Annex G

Current Situation of SWM

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G Current Situation of Solid Waste Management

G.1 Service Projected Population

As for the present population of the Study Area, appropriate data does not exist. An estimated population by the Statistic and Census Department, Ministry of Economy ("Proyección de la Población de El Salvador") is one of reliable data as same as the estimated population in the country. It says that the population in the Study Area in 1998 is 1,895,160 persons and in 1999 is 1,948,794 persons. This is to be used for the Study as the present population in the Study Area.

"Proyección de la Población de El Salvador" and other materials such as "Encuesta de Hogares de Propósitos Múltiples 1998[1]" consider no rural area in AMSS except Tonacatepeque. In veiw of waste collection service, however, the Study Team take into account rural area in some municipalities. The municipalities have some population whom the municipalities understand that no waste collection service is necesarry because they are livng in rural areas. The population forecast reflects this point of view (See Table G-1).

Table G-1: Estimated Population in the Study Area in 1998 and 1999

No.	Municipality	1998			1999		
		Urban	Rural	Total	Urban	Rural	Total
1	San Salvador	467,006	0	467,006	473,374	0	473,374
2	Mejicanos	180,775	0	180,775	185,204	0	185,204
3	Ciudad Delgado	145,189	0	145,189	149,394	0	149,394
4	Cuscatancingo	85,825	0	85,825	90,079	0	90,079
5	Ayutuxtepeque	26,216	10,028	36,244	28,000	10,158	38,158
6	San Marcos	68,685	0	68,685	69,660	0	69,660
7	Nueva San Salvador	133,461	13,820	147,281	138,723	14,000	152,723
8	Antiguo Cuscatlán	40,515	0	40,515	42,773	0	42,773
9	Soyapango	282,066	0	282,066	283,598	0	283,598
10	Ilopango	122,309	0	122,309	127,434	0	127,434
11	San Martín	66,861	27,726	94,587	73,000	28,086	101,086
12	Apopa	155,588	0	155,588	163,974	0	163,974
13	Nejapa	14,464	16,255	30,719	15,000	16,466	31,466
14	Tonacatepeque	27,640	10,731	38,371	29,000	10,871	39,871
Total population		1,816,600	78,560	1,895,160	1,869,213	79,581	1,948,794

Source: arranged by the Study Team on the basis of information from the municipalities and Dirección General de Estadística y Censos, Ministerio de Economíca, 1995, "Proyección de la Población de El Salvador," El Salvador

Therefore, the population in the columns of "urban" in the table is defined as "service projected population".

[1] Ministerio de Economía Dirección General de Estadística y Censos Digestyc, 1999, Encuesta de Hogares de Propósitos Múltiples 1998, El Salvador

G.2 History of Solid Waste Management

San Salvador Metropolitan Area has had an intensive activity regarding solid waste management, and because of their background deriving from the Spanish colonization, the cities preserve their customs. Therefore, it can be said that the responsibility of cleansing duties has belonged to the municipalities since the colonial age. In recent years, the cleansing service has been operated both by private entities and the municipality, with good experiences that unfortunately have not been taken advantage of.

a. Period of 1955-1967

The service is rendered by the private sector through a public tender, which is awarded to Mr. Francisco Sabater Araza. Operations began on October 1st, 1955, and employing 11 compaction trucks, and wastes were delivered to a compost processing plant (which worked during the initial years of this period), but later wastes were disposed of directly to the Acelhuate river. The price paid to this plant when their operations began was ¢8.00 colons/ton and they expected a production of 120 ton/day. However, four months after operations began the price was renegotiated and 2 additional colons were summed, adding up to¢10.00 per ton; this addition was due to the fact that actually only 70 tons were produced. This shows that the service was rendered to 100% coverage[2]. The service operated during 12 years, but due to economic reasons by the enterprise and labor achievements, the enterprise goes bankrupt and passes on the service to the municipality, which according to law is still responsible for it.

a.1 Composition of Waste[3]

According to the compost plant, between 14 to 20% were cans, metals, bottles, etc., and from 80 to 86% organic compostable waste.

b. Period of 1967-1979

The service is run by the municipality and the duties become more technical. Sanitary landfills with the use of tractors are first utilized, such as that of *colonia* Escalón, Avenida José Matías Delgado where the soccer fields of the Salvadoran Soccer Association are currently located (1968-1971); Las Margaritas landfill in Boulevard del Ejército that is currently known as *colonia* 22 de abril (1969-1977); likewise, the land located in Soyapango and called as La Oliva landfill is also utilized. During this period inter-municipal collaboration appears. and municipalities such as Mejicanos, Delgado, Soyapango, Ilopango and San Marcos used these disposal sites.

During this period, the first waste composition classification by population sector is conducted, and indicators were obtained but that are unavailable nowadays. The results are shown in Table G-2.

[2] Municipality of San Salvador, Minute Book 1953-1957.
[3] Conde-Duarte, *Estudio de la disposición final de San Salvador 1971*

Table G-2: Waste Composition by Population Sector, 1967

Item	Escaló %	Market %	Centenari %	Montserra %	Average %
Organic animal waste	1.91	18.57	7.32	6.26	10.21
Organic vegetal waste	33.43	11.16	6.50	6.26	12.46
Kitchen waste	15.27	15.06	12.21	35.92	17.65
Carton, paper, textiles, wrapping material	1.21	34.20	52.02	6.26	29.92
Stone, sand and soil	1.00	19.34	17.88	34.35	18.39
Glass and metals	40.73	1.49	4.07	6.26	9.48
Others	6.45	0.18	0.00	4.69	1.89
Density (kg/m^3)	295.70	478.80	517.40	277.00	400.00

Source: Conde y Duarte, 1971, *Estudio de la Disposición Final de la Basura en San Salvador.*

Such waste composition survey showed that 72.13 % was fermentable matter and 27.87 % was non-fermentable material, with an average density of 400 kg/m^3 for loose waste.

By 1971, the service in San Salvador was provided by the municipality and organized as follows:

Manual sweeping: The city was divided into 13 zones with 2150 blocks and cleaned by 218 workers, who were supervised by 18 foremen;

Mechanical sweeping: 5 mechanical sweepers were available; four diurnal and one nocturnal. The diurnal work serviced 1629 blocks in residential zones, whereas the nocturnal one covered 410 blocks of the commercial zone in the city. For this task 46 workers and 6 foremen did the job. The workers swept the sidewalks towards the curbs, so that wastes were collected by the machines, which had a container of 2.28 m^3 and two brooms.

b.1 Curbside Containers (wastepaper baskets)

The municipality used three-wheeled bikes specifically designed to collect the waste from these containers.

b.2 Collection and Haulage

The municipality collected residential, industrial, commercial and street sweeping wastes. The city was divided into 22 residential zones and one for markets; each zone had a collection truck with a driver and 4 workers. They collected the waste disposed of in drums (2196) located at corners by the municipality, in which the sweeping, residential, commercial, etc. waste accumulated. Collection workers tried not to pass twice by the same place and made 54 trips daily, with an effective collection distance of 373.5 km and a distance of 519.0 km when collection tasks were not performed.

During this period the collection by means of exchangeable containers is introduced.

b.3 Generation per Inhabitant

Collection was carried out daily, but the maximum collection day was on Tuesdays, whereas the minimum was on Sundays. The average daily collection amount was 180 ton.

Population from the 22 zones added up to 317,953 inhabitants and their generation amount was 165.02 ton/day, plus 14.98 ton of the Calvario zone (commercial area).

The average generation per inhabitant was 0.55 kg/inhabitant/day, and the generation/inhabitant/zone was also calculated, with a minimum value of 0.356 kg/person/day ad the maximum of 1.118 kg/person/day. This information was estimated with the 1965,1966 and 1967 averages.

b.4 Waste Composition

A public works laboratory analysis showed the following composition.

Table G-3: Waste Composition in 1971

Item	%
Metals	1.57
Glass, bottles, porcelain	2.0
Plastic	3.14
Paper and cardboard	26.53
Leather and rags	4.16
Vegetal and animal matter	62.60

Source: Conde-Duarte, *Estudio de la disposición final en San Salvador, 1971*

From 26.53 % of paper and cardboard, 6% were large size cartons, which resulted in 16.87% of non-fermentable waste and 83.13% of fermentable waste.

The humidity rate during the rainy season at that time reached 50.50%, whereas in the dry season was 47%. The specific weight was set at 400 kg/m^3.

This period ends with a strong deterioration of the service as a consequence of the hard times undergone by the country; such period was characterized by strikes, political repression and ended up in a civil war.

c. Period of 1978-1989

This period began with several social problems, to the extent that being a public official was a reason for being killed, and of course these problems impinged upon the collection service; therefore, this period caused that the service provided underwent a substantial backwardness. The efforts in spite of the limited possibilities, plus the unfortunate acquisition of 20 collection units with rotator-type compactors that were out of in less than 2 years and two-axle compactor trucks with a capacity of 25 yd ^{3} of a good quality and the available equipment greatly reduced the quality of the service. In 1984, two Caterpillar D7 tractors with blade for sanitary landfills were acquired, with which there is a shift from an open dumping site and permanent burning to a controlled dumping site, and the quality of the final disposal service utilized by several municipalities improved.

By 1988 the Japanese government, concerned about the sanitary deterioration of the country, offered a non-reimbursable cooperation to improve the cleansing service in the metropolitan area through the Japan International Cooperation Agency (JICA); such aid was completed by the end of 1989 and beginning of 1990.

In 1989 the Japanese government donated 56, 16yd^3 compactor trucks and 8 container lifter trucks, 94 7yd^3 containers and 6 D6H Carterpillar tractors with special blades for sanitary landfills, which were evenly distributed among 12 municipalities in the metropolitan area (see Table G-4). In that same year (1989) the land used as a landfill was closed because its capacity was reached, and its useful life was over (1977-1989).

This decade was positive regarding technical support and knowledge, and several studies were developed, including the Master Plan for AMMS; training for officials and employees involved in the system, as well as the proposal to allow the cleansing service to become a metropolitan service operated by means of a decentralized enterprise.[4] However, these studies were not executed by the authorities and is forgotten due to the war going on at that time.

Table G-4: Donations by the Japanese Government

Municipality	1989			1996			
	16 yd^3 compactor	Container lifter truck	7 yd^3 container	25 yd^3 compactor	18yd^3 compactor	11yd^3 compactor	2 mts^3 container
San Salvador	22	6	71	2	16	5	54
Soyapango	4	-	-	1	9	3	30
Mejicanos	4	2	23	-	5	2	15
Nueva San Salvador	5	-	-	-	4	1	12
Ciudad Delgado	4	-	-	-	5	2	15
Apopa	2	-	-	-	4	1	12
Ilopango	2	-	-	-	4	1	12
Cuscatancingo	2	-	-	-	3	1	9
San Marcos	4	-	-	-	2	1	6
Antiguo Cuscatlán	3	-	-	-	1	1	3
Santo Tomas 1/	1	-	-	-	1	1	3
Ayutuxtepeque	1	-	-	-	1	-	3
San Martín	-	-	-	-	3	1	9
Nejapa	-	-	-	-	1	1	3
Santiago Texacuango[1]	-	-	-	-	1	-	3
Tonacatepeque [2]	-	-	-	-	-	-	-
Total	56	8	94	3	60	21	189

Note: [1] Municipalities not belonging to COAMSS
[2] Tonacatepeque was not subject to donation since it was not considered as part of AMSS.

d. Period of 1990-1998

This period began with the donation by the Japanese government to the municipality of San Salvador. The constant changes of staff and operation chiefs brought the loss of important technical human resources, but the experience and knowledge acquired at the beginning of this period is considerable. The closure of La Oliva landfill site caused that the municipalities disposing of at this site use the land utilized by Santa Tecla; however, due to a landslide that buried several scavengers, the site was used until the end of 1990. In 1991, the municipality that faced more problems was San Salvador because of its high generation of wastes; additionally, war made it difficult to search final disposal sites and wastes were disposed of at any ravine or open dumping site. One of these places was located the highway to the airport, close to San

[4] César Tapia Gamarra, *Propuesta de Organización para la Empresa Metropolitana de Aseo (EMA)*, 1989

Marcos; another site was in the Pan-American km 27 towards Cojutepeque; and Ilopango dumping site, located at the south side of Ilopango airport. Finally, in 1992 the site known as Nejapa, Mariona and/or Apopa controlled dumping site was utilized. Fortunately, in that same year (1992) peace was signed between the guerrilla and the government. However, despite all the knowledge acquired, the site was not prepared properly, as the system had no leachate evacuation system. Due to the fact that the distance to the new site was in average beyond 20 km, this had a repercussion on the quality of the service.

By 1992 as Table G-5 shows, the collection service rendered by the municipalities that currently form AMSS had an average coverage of 57.14% in their urban areas; the municipality with less coverage was Nejapa 10.92% and the greatest coverage was by Antiguo Cuscatlán with 88.80%, followed by San Salvador with 78.07%. The service provided by private collector covered 12.43% of the metropolitan area, among which Soyapango (36.90%) Nueva San Salvador (22.10%) and Mejicanos (16.97%) stand out; the remaining municipalities had lower figures.

Table G-5: Collection Coverage in the Urban Area in 1992 and 1996

Municipality	Municipal service 1992[1] %	Private service 1992[1] %	Total 1992 %	Municipal service 1996[2] %	Municipal service 1998[3] %	Private service 1998[3] %	Total 1998 %
San Salvador	78.07	4.04	82.11	75.60	80.57	0.57	81.14
Mejicanos	55.99	16.97	72.96	41.06	65.63	19.27	84.90
Delgado	33.59	1.80	35.39	13.60	71.00	4.00	75.00
Cuscatancingo	39.48	3.26	42.74	25.99	70.97	0.54	71.51
Ayutuxtepeque	53.60	2.41	56.01	54.19	66.67	0.00	66.67
San Marcos	53.76	2.44	56.20	53.20	63.69	1.12	64.81
Nueva San Salvador	61.72	22.10	83.82	56.07	67.06	26.47	93.53
Antiguo Cuscatlán	88.80	2.86	91.66	56.54	92.11	0.00	92.11
Soyapango	48.85	36.90	85.75	28.50	82.11	12.63	94.74
Ilopango	52.05	9.54	61.59	41.03	40.12	9.88	50.00
San Martín	15.18	14.81	29.99	9.40	52.63	12.72	65.35
Apopa	59.39	2.00	61.39	29.20	72.73	0.00	72.73
Nejapa	10.92	0.28	11.2	22.24	52.66	0.00	52.66
Tonacatepeque	14.40	0.28	NA	NA	NA	NA	NA
Total	57.14	12.43	69.57	51.18	67.09	6.75	73.84

Source: [1] Made with the IV Housing Census information, 1992.
[2] Department of Environmental Sanitation, municipality of San Salvador.
[3] DIGESTYC, *Encuesta de hogares de propósitos Múltiples 1998.*
NA:Not available

In 1993 the Executive Secretariat of Environment (which would eventually become MARN in 1998), with the collaboration of the municipality of San Salvador and the Ministry of Health made a request to the Japanese government for the donation of collection trucks, which was accepted by the government of Japan. Therefore, in September 1994, a Japanese Study Mission arrived to the country and a minute is signed, being COAMSS the counterpart. In 1995 the public tender among Japanese enterprises to supply the equipment was held, and in June 1996 the collection equipment shown in Table G-4 was received, expecting that the municipalities could

reach 90% and 95% service coverage. Additionally to the table, two landfill compactors, 2 tractor-scrapers, one power shovel of 1 m^3 and two 40 ton weighbridges were delivered, and the latter re being used since 1997.

In the beginning of 1996, the municipality of San Salvador, which operated the Mariona landfill, calculated a coverage that is shown in Table G-5, and in general terms it is perceived that coverage has decreased if compared with 1992.

In 1995 San Salvador acquires two mechanical sweepers for the main roads. During this period the idea of acquiring of a new land to use it as a landfill began to shape, since the Mariona landfill had the capacity for two years more. Nevertheless, the administration did not authorize the technicians to start looking for a new land, since the Canadian company Continental Waste Inc. signed a contract with COAMSS to install a Canadian gasification, and a site was required to implement such gasification because, in accordance with the offer, a sanitary landfill was not necessary as everything would be incinerated and the ashes and slag generated could be used for construction works. The company acquired such land in the municipality of Apopa, 5 km south of Mariona.

The enterprise did not manage to install the facility in the two years foreseen and the technicians are required to look for a site that could be used as a sanitary landfill; such place was chosen according to technical information and visits to the site. COAMSS bought a 50-block property in the municipality of Tonacatepeque in 1996. In that same year San Salvador acquired 6 Freightliner trucks of 18 yds^3 each. In 1997 there is a change in the administration of San Salvador and the gasifier is left aside, despite of being a contract, since it was considered that it was a potential polluter. Therefore, a competition to offer integral management alternatives was promoted.

The 14 municipalities belonging to COAMSS begin a search of final disposal alternatives, as the Mariona site was about to be closed. Different alternatives were received, of which two were chosen and eventually the environmental-friendly choice that was closer to the integral management was selected[5]. From that moment, due to political and economic reasons, four municipalities did not longer continue with the project, reason why only 10 Mayors of COAMSS signed in November 1997 the agreement of concession of haulage and final disposal of wastes with the Canadian company CINTEC INC, which offered financing. Therefore, the 10 municipalities and the company formed a mixed enterprise known as *Sociedades de Economía Mixta* and called MIDES SEM de CV, in which 10% of the shares were owned by the municipalities and the rest to CINTEC INC. Within the agreement reached there was the construction of a modern sanitary landfill that meet the highest technical specifications such as geomembranes, leachate treatment and not receiving medical or industrial waste, as well as the construction of a transfer station furnished or not with a separation facility; all the aforementioned should be ready in no more than a 5-year period.

In the multiple purpose survey of 1998, by DIGESTYC presented the information obtained on the collection service: municipal 67% and private 6.75%. It is observed that all the municipalities, with the exception of Ilopango, increased their collection coverage with respect to 1992 and 1996, and private collectors were displaced by far.

[5] Integral management should be understood as that integrating all the stages in the management and the financial-economic part.

In 1998 the municipality of San Salvador acquired 3 more mechanical sweepers and 12 collection trucks of 18 yd^3.

On May 3rd, 1999 the sanitary landfill was opened, which was located north of the municipality of Nejapa. The cost per ton received was US$18.00 + 13% V.A.T. The enterprise has also acquired a land in the municipality of Apopa, 5 km to the south of the former Mariona dumping site to build the transfer station.

The expected amount of wastes to be received by this landfill is of 360,000 ton/year, of which 168,000 ton will belong to San Salvador that accounts for 46.67% of the total.

G.3 Waste Stream

The waste stream was formulated on municipal SW and medical waste.

G.3.1 Municipal Solid Waste

G.3.1.1 Concept of Waste Stream

The present waste stream in the Study Area was formulated based on the following surveys and analysis:

- Waste Amount and Composition Survey (WACS)
- Interview Survey at Generation Sources
- Analysis of existing disposal amount data (weighing data at final disposal site)

The concept of present waste stream is shown in Figure G-1.

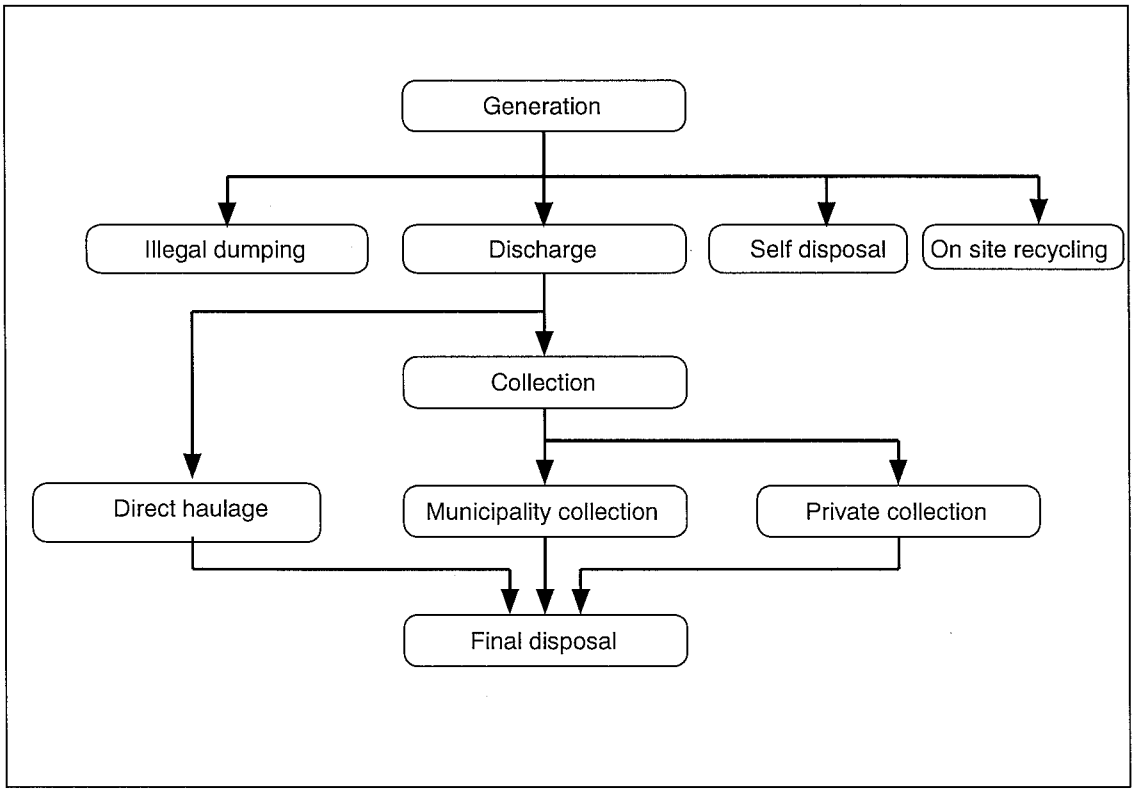

Figure G-1: Concept of Present Waste Stream

According to the concept above, the Study Team has quantified the waste amount in each component of the waste stream.

G.3.1.2 Waste Generation Ratio and Generation Amount

a. Waste Generation Ratio

The study set up waste generation ratio based on the result of WACS and referred to such data in Latin American countries (shown in Table G-6 and Table G-7).

Table G-6: Comparison of Waste Generation Ratio in Latin American Countries

Sources		unit	AMSS		Mexico[2] D.F/1998	Nicaragua principal cities[3] 1996	Honduras Tegucigalpa[4] /1997	Paraguay Asuncion[5] /1994
			WACS in this Study	PAHO[1]				
Household	High income	g/person/day	600 (500 to 700)	750	616	675	566	682
	Middle income	g/person/day	540 (420 to 670)					
	Low income	g/person/day	420 (320 to 520)					
Commercial	Restaurant	g/seat/day	466	NA	NA	NA	NA	NA
	Others	g/employee/day	482	NA	NA	1,676	NA	NA
Institutional		g/employee/day	196	NA	413	98	NA	NA
Market		g/stall/day	1,674	NA	1,025	2,827	NA	NA
Street sweeping		g/m/day	198	NA	NA	NA	NA	NA

Source : [1] SOLID WASTE SECTORAL ANALYSIS IN EL SALVADOR July 1998 PAHO
[2] JICA study 1999 [3] JICA study 1997 [4] JICA study 1998 [5] JICA study 1996

Table G-7: Waste Generation Ratio

Source		unit	Generation ratio
Household waste	High income	g/person/day	600
	Middle income		540
	Low income		420
Commercial waste	Restaurant	g/seat/day	466
	Others	g/employee/day	482
Institutional waste		g/employee/day	196
Market waste		g/stall/day	1,674
Street sweeping waste		g/m/day	198

b. Waste Generation Amount

Waste generation amount is calculated based on the data of WACS, POS and weighing data at the final disposal site. The weighing data for the months from April 1999 to November 1999 given to the Team seem unrealistic and not to encompass the total actual amount disposed, therefore, the 1998 weighing data was used for the calculation of the waste generation amount.

b.1 Household Waste

The generation amount of household waste was calculated by multiplying mean values of generation ratio per income level obtained from WACS with population per income level that is induced from the POS results.

Table G-8: Population Ratio of Income Level

	High income (%)	Middle income (%)	Low income (%)	Total (%)
San Salvador	30.3	23.0	46.7	100.0
Mejicanos	3.1	33.0	63.9	100.0
Delgado	3.2	12.9	83.9	100.0
Cuscatancingo	0.0	11.8	88.2	100.0
Ayutuxtepeque	10.0	45.0	45.0	100.0
San Marcos	0.0	26.9	73.1	100.0
Nueva San Salvador	24.3	63.9	11.8	100.0
Antiguo Cuscatlan	56.4	35.7	7.9	100.0
Soyapango	0.0	16.8	83.2	100.0
Ilopango	0.0	22.7	77.3	100.0
San Martin	0.0	20.6	79.4	100.0
Apopa	0.0	4.9	95.1	100.0
Nejapa	0.0	50.0	50.0	100.0
Tonacatepeque	0.0	50.0	50.0	100.0

Source : results of public opinion survey in this study

Table G-9: Household Waste Generation Amount in 1998

	Service projected population (1998)				Waste generation amount (ton/day)			
	Total	High income	Middle income	Low income	High income	Middle income	Low income	Total
San Salvador	467,006	141,690	107,318	217,998	85.0	58.0	91.6	234.6
Mejicanos	180,775	5,586	59,638	115,551	3.4	32.2	48.5	84.1
Delgado	145,189	4,690	18,729	121,770	2.8	10.1	51.1	64.0
Cuscatancingo	85,825	0	10,093	75,732	0.0	5.5	31.8	37.3
Ayutuxtepeque	26,216	2,603	11,808	11,805	1.6	6.4	5.0	13.0
San Marcos	68,685	0	18,490	50,195	0.0	10.0	21.1	31.1
Nueva San Salvador	133,461	32,431	85,268	15,762	19.5	46.0	6.6	72.1
Antiguo Cuscatlan	40,515	22,830	14,476	3,209	13.7	7.8	1.3	22.8
Soyapango	282,066	0	47,302	234,764	0.0	25.5	98.6	124.1
Ilopango	122,309	0	27,801	94,508	0.0	15.0	39.7	54.7
San Martin	66,861	0	13,767	53,094	0.0	7.4	22.3	29.7
Apopa	155,588	0	7,670	147,918	0.0	4.1	62.1	66.2
Nejapa	14,464	0	7,232	7,232	0.0	3.9	3.0	6.9
Tonacatepeque	27,640	0	13,820	13,820	0.0	7.5	5.8	13.3
Total	1,816,600	209,830	443,412	1,163,358	126.0	239.4	488.5	853.9

b.2 Commercial Waste

Number of seats in the restaurants and the number of employees in other commercial institutions (excluding restaurants) in AMSS are derived from the DIGESTYC census data in 1998. The generation ratio (per seat or per employee) of commercial waste is surveyed through WACS. Commercial waste generation amount is calculated by multiplying the above-mentioned generation ratios by the number of seats or employees as shown in the table below.

Table G-10: Commercial Waste Generation Amount

	Restaurant		Other commercial		Total amount (ton/day)
	Nos. of seat	Amount (ton/day)	Nos. of Employee	Amount (ton/day)	
San Salvador	18,445	8.6	46,606	22.5	31.1
Mejicanos	8,643	4.0	18,839	9.1	13.1
Delgado	7,197	3.4	17,662	8.5	11.9
Cuscatancingo	5,938	2.8	8,515	4.1	6.9
Ayutuxtepeque	785	0.4	2,324	1.1	1.5
San Marcos	3,413	1.6	5,007	2.4	4.0
Nueva San Salvador	4,823	2.2	11,498	5.5	7.7
Antiguo Cuscatlan	1,363	0.6	4,147	2.0	2.6
Soyapango	21,946	10.2	25,293	12.2	22.4
Ilopango	6,069	2.8	8,808	4.2	7.0
San Martin	6,612	3.1	7,191	3.5	6.6
Apopa	13,141	6.1	12,207	5.9	12.0
Nejapa	1,259	0.6	2,078	1.0	1.6
Tonacatepeque	1,270	0.6	3,866	1.9	2.5
Total	100,904	47.0	174,041	83.9	130.9

b.3 Institutional Waste

Institutional waste generation amount is calculated by using institutional waste generation ratio, taken from WACS results, and the number of employees in institutions, extracted from the 1998 DIGESTYC census data.

Table G-11: Institutional Waste Generation Amount

	Nos. of Employee	Generation amount (ton/day)
San Salvador	85,040	16.7
Mejicanos	36,078	7.1
Delgado	18,883	3.7
Cuscatancingo	10,379	2.0
Ayutuxtepeque	6,386	1.3
San Marcos	5,929	1.2
Nueva San Salvador	27,799	5.4
Antiguo Cuscatlan	12,938	2.5
Soyapango	41,334	8.1
Ilopango	12,486	2.4
San Martin	7,587	1.5
Apopa	10,813	2.1
Nejapa	1,475	0.3
Tonacatepeque	12,060	2.4
Total	289187	56.7

b.4 Market Waste

The generation ratio (per stall) of market waste is surveyed through WACS. Number of stalls in markets in AMSS are derived from the OPAMSS[6] survey data in 1999. Market waste generation amount in AMSS is calculated by multiplying these data as shown in the table below.

Table G-12: Market Waste Generation Amount

	Nos. of Stall	Generation amount (ton/day)
San Salvador	21,338	35.7
Mejicanos	1,413	2.4
Delgado	427	0.7
Cuscatancingo	0	0.0
Ayutuxtepeque	193	0.3
San Marcos	465	0.8
Nueva San Salvador	2,220	3.7
Antiguo Cuscatlan	391	0.7
Soyapango	3,363	5.6
Ilopango	401	0.7
San Martin	2,400	4.0
Apopa	4,472	7.5
Nejapa	85	0.1
Tonacatepeque	138	0.2
Total	37,306	62.4

b.5 Road Sweeping Waste

The generation ratio (per road length swept) of road sweeping waste is surveyed through WACS. Road length swept in 14 municipalities in AMSS is surveyed by the inquiries to the counterpart members. The generation amount of road sweeping waste in AMSS is calculated by multiplying these data as shown in the table below.

Table G-13: Road Sweeping Waste Generation Amount

	Swept length (m)	Generation amount (ton/day)
San Salvador	324,769	64.4
Mejicanos	29,060	5.8
Delgado	15,036	3.0
Cuscatancingo	8,970	1.8
Ayutuxtepeque	2,660	0.5
San Marcos	7,010	1.4
Nueva San Salvador	43,080	8.5
Antiguo Cuscatlan	51,630	10.2
Soyapango	12,618	2.5
Ilopango	1,760	0.3
San Martin	1,700	0.3
Apopa	5,615	1.1
Nejapa	668	0.1
Tonacatepeque	3,225	0.6
Total	507,801	100.5

[6] Plan Sectorial del Sistema Metropolitano de Mercados y Terminales del Transporte Público en el Gran San Salvador, SAN SALVADOR, MARZO, 3 DE 1999 EL SALVADOR

c. Aggregate Waste Generation Amount

Waste generation amount per respective generation source is summarized as shown in Table G-14.

Table G-14: Waste Generation Amount

	Household	Restaurant	Other than restaurant	Institutional	Market	Road sweeping	Total
Generation amount (ton/day)							
San Salvador	234.6	8.6	22.5	16.7	35.7	64.4	382.5
Mejicanos	84.1	4.0	9.1	7.1	2.4	5.8	112.5
Delgado	64.0	3.4	8.5	3.7	0.7	3.0	83.3
Cuscatancingo	37.3	2.8	4.1	2.0	0.0	1.8	48.0
Ayutuxtepeque	13.0	0.4	1.1	1.3	0.3	0.5	16.6
San Marcos	31.1	1.6	2.4	1.2	0.8	1.4	38.5
Nueva San Salvador	72.1	2.2	5.5	5.4	3.7	8.5	97.4
Antiguo Cuscatlan	22.8	0.6	2.0	2.5	0.7	10.2	38.8
Soyapango	124.1	10.2	12.2	8.1	5.6	2.5	162.7
Ilopango	54.7	2.8	4.2	2.4	0.7	0.3	65.1
San Martin	29.7	3.1	3.5	1.5	4.0	0.3	42.1
Apopa	66.2	6.1	5.9	2.1	7.5	1.1	88.9
Nejapa	6.9	0.6	1.0	0.3	0.1	0.1	9.0
Tonacatepeque	13.3	0.6	1.9	2.4	0.2	0.6	19.0
Total	853.9	47.0	83.9	56.7	62.4	100.5	1,204.4
Generation amount (ton/year)							
San Salvador	85,629	3,139	8,213	6,096	13,031	23,506	139,614
Mejicanos	30,697	1,460	3,322	2,592	876	2,117	41,064
Delgado	23,360	1,241	3,103	1,351	256	1,095	30,406
Cuscatancingo	13,615	1,022	1,497	730	0	657	17,521
Ayutuxtepeque	4,745	146	402	475	110	183	6,061
San Marcos	11,352	584	876	438	292	511	14,053
Nueva San Salvador	26,317	803	2,008	1,971	1,351	3,103	35,553
Antiguo Cuscatlan	8,322	219	730	913	256	3,723	14,163
Soyapango	45,297	3,723	4,453	2,957	2,044	913	59,387
Ilopango	19,966	1,022	1,533	876	256	110	23,763
San Martin	10,841	1,132	1,278	548	1,460	110	15,369
Apopa	24,163	2,227	2,154	767	2,738	402	32,451
Nejapa	2,519	219	365	110	37	37	3,287
Tonacatepeque	4,855	219	694	876	73	219	6,936
Total	311,678	17,156	30,628	20,700	22,780	36,686	439,628

The aggregate waste generation amount in AMSS in respective categories (e.g., household, restaurant, other commercial, institutional, market) would be reasonably judged as correct figures, because the respective population in AMSS used for this calculation is taken from the DIGESTYC census data. However, if the individual figures for respective municipality are examined, it could be judged that some of the figures might not reflect the actual situation of respective waste generation in respective municipality.

d. Waste Generation Amount in Respective Municipality

In this context, waste generation amount in respective municipality is adjusted herewith referring to the disposal amount data in 1998 that have breakdown of 3 collection routes and 3 waste categories.

The adjustment is made in the following manner.

- Respective municipality's disposal amount in 1998 is recorded with breakdown of 3 collection routes (municipal collection, direct haulage and private collection) and breakdown of 3 waste categories (market, household and commercial wastes) as shown in Table G-15.
- The proportion of each element (breakdown into 14 municipalities, 3 collection routes, 3 waste categories) to the total disposal amount in 1998 recorded at Mariona site is automatically given.
- Those proportions are multiplied to the gross generation amount of 439,628 ton (as shown in Table G-14) derived by the WACS in this Study, in order to estimate waste collection amount respectively for municipal collection, direct haulage and private collection for the respective 14 municipalities.

The adjusted waste generation amount in respective municipalities with breakdown of respective collection routes is summarized in Table G-16.

Table G-15: Weighing Data at Mariona Final Disposal Site (1998)

Unit: ton/year

Collector	City	Market	Household	Commercial
Municipality collection	01SS	18,014.2	139,399.3	5,493.8
	02MJ	227.4	23,988.8	0.0
	03CD	15.0	10,560.8	0.0
	04CT	0.0	8,995.9	0.0
	05AY	0.0	3,531.6	0.0
	06SM	5.8	10,807.6	0.0
	07ST	197.6	26,469.6	3.1
	08AC	0.0	14,471.3	0.0
	09SY	0.0	43,231.1	2.4
	10IL	0.0	14,852.8	0.0
	11SMT	0.0	8,395.0*	0.0
	12AP	15.8	15,814.9	0.0
	13NJ	0.0	1,648.2	4.7
	14TN	0.0	7,300.0*	0.0
	total	18,475.8	329,466.9	5,504.0
Direct haulage	01SS	16.4	1,011.5	798.0
	02MJ	24.5	179.7	42.3
	03CD	0.0	0.0	0.0
	06SM	0.0	3.6	0.0
	07ST	0.0	24.4	7.2
	08AC	13.6	321.2	362.8
	09SY	20.7	1,935.1	1,450.0
	10IL	2.2	283.9	12.4
	11SMT	0.0	0.0	0.0
	12AP	0.0	25.8	0.5
	13NJ	0.0	0.0	0.0
	14TN	0.0	0.0	0.0
	total	77.40	3,785.20	2,673.20
Private Contractor	01SS	0.0	37.9	0.0
	07ST	0.0	2,986.7	0.0
	09SY	0.0	1,299.0	0.0
	total	0.00	4,323.60	0.00
Total (ton/year)		18,553.20	337,575.70	8,177.20

Note: * data from hearing survey, sources: San Salvador Municipality

G.3.1.3 Waste Collection Routes for Respective Municipalities

The waste stream with breakdown of 3 collection routes for each respective municipality is given in the table below.

Table G-16: Waste Stream with Collection Routes Breakdown (After Adjustment) in 1998

Unit: ton/year

Collector	City	Market	Household	Commercial	Total
Municipality	01SS	22,118	159,486	20,577	202,181
	02MJ	279	27,445	0	27,724
	03CD	18	12,082	0	12,100
	04CT	0	10,292	0	10,292
	05AY	0	4,040	0	4,040
	06SM	7	12,365	0	12,372
	07ST	243	30,283	12	30,538
	08AC	0	16,557	0	16,557
	09SY	0	49,460	9	49,469
	10IL	0	16,993	0	16,993
	11SMT	0	9,605	0	9,605
	12AP	19	18,094	0	18,113
	13NJ	0	1,886	17	1,903
	14TN	0	8,352	0	8,352
	Total	22,684	376,940	20,615	420,239
Direct haulage	01SS	20	1,157	2,989	4,166
	02MJ	30	206	158	394
	03CD	0	0	0	0
	04CT	0	0	0	0
	05AY	0	0	0	0
	06SM	0	4	0	4
	07ST	0	28	27	55
	08AC	17	367	1,359	1,743
	09SY	26	2,214	5,431	7,671
	10IL	3	325	47	375
	11SMT	0	0	0	0
	12AP	0	30	2	32
	13NJ	0	0	0	0
	14TN	0	0	0	0
	Total	96	4,331	10,013	14,440
Private Contractor	01SS	0	43	0	43
	02MJ	0	0	0	0
	03CD	0	0	0	0
	04CT	0	0	0	0
	05AY	0	0	0	0
	06SM	0	0	0	0
	07ST	0	3,417	0	3,417
	08AC	0	0	0	0
	09SY	0	1,486	0	1,486
	10IL	0	0	0	0
	11SMT	0	0	0	0
	12AP	0	0	0	0
	13NJ	0	0	0	0
	14TN	0	0	0	0
	Total	0	4,946	0	4,946
Total		22,780	386,220	30,628	439,628

G.3.1.4 Self Disposal Amount

In setting up the waste stream, it is necessary to set up a breakdown of the self disposal amount (i.e., amounts of illegal dumping, self disposal, and on-site recycling). These figures are estimated from the DIGESTYC census data in 1998.

Table G-17: DIGESTYC Census Data

Self disposal method / City	Unit	Bury	Burn	Dispose to anywhere	Other	NA	Total
San Salvador	No.	10	-	8	2	-	20
Mejicanos	No.	3	5	16	-	-	24
Delgado	No.	1	7	22	5	1	36
Cuscatancingo	No.	2	3	12	2	-	19
Ayutuxtepeque	No.	1	16	25	5	-	47
San Marcos	No.	3	10	23	3	-	39
Nueva San Salvador	No.	-	4	3	-	-	7
Antiguo Cuscatlan	No.	-	2	7	-	1	10
Soyapango	No.	-	3	2	-	-	5
Ilopango	No.	2	2	34	15	-	53
San Martin	No.	2	24	37	3	1	67
Apopa	No.	4	14	20	3	-	41
Nejapa	No.	16	31	36	4	1	88
Total (nos. of household)	No.	44	121	245	42	4	456
Ratio	%	10%	27%	54%	8%	1%	100%

Proportions of illegal dumping, self disposal, and on-site recycle are set up as shown in Table G-18.

Table G-18: Ratio of On-site Disposal Method

Item	Ratio (%)
Illegal dumping	54
Self disposal	37
On-site recycling	9

G.3.1.5 Waste Stream for Respective Municipalities

Waste stream of each municipality calculated based on the data above is summarized in Table G-19 and illustrated in Figure G-2 through Figure G-16.

Table G-19: Waste Stream in 1998

	Generation	Collection			Direct haulage	Final disposal	Final disposal ratio (%)	Without collection			
		Municipality	Private	total				Total	Illegal dumping	Self disposal	On-site recycle
unit : ton/year											
San Salvador	206,391	162,907	38	162,945	1,826	164,771	79.8	41,619	22,474	15,399	3,746
Mejicanos	28,119	24,216		24,216	247	24,463	87.0	3,656	1,974	1,353	329
Delgado	12,101	10,576		10,576	0	10,576	87.4	1,525	824	564	137
Cuscatancingo	10,292	8,996		8,996	0	8,996	87.4	1,296	700	480	116
Ayutuxtepeque	4,040	3,532		3,532	0	3,532	87.4	508	275	188	45
San Marcos	12,376	10,813		10,813	4	10,817	87.4	1,559	842	577	140
Nueva San Salvador	34,011	26,670	2,987	29,657	32	29,689	87.3	4,322	2,334	1,599	389
Antiguo Cuscatlan	18,300	14,471		14,471	698	15,169	82.9	3,131	1,691	1,159	281
Soyapango	58,627	43,234	1,299	44,533	3,406	47,938	81.8	10,689	5,772	3,955	962
Ilopango	17,368	14,853		14,853	299	15,151	87.2	2,217	1,197	820	200
San Martin	9,605	8,395		8,395	0	8,395	87.4	1,210	653	448	109
Apopa	18,145	15,831		15,831	26	15,857	87.4	2,288	1,236	847	205
Nejapa	1,903	1,653		1,653	0	1,653	86.9	250	135	93	22
Tonacatepeque	8,352	7,300		7,300	0	7,300	87.4	1,052	568	389	95
Total	**439,630**	**353,447**	**4,324**	**357,771**	**6,536**	**364,306**	**82.9**	**75,323**	**40,675**	**27,871**	**6,777**
unit : ton/day											
San Salvador	565.5	446.3	0.1	446.4	5.0	451.4	79.8	114.1	61.6	42.2	10.3
Mejicanos	77.0	66.3	0.0	66.3	0.7	67.0	87.0	10.0	5.4	3.7	0.9
Delgado	33.2	29.0	0.0	29.0	0.0	29.0	87.4	4.2	2.3	1.6	0.3
Cuscatancingo	28.2	24.6	0.0	24.6	0.0	24.6	87.4	3.6	1.9	1.3	0.4
Ayutuxtepeque	11.1	9.7	0.0	9.7	0.0	9.7	87.4	1.4	0.8	0.5	0.1
San Marcos	33.9	29.6	0.0	29.6	0.0	29.6	87.4	4.3	2.3	1.6	0.4
Nueva San Salvador	93.2	73.1	8.2	81.3	0.0	81.3	87.3	11.9	6.4	4.4	1.1
Antiguo Cuscatlan	50.1	39.6	0.0	39.6	2.0	41.6	82.9	8.5	4.6	3.1	0.8
Soyapango	160.6	118.4	3.6	122.0	9.3	131.3	81.8	29.3	15.8	10.8	2.7
Ilopango	47.6	40.7	0.0	40.7	0.8	41.5	87.2	6.1	3.3	2.3	0.5
San Martin	26.3	23.0	0.0	23.0	0.0	23.0	87.4	3.3	1.8	1.2	0.3
Apopa	49.7	43.4	0.0	43.4	0.1	43.5	87.4	6.2	3.4	2.2	0.6
Nejapa	5.2	4.5	0.0	4.5	0.0	4.5	86.9	0.7	0.4	0.3	0.0
Tonacatepeque	22.9	20.0	0.0	20.0	0.0	20.0	87.4	2.9	1.6	1.1	0.2
Total	**1,204.5**	**968.2**	**11.9**	**980.1**	**17.9**	**998.0**	**82.9**	**206.5**	**111.6**	**76.3**	**18.6**

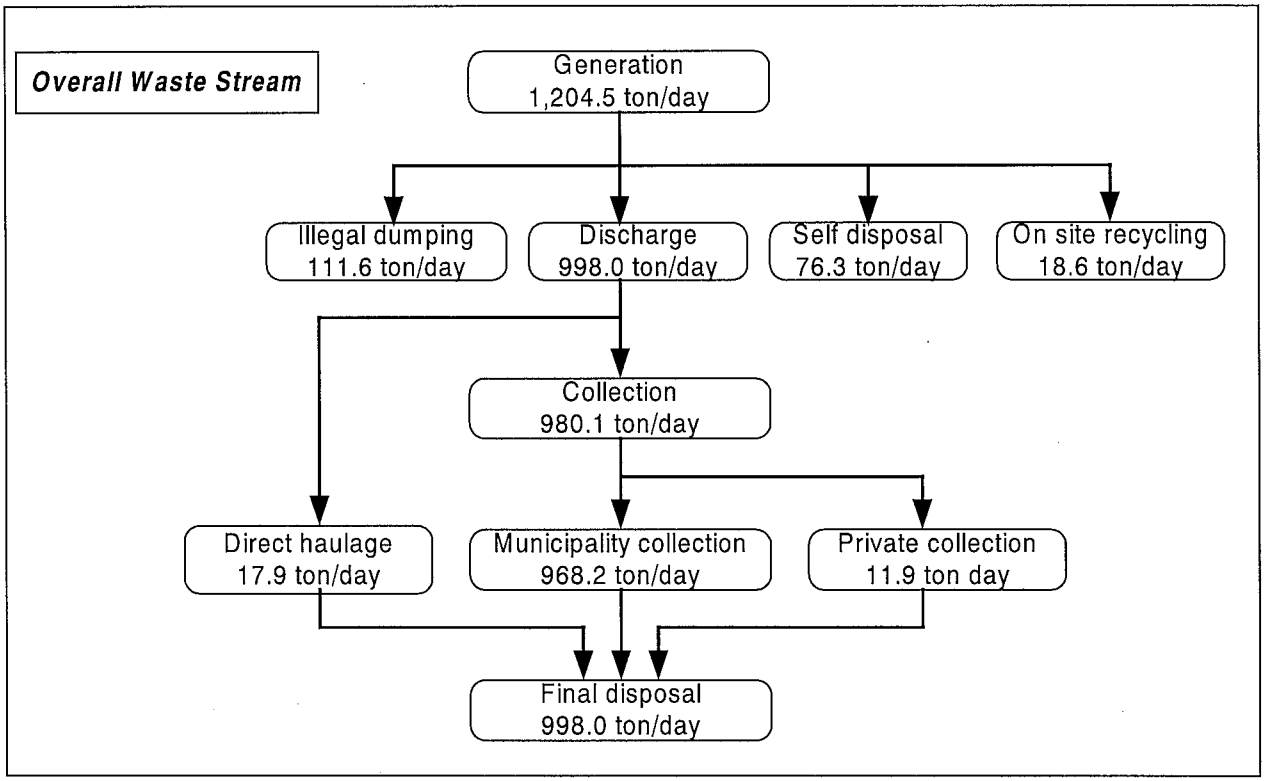

Figure G-2: Overall Waste Stream in 1998

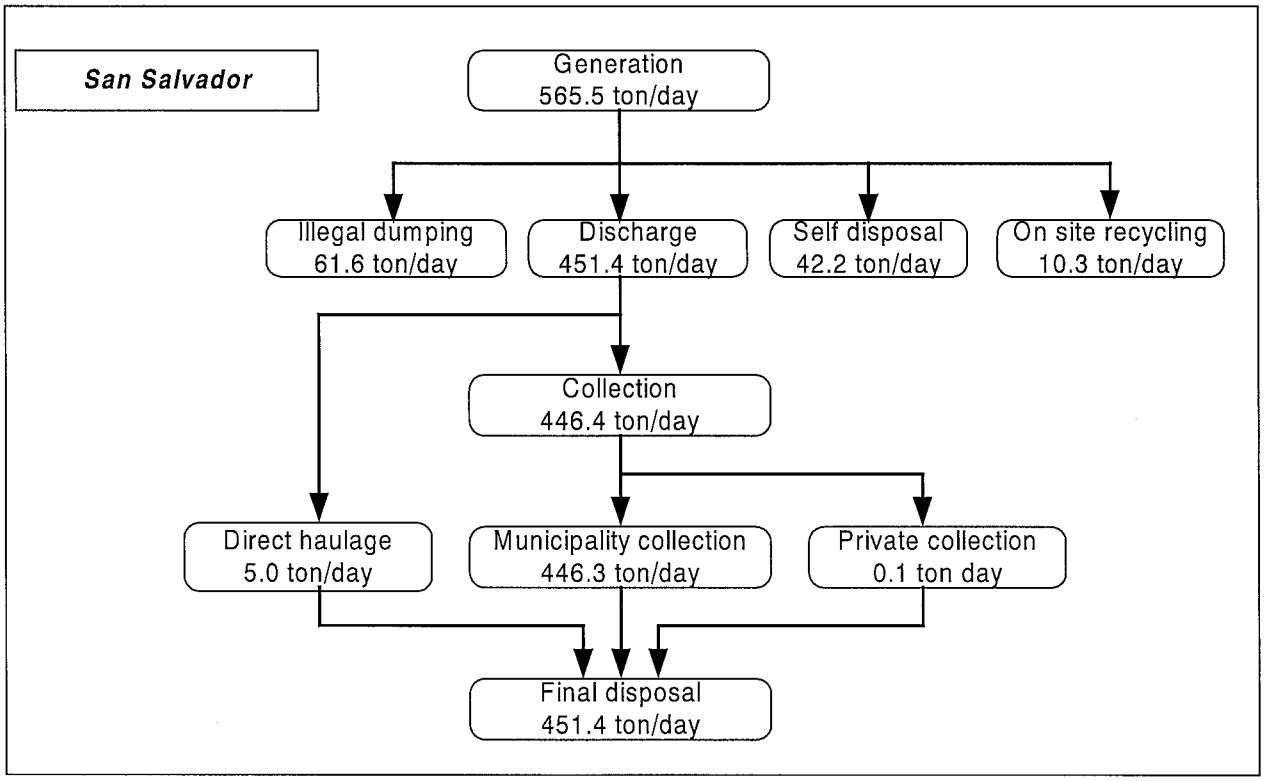

Figure G-3: Waste Stream of San Salvador in 1998

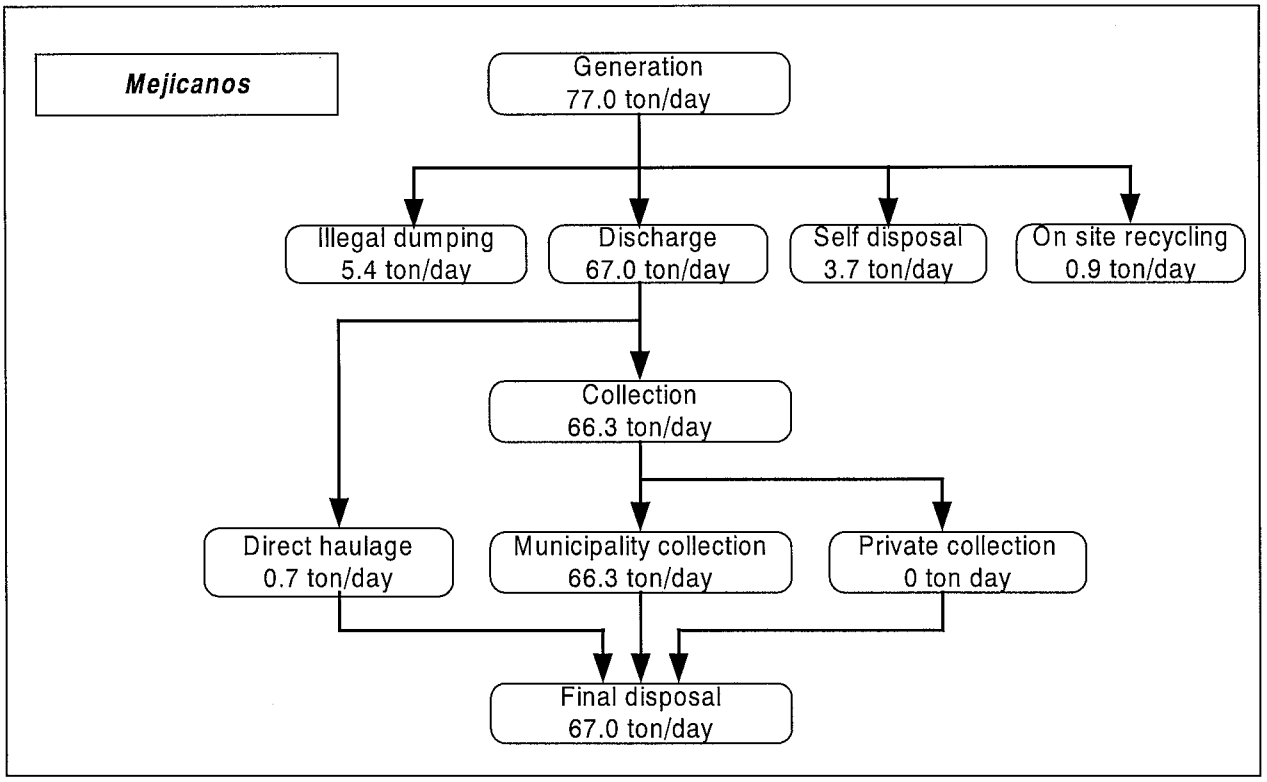

Figure G-4: Waste Stream of Mejicanos in 1998

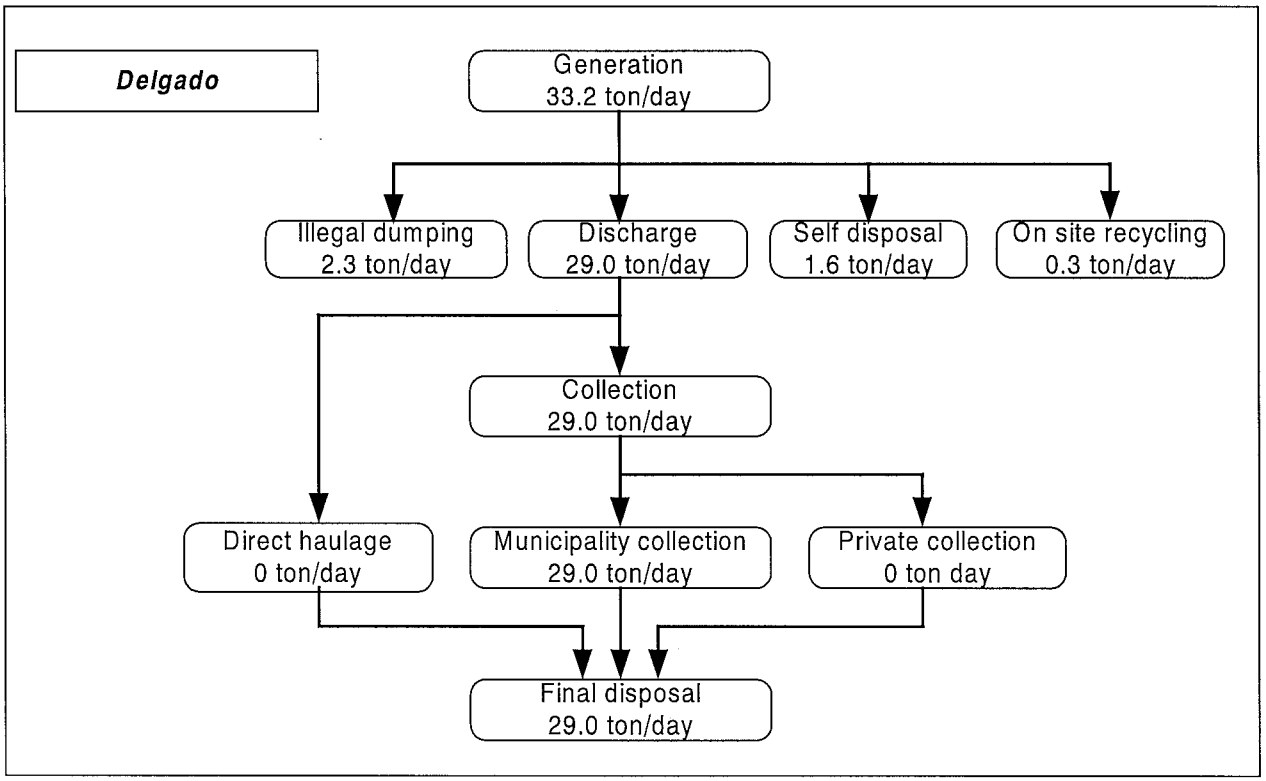

Figure G-5: Waste Stream of Delgado in 1998

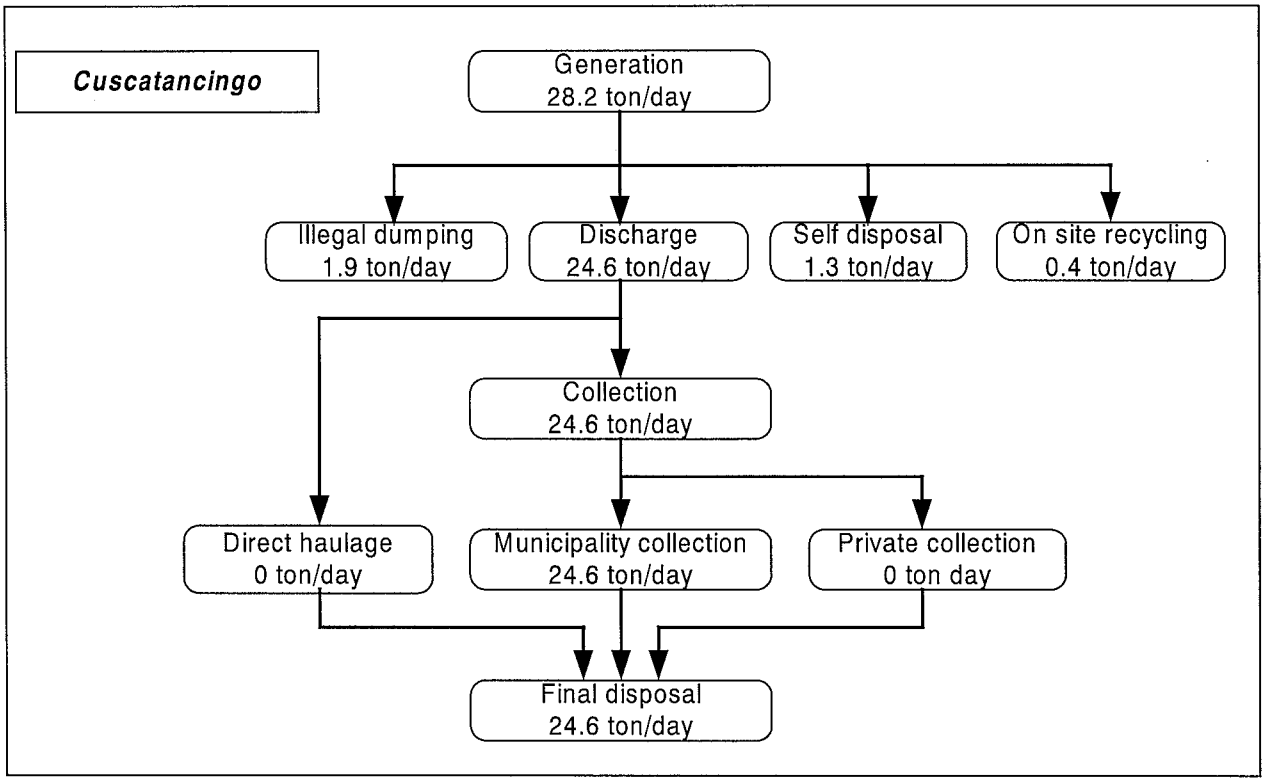

Figure G-6: Waste Stream of Cuscatancingo in 1998

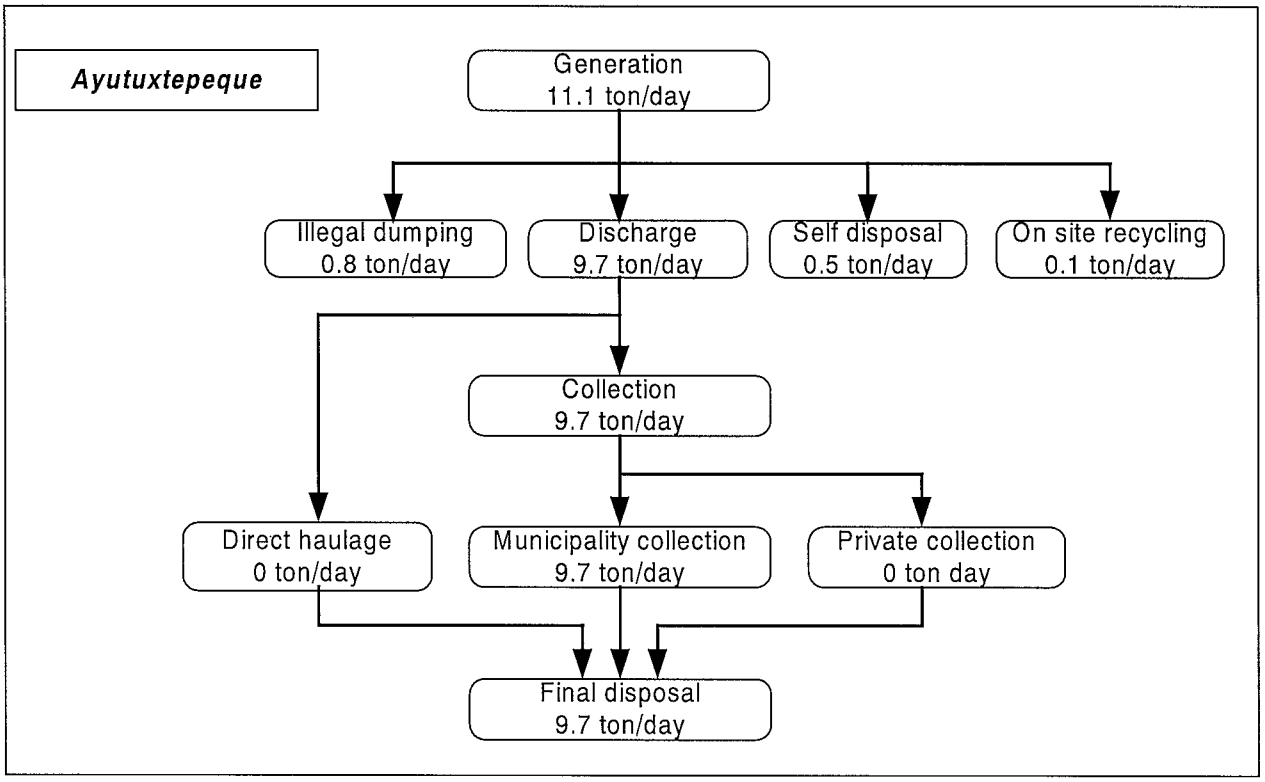

Figure G-7: Waste Stream of Ayutuxtepeque in 1998

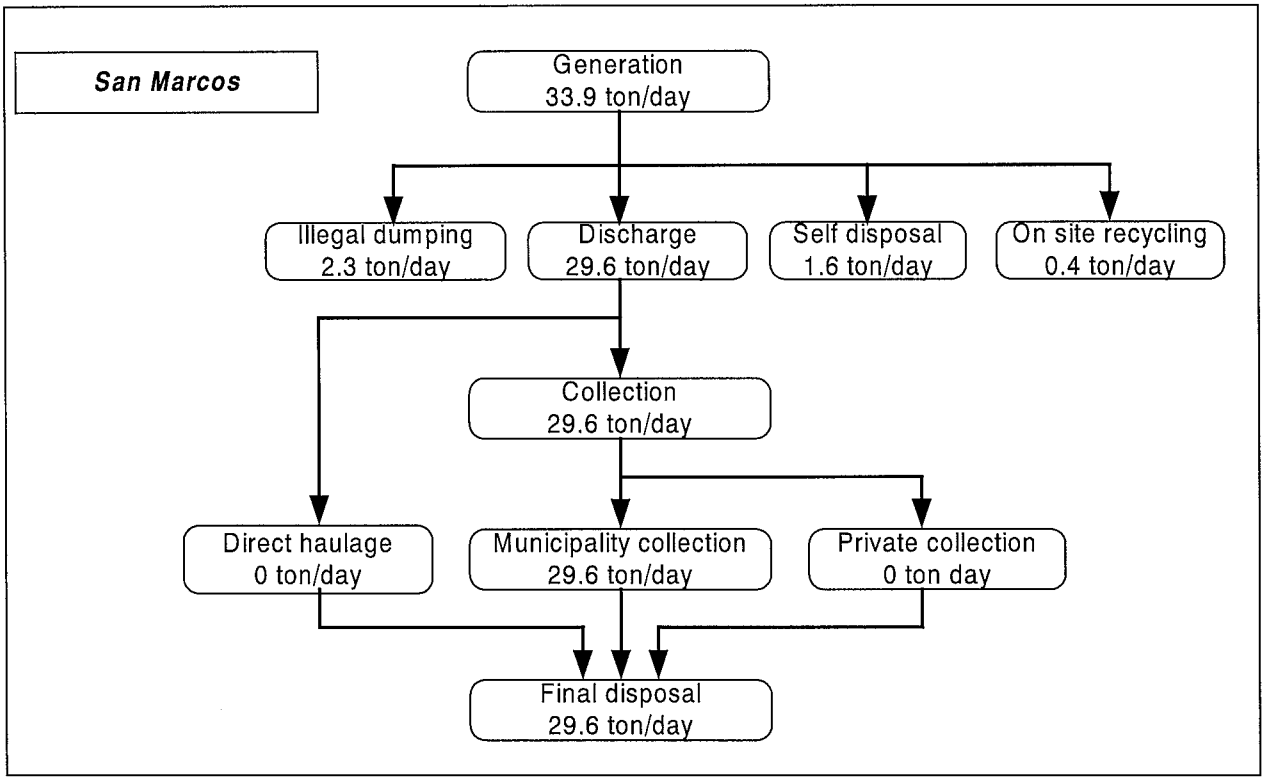

Figure G-8: Waste Stream of San Marcos in 1998

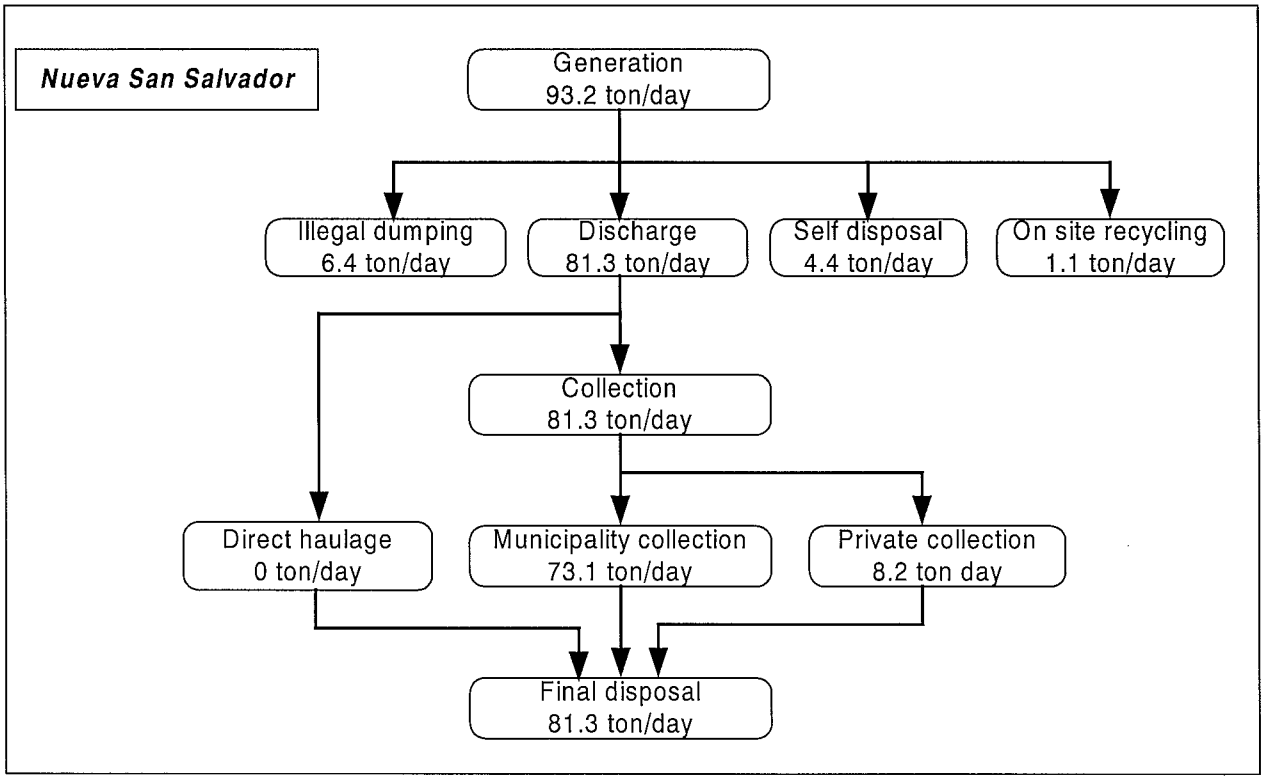

Figure G-9: Waste Stream of Nueva San Salvador

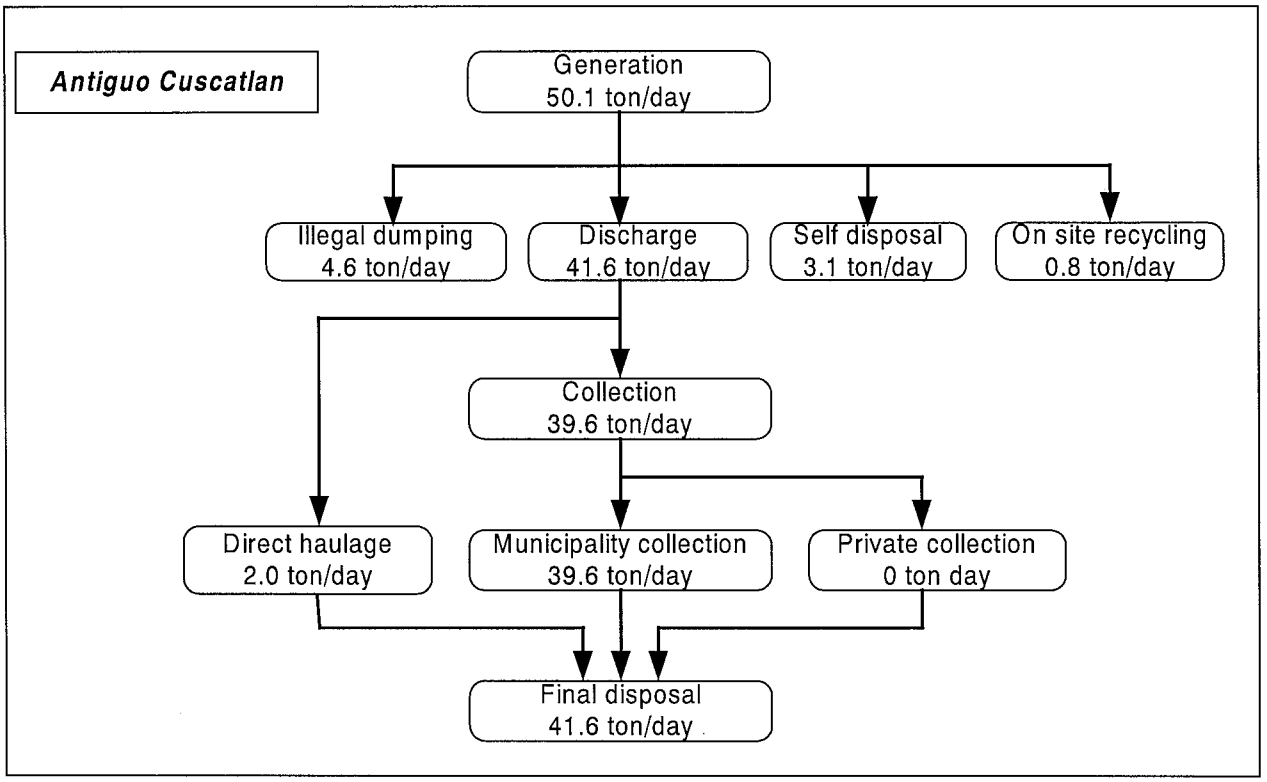

Figure G-10: Waste Stream of Antiguo Cuscatlan in 1998

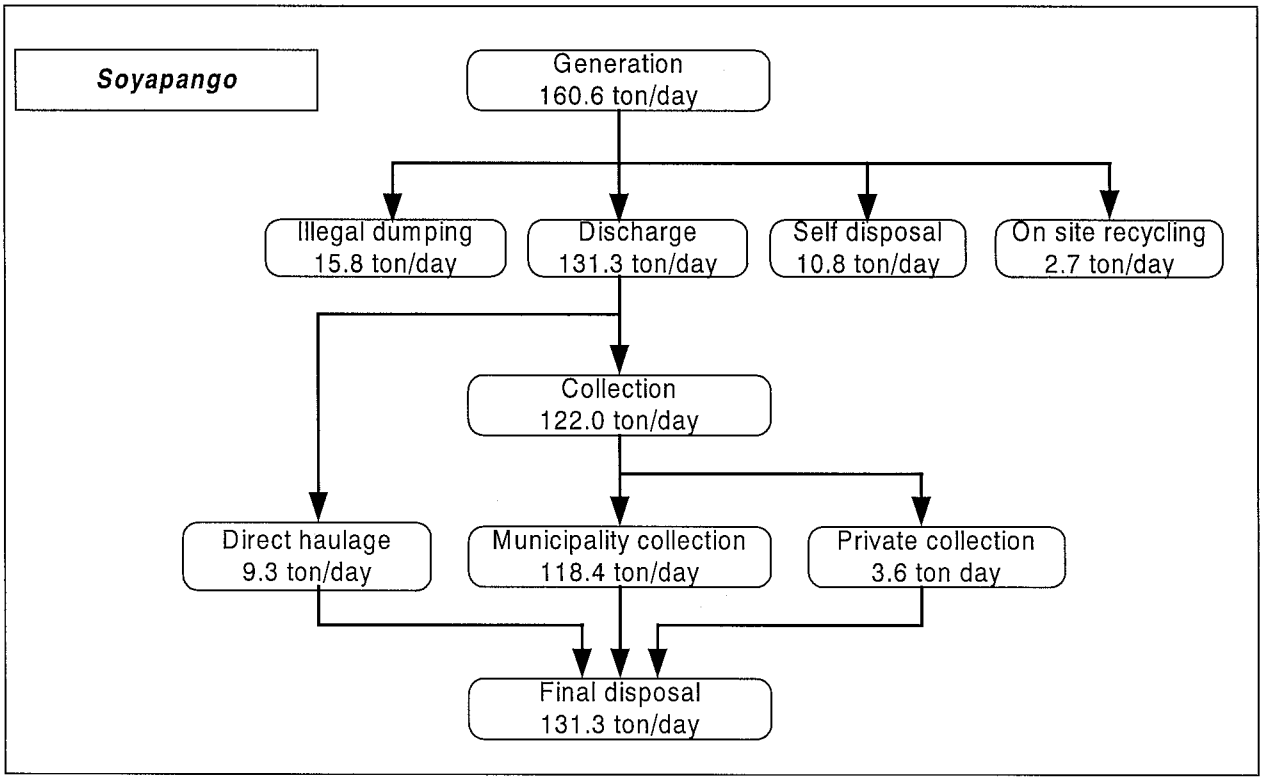

Figure G-11: Waste Stream of Soyapango in 1998

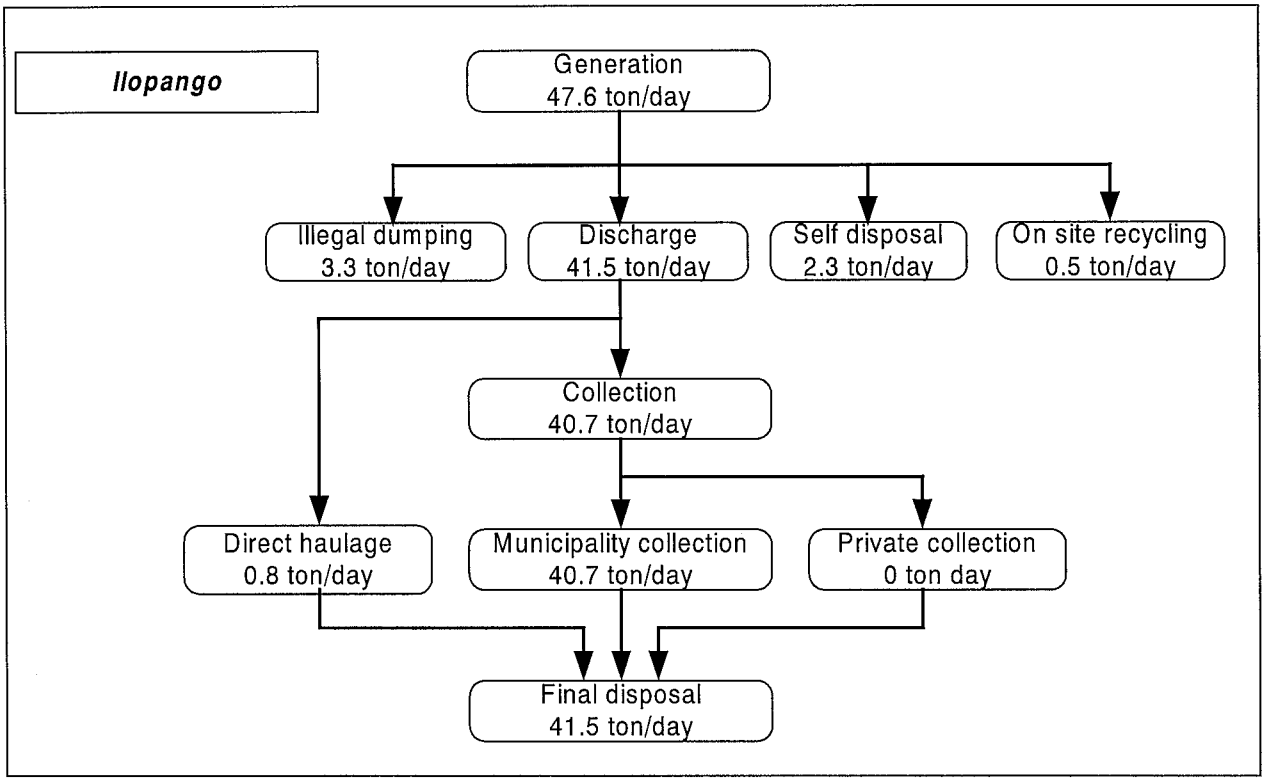

Figure G-12: Waste Stream of Ilopango in 1998

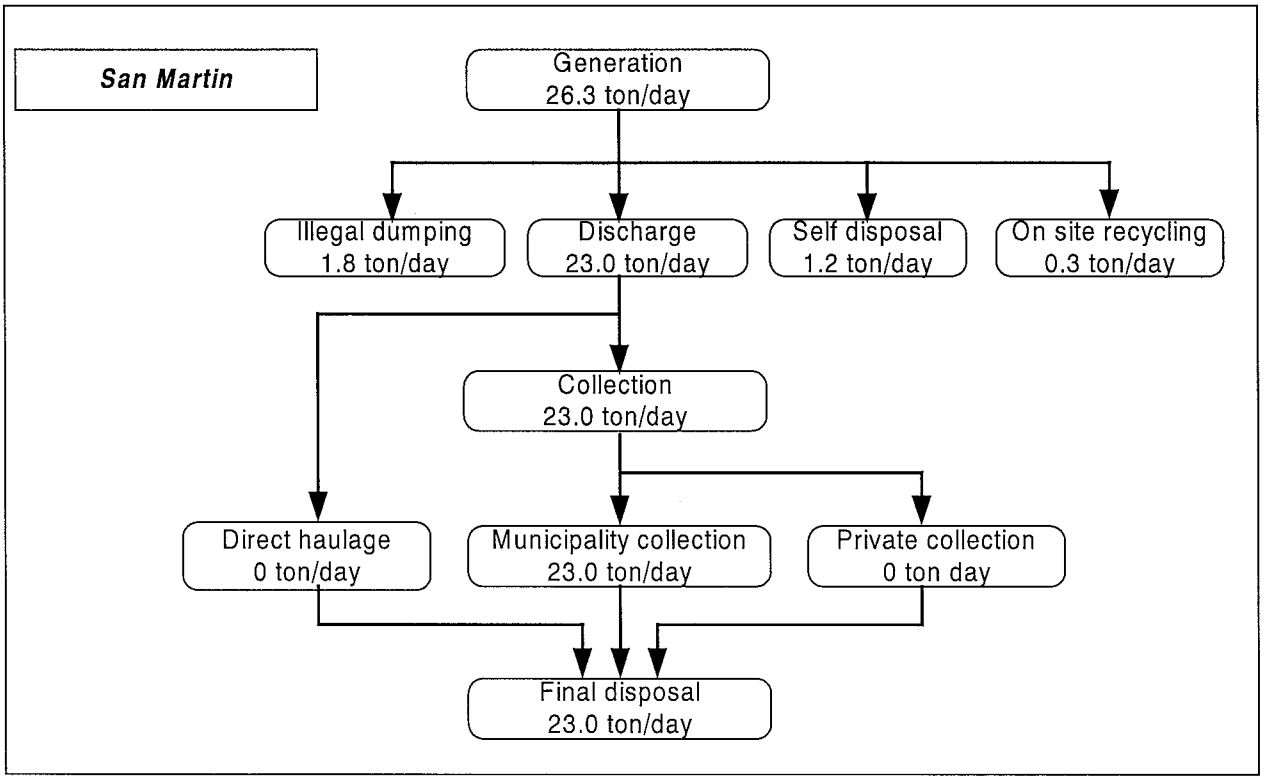

Figure G-13: Waste Stream of San Martin in 1998

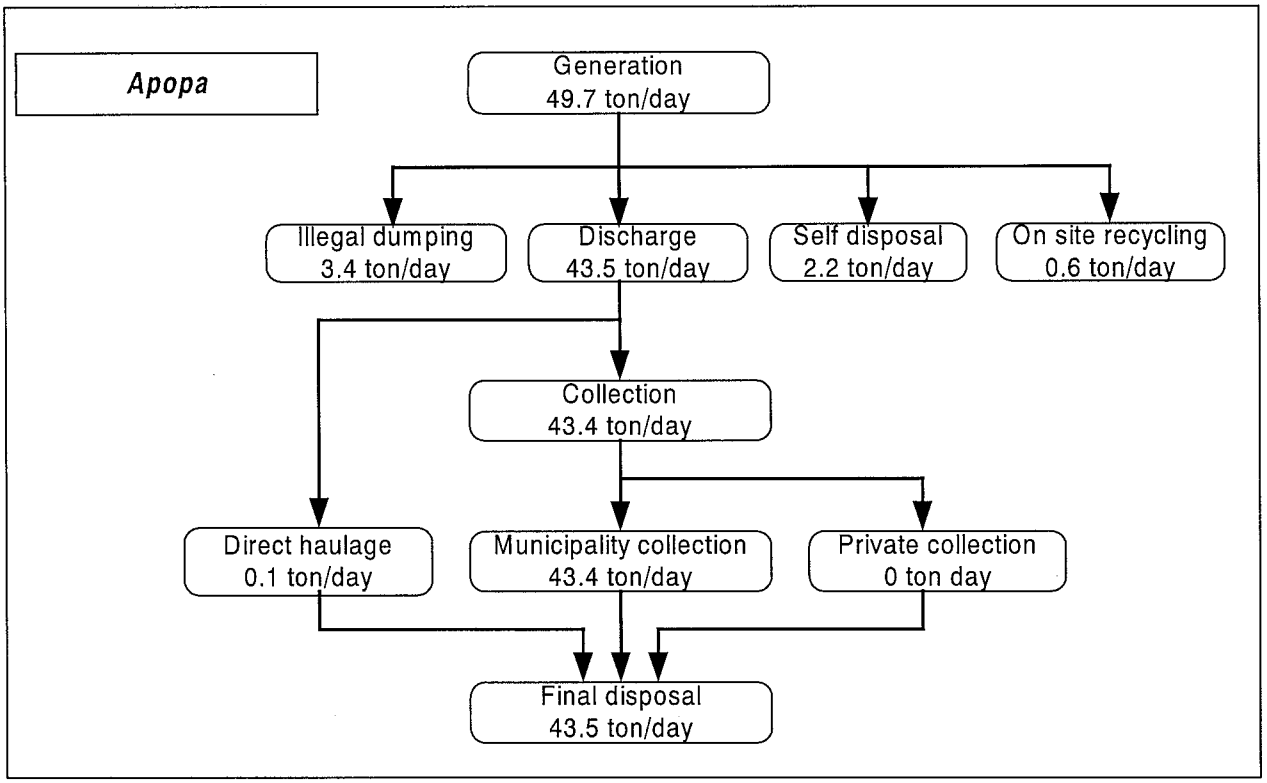

Figure G-14: Waste Stream of Apopa in 1998

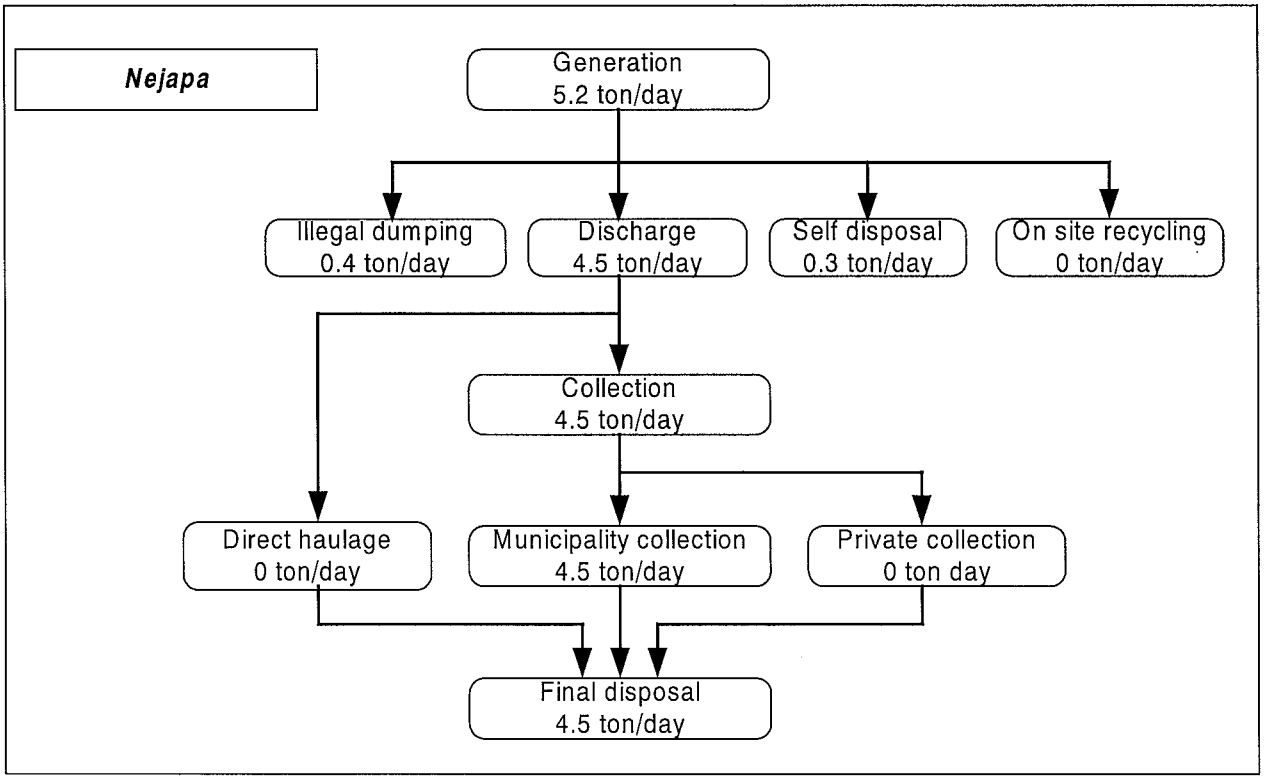

Figure G-15: Waste Stream of Nejapa in 1998

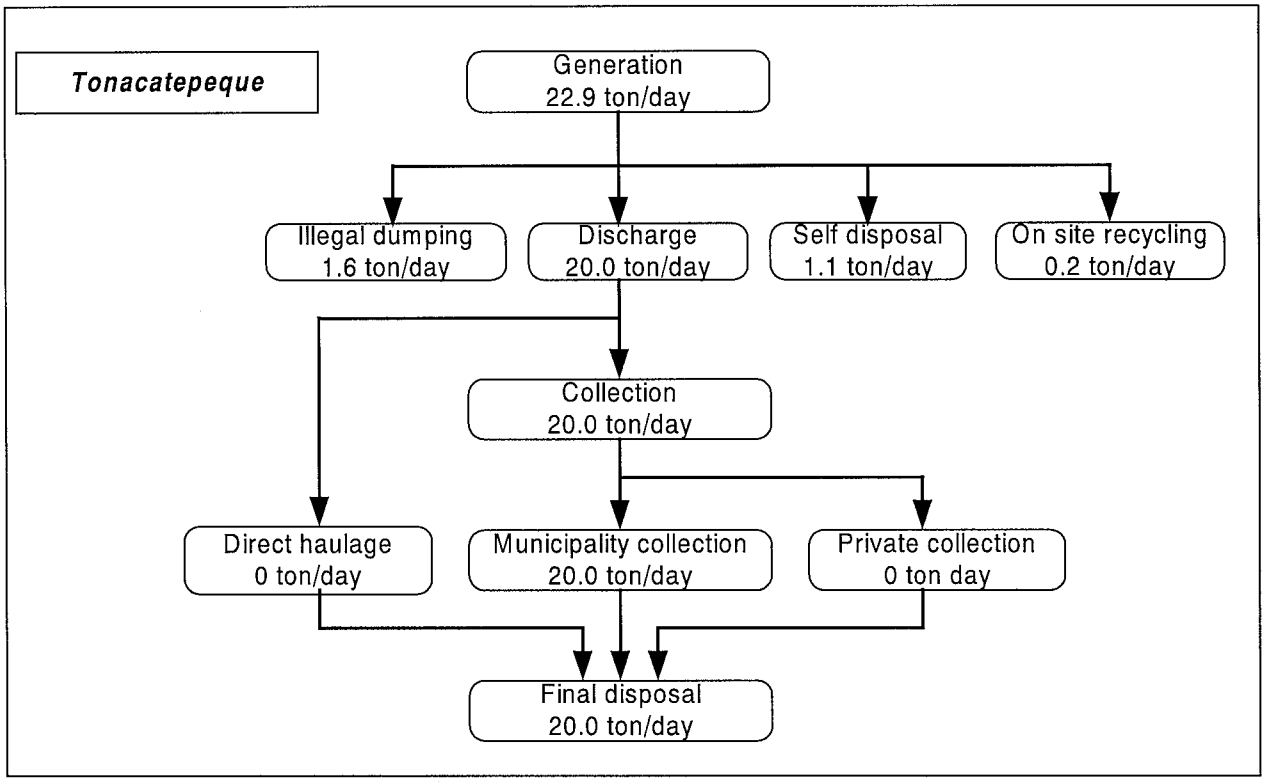

Figure G-16: Waste Stream of Tonacatepeque in 1998