MONITORING OF SOLID WASTE IN HONG KONG 1995

Environmental Protection Department

Monitoring of Solid Waste in Hong Kong

1995

Facilities Planning Group
Environmental Protection Department
HONG KONG GOVERNMENT

1997

Printed on recycled paper

Monitoring of Solid Waste in Hong Kong, 1995

Report Number	:	EPD/TR/1/97
Date	:	March 1997
Authors	:	Dr. C.C. TSANG, K.F. NG
Work Done By	:	K.F. NG, Gordon L.S. CHEUNG, Ann S. C. CHENG, Ben C.W. MAN, Charles P.L. CHAN, C.K. CHU, Desmond Y.C. WU, Arthur W.K. LAU
Approved By	:	Dr. M.M. LAU
Security Classification	:	Unrestricted

Table of Contents

List of Figures

List of Tables

List of Appendices

Abbreviations

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 1995. Inert materials suitable for land reclamation reuse were delivered to public dumps. A small fraction of about 3% of solid wastes are combusted in KCIP.

(2) In 1995, a daily average of about 22,300 tonnes of solid wastes was disposed of at landfills and the KCIP. Of this 22,300 tonnes of solid wastes, there were about 6,200 tonnes of domestic waste, 1,600 tonnes of commercial and industrial waste and 14,100 tonnes of construction & demolition waste. An overall drop of about 8% was observed in the total quantity of solid wastes in 1995 with a substantial decrease in the quantity of commercial and industrial waste by 33% as compared to 1994 statistics.

(3) In 1995, the third strategic landfill, NENT was commissioned in June while TKOL and SWL were closed in February and September respectively. Amongst all the landfills, the waste intake at SENT was the greatest (about 7,000 tonnes per day) while both SENT and PPVL demonstrated substantial increase of waste intake from 1994 to 1995. About 60% of waste intake at all landfills could be categorized as construction & demolition waste.

(4) A total amount of 32,000 tpd of construction & demolition waste was delivered to public dumps and landfills in 1995. Of this amount, 56% was delivered to public dumps while the remaining 44% was landfilled. When compared with 1994, this represents a drop of about 9% in the quantity of construction & demolition waste landfilled while the amount disposed of at public dumps increased by almost 120%.

(5) In 1995, the major components of municipal solid waste were putrescibles, paper and plastics (about 64% by weight of the waste stream). Putrescible matter dominated the domestic waste stream while paper was dominant in commercial and industrial waste. Nearly 80% of the construction & demolition waste landfilled was estimated to be inert materials.

(6) The average bulk density and moisture content of domestic waste in 1995 were 195 kg/m^3 and 50% respectively. The average bulk density and moisture content of commercial and industrial waste in 1995 were 69 kg/m^3 and 32% respectively.

(7) Analysis of the recyclable materials in municipal solid waste disposed of at waste facilities revealed that paper and plastics were the two major types of recyclable materials. Plastic bags were the major recyclable plastics in municipal solid waste and there was an increase in the amount of plastic beverage bottles.

(8) In 1995, about 2 million tonnes, 40% by weight of municipal solid waste were recovered for recycling. The quantity of recovered waste exported for recycling was about 1.5 million tonnes with a value of about HK$ 2.9 billion. By weight, paper and ferrous metals were the most recovered material for recycling. Non-ferrous metals, however, has the greatest export value.

(9) The domestic waste generation rate remained at about 1 kg/person/day in 1995. The commercial and industrial waste generation rate, however, dropped from 1.38 kg/employee/day in 1994 to 0.88 kg/employee/day in 1995. The survey data continued to demonstrate the linear relationship between the quantity of municipal solid waste and the total GDP.

(10) 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 and industrial waste would be 1.46 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 15,300 tpd in 2011. Of this amount, there would be about 11,800 tpd of domestic waste and 3,500 tpd of commercial and industrial waste. The quantity of construction & demolition waste would amount to 21,000 tpd in 2011.

1. Introduction

1.1 Background

1.1.1 Hong Kong often takes pride in her economic success. The growing economy in the past has brought wealth to the community, but it has also produced various environmental challenges. A key challenge is the management of the large quantity of solid waste generated by our community. With the continuous growth in population and economy, the quantity of waste discarded from households, commercial and industrial activities and construction activities has increased substantially. In the period from 1986 to 1995, the quantity of waste disposed of in Hong Kong has increased by almost 150%. As the Waste Disposal Authority of Hong Kong, EPD has to take up the challenge of managing the disposal of large quantity of solid waste which can amount to around 22,000 tpd in recent years.

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 1995 marks the fifteenth 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.

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 twelfth 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 1995, which covers the following aspects :

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

1.3.2 This report sets out the forecast of the geographical distribution as well as the quantities of municipal solid waste for the years 2001, 2006 and 2011. Forecast of the quantities of construction & demolition waste in 2001, 2006 and 2011 is also included in this report.

1.3.3 Several new features have been incorporated into this report and they are as follows :

(a) inclusion of waste statistical data for the period of 1986 to 1995;
(b) enhanced coverage on the section of waste recovery and recycling;
(c) more comprehensive analysis of the monitoring results; and
(d) a section on the review of the methodologies adopted in the waste monitoring programme.

2. Classification of Solid Waste and the Waste Monitoring Survey 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 waste, chemical waste, special waste and other waste. The classification of solid waste is depicted in Figure 1.

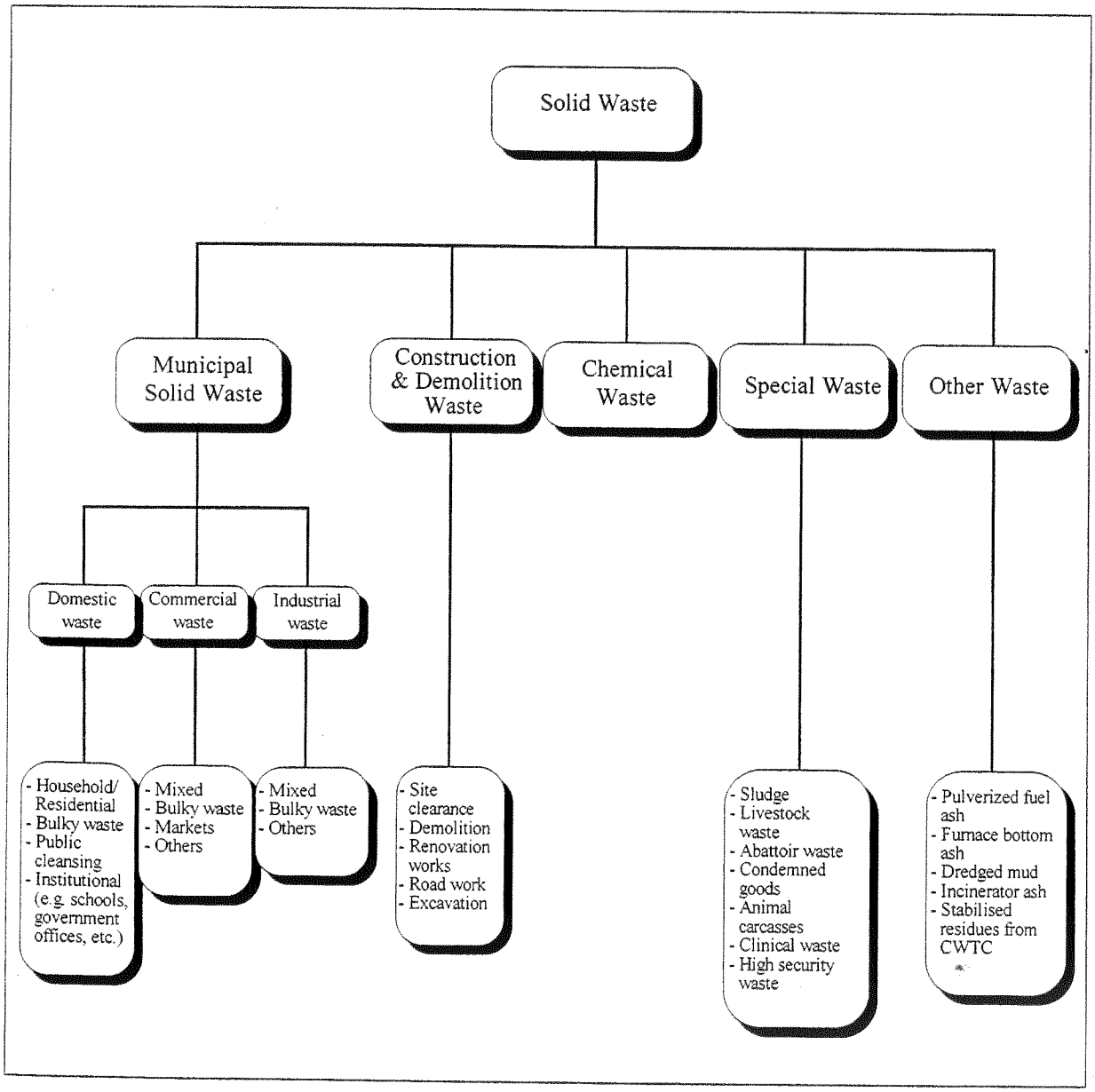


Figure 1 Current classification of solid waste

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 construction & demolition 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 can arise from residential premises, commercial and industrial activities and are usually collected separately.

2.1.3 **Construction & demolition waste** includes waste arising from construction sites clearance, demolition activities, roadworks, excavation and renovation of buildings.

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 Survey Methodology

2.2.1 In 1995, two surveys covering both the wet and dry seasons were carried out in the period of June to July and November to December. In the surveys, EPD staff visited landfills, KCIP and RTS, and carried out the following types of field work :

- weighbridge monitoring ;
- composition analysis of municipal solid waste by manual sorting (at landfills only) ;
- estimation of the composition of construction & demolition waste by visual observation (at landfills only) and ;
- determination of moisture content and bulk density of municipal solid waste.

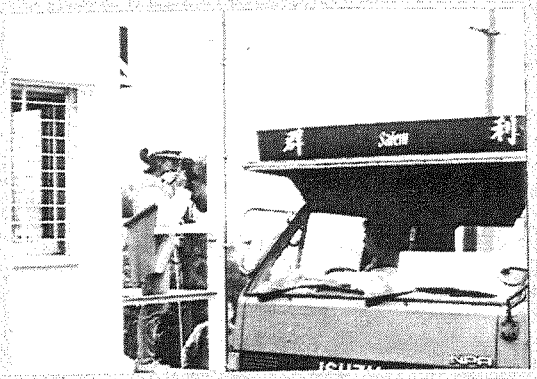
Further details of the scope of the above field work and the type of information collected are summarized in Table 1.

2.2.2 Based on statistical analysis of data from previous years, the composition of municipal solid waste in the wet and dry seasons were found to be similar with little variations. In an attempt to streamline the survey programme, the composition analysis of municipal solid waste in the 1995 survey was carried out in the wet season only, whilst the determination of moisture content was maintained in both wet and dry seasons to take into account the seasonal variations.

2.2.3 Surveys on composition of construction & demolition waste were carried out by visual inspection. This involves two survey teams to observe independently the composition of construction & demolition waste disposed of at landfills. Composition of the five categories of construction & demolition waste, namely roadworks materials, excavated soil, demolition waste, site clearance waste and renovation waste were studied using this method.

2.2.4 In addition to the above surveys, the following data were also 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;

Type of survey work	What have we done in the survey?
Weighbridge monitoring 	Interview drivers to collect information on waste delivered by vehicles arriving at each operating waste disposal facility
Composition analysis of municipal solid waste 	Manual sorting of 1 m^3 samples of municipal solid waste. A minimum of 5 samples (collected from 5 or more loads of different vehicles) were analyzed on each survey day the composition analysis was conducted. Bake 1-2 kg samples of municipal solid waste at 100°C overnight
Composition analysis of construction & demolition waste 	Two survey teams stayed at the tipping face of landfill throughout normal working hours and independently estimated the composition of loads of construction & demolition waste by observation of the waste off-loaded.

Notes :
Total number of survey days in 1995 : 52
Total number of samples of municipal solid waste analyzed for their composition : 93
Total number of samples of municipal solid waste analyzed for their moisture content: 173
Total number of truck loads of construction & demolition waste observed for composition analysis: 3060
* Such data/results are not presented in this report

Table 1 The waste monitoring survey -

What information have we collected ?	Summary of results in this report
•Arrival time*	
•Vehicle Registration Number and Ownership*	
•Waste Type	Tables 2, 5
•Source of Waste	Table 5
•Waste Quantity (from weighbridge records)	Figure 3 Appendix 3
•Composition (by weight) of the selected samples	Figures 6, 7, 8
•Quantities and percentage of recyclable materials in the selected samples	Tables 9, 10
•Types and quantities of plastic components in selected samples	Table 10
•Bulk density of municipal solid waste	Table 6
•Moisture content of municipal solid waste	Table 6
•Composition (by volume) of each truck load of construction & demolition waste. Together with the payload of that truck, the composition (by weight) of construction & demolition waste can be worked out.	Tables 7, 8

work involved and information collected

- 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.

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

3. Waste Quantities

3.1 Waste Disposal Statistics

3.1.1 In 1995, a daily average of 22,269 tonnes of solid waste was disposed of at the solid waste facilities viz. landfills, RTS and KCIP in Hong Kong. Table 2 summarizes the quantities of municipal solid waste, construction & demolition waste, and special waste disposed of in 1995. Compared with 1994, there was an overall reduction of about 8% 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 by 2%; commercial and industrial waste dropped by 25% and 36% respectively. For construction & demolition waste and special wastes, a decrease by 9% was observed for both types of waste.

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 2. The majority of commercial and industrial waste were collected by private waste collectors. However, the Municipal Councils have been collecting commercial and 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 and industrial waste.

3.1.3 In an attempt to estimate the quantity of publicly collected commercial and industrial waste, the RCV collection routes and the results of the weighing exercises provided by USD/RSD were examined. This exercise could provide an estimate of the quantity of commercial and industrial waste collected from commercial and industrial buildings or centres, but not the quantity of commercial and industrial waste which are mixed with domestic waste before disposal. In 1995, it was estimated that about 250 tpd of waste was collected from commercial and industrial buildings by USD/RSD.

3.1.4 Table 3 shows the quantities of municipal solid waste, construction & demolition waste and special wastes disposed of at solid waste facilities from 1986 to 1995. A steady growth in the quantity of domestic waste can be noted. The rising trend, however, is not apparent for commercial and industrial waste; and for construction & demolition 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 the 10-years period. The economy, the level of construction activities which vary from time to time could affect the

Waste type	Quantity (tpd)			Percentage change from previous year (+/-%)
	Collection agents		Total	
	Public[1]	Private[2]		
a. Domestic waste				
- household mixed/public cleansing	4,777	951	5,728	
- bulky waste	412	70	482	
Sub-total	**5,189[3]**	**1,021**	**6,210**	**+2%**
b. Commercial waste				
- commercial mixed	-	451	451	
- bulky waste	-	14	14	
- markets	-	16	16	
- others	-	40	40	
Sub-total		**521**	**521**	**-25%**
c. Industrial waste				
- manufacturing mixed	-	798	798	
- bulky waste	-	34	34	
- others	-	231	231	
Sub-total		**1,063**	**1,063**	**-36%**
d. Municipal solid waste received at disposal facilities (a+b+c)	5,189	2,605	7,794	-8%
e. Construction & demolition waste (landfilled)	-	14,121	14,121	-9%
f. Special waste (landfilled)	176	178	354	-9%
g. All waste received at waste facilities (d+e+f)	5,365	16,904	22,269	-8%

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 2 Quantities of solid waste disposed of at landfills, incineration plant and RTS in 1995

Year	Types of waste					
	Domestic & public cleansing (tpd)	Commercial (tpd)	Industrial (tpd)	Construction & demolition (landfilled) (tpd)	Special (landfilled) (tpd)	TOTAL (tpd)
1986	4,420	370	1,080	2,850	240	8,960
1987	4,630	430	1,240	4,220	250	10,770
1988	4,580	420	1,410	6,520	260	13,190
1989	4,870	450	1,270	5,580	310	12,480
1990	5,460	380	1,270	8,450	360	15,920
1991	5,560	400	1,430	16,380	340	24,110
1992	5,760	460	1,710	11,960	320	20,210
1993	6,000	570	1,880	11,520	250	20,220
1994	6,070	700	1,660	15,480	390	24,300
1995	6,210	520	1,060	14,120	350	22,260

Note :
Figures rounded off to the nearest tenth

Table 3 Summary of the major types of solid waste disposed of at solid waste facilities from 1986 - 1995

quantities of commercial and industrial waste; and construction & demolition waste. This could account for the less apparent rising trend for commercial and industrial waste as well as construction & demolition waste.

3.1.5 The quantities and disposal methods of special and other wastes are summarized in Table 4. A type of special waste not considered in Table 4 is grease trap waste which is regarded as a special aqueous waste due to its high water content. Grease trap waste is currently delivered to landfills for co-disposal and about 45 tpd of grease trap waste was disposed of at landfills in 1995.

3.2 Geographical Distribution of Municipal Solid Waste and Construction & Demolition 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 WAD which are further subdivided into 54 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 1995 by WAD is shown in Table 5.

3.2.2 Compared with 1994, there was a significant drop in the quantity of commercial and industrial waste from the Eastern and Southern Districts of Hong Kong Island (-44%), Wong Tai Sin (-65%), Kwun Tong (-37%), Tsuen Wan (-44%), Tuen Mun (-51%) and Sai Kung (-65%). Old industrial buildings and estates can be found in most of these districts. Many of the old factories in these districts are either closed or relocated to Mainland China and this could be related to the substantial reduction of commercial and industrial waste from these districts.

3.2.3 According to the weighbridge monitoring results in 1995, about 60% (8,800 tpd) of the construction & demolition waste landfilled in Hong Kong was collected from the New Territories. This represents an increase of about 5% when compared with 1994. This small increase was due to the rise in the quantity of construction & demolition waste generated from Kwai Tsing (+105%), Tuen Mun (+28%) and Tai Po (+34%).

3.2.4 It should be noted that 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 and whether suitable facilities are located within the region. This finding is depicted in Figure 2 and it can be seen that this is particularly the case for construction & demolition waste.

Waste type	Disposal method	Quantity disposed of
Chemical waste other than asbestos waste	CWTC	239 tpd
	Co-disposal at landfills	5 tpd
Asbestos waste	Co-disposal at landfills	13 tpd
Waterworks sludge(from Sha Tin Water Treatment Works)	Marine disposal	354 cu.m/day
Sewage sludge(from Sha Tin Sewage Treatment Works)	Marine disposal	787 cu.m/day
Dewatered sludge	Landfilling	117 tpd
Sewage works screenings	Landfilling	43 tpd
Abattoir waste	Landfilling	19 tpd
Animal carcasses	Landfilling	6 tpd
	Crematories, Kennedy Town By-Product Plant	4 tpd
Livestock waste	Composting and other environmentally acceptable means	630 tpd
Condemned goods	Landfilling	19 tpd
High security waste	Incineration	11 tpd
Clinical waste	Co-disposal at landfills*	less than 1 tpd
	Pathological waste incinerators at hospitals	2 tpd
	Mixing with general refuse	2 tpd
Dredged mud and excavated materials	Marine dumping	49,038 cu.m/day
Pulverised fuel ash	Concrete manufacturing, stored in lagoon	2,479 tpd
Furnace bottom ash	Concrete manufacturing, stored in lagoon	326 tpd
Incinerator ash	Landfilling	156 tpd
CWTC stabilised residue	Landfilling	50 tpd

SWL 58 tpd
PPVL 29 tpd
NENT 30 tpd

Note :

* Excluding waste delivered by USD

Table 4 Quantities of different kinds of special and other wastes disposed of in 1995

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	322	47	72	441	882	1,323
Wanchai	234	76	64	374	426	800
Eastern	391	112	70	573	509	1,082
Southern	235	25	34	294	331	625
Hong Kong Island Sub-total	**1,182**	**260**	**240**	**1,682**	**2,148**	**3,830**
Yau Tsim Mong	484	116	113	713	577	1,290
Sham Shui Po	309	87	74	470	424	894
Kowloon City	313	52	109	474	755	1,229
Wong Tai Sin	282	22	17	321	358	679
Kwun Tong	410	55	180	645	1,051	1,696
Kowloon Sub-total	**1,798**	**332**	**493**	**2,623**	**3,165**	**5,788**
Kwai Tsing	321	173	125	619	2,355	2,974
Tsuen Wan	205	68	146	419	1,533	1,952
Tuen Mun	360	26	95	481	1,184	1,665
Yuen Long	269	28	118	415	297	712
North	177	21	53	251	484	735
Tai Po	230	44	135	409	1,148	1,557
Sha Tin	389	52	154	595	1,051	1,646
Sai Kung	153	17	25	195	709	904
New Territories Sub-total	**2,104**	**429**	**851**	**3,384**	**8,761**	**12,145**
Cheung Chau[4]	37	-	-	37	-	-
Mui Wo[4]	23	-	-	23	-	-
Peng Chau[4]	11	-	-	11	-	-
Discovery Bay[4]	14	-	-	14	-	-
Lamma Island[4]	15	-	-	15	-	-
Hei Ling Chau[4]	5	-	-	5	-	-
Outlying Islands Sub-total	**105**	**-**	**-**	**105**	**47[3]**	**152[3]**
Territorial Total	**5,189**	**1,021**	**1,584**	**7,794**	**14,121**	**21,915**

Notes :

(1) Includes 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

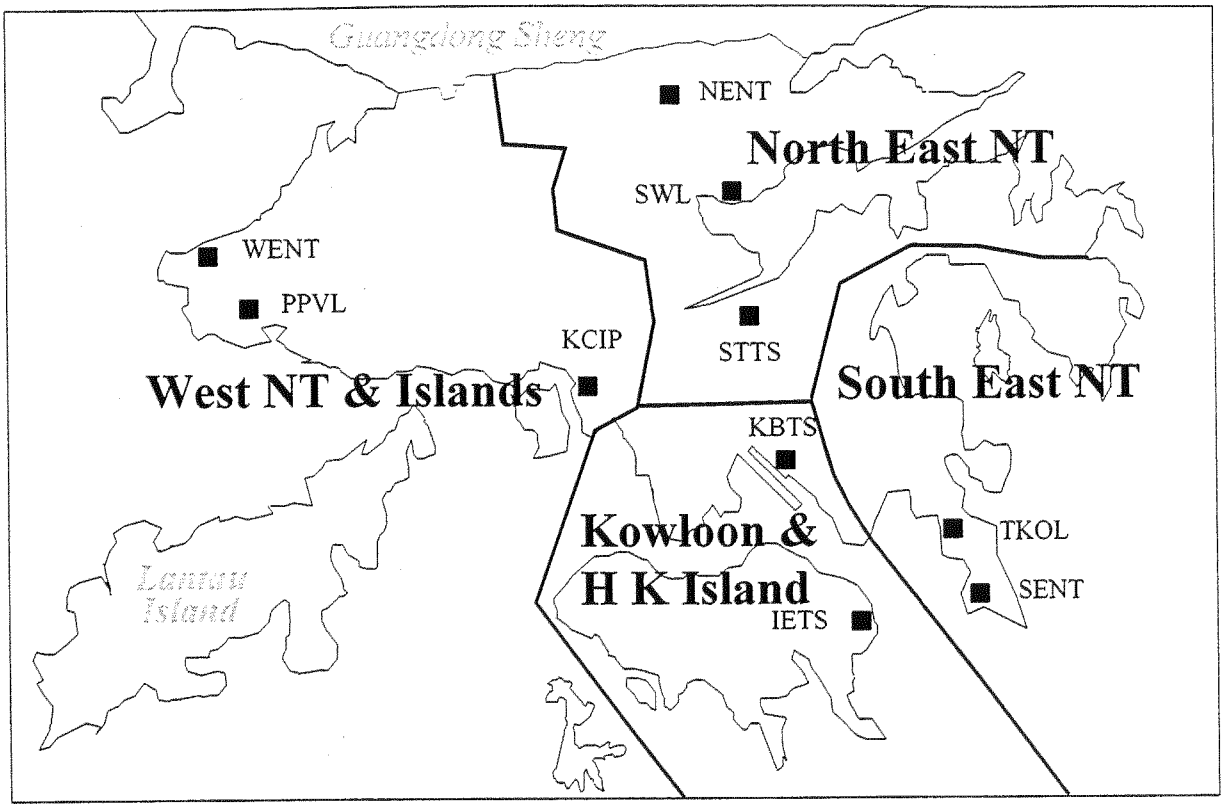
(4) These islands are aggregated to form one WAD; Outlying Islands

(5) Special waste not included in this table

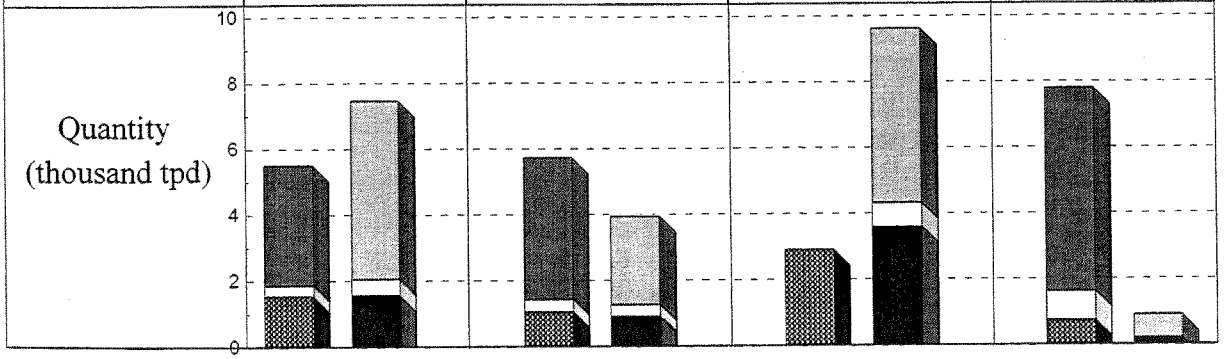
Remark :

The geographical distribution presented is worked out based on information collected from drivers of RCV/trucks during weighbridge monitoring.

Table 5 Geographical distribution of solid waste disposed of in 1995



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



Waste disposed of at the waste facilities within this region

- Construction & demolition waste (for landfilling)
- Commercial & industrial waste
- Domestic waste

Waste collected for disposal from this region

- Construction & demolition waste (for landfilling)
- Commercial & industrial waste
- Domestic waste

Note:

(1) There were no landfills operating in the region and the landfills closest to Kowloon & HK Island were TKOL and SENT

Figure 2 Comparison of the quantity of solid waste collected and disposed of at waste facilities within the same geographical region in 1995

3.3 Utilization of Waste Facilities

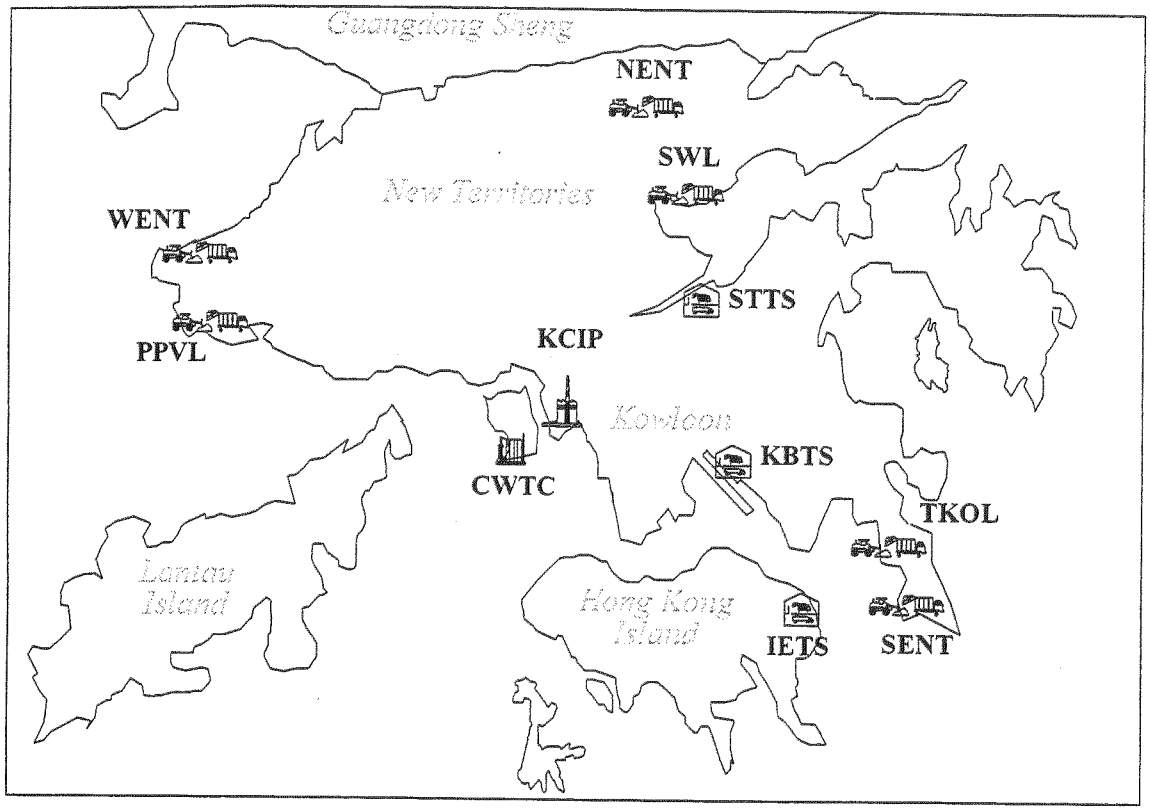
3.3.1 Figure 3 presents the provision of waste facilities in 1995 and the waste intake at these facilities. In 1995, the third strategic landfill, NENT was commissioned in June while two old landfills, TKOL and SWL were decommissioned in February and September respectively. Amongst all the landfills, SENT received the greatest amount of waste in 1995. This was mainly due to the proximity of SENT to the urban areas. A substantial increase of waste intake was observed at SENT and PPVL during the year. This was the result of the closure of TKOL and SWL and the subsequent diversion of construction & demolition waste from TKOL and SWL to SENT and PPVL. A breakdown of the waste intake at landfills, KCIP and RTS by each major waste type is shown in Appendix 3.

3.3.2 The provision of waste facilities and the respective waste intake in the past decade from 1986 to 1995 are summarized in Appendix 4. It can be noted that old waste facilities, like the old landfills in urban area and the old incineration plants have been replaced gradually by the three strategic landfills and a network of RTS. The two remaining old waste facilities, PPVL and KCIP, are scheduled for closure in January 1997 and mid-1997 respectively. Two new RTS in Hong Kong Island West and West Kowloon are scheduled for commissioning around mid-1997. By then, there will be 5 RTS providing waste transfer services to the community.

3.4 Disposal of Construction & Demolition Waste at Landfills and Public Dumps

3.4.1 Public dump is an outlet for inert construction & demolition waste which can be used for land reclamation. The quantities of construction & demolition waste disposed of at landfills and public dumps in 1994 and 1995 are shown in Figure 4. It can be noted that the total amount of construction & demolition waste disposed of at both public dumps and landfills increased from 24,000 tpd in 1994 to 32,000 tpd in 1995. However, due to the opening of a new public dump at Tuen Mun in October 1995 and the commissioning of a Public Dumping Barging Point at Aldrich Bay in October 1995, the quantity of construction & demolition waste delivered to public dumps increased from an average of 8,400 tpd in 1994 to 18,300 tpd in 1995. Correspondingly, the percentage of construction & demolition waste delivered to landfills reduced significantly from 65% to 44%.

3.4.2 Figure 5 summarizes the proportion of construction & demolition waste out of the total amount of waste disposed of at the landfills in 1994 and 1995. Construction & demolition waste constituted about 60% of the total waste intake at landfills. SENT and PPVL were the landfills which received construction & demolition waste throughout 1995 while WENT did not accept any construction & demolition waste during the year. NENT did not receive any construction & demolition waste until September while TKOL and SWL ceased operation in February and September respectively.



North East New Territories Landfill (NENT)
2,619 tpd
(Commissioned in June 1995)

Island East Transfer Station (IETS)(1)
1,203 tpd (-3.6%)

Pillar Point Valley Landfill (PPVL)
4,687 tpd (+92.9%)

South East New Territories Landfill (SENT)
7,072 tpd (+509.1%)

Kowloon Bay Transfer Station (KBTS)(2)
1,691 tpd (-4.0%)

Shuen Wan Landfill (SWL)
6,230 tpd (-17.7%)
(Decommissioned in September 1995)

West New Territories Landfill (WENT)
2,810 tpd (+4.0%)

Sha Tin Transfer Station (STTS)(3)
797 tpd (+34.6%)

Tseung Kwan O Landfill (TKOL)
4,882 tpd (-53.5%)
(Decommissioned in February 1995)

Chemical Waste Treatment Centre (CWTC)
239 tpd (+7.7%)

Kwai Chung Incineration Plant (KCIP)
717 tpd (+1.7%)

Notes:
(1) Waste from IETS was transferred to WENT by barge
(2) Waste from KBTS was transferred to WENT by road until August 95 and was then transferred to NENT starting from August 95
(3) Waste from STTS was transferred to WENT by road until June 95 and was then transferred to NENT starting from June 95

Remarks:
The quantities shown here do not include incinerator ash disposed of at landfills(156 tpd)
(%) --Percentage increase / decrease over previous year
--Facilities under the management of EPD

Figure 3 Waste intake at waste facilities in 1995

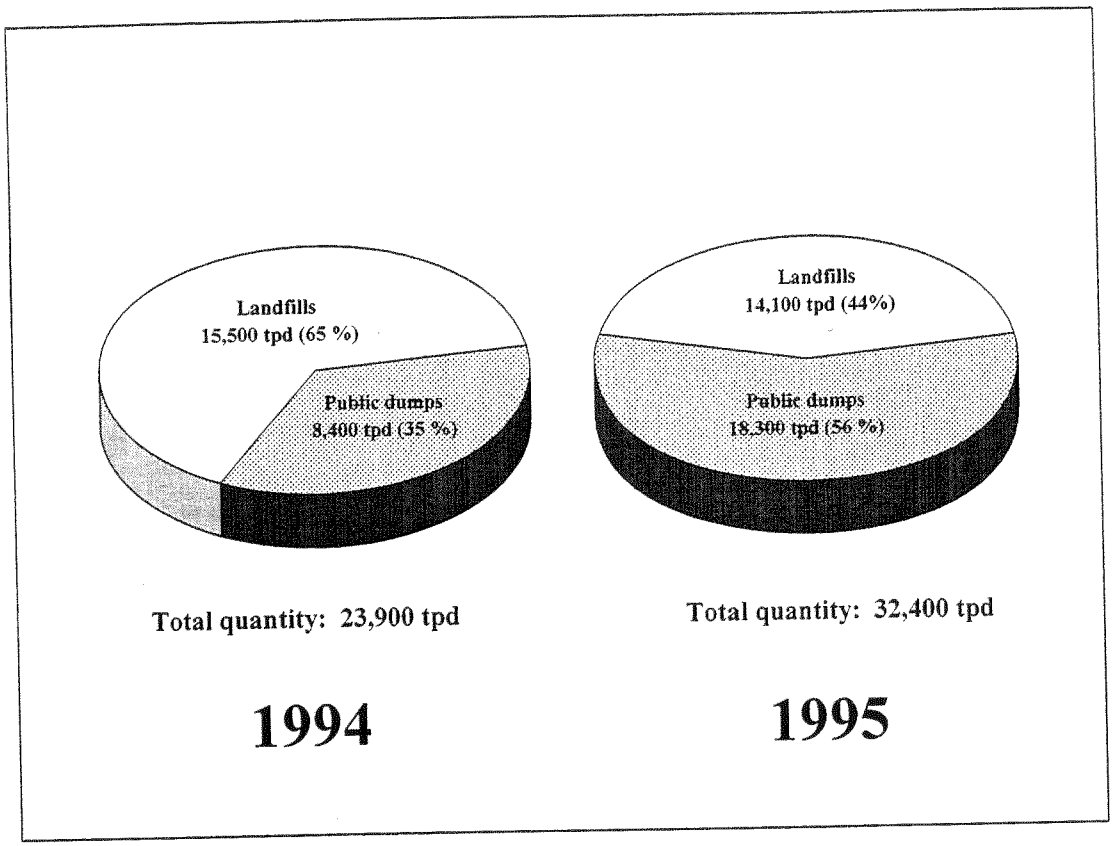


Figure 4 Quantity of construction & demolition waste delivered to landfills and public dumps in 1994 and 1995

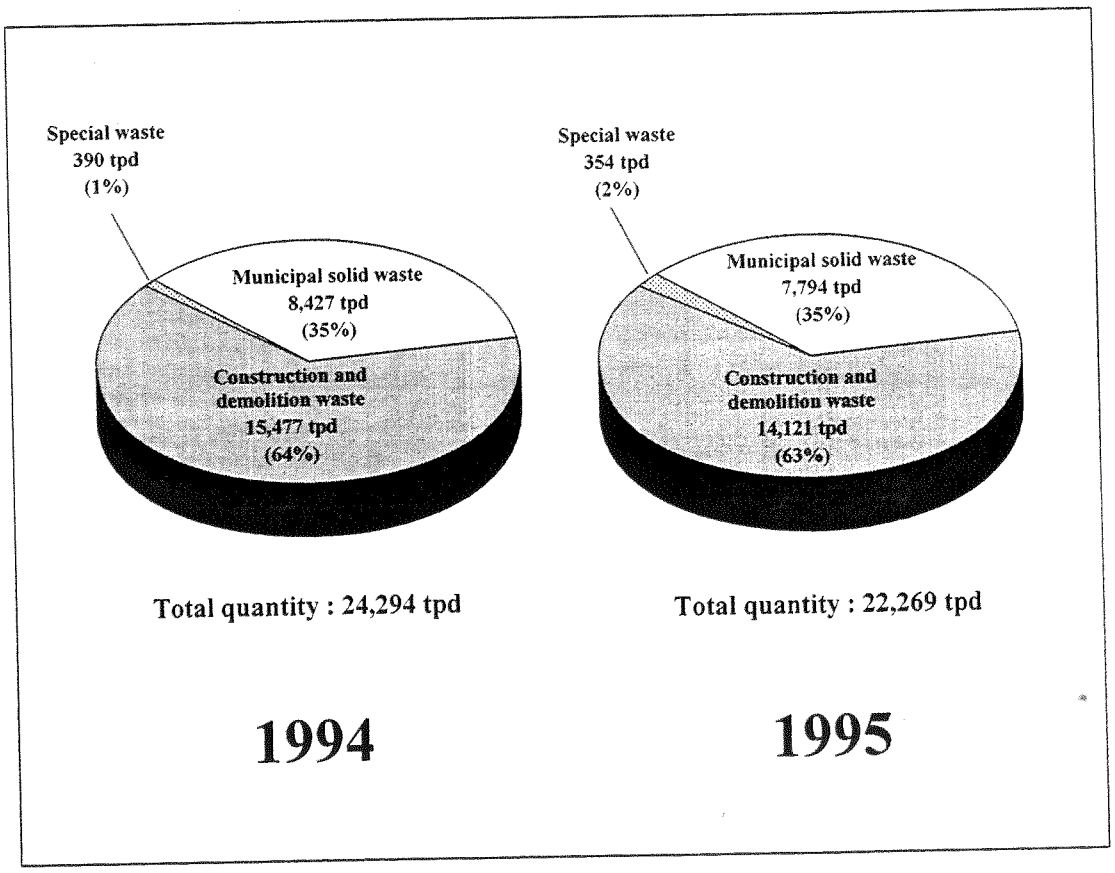


Figure 5 Construction & demolition waste disposal at landfills in 1994 and 1995

4. Waste Characteristics

4.1 Composition of Municipal Solid Waste

4.1.1 The composition of municipal solid waste disposed of at waste facilities in 1994 and 1995, expressed as percentage by weight, are shown in Fig 6. It can be noted that putrescibles, paper and plastics were the major components of municipal solid waste. These three components constituted about 64% by weight of municipal solid waste. Apart from unclassified materials, rubble and ceramics (0.1%), non-ferrous metals (1.1%) and ferrous metals (2.6%) were the components least commonly found in the municipal solid waste stream. In contrast to previous years' reports, bulky waste is included as a component of the municipal solid waste in the current analysis.

4.1.2 Appendix 5 provides a review of the composition of municipal solid waste disposed of at waste facilities from 1986 to 1995. The percentage by weight of each of the components remained relatively constant over the past ten years. The estimated quantity of each of these components in the municipal solid waste stream from 1986 to 1995 is also made.

4.1.3 The composition of domestic waste disposed of at waste facilities in 1994 and 1995 are shown in Figure 7. The composition of domestic waste is very similar to that of municipal solid waste with the three major components being putrescibles, paper and plastics (about 66% by weight of domestic waste). This is expected as domestic waste comprises the majority of municipal solid waste. A more detailed analysis of the composition of domestic waste revealed that newspaper was the major kind of waste paper found in domestic waste, while plastic bags constituted the bulk of waste plastics (please refer to Tables 9 and 10 for data).

4.1.4 The composition of domestic waste disposed of at waste facilities, in terms of percentage by weight and estimated quantity of each component from 1986 to 1995 is shown in Appendix 6. Like municipal solid waste, the composition of domestic waste did not have drastic variations over the past ten years. The various components in the domestic waste stream remained generally stable over the period.

4.1.5 The composition of commercial and industrial waste (percentage by weight) disposed of at waste facilities in 1994 and 1995 are shown in Figure 8. The major components were paper, plastics, rattan and wood which constituted about 65% by weight of commercial and industrial waste. Paper were mainly originated from offices. Plastics were mainly plastic bags and plastic food-and-drinks containers. Wood were mainly wood pallets for handling cargoes and sawdust from wood mills. Unlike domestic waste, the

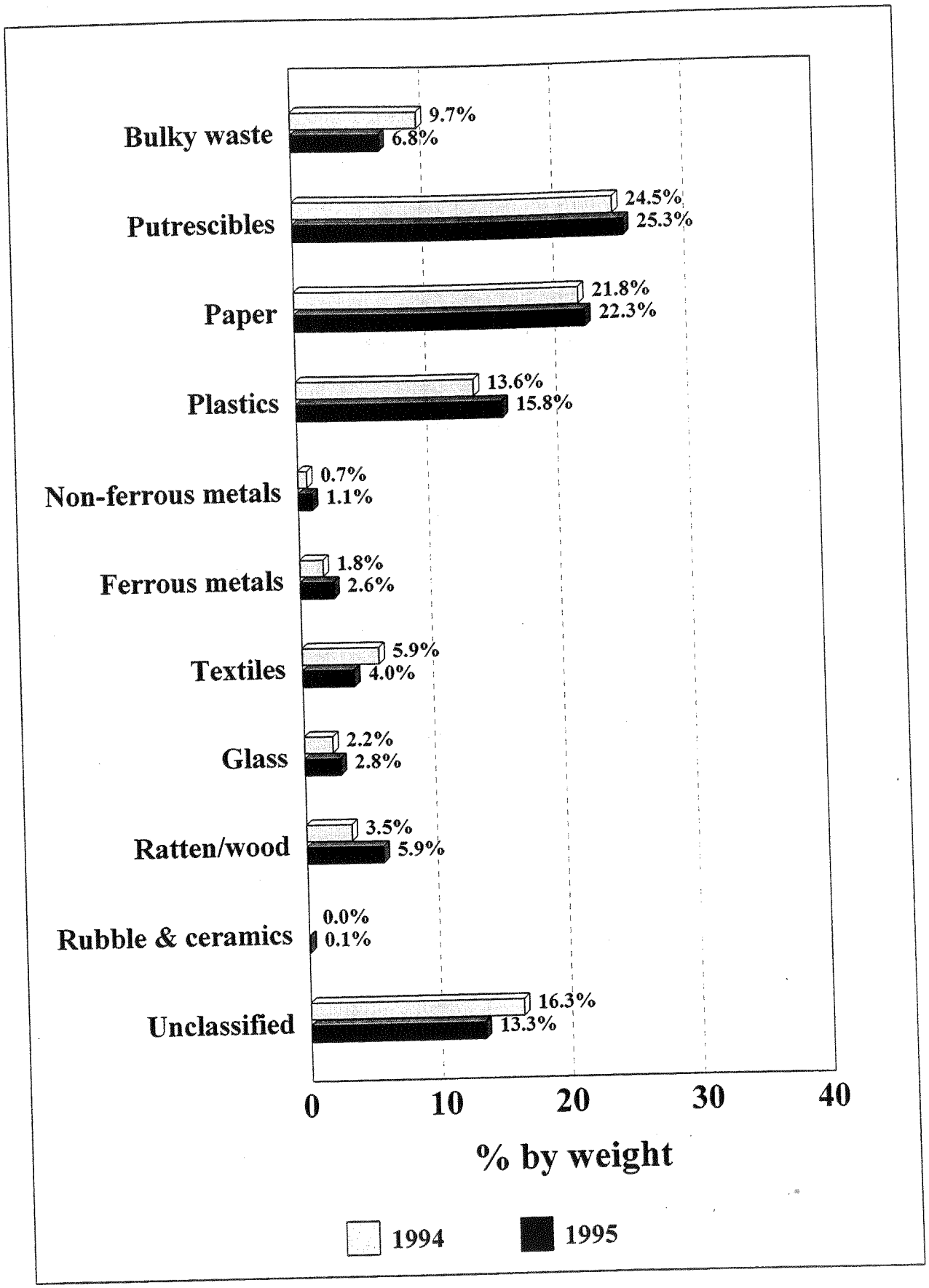


Figure 6 Composition of municipal solid waste (percentage by weight) in 1994 and 1995

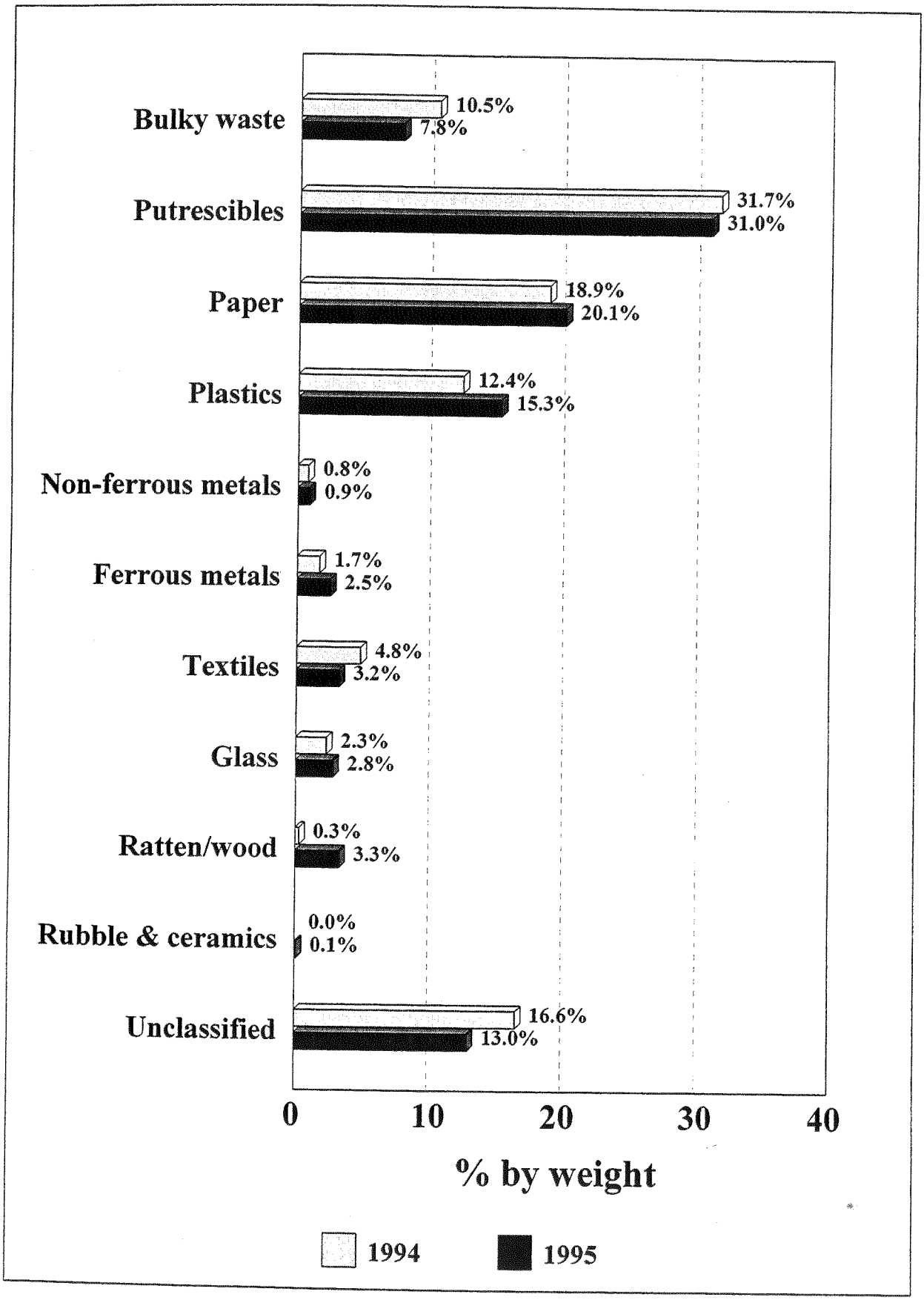


Figure 7 Composition of domestic waste (percentage by weight) in 1994 and 1995

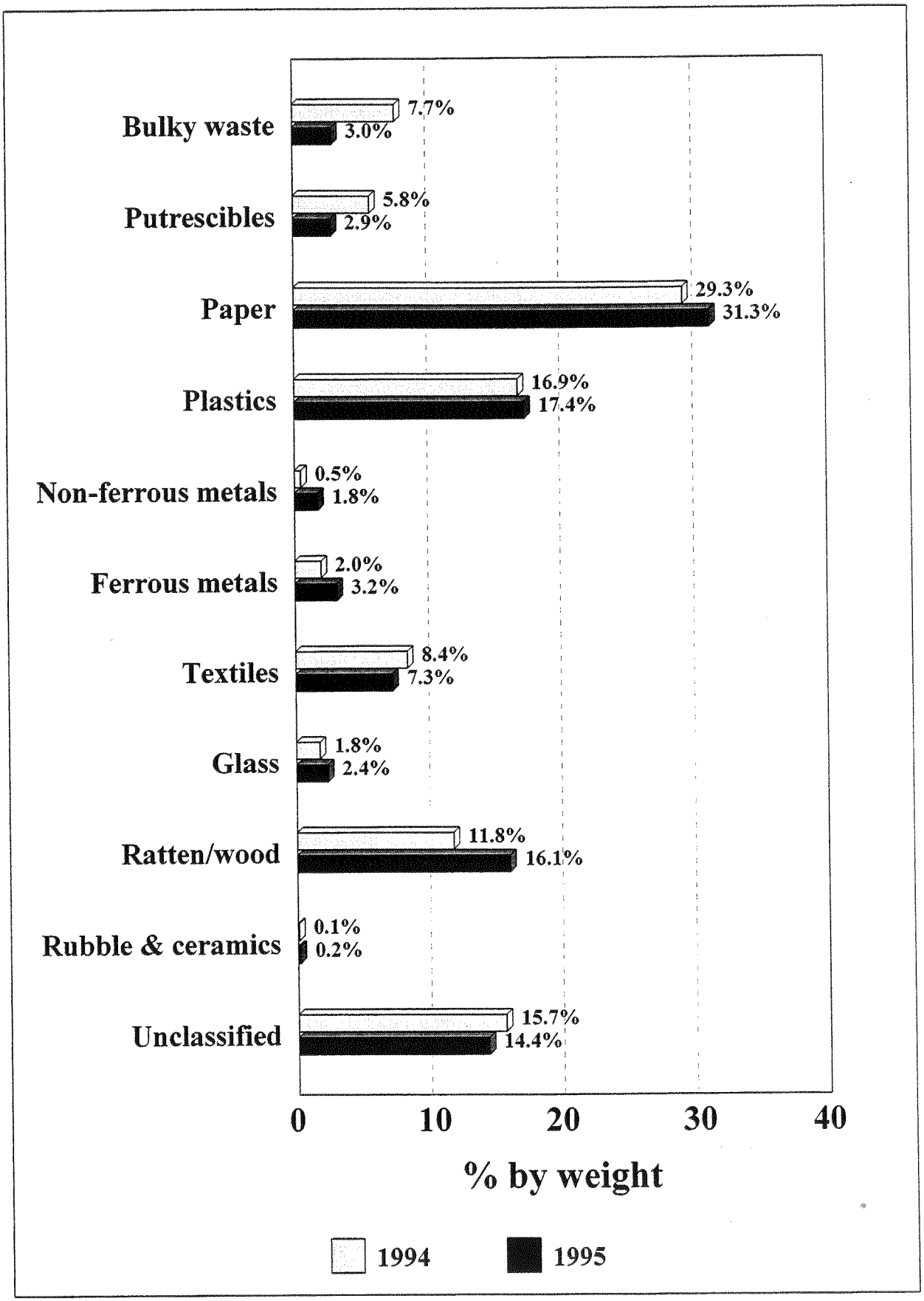


Figure 8 Composition of commercial and industrial waste (percentage by weight) in 1994 and 1995

percentage of putrescibles in commercial and industrial waste was very small and constituted only 2.9% of the waste stream.

4.1.6 The composition of commercial and industrial waste disposed of at waste facilities from 1986 to 1995 is summarized in Appendix 7. The percentage by weight of the different waste components in commercial and industrial waste remained generally constant over the period, except for paper and textiles. The proportion of paper increased from an average of around 20% before 1992 to about 30% in the period of 1993 to 1995. The proportion of textiles in commercial and industrial waste has been decreasing since 1991 and dropped from 19% in 1991 to 7.3% in 1995. This trend may be related to the diminishing activities of the textiles or garment manufacturing industry.

4.2 Moisture Content and Bulk Density of Municipal Solid Waste

4.2.1 The average moisture content and average bulk densities of domestic, commercial and industrial waste in 1994 and 1995 are shown in Table 6. The bulk density of domestic waste was found to be higher than that of commercial and industrial waste, which could be due to its higher moisture content. It was noted from Table 6 that there was no significant change in the average moisture content for both types of waste in 1994 and 1995. However, the average bulk density of commercial and industrial waste had dropped from 91 kg/m^3 in 1994 to 69 kg/m^3 in 1995.

4.3 Composition of Construction & Demolition Waste

4.3.1 The composition of the five main categories of construction & demolition waste disposed of at landfills is shown in Table 7. As mentioned in section 2.2.3, the figures are derived from visual inspection primarily for indicative purpose. It can be observed that excavated soil was the predominant category of construction & demolition waste disposed of at landfills in 1995 (about 60% of construction & demolition waste was excavated material). From the loads of excavated soil studied, the major components were found to be sand or soil (about 74 % by weight) and rock or rubble (about 13 % by weight), both being materials suitable for land reclamation.

4.3.2 For the other four categories of construction & demolition waste, the percentage of waste generated from site clearance activities and renovation works still remained roughly the same as in 1994. In 1994, about 15% and 18% of construction & demolition waste landfilled was from site clearance and renovation works respectively. However, a significant reduction was observed for roadwork material (12% of construction & demolition waste landfilled in 1994) and demolition waste (22% of construction & demolition waste landfilled in 1994) in 1995.

Waste type	Average bulk density (kg/m^3)		Average moisture content (%)	
	1994	1995	1994	1995
Domestic	197	195	45	50
Commercial & industrial	91	69	30	32

Table 6 Bulk density & moisture content of domestic, commercial and industrial waste in 1994 and 1995

Component	Composition of each category of construction & demolition waste (% by weight)				
	Roadwork material	Excavated soil	Demolition waste	Site clearance	Renovation waste
Soil/Sand*	23.0	73.8	21.5	33.0	19.4
Concrete/Mortar*	16.9	1.2	10.8	4.6	7.4
Rock/Rubble*	14.4	12.5	27.7	15.0	38.8
Reinforced concrete*	14.2	0.4	5.8	0.9	7.0
Bricks/Tiles*	0.8	0.4	12.1	1.4	9.6
Slurry & mud	1.8	9.7	1.5	1.0	3.1
Asphalt	24.7	0.0	0.0	0.2	0.0
Cement contaminated	1.7	0.4	3.2	15.6	3.3
Wood	0.6	0.9	10.5	13.3	7.1
Ferrous metals	0.5	0.0	0.6	1.0	1.3
Non-ferrous metals	0.0	0.0	0.7	0.2	0.1
Others (include bamboo, trees, glass, plastics, bulky waste/fixtures, organics & garbage)	1.4	0.7	5.6	13.8	2.9
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Percentage of total quantity of construction & demolition waste landfilled	**5.2**	**59.4**	**8.5**	**14.6**	**12.3**

Note :
* Inert materials which are considered suitable for public dumping
The above figures are estimated by visual inspection of 3060 truck loads delivering construction & demolition waste in 1995. They should be regarded as indicative only rather than the actual composition of construction & demolition waste during the year.

Table 7 Composition of construction & demolition waste disposed of at landfills in 1995

4.3.3 The composition of construction & demolition waste disposed of at each landfill accepting construction & demolition waste (except TKOL which was only opened for the first two months in 1995) is shown in Table 8. About 80% of construction & demolition waste disposed of at landfills was considered as inert materials and they were mainly soil, sand, rubble and rock.

Component	Composition of construction & demolition waste disposed of at each landfill (% by weight)			
	PPVL	SENT	SWL	Total
Soil/Sand *	72.6	47.6	40.7	54.0
Concrete/Mortar *	0.5	5.3	6.8	4.1
Rock/Rubble *	12.8	21.8	14.5	17.5
Reinforced concrete *	0.2	3.6	3.6	2.5
Bricks/Tiles *	0.6	4.5	1.7	2.7
Slurry & mud	7.0	5.9	7.1	6.5
Asphalt	0.6	2.3	0.0	1.3
Cement contaminated	1.6	1.8	9.4	3.3
Wood	2.1	4.8	6.4	4.3
Ferrous metals	0.2	0.4	0.7	0.4
Non-ferrous metals	0.0	0.0	0.4	0.1
Others (include bamboo, trees, glass, plastics, bulky waste/fixtures, organics & garbage)	1.8	2.0	8.7	3.3
Total	**100.0**	**100.0**	**100.0**	**100.0**
Percentage of total quantity of construction & demolition waste landfilled	**31.2**	**48.5**	**20.3**	**100.0**

Note :
* Inert materials which are considered suitable for public dumping
The above figures are estimated by visual inspection of 3060 truck loads delivering construction & demolition waste in 1995. They should be regarded as indicative only rather than the actual composition of construction & demolition waste during the year.

Table 8 Composition of construction & demolition waste disposed of at PPVL, SENT and SWL in 1995

5. Waste Recovery and Recycling

5.1 Recyclable Content of Municipal Solid Waste Disposed of at Waste Facilities

5.1.1 Based on the composition analysis of municipal solid waste, the proportion and quantity of major recyclable materials in the waste stream can be worked out. Only materials in the form suitable for recycling were considered in the analysis and the findings are summarized in Table 9. It can be noted that about 42% by weight of domestic waste and 52% by weight of commercial and industrial waste were recyclable materials which included paper, glass, plastics, ferrous metals and non-ferrous metals. These figures reflected that about half of the municipal solid waste disposed of at waste facilities could still be recovered for recycling. Obviously, the actual amount of the waste which can be recycled depends on whether they have been contaminated with other non-recyclable materials like putrescibles.

5.1.2 Among the recyclable materials, paper and plastics were the major components found in municipal solid waste (35% by weight of domestic waste and 45% by weight of commercial and industrial waste). Newspaper was found to be the predominant type of waste paper in the domestic waste stream whereas there was no one type of paper which dominated commercial and industrial waste.

5.1.3 A more detailed breakdown of the recyclable plastics in municipal solid waste is shown in Table 10. As in the previous years, plastic bags were again the major component of all recyclable plastics (domestic waste: 69%, commercial and industrial waste: 42%). Next came expanded polystyrene (EPS) food/drink containers and other polyfoams in domestic waste (about 10%) and commercial and industrial waste (17%). It is noted that the quantity of plastic beverage bottles in domestic waste had increased from 16 tpd in 1994 to 56 tpd in 1995. For commercial and industrial waste, the quantity also increased from 2 tpd in 1994 to 11 tpd in 1995.

5.2 Recovery and Recycling of Municipal Solid Waste

5.2.1 In 1995, about 2 million tonnes (40% by weight) of the municipal solid waste generated in the territory was recovered for recycling. As shown in Figure 9, about 0.5 million tonnes were recycled locally while 1.5 million tonnes were exported for recycling overseas. The composition of municipal solid waste recovered in 1995 is presented in Figure 10. It is noted that ferrous metals and paper, by weight, were the major materials recovered for recycling.

5.2.2 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

Component	Domestic waste		Commercial and industrial waste	
	% by weight	Quantity (tpd)	% by weight	Quantity (tpd)
Paper - Writing Paper	4.28	266	7.39	117
Paper - Newspaper	9.28	576	6.57	104
Paper - Others	6.52	405	13.64	216
Sub-total (paper)	**20.08**	**1,247**	**27.60**	**437**
Glass - colour bottles	1.59	99	1.20	19
Glass - clear bottles	1.26	78	0.63	10
Sub-total (glass bottles)	**2.85**	**177**	**1.83**	**29**
Plastics	15.33	952	17.42	276
Ferrous metals	2.46	153	3.16	50
Non-ferrous metals	0.93	58	1.83	29
Total	**41.65**	**2,587**	**51.84**	**821**

Table 9 **Selected recyclable materials in domestic, commercial and industrial waste disposed of at waste facilities in 1995**

Component	Domestic waste		Commercial and industrial waste	
	% by weight	Quantity (tpd)	% by weight	Quantity (tpd)
EPS food/Drink containers	1.13	70	1.64	26
Other polyfoams	0.43	27	1.26	20
Beverage bottles	0.90	56	0.69	11
Colour bags	8.50	528	4.17	66
Clear bags	2.08	129	3.22	51
Toys & appliances	0.26	16	0.50	8
Household utensils	1.38	86	0.57	9
Trim-Off & scraps	0.13	8	0.95	15
Vacuum packaging	0.13	8	0.38	6
Others	0.39	24	4.04	64
Total	**15.33**	**952**	**17.42**	**276**

Table 10 **Plastic components of domestic, commercial and industrial waste disposed of at waste facilities in 1995**

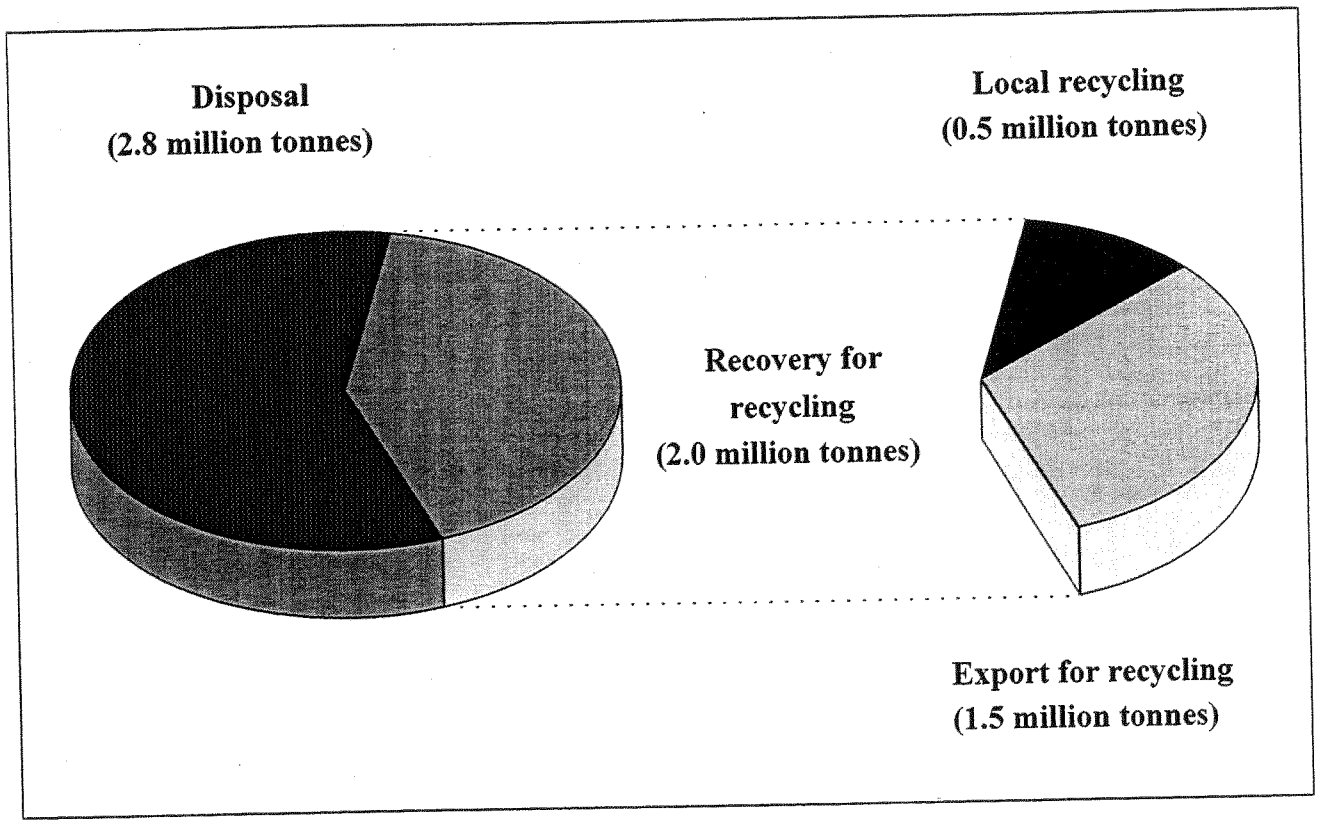


Figure 9 Recovery of municipal solid waste in 1995

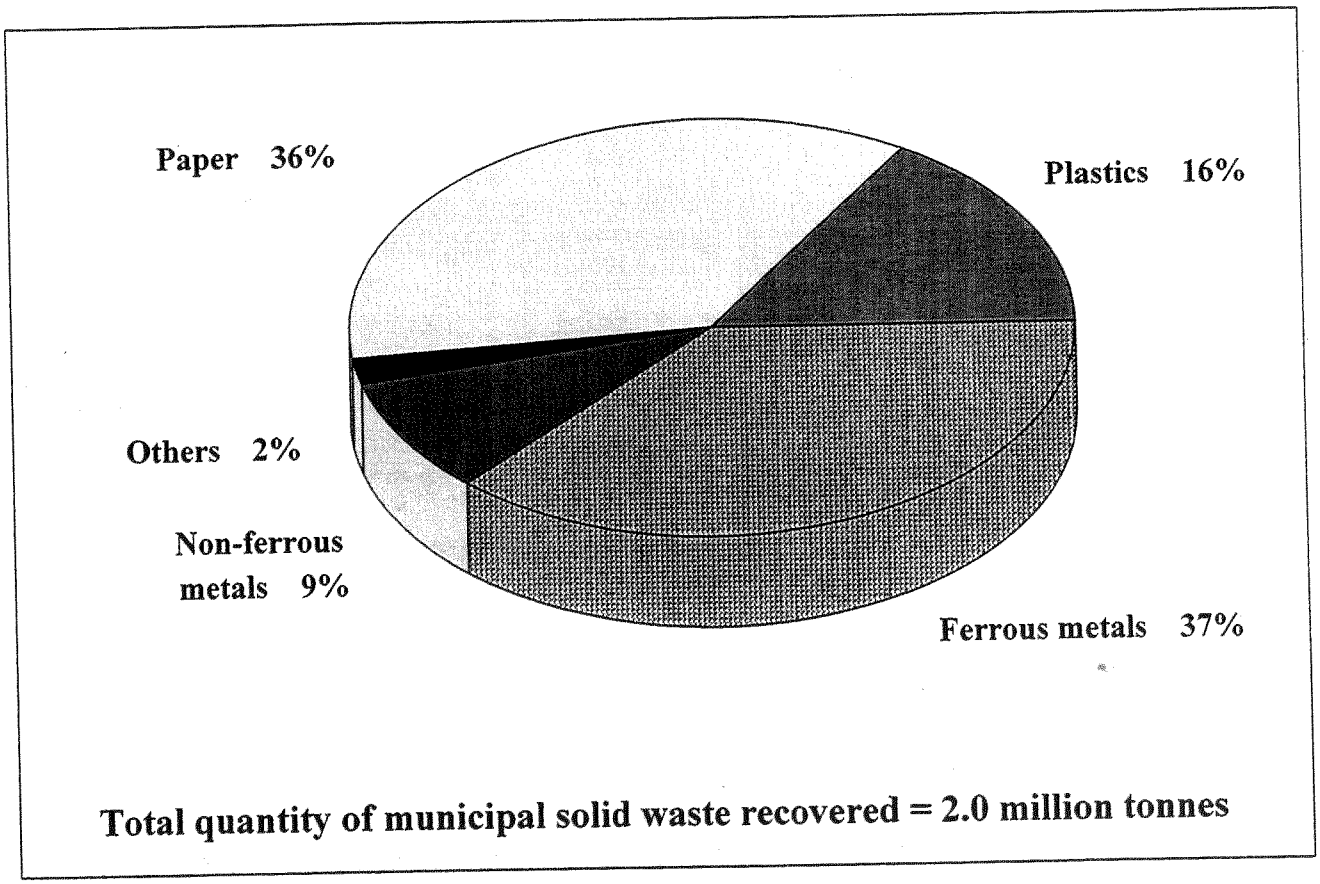


Figure 10 Composition of municipal solid waste recovered in 1995

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.

5.2.3 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 11 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 10 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 11. A summary of these recycling statistics is also provided at Appendix 8.

5.2.4 A number of local constraints limit the present extent of waste recovery and recycling activities. In an attempt to tackle these constraints, EPD commissioned a consultancy study called the Waste Reduction Study in 1994. In the Study, the following barriers which restricted waste recycling or recovery to its present level were identified:

- current regulations prohibit the recovery of wastes from public refuse collection points;

- little financial incentive to reduce the amount of waste for disposal;

- small and medium enterprises refrain from investing in technology and management to help recycling;

- space constraints in domestic, commercial or industrial premises which affects the viability of waste separation and sorting activities;

Categories of waste materials		Quantity (tonnes)	Value ($,000)
a. Wood & paper			
- wood (include sawdust)		407	529
- paper		489,568	530,291
	Sub-total	**489,975**	**530,820**
b. Glass			
	Sub-total	**548**	503
c. Plastics			
- polyethylene		49,942	93,044
- polystyrene & copolymers		77,207	226,302
- polyvinyl chloride		46,113	109,611
- others		125,224	228,686
	Sub-total	**298,486**	**657,643**
d. Ferrous metals & steel			
- pig or cast iron		36,976	29,014
- alloy steel scrap		44,009	238,251
- other scraps		412,234	428,725
- tinplate		0	0
	Sub-total	**493,219**	**695,990**
e. Non-ferrous metals			
- copper & alloys		100,717	677,054
- nickel		143	4,291
- aluminium		65,723	282,269
- lead		329	2,226
- zinc		3,854	8,461
- tin		46	624
- metal ash & residues		332	2,586
- magnesium		20	157
- precious metal		1	984
- other base metals		0	208
	Sub-total	**171,165**	**978,860**
f. Textile fibre			
- silk		9	505
- cotton		8,238	33,651
- man-made fibres		15	90
- wool/other animal hair (not pulled)		83	1,914
- wool/other animal hair (pulled)		0	0
- old clothing & other old textile articles, rags, etc.		6,672	26,016
	Sub-total	**15,017**	**62,176**
	Total	**1,468,410**	**2,925,992**

Note :
Figures rounded off to nearest 1

Table 11 Export of recovered waste materials in 1995

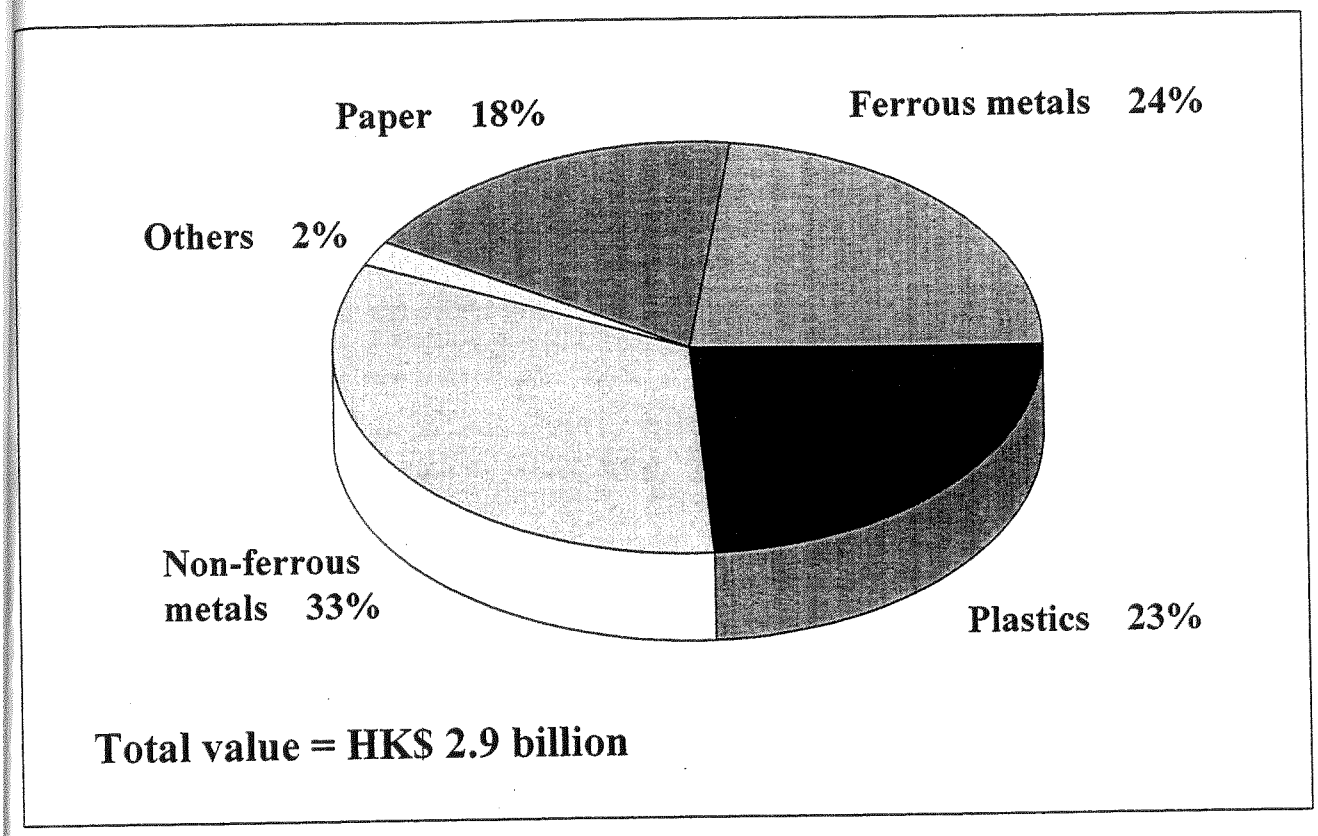


Figure 11 Values of the exported recyclable materials in 1995

- current environmental awareness of the general public is relatively low; and
- lack of local markets for recovered materials and recycled products, for instance, the existing demand and value for plastics, glass, textiles and tyres are low.

The proposals of the Waste Reduction Study form basis for the development of a comprehensive Waste Reduction Plan for Hong Kong. The Plan aims to curb the escalating growth of municipal solid waste and to promote waste recycling in Hong Kong such that the life span of the new strategic landfills could be extended.

5.3 Recovery and Recycling of Construction & Demolition Waste

5.3.1 In Figure 5, it can be noted that about 60% of waste intake at landfills was construction & demolition waste. As mentioned in section 4.3.3, about 80% of the waste was inert materials, which was often mixed or contaminated with non-inert materials like wood and refuse. If there was proper separation done at source, the inert materials could be reused beneficially and thus the demand of landfill capacity for their disposal could be reduced.

5.3.2 To tackle this problem, the government has developed and implemented a construction & demolition waste management strategy. The objective of the strategy is to reduce the quantity of construction & demolition waste disposed of at landfills; public dumps as well as to reduce the generation of construction & demolition waste and to reuse and recycle the demolition waste as much as possible.

5.3.3 To achieve this objective, the following measures are at different stages of planning or implementation:

- Promote the reuse of inert construction & demolition waste in land reclamation by providing more public dumps at strategic locations and extending the operation hours of public dumps.

- The government has commissioned a consultancy study to review the public dumping programme and strategy with an aim to maintain sufficient and continual supply of public dumps for the disposal of inert construction & demolition waste. The study will also explore other means to reuse and recycle construction & demolition waste.

- The government has incorporated on-site sorting requirements in some government works contracts like the Kowloon Walled City demolition contract and all Housing Department's demolition contracts. The government will continue to liaise with the construction industry to promote the concept of on-site sorting.

- A pilot scale intermediate sorting plant was set up at SENT to minimize the amount of inert construction & demolition waste disposed of at the landfill. Commissioned in September 1995, this facility has a design capacity of 2,000 tpd of mixed construction & demolition waste. Inert materials sorted out would be stockpiled and used by the landfill contractor in their engineering works. The residual waste would be delivered to the tipping face of the landfill for disposal.

- The proposed landfill charging scheme will help provide the financial incentives for reducing the disposal of construction & demolition waste at landfills.

5.3.4 Together with the waste minimization initiatives for municipal solid waste, it is expected that these measures will help preserve our precious landfill space and to prolong the life span of the three strategic landfills.

6. Waste Generation Rates and Forecasts

6.1 Generation Rates of Municipal Solid Waste

6.1.1 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 and 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.

6.1.2 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 and 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.

6.1.3 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 1995 together with data in 1994 are shown in Table 12.

6.1.4 For domestic waste generation rate, the following major observations for 1995 are noted from Table 12 :

- the territorial average generation rate dropped by 3%;
- the generation rate for the outlying islands dropped by 33% as a result of a small increase in the domestic waste arisings but a sudden rise of the population by 37%;
- the generation rates for Sha Tin and Sai Kung dropped by more than 10%;
- the generation rate for Kwai Tsing increased by about 43%; and

District	Domestic waste (kg/person/day)		Commercial & industrial waste (kg/employee/day)	
	1994	1995	1994	1995
Central & Western	1.54	1.39	0.37	0.30
Wanchai	1.80	1.76	0.55	0.37
Eastern	0.87	0.85	1.07	0.52
Southern	1.00	0.91	1.65	0.95
Hong Kong Island	1.17	1.10	0.65	0.41
Yau Tsim Mong	2.04	2.17	0.54	0.44
Sham Shui Po	1.14	1.17	0.69	0.60
Kowloon City	1.03	0.98	1.44	1.01
Wong Tai Sin	0.78	0.78	0.79	0.29
Kwun Tong	0.82	0.78	1.63	0.98
Kowloon	1.09	1.08	0.97	0.67
Urban area	1.12	1.09	0.83	0.56
Kwai Tsing	0.74	1.06	1.22	0.85
Tsuen Wan	1.07	1.01	2.87	1.51
Tuen Mun	0.85	0.85	4.08	1.90
Yuen Long	0.99	0.90	3.75	3.12
North	0.97	0.96	4.11	2.44
Tai Po	1.05	0.98	6.08	3.97
Sha Tin	0.93	0.77	3.20	2.07
Sai Kung	1.01	0.88	8.51	2.32
New Territories	0.93	0.92	3.02	1.80
Outlying Islands	2.39	1.58	cannot be determined	
Territorial average	1.04	1.01	1.38	0.88

Table 12 Geographical variation in generation rates of municipal solid waste in 1994 and 1995

- the generation rates of the other WAD remained largely the same as in 1994 with deviations smaller than 10%.

6.1.5 For commercial and industrial waste generation rate, the following major observations for 1995 are noted from Table 12 :

- the territorial average generation rate dropped by 36%. This was comparable to the order of decrease in the quantity of commercial and industrial waste;

- the generation rates of all 18 WAD generally decreased in 1995;

- the percentage drop of the generation rates in several WAD were greater than the territorial average, these include Eastern District (51%), Southern District (42%), Wong Tai Sin (63%), Kwun Tong (40%), Tsuen Wan (47%), Tuen Mun (53%), North Districts (41%) and Sai Kung (73%);

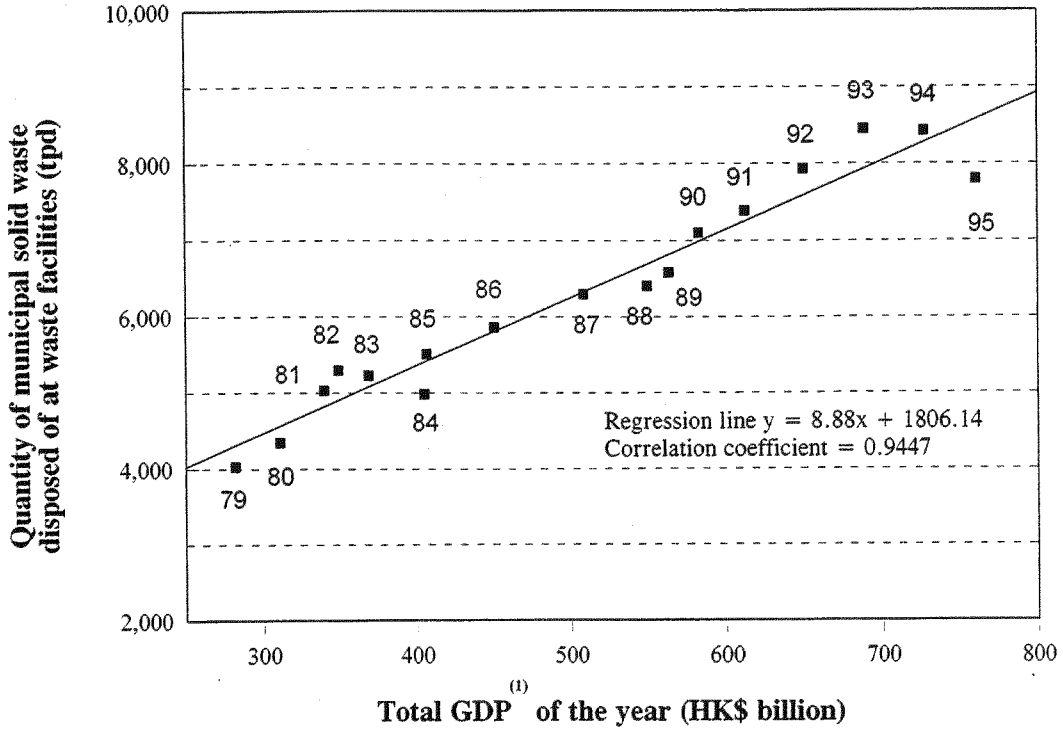
- there was a slight increase of about 5% in the number of employees in the whole territory from 1994 to 1995. The drop in the generation rate was therefore mainly due to a drop in the quantity of commercial and industrial wastes disposed; and

- the low generation rates in the well-developed districts such as Central & Western, Yau Tsim Mong indicated that a significant portion of commercial and industrial waste was mixed with the domestic waste collected by USD. For outlying islands, virtually all commercial and industrial waste were delivered to refuse collection points and were then mixed with domestic waste before collection by RSD. Thus, the commercial and industrial waste generation rate for outlying islands cannot be determined. This also explains why the domestic waste generation rate for outlying islands is higher than the territorial average.

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

6.2.1 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 12 demonstrated a linear relationship between the quantity of municipal solid waste and the total GDP. The quantity of municipal solid waste as shown in Figure 12 only includes the municipal solid waste disposed of at waste facilities, but not municipal solid waste recovered for recycling.

6.2.2 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.



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	761 (3)

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

Figure 12 Correlation of municipal solid waste with total GDP from 1979 - 1995

6.3 Forecast of Municipal Solid Waste

6.3.1 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 6.1.2, 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 and 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.

6.3.2 The actual quantities and generation rates for the two types of municipal solid waste from 1986 to 1995 are tabulated in Figure 13. The domestic waste generation rate has generally been increasing over the period. The increasing trend is less obvious for commercial and industrial waste. It should be noted that generation rates for both types of waste had dropped in 1995.

6.3.3 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 0.028 kg/person/day. The commercial and industrial waste generation rate displays an average annual increase of about 0.038 kg/employee/day. The linear regression models adopted for determining the future waste generation rates are as follows:

- domestic waste:

$$y_t = 0.0280t - 54.84$$

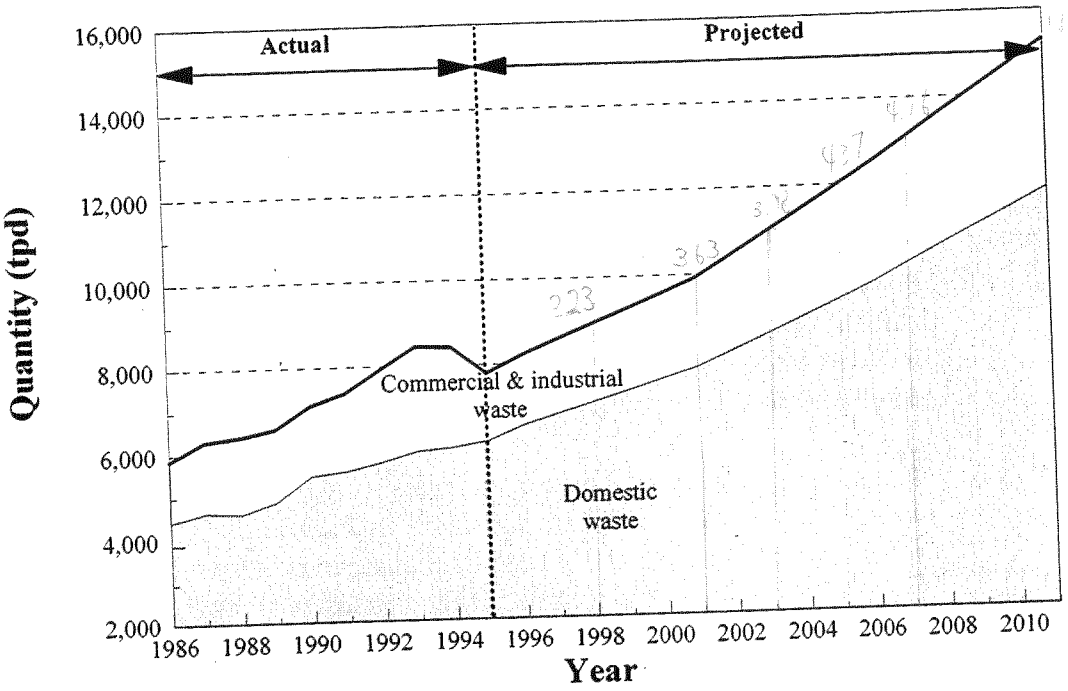
- commercial and industrial waste:

$$y_t = 0.0378t - 74.53$$

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

6.3.4 The projected per capita generation rates for the whole territory in the years 2001, 2006, 2011 are presented in Figure 13. In 2011, the domestic waste generation rate would reach 1.46 kg/person/day whereas that for commercial and industrial waste would be 1.49 kg/employee/day if the current growing trend of the generation rates continue.

6.3.5 While there is a general growing trend of the waste generation rates, it can be noted from Figure 13 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,



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
2001	*7,830	*1.18	*2,090	*1.11	*9,920
2006	*9,690	*1.32	*2,790	*1.30	*12,480
2011	*11,820	*1.46	*3,470	*1.49	*15,290

Note :
* Forecast figures

Figure 13 Per capita generation rates and the quantities of municipal solid waste disposed of at waste facilities, 1986 - 2011

there is no conclusive evidence to indicate potential limits to the growth of waste generation rates.

6.3.6 Based on the method mentioned in section 6.3.1 above, the forecast quantities of domestic waste, commercial and industrial waste on a territorial basis for the years 2001, 2006 and 2011 were calculated and are shown in Figure 13. In 2011, it is estimated that about 15,290 tpd of municipal solid waste would be generated for disposal in Hong Kong. Of this amount, there would be 11,820 tpd of domestic waste and 3,470 tpd of commercial and industrial waste.

6.3.7 The forecast of domestic, commercial and industrial waste for each WAD in the years 2001, 2006 and 2011 is presented in Table 13. 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.

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

- the Waste Reduction Plan to be developed 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.

6.4 Forecast of Construction & Demolition Waste

6.4.1 Construction & demolition waste is forecasted by linear regression of the quantity of construction & demolition waste disposed of per manual worker in construction sites during the period of 1986-1995 (correlation coefficient of regression line: 0.73). This factor is expressed as tonne/site worker/day. By multiplying the regressed value of the factor for 1995 with the forecast number of manual workers, the quantities of construction & demolition waste could be estimated. The forecast of manual workers are based on the proportion of manual workers to the entire construction industry for the past years. Forecast of the total job places in the construction industry (HSIC

Year / District	Waste quantity: Domestic waste					
	Public			Private		
	2001	2006	2011	2001	2006	2011
Central & Western	380	510	740	60	70	110
Wanchai	250	350	410	80	110	130
Eastern	460	500	570	130	140	160
Southern	230	250	350	20	30	40
Hong Kong Island	**1,320**	**1,610**	**2,060**	**290**	**360**	**440**
Yau Tsim Mong	700	790	900	170	190	210
Sham Shui Po	380	420	470	110	120	130
Kowloon City	430	650	800	70	110	130
Wong Tai Sin	360	390	430	30	30	30
Kwun Tong	390	410	450	50	50	60
Kowloon	**2,260**	**2,650**	**3,060**	**430**	**500**	**580**
Kwai Tsing	350	370	410	190	200	220
Tsuen Wan	180	240	260	60	80	90
Tuen Mun	440	510	600	30	40	40
Yuen Long	580	830	980	60	90	100
North	250	300	460	30	40	50
Tai Po	250	290	320	50	60	60
Sha Tin	430	470	530	60	60	70
Sai Kung	320	500	560	40	60	60
New Territories	**2,820**	**3,520**	**4,130**	**510**	**610**	**700**
Outlying Islands	**160**	**370**	**720**	**30**	**70**	**140**
Territorial Total	**6,560**	**8,150**	**9,960**	**1,260**	**1,540**	**1,860**

Note :
Figures rounded off to the nearest tenth

Table 13 Forecast quantities of municipal solid waste by

(tpd) Commercial & industrial waste			Total municipal solid waste		
2001	2006	2011	2001	2006	2011
90	140	190	530	730	1,030
60	80	100	380	540	640
90	110	130	690	760	850
40	50	60	300	320	440
290	**380**	**470**	**1,900**	**2,350**	**2,970**
170	230	270	1,040	1,200	1,380
90	110	130	580	650	730
150	230	300	650	990	1,240
20	20	30	410	440	490
200	230	250	640	690	770
630	**830**	**990**	**3,310**	**3,980**	**4,620**
160	160	170	690	730	800
140	180	230	380	500	580
120	140	150	600	690	800
200	390	540	840	1310	1620
120	140	240	400	480	760
170	190	240	470	540	620
180	210	250	670	750	850
70	120	120	430	670	740
1,150	**1,530**	**1,940**	**4,480**	**5,660**	**6,770**
20	50	70	210	490	930
2,090	**2,790**	**3,470**	**9,920**	**12,480**	**15,290**

waste arisings districts in 2001, 2006 and 2011

Division 5) was based on data provided by Plan. D whereas the actual number of manual workers and job places in the construction industry were provided by C & SD.

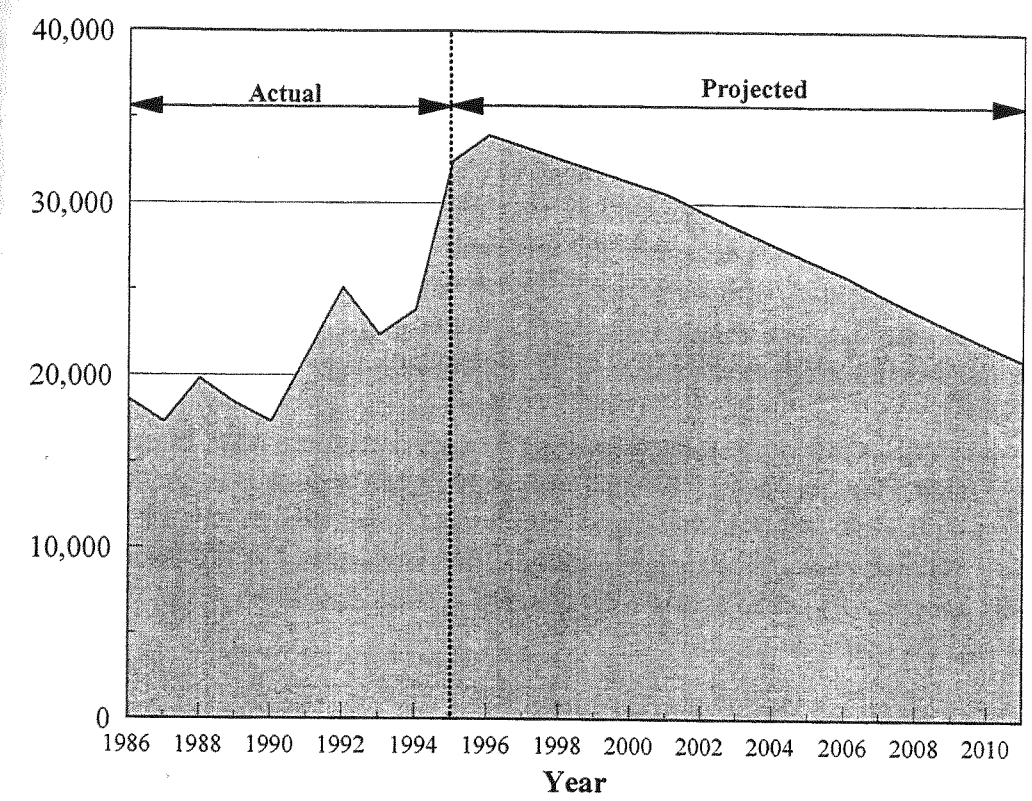
6.4.2 The actual quantities of construction & demolition waste disposed of at landfills and public dumps together with the quantity of construction & demolition waste disposed of per site worker per day from 1986 to 1995 are summarized in Table 14. The forecast quantities for 2001, 2006 and 2011 for the whole territory are presented in Figure 14.

6.4.3 In contrast with the forecast of municipal solid waste, the quantity of construction & demolition waste cannot be easily projected at WAD level. This is due to the possible immense fluctuation of the quantity of construction & demolition waste arising from a WAD which can be attributed to many uncertainties such as expedition or slippage of works projects, the nature of works, the stage of construction & demolition works, differences in the engineering technology adopted and the possibility of ad-hoc maintenance works (e.g. road surface) in a WAD. As such, the forecast of construction & demolition waste at WAD level could better be achieved through the adoption of more relevant planning parameters.

Year	Quantity of construction & demolition waste (tpd)			Quantity of construction & demolition waste disposed of per construction site manual worker (tonnes/site worker/day)
	Landfills	Public Dumps	Total	
1986	2,850	15,780	18,630	0.28
1987	4,220	13,070	17,290	0.26
1988	6,520	13,320	19,840	0.27
1989	5,580	12,820	18,410	0.27
1990	8,450	8,900	17,350	0.31
1991	16,380	4,880	21,260	0.41
1992	11,960	13,170	25,130	0.47
1993	11,520	10,880	22,400	0.46
1994	15,480	8,370	23,850	0.42
1995	14,120	18,280	32,400	0.49

Note :
Figures rounded off to the nearest tenth

Table 14 Summary of the construction & demolition waste intake at landfills and public dumps and the quantity disposed of per construction site manual worker from 1986-1995



Year	Quantity of construction & demolition waste (tpd)
1986	18,630
1987	17,290
1988	19,840
1989	18,410
1990	17,350
1991	21,260
1992	25,130
1993	22,400
1994	23,850
1995	32,400
2001	*30,590
2006	*25,930
2011	*21,020

Note:
* Forecast figures

Figure 14 Quantity of construction and demolition waste disposed of at landfills and public dumps, 1986 - 2011

7. Review of the Waste Monitoring Programme

7.1 Since the commencement of the waste monitoring programme in 1981, there have been new developments and changes in the operation and design needs of the waste management system. These include the progressive replacement of old waste facilities by new waste facilities which operate at higher environmental standards as set out in the 1989 Waste Disposal Plan and the development of the Waste Reduction Plan. The waste monitoring programme needs to be reviewed in light of these developments.

7.2 EPD is developing a new computerized planning tool, the Integrated Waste Management Planning Tool (IWMPT) for waste management planning purpose. As the data collected through the waste monitoring programme will be fed into the IWMPT to analyze waste management plans, the integration of the IWMPT with the existing monitoring work is another element to be considered such that necessary modifications could be made.

7.3 A study to review the methodology of the existing waste monitoring programme was commissioned by EPD in November 1995. Several recommendations on modifying the methodology were made and they are summarized as follows:

- modify the existing classification of solid waste;
- review the current weighbridge monitoring work;
- more focus on the composition analysis of municipal solid waste and the factors which affect the quantity generated for disposal;
- make necessary changes in the administration of the field survey work to streamline the entire monitoring programme; and
- review the existing waste forecasting methodology and explore other socio-economic parameters which could be useful in making waste forecasts.

7.4 EPD is currently considering the above recommendations and the ways to implement these modifications in the future waste monitoring programme.

Appendices

Appendix I

Sources of data on chemical, special and other wastes in 1995

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 8

Breakdown of waste delivered to incineration plants, refuse transfer stations and landfills in 1995

Disposal facilities	Average daily waste intake[1] by waste type in 1995 (tpd)					
	MSW		Construction & demolition	Special	Total	Incinerator ash
	Public	Private				
Kwai Chung Incineration Plant (KCIP)	717	-	-	-	717	
Kowloon Bay Transfer Station[2] (KBTS)	1,691	-	-	-	1,691	
Island East Transfer Station[3] (IETS)	1,203	-	-	-	1,203	
Sha Tin Transfer Station[4] (STTS)	797	-	-	-	797	
Tseung Kwan O Landfill (TKOL)	0	0	788	1	789	
Shuen Wan Landfill (SWL)	9	422	4,162	66	4,659	
Pillar Point Valley Landfill (PPVL)	332	533	3,649	173	4,687	133
WENT Landfill	277[5]	0	-	7	284[5]	19
SENT Landfill	163	1,452	5,384	73	7,072	4
NENT Landfill	0	198	138	34	370[5]	
Sub-total	**5,189**	**2,605**				
Total	**7,794**		**14,121**	**354**	**22,269**	**156**

Notes :

(1) Average daily intake shown here is calculated by dividing the total waste intake in 1995 by 365 days irrespective of the operational period of the site

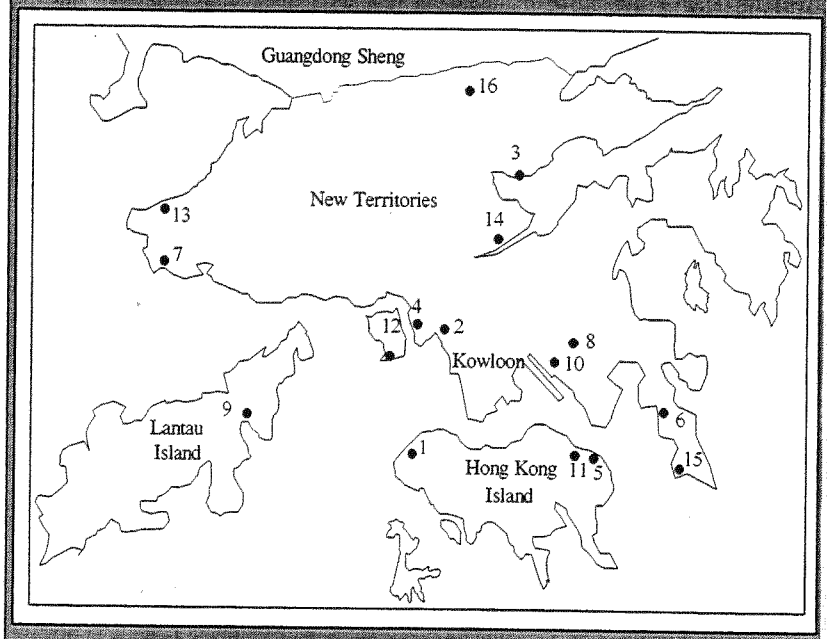
(2) Waste from KBTS was delivered to WENT until August 95 and diverted to NENT after August 95

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

(4) Waste from STTS was delivered to WENT until June 95 and diverted to NENT after June 95

(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	
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	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	Scheduled in 1997
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	
-	-	-	-	-	-	- (2)	1,140	1,250	1,200	
-	-	-	-	-	-	-	90	220	240	
-	-	-	-	-	-	-	1,170	2,700	2,810	
-	-	-	-	-	-	-	-	- (3)	800	
-	-	-	-	-	-	-	-	1,160	7,070	
-	-	-	-	-	-	-	-	-	2,620	

Review of composition of municipal solid waste

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

Notes :

1. Figures rounded off to the nearest tenth
2. 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

Appendix 5

(tpd)
weight (%)]

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

Review of composition of domestic waste

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

Notes :

1. Figures rounded off to the nearest tenth
2. 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

Appendix 6

(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]	

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]

Notes :

(1) Figures rounded off to the nearest tenth

(2) N.A. = Data not available

(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

(tpd)
weight (%)]

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

Appendix 8

Recovery of major recyclable wastes in 1995

Waste type	Quantity of waste recovered in 1995 ('000 tonnes)		
	Exported to overseas (C & SD figures) (a)	Recycled locally (b)	Total recovery (c) = (a) + (b)
Paper	490	210	700
Plastics	298	16	314
Ferrous metals	493	216	709
Non-ferrous metals	171	9	180
Glass[1]	0.5	3	3.5
Wood	0.4	5	5.4
Rubber tyre	0	5	5
Textiles	15	1	16
Total	**1468**	**465**	**1933**

Note :

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