3.4.2 Results of the Field Surveys

1) Solid Waste Amount Disposed at Disposal Sites

The solid waste amount transported to Suhudol and Dolni Bogrov disposal sites in the winter survey was 455.2 ton/day and 620.5 ton/day respectively as shown in Table 3-4-1, on the following page. This amount is slightly more than the respective summer survey results due to seasonable fluctuation.

Types of waste and amounts disposed at both disposal sites in winter and summer are shown in Table 3-4-2. Average disposed amount in 1993 was 1,057.1 ton/day excluding waste hauled from outside of Sofia.

Table 3-4-2 Solid Waste Amount disposed at Suhudol and Dolni Bogrov by type
(unit: ton/day)

Type of Waste	Waste Amount		
	Winter	Summer	Average
Domestic & Commercial			
Domestic	987.1	915.4	951.3
Commercial	8.3	6.2	7.2
Sub-total	995.4	921.5	958.5
Street and Park			
Street waste	18.5	-	18.5
Commercial waste	5.9	-	5.9
Sub-total	24.4	24.4	24.4
Other waste			
Medical	9.8	-	11.2
Building	22.9	-	26.1
Industry	32.5	-	37.0
Sub-total	65.2	83.5	74.3
Total	1,084.9	1,029.4	1,057.1
Covering soil	1.0	-	1.0
From outside Sofia	11.8	-	11.8
Grand Total	1,096.7	1,029.4	1,069.9

Unit generation rate of domestic and commercial waste is 842 g/capita/day on average. However, range of unit generation rate by district varied from 1,743 g/capita in Novi Iskar district to 553 g/capita in Nadezhda district as shown in Table 3-4-3.

Table 3-4-1 Solid Waste Amount Surveyed at Disposal Sites

Dolny Bogrov — **16 Dec. 1993**

	6 Mon	7 Tue	8 Wed	9 Thu	10 Fri	11 Sat	12 Sun	13 Mon	Total 7-13	ton / day	t/day June	t/day av.	t/year
Domestic		616.7	590.6	631.4	688.8	232.2	68.6	776.4	3,604.7	515.0	476.8	495.9	181,002
Commercial		14.5	4.6	8.1	12.4	3.0	0.0	15.2	57.8	8.3	6.2	7.2	2,631
Sub-total		**28.9**	**8.7**	**27.8**	**18.5**	**10.6**	**4.0**	**31.2**	**129.7**	**18.5**			
Street sweeping													
Garden		4.5	12.1	4.1	9.5	1.0	0.0	9.9	41.1	5.9			
Sub-total		**33.4**	**20.8**	**31.9**	**28.0**	**11.6**	**4.0**	**41.1**	**170.8**	**24.4**	**15.5**	**19.9**	**7,278**
Medical		6.7	8.3	7.5	16.1	6.0	3.7	18.8	67.1	9.6			
Construction		14.0	10.2	54.0	29.7	41.9	0.7	7.7	158.1	22.6			
Industrial		46.3	35.6	53.4	25.3	9.7	0.0	39.9	210.2	30.0			
Sub-total		**67.0**	**54.1**	**114.8**	**71.1**	**57.6**	**4.4**	**66.4**	**435.4**	**62.2**	**82.3**	**72.3**	**26,378**
Total		**731.6**	**670.1**	**786.1**	**800.3**	**304.4**	**77.0**	**899.1**	**4,268.6**	**609.8**	**580.8**	**595.3**	**217,288**
Covering soil		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Outside Sofia		14.2	14.2	11.6	12.1	1.5	13.6	7.6	74.8	107			
Grand-total		**745.8**	**684.3**	**979.7**	**812.4**	**305.9**	**90.6**	**906.7**	**4.343**	**620.5**			

Suhodol — **16 Dec. 1993**

	6 Mon	7 Tue	8 Wed	9 Thu	10 Fri	11 Sat	12 Sun	13 Mon	Total 7-13	ton / day	t/day June	t/day av.	t/year
Domestic	610.9	531.1	577.5	593.2	600.3	178.5	147.2	677.2	3,305.0	472.1	438.6	455.3	166,202
Commercial	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Sub-total	**614.9**	**531.1**	**577.5**	**593.2**	**600.3**	**178.5**	**147.2**	**677.2**	**3,305.0**	**472.1**	**438.6**	**455.3**	**166,202**
Street sweeping	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Garden	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Sub-total	**5.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**8.9**	**4.4**	**1,619**
Medical	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.2			
Construction	0.0	0.0	1.0	1.5	0.0	0.0	0.0	0.0	2.5	0.4			
Industrial	1.4	0.0	5.9	5.8	2.9	0.0	0.0	2.6	17.2	2.5			
Sub-total	**2.8**	**0.0**	**6.9**	**8.6**	**2.9**	**0.0**	**0.0**	**2.6**	**20.9**	**3.0**	**1.1**	**2.1**	**750**
Total	**623.4**	**531.1**	**584.4**	**601.8**	**603.2**	**178.5**	**147.2**	**679.8**	**3,326.0**	**475.1**	**448.5**	**461.8**	**168,570.9**
Covering soil	0.0	6.7	0.0	0.0	0.0	0.0	0.0	0.0	6.7	1.0			
Outside Sofia		7.9	0.0	0.0	0.0	0.0	0.0	0.0	7.9	1.1			
Grand-total	**545.7**	**584.4**	**601.8**	**603.2**	**178.5**	**147.2**	**679.8**	**3,340.6**	**477.2**				

Dolny Bogrov and Suhodol

	7 Tue	8 Wed	9 Thu	10 Fri	11 Sat	12 Sun	13 Mon	Total 7-13	ton / day	t/day June	t/day av.	t/year
Domestic	1,147.8	1,168.1	1,224.6	1,289.1	410.7	215.8	1,453.6	6,909.7	987.1	915.4	951.2	347,205
Commercial	14.5	4.6	8.1	12.4	3.0	0.0	15.2	57.8	8.3	6.2	7.2	2,631
Sub-total	**1,162.3**	**1,172.7**	**1,232.7**	**1,301.5**	**413.7**	**215.8**	**1,468.8**	**6,967.5**	**995.4**	**921.5**	**958.5**	**349,835**
Street sweeping	28.9	8.7	27.8	18.5	10.6	4.0	31.2	129.7				
Garden	4.5	12.1	4.1	9.5	1.0	0.0	9.9	41.1				
Sub-total	**33.4**	**20.8**	**31.9**	**28.0**	**11.6**	**4.0**	**41.1**	**170.8**	**24.4**	**24.4**	**24.4**	**8,897**
Medical	6.7	8.3	8.8	16.1	6.0	3.7	18.8	68.4				
Construction	14.0	11.2	55.5	29.7	41.9	0.7	7.7	160.6				
Industrial	46.3	41.5	59.2	28.2	9.7	0.0	42.5	227.3				
Sub-total	**67.0**	**61.0**	**123.4**	**74.0**	**57.6**	**4.4**	**69.0**	**456.3**	**65.2**	**83.5**	**74.3**	**27,127**
Total	**1,262.7**	**1,254.5**	**1,387.9**	**1,403.5**	**482.9**	**224.2**	**1,578.9**	**7,594.5**	**1,084.0**	**1,029.4**	**1,057.1**	**385,859**
Covering soil	6.7	0.0	0.0	0.0	0.0	0.0	0.0	6.7	1.0	0.0	0.0	0.0
Outside Sofia	22.1	14.2	11.6	12.1	1.5	13.6	7.6	82.7	11.8			
Grand-total	**1,2915**	**1,268.7**	**1,399.5**	**1,415.6**	**484.4**	**237.8**	**1,586.5**	**7,683.9**	**1,096.7**			

Table 3-4-3 Waste Amount by District (Ave. of Summer & Winter)

DISTRICT	POPULATION	WASTE AMOUNT				GENERATION
		DOMES.	COMM.	RECYCLE	TOTAL	RATE
	PERSON	ton/day	ton/day	ton/day	ton/day	g/capita
1) Sredets	40,551	39.8	0.5	1.9	42.2	1,041
2) Krasno selo	76,463	52.0	0.0	2.5	54.5	713
3) Vazrazhdane	40,252	32.5	0.0	1.6	34.1	847
4) Oborishte	34,852	33.7	0.2	1.6	35.5	1,019
5) Serdika	45,284	37.5	0.5	1.8	39.8	879
6) Poduyane	52,645	37.8	1.1	1.9	40.8	775
7) Slatina	56,177	47.7	0.4	2.3	50.4	897
8) Izgrev	30,389	21.8	0.7	1.1	23.6	777
9) Lozenets	37,962	27.7	0.6	1.4	29.7	782
10) Triaditsa	60,037	34.3	0.4	1.7	36.4	606
11) Krasna polyana	57,726	55.9	0.5	2.7	59.1	1,024
12) Ilinden	34,818	41.3	0.0	2.0	43.3	1,244
13) Nadezhda	70,492	37.6	0.0	1.8	39.4	559
14) Iskar	64,355	39.3	0.0	1.9	41.2	640
15) Mladost	101,412	66.0	2.5	3.3	71.8	708
16) Studentska	47,687	27.2	0.0	1.3	28.5	598
17) Vitosha	38,058	54.3	0.1	2.6	57.0	1,498
18) Ovcha Kupel	36,727	30.1	0.0	1.5	31.6	860
19) Lyulin	113,544	63.4	0.0	3.1	66.5	586
20) Vrabnitsa	39,757	40.6	0.0	2.0	42.6	1,072
21) Novi Iskar	29,024	48.8	0.0	2.4	51.2	1,764
22) Kremikovtsi	43,330	38.4	0.1	1.9	40.4	932
23) Pancharevo	22,950	33.3	0.2	1.6	35.1	1,529
24) Bankya	8,204	10.5	0.0	0.5	11.0	1,341
TOTAL	1,182,696	951.3	7.2	46.3	1005.7	850
Other area		11.8				
TOTAL		961.7				
Standard deviation						318
Average						945

2) Solid Waste Amount Generated in Specified Areas (15 areas)

Both summer and winter field surveys were conducted at the same 15 specified areas. Survey results are shown in Table 3-4-4.

Generation rates of residential areas varied between 0.43 kg/capita to 6.1 kg/capita in the winter survey. Boundaries for summer generation rates were higher at 0.75 kg/capita and 6.77 kg/capita. However, generation rate at Mladost, with the largest population of the 15 areas is 764 kg/capita in winter, almost the same as the corresponding figure in the summer survey.

Table 3-4-4 Solid Waste Amount in specified Areas

Residential area	Generation rate		Density	
	Summer	Winter	Summer	Winter
	kg/capita		ton/m3	
1. Boyana	6.77	3.28	0.83	0.36
2. Hemus	1.00	1.81	0.20	0.35
3. Pirotska	6.31	2.92	0.54	0.15
4. Belite Brezi	1.52	1.47	0.27	0.19
5. Ovcha Kupel	0.75	0.43	0.23	0.21
6. Lyulin	2.16	2.40	0.17	0.32
7. Mladost	0.75	0.76	0.20	0.22
8. Dolni Bogrov	1.58	6.11	0.23	0.89
9. Fuklteta	1.24	0.75	0.22	0.22
Commercial, etc	Generation rate		Density	
	Summer	Winter	Summer	Winter
	kg/m2 floor		ton/m3	
10. Vitosha & Denkoglo	1.01	0.94	0.19	0.28
11. Shopping center RUM	0.14	0.11	0.22	0.24
12. Genski Pazar	0.20	0.05	0.24	0.08
13. Ministry of Construction	0.20	0.09	0.30	0.25
14. Slavianska & Aksakov	1.59	1.30	0.34	0.15
15. Novotel Hotel	0.49	1.20	0.39	0.37

Solid waste density also varies widely, not only by area but also by day. Sometimes construction waste is discharged in the container. Average density is calculated excluding such heavy waste and is estimated to be 0.23 ton/m^3.

3) Solid Waste Composition in Specified Areas (15 areas)

Solid waste samples were taken from the 15 specified areas. Physical composition, ash content, calorific value and elements were analyzed for each component of the samples. Analysis results are shown in Table 3-4-5 and described hereafter.

(1) Physical composition (Wet base and dry base)

Winter survey result shows a high content of non-combustible components, specially glasswork and cinder. Differences between both surveys are as follows:

a. Percentages of paper and textile in winter are lower and putrecsible matter is higher.
b. Percentage of combustibles is summer is higher.
c. Percentages of cinder and non-combustibles in winter are higher.

(2) Moisture, Organic and Ash content

Moisture content result of the winter survey is only 35% in average, although the same survey's average of residential area is 40%, which is less than the summer survey' corresponding figure. Ash content result in winter is very high and more than that of the summer survey.

(3) Elemental Content

According to average elemental analysis results, organic matter of solid waste in Sofia consists of:

Carbon	55.9%,	Hydrogen	7.5%,	Nitrogen	0.8%
Chlorine	0.1%,	Sulfur	0.5%,	Oxygen	35.2%

(4) Lower Calorific Value

Lower calorific value was measured by each component and was also estimated by several methods. Lower calorific value of solid waste in Sofia is 1,200 Kcal/kg in average.

Table 3-4-5 Sampling and Separation Record

Wet base composition	Average of total Winter	Summer	Average	Average in residential Winter	Summer	Average
Combustible						
Paper	19.48	28.44	23.96	21.66	21.91	21.79
Textile	2.90	9.32	6.11	3.15	13.04	8.09
Plastic	5.60	6.30	5.95	4.76	4.85	4.80
Rubber & Leather	0.08	2.77	1.42	0.13	2.25	1.19
Wood	0.49	2.88	1.69	0.53	3.28	1.90
Putrescible matter	29.20	20.87	25.03	34.63	20.99	27.81
Animal Residues	0.01	1.71	0.86	0.02	2.49	1.25
Sub total	57.75	72.28	65.02	64.87	68.80	66.83
Non-Combustible						
Metal	3.17	2.66	2.92	4.13	2.29	3.21
Glasswork	16.41	14.74	15.57	15.49	12.10	13.79
Stone	1.37	2.27	1.82	2.20	3.51	2.85
Cinder(over 5 mm)	12.03	1.07	6.55	8.00	1.60	4.80
Concrete & block	1.52	2.23	1.88	0.46	4.19	2.32
Other (Over 5mm)	3.15	2.88	3.01	3.06	4.84	3.95
Other (Under 5mm)	4.60	1.86	3.23	1.80	2.68	2.24
Sub total	42.25	27.72	34.98	35.13	31.20	33.17
Total	100.00	100.00	100.00	100.00	100.00	100.00
Dry base composition						
Combustible						
Paper	16.75	25.25	21.00	18.01	18.91	18.46
Textile	2.41	6.46	4.43	2.73	8.44	5.58
Plastic	6.44	9.79	8.11	5.91	7.91	6.91
Rubber & Leather	0.10	2.57	1.34	0.16	1.99	1.08
Wood	0.51	3.15	1.83	0.61	3.65	2.13
Putrescible matter	21.25	11.75	16.50	24.75	13.25	19.00
Animal Residues	0.01	1.81	0.91	0.02	2.64	1.33
Sub total	47.47	60.78	54.12	52.18	56.79	54.48
Non-Combustible						
Metal	4.35	4.21	4.28	6.31	3.76	5.03
Glasswork	23.90	23.72	23.81	24.53	21.48	23.00
Stone	1.90	2.01	1.96	3.26	3.08	3.17
Cinder(over 5 mm)	13.31	1.67	7.49	8.39	2.54	5.46
Concrete & block	2.03	2.21	2.12	0.68	4.15	2.42
Other (Over 5mm)	2.81	2.74	2.77	2.92	4.31	3.62
Other (Under 5mm)	4.22	2.66	3.44	1.73	3.90	2.81
Sub total	52.53	39.22	45.87	47.82	43.21	45.52
Total	100.00	100.00	100.00	100.00	100.00	100.00

Table 3-4-5 (cont...)

	Average of total			Average in residential		
	Winter	Summer	Average	Winter	Summer	Average
Balk density	0.261	0.292	0.276	0.276	0.308	0.292
Tree component						
Moisture	34.87	44.56	39.72	39.42	46.79	43.10
Organic	30.06	33.10	31.58	25.96	29.05	27.51
Ash	35.07	22.34	28.70	34.62	24.16	29.39
Lower Calorific Value	1144	1222	1183	932	1027	979
Karigo formula	1284	1408	1351	1050	1170	1061
Calculation	1255	1424	1359	1190	1234	1221

Moisture	Average of total			Average in residential		
	Winter	Summer	Average	Winter	Summer	Average
Combustible						
Paper	47.25	50.77	49.01	50.44	54.07	52.26
Textile	48.03	61.57	54.80	50.36	65.56	57.96
Plastic	29.16	13.88	21.52	27.43	13.19	20.31
Rubber & Leather	25.00	48.43	36.72	25.00	53.00	39.00
Wood	40.31	39.43	39.87	39.13	40.69	39.91
Putrescible matter	56.98	68.77	62.88	55.74	66.41	61.07
Animal Residues	50.00	41.31	45.66	50.00	43.58	46.79
Sub total	48.36	53.38	50.87	51.73	56.08	53.90
Non-Combustible						
Metal	20.51	12.32	16.42	8.40	12.48	10.44
Glasswork	3.43	10.78	7.11	2.72	5.56	4.14
Stone	22.50	50.90	36.70	11.57	53.42	32.49
Cinder(over 5 mm)	28.89	13.91	21.40	33.20	15.61	24.41
Concrete & block	20.98	45.06	33.02	19.23	47.26	33.25
Other (Over 5mm)	41.61	47.26	44.43	39.26	52.56	45.91
Other (Under 5mm)	38.09	20.71	29.40	39.03	22.42	30.72
Sub total	18.43	21.56	19.99	13.23	26.30	19.76
Total	34.87	44.56	39.72	39.42	46.79	43.10

3.5 Storage and Discharge

3.5.1 Citizens Awareness Survey

The storage and discharge practices of Greater Sofia residents and commercial establishments were identified by the Citizens Awareness Survey (CAW survey) executed under this Study in June 1993. While the sample interviewed is too small to represent the whole population of SGM it does reflect to a certain degree the storage and discharge practices.

A number of 110 households and 40 commercial establishments were covered in the survey. Fifteen locations of the city where solid waste samples were collected under the Solid Waste Survey were selected. The survey was conducted through visits to the interviewee and using a questionnaire sheet. On the whole the interviewees were cooperative although the percentage of "no response" replies were high for some questions concerning family income, expenditures, and profession.

The interviewees' practices and opinions were surveyed on the following items among others:

(1) Storage and discharge
    - Type of storage container
    - Discharge frequency and time
    - Waste separation at source
(2) Collection and disposal
    - Condition of communal containers stations
    - Payment to cleaning authorities
    - Knowledge on disposal sites and disposal systems
    - Collection service
(3) Street Cleaning

3.5.2 Solid Waste Storage

1) Residential Solid Waste

Small plastic bins are used in majority of households for storage of waste. These are not standard containers, and plastic buckets with a lid are most common. Container liners by placing a plastic or paper bag is not common practice, and the majority of households just put a newspaper page at the bottom of the container. Most households surveyed (73%) carry the same container used for storage to the communal containers station and empty the storage container and return it.

Surprisingly those interviewed households that had trouble with the storage of waste within the house were less than a quarter of the total interviewed households. Dwelling areas in Sofia tend to be small (1992 census shows that 87% of all dwellings in Sofia were less than 59 m^2) and more complaints concerning odor and taking up of space were anticipated. One practice is to place the main household container in the balcony.

One factor that discourages waste separation at the source is the need to have more space for more than one container. However the fact that, out of 110, only one interviewee complained that the waste takes up too much space is an encouraging sign of the possibility of introducing waste separation.

2) Commercial and Market Waste

Small shops, offices, a hotel, and stalls at markets were interviewed. Roughly 70% used containers made of plastic or metal and the same container used for storage on the premises is taken out and emptied.

3.5.3 Solid Waste Discharge

1) Residential Solid Waste

Stations with community containers are provided for housing blocks while for single unit dwellings or buildings in the central districts of the city, community containers are placed in front of buildings, or in building yards.

Most block buildings are served by chutes with openings at each floor to discharge waste. But these chutes are hardly used. The sight of residential waste being discharged in open lots is not common in Sofia, although placing of waste beside full communal containers and in construction sites mixed with construction waste is sometimes observed.

Basically there are no regulations governing discharge time. In one case only, a sub-district of Oborishte district, where discharge by plastic bags provided by the district is practiced, citizens are required to observe discharge hours of 8 PM to 8 AM. CAW survey showed that half the interviewed households have no regular discharge time, while about 30% discharge during the morning hours of 7 to 9 AM, or evening hours of 6 to 9 PM.

Greater Sofia citizens are allowed to discharge their waste on any day of the week. About 75% of those surveyed discharge their waste daily or once every two days. Figure 3-5-1 shows a graphical presentation of the survey results on discharge frequency.

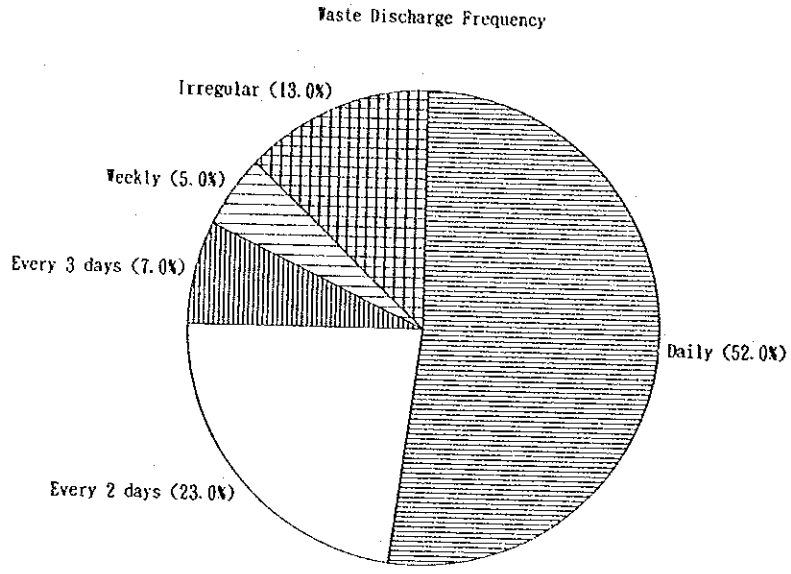


Figure 3-5-1 Frequency of Waste Discharge

Residential waste is discharged by family members, usually the husband (33%) and the wife (30%) or both (2%).

Separation of waste at the source is uncommon among Sofia citizens as identified by the CAW survey. Of 35% of households that separate their waste, common items separated and sold are glass bottles, plastic bottles and newspapers.

Present discharge practices indicate that residents observe the designated discharge locations, but are not restricted in terms of discharge day and hour.

It is also significant that over 83% of those interviewed responded positively to willingness to separate waste provided a profit was attached (56%) or just to assist in the cleaning activity. It is worthwhile to note here that about five years ago there was an attempt by one company to collect separated waste from the source. This project was discontinued. A report prepared by SGM attributed the project failure to lack of sufficient organization and negative attitude of the citizens. However in interviews with the district cleaning

companies by the Study Team the failure of that project was blamed solely on lack of organization and facilities of the company involved in the project. Whatever the reasons, a study on the separation of waste at the source and its phased application is strongly recommended and shall be considered within the context of the master plan.

2) Commercial and Market Waste

Over 95% of interviewed establishments and shops discharge waste daily. This large percentage may be attributed to two factors; locating of large sized containers on premises of factories, public buildings, and markets and the small shop spaces.

Over three-quarters of the interviewed establishments do not separate their waste and willingness to separate the waste provided a profit was attached or to assist the cleaning authorities, at 65%, was slightly less than that for residential interviews but still an encouraging sign.

3.6 Collection and Haulage

3.6.1 Organizations Involved

1) Public Services Companies (BKC)

In 1990 SGM was reorganized into 24 districts with each assuming SWM responsibility. District authorities responsible for SWM have been organized into BKC. In addition to a cleaning dept. (Chistota) most BKC provide other services as road and building maintenance, small construction, landscaping, and shop operation. Table 3-6-1 shows BKC activities.

Table 3-6-1 District Public Services Companies

District	Area (ha)	1992 Pop.	Cleansing Agency	Agency Activities					Total Staff	Chis tota Staff	Chis tota Staff/ 1000 pop
				Chis tota	Road	Lscp	Bldg	Comm			
1.SRED	129.1	40,551	BKC	o	o	o	o	-	336	163	4.0
2.KSEL	375.4	76,463	BKC	o	o	o	o	-	340	155	2.0
3.VAZR	199.1	40,252	BKC	o	o	o	o	-	245	140	3.5
4.OBOR	147.4	34,852	D.CO.	o	-	-	-	-	161	151	4.3
5.SERD	443.6	45,284	BKC	o	o	o	o	-	273	156	3.4
6.PODU	274.3	52,645	D.CO.	o	o	o	o	o	232	113	2.1
7.SLAT	380.6	56,177	BKC	o	o	o	o	-	200	110	2.0
8.IZGR	166.6	30,389	BKC	o	o	o	o	-	137	61	2.0
9.LOZN	267.4	37,962	BKC	o	o	o	o	-	150	65	1.7
10.TRID	253.3	60,037	BKC	o	o	o	o	-	222	129	2.1
11.KPOL	292.0	57,726	BKC	o	o	o	o	-	221	121	2.1
12.ILIN	167.7	34,818	BKC	o	o	o	o	-	157	104	3.0
13.NADZ	336.7	70,492	BKC	o	o	o	o	-	211	121	1.7
14.ISKR	414.5	64,355	D.CO.	o	-	-	-	-	120	120	1.9
15.MLAD	549.1	101,412	BKC	o	o	o	o	-	302	165	1.6
16.STUD	345.9	47,687	BKC	o	o	o	o	-	90	58	1.2
17.VITS	889.1	38,058	D.CO.	o	o	o	o	-	180	110	2.9
18.OKUP	481.2	36,727	EKO.H	o	o	o	o	-	156	94	2.6
19.LYUL	597.5	113,544	BKC	o	o	o	o	-	304	172	1.5
20.VRAB	355.8	39,757	(Data not available)								
21.NISK	1,379.3	29,024	BKC	o	o	o	o	-	140	76	2.6
22.KREM	1,197.8	43,330	BKC	o	o	o	o	-	148	81	1.9
23.PANC	924.6	22,950	D.CO.	o	-	o	-	-	107	80	3.5
24.BANK	562.4	8,204	BKC	o	o	o	o	-	90	38	4.6
Total	11,130.4	118,2696							4522	2583	2.3

Employees working in the Chistota dept. are on average 60% of total company employees indicating dominance of the cleansing activity. Chistota staff as quoted in the table includes drivers of waste transport and street cleaning vehicles, and labour used for both activities. Although drivers are basically assigned to specific vehicles, labourers may be rotated between street cleaning and waste collection activities.

Sredets and Oborishte districts have comparatively high rates of Chistota staff/1000 population which may be explained by the fact that both districts are in the central area of the capital and day time population may double in both (no data on day time populations are available and figures in the table are night time populations). On the other hand the heavily populated districts of Lyulin and Mladost both have rates below the average of 2.3. It is significant to note that in interviews with Lyulin BKC they indicated their satisfaction with the existing Chistota manpower.

In addition to the 24 BKC, SGM has a company called Chistota General Co., which is responsible for cleaning of some major streets of the municipality and operation of disposal sites at Dolny Bogrov and Suhodol. Chistota Co. workshops also provide specialized repairs for BKC vehicles. Each BKC has its own vehicle fleet and garage with attached workshop for minor repairs.

A number of private small companies or individuals (a driver with truck) appear to be active in collection and transport of commercial and industrial waste but no firm data is available. This activity is not supervised by any known authority in SGM, although these vehicles are supposedly registered as they enter the Chistota Co. operated disposal sites.

2) Awarding of Work

Each BKC is basically responsible for waste collection and street cleaning within its district. This is partly true for waste collection.

District residential waste collection is handled by the respective district BKC. On the other hand, strong competition is appearing lately among different BKC to collect and transport commercial and public buildings waste irrespective of their locations within or outside the district. Only very minor instances of private companies transporting either residential or commercial waste have been reported.

Each district receives a budget from SGM for waste collection and street cleaning. However on the district level the budget received may be modified (usually decreased). Districts are then supposed to enter into annual or quarterly contracts with BKC, but at present most BKC are working without contracts, but on agreed working schedules and scales.

In case of commercial (shops, markets, etc) and public buildings (hospitals, ministries, offices, etc) contracts are directly concluded with BKC.

3.6.2 Description of Activity

1) System Employed

For collection and transport of domestic and mixed domestic/commercial waste stationary container system (SCS) is employed. Communal containers are placed in certain locations where BKC compactor vehicles come and empty the containers.

However in some areas a different type of collection system, hauled container system (HCS) is employed. Large containers are hoisted on trucks and transported to disposal sites where they are emptied and empty container returned to the collection point. This system is mainly used fo non-hazardous waste generated from factories, commercial centers, public buildings, etc. This system is also used in residential villages or places where accessibility is difficult for large collection vehicles, such as hilly areas in Vitosha district.

2) Equipment Utilized

(1) Communal Containers

Four containers types are used in the municipality;
- Kison: 4.0m^3
- Ra : 1.1m^3
- Meva : 0.1m^3
- 0.75m^3

Kison and 0.75m^3 containers are used in the HCS, while the other two types are employed in the SCS.

In principle, Ra containers serve block buildings while Meva containers are placed in front of single detached dwellings and buildings located in the city center. However there are exceptions. In Triadiste district, the large number of block

buildings located south of Vitosha boulevard are all served by Meva containers.

Ra containers are mounted on wheels and have an attached sliding cover. Meva containers have no wheels and detached covers wh ich are easily stolen. A sample survey showed that over 35% of Ra containers had none, or broken covers.

Ra containers are distributed in a manner that 1 Ra container serves about 30 flats in block buildings. At present household size of 2.6 persons, roughly 0.26 m^3 of waste is discharged from 30 flats, and therefore 1 Ra container can accommodate about 3.5 days of waste. In front of single unit dwellings at least one Meva container is placed, and by the same calculation 12 days of waste can be stored in it.

Ra and Meva containers are BKC property. Both are produced in Bulgaria. But small shops and other places such as restaurants and cafe shops in central parts of the city are supposed to purchase their own containers and maintain purchase receipts to prove ownership. Such shops are prohibited from discharging waste in communal containers reserved for residential waste.

Some containers are put in enclosures made of steel panels, however this practice has been discontinued as the panels are subject to theft. Indeed even containers are being stolen in such numbers as to create a problem in a number of districts.

Table 3-6-2 shows distribution of containers by districts.

SGM average container capacity can accommodate 5 days of generated waste and most of districts' capacities are close to that figure. However for suburban districts of Novi Iskar, Kremikovtsi, Pancharevo, Bankia and Vitosha capacities jump up to about 11 days generated amount. Waste is collected from such remote areas once a week and sometimes every ten days.

Significantly the average storage capacity is only 3 days in the heavily populated districts of Lyulin and Mladost.

From interviews with BKC and visual inspection it is safe to assume that at least 30% of the quoted number of containers are not usable, and average storage capacity will fall to 3.6 days. Estimations in the table are based upon waste generation in summer and from past records winter generation rates are higher. In interviews with district cleaning companies only one company explained that container number is increased

in winter while most other companies stated that the container number in winter is not sufficient.

Table 3-6-2 Container Capacity by District

District	Total Waste (m3/cap /day)	Container Capacity (80% full) Kison (4m3)	Meva (0.11m3)	Bobar (1.1m3)	(0.751)	Total Container Cap.	Cont. Cap/ Tot. Waste
1.SRED	123.3	0	627	26	0	653	5.3
2.KSEL	232.4	0	290	898	0	1188	5.1
3.VAZR	122.4	0	466	185	0	651	5.3
4.OBOR	106.0	16	393	95	0	504	4.8
5.SERD	137.7	19	157	210	0	386	2.8
6.PODU	160.0	67	93	753	0	913	5.7
7.SLAT	170.8	0	481	635	0	1116	6.5
8.IZGV	92.4	38	4	475	0	518	5.6
9.LOZN	115.4	173	792	12	0	977	8.5
10.TRID	182.5	77	1056	0	0	1133	6.2
11.KPOL	175.5	74	432	451	48	1004	5.7
12.ILIN	105.8	0	60	290	0	350	3.3
13.NADZ	214.3	0	239	855	16	1110	5.2
14.ISKR	195.6	0	82	553	0	635	3.2
15.MLAD	308.3	96	212	845	0	1153	3.7
16.STUD	145.0	26	46	396	0	468	3.2
17.VITS	115.7	80	1077	178	32	1367	11.8
18.OKUP	111.7	0	468	299	0	767	6.9
19.LYUL	345.2	38	176	1100	0	1314	3.8
20.VRAB	120.9	0	347	280	0	627	5.2
21.NISK	88.2	403	748	0	0	1151	13.0
22.KREM	131.7	800	602	185	0	1587	12.0
23.PANC	69.8	320	741	0	0	1061	15.2
24.BANK	24.9	0	378	132	0	510	20.5
Total	3595.4	2227	9968	8854	96	21145	5.9

Notes:
1) Waste generation estimated on the basis of 0.76 kg/cap/day and density of 250 kg/m^2, and 1992 nighttime population
2) Container number obtained from Study Team/Counterpart survey

Finally it is noteworthy to include here citizens opinion concerning container system based on CAW survey. Most respondents were satisfied about distances to nearest container (87% of total), and container capacity (66%), but over 61% considered containers do not fit in well with area's at-

mosphere. The main two complaints were that waste was always scattered around containers and not cleared by BKC, followed by containers being always full and subject to scavenging.

These problems, in addition to not disinfecting or washing containers are wide spread. To lesser degrees odor and insect attraction are also identified. While placing of 2 to 4 Ra containers in front of block buildings may not disturb appearance so much, lining 10 to 20 Meva containers in one row in front of blocks is definitely disturbing. Furthermore placing Meva on such important commercial streets as Vitosha Blvd. does not contribute positively to area's atmosphere.

The master plan considers introduction of plastic bags in commercial areas, with fixed discharge time, and appropriately sized Ra containers in front of block buildings.

(2) Waste Collection and Haulage Vehicles

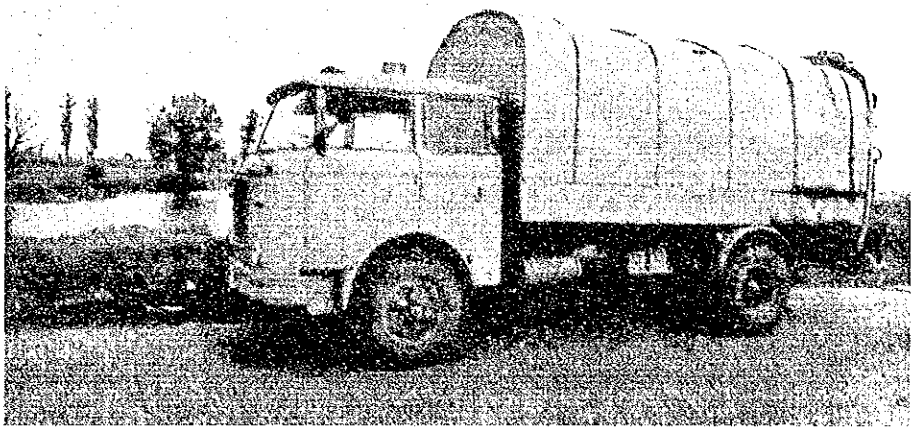
A. Vehicle Types

Self-rear-loading compaction type vehicles, container hoisted trucks and dump trucks are utilized in SWM.

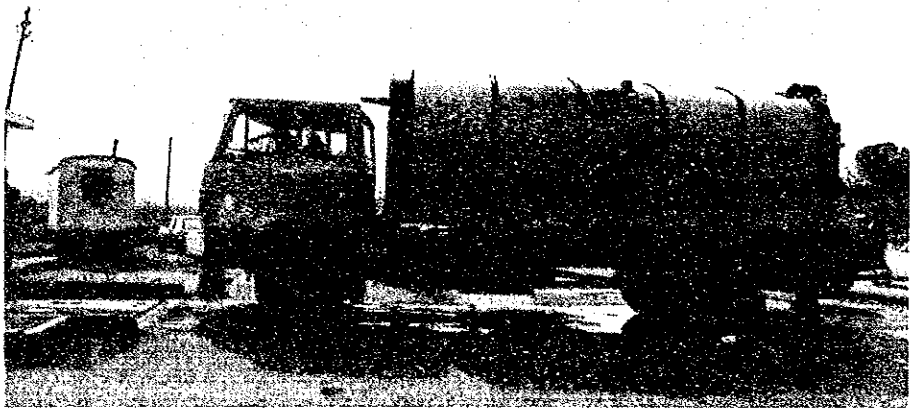
Truck chassis are Skoda (Swedish made), Madara (Bulgarian assembled), GAZ 53 and ZIL (both Russian made). On the other hand, compactors utilized are Bobar and Europa (both Check made), Norba (Swedish), RTK (Swedish) and GAZ 53 KM (Russian made). The types and capacities of the vehicles are shown in Table 3-6-3, and the photographs are shown in Plate 3-6-1.

Table 3-6-3 Waste Collection Vehicle Types in Sofia

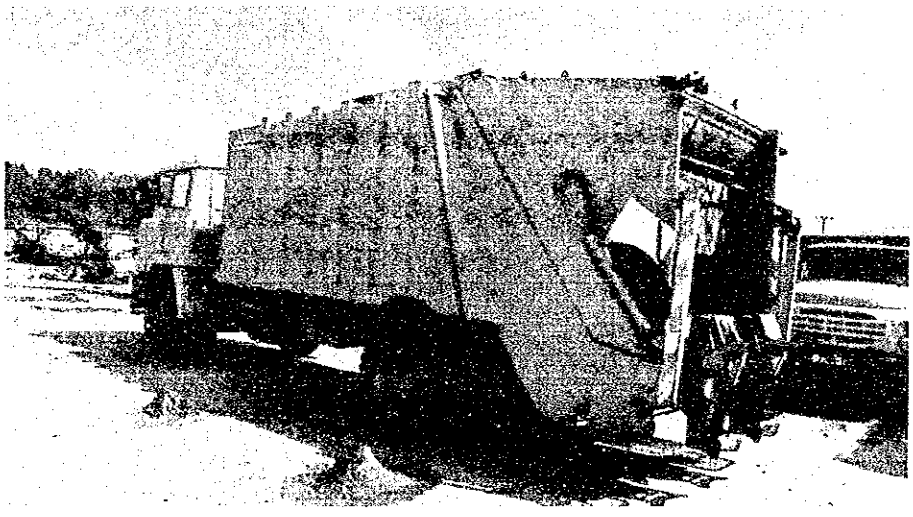
Vehicle Type	Placing Capacity (m3)	Compaction Coef.	Max. Cap. (ton)	Max. Cap. Surveyed	Remarks
1. Skoda Bobar/Europa	11.5	1.5-2.0	6.5	4.7	Chassis Swedish, drum Check
2. Norba Skoda/Madara	13.5	3.0	10.0	4.9	Chassis Swedish, or Bulgarian assembled, drum Swedish
3. Skoda RTK	10.7	1.5	4.5	3.2	Chassis & drum Swedish
4. GAZ 53 M	7.0	1.7	3.0	2.2	Chassis & drum Russian
5. GAZ 53 KM	4.0	1.0	1.0	1.2	Chassis Russian
6. GAZ 53 Ko 413	6.0	1.0	1.4	0.5	Chassis Russian
7. GAZ 53 Dump Truck	(3t)	1.0	3.0	2.0	Chassis Russian
8. ZIL 555/ZIL 506	(4t)	1.0	4.0	3.0	Chassis Russian



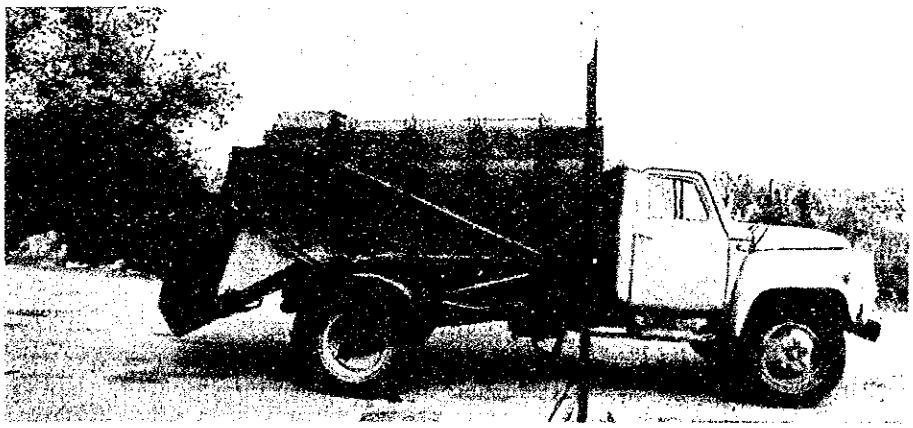
RTK



Skoda Bobar



Norba Skoda

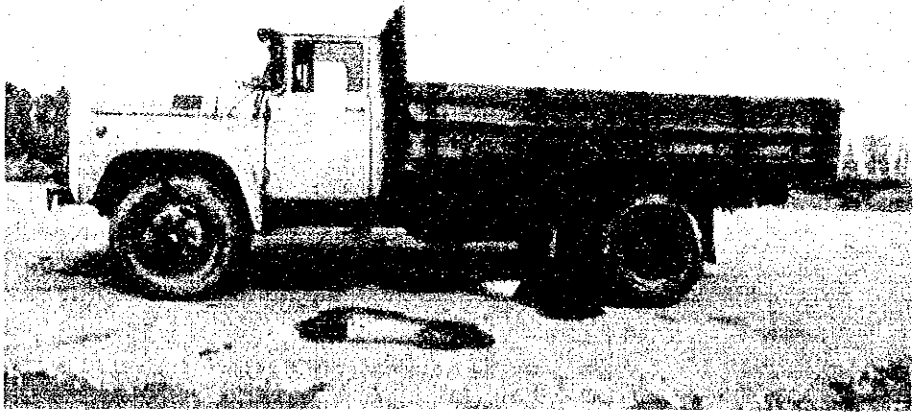


GAZ 53M

Plate 3-6-1

GAZ 53KM

ZIL 555



ZIL 130

Plate 3-6-1 (cont..)

B. Vehicle Distribution by District

Three years ago, when SGM was reorganized into 24 districts, available vehicle fleet was likewise divided among the districts in accordance with population and to an extent district features. Since then (as of Summer 1993) no new self-rear-loading compactor vehicles have been purchased. Table 3-6-4 shows the fleet available to each district.

Table 3-6-4 Waste Transport Vehicles by District

District	Total Waste (ton/d)	Number of Vehicles (BKC interviews)								Tot. Haul Cap. (ton)	Haul Cap/ Gen. Waste
		Bobar /Europa	Nor-ba	RTK	GAZ 53M	GAZ 53KM	GAZ 53K 0413	GAZ 53 Truck	ZIL 555 /506		
1.SRED	30.8	7	3	0	3	0	0	0	0	85	2.7
2.KSEL	58.1	5	3	0	1	6	0	0	1	84	1.4
3.VAZR	30.6	2	3	7	5	0	0	2	1	104	3.4
4.OBOR	26.5	6	3	0	0	8	0	1	4	113	4.3
5.SERD	34.4	8	3	0	1	5	0	0	0	95	2.8
6.PODU	40.0	6	1	1	0	4	1	0	3	83	2.1
7.SLAT	42.7	8	3	2	1	4	2	3	8	168	3.9
8.IZGR	23.1	4	1	0	3	0	0	3	0	57	2.5
9.LOZN	28.9	4	4	0	0	6	0	1	0	82	2.8
10.TRID	45.6	8	3	0	0	4	0	1	0	94	2.1
11.KPOL	43.9	8	3	0	1	3	0	3	0	103	2.3
12.ILIN	26.5	2	1	2	0	5	0	2	0	50	1.9
13.NADZ	53.6	4	2	0	0	1	4	0	0	60	1.1
14.ISKR	48.9	4	3	0	0	0	1	1	0	63	1.3
15.MLAD	77.1	6	4	0	1	10	0	0	3	120	1.6
16.STUD	36.2	6	0	0	0	3	0	0	0	45	1.2
17.VITS	28.9	6	2	0	0	4	5	2	4	114	3.9
18.OKUP	27.9	4	2	0	0	2	3	0	0	59	2.1
19.LYUL	86.3	7	3	0	2	1	1	1	0	91	1.0
20.VRAB	30.2	6	3	0	2	2	0	0	0	79	2.6
21.NISK	22.1	6	0	0	5	0	0	0	1	60	2.7
22.KREM	32.9	8	4	0	1	5	1	2	0	116	3.5
23.PANC	17.4	0	1	5	0	5	0	0	3	61	3.5
24.BANK	6.2	4	0	0	0	0	0	0	0	26	4.2
Total	898.8	129	55	17	26	78	18	22	28	2009	2.2
Ave. Age (year		5.5	7.0	6.3	7.0	5.4	6.4	6.5	8.9	6	

In terms of available fleet capacity the four districts of Lyulin, Nadezhda, Studenska and Iskar have only one day's haulage capacity (assuming one trip/veh). On the other hand fleet capacities in Oborishte, Vitosha and Slatina districts exceed one day's estimated generated waste in these districts by about four times. Waste generated was calculated based on night time populations multiplied by generation rate. However Oborishte is a central district and Bankia a popular health resort area and therefore daytime populations (no figures available) are considerably higher than nighttime populations. It is therefore plausible that waste generated in these two districts is higher than that calculated in the table based on nighttime populations.

C. Vehicle Distribution by Age

As explained earlier, no major waste collection vehicle purchases have been made seen 1990. On average about 70% of the total vehicles have an age of between 3 and 7 years. By district, average vehicle fleet age falls between 5 and 7 years, with Nadezhda having the oldest fleet at 7.5 years. Table 3-6-5 shows the results of vehicle classification by age.

Table 3-6-5 Waste Transport Vehicle Fleet Age

District	Number of Vehicles						Ave. Veh. Age
	<3 year	->5 year	->7 year	->9 year	->11 year	>11 year	
1.SRED	0	7	5	0	1	0	5.6
2.KSEL	NA	NA	NA	NA	NA	NA	NA
3.VAZR	0	8	8	4	0	0	6.1
4.OBOR	5	4	7	3	1	2	6.0
5.SERD	3	5	8	2	0	0	5.4
6.PODU	2	14	0	0	0	0	4.1
7.SLAT	2	8	6	7	0	8	7.5
8.IZGR	1	5	1	4	0	0	5.9
9.LOZN	1	4	6	3	0	1	6.4
10.TRID	1	6	7	2	1	0	5.9
11.KPOL	0	8	3	6	0	1	6.5
12.ILIN	0	8	4	0	0	0	5.1
13.NADZ	0	4	3	1	2	2	7.5
14.ISKR	0	3	4	2	0	0	6.2
15.MLAD	3	9	7	3	1	1	5.8
16.STUD	2	6	1	0	0	0	4.1
17.VITS	1	6	13	1	1	2	6.5
18.OKUP	0	7	4	0	0	0	5.2
19.LYUL	0	4	4	4	2	1	7.3
20.VRAB	NA	NA	NA	NA	NA	NA	NA
21.NISK	1	3	6	0	0	2	6.5
22.KREM	1	3	13	3	0	1	6.5
23.PANC	0	3	6	5	0	2	7.4
24.BANK	0	2	1	1	0	0	6.0
Total	23	127	117	51	9	23	
Share(%)	7%	36%	33%	15%	3%	7%	

Source: JICA Study questionnaire to BKC

3) Operation

(1) Waste Collection Manual

A manual has been published by SGM in 1989 detailing the solid waste collection and transport management to be followed by BKC companies in discharging their duties. Highlights of the manual relevant to the study are as follows:

- Identification of container types
- Identification of waste collection vehicles
- Division of district into working sections
- Classification of working sections by category
- Calculation method of vehicle operation and labour costs

Waste collection sections are classified into three categories employing a point system as shown in Table 3-6-6.

Table 3-6-6 Description of Waste Collection Sections

Item	points: 3	2	1
A. Street	Main	Minor	Local
B. Container collection freq.	Daily	Thrice weekly	Twice weekly
C. Container type (Kison: 4 pts)	750 l	Ra	Meva
D. Distance to disposal site	⟨10km	11-17km	⟩18km
E. Vehicle type (GAZ: 4 pts)	Norba	Bobar	RTK

Based upon point total sections are classified into categories as follows: Category I: 12 - 13 points
Category II: 9 - 11 points
Category III: up to 8 points

In principle waste collection vehicle trip frequency for each section is determined based upon the category in which the section falls, with the number of trips decreasing from Category I to Category III.

(2) Actual Practice

A. Waste Collection sections

SGM is divided into roughly 320 waste collection sections. Each section is usually served by one vehicle, making either one or two trips a day.

Trip frequency in each section is determined according to the above category system in principle, however recently budgetary restraints have become the decisive factors. In the central districts waste collection frequency is mainly once a day. On the other hand sections with detached single unit dwellings are usually served once a week.

Working sheets for each section are prepared by the concerned BKC and must be approved by the respective district. These sheets show the section description, vehicle type to be used, driver's name (in some cases), and trip frequency and number.

B. Crews

Most BKC assign each driver a specific vehicle. Drivers are knowledgeable of simple mechanical repairs. Drivers are not allowed to take part in handling of waste containers, with the exception of GAZ 53 KM drivers where the driver must manipulate the containers by himself.

Crews are usually formed of four workers. For Meva containers sometimes crews number five members. Crew members are collected from a point just before the collection route in the morning and after completion of waste collection on a route are left there. They do not go to the disposal site. Their main task is manipulation and emptying of containers and not discharge of waste at disposal site. They are also responsible for cleaning waste scattered around containers although there is much complaining from the citizens about the inadequacy of that activity.

In the discharge of their duties workers usually have gloves on to protect them from sharp waste articles, etc.

In interviews with BKC companies the Study Team was informed that there is no problem in recruiting personnel for this activity. Drivers and workers are given special allowances in lieu of poor working conditions. Official working days are five a week and special overtime is paid for working on weekends or during national holidays.

Some BKC companies allow 3 workers to work a 4-member crew shift and divide the pay allocated to a fourth worker as an incentive.

C. Work Appraisal System

BKC's main client is the district and an appraisal system is in place whereby district inspectors and BKC checkers together inspect waste collection work. The inspection tour is held around mid-day and a minutes document is prepared.

Appraisal criteria is outlined in the waste collection manual (Table 3-6-7). In case of a bad appraisal the district may decide to deduct a certain sum from the agreed trip rate. BKC may in turn deduct a sum off the salaries of the responsible crew. In meetings with both the district inspectors and BKC checkers the fact that unrestricted discharge time allows residents to discharge waste at any time and hence containers emptied early in the morning may be full by the time of the appraisal tour remains a debatable issue.

Table 3-6-7 Waste Collection Appraisal Criteria

Criteria	Excellent (100%)	Good (80%)	Fair (60%)
1. Waste containers handling	All containers emptied and returned to their original position	Same	Up to 5 unemptied and unreplaced containers
2. Cleaning beside and under containers	Containers surrounding clean	Up to 2 positions not clean	Up to 4 positions not clean
3. Container appearance	All containers have a good appearance	Same	Up to 5 containers not with good appearance
4. Complaints made about work	No complaints	No complaints	Up to two complaints
5. Crew performance	No deviation from trip route and truck and dispatch papers in order	Same	Same

Two surveys to assist in evaluating operation were conducted by the Study; a time and motion survey, and solid waste survey at the two disposal sites for one week. Survey results are compiled in Supporting Report I.

3.6.3 Waste Collection and Transportation Evaluation

Quantitative evaluation of equipment and operation on district level are summarized in Table 3-6-8.

Table 3-6-8 Overall Evaluation of Equipment and Operation

District	Facilities			Operation	
	Container Capacity (note 1)	Vehicle Fleet (n. 2)	Chistota Staff (n. 3)	Haulage Efficiency (n. 4)	Cost Lv/m3 (n. 5)
1.SRED	C	C	A	C	C
2.KSEL	C	D	C	B	A
3.VAZR	C	B	B	B	B
4.OBOR	C	A	A	B	B
5.SERD	D	C	B	A	B
6.PODU	C	C	C	B	B
7.SLAT	B	B	C	B	B
8.IZGV	C	C	C	A	B
9.LOZN	B	C	D	B	D
10.TRID	B	C	C	B	D
11.KPOL	C	C	C	B	B
12.ILIN	D	D	B	A	B
13.NADZ	C	D	D	A	B
14.ISKR	D	D	D	B	A
15.MLAD	D	D	D	B	A
16.STUD	D	D	D	A	B
17.VITS	A	B	C	C	B
18.OKUP	B	C	C	B	A
19.LYUL	D	D	D	A	A
20.VRAB	C	C	(na)	B	B
21.NISK	A	C	C	B	B
22.KREM	A	B	D	C	B
23.PANC	A	B	B	B	D
24.BANK	A	A	A	A	B

Note 1: Evaluation item is container cap./generated waste
A: >10, B: 6-10, C: 4-6 and D: <4 (Table 3-6-2)
Note 2: Evaluation item is veh. cap./generated waste
A: >4, B: 3-4, C: 2-3 and D: <2 (Table 3-6-4)
Note 3: Evaluation item is Chistota staff/1000 population
A: >4, B: 3-4, C: 2-3 and D: <2 (Table 3-6-1)
Note 4: Evaluation item is surveyed loading/design capacity
A: 60-70%, B: 50-59$, and C: <50% (Supp. Rep. I))
Note 5: Evaluation item is cost for 1 m^3
A: <50 Lev/m^3, B: 50-100, C: 51-100, and D:>150 (Supp. Rep I)

Districts having a large container capacity does not necessarily mean that waste collection is good there. Suburban districts of Novi Iskar, Kremikovtsi, Pancharevo, and Bankia and the remote areas of Vitosha districts have many containers because waste collection frequency in these areas is low; once a week or even every ten days (in hilly areas of Vitosha). Although Triadiste has a 6 days storage capacity of containers it should be noted that containers serving that district are the Meva type which are time consuming to empty and have a bad appearance lining the streets of the district.

The unwelcome presence of containers in central and commercial areas may be the reason behind the comparatively lower rate of containers in the central districts (grade C). The distribution of containers in the heavily populated districts of Lyulin and Mladost does not appear to have kept pace with the development there and less than 4 days waste storage capacity is available.

Vehicle capacity in the central districts is slightly higher than in residential and suburban districts. Chistota staff in the central districts again is higher than in the other districts, due to the street sweeping activities associated with the central areas.

As discussed earlier, operation indices are based on the results of the surveys of this Study. The districts of Lyulin, Mladost, Oucha Kupel, Studenska and Nadezhda seem to be making the best of their comparatively lesser facilities in terms of efficient haulage and low VOC cost.

3.7 Street Cleaning

3.7.1 Organizations Involved

Street sweeping and washing is handled by both BKC and the Chistota Company.

3.7.2 Description of Street Cleaning Activity

1) Activity Guidelines

Guidelines have been set for street sweeping and washing activities by both the Ministry of Territorial Development and Construction and the SGM manual (described in section 6 of this chapter). Major guidelines are outlined hereafter.

(1) Road Classification

City streets are swept and washed on a frequency relative to the road classification. The three road classifications are:

- Class A:
  Arterial roads, roads with intensive vehicular traffic including trucks, roads with considerable pedestrian traffic, roads with public transport routes and roads in the central part of the city.
- Class B:
  Distributor roads with interrupted medium traffic.
- Class C:
  Feeder and service roads, roads with light traffic, residential area streets and lanes.

Cleaning and washing of many of the roads categorized under Class A fall under the responsibility of Chistota Co. On the other hand all roads in Class C and most of Class B roads are taken care of by the respective BKC company.

(2) Sweeping Frequency and Time

Sweeping activity is seasonal and frequency changes accordingly. In winter there is usually no sweeping activity. Street sweeping always precedes street washing. The recommended frequency of road sweeping is shown in Table 3-7-1.

Table 3-7-1 Road Sweeping Frequency Guidelines

Activity	Frequency of Sweeping (no. of times/week)		
	Spring	Summer	Autumn
1) Machine sweeping of road gutters and lanes			
- Class A roads	5	3	5
- Class B roads	3	2	2
- Class C roads	1	1	2
2) Machine sweeping of sidewalks			
- Class A roads	5	3	5
- Class B roads	3	2	2
- Class C roads	1	1	1
3) Manual sweeping			
- Class A roads	5	2	5
- Class B roads	2	1	2
- Class C roads	--	--	--

Source: Ministry of Territorial Development and Construction

The guidelines recommend that sweeping frequency be increased above that described in the Table where there is no road drainage, the area is a touristic location, or there are heavy commercial activity and pedestrian traffic.

Street sweeping is considered day time work and only in special cases is night work recommended. These cases involve roads with heavy day time traffic where day time sweeping may hamper traffic and lower the sweeping efficiency.

(3) Street Washing Frequency and Time

Street washing also differs according to the season, and the guidelines are shown in Table 3-7-2.

Night time washing is recommended for Class A roads due to the heavy day time traffic along these roads.

Table 3-7-2 Road Washing Frequency Guidelines

Activity	Frequency of Washing (no. of times/week)					
	Spring		Summer		Autumn	
	Nozzle	Hose	Nozzle	Hose	Nozzle	Hose
1) Washing of road lanes						
- Class A roads	2-3	2-3	2-3	1-2	1-2	2
- Class B roads	1	2	1	1	1	2
- Class C roads	--	2	--	2	--	2
2) Washing of Road Gutters						
- Class A roads	2-3	2-3	2-3	1-2	1-2	2
- Class B roads	1	2	1	1	1	2
- Class C roads	--	2	--	2	--	2

Source: Ministry of Territorial Development and Construction

(4) Appraisal Guidelines

As described in the waste collection activity, work appraisal teams are formed of district inspectors and BKC checkers to appraise the work and decide upon issuing full payment or making reductions. Criteria for appraisal are described in Table 3-7-3.

2) Available Equipment

At present the main equipment employed in street cleaning operations are mechanical sweepers and washing vehicles.

Mechanical sweepers are fitted with two brushes at the front end of the vehicle on a vertical axis designed for sweeping road gutters, and one main cylindrical brush on a horizontal axis for sweeping road pavement. Automatic sweepers are fitted with a water tank and a waste storage tank. The two types of mechanical sweepers in use in Sofia are IFA and Unimog.

Street washing is carried out by two types of vehicles, those fitted with nozzles and those having only hoses. The two types of vehicles employed are ZIL 130 (fitted with a water tank of capacity is $6m^3$) and Skoda CA-8 (tank capacity $8m^3$).

Table 3-7-3 Street Cleaning Appraisal Criteria

Criteria	Excellent (100%)	Good (80%)	Fair (60%)
1. Cleaning of road lanes and pedestrian paths and gutters	No dust rises in air during vehicle motion, and all gutters clean	Same	Up to 5% of road section not clean, and 1 section of gutter dirty
2. Cleaning areas beside bus-stops	No paper or other waste remains	Same	1 bus-stop remains dirty with waste
3. Cleaning of street waste baskets and maintaining their appearance	No unemptied baskets, and appearance maintained	1 basket unemptied and dirty	Up to 2 baskets unemptied and dirty
4. Removal of obituary notices from facades	No obituary notices nor advertisments except at designated places	1 place where there are obituary notices or advertisments	Up to 3 places where there are obituary notices of advertisements

Source: Sofia Greater Municipality Manual

The total road area in the city is 2.7 hectares, roughly 2% of the total municipality area. Of course this low percentage is due to inclusion of all the territory of the municipality, urban and rural in the area. In the central districts of Sredetz and Krassno Sello the road area accounts for approximately 20% of the total district area respectively which is within the norms of built-up areas.

In total 326 sweeping and washing vehicles are available to Sofia Greater Municipality, 61 mechanical sweepers and 225 street washing vehicles. Table 3-7-4 shows the road area and vehicle fleet by district.

The central districts and those immediately adjacent to them have more sweepers than suburban districts. In fact, Kremikovtsi district has no sweeper vehicle. A rough way to evaluate vehicle distribution was to calculate the road area per vehicle for each district. Overall vehicle distribution in the central districts was significantly higher than that in the suburban districts. This is logical when considering the commercial and political importance of the city's central districts.

Mechanical street sweeper crew is composed of the driver only. For street washing vehicles, the crew size depends upon whether the vehicle is fitted with nozzles or hoses. The crew of a hose fitted vehicle includes three, a driver and two workers. Nozzle fitted vehicles require only the driver.

Specifications indicate that mechanical sweeper vehicles can operate 5.5 hours per shift, and washing vehicles can run 5 or 6 trips during one shift.

Table 3-7-4 Street Sweeping and Cleaning Vehicles

District	District Area (Ha)	Road Area		Total Road Area (Ha)	Rd. Area/ Tot. Area	Number of Vehicles				Total Sweeping & Washing Veh.	Rd. Area per Veh.
		Carriage (Ha)	Pedestrian (Ha)			IFA	Unimog	Zil 130 PM	Skoda CA8		
1.SRED	293	38	23	61	0.21	3	1	3	6	13	4.7
2.KSEL	593	75	37	112	0.19	4	0	9	0	13	8.6
3.VAZR	287	35	23	58	0.20	1	0	5	9	15	3.9
4.OBOR	264	98	72	170	0.65	3	0	9	4	16	10.7
5.SERD	1,735	80	39	119	0.07	3	0	5	6	14	8.5
6.PODU	638	65	26	91	0.14	2	0	7	6	15	6.1
7.SLAT	1,389	89	26	115	0.08	3	0	6	5	14	8.2
8.IZGR	478	35	30	64	0.13	2	0	5	3	10	6.4
9.LOZN	906	100	58	157	0.17	1	0	3	5	9	17.5
10.TRID	902	36	26	61	0.07	4	0	3	5	12	5.1
11.KPOL	883	52	52	104	0.12	4	0	5	5	14	7.4
12.ILIN	331	31	12	43	0.13	2	0	4	4	10	4.3
13.NADZ	1,111	59	30	88	0.08	3	0	5	5	13	6.8
14.ISKR	2,484	96	61	157	0.06	2	0	11	6	19	8.3
15.MLAD	1,678	168	192	360	0.21	2	0	8	6	16	22.5
16.STUD	877	94	44	138	0.16	1	0	0	4	5	27.5
17.VITS	12,215	180	32	212	0.02	2	0	3	2	7	30.3
18.OKUP	4,276	NA	NA	0	0.00	2	0	7	1	10	0.0
19.LYUL	2,222	NA	NA	0	0.00	3	0	12	8	23	0.0
20.VRAB	2,662	133	70	203	0.08	NA	NA	NA	NA	0	NA
21.NISK	23,833	225	41	266	0.01	1	0	3	1	5	53.2
22.KREM	26,938	NA	NA	0	0.00	0	0	9	4	13	0.0
23.PANC	35,090	62	13	75	0.00	1	0	0	2	3	24.9
24.BANK	5,831	31	11	42	0.01	1	0	4	2	7	5.9
Chistota				150		7	1	30	12	50	3.0
Total	127,916	1781	916	2,697	0.03	57	2	156	111	326	8.3

3) Actual Operation Conditions

A questionnaire was prepared and dispatched to each of the 24 districts and Chistota General Co. enquiring about actual sweeping and washing operations in each district. Specifically areas of streets subject to washing and sweeping and frequencies of these activities. Unfortunately however there was been no response to any of the questionnaires. A second approach involved obtaining information from a selected number of BKC about their street cleaning operations. Over 16 BKC were interviewed and important points are described.

However overall it is safe to say that while the waste collection and transport activity is being done in a consistent, if sometimes inefficient manner, street cleaning is subject to financial conditions and is suspended when funds are lacking or when it is necessary to appropriate the available small funds to the waste collection activity. It is conceivable that a more efficient waste collection operation may result in savings which can in turn be used for street cleaning activities.

In general main roads are well cleaned and cleaning vehicles are very active there in day time and also with night shifts. However side roads and roads in residential areas are obviously not properly cleaned.

It is worthwhile to note that in the CAW survey, only 28% of those surveyed were satisfied with the street cleanliness conditions in general, and again a minority of 31% replied positively that streets near their dwellings were regularly cleaned. Perhaps a gradual shift of the burden of street sweeping to the citizens may be required. In the CAW survey 55% replied that they sweep the streets near their houses, although their sweeping frequency was low, the majority of 40% said that they do this 2 or 3 times a year.

The results of an interview survey of a number of BKC and Chistota General Co. are described in Supporting Report I.

3.8 Disposal

3.8.1 Introduction

No formal historical records or central co-ordinating register of the Municipality's Solid Waste Disposal sites are held in the region. Some records have been located in relation to specific sites or one-time intended planning proposals. Some partial records of past periodic solid waste reviews have been found. One plan and a brief overview of the approximate positions of old deposit sites, possible future sites and transfer stations was located. Although these documents have proved useful and have provided background material, there is a clear need for a comprehensive and authoritative set of records to be set up.

3.8.2 Waste type

The existing solid waste disposal sites in Sofia at present handle and contain around 1,000 ton/day of solid waste as described in Section 3.4. All types of solid wastes generated by municipal households are accepted in addition to:

- commercial waste including waste generated from hotels, restaurants, etc.
- street and park waste
- part of industrial waste

It is apparent that apart from Veterinary Waste, Major industrial sludges and slags, Radioactive waste, and Military Pathological Wastes (and some solids considered 'hazardous'), almost all other disposable 'Solid Waste' is accepted by the municipality landfill sites.

Existing general disposal methods follow the practices heredescribed hereafter:

- Illegal dumping of household waste at a large number of scattered sites particularly in rural areas. Most of these are quite small from a few rubbish piles to say 100 m^2. Together they present a major clean up problem for either SGM or the new landowners;
- illegal tipping of building waste and other rubbish at road sides or on derelict land. This is extensive and particularly intensive on minor roads leading to official landfill sites;

- incineration of hospital domestic waste and a portion of medical waste at the Sofia Military hospital;
- incineration of Veterinary waste and abattoir refuse at the main state slaughterhouse;
- formal but uncontrolled landfilling at specific uncontrolled municipal sites designated as being solely for inert (construction and earthmoving) surpluses;
- formal but uncontrolled or partially controlled dumping of municipal and industrial (medical etc) waste at Dolny Bogrov;
- formal and partially controlled planned landfill of municipal waste and some hospital and industrial waste at the municipality's currently open Suhudol Site;
- retention on the owners' premises or sites of all Special hazardous and some other wastes (radioactive sludges, furnace slags, chemical works sludges and the like).

3.8.3 Municipal Landfill Sites in Sofia

There are two types of landfill site under the care of, or are owned by SGM. They are shown located Figure 3-8-1. Related data in respect of main sites is set out in Table 3-8-1.

The 'closed' sites are reported to have been covered over with around 1 m of earth and some 500 mm of soil.

Data in respect of the sites' classification is summarised in the following listing and described in the Supporting Report.

A: Sites principally intended for the storage of mixed municipal waste.
Operational sites:
(i) Suhudol (new)
(ii) Dolny Bogrov
Major Closed Sites:
(iii) Gorublyane
(iv) Milevo Hanche
(v) Philipovtsi
(vi) Suhudol (old)
(vii) Gorna Banya
Minor Old Closed Sites:
(viii) These are believed to exist at least 72 different locations around the Sofia region.

B: Sites principally intended as monofill sites for inert construction wastes and earth surpluses:
Operational sites:

Figure 3-8-1

LANDFILL SITES
● Major Closed Sites
⊙ Major Operational Sites
• Other Sites
N Scale 0 5 10 km

Table 3-8-1 Existing Municipal Waste Land Fill and Dump Sites (Basic Data)

Location	Function	Filling Type	Years of operation	Area Ha	Approx. Av. Depth	Approx. Volume (m^3)	Max. Depth (m)	Comments
Dolny Bogrov	Municipal Dump Site	Mixed	1976 - present	65 - 70	7 - 8	≈ 5,000,000	11	
Gorna Banya	Municipal Dump Site	Municipal Waste	1970-1980	7.5	6	451,000	15	Used for agriculture
Gorublyane	Municipal Dump Site	Mixed	1961-1972	30	11	3,300,000	20	Water Co. depot occupies part of site. Further development planned
Milevo Hanche	Municipal Dump Site	Mixed	1965-1967	9	2.5	225,000	4	Garage built over bulk of site area
Philipovtsi	Municipal Dump Site	Mixed	1967-1972	4	2.5	100,000	3	Used for agriculture
Suhodol 1 (old)	Municipal Dump Site	Mixed	1970-1974	1.5	6	90,000	12	Buildings designed over site
Suhodol 2	Municipal Monofill	Building Waste	1983-1993	6.70	6	2,680,000	20	Remaining capacity 325,000 m^2
Suhodol 3 (new) Stage 1	Municipal Landfill	Mixed	1986 - present	15	3	1,710,000	6	
Suhodol 3 (new) Stage 2	Municipal Landfill	Mixed	-	18		2,200,000		Further proposed site for Municipal Collected Waste
Vrazhdebna	Municipal Monofill	Building Waste	1985 - 1994	1.5	5	750,000		
Mladost IV	Municipal Monofill	Building Waste	1991 - 1994	2.5	2	500,000	6	
Dobroslavtsi	Municipal Monofill	Building Waste	1986 - 1993	2	5	1,000,000	8	

(i) Suhudol monofill
(ii) Vrazhdebna
(iii) Mladost IV
(iv) Dobroslavtsi
Closed Sites:
Not investigated

3.8.4 Suhudol

1) General

This site was selected to receive only Household wastes. It serves the 10 most westerly of the 24 BKC. It was the first landfill site intended for applying state-of-the art landfilling technology in SGM. The lands acquired were planned to be developed in two stages and the first of these was completed in 1986.

The Site 1st stage is now almost full and it is the Municipality's expressed intent to commence construction of the 2nd stage development since August 1993. Funds however have not been paid to enable development to proceed.

Suhudol disposal site is located directly west of the Sofia City central zone; 1 to 1.5 km South West of the Suhudol Village. The site is Geographically located in Figure 3-8-1 and is shown in Figure 5-1-1 as being in Region 5 of the Study locational criteria developed in Chapter 5.

Although this particular dumping site was first considered as early as 1984, it was not until 1987 that initial site development was completed and the first waste was stored on the site. Site plan is described hereafter and site geology and hydrogeology is detailed in Supporting Report I.

2) Site Plan

Suhudol site, as engineered, was planned in three stages. These are illustrated in small scale on Figure 3-8-2.

a. The initial (1987) development comprising administration and reception facilities, site roads, drainage system etc. The designers arranged the 1st stage proposals to accommodate a 1st stage capacity of 1,710,000 m^3. The arrangements were designed to contain this initial capacity in the upper half of the Suhudol site valley.

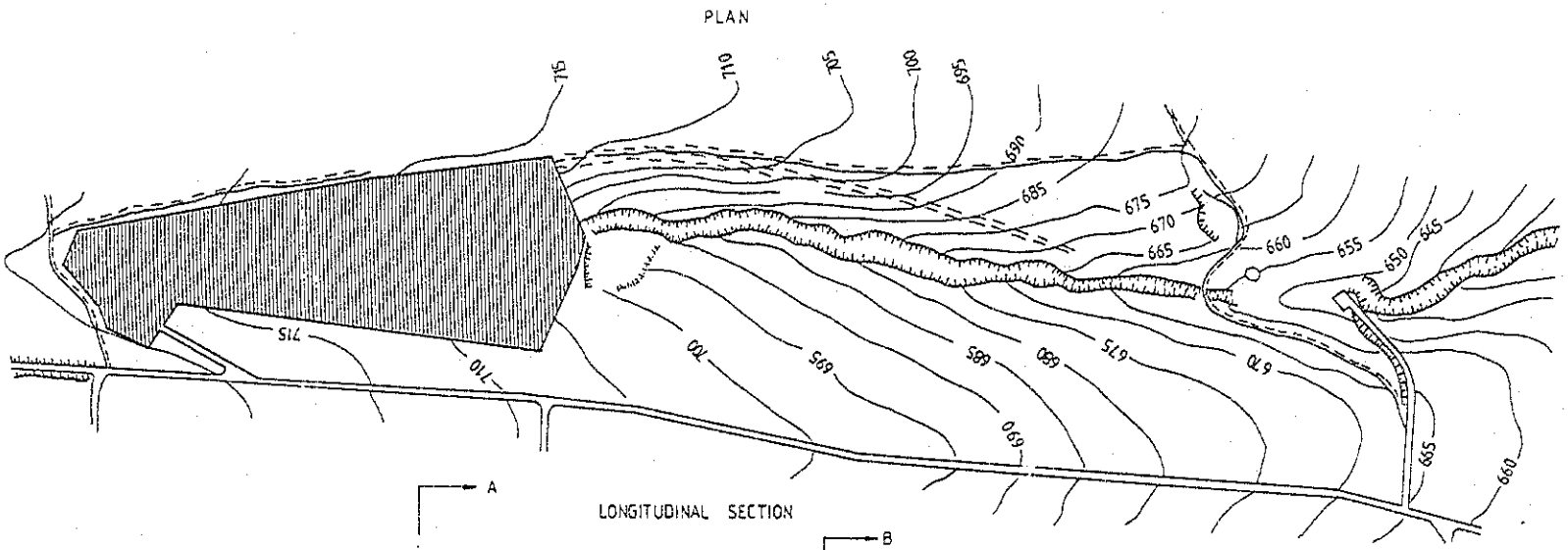


Figure 3-8-2

SUHOOOL SITE STAGING

Scheme

b. The second (possibly late 1993) stage development was planned in order to maximise the site storage potential to receive further deposit of some 2,200,000 m^3.

c. As the final 3rd stage of investment it was planned to construct a site effluent pipeline in order connect the site effluent to a new sewerage system to be constructed in the village and hence save treatment and tankering costs by connecting the site leachate collection sump to the Sofia City Sewers.

3) Site Facilities and Statistics

The following summarises the Suhudol facilities/operation as noted on site and as advised by the site manager.

- Opening hours: Formally open 7 days per week, weekdays from 8am to 7pm
- Access: By municipality predesignated new roadway routing by-passing Suhudol town and thereafter by tarmacked road into and along the length of the landfill site.
- Facilities and Equipment:
  Double Weighbridge and small reception office.
  Staff rest room and toilet.
  Store Garage for Site tankers & trucks
  Site roadway lighting
  Site fencing
  Two towable staff huts
  Weighbridges: 0 to 20 Tonne balance type vehicle weighers.
  Tracked bulldozers - Hired
  6 on site
  weekday :- 4 in operation
  saturday:- 3 in operation
  sunday :- 2 in operation6 on site
  Water Tankers - 4 No
  Tyred front loader - 1 No
  Dumper trucks - 2 No
  Water supply but rarely useable due to pressure failure
  Radio link to company HQ and Dolny Bogrov
- Cleaning Co Staff:
  18 Persons including
  (1 no) Site Manager
  (2 no) Weight & Record Clerks
  (1 no) Hygienist
  (4 no) Drivers

3.8.5 Dolny Bogrov

1) General

This is the other main dumping site in use. The disposal site is located North-west of and next to the village of Dolny Bogrov. Geographically it lies in the central part of the East Sofia Plain. The Site rests within the higher rate flowing aquifers of the Greater Sofia plain. The site serves the 14 more easterly BKC.

Being one of the older sites dating back to 1976, it was opened as was the practice, to also accommodate the City's non-hazardous industrial waste. It is located at one end of a large sand quarry and appears to offer several years' of spare capacity.

Dolny Bogrov is however, most unfortunately located in an ecologically sensitive spot. It is causing gross contamination to an aquifer and polluting surface ponds and endangering wild life (including otters and other protected species).

Dolny Bogrov is currently Sofia's main Solid Waste Dumpsite.

It's location is shown on Figures 3-8-1 and 3-8-3 some 16 km west of the city's edge and next to the outer city ring road. The dumpsite development is shown in Figure 3-8-4. It was first opened in 1974 and principally serves the Eastern BKC, the other areas being served by sites such as Gorna Banya and Suhudol.

The site is on the left bank of the old Lesnovska river bed. The river having now been channelled as part of the area's river regulating activities. Most probably older river bed meanders lie under the operating disposal site.

The terrain is generally flat and 522-524m above sea level with a slight slope to North-west (along the river flow). Site geology is described in Supporting Report I.

Deserted sand and gravel quarries are used for SHW disposal. The excavations were not deeper than 10-12 m. Total area of the site is 257,000 m^2.

The present dumping operations on site are located at one end of the sand quarry (see Figure 3-8-3). The quarry is now mainly used at the other end as a groundwater abstraction point for irrigation & industrial supplies. This far end (at

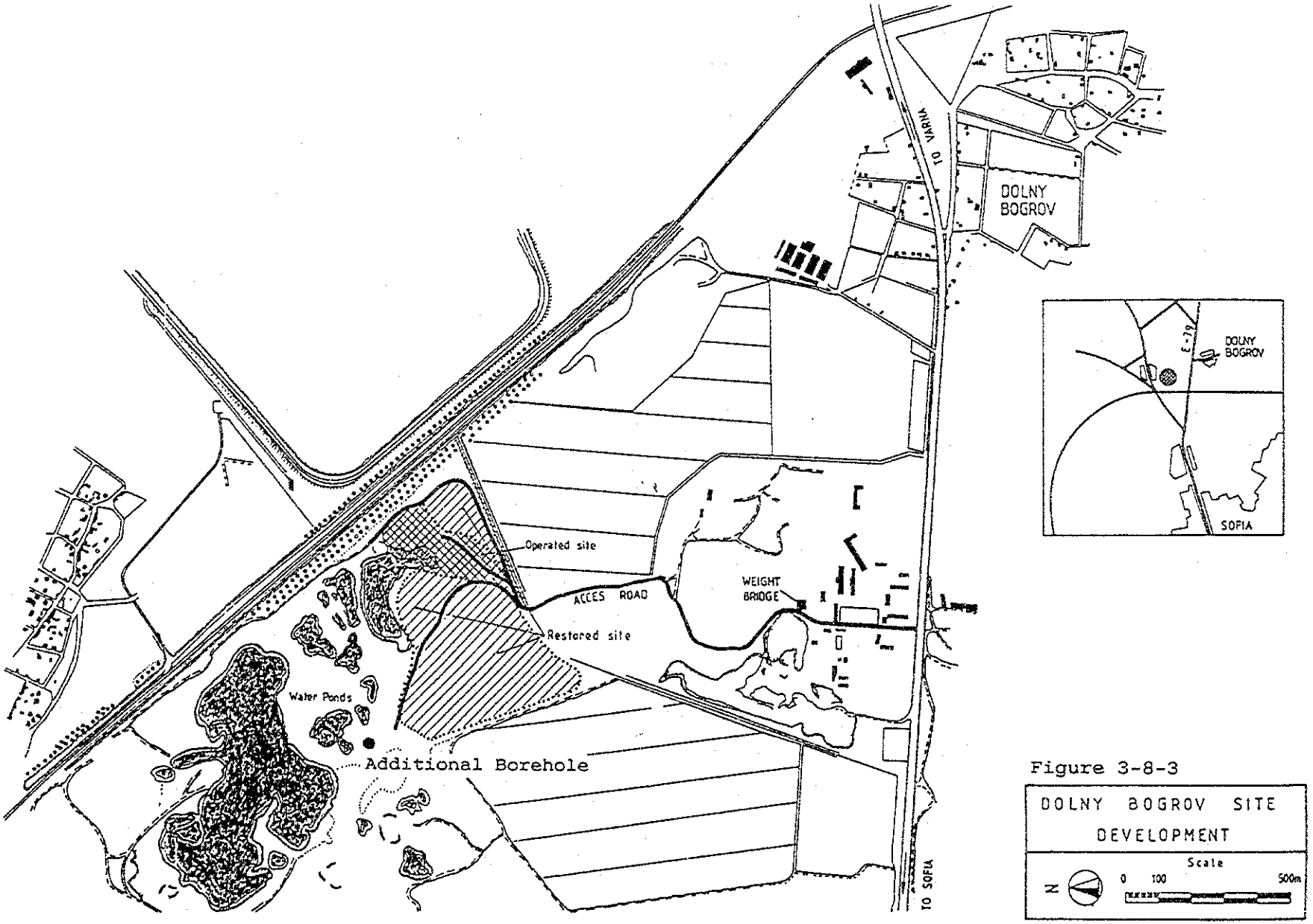


Figure 3-8-3

DOLNY BOGROV SITE DEVELOPMENT

Scale

N 0 100 500m

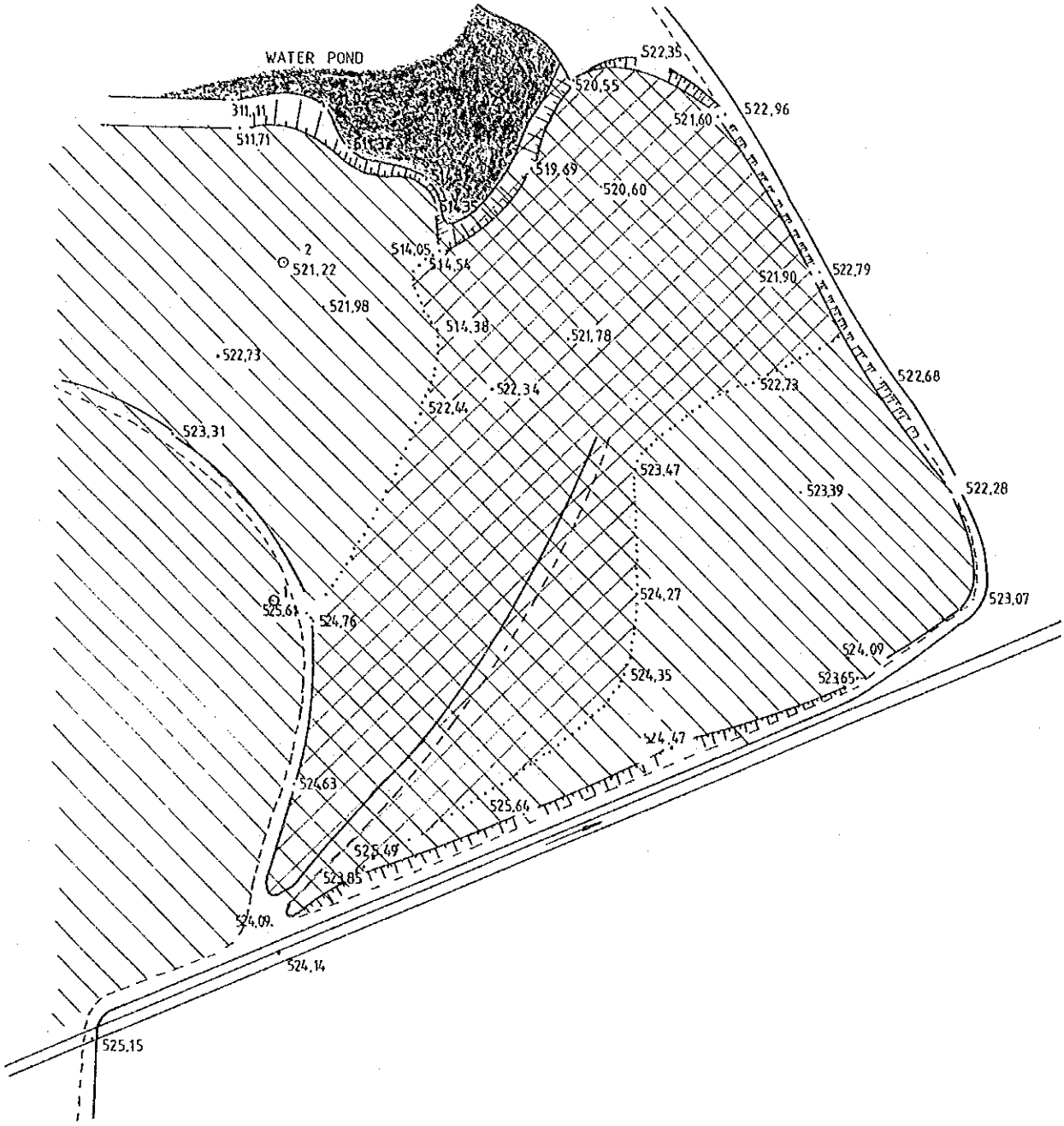


Figure 3-8-4

DOLNY BOGROV - SURVEY OF THE FILLED AREA

Operated site

Restored site

N

Scale

0 20 100m

the NW) of the quarry was first developed as an irrigation pumping station and draws up to 300 l/sec from further excavations made into the quarry floor to enable supplies to be drawn from the aquifer. At the present time it is understood that some of this water is used by the Kremikovtsi Complex as process waters and the 1993 irrigation demand on the system has to date not been significant. The abstraction point is a registered water quality monitoring station No 1233.

Aerial photographs of 1970 show the site to have been excavated down to the ponding and to around the present 511.0 m level. The photographs consulted showed that in 1970 ponds lay in the area now covered since dumping started in 1976.

2) Fill Quantities on Site

In order to appraise the extent of the existing dumped material, in May 1993 a survey of the filled area was made. The results of this work are shown in Figure 3-8-4. Older aerial photographs and other older maps were consulted in order to establish likely ground profiles underneath the existing landfilling areas.

It is estimated in 1993, that:
- The total plan area of the existing fill was some 21.3 Ha;
- of this, some 21.3 Ha was covered with earth and some 4.4 Ha was 'under operation';
- the approximate depth of the 'covered' fill material was in the 3 to 4 m range;
- the average depth of the working area was approx. 7 m and the elevation of the top of advancing face of fill above the foot of the water pond into which the waste was being pushed was 12 m.

On the greater part of the area (213,000 m^2), no disposal of waste is carried out at present and an attempt to establish recultivation was made with a covering of a layer of soil and clay material. That part of the area rises to 3 to 4 m above natural levels. Probably the depth of the waste layer does not exceed some 10 to 12 m.

On the remaining area of the site (44,000 m^2) disposal of waste still continues and part of the waste comprises a steep advancing front which Chistota Co's subcontractor is bulldozing over the tip edge so the fill falls at it's natural angle of repose into the site water ponds.

3) Future Closure of this Site and Temporary Measres

The requirement to close this site as soon as possible has been recognised for at least 5 years. The requirement is urgent: It is believed that continuing use of this tip is seriously compounding a problem which is already manifesting itself in terms of reduced water sample quality and obvious on-site ecological deterioration and serious future risk.

4) Site Facilities/Operation

The following summarizes Dolny Bogrov facilities as noted on site and as advised by the site manager.

- Fencing: The site is unfenced and appears unguarded.
- Scavengers: Scavengers (mostly gypsies) dominate the site and have been permitted to construct some 15 or so semi-permanent shacks or other structures on the site fringes and fill areas.
- Opening hours: Formally open daily from 7am to 7pm.
- Access: By tarmacked road into the dumpsite from the main city outer ring road.
- Facilities and equipment:
  Small reception office and a management hut
  Two mobile trailer type staff rest wagons
  One external toilet hut
  Weighbridge: 0 to 20 Tonnes balance type vehicle weigher.
  Tracked bulldozers - Hired
  6 on site
  weekday :- 4 in operation
  saturday:- 3 in operation
  sunday :- 2 in operation6 on site
  Water Tankers - 1 No
  Tyred front loader - 1 No
  Dumper trucks - 2 No
  Water supply but rarely useable due to pressure failure
  Radio link to company HQ and Dolny Bogrov
- Cleaning Co Staff:
  18 Persons including;
  (1 no) Site Manager
  (2 no) Weight and Record Clerks
  (1 no) Hygienist
  (4 no) Drivers
  Watchmen (not seen)

3.8.6 Chistota Co. Site Operations and Staffing

The overall routine operation of the disposal sites rests with the Chistota Company, but by restricting the availability of the sites and by limiting capital available to the Chistota Co, (providing the machinery etc), SGM effectively controls and therefore ultimately is responsible for the operation of these sites.

Upon site closure SGM, as owner is responsible for all after-care and environmental clean up of all consequences of their sub contractor's operations.

A Contract exists between the Chistota Company and SGM. It is relatively brief.

Related to solid waste disposal and as translated, the contract obligations are summarised:

a. Chistota Co shall keep in perfect sanitary-hygienic conditions the areas to be maintained by them.
b. Chistota Co shall receive deliveries of household and industrial wastes on the solid waste dumping sites and treat them with the accepted technology;
c. SGM shall pay all actual landfill operational costs plus a 5% profit incentive;
d. Chistota Co shall be free to determine the quantity, quality and type of machinery it requires.

3.9 Recycling

3.9.1 General

There are now no formal recycling activities by SGM or BKC. In the past several campaigns have been conducted to promote national recycling. Whereas these efforts have all been successful to various degrees, none have been sufficiently beneficial to be worth sustaining as an established routine, in the present depressed state of the city's economy, to form the basis of a regular and formal 'municipal recycling' service. There are therefore no municipal collection points for pre-separated wastes (eg paper, glass, cans, etc).

Formal commercial 'recycling' operations are undertaken by several private scrap merchants and by one state owned company - Mehaplast Ltd. This latter organization has been visited and their operations reviewed in some detail as they were identified as representative the 'recycling' and resource recovery industry in the Sofia region.

3.9.2 Mehaplast

Mehaplast has a declared capital foundation of 113,000,000 lv and a labor force of 400. Scrap yards and purchasing offices are well distributed throughout SGM. Mehaplast themselves run or sublet some 70 'shops' which purchase from the public paper and card, plastics, scrap metal and the like. Textiles and glass are dealt with in small quantities only as there is insufficient demand to support their economic resale. The privately operated concerns have some 'shops' but mostly run mobile pick-up services around the city calling almost on a 'door-to-door' basis to purchase resalable materials. Most of these operations locally appear to be small scale marginal activities but when considered together, the total operations represent a notable fringe industry. (As manifested by the persistent scavenging activities at Dolny Bogrov.)

Data relating to these activities is summarized:

- Mehaplast's paper recovery operations feed a paper baling plant from which raw material is sold to an adjacent paper mill (manufacturing corrugated card). Resale price of the shredded and baled product varies from 500 to 700 lv/ton.
- Mehaplast run a plastics recovery factory from which they market quality decontaminated PE PVC and PP granules. The factory is currently running at 1/3rd its potential (3,000

t/yr) and is reported to be under severe financial strain. It is understood that this originates from high factory capital repayment charges and statutory controls on the export of recycled plastics (local market price is depressed at 1500 lv/ton whereas the export price achievable is reported to be around 12,000 lv/ton).
- Various small scale privately run plastics recycling plants are prospering and undercut the state industry with partially processed materials.
- Mehaplast's main strength is in offering recycling and reuse services to industrial concerns. Eg: guillotining steel rejects for recycling and industrial material recovery subcontracting;

Discussions with Mehaplast recovery experts were not too optimistic regarding the future of Municipal Recycling. Their current Municipal operations:
- were threatened with the loss of some 60% of their purchasing shops: Inability to pay new economic municipal rents and because they were having to return appropriated property to former landowners.
- were threatened with demands to maintain high interest and capital repayment rates;
- were subsidized by their industrial operations.

Mehaplast saw no commercial future in promoting domestic glass pre-separation for recycling in the current economic climate. Enquiries showed they would not even be willing to partake in experimental trials (eg setting up trial bottle collection banks): The collection and handling costs would, they estimated, be more than the price obtainable.

3.9.3 Scavenging

All operational SGM sites visited supported a scavenging population. At the building waste monofill sites these appeared to be on a 'visiting' basis. At Dolny Bogrov and Suhudol sites scavenging was a full time activity. Dolny Bogrov supports a resident gypsy population living in some 15 temporary on-site shacks and other daily visitors totaling 50 or so active working scavengers who clearly dominate site activities and often personally control waste tipping.

It was noted that during peak hours Dolny Bogrov typically supported some 6 to 8 Discharging Waste collection vehicles, a hand cart, two horses with carts, a scrap collection vehicle loading and some 10 to 20 gypsies sifting the discharged

waste piles. Elsewhere on site, others would be assembling stock piles of such as plastic cups, card, paper, iron and etc. Some would be sifting through truck loads of industrial/commercial waste which they had arranged to be especially located for the purpose. Amongst this mixture of vehicles, carts and scavengers, the Chistota Co Bulldozers spread out the dumped piles as the scavengers permitted.

The impression was that some degree of cooperation with the scavengers had to be maintained in order to avoid complete chaos on site. Because of their presence, full control of operations was impossible, proper compaction was not occurring and prompt covering would upset the dominant majority.

At Suhudol scavenging operations were more of a fringe activity and appeared to be facilitated by the lack of covering material and compaction on site.

Results of a survey (June 1993) of the 'scrap market' investigating prices at the Mehaplast Shops, from a private merchant ('Nissan') and the wholesale cash price offered by intermediaries to the Dolny Bogrov scavengers are reported in Table 3-9-1.

Table 3-9-1 Scavenged Material (June 1993 Prices)
(unit: Lv/kg)

Material	Mehaplast Shop rate	Nissan * Shop rate	Scavenging Bulk Collection
Paper + Card (Kg)	0.70	0.70	1.30
Aluminum	4.75 to 9	6.0	8.50
Steel Cans (tinned)	Nil	Nil	0.60
Iron	0.25	0.2 to 0.5	1.20
Glass	Nil	Nil	Nil
Brass	5.75 to 18	6.0	12 to 18
Copper	7 to 28	10 to 20	20 to 25
Lead	3.05		
Zinc	3 to 10		
Textiles	1.50		
Plastics (general)	-		
Plastics (LP)	1.40		
Plastics (HP)	0.88		
Polystyrol	1.50		
PVC	0.80		
Polypropylene	2.50		

Note: Nissan's prices are variable from shop to shop.

3.9.4 Possibility of Recycling

Recycling is actively promoted in most Western European countries. German authorities have extensive recycling facilities and enjoy substantial cooperation from the public who willingly separate wastes, recycle packing materials (in supermarkets), and even pay a premium for recycled paper.

In the UK where local authority budgets have been subject to central government cutbacks, some recycling activities have been abandoned as privatization of collection and transportation is introduced. Edinburgh city for example, is located near Europe's largest paper mills and yet it has recently abandoned separate waste paper collection as the cost of handling was more than the resale price of waste paper.

Despite these local economic constraints, UK legislation is currently being prepared which will require all Waste authorities to attempt to recycle 25% of domestic waste by 2000. Local authority opinion is that whereas some 40% of UK waste is theoretically recyclable, some subsidy will be required to meet the targets. In Scotland for example 1989/90 landfill costs were as low as PDS 5.39/ton (200 lv/ton); the English cost approximated PDS 25/ton (1000 lv/t). The UK DoE figures published tend to imply that as costs increase towards the end of the century it will still be cheaper to use landfill than to recycle suitable waste.

Current prices quoted as examples of the return achievable by municipalities (or their privatized operators) for recoverables from UK municipal pre sorted recyclable sources are:
- Aluminum cans (Baled) - PDS 300/Ton (12000 lv/t) in UK
- Steel cans (for tin recovery) - PDS 20/Ton (800 lv/t) in UK

Separation for recycling is possible by machine with gross costs approximate 1800 lv/ton. More economically, hand separation is occasionally still advocated for poorer communities of developing countries. The Study team believes however that hand sorting would be difficult to implement satisfactorily in Bulgaria and incompatible with the employment and environmental targets of a major European Capital.

3.10 Maintenance

The vehicle fleets operated by the district cleaning companies are repaired and maintained at each company's workshop and at the Chistota General Co.

3.10.1 District Cleaning Company Workshops

Workshops are attached to each of the 24 BKC. These workshops share the same area with the garage space. Only minor repairs and maintenance works are done at these workshops, and in interviews with the BKC most complained of difficulty in procuring spare parts. This situation was also evident in visits to some of the workshops.

3.10.2 Chistota General Co. Workshop

The Chistota General Co. has a big workshop where repairs for its own fleet and for fleets of the other district companies are made. The Chistota's workshop is composed of three sections as follows;

I. Vehicles Repairs Section
II. Metal Processing Section
III. Wood Procesing Section

The departments attached to the workshop are as follows:

- Purchasing Dept. 3 personnel
- Repairs Activities 50 personnel
- Elect. & Mech. Dept. 14 personnel
- Technical Dept. 4 personnel

A visit to the Chistota's workshop revealed that the facility was well equipt with spare parts and tools. According to the Chistota officials explanation, the Chistota does not have any difficulties in acquiring spare parts.

The main equipment in each section are as shown in Table 3-10-1;

Table 3-10-1 Equipment in Sections

I.Vehicle Repair Section	II.Metal Processing Section	III.Carpentry Section
1. Exhaust gas meter	1. Stationary elec. driller	1. Band saw
2. Gas analyzer	2. Metal sheet flexing shaft	2. Smoothing plane
3. Fuel supply pump tester	3. Bridge crane	3. Thicknessing machine
4. Acetylene generator	4. Sharpening machine	4. Milling machine
5. Drill press	5. Sheet flexing machine	
6. Electro vulcanizer	6. Flat grinding machine	
7. Welding machine	7. Metal shaper	
8. Compresspor	8. Milling machine	
9. Console crane	9. Cutting machine	
10. Painting chamber	10. Hydraulic data	
11. Upholestry machines	11. Lathe machine	
12. Lights adjusting machine	12. Grinding machine	
13. Axle adjusting device		
14. Carburator tester		
15. Brakes tester		
16. Pneumatic smith hammer		
17. Electric furnace		
18. Others		

Source: Chistota General Co.

3.11 Industrial Waste

3.11.1 General

Over the past two years the Government of Bulgaria has made enormous efforts in enforcing legislation on protection of human health and environment and on improvement of quality of life. A number of laws and institutional structures concerning "waste" have already been adopted or are due to be considered in the near future. Industrial waste is produced by manufacturers, industrial activities, and processors and shall be dealt with as non-hazardous and hazardous waste.

Bulgaria's gross national product has decreased since 1990 by more than one third. This is closely related to the decline in industrial production, which has a 20-22% decrease in 1991 compared to 1990. The reduction of industrial production leads to a consequent reduction of industrial waste.

In December 1992 the Laboratory and Information Center of the Ministry of Environment launched a study aimed at identifying all kinds of waste generated in Bulgaria. Unfortunately, most factories and companies in SGM have so far failed to submit their answers to the questionnaire sent to them by the Laboratory; and so typical data regarding the amounts of industrial waste generated in SGM is not available.

The National Statistics Institute is responsible for processing the statistical data regarding the quantities of waste generated in SGM.

During the industrial waste survey in this Study a sample of companies and factories were visited. They also filled out a questionnaire prepared by the JICA Study Team on the waste situation in their organizations. Relative data are enclosed in the Supporting Report.

3.11.2 Amount of Industrial Waste

1) Non-Hazardous Waste

The Laboratory and Information Center of the Ministry of Environment issues a yearbook containing data on the Natural Environment of all Bulgaria which, among other things, includes data on municipal and industrial wastes. Unfortunately, the data is not provided according to regions.

The National Statistics Institute of Bulgaria issues statistical data on the amounts of industrial waste generated in SGM which do not contain harmful pollutants. According to this document in 1991 the amount of industrial waste containing no harmful pollutants was about 1,929,048 ton.

In 1992 the total estimated industrial waste amount (same source) was about 1,668,105 ton (Supporting Report). If mining and construction waste which is different from the rest of industrial waste is excluded, the amount will be about 387,313 ton for 1991 and about 320,894 ton for 1992. This means that there has been an approximately 20.7% reduction which seems realistic with regard to the economical state of the country. The total amount over the last two years is shown in Table 3-11-1 below (in ton).

Table 3-11-1 Statistical Data on Non-hazardous Industrial Waste Generated in SGM

Year	1991	1992 (tons)	Difference (%)	Difference
Available at year start	199,181,450	200,559,959	1,378,509	0.69
Received from other companies	1,391	2,729	1,338	96.20
Produced	1,929,048	1,668,105	-260,943	-13.53
Internal reuse	4,217	14,121	9,904	234.86
Delivered to other companies	517,881	296,121	-221,760	-42.82
Ecologically deactivated	45	10	-35	-77.78
Lost (or illegal dumped)	32,871	31,701	-1,170	-3.56
Available at year end	200,556,875	201,886,840	1,331,965	0.66

(1) RULON ISKAR AG Pulp and Paper Factory

The factory was built in 1965 and produces paper, corrugated cardboard and packaging paper with a total annual production capacity of 109,000 t.

The factory recycles 30,000 t/year of paper delivered by about 200 private and state suppliers and is able to extend this amount up to 40% of the total raw material.

The company is one of the biggest water consumers in SGM and consequently, besides saw dust, it also generates waste water that is discharged into the city sewage network following local treatment. The cost of $1m^3$ that is paid to the sewage treatment plant has increased in the last 5 years more than 37 times ($1m^3$ waste water at present costs 1.86 lv).

Wood waste amounts generated are shown in Table 3-11-2.

Table 3-11-2 Industrial Waste Generated by Rulon Iskar AG

Year	Sawdust and residues	Waste water	Difference to the year before
1989	1,064 t	3,575,000 m^3	-
1990	379 t	2,251,000 m^3	35.5%
1991	812 t	1,498,000 m^3	214.2%
1992	854 t	1,980,000 m^3	105.2%
1993 (4 months)	167 t	530,000 m^3	-
1993 (12 months estimate)	501 t	1,590,000 m^3	58.7%

In comparison with statistical data shown in the Supporting Report according to which only 3t wood waste has been discharged in 1991 and 1992, it can be concluded that data is missing and/or suspect.

(2) Municipal Waste Water Treatment Plant

The Municipal Waste Water Treatment Plant started operating in 1984 and its design capacity is 450,000 - 500,000 m3/day of domestic wastewater, industrial wastewater (after local treatment), and rain water run-off. Following treatment the water is discharged into Iskar river. Some local industrial waste water treatment plants however lack an optimal operation capacity, thus imposing an unexpected burden on the Municipal Waste Water Treatment Plant which has problems in meeting standard concentration limits (e.g. for hydrocarbon components) and at present these concentration limits are temporarily exceeded.

The sludge generated by Sofia Municipal Waste Water Treatment Plant - about 80,000 - 86,000 t/year; moisture - 70% (65 - 70t dry substance daily) - is not included in the statistical data at all. The sludge from the Municipal Waste Water Treatment plant is presently discharged at Kremikovtsi.

The collected screenings average 15m^3 daily and are deposited at the existing Dolny-Bogrov landfill.

The listed statistical data does not include sludge quantity at all. It is not therefore recommended to regard the existing statistical data as reliable and representative. It will be considered only as an indication of current tendencies.

2) Medical Waste

(1) General

There are about 50 hospitals and clinics with a total of 13,210 beds in SGM. The so-called "polyclinics" in the region do not have beds for stationary treatment of patients. Each polyclinic (or medical center) is responsible for a certain area in the city with a certain population number. There are about 36 such polyclinics for a total population of 1.7 million persons. Workers' Polyclinics V and VII have respectively 30 and 51 beds for stationary treatment.

Within the frame of a country-wide project supported by the Ministry of Health amount of pathological (hospital specific) and non-pathological waste generated by hospitals was studied. A recent inquiry was carried out by the Institute of Medical Facilities Construction (IMFC). The results of this inquiry being unsatisfactory due to missing data, IMFC prepared their own estimation based on experimental data from representative studies.

(2) Quantity, Nature, and Current Medical Waste Removal Practice

a. Quantity and Nature of Medical Waste

Certain waste quantities generated by hospitals are not recorded. The Higher Military Medical Institute (Military Hospital), for instance, has not been included at all in the IMFC study.

With some hospitals there is no distinction between pathological and household waste.

According to data on specific waste generated (kg/bed/day), values vary between 0.07 (kg/bed/day) and 1.31 (kg/bed/day). This ratio (more than 18 times) seems very high.

Unfortunately, there is no waste separation in most of the hospitals in the Sofia Greater Municipality. Only very few hospitals like First City Hospital have stated their waste quantities in terms of household and pathological waste components. The share of pathological waste varies from 0,5% to 25%, which appears to be a very large range. These data recorded from the recent inquiry cannot be considered representative.

The IMFC has evaluated data on different kinds of waste in hospitals of the SGM. These data are more realistic than that in the recent inquiry. In the present study only the representative evaluated data will be taken into consideration.

Total amount of medical waste generated in SGM is about 24,408 ton/day including the waste generated and incinerated in the Military Hospital in Sofia.

The range of specific waste generated in hospitals is 1.6 (kg/day/bed) to 2.0 (kg/day/bed). This estimation excludes the waste generated in the Military Hospital in Sofia since the data recorded from it cannot be considered reliable. It is assumed that the Military Hospital, with a capacity of 1,000 beds, generates about 1 ton/day.

b. Nature of Medical Waste

According to the IMFC study the only waste separation in most SGM hospitals is of food waste. Pathological waste in hospitals is not properly and separately collected.

Amounts of specific medical waste generated in SGM are presented in the data recorded by the IMFC as shown below:

Food waste from hospitals	5,403 kg	(22.1%)
Houshold waste (resembles household waste)	15,432 kg	(63.2%)
Hospital specific waste	3,572 kg	(14.7%)
Total	24,408 kg	(100%)

3) Hazardous Waste

(1) General

A series of studies on hazardous waste have already been carried out in the last years.

In December 1987 a study was carried out on the origin and quantity of waste from industrial petroleum products in the capital and the development of a system of its collection, transportation, storage, and utilization. In June 1988 an investigation and definition of the kinds of industrial toxic waste and its quantities within the Sofia City area were worked out; former studies were been updated.

The objective of these two studies (first and second) was to define the quantity of hazardous waste generated and its regular disposal, including waste containing hydrocarbon components, in order to test its qualities and propose appropriate deactivation methods for it. Both studies were funded by SGM.

Furthermore, an inventory listing and cadastre map of hazardous waste on the territory of SGM was completed in 1991. The aim was to determine its quantities in the various kinds of waste in view of their centralized collection and treatment (disposal) on an appropriate site outside Sofia.

Finally, in June 1992 a study was completed for recording the quantity and quality of petroleum products caught in the Sofia Municipal Waste Water Treatment Plant coming from the petroleum industry waste water discharged in the city sewage network.

The aim of the fourth study was to update the quantities of petroleum containing waste products and sediments from the local treatment plants and Sofia Municipal Waste Water Treatment Plant in view of defining required capacity of a central incineration facility for this waste. The study was funded by the Kazanluk "NITI" (Scientific Institute for Technical Research) who are responsible for the preparation of the installation design.

The third and fourth studies are most comprehensive and complete, and are also more recent which is why the following section contains the hazardous waste data recorded in them.

(2) Hazardous Waste Quantities and Their Origin

The hazardous waste quantities were specified after studying the report cards. Almost 90% of the plants on the territory of Sofia filled out the necessary data or provided them in person to members of the team. Around 10% of the plants failed to submit their completed forms, although strenuous efforts were made to collect them.

The hazardous waste quantities from industrial plants on the territory of Sofia are given in the Supporting Report. According to the catalogue prepared by a team at the Ministry of Environment, the data include different waste indices, quantities of periodically discharged wastes, the quantity of the stored ones and of the internally reused or externally discharged waste.

3.11.3 Future State of the Industrial Waste in SGM

At this time of economic changes in the country it is difficult to make any forecasts regarding industrial hazardous and non-hazardous waste quantities using the existing references in this field alone. The hazardous waste quantities were measured under normal conditions. At present, with privatization in progress, many production lines are transformed, new capacities are introduced or are gradually closed down, and new small private plants are starting up.

In order to prepare a more precise forecast it is necessary to:

- update hazardous waste quantities from industrial plants on SGM territory against the new economic background;
- study the newly opened small private plants to specify their hazardous waste quantities;
- obtain more precise waste data by personally visiting plant managers and measuring hazardous waste quantities, besides sending out questionnaires.

When the above is completed it should be possible to be more confident regarding any forecast of the quantities and qualities of the generated hazardous wastes within SGM.

Industrial waste treatment methods are introduced in Supporting Report I.

3.11.4 Recommendations concerning Industrial Waste

1) General

It is difficult to define any precise and detailed recommendations concerning industrial waste. Some general recommendations however can be mentioned.

Production processes that generate industrial waste, both hazardous and non-hazardous, should be optimized and modified in such a way that would minimize the generated waste.

2) Non-hazardous Waste

A proportion of the city's non-hazardous industrial (and commercial) waste at present comes to Dolny Bogrov where Chistota Company is contracted to handle it. Here SGM has an excellent opportunity to monitor nature and extent of wastes being received. In addition, all industrial companies should

systematically record their non-hazardous industrial waste, including recovered waste. In this way a close relationship between production and waste generation can be established, and SGM can monitor the extent of burdens and responsibilities it has to meet.

In order to reduce their industrial waste, different companies have to introduce a system of non-hazardous industrial waste separation at the generation source, if such a method of collection is not practiced, or to implement it to such an extent as is possible. This can be achieved by placing a number of containers for different waste types in the factories (eg for paper, carton, metal, glass, plastic, and wood).

Existing private collecting centers such as Mehaplast have to be preserved and extended, if necessary.

The existing plastic recycling plant, designed for 3t/h, currently works below its design capacity by 1t/h. This means that the required plastic recycling capacity is already available and should be used.

3) Medical Waste

Because of the different treatment methods, removal practices, and the dangerous impact of medical specific waste, it is very important for the latter to be collected at its source (in the hospitals); moreover, medical specific waste should be carefully separated from the other waste that is generated in the hospitals.

Available capacity of the existing incineration plant for medical waste in the Higher Military Medical Institute should be fully used. The plant is currently operating at approximately 1/3rd its actual capacity. Only 1 t/day is incinerated. The plant can treat 2.7 t/day of medical specific waste at an 8 hour run. With some small modifications (installing equipment with an ash extraction system) plant capacity can be extended to 4.8 t/day at a 16 hour run. In terms of the total daily hospital specific waste generated in the SGM, which is about 3.6 tons, with the capacity thus made available the incineration plant can recover and turn into energy the total amount of medical specific waste generated in SGM.

The incineration plant should be equipped with an adequate flue gas treatment facility, so that pollutants as HCl, HF, SOx, NOx, and dust will be caught from the atmospheric emission.

Untreated pathological waste should not be deposited in the existing municipal landfills (Dolny Bogrov or Suhudol) which are designed for household waste.

4) Hazardous Waste

Total quantity of hazardous waste generated in 1990 within SGM is approximately 53,000 ton. The actual total amount of hazardous for 1992/1993 is not known because of the economical and industrial changes taking place in the country. It should be recorded within the frame of a new survey and study.

The hazardous waste quantities are deposited at Dolny Bogrov, a landfill that has not been designed for such waste. The Municipality should urgently carry out a study on alternative solutions for hazardous waste disposal. The disposal of hazardous waste at Dolny Bogrov causes environmental damage which will be preserved and will increase in the future.

The Municipality should proceed on the assumption that the quantity of hazardous waste which will be generated on its territory will reach the 1990 amount, namely 53,000 t/year. In order to become efficient in hazardous waste disposal, the Municipality should carry out a study on waste incineration and examine whether it would be financially justified in terms of Sofia industries; after which it would be possible to reduce the amounts of hazardous waste by incineration, as well as protect the environment.

3.12 Identification of Issues

3.12.1 General

The master plan and priority project should provide the strategy and policies for dealing with the forecast solid waste management scale (amount, expenditure, manpower, etc..) and resolve outstanding issues that affect the present SWM in the municipality

A number of issues which should be considered in the master plan and priority project have been identified. These issues are dealt with hereafter by SWM component, and setout in Figure 3-12-1.

3.12.2 Issues related to Discharge, Collection and Haulage

The master plan should upgrade efficiency of the present practices and rationalize use of equipment and facilities in collection and haulage, which is the most costly component of SWM. The issues which the master plan may deal with to realize this objective are outlined hereafter.

- Lack of plans or efforts for encouraging waste separation at source.
- Recycling carried out at a very limited scale.
- Waste presently discharged at any time and waste always remaining at communal station.
- Containers presently not washed nor disinfected on a regular basis and maintenance very poor
- Ra containers (1.1 m^3) are mounted on wheels to facilitate maneuvering of the containers. However many of the wheels are broken and consequently moving containers to waste collection vehicles and back to their place takes time.
- Land use not sufficiently considered in selection of container type.
- Poor vehicle utilization efficiency
- Aging and mostly East European and Russian equipment.
- Lack of programs to encourage residents' cooperation or educate residents' cooperation on SWM.

3.12.3 Issues related to Disposal

Issues briefly described hereafter relate to existing solid waste treatment practice in the municipality; which is landfill disposal. The issues can be outlined as follows:

- No plans for identification and allocation of land for future landfill sites
- Acceptance of all waste types at municipal disposal site without control
- Insufficient monitoring of waste amount and types accepted at disposal sites
- Dwindling capacity of existing disposal sites capacity
- Improper sanitary landfill operation at disposal sites
- Poor maintenance of disposal site equipment
- Lack of environmental protection and land use plans after closing down existing disposal sites

3.12.4 Issues related to Administration

The outstanding SWM administrative issues may be summarized as follows:

- Inadequate design and supervision of work. In house supervision capacity lacking.
- Excessive decentralization of regional districts and their respective BKC.
- Poor administrative decisions concerning operation at the disposal site, such as: Subcontracting of cover materials instead of in house cooperation with landscaping department to achieve cost reduction, and subcontracting of heavy equipment in favor of direct purchase where better efficiency and cost reduction may be achieved
- Lack of SGM control over BKC working on the district level
- No private sector participation in SWM activities

3.12.5 Issues related to Laws and Regulations

- No effort to compare existing standards with EC standards
- Lack of understanding of SWM existing laws and regulation
- Insufficient laws regulating SWM
- Lack of special regulations regarding hazardous waste management

3.12.6 Issued related to Finance

One of the critical problems of SWM in Sofia is the shortage of financial resources. Other outstanding issues may be listed as follows:

- Self-financing rate is too low to maintain SWM
- Lack of periodical evaluation of property values on which tariff rates are pegged
- Large discrepancy in waste tax rate charged on household and that charged on commercial establishments
- Weak management for waste tax control
- Lesser liability for implementation of SWM projects due to large fluctuations of the SGM budget allocations
- No waste tax levied on governmental organizations
- Tipping fee for disposal determined on waste volume basis
- temporary reduction or exemption from profit taxes

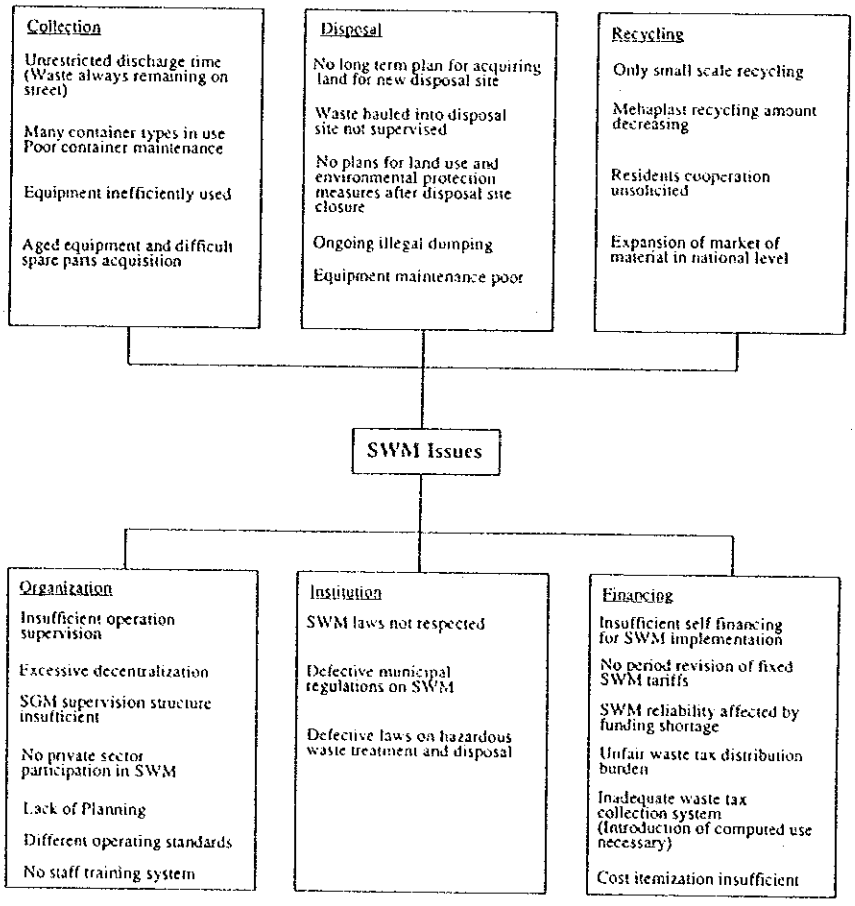


Figure 3-12-1 Present SWM Issues

PART II MASTER PLAN

CHAPTER 4

PRECONDITIONS OF THE MASTER PLAN

CHAPTER 4 PRECONDITIONS OF THE MASTER PLAN

4.1 Target Years

The target years for the master plan shall be the years 2000, 2005 and 2010.

4.2 Study Area

The master plan was conducted for the territory of Sofia Greater Municipality with an area of 1,310 Km^2. The future disposal site was selected within SGM based on a study of potential sites within the territory.

4.3 Waste Type

The waste types that were covered in the study are in principle municipal wastes, which comprise domestic, commercial, street, garden and non-hazardous industrial waste. Non-hazardous industrial waste types were limited to those presently disposed of at municipal disposal sites.

Street waste coverage in this Study is confined to disposal consideration of the amount to be received at the disposal site, exclusive of street waste collection and transport.

For industrial waste, the Study was limited to reviewing existing data with some additional data collection and making general recommendations to improve industrial waste management. A partial amount of non-hazardous industrial shall be reveived at the disposal site under this master plan.

4.4 SGM Socioeconomic Conditions forecast by Master Plan

4.4.1 Future Population

Past trends can not be applied to arithmetic, geometric nor logistic modeling because of the significant drop in population levels after the collapse of communist rule.

This Study shall adopt the approved forecasts prepared by SGM. However it is necessary to note that these results shall be adjusted based on the 1992 population census results by the Municipality.

Population is expected to increase by about 10,000 annually. Up to 1995, migration is expected to slightly decrease or remain constant. Recovery and development of the economy, and stability of legislation will encourage the number of migration.

The population forecasts are described in Table 4-4-1.

Table 4-4-1 Population Forecasts in SGM

Year	1993	1995	2000	2005	2010
SGM forecast:- Upper Limit	1,183,000	1,215,000	1,240,000	1,265,000	1,290,000
- Lower Limit		1,230,000	1,280,000	1,330,000	1,380,000
Adopted forecast	1,183,000	1,205,000	1,280,000	1,330,000	1,380,000

The future population in SGM is forecast to be 1,380,000 persons in the year 2010 according to SGM's upper limit estimation. This estimation is used for this study with small adjustment up to the year 2000 because there is some gap at present due to unexpected decrease of population in 1992.

Distribution of population by the 24 districts was done based on population data (1985 and 1992), present land use and existing regional development plans.

4.4.2 Economic Forecasts

It is very difficult to forecast economic growth until 2010 in Bulgaria, especially in this period of transformation. However as economic conditions strongly effect solid waste amount and quality forecasts, assumptions based on available information have been made.

Statistical data shows that decline in industry is continuing, although rate of decrease appears to be dropping. There are many forecasts, ranging from the very optimistic to most pessimistic. Historical experience in Asian countries has shown that it is possible to achieve a growth of 8% per annum, under circumstances closely resembling those at present witnessed in Bulgaria, of abrupt reduction in economic growth caused by social disorder.

This Study assumes two cases for consideration as follows;

- Case 1
  Recovery of the Bulgarian economy will start in 1993 and GDP in 1995 will reach the 1990 level. After 1995, an annual growth rate of 8% will continue for five years, and decrease to 5% during the period of 2001 to 2010.

- Case 2
  The Bulgarian economy recovery will start in 1995 and GDP in 1998 will reach the same level of that of 1990. After 1998 an annual growth of 6% will continue for 5 years, dropping slightly to 4% after 2003 and continuing at that rate up to 2010.

The assumptions are summarized in Table 4-4-2 and shown graphically in Figure 4-4-1.

Table 4-4-2 GDP Assumptions in Bulgaria

(unit: Biln US$)

Year	1990	1993	1995	1998	2000	2003	2005	2010
Case 1	19.9	8.0	19.9	25.1	29.3	33.9	37.3	47.7
Case 2	19.9	8.0	8.0	19.9	22.4	26.6	28.8	35.1

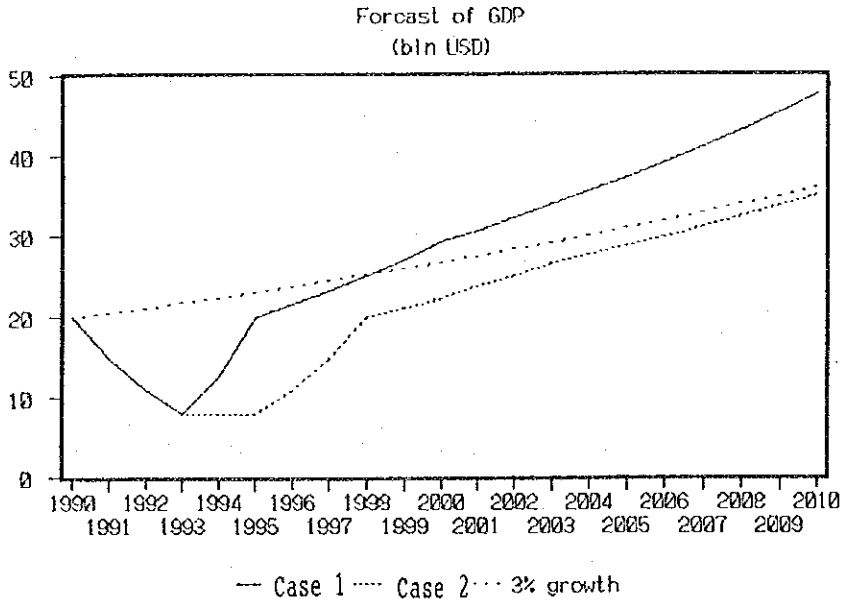


Figure 4-4-1 Forecast of GDP Growth

If the population of Bulgaria is assumed to remain the same in 2010 as that of 1990, GDP per capita in that year shall be US$ 5,380 (Case 1) or US$ 3,960 (Case 2). Sofia's GRDP is assumed to be 14% of the GDP throughout the whole period.

For financial evaluation purpose, 1993 prices are used for all the years to be evaluated. Financial capability of SGM is assumed to increase in proportion to GDP.

These assumptions are summarized in Table 4-4-3.

Table 4-4-3 Financial Capability Assumptions in SGM
(unit: Biln Lv)

Year	1993	1995	1998	2000	2003	2005	2010
Case 1	5.5	13.7	17.3	20.2	23.4	25.8	32.9
Case 2	5.5	5.5	13.7	15.4	18.4	19.9	24.2

Household income is also assumed to increase in proportion to GDP. Household income in 1993 is assumed to have increased by the same rate as that of inflation.

Household income per capita in 1991 8,311 Lv
Inflation rate in 1992 80%
Estimated inflation rate in 1993 60%
Household income in 1993 (per cap) = 8,311 x 1.8 x 1.6 = 23,936 Lv

The assumptions are summarized in Table 4-4-4.

Table 4-4-4 Household Income Assumptions (per cap)
(unit: 1000 Lv)

Year	1993	1995	1998	2000	2003	2005	2010
Case 1	23.9	59.6	75.0	87.5	101.3	111.7	142.6
Case 2	23.9	23.9	59.6	66.9	79.7	86.2	104.9

The Study has adopted Case 2 as the more realistic of the two cases and the Master Plan has been prepared under that assumption. Accordingly the socioeconomic indices forecast under the master plan are summarized in Table 4-4-5.

Table 4-4-5 Master Plan Socioeconomic Forecasts

Year	1995	1998	2000	2005	2010
GDP (Mill. US$)	8,000	19,900	22,400	28,800	35,100
GRDP (Mill. US$)	1,120	2,786	3,136	4,032	4,914
SGM Budget (Mill. US$)	208	517	581	750	913
Household Income (US$)	901	2,249	2,524	3,253	3,958
Population (1000 cap.)	1,205	1,250	1,280	1,330	1,380

4.5 Solid Waste Amount and Composition

4.5.1 Solid Waste Amount in 1993

Solid waste amount in 1993 was estimated based on the summer and winter survey results and information collected on recycling activity in SGM.

As explained in Chapter 3, domestic/commercial waste amount disposed of at Suhudol and Dolny Bogrov is 958.5 ton/day. Of that amount, 46.3 ton/day is recycled according to Mehaplast data. Total domestic/commercial waste amount was 1,004.8 ton/day in 1993. Accordingly unit generation rate of domestic/commercial waste was 850 g/capita in 1993.

Since most commercial waste is collected together with domestic waste, actual amount of commercial waste is unclear. However, commercial waste is estimated to be 12% of domestic/commercial waste. This estimation is made on the basis that unit generation rates of some mainly residential districts are about 750 g/capita as shown in Table 3-4-3 and this figure can be adopted as the average unit generation rate of domestic waste.

A total of 24.4 ton/day of street waste (18.5 ton/day) and park waste (5.9 ton/day) is disposed of at Suhudol and Dolny Bogrov disposal sites.

In addition the above two disposal sites receive 74.3 ton/day of other non-hazardous waste consisting of 11.2 ton/day of medical waste, 26.1 ton/day of construction waste and 37.0 ton/day of industrial waste. Thirty percent (30%) of this waste amount is hauled by BKC and 70% by the generators.

Recycled waste amount handled by Mehaplast was 56.8 ton/day in 1993. Of that amount around 82% (46.3 ton/day) was from

domestic/commercial waste and the remaining 18% (10.5 ton/day) was from industry.

Also it is reported that 86.8 ton/day of industrial waste excluding waste from mining industry may have been illegally dumped in 1992. That consists of mainly construction waste that shall be legally dumped mostly at inert disposal site in the future. However, it is better to receive the remaining 29.9 ton/day at municipal disposal site to prevent illegal dumping.

4.5.2 Prediction of Future Solid Waste Amount

1) Unit Generation Rate of Domestic/Commercial Waste

The future unit generation rate has been estimated by two methods: one uses correlation between unit generation rate and GRDP (Gross regional domestic product) per capita in the last 3 years. The second method applies the annual increase rate recorded in the past in Japan. As shown below, the difference in the two estimations is only 7%, with the former case giving larger estimates. Therefore, future solid waste amount is set based on the estimation of the former case.

a. Unit generation rate using correlation with GRDP/capita.

Correlation between unit generation rate of domestic/commercial waste and GRDP per capita is presented by the following formula.

$$q = 0.0913 \times G + 753$$

where;

q : Unit generation rate of domestic/commercial waste (g/capita/day)

G : GRDP per capita (US$/capita/year)

Applying the estimated GRDP per capita of US$ 3,555 in the year 2010, the corresponding unit generation rate shall be 1,078 g/capita/day.

b. Yearly increase rate in Japan in the past

Unit generation rate in Japan increased from 778g/capita in 1976 to 857g/capita in 1986. Yearly increase rate was approximately 1%. Unit generation rate in 2010 is calculated to be 1,007g/capita adopting an annual growth rate increase of 1%.

2) Ratio of domestic waste and commercial waste

Of total domestic/commercial waste amount calculated based on forecast unit generation rate and population, present shares of domestic and commercial wastes of 88% and 12% will be applied.

3) Street and park waste

Street and park waste will increase according to increase in road and park area. Annual increase rate of street and park waste is assumed to be 0.04% in the future.

4) Other waste

Other waste received at municipal disposal site at present will increase in the same rate as unit generation rate of domestic/commercial waste.

5) Future solid waste amount

Applying the population forecasts explained in Section 4.4 of this Chapter, and method for estimating various waste types as outlined above, the future solid waste amount is estimated as shown in Table 4-5-1.

Table 4-5-1 Future Solid Waste Amount

(unit: ton/day)

Year	Domestic	Commercial	Total	Street/ Park	Other waste Receiving	Other waste Additional
1993	885	121	1,005	24	74	(30)
1995	889	121	1,010	25	74	(30)
2000	1,100	150	1,250	25	86	30
2005	1,205	164	1,370	26	91	30
2010	1,309	178	1,487	26	95	30

4.5.3 Forecast of Solid Waste Composition

1) General

Future prediction of solid waste composition was prepared based on summer survey results then revised taking into consideration the results of the following winter survey.