11.3 Operation Plan

11.3.1 Sorting Plant

a. Fundamental Issues

This part describes the operation plan of the sorting plant proposed for the MGM.

The operation plan will cover the work flow from waste reception to recyclable materials storage.

a.1 Working Hours

This sorting plant is open the following hours.

- Mondays - Sundays: 7:00 - 23:00 (16 hour/day)
- National Holidays: Closed.
- Waste received time 16 hours/day
- Equipment operation hours 13 hours/day

a.2. Types of Solid Wastes

The sorting plant will receive the following types of wastes.

- Non-compostable MSW separated at source such as households and commercial enterprises.

a.3 Main Design Parameters

Table 11-23 summarises the design parameters based on the above design assumptions.

Table 11-23: Design Parameters of the Sorting Plant in Cimsa

Raw Material			
	Amount	32,095 ton/year (2005)	
	Moisture content	55.7 %	*1
	Bulk density	300 kg/m^3	*1
Plant Specification			
	Type	Hand-sorting + a magnetic separator	
	Treatment line	One line	
	Treatment Capacity	100 ton/day	
	Operation	350 day/year	
		16 hour/day by two shifts	
	Recovered Material	(1) Paper (mainly Cardboard)	
		(2) Plastics (Film and PET bottles)	
		(3) Glass (Bottles and Cullet)	
		(4) Ferrous metal	
		(5) Non-ferrous metal (mainly Aluminium cans)	
		(6) Textile	

*1 : Estimates from the pilot project

a.4 Process Flow of the Plant

The process flow of the proposed sorting plant is presented in Figure 11-2.

a.5 Layout of Proposed Sorting Plant

The layout of the proposed sorting plant is presented in Figure 11-4 : Layout of the Sorting Plant.

b. Staff and Job Description

Operation and maintenance (O&M) will be contracted out to the private sector, while the MGM will instruct and supervise the plant and bear responsibility to prevent any adverse impacts on the environment.

Table 11-24 is the staff allocation schedule of the plant. The number of operators and manual workers is derived from the volume of materials to be processed and plant operation capacity.

b.1 Administration

Administrative work will be executed by a director, who overseas the operation and management of the sorting plant, and supporting staff including an accountant and secretary.

b.2 Operation

Plant operation is overseen by a sub-manager of the plant involving five sections. Each is headed by one supervisor for one shift.

b.2.1 Waste Reception Section

Waste is received in this section and fed to the plant. Wastes unsuitable for the sorting process such as bulky wastes should be manually rejected by the workers. A wheel-loader is used to feed wastes to a hopper. These works are managed by the waste reception supervisor.

b.2.2 Facility Operation Section

The workers of this section, headed by the sub-manager, operates the facility such as the feed hoppers and the hand-sorting conveyors. The entire operation work will be done in a central control room. This section shall also take responsibility of the electrical control system.

This section is in a key position co-ordinating the preceding waste reception section and the following hand-sorting section. The capability to assess the situation of the plant as a whole is required.

b.2.3 Manual Sorting Section

This is the section where recyclable materials are sorted out from the waste on a conveyor belt. The manual sorting supervisor looks after waste composition and sorting works, and adjust the speed of the conveyor. The line workers are allocated on the both sides of the conveyor and manually pick up a specific item assigned to each worker in advance.

b.2.4 Product Section

The product section conditions recyclable materials separated by the manual sorting section and store it if needed. The supervisor of this section gives instruction on

product handling and storage to the product separation workers, press machine operators, baling machine operator, and fork lift driver.

b.2.5 Transport Section

This section manages the transport of waste residue form the plant to the final disposal site. The truck drivers supervise waste residue loading onto the trucks, transport it, and maintain the vehicles.

Table 11-24: Staffing Schedule in Cimsa

Position		Shift		Total
		1	2	
ADMINISTRATION				
	Sub-manager	1	---	1
	Accountant	1	---	1
	Secretary	1	---	1
	sub-total	3	---	3
OPERATION				
	Pre-treated section			
	Supervisor	1	1	2
	Facility operate section			
	Machine operator	2	2	4
	Reception section			
	Loader operator	1	1	2
	Labourer	1	1	2
	Manual-sorting section			
	Hand-sorting supervisor	1	1	2
	Hand-sorting labourer	12	12	24
	Product section			
	Supervisor	1	1	2
	Labourer	7	7	14
	Press machine operator	2	2	4
	Baler machine operator	1	1	2
	Fork lift driver	1	1	2
	Transport section			
	Truck driver	1	1	2
	Labourer	1	1	2
	sub-total	32	32	64
	Total	35	32	67

11.3.2 Compost Plant

a. Fundamental Issues

This operation plan is designed for the compost plant proposed for the MGM. It covers the process from waste reception to final product storage.

a.1 Working Hours

This compost plant is open the following hours.

- Mondays - Sundays 7:00 - 23:00 (16 hour/day)
- National Holidays Closed
- Waste Received time 16 hour/day

- Equipment operation hours 13 hour/day

a.2 Types of Solid Wastes

The compost plant will receive the following types of wastes.

- Compostable MSW separated at sources such as households, commercial enterprises, etc.
- Garden wastes (as moisture adjusting agent)

a.3 Main Design Parameters

A table below summarises the design parameters taking the above design assumptions into account.

Table 11-25: Design Parameters of the Compost Plant in Cimsa

Composting section				
	Type	Aerated Static Pile		
	Raw Material (Compostable Waste)	Amount	110 ton/day	
		Compostable Content	20.3 % by Dry weight	*1
		Moisture Content	70 %	
		Apparent Specific Gravity (ASG)	500 kg/m^3	*2
	Operation		350 day/year 16 hour/day	
	Treatment Capacity		110 ton/day	
	Composting Period		28 days	
	Pile Temperature		>55^{o}C	
Maturation (Curing) section				
	Operation		350 day/year 16 hour/day	
	Treatment Capacity	Mature compost product	~ 20.0 ton/day	
		Moisture Content	~ 40 %	
		Apparent Specific Gravity (ASG)	500 kg/m^3	*2
	Maturation Period		60 day	
Final Separation section				
	Type	Trommel screen		
	Operation Time		350 day/year 16 hour/day	
	Treatment Capacity	Fine compost product	~ 16.2 ton/day	
		Coarse compost product	~ 3.8 ton/day	
		Moisture Content	~ 40 %	
		Apparent Specific Gravity (ASG)	500 kg/m^3	*2

Notes: *1 : Obtained from "Composition of the Compostable Waste" (composite of kitchen waste, grass and wood)
*2 : Estimates from the pilot project.

a.4 Process Flow of the Plant

The process flow of the compost plant is presented in Figure 11-6.

b. Staff and Job Descriptions

Table 11-26 shows the staff allocation schedule for the proposed compost plant. The number of operators and manual workers is derived from the volume of materials to be processed and plant operation capacity.

b.1 Administration

Administrative work will be executed by a director, who supervises the operation and management of the plant, an accountant, who will be also in charge of product sales promotion, and a secretary.

b.2 Operation

Operation is managed by a sub-manager of the plant and involves two parts: pre-treatment section and composting section. Both consist of sections, each of which is headed by one supervisor for one shift. The job description of the sections is as follows.

b.2.1 Pre-treatment

i. Waste Reception Section

Compostable wastes is received by this section and transferred to pre-treatment equipment. The section has workers who reject wastes unsuitable for equipment and a wheel loader operator who feeds the other wastes to a feed hopper. These works are controlled by the reception supervisor.

ii. Facility Operation Section

The facility operators, under the supervision of the sub-director, operate pre-treatment equipment such as the feed hopper, feed conveyor, and selective crushing separator (SCS). All of these will be managed in a central control room. This section is also responsible for the electricity control works.

This section is in a key position coordinating the preceding waste reception section and the following transport section. The capability to assess the entire pre-treatment section is required.

iii. Selective Crushing Separation Section

The supervisor of this section controls the performance of the SCS by observing the waste input and the waste output. When the moisture content of the fed wastes is found to be high, he/she directs the operator and workers to add some moisture adjusting agent. He/she also directs the transport of the materials pre-treated by the SCS.

iv. Transport Section

After the screening of the SCS, the pre-treated materials and the rejects are transported to the next proper section. The supervisor manages material transport by giving instructions to the truck drivers on when and where the materials will be transported to.

b.2.2 Composting

i. Static Pile Section

The supervisor of this section directs the loader operators to pile pre-treated materials onto an appropriate place. He/she is responsible for the maintenance of the aerobic environment in the piles by adjusting the air blowing rate. Further, he/she gives instructions to the workers about turning and water supply to the piles.

ii. Screening Section

There are two stages of screening: primary screening for raw compost and final screening for mature compost. The primary screening line and the final screening line is operated alternately by the same operators and workers. They also operate the packaging machine of the final compost product.

iii. Maturation Section

The screened raw compost from the screening section is matured in this section. Although it is usual to mature the materials to ensure stabilisation, market demand for the screened raw compost without maturation may rise. In such occasion, the plant director and sub-director have to give necessary instructions to the workers of this section.

Table 11-26: Staff Allocation Schedule in Cimsa

Position	Shift		Total
	1	2	
ADMINISTRATION			
Sub-manager	1	---	1
Accountant	1	---	1
Secretary	1	---	1
sub-total	3	---	3
OPERATION			
Pre-treated section			
Supervisor	1	1	2
Facility operate section			
Machine operator	2	2	4
Reception section			
Loader operator	1	1	2
Labourer	1	1	2
Transport section			
Labourer	2	2	4
Truck driver	1	1	2
sub-total	8	8	16
Composting section			
Supervisor	1	1	2
Static pile section			
Loader operator	1	1	2
Labourer	2	2	4
Transport section			
Loader operator	---	---	---
Labourer	---	---	---
Truck driver	1	1	2
Separate section			
Operator	1	1	2
Loader operator	1	1	2
Labourer	2	2	4
Curing section			
Loader operator	1	1	2
Labourer	2	2	4
sub-total	12	12	24
Total	23	20	43

11.3.3 Final Disposal Site

a. Fundamental Issues

This operation plan shall be applied for the proposed disposal site in MGM.

b. Working Hours

This proposed disposal site is open the following hours.

- Mondays - Fridays: 7:00 - 23:00 (16 hour/day)
- Saturdays, Sundays and National Holidays: Closed
- Equipment operation hours 7 hours/day

c. Types of Solid Wastes

The disposal site will receive the following types of wastes.

- Mixed municipal solid waste such as households and commercial enterprises.
- Rejected waste from the Sorting plant and the Compost plant.
- Other wastes (Industrial Waste, Waste of Adjacent Municipalities)

d. Preliminary Design

The outline of the preliminary design for proposed disposal site. is shown in Table 11-27.

Table 11-27: Outline of the Cimsa Disposal Site in Cimsa

Items	Description		
Land Area and Proposed Land Use	Total Area :24ha		
	Phase1:Landfill Area		:5ha
	Phase2:Landfill Area		:4ha
	Phase3:Landfill Area		:4ha
	Plant :Area		:3ha
	Medical waste Landfill Are		:2ha
	Buffer zone :Area		:6ha
Landfill Volume	Phase	Capacity	Disposal Period
	Phase 1	463,000m^3	2002-2003
	Phase 2	397,000m^3	2004-2004
	Phase 3	297,000m^3	2005-2005

e. Personnel and Heavy Vehicle Plan

The following personnel and heavy vehicle are required to operate at the landfill site.

Table 11-28: Personnel and Heavy Vehicle Plan in Cimsa

Personnel and heavy vehicle	Number	
Personnel		
Site Manager	1 person	(2002-2005)
Waste controller	1 person	(2002-2005)
Operator	4 person	(2002-2005)
Driver	3 person	(2002-2005)
Worker	2 person	(2002-2005)
Security guard	2 person	(2002-2005)
Total	13 person	(2002-2005)
heavy vehicle		
Bulldozer(230HP)	2Unit	(2002-2005)
Excavator(99HP)	1Unit	(2002-2005)
Dump truck($8m^3$)	3Unit	(2002-2005)
Water tanker	1Unit	(2002-2005)
Total	7unit	(2002-2005)

f. Operation Plan

f.1 Weighbridge

The final disposal site, sorting plant and composting plant, which are to be sited in the same land plot, will share two weighbridges.

The weighbridge will be used to measure the following.

- Mixed wastes directly delivered to the landfill.
- Medical wastes directly delivered to the landfill.
- Non-compostable wastes fed to the sorting plant.
- Recyclable materials and residue segregated at the sorting plant.
- Compost and residue from the compost plant.

f.2 Operation at Landfill Area

f.2.1 Landfill Method

With the cell method, soil is spread daily to cover solid wastes dumped. Through this method a highly compacted landfill can be obtained and this prevents scattering of solid waste, generation of offensive odour and the breeding of disease vectors and noxious insects. Therefore, the cell method should be applied.

f.2.2 Cover Soil

Cover soil will be placed, and the thickness of each layer is as follows.

- daily covering soil: 20 cm
- final covering soil: 100 cm (depending on the ultimate use)

The ratio of cover soil to the disposal volume of waste will be 20 %, excluding final covering soil.

f.2.3 Landfill Procedure

The area and volume of Phase 1 landfill site shall be 4 ha and 463,000m^3 respectively. Those of Phase 2 landfill site shall be 4 ha and 397,000m^3 respectively. MSW can be filled for the period of 3 years at both phases. Area and volume of Phase 3 landfill site shall be 4 ha and 297,000m^3 respectively. MSW can be filled for 1 year at this phase.

Landfill operation shall be executed from downstream towards upstream in order to connect leachate collection pipe easier. Rainfall drainage pipe shall be provided from upstream lot adjacent to the landfill area in order not to mix the rainfall water and leachate. This rainfall drainage pipe shall be extended according to the progress of landfill operations.

g. Conditions of Landfill Site at Each Stage

Conditions of landfill site at final cover stage are as follows.

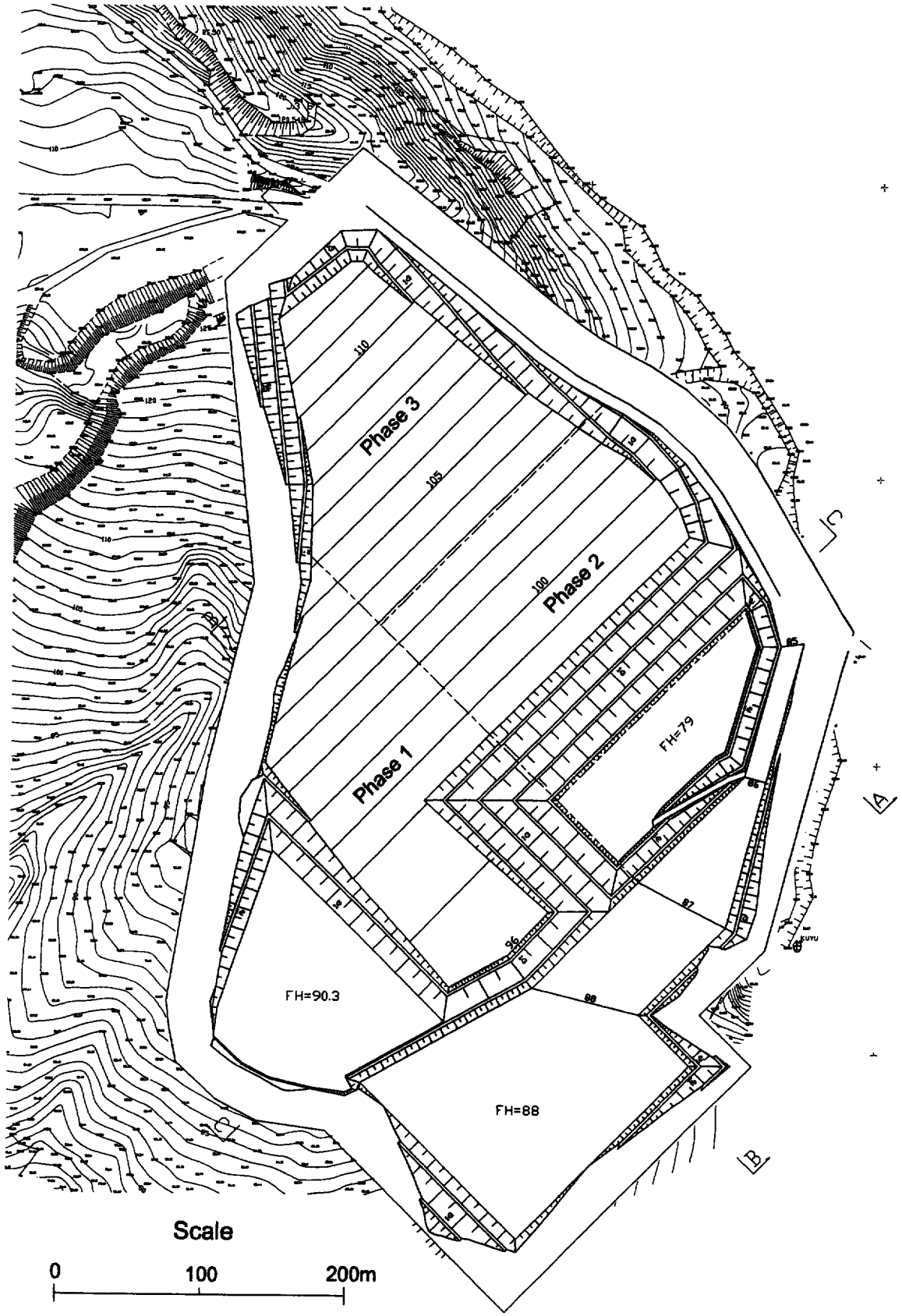

Figure 11-15: The Condition of Proposed Landfill Site at Final Cover Stage in Cimsa

11.3.4 Medical Waste Disposal Site

a. Fundamental Issues

a.1 Working Hours

This proposed disposal site is open the following hours.

- Mondays - Fridays: 7:00 - 14:00 (7 hour/day)
- Saturdays, Sundays and National Holidays: Closed
- Equipment operation hours 7:00 - 16:00

b.2 Types of Solid Wastes

The disposal site will receive the following types of wastes.

- Medical waste
- Infected waste
- Pathogenic waste
- Pathological waste

a.3 Preliminary Design

Outline of the preliminary design for the proposed medical disposal site is shown in Table 11-29

Table 11-29: Outline of the Medical Disposal Site in Cimsa

Items	Description
Land Area	Total Area : 3ha
Landfill Volume	Capacity : 57,500m^3 Disposal Period : 2002-2020

b. Operation Plan

b.1 Weighbridge

The final disposal site, sorting plant and compost plant, which are to be sited in the same land plot, will share two weighbridges.

The weighbridge will be used to measure the following.

- Mixed wastes directly delivered to the landfill.
- Medical wastes directly delivered to the landfill.
- Non-compostable wastes fed to the sorting plant.
- Recyclable materials and residue segregated at the sorting plant.
- Compost and residue from the compost plant.

b.2 Operation at Landfill Area

b.2.1 Landfill Implementation

Landfill implementation of the medical landfill is shown in Table 11-30.

Table 11-30: Landfill Implementation of the Medical Landfill in Cimsa

Item	Sub-Item	During Operation
Landfill Implementation	landfill method	-cover soil immediately after dumping of medical waste - landfill division by divider(1 year / divider) - cover soil from quarry site in landfill site
	final disposal foundation	article 34 of design standard
	Disposal site floor	article 35 of design standard
	drainage system	article 36 of design standard
	deposition of waste	article 37 of design standard
	top cover	article 38 of design standard
	gas removal	Every 50 meters(vertically and horizontally)
	vegetation of disposal site	article 39 of design standard
Leachate	system	-recirculation system -gravity fall from slope surface
Rain water	drainage system	-individual collection and direct discharge

b.3 Landfill Procedure

The area and the volume of medical waste landfill site are 3 ha and 57,500m^3 respectively. Medical waste can be filled for 19 years at this site.

Landfill operation shall be executed from downstream upwards in order to prevent leachate amount to be increased due to rainfall water flowing from upstream. Therefore temporary drainage shall be constructed at upstream lot adjacent to the landfill area in order not to mix the rainfall water and leachate. This temporary drainage shall be abolished and changed to the leachate drainage system according to the progress of landfill operations.

11.4 Cost Estimation

11.4.1 Separate Collection System

The following cost estimate is based on the preliminary design of the proposed separate collection system carried out during the F/S.

Table 11-31: Procurement Schedule of Container for Separate Collection (2002-2005)

		2000	2001	2002	2003	2004	2005
Container (800 lit.)	nos.	470	486	63	62	72	67
	US$ 1,000	5	5	1	1	1	1
Compactor (16m^3)	nos.	-	21	4	3	5	4
	US$ 1,000	-	1,344	256	192	320	256

Table 11-32: Operation & Maintenance Cost of Collection Vehicle (2002-2005)

	2002	2003	2004	2005
Number of Collection Vehicles (nos.)	21	25	28	33
O & M Cost (US$ 1,000)	924	1,100	1,232	1,452

11.4.2 Sorting Plant

Investment cost and schedule for the sorting plant are shown in Table 11-33 and Table 11-34 respectively. The cost has two components: facility construction and operation equipment. It should be noted that the cost for land preparation is not included here, but is in the cost estimate of the landfill site.

Table 11-33: Investment Cost of the Sorting Plant (2001)

Item		Cost (US$)
Sorting plant construction		317,200
Equipment		1,154,000
Sub-total		1,471,200
Miscellaneous	10%	146,800
Direct cost		1,618,000
General expenses/overhead	30%	486,000
Total construction cost		2,104,000
Physical contingency	10%	210,000
VAT	15%	315,000
Total cost		2,629,000

Table 11-34: Investment Schedule of the Sorting Plant (2999-2005)

unit : US$ 1,000

	2000	2001	2002	2003	2004	2005	Total
D/D	142	---	---	---	---	---	142
Civil	---	567	---	---	---	---	567
Machine	---	1,685	---	---	---	---	1,685
V&E	---	377	---	---	---	---	377
O&M	---	---	378	378	378	378	1,512
Total	142	2,629	378	378	378	378	4,283

Note: D/D : Detailed design, Civil : Civil works, Machine :Machinery
V&E : Vehicles and Equipment, O&M : Operation and maintenance

11.4.3 Compost Plant

Investment cost and schedule for the compost plant are shown in Table 11-35 and Table 11-36 respectively. The cost has two components: facility construction and operation equipment. It should be noted that the cost for land preparation is not included here, but is in the cost estimate of the landfill site.

Table 11-35: Investment Cost of the Compost Plant (2001)

Item		Cost (US$)
Compost plant construction		486,900
Equipment		2,240,000
Sub-total		2,726,900
Miscellaneous	10%	274,100
Direct cost		3,001,000
General expenses/overhead	30%	900,000
Total construction cost		3,901,000
Physical contingency	10%	390,000
VAT	15%	586,000
Total cost		4,877,000

Table 11-36: Investment Schedule of the Compost Plant (2000-2005)

unit : US$ 1,000

	2000	2001	2002	2003	2004	2005	Total
D/D	263	---	---	---	---	---	263
Civil	---	872	---	---	---	---	872
Machine	---	3,138	---	---	---	---	3,138
V&E	---	867	---	---	---	---	867
O&M	---	---	440	440	440	440	1,760
Total	263	4,877	440	440	440	440	6,900

Note: D/D : Detailed design, Civil : Civil works, Machine :Machinery
V&E : Vehicles and Equipment, O&M : Operation and maintenance

11.4.4 Final Disposal Site

a. Control Facility, Phase1 and Phase 2

Investment cost of construction and vehicle & equipment for the control facility in Phase1 and Phase 2 are shown in Table 11-37 and Table 11-38 respectively.

Table 11-37: Investment Cost of Construction of the MSW Landfill Site (Phase1 and Phase2) & Administration Area

Item		Cost (US$)
Control facilities		440,586
Phase 1 and Phase 2 MSW landfill site		2,460,170
Sub-total		2,900,756
Miscellaneous	10%	290,076
Direct cost		3,190,832
General expenses/overhead	30%	957,250
Total construction cost		4,148,082
Physical contingency	10%	414,808
VAT	15%	622,212
Total cost		5,185,102

Table 11-38: Investment Cost for Vehicle & Equipment for the MSW Landfill Site (2001)

Item		Cost (US$ 1,000)
Vehicle & Equipment		931
Spare parts	10%	93
Physical contingency	10%	93
VAT	15%	140
Total cost		1,257

b. Phase 3

Investment cost for the phase 3 are shown in Table 11-39.

Table 11-39: Investment Cost of Construction of the MSW Landfill Site (2005)

Item		Cost (US$)
Phase 3 MSW landfill site		1,010,295
Miscellaneous	10%	101,030
Direct cost		1,111,325
General expenses/overhead	30%	333,398
Total construction cost		1,444,723
Physical contingency	10%	144,472
VAT	15%	216,708
Total cost		1,805,903

c. Investment Schedule

Investment schedule for MSW Landfill Site are shown in Table 11-40.

Table 11-40: Investment Schedule of MSW Landfill Site (2000-2005)

unit : US$ 1,000

	2000	2001	2002	2003	2004	2005	Total
D/D	317			25	105		447
Civil		5,185			1,805	7,548	14,538
V&E		1,257					1,257
O&M			375	375	375	341	1,466
Total	317	6,442	375	400	2,285	7,889	17,708

Note: D/D : Detailed design, Civil : Civil works,
V&E : Vehicles and Equipment, O&M : Operation and maintenance

11.4.5 Medical Waste Disposal Site

Investment cost of construction and vehicle & Equipment for the medical waste disposal site are shown in Table 11-41 and Table 11-42 respectively. And also, investment schedule for the medical waste disposal site are shown in Table 11-43.

Table 11-41: Investment Cost of Construction of the Medical Solid Waste Landfill (2001)

Item		Cost (US$)
Medical Waste Landfill Site		1,045,300
Miscellaneous	10%	104,530
Direct cost		1,149,830
General expenses/overhead	30%	344,949
Total construction cost		1,494,779
Physical contingency	10%	149,478
VAT	15%	224,217
Total cost		1,868,474

Table 11-42: Investment Cost for Vehicle & Equipment of the Medical Waste Landfill Site (2001)

Item		Cost (US$ 1,000)
Vehicle & Equipment		253
Spare parts	10%	25
Physical contingency	10%	25
VAT	15%	38
Total cost		341

Table 11-43: Investment Schedule for the Medical Solid Waste Landfill Site (2000-2005)

unit : US$ 1,000

	2000	2001	2002	2003	2004	2005	Total
D/D	91						91
Civil		1,869					1,869
V&E		341					341
O&M			53	53	53	53	212
Total	91	2,210	53	53	53	53	2,513

Note: D/D : Detailed design, Civil : Civil works,
V&E : Vehicles and Equipment, O&M : Operation and maintenance

11.5 Institutional Development Plan

11.5.1 Administration and Organisation

a. General

The Ministry of Environment complains in general that; while solid waste collection activities are more or less successfully carried out by the district municipalities, unfortunately the greater municipalities have failed to a large extent in accomplishing their duties related to recycling and sanitary landfilling. The Mersin Greater Municipality should be now in the position to get rid of such an image in the views of

the Ministry of Environment and realise an exemplary planning action with respective operations. These attempts must be models for ministerial extension services and provide an impetus for similar attempts in other greater municipalities.

Each municipality or any other municipally authorised agency dealing with dumping, landfilling and final waste disposal have to fulfil certain administrative obligations and regularly inform the Ministry of Environment about their previous and on-going activities in this regard. This obligation serves for the purpose that; the Ministry of Environment firstly gets acquainted with the current landfill practices in municipal areas, and secondly, be informed about prospective activities which need to be evaluated, oriented and formally controlled.

Likewise, the Mersin Greater Municipality should also inform the Ministry of Environment on its plans regarding the further use of the present site in the short run and subsequently its closure. This administrative duty is also valid for the identification of location for the new sanitary landfill in Cimsa site, at which sorting and compost plants will also take place. It has to be substantially justified that those decisions are made in accordance with a series of criteria as set forth by respective regulations of the Ministry of Environment. The related decision process must be adequately followed in this regard.

The Mersin Greater Municipality is aware of the fact that, necessary formal procedure must be fulfilled by respective municipalities in Turkey to allocate the disposal sites in urban development and landuse plans and precisely indicate whether they are currently used or closed. As legally envisaged, these areas are prohibited to settlement actions, and this issue has to be adequately pursued throughout the decision and enforcement process running under the initiative of the municipal councils and municipal parliaments. The prohibit duration is 30 years for present landfill sites and 40 years for closed landfill sites. It is also a compulsory administrative duty of the Mersin Greater Municipality to obey these judicial provisions, which are in close connection with prospective activities in solid waste management.

In fact, currently used dumpsite and the prospective sanitary disposal site in Cimsa area have been adequately identified in urban development and landuse plans of Mersin. However, contradictory actions and amendment initiatives by some local authorities and interest groups have been started, which do not reveal suitable behaviour and lack sufficient substantiations. All responsible agencies have to accept official decisions; in other words, officially justified and confirmed decisions. Moreover, these agencies have to regard the implementation of official decisions as administrative obligations.

In compliance with prospective activities, administrative liabilities must be identified and organisational schemes must be developed for:

- Rehabilitation of the present disposal site in Mersin,
- Operation of a new sanitary landfill at Cimsa site
- Operation of a new sorting plant and
- Operation of a new compost plant.

b. Rehabilitation of the Present Disposal Site in Mersin

It falls under the responsibility of the Mersin Greater Municipality to look after the fulfilment of managerial and operational requirements as well as technical provisions and specifications, as set forth in respective regulations and instructions of the Ministry of Environment, related to sanitary landfill management. While layering the new wastes by taking necessary measures and meeting requirements of a sanitary waste disposal practice, the Mersin Greater Municipality should also provide the appropriate network for gas exhaustion and leachate collection along with adequate outlet systems prior to laying a surface cover for closure.

According to regulations, the final disposal sites have to be surrounded by fence. Entries to and departures from the site have to be supervised and controlled. A guard hut should be constructed along with an operation room and a weighbridge. All these requirements are met in Mersin, however more importance need to be attached in order to ensure a serious and proper management and service.

Private and municipal agencies, or corporate entities, that are responsible for the operation of final disposal site, should legally employ a technician, who has to be in charge of the control of wastes entering into the site as well as of landfilling operations within the site. The operator of the disposal site is obliged to prepare an operation plan in compliance with Solid Waste Sanitary Landfill Operations Procedures as developed by the Ministry of Environment. Within the framework of this operation plan, certain monitoring activities must be carried out; primarily, leachate and gas emissions, and the results of periodical measurings must be forwarded to the Ministry of Environment, if required. These measuring and monitoring obligations are valid for 10 years upon the termination of the sanitary landfill operations and closure of the site.

There are also some subsidiary legal obligations pertaining to two main concerns. One of them is the training of personnel on environmental risks and the other one is the applications of requirements for cleanliness in working place. The training of personnel on environmental protection practices is not only necessary for himself, but also for the welfare of his human and natural environment. The workers should be sufficiently informed about the risks of their occupational engagement and be trained about protection measures on the job. Sanitation and disinfection of work garments, equipment and vehicles constitute a significant duty to be taken up, respectively. Trucks and excavators operating in the landfill site must be cleaned before leaving the site. The municipal administration is in this regard legally instructed to look after the prompt loyalty to training and sanitation requirements by the contractor or other assigned agency. This principle naturally also applies for the landfill operations of the Mersin Greater Municipality.

c. Sanitary Landfilling in Cimsa Site

In the management and operation of a sanitary landfill site, the minimum level of staffing varies, depending on the quantity of waste received as well as the method applied in landfilling operations. For those landfill sites with a capacity over 250 ton per day, where waste is placed and compacted by machines, a reasonable staffing should include the following personnel:

Personnel and heavy vehicle	Number
Personnel	
Site Manager	1 person (2002-2005)
Waste controller	1 person (2002-2005)
Operator	4 person (2002-2005)
Driver	3 person (2002-2005)
Worker	2 person (2002-2005)
Security guard	2 person (2002-2005)
Total	13 person (2002-2005)

In identification of the definitive personnel size, mainly three criteria have to be referred:

i. waste volume handled.
ii. number of work shifts a day.
iii. mechanisation level.

Thereafter the personnel size needed for sanitary landfilling operations at Cimsa site can be finalised.

The daily operations at the landfill site fall generally into three groups of activities; namely, waste reception, waste deposition as well as site maintenance and control.

Waste reception comprises operations as;

- checking vehicles and loads at the site entrance,
- segregating wastes and loads,
- temporary storage for on-site roads,
- registry and record keeping,
- on-site traffic control and direction to the working face.

Waste deposition encompasses on-site operations, which are;

- waste placement in the working face,
- compaction,
- excavating cover material,
- spreading cover material,
- construction of on-site haul roads,
- construction of bunds and earthworks.

Site maintenance and control embraces mainly supervision and monitoring activities, such as;

- litter and dust control,
- maintenance of buildings, fences and plants,
- surface water control,
- leachate control,
- gas and odour control,
- vermin and bird control,
- environmental monitoring.

All these operations have to be carried out within the framework of the Operation Plan as required by the Ministry of Environment in compliance with Solid Wastes Sanitary Landfill Operations Procedures.

d. Rehabilitation of the Present Disposal Site in Mersin

A separate personnel list must also be prepared for the rehabilitation activities to be carried at the present final disposal site in Mersin upon the initiation of sanitary landfill operations at Cimsa site. A reasonable rehabilitation staffing level may well include:

- A rehabilitation manager based at the site,
- A deputy manager or supervisor,
- A gate keeper and security guards,
- A clerk,
- Traffic marshals directing vehicles in the site,
- Vehicle operators for landfill and earthmoving,
- A maintenance mechanic,
- 4 manual labourers per shift.

The size of the staff can be identified in the light of

i. definitive waste and earth volume to be handled daily,
ii. number of work shifts a day, and
iii. mechanisation level, as well.

e. Sorting and Compost Plants at Cimsa Site

There are two options for the management of the operations of sorting and compost plants; either separately or jointly. If these two plants are located at the same site in close physical distance to each other, it would naturally be rational and economic to manage their operations, jointly.

Departing from this point of view, the following staffing has been represented in the table below, where one can distinguish between separate personnel and joint personnel of the compost and sorting plants, alternatively and respectively.

Table 11-44: Staffing of Compost and Sorting Plants at Cimsa Site

Personnel	Compost Plant	Sorting Plant
Sub-manager	1	1
Accountant	1	1
Secretary	1	1
Supervisor	4	6
Machine operator	6	10
Loader operator	8	2
Labourer	18	42
Driver	4	4
Total	43	67

11.5.2 Legislation and Enforcement

The first legal regulation related to solid waste management has been made by the General Public Health Act of 1930 and this duty has been given to the municipalities. According to the Greater Municipalities Act of 1984, the greater municipalities are obliged to identify the locations, where solid wastes and industrial wastes have to be collected, sorted, recycled and disposed within the overall waste management system. The greater municipalities have been further obliged to set up the necessary sites and plants as well as to operate them, whilst the district municipalities are associated solely with waste collection activities. The greater municipalities, and likewise the Mersin Greater Municipality, are free either to set up and operate recycling plants and final disposal sites by themselves or let them be set up and operated by a certain company on contractual basis.

The municipalities or any other municipally authorised organisations, which are in charge of establishing and operating landfills are legislatively obliged to submit their recent reports to the Ministry of Environment about the status of their SWM activities and current state of dumpsites, landfills, or closed disposal sites. This was made compulsory and binding for the municipalities through the Regulation on Solid Waste Landfill Sites prepared by the Department for the Management of Wastes and Chemicals of the Ministry of Environment and issued in May 1993.

Accordingly, the Mersin Greater Municipality is bound, like rest of the municipalities, to meet the requirements and forward necessary documents to the Ministry of Environment in this concern. The regulation also states that the municipalities have to identify the locations of current dumpsites, disposal sites and landfills in their urban development and land use plans and prohibit any settlement on these areas for 30 years. A special attention and care have to be devoted by the Mersin Greater Municipality to this issue.

For the closure of dumpsites, landfills and final disposal sites, the regulation envisages no final surface coverage to be undertaken without establishing necessary systems required for gas exhaust and outlet. In case of omitting any responsibility or obligation stated in the regulation, the Mersin Greater Municipality will be subjected to penalties as indicated under the provisions of Article 46.

According to the Regulation on Solid Waste Landfill Sites again, the Mersin Greater Municipality is obliged to indicate the location of the closed dumpsites, landfills and final disposal sites on urban development and landuse plans as well as to permit no construction or settlement on these sites for 40 years following the closure.

The Mersin Greater Municipality is also legally obliged to train personnel engaged in sorting, recycling, composting and disposal practices. They must provide not only vocational training, but also consciousness building on basic environmental protection and public health principles is also legally envisaged.

In the identification of eligible locations to be used for sanitary landfill sites, sorting and compost plants and in making final decision on Cimsa site as well, a series of criteria set forth by the regulation have been met; such as, distance to settlement areas; water resources; underground water movements; geological, geo-technical and hydrogeological structure; traffic and transportation distance; aesthetics; and landfill capacity.

However, there are also some legal liabilities to be accomplished by the sanitary landfill operator during final disposal activities. The sanitary landfill has to be operated in accordance with Solid Waste Sanitary Landfill Operations Procedures as envisaged by the Ministry of Environment. Following the completion of landfill operations and closure of the sanitary disposal site, the monitoring activities must be obeyed for 10 years.

The Amendment on the Regulation for Solid Waste Control issued on September 15th, 1998 declares that the Ministry of Environment is in favour of utilisation of recyclables and assigns the governorates and municipalities to promote and to encourage actions and implementations in this respect. With the aid of incentives, these agencies are also supposed to foster use of recycled materials wherever possible.

The regulation stresses that medical wastes, chemicals, radioactive wastes, and hazardous wastes must be separately disposed. The governorates and municipalities are responsible for the separate disposal of hazardous and medical wastes pursuant to the Regulation for the Control of Hazardous Wastes issued on September 27th, 1995 and Regulation for the Control of Medical Wastes issued on May 20th, 1993, respectively.

The commercial and industrial enterprises producing, importing and selling products in PET, PVC, PE, PS, PP, aluminium, tin, glass, etc. type of recyclable containers are subject to material recovery and must collect a certain portion of their empty containers back. This material recovery action based on quota and deposits practices is managed by a commission, which fixes yearly target rates for each enterprise, individually. If the target rates are not achieved by the enterprise, the quota conditions for the following year get harder.

According to the Regulation for Solid Waste Control, the mayors within the municipal boundaries, and the governors in rest of the adjacent municipalities within the provincial boundaries, are obliged to take necessary measures for separate collection or sorting of recyclables in order to ensure a more environmentally sound waste disposal and a more economic utilisation of collected inorganic and organic but recyclable household, commercial, institutional, market and park wastes.

11.5.3 Financial System

a. Problems in the Present Cleansing Tax System

The cleansing tax system was introduced in 1994 in the aim to establish a financial base for the cleansing services. The system does not function, however, due to the following problems.

- Revisions in the cleansing tax tariff are not in accordance with the increase in cleansing service expenses.
- The cleansing tax tariff does not reflect waste discharge characteristics and the taxpayers' ability to pay.
- The number of buildings to be taxed are not fully identified.
- Since the cleansing tax is only standardised by province, the tax amount does not take into account the disparity in municipal cleansing service expenses.

- Since the cleansing tax is imposed by building use, incentives to promote waste volume reduction and separate collection are difficult to establish.

b. Improvement Measures

The introduction of a cleansing tax system by waste amount is one way to solve the aforementioned problems. This would refer to the setting up and collection of a cleansing tax tariff in accordance with the discharge amount. This is not to say, however, that this system is without any problems. The table below compares the advantages and disadvantages of a cleansing tax system by waste amount and a cleansing tax system by building use.

Table 11-45: Advantages and Disadvantages of Cleansing Tax System by Waste Amount and by Building Use

	Advantages	Disadvantages
Cleansing Tax System by Waste Amount	• Willingness to pay the SWM expenses is clearly determined. • The SWM collection fee may be established by service level. • Imposing taxes by waste amount would enable activities that would encourage waste minimisation.	• Waste discharge amount is difficult to measure. • Establishing a tariff that reflects waste discharge characteristics and the peoples ability to pay is difficult. • Cost involved in fee collection can easily rise. • Easily induces illegal dumping.
Cleansing Tax System by Building Use	• Facilitates establishing of fees. • Cost involved in fee collection becomes cheaper	• Establishing a waste collection fee by service level is difficult. • Incentives to promote separate collection and waste minimisation are difficult to promote if collection is by building.

As in other taxes, the collection of the cleansing tax is compulsory, hence it is generally said that 70 to 80% of the amount is collected. Joining the cleansing tax with the real estate tax is also expected to further increase the rate.

In contrast, it is difficult to make collection compulsory under a direct collection system. If direct collection is carried out in accordance with the waste amount, a weighing system should be established.

From the results of the above studies, this study recommends the restructuring of the cleansing tax system.

c. Actualisation of the Implementation Plan

The factor to be considered first and foremost in the implementation of a financial system is the full utilisation of the advantages of the cleansing tax system introduced. This would mainly refer to the following:

- Establishing an adequate tax tariff
- Raising the collection rate to over 90%

In addition, to promote separate discharge and waste minimisation, specific waste bags should be introduced and a separate fee for bulky discharges should be established to gain public co-operation.

The following points regarding the financial system should be improved to actualise the implementation plan.

- Improvement of cleansing tax collection rate
- Reconsideration of cleansing tax tariff

c.1 Improvement of Cleansing Tax Collection Rate

Aiming for a 90% cleansing tax collection rate would significantly require not only the establishment of a solid financial base, but also the implementation of the beneficiary pays principle. Almost all of the residents discharge their own waste, while nearly all households receive the waste collection, treatment, and disposal services. At present the number of buildings subject to the cleansing tax is not systematically identified. To discourage cleansing tax evasion, cleansing tax should be billed jointly with the real estate tax.

c.2 Reconsideration of Cleansing Tax Tariff

The cleansing tax is reviewed yearly but still is not enough for the ever increasing cleansing service costs. The waste discharge characteristics cannot be reflected in the tax due to the standardisation of the tax tariff. It is, therefore, important to study the discharge conditions in households and offices to adopt a suitable tax tariff. Cross subsidy should also be considered for households.

c.3 Elucidation of Cleansing Service Expenditures

The accounting of various SWM cleansing services are currently not carried out separately. A separate accounting should be carried out in order to clarify how much is being spent on every service.

11.5.4 Privatisation and Contracting System

In fulfilling its legally obligatory services related to recycling and sanitary landfill management, the Adana Greater Municipality like rest of the municipalities, has the right either to undertake these activities by itself, or commission a private entity to undertake them on its behalf. If commissioning an entity is found appropriate and beneficial, this is naturally possible through a privatisation action based on certain contractual provisions.

It is for sure that the Mersin Greater Municipality has gained a considerable experience in general aspects of privatisation. Relying on this experience the following can be contracted out to the private secotor:

- Betterment of composting operations at the present disposal site.
- Rehabilitation operations in the present disposal site.
- Prospective sanitary landfill operations in the Cimsa site.
- Sorting operations at the prospective sanitary landfill site.
- Composting operations at the prospective sanitary landfill site.

There are however a series of legal obligations which deserve due attention in contracting. These legal obligations which have to be of binding character for the contractor are:

- Security obligations - physical instalments for the safety of site,
- Monitoring and reporting obligations - environmental quality assessments and measurings,
- Training obligations - environmental protection and public health measures,
- Hygienic obligations – personnel, equipment and vehicle sanitation,
- Follow up obligations – monitoring for after care measures.

Special care has to be taken to above mentioned issues within the contractual framework for judicial reasons without neglecting the following issues for professional reasons:

- Managerial and operational obligations – tasks and performances,
- Personnel obligations - qualification and size of managerial and operational staff,
- Financial obligations – investment, personnel, operation and maintenance costs and payments,
- Scheduled obligations – timely achievements.

The contracting conditions could be made mutually favourable and beneficial, if the municipality and the contractor agree on a gentleman's protocol for the renewal of their contract, which is legally restricted to 1 year.

11.5.5 Monitoring and Information Management System

A legal enforcement executed by the Ministry of Environment through the Regulation on Solid Waste Landfill Sites requires each municipality or municipally authorised organisation, to forward to the ministry relevant information on previous and recent status of waste discharge activities as well as current situation of dumpsites, landfills and closed disposal sites. Mersin Greater Municipality must also obey this action. The aim of the Ministry of Environment through this legislative instrument is, at the first glance, to assess leachate and gas emissions endangering natural and human resources in close surrounding, and followingly, to set up a perpetual monitoring of activities and measures taken in this regard.

The Ministry of Environment emphasises that, the greater municipalities should provide such an information channel to put the ministry in a better position to assess the current and potential environmental risks, whereby the locational conditions and disposed waste amount are taken into consideration. This commitment is further important for the ministry to identify necessary measures in currently used and / or previously used but recently closed landfill sites based on analyses related to waste volume, waste composition, locational specifications, geological and hydrogeological structures, etc. The Ministry of Environment asks the municipalities for information exchange and calls for coordination in these issues.

In the light of above explanations, it is obvious that, the operating agency of the sanitary landfill site of Mersin has to enter into certain legal commitments with the Ministry of Environment within the framework of an operation plan. This prepared

plan must be confirmed by the ministry in respect to its compliance with the Solid Waste Sanitary Landfill Site Operations Procedures. Not only operation regulations and instructions are indicated in this plan, but also a series of monitoring activities. These monitoring requirements, which are basically confined to leachate and gas emissions, must be periodically fulfilled and the results reported to the Ministry of Environment. Therefore a precise list and description of monitoring tasks must be developed, in which specifications related to measuring activities are amply identified along with reporting procedures to be pursued upon evaluations. These obligations necessitate an adequate information system to be structured upon a periodical checklist for an effective monitoring.

The Mersin Greater Municipality must prepare an operation plan for Cimsa site, in which sanitary landfill practices will start. In addition to this plan, another specific document has to be prepared for present disposal site, in which rehabilitation activities must be carried out. All these operation plans will naturally be associated with monitoring obligations on procedural basis.

Another important subject is the monitoring and control of settlement actions nearby the landfills. The regulation envisages that currently used waste disposal sites, as indicated in the landuse plans, must not be permitted for any settlement purpose for a time period of 30 years. A similar action is also envisaged for closed dumpsites, which prohibits any settlement over this area for 40 years following the closure. Those closed dumpsites have to be regularly inspected and monitored by undertaking periodical samples related to gas generation, leachate percolating, and underground and surface water contamination. Closed sanitary waste disposal sites on the other hand, which is presently a very rare case in Turkey, must be monitored for 10 years following the closure, as mentioned in the regulation.

From a locational standpoint, the Cimsa site possesses such physical assets, which does not favour any settlement intention in long run. However, the present compost plant and waste disposal site in Mersin, in which operations are ought to be terminated in short run, must be cautiously rehabilitated and nearby settlement structure must be effectively preserved.

The consequence to be drawn from legal provisions is that, over the present compost and waste disposal site, no settlement action will be permitted in consecutive 40 years upon its closure. This site will additionally be kept under monitoring throughout this period. Following the termination of sanitary landfill operations in prospective Cimsa landfill site in Mersin, this site will also be monitored 10 years long.

According to the Regulation on the Solid Waste Landfill Sites 1993 again, it is not sufficient to secure the bottom impermeability of waste storage and outlet for methane gas. Wastes must be adequately laid over and they should therefore be weighted and controlled before being admitted to the site. No domestic or wild animal should be allowed into the fenced sanitary landfill site. The leachate and gas emissions must be regularly assessed and monitored, as well.

Regarding the closure of old dumpsites, it is neither sufficient to cover the surface of stored wastes and establish a functioning gas collection and outlet system. The closed dumpsites must be inspected and controlled continuously. Especially in those closed dumpsites near the residential areas, methane gas must particularly be measured . On regular monitoring basis; the plant cover over the waste storage, access and entrance

roads as well as the gate, surface water drainage, leachate collection systems and gas outlets must be maintained and repaired, if required.

11.5.6 Human Resources Development

In the Regulation on Solid Waste Disposal Sites issued in May 1993, the Ministry of Environment sets forth, that all solid waste management activities of the municipalities should be carried out in association with training. All engaged personnel have to be conscious about and be trained on the "environmental protection from cradle to grave" principle.

In compliance with above stated principle, the municipal and private personnel engaged in solid waste management must be mentally well prepared for environmental protection and fulfil the requirements adequately throughout implementations and operations. The Ministry of Environment is in the expectation, as articulated in the regulation, that those individuals working on waste collecting, sorting and storing phases of solid waste management process are obliged to be informed about the risks generated by wastes and must take necessary measures in this regard. Similarly, the manpower working in rehabilitation of old dumpsites must be priory well trained about the dangers caused by the methane gas. They have to be equipped properly and must know how to take necessary measures.

According to the regulation, the personnel working in operational and field services have to wear gloves, protective glasses, boots and special garments. Work garments equipment, and vehicles ought to be disinfected and cleaned on a periodical basis.

Cleanliness is another prime issue that needs to be emphasised by every occasion. The garments worn by the personnel, instruments, and vehicles used during operations must be cleaned and disinfected. The personnel must get used to cleanliness and learn it from his near social and labour environment.

These provisions require the Mersin Greater Municipality to give more efforts on training of personnel on general environmental protection issues, environmental relevance and risks as well as protection regulations and implementations to be pursued throughout their tasks related to solid waste collection, transportation and disposal as well as after care engagements subsequent to closures.

11.5.7 Public Education and Co-operation

a. Promoting Education, Public Awareness, and Training

a.1 Initiative for Source Separation

Continuous experimental pilot projects should be carried out as environmental education and co-operation projects, with the following objectives:

- To raise public awareness on SWM issues and change people attitudes towards waste minimisation, recovery, and recycling.
- To ask public co-operation for waste separation at source (compostable and non-compostable wastes) in order to improve the quality of compost product in the existing and future composting plants.

- To introduce public co-operation and participation as a mean of promoting separate waste collection system in the whole city. Awareness of the limitation of natural resources, and of the magnitude of the impacts of human activities on the environment, learning about composting and recycling as a ways to help to reduce the amount of waste being produced.

- To formulate and conduct public education programs on SWM issues through meetings and workshops.

In making the pilot project for public education, it is necessary to select the more appropriate area and materials to get joint participation of the whole area population. In order to achieve the objectives of campaign project the following campaign materials are recommended:

Table 11-46: Education Materials

Material	Advantages	Disadvantages
Printed flyers	Repetition effect Re-usability	Little impression
Charts and posters	High portability	Limitation of information Not for the masses
Overhead projector (OHP)	Can be used in lecture theatres	High cost (projector) Heavy and low mobility
Slides	Good for a large number of people Relatively low cost	High cost (projector & development)
Sound filmstrips	Good for a large number of people Story-like explanation	High cost (projector & dark curtain & film making)
Use of real examples	Instant explanation with local materials (easy access and high familiarity)	Seasonal and location constraints
Radio & television	High impact with repetition effect	High cost
Video film	High impact Quick replay	Needed electric facilities High cost (VCR & parts)

a.2 Education on Sustainable Development

To improve the present SWM problems with the promotion of the independent and positive involvement of the general public for reducing environmental load, it is essential to spur changes in the socio-economic and cultural system.

In order to promote such voluntarily involvement by the general public, it is required to promote public education, and environmental-related learning from the viewpoint of lifelong learning, at greater municipal level, at home, school, and the workplace, so that the various sectors can obtain basic knowledge of relation between human beings and the environment, and so that they can deepen their understanding of the environment and take voluntary action for environmental conservation.

Taking into account the above, Mersin GM must attach importance to the implementation of the following activities.

- Mersin GM must develop the information base, which is conductive to the environmental education of the general public, and must promote the provision of information through various kinds of media. It should also foster human

resources for the promotion of separate collection activities and should develop facilities for environmental learning, etc. Also, in order to improve work for public education by local authorities, Mersin GM must promote programs, which has to do with environmental education, in towns and cities.

a.3 Promoting Training

To effectively promote measures for separate collection experiment, it is necessary to improve and strengthen systems to carry out these measures by continuously fostering human resources to fulfil the role of such promotion in a well-planned manner.

b. Environmentally Sound SWM

It is necessary to reduce as much as possible the final amount of waste to be treated in order to minimise waste, by limiting the generation of wastes, promoting the use of recycled resources, and properly disposing of wastes as well as reducing the amount of wastes.

As mentioned in Section 5.4, the main objectives of public education program in Mersin are to introduce a separate collection and promote the reduction of wastes and resources recovery.

As the issue of waste represents a big problem, which must be solved in order to construct a socio-economic system with reduced environmental load, in addition to limiting the generation of wastes, it will be necessary to reduce waste amount by promoting the reuse, reduce and recycling of resources.

c. Education Program Guideline

Environmental education is given by a number of institutions, organisations and agencies. However, no separate collection system has been globally introduced at the city level (except the experiment on separate collection carried out in GSHC) and the public is hardly aware of the SWM problems. In order to deepen understanding of the SMW problems and contribute for minimisation and recycling, an education program for the priority projects is guideline consisting of the following elements:

1) The present public education system in Mersin GM will offer the basis for the education program proposed. No drastic reforms or changes may be applied for the system, since these require extra governmental expenditure and, at the same time, create unwelcome disorder within the system.

2) Harmonious co-ordination is required among “formal education programs” and “community-base education programs”. This stabilise the ties between government and private sectors, and encourage sustainable SWM improvement in Mersin GM.

3) The program should take stepwise deployment onto short, middle and long range targets: the short term program aims to establish a fundamental basement and plays the role of a “booster” for the middle and long term programs off; the middle and long term programs will be an engine of sustainable separate collection improvement.

4) Each roles of related entities and actors should be clarified both in the co-operative program planning and implementation. The program will

provide each entity occasions to practice co-operative actions. This may lead a moderate institutional reform in the field of co-operative SMW improvement.

d. Key Approach for Sustainable Development

This approach is consisted of three stages, that is, short range, middle range and long range programs.

Short Range Program: targeting the year 2005

This program identified as a booster for taking off the pilot project. It aims to enhance people's conscious on separate collection system; introduce co-operative scheme on SWM improvement; renovate former useful programs for SWM and community participation, and offer basic knowledge on separate collection.

Middle Range Program: targeting the year 2010

This second stage booster will enforce and expand the basic ideas and strategy in the former stage bridging toward the next program. Review on the short program will be expected to indicate useful lesson in the next stage.

Long Range Program: targeting the year 2020

The final program will pursuit to review and estimate impacts of the first and second programs, and establish a harmonious sound SWM system with long span sustainability in total.

e. Recommendation to Promote Separate Collection System at a Housing Complex in the Selected Priority Project Area

Most of householders in the housing complex may have interest to participate in the separate waste collection experiment. Some apartment dwellers, however, will not be able to take part in waste separation activities for a variety of reasons. But most of the people understand that objectives of waste separation contribute for the better environment and the future of its city.

The followings are simple issues to be considered to promote the experiment:

1) To discuss the idea with the building representatives and doorkeepers. They are familiar with the buildings, its tenants and how waste is collected.

2) To find out how garbage is handled now. To verify if each householder required bringing the garbage to a collective waste bin installed on each floor. If there are containers outside the buildings to store the garbage, etc.

3) To determine what composting and recycling opportunities are available in the area.

4) Design a separate collection and recycling systems that fits into each situation and area. For example, if each tenant places their garbage into a waste bin or container, then set up a separate waste bin and container for organic wastes and recyclable materials, providing instructions on what should and should not go into it.

5) To prepare information (e.g., leaflets, pamphlets, etc.) for householders on how the program is to work and why it is important to participate.

6) To launch the program using the building representatives, doorkeepers or internal newsletter to broadcast the program.

7) Monitor the program to make sure everyone knows how to participate properly and receives information on how well they are doing to encourage their continuous co-operation.

11.6 Project Evaluation

11.6.1 Technical Evaluation

Technical systems of the priority projects comprise:

1. Introduction of a separate collection system
2. Construction of a sorting plant
3. Construction of a compost plant
4. Construction of Cimsa MSW disposal site
5. Construction of Cimsa medical waste disposal site

The technical evaluation assesses the feasibility of these priority projects, with reference to the present technical capabilities of the target area.

a. Separate Collection System

The introduction of the separate collection system is expected to be difficult as mixed collection is currently practised in the target areas. To overcome this difficulty, separate collection is going to be introduced gradually, first in areas where the system can be easily implemented. In the F/S, areas like GSHC - pilot project area in Mersin - are prioritised and the aim is to disseminate the practice to 30% of the population by 2005.

Based on the pilot project in Mersin, it is concluded that properly explaining the objectives, the methods, and the degree of public co-operation required to the residents would ensure the feasibility of introducing the separate collection system. The pilot project verified the feasibility as non-compostable waste in compostable waste is only less than 10%. By modifying the contents to suit the conditions in whole Mersin GM, the education book produced to promote the pilot project is also an indispensable tool in gaining very effective public participation.

Conclusively, by making full use of the experiences gained from the pilot project in Mersin, the gradual introduction of the separate collection system is very feasible.

b. Sorting and Compost Plant

Mersin is one of the municipalities in Turkey with some experience in the construction and operation of a compost plant. The plants, however, are not successfully operated. The sorting facilities that are constructed in some cities are very simple in structure and totally different from what this study proposes. In the planning, design, construction, and operation of the sorting and compost plant, therefore, a fully experienced consultant and plant manufacturer from advanced

nations should be contracted on condition that they enter a joint venture with local firms. This would facilitate the transfer of the relevant techniques and know-how to local firms.

With the exclusion of the plastic bag breaker for the sorting plant and the selective crushing separator (SCS) for the compost plant, all relevant equipment can be procured locally, and would therefore eliminate any worries in the acquisition of spare parts and in maintenance. The plastic bag breaker and the SCS will be imported, but since the structure of both equipment is not complex, no problems are foreseen to arise especially with the transfer of techniques required for the operation and maintenance of these equipment using the aforementioned methods. In terms of acquisition of spare parts and maintenance, the setting up of a local agency could overcome any problem.

c. MSW and Medical Waste Disposal Site

The local construction firms are deemed fully capable of developing the MSW and medical waste disposal sites. The disposal sites in Turkey, however, do not fully carry out sanitary landfilling as stipulated by the SWM and Medical Waste Control Regulations of MoE. A consultant from an advanced country that is fully experienced in the planning, design, construction and operation of a sanitary landfill will be contracted and made to work hand in hand with a local firm, also in consideration of technology transfer.

No problems are forecast to arise in the procurement of the equipment necessary for the operation of the MSW and medical waste disposal sites, as all that is necessary are available locally.

11.6.2 Social Evaluation

The priority project would incur various social impacts, however, only the intangible social impacts were evaluated.

Negative Impacts:

- Opposition from the residents in the vicinity of the Cimsa site
- Loss of livelihood for scavengers.
- Rise in cleansing tax rates.

Positive Impacts:

- Improvements in sanitary and public health conditions of the Compost Plant dumpsite surrounding area
- Promote investment and tourism.
- Increase in land value.

a. Measures to Mitigate Negative Impacts

a.1 Opposition from the Residents in the Vicinity of the Cimsa Site

Although proposed Cimsa disposal site is located more than 1,000 metre from the nearest inhabitant, it has already received opposition from the residents in the vicinity of the site. In order to mitigate the opposition, a 30 metre wide buffer zone (tree,

plants) will be constructed along the boundary of the proposed site to isolate the disposal site from the surrounding residents and thereby ease resident.

a.2 Loss of Livelihood for Scavengers

The priority project proposes to prohibit the entry of unauthorised persons into the disposal site in 2002 for an effective sanitary landfill operation. If this is enforced, this will deprive the scavengers, who work in the dump site, of their livelihood. As for the mitigation measures, Mersin GM may request the operator of the sorting plant to hire scavengers as sorting workers.

a.3 Rise in Cleansing Tax Rates

The priority project proposes to raise the present cleansing tax rate and increase the revenue of SWM services to implement the proposed projects. Although this would increase the financial burden of the citizens, the following considerations are taken into account to minimise the negative impacts.

a) To introduce a cross-subsidy mechanism (i.e., the affluent pays for the less well off).

b) To keep the proposed rate below the amount that people are willing to pay (WTP).

c) To keep the proposed rate below 1.0% of the resident's income.

The table below compares these amounts.

Table 11-47: Ratio of Cleansing Tax to Income

	2002	2003	2004	2005
Average annual household income (US$/year)*[1]	6,000	6,100	6,210	6,320
Cleansing tax per household (US$/year)	12.7*[2]	23.0	23.1	46.5
Ratio of cleansing tax (%) to income	0.21	0.38	0.37	0.74

Note: *1: Calculated assuming that the increase is in proportion to the per capita GRDP.
*2: Amount of willingness to pay from POS

The priority project proposes a cleansing tax rate higher than the amount residents are willing to pay (US$ 12.7 /year) assuming that they can afford to pay more as the WTP is far below 1 % of the average income.

b. Positive Impacts

b.1 Improvements in Sanitary and Public Health Conditions of the Compost Plant Dumpsite Surrounding Area

The implementation of the project will bring various benefits. The current open dumping adversely affects the Compost Plant dumpsite and its surrounding area. Consequently, neighbours frequently complain about these unfavourable conditions, and therefore strongly oppose the use of the site. These adverse impacts will be considerably mitigated by the rehabilitation of the Compost Plant dumpsite. The implementation of the project, therefore, will improve the sanitary and public health conditions of the Compost Plant dumpsite surrounding area, and terminate resident opposition to the operation of the disposal site. In particular fire outbreaks, which

affects not only the surroundings, but also the city centre will be eliminated completely.

b.2 Promotion of Investment and Tourism

In addition to the health effects, separate collection, promotion of government related recycling by constructing sorting and compost plants, and the proper disposal of wastes will provide Mersin GM with a favourable environment would eventually lure foreign investment and promote tourism. Since Mersin GM is the centre of economic and social activities in the Icel Province, the improvement of its environment will enhance its image and eventually contribute to attracting more investors and tourists to the area.

b.3 Increase in Land Value

Well-managed waste disposal operation will improve the living environment, which in turn will increase the value of the land in the area. A study on the relationship between the living environment and land value suggests that, other factors held constant, housing values rise at an average rate of 6.2 % a mile within a two-mile radius of the landfill, presumably because the environmental and aesthetic problems associated with living near a landfill diminish as distance increases. Thus, the implementation of projects, sanitary landfill operation, etc., increases the land value around the present Compost Plant disposal site.

11.6.3 Environmental Evaluation

The table below summarises the impacts that are predicted to occur with the implementation of the priority project.

Table 11-48: Summary of the Priority Project Environmental Evaluation in Mersin

Project	Positive Impacts	Negative Impacts
Separate Collection	• Removal of offensive odour • Improvement in aesthetic conditions • Contributes to the prevention of global warming • Creation of job opportunities	• Increase in traffic ⇒ Air pollution ⇒ Global warming ⇒ Traffic accidents ⇒ Traffic congestion ⇒ Consumption of fossil fuel
Sorting and Compost Plants	• Creation of job opportunities • Soil improvement of farm land • Contributes to global environmental conservation ⇒ Energy saving ⇒ Prevention of air pollution ⇒ Consumption of fossil fuel	• Operation of plants ⇒ Air pollution ⇒ Noise ⇒ Vibration ⇒ Consumption of fossil fuel
Improvement of MSW and Medical Waste Disposal Site	• Improvement of sanitary and public health conditions • Reduction of landfill gas ⇒ Less air pollution ⇒ Contributes to the prevention of global warming • Treatment of leachate ⇒ Control water pollution • Improvement in aesthetic conditions • Increase in land prices in the surrounding area of	• Increase in equipment ⇒ Air pollution ⇒ Noise ⇒ Vibration ⇒ Consumption of fossil fuel • Decrease in land prices in the surrounding area of proposed Cimsa site

Project	Positive Impacts	Negative Impacts
	present Compost Plant dumpsite • Reduction of public nuisance • Creation of job opportunities	

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

Construction and operation of sorting and compost plants will have various significant positive impacts on the target area. This benefit will outnumber the negative impacts that will result from the operation of the plants.

The rehabilitation of the Compost Plant dumpsite and development of a sanitary landfill at Cimsa site will significantly mitigate the existing negative impacts, and outnumber the negative impacts that will result from an increase in the use of heavy landfill equipment.

11.6.4 Financial Evaluation

a. Financial Evaluation Method

Financial evaluation is carried out to determine whether the cleansing service management and financial plan can be realised within the financial capacity of the agency in charge. Since the cleansing services involve quite a number of agencies, the evaluation of the financial state of each agency would be difficult. Here, an overall financial evaluation of the cleansing service conditions in the target area, that consists of Mersin GM, Akdeniz DM, Toroslar DM, and Yenisehir DM, is carried out in accordance with the conditions shown in the table below.

Table 11-49: Major Assumptions for Financial Evaluation in Mersin

Agency in charge of cleansing services	Contracting out of waste collection and public area cleansing services to private companies and planning and monitoring should be carried out by the DMs. Contracting out of the cleansing of main roads and the operation of the sorting plant, compost plant, and disposal site to private companies is promoted. However, planning and monitoring should be carried out by the GM.
Evaluation Period	Financial evaluation is carried out by calculating the FIRR and preparing the cash flow based on revenues and expenditures from 2000 to 2016 (17 year period).
Revenue	Revenues refer to those gained from: • cleansing tax • budget allocation from general finances of the DMs and the GM • sale of recoverables and compost • tipping fee for direct haulage and medical waste Alternative studies are carried out on the cleansing tax and budget allocation from general finances. The revenue in 2005 will be adopted for the period from 2006 to 2016.
Investment Cost	The following investment costs until 2005 is considered: • introduction of a separate collection system • construction of a sorting plant • construction of a compost plant • development of an MSW disposal site

	• construction of a medical waste disposal site For collection vehicles and heavy machinery, the life span is set at 7 years, with due consideration of the required renewal cost from 2006 to 2016. For the MSW disposal site, the investment for site renewal used for 2005 is adopted for 2009 and 2013, and the residual cost in 2016 is calculated as the negative investment cost for 2017. Also, for collection vehicles and heavy machinery with a life span exceeding 2015, the residual cost in 2016 is calculated as the negative investment cost for 2017. Alternative studies is carried out for the allocation of the investment cost.
Operation Cost	The estimated cost is adopted until 2005. The expenditures adopted for 2006 to 2016 are as in 2005.
Cut-off Rate	The interest in foreign funds for main projects is currently 4 to 5%. The standard cut-off rate (8%) used by the European Development Bank and World Bank is applied.
Price Increase	The prices for 1998 is adopted in the financial evaluation; price increase is not considered.

b. Case Studies

The following case studies are implemented to determine financial sources for the investment, maintenance, and management costs.

b.1 Cleansing Tax

The problem with the current cleansing tax system is its inablility to cope with the increasing SWM costs. This is mainly because of the absence of sufficient feedback due to a lack of clear understanding of the buildings taxed and the SWM expenses. The following three case studies are implemented with regard to the cleansing tax system.

Case Study	Cleansing Tax Rate	Collection Rate	No. of Taxpayers*
CT.1	Maintaining the 1998 tax rate	90% in 2002	cleansing tax for households will increase in proportion to the population; cleansing tax for offices will increase in proportion to the GRDP.
CT.2	The fee in 2005 will be raised by 3.6 times the 1998tax rate, and the total amount to be collected will be 7.3 times the present amount. (This will cover 67% of the cleansing service expenses including depreciation costs.)	90% in 2002	cleansing tax for households will increase in proportion to the population; cleansing tax for offices will increase in proportion to the GRDP.
CT.3	The fee in 2002 will be raised 3.6 times the 1998 tax rate, and the total amount to be collected will be 7.3 times the present amount. (This will cover 67% of the cleansing service expenses including depreciation costs.)	90% in 2002	cleansing tax for households will be in proportion to the population. Cleansing tax for office will be in proportion to GRDP.

Note: *: number of buildings taxed.

b.2 Allocation from General Financial Source

Although Mersin GM receives cleansing tax payments from the DMs, 4% of its finances (municipal budget) is allocated to the cleansing services. The DMs allocate 11% of their revenues, excluding those acquired from the cleansing tax, to the

cleansing services. Below are the three case studies implemented with regard to the allocation of budget for SWM.

Case	GM	DM	General Financial Source Growth Rate in Real Terms (Estimate)
MB.1	2.%	5.5%	1.3 times the 1998 figure by 2005
MB.2	4%	11%	1.3 times the 1998 figure by 2005
MB.3	6%	16.5%	1.3 times the 1998 figure by 2005

b.3 Investment Fund Allocation

In Turkey, investment funds are either derived from foreign loans or central government subsidies. Municipalities repay foreign loans with interest. For the investment required for SWM, the following two case studies are implemented for 2000 and 2001.

Case Study	OECF Loans*[1]	Government Subsidy
FI-1	75%	25%
FI-2	50%	50%

Note: *[1]: loans are repayable in 25 years, with a 7 year grace period and an interest rate of 2.2%

c. Expenditure Plan

c.1 Required SWM Costs

The overall SWM cost needed for the implementation of the priority project (target year: 2005) is summarised in the following table.

Table 11-50: Cost Summary of the Priority Projects for Financial Evaluation

unit: US$1,000

Items		2000	2001	2002	2003	2004	2005	Total
Investment	Separate Collection	0	1,349	257	193	321	257	2,377
	Sorting Plant	142	2,629	0	0	0	0	2,771
	Compost Plant	263	4,877	0	0	0	0	5,140
	Final Disposal Site	317	6,442	0	25	1,891	6,189*[6]	14,864
	Medical WDS	91	2,210	0	0	0	0	2,301
	Sub-total	813	17,507	257	218	2,212	6,446	27,453
O & M Costs	Separate Collection	0	0	924	1,100	1,232	1,452	4,708
	Sorting Plant	0	0	378	378	378	378	1,512
	Compost Plant	467*[2]	467*[2]	440	440	440	440	2,694
	Final Disposal Site	1,650*[3]	1,763*[3]	375	375	375	341	4,879
	Medical WDS	0	0	34	34	34	34	136
	Administration*[1]	402	423	524	538	549	577	3,013
	Sub-total	2,519	2,653	2,675	2,865	3,008	3,222	16,942
Existing System	Collection & Haulage*[4]	4,029	4,291	3,468	3,468	3,468	3,468	22,192
	Public Area Cleansing*[5]	1,888	1,947	2,008	2,072	2,138	2,206	12,259
	Sub-total	5,917	6,238	5,476	5,540	5,606	5,674	34,451
Overall SWM expenses		9,249	26,398	8,408	8,623	10,826	15,342	78,846
Overall SWM costs		8,436	8,891	11,011	11,288	11,522	12,121	63,269

Note: *1: 5% of the overall SWM expenses (inclusive of depreciation cost)

*2: Calculated based on US$32/ton (US$19/ton of the current O&M cost of the compost plant + US$13/ton of depreciation cost)
*3: Calculated based on US$10/ton
*4: Calculated based on US$25/ton
*5: Calculated based on US$221/ton
*6: Modified the investment cost according to the disposal volume after 2006 assumed to be equivalent to the volume of 2005 for the financial evaluation.

The overall SWM cost for 2005, calculated by converting the priority project investment cost into the depreciation cost, is US$12.1 million – 2.5 times the overall SWM expenses (US$4.8 million) at present.

c.2 Investment Plan for Financial Evaluation

In the financial evaluation, the renewal cost from 2006 to 2016 and the residual value by the end of 2016 are calculated as negative investment costs for 2017. The table below summarises the investment costs for each priority project.

Table 11-51: Investment Costs for Financial Evaluation in Mersin

unit: US$1,000

		2000-2001	2002-2005	2006-2016	Salvaged Value
Investment	Collection & Haulage	1,349	1,028	3,983	-1,643
	Sorting Plant	2,771	0	754	-323
	Compost Plant	5,140	0	4,257	-743
	Final Disposal Site	6,759	8,105	17,352	-4,212
	Medical Disposal Site	2,301	0	682	-292
	Total	18,320	9,133	27,028	-7,213

c.2 Cost, Waste Volume, and Collection and Treatment Unit Cost

Using the aforementioned investment amount as a basis, the following life spans are assumed to calculate the depreciation costs.

- Civil Work 30 years
- Facilities 15 years
- Vehicles and heavy machinery 7 years
- Containers 7 years

The following table summarises the annual expenses inclusive of the depreciation cost and operation cost.

Table 11-52: Annual SWM Costs in Mersin

unit: US$1,000/year

	2002	2003	2004	2005	2002-2005 average
Collection & Haulage	4,565 (173)	4,774 (206)	4,931 (231)	5,193 (273)	4,866 (221)
Public Area Sweeping	2,008 (0)	2,072 (0)	2,138 (0)	2,206 (0)	2,106 (0)
Sorting Plant	586 (208)	586 (208)	586 (208)	586 (208)	586 (208)
Compost Plant	836 (396)	836 (396)	836 (396)	836 (396)	836 (396)
Final Disposal Site	2,301 (1,926)	2,301 (1,926)	2,301 (1,926)	2,542 (2,201)	2,361 (1,995)

Medical Disposal Site	200 (147)	200 (147)	200 (147)	200 (147)	200 (147)
Administration*	525	538	550	578	548
Total SWM Works	11,021 (2,850)	11,307 (2,883)	11,542 (2,908)	12,141 (3,225)	11,503 (2,967)

Note: * 5% of every SWM cost (total); Figures in the ( ) are depreciation costs.

On the other hand, the collection, treatment, and disposal amount are as shown in the table below.

Table 11-53: Waste Amount for Financial Evaluation in Mersin

unit: ton/year

	2002	2003	2004	2005	2002-2005 average
Collection & Haulage	183,567	196,221	208,499	222,592	202,720
Public Area Cleansing	9,087	9,374	9,672	9,980	9,528
Sorting Plant	23,696	26,522	28,798	32,095	27,778
Compost Plant	34,100	35,156	36,653	37,677	35,897
Final Disposal Site	160,799	172,780	183,736	196,729	178,511
Medical Disposal Site	694	730	767	803	748
Total SWM Works*	192,654	205,594	218,171	232,572	212,248

Note: *: Collection amount + public area cleansing amount.
** average of the amount to calculate in 1997 and 1998.

Based on the above results, the collection, treatment, and disposal unit costs are as shown below.

Table 11-54: Unit Costs for Financial Evaluation in Mersin

unit: US$/ton

	2002	2003	2004	2005	2002-2005 average	Reference Present*
Collection & Haulage	24.9	24.3	23.6	23.3	24.0	10.5
Public Area Cleansing	221.0	221.0	221.0	221.0	221.0	315.7
Sorting Plant	24.7	22.1	20.3	18.3	21.1	0
Compost Plant	24.5	23.8	22.8	22.2	23.3	21.7
Final Disposal Site	14.3	13.3	12.5	12.9	13.2	1.1
Medical Disposal Site	288.2	274.0	260.8	249.1	267.0	> 1.1
Total SWM Works	57.2	55.0	52.9	52.2	54.2	37.6

Note: * average of the unit costs in 1997 and 1998.

c. Revenue Plan

c.1 Cleansing Tax Revenues

Tax collection in district municipalities for household and commercial wastes currently vary considerably. There are discrepancies between the amount collected and the POS results. Here the potential for tax collection is calculated based on the willingness to pay shown by the residents and enterprises in the POS: 300,000 TL or US$12.7/household/year and 626,560 TL or US$26.4/enterprise/year. Because accurate statistics regarding enterprises are not available, the rate used by Yenisehir DM for the number of buildings taxed (households: 37,600, enterprises: 7,400) are used.

The study assumes the number of households to increase with the population and the number of enterprises with GRDP. The table below shows the cleansing tax collection potential and the revenue plans.

Table 11-55: Revenue Plan (Cleansing Tax) in Mersin

			1998	2002	2003	2004	2005
Household	Population		634,850	718,412	741,141	764,660	788,999
	No. of households*		126,970	143,682	148,228	152,932	157,800
	Potential (US$1,000)		1,613	1,825	1,882	1,942	2,004
	Collection rate (%)		-	90.0	90.0	90.0	90.0
	Revenue Plan (US$1,000)	Case CT.1	-	1,643	1,694	1,748	1,804
		Case CT.2		1,643	1,694	1,748	6,494
		Case CT.3		5,914	6,098	6,293	6,494
Commercial	GRDP (billion TL**)		851,820	1,045,270	1,097,540	1,152,420	1,210,020
	No. of enterprises		24,989	30,664	32,197	33,807	35,497
	Potential (US$1,000)		-	810	850	893	937
	Collection rate (%)		-	90.0	90.0	90.0	90.0
	Revenue Plan (US$1,000)	Case CT.1	-	729	765	804	843
		Case CT.2		729	765	804	3,035
		Case CT.3		2,624	2,754	2,894	3,035
Total	Case CT.1		1,171**	2,372	2,459	2,552	2,647
	Case CT.2			2,372	2,459	2,552	9,529
	Case CT.3			8,534	8,852	9,182	9,529

Note: * The number of family members per household is assumed to average 5 persons.
** Actual collected amount in 1998 was TL 332,222 million (US$1.00 = TL 284,480)

c.2 Revenues from Sale of Recoverables and Compost

In comparison with the sale of recoverables by scavengers, the introduction of the sorting plant and the compost plant is seen to encourage competitive pricing as a sizable amount of recoverables and compost product would be generated.

As shown in the table below, when combined, the sales of recoverables from the compost plant and disposal site generated by the scavengers in 1997 and the unit sales price of the middlemen in 1998 produced a unit cost of TL 29.2 million/ton (US$103/ton).

Table 11-56: Amount and Price of Recycled Materials for Mersin

	Amount	Price	Expected Revenue	
	ton/month (A)	1000 TL/kg or million TL/ton (B)	million TL/month (C=A x B)	US$/month*
Metal	56	25	1,400	4,921
Aluminium	10	270	2,700	9,491
Glass	158	12.5	1,975	6,942
Plastic	75	80	6,000	21,091
PET	31	50	1,550	5,449
Paper	279	25	4,185	14,711
Bone	-	11.4	-	-
Total	609	29.2	17,819	62,605

Note: US$1.00 = TL 284,480 is adopted.

Looking at the results of the compost market survey in 1999, the following compost market prices can be expected: TL 5.9 million/ton (US$14.5/ton) for fine compost and TL 3.1 million/ton (US$7.6/ton) for coarse compost. The proposed plant is

expected to produce 80% fine compost and is estimated during the financial evaluation to gain a revenue shown in the following table.

Table 11-57: Revenue Plan (Sale of Recoverables and Compost) for Mersin

unit: US$1,000

		2002	2003	2004	2005
Amount (ton/year)	Recycling Material	6,030	6,717	7,279	8,080
	Compost	6,138	6,328	6,598	6,782
Recycling Materials		621	692	750	832
Fine Compost (80%)		71	73	77	79
Course Compost (20 %)		9	10	10	10
Total		701	775	837	921

c.3 Revenue from Tipping Fees

The average unit cost of US$13.2/ton will be collected from those directly hauling MSW into the disposal site. A tipping fee of US$267/ton will be collected from those directly hauling medical waste into the medical waste disposal site. The following revenues were assumed for the financial evaluation.

Table 11-58: Revenue Plan (Tipping Fee) for Mersin

unit: US$1,000

		2002	2003	2004	2005
Amount (ton/year)	Direct haulage	6,570	7,300	7,665	8,030
	Medical waste	694	730	767	803
Direct haulage		87	96	101	106
Medical waste		185	195	205	214
Total		272	291	306	320

c.4 Budget Allocation

The table below shows the estimated municipal budget (excluding cleansing tax) in 2002 to 2005 and the amount allocated from the cleansing service budget specified in every case study.

Table 11-59: Revenue Plan (Budget Allocation) for Mersin

		Unit	2002	2003	2004	2005
GM Budget		billion TL*	9,922	10,378	10,855	11,354
		US$1,000*	34, 878	36,479	38,156	39,911
DMs Budget		billion TL*	6,163	6,353	6,550	6,754
		US$1,000*	21,666	22,333	23,025	23,742
Budget allocation for SWM	MB.1	US$1,000	1,889	1,958	2,030	2,105
	MB.2	US$1,000	3,778	3,916	4,059	4,209
	MB.3	US$1,000	5,667	5,874	6,089	6,314

Notes: * 1998 Turkish Lira rate was used.
** US$1 = 284,480 TL

d. FIRR and Account Balance

d.1 Study on Financial Plan

The FIRR is calculated by assuming a total of 9 cases, 3 each for the cleansing tax and the budget allocation from other sources. The results are as shown below.

Table 11-60: FIRR by Revenue Case for Mersin

Case	Changes in Cleansing Tax	Allocation from Municipal Tax	FIRR	Benefit/Cost Ratio under a Cut-off Rate of 8%
1-A	CT.1	MB.1	N/A	0.3414
1-B		MB.2	N/A	0.4813
1-C		MB.3	N/A	0.6213
2-A	CT.2	MB.1	N/A	0.7234
2-B		MB.2	1%	-
2-C		MB.3	7%	-
3-A	CT.3	MB.1	-3%	-
3-B		MB.2	7%	-
3-C		MB.3	14%	-

Only the case 3-C(3.6 times increase in cleansing tax and 1.5 times budget allocation from municipal revenues in 2002) will generate an FIRR exceeding the cut-off rate.

Although still under the cut-off rate, 2-C (3.6 times increase in cleansing tax in 2005 and 1.5 times increase in budget allocation from municipal revenues in 2002) and 3-B (3.6 times increase in cleansing tax in 2002 and maintain present budget allocation rate from municipal revenues) show the highest FIRR of the case studies, at 7%.

d.2 Study on Investment Fund Allocation

For the 2 case studies with an FIRR that is positive but lower than the cut-off rate, the investment funds for 2000 ~ 2001 were determined by calculating the FIRR of FI-1 (25% of the investment by government subsidy) and FI-2 (50% of investment by government subsidy).

- Case 2-C (CT.2 - MB.3)

  Implement a 1.5 times increase in the SWM budget allocated from the municipal tax revenues and an increase in the cleansing tax rate in 2005.

- Case 3-B (CT.3 - MB.2)

  Maintain present budget allocation rate from the municipal tax revenues and an increase in the cleansing tax rate in 2002.

The results are as shown in the table below.

Table 11-61: FIRR by Investment Funding for Mersin

Case	Combination	FIRR
Case 2-C-1	CT.2 - MB.3 - FI.1	9%
Case 2-C-2	CT.2 - MB.3 - FI.2	11%
Case 3-B-1	CT-3 - MB-3 - FI.1	9%
Case 3-B-2	CT-3 - MB-3 - FI.2	11%

If it is possible to obtain government subsidy for more than 25% of the required investment in 2000 and 2001, all cases in case 2-C and 3-B would clearly incur an FIRR that widely exceeds the cut-off rate.

e. Sensitivity Analysis

In view of the financial state of the Turkish government, subsidising half of the investment required by Mersin for the 2000 - 2001 period is considered difficult even if the amount required is only nearly US$ 9 million. Here, sensitivity analysis is carried out on the rise and fall of revenue and expenditure for Case 2-C (raise the cleansing tax and increase the budget allocated from municipal tax revenues to 1.5 times the present rate). The results of the analysis are as shown in the following table.

Table 11-62: Sensitivity Analysis for Case 2-C for Mersin

unit: %

	Expenditure					
Revenue		- 10%	- 5%	0%	+ 5%	+ 10%
	- 10%	7	5	3	0	-26
	- 5%	10	7	5	3	1
	0 %	12	10	7	5	3
	+ 5%	14	12	9	7	5
	+ 10%	16	13	11	9	7

The results confirm that in order to surpass the opportunity costs, a 5% increase in the revenues or a 5% decrease in the expenditures should be incurred.

f. Financial Evaluation

The results of the aforementioned studies gave a clearer understanding of the following issues.

- Case CT.1

  This case scenario, which pegs the future cleansing tax rate to the present rate, is considered financially infeasible.

- Case CT.2

  This case scenario, which intends to more than triple (3.6) the 1998 cleansing tax rate in 2005, is considered feasible if the SWM budget to be allocated (MB.3) is 1.5 times the present rate and more than 25% of the required investment in 2000 -2001 is subsidised by the government (FI.1 and FI.2).

- Case CT.3

  This scenario which intends to more than triple (3.6) the 1998 cleansing tax rate in 2002, is considered feasible if the SWM budget to be allocated (MB.3) is 1.5 times the present rate or pegging of the present rate in budget allocation (MB.2) and getting subsidy more than 25% of the required investment in 2000 -2001 from the government (FI.1 and FI.2).

CT.2-MB.3, on the other hand, is considered feasible if a more than 5% reduction in expenses can be attained.

Based on the above results, the following table showing the financially feasible SWM cases was prepared.

Table 11-63: Financially Feasible Cases

	Cleansing Tax* (CT)	Budget Allocation (MB)	Investment Funding (FI)	Cost Reduction
R1	more than triple (3.6) the present rate in 2002. (CT.3)	1.5 times the budget allocation rate from the municipal tax. (MB.3)	no government subsidy	none
R2	more than triple (3.6) the present rate in 2005. (CT.2)	1.5 times the budget allocation rate from the municipal tax. (MB.3)	government subsidy for more than 25% of investment required in 2000 - 2001 (FI.1 and FI.2)	none
R3	more than triple (3.6) the present rate in 2005. (CT.2)	1.5 times the budget allocation rate from the municipal tax. (MB.3)	no government subsidy	- 5%
R4	more than triple (3.6) the present rate in 2002. (CT.3)	maintain present budget allocation rate from municipal tax (MB.2)	government subsidy for more than 25% of investment required in 2000 - 2001 (FI.1 and FI.2)	none

Note: All cases target a collection rate of 90% in 2002.

This study recommends R1, which entails the attainment of a 90% cleansing tax collection rate by 2002, along with ensuring the collection of a cleansing tax amount that would provide 67% of the needed funds for the cleansing services, including the depreciation cost. Accordingly, there is a need to either implement a more than 5% reduction in the expenses by contracting out the services and properly managing the administration cost, or secure government subsidy for 25% of the required investment cost.

g. Implementation Plan Study

g.1 Issues on the Implementation Plan

The most significant issue in the formulation of the implementation plan is who will shoulder the increase in the SWM costs aforementioned and how. Although the cleansing tax will be ultimately used to cover 100% of the cost, a phased development is required.

The results of the financial evaluation of the priority project recommends raising the collection rate of the cleansing tax to 90% by 2002 and the collection of an amount that would provide 67% of the amount required to cover the SWM costs (inclusive of depreciation cost). In reality, however, this is not easy to attain. As is seen in most countries, a price increase of 3.6 times in real terms easily generates social unrest. Further, the proposed government subsidy for 50% of the investment in 2000-2001 is considered difficult to realise in view of the current financial state of the nation.

Accordingly, the following phases are considered in the study on the implementation plan.

Phase 1:

Realise the collection of 90% of the cleansing tax by 2001; secure a foreign loan with low interest. (Secure government subsidy for the domestic expenses to be incurred.)

Phase 2:

Raise the cleansing tax 1.8 times in real terms in 2003; raise 1.4 times the allocation rate from the municipal budget for cleansing services.

Phase 3:

Further raise (double in real terms) the cleansing tax in 2005, aiming to provide 67% of the SWM cost (including depreciation cost).

g.2 FIRR Calculation and Study on Residents' Share of the Cost

g.2.1 FIRR Calculation

After increasing the collection rate by 2001, the cleansing tax will be raised gradually, 1.8 times in real terms in 2003 and twice in real terms in 2005. With this as a premise, a combination of case studies based on the financial evaluation results were carried out on the rate to be allocated from municipal tax revenues and the government subsidy (in percentage). The case studies are as shown below (4 x 3 = 12 cases).

Table 11-64: Case Studies for the Implementation Plan

Financial Resource	Case	Allocation Rate
Municipal tax revenues (MB)	MB.a	1.2 times
	MB.b	1.3 times
	MB.c	1.4 times
	MB.d	1.5 times
Government subsidy (F.1)	FI.a	20%
	FI.b	25%
	FI.c	30%

The results of the calculation are as shown in the following table.

Table 11-65: FIRR by Implementation Plan Case Studies

Government Subsidy Rate Rate of allocation from Municipal Tax Revenues	FI.a (20%)	FI.b (25%)	FI.c (30%)
MB.a (1.2 times)	5.7%	6.0%	6.4%
MB.b (1.3 times)	7.0%	7.3%	7.6%
MB.c (1.4 times)	8.1%	8.5%	8.8%
MB.d (1.5 times)	9.3%	9.6%	10.0%

As shown in the table, raising the rate allocated from municipal tax revenues to 1.4 times would ensure the feasibility of the project if a 20% subsidy can be obtained from the government.

g.2.2 Residents' Share

Although nothing is clearly known about the average household income from 1994 onwards, this is assumed at US$5,530 in 1998 (1.3 times the 1994 figure) in consideration of the growth in Turkey's economy. The following table shows how increasing the cleansing tax in real terms in 2002 and 2005 would affect the residents.

Table 11-66: Changes in Residents' Share

	2002	2003	2004	2005
Average annual household income (US$/year)*1	6,000	6,100	6,210	6,320
Cleansing tax per household (US$/year)	12.7*2	23.0	23.1	46.5
Ratio of cleansing tax (%) to income	0.21	0.38	0.37	0.74

Note: *1: Calculated assuming that the increase is in proportion to the per capita GRDP.
*2: Willingness to pay from POS

As far as the ratio of the cleansing tax to the annual income is concerned, the two gradual steps proposed for price increase will not have a significant impact.

g.3 Balance in Revenue and Expenditure

Of the case studies, the cash flow of the recommended case, MB.c - FI.a (1.4 increase in the allocation rate from the municipal tax; 20% government subsidy), was prepared as shown in the table below.

This case would incur a deficit until 2004. After 2005, however, financial conditions improve giving the capacity to cover the cleansing service expenses, including depreciation costs. By the end of 2005 the accumulation of US$ 3 million in reserve can be expected. Consequently, there will be no problems in funding the renewal costs.

g.4 Actualisation of the Implementation Plan

The phased appreciation of the cleansing tax clearly confirms the feasibility of the implementation plan. However, the following points regarding the financial system should be improved to actualise the plan.

- Improvement of cleansing tax collection rate
- Reconsideration of cleansing tax fee (rate)

g.4.1 Improvement of Cleansing Tax Collection Rate

Aiming for a 90% cleansing tax collection rate would significantly require not only the establishment of a solid financial base, but also the implementation of the beneficiary pays principle. Most of the residents discharge their own waste, while most of the households receive the waste collection, treatment, and disposal services. At present the number of buildings subject to the cleansing tax is not systematically identified. To discourage cleansing tax evasion, cleansing tax should be billed jointly with the real estate tax.

g.4.2 Reconsideration of Cleansing Tax Fee

The cleansing tax is reviewed yearly but still is not enough for the ever increasing cleansing service costs. The waste discharge characteristics cannot be reflected in the tax due to the standardisation of the tax amount. It is, therefore, important to study the discharge conditions in households and offices to adopt a suitable tax amount. Cross subsidy should also be considered for households.

Table 11-67: Cash Flow of the Recommended Case (MB.c-FI.a)

unit: US$ 1,000

Cash Flow

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
a.	Cash-in																		
a.1	Finance																		
	Grant	163	3,501																3,664
	Loan	3,778	17,451	1,936	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23,165
	Long Term Loan	650	14,006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14,656
	Short Term Loan	3,128	3,445	1,936	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8,509
	Finance Total	3,941	20,952	1,936	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26,829
a.2	Revenue																		
	Cleansing Tax	1,771	2,071	2,371	4,426	4,592	9,529	9,529	9,529	9,529	9,529	9,529	9,529	9,529	9,529	9,529	9,529	9,529	129,581
	Budget Allocation	3,520	3,646	3,778	5,482	5,683	5,893	5,893	5,893	5,893	5,893	5,893	5,893	5,893	5,893	5,893	5,893	5,893	92,820
	Recycling materials	17	9	621	692	750	832	832	832	832	832	832	832	832	832	832	832	832	12,073
	Compost	0	0	80	83	87	89	89	89	89	89	89	89	89	89	89	89	89	1,318
	Direct haulage	0	0	87	96	101	106	106	106	106	106	106	106	106	106	106	106	106	1,556
	Medical waste	0	0	185	195	205	214	214	214	214	214	214	214	214	214	214	214	214	3,158
	Revenue Total	5,308	5,726	7,122	10,975	11,417	16,663	16,663	16,663	16,663	16,663	16,663	16,663	16,663	16,663	16,663	16,663	16,663	240,507
	Cash-in Total	9,249	26,678	9,058	10,975	11,417	16,663	16,663	16,663	16,663	16,663	16,663	16,663	16,663	16,663	16,663	16,663	16,663	267,336
b.	Cash-out																		
b.1	Investment	813	17,507	257	218	2,212	6,446	0	0	6,992	8,628	193	321	257	6,189	0	4,191	257	54,481
b.2	Expenditure																		
	O&M Cost	8,436	8,891	8,171	8,424	8,634	8,916	8,825	8,825	8,825	8,825	8,833	8,833	8,833	8,833	8,833	8,833	8,833	148,603
	Interest	0	280	630	501	337	337	337	337	319	301	283	265	247	229	211	193	176	4,983
	Expenditure Total	8,436	9,171	8,801	8,925	8,971	9,253	9,162	9,162	9,144	9,126	9,116	9,098	9,080	9,062	9,044	9,026	9,009	153,586
b.3	Repayment	0	0	0	0	0	0	0	814	814	814	814	814	814	814	814	814	814	8,140
	Cash-out Total	9,249	26,678	9,058	9,143	11,183	15,699	9,162	9,976	16,950	18,568	10,123	10,233	10,151	16,065	9,858	14,031	10,080	216,207
c.	Reserved Fund (a.-b.)	0	0	0	1,832	2,066	3,030	10,532	17,219	16,932	15,027	21,567	27,998	34,510	35,108	41,913	44,545	51,129	51,129

Table 11-68:Profit and Loss Statement

unit: US$ 1,000

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
a.	Revenue	5,308	5,726	7,122	10,975	11,417	16,663	16,663	16,663	16,663	16,663	16,663	16,663	16,663	16,663	16,663	16,663	16,663	240,507
b.	Cost																		
b.1	Expenditure	8,436	9,171	8,801	8,925	8,971	9,253	9,162	9,162	9,144	9,126	9,116	9,098	9,080	9,062	9,044	9,026	9,009	153,586
b.2	Depreciation	0	0	2,850	2,883	2,908	3,225	1,395	1,395	1,395	1,395	1,563	1,563	1,563	1,563	1,563	1,563	1,563	28,387
	Cost Total (b.1+b.2)	8,436	9,171	11,651	11,808	11,879	12,478	10,557	10,557	10,539	10,521	10,679	10,661	10,643	10,625	10,607	10,589	10,572	181,973
c.	Profit and Loss (a.-b.)	-3,128	-3,445	-4,529	-833	-462	4,185	6,106	6,106	6,124	6,142	5,984	6,002	6,020	6,038	6,056	6,074	6,091	58,534

11.6.5 Economic Evaluation

a. Economic Evaluation Method

Economic evaluation is carried out to determine the necessity of the project in view of present national economic conditions. Because environmental benefits are difficult to quantify, the economic evaluation is mostly limited to cost minimisation methods and qualitative evaluation. With resource-recovery and disposal site cost reduction as the benefits that can be expected from the introduction of an intermediate treatment facility, a comparison is being carried out between costs and benefits of a project that involves (*with-project*) and does not involve (*without-project*) the introduction of such facility.

In this study, the proposed project characteristics are as follows:

- Promote resource recovery and reduction of disposal amount through the construction of a sorting plant and compost plant.
- Introduce separate collection to improve compost quality.

Taking the above into consideration, the evaluation of the project is carried out as follows.

Table 11-69: Economic Evaluation Method for Mersin

	Collection & Public Area Cleansing	Intermediate Treatment	Final Disposal
Evaluation Method	Qualitative Evaluation	Quantitative Evaluation (Cost-benefit Analysis) Qualitative Evaluation	Qualitative Evaluation
Evaluation Period		17 years (2000-2016)	

The benefits and costs for quantitative evaluation are as shown in the table below.

Table 11-70: Benefits & Costs for Mersin

	Intermediate Treatment
Benefits (B)	● Resource recovery (Recoverables and compost) ● Reduced disposal cost ● Reduced haulage cost*[1] ● Effective land use
Costs (C)	The following were converted into economic cost: ● Investment cost for and O&M cost of separate collection ● Investment cost for and O&M cost of sorting plant ● Investment cost for and O&M cost of compost plant
Evaluation Standard	EIRR > 0

Note:*1 Since Cimsa site and other candidate sites locate almost the same distance from the centre of the city (about 20 km), the benefit of reduced haulage cost is not expected.

The benefits and O&M costs in 2005 will be used for 2006 - 2016. As in the financial evaluation, the investment required for renewal is considered for investment

cost. In addition, the salvage value in 2016 is calculated as the negative cost in 2017.

b. Benefits

b.1 Resource Recovery

The benefits from resource recovery are calculated using the sales price of recyclables and compost. The price is the unit price used in the financial analysis.

Table 11-71: Benefits from Recoverables and Compost for Mersin

unit: US$1,000

Item		Unit Price (US$/ton)	2002	2003	2004	2005
Recycling materials		103.0*	621	692	750	832
Compost	Fine	14.5*	71	73	77	79
	Coarse	7.6*	9	10	10	10

Note: * In view of global environmental preservation, this value is considered to be underestimated due to the connection between recycling and energy-saving measures.

b.2 Reduced Disposal Cost

The benefit from a reduced disposal cost was calculated at US$13.2/ton, the unit price for disposal in the disposal site in CIMSA in 2002-2005.

Table 11-72: Benefits from Reduced Disposal Cost

Item	Unit	2002	2003	2004	2005
Waste Reduction	ton/year	14,394	14,778	15,274	15,351
Benefit (US$ 1,000)	US$13.9/ton	190	195	202	203

b.3 Effective Land Use

The reduction in disposal amount would lead to the need for a smaller disposal site.

- For the landfill area and capacity targeted for the disposal site in CIMSA, reductions in the disposal site space required means the acquisition of 156m^2 for every 1,000 ton of waste.
- If the reduction in disposal amount after 2006 is considered equivalent to 2005, the reduction in the disposal amount within a 15 year period (2002-2016) will total 228,663 ton.
- Consequently, 3.6ha of the site can be used for other purposes.
- 228,663 ton x 156m^2/1,000 ton/10,000m^2 = 3.6ha
- Wheat production in Turkey averages 2,000kg/ha and is sold by farmers for US$180/ton. Consequently, the extra space (from the 3.6ha) will be converted into a wheat field that is expected to generate a sales of US$360/ha per annum.
- The extra space (from the 3.6 ha) is expected to generate a yearly wheat sales of US$1,296.

  3.6ha x US$360 = US$1,296

Table 11-73: Land Use Benefits for Mersin

Item	Unit *	2002	2003	2004	2005
Land Use	ha	3.6	3.6	3.6	3.6
Land use	US$1,000	1	1	1	1

c. Cost

The following rates are used for conversion of market prices into economic prices, with due consideration of the value added tax rate (15%), income tax rate (personal: 20%; corporate: 25%), income of farmers (72% of the urban working households).

Table 11-74: Conversion Rates for Economic Evaluation for Mersin

Items			Conversion rate	Remarks
Investment	Vehicles, heavy equipment		0.825	VAT15%, income tax 2.5%
	Plant		0.818	Combination of personnel cost and materials
	Civil work		0.608	Combination of personnel cost and materials
O&M cost	Personnel	Skilled	0.800	Income tax 20%
		Unskilled	0.580	Skilled cost x 72%
	Service		0.741	Combination of personnel cost and materials
	Fuel		0.768	VAT15%, Fuel consumption tax 7.2%, Income tax 1%
	Other materials		0.840	VAT15%, Income tax 1%

The investment costs converted into economic prices are summarised in the following table.

Table 11-75: Investment Costs for Economic Evaluation for Mersin

unit: US$1,000

		1999-2001	2002-2005	2006-2016	Salvaged Value
Investment	Collection & Haulage*	326	230	951	-395
	Sorting Plant	3,818	0	880	-703
	Compost Plant	5,891	0	1,796	-1,224
	Total	10,035	230	3,627	-2,322

Note: * The introduction of containers and the standardisation of collection vehicles would increase collection service efficiency. Not considering improvements in collection efficiency, 30% of the cost involved in the introduction of the separate collection system is considered.

The O&M costs by year converted into economic prices are as shown in the following table.

Table 11-76: O&M Costs for Economic Evaluation

unit: US$1,000

	2002	2003	2004	2005
Collection & Haulage*	199	237	265	313
Sorting Plant	263	263	263	263
Compost Plant	332	332	332	332
Total	794	832	860	908

Note: * The introduction of containers and the standardisation of collection vehicles would increase collection service efficiency. Not considering improvements in collection efficiency, 30% of the cost involved in the introduction of the separate collection system is considered.

b. EIRR Calculation Results

With the above benefits and costs, the EIRR cannot be calculated as the ratio of the benefits to the costs is low at 0.75 even under a cut-off rate of 0%.

The benefits from resource recovery are considered to include various improvements in global environmental issues, e.g., reduction of CO_2 levels in the atmosphere. Therefore, various issues will need to be addressed if the benefits are evaluated in terms of market price.

If the benefits are evaluated as double the market price, the EIRR would be calculated at 11%, which over the cut-off rate 8 %.

c. Qualitative Evaluation

c.1 Intermediate Treatment

Only a few of the benefits were subjected to quantitative evaluation. The established evaluation standards, however, cannot be met with only the benefits quantitatively measured.

As awareness of the importance of global environmental preservation intensifies world-wide, the effects of resource recovery through the construction of a sorting plant and a compost plant would widely surpass the benefits quantitatively measured.

The following are also some of the effects that is considered to result from resource recovery:

- Soil conditioning by compost utilisation
- Generation of jobs from the operation of the sorting plant
- Improvements in resource recovery activities
- CO_2 reduction due to energy conservation

In view of these impacts, therefore, the need to implement the proposed priority project is fully justified.

c.2 Collection and Public Area Cleansing

The need to promptly eliminate the waste from the urban area is fully acknowledged and is the premise for the operation of the cleansing service and cleansing tax

collection system. Some of the positive impacts this action is foreseen to bring about are as follows:

- Secure urban public health and sanitation (control the generation of vermin and rodents; lower the incidence of infectious diseases)
- Prevent canal clogging and traffic congestion
- Secure pleasant environment (prevent the generation of offensive odour; improve landscape)
- Encourage smooth conduct of economic activities and develop the tourism industry

c.3 Final Disposal

The adequate final disposal of hauled waste prevents the occurrence of adverse environmental impacts.

The rehabilitation of the present disposal site in CIMSA is foreseen to have the following impacts:

- Improvement in public health and environment around the disposal site
- Prevention of leachate runoff to outer areas by adopting the circulation process
- Site acquisition
- Reduction in haulage cost

To counter-act any risk that may result from the handling or unexpected contact with contagious materials, the development of a medical waste disposal site is of extreme importance. This undertaking will not meet any opposition as this would actually contribute to eliminating the fears and worries of the surrounding residents.

Based on the above qualitative evaluation, the priority project is deemed feasible.

11.7 Rehabilitation of the Composting Plant Disposal Site

11.7.1 Existing Condition of Present Landfill

Dumping on the site started in 1985, when the compost plant was put into operation. However, no precautions were taken to protect the environment. The landfill was operated as a simple dumpsite until people started to complain; the main reasons being:

- Frequent fire outbreaks leading to the generation of bad smell.
- Waste was dumped on the neighbouring main road (Old Soda Road).
- Soil coverage was only carried out occasionally.

In 1992 efforts were undertaken to rehabilitate the landfill. The rehabilitation included construction works as presented in the following table, which also outlines the present condition of the construction works. The numbers in the table refer to the numbering in the following Table.

Table 11-77: Construction Works in 1992 and their Present Condition

	Facility constructed in 1992	Present Condition
1	Pipeline under the HDPE-liner for diversion of clean run-off water	The inlet to the pipe is covered with waste and the outlet is closed due to an earth slip. Clean run-off water is again percolating into the landfill.
2	20,000m^2 bottom liner (HDPE)	The waste has far exceeded the area that was furnished with bottom liner. New bottom liners were not constructed. Area 6 was planned for future extension of the landfill. However, area ‘ 7 was used because access was easy.
3	Pipeline for leachate	The outlet is closed due to an earth slip. Leachate is accumulating on top of the HDPE-liner creating a soft ground that cannot carry trucks or bulldozers.
4	Pond with bottom liner and pump installations to collect and recirculate/evaporate leachate.	The facilities are disconnected and leachate is again discharged directly into the nearby ditch at Old Soda Road.

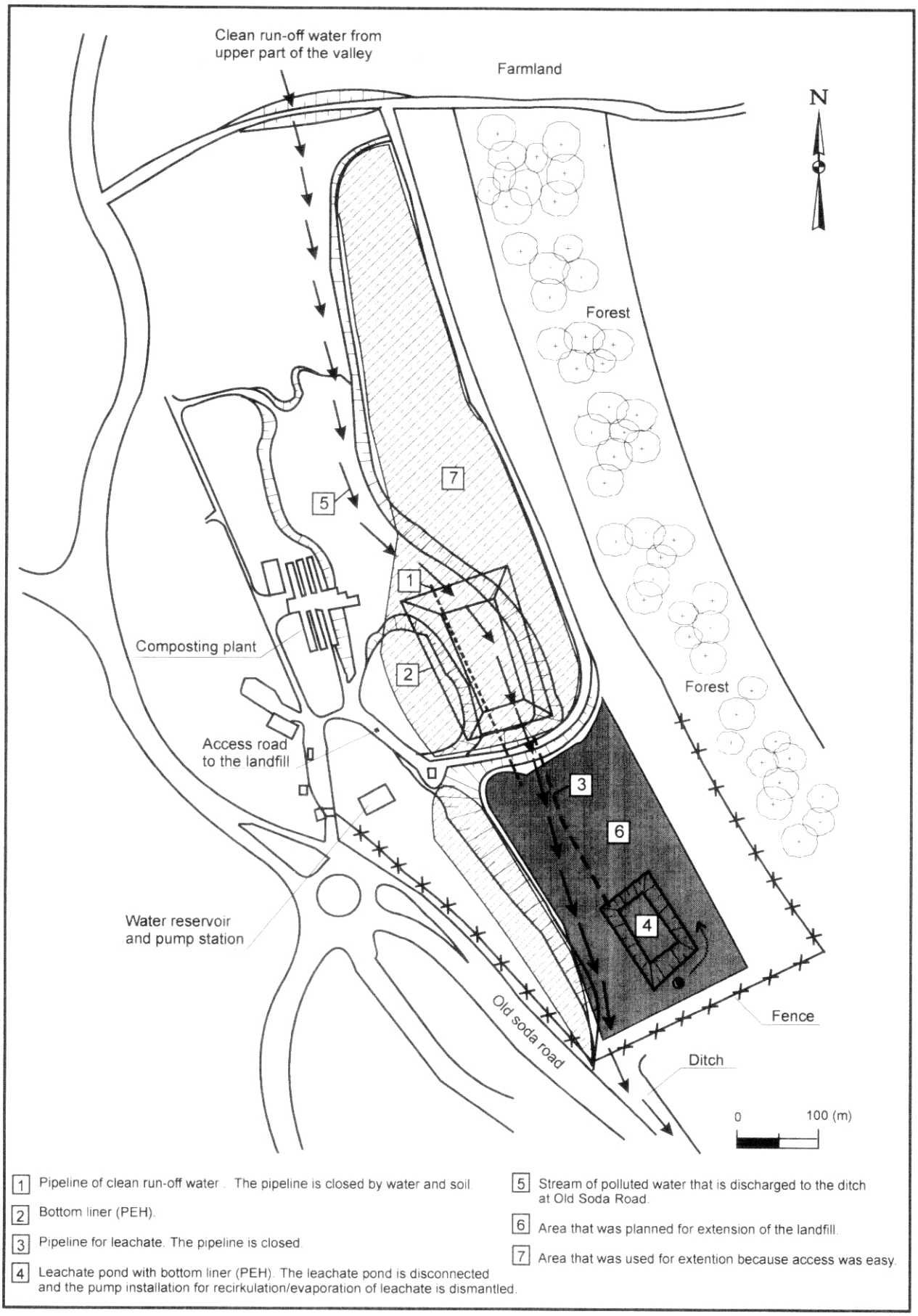

Figure 11-16: Layout of the Present Landfill

The site is located in a valley, but the upper part of the valley is occupied by farmlands. Run-off water from the upper part of the valley penetrates the landfill, causing the generation of leachate. As the landfill area neighbours farmland to the north, and a forest area to the east, it will be very difficult to extend the boundary of the landfill. Thus, it is estimated that the remaining landfill volume of the site is very limited, and that the site can only be operated as a landfill for another 2 years.

11.7.2 Rehabilitation Plan of Present Landfill

Rehabilitation plan will be carried out in order to improve following conditions.

- Outflow of leachate to downstream
- Fire and smoke pollution caused by spontaneous combustion in the disposal site

Following countermeasures are suggested.

a. Prevention of Outflow of Leachate to the Downstream

Leachate, which flows downstream, shall be collected in the leachate pond constructed in 1992, by leachate drain with Cobol stone. Collected leachate shall be returned to the landfill site using a pumping system ,and circulation treatment shall be carried out by utilising evaporation effect. A brief outline of the leachate circulation system is as follows.

Leachate from Landfill➔Main Leachate Drain➔Regulation Pond

➔Pump Station➔Leachate Pipe➔Valve & Leachate Feeding Drum➔

➔Leachate Feeding Drain➔ Landfill

b. Prevention of Fire and Smoke Pollution Caused by Spontaneous Combustion in the Disposal Site

The following fire extinguishing measures were included in the design as countermeasures to extinguish spontaneous fires at the site.

- Sprinkling of water
- Flatting steep slope
- Soil covering

c. Other Measures

- Gas removal facility
- Pipe line of clean run-off water to block rainwater infiltration from upper part of the valley

Overall plan of the rehabilitation of present landfill is following figure.

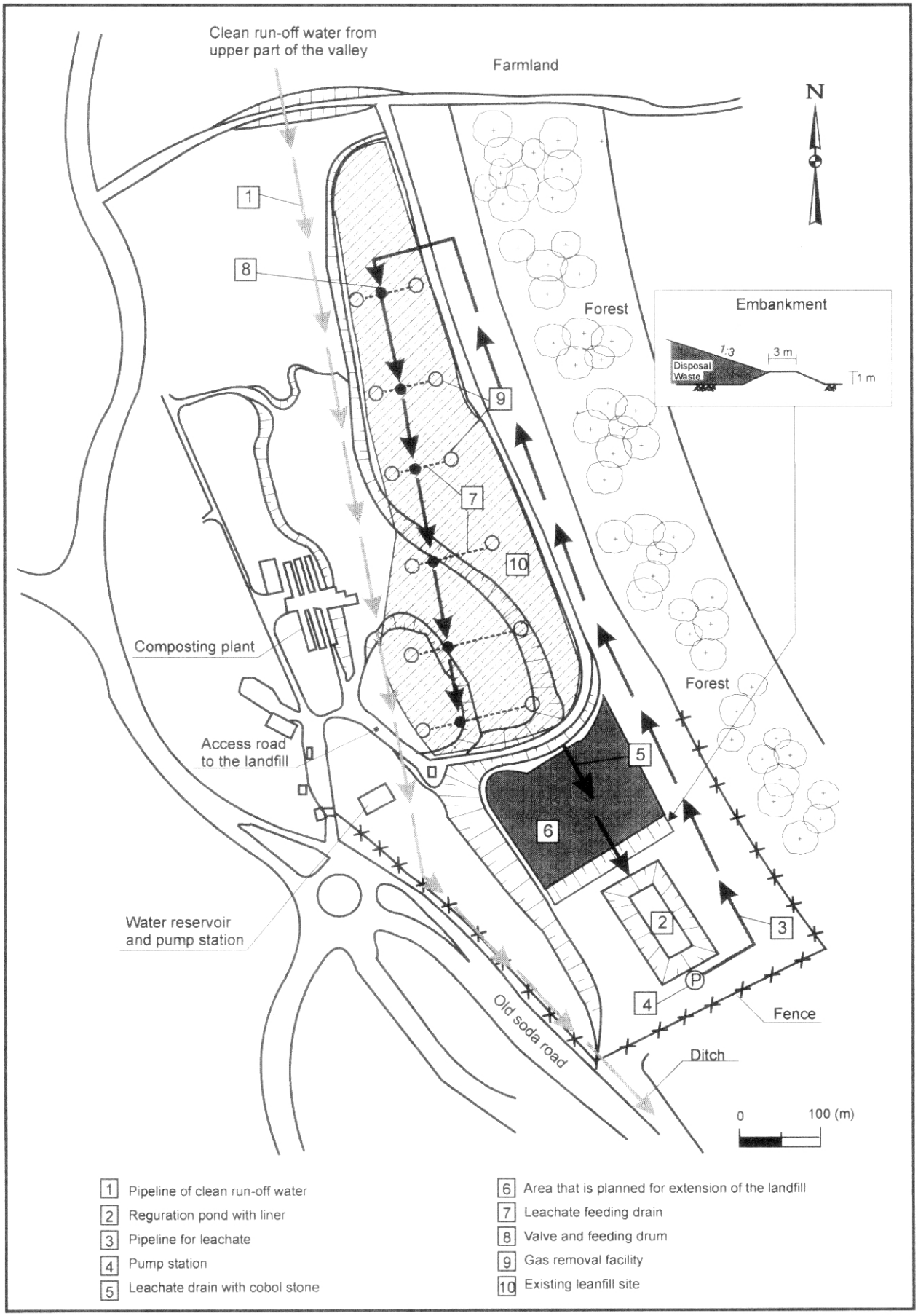

Figure 11-17: Overall Plan of the Rehabilitation of Present Landfill