175	375,549	388,835	404,384	416,794	427,050	438,256	449,388	461,360	473,551	486,582	499,758	514,030	
		Willingness to pay (US\$1,000)	27,972	28,925	29,948	31,146	32,101	32,891	33,754	34,612	35,534	36,473	37,477	38,491	39,591	438,915

Table 10-91: 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.

10.5.4 Institutional Evaluation

The proposed institutional system of the M/P is oriented to form the “Development of the Institutional Capacity” of DIMAUD.

The objectives and activities in the following five sectors that compose the system interact among themselves to achieve the most synergy possible and attain the goals proposed in the M/P.

a. Sector of Policies and Regulations

It is expected that the Panama Municipal Council will approve the Cleansing Regulation (Municipal Ordinance). This regulation would establish a policy related to solid waste management in the District and the regulation to provide this type of service.

DIMAUD is compelled to provide the service with levels that are defined in the regulation. Additionally, the clients and general public are to collaborate and participate actively. In few words, the “rules of the game” have been defined.

The private sector would be able to develop its activities through a competition based on quality and price set by the regulation. This situation will certainly benefit the ICI waste dischargers who are possible clients to the private sector’s service.

b. Adjustment of the Organization Structure

The top management of DIMAUD has decided to initiate the adjustment of the organizational structure with the purpose to adapt it to the requirements of the objectives of the entity.

The adjustment would facilitate to attain the synergy among all administrative units including the existing ones and those which are being proposed.

The organization gains efficiency by establishing new administrative units. These units will execute current and new activities: for example, the Department of Operations (optimization of operations); the Executive Unit (planning and development); Management Control (management improvement and control); Customer Service (relations with the clients).

c. Development of Human Resources

It is usually said that human resources are the most valuable asset in any entity. For each administrative unit, programs and activities have been proposed directed to train the personnel and improve their skills.

Social and human aspects are considered with great concern. There are plans to negotiate with the Caja del Seguro Social (CSS) the situation of workers who are close or past the retirement age and others who have disabilities and provide their service in street sweeping as a manner of anticipated retirement in order for them to receive pensions.

The control and reduction of labor accidents and professional diseases, such as back problem, can be achieved by strengthening the occupational program of the CSS.

All these activities are positive; they generate greater trust and devotion on the workers, and also create a loyalty with the entity.

d. Management Development

The establishment of a system management control will serve as a guide to take decisions. An understanding of the performance levels and their comparison with standards from other countries with similar development degree will derive on the improvement of the efficiency on the services that are being provided.

The top management of the entity should have management information tools of great value to orient and arrange all the activities. The operative personnel could use them to control the daily operations and suggest improvements which can lead to provide a service with better quality and with less cost.

e. Financial Development

The financial analysis shows a reasonable equilibrium between the investment foreseen in the M/P and expenditures for operation and management, and the projected income. In order to attain these results, it is required a great discipline to manage the funds, an improvement the efficiency of the ordinary collection service, implementation of the special collection service for ICI's, to modernize the commercialization system and an skilful negotiation of the concession process of the sanitary landfill.

The M/P provides a series of procedures and tools to materialize the financial equilibrium aforementioned.

10.5.5 Social Evaluation

Aiming at environmental conservation, the M/P includes separate collection. It desperately requires cooperation from the citizens. Therefore, the environmental education will be an inevitable factor to encourage citizens for proper understanding of SWM and environment.

The M/P emphasizes the environmental education as a social component, which is expected to realize resource conservation and efficient MSWM.

During the Study, pilot projects verify that material recovery proposed in the M/P is viable. It is judged that separate collection at source and community based material recovery will be workable with proper provision of environmental education in Panama District.

Meanwhile, there is another important social issue in MSWM, i.e., waste-pickers. As one of tools to solve this problem, the Municipal Ordinance stipulates that the material extraction in the flow of discharged wastes is prohibited and the Panama Municipality will carry out the required formalities. Such required formalities would be control and job opportunity creation. Fence around Etapa 2 will be constructed at the beginning of 2003, then entrance and exit of

the waste-pickers will be controlled at one gate. The MRF proposed in the M/P would be a job opportunity.

Consequently, it is evaluated that the M/P will contribute to solution of social problems.

10.5.6 Environmental Evaluation

From an environmental point of view, the M/P is evaluated at the following respects.

- Resource conservation and minimization of final disposal amount through separate collection
- Promotion of recycling through introduction of MRF
- Environmental improvement through appropriate installation and operation of the final disposal site

The introduction of separate collection and installation of MRF contribute to environmental improvement. Recyclable materials that used to be disposed as wastes are recovered and “re-cycled” as resources, which leads to conservation of natural resources and minimization of final disposal amount.

Installation of the final disposal site with appropriate specification and its proper operation in accordance with the M/P will mitigate environmental impact around the final disposal site.

10.5.7 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 (MINSAs 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.