

## 3.2 Present SWM in Mersin GM

### 3.2.1 Present Waste Stream

The figure below shows the present waste stream in the Greater Municipality of Mersin.

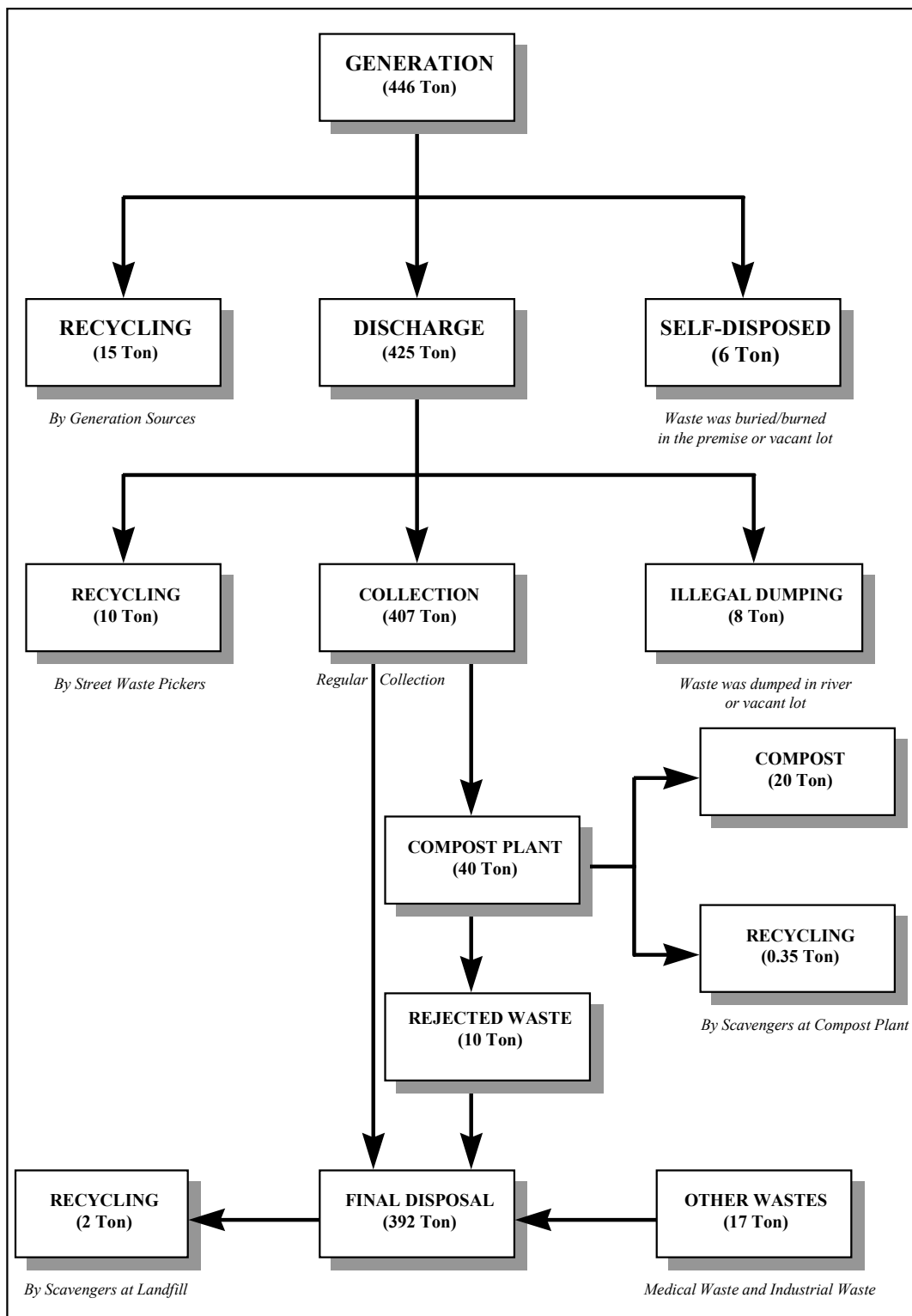


Figure 3-8: Present Waste Stream in Mersin GM

### 3.2.2 Technical System

The Mersin Greater Municipality is responsible for solid waste management activities through the “Directorate for Environmental Health” within the city. It is responsible for the cleansing of main streets, treatment and disposal of solid wastes, where the district municipalities of Yenisehir, Akdeniz, and Toroslar are responsible for the collection and transfer of municipal wastes and also cleansing of streets.

#### a. Discharge and Storage

Solid wastes in Mersin are produced in households, commercial and industrial premises, institutions, hospitals and on streets. Data necessary to identify the storage and collection system of Adana highlighted during discussions with the district municipalities are given in Table 3-34.

Table 3-34: Mersin Storage and Collection System

Data	Yenisehir DM	Akdeniz DM	Toroslar DM
Population (1997 Census)	117,000	200,000	225,000
Service Area	3,000ha	3,500ha	3,500ha
Households Served	35,000	-	5,200
Waste Generation Amount	120 t/d	375 t/d	160 t/d
Household Waste	80% of total waste amount	unknown	unknown

When discussing the waste storage in Mersin, one system is being identified:

- Communal

Communal storage is where a number of dwellings, sometimes commercial, use one common container. The average container size in this system in Mersin is 0.4-0.8m<sup>3</sup>, and the type of containers used is often standard wheeled containers.

There is an intensive usage of 400-800lit. standard wheeled containers. The 400lit. containers are made of metal and the 800lit. are made of plastic and metal. The type, capacities, and quantity of storage receptacles used in Mersin are given in Table 3-35.

Table 3-35: Type, Capacity & Quantity of Waste Containers in Mersin

Storage Units	Yenisehir DM	Akdeniz DM	Toroslar DM
Wheeled containers			
400 lit.	2000	2700	500
800 lit.	1700	1300	2500

The ownership of waste storage receptacles in Mersin are given in the table below.

Table 3-36: Ownership of Waste Containers in Mersin

Containers	Yenisehir DM	Akdeniz DM	Toroslar DM
Wheeled containers			
400lit.	households	municipality	municipality
800lit.	households	municipality	municipality

Akdeniz and Toroslar District Municipalities own the containers, while the wheeled containers were purchased by households in the Yenisehir DM from the Cleansing Department.

## **b. Collection and Haulage**

Yenisehir, Akdeniz and Toroslar District Municipalities are responsible for solid waste collection in Mersin. The collection service is partly privatised to a private contractor, who supply the municipality with manpower: the contractor hires the staff to the municipality and utilises the municipal equipment and vehicles for collection.

Cleansing Departments of these district municipalities make their own plans and programmes in order to manage the collection and cleansing activities.

Collection of solid wastes is carried out on collection zone basis in Mersin. Yenisehir District Municipality covers 14 collection districts and 14 *mahalles*, Akdeniz covers 2 collection districts, and Toroslar collects waste from 21 *mahalles*, each specified as a collection district.

### **b.1 Collection System**

Existing collection system within the municipal districts of Mersin is a mixture of the following three methods:

- Communal collection

In this system, solid waste is deposited in communal containers shared by a number of dwellings or commercial premises is collected by collection vehicles. This system is mostly applied in high and middle-income residential areas, commercial, and market areas in Mersin, especially in Yenisehir and Akdeniz. This system mostly uses standard wheeled containers (400-800lit.). While loading the waste into the collection vehicle, deposits on the ground are manually swept and placed into the truck.

- Curbside collection

The places where the curbside collection system is applied are apartment/buildings that place their own containers by the curb. These containers are carried over to the collection vehicle by the municipal collection worker for discharge, and then returned back to the collection point. This system is applied in high and middle income residential areas in Mersin, especially in Yenisehir and Akdeniz. The system uses standard wheeled containers. The significant amount of street litter is also disposed of into the vehicle manually by the collection worker.

- Door-to-door collection

Door-to-door collection in Mersin is applied in low income *mahalles* (especially in the *gecekondur* areas in Toroslar) where waste collection workers collect the container from within the perimeter of the household, discharges the waste into the collection vehicle and returns the container back to its original place. Bins are used in this system. The significant amount of street litter is also disposed of into the vehicle manually by the collection worker.

Waste collection is carried out daily (single shift) in Mersin. Only Yenisehir District Municipality has additional shifts whenever deemed necessary. The working hours adopted for the municipal collection system in Mersin is given in Table 3-37.

Table 3-37: Mersin Collection System Working Hours

Data	Yenisehir DM	Akdeniz DM	Toroslar DM
Operation hours	Summer: 2100 - 0100 Winter: 0700 - 1300	District 1: 0800 - 1300 District 2: 1300 - 2000	0800 - 1400
Collection frequency	Daily	Daily	Daily

When formulating the national strategy for solid waste management in Turkey, it is necessary that proper attention is given by the municipalities on the avoidance of generating unnecessary waste, waste minimisation, source separation, and recycling.

There are no recycling activities in Mersin which is planned or executed by the district municipalities, except for a high degree of informal scavenging. There is also no transfer system, hence vehicles haul waste directly after collection to the disposal site.

### b.2 Routing

An efficient collection system cannot be established without defining the collection vehicle route, which is fundamental for the effective use of both workforce and equipment.

During the Time and Motion survey executed in Mersin, it is understood that the routes to be followed by the collection vehicles during trips are not properly defined. There is a route which is mainly clarified by the cleansing department associated by the driver, but it has been observed that oftentimes the route is changed according to the driver's discretion.

### b.3 Privatisation

The Directorate for Environmental Health of the Mersin Greater Municipality as well as the district municipalities of Yenisehir, Akdeniz, and Toroslar have undertaken diverse steps towards the privatisation of solid waste management services.

The Directorate for Environmental Health, who is responsible for the cleansing and sweeping of primary avenues, contracts out some of these services to Oz-Gul Ltd., a private firm, through a joint tender, in which Akdeniz District Municipality also acts as a client.

Akdeniz District Municipality also uses a highly privatised solid waste management model, by monitoring the activities of Oz-Gul Co., Ltd., which comprise of street cleansing and washing, and waste collection.

Yenisehir District Municipality also privatised the collection and transportation of solid wastes along with street cleansing and the maintenance of green areas, public parks and open spaces within the boundaries of the municipality to Kaya Kent Cleansing Co., Ltd.

Similar to other district municipalities, Toroslar privatised waste collection and cleansing services within the municipal boundary. The cleansing department of

Toroslar is organised to function as a controlling and monitoring agency. It controls and monitors the activities of the private sector regarding solid waste management.

The employees of all district municipalities are actively engaged in street sweeping, parks and public area cleansing activities.

#### b.4 Equipment and Labour

- Equipment

Mersin has a mechanised solid waste collection system, with a collection fleet of 12m<sup>3</sup> and 16m<sup>3</sup> compaction vehicles.

For waste collection and cleansing services, the district municipalities in Mersin use their own resources, i.e., vehicles and equipment. However, a private contractor provides the required staff. Additional equipment required is provided by the contractor himself. The type and capacity of the collection fleet of Yenisehir, Akdeniz, and Toroslar are as shown in Table 3-38.

Table 3-38: Collection Fleet of Yenisehir, Akdeniz, and Toroslar District Municipalities

Vehicle Type & Capacity	No. of Vehicles		
	Yenisehir DM	Akdeniz DM	Toroslar DM
Compaction truck			
16m <sup>3</sup>	4	8	4
12m <sup>3</sup>	8	8	8
No. of Trips	1-2	2	1

- Labour

The Directorate for Environmental Health of Mersin Greater Municipality carries out its solid waste management duties with 5 engineers and 5 supporting staff. City cleansing and street sweeping services have been organised through a mixed model in which both the municipal and private company personnel is actively engaged in the service operations.

Yenisehir District Municipality takes care of the planning, programming and supervision of the required waste management services through the cleansing department which is formed by 1 director and 14 subordinate employees. The main service for collection in the municipal boundary is carried out by Kaya Kent Cleansing Co., Ltd.

The manpower of the private contractor, Kaya Kent, for the Yenisehir District Municipality is shown in Table 3-39.

Table 3-39: Manpower of Kaya Kent Co., Ltd.

Position	No. of Staff
Foremen	6
Drivers	12
Collection Workers	24
Total	42

The Cleansing Department of Akdeniz District Municipality manages and co-ordinates solid waste services with a core staff of 1 director, 2 control foremen, 2 drivers and 4 collection workers. The collection activities are carried out by Oz-Gul Co., Ltd. The labour force of the private contractor engaged by the Akdeniz District Municipality is shown in Table 3-40.

Table 3-40: Manpower of Oz-Gul Co., Ltd.

Position	No. of Staff
Director	1
Foremen	2
Drivers	17
Collection Workers	34
Total	54

Toroslar District Municipality manages the street sweeping and collection of solid wastes with 1 director, 1 deputy director, 3 chiefs, 5 drivers and 7 collection workers. The collection and cleansing activities are carried out by Ercay Co., Ltd.

Table 3-41: Manpower of Ercay Co., Ltd.

Position	No. of Staff
Foremen	2
Drivers	12
Labourer	24
Total	38

The collection team in all district municipalities consists of a driver and two collection workers.

### c. Public Area Cleansing

Public area cleansing and street sweeping are one of the most visible of all municipal waste collection services. Consciously or not, residents allow their opinions on the effectiveness of street sweeping programs, influence their assessment of the credibility of their municipal leaders and local officials. Visitors instinctively rate municipalities based on their external conditions, i.e., cleanliness. Dirty cities do not attract foreign investors. These opinions should be positively used to stimulate the residents to build a better city.

Street sweeping programs were conducted mainly to remove litter and dirt so that streets appear presentable, and traffic will not create dust. Specifically, in some areas, regular street sweeping is necessary to prevent sewers from becoming clogged. Dust is also recognised as a potential pollutant.

In Mersin, public areas and street wastes arise from the following three main sources:

- Natural wastes which were including the dust blown from unpaved areas and infrastructural works, decaying vegetation and fallen leaves, etc.
- Road traffic wastes which were including the motor vehicles deposits, rubber and mud, and sometimes spills from vehicles.

- Pedestrian wastes which include the litter dropped by pedestrians or swept onto the footways by shopkeepers, markets, etc.

The Directorate for Environmental Health of Mersin Greater Municipality is responsible for the cleansing and sweeping of main roads, avenues, parks and public areas, and main streets. The manpower of the Mersin Greater Municipality Cleansing Department and the Private Cleansing Company is shown in Table 3-42.

Table 3-42: Manpower of Mersin Cleansing Department and Private Cleansing Co.

Position	Manpower	
	Mersin Cleansing Department	Oz-Gul Co., Ltd
Director	1	1
Foremen	1	3
Drivers	3	3
Mechanics	-	6
Street Sweepers	37	74
Total	42	87

The cleansing of streets, roads and public areas is under the responsibility of district municipalities. The manpower of the private companies contracted by Mersin GM for public area cleansing is shown in Table 3-43.

Table 3-43: Manpower of Private Companies Contracted by the Cleansing Departments in Mersin

Position	Manpower		
	Kaya Kent Co., Ltd. Yenisehir DM	Oz-Gul Co., Ltd. Akdeniz DM	Ercay Co., Ltd. Toroslar DM
Foremen	2 + 1 (electrician)	1	1
Drivers	2	-	-
Street Sweepers	142	171	124
Total	147	172	125

The equipment used for public area cleansing are as shown in Table 3-44.

Table 3-44: Public Area Cleansing Equipment

Municipality	Equipment/No.
Mersin GM	Street Cleansing Vehicle (4) Street Sweeper (2)
Yenisehir DM	-
Akdeniz DM	-
Toroslar DM	-

#### d. Recycling

The study team conducted surveys on the recycling system in the target area, including a survey on the informal recycling activities carried out at present. The surveys were carried out by distributing questionnaires and interviewing relevant authorities. The details of the survey are shown in section 2.5.2, *Survey on Recycling System*.

Based on the results of the survey the team concluded the recycling rate in Mersin GM is **10.7 %** as shown in the table below. According to the table the recycling at the composting plant which is considered as the recycling by the public sector is 4.6 %, while it by the private sector is 6.1 %.

Table 3-45: Recycling Amount in Mersin GM

unit: ton/day	
Mersin GM	
A. Recycling by the Private Sector	
1. Consumers/Generation Sources	15
2. Street Waste Pickers	10
3. Scavengers at the Dump Site	1.5
<b>Sub-total (A)</b>	<b>26.5 (6.1 %)</b>
Recycling by the Public Sector	
4. Materials Recovered by the Composting Plant	0.35
5. Compost Production	20
<b>Sub-total (B)</b>	<b>20.35</b>
<b>Total (A + B)</b>	<b>46.85</b>
Estimated SW Generation	436
<b>Recycling Ratio (%)</b>	<b>10.7 %</b>

#### e. Intermediate Treatment

This section details the present compost plant in Mersin.

##### e.1 Location of the Compost Plant

The composting plant is situated in the northern part of Toroslar District, near Cavuslu Village. The location is shown in Figure 3-9. The composting plant is located at the crossing between the following roads: Gozne Road and Old Soda Road, approximately 6km north of Mersin City centre. It is located conveniently close to the present landfill. Thus, rejected waste material from the composting plant can easily be transported to the landfill. The site of the composting plant and the landfill has an approximate size of 65ha. Approximately 20ha is used by the composting plant.

The city planning (Mersin Master Plan, 1996) for the site and its surroundings is presented in the section on landfill (see Figure 3-13). In accordance with the city plan, part of the site comprising the area with the composting plant, is planned for future municipal facilities such as a bus station. Immediately south and east to the site are planned or already existing housing areas and 500m to the west is a new housing area under construction.



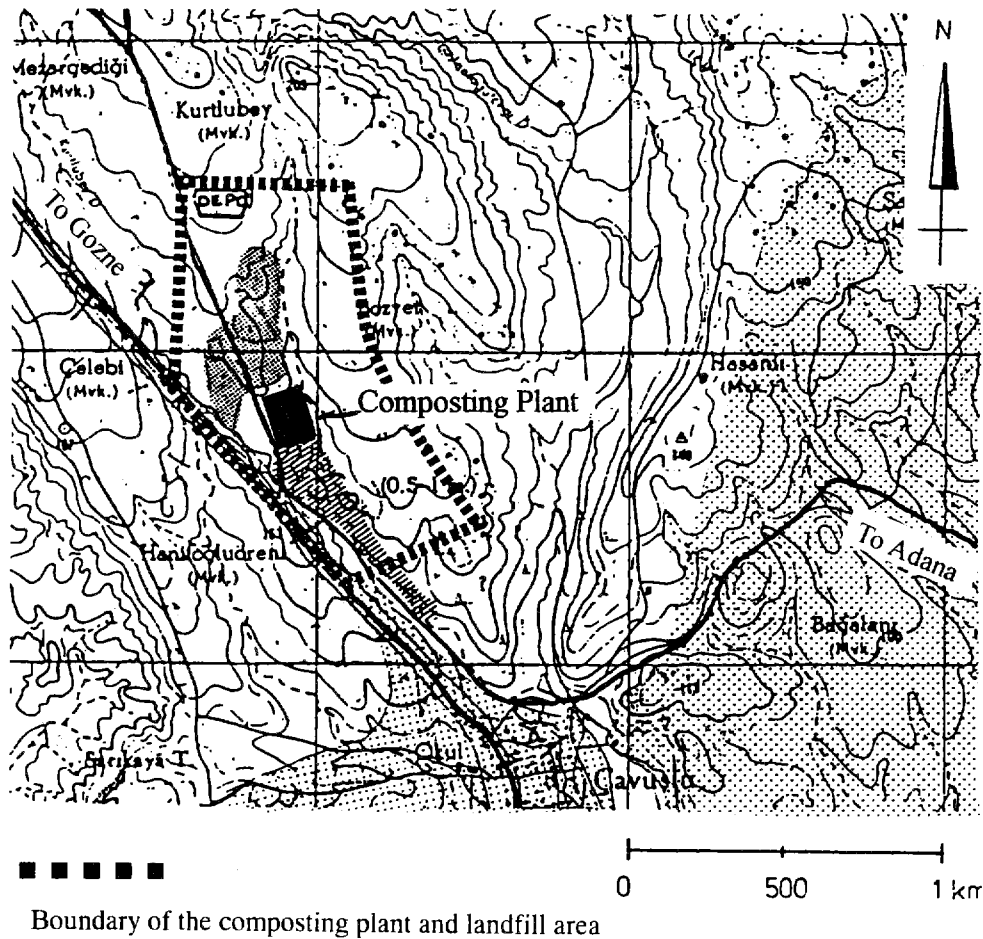


Figure 3-9: Location of the Mersin Compost Plant and Landfill

## e.2 Background

The composting plant was put into operation in 1985. The supplier of the compost plant was a French company which no longer exists. The intended operational principle of the plant was as follows:

- Upon being unloaded in big containers (36m<sup>3</sup>) forced aeration was applied for one week.
- The aerated and partly degraded waste would then be milled applying hammer mills.
- After milling ferrous materials was removed by an over band magnet, and the remaining material was placed in windrows on the maturation area.
- During the maturation period the waste was turned by front end loaders.
- Finally the compost was screened before being salable.

Shortcomings occurred immediately after the plant had started to operate. The mayor being the inability of the aeration system to keep the waste fully aerobic during the pre-composting in containers. This resulted in very bad working conditions for the employees of the plant. When all efforts to alleviate the problems failed the pre-

pre-composting part of the plant was dismantled, although the enclosing buildings remain and the original constructed unloading ramp for refuse trucks is not in use.

In 1990 the capacity of the plant did no longer meet the requirement for treatment of waste from Mersin, and an effort to rehabilitate and upgrade the composting plant was undertaken. However, too large investments were required and the rehabilitation and upgrading of the composting plant was given up.

### **e.3 Layout of the Compost Plant**

The layout of buildings and internal roads is presented in Figure 3-10.

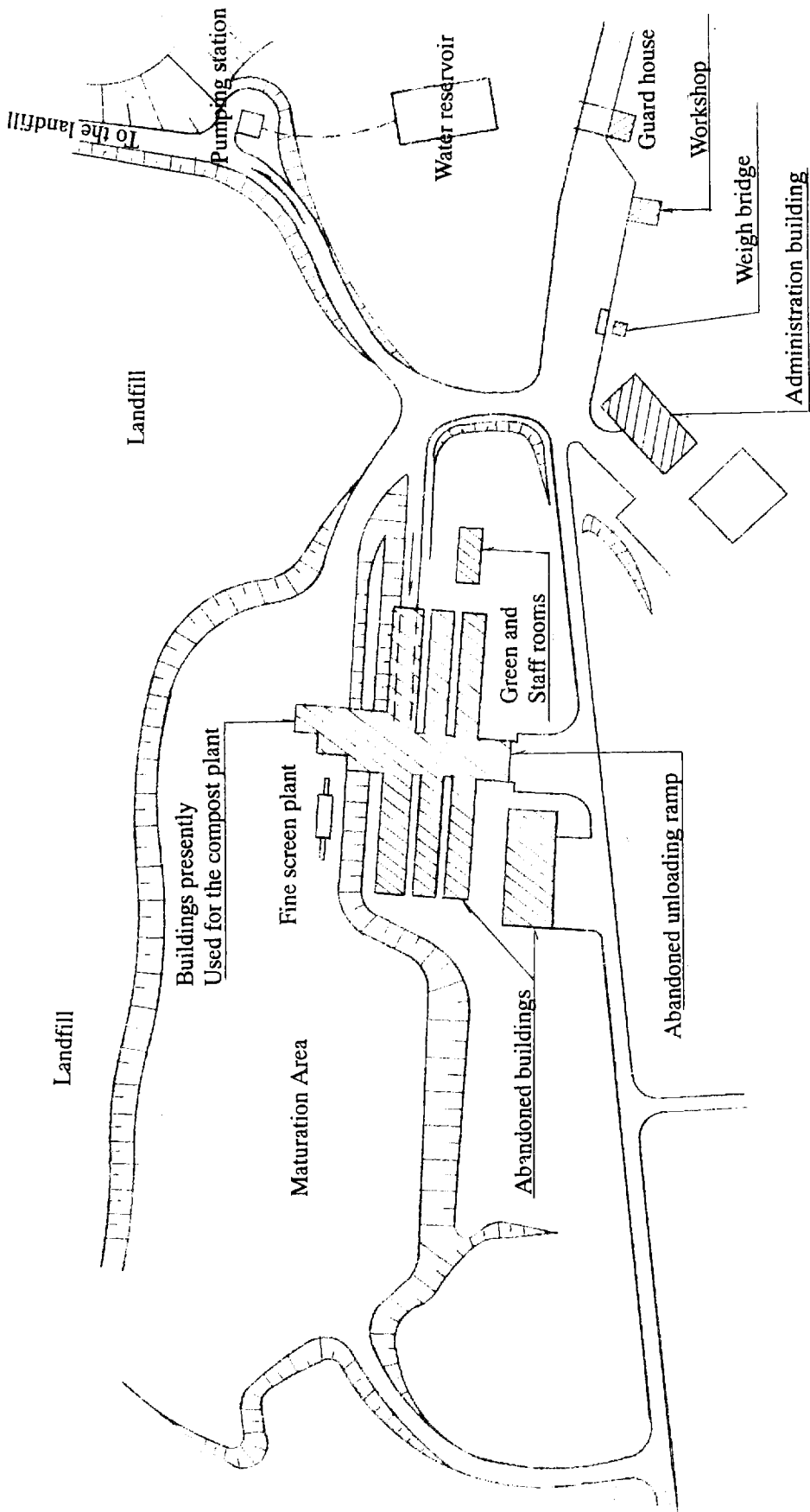


Figure 3-10: Layout of Buildings and Roads

The following facilities are jointly used by the composting plant and the landfill:

- Entrance area and guard house
- Weigh bridge and weighing house
- Administration building
- Workers canteen and staff rooms
- Workshop and store building

In accordance with the original constructed composting plant approximately 3,500m<sup>2</sup> buildings are available. Only 1,000m<sup>2</sup> are used by the present composting plant. The layout of the present composting plant is presented in Figure 3-11.

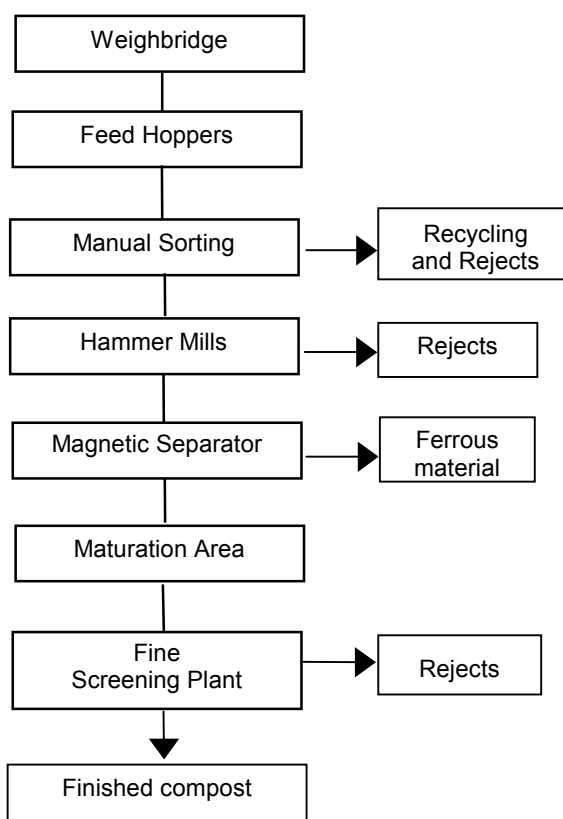


Figure 3-11: Flow Chart of the Present Compost Plant

### e.3.1 Weighbridge

The weighbridge is a manual operated mechanical type. The total allowable load is 40 ton. The weighbridge is in a good working condition and fully satisfying for serving both the landfill and the composting plant.

### e.3.2 Feed Hoppers

The waste is unloaded into 2 feed hoppers from where it after sorting is fed into the hammer mills. Each feed hopper has a capacity of 25 m<sup>3</sup> or approximately 3 truck loads, each 4-5 ton. The 2 feed hoppers do not have sufficient capacity to equalise the

load of incoming waste over the full day, causing diversion of waste to the landfill during peak hours and waste to be unloaded on the floor in front of the feed loaders.

The feed hoppers are made of steel and can easily be maintained by the employees of the plant. The floor of the feed hoppers are heavy duty steel plate conveyors driven by hydraulic motors. Spare parts are easily available.

### **e.3.3 Conveyor Used as a Sorting Band**

Originally no sorting was intended. Thus, no proper facility has been constructed for this propose. However, sorting has to be carried out before the waste enters the hammer mills, as the waste contains material, that can be recycled and materials that are harmful (e.g., big pieces of textile) to the hammer mills.

A private contractor has been awarded the license to manually pick recyclable and uncompostable materials from the conveyor that takes the waste from the feed hoppers to the hammer mills. A fee of 2,600,000,000 TL is paid in 1998 to the Municipality for this license and it was confirmed that workers employed by the private contractor take orders directly from the manager of the composting plant and without any disputes.

### **e.3.4 Hammer Mills**

The hammer mills serves the purpose to reduce the size of waste particles and make the waste more readily accessible for biological degradation.

The mills are manufactured by Gondard, a French company, and are equipped with hammers on a horizontal shaft. The waste falls down on the rotating hammers and is milled to a particle size small enough to let it pass the grit under the rotating hammers. Heavy non-breakable particles are thrown upwards and leave through a chute for reject that is transported to the landfill. The milling process will also cause metal which is present in the waste to be torn up into small pieces of tin, lead, copper and other metals which are harmful to the finished compost.

The hammer mills have a design capacity of 10ton/hour each. This is, however, only obtainable when the hammers are new. The actual average working capacity is estimated at 8 ton/hour for each hammer mill. The hammer mills are clearly the limiting equipment regarding the capacity of the composting plant. As the composting plant is presently operated with 1 shift per day and assuming an efficient working day of 6hours/day, the average capacity of the composting plant is estimated at  $8 \times 6 \times 2 \cong 100$  ton/day or  $52 \times 5 \times 100 \cong$  **25,000 ton/year**, corresponding to actual quantities treated from 1995 to 1997, as stated in Table 3-48. The hammer mills are in good working condition. Hammers are manufactured from local steel and other spare parts are readily available.

### **e.3.5 Magnet**

The over band magnet removes ferrous materials from the raw compost before the compost is taken to the maturation area. However the magnet cannot remove metals that are non magnetic. The magnet would have been more effective if placed before the hammer mills, that are disintegrating metals into small pieces. The magnet is in good working condition.

### **e.3.6 Conveyors**

The conveyors are of the classical type using laminated rubber belts. All conveyors are in a good working condition. They can easily be maintained by the employees of the composting plant and spare parts are readily available.

### **e.3.7 Maturation Area and Water Supply**

The maturation area is unpaved and without any drainage facilities. No measures have been taken to prevent contaminated run-off water from the maturation area and waste water from the compost buildings to seep into the ground.

Due to wet conditions on the maturation area in winter time (beginning of November to end of March) it is normally not possible to operate the composting plant for a period of 3 months. Moisturising of raw compost is not carried out. Even if a municipal water reservoir is located next to the composting plant no installations have been provided to facilitate moisturising of raw compost. No control of temperature in windrows is carried out during the composting process. For aeration, the windrows are normally turned one during the maturation process applying a front end loader. The plant manager considers 2 months of maturation to be appropriate.

It is estimated that the time for maturation in windrows ought to be at least 9 weeks, and that the windrows should be turned and moisturised at least 3-4 times during that period. The present front end loader is clearly not sufficient for this job.

### **e.3.8 Laboratory Facilities**

No laboratory facility is available. It is not possible to check whether the compost is mature or not.

### **e.3.9 Fine Screen**

The fine screen is a rotating drum screening plant. Its design capacity is 8 ton/hour when applying 36mm mesh. The capacity of the feed hopper is only about 1m<sup>3</sup>, requiring a loading equipment (an old Poclain excavator) to be continuously available at the fine screen. The fine screen plant is seldom in operation.

### **e.3.10 Running Equipment**

Transport to the maturation area is carried out by 2 trucks, 12 years old. The same trucks are used when transporting mature compost to the fine screen. Turning of windrows are carried out by front end loader equipped a 2 m<sup>3</sup> bucket. The capacity of this type of equipment is clearly not sufficient for this job especially as it has many other tasks at the plant. The transport to the fine screen is carried by the same equipment as mentioned above.

### **e.3.11 Electrical Installation**

In general the electrical installations are sufficient for heavy polluted areas. Motors are standard types installed in enclosures appropriate for easy replacement. Cables are run in cable trays or in steel pipes. However, the protection of electrical boards is unsatisfactory. A thick layer of dust is covering the components in several boards.

### e.3.12 Summary on Condition and Capacity of Equipment

The present condition and capacity of equipment is summarised as follows. The capacities stated in the following table are theoretical design values.

Table 3-46: Present Condition and Capacity of Equipment

	Capacity	Present Condition	Availability of Spare Parts
Weighbridge	40 ton	fine	easily obtainable
Storage of feed hopper	2 x 25m <sup>3</sup>	fine	easily obtainable
Conveyors	ok	fine	easily obtainable
Hammer mills	2 x 10 ton/hour	good	most parts can be obtained easily
Magnet	ok	good	most parts can be obtained easily
Maturation area	10,000m <sup>2</sup>	unpaved; no drainage and water supply system, no proper equipment for turning of windrows	-
Laboratory facilities	none	-	-
Fine screen	8 ton/hour with 36mm mesh	good, but lacking equipment for loading the fine screen. Fine screening has not been carried out for a year.	to be imported
Electrical installation	ok	not bad	easily obtainable
Water supply	none	-	-
2 trucks	5 ton	12 years	easily obtainable
1 front end loader	2m <sup>3</sup> shovel	good	easily obtainable

### e.4 Organisation, Manpower, and Working Hours

Part of the organisation chart for Mersin Greater Municipality covering the Department for Environment, Health and City Cleansing is presented in Figure 3-12.

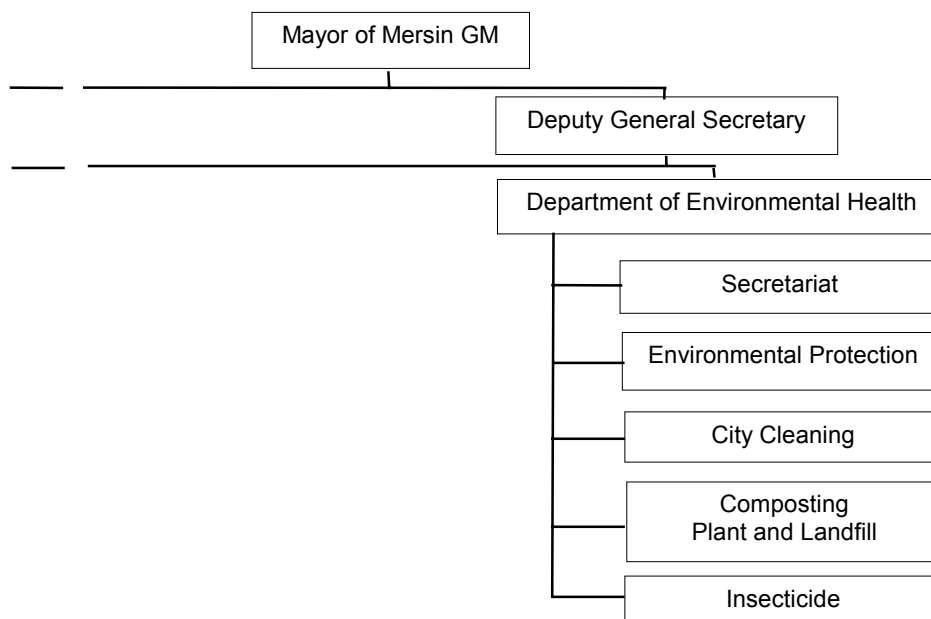


Figure 3-12: Part of the Organisation Chart of Mersin GM

From the organisation chart it appears that the management of the composting plant is undertaken by the Composting Plant Office. The present staff at the composting plant is as follows:

- 1 manager
- 1 foreman
- 1 weighbridge operator
- 2 drivers for the trucks
- 1 wheel loader operator
- 3 labourers
- 2 mechanics
- 1 electrician
- 1 warehouse keeper

In total 13 persons are employed at the composting plant, which is operated as follows.

- 1 shift on weekdays (5 days/week)
- Closed on Saturdays and Sundays.

As collection of waste is carried out 7 days a week, waste has to be directed to the landfill on Saturdays and Sundays.

#### **e.5 Waste Received by the Composting Plant**

The composting plant is serving the Greater Municipality of Mersin comprising the following districts: Yenisehir, Toroslar and Akdeniz.

##### **e.5.1 Quality**

Waste transported to the composting plant is mixed waste from the following sources. Except street pickers picking of recyclable material from containers, no sorting of waste is carried out at these sources:

- Households
- Commercial establishments (offices, shops, etc.)
- Street sweeping

Physical composition analysis of waste from incoming trucks and of waste taken after the sorting band (before the hammer mills) were carried out. The results are presented in the following table, also indicating results of analysis that the Municipality informed were carried out in 1986, when the composting plant was constructed. Table 3-47 below shows the physical composition analysis of waste including specific gravity and moisture content.



Table 3-47: Waste Physical Composition Analysis

	Waste from trucks <sup>1</sup> (%)	Waste taken after sorting <sup>2</sup> (%)	Composition in 1986 (%)
Kitchen waste	51.0	43.6	60.2
Paper	19.9	24.5	4.3
Textiles	3.5	8.8	2.7
Grass and wood	3.6	4.7	-
Plastics	10.1	9.5	2.8
Rubber and leather	0.3	0	-
Metals	1.9	1.2	0.8
Bottles and glass	5.3	2.2	1.5
Stones, ceramics	4.3	3.8	27.7
Miscellaneous	0.1	1.7	-
Total	100	100	100
Specific gravity (kg/m <sup>3</sup> )	320	360	-
Moisture content	-	-	-

Note:

- <sup>1</sup>: Based on 10 samples taken with more than 10 minutes interval immediately before being sorted at the conveyor belt
- <sup>2</sup>: Based on 10 samples taken with more than 10 minutes interval after the waste has been sorted.

The method of sampling has proved to be inappropriate (e.g., the amount of kitchen waste from incoming trucks should not be bigger than the amount of kitchen waste after sorting). Better facilities for sorting and for taking samples is recommended to be constructed when the next composition analysis is carried out in February 1999. However, on the basis of Table 3-47, it is concluded that the present waste supplied to the composting plant contains more paper and plastics than in 1986, when the plant was constructed. This is due to waste from households, shops, etc. being mixed. Waste composition analysis carried out by this study clearly indicates that waste from house holds contain more than 70 % of kitchen waste.

### e.5.2 Quantity

Due to lack of capacity of the compost plant, not all waste collected in the municipality is treated at the compost plant. The remaining waste is disposed of at the landfill.

The quantity of waste that has been received on the composting plant since 1985 is presented in the following table, also presenting waste quantities received on the landfill. Rejects from the composting plant are also disposed of on the landfill, however no record on rejects is available.

Table 3-48: Waste Quantity Transported to the Compost Plant and Landfill

Year	unit: ton/year	
	Waste Quantity Transported to the Composting Plant	Waste Quantity Transported to the Landfill
1985	44,000	no records
1986	45,600	no records
1987	57,200	no records
1988	55,900	14,900
1989	no records	72,400
1990	47,500	30,700
1991	48,800	41,300
1992	no record	95,100
1993	33,200	73,800
1994	31,900	69,500
1995	31,100	68,500
1996	28,600	81,900
1997	21,200	95,500

The decreasing quantity of waste being treated on the composting plant is explained to be due to less priority for the production of compost. Up to year 1991 the composting plant was working 2 shifts per day. Presently only 1 shift per day is applied.

#### e.6 Materials Sorted for Recycling

Materials sorted out for recycling are presented in the following table, also indicating prices that are presently obtained and factories that are the final buyer of the materials.

Table 3-49: Sorted Materials (Quantity, Final Buyer, Prices)

	1997	1996	1995	Final Buyer	Price* (TL/kg)
	ton				
Steel	12	13	15	Iskenderun, Mersin	22,000
Cans, Al	2	1.5	1	Iskenderun, Mersin	180,000
Cans, Fe <sup>1)</sup>	25	30	35	Iskenderun, Mersin	11,000
Plastic	10	8	7	Boztaslar Ticaret, Mersin	30,000
Plastic (PET)	5	4	3.5	SASA, Adana	50,000
Bottles, glass	60	65	70	Anadolu Glass Factory, Mersin	6,500
Paper	10	12	12	SEKA and Donkasan, Adana	11,000
Others	very little	very little	very little		
Total	124	133.5	143.5		

Note

<sup>1)</sup> Also includes materials from the magnet.

\* Price calculations were based on the September 1998 prices.

#### e.7 Quality and Quantity of Finished Compost

##### e.7.1 Quality

Two (2) types of mature compost are being sold or used by the Municipality itself:

- coarse compost, i.e., compost that has not been finally screened
- fine compost which is compost that has been finally screened

Physical composition analysis (wet base) and sieve analysis were carried out and the results are presented in the following table, including the results of the chemical analysis carried out by the Cukurova University in Adana in 1998 and the Danish Technological Institute in 1991.

Table 3-50: Analysis of Fine Compost

Item	Mersin Compost Plant	Compost Produced from Pilot Project			
	1991*	1998**	1999***		
	Present Compost			With Manual Sorting	Without Manual Sorting
	Fine	Coarse	Fine	Fine	Fine
<b>Physical Composition Analysis</b>					
Compost		60.2%	87.8%		
Paper		1.0%	1.1%		
Textile		5.7%	1.3%		
Grass and Wood		1.0%	0.6%		
Plastic		11.9%	5.8%		
Rubber and Leather		0.7%	0.4%		
Metal		0.0%	0.0%		
Bottle and Glass		0.5%	0.4%		
Ceramic and Stone		19.0%	2.6%		
Total		100%	100%		
<b>Sieve Analysis</b>					
% over 19 mm sieve		0.453	0.158		
% passing 19 mm sieve		0.206	0.129		
% passing 11.2 mm sieve				0.142	0.094
% passing 8 mm sieve		0.106	0.047		
% passing 5 mm sieve				0.252	0.182
% passing 2 mm sieve		0.235	0.437	0.441	0.493
% passing 0.5 mm sieve			0.229	0.154	0.23
<b>Chemical Analysis</b>					
Dry matter, DM (%)	87%		83.8%		
Carbon (mg/kg DM)			25.1%		26.0%
Nitrogen (mg/kg DM)			1.3%		2.3%
pH	8.6		8.5		7.71
Pb (mg/kg DM)	36		66.6		109.8
Cd (mg/kg DM)	0.6		11.0		52.5
Cr (mg/kg DM)	12 to 16		124.5		11.69
Cu (mg/kg DM)	117 to 251		247.2		9.9
Ni (mg/kg DM)	86		55.0		28.33
Hg (mg/kg DM)	0.1 to 0.2		Trace		Trace
Zn (mg/kg DM)			49.7		208.3

Note : \*Chemical analysis carried out by DTI, Denmark for the Feasibility Study on Rehabilitation of Composting Plant and Construction of Sanitary Landfill, Ramboll & Hannemanns, December 1991.

\*\*Analysis by JICA Study Team in October 1998.

\*\*\*Analysis by JICA Study Team for pilot project in June 1999

The following conclusions were drawn based on the data shown in Table 3-50.

- The contents of plastic and textiles will be reduced to half, if final screening of the compost is carried out on the present fine screen plant. However, the compost still contains far too much plastic.

- The contents of textiles, stones and ceramics will be reduced considerably, if final screening of the compost is carried out on the present fine screen plant.

### e.7.2 Quantity

Compost is either sold or used in parks by the Municipality. The amount of compost sold is presented in the following table. No record of the produced quantity of compost or quantity used by the Municipality is available. However, assuming the produced quantity of compost equals 50 % of the waste quantity transported to the composting plant (refer to Table 3-48), the table also indicates the estimated quantity used in municipal parks.

Table 3-51: Quantity of Compost Produced and Sold

	Sold Compost		Estimated	Estimated
	Fine Compost (t/year)	Coarse Compost (t/year)	Compost Produced (50 % of waste received) (t/year)	Quantity used in municipal parks (t/year)
1985	3,448	19,167	22,000	0
1986	3,898	15,701	22,800	3,200
1987	3,094	12,163	28,600	13,343
1988	4,589	13,228	28,000	10,183
1989	3,337	8,054	no record	-
1990	3,669	6,136	23,700	13,895
1991	4,780	5,394	24,400	14,226
1992	694	2,283	no record	-
1993	102	24	16,600	16,474
1994	2,345	954	16,000	12,701
1995	568	2,230	15,600	12,802
1996	1,354	1,263	14,300	11,683
1997	1,174	319	10,600	9,107

From the above table, it can be seen that since 1990 most of the compost have been used by the Municipality itself, although a smaller part have been sold to farmers. The compost prices (September 1998) are as follows:

- Coarse compost: 500,000 TL/ton (i.e., fine screening is not applied)
- Fine compost: 750,000 TL/ton

A separate report on surveys on the compost market is presented in Chapter 2, section 2.5, *Survey on Recycling Activities*.

### e.8 Financial Data on the Present Composting Plant

Financial data were obtained as presented in the following table.

Table 3-52: Financial Data

	Income from sale of compost (mil. TL)	Income from sale of recycled material* (mil. TL)	Total income (mil. TL)	Expenses** (Salary, electricity, fuel, spare parts, workers) (mil. TL)
1997	682.5	1,600.0	2,682.5	6,544.1
1996	530.6	1,751.0	2,281.6	3,609.5
1995	338.7	200.0	538.7	1,705.0
1994	240.3	40.0	280.3	926.6
1993	6.3		6.3	560.5
1992	59.0		59.0	328.9
1991	129.9	14.5	144.4	202.4
1990	57.2		57.2	124.9
1989	35.7	8.0	43.7	72.1
1988	70.5		70.5	45.5
1987	35.6	6.2	41.8	33.7
1986	32.0	4.8	36.8	24.3
1985	26.6	4.2	30.8	16.2

Note: \* Including recycled material from the landfill.

\*\* Including operation and maintenance of one bulldozer in the landfill.

The table above reflects the enormous inflation in Turkey. However, it also shows that the running expenses of operating far exceeds the income from the sale of compost and recyclable materials.

For the final evaluation of the feasibility of a new composting plant, the value of saved landfill volume should be taken into consideration as well as the value of compost used by the Municipality in parks.

### e.9 Summary of Deficiencies

Main deficiencies of the composting plant are summarised as follows:

- No source separation or other selection of waste that is treated at the composting plant is carried out. The waste that is received at the composting plant is a mixture from household waste, commerce, and street sweeping. The mixed waste is not suitable for the production of good compost.
- The feed hoppers for trucks unloading of waste do not have sufficient capacity to equalise the load of incoming waste over the day, causing diversion of waste to the landfill.
- Dangerous and insanitary manual picking of recyclable materials from a conveyor belt that was originally not intended for this purpose. As mixed waste is received, the picking is a must for the operation of the hammer mills, i.e., large pieces of textile will close the operation of the hammer mills for days.
- The picking at the sorting belt is carried out by a private contractor who is more interested in picking material that can be sold. A lot of plastic bags are entering the hammer mills and ending up in the final compost as small pieces of plastic.
- As no source separation of waste is carried out and no magnet except the very simple sorting facility, is provide before the hammer mills the hammer mills

cause metals present in the waste to be reduced in size, resulting in heavy metals to be distributed in the raw compost.

- The maturation area is unpaved and without any drainage facilities. Only a wheel loader is available for turning windrows and no water is added when windrows are turned.
- No laboratory facilities are available, resulting in the maturation process not to be properly controlled.
- No proper feed hopper is constructed for the fine screen plant.
- Even if the waste collection is carried out 7 days a week, the composting plant employ only 1 shift per day 5 days a week, resulting in a low capacity at 25,000 - 30,000 ton/year. The remaining waste that is collected (presently 70,000 - 90,000 ton/year), is diverted to the landfill.
- Expenses from operating the plant far exceeds income from sale of compost and recyclable materials. However the value of saved landfill volume should be taken in consideration as well as the value of compost used by the Municipality in parks.

#### **e.10 Conclusion**

The composting plant has been operated since 1985, and most equipment is worn out. The plant has many deficiencies and is producing a bad quality of compost.

The City planning for the site and its surroundings is in great contradiction with the present composting plant and landfill. Immediately south and east of the site are existing or planned housing areas and 500 m to the west is a new housing area under construction.

The Cukurova plain is by nature very fertile, while in mountain areas, the soil is “hard” and requires soil conditioning. However, in the long term it will be difficult to sell compost derived from waste, unless the compost is of a high quality without plastic and heavy metals. The present quality of compost from the composting plant is far from the quality that ought to attract customers. The contents of plastics is far to high.

#### **e.11 Recommendations**

It is recommended that the composting plant should stop operating on this site at the same time as the present landfill is closed and rehabilitated, due to the following reasons:

- The plant has many deficiencies and is producing compost of bad quality.
- It will be more expensive to operate the composting plant on this site, when the landfill has been rehabilitated and a new landfill is in operation. This is because rejects from the composting plant has to be transported to the new landfill and because personnel and facilities like weighbridge, administration building, etc. cannot be used jointly by the new landfill and the present composting plant.

It is also recommended that the whole site is rehabilitated and prepared for municipal services (bus station) in accordance with the Mersin Master Plan, 1996.

Depending on results from further investigations that will be carried out during the course of this study, a new composting plant may be constructed on the same site as the new landfill. The investigations are recommended to include:

- A pilot project carried out with aims to improve the quality compost from the present composting plant, and to estimate the price that can be obtained for this product.
- A more detailed market survey to be carried out.

## **f. Final Disposal**

This section describes the present landfill at the compost plant in Mersin, and identifies the technical and operational problems.

### **f.1 Location and City Planning**

The landfill is located next to the Mersin composting plant in the northern part of Toroslar District (see Figure 3-9). The site comprises an area of approximately 65ha; approximately 20ha is used by the composting plant and the remaining part by the landfill. The city planning (Mersin Master Plan, 1996) for the site and its surroundings is presented in Figure 3-13.

Immediately south and west of the site are planned or already existing housing areas and 500m to the east is a new housing area under construction. In accordance with the Master Plan, part of the site comprising the area with the present landfill is appointed to be geologically inadequate land formerly used for forestry. Part of the site comprising the area with the composting plant is planned for future municipal facilities such as a bus station.

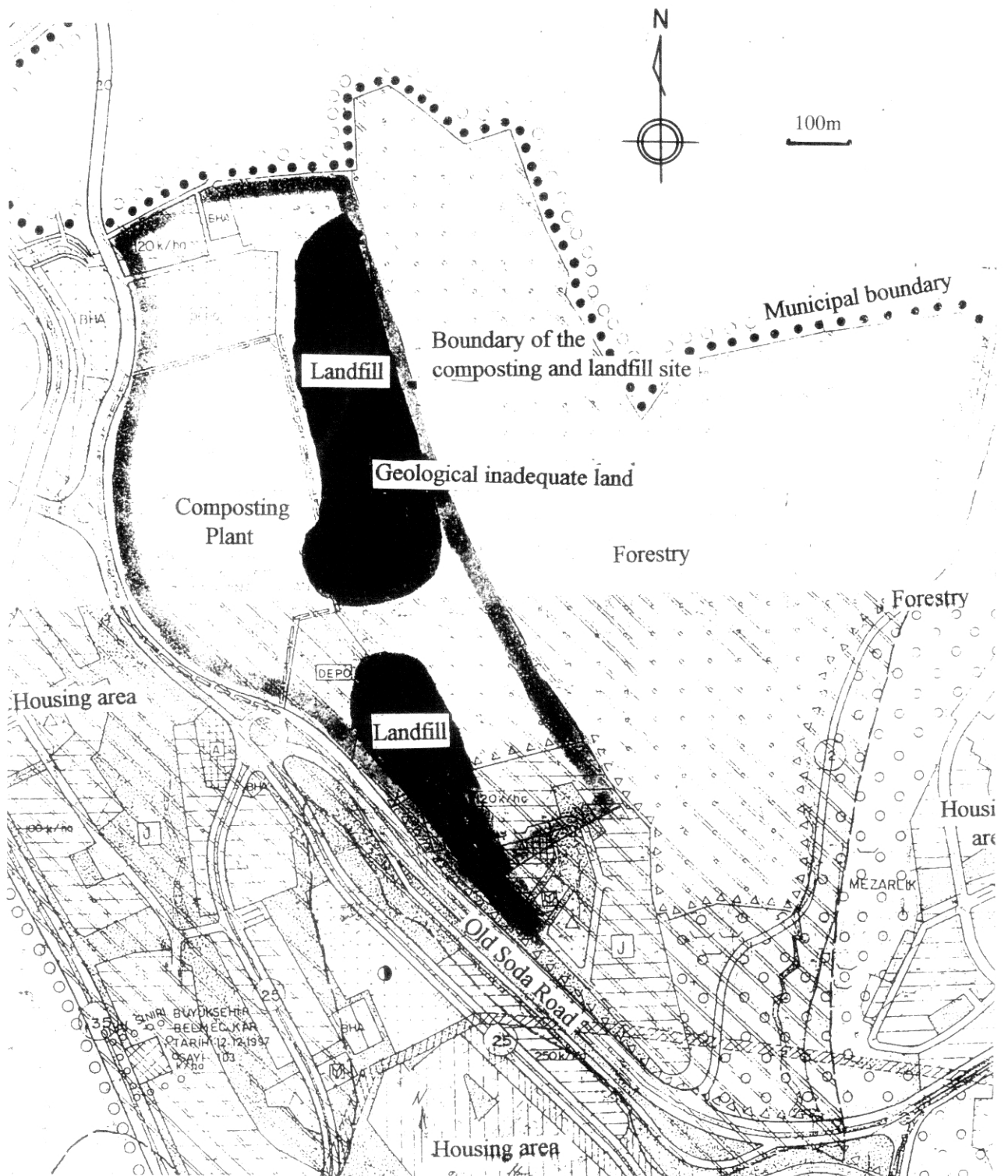


Figure 3-13: City Planning for Areas Near the Landfill (1:10,000)



## f.2 Hydrogeological Conditions

Devlet Su Isleri General Mudurlugu (DSI) has carried out hydrogeological investigations for the Mersin-Berdan and Efrenk Plains. The conditions of groundwater flow in the environments of the landfill are as shown in the following figure.

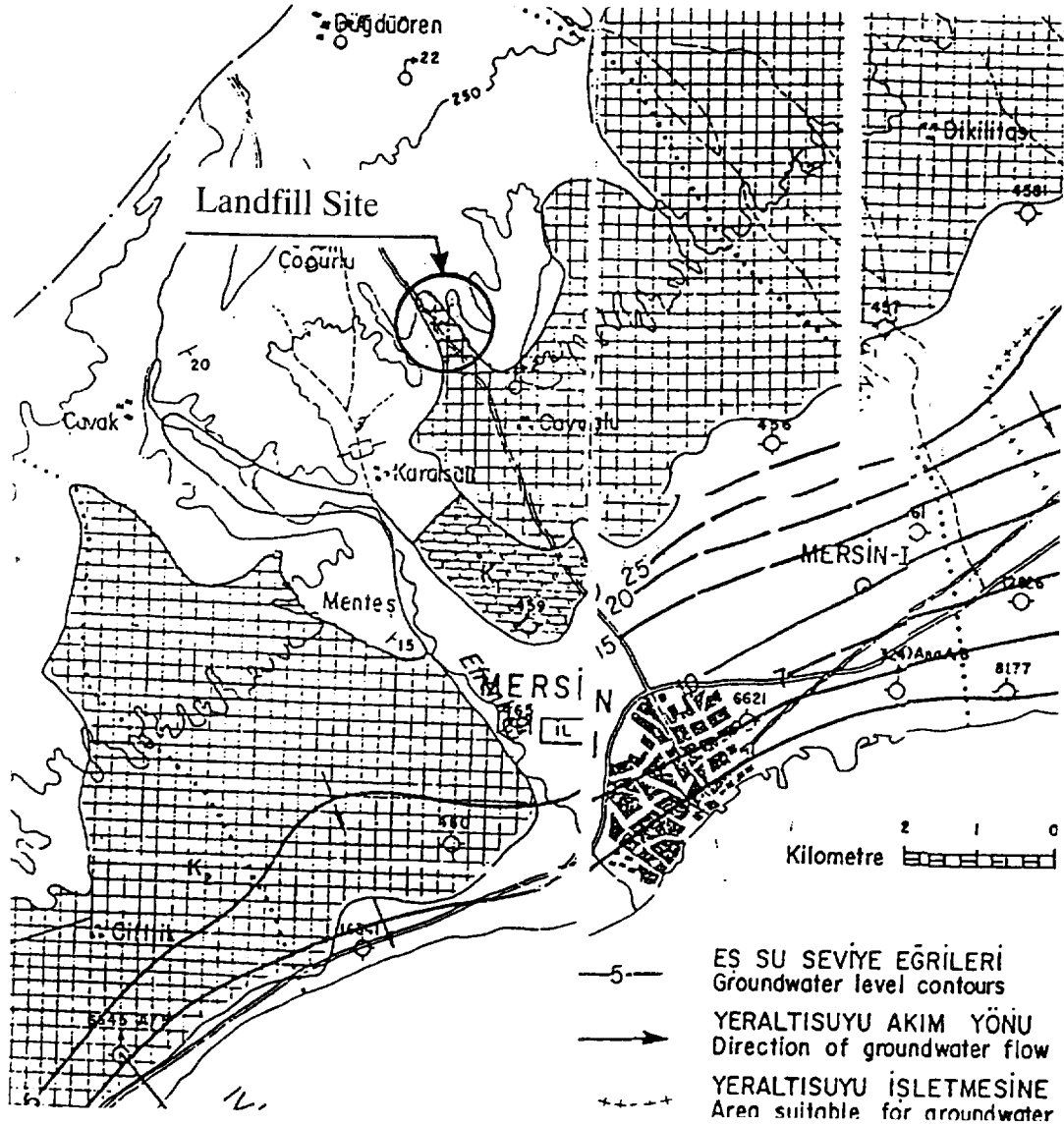


Figure 3-14: Hydrogeological Map of the Mersin-Berdan and Efrenk Plains (DSI, 1978)

The groundwater resources downstream the landfill towards the Mediterranean are of low interest. Some wells used for agricultural irrigation at Cavuslu are reported to be abandoned due to pollution from the landfill.

The water supply of Mersin is based on surface water from the Tarsus Mountains. The water treatment plant at Berdan Dam near Tarsus has a capacity of 260,000m<sup>3</sup>/day.

### f.3 Layout of the Landfill

Dumping on the site started in 1985, when the compost plant was put into operation. However, no precautions whatsoever were taken to protect the environment. The landfill was operated as a simple dumpsite until people started to complain, 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 Figure 3-15.

Table 3-53: 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 <sup>2</sup> 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 4 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.

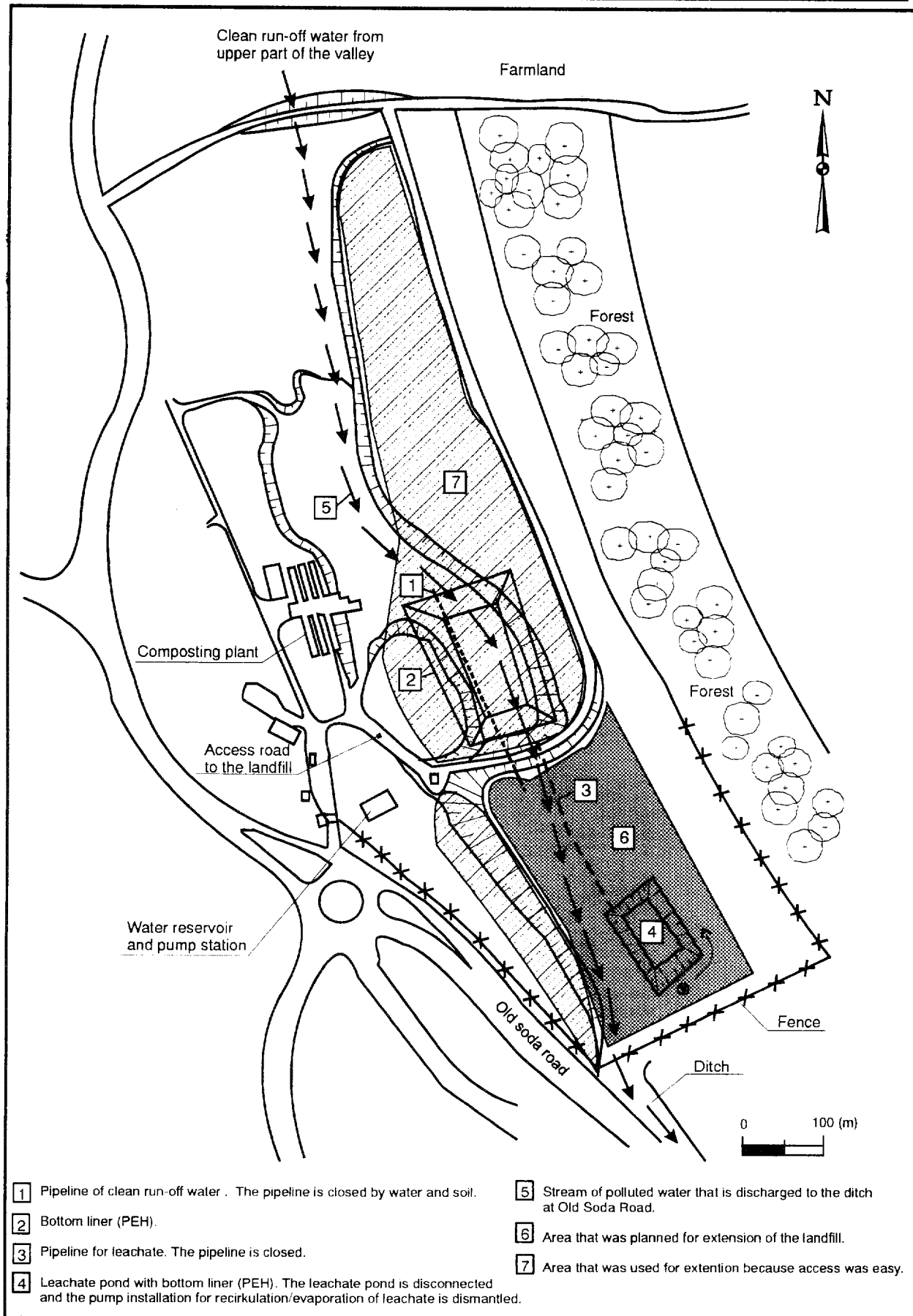


Figure 3-15: Layout of the Present Landfill in Mersin

The site is located in a valley. However not at the upper part of the valley that is occupied by farmlands. Run-off water from the upper part of the valley penetrates into the landfill, creating an unnecessary large generation of leachate. As the landfill area is neighbouring 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 a maximum of another 2 years.

The following facilities are jointly used by the composting plant and the landfill:

- Entrance area and guard house
- Weigh bridge and weighing house
- Administration building
- Workers canteen and staff rooms
- Workshop and store building
- Fences around the southern part of the landfill

No precautions for control of gas from the landfill has been constructed.

#### **f.4 Landfill Operation**

The landfill is operated 7 days a week in 1 shift, as waste collection is carried out 7 days a week. One (1) bulldozer (Caterpillar D7) is always at the landfill. It is 15-20 years old and not in good condition. Furthermore, 1 excavator is normally available from the composting plant when required; but no trucks. Soil coverage is only carried out when the Municipality brings soil to the landfill.

Although, proper operation procedures were introduced in 1992, these are again very inappropriate. Daily unloading of collection trucks takes place on a selected but very big area. The waste heaps are not levelled by the bulldozer on the same day. It can take days before the scavengers have completed picking. When the scavengers have finished, the bulldozer normally dumps the waste over a steep waste front, where it cannot be covered by soil. The waste front constantly emits smoke. Sometimes the waste heaps are levelled by the bulldozer; but the works are not carried out until days after the waste has been unloaded. The present operation of the landfill can merely be characterised as simple dumping.

#### **f.5 Organisation and Manpower**

Part of the organisation chart for Mersin Metropolitan Municipality covering the Department for Environment, Health and City Cleansing is presented in Figure 3-12. From the organisation chart it appears that the management of the landfill is undertaken by the Composting Plant Office. The manager of the composting plant is also manager of the landfill. Only 1 person (the operator of the bulldozer) is permanently employed at the landfill. Workers and other staff that is sometimes required on the landfill are borrowed from the composting plant.

#### **f.6 Waste Transported to the Landfill**

The landfill is serving Mersin GM, which comprises the following districts municipalities: Yenisehir, Toroslar and Akdeniz.

### f.6.1 Quantity

The quantity of waste that has been transported to the landfill since 1985 is presented in the following table. For comparison, the table also indicates waste quantities transported to the composting plant.

Table 3-54: Waste Quantity Transported to the Landfill and Compost Plant

unit: ton/year

	Waste transported to the Landfill (excluding rejects from the composting plant)	Waste Transported to the Composting Plant
1985	no record	44,000
1986	no record	45,600
1987	no record	57,200
1988	14,900	55,900
1989	72,400	no record
1990	30,700	47,500
1991	41,300	48,800
1992	95,100	no record
1993	73,800	33,200
1994	69,500	31,900
1995	68,500	31,100
1996	81,900	28,600
1997	95,500	21,200

### f.6.2 Waste Types

Waste that cannot be treated in the composting plant due to its lack of capacity is disposed of on the landfill. The waste derives from the following sources:

- Households
- Commercial (offices, shops, etc.)
- Street sweeping
- Rejects from the composting plant
- Putrefied foodstuffs from privates (transported by ship and truck)

Furthermore hospital waste is disposed of in special excavations on the landfill. The landfill does not receive industrial waste and demolition waste. These waste types are disposed of by the waste producers themselves.

### f.7 Materials Sorted Out by Scavengers

Materials sorted out by scavengers are presented in the following table, also indicating prices that are presently obtained and factories that are the final buyer of the materials. The information was received from the middleman who also operates the recycling system at the compost plant.

Table 3-55: Sorted Materials (Quantity, Final Buyer, Prices)

Materials	Quantity**			Final Buyer	Price* (TL/kg)	Revenue in 1997***
	1997	1996	1995			
Steel	33	13	35	Iskenderun, Mersin	22,000	726 mil. TL
Can, Al	6	4.5	3	Iskenderun, Mersin	180,000	1080 mil. TL
Can, Fe	60	60	65	Iskenderun, Mersin	11,000	660 mil. TL
Plastic	50	42	38	Boztaslar Ticaret, Mersin	30,000	1500 mil. TL
Plastic (PET)	25	19	16.5	SASA, Adana	50,000	1250 mil. TL
Bottles, glass	340	355	380	Anadolu Glass Factory, Mersin	6,500	2210 mil. TL
Paper	35	38	38	SEKA and Donkasan, Adana	11,000	385 mil. TL
Other	very little	very little	very little			
Total	549	531.5	575.5			7811 mil. TL

Note: \* September 1998 prices: US\$100 = 27.8 mil. TL.  
 \*\* Quantities from 1995-1997.  
 \*\*\* Revenue calculated according to 1998 prices.

As can be seen from the table, the revenue from scavenging on the landfill is quite considerable, approximately US\$ 28,000/year.

### f.8 Leachate Generation

The following table presents the monthly and annual mean values (1987 to 1996) for precipitation and evaporation, as obtained from the Meteorological Station in Mersin via a central office in Ankara.

Table 3-56: Precipitation and Evaporation in Mersin

mm/month	Month												Year
	1	2	3	4	5	6	7	8	9	10	11	12	
Mean Precipitation	91	86	73	35	29	12	14	3	15	58	103	153	671
Mean Potential Evaporation from land	88	94	110	122	133	141	155	165	177	169	117	82	1557
Mean Evaporation from lake	46	54	86	114	148	168	200	192	163	119	71	49	1410

The actual evaporation from land depends on climatic conditions (precipitation, temperature, wind, etc.), the kind of topsoil of the area, the kind of vegetation, and the actual availability of water to be evaporated.

The following table presents a water balance calculation for a landfill section with final soil coverage (1m sandy clay) and with vegetation e.g., grass, trees, and bushes. The quantity of run-off water from the sloping ground ( $\cong$  1:20) of the landfill is assumed at approximately 10 % of the precipitation.

Table 3-57: Water Balance for a Landfill Section with Final Soil Coverage and Vegetation, and Annual Average Precipitation and Evaporation

Units in mm		Month												Year
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
A	Average Precipitation	91	86	73	35	29	12	14	3	15	58	103	153	672
B	Run-off water	9	9	7	4	3	1	1	0	2	6	10	15	67
C	Infiltration (A - B)	82	77	66	32	26	11	13	3	14	52	93	138	604
D	Potential Evaporation	88	94	110	122	133	141	155	165	177	169	117	82	1553
E	C - D	-6	-17	-44	-91	-107	-130	-142	-162	-164	-117	-24	56	
F	Water deficit	50	67	100	100	100	100	100	100	100	100	100	44	
G	Leachate Generation	0	0	0	0	0	0	0	0	0	0	0	0	0
H	Actual Evaporation	82	77	66	32	26	11	13	3	14	52	93	82	551
I	Pot.-Act. Evap. (D-H)	6	17	44	90	107	130	142	162	163	117	24	0	1002

Note: The water deficit expresses the quantity of water that is missing in the top layer before it is moisture-saturated.

From the table it is seen that the annual average leachate generation is calculated at 0 mm/year from a landfill section with final soil coverage and vegetation. However, it should be noted that the leachate generation may vary considerably during the dry and wet season.

Because of high rates of evaporation, leachate generation and groundwater recharge occur only in December. The actual evaporation is estimated at 551mm/year while potential evaporation is informed to be 1,553mm/year. Thus, except for December, it will be possible to evaporate leachate from a landfill with final soil coverage and vegetation, especially from April to October.

## f.9 Financial Data

Data on income from operating the landfill were obtained and shown in the following table. Expenses for operating 1 bulldozer on the landfill is included in the accounts for the composting plant.

Table 3-58: Financial Data

unit: million TL

Year	Income from sale of recycled materials*	Income from private companies	Total income
1997	1,600.0	381.1	1,981.1
1996	1,751.0	549.5	2,300.5
1995	200.0		200.0
1994	40.0		40.0
1993			
1992			
1991	14.5		14.5
1990			
1989	8.0		8.0
1988			
1987	6.2		6.2
1986	4.8		4.8
1985	4.2		4.2

Note: Including materials recycled at the composting plant.

As can be seen waste is also received from private companies (mostly putrefied foodstuffs transported by ships and trucks. The present rate is 1,250,000 TL/ton plus 15% tax.

#### **f.10 Summary of Deficiencies**

Main deficiencies are summarised as follows:

- The site is located in a valley. However not at the upper part of the valley, and a pipeline that was constructed for diversion of clean run-off water is not maintained. The inlet is covered by waste and run-off water from the upper part of the valley is penetrating into the landfill creating an unnecessary large generation of leachate.
- A leachate pipeline from the area with the HDPE-liner 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 landfill equipment.
- The facilities for collection and recirculation/evaporation of leachate are disconnected. Leachate is discharged directly into the nearby ditch at Old Soda Road.
- The present waste front along the maturation area is very steep, and in some places more than 10 m high. Because it is so steep the waste front cannot be covered with soil. It is always smoking.
- Operation procedures are inappropriate. Daily unloading of collection trucks takes place on a selected but very big area. The waste heaps are not levelled by a bulldozer on the same day. It can take days before the scavengers have completed picking. When the scavengers have finished, the bulldozer normally dumps the waste over a very steep high waste front, where it cannot be covered by soil. Sometimes the waste heaps are levelled by the bulldozer; but the works are not carried out until days after the waste was unloaded. The operation of the landfill can merely be characterised as simple dumping.

#### **f.11 Conclusion**

The city planning for the site and its surroundings is in great contradiction with the landfill. Immediately south and west of the site are existing or planned housing areas and 500m to the east is a new housing area under construction. Thus, it will be very difficult to operate a landfill on the site for many more years.

As the landfill area is neighbouring farmland to the north and a forest area to the east it will be very difficult to extend the boundary of the landfill. 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 maximum 2 years. Rehabilitation works are urgently required.

It is recommended that the landfill be closed and rehabilitated as soon as possible. However, the main task for securing operation of a new landfill will be that new procedures for operating the landfill are introduced:



- A precondition for proper landfill operation is that an access road is constructed to the bottom of the landfill area.
- Since scavenging obstructs proper landfill operation, but contributes with a considerable income, due consideration must be taken to the issue of how to combine scavenging with the proper operation of the landfill.

#### **g. Operation and Maintenance of Vehicles and Equipment**

The district municipalities have central workshops where general repair and maintenance of vehicles and equipment are carried out on a regular basis. Major repairs are forwarded to private workshops. The workshop area is also used for washing and parking of vehicles.

Daily inspection is the responsibility of the drivers. Periodical inspection of all vehicles, tire repair, lubrication, daily washing and disinfection are handled in the workshop as well.

There is no preventive maintenance for equipment. A preventive maintenance program would certainly ensure the sustainable use of the equipment.

#### **h. Medical SWM**

##### **h.1 Regulation on Control of Medical Wastes**

In accordance with the regulation prepared in pursuant to the Environmental Act (Law 2872 of 8 September 1983), infectious and hazardous waste should be handled separately. The regulation also stipulates incineration as the basic means of disposing waste. However, the results of the survey on medical institutions and the observations carried out in the final disposal site indicated that actual medical waste management conditions in Mersin GM do not comply entirely with the legislation concerned.

##### **h.2 SWM in Medical Institutions**

Thirteen major medical institutions in Mersin GM were interviewed to survey medical waste management conditions. The survey results are outlined as follows.

###### **h.2.1 Waste Storage in the Departments (at points of discharge)**

Nine hospitals do not to generate hazardous wastes (including X-ray solutions).

All the hospitals surveyed comply with the regulation and separate general waste, infectious waste, and hazardous waste.

###### **h.2.2 Waste Storage in the Departments (at points of discharge)**

All hospitals surveyed (100%) maintain the storage system used in the department at the central collection point.

The most preferred storage container for infectious wastes at the central collection point is a 275lit. metallic container with a lid and a lock. The next common storage containers are a 275lit. with a lid but without a lock and a 400lit. metallic containers with a lid and a lock. Four (30.7%) of the hospitals that generate X-ray solutions were found to use plastic water barrels for storage.

### **h.2.3 Treatment of Infectious and Hazardous Wastes Prior to Discharge**

Twelve (92.3%) of the surveyed hospitals do not treat their infectious waste prior to discharge. One hospital surveyed to do so adopts incineration as a form of waste treatment.

Of the four hospitals producing hazardous waste, none conducts treatment prior to discharge. The private sector is responsible for the removal of radioactive waste from four of the surveyed hospitals.

The municipality is responsible for the removal of infectious waste from 12 of the surveyed hospitals. Only one of the surveyed hospitals is responsible for the removal of its own infectious waste.

Six of the surveyed hospitals receive collection services for infectious waste at a frequency of five to six times a week. Others receive the services twice a week, once a week, everyday, or twice a month.

### **h.2.4 Handling, Storage, Treatment, and Recycling**

The most preferred storage container for general waste at the central point of discharge is a 275lit. metallic container with a lid; 9 hospitals surveyed use this container. The next is a 400lit. metallic container with a lid.

The municipality is responsible for the removal of general waste from all of the 13 surveyed hospitals.

Twelve of the surveyed hospitals receive daily waste collection services. Eight have a recycling system for glassware, and two recycle both glassware and paper.

In seven of the hospitals surveyed, waste pickers gain access to manually separate general wastes in over half of the hospitals.

### **h.2.5 Final Disposal**

Infectious waste collectors dispose of the plastic bags containing infectious wastes in an excavated area within the existing dump site and cover the waste with soil (trenching method). Cover soil is applied frequently, creating a sanitary condition at the site.

### **h.2.6 Financial Obligations**

Under the law, medical institutions are financially obliged to support the management of infectious waste, hazardous waste, and general waste, but over 15% do not pay for their infectious waste services, 100% for their hazardous waste services, and 30% for their general waste services. On average, hospitals pay 1008864 TL per day for infectious waste, which is equivalent to approximately 16658 TL/kg.

The tariffs for general waste are set by the central government as the Cleansing Tax; the Greater Municipality allocates the category to the hospitals, which pay the Cleansing Tax according to the number of beds. The District Municipality collects the Cleansing Taxes from the hospitals under their jurisdiction, for the DMs provide the waste collection services.

### **h.2.7 Staff Training and Administration**

All of the hospitals have written instructions on the separation and management of medical waste, including the definition/classification of infectious waste and hazardous waste and the special requirements for their handling. The staff are trained at least once in all of the hospitals, and all of the hospitals replied that their staff wear protective clothing when handling infectious waste and hazardous waste.

Over 92% of the hospitals replied that they keep written records on the management of infectious waste, and, of those that generate hazardous waste, 100% keep records on the management of hazardous waste, but none of the hospitals keep records on the management of general waste.

Table 3-59: Summary of the Present Medical Waste Management by Hospitals in Mersin

Waste Type	Discharge Point	Central Collection	Treatment & Recycling	Disposal
Infectious	Separated from general waste. Not discharged with hazardous waste	All hospitals maintain the separation practices from the discharge point. Most popular containers are 257 lit., medium sized with a cover.	Almost no treatment of infectious waste onsite. No indication that infected glassware (if recycled) is autoclaved, washed, or disinfected. One of the hospitals incinerate infectious waste onsite.	Collected by a special vehicle from the district municipality. Dumped in special trenches at the municipal landfill, separate from domestic waste.
Hazardous	Not produced by 70% of the hospitals. No reports of radioactive waste being generated.	All hospitals maintain the separation practices from the discharge point. Most popular containers are hard plastic water barrels for x-ray development solutions.	No treatment internally.	All the hospitals hand their waste to private contractors. But none of these hospitals pay for their collection services.
General	Separation of glassware and paper for recycling. General waste separated from hazardous and infectious waste.	All hospitals maintain the separation practices from the discharge point. Most popular containers are metallic, 257 lit., medium sized with a cover.	No treatment, but glassware is crushed, prior to discharge, for recycling. Manual sorting of general waste by waste pickers at the central storage area reported by some hospitals.	General waste is collected by the municipality everyday in almost all the hospitals, as part of the normal collection service.

### **3.2.3 Institutional System**

The analysis of compiled data based on responses to the inquiries in the questionnaire as well as personal interviews and gathered information from diverse publications reveal that in Mersin Province, the Mersin Greater Municipality along with the Yenisehir, Akdeniz and Toroslar Municipalities have undertaken considerable steps towards privatisation in solid waste management process.



**a. Administration and Organisation**

**a.1 Mersin Greater Municipality**

Solid waste management activities of the Mersin Greater Municipality are carried out by the Directorate of Environmental Health, which functions under the supervision of the Deputy General Secretary. The Directorate of Environmental Health carries out these duties with 5 engineers and 5 support staff serving (i) Environmental Protection, (ii) City Cleansing and (iii) Composting Plant & Landfill Sections.

The organisational chart of Mersin GM is shown in

**a.2 Yenisehir District Municipality**

The Yenisehir District Municipality takes care of planning, programming and supervision of contracted services through the Cleansing Directorate, which is constituted by 1 director and 14 subordinate employees. All these municipal employees are active in the field in order to supervise and control the services to be provided by the contractor.

**a.3 Toroslar District Municipality**

The Toroslar District Municipality manages the street sweeping and solid waste disposal services with 1 director and 1 deputy along with 3 chiefs, 5 drivers and 7 employees of the Cleansing Directorate.

**a.4 Akdeniz DM**

The Cleansing Department of the Akdeniz District Municipality has a core staff composed of 1 director with 2 controlling employees, 2 drivers and 4 labourers.

**b. Legislation and Enforcement**

**b.1 Mersin Greater Municipality**

The Department of Environmental Health of the Mersin Greater Municipality has been established in April 20th, 1995 pursuant to Greater Municipality Law No. 3030, by which the local authorities are empowered and assigned to undertake necessary steps to protect environmental health for the welfare of the public.

The tasks of the Department of Environmental Health encompass:

1. Protecting, monitoring and controlling pollutants, including noise emissions, that endanger soil, water and air quality.
2. Undertaking required implementations for the sake of environmental protection.
3. Acknowledging, evaluating and processing environment related public complaints.
4. Supporting regional solid waste management efforts including collection and disposal of medical wastes.
5. Undertaking research studies in environmental aspects.
6. Supervising and controlling sea pollution caused by vessels in the port.

7. Granting licenses for environmentally sound entrepreneurial and professional activities in commercial and industrial sectors.

A brief indication and summary of achievements regarding above mentioned tasks within the time period June 1, 1996 and May 31, 1997 is made in the Activity Report of the Mersin Greater Municipality issues in June 1997. Street sweeping and park cleansing services have been contracted through a joint tender, in which the Mersin Greater Municipality and Akdeniz District Municipality are the clients.

### **b.2 Yenisehir District Municipality**

For the fulfilment of its obligations related to cleansing services as envisaged in the Municipalities Law No. 1580, Yenisehir District Municipality has contracted the collection and transportation of solid waste along with street cleansing and care of green areas, public parks and open spaces within the municipal boundaries to a private company pursuant to Decree No. 18 of the Mayor's Office issued on Oct. 23, 1997.

Regarding the scope of the works to be accomplished by the contractor, the Yenisehir Municipality has prepared a well-tailored tender document with specific references to:

1. Job descriptions
2. Manpower allocations
3. Qualification and skill profiles
4. Service areas, service frequencies and service duration
5. Waste collection means and equipment as well as transport vehicles
6. Sanitation measures
7. Dressing the cleansing personnel in uniforms
8. Control and supervision of contractor performances with respective penalty regulations.

### **b.3 Toroslar District Municipality**

The Toroslar District Municipality has also undertaken a considerable privatisation action in performing assigned cleansing services pursuant to the Municipalities Law No. 1580. As indicated by the responsible personalities as well as in the Annual Activity Report, 1997–1998, of the Toroslar Municipality, the members of the Cleansing Directorate are organised to function on behalf of the municipality as a controlling and monitoring agency for the privatised services in waste management operations. Supervision of services in compliance with the contractual provisions as well as execution of warning and punishing clauses are comprised under the duties of the Cleansing Directorate.

### **b.4 Akdeniz District Municipality**

In fulfilling the compulsory services, as set forth in the Municipalities Law No. 1580, related to urban cleansing, the Akdeniz District Municipality also applies a highly privatised solid waste management model. The Cleansing Directorate is monitoring the activities of the contractor, comprising street cleansing and washing as well as solid waste collection. In accordance with the joint contract signed together with the Mersin Greater Municipality, the contractor carries out those tasks specified for the Akdeniz District Municipality.



### c. Environmental Protection Tax

The environmental protection tax (cleansing tax) is collected by the district municipalities (DMs) according to building type and scale. Of the collected amount 20% is paid to the greater municipality. Since another 10% is reserved as environmental pollution preservation fund, the amount appropriated for cleansing services is only 70% of the collected total.

Every year the Undersecretariat of Treasury of Prime Minister's Office publishes the tax amount by group and rank, and every provincial collection committee (made up of representatives from the regional office of the Undersecretariat of Treasury, the province, and every municipality), sets the appropriate tax amount by building type. In Icel Province, the tax amount is set according to 8 groups and 46 rankings (see table below).

Table 3-60: Tariff of Environmental Tax in Icel Province

unit: 1,000 TL/month

Group	Detail of Group	Rank	1994	1995	1996	1997	1998	1999
Housing (1)*	Area > 150m <sup>2</sup>	7-1	100	153	229	312	437	606
	100-150m <sup>2</sup>	7-2	80	123	184	250	350	486
	<100m <sup>2</sup>	7-3	60	92	137	186	260	361
Housing (2)*	>150m <sup>2</sup>	7-2	80	123	184	250	350	486
	100-150m <sup>2</sup>	7-3	60	92	137	186	260	361
	<100m <sup>2</sup>	7-4	50	76	113	154	215	298
Housing (3)*	>150m <sup>2</sup>	7-3	60	92	137	186	260	361
	100-150m <sup>2</sup>	7-4	50	76	113	154	215	298
	<100m <sup>2</sup>	7-5	25	38	56	76	106	147
Schools	No. of students > 750	1-3	3,000	4,614	6,909	9,423	13,211	18,350
	500-750	2-3	2,000	3,076	4,606	6,282	8,807	12,232
	250-499	3-3	1,500	2,307	3,454	4,711	6,604	9,172
	100-249	4-3	600	922	1,380	1,882	2,638	3,664
	50-99	5-3	400	615	920	1,254	1,758	2,441
	20-49	6-3	200	307	459	626	877	1,218
	< 20	7-3	60	92	137	186	260	361
Hospitals	No. of beds > 500	1-1	5,000	7,690	11,515	15,706	22,019	30,584
	300-500	2-2	2,500	3,845	5,757	7,852	11,088	15,290
	150-299	3-3	1,500	2,307	3,454	4,711	6,604	9,172
	50-149	4-3	600	922	1,380	1,882	2,638	3,664
	20-49	5-4	250	384	576	784	1,099	1,526
	< 20	6-4	150	230	344	469	657	912
Restaurants	Area > 1000m <sup>2</sup>	1-2	4,000	6,152	9,212	12,565	17,616	24,468
	500-1000m <sup>2</sup>	2-3	2000	3,076	4,606	6,282	8,807	12,232
	250-499m <sup>2</sup>	3-4	1,000	1,538	2,303	3,141	4,403	6,115
	100-249m <sup>2</sup>	4-4	400	615	920	1,254	1,758	2,441
	50-99m <sup>2</sup>	5-5	150	230	344	467	657	912
	<50m <sup>2</sup>	6-5	100	153	229	312	437	606

Stadiums	Area > 5000m <sup>2</sup>	1-1	5,000	7,690	11,515	15,706	22,019	30,584
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Group	Detail of Group	Rank	1994	1995	1996	1997	1998	1999
	4000-5000m <sup>2</sup>	2-1	3000	4,614	6,909	9,423	13,211	18,350
	3000-3999m <sup>2</sup>	3-1	2,000	3,076	4,606	6,282	8,807	12,232
	2000-2999m <sup>2</sup>	4-1	1,000	1,538	2,303	3,141	4,403	6,115
	1000-1999m <sup>2</sup>	5-1	600	922	1,380	1,882	2,638	3,664
	500-999m <sup>2</sup>	6-1	300	461	690	941	1,319	1,832
	< 500m <sup>2</sup>	7-1	100	153	229	312	437	606
Cinemas	No. of seats > 2000	1-3	3,000	4,614	6,909	9,423	13,211	18,350
	1500-2000	2-3	2000	3,076	4,606	6,282	8,807	12,232
	1000-1499	3-3	1,500	2,307	3,454	4,711	6,604	9,172
	500-999	4-3	600	922	1,380	1,882	2,638	3,664
	250-499	5-3	400	615	920	1,254	1,758	2,441
	100-249	6-3	200	307	459	625	877	1,218
	< 100	7-3	60	92	137	185	260	361
Offices	No. of employees > 300	1-1	5,000	7,690	11,515	15,706	22,019	30,584
	200-300	2-1	3000	4,614	6,909	9,423	13,211	18,350
	100-199	3-1	2,000	3,076	4,606	6,282	8,807	12,232
	50-99	4-1	1,000	1,538	2,303	3,141	4,403	6,115
	10-49	5-2	500	769	1,151	1,569	2,199	3,054
	4-9	6-5	250	384	575	784	1,099	1,526
	< 3	7-5	80	123	184	250	350	486

Source: Yenisehir, Toroslar and Akdeniz District Municipality  
Note: \*:It depends on the location of the building.

The following table shows the amount of cleansing tax collected in each district municipality.

Table 3-61: Amount of Cleansing Tax Collected in Each DM (1994 -1998)

unit: million TL/year

DM	1994	1995	1996	1997	1998
Yenisehir DM	4,441	22,481	45,987	67,943	89,225
Toroslar DM	5,249	19,550	36,611	56,930	76,701
Akdeniz DM	9,071	37,1015	63,867	105,477	167,296
Total in TL	18,861	79,136	146,465	230,350	333,222
Exchange Rate	35,200	50,803	97,306	180,655	284,480
US\$1,000	536	1,558	1,505	1,275	1,171

Source: Yenisehir, Toroslar and Akdeniz District Municipality

The table above clearly shows that the actual income (in US\$) in 1998 was only 75% of 1995, This is attributed to the fact that in spite of the inflation in 1995-1998 that dragged the exchange rate of the Turkish lira down to 1/6 of the dollar, the cleansing fee was raised only 4 times the 1995 rate and the collection rate was low.

The collection rate is informed 80% in Yenisehir, 70% in Toroslar, and over 90% in Akdeniz. In contrast with the initial budget, however, the collection rate in 1998 only amounts to 45% in Yenisehir and 53% in Toroslar.

Table 3-62: Initial Budget and Collection Rate of Cleansing Tax in Yenisehir, Toroslar and Akdeniz DMs

unit: million TL/year

		1994	1995	1996	1997	1998
Yenisehir District	initial budget	18,778	25,717	77,727	178,087	200,000
	collection rate/budget (%)	23.7	87.4	59.2	38.2	44.6
Toroslar District	initial budget	6,414	28,603	54,112	82,371	145,000
	collection rate/budget (%)	81.8	68.3	84.7	69.1	52.9
Akdeniz District	initial budget	11,091	52,607	?	149,941	180,000
	collection rate/budget (%)	81.8	70.5	?	70.3	92.9

Source: Yenisehir, Toroslar and Akdeniz District Municipality

The cleansing tax bands chargeable to domestic household ranged from TL 106 thousand to TL 437 thousand/household/month, which is US\$ 4.5-18/year/household, if an average exchange rate for 1998 of US\$1:TL284,480 is used. The result of POS showed that the average payment in Mersin was TL 800 thousand/month/household, which is US\$ 33.7/year/household and about 1.8 times of the max range of the tax. If an average household is taken to consist of five persons each generating 160 kg/year, then the total waste generated is 0.80ton/year/household. Presenting the tax on a tonnage basis gives a range of US\$ 5.6-22.5/ton.

The potential of the cleansing tax from household can be calculated to be TL 1,218,912 million, assuming that the number of population was 634,850 in 1998 and average family number was five.

$$800,000 \text{ TL/month/household} \times 12 \text{ months} \times 634,850/5 = 1,218,912 \text{ million}$$

It was too big to the budgetary figures.

On the other hand, the cleansing tax bands chargeable to commercial/business enterprises ranged from TL 350 thousand to TL 22,019 thousand/enterprise/month, which is US\$ 14.8-929/year/enterprise. The result of POS showed that the average payment was TL 830 thousand/month/enterprise, which is US\$ 35/year/enterprise. It was difficult to get reliable number of enterprise, therefore the rate of Yenisehir DM; domestic building chargeable 37,600; office building chargeable 7,400 was used.

$$830,000 \text{ TL/month/household} \times 12 \text{ months} \times 634,850/5 \times 7,400/37,600 = 248,888 \text{ million}$$

The table below shows that the revenue of Mersin GM from the cleansing tax was 16% of the amount of cleansing tax collected in 1998 in Yenisehir, Toroslar, and Akdeniz. The theoretical amount should be 84,000 million TL, which was calculated by the budgetary amount of three DMs (525,000 million TL) and 16% ( $0.2 \times 0.8 \times 100 =$  theoretical rate for the Mersin GM).

Table 3-63: Cleansing Tax Collected in Mersin GM

unit: million TL, %

	1994	1995	1996	1997	1998
Mersin GM	29,385 (?)	1,646	15,272	32,893	54,273
Rate to collection rate of 3 municipalities (%)	?	2.1	10.4	14.3	16.3

Source: Mersin Greater Municipality

## d. Financial Status

### d.1 Changes in the SWM Expenses

#### d.1.1 Yenisehir District Municipality

The changes in the expenses of the cleansing services of Yenisehir Municipality are as shown in the following table.

Table 3-64: Expenses of the Cleansing Services of Yenisehir DM

unit: million TL

Items	Details	1994	1995	1996	1997	1998
Initial Budget		6,179	8,047	28,870	79,440	198,080
Actual Expenditure	current expenditure	6,150	18,308	52,924	135,387	178,175
	personnel	3,952	5,236	1,694	0*	0*
	contracted out	2,165	7,275	43,915	128,221	152,194
	materials & supplies	33	5,753	7,296	7,117	25,916
	others**	0	38	19	49	65
	investment cost	0	0	0	0	0
	<b>Total</b>		<b>6,150</b>	<b>18,308</b>	<b>52,924</b>	<b>135,387</b>
Exchange Rate	US \$ 1 to TL	35,200	50,803	97,306	180,655	284,480
Total expenditure in US\$	<b>US\$1,000</b>	<b>175</b>	<b>360</b>	<b>544</b>	<b>749</b>	<b>626</b>

Source: Yenisehir District Municipality

Note: \*: Since the municipality shares its employees with other departments, the direct personnel expenses of the cleansing department was not calculated.

\*\* : It includes maintenance cost, etc.

The above table shows a huge increase in the cleansing service expenses. The expenses for services contracted out have increased sharply, from 35% of the overall expenses in 1994 to 80% in 1996 and 95% in 1997 (due to privatisation). In 1998, the share of services contracted out went down a little to 85%.

#### d.1.2 Toroslar District Municipality

Changes in the cleansing service expenses of Toroslar Municipality are shown in the following table.

Table 3-65: Expenses of the Cleansing Services of Toroslar DM

unit: million TL

Items	Details	1994	1995	1996	1997	1998
Initial Budget		13,499	31,460	47,090	83,500	261,320
Actual Expenditure	current expenditure	24,104	46,677	57,861	125,312	177,816
	personnel	23,988	27,658	12,108	36,792	44,703
	contracting -out	110	14,051	39,996	80,455	125,899
	materials & supplies	6	4,968	5,757	6,180	7,156
	others**	0	0	0	1,885	58
	investment cost	0	0	0	3,295	0
	<b>Total</b>		<b>24,104</b>	<b>46,677</b>	<b>57,861</b>	<b>128,607</b>
Exchange Rate	US\$1 to TL	35,200	50,803	97,306	180,655	284,480
Total Expenditure in US\$	<b>US\$1,000</b>	<b>685</b>	<b>919</b>	<b>595</b>	<b>712</b>	<b>625</b>

Source: Toroslar District Municipality

The above table shows a stagnate trend in the cleansing service expenses. The expenses for services contracted out are lower than Yenisehir DM and make up 71% of the overall cleansing expenses of Toroslar DM in 1998.

### d.1.3 Akdeniz District Municipality

The changes in the cleansing service expenses of Akdeniz Municipality are as shown in the table below.

Table 3-66: Expenses of the Cleansing Services of Akdeniz DM

unit: million TL

		1994	1995	1996	1997	1998
Initial Budget		34,864	41,677	101,257	201,570	451,450
Actual Expenditure	current expenditure	26,744	30,935	42,926	273,177	477,942
	personnel	25,607	25,277	29,058	51,713	114,110
	contracted out	297	459	4,067	196,744	317,054
	materials & supplies	838	5,198	9,769	24,671	46,301
	others	2	1	32	49	477
	Investment cost	83	12,790	80,862	22,354	19,347
	<b>Total</b>	<b>26,827</b>	<b>43,725</b>	<b>123,788</b>	<b>295,531</b>	<b>497,289</b>
Exchange Rate	US\$1 to TL	35,200	50,803	97,306	180,655	284,480
Total Expenditure in US\$	<b>US\$1,000</b>	<b>762</b>	<b>861</b>	<b>1,272</b>	<b>1,638</b>	<b>1,748</b>

Source: Akdeniz District Municipality

The table above shows a huge increase in the cleansing service expenses. The expenses for services contracted out have increased sharply, from 1% of the overall expenses in 1995 to 67% in 1997 (due to privatisation). The expense was 64% in 1998 and the lowest in the three DMs.

### d.1.4 Mersin Greater Municipality

The changes in the cleansing service expenses of Mersin GM are as shown in the following table.

Table 3-67: Expenses of the Cleansing Services of Mersin GM

unit: million TL

Items	Details	1994	1995	1996	1997	1998
Initial Budget		7,047	509,873	1,134,294	1,550,273	845,425
Actual Expenditure	current expenditure	3,765	62,575	61,032	211,482	220,658
	personnel	3,038	40,600	40,070	136,189	173,901
	contracted out	516	17,812	11,755	62,551	16,767
	materials & supplies	8	4,153	9,186	12,728	29,708
	others	203	10	21	14	282
	investment cost	53	94,320	75,289	196,601	158,620
	<b>Total</b>	<b>3,818</b>	<b>156,896</b>	<b>136,321</b>	<b>408,083</b>	<b>379,278</b>
Exchange Rate	US\$1 to TL	35,200	50,803	97,306	180,655	284,480
Total Expenditure in US\$	<b>US\$1,000</b>	<b>108</b>	<b>3,088</b>	<b>1,401</b>	<b>2,259</b>	<b>1,333</b>

Source: Mersin Greater Municipality

The table above shows a fluctuated trend in the cleansing service expenses caused by the delay of payment. It may be necessary to establish a financial base and to manage steady payment.

## **d.2 Cleansing Service Cost Assumption**

The municipalities do not calculate the costs by the type of cleansing service. For the formulation of the M/P, calculations were made in accordance with the following assumptions:

1. Personnel expenses will be calculated according to the number of employees in the following units: administration, collection and haulage, public area cleansing.
2. According to the report “Conceptual Issues and Experiences in Developing Countries, December 1991 by Sandra Cointreau-Levine” (hereinafter the Sandra Report), the cost of collection in the middle income country ranges about US\$ 9 to 21/capita/year and about 30 % (US\$ 2.7 to 6.3/capita/year) of it is the operation and maintenance (O&M) cost excluding personnel expenses. On the other hand the cost of public area cleansing in the middle income country ranges about US\$ 1.8 to 4.2 /capita/year and about 10 % (US\$ 0.2 to 0.4 /capita/year) of it is the operation and maintenance (O&M) cost excluding personnel expenses. Based on the Sandra Report the expenses for materials was calculated by allocating 15/16 of the expenses to collection and 1/16 to public area cleansing activities.
3. Since the Sandra Report also indicates about 30 % (US\$ 2.7 to 6.3/capita/year) of the collection cost in the middle income country is the capital investment while about 20 % (US\$ 0.4 to 0.8 /capita/year) of the public cleansing cost. Thus the expenses for capital was calculated by allocating 15/17 of the expenses to collection and 2/17 to public area cleansing activities.
4. The expenses for the contracting out was calculated by allocating 2/3 of personnel expenses and 1/3 of materials based on the information given by the private contractor of Yenisehir DM.
5. Others will be calculated by the percentage of the total of the personnel expenses and expenses for materials, investment and contracting out.

### **d.2.1 Yenisehir District Municipality**

#### **i. Cleansing Service Cost by Service Type**

The 1998 cleansing service expenses of Yenisehir DM were estimated as shown in the following table.

Table 3-68: Cleansing Service Cost of Yenisehir DM in 1998

unit: million TL

Expenses		Administration	Collection/Haulage	Public area cleansing	Total
Personnel		15	(42)	(144)	15 + (186)
Direct Personnel Expenses		0			0
Material Expenses			24,296	1,620	25,916
Investment Cost			0	0	0
Contracted out	Personnel		22,911	78,552	101,463
	Materials		47,560	3,171	50,731
Subtotal		0	94,767	83,343	178,110
Others		0	35	30	65
<b>Total</b>		<b>0</b>	<b>94,802</b>	<b>83,373</b>	<b>178,175</b>

Source: Yenisehir DM

Note: ( ) : employed by private contractor

The direct personnel expenses in 1998 was not listed in expenditure statement by branches. The expenses for services contracted out averaged 546 million TL/employee/year which were calculated by the number of the employees (186 people) of the private company. That was about half of that of Seyhan DM in Adana.

## ii. Unit Cost of Cleansing Services

The collection and haulage, and overall service costs were calculated by unit weight and service population, while the public area cleansing service cost was calculated by unit weight and the length (km) of the road covered.

Table 3-69: Unit Cost of Cleansing Services in Yenisehir DM (1998)

Items	Cost (million TL)	Unit	Amount	Unit Price (1,000 TL)	Unit Price (US\$)*
Collection/haulage	94,802	ton	31,303 ton/year	3,029	10.64
		capita/year	145,310 people	652	2.29
Public area cleansing**	83,373	ton	1,866 ton/year	44,680	157.06
		km/year	96 km	868,469	3,052.83
Administration	0				
Total	178,175	ton	33,169 ton/year	5,372	18.88
		capita/year	145,310 people	1,226	4.31

Note \*: US\$1.00 = 284,480 TL

\*\* : including park cleansing (13.1 ha)

The unit cost of collection/haulage seems to be very low comparing to those of Adana DMs. But considering that that unit cost did not include both direct personnel cost and depreciation cost, the unit price of Yenisehir DM is reasonable.

If the overall costs were to be calculated based on a family size of 5 people, the amount would be US\$ 21.55/household/year.

## d.2.2 Toroslar District Municipality

### i. Cleansing Service Cost by Service Type

The 1998 cleansing service expenses of Toroslar DM estimated as shown in the following table.

Table 3-70: Cleansing Service Cost of Toroslar DM in 1998

unit: million TL

Expenses	Administration	Collection/ Haulage	Public area cleansing	Total
Personnel	17	(38)	(125)	17 + (163)
Direct Personnel Expenses	44,703	0	0	44,703
Material Expenses		6,709	447	7,156
Investment Cost		0	0	0
Contracted out	Personnel	19,567	64,366	83,933
	Materials	39,343	2,623	41,966
Subtotal	44,703	65,619	67,436	177,758
Others	15	21	22	58
<b>Total</b>	<b>44,718</b>	<b>65,640</b>	<b>67,458</b>	<b>177,816</b>

Source: Toroslar DM

Note: ( ): employed by private contractor

The direct personnel expenses calculated by the number of employees in the cleansing department (17 people) averaged 2,630 million TL/employee/year. The contracting out expenses averaged 515 million TL/employee/year, and were calculated by the number of the employees (163 people) of the private company. That was less than half of that of Seyhan DM.

### ii. Unit Cost of Cleansing Services

The collection and haulage, and overall service costs were calculated by unit weight and service population, while the public area cleansing service cost was calculated by unit weight and the length (km) of the road covered.

Table 3-71: Unit Cost of Cleansing Services in Toroslar DM (1998)

Items	Cost (million TL)	Unit	Amount	Unit Price (1,000 TL)	Unit Price (US\$)*
Collection/haulage	65,640	ton	50,925 ton/year	1,289	4.53
		capita/year	234,024 people	280	0.99
Public area cleansing**	67,458	ton	3,012 ton/year	22,396	78.73
		km/year	155 km	435,213	1,529.85
Administration	44,718				
Total	177,816	ton	53,937 ton/year	3,297	11.59
		capita/year	234,024 people	760	2.67

Note \*: US\$1.00 = 284,480 TL

\*\* : including ark cleansing (21.2 ha)

The unit cost of collection/haulage was very low even if the direct personnel cost and the depreciation cost were not included in it.



If the overall costs were to be calculated based on a family size of 5 people, the amount would be US\$ 13.35/household/year.

### d.2.3 Akdeniz District Municipality

#### i. Cleansing Service Cost by Service Type

The 1998 cleansing service expenses of Akdeniz DM estimated as shown in the following table.

Table 3-72: Cleansing Service Cost of Akdeniz DM in 1998

unit: million TL

Expenses	Administration	Collection/Haulage	Public area cleansing	Total
Personnel	9	(52)	(172)	9 + (224)
Direct Personnel Expenses	114,110	0	0	114,110
Material Expenses		43,407	2,894	46,3010
Investment Cost		17,071	2,276	19,347
Contracted out	Personnel	49,068	162,301	211,369
	Materials	99,080	6,605	105,685
Subtotal	114,110	208,626	174,076	496,812
Others	110	200	167	477
<b>Total</b>	<b>114,220</b>	<b>208,826</b>	<b>174,243</b>	<b>497,289</b>

Source: Akdeniz DM

Note: ( ): employed by private contractor

In comparison with other municipalities, the direct personnel expenses of Akdeniz, calculated by the number of employees of the cleansing section (9 people), is very high averaging 12,679 million TL/employee/year. The expenses for services contracted out, calculated by the number of the employees (224 people) of the private company, is also quite high in comparison with other municipalities at 944 million TL/employee/year.

#### ii. Unit Cost of Cleansing Services

The collection and haulage, and overall service costs were calculated by unit weight and service population, while the public area cleansing service cost was calculated by unit weight and the length (km) of the road covered.

Table 3-73: Unit Cost of Cleansing Services in Akdeniz DM (1997)

Items	Cost (million TL)	Unit	Amount	Unit Price (1,000 TL)	Unit Price (US\$)*
Collection/haulage	208,826	ton	56,473 ton/year	3,698	13.00
		capita/year	255,516 people	475	2.63
Public area cleansing**	174,243	ton	3,284 ton/year	53,058	186.51
		km/year	169 km	1,031,024	3,624.24
Administration	114,220				
Total	497,289	ton	59,757 ton/year	8,322	29.25
		capita/year	255,516 people	1,946	6.84

Note \*: US\$1.00 = 284,480 TL

\*\* : including park cleansing (23.1 ha)

If the overall costs were to be calculated based on a family size of 5 people, the amount would be US\$ 34.20/household/year.

#### **d.2.4 Mersin GM**

##### **i. Cost of Cleansing Services**

In Mersin GM, a separate accounting between two groups such as administration and public cleansing services and composting and landfill services was tried in 1995, though some parts of the expenses were not paid because of financial fluctuation. According to the information and advice by the director of Financial Department, the budget figure by items in 1995 was used to calculate the SWM expenses by services basically.

The calculation of the costs by services were done in two steps. The separation of the expenses in 1998 to two groups such as administration and public cleansing services and composting and landfill services was done first. After that, the calculation of expenses by SWM services was done under the following additional assumptions.

##### Step 1: Separation to two groups

1. Personnel expenses which were not listed in the 1995 budget were separated according to the number of employees in the following groups: administration and public area cleansing services and composting and landfill services. Wage expense (item code 130) was separated according to the budget figures.
2. Service expense which were not listed in 1995 budget were separated in proportion to the sub-total of the listed expenses.
3. Considering the present payment of fuels expense (item code 430), 70% of the expense was separated to composting and landfill services, though the expense was listed only for administration and public cleansing services in the 1995 budget.
4. The expense for food (item code 450), which was not listed in the 1995 budget, was separated in proportion to the sub-total of other material expenses. (item codes from 410 to 490)
5. Considering the present purchase of vehicles (item code 610), 20% of the expense was separated to composting and landfill services, though the expense was listed only for administration and public cleansing services in the 1995 budget.

The expenses by items for administration and public cleansing services and composting and landfill services and calculation results for two groups are shown in the following table.

Table 3-74: Separate Accounting Budget by items in 1995 and Calculation Result in 1998

unit: million TL

			1995 (budget)		1998		
			Administration /Cleansing	Composting /Landfill	Total (actual)	Administration /Cleansing	Composting /Landfill
Personnel					68	52	16
Personnel Expenses	110	Salary	0	0	6,073	4,644	1,429
	130	Wages	38,300	2,785	160,341	149,474	10,867
	140	Social security	0	0	373	286	87
	150	Overwork	0	0	247	189	58
	160	Compensation	0	0	6,285	4,807	1,478
	180	Medical treatment	0	0	583	445	138
	190	Practice course	0	10	0	0	0
Travelling Expenses	210	Domestic	20	20	112	56	56
	240	Overseas	20	20	0	0	0
Service Expenses	310	Advisory companies	0	0	238	238	0
	320	Transportation & Communication	50	30	263	165	98
	330	Haulage	0	0	0	0	0
	340	Additional fees	742	100	223	196	27
	350	Rent	15,601	0	5,794	5,794	0
	360	Repair of machine, etc.	655	574	8,579	4,572	4,007
	370	Small repair	100	141	1,641	681	960
390	Other services	0	0	30	21	9	
Material Expenses	410	Stationary	30	20	434	260	174
	420	Fuel (solid)	30	20	0	0	0
	430	Fuel (liquid)	2,000	0	10,194	3,058	7,136
	440	Electric, water & gas	100	1,500	7,264	455	6,809
	450	Food	0	0	231	101	1230
	460	Special materials	100	311	3,058	744	2,314
	490	Other materials	4,000	30	8,527	8,463	64
Other current Expenses	510	Office materials	30	10	145	109	36
	520	Office machine	20	10	16	11	5
	530	Fire protection	0	30	0	0	0
	590	Other furniture	0	19	6	0	6
Investment Expenses	610	Vehicles	93,345	0	157,463	125,971	31,492
	620	Machine	2,000	100	778	740	38
	710	Larger maintenance	0	347,000	380	0	380
<b>Total</b>			<b>157,143</b>	<b>352,730</b>	<b>379,278</b>	<b>311,480</b>	<b>67,798</b>

Source: Financial Department of Mersin GM

### Step 2-1: Separation to Administration service and Public Cleansing Service

1. Personnel expenses were separated according to the number of employees, though wage expense (item code 130) was assumed to be for public cleansing services.

2. Travelling expenses were also separated according to the number of employees.
3. Service expenses were also separated according to the number of employees.
4. The expense for liquid fuels (item code 430) was assumed to be for public cleansing service fully. Other material expenses were separated according the number of employees.
5. The expenses for furniture were separated according to the number of employees.
6. Investment expenses were assumed to be for public cleansing service fully.

Step 2-2: Separation to Composting service and Landfill Service

1. Personnel expenses were separated according to the number of employees.
2. Travelling expenses were also separated according to the number of employees.
3. Service expenses were also separated according to the number of employees.
4. The expense for liquid fuels (item code 430) was assumed to be for landfill services, while the expense for electric and etc. (item code 440) was assumed to be for composting. Other material expenses were assumed to be 1:1 for both services.
5. The expenses for furniture were separated according to the number of employees.
6. Investment expenses were assumed to be 1:1 for both services.

The 1998 cleansing service expenses are estimated as shown in the table below.

Table 3-75: Cleansing Service Cost of Mersin GM in 1998

unit: million TL

		Group 1			Group 2		
		Total	Administration	Public cleansing	Total	Composting	Landfill
Personnel		68	15	37	16	13	3
Personnel expenses	110	4,644	1,340	3,304	1,429	1,161	268
	130	149,474	0	149,474	10,867	8,830	2,037
	140	286	83	203	87	71	16
	150	189	55	134	58	47	11
	160	4,807	1,387	3,420	1,478	1,201	277
	180	445	128	317	138	112	26
	190	0	0	0	0	0	0
Travelling expenses	210	56	16	40	56	46	10
	240	0	0	0	0	0	0
Service expenses	310	238	69	169	0	0	0
	320	165	48	117	98	80	18
	330	0	0	0	0	0	0
	340	196	56	140	27	22	5
	350	5,794	1,671	4,123	0	0	0
	360	4,572	1,319	3,253	4,007	3,256	751
	370	681	196	485	960	780	180
	390	21	6	15	9	7	2
Material expenses	410	260	75	185	174	87	87
	420	0	0	0	0	0	0
	430	3,058	0	3,058	7,136	0	7,136
	440	455	132	323	6,809	6,809	0
	450	101	29	72	130	65	65
	460	744	214	530	2,314	1,157	1,157
	490	8,463	2,441	6,022	64	32	32
Other current expenses	510	109	32	77	36	29	7
	520	11	3	8	5	4	1
	530	0	0	0	0	0	0
	590	0	0	0	6	5	1
Investment expenses	610	125,971	0	125,971	31,492	15,746	15,746
	620	740	0	740	38	19	19
	710	0	0	0	380	190	190
<b>Total</b>		<b>311,480</b>	<b>9,300</b>	<b>302,180</b>	<b>67,798</b>	<b>39,756</b>	<b>28,042</b>

If the direct personnel expenses calculated by the number of employees (63 people) in the cleansing department average 2,537 million TL/employee/year. Assuming the service expenses were used for the expenses for services contracted out, it was calculated by the number of the employees (86 people) of the private company and averaged only 136 million TL/employee/year. The amount is slightly lower than DMs.

## ii. Unit Cost of Cleansing Services

The collection and haulage, and overall service costs were calculated by unit weight and service population, while the public area cleansing service cost was calculated by unit weight and the length (km) of the road covered.

Table 3-76: Unit Cost of Cleansing Services in Mersin GM (1998)

Items	Cost (million TL)	Unit	Amount	Unit Price (1,000 TL)	Unit Price (US\$)*
Public area cleansing	302,180	ton	1,692 ton/year	178,593	1,592.89
		km/year	90 km	3,357,556	11,802.43
Final disposal	28,042	ton	143,262 ton/year	196	0.70
		capita/year	634,850 people	44	0.16
Composting plant	39,756	ton	7,300 ton**	5,446	19.14
Administration	93,000	ton			
Total	379,278	ton	148,555 ton/year***	2,553	8.97
		capita/year	634,850 people	597	2.10

Note \*: US\$1.00 = 284,480 TL

\*\* : 20 ton/day x 365 days = 7,300 ton/year

\*\*\* Sum of the collection/haulage amount and public cleansing amount in Mersin area.

The final disposal cost (US\$ 0.70/ton) is deemed to be slightly low considering the current sanitary level of the landfill. If a household averages 5 people, the final disposal cost per household would be US\$ 0.16 /household/year. The overall cleansing service cost of Mersin GM will become US\$ 10.50/household. Adding the overall cleansing service cost of each DM to the cost of Mersin, the cost would be US\$ 32.05 /household/year in Yenisehir, US\$ 23.85/household/year in Toroslar, and US\$ 44.70/household/year in Akdeniz.

### d.2.5 Unit Costs to be Used in Master Plan

The unit costs calculated above are very differ by municipalities and by services. One of the reasons is supposed that some municipalities did not fully pay the necessary expenses in 1998.

In the same way, unit costs by service in 1997 were calculated. The unit costs by service in 1997 and 1998 are summarised as following table.

Table 3-77: Unit Costs by Service (Mersin)

unit: US\$/ton

		1997	1998
Yenisehir DM	Collection/haulage	15.5	10.6
	Public area cleansing	250.8	157.1
	Overall SWM	28.8	18.9
Toroslar DM	Collection/haulage	5.4	4.5
	Public area cleansing	119.8	78.7
	Overall SWM	16.8	11.6
Akdeniz DM	Collection/haulage	14.8	13.0
	Public area cleansing	267.0	186.5
	Overall SWM	34.8	29.3
Total of three DMs	Collection/haulage	11.5	9.4
	Public area cleansing	208.8	140.0
	Overall SWM	26.8	20.4
Mersin GM	Public area cleansing	1,367.0	627.8
	Composting Plant	24.2	19.1
	Final Disposal	1.4	0.7
	Overall SWM	19.4	9.0

The unit cost of public area cleansing is considered to include some parts of the costs of other SWM services.

“Study on Appropriate Solid Waste Management Practice” suggested that the cost for collection and haulage ranged of US\$ 20 to 28/ton, and that for final disposal ranged of US\$ 5 to 10/ton. The report pointed out that an indicative unit cost for domestic waste collection and disposal in the medium term is taken to be at least US\$ 40/ton. Considering these unit costs in Turkey, the following costs for existing system are used to formulate the master plan.

- Collection and haulage US\$ 25/ton
- Public area cleansing US\$ 221/ton

### d.3 Financial Assessment

The revenue (cleansing tax) and expenditures of the cleansing services shown above clearly shows the critical financial state the solid waste management services is in. Here it is assumed that 70% of the collected cleansing tax is allocated to the municipal cleansing offices.

#### d.3.1 Yenisehir District Municipality

The revenue and expenditure of the cleansing services of Yenisehir DM are as shown below.

Table 3-78: Revenue & Expenditure of the Cleansing Services of  
Yenisehir DM

unit: million TL

Items	1994	1995	1996	1997	1998
Revenue (A)	3,109	15,737	32,191	47,560	62,458
Expenditure (B)	6,150	18,307	52,924	135,387	178,175
Balance (A-B)	-3,041	2,570	-20,733	-87,827	-115,717
<b>Cost covering rate (% = A/B x 100)</b>	<b>50.6</b>	<b>86.0</b>	<b>60.8</b>	<b>35.1</b>	<b>35.1</b>

The table above clearly shows that the current cleansing tax collection system cannot support the cleansing service expenses. The deficit of costs is covered by other revenue of municipality, and the share of the deficit to the whole revenue of Yenisehir DM was 7.7% in 1998.

### d.3.2 Toroslar District Municipality

The revenue and expenditure of the cleansing services of Toroslar DM are as shown in the table below.

Table 3-79: Revenue and Expenditure of the Cleansing Services of  
Toroslar DM

unit: million TL

Items	1994	1995	1996	1997	1998
Revenue (A)	3,744	13,685	25,628	39,851	53,691
Expenditure (B)	24,104	46,677	57,861	128,607	177,816
Balance (A-B)	-20,360	-32,992	-32,233	-88,756	-124,125
<b>Cost covering rate (% = A/B x 100)</b>	<b>15.5</b>	<b>29.3</b>	<b>44.3</b>	<b>31.0</b>	<b>30.2</b>

The table above clearly shows that the current cleansing tax collection system cannot support the cleansing service expenses. The deficit of costs is covered by other revenue of municipality, and the share of the deficit to the whole revenue of Toroslar DM was 6.9% in 1998.

### d.3.3 Akdeniz District Municipality

The revenue and expenditure of the cleansing services of Akdeniz DM are as shown in the table below.

Table 3-80: Revenue and Expenditure of the Cleansing Services of  
Akdeniz DM

unit: million TL

Items	1994	1995	1996	1997	1998
Revenue (A)	6,350	25,974	44,707	73,834	117,107
Expenditure (B)	26,827	43,725	123,788	295,530	497,289
Balance (A-B)	-20,477	-17,751	-79,081	-221,696	-380,182
<b>Cost covering rate (% = A/B x 100)</b>	<b>23.7</b>	<b>59.4</b>	<b>36.1</b>	<b>25.0</b>	<b>23.5</b>



The table above clearly shows that the current cleansing tax collection system cannot support the cleansing service expenses. The deficit of costs is covered by other revenue of municipality, and the share of the deficit to the whole revenue of Akdeniz DM was 15.3% in 1998.

#### d.3.4 Mersin GM

Aside from payments of the cleansing tax from the three district municipalities, Mersin GM accumulates revenues from the sale of compost and recyclables, as well as disposal fees paid by some enterprises. The table below shows the cleansing service revenue and expenditure.

Table 3-81: Revenue and Expenditure of the Cleansing Services of Mersin DM

unit: million TL

	1994	1995	1996	1997	1998
Revenue (from the 3 DMs)	?	150	253	34,690	54,273
Sale of compost	240	339	531	683	1,037
Sale of recoverables	40	200	1,751	1,600	2,600
Tipping fee			550	381	2,297
Total Revenue (A)	-	689	3,085	39,604	60,207
Expenditure (B)	3,818	156,896	138,988	408,083	379,278
Balance (A-B)	-	-156,207	-135,903	-368,479	-319,071
<b>Cost covering rate (% = A/B x 100)</b>	-	<b>0.4</b>	<b>2.2</b>	<b>9.7</b>	<b>15.9</b>

The table above clearly shows that the current cleansing tax collection system cannot support the cleansing service expenses. The deficit of costs is covered by other revenue of municipality, and the share of the deficit to the whole revenue of Mersin GM was 3.8% in 1998.

#### e. Privatisation and Contracting System

##### e.1 Mersin Greater Municipality

The Department of Environmental Health is active in diverse branches of solid waste management: dump-site and composting plant management, disposal of medical wastes. City cleansing and street sweeping services have been organised through a mixed-model, in which both the municipal (37 labourers) and private company (86 employees) personnel are active in street and park cleansing along with waste disposal services. The municipal personnel is performing services in the areas which are not commissioned to the contractor. Street sweeping, park cleansing and waste disposal services have been contracted to the Oz-Gul Co., Ltd. through a joint tender dated December 16th, 1997, in which the Greater Mersin Municipality and the Akdeniz District Municipality are clients.

A thorough tender document has been prepared by both municipalities describing the scope of services to be provided by the contractor for each municipality, respectively. Required type of services with local specifications have been amply emphasised in the contract and listed along with working principles set by the clients. Provisions related to program preparation and approval as well as supervision of performances have

been distinctively identified with regard to exceptional cases accompanied by applied regulations for defaults. Further issues in the contract refer to physical appearance of the personnel, hygienic and sanitary working style, as well as frictionless relations with the target groups. The financial matters of the contract encompass the maintenance, repair and operation costs as well as personnel wages, payment conditions and price escalations.

However, the scope of services provided by the contractor to the Mersin Greater Municipality is restricted to the cleansing of essential business and material flow centres (e.g., vegetable and fruit wholesale market, fish and meat markets), sweeping of secondary avenues and alleys, maintenance of public parks under 3 ha in size, collection and transportation of wastes in the main avenues. For this purpose, 3 trucks of the municipality are made available to the contractor. The contractor fulfils his contractual obligations by 1 Director, 3 shift foremen, 3 drivers, 6 mechanics and 74 sweeping labourers. The rest of the cleansing activities, such as, sweeping of the main avenues and maintenance of public parks over 3 ha in size, etc., is performed by the personnel of the Mersin Greater Municipality.

### **e.2 Yenisehir District Municipality**

In compliance with the contractual provisions valid between Jan. 1st – Dec. 31st , 1998, as agreed with Kaya Kent Cleansing Company, the Yenisehir Municipality provides the contractor with a vehicle pool composed of 12 waste collection trucks, 1 mini-truck and 1 mini-bus. The contractor in return meets additional equipment requirements. The contractor fulfils his obligations pertaining to cleansing of streets, pavements and sidewalks as well as collection and transportation of wastes from public containers to the dumpsite, with 6 foremen, 14 drivers, 24 loading labourers and 102 cleansing labourers. In order to carry out the rest of his liabilities regarding care, maintenance and cleansing of public parks and open spaces of schools and kindergartens, the contractor further employs 2 foremen, 40 labourers and 1 electrician. The operation and maintenance costs of the contracted solid waste removal services comprising street sweeping, waste collection, transportation and dumping are borne by the contractor.

These privatisation implementations have been also documented in periodical reports. In the Annual Activity Report (01.06.1997–01.06.1998) of the Yenisehir Municipality, it is stated that two consecutive tenders have been finalised on Dec. 10th, 1996 for the year 1997 and on Dec. 4th, 1997 for the year 1998, each amounting to 70 billion TL (effective payment of 80 billion TL due to price escalation) and 140 billion TL (effective payment undertaken by the end of May, 1998), respectively. The scope of work has been mentioned as collection of urban wastes, street sweeping, cleansing and maintenance of parks as well as sanitation of the community containers.

### **e.3 Toroslar District Municipality**

The Toroslar District Municipality follows a partial privatisation approach in which the contractor is obliged to carry out street sweeping and waste collection in 21 zones of the Toroslar District as well as their transportation to the dumpsite. The contractor, Ercay Co., Ltd. carries out his operations with 3 foremen, 12 drivers and 124 cleansing labourers and is materially supported by the municipality with 12 waste collection trucks. However cleaning and maintenance of public parks and open

green spaces are not covered under the tasks of the contractor. Those services are respectfully carried out by the municipal personnel.

#### **e.4 Akdeniz District Municipality**

The Director of the Cleansing Directorate is responsible for preparing and monitoring the cleansing and waste collection program along with supervision of tasks, which are jointly contracted with the Mersin Greater Municipality. The contractor, Oz-Gul Co., Ltd. carries out those tasks specified for the Akdeniz District Municipality by 1 director, who is in charge of 3 foremen, 17 drivers as well as 34 loading and 171 cleansing labourers. In this context, each of the two controlling employees of the Department ought to be ready for emergency cases and immediate service actions which have to be taken up in (i) central business zone and (ii) rest of the avenues plus streets within the district, respectively. In control operations, they are supported by drivers and labourers of the Cleansing Directorate.

The Director of the contractor Oz-Gul Co., Ltd., looks after the services to be performed in accordance with the contractual requirements. The three foremen in the company are responsible for their respective sub-zones, whereas the chief-driver provides smooth and effective run of vehicles by undertaking necessary maintenance and repair activities. In the line of above mentioned terms as agreed between the Akdeniz District Municipality and Oz-Gul Co., Ltd., the municipality has allocated its 17 compactors at the disposal of the contractor, provided that the maintenance, repair and all relevant costs are borne by the recipient.

#### **f. Monitoring and Information Management System**

Similar to the practices in Adana, the main indicator of performance in solid waste management services in Mersin, is the visual appearance of public spaces and environs. Since the municipalities in Mersin apply privatisation practices in broader sense in comparison to the municipalities in Adana, they are supposed to be more familiar and equipped with monitoring instruments. However, the scene does not reflect the expected picture, where information management and monitoring activities are largely based on non-formalised but verbalised terms. Insufficient documentation system in individual municipalities hinders the establishment of an effective central monitoring in order to follow the service performances in a proper and accurate manner.

In regard to management related monitoring, the Mersin Greater Municipality and Yenisehir District Municipality execute a more effective and professional approach, when compared with the Toroslar and Akdeniz Municipalities. This could be attributed firstly to the past experience of the Mersin Municipality, which is presently the Mersin Greater Municipality. Secondly, accompanied with managerially skilled performances of the Yenisehir District Municipality, the service area of these both municipalities are relatively more urban in character and avail manageable operations.

The Mersin Greater Municipality and Akdeniz District Municipality cooperate interdependently in service provision, supervision and monitoring to a certain extent within the framework of their joint-contract for the commissioning of privatised waste removal and street cleansing services. Although they both carry out monitoring of operations with a small-sized core staff, a considerable supervisory support is also provided by the community.

When compared with the physical and socio-cultural characteristics of the service environment of the Mersin Greater Municipality and Yenisehir District Municipality, the Toroslar and Akdeniz District Municipalities are faced with relatively disadvantaged working conditions. Monitoring of privatised services in residential areas of low-income groups, which are characterised by steadily developing infrastructure facilities and housing expansions, is not an easy task neither for Toroslar nor Akdeniz district municipalities.

Additional handicaps in these both municipalities are also obvious in managerial skills and problem handling styles as well as information exchange and communication channels, which are typically lack of formalisation and standardisation based on ordinary norms and formats. Although these deficiencies are of common character shared also by other municipalities, however, the restrictive capabilities of the Toroslar and Akdeniz Municipalities in organisational and structural terms, hamper an effective monitoring of privatised services in waste management.

Since all municipalities apply a centrally organised fiscal monitoring approach, specific fiscal monitoring for individual units dealing with solid waste management as well, has not been developed in respective municipalities. This is a substantial handicap to establish a successive monitoring system based on daily, weekly, monthly and yearly supervision records availing the calculation of unit costs, development of alternatives, determination of criteria, evaluation of choices, preparation of budgets, organisation of programs, regulation of norms and standards, supervision of operations, application of goals-achievement-analyses and performance assessments, and finally, identification and implementation of measures for more efficient and cost-effective service attainment.

#### **g. Human Resources Development**

Although it is extremely hard to find well educated and trained manpower in Turkey, where waste management is further regarded as an inferior professional occupation, the Mersin Greater Municipality reflects an inadequate example for effective activation and mobilisation of scarce but available human resources in this sector. It seems that the Mersin Greater Municipality had external contacts over the last decade related to solid waste and compost plant management issues. However, prior involvement of the personnel in these issues as well as experiences gained in this respect, have not been adequately utilised. These human resource potentialities are unfortunately kept idle for the time being by the Mersin Greater Municipality where limited reference is given to previously gained experiences.

Although the size and professional adequateness of the mid-career and support personnel raises some question marks in minds related to appropriate monitoring and control of contracted service, the Cleansing Section of the Mersin Greater Municipality and the Cleansing Directorate of the Yenisehir District Municipality reflect a reasonable adaptiveness for the management of privatised solid waste management activities. Not only the physical and locational commutability of both municipalities, but also the personnel mentality have rendered them easy to be engaged in privatised solid waste and street cleansing services.

Although the Toroslar and Akdeniz District Municipalities have also undertaken considerable privatisation actions, they have serious hardships in coping with

management requirements in an effective manner. Those both district municipalities need to be more experienced, trained and managerially skilled in order to handle the legal, organisational, financial, operational and technical instruments of solid waste management, efficiently. The personnel of these municipalities require more support in training and improvement of managerial skills, since their service areas are undergoing through a substantial development process, where commercial, industrial and residential expansion is observed by all means. The top level personalities of the Toroslar and Akdeniz District Municipalities articulate that, even the magnitude of service requirements are increasing day by day, there are also some weaknesses in respect of qualified human resources and manpower in tackling with all these problems.

A common issue shared by all municipalities in Mersin is, however, the quantitative expression of service scopes as well as assessment of efficiency and performance levels in solid waste management activities. The observations undertaken in this regard lead to the impression that the personnel is not amply informed or eager to be in-depth informed about the scope and content of the assigned job. This is partially due to lack of research habits and partially lack of vertical and horizontal coordination. On the other hand, it would not be false to indicate that the personnel is not encouraged through any awarding and promoting system, in contrary, the repercussions of communal politics on municipal personnel is regarded as a discouraging factor in general.

#### **h. Public Education and Cooperation**

Comparing with Adana, Mersin has smaller communities. But detached houses share more part than Adana. Thus, community system seems a little bit different than that of Adana. In the Central Business District (CBD) and along the coastal areas, however, high rise apartments are major building stiles. In these apartments, *kapici* (doorkeeper) system is working. But in detached houses in fringe areas, housewives have another kind of community. In preparing public education system, these groups (building representatives, *kapicis* and housewives) are quite adequate for group instruction, such like segregation or manners to discharge their garbage.

In Mersin, just the same public education system is carried out like in Adana. Environmental education is given by a number of institutions, organisations and agencies. The Ministry of Environment is conducting education in schools and campaigning, co-operating with the Ministry of National Education (MNE). In school educational programs have included environmental care issues and in some schools, children collect waste paper for recycling. However, this kind of action is still with small scale and only few examples. Greater Municipality itself is quite passive in these activities. It is highly expected to co-operate these three authorities in public education.

Extensive education system but inadequate educational contents do not convey appropriate information specifically for factual needs or identified target groups. Society as a whole can barely grasp on the surface the magnitude of the solid waste problems; as a result, limited participation from the population in SWM and modest public awareness has been observed. However, it should be noted that citizen participation does not happen spontaneously. For participation beyond rhetoric,

mechanism should be established, space should be created, and some basic input should be financed.

#### **i. Guidelines**

The evaluation carried out among the municipalities in Mersin regarding legislative, administrative, managerial, operational and technical guidelines they apply, results in following identifications.

In the line of legislative guidelines, the Mersin Greater Municipality is responsible for the cleansing of main avenues, essential public facilities and open spaces as well as operation of the dumpsite and the compost plant along with the establishment of a sanitary landfill, as indicated in the Greater Municipality Law No. 3030. The District Municipalities in Mersin, namely Yenisehir, Toroslar and Akdeniz, on the other hand, carry out waste collection, transportation and dumping activities, either by themselves or by contracting, as indicated in the Municipalities Law No. 1580.

The administrative guidelines have been also applied with particular organisation models in order to fulfil the solid waste service requirements, as indicated in the legislative guidelines. The Mersin Greater Municipality has accordingly developed its own administrative unit, to deal with solid waste management assignments, which might however differ in name and structure, if compared with other greater municipalities' organisation schemes.

Regarding managerial guidelines, each municipality has developed own options based diverse by-laws, regulations and instructions. Except personnel management regulations, which is of strictly binding character, the municipalities can enjoy the selection of alternative options offered by the privatisation and contracting regulations. The choice for management models for administrative purposes and preference of management options for operational purposes have been taken up by each municipality in accordance with legislative and managerial guidelines. The results of the assessment carried out in this respect reveal, that the Mersin Greater Municipality together with the Akdeniz and Yenisehir District Municipalities attach high priority to privatisation, while the Toroslar District Municipality prefers to follow a partial privatisation model. A common characteristic of all these municipalities in regard of information management, fiscal and financial management, decision making and action management is that those issues are handled in a very traditional manner which require current adoptions and updating for efficiency enhancement purposes.

Operational guidelines comprising field activities of solid waste management as well as monitoring and control of service have not been precisely structured on a formal basis. Pragmatic instructions have been developed for field operations and in-house monitoring while the publicity is expected to be the main watcher of the quality of provided cleansing and solid waste removal services. However, concrete guidelines are not available related to public relations and communal cooperation issues in solid waste management activities.

Technical guidelines as issued in the regulations related to solid waste management as well as control of medical wastes, harmful chemicals and products, hazardous wastes and water pollution along with solid waste collection, transfer and transportation, dumping and disposal techniques are applied with considerable deficiencies. These

deficiencies are more conspicuous in regulatory obligations than in manual and mechanical implementations. Although the Ministry of Environment nowadays circulate an ‘Environment Manual for Municipalities’, the technical implementations shown in this transcript need to be transferred to the municipal personnel within the framework of an extensive training program. A factual approach also requires to deal with financial aspects of these techniques, which are of vital importance for all municipalities, not only for those located in Mersin.

#### **j. Medical SWM**

The Regulation on Control of Medical Wastes, under the Environment Act governs the way “pathological or non-pathological, infected, chemical and pharmaceutical wastes, lacerating and piercing materials and compressed containers” from medical institutions, and other sources of medical waste, are handled. The regulation not only covers hospitals and teaching hospitals of medicine, dentistry, veterinary science, and biomedical sciences, but also centres and outfits that conduct work on blood and its products, medical analysis laboratories and all laboratories that house animals for biomedical research, clinics, medical examination units, polyclinics, dental clinics, and infirmaries. Medical and veterinary surgeries, mobile health units, pharmacies and pharmaceutical repositories, and other similar sources are also covered by the law.

The institutional system for Mersin is the almost same as Adana’s institutional system, for the regulatory authority lies solely with the Ministry of the Environment. The only difference with Adana, is the way in which the Cleansing Tax is set and is collected; the Greater Municipality determines the category of hospital, which pays its cleansing tax to the District Municipality.

### **3.2.4 Assessment of Present SWM**

#### **a. Technical System**

##### **a.1 Municipal SW Generation**

In contrast with other economically comparable countries, the household waste discharge ratio is small at 434g/person/day (on weighted average of population in income level), as the people mainly live in condominiums.

Kitchen waste constitutes, on average, 72.7% of the household waste amount

##### **a.2 Collection and Haulage**

First of all urban SWM aims to handle the waste to keep the living environment; the collection service to attain this objective is fully established. Almost all urban residents receive collection services.

There is no government related separate collection which is essential for waste minimisation and resource-recovery. However, a voluntary source separate collection system through the “Eskici” is well functioned as well as donation system of recyclable waste.

There is no long-range transfer system, and waste collected is directly hauled to the disposal site. Problems may arise in the haulage services, as the disposal site’s location is far removed from the city.

The collection and haulage expenses make up the bulk of the SWM expenses (most of the other countries, it is over 70%), therefore the improvement of collection and haulage system is extremely important.

### **a.3 Cleansing of Street and Parks**

The present cleansing services contribute to make up the city clean.

A labour intensive cleansing system is employed at present. It, however, contributes to provide jobs to the unemployed labour force.

### **a.4 Intermediate Treatment**

The compost plant which has been operated since 1985 is now obsolete and has various operational problems.

The compost market survey carried out by the study team indicates a potentially high demand for compost, but the plant lacks the capability to produce compost of good quality. The survey results also indicate a production of only 80 ton/day in 1997 despite a claim of having a capability to produce 128 ton/day.

### **a.5 Recycling**

A recycling system formed by the private sector, which consists of a lot of informal individuals, is well established and very active. In particular, the informal collection of recyclable materials by “Eskici” at generation sources and street waste picker at discharge points is very active. It is assumed that almost 6.1 % of the total waste is recycled while the recycling rate of the composting plant which is considered as the public sector recycling is only 4.6 %.

In the landfill at the composting plant, a private company, who has obtained a concession for picking up recyclables from composting plant and the landfill, employs scavengers and pay a certain amount to Mersin Greater Municipality (MGM). Because the MGM accepts the activities of scavengers in the site, disposal operations are usually hampered, such as delay of covering soil, widely scattered working faces, etc.

### **a.6 Final Disposal**

As for the most serious problem rapid urbanisation has extended the city periphery to within a few hundreds of meters of the disposal site. As a result, the MGM frequently receives complaints from the residents.

Further, the disposal site is also nearing its capacity. The construction of a new disposal site and the closure of the present disposal site is therefore a matter of urgency.

Environmental preservation measures was adopted in 1992 are not maintained at the compost plant disposal site where waste covering is irregularly carried out. Consequently, outbreaks of fire and leachate leakage adversely affect the surrounding environment, e.g., stream contamination.



## **a.7 Equipment Maintenance**

There is an operation and maintenance system for equipment used in waste collection and haulage, and for the cleansing of streets and parks.

The operation and maintenance of the heavy machinery at the disposal site, where working conditions are considerably poor, are not efficiently carried out which is one of the reasons for frequent machinery breakdown.

## **b. Institutional System**

### **b.1 Operational and Organisational System**

The organisations responsible for SWM in both MGM and three DMs (District Municipalities) are not well established.

In particular, the MGM responsible for composting plant, final disposal and hazardous waste management could not manage them properly due to the weak organisation.

### **b.2 Financial Matters**

There is a great tendency for municipalities to receive a greater share of their income from the Central Government, as the local authorities can not take decision on local taxes except for the sign and advertisement fees.

Revenue for SWM is insufficient.

The Cleansing Tax and its collection rate are insufficient, the proportion of the tax compared with SWM costs is extremely low. Because the legal basis of the Cleansing Tax is weak, with payment of this tax being essentially voluntary, and allowed annual increases being fixed at only half the rate of inflation.

### **b.3 Contract-out System**

Privatisation is highly appreciated by the cleansing departments, which results in satisfactory services under existing terms and conditions.

### **b.4 Legislation**

Although laws, regulations, and standards related to SWM are gradually being established, the problem lies in the way they will be enforced.

Although slightly extreme, the conditions in the disposal site will be used as an example. The composting plant disposal site contaminates the environment as fires break out and leachate flows into drains.

### **b.5 Public Co-operation**

As wastes are discharged and collected using mainly communal containers without any form of segregation, the residents are hardly aware of the SWM problems.

Separate collection is indispensable to waste volume reduction, resource-recovery, and in particular, the improvement of the quality of compost produced. However, its introduction is predicted to be considerably difficult.

### **b.6 Medical Waste Management**

In accordance with Law 2872, infectious and hazardous medical waste should be handled separately.

Thirteen main medical institutions were surveyed to identify medical waste management in MGM. The survey results indicate medical waste management system of MGM is still at low level, although the system was clearly explained by law and almost all of the institutions were aware of that. People were sufficiently informed about the system and risks of infectious/hazardous wastes, and the institution had taken precautions and many applied these to their collecting systems.

All institution reported the insufficiency of MGM about the disposal of infectious/hazardous wastes after they are separately collected from their institutions.

The institutions are ready to cover the necessary expenses, and are willing to help to protect the environment, and the human in general.

### **b.7 Industrial Waste Management**

Although regulatory and monitoring systems are gradually established in accordance with the legislation related to the handling of hazardous industrial waste, the problem lies in the way they will be enforced. Many of the industrial wastes are disposed of in the disposal site along with other urban solid wastes.