MONITORING OF SOLID WASTE IN HONG KONG 1997

Environmental Protection Department

inside cover : loading refuse container into a marine vessel (top) for bulk transfer to landtill and subsequent disposal (bottom)

front cover : The Island West Transfer Station and the West Kowloon Transfer Station came into operation in mid - 1997

Monitoring of Solid Waste in Hong Kong 1997

Facilities Planning Group
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Monitoring of Solid Waste in Hong Kong 1997

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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
EPS	-	Expanded polystyrene
GDP	-	Gross Domestic Product
IETS	-	Island East Refuse Transfer Station
IWTS	-	Island West Refuse Transfer Station
KBTS	-	Kowloon Bay Refuse Transfer Station
KCIP	-	Kwai Chung Incineration Plant
MSW	-	Municipal Solid Waste
NENT	-	North East New Territories Landfill
NT	-	New Territories
PET	-	Polyethylene terephthalate
Plan. D	-	Planning Department
RSD	-	Regional Services Department
RTS	-	Refuse Transfer Stations
SENT	-	South East New Territories Landfill
STTS	-	Sha Tin Refuse Transfer Station
TDSR	-	Territorial Development Strategic Review
tpd	-	tonnes per day
USD	-	Urban Services Department
WAA	-	Waste Arising Area
WAD	-	Waste Arising District
WENT	-	West New Territories Landfill
WKTS	-	West Kowloon Refuse Transfer Station

Executive Summary

(1) The monitoring of solid waste in 1997 was a continuation of previous work initiatives. The latest findings were recorded under similar headings and formats of previous reports in the same series and summarized in the following paragraphs.

(2) In 1997, Hong Kong generated more than 42,000 tonnes of solid waste and reusable materials daily. The net intake quantity of solid waste in 1997 at all waste facilities was 15,800 tonnes per day; a small drop by 2 per cent from 1996. The major types of solid waste disposed of at waste facilities were municipal solid waste (8,680 tonnes per day) and construction & demolition waste (6,480 tonnes per day). Landfilled municipal solid waste was made up of 6,760 tonnes of domestic waste, 1,220 tonnes of commercial waste and 700 tonnes of industrial waste. As regards recovered materials, 21,950 tonnes of inert construction & demolition materials were reused daily for land formation and another 4,200 tonnes of municipal solid waste was recovered for recycling.

(3) 33 per cent (i.e. 1.54 million tonnes) of total municipal solid waste was recovered and recycled, of which 0.31 million tonnes was recycled locally and 1.23 million tonnes was exported for recycling in 1997. All other municipal solid wastes in Hong Kong were disposed of at the three strategic landfills, abbreviated as SENT, NENT and WENT, after the decommissioning of the Kwai Chung Incineration Plant in May 1997. The SENT landfill had the highest daily waste intake of about 7,800 tonnes and the NENT landfill the lowest daily intake of about 3,500 tonnes whereas the WENT landfill accepted more than 4,200 tonnes.

(4) Upon the opening of two additional refuse transfer stations in mid-1997 at West Kowloon and Island West, all five refuse transfer stations transferred daily more than 5,000 tonnes of publicly collected municipal solid waste in bulk containers to the WENT and NENT landfills by sea and road respectively.

(5) The overall intake of construction & demolition waste at all landfills reduced further to 42 per cent of the total waste landfilled in 1997, as a result of continued diversion of reusable materials to public filling areas and the provision of new barging

points and public filling areas. The total quantity of construction & demolition waste delivered to public filling areas and landfills in 1997 was 7 per cent lower than that of 1996.

(6) The relative proportions of the major components in domestic waste, com mercial & industrial waste and municipal solid waste remained fairly constant in recent years. Paper and putrescibles were the major components constituting more than half of the landfilled municipal solid waste, representing 25.7 per cent and 25.5 per cent respectively. Paper waste was the most popular item for recycling in 1997 and non-ferrous metals had the greatest financial value for recovery despite their relatively small percentage by weight.

(7) The generation rate of domestic waste in 1997 was about 1.04 kilogram per person per day. The annual generation rates over the last six years since 1992 fluctuated over a small range of 1.00 to 1.04 kilogram per person per day. However, the generation rate of commercial & industrial waste increased slightly to 1.10 kilogram per employee per day in 1997, compared to 1.07 kilogram per employee per day in 1996.

(8) If the current growing trend in the quantity of municipal solid waste continues, per capita generation rates of domestic waste and commercial & industrial waste would be 1.15 kilogram per day and 1.41 kilogram per day respectively in year 2011. The predicted quantity of municipal solid waste requiring final disposal in year 2011 would be 12,810 tonnes daily; making up of 9,570 tonnes of domestic waste and 3,240 tonnes of commercial & industrial waste.

1. Introduction

1.1 Background

1.1.1 Following the growth in population and economy in Hong Kong since the 1980s when the monitoring of solid waste started, the total quantity of waste discarded from households, commercial and industrial activities has over the years generally increased. Figure 1 portrays the wasteloads requiring disposal at waste facilities over the last decade by type.

1.1.2 In 1981, the Environmental Protection Agency, the predecessor of the Environmental Protection Department (EPD), launched a waste monitoring programme to gather information related to the design needs of the waste management system. The objectives of this programme include establishing geographical distribution of solid waste and their major constituents as well as identifying socio-economic parameters that can be used for forecasting future waste management needs and planning for appropriate waste facilities. Since then, subsequent waste monitoring has been conducted annually.

1.1.3 The information collected from the monitoring work has been used in various aspects of waste management planning which include the development of the Waste Disposal Plan (1989) and the Waste Reduction Framework Plan (1998).

1.1.4 The Waste Disposal Plan published in 1989 sets out the disposal strategy for solid waste and includes the development of cost-effective new waste facilities of high environmental standards. In 1997, these new facilities include the Chemical Waste Treatment Centre, three specially-built landfills and a network of five refuse transfer stations under the management of the EPD.

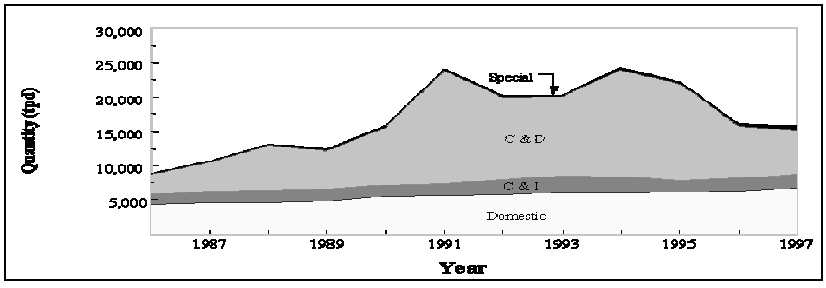


Figure 1 : Quantity of the major types of solid waste disposed of at solid waste facilities 1986-1997

(Note : Please refer to paragraph 2.1 for detailed interpretations of waste terminology)

1.2 Importance of the Waste Monitoring Programme

1.2.1 Waste monitoring is an important exercise for keeping track of waste statistics and relevant development. The existing database of fundamental waste information has been compiled since 1981. The latest waste disposal records and data collected each year from the waste monitoring programme enable the EPD to fine-tune waste forecasting and take account of the best estimates for strategic waste management and planning such as:-

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

1.3 Scope of this Report

1.3.1 This annual report for calendar year 1997 is the fourteenth in a series of reports on the solid waste monitoring work carried out by the EPD. The latest findings of waste monitoring surveys and records of waste handling at all waste disposal facilities are compiled under various tables and figures in Chapters 3 to 5, and appendices at the end of this publication in similar structure and headings as in recent reports.

1.3.2 Chapter 2 describes the approaches in monitoring waste information in 1997 together with relevant sources of reference. It also covers the classification and terminology of different types of solid waste used in this report.

1.3.3 Chapter 3 summarizes the waste disposal records at various disposal outlets such as landfills, refuse transfer stations, chemical waste treatment centre and incineration plant.

1.3.4 Updated information on recovery and recycling of municipal solid waste and

financial values of various recovered waste materials are presented in Chapter 4.

1.3.5 Chapter 5 provides per capita generation rates of domestic waste and commercial & industrial waste in 1997 and their projections up to 2011. This chapter also presents the forecasted quantities of municipal solid waste and construction & demolition waste up to 2011.

2. Classification of Solid Waste and Waste Monitoring Methodology

2.1 Waste Classification and Terminology

2.1.1 In this report, solid waste is classified into five main groups by making reference to the source of waste and the institutional arrangements for waste collection and disposal. These five groups of solid waste are municipal solid waste, construction & demolition (C&D) waste, chemical waste, special waste and other waste. The current classification system of solid waste is depicted in Figure 2 and detailed interpretations of some commonly used terms are described below.

2.1.2 Municipal solid waste includes domestic waste, commercial waste and industrial waste but excludes C&D waste.

- Domestic waste refers to waste generated from daily activities in residential premises and refuse collected from public cleansing services. Public cleansing waste includes dirt and litter collected by the two Municipal Councils (or Provisional Municipal Councils in the second half of 1997), marine refuse collected by the Marine Department and waste from country parks collected by the 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 is mixed with domestic waste and 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 refuse collection vehicle. These items are regarded as bulky waste. They may come

from residential premises, commercial and industrial activities and are usually collected separately.

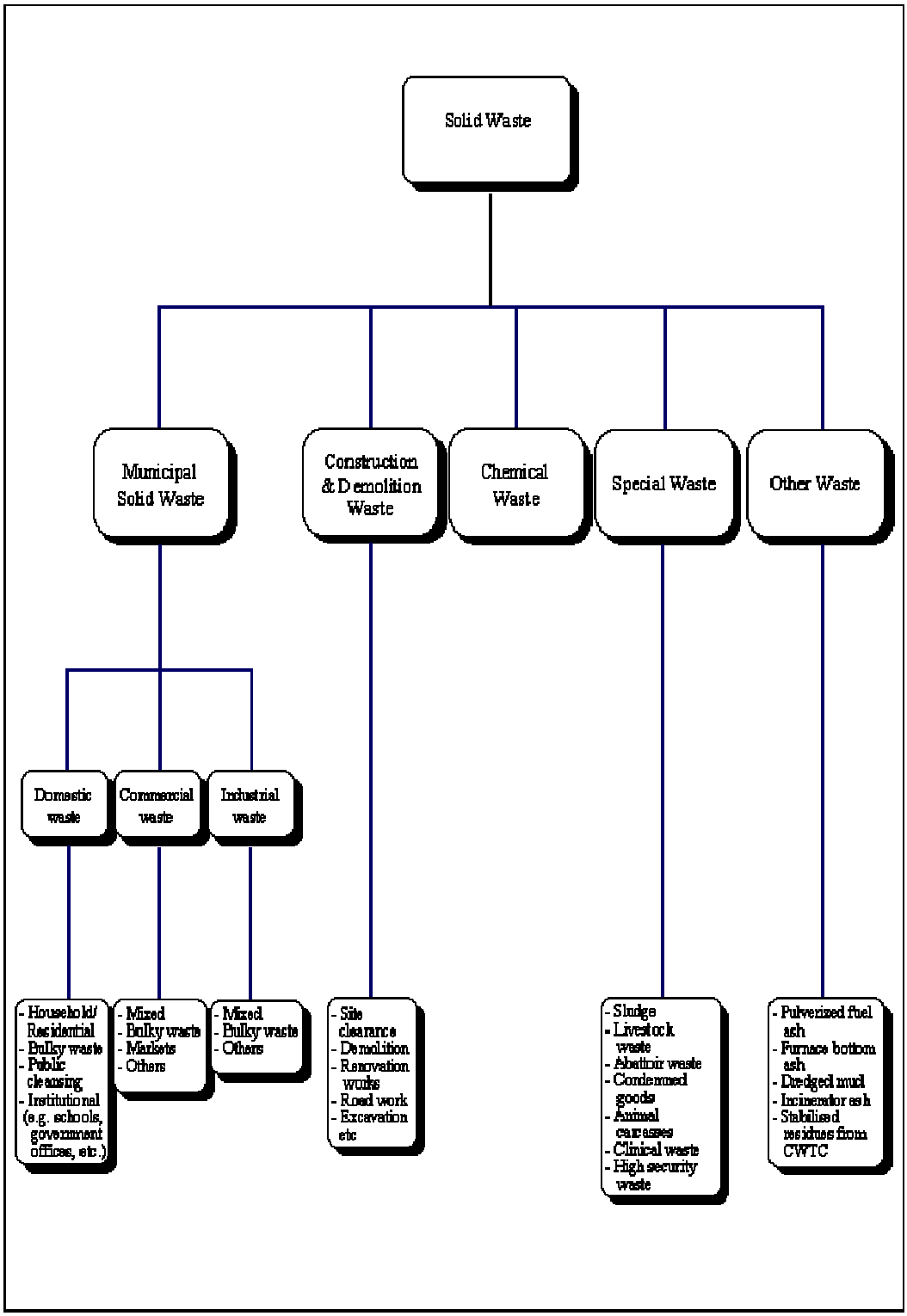


Figure 2 : Current classification of solid waste

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 per cent by volume (or 30 per cent 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&D waste, which is not normally accepted by landfills, consists of more than 20 per cent by volume (or 30 per cent 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 to the environment or become a risk to health.

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

2.1.6 Other waste refers to waste types not covered by the above descriptions. These include coal ash, incineration plant ash, stabilized residues from Chemical Waste Treatment Centre, dredged mud and excavated materials disposed of at marine dumps.

2.2 Methodology

2.2.1 Waste data are mainly collected by two approaches : weighing exercise at all facilities throughout the year and waste characterization using sampling techniques. After the closure of the last one of the old generation incinerators at Kwai Chung in May 1997, all solid waste facilities in Hong Kong are now managed by the EPD whereas public filling areas and barging points accepting inert C&D materials are managed by the CED. Whilst the wasteload of each intake is monitored immediately at each waste disposal facility, waste

composition is characterized in a separate survey exercise. Other departments, such as the RSD, USD, CED, C&SD and Plan.D also provide the EPD with relevant statistics regularly.

2.2.2 The following data were collected from various sources throughout the whole year and compiled into various tables, figures and appendices:-

- weighbridge intake records at landfills, refuse transfer stations (RTS) and incineration plant (KCIP); the latter being managed by the EMSD;
- results of waste composition characterization conducted in July/August and November/December 1997 at landfills and RTS;
- collection routes & schedules of the refuse collection fleet of the USD and RSD;
- results of the weighing exercise of refuse collected by the USD and RSD;
- concluded annual figures of total gross domestic product (GDP), population and employment from the Census & Statistics Department;
- predicted figures of population and employment in 2001, 2006 and 2011 from the Planning Department under Scenario B of the TDSR; and
- quantities of special wastes and other wastes from relevant specialist groups in the EPD and concerned government departments.

3. Waste Quantities and Characteristics

3.1 Waste Disposal Statistics

3.1.1 In 1997, solid waste disposed of at all landfills, refuse transfer stations and incineration plant dropped by 2 per cent from 1996 to a daily average of 15,775 tonnes. The three specially-built landfills at the south east, north and west New Territories, abbreviated as SENT, NENT and WENT, were supported by a network of five refuse transfer stations at Kowloon Bay (KBTS), Island East (IETS), Sha Tin (STTS), West Kowloon (WKTS) and Island West (IWTS).

3.1.2 Table 1 summarizes by waste type the quantity of solid waste disposed of at these facilities and its percentage change from 1996. Domestic waste and construction & demolition (C&D) waste were the major components summing up to 84 per cent of all solid waste. The domestic waste had the highest increase in terms of quantity from 1996 by 500 tonnes per day (tpd) but the C&D waste had the highest reduction by 1,040 tpd. The net effect was an overall decrease in the quantity of solid waste requiring disposal. The reduced intake of C&D waste at landfills was a result of a decrease of total C&D waste arisings in 1997 by 7 per cent.

3.1.3 The domestic waste intake at waste facilities increased by 8 per cent to 6,755 tpd. There was a 2 per cent increase in commercial & industrial (C&I) waste. Commercial waste intake increased by 12 per cent to 1,220 tpd but industrial waste intake decreased by the same percentage to 701 tpd. Municipal solid waste (MSW) increased by a net 7 per cent to 8,676 tpd. Special waste intake increased by 26 per cent to 618 tpd due to the diversion of sewage and waterworks sludge to landfills subsequent to the suspension of marine disposal.

3.1.4 Table 1 also presents the breakdown of solid waste collected by the public and private sectors. In general, C&D waste and C&I waste were collected by private waste collectors whereas domestic waste by the Urban Services Department (USD) and Regional Services Department (RSD). However, publicly collected domestic waste included some C&I waste owing to (i) mixing of C&I waste with domestic waste prior to delivery to refuse collection points in some old urban areas, (ii) historical reason that the Municipal Councils have been collecting C&I

waste at some commercial districts, and (iii) the current practice that the Municipal Councils collect some market waste.

Waste type		Quantity (tpd)			Percentage change from 1996
		Public(1)	Private(2)	Total	
a.	**Domestic waste**				
	- household mixed/public cleansing	5,414	1,048	6,462	
	- bulky waste	274	19	293	
	Sub-total	5,688[3]	1,067	6,755	+8%
b.	**Commercial waste**				
	- commercial mixed	-	1,073	1,073	
	- bulky waste	-	80	80	
	- markets	-	60	60	
	- others		7	7	
	Sub-total		1,220	1,220	+12%
c.	**Industrial waste**				
	- manufacturing mixed	-	273	273	
	- bulky waste	-	11	11	
	- others	-	417	417	
	Sub-total		701	701	-12%
d.	**Municipal solid waste received at**	5,688	2,988	8,676	+7%
e.	**Construction & demolition waste**	-	6,481	6,481	-14%
f.	**Special waste (landfilled)**	398	220	618	+26%
g.	**All waste received at waste facilities**	**6,086**	**9,689**	**15,775**	**-2%**

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

Table 1: Quantity of solid waste disposed of at landfills, RTS and incineration plant in 1997

3.1.5 The average daily waste intake at each facility by waste type in 1997 is given in Appendix 2.

3.1.6 The past disposal records of solid waste from 1986 to 1997 at all waste facilities are compiled by waste type in Table 2 and by facility in Appendix 3. Only domestic waste showed a continued increasing disposal trend over the last decade. Its quantity was primarily dependent on population which had also increased steadily during the period. Similar pattern was not observed for other waste types. Their quantities were affected by the territory's economic and construction activities which varied from time to time. The substantial reduction of C&D waste intake at landfills after 1995 was a result of (i) joint effort amongst government departments in providing new barging points and public filling outlets for inert C&D materials and promoting their re-utilization, and (ii) support from the construction trade.

Year	Quantity of waste by type (tpd)						
	Municipal solid waste				C&D (landfilled) (e)	Special (landfilled) (f)	TOTAL (g)=(d)+(e)+(f)
	Domestic[1] (a)	Commercial (b)	Industrial (c)	Sub-total (d)=(a)+(b)+(c)			
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	7,10	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
1997	6,760	1,220	700	8,680	6,480	620	15,780

Notes :

(1) Some domestic waste was incinerated up to May 1997

Figures may not add up to total due to rounding-off

Table 2: Summary of the major types of solid waste disposed of at landfills, RTS and incineration plant 1986 - 1997

3.1.7 Whilst territorial intake quantities of solid waste at all waste facilities have been summarized in Tables 1 & 2 and Appendices 2 & 3, seasonal fluctuation occurred again in 1997 with a maximum of 8 per cent surge in the summer months from the annual average. The surge might be explained by the increased production of domestic waste during the summer time, for instance, soft drink container and fruit waste.

3.1.8 The quantities and disposal methods of special and other wastes are summarized in Table 3. About 74 tpd grease trap waste was accepted for treatment at the Interim Grease Trap Waste Treatment Facility located at the WENT landfill prior to co-disposal. This waste is not included in Table 3 for it is regarded as a special aqueous waste due to its high water content.

Waste type	Disposal method	Quantity disposed of
Chemical waste other than asbestos waste	CWTC	189 tpd
	Co-disposal at landfills	4 tpd
Asbestos waste	Co-disposal at landfills	12 tpd
Dewatered waterworks and sewage sludge	Landfilling	307 tpd
Sewage works screenings	Landfilling	49 tpd
Abattoir waste	Landfilling	24 tpd
Animal carcasses	Landfilling	19 tpd
	Crematories, Kennedy Town By-Product Plant	
Livestock waste	Composting and other environmentally acceptable means	490 tpd
Condemned goods	Landfilling	18 tpd
High security waste	Incineration	12 tpd
Clinical waste	Co-disposal at landfills	
Dredged mud and excavated materials	Marine dumping	37,052 cu.m/day
Pulverised fuel ash	Concrete manufacturing, stored in lagoon	1,607 tpd
Furnace bottom ash	Concrete manufacturing, stored in lagoon	217 tpd
Incinerator ash	Landfilling	155 tpd
CWTC stabilised residue	Landfilling	53 tpd

Note :
(1) Figure up to decommissioning of Kwai Chung Incineration Plant, i.e. May 1997 & provided by Electrical and Mechanical Services Department

Table 3 : Quantities of different kinds of special and other wastes disposed of in 1997

3.2 Geographical Distribution of Major Solid Waste

3.2.1 The quantity of each type of solid waste disposed of at waste facilities is attributed to 18 waste arising districts (WAD) identical to that of the District Board districts. In order to facilitate the monitoring of distribution of waste source, these 18 WAD districts have been sub-divided into 54 waste arising areas (WAA) which are aggregates of tertiary planning units. Details of each WAD and its WAA are summarized in Appendix 1. Table 4 shows the geographical distribution of the major solid waste disposed of in 1997 by WAD. The geographical breakdown should be regarded as indicative only because the information was provided by drivers who generally stated the last pick up location before entering any weighbridge of waste facilities when each waste collection vehicle might have visited a number of locations.

3.2.2 Figure 3 depicts the bulk containerized transfer routings of solid waste by road and sea from refuse transfer stations to landfills. Figure 3 also portrays in bar-charts the quantities of domestic waste and C&I waste collected and disposed of at waste facilities within four geographical regions. Kowloon & Hong Kong Island had the highest collected quantity of MSW in the territory in 1997. Since there was no final disposal outlet in this region, the huge quantity of domestic waste was delivered to the adjacent refuse transfer stations for containerized bulk transfer to landfills. Waste collected from a particular geographical region may not end up in a final waste disposal outlet in its vicinity. The flexibility of the waste transfer system is that its destiny can be changed to where the new disposal facility will be, without disrupting the waste collection services in any region.

3.3 Utilization of Waste Facilities

3.3.1 Appendix 2 summarizes the waste intake by type at each waste facility in 1997. All refuse transfer stations and the Kwai Chung Incineration Plant accepted only publicly collected MSW. Among the three strategic landfills, the SENT landfill received the majority of landfilled C&D waste and privately collected MSW in 1997. It also received the greatest amount of waste in 1997. More than 81 per cent solid waste intake at the WENT or NENT landfill was MSW. In addition, the WENT and NENT landfills each accepted about 50

per cent RTS processed MSW for final disposal.

3.3.2 Figure 4 presents the provision of waste facilities in 1997, the total quantity of daily waste intake at each waste facility in 1997 and its percentage change over the previous year 1996. Upon the commissioning of two refuse transfer stations at West Kowloon and Island West in mid-1997, a substantial increase of waste intake at the WENT landfill was observed. The average daily intake quantity at the WENT landfill was more than double its intake in 1996. The change was mainly due to bulk transfer of containerized MSW by sea to the WENT landfill after compaction at the new transfer stations. The increased acceptance at the WENT landfill was accompanied by a reduction of waste intake at the NENT landfill from July 1997 onwards.

Waste Arising District (WAD)	Quantity[1] (tpd)					
	Domestic waste		C&I Waste	Municipal solid waste	C&D waste (Landfilled)	All solid waste[3]
	Publicly collected[2] (a)	Privately collected (b)	(c)	(d) =(a)+(b)+(c)	(e)	(f) =(d)+(e)
Central & Western	345	52	86	483	553	1,036
Wanchai	246	65	83	394	277	671
Eastern	437	123	101	661	321	982
Southern	265	18	53	336	102	438
Hong Kong Island Sub-total	**1,293**	**258**	**323**	**1,874**	**1,253**	**3,127**
Yau Tsim Mong	511	114	132	757	876	1,633
Sham Shui Po	333	69	106	508	294	802
Kowloon City	316	65	111	492	313	805
Wong Tai Sin	296	14	37	347	271	618
Kwun Tong	437	74	225	736	1,082	1,818
Kowloon Sub-total	**189,325**	**336**	**611**	**2,840**	**2,836**	**5,676**
Kwai Tsing	326	10	100	436	189	625
Tsuen Wan	216	103	165	484	291	775
Tuen Mun	392	66	164	622	287	909
Yuen Long	343	37	161	541	86	627
North	215	132	133	480	370	850
Tai Po	271	44	62	377	106	483
Sha Tin	433	60	150	643	219	862
Sai Kung	176	21	52	249	660	909
NT - Mainland Sub-total	**2,372**	**473**	**987**	**3,832**	**2,208**	**6,040**
Cheung Chau[4]	46	-	-	46	-	-
Mui Wo[4]	28	-	-	28	-	-
Peng Chau[4]	15	-	-	15	-	-
Discovery Bay[4]	16	-	-	16	-	-
Lamma Island[4]	18	-	-	18	-	-
Hei Ling Chau[4]	7	-	-	7	-	-
NT - Outlying Islands Sub-total	**130**	**-**	**-**	**130**	**184[5]**	**314**
Territorial Total	**5,688**	**1,067**	**1,921**	**8,676**	**6,481**	**15,157**

Note :

(1)The geographical distribution of solid waste is based on weighbridge records and should be regarded as indicative only

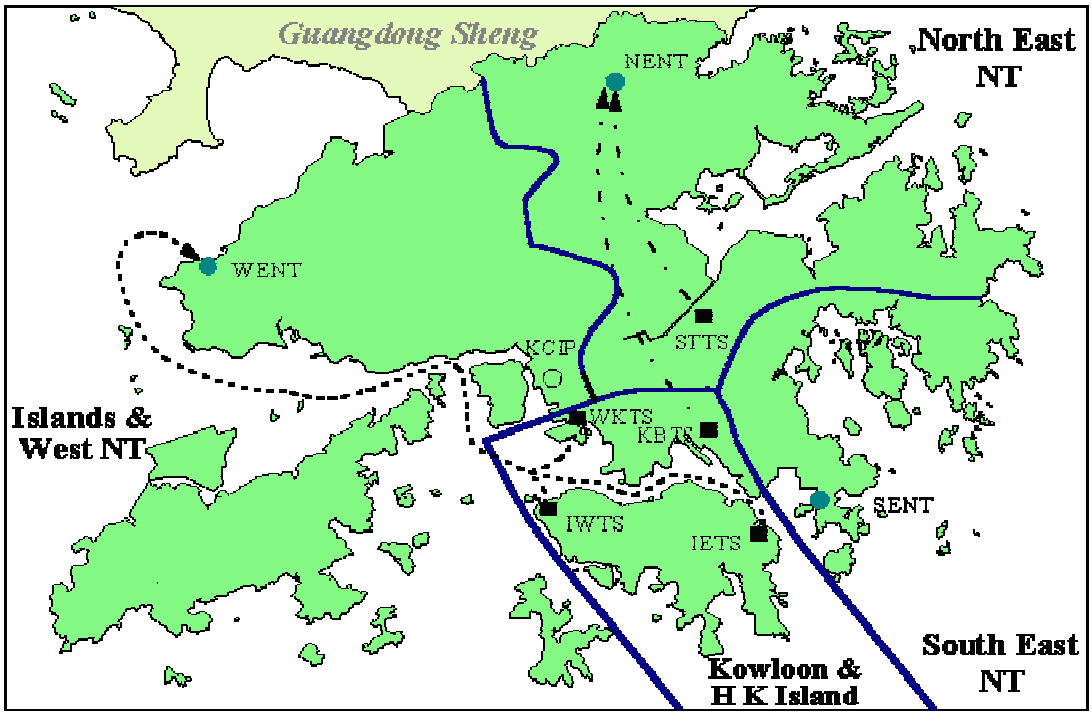
(2)Publicly collected domestic waste included public cleansing waste as well as some commercial and industrial waste

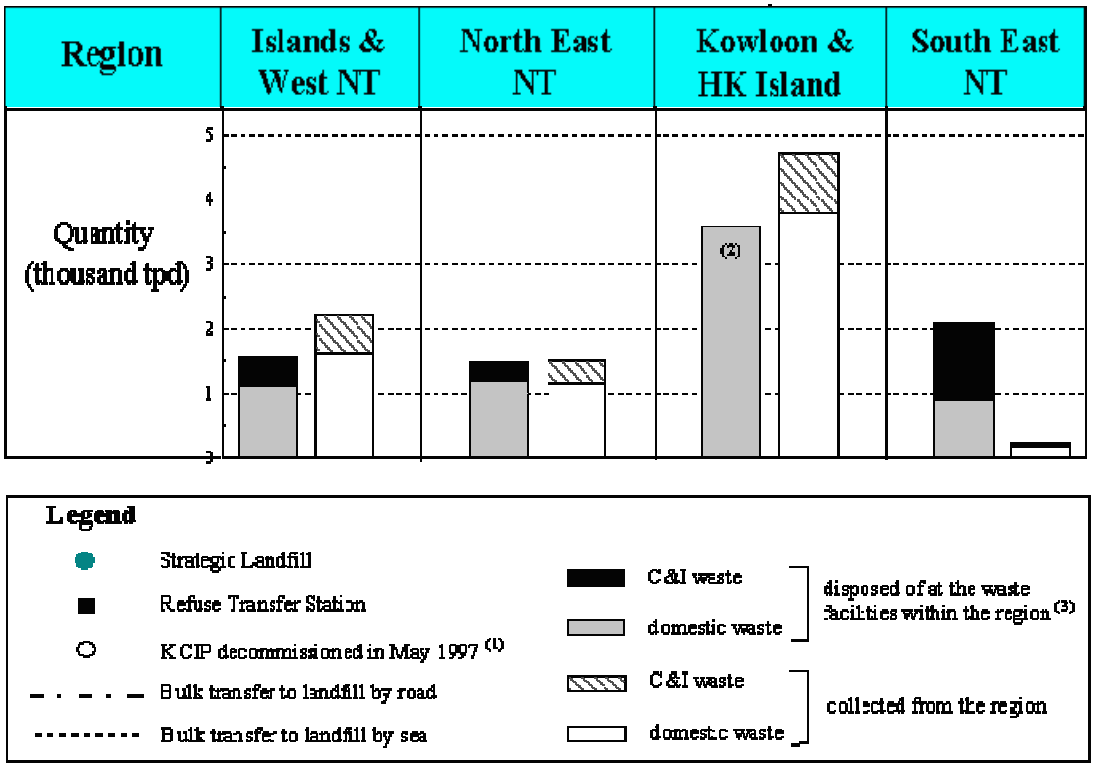
(3)Special waste not included in this table

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

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

Table 4 : Geographical distribution of major solid waste disposed of in 1997





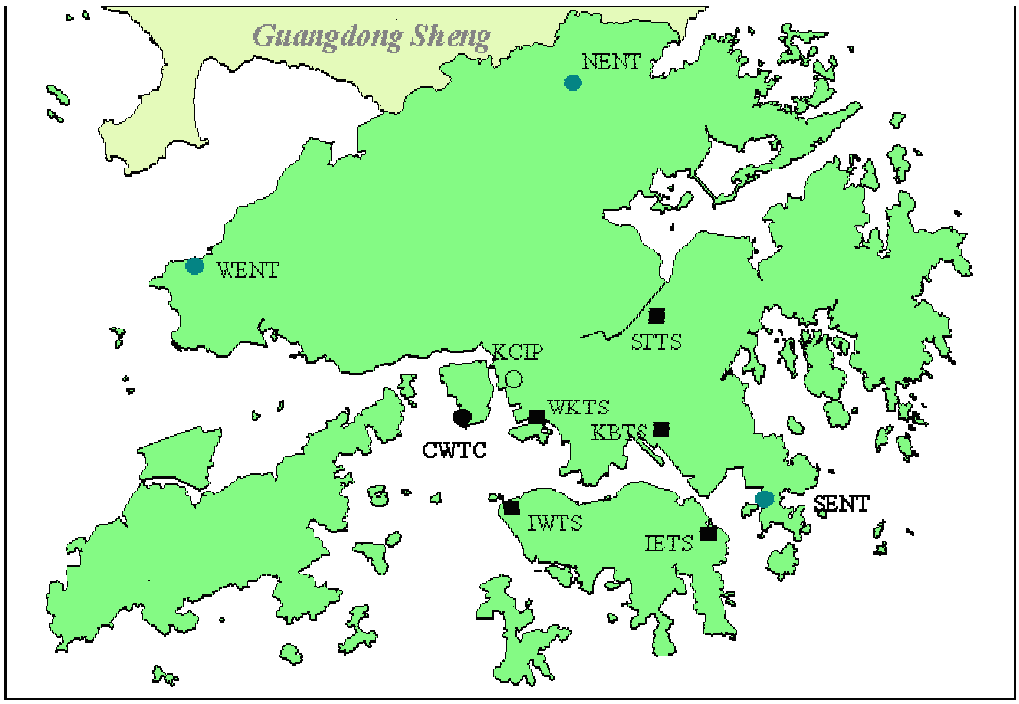
Notes :

(1) Upon decommissioning of KCIP in May 1997, waste arising from Kwai Chung and Tsuen Wan districts was substantially delivered to the WKTS.

(2) Domestic waste disposed of at RTS in the region of Kowloon & HK Island was transferred to WENT and NENT landfill by sea and road respectively.

(3) Quantity excludes RTS processed MSW.

Figure 3 : Quantity of municipal solid waste collected and disposed of at waste facilities in 1997 by geographical region



Landfill		WENT[2] 4,178 tpd (+111.8%)	SENT 7,825 tpd (+8.2%)	NENT 3,495 tpd (+1.5%)		
RTS		IETS[3] 944 tpd (-22.9%)	IWTS[3][5] 458 tpd	WKTS[3][5] 1,445 tpd	KBTS[4] 1,399 tpd (-19.6%)	STTS[4] 919 tpd (+7.7%)
CWTC		189 tpd (+7.4%)				
Incinerator		KCIP[6] 755 tpd (+7.1%)				

Notes:
(1) Percentage increase/decrease over previous year is shown in brackets
(2) The quantities shown here do not include incinerator ash disposed of at landfills
(3) Waste from IETS, IWTS and WKTS was transferred to WENT by barge;IWTS&WKTS were commissioned in May & June 1997 respectively.
(4) Waste from KBTS and STTS was transferred to NENT by road
(5) Waste intake since commissioning
(6) Waste intake up to decommissioning in May 1997

Facilities under the management of EPD

Figure 4 : Waste intake at waste facilities in 1997[1]

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

3.4.1 Public filling areas are proper disposal outlets for inert C&D materials (commonly known as public fill) which can be reused beneficially for land formation. Public filling areas and public filling barging points are managed by the Civil Engineering Department.

3.4.2 The quantity of C&D waste delivered to public filling areas and landfills in 1996 and 1997 are shown in Figure 5. The total amount of C&D waste delivered to these disposal outlets decreased by 7 per cent from 30,510 tpd in 1996 to 28,430 tpd in 1997. The quantity of inert C&D materials delivered to public filling areas dropped from 22,990 tpd in 1996 to 21,950 tpd in 1997. Similarly, the quantity of C&D waste delivered to landfills reduced from 7,520 tpd to 6,480 tpd in 1997 which represents 23 per cent of total C&D waste arisings, as a result of continued diversion of reusable materials to public filling areas.

3.4.3 Figure 6 presents the relative proportion of C&D waste out of the total amount of waste intake at landfills in 1996 and 1997. Percentage of C&D waste intake at landfills dropped further from 49% in 1996 to 42 per cent in 1997. As C&D waste taken to the landfills still consists of significant amount of inert materials, more void space at landfills can be saved if these inert C&D materials can be sorted for beneficial reuse at public filling areas.

3.5 Waste Characteristics

3.5.1 In 1997, the characteristics of MSW were identified through the summer and winter sampling exercises conducted at refuse transfer stations and landfills. Estimated quantity of each waste component of domestic waste, C&I waste and MSW from 1986 to 1997 is summarized in Appendices 4, 5 & 6 respectively. The proportions of major waste components have remained fairly constant. The average moisture contents for domestic waste and C&I waste were estimated to be 28 per cent and 21 per cent respectively based on the representative number of samples collected during surveys. The estimated bulk densities of domestic waste and C&I waste were 199 and 103 kilograms per

cubic metre respectively.

3.5.2 The three major components of domestic waste were again putrescibles (30.4 per cent), paper (25.8 per cent) and plastics (17.2 per cent). Other minor components included bulky waste (4.3 per cent), glass (3.5 per cent), metals (3.5 per cent), textiles (3.4 per cent), and rattan/wood (1.4 per cent).

3.5.3 Likewise, the three major components of C&I waste were paper (25.5 per cent), rattan/wood (17.6 per cent) and plastics (16.4 per cent). Other minor components included putrescibles (8.3 per cent), textiles (7.0 per cent), bulky waste (4.8 per cent), metals (4.0 per cent) and glass (2.1 per cent). In line with the diminishing textile and garment manufacturing industry in Hong Kong, the total quantity as well as the relative proportion of textile waste has dropped in recent years.

3.5.4 The composition of MSW in 1997 is a summation of its components in domestic waste and C&I waste and summarized in Table 5. The major components of MSW were paper (25.7 per cent), putrescibles (25.5 per cent) and plastics (17.1 per cent). Other components included rattan/wood (5.0 per cent), bulky waste (4.4 per cent), textiles (4.2 per cent), metals (3.6 per cent) and glass (3.2 per cent).

3.5.5 In addition to identifying the above waste components, each sub-component of recyclable materials was estimated through sample weighing during surveys. Recyclable content of waste is useful for the investigation of further opportunities to increase the level of recycling. Breakdown of the selected recyclable materials in domestic waste and C&I waste disposed of at waste facilities in 1997 is compiled in Table 6. It should be noted that the actual amount of waste which could be recycled depends on the extent of contamination, practicality in separating reusable materials, and financial incentive.

3.5.6 In 1997, the major recyclables in either domestic waste or C&I waste were still paper and plastics, constituting more than 40 per cent by weight together. In domestic waste, newsprint and colour bags were the main recyclable sub-components of paper and plastics respectively. This standout phenomenon

was not obvious in C&I waste where recyclable sub-components were more evenly spread. For instance, cardboard, newsprint and writing paper wastes constituted by weight 6.5 per cent, 5.7 per cent and 4.2 per cent of total C&I waste respectively in 1997.

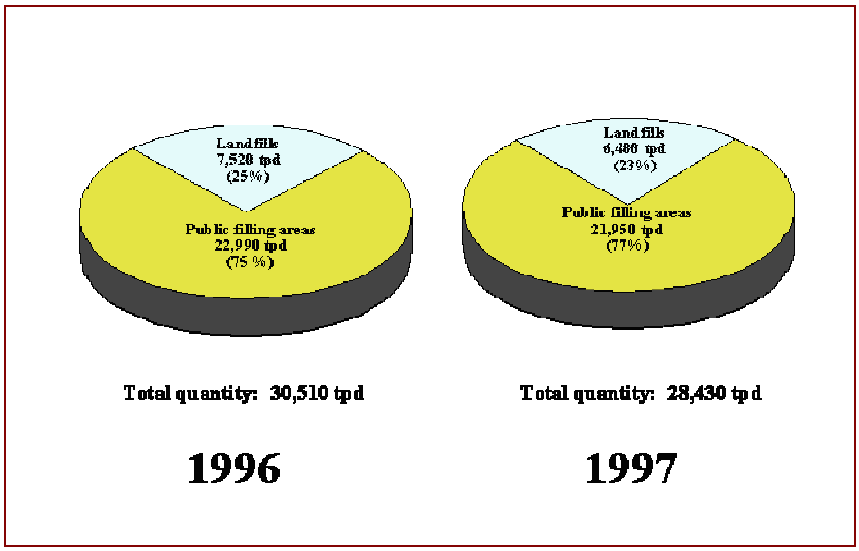


Figure 5 : Quantity and percentage of C&D waste delivered to public filling areas and landfills in 1996 and 1997

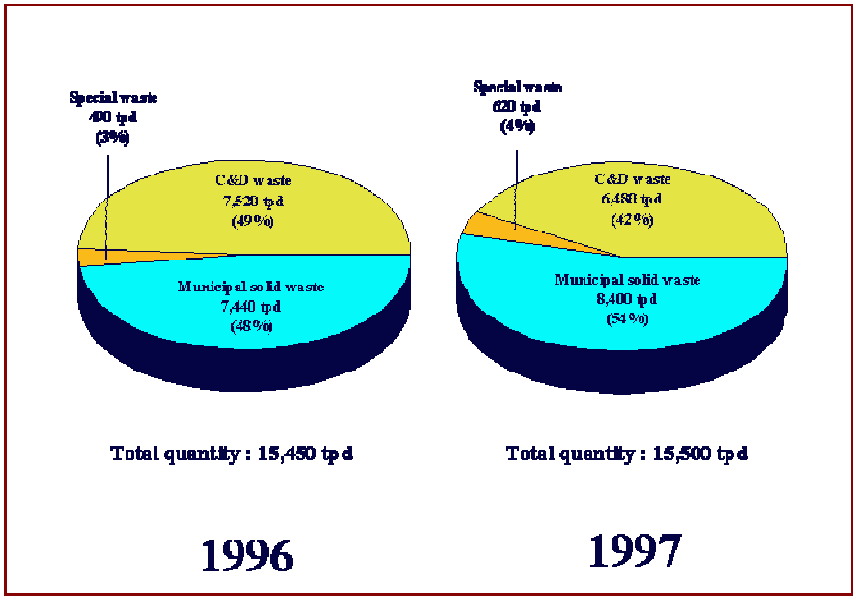


Figure 6 : Quantity and percentage of C & D waste disposed of at landfills in 1996 and 1997

Component	Quantity (tpd) and its percentage by weight		
	Domestic Waste (a)	Commercial & Industrial Waste (b)	Municipal Solid Waste (c)=(a)+(b)
Bulky waste	**290** (4.3%)	**90** (4.8%)	**380** (4.4%)
Paper	**1,740** (25.8%)	**490** (25.5%)	**2,230** (25.7%)
Glass	**240** (3.5%)	**40** (2.1%)	**280** (3.2%)
Metals	**240** (3.5%)	**80** (4.0%)	**310** (3.6%)
Plastics	**1,160** (17.2%)	**320** (16.4%)	**1,480** (17.1%)
Textiles	**230** (3.4%)	**140** (7.0%)	**370** (4.2%)
Rattan/wood	**100** (1.4%)	**340** (17.6%)	**440** (5.0%)
Putrescibles	**2,050** (30.4%)	**160** (8.3%)	**2,210** (25.5%)
Others	**710** (10.5%)	**280** (14.3%)	**980** (11.3%)
Total	**6,760** (100%)	**1,920** (100%)	**8,680** (100%)

Note :
Figures may not add up to total due to rounding-off

Table 5 : Estimated composition of municipal solid waste in 1997

Component		Domestic Waste		C&I Waste	
		Quantity (tpd)	% by weight	Quantity (tpd)	% by weight
Paper	- Writing	45	(0.7%)	80	(4.2%)
	- Newsprint	955	(14.2%)	110	(5.7%)
	- Cardboard	237	(3.5%)	124	(6.5%)
	- Others[1]	502	(7.4%)	175	(9.1%)
	(Paper) Sub-total	1,739	(25.8%)	489	(25.5%)
Glass bottles	- Brown	45	(0.7%)	7	(0.4%)
	- Green	48	(0.7%)	10	(0.5%)
	- Clear	132	(1.9%)	15	(0.8%)
	(Glass bottles) Sub-total	225	(3.3%)	32	(1.7%)
Plastics	- EPS food/drink containers	60	(0.9%)	22	(1.1%)
	- Other Polyfoams	21	(0.3%)	7	(0.4%)
	- PET bottles	48	(0.7%)	11	(0.6%)
	- Other beverage bottles	70	(1.0%)	8	(0.4%)
	- Colour bags	599	(8.9%)	80	(4.2%)
	- Clear bags	164	(2.4%)	66	(3.4%)
	- Trim-off & scraps	1	(0.0%)	6	(0.3%)
	- Others[2]	201	(3.0%)	115	(6.0%)
	(Plastics) Sub-total	1,164	(17.2%)	315	(16.4%)
Ferrous metals		176	(2.6%)	60	(3.1%)
Non-ferrous metals		61	(0.9%)	17	(0.9%)
	Total	**3,365**	**(49.8%)**	**913**	**(47.6%)**

Notes :
(1) Other paper subcomponents include drink pack (tetrapak) and tissue paper
(2) Other plastics subcomponents include household utensils, packaging materials and toys

Table 6 : Selected recyclable materials in domestic and commercial & industrial (C&I) waste disposed of at waste facilities in 1997

4. Waste Recovery and Recycling

4.1 Recovery and Recycling of Municipal Solid Waste

4.1.1 In 1997, about 1.54 million tonnes of municipal solid waste (MSW) generated in the territory was recovered for recycling. This represents about 33 per cent of the total MSW arisings, amongst which 0.31 million tonnes (20 per cent) was recycled locally and 1.23 million tonnes (80 per cent) was exported for recycling overseas (see Figure 7). The composition of recovered MSW for recycling locally and overseas is tabulated in Appendix 7 and the relative proportion of each major recyclable is presented in Figure 8. The major components of recovered MSW for recycling were paper (46 per cent), ferrous metals (34 per cent), plastics (11 per cent) and non-ferrous metals (8 per cent). The remaining 1 per cent included glass bottles, wood, rubber tyres and textiles.

4.1.2 Paper waste was the most popular item for recycling in 1997. Its actual volume being handled in 1997 was substantially larger than that of metals which have higher density than paper but lower recovered weight. The recycling of plastics was considerable in view of their low density. Recycled plastics mainly consisted of relatively clean scraps and rejects from manufacturing sources and there was very little reprocessing of post-consumer plastic packaging waste such as polyethylene terephthalate (PET) bottles and plastic bags in the territory. Some of the reasons and practical constraints might be as follows:-

- Recycling of paper was relatively more popular, convenient and well publicized. Recycling boxes for paper waste could be found in many housing estates, railway stations and offices easily. In contrast, similar facilities for ferrous metals, non-ferrous metals and plastics were less common in 1997.

- The main reason of extensive paper recycling might be the presence of relatively greater market demand for recycled paper.

- Most plastics found in waste were usually packaging materials (like plastic bags and beverage bottles) which were usually contaminated. In addition, the cost of transporting plastics per unit weight was high and hence its profit margin of recycling was low.

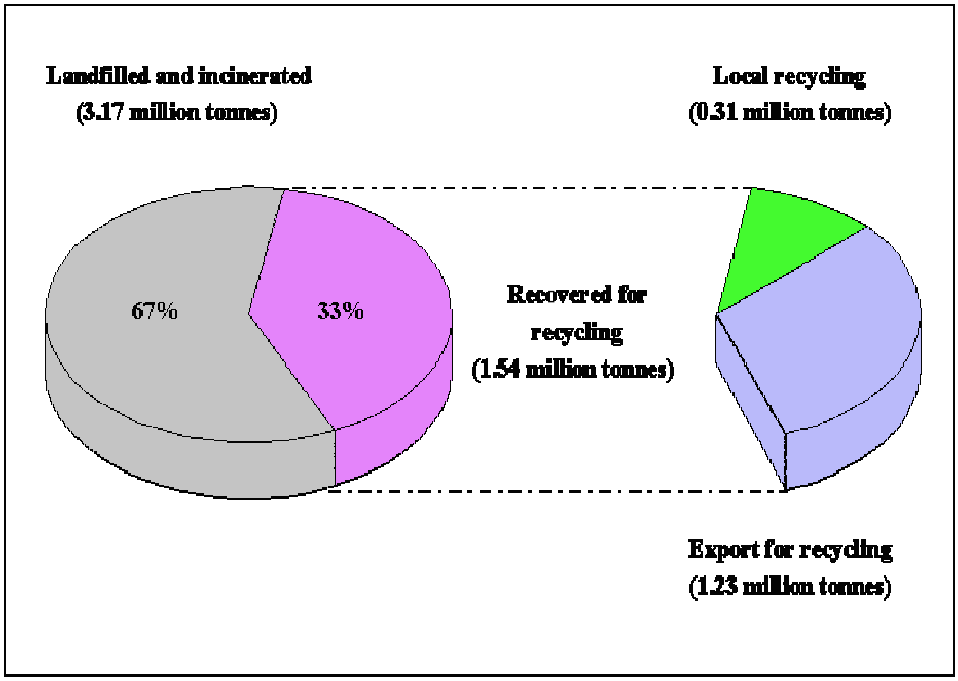


Figure 7 : Recovery of municipal solid waste in 1997

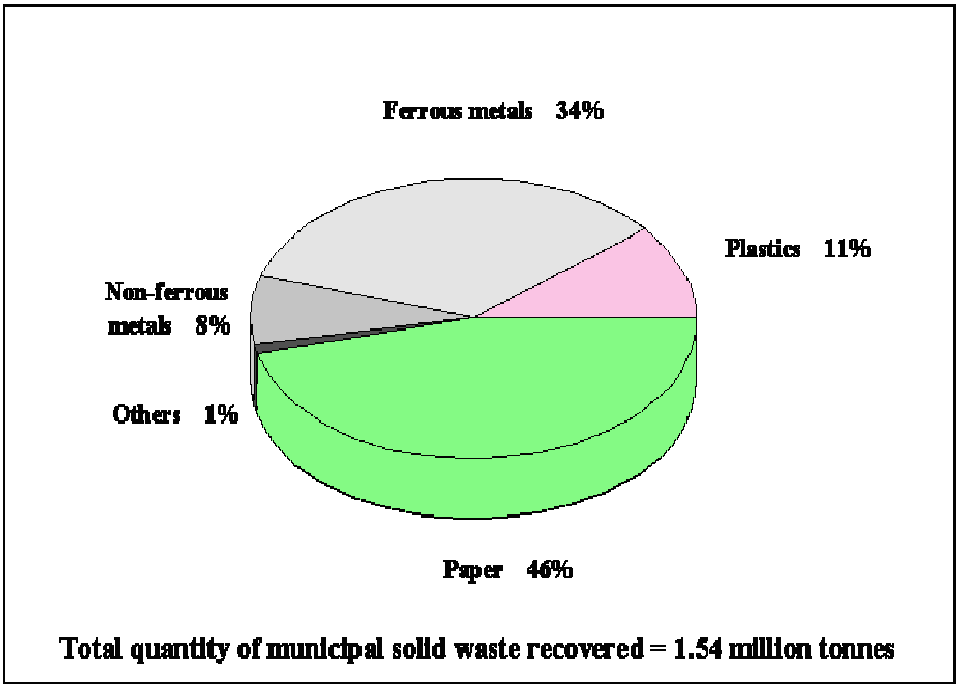


Figure 8 : Composition of municipal solid waste recovered in 1997

4.1.3 Opportunities for economic recycling depend on the prices of competing raw materials, the market demand for recycled products, and to a lesser extent on the prevailing prices for the disposal alternative. The government would therefore implement appropriate initiatives under its Waste Reduction Framework Plan to promote recycling and to help developing the recycling industries. As recycling activities in Hong Kong are largely market driven, the extent of recycling may be reflected by the financial values of different types of recyclable materials. Table 7 compiled in details the quantity and value of each exported recyclable material and its value per unit weight in 1997.

4.1.4 The relative exported values of the four major recyclables are shown in Figure 9. The export value of non-ferrous metals, including copper & alloys and aluminium, was the greatest in 1997. It seems that the corresponding financial incentive and market potential for recovering ferrous metals for recycling overseas were also attractive.

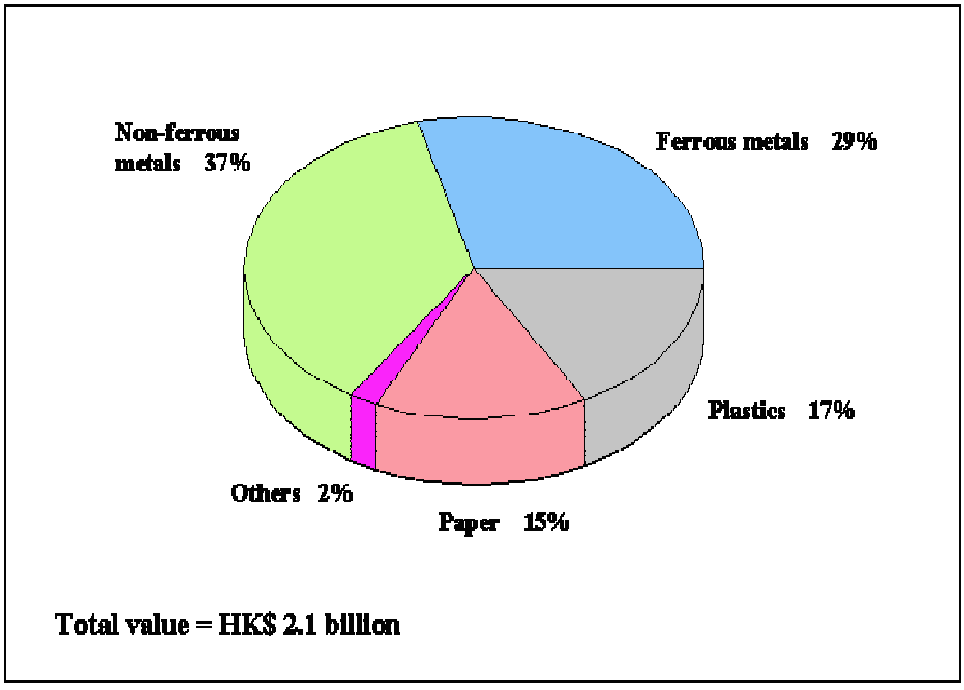


Figure 9 : Values of exported recyclable materials in 1997

4.2 Recovery and Recycling of Construction & Demolition Waste

4.2.1 In 1997, about 10.4 million tonnes of construction & demolition (C&D) waste was delivered to landfills and public filling areas. About 77% of the total C&D waste was beneficially reused as fill material for reclamation and earth filling projects whilst the rest was disposed of at landfills (see Figure 5). C&D waste, which contains a mixture of inert and non-inert materials, arises from site clearance, excavation, construction, refurbishment, renovation, demolition and roadworks. The non-inert portion of C&D waste, comprising bamboo, plastics, timber, vegetation and other organic materials, disposed of at landfills was often mixed with inert C&D materials. It can be noted that, in Figure 6, 6,480 tpd C&D waste was disposed of at landfill, representing 42% of all waste intake at landfills. If separation of inert materials at source is more effective, more landfill spacing could be saved.

4.2.2 The government has developed and implemented a C&D waste management strategy which is essentially to avoid, minimize, recycle, and dispose of waste (in order of desirability). The target is to reduce the intake of C&D waste at landfills and its generation, and to reuse and recycle as much C&D waste as possible.

Categories of waste materials		Quantity[1] (tonnes)	Value[1] ($ thousand)	Value per unit weight ($ / tonne)
a. Wood & paper				
- wood (include sawdust)		- [2]	- [2]	- [2]
- paper		439,831	309,689	704
	Sub-total	**439,831**	**309,689**	**704**
b. Glass				
	Sub-total	**155**	**331**	**2,135**
c. Plastics				
- polyethylene		12,992	33,079	2,546
- polystyrene & copolymers		47,950	129,250	2,696
- polyvinyl chloride		17,002	43,552	2,562
- others		71,284	136,887	1,920
	Sub-total	**149,228**	**342,768**	**2,297**
d. Ferrous metals & steel				
- pig or cast iron		34,118	30,791	902
- alloy steel scrap		41,118	124,302	3,023
- other scraps		443,060	441,275	996
- tinplate		0	0	-
	Sub-total	**518,296**	**596,368**	**1,151**
e. Non-ferrous metals				
- copper & alloys		71,614	565,960	7,903
- nickel		32	1,035	32,344
- aluminium		34,702	195,696	5,639
- lead		72	2,736	38,000
- zinc		351	1,828	5,208
- tin		42	738	17,571
- metal ash & residues		68	381	5,603
- magnesium		0	0	-
- precious metal		4	6,955	1,738,750
- other base metals		0	0	-
	Sub-total	**106,885**	**775,329**	**7,254**
f. Textile fibre				
- silk		0	0	-
- cotton		8,487	22,545	2,656
- man-made fibres		328	1,129	3,442
- wool/other animal hair (not pulled)		179	2,532	14,145
- wool/other animal hair (pulled)		0	0	-
- old clothing & other old textile articles, rags, etc.		3,346	17,055	5,097
	Sub-total	**12,340**	**43,261**	**3,506**
	Total	**1,226,735**	**2,067,746**	**1,686**

Note :

(1) Figures provided by the Census & Statistics Department and rounded off to the nearest 1

(2) Reliable data are not available in 1997

Table 7 : Quantities and values of exported recyclable materials by type in 1997

5. Waste Generation Rates and Forecasts

5.1 Generation Rates of Municipal Solid Waste

5.1.1 Waste generation per capita, expressed in kilograms per head per day, is a common basis for comparison of the historical trend of municipal solid waste (MSW) generation. Per capita generation rates of both domestic waste and commercial & industrial (C&I) waste have been considered separately since previous monitoring work on waste arisings revealed close relationships between population and domestic waste quantity, and between economic activities and C&I waste quantity. Economic activities were indirectly measured in terms of employee size of all sectors grouped under Division 3, 6 and 8 of the Hong Kong Standard Industrial Classification. These commercial and industrial sectors include manufacturing, wholesale, retail, import and export trades, restaurants, hotels, finance, insurance, real estate and business services.

5.1.2 In working out the territorial waste generation rates in 1997 by district, the population and employment data and their geographical distribution into 18 waste arising districts used in the calculation are based on Census & Statistics Department's consolidated information. Per capita generation rates of domestic waste and C&I waste of each district in 1996 and 1997 are shown in Table 8. The historical territorial average per capita generation rates of both waste types from 1986 to 1997 are tabulated in Figure 11.

5.1.3 The key point of interest is the small fluctuation of the territorial average per capita generation rates of domestic waste in the 1990s. Whilst there was a steady growth from 1986 to 1992, the generation rate of 1.04 kilogram per person per day in 1997 was similar to that in the previous five years from 1992 to 1996 (in the range of 1.00 to 1.04 kilogram per person per day). This trend may be attributed to factors such as changes in economy, lifestyle and throw-away habits being adopted by the community as a result of increasing environmental consciousness.

5.1.4 Other observations for domestic waste and C&I waste are highlighted below separately.

(I) Per capita generation rate of domestic waste in 1997:-

- The territorial average generation rate increased by 4 per cent from 1996 to 1.04 kilogram per person per day.

- Per capita generation rates of both the urban areas (1.10 kilogram per person per day) and the New Territories mainland (0.96 kilogram per person per day) are very close to that of the territorial average.
- The largest deviations from the territorial average are observed in outlying islands (1.92 kilogram per person per day) and commercial districts, such as Yau Tsim Mong (2.12 kilogram per person per day), Wanchai (1.79 kilogram per person per day) and Central & Western (1.42 kilogram per person per day). Owing to the existing practice of disposing unsegregated waste, particularly in the above districts, C&I waste has been mixed to various degrees with domestic waste prior to collection by the Regional Services Department and Urban Services Department. The amount of C&I waste added to domestic waste was most significant in the commercial districts (Yau Tsim Mong, Wanchai, Central & Western) having a large employee size of more than 676,000; about 40 per cent total employment figure of the selected sectors.
- Waste arising districts having more than 10 percent variation from 1996's generation rate include the North NT (+31 per cent), Tai Po (+14 per cent) and Tuen Mun (+13 per cent).

(II) Per capita generation rate of commercial & industrial waste in 1997:-

- The territorial average generation rate of 1.1 kilogram per employee per day in 1997 is 3 per cent higher than that in 1996. This is comparable to the order of increase in the total quantity of C&I waste with a similar employee size of more than 1,745,000 from the selected sectors.
- The largest deviations of district's per capita generation rate from the territorial average are found in the New Territories such as the North NT (5.43 kilogram per employee per day), Sai Kung (4.63 kilogram per employee per day) and Yuen Long (4.29 kilogram per employee per day) where the subtotal employee size of these districts (73,000) constituted only 4 per cent of the selected sectors total.
- Similarly, per capita generation rate of the New Territories mainland (2.17 kilogram per employee per day) is higher than the territorial average in view of the small employee size (454,000, about 26 per cent

of the selected sectors total). As regards the urban areas, the average waste generation rate (0.73 kilogram per employee per day) is smaller than the territorial average due to high employee size in these areas (about 1,285,000, 74 per cent of the selected sectors total).

- The lowest per capita generation rates are found in Central & Western (0.35 kilogram per employee per day), Wanchai (0.48 kilogram per employee per day) and Yau Tsim Mong (0.52 kilogram per employee per day). As discussed in (I) above, the mixing of a considerable amount of C&I waste with domestic waste in these districts had caused an apparent reduced quantity of C&I waste for collection by private waste collectors.
- For outlying islands, virtually all C&I waste was delivered to refuse collection points and then mixed with domestic waste before collection by the Regional Services Department; hence per capita generation rate of C&I waste for outlying islands could not be determined.
- The average generation rates of both the Hong Kong Island and Kowloon in 1997 increased by 14 per cent from that of 1996 but the average of the New Territories Mainland dropped slightly by 6 per cent from 1996.

District	Domestic waste (kg/person/day)		C&I waste (kg/employee/day)	
	1996	1997	1996	1997
Central & Western	1.36	1.42	0.33	0.35
Wanchai	1.82	1.79	0.37	0.48
Eastern	0.88	0.88	0.58	0.68
Southern	0.9	0.96	1.36	1.55
Hong Kong Island Average	**1.1**	**1.12**	**0.47**	**0.54**
Yau Tsim Mong	2.3	2.12	0.49	0.52
Sham Shui Po	1.11	1.09	0.63	0.95
Kowloon City	0.96	1.01	1.15	1.12
Wong Tai Sin	0.76	0.74	0.52	0.73
Kwun Tong	0.79	0.86	1.22	1.36
Kowloon Average	**1.07**	**1.08**	**0.79**	**0.9**
Kwai Tsing	0.72	0.66	1.03	0.73
Tsuen Wan	1.04	1.11	1.59	1.81
Tuen Mun	0.84	0.95	4.85	3.63
Yuen Long	1.07	1.14	5.63	4.29
North	1.05	1.38	3.42	5.43
Tai Po	0.96	1.1	2.36	1.75
Sha Tin	0.8	0.8	1.76	2.05
Sai Kung	0.89	0.91	4.15	4.63
NT - Mainland Average	**0.89**	**0.96**	**2.32**	**2.17**
NT - Outlying Islands Average	**1.79**	**1.92**	**-**	**-**
Urban areas (HK & Kln) Average	**1.08**	**1.1**	**0.64**	**0.73**
Territorial Average	**1**	**1.04**	**1.07**	**1.1**

Table 8 : Per capita generation rates of domestic and commercial & industrial (C&I) waste by district in 1996 and 1997

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

5.2.1 It has been established in previous reports that the quantity of MSW correlates well with the territory's economic activities as measured by the total gross domestic product (GDP). Figure 10 shows three best plotted straight lines of total GDP against quantity of MSW and its individual constituents disposed of at waste facilities from 1979 to 1997. The quantities as shown in the figure only include waste disposed of at waste facilities but not the waste recovered for recycling

5.2.2 Domestic waste has an almost straight line relationship with the total GDP in Hong Kong whereas C&I waste has a weaker linear correlation. Due to the large contribution of domestic waste to MSW, the linear relationship of MSW to total GDP is strong.

5.2.3 If the correlation of MSW or domestic waste with total GDP continues to exist in the future years, the quantity of MSW or domestic waste could be projected based on forecast of total GDP figures. This approach can be a counter-check of the forecasted waste quantities on the basis of waste generation rates.

5.3 Forecasting Municipal Solid Waste

5.3.1 The existing methodology of forecasting the quantity of MSW, made up of domestic waste and C&I waste, is based on two sets of parameters, viz. projected waste generation rates and predicted figures on population and employment size. Both parameters are regularly updated and easily accessible; the former by the EPD and the latter by the Planning Department. More importantly, they provide a reliable and simple method in forecasting future solid waste arisings which can be worked out easily by multiplying the above projected waste generation rate per capita with predicted population or number of employees.

5.3.2 In view of the increasing trend of waste generation since the 1980s, projected waste generation rates in earlier reports were calculated by linear projection of the past statistics on per capita generation rates of domestic waste and C&I waste. Taking account of the latest information in 1997 and adopting a similar linear projection, updated projected waste generation rates in 2001, 2006 and 2011 are tabulated in Figure 11 together with the recorded generation rates and quantities of both types of MSW from 1986 to 1997.

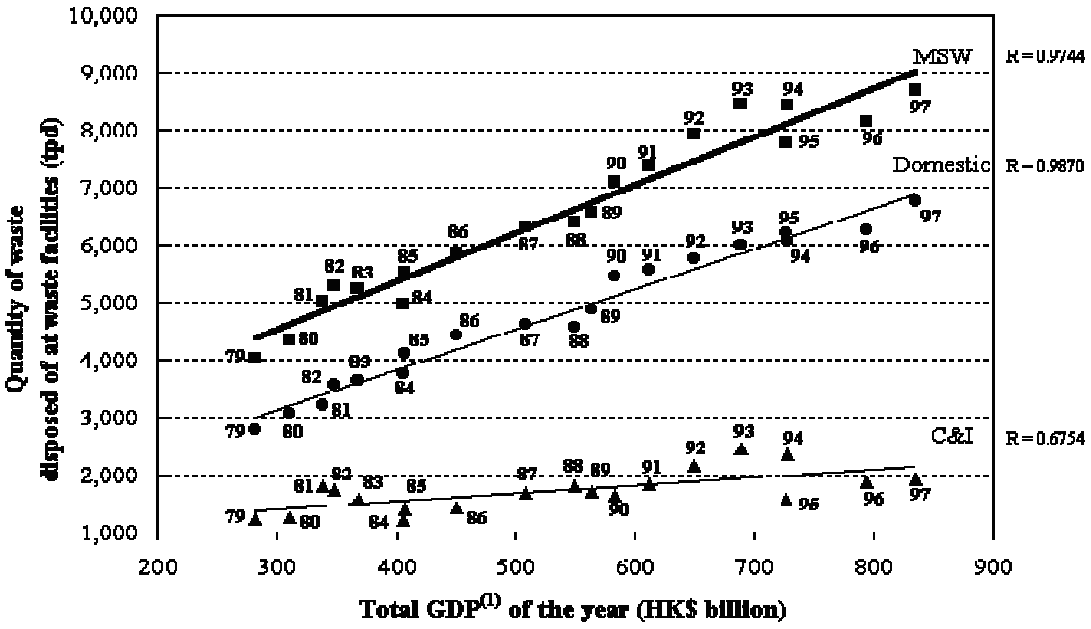
5.3.3 Based on the above updated projections, per capita generation rates of domestic waste and C&I waste would be increased annually by about 0.008 and 0.022 kilogram per person per day to 1.15 and 1.41 kilogram per person per day respectively in 2011. The revised linear regression expressions for the projection of future generation rates of both waste types are as follows:-

- per capita generation rate of domestic waste : y_t=0.008184t - 15.31025
- per capita generation rate of C&I waste : y_t = 0.02210t - 43.03

where y_t = per capita waste generation rate at year t (kilogram per person per day)

t = year in four figures (e.g. 2000)

5.3.4 The forecast quantity of domestic waste or C&I waste is then worked out by multiplying its projected generation rate by the predicted population or employment size respectively. A graphical presentation of the projected waste quantity by waste type up to 2011 is depicted in Figure 11.



Year	Domestic waste ●	C&I waste ▲	Municipal solid waste ■	Total GDP(1) (HK $ billion)
	Quantity (tpd)			
1979	2,790	1,240	4,030	282
1980	3,080	1,270	4,350	310
1981	3,220	1,820	5,030	339
1982	3,570	1,730	5,300	348
1983	3,650	1,580	5,230	368
1984	3,770	1,220	4,990	405
1985	4,120	1,400	5,510	407
1986	4,420	1,440	5,870	450
1987	4,630	1,680	6,300	509
1988	4,580	1,820	6,410	549
1989	4,870	1,720	6,580	563
1990	5,460	1,650	7,100	583
1991	5,560	1,830	7,390	612
1992	5,760	2,170	7,930	650
1993	6,000	2,450	8,450	690
1994	6,070	2,360	8,430	727
1995	6,210	1,580	7,790	726
1996	6,260	1,880	8,140	794
1997	6,760	1,920	8,680	835 (2)

Notes :

(1) GDP at constant (1990) market prices

(2) Preliminary estimate

R = 1 shows that best fitted regression line

Figures may not add up to total due to rounding-off

Figure 10 : Correlation of municipal solid waste with total GDP 1979 - 1997

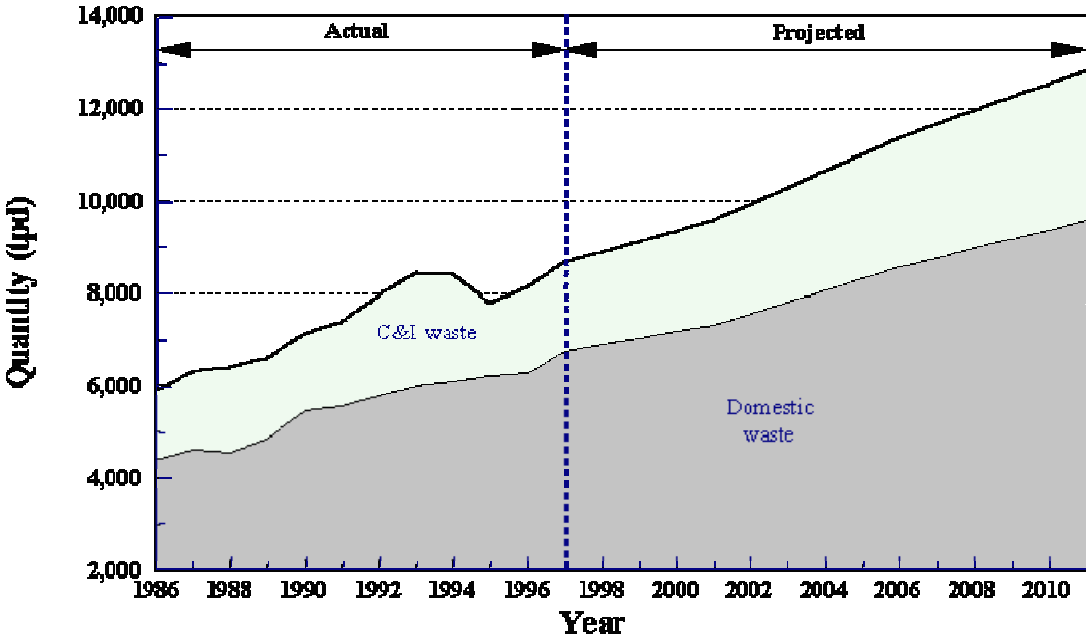
5.3.5 The above forecasted waste quantities could be sub-divided into 18 waste arising districts according to their predicted population and employment figures and the forecasted waste generation rate in each district. The latter parameter takes into account the latest waste generation estimate of a specific district and thus has the advantage in providing additional adjustment to simple population distribution. Detailed breakdown of forecasted MSW and its constituents, i.e. domestic waste and C&I waste, by district is consolidated into Table 9.

5.3.6 Nevertheless, it should be noted that besides population and employment size, the future generation rate of waste and the forecasted quantity of MSW would also be affected by a number of factors such as:

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

5.4 Forecasting Construction & Demolition Waste

5.4.1 Forecasting construction & demolition (C&D) waste from 1998 onwards has been taken up by the CED which oversee the management of public fill through its Fill Management Committee. Development of a public fill (i.e. inert C&D materials) planning model is one of the key elements of the public filling strategy set out by the Committee. Based on the computer planning model, the projected quantities of total C&D waste in 2001, 2006 and 2011 for the whole territory are summarized in Figure 12. The actual quantities of public fill and C&D waste disposed of at public filling areas and landfills respectively since 1986 are also tabulated in Figure 12.



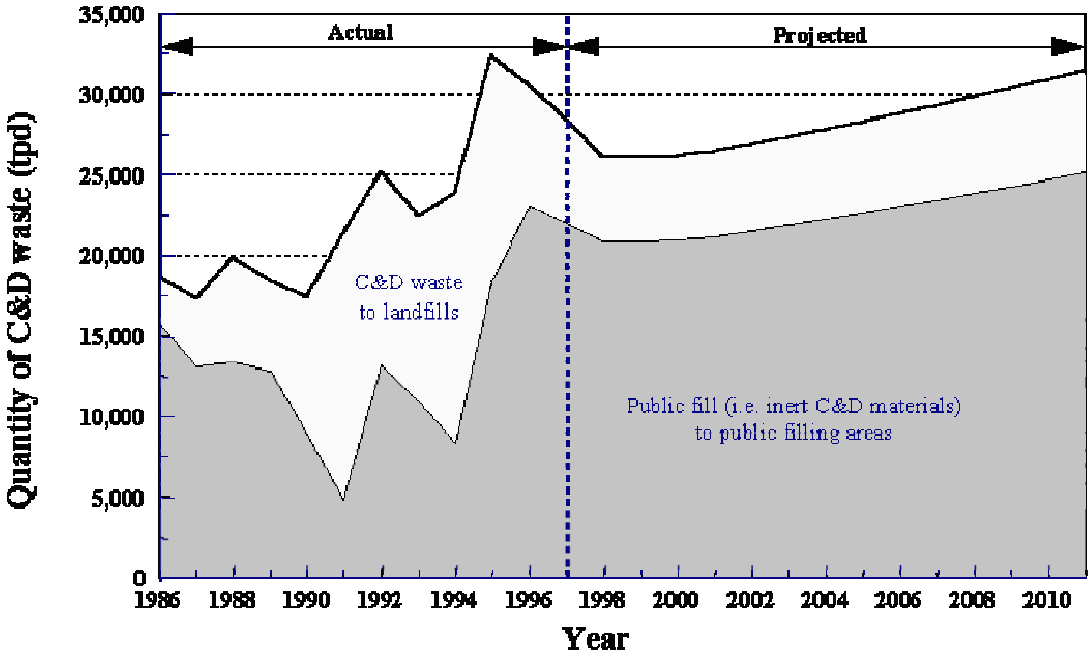
Year	Domestic waste		Commercial & industrial waste		Municipal [3] solid waste
	Quantity (tpd)	Per capita generation rate (kg/person/day)	Quantity (tpd)	Per capita generation rate (kg/employee/day)	Quantity (tpd)
1986	4,420	0.80	1,440	0.86	5,870
1987	4,630	0.83	1,680	0.97	6,300
1988	4,580	0.82	1,820	1.03	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
1997	6,760	1.04	1,920	1.10	8,680
2001	7,320	1.07 [1]	2,240	1.19 [2]	9,560
2006	8,550	1.11 [1]	2,790	1.30 [2]	11,350
2011	9,570	1.15 [1]	3,240	1.41 [2]	12,810

Note :
(1) Figures are estimated by linear projection from 1990 onwards.
(2) Figures are estimated by linear projection from 1986 onwards.
(3) Figures may not add up to total due to rounding-off.

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

	Domestic waste (tpd)						Commercial & Industrial waste (tpd)			Total MSW (tpd)		
	Public			Private								
Year	2001	2006	2011	2001	2006	2011	2001	2006	2011	2001	2006	2011
District												
Central & Western	340	360	460	50	50	70	80	140	140	470	550	670
Wanchai	260	270	270	70	70	70	60	110	120	390	450	460
Eastern	430	440	440	120	120	120	90	130	130	640	690	690
Southern	260	260	290	20	20	20	50	60	70	330	340	380
Hong Kong Island	**1,290**	**1,330**	**1,460**	**260**	**260**	**280**	**280**	**440**	**460**	**1,830**	**2,030**	**2,200**
Yau Tsim Mong	540	620	640	120	140	140	150	180	200	810	940	980
Sham Shui Po	340	450	470	70	90	100	110	160	190	520	700	760
Kowloon City	370	420	490	70	90	100	120	110	110	560	620	700
Wong Tai Sin	310	380	390	20	20	20	40	40	50	370	440	460
Kwun Tong	470	510	530	80	90	90	210	280	310	760	880	930
Kowloon	**2,030**	**2,380**	**2,520**	**360**	**430**	**450**	**630**	**770**	**860**	**3,020**	**3,580**	**3,830**
Kwai Tsing	350	400	390	10	10	10	100	140	150	460	550	550
Tsuen Wan	210	220	250	100	100	120	130	180	220	440	500	590
Tuen Mun	400	480	520	70	80	90	170	150	190	640	710	800
Yuen Long	500	690	750	50	70	80	210	170	220	760	930	1,050
North	220	260	320	140	160	200	200	130	140	560	550	660
Tai Po	280	290	300	40	50	50	60	60	60	380	400	410
Sha Tin	440	490	500	60	70	70	130	180	190	630	740	760
Sai Kung	270	390	460	30	50	50	110	260	320	410	700	830
NT - Mainland	**2,670**	**3,220**	**3,490**	**500**	**590**	**670**	**1,110**	**1,270**	**1,490**	**4,28**	**5,080**	**5,650**
NT - Outlying Islands	**210**	**350**	**700**	**-**	**-**	**-**	**220**	**310**	**430**	**430**	**660**	**1,130**
Territorial Total	**6,200**	**7,280**	**8,170**	**1,120**	**1,280**	**1,400**	**2,240**	**2,790**	**3,240**	**9,560**	**11,350**	**12,810**

Table 9 : Forecast quantities of municipal solid waste (MSW) by waste arising district in 2001, 2006 and 2011



Year	C&D waste to landfills		Public fill to Public Filling Areas		Total C&D waste
	Quantity (tpd)	% of total C&D waste	Quantity (tpd)	% of total C&D waste	Quantity (tpd)
1986	2,850	15.3	15,780	84.7	18,630
1987	4,220	24.4	13,070	75.6	17,290
1988	6,520	32.9	13,320	67.1	19,840
1989	5,580	30.3	12,820	69.7	18,410
1990	8,450	48.7	8,900	51.3	17,350
1991	16,380	77.0	4,880	23.0	21,260
1992	11,960	47.6	13,170	52.4	25,130
1993	11,520	51.4	10,880	48.6	22,400
1994	15,480	64.9	8,370	35.1	23,850
1995	14,120	43.6	18,280	56.4	32,400
1996	7,520	24.6	22,990	75.4	30,510
1997	6,480	22.8	21,950	77.2	28,430
2001[1]	5,290	20.0	21,150	80.0	26,440
2006[1]	5,750	20.0	23,000	80.0	28,750
2011[1]	6,280	20.0	25,140	80.0	31,420

Note :
(1) Forecast figures on total C&D waste are provided by the Civil Engineering Department. Figures may not add up to total due to rounding-off

Figure 12 : Quantity of construction and demolition (C&D) waste disposed of at public filling areas and landfills 1986 - 2011

Appendix 1: System of waste arising districts/areas used in waste arising survey

District identity code	District name	Source area identity code	Source area name
1010	Central & Western	1011 1012 1013 1014 1015	Central Sheung Wan Mid Levels Peak Kennedy Town
1020	Wanchai	1021 1022	Wanchai Tai Hang / Happy Valley
1030	Eastern	1031 1032 1033 1034	North Point Quarry Bay Shau Kei Wan Chai Wan
1040	Southern	1041 1042 1043	Pok Fu Lam Aberdeen Stanley
2010*	Yau Tsim	2011 2012 2013	Tsim Sha Tsui East Tsim Sha Tsui West Yau Ma Tei
2020*	Mongkok	2021 2022	Mongkok North Mongkok South
2030	Sham Shui Po	2031 2032 2033 2034	Sham Shui Po Shek Kip Mei Cheung Sha Wan Lai Chi Kok
2040	Kowloon City	2041 2042 2043	Hung Hom Ho Man Tin Kowloon Tong
2050	Wong Tai Sin	2051 2052	Wong Tai Sin Ngau Chi Wan
2060	Kwun Tong	2061 2062 2063 2064	Kwun Tong East Kwun Tong West Sau Mau Ping Lam Tin
3010	Kwai Tsing	3011 3012	Kwai Chung Tsing Yi
3020	Tsuen Wan	3021	Tsuen Wan
3030	Tuen Mun	3031 3032	Tuen Mun Lam Tei
3040	Yuen Long	3041 3042 3043 3044	Yuen Long Tin Shui Wai Kam Tin / Shek Kong San Tin
3050	North	3051 3052	Sheung Shui / Fanling Shau Tau Kok
3060	Tai Po	3061 3062 3063 3064	Tai Po Shuen Wan Tai Po Rural Sai Kung North
3070	Sha Tin	3071 3072 3073 3074	Sha Tin West Sha Tin East Sha Tin South Ma On Shan
3080	Sai Kung	3081 3082 3083	Sai Kung South Clear Water Bay Junk Bay
4000	Outlying Islands		

Note :

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

Appendix 2 : Breakdown of waste delivered to incineration plant, refuse transfer stations and landfills in 1997

Disposal facilities	Average daily waste intake[1] by waste type in 1997 (tpd)					
	MSW		Construction & demolition	Special	Total	Incinerator ash
	Public	Private				
KCIP - Kwai Chung Incineration Plant [2]	227	-	-	-	277	
KBTS - Kowloon Bay Refuse Transfer Station[3]	1,399	-	-	-	1,399	-
IETS - Island East Refuse Transfer Station[4]	944	-	-	-	944	
STTS - Sha Tin Refuse Transfer Station[3]	919	-	-	-	919	-
IWTS - Island West Refuse Transfer Station[4][5]	349	-	-	-	349	
WKTS - West Kowloon Refuse Transfer Station[4][6]	889	-	-	-	889	-
WENT - West New Territories Landfill	735[7]	539	490	232	1,996 [7]	65[2]
SENT - South East New Territories Landfill	176	1,907	5,473	269	7,825	-
NENT - North East New Territories Landfill	0[7]	542	518	117	1,177 [7]	
Sub-total	**5,688**	**2,988**				
Total	**8,676**		**6,481**	**618**	**15,775**	**65**

Notes :

(1) Average daily intake shown here is based on the whole calendar year irrespective of the operational period of the facilities

(2) KCIP was decommissioned in May 1997; its average daily waste intake and ash produced for disposal at WENT landfill up to its decommissioning were 755 tpd and 155 tpd respectively

(3) Waste from KBTS and STTS was delivered to NENT through road network

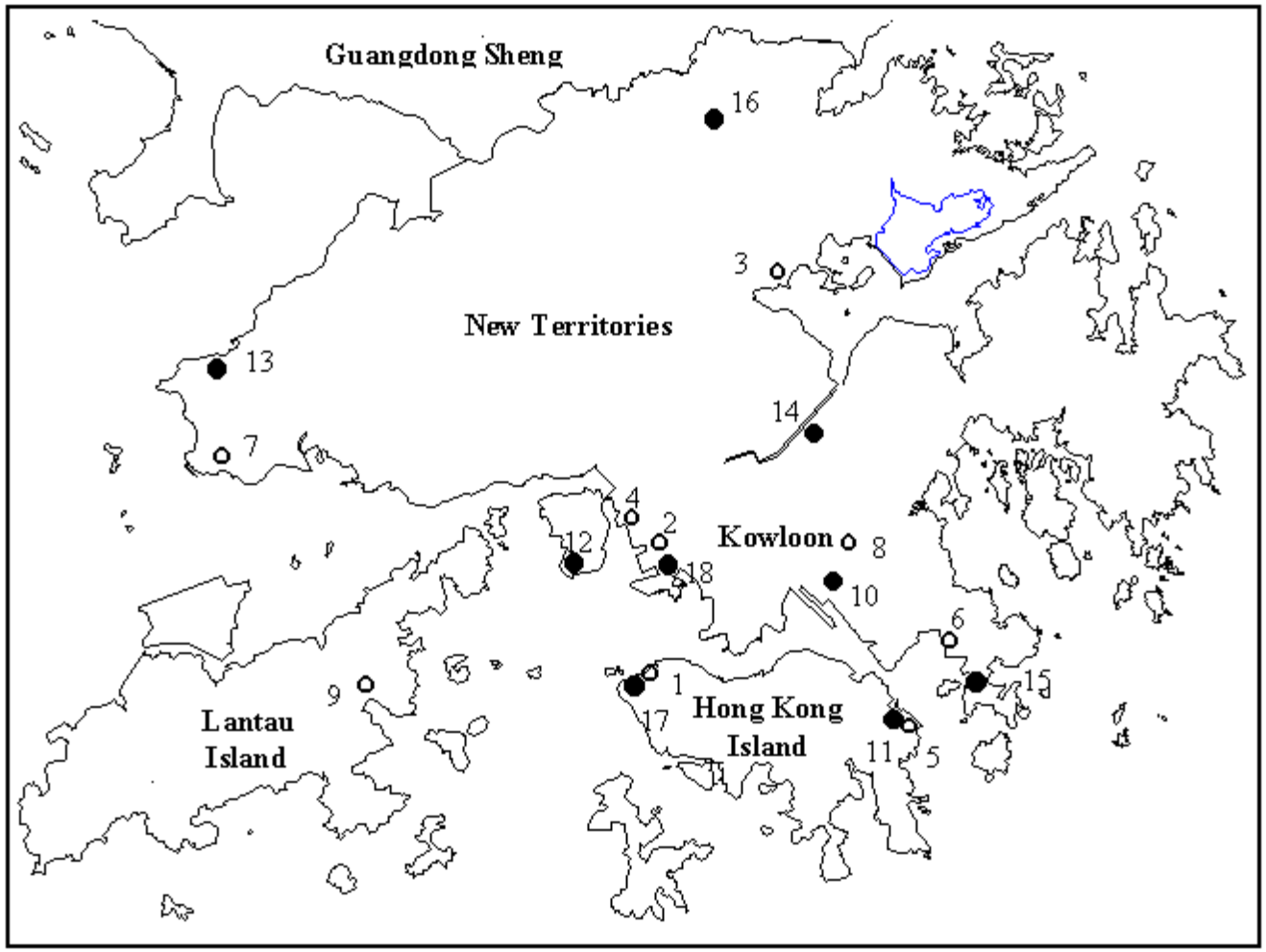
(4) Waste from IETS, IWTS and WKTS was delivered to WENT by barge

(5) IWTS was commissioned in May 1997 and its average daily waste intake since commissioning was 458 tpd

(6) WKTS was commissioned in June 1997 and its average daily waste intake since commissioning was 1,445 tpd

(7) The quantity shown here does not include waste transferred from the RTS

Appendix 3 : Review of the waste intake at waste facilities



○ Decommissioned
● In operation

	Waste facilities		Year commissioned	Average daily intake (tpd) [1]												Year decommissioned
				1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	
1	○	Kennedy Town Incineration Plant	1967	630	550	580	780	820	780	680	*420*	-	-	-	-	1993
2	○	Lai Chi Kok Incineration Plant	1969	1010	480	470	500	*380*	-	-	-	-	-	-	-	1990
3	○	Shuen Wan Landfill	1974	1,240	1,360	1,950	2,450	3,750	7,000	5,670	6,410	7,570	*6,230*	-	-	1995
4	○	Kwai Chung Incineration Plant	1978	820	880	860	800	820	790	760	750	710	720	710	*760*	1997
5	○	Chai Wan Composting/ Pulverisation Plant	1979	350	420	490	390	390	*430*	-	-	-	-	-	-	1991
6	○	Tseung Kwan O Landfill	1979	2,200	4,560	6,050	4,730	6,330	13,150	9,890	10,660	10,490	*4,880*	-	-	1995
7	○	Pillar Point Valley Landfill	1983	1,330	1,560	1,790	1,920	2,070	2,640	3,410	2,130	2,430	4,690	*2,800*	-	1996
8	○	Jordon Valley Landfill	1986	*380*	970	1,010	930	*370*	-	-	-	-	-	-	-	1990
9	○	Mui Wo Incineration Plant	1987	-	*10*	10	10	10	10	10	10	*10*	-	-	-	1994
10	●	Kowloon Bay Transfer Station	1990	-	-	-	-	*980*	1,530	1,600	1,720	1,760	1,690	1,740	1,400	
11	●	Island East Transfer Station	1992	-	-	-	-	-	-	*40*	1,140	1,250	1,200	1,220	940	
12	●	Chemical Waste Treatment Centre	1993	-	-	-	-	-	-	-	*90*	220	240	180	190	
13	●	WENT Landfill	1993	-	-	-	-	-	-	-	*1,170*	2,700	2,810	1,970	4,180	
14	●	Sha Tin Transfer Station	1994	-	-	-	-	-	-	-	-	*650*	800	850	920	
15	●	SENT Landfill	1994	-	-	-	-	-	-	-	-	*1,160*	7,070	7,230	7,830	
16	●	NENT Landfill	1995	-	-	-	-	-	-	-	-	-	*2,620*	3,440	3,500	
17	●	Island West Transfer Station	1997												*460*	
18	●	West Kowloon Transfer Station	1997												1,450	

Note：

(1) Italic figures are average of actual operation days rather than 365 days during the year of commissioning and decommissioning

Appendix 4 : Review of composition of domestic waste

Year	Quantity (tpd) and its percentage by weight [1]									
	Bulky waste	Paper	Glass	Metals	Plastics	Textiles	Rattan/wood	Putrescibles	Others	Total
1986	320 (7.2%)	970 (22.0%)	110 (2.5%)	150 (3.4%)	630 (14.3%)	190 (4.2%)	190 (4.2%)	1,340 (30.4%)	520 (11.8%)	4,420
1987	250 (5.5%)	1,000 (21.7%)	130 (2.7%)	160 (3.4%)	680 (14.8%)	210 (4.5%)	190 (4.1%)	1,450 (31.4%)	550 (11.9%)	4,630
1988	280 (6.1%)	870 (19.1%)	180 (3.9%)	190 (4.1%)	720 (15.6%)	240 (5.2%)	130 (2.8%)	1,190 (26.1%)	780 (17.1%)	4,580
1989	220 (4.6%)	1,040 (21.4%)	170 (3.4%)	210 (4.3%)	740 (15.3%)	290 (5.9%)	70 (1.4%)	1,390 (28.6%)	730 (15.1%)	4,870
1990	240 (4.4%)	1,040 (19.1%)	130 (2.4%)	130 (2.5%)	810 (14.9%)	220 (4.0%)	70 (1.4%)	2,070 (38.0%)	730 (13.3%)	5,460
1991	320 (5.8%)	1,010 (18.2%)	140 (2.5%)	170 (3.0%)	870 (15.7%)	270 (4.8%)	130 (2.4%)	1,740 (31.4%)	900 (16.2%)	5,560
1992	490 (8.5%)	1,080 (18.7%)	110 (2.0%)	170 (3.0%)	790 (13.8%)	230 (3.9%)	130 (2.2%)	1,910 (33.1%)	860 (14.8%)	5,760
1993	770 (12.8%)	1,210 (20.2%)	150 (2.5%)	150 (2.5%)	890 (14.8%)	240 (4.0%)	130 (2.2%)	1,600 (26.7%)	860 (14.3%)	6,000
1994	640 (10.5%)	1,150 (18.9%)	140 (2.3%)	150 (2.5%)	750 (12.4%)	290 (4.8%)	20 (0.3%)	1,920 (31.7%)	1,010 (16.6%)	6,070
1995	480 (7.8%)	1,250 (20.1%)	180 (2.8%)	210 (3.4%)	950 (15.3%)	200 (3.2%)	200 (3.3%)	1,930 (31.0%)	820 (13.1%)	6,210
1996 [2]	250 (4.0%)	1,270 (20.3%)	160 (2.5%)	190 (3.0%)	950 (15.2%)	270 (4.4%)	140 (2.2%)	2,030 (32.5%)	990 (15.9%)	6,260
1997	290 (4.3%)	1,740 (25.8%)	240 (3.5%)	240 (3.5%)	1,160 (17.2%)	230 (3.4%)	100 (1.4%)	2,050 (30.4%)	710 (10.5%)	6,760

Notes :

(1) The estimated quantity of each waste component shown here is based on composition analysis of municipal solid waste

(2) 1996 data are estimates based on the trends in previous years as composition analysis was not conducted

Figures may not add up to total due to rounding-off

Appendix 5 : Review of composition of commercial & industrial waste

Year	Quantity (tpd) and its percentage by weight [1]									
	Bulky waste	Paper	Glass	Metals	Plastics	Textiles	Rattan/wood	Putrescibles	Others	Total
1986	N.A.	280 (19.3%)	50 (3.2%)	60 (4.0%)	240 (16.9%)	290 (20.2%)	150 (10.7%)	240 (16.9%)	130 (8.8%)	1,440
1987	N.A.	340 (20.2%)	70 (3.9%)	60 (3.8%)	300 (17.8%)	280 (16.4%)	210 (12.5%)	260 (15.7%)	160 (9.7%)	1,680
1988	N.A.	290 (16.1%)	60 (3.5%)	80 (4.2%)	290 (16.0%)	290 (16.0%)	250 (13.6%)	270 (15.1%)	280 (15.5%)	1,820
1989	20 (1.3%)	330 (19.4%)	40 (2.6%)	90 (5.0%)	310 (17.9%)	290 (17.0%)	170 (10.0%)	180 (10.2%)	290 (16.6%)	1,720
1990	20 (0.9%)	330 (20.3%)	30 (1.9%)	90 (5.7%)	300 (18.0%)	420 (25.5%)	160 (9.7%)	150 (9.0%)	150 (9.0%)	1,650
1991	30 (1.8%)	340 (18.4%)	50 (2.6%)	70 (4.0%)	320 (17.7%)	350 (19.0%)	180 (9.9%)	240 (12.9%)	250 (13.7%)	1,830
1992	50 (2.5%)	430 (19.8%)	50 (2.2%)	60 (2.9%)	460 (21.4%)	400 (18.5%)	190 (9.0%)	160 (7.5%)	350 (16.2%)	2,170
1993	40 (1.6%)	780 (31.7%)	20 (0.9%)	80 (3.2%)	430 (17.3%)	280 (11.6%)	260 (10.4%)	130 (5.3%)	440 (18.0%)	2,450
1994	180 (7.7%)	690 (29.3%)	40 (1.8%)	60 (2.5%)	400 (16.9%)	200 (8.4%)	280 (11.8%)	140 (5.8%)	370 (15.8%)	2,360
1995	50 (3.0%)	500 (31.3%)	40 (2.4%)	80 (5.0%)	280 (17.4%)	120 (7.3%)	250 (16.1%)	50 (2.9%)	230 (14.6%)	1,580
1996 [2]	80 (4.1%)	570 (30.1%)	30 (1.8%)	70 (3.5%)	310 (16.2%)	130 (6.8%)	320 (16.9%)	90 (4.7%)	300 (15.9%)	1,880
1997	90 (4.8%)	490 (25.5%)	40 (2.1%)	80 (4.0%)	320 (16.4%)	140 (7.0%)	340 (17.6%)	160 (8.3%)	280 (14.3%)	1,920

Notes :

(1) The estimated quantity of each waste component shown here is based on composition analysis of municipal solid waste

(2) 1996 data are estimates based on the trends in previous years as composition analysis was not conducted

Figures may not add up to total due to rounding-off

N.A. = Not available

Appendix 6 : Review of composition of municipal solid waste

Year	Quantity (tpd) and its percentage by weight [1]									
	Bulky waste	Paper	Glass	Metals	Plastics	Textiles	Rattan/wood	Putrescibles	Others	Total
1986	320 (5.4%)	1,250 (21.3%)	160 (2.7%)	210 (3.5%)	880 (15.0%)	480 (8.1%)	340 (5.8%)	1,590 (27.1%)	650 (11.1%)	5,870
1987	250 (4.0%)	1,340 (21.3%)	190 (3.0%)	220 (3.5%)	980 (15.6%)	490 (7.7%)	400 (6.3%)	1,720 (27.2%)	710 (11.4%)	6,300
1988	280 (4.4%)	1,170 (18.2%)	240 (3.8%)	270 (4.1%)	1,010 (15.7%)	530 (8.3%)	380 (5.9%)	1,470 (22.9%)	1,070 (16.7%)	6,410
1989	250 (3.7%)	1,370 (20.9%)	210 (3.2%)	300 (4.5%)	1,050 (16.0%)	580 (8.7%)	240 (3.7%)	1,570 (23.8%)	1,020 (15.5%)	6,580
1990	260 (3.6%)	1,380 (19.4%)	160 (2.3%)	230 (3.2%)	1,110 (15.6%)	640 (9.0%)	230 (3.3%)	2,220 (31.3%)	880 (12.3%)	7,100
1991	350 (4.8%)	1,350 (18.3%)	180 (2.5%)	240 (3.2%)	1,200 (16.2%)	610 (8.3%)	320 (4.3%)	1,980 (26.8%)	1,150 (15.6%)	7,390
1992	540 (6.8%)	1,510 (19.0%)	160 (2.1%)	230 (3.0%)	1,260 (15.9%)	630 (7.9%)	320 (4.0%)	2,070 (26.1%)	1,210 (15.2%)	7,930
1993	810 (9.5%)	1,990 (23.6%)	170 (2.0%)	230 (2.7%)	1,320 (15.6%)	520 (6.2%)	380 (4.5%)	1,730 (20.5%)	1,300 (15.4%)	8,450
1994	820 (9.7%)	1,840 (21.8%)	180 (2.2%)	210 (2.5%)	1,150 (13.6%)	490 (5.9%)	300 (3.5%)	2,060 (24.5%)	1,380 (16.3%)	8,430
1995	530 (6.8%)	1,740 (22.3%)	210 (2.8%)	290 (3.7%)	1,230 (15.8%)	310 (4.0%)	460 (5.9%)	1,970 (25.3%)	1,050 (13.4%)	7,790
1996 [2]	330 (4.0%)	1,840 (22.6%)	190 (2.4%)	260 (3.1%)	1,260 (15.4%)	400 (4.9%)	450 (5.6%)	2,120 (26.1%)	1,290 (15.9%)	8,140
1997	380 (4.4%)	2,230 (25.7%)	280 (3.2%)	310 (3.6%)	1,480 (17.1%)	370 (4.2%)	440 (5.0%)	2,210 (25.5%)	980 (11.3%)	8,680

Notes :

(1) The estimated quantity of each waste component shown here is based on composition analysis of municipal solid waste

(2) 1996 data are estimates based on the trends in previous years as composition analysis was not conducted

Figures may not add up to total due to rounding-off

Appendix 7 : Recovery of major recyclable wastes in 1997

Waste type	Quantity of waste recovered in 1997 (thousand tonnes)		
	Exported for recycling (C&SD figures) (a)	Recycled locally (b)	Total recovery (c) = (a) + (b)
Paper	440	270	710
Plastics	149	16	165
Ferrous metals	518	8	526
Non-ferrous metals	107	10	117
Glass[1]	0.2	1.7	1.9
Wood	less than 0.1	1.7	1.7
Rubber tyre	0	7.5	7.5
Textiles	12	less than 1	12
Total	**1,226**	**315**	**1,541**

Note :

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