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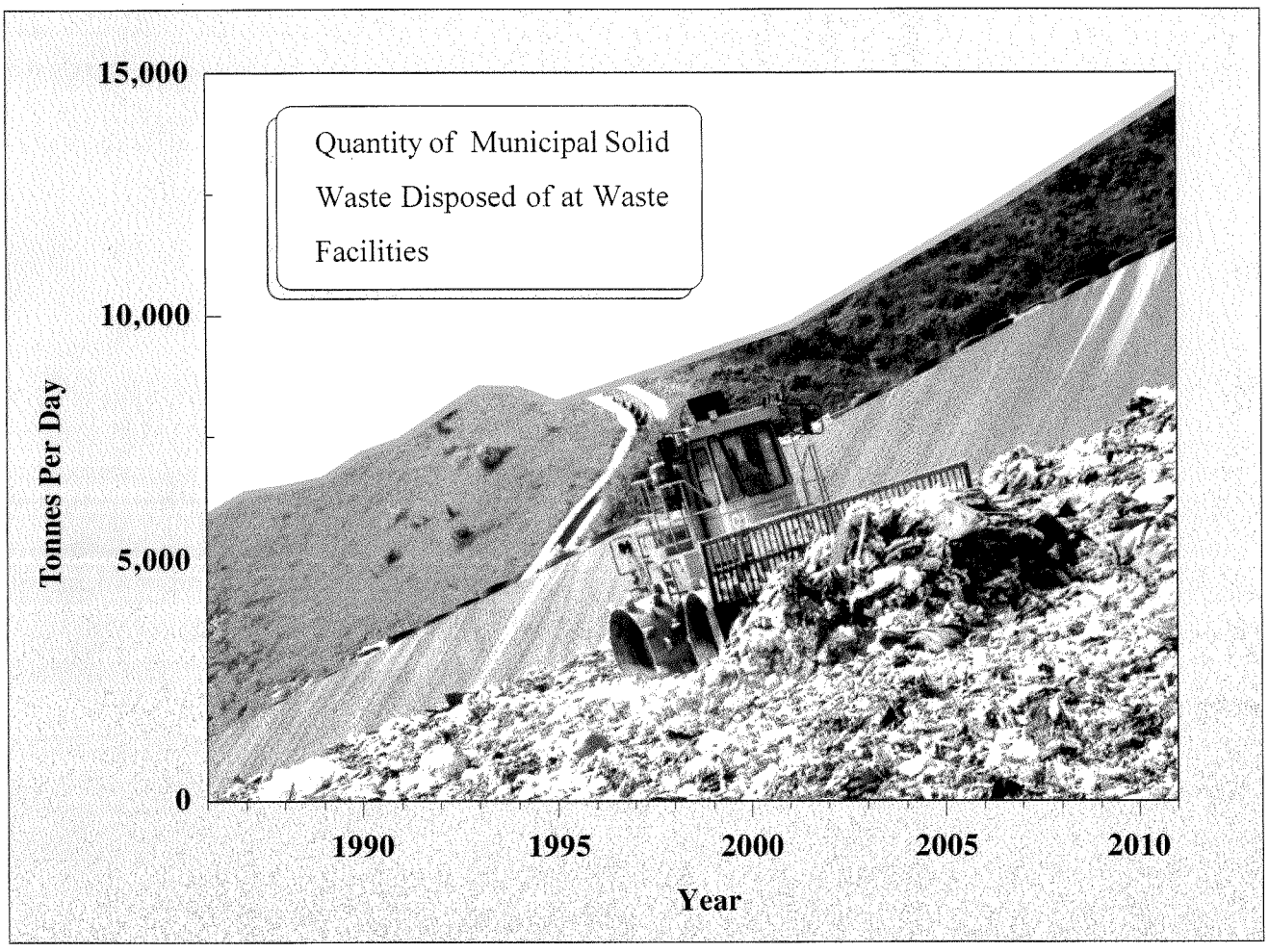
MONITORING OF SOLID WASTE IN HONG KONG 1996



Environmental Protection Department

Monitoring of Solid Waste in Hong Kong

1996

Facilities Planning Group
Environmental Protection Department

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Monitoring of Solid Waste in Hong Kong, 1996

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Abbreviations

C & D	-	Construction and Demolition
C & I	-	Commercial and Industrial
C & SD	-	Census and Statistics Department
CED	-	Civil Engineering Department
CWTC	-	Chemical Waste Treatment Centre
EMSD	-	Electrical and Mechanical Services Department
EPD	-	Environmental Protection Department
GDP	-	Gross Domestic Product
IETS	-	Island East Refuse Transfer Station
KBTS	-	Kowloon Bay Refuse Transfer Station
KCIP	-	Kwai Chung Incineration Plant
NENT	-	North East New Territories Landfill
Plan. D	-	Planning Department
PPVL	-	Pillar Point Valley Landfill
RCV	-	Refuse Collection Vehicle
RSD	-	Regional Services Department
RTS	-	Refuse Transfer Stations
SENT	-	South East New Territories Landfill
STTS	-	Sha Tin Refuse Transfer Station
SWL	-	Shuen Wan Landfill
TKOL	-	Tseung Kwan O Landfill
tpd	-	tonnes per day
USD	-	Urban Services Department
WAA	-	Waste Arisings Area
WAD	-	Waste Arisings District
WENT	-	West New Territories Landfill

Executive Summary

(1) Most of the solid wastes in Hong Kong were disposed of at landfills including SENT, WENT, NENT and PPVL in 1996. The inert materials suitable for land reclamation reuse were delivered to public filling areas (past known as public dumps). A small fraction of about 4% of solid wastes was combusted in KCIP.

(2) In 1996, a daily average of about 16,150 tonnes of solid wastes was disposed of at landfills and the KCIP. Among them, there were about 6,260 tonnes of domestic waste, 1,880 tonnes of commercial & industrial waste and 7,520 tonnes of construction & demolition (C & D) waste. An overall drop of about 27% was observed in the total quantity of solid wastes in 1996.

(3) Amongst all the landfills, the waste intake at SENT was the greatest (about 7,230 tonnes per day). There was a 32% increase in waste intake in NENT while both WENT and PPVL demonstrated substantial decrease of waste intake from 1995 to 1996. About 47% of waste intake at all landfills were categorized as C & D waste.

(4) A total amount of 30,500 tpd of C & D material/waste was delivered to public filling areas and landfills in 1996. Of this amount, 75% was delivered to public filling areas while the remaining 25% was landfilled. When compared with 1995, this represents a drop of about 47% in the quantity of C & D waste landfilled while the amount disposed of at public filling areas increased by almost 26%. This was mainly due to an increased supply of public filling outlets as contrary to the past few years.

(5) In 1996, about 1.6 million tonnes, 36% by weight of municipal solid waste were recovered for recycling. The quantity of recovered waste exported for recycling was about 1.2 million tonnes with a value of about HK$ 2.4 billion. By weight, paper and ferrous metals were the most recovered material for recycling. Non-ferrous metals, however, has the greatest export value.

(6) The domestic waste generation rate remained at about 1.0 kg/person/day in 1996. The commercial & industrial waste generation rate, however, increased from 0.88 kg/employee/day in 1995 to 1.07 kg/employee/day in 1996. The survey data continued to demonstrate the linear relationship between the quantity of municipal solid waste and the total GDP.

(7) If the current growing trend in the quantity of municipal solid waste continues, it is projected that the per capita generation rate for domestic waste and commercial & industrial waste would be 1.37 kg/person/day and 1.49 kg/employee/day respectively in 2011. The forecast quantity of municipal solid waste that would require final disposal would be almost 14,600 tpd in 2011. Of this amount, there would be about 11,100 tpd of domestic waste and 3,500 tpd of commercial & industrial waste.

1. Introduction

1.1 Background

1.1.1 With the continuous growth in population and economy in Hong Kong, the quantity of waste discarded from households, commercial and industrial activities and construction activities has increased substantially. As shown in Figure 1, the quantity of waste disposed of in Hong Kong increased since 1986 and reached a maximum in 1994. From 1995 onward, this quantity started to decline but there was still a 80% increase in 1996 when compared with 1986.

1.1.2 In 1981, the Environmental Protection Agency, the predecessor of EPD, launched a waste monitoring programme to gather information related to the design needs of the waste management system. This included establishing geographical distribution of solid waste, their major constituents and identification of socio-economic parameters that can be used for forecasting future waste management needs and the planning for appropriate waste facilities. The work done in 1981 became a basis of subsequent annual waste monitoring survey.

1.1.3 The year 1996 marks the sixteenth year of the waste monitoring programme. The information collected from the monitoring work has been used in various aspects of waste management planning which include the development of the 1989 Waste Disposal Plan and the 1997 Draft Waste Reduction Plan.

1.2 Importance of the Waste Monitoring Programme

1.2.1 The data collected from the waste monitoring programme can shed light on the trend of waste disposed and help us to monitor the implementation of the Waste Disposal Plan. Such information can be used to plan for our future waste management needs which include :

(a) planning for new waste disposal facilities;
(b) forecast future utilization of waste disposal facilities;
(c) planning for waste reduction measures;
(d) forecast waste arisings and their geographical distribution; and
(e) establish waste management models for development of cost-effective waste management plans.

1.3 Scope of this Report

1.3.1 This is the thirteenth report of the series of reports on the waste monitoring work carried out by EPD. The report presents the findings of the monitoring work on solid waste disposal carried out in 1996, which covers the following aspects :

(a) waste quantity, estimated composition and characteristics;
(b) geographical distribution of solid waste;
(c) recyclable components; and
(d) quantities and characteristics of recovered materials.

1.3.2 Based on the 1996 data and the past trend, the forecasts of the geographical distribution as well as the quantities of municipal solid waste for the years 2001, 2006 and 2011 are included in this report.

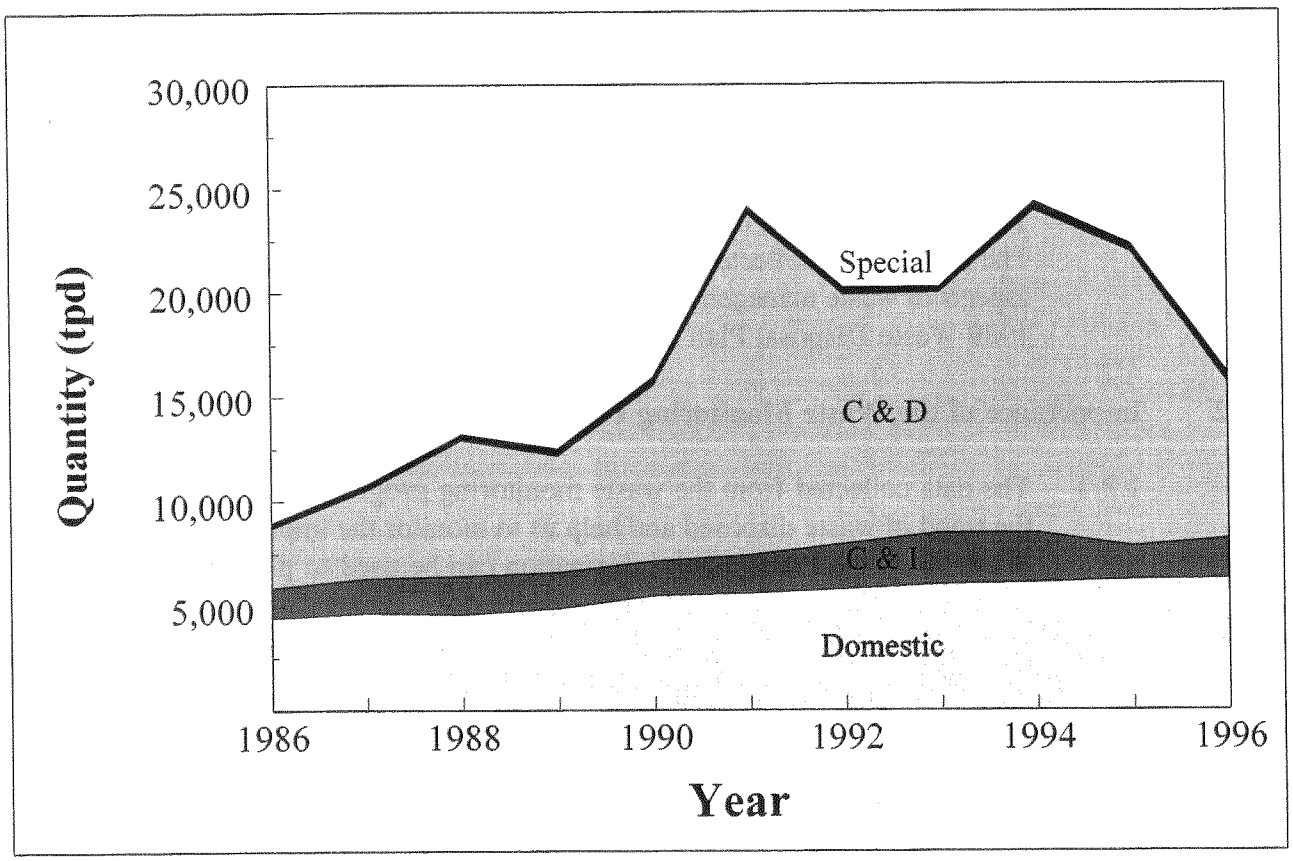


Figure 1 Quantity of the major types of solid waste disposed of at solid waste facilities from 1986-1996

2. Classification of Solid Waste and the Waste Monitoring Methodology

2.1 Waste Classification and Terminology

2.1.1 In this report, waste is classified by making reference to the source of waste and the institutional arrangements for waste collection and disposal. The major waste types are municipal solid waste, construction & demolition (C & D) waste, chemical waste, special waste and other waste. The classification of solid waste is depicted in Figure 2.

2.1.2 **Municipal solid waste** includes domestic waste, commercial waste and industrial waste.

- **Domestic waste** refers to waste generated from residential premises in the course of daily activities and public cleansing activities. Public cleansing waste includes dirt and litter collected by the two Municipal Councils from street cleansing, beaches and litter bins; marine refuse collected by Marine Department and waste from country parks collected by Agriculture and Fisheries Department.

- **Commercial waste** is waste arising from commercial activities taking place in markets, shops, restaurants, hotels and offices etc. It is collected mainly by private waste collectors. However, some commercial waste could be mixed with domestic waste and are collected by the Municipal Councils.

- **Industrial waste** is waste arising from industrial activities and does not include chemical waste and C & D waste. Industrial waste is usually collected by private waste collectors. However, some industries may deliver their own waste directly to landfills for disposal.

  It should be noted that there are bulky items like furniture and domestic appliances which cannot be handled by conventional compactor type RCV. These items are regarded as bulky waste and they may come from residential premises, commercial and industrial activities and are usually collected separately.

2.1.3 **Construction & Demolition (C & D) waste** includes waste arising from any land excavation or formation, civil/building construction, site clearance, demolition activities, roadworks, excavation and building renovation. It includes various types of building debris, rubble, earth, concrete, timber and mixed site clearance materials. Type I C & D waste, as stated in the landfill contracts, is defined as C & D waste containing not more than 20% by volume (or 30% by weight) inert materials. Inert material comprises dirt/soil/mud, concrete, reinforced concrete, asphalt, brick/sand, cement plaster/mortar, aggregate, inert building debris, and rock/rubble. Type II C

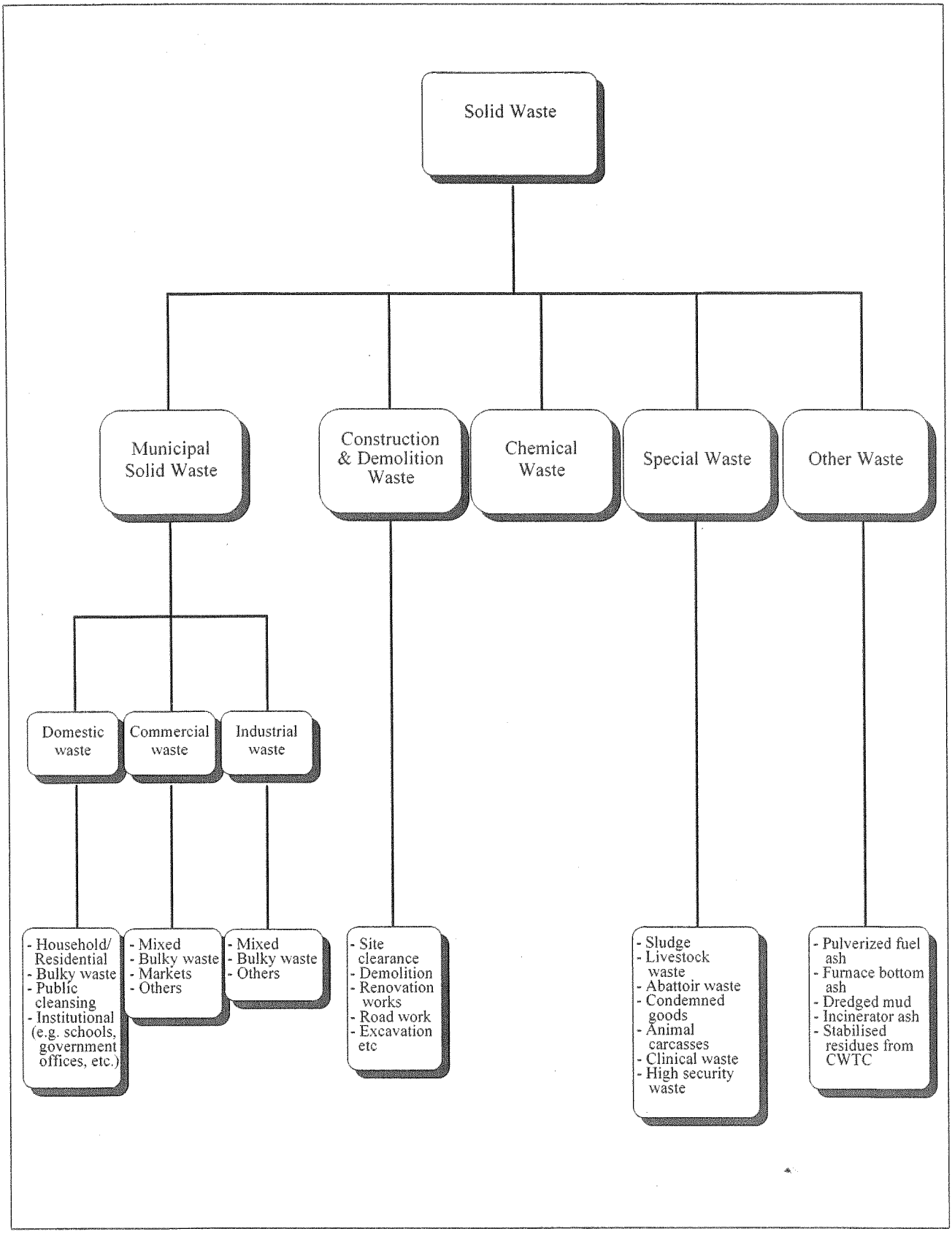


Figure 2 Current classification of solid waste

& D waste, which are not normally accepted by landfills, consists of more than 20% by volume (or 30% by weight) of inert material content.

2.1.4 **Chemical waste** is defined in the Waste Disposal (Chemical Waste) (General) Regulation under the Waste Disposal Ordinance (Cap 354). Chemical waste can be any substance arising from any process or trade activity which contains chemical in such form, quantity or concentration that can cause pollution of the environment or become a risk to health.

2.1.5 **Special waste** includes animal carcasses, high security waste, abattoir waste, condemned goods, waterworks and sewage sludge, sewage works screenings, livestock waste and clinical waste.

2.1.6 **Other waste** refers to waste types not covered by definitions mentioned above. These include coal ash, incineration plant ash, stabilised residues from CWTC, dredged mud and excavated materials disposed of at marine dumps.

2.2 Methodology

2.2.1 As compared with the composition of municipal solid waste in the past, it is noted that the compositions in recent years varied only insignificantly. Hence, the survey on composition analysis was not undertaken in 1996 and the corresponding data is estimated based on the trends in recent years and the data in *Monitoring of Solid Waste in Hong Kong 1995*.

2.2.2 The following data were collected from various sources throughout the whole year:

- weighbridge records of landfills, RTS and KCIP managed by EPD, CED and EMSD;
- collection routes and schedules of the RCV of USD and RSD;
- results of the weighing exercise of the refuse collected by USD and RSD;
- current GDP figures; population and employment figures by District Board Districts from C & SD;
- projected population and employment figures in 2001, 2006 and 2011 from Plan. D; and
- quantities of special wastes and other wastes from relevant specialist groups in EPD and concerned government departments. Sources of data are shown in Appendix 1.

2.2.3 The above data were analyzed in working out the quantities of different types of waste disposed, their geographical distribution and composition.

3. Waste Quantities and Characteristics

3.1 Waste Disposal Statistics

3.1.1 In 1996, a daily average of 16,153 tonnes of solid waste was disposed of at the solid waste facilities viz. landfills, RTS and KCIP in Hong Kong. Table 1 summarizes the quantities of municipal solid waste, C & D waste and special waste disposed of in 1996. Compared with 1995, there was an overall reduction of about 27% in the total quantity of solid waste disposed of at the waste facilities. For the individual major waste types, it can be noted that domestic waste increased slightly by 1%; while commercial waste doubled to 1088 tpd. The quantities of commercial waste have been fluctuating significantly in the past years (Figure 1 refers). There was a 25% and 47% decrease in industrial and landfilled C & D waste respectively. A 38% increase was also observed in landfilled special waste. On account of the offset of increasing commercial waste by decreasing industrial waste, the total quantity of MSW received in disposal facilities increased by only 4%.

3.1.2 The quantities of different types of waste collected by the government collection agents and private waste collectors are also shown in Table 1. Generally, USD/RSD are responsible for collecting domestic waste, while the majority of commercial & industrial waste were collected by private waste collectors. However, the Municipal Councils have been collecting commercial & industrial waste to a limited extent for historical reasons. In some old urban areas, commercial waste generated from the old mixed commercial and residential buildings is often mixed with domestic waste prior to delivery to refuse collection points. Waste is also collected from the markets and some commercial establishments in these old urban areas by the Municipal Councils. This collection practice has complicated the estimation of the quantity of publicly collected commercial & industrial waste.

3.1.3 Table 2 shows the quantities of municipal solid waste, C & D waste and special wastes disposed of at solid waste facilities from 1986 to 1996. A steady growth in the quantity of domestic waste can be noted. The rising trend, however, is not apparent for commercial & industrial waste and C & D waste. The growth patterns observed for the different types of waste could be attributed to many factors. The quantity of domestic waste is primarily dependent on population which has been increasing in this period. The economy and the level of construction activities which vary from time to time could affect the quantities of commercial & industrial waste and C & D waste. This could account for the less apparent rising trend for these two waste categories. On the other hand, increasing amount of diversion of C & D material/waste to public filling outlets (Section 3.4) due to the provision of more public filling outlets can account for the steady decrease of the quantities of C & D waste landfilled.

Waste type	Quantity (tpd)			Percentage change from previous year (+/-%)
	Collection agents		Total	
	Public[1]	Private[2]		
a. Domestic waste				
- household mixed/public cleansing	5,115	897	6,012	
- bulky waste	224	24	248	
Sub-total	**5,339[3]**	**921**	**6,260**	**+1%**
b. Commercial waste				
- commercial mixed	-	962	962	
- bulky waste	-	67	67	
- markets	-	44	44	
- others	-	15	15	
Sub-total		**1,088**	**1,088**	**+109%**
c. Industrial waste				
- manufacturing mixed	-	428	428	
- bulky waste	-	11	11	
- others	-	356	356	
Sub-total		**795**	**795**	**-25%**
d. Municipal solid waste received at disposal facilities (a+b+c)	5,339	2,804	8,143	+4%
e. Construction & demolition waste (landfilled)	-	7,521	7,521	-47%
f. Special waste (landfilled)	276	213	489	+38%
g. All waste received at waste facilities (d+e+f)	**5,615**	**10,538**	**16,153**	**-27%**

Notes:
(1) Waste collected by RSD and USD, RSD/USD contractors and other government vehicles
(2) Waste collected by private cleansing/waste management companies
(3) Publicly collected waste included some commercial and industrial waste

Table 1 Quantities of solid waste disposed of at landfills, incineration plant and RTS in 1996

Year	Types of waste (tpd)						
	Municipal solid waste				Construction & demolition (landfilled)	Special (landfilled)	TOTAL
	Domestic & public cleansing	Commercial	Industrial	Sub-total			
	(a)	(b)	(c)	(d) = (a) + (b) + (c)	(e)	(f)	(g) = (d) + (e) + (f)
1986	4,420	370	1,080	5,870	2,850	240	8,960
1987	4,630	430	1,240	6,300	4,220	250	10,770
1988	4,580	420	1,410	6,410	6,520	260	13,190
1989	4,870	450	1,270	6,580	5,580	310	12,480
1990	5,460	380	1,270	7,100	8,450	360	15,920
1991	5,560	400	1,430	7,390	16,380	340	24,110
1992	5,760	460	1,710	7,930	11,960	320	20,210
1993	6,000	570	1,880	8,450	11,520	250	20,220
1994	6,070	700	1,660	8,430	15,480	390	24,300
1995	6,210	520	1,060	7,790	14,120	350	22,260
1996	6,260	1,090	800	8,140	7,520	490	16,150

Notes :
(1) Figures rounded off to the nearest tenth
(2) Figures may not add up to total due to rounding-off

Table 2 Summary of the major types of solid waste disposed of at solid waste facilities from 1986 - 1996

3.1.4 Seasonal fluctuation is observed in the total amount of MSW landfilled and incinerated. It is interesting to note that there is a slight increase in MSW from May to September in the order of up to 6%. The surge can be explained by the increased production of domestic waste (e.g. softdrink container, fruit waste) during the summer time.

3.1.5 The quantities and disposal methods of special and other wastes are summarized in Table 3. One type of special waste not included in this table is grease trap waste which is regarded as a special aqueous waste due to its high water content. In 1996, about 65 tpd of grease trap waste was co-disposed of at landfills with other waste. Currently, this kind of special waste is processed in the Interim Grease Trap Waste Treatment Facility located at WENT before disposal at the landfill.

3.2 Geographical Distribution of Municipal Solid Waste

3.2.1 For the purpose of monitoring the geographical distribution of solid waste in Hong Kong, the whole territory is divided into 18 waste arisings districts (WAD) which are further subdivided into 54 waste arisings areas (WAA). The different WAD and WAA are shown in Appendix 2. The boundaries of WAD are generally in accordance with those of the District Boards. WAA are aggregates of tertiary planning units with similar socio-economic characteristics. With the exception of special waste, the geographical distribution of the solid waste disposed of at waste facilities in 1996 by WAD is shown in Table 4.

3.2.2 From Figure 3, it is noted that the waste collected from a particular geographical location may not end up in a waste facility in its vicinity. The final waste disposal outlet is often dependent on the collection route of RCV or dumper trucks and whether suitable facilities are located within the region.

3.3 Utilization of Waste Facilities

3.3.1 Basically, each strategic landfill has its particular waste intake characteristic. In 1996, SENT and PPVL were responsible for receiving the majority of landfilled C & D waste and privately collected MSW. NENT received nearly 70% of RTS-processed MSW, whereas WENT handled mainly publicly collected waste with negligible amount of C & D and privately collected waste.

3.3.2 Figure 4 presents the provision of waste facilities in 1996 and the waste intake at these facilities. PPVL, the last of the old generation of landfills, was decommissioned at the end of December 1996. Amongst the three strategic landfills, SENT received the greatest amount of waste in 1996. It is not only due to its proximity to the urban area, but also due to the fact that SENT was mainly collecting mixed C & D waste which is obviously heavier than other waste types. A substantial decrease of waste intake was observed at WENT and PPVL during 1996. The decrease in WENT can be explained

Waste type	Disposal method	Quantity disposed of
Chemical waste other than asbestos waste	CWTC	176 tpd
	Co-disposal at landfills	6 tpd
Asbestos waste	Co-disposal at landfills	18 tpd
Waterworks sludge(from Sha Tin Water Treatment Works)	Marine disposal	381 cu.m/day
Sewage sludge(from Sha Tin Sewage Treatment Works)	Marine disposal	685 cu.m/day
Dewatered sludge	Landfilling	204 tpd
Sewage works screenings	Landfilling	44 tpd
Abattoir waste	Landfilling	21 tpd
Animal carcasses	Landfilling	4 tpd
	Crematories, Kennedy Town By-Product Plant	1 tpd
Livestock waste	Composting and other environmentally acceptable means	792 tpd
Condemned goods	Landfilling	65 tpd
High security waste	Incineration	10 tpd
Clinical waste	Co-disposal at landfills	2 tpd
	Pathological waste incinerators at hospitals	2 tpd
	Mixing with general refuse	2 tpd
Dredged mud and excavated materials	Marine dumping	48,317 cu.m/day
Pulverised fuel ash	Concrete manufacturing, stored in lagoon	1,545 tpd
Furnace bottom ash	Concrete manufacturing, stored in lagoon	261 tpd
Incinerator ash	Landfilling	151 tpd
CWTC stabilised residue	Landfilling	66 tpd

Table 3 Quantities of different kinds of special and other wastes disposed of in 1996

Waste Arisings District (WAD)	Quantity (tpd)					
	Domestic waste		Commercial & industrial waste	Municipal solid waste	Construction & demolition waste (Landfilled)	All solid waste[5]
	Publicly collected[1],[2] (a)	Privately collected (b)	(c)	(d) = (a) + (b) + (c)	(e)	(f) = (d) + (e)
Central & Western	314	46	83	443	511	954
Wanchai	241	71	66	378	281	659
Eastern	415	114	78	607	376	983
Southern	245	19	51	315	110	425
Hong Kong Island Sub-total	**1,215**	**250**	**278**	**1,743**	**1,278**	**3,021**
Yau Tsim Mong	488	125	124	737	685	1,422
Sham Shui Po	316	75	73	464	267	731
Kowloon City	307	57	110	474	330	804
Wong Tai Sin	296	21	26	343	337	680
Kwun Tong	413	57	223	693	1,182	1,875
Kowloon Sub-total	**1,820**	**335**	**556**	**2,711**	**2,801**	**5,512**
Kwai Tsing	328	15	136	479	444	923
Tsuen Wan	203	91	148	442	540	982
Tuen Mun	362	31	217	610	849	1,459
Yuen Long	298	46	203	547	217	764
North	189	57	87	333	283	616
Tai Po	243	25	80	348	71	419
Sha Tin	397	58	135	590	262	852
Sai Kung	166	13	43	222	635	857
New Territories Sub-total	**2,186**	**336**	**1,049**	**3,571**	**3,301**	**6,872**
Cheung Chau[4]	41	-	-	41	-	-
Mui Wo[4]	26	-	-	26	-	-
Peng Chau[4]	13	-	-	13	-	-
Discovery Bay[4]	15	-	-	15	-	-
Lamma Island[4]	17	-	-	17	-	-
Hei Ling Chau[4]	6	-	-	6	-	-
Outlying Islands Sub-total	**118**	-	-	**118**	**141[3]**	**259[3]**
Territorial Total	**5,339**	**921**	**1,883**	**8,143**	**7,521**	**15,664**

Notes :

(1) Included public cleansing waste

(2) Publicly collected waste included some commercial and industrial waste

(3) Data collected from waste survey and breakdown into individual islands is not available

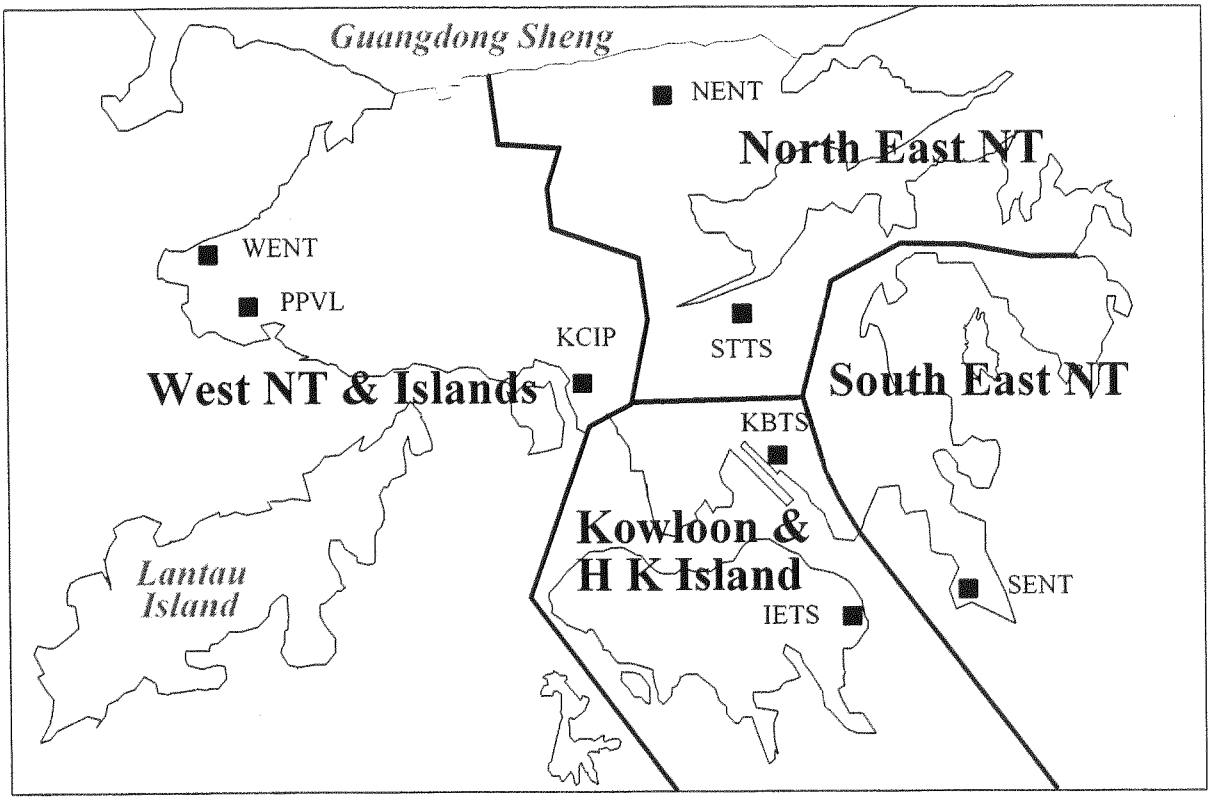
(4) These islands are aggregated to form one WAD - Outlying Islands

(5) Special waste not included in this table

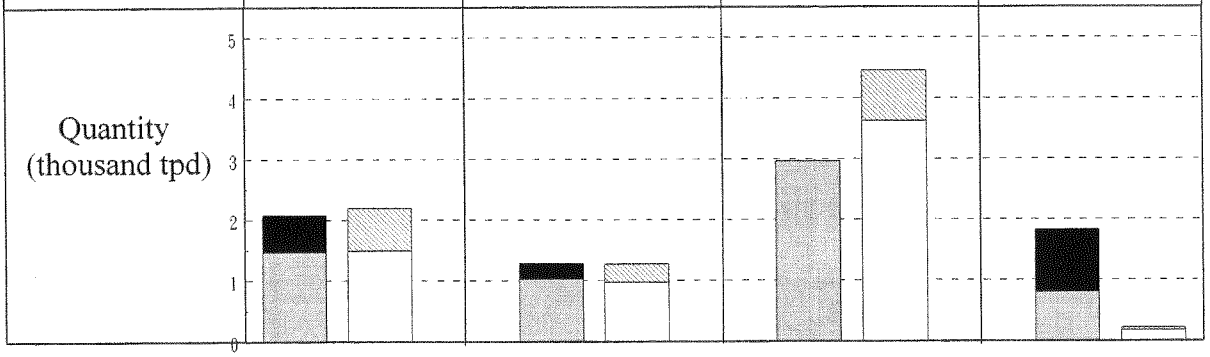
Remark :

The geographical distribution presented is worked out based on information collected from drivers of RCV/trucks during weighbridge monitoring or from weighbridge records and should be regarded as indicative only.

Table 4 Geographical distribution of solid waste disposed of in 1996



Region	West NT & Islands	North East NT	Kowloon & HK Island	South East NT
Waste facilities located within the region	WENT, PPVL and KCIP	NENT and STTS	IETS and KBTS(1)	SENT



Waste disposed of at the waste facilities within this region

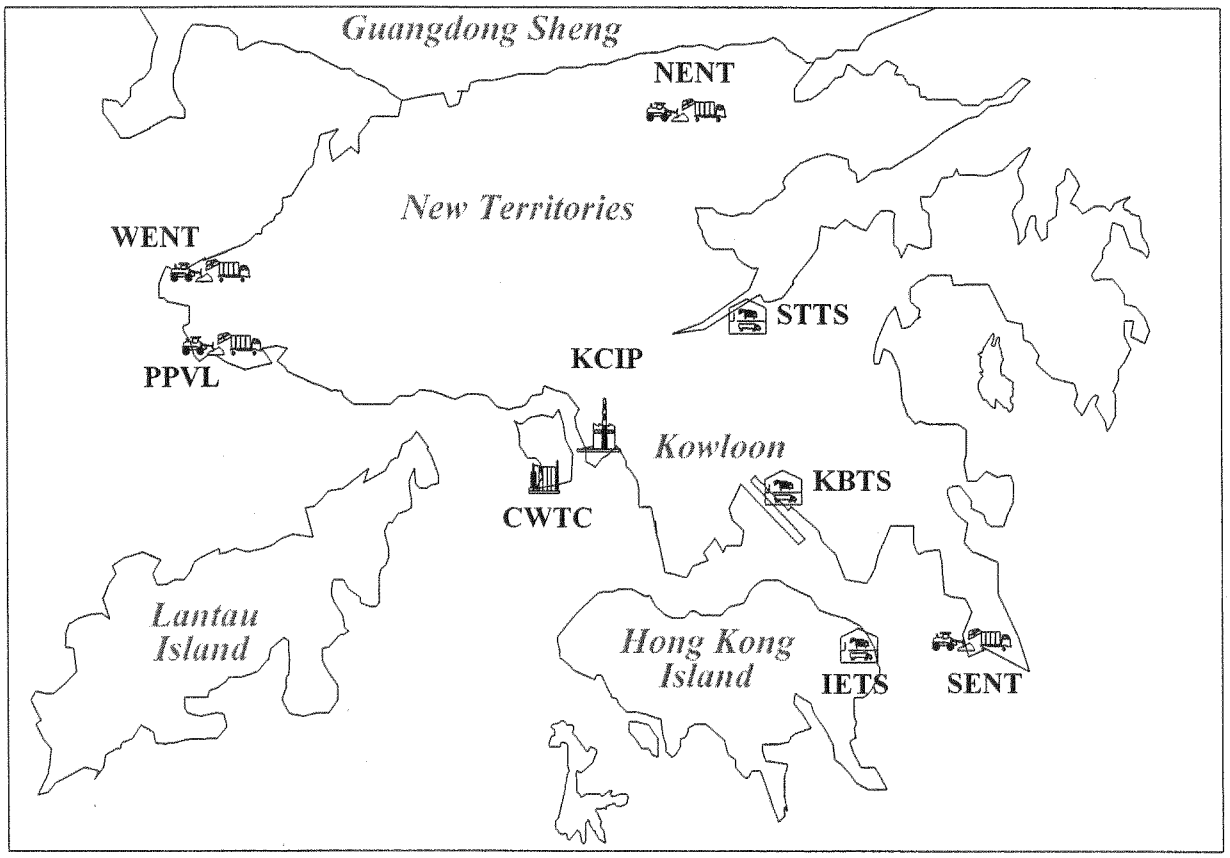
- Commercial & industrial waste
- Domestic waste

Waste collected for disposal from this region

- Commercial & industrial waste
- Domestic waste

Note:
(1) There were no landfills operating in the region and the landfill closest to Kowloon & HK Island was SENT

Figure 3 Comparison of the quantity of municipal solid waste collected and disposed of at waste facilities within the same geographical region in 1996



NENT
3,443 tpd (+31.5%)

IETS (1)
1,224 tpd (+1.8%)

PPVL
2,802 tpd (-40.2%)

SENT
7,230 tpd (+2.2%)

KBTS (2)
1,739 tpd (+2.8%)

KCIP
705 tpd (-1.7%)

WENT
1,973 tpd (-29.8%)

STTS (3)
853 tpd (+7.0%)

CWTC
176 tpd (-26.4%)

Notes:
(1) Waste from IETS was transferred to WENT by barge
(2) Waste from KBTS was transferred to NENT by road
(3) Waste from STTS was transferred to NENT by road

Remarks:
The quantities shown here do not include incinerator ash disposed of at landfills
(%) --Percentage increase / decrease over previous year

--Facilities under the management of EPD

Figure 4 Waste intake at waste facilities in 1996

by the diversion of part of the publicly collected MSW from WENT to STTS and KBTS since August 1995. This can also be observed by the corresponding increase in waste intake in NENT. In case of PPVL, the drop can be attributed to the reduced waste intake during its decommissioning. A breakdown of the waste intake at landfills, RTS and KCIP by each major waste type is shown in Appendix 3. A review of waste intake at waste facilities dated back to 1986 is also tabulated in Appendix 4.

3.4 Disposal of C & D Material/Waste at Landfills and Public Filling Areas

3.4.1 Public filling area is an outlet for inert C & D materials (or known as public fill) which can be used for land reclamation. The quantities of C & D material/waste disposed of at landfills and public filling areas in 1995 and 1996 are shown in Figure 5. It can be noted that the total amount of C & D material/waste disposed of at both public filling areas and landfills decreased from 32,400 tpd in 1995 to 30,500 tpd in 1996. Due to the opening of a new public filling area at Tuen Mun and the commissioning of a Public Filling Barging Point at Aldrich Bay in October 1995, the quantity of C & D waste delivered to public filling areas increased from an average of 18,300 tpd in 1995 to 23,000 tpd in 1996. Correspondingly, the quantity of C & D waste delivered to landfills reduced significantly from 44% of total C & D waste arisings to 25% of total.

3.4.2 Figure 6 summarizes the proportion of C & D waste out of the total amount of waste disposed of at the landfills in 1995 and 1996. It can be noted that the constitution of C & D waste in total waste intake at the landfills decreased from 63% to 47%. Similar to 1995, SENT received the majority of landfilled C & D waste in 1996, while WENT did not receive any until December 1996.

3.4.3 In Figure 6, it can be noted that 47% of waste intake at landfills in 1996 was C & D waste. Usually, such waste was mixed or contaminated with non-inert materials like wood and refuse. If there was proper separation done at source (or not mixing different types of waste together), the inert materials could be reused beneficially and thus the demand of landfill capacity for their disposal could be reduced.

3.5 Waste Characteristics

3.5.1 The composition of domestic waste disposed of at waste facilities, in terms of percentage by weight, and the estimated quantity of each component from 1986 to 1996 is shown in Appendix 5. It can be noted that the composition of domestic waste did not vary much over the past ten years. The various components in the domestic waste stream remained generally stable over the period.

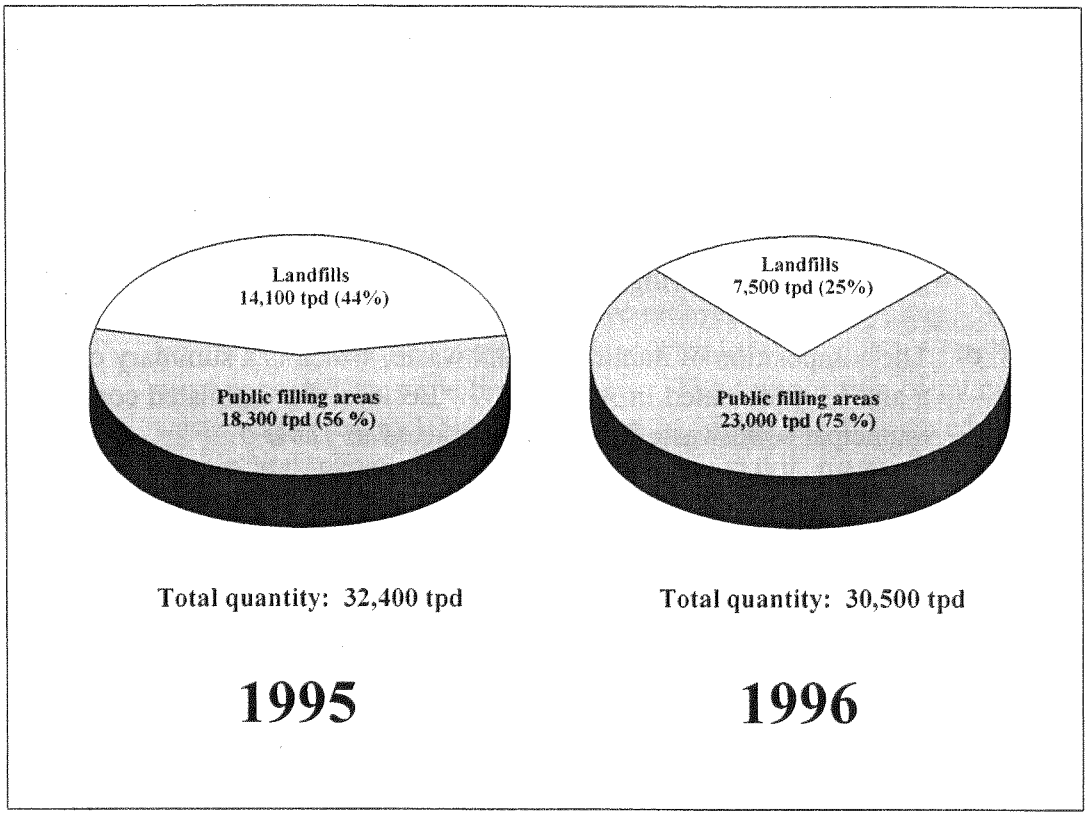


Figure 5 Quantity of C & D material/waste delivered to landfills and public filling areas in 1995 and 1996

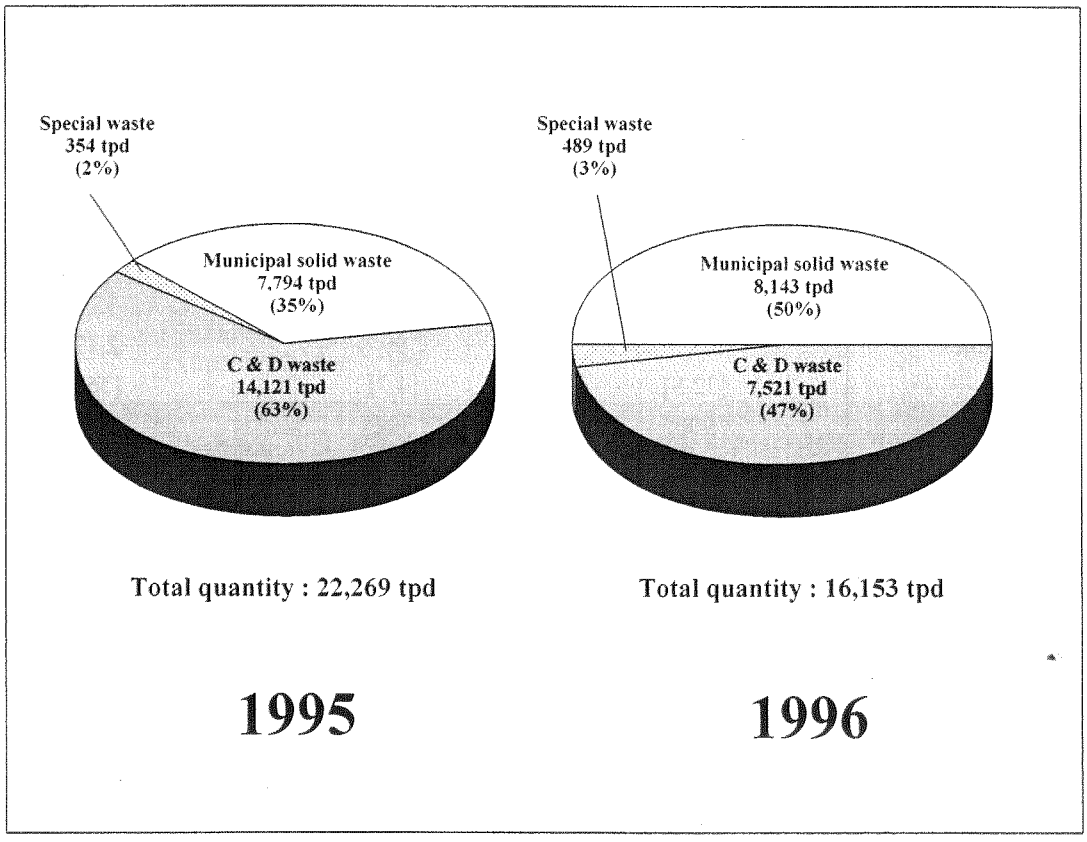


Figure 6 C & D waste disposal at landfills in 1995 and 1996

3.5.2 The composition of commercial & industrial waste disposed of at waste facilities from 1986 to 1996 is summarized in Appendix 6. The percentage by weight of the different waste components in commercial & industrial waste remained generally constant over the period of 1993 to 1996. The proportion of textiles in commercial & industrial waste has been decreasing steadily since 1991 and dropped from 19% in 1991 to about 7% in 1996. This trend may be related to the diminishing activities of the textiles or garment manufacturing industry.

3.5.3 The composition of municipal solid waste, which is a summary of Appendix 5 and 6, is tabulated in Appendix 7. Besides, the estimated composition of municipal solid waste in 1996 is extracted in Table 5.

Components	Quantity (tpd) [percentage by weight (%)]		
	Domestic Waste (a)	Commercial & Industrial Waste (b)	Municipal Solid Waste (c) = (a) + (b)
Bulky waste	250	80	330
	[4.0]	[4.1]	[4.0]
Paper	1,270	570	1,840
	[20.3]	[30.1]	[22.6]
Glass	160	30	190
	[2.5]	[1.8]	[2.4]
Metals	190	70	260
	[3.0]	[3.5]	[3.1]
Plastics	950	310	1,260
	[15.2]	[16.2]	[15.4]
Textiles	270	130	400
	[4.4]	[6.8]	[4.9]
Rattan/wood	140	320	450
	[2.2]	[16.9]	[5.6]
Putrescibles	2,030	90	2,120
	[32.5]	[4.7]	[26.1]
Others	990	300	1,290
	[15.9]	[15.9]	[15.9]
Total	6,260	1,880	8,140
	[100]	[100]	[100]

Notes:
(1) Figures rounded off to the nearest tenth
(2) Figures may not add up to total due to rounding-off
(3) All data are estimate based on the trend in recent years

Table 5 Estimated composition of municipal solid waste in 1996

4. Waste Recovery and Recycling

4.1 Recovery and Recycling of Municipal Solid Waste

4.1.1 In 1996, about 1.6 million tonnes (36% by weight) of the municipal solid waste generated in the territory were recovered for recycling. As shown in Figure 7, 0.46 million tonnes were recycled locally while 1.17 million tonnes were exported for recycling overseas. The composition of municipal solid waste recovered in 1996 is presented in Figure 8. It is noted that ferrous metals and paper, by weight, were the major materials recovered for recycling.

4.1.2 It should be mentioned that paper is much lighter than ferrous metals. The quantity of paper recovered being comparable to that of ferrous metals may reflect the recycling activities for paper were more extensive and vigorous than those for ferrous metals. Similarly, in view of the low density of most plastics, the recycling of plastics would also be quite substantial although it may not be as extensive as paper due to the smaller quantity of plastics recovered. The reasons behind these observations could be as follows:

- Recycling of paper is getting very common, convenient and well publicized. Recycling boxes for waste paper could be easily found in many housing estates, railway stations and offices etc. In contrast, similar facilities for ferrous metals, non-ferrous metals or even plastics are not that common.

- Most plastics found in waste are usually packaging materials (like plastic bags and beverage bottles) which could be contaminated with other materials. This may restrict the level of recycling plastics.

- It is well known that there has been a great market demand on waste paper for recycling purpose and this could be the most important reason why paper is extensively recycled.

4.1.3 As recycling activities in Hong Kong are largely market driven, it is important to look at the financial incentives of recycling different types of materials. Figure 9 shows the value of each type of exported recyclable materials. It is noted that the export value of non-ferrous metals for recycling overseas was the greatest among other recyclable materials even though only 9% by weight of recovered municipal solid waste was non-ferrous metals (Figure 8 refers). There seems to be significant financial incentive and market potential for recycling of non-ferrous metals. A detailed breakdown of the values and quantities of different recyclable materials is shown in Table 6. A summary of these recycling statistics is also provided at Appendix 8.

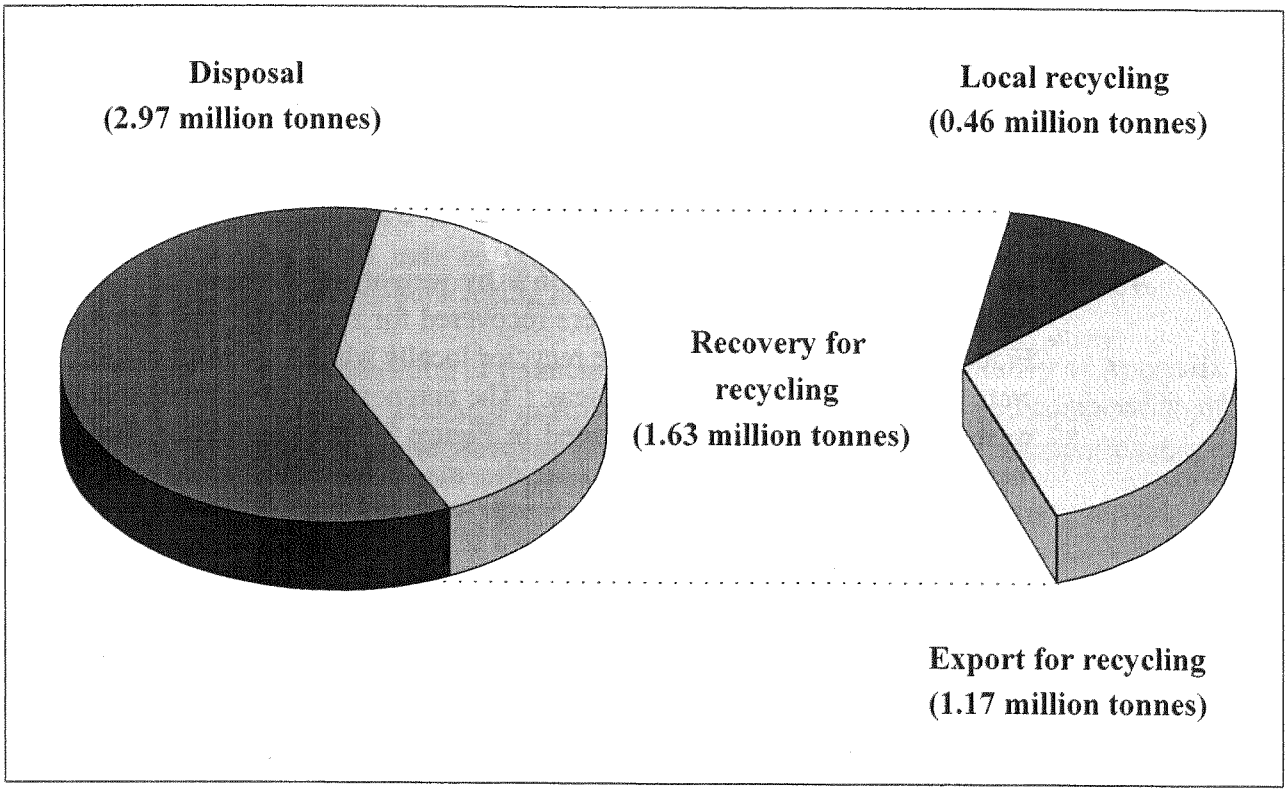


Figure 7 Recovery of municipal solid waste in 1996

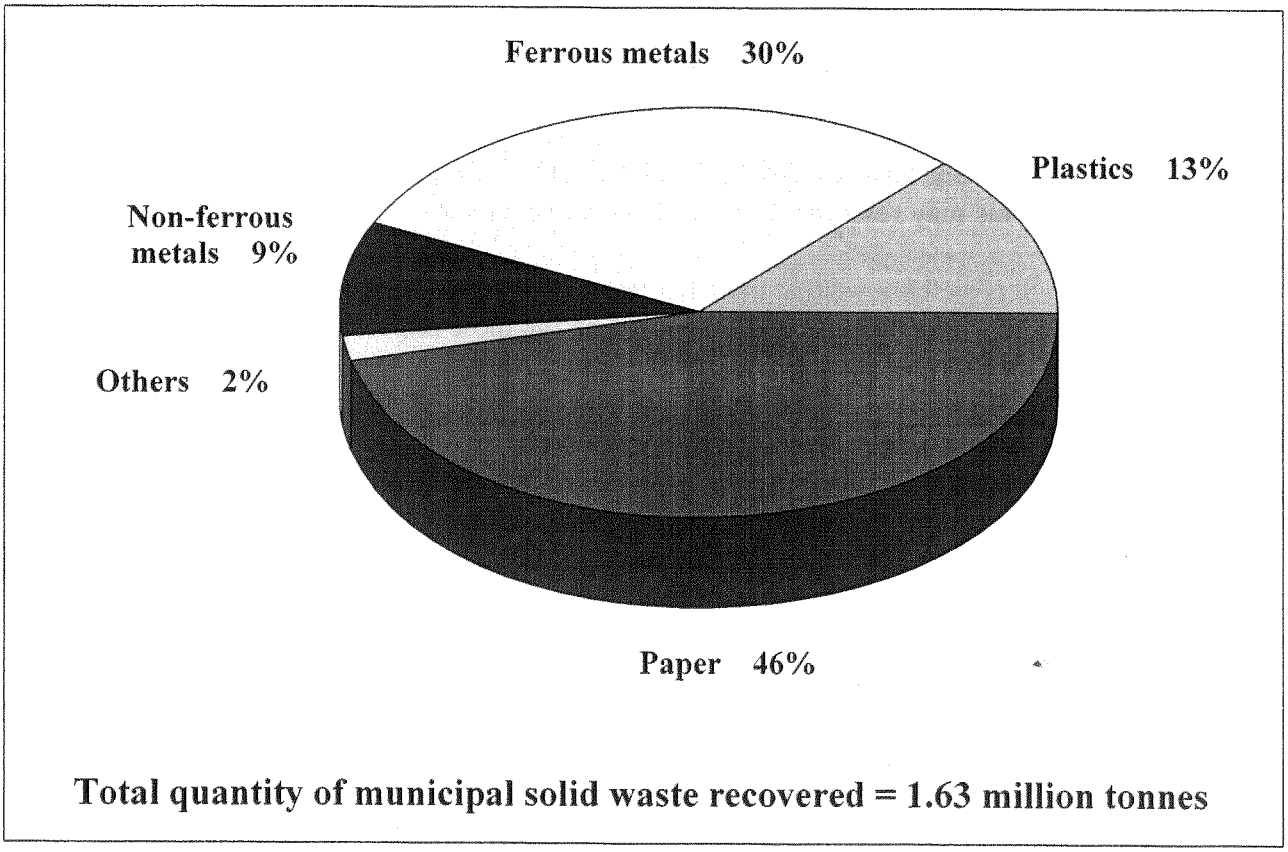


Figure 8 Composition of municipal solid waste recovered in 1996

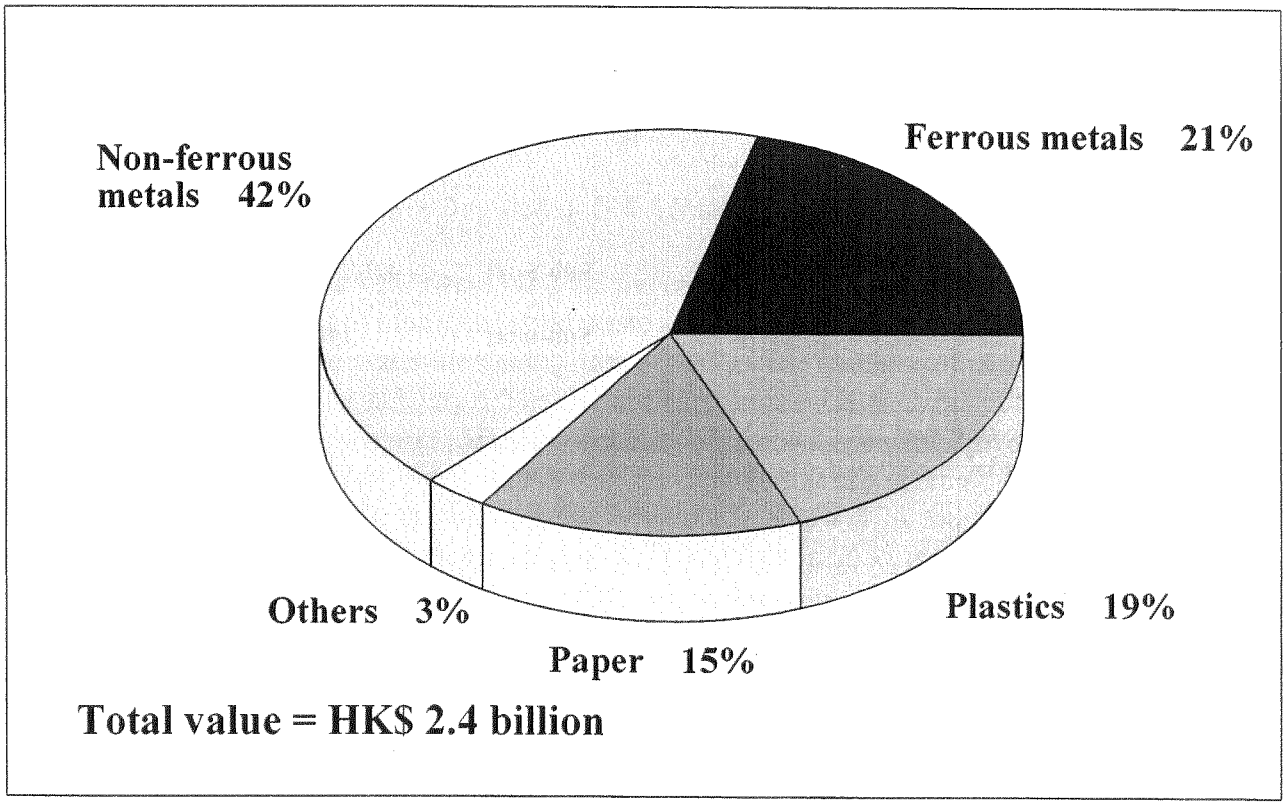


Figure 9 Values of the exported recyclable materials in 1996

Categories of waste materials		Quantity (tonnes)	Value ($,000)
a. Wood & paper			
- wood (include sawdust)		129	464
- paper		425,134	344,448
	Sub-total	**425,263**	**344,912**
b. Glass			
	Sub-total	**190**	**121**
c. Plastics			
- polyethylene		23,803	54,493
- polystyrene & copolymers		63,093	176,670
- polyvinyl chloride		31,414	74,288
- others		82,405	149,640
	Sub-total	**200,715**	**455,091**
d. Ferrous metals & steel			
- pig or cast iron		32,157	26,311
- alloy steel scrap		20,847	125,365
- other scraps		337,542	351,918
- tinplate		0	0
	Sub-total	**390,546**	**503,594**
e. Non-ferrous metals			
- copper & alloys		93,325	690,006
- nickel		132	2,807
- aluminium		47,948	290,404
- lead		156	2,713
- zinc		1,148	3,249
- tin		28	289
- metal ash & residues		336	1,635
- magnesium		0	0
- precious metal		5	6,691
- other base metals		0	0
	Sub-total	**143,078**	**997,794**
f. Textile fibre			
- silk		0	0
- cotton		8,543	28,692
- man-made fibres		89	355
- wool/other animal hair (not pulled)		124	4,727
- wool/other animal hair (pulled)		0	0
- old clothing & other old textile articles, rags, etc.		4,975	26,091
	Sub-total	**13,731**	**59,865**
	Total	**1,173,523**	**2,361,377**

Note :
Figures rounded off to the nearest 1

Table 6 Export of recovered waste materials in 1996

5. Waste Generation Rates and Forecasts

5.1 Generation Rates of Municipal Solid Waste

5.1.1 Waste generation rates are the common basis for comparison of the historical trend of municipal solid waste arisings. In this report, the per capita domestic waste generation rate is expressed as the quantity of waste disposed of per person per day. The per capita commercial & industrial waste generation rate is expressed as the quantity of waste disposed of per employee per day. The employees included in the calculation are people engaged in economic activities grouped under Division 3, 6 and 8 of the Hong Kong Standard Industrial Classification (HSIC) which include manufacturing, wholesale, retail, import and export trades, restaurants, hotels, finance, insurance, real estate and business services. Calculations were based on population and employment size data provided by C & SD.

5.1.2 Waste generation rates are the key parameters used in the existing waste forecasting methodology. Forecasts of waste generation rates are made by linear projection of the trend in the past. Experience obtained from past years' monitoring work indicated that domestic waste quantity was dependent on the population size while commercial & industrial waste was dependent on the employment size in the relevant commercial and industrial sectors. Variations in population or employment size could therefore affect the total waste quantity. As waste generation rates are independent of the population and employment size, they are therefore used in examining the trend of waste quantities.

5.1.3 The waste generation rates also provide a common basis for comparison between different geographical areas or WAD with different population and employment size. The generation rates for the 18 WAD in 1996 together with data in 1995 are shown in Table 7.

5.1.4 For domestic waste generation rate, the following major observations for 1996 are noted from Table 7 :

- the territorial average generation rate dropped slightly by 1% as compared with 1995, and 4% as compared with 1994;
- the generation rate for Yuen Long increased by 19%;
- the generation rates for Kwai Tsing dropped by 32%;
- the generation rate of the other WAD remained more or less the same as in 1995 with deviations smaller than 10%.

District	Domestic waste (kg/person/day)		Commercial & industrial waste (kg/employee/day)	
	1995	1996	1995	1996
Central & Western	1.39	1.36	0.30	0.33
Wanchai	1.76	1.82	0.37	0.37
Eastern	0.85	0.88	0.52	0.58
Southern	0.91	0.90	0.95	1.36
Hong Kong Island	1.10	1.10	0.41	0.47
Yau Tsim Mong	2.17	2.30	0.44	0.49
Sham Shui Po	1.17	1.11	0.60	0.63
Kowloon City	0.98	0.96	1.01	1.15
Wong Tai Sin	0.78	0.76	0.29	0.52
Kwun Tong	0.78	0.79	0.98	1.22
Kowloon	1.08	1.07	0.67	0.79
Urban area	1.09	1.08	0.56	0.64
Kwai Tsing	1.06	0.72	0.85	1.03
Tsuen Wan	1.01	1.04	1.51	1.59
Tuen Mun	0.85	0.84	1.90	4.85
Yuen Long	0.90	1.07	3.12	5.63
North	0.96	1.05	2.44	3.42
Tai Po	0.98	0.96	3.97	2.36
Sha Tin	0.77	0.80	2.07	1.76
Sai Kung	0.88	0.89	2.32	4.15
New Territories	0.92	0.89	1.80	2.32
Outlying Islands	1.58	1.79	cannot be determined	
Territorial average	1.01	1.00	0.88	1.07

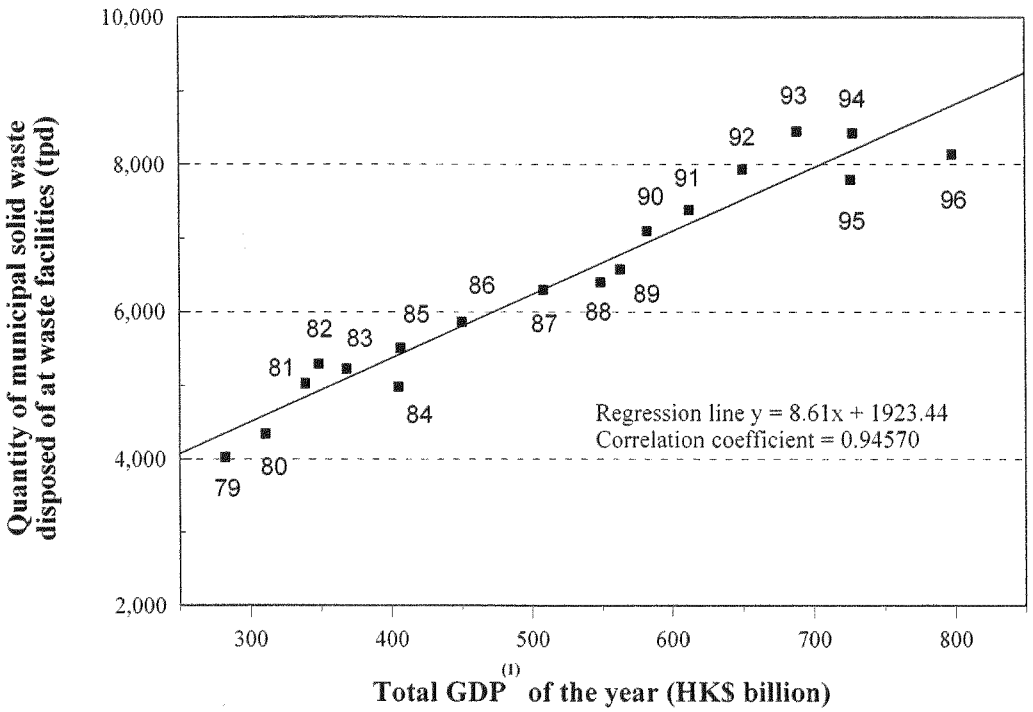
Table 7 Geographical variation in generation rates of municipal solid waste in 1995 and 1996

5.1.5 For commercial & industrial waste generation rate, the following major observations for 1996 are noted from Table 7 :

- the territorial average generation rate surged by 22%. This was comparable to the order of increase in the total quantity of commercial & industrial waste;
- the generation rates of most of the WAD generally increased in 1996;
- the percentage rise of the generation rates in several WAD were greater than the territorial average, these included Southern District (43%), Wong Tai Sin (79%), Kwun Tong (24%), Tuen Mun (155%),Yuen Long (80%), North Districts (40%) and Sai Kung (79%);
- only two WAD, Tai Po and Shatin, had a decrease of waste generation rate. There was a 41% and 15% drop, respectively, as compared with 1995.
- the boost of commercial & industrial waste generation rate could be attributed to the increase in commercial and industrial activities in Hong Kong. This could be revealed by a 10% rise of GDP (Figure 10 refers) in 1996;
- there was a slight decrease of about 2% in the number of employees in the whole territory from 1995 to 1996. The increase in the generation rate was therefore partly due to an increase in the quantity of commercial & industrial waste disposed of by decreasing amount of employees; and
- the low generation rates in the well-developed districts such as Central and Western, Wanchai and Yau Tsim Mong indicated that a significant portion of commercial & industrial waste was mixed with the domestic waste collected by USD. For outlying islands, virtually all commercial & industrial waste were delivered to refuse collection points and were then mixed with domestic waste before collection by RSD. Thus, the commercial & industrial waste generation rate for outlying islands could not be determined. This also explained why the domestic waste generation rate for outlying islands was higher than the territorial average.

5.2 Correlation of Quantity of Municipal Solid Waste with Gross Domestic Product

5.2.1 From previous data, it has been established that the quantity of municipal solid waste has a close relationship with the economic activities of Hong Kong as measured by GDP. Figure 10 demonstrates a linear relationship between the quantity of municipal solid waste and the total GDP. The quantity of municipal solid waste as shown in the figure only includes the municipal solid waste disposed of at waste facilities, but not municipal solid waste recovered for recycling.



Year	Municipal solid waste (2) (tpd)	GDP (1) (HK $ billion)
1979	4,030	282
1980	4,350	310
1981	5,030	339
1982	5,300	348
1983	5,230	368
1984	4,990	405
1985	5,510	407
1986	5,870	450
1987	6,300	509
1988	6,410	549
1989	6,580	563
1990	7,100	583
1991	7,390	612
1992	7,930	650
1993	8,450	690
1994	8,430	727
1995	7,790	726
1996	8,140	798(3)

Notes :
(1) GDP at constant (1990) market prices
(2) Figures rounded off to the nearest tenth
(3) Revised estimate

Figure 10 Correlation of municipal solid waste with total GDP from 1979 - 1996

5.2.2 If it is assumed that this correlation continues to exist in the future years, the quantity of municipal solid waste could be projected based on forecast of GDP figures. The forecast quantities of municipal solid waste using this approach can also be a counter-check of the forecast of waste quantities based on waste generation rates.

5.3 Forecast of Municipal Solid Waste

5.3.1 The existing methodology of forecasting the quantity of municipal solid waste (i.e. domestic waste and commercial & industrial waste) is based on two sets of parameters, viz. the projected waste generation rates and parameters on population and employment size. As noted in section 5.1.2, the future waste generation rate was determined using a linear projection of the past data. The forecast quantity of domestic waste could be worked out by multiplying the projected generation rate by the forecast population. For commercial & industrial waste, the projected generation rate times the forecast employment size will provide the forecast quantity. Population and employment size forecasts were provided by Plan. D.

5.3.2 The actual quantities and generation rates for the two types of municipal solid waste from 1986 to 1996 are tabulated in Figure 11. The domestic waste generation rate has generally been increasing over the period. The increasing trend is less obvious for commercial & industrial waste. It should be noted that generation rate for commercial & industrial waste surged in 1996.

5.3.3 Statistical trend analysis was applied to determine the underlying pattern of growth for municipal solid waste in the future years. It is noted that the average annual growth of the per capita domestic waste generation rate would be about 0.024 kg/person/day. The commercial & industrial waste generation rate displays an average annual increase of about 0.028 kg/employee/day. The linear regression models adopted for determining the future waste generation rates are as follows:

- domestic waste:

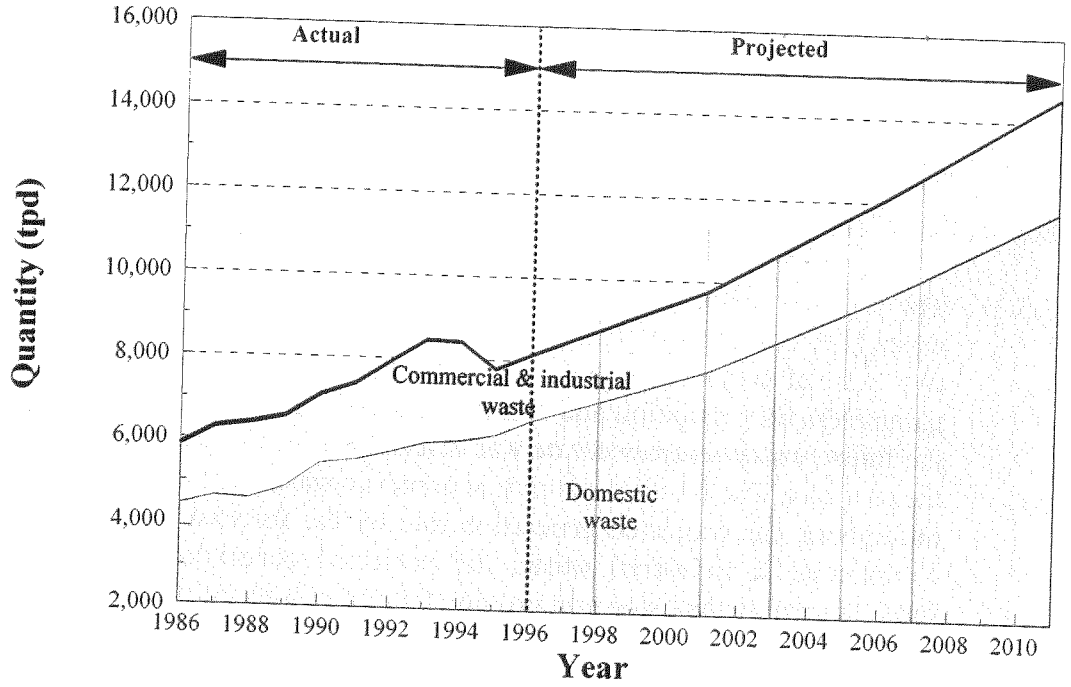
$$y_t = 0.0243t - 47.50$$

- commercial & industrial waste:

$$y_t = 0.0279t - 54.61$$

where y_t = per capita waste generation rate at year t
t = year

5.3.4 The projected per capita generation rates for the whole territory in the years 2001, 2006, 2011 are presented in Figure 11. In 2011, the domestic waste generation rate would reach 1.37 kg/person/day whereas that for commercial & industrial waste would be 1.49 kg/employee/day if the current growing trend of the generation rates continues.



Year	Domestic waste		Commercial & industrial waste		Municipal solid waste
	Quantity (tpd)	Per capita generation rate (kg/person/ day)	Quantity (tpd)	Per capita generation rate (kg/employee/ day)	Quantity (tpd)
1986	4,420	0.80	1,440	0.86	5,870
1987	4,630	0.83	1,680	0.97	6,300
1988	4,580	0.82	1,820	1.03	6,410
1989	4,870	0.86	1,720	0.96	6,580
1990	5,460	0.95	1,650	0.92	7,100
1991	5,560	0.98	1,830	1.09	7,390
1992	5,760	1.01	2,170	1.29	7,930
1993	6,000	1.02	2,450	1.44	8,450
1994	6,070	1.04	2,360	1.38	8,430
1995	6,210	1.01	1,580	0.88	7,790
1996	6,260	1.00	1,880	1.07	8,140
2001	*7,460	*1.13	*2,290	*1.21	*9,750
2006	*9,150	*1.25	*2,910	*1.35	*12,060
2011	*11,080	*1.37	*3,480	*1.49	*14,560

Note :
* Forecast figures

Figure 11 Per capita generation rates and the quantities of municipal solid waste disposed of at waste facilities, 1986 - 2011

5.3.5 While there is a general growing trend of the waste generation rates, it can be noted from Figure 11 that the generation rates for both types of waste may reach a steady trend over a period of time. This is not unusual as many factors like economy, changes in lifestyle, throw-away habits and waste reduction initiatives would affect waste generation. As data on waste generation rates are only available over a relatively limited time frame, there is no conclusive evidence to indicate potential limits to the growth of waste generation rates.

5.3.6 Based on the method mentioned in section 5.3.1 above, the forecast quantities of domestic waste, commercial & industrial waste on a territorial basis for the years 2001, 2006 and 2011 were calculated and are shown in Figure 11. In 2011, it is estimated that about 14,560 tpd of municipal solid waste would be generated for disposal in Hong Kong if no waste reduction measure is implemented. Of this amount, there would be 11,080 tpd of domestic waste and 3,480 tpd of commercial & industrial waste.

5.3.7 The forecast of domestic, commercial & industrial waste for each WAD in the years 2001, 2006 and 2011 is presented in Table 8. The forecast for each WAD is derived by multiplying the projected waste generation rate for each type of waste in the WAD by the respective population/employment size obtained from Plan. D.

5.3.8 The forecast quantity of municipal solid waste may be affected by the following factors:

- the Waste Reduction Plan to be implemented by the Government;
- financial instruments like the Landfill Charging Scheme which would be an incentive for the public to reduce the disposal of waste;
- extent of recycling activities;
- changes in environmental awareness, lifestyle, consumers behaviour, economic activities, manufacturing and product packaging technology;
- progress on the development of the new towns and redevelopment of urban areas; and
- changes in the forecast figures of future population and employment size.

5.4 Forecast of C & D Waste

5.4.1 CED has commissioned a consultancy study to review the public filling programme and strategy. The study will, among other things, forecast the quantity of C & D waste generated from 1998 onwards.

Year / District	Waste quantity: Domestic waste					
	Public			Private		
	2001	2006	2011	2001	2006	2011
Central & Western	350	470	660	50	70	100
Wanchai	250	340	400	70	100	110
Eastern	460	490	550	130	130	150
Southern	220	230	320	20	20	30
Hong Kong Island	**1,280**	**1,530**	**1,930**	**270**	**320**	**390**
Yau Tsim Mong	690	770	860	180	200	220
Sham Shui Po	360	380	430	90	90	100
Kowloon City	400	580	720	70	110	130
Wong Tai Sin	340	360	390	20	20	30
Kwun Tong	360	380	420	50	50	60
Kowloon	**2,150**	**2,470**	**2,820**	**410**	**470**	**540**
Kwai Tsing	330	340	380	20	20	20
Tsuen Wan	160	210	230	70	90	100
Tuen Mun	410	470	540	30	40	50
Yuen Long	620	880	1,020	90	130	160
North	230	260	400	70	80	120
Tai Po	250	280	310	30	30	30
Sha Tin	420	450	500	60	70	70
Sai Kung	320	500	540	30	40	40
New Territories	**2,740**	**3,390**	**3,920**	**400**	**500**	**590**
Outlying Islands	**180**	**400**	**760**	**30**	**70**	**130**
Territorial Total	**6,350**	**7,790**	**9,430**	**1,110**	**1,360**	**1,650**

Note :
Figures rounded off to the nearest tenth

Table 8 Forecast quantities of municipal solid waste by

(tpd) Commercial & industrial waste			Total municipal solid waste		
2001	2006	2011	2001	2006	2011
90	130	170	490	670	930
50	70	80	370	510	590
90	100	110	680	720	810
50	50	60	290	300	410
280	**350**	**420**	**1,830**	**2,200**	**2,740**
160	200	230	1,030	1,170	1,310
80	100	110	530	570	640
150	210	270	620	900	1,120
30	30	40	390	410	460
220	240	240	630	670	720
640	**780**	**890**	**3,200**	**3,720**	**4,250**
160	160	160	510	520	560
130	150	190	360	450	520
260	290	300	700	800	890
320	560	750	1,030	1,570	1,930
140	160	260	440	500	780
90	100	110	370	410	450
130	140	160	610	660	730
110	170	170	460	710	750
1,340	**1,730**	**2,100**	**4,480**	**5,620**	**6,610**
30	**50**	**70**	**240**	**520**	**960**
2,290	**2,910**	**3,480**	**9,750**	**12,060**	**14,560**

waste arisings districts in 2001, 2006 and 2011

Appendices

Appendix 1

Sources of data on chemical, special and other wastes in 1996

Waste type	Source of data
Chemical waste	Environmental Protection Department
Waterworks sludge (from Sha Tin Water Treatment Works)	Environmental Protection Department
Sewage sludge(from Sha Tin Sewage Treatment Works)	
Dewatered sludge	Environmental Protection Department(1); Civil Engineering Department(1)
Sewage works screenings	Environmental Protection Department(1); Civil Engineering Department(1)
Abattoir waste	Environmental Protection Department
Animal carcasses	Environmental Protection Department
Livestock waste	Environmental Protection Department
Condemned goods	Environmental Protection Department
High security waste	Electrical and Mechanical Services Department(1)
Clinical waste	Environmental Protection Department
Dredged mud and excavated materials	Environmental Protection Department
Pulverised fuel ash	Environmental Protection Department
Furnace bottom ash	
Incinerator ash	Environmental Protection Department(1); Civil Engineering Department(1)
CWTC stabilised residue	Environmental Protection Department

Note :
(1) Weighbridge record

System of waste arisings districts/areas used in waste arisings survey

District identity code	District name	Source area identity code	Source area name
1010	Central & Western	1011	Central
		1012	Sheung Wan
		1013	Mid Levels
		1014	Peak
		1015	Kennedy Town
1020	Wanchai	1021	Wanchai
		1022	Tai Hang / Happy Valley
1030	Eastern	1031	North Point
		1032	Quarry Bay
		1033	Shau Kei Wan
		1034	Chai Wan
1040	Southern	1041	Pok Fu Lam
		1042	Aberdeen
		1043	Stanley
2010*	Yau Tsim	2011	Tsim Sha Tsui East
		2012	Tsim Sha Tsui West
		2013	Yau Ma Tei
2020*	Mongkok	2021	Mongkok North
		2022	Mongkok South
2030	Sham Shui Po	2031	Sham Shui Po
		2032	Shek Kip Mei
		2033	Cheung Sha Wan
		2034	Lai Chi Kok
2040	Kowloon City	2041	Hung Hom
		2042	Ho Man Tin
		2043	Kowloon Tong
2050	Wong Tai Sin	2051	Wong Tai Sin
		2052	Ngau Chi Wan

Note :

* Yau Tsim (2010) and Mongkok (2020) District are amalgamated into one waste arisings district in accordance with the merging of the District Board Districts of Yau Tsim and Mongkok.

Appendix 2

District identity code	District name	Source area identity code	Source area name
2060	Kwun Tong	2061	Kwun Tong East
		2062	Kwun Tong West
		2063	Sau Mau Ping
		2064	Lam Tin
3010	Kwai Tsing	3011	Kwai Chung
		3012	Tsing Yi
3020	Tsuen Wan	3021	Tsuen Wan
3030	Tuen Mun	3031	Tuen Mun
		3032	Lam Tei
3040	Yuen Long	3041	Yuen Long
		3042	Tin Shui Wai
		3043	Kam Tin / Shek Kong
		3044	San Tin
3050	North	3051	Sheung Shui / Fanling
		3052	Shau Tau Kok
3060	Tai Po	3061	Tai Po
		3062	Shuen Wan
		3063	Tai Po Rural
		3064	Sai Kung North
3070	Sha Tin	3071	Sha Tin West
		3072	Sha Tin East
		3073	Sha Tin South
		3074	Ma On Shan
3080	Sai Kung	3081	Sai Kung South
		3082	Clear Water Bay
		3083	Junk Bay
4000	Outlying Islands		

Appendix 3

Breakdown of waste delivered to incineration plants, refuse transfer stations and landfills in 1996

Disposal facilities	Average daily waste intake[1] by waste type in 1996 (tpd)					
	MSW		Construction & demolition	Special	Total	Incinerator ash
	Public	Private				
Kwai Chung Incineration Plant (KCIP)	705	-	-	-	705	-
Kowloon Bay Transfer Station[2] (KBTS)	1,739	-	-	-	1,739	-
Island East Transfer Station[3] (IETS)	1,224	-	-	-	1,224	-
Sha Tin Transfer Station[4] (STTS)	853	-	-	-	853	-
Pillar Point Valley Landfill (PPVL)	16	625	2,027	134	2,802	78
WENT Landfill	633[5]	94	4	18	749[5]	73
SENT Landfill	169	1,654	5,159	248	7,230	-
NENT Landfill	0	431	331	89	851[5]	-
Sub-total	**5,339**	**2,804**				
Total	**8,143**		**7,521**	**489**	**16,153**	**151**

Notes :

(1) Average daily intake shown here is calculated by dividing the total waste intake in 1996 by 365 days irrespective of the operational period of the site

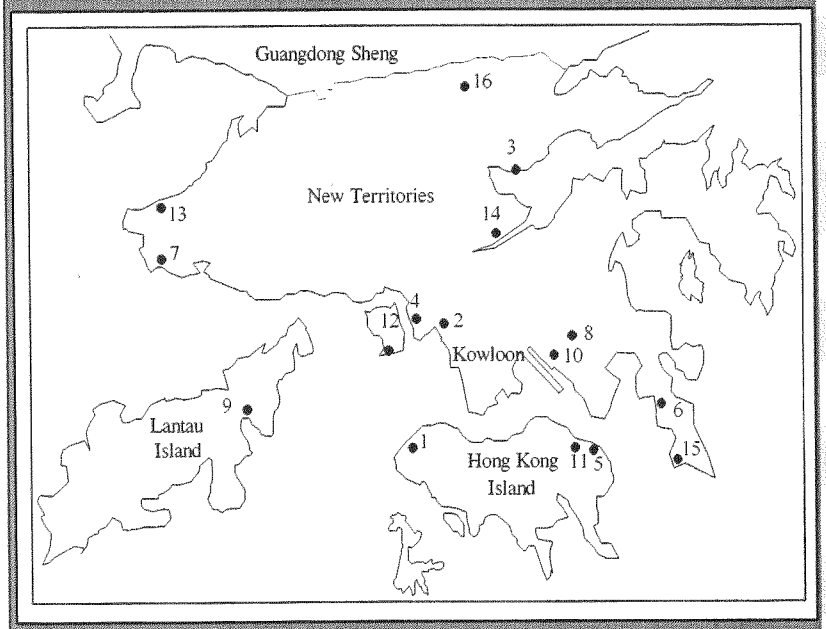
(2) Waste from KBTS was delivered to NENT

(3) Waste from IETS was delivered to WENT by barge

(4) Waste from STTS was delivered to NENT

(5) The quantity shown here does not include the waste from the RTS. Please also refer to Notes (2) - (4) above

Review of the waste intake at waste facilities



	Waste facilities	Year commissioned
1	Kennedy Town Incineration Plant	1967
2	Lai Chi Kok Incineration Plant	1969
3	Shuen Wan Landfill	1974
4	Kwai Chung Incineration Plant	1978
5	Chai Wan Composting/ Pulverisation Plant	1979
6	Tseung Kwan O Landfill	1979
7	Pillar Point Valley Landfill	1983
8	Jordon Valley Landfill	1986
9	Mui Wo Incineration Plant	1987
10	Kowloon Bay Transfer Station	1990
11	Island East Transfer Station	1992
12	Chemical Waste Treatment Centre	1993
13	WENT Landfill	1993
14	Sha Tin Transfer Station	1994
15	SENT Landfill	1994
16	NENT Landfill	1995

Notes :

(1) Figures refer to actual quantity of waste received by the facility, rounded off to the nearest tenth

(2) IETS was commissioned in Nov. 1992

(3) STTS was commissioned in Oct. 1994

Appendix 4

Average daily intake (tpd)											Year decommissioned
1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	
630	550	580	780	820	780	680	420	-	-	-	1993
1010	480	470	500	380	-	-	-	-	-	-	1990
1,240	1,360	1,950	2,450	3,750	7,000	5,670	6,410	7,570	6,230	-	1995
820	880	860	800	820	790	760	750	710	720	710	Scheduled in 1997
350	420	490	390	390	430	-	-	-	-	-	1991
2,200	4,560	6,050	4,730	6,330	13,150	9,890	10,660	10,490	4,880	-	1995
1,330	1,560	1,790	1,920	2,070	2,640	3,410	2,130	2,430	4,690	2,800	1996
380	970	1,010	930	370	-	-	-	-	-	-	1990
-	10	10	10	10	10	10	10	10	-	-	1994
-	-	-	-	980	1,530	1,600	1,720	1,760	1,690	1,740	
-	-	-	-	-	-	- (2)	1,140	1,250	1,200	1,220	
-	-	-	-	-	-	-	90	220	240	180	
-	-	-	-	-	-	-	1,170	2,700	2,810	1,970	
-	-	-	-	-	-	-	-	- (3)	800	850	
-	-	-	-	-	-	-	-	1,160	7,070	7,230	
-	-	-	-	-	-	-	-	-	2,620	3,440	

Review of composition of domestic waste

Year	Quantity [percentage by				
	Bulky waste	Paper	Glass	Metals	Plastics
1986	320	970	110	150	630
	[7.2]	[22.0]	[2.5]	[3.4]	[14.3]
1987	250	1,000	130	160	680
	[5.5]	[21.7]	[2.7]	[3.4]	[14.8]
1988	280	870	180	190	720
	[6.1]	[19.1]	[3.9]	[4.1]	[15.6]
1989	220	1,040	170	210	740
	[4.6]	[21.4]	[3.4]	[4.3]	[15.3]
1990	240	1,040	130	130	810
	[4.4]	[19.1]	[2.4]	[2.5]	[14.9]
1991	320	1,010	140	170	870
	[5.8]	[18.2]	[2.5]	[3.0]	[15.7]
1992	490	1,080	110	170	790
	[8.5]	[18.7]	[2.0]	[3.0]	[13.8]
1993	770	1,210	150	150	890
	[12.8]	[20.2]	[2.5]	[2.5]	[14.8]
1994	640	1,150	140	150	750
	[10.5]	[18.9]	[2.3]	[2.5]	[12.4]
1995	480	1,250	180	210	950
	[7.8]	[20.1]	[2.8]	[3.4]	[15.3]
1996	250	1,270	160	190	950
	[4.0]	[20.3]	[2.5]	[3.0]	[15.2]

Notes :

(1) Figures rounded off to the nearest tenth

(2) Figures may not add up to total due to rounding-off

(3) The quantity of each waste component shown here is estimate based on the percentage by weight of the component as determined from the composition analysis of municipal solid waste

(4) All 1996 data are estimate based on the trend in recent years

Appendix 5

(tpd)
weight (%)]

Textiles	Rattan/wood	Putrescibles	Others	Total
190	190	1,340	520	4,420
[4.2]	[4.2]	[30.4]	[11.8]	
210	190	1,450	550	4,630
[4.5]	[4.1]	[31.4]	[11.9]	
240	130	1,190	780	4,580
[5.2]	[2.8]	[26.1]	[17.1]	
290	70	1,390	730	4,870
[5.9]	[1.4]	[28.6]	[15.1]	
220	70	2,070	730	5,460
[4.0]	[1.4]	[38.0]	[13.3]	
270	130	1,740	900	5,560
[4.8]	[2.4]	[31.4]	[16.2]	
230	130	1,910	860	5,760
[3.9]	[2.2]	[33.1]	[14.8]	
240	130	1,600	860	6,000
[4.0]	[2.2]	[26.7]	[14.3]	
290	20	1,920	1,010	6,070
[4.8]	[0.3]	[31.7]	[16.6]	
200	200	1,930	820	6,210
[3.2]	[3.3]	[31.0]	[13.1]	
270	140	2,030	990	6,260
[4.4]	[2.2]	[32.5]	[15.9]	

Review of composition of commercial and industrial waste

Year	Quantity [percentage by				
	Bulky waste	Paper	Glass	Metals	Plastics
1986	N.A.	280 [19.3]	50 [3.2]	60 [4.0]	240 [16.9]
1987	N.A.	340 [20.2]	70 [3.9]	60 [3.8]	300 [17.8]
1988	N.A.	290 [16.1]	60 [3.5]	80 [4.2]	290 [16.0]
1989	20 [1.3]	330 [19.4]	40 [2.6]	90 [5.0]	310 [17.9]
1990	20 [0.9]	330 [20.3]	30 [1.9]	90 [5.7]	300 [18.0]
1991	30 [1.8]	340 [18.4]	50 [2.6]	70 [4.0]	320 [17.7]
1992	50 [2.5]	430 [19.8]	50 [2.2]	60 [2.9]	460 [21.4]
1993	40 [1.6]	780 [31.7]	20 [0.9]	80 [3.2]	430 [17.3]
1994	180 [7.7]	690 [29.3]	40 [1.8]	60 [2.5]	400 [16.9]
1995	50 [3.0]	500 [31.3]	40 [2.4]	80 [5.0]	280 [17.4]
1996	80 [4.1]	570 [30.1]	30 [1.8]	70 [3.5]	310 [16.2]

Notes :

(1) Figures rounded off to the nearest tenth

(2) Figures may not add up to total due to rounding-off

(3) N.A. = Data not available

(4) The quantity of each waste component shown here is estimate based on the percentage by weight of the component as determined from the composition analysis of municipal solid waste

(5) All 1996 data are estimate based on the trend in recent years

Appendix 6

(tpd)
weight (%)]

Textiles	Rattan/wood	Putrescibles	Others	Total
290	150	240	130	1,440
[20.2]	[10.7]	[16.9]	[8.8]	
280	210	260	160	1,680
[16.4]	[12.5]	[15.7]	[9.7]	
290	250	270	280	1,820
[16.0]	[13.6]	[15.1]	[15.5]	
290	170	180	290	1,720
[17.0]	[10.0]	[10.2]	[16.6]	
420	160	150	150	1,650
[25.5]	[9.7]	[9.0]	[9.0]	
350	180	240	250	1,830
[19.0]	[9.9]	[12.9]	[13.7]	
400	190	160	350	2,170
[18.5]	[9.0]	[7.5]	[16.2]	
280	260	130	440	2,450
[11.6]	[10.4]	[5.3]	[18.0]	
200	280	140	370	2,360
[8.4]	[11.8]	[5.8]	[15.8]	
120	250	50	230	1,580
[7.3]	[16.1]	[2.9]	[14.6]	
130	320	90	300	1,880
[6.8]	[16.9]	[4.7]	[15.9]	

Review of composition of municipal solid waste

Year	Quantity [percentage by				
	Bulky waste	Paper	Glass	Metals	Plastics
1986	320	1,250	160	210	880
	[5.4]	[21.3]	[2.7]	[3.5]	[15.0]
1987	250	1,340	190	220	980
	[4.0]	[21.3]	[3.0]	[3.5]	[15.6]
1988	280	1,170	240	270	1,010
	[4.4]	[18.2]	[3.8]	[4.1]	[15.7]
1989	250	1,370	210	300	1,050
	[3.7]	[20.9]	[3.2]	[4.5]	[16.0]
1990	260	1,380	160	230	1,110
	[3.6]	[19.4]	[2.3]	[3.2]	[15.6]
1991	350	1,350	180	240	1,200
	[4.8]	[18.3]	[2.5]	[3.2]	[16.2]
1992	540	1,510	160	230	1,260
	[6.8]	[19.0]	[2.1]	[3.0]	[15.9]
1993	810	1,990	170	230	1,320
	[9.5]	[23.6]	[2.0]	[2.7]	[15.6]
1994	820	1,840	180	210	1,150
	[9.7]	[21.8]	[2.2]	[2.5]	[13.6]
1995	530	1,740	210	290	1,230
	[6.8]	[22.3]	[2.8]	[3.7]	[15.8]
1996	330	1,840	190	260	1,260
	[4.0]	[22.6]	[2.4]	[3.1]	[15.4]

Notes :

(1) Figures rounded off to the nearest tenth

(2) Figures may not add up to total due to rounding-off

(3) The quantity of each waste component shown here is estimate based on the percentage by weight of the component as determined from the composition analysis of municipal solid waste

(4) All 1996 data are estimate based on the trend in recent years

Appendix V

(tpd)
weight (%)]

Textiles	Rattan/wood	Putrescibles	Others	Total
480	340	1,590	650	5,870
[8.1]	[5.8]	[27.1]	[11.1]	
490	400	1,720	710	6,300
[7.7]	[6.3]	[27.2]	[11.4]	
530	380	1,470	1,070	6,410
[8.3]	[5.9]	[22.9]	[16.7]	
580	240	1,570	1,020	6,580
[8.7]	[3.7]	[23.8]	[15.5]	
640	230	2,220	880	7,100
[9.0]	[3.3]	[31.3]	[12.3]	
610	320	1,980	1,150	7,390
[8.3]	[4.3]	[26.8]	[15.6]	
630	320	2,070	1,210	7,930
[7.9]	[4.0]	[26.1]	[15.2]	
520	380	1,730	1,300	8,450
[6.2]	[4.5]	[20.5]	[15.4]	
490	300	2,060	1,380	8,430
[5.9]	[3.5]	[24.5]	[16.3]	
310	460	1,970	1,050	7,790
[4.0]	[5.9]	[25.3]	[13.4]	
400	450	2,120	1,290	8,140
[4.9]	[5.6]	[26.1]	[15.9]	

Appendix B

Recovery of major recyclable wastes in 1996

Waste type	Quantity of waste recovered in 1996('000 tonnes)		
	Exported to overseas (C & SD figures) (a)	Recycled locally (b)	Total recovery (c) = (a) + (b)
Paper	425	325	750
Plastics	201	11	212
Ferrous metals	391	103	494
Non-ferrous metals	143	10	153
Glass[1]	0.2	2	2.2
Wood	0.1	3	3.1
Rubber tyre	0	6	6
Textiles	14	1	15
Total	**1,174**	**461**	**1,635**

Note :

(1) Excluding glass beverage bottles recovered through deposit-and-refund system operated by local beverage manufacturers