

The composition of municipal solid waste in Scotland



A report that describes the composition of municipal solid waste in Scotland from the physical analysis of waste collected by a representative sample of local authorities. The information can be used by national and local governments and by the waste management industry to inform waste management policy and practice.

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Written by: WastesWork and AEA



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Executive summary

Aims and objectives

The Scottish Government is committed to a more sustainable approach to waste management. Scotland has increased its municipal waste recycling rate from less than 5% in 2000 to over 34% by 2008/09. In 2009 the Scottish Government consulted on a new 'Zero Waste' plan for Scotland, which included a target to recycle or compost 70% of municipal waste by 2025. Although some local authorities in Scotland have conducted analyses of a number of the waste streams that comprise municipal waste (e.g. normal or "residual" household collected waste and waste arising at household waste recycling centres), knowledge about the overall composition of municipal waste in Scotland is limited. The Scottish Government identified the need to commission a full-scale waste composition analysis of municipal solid waste (MSW) in Scotland. The analysis will increase overall confidence in the available data and help underpin future service and policy decisions.

A steering group, with representatives from Scottish Government, SEPA, and Zero Waste Scotland was set up to oversee the project. Also participating in the steering group were the local authorities selected to take part in the study. The work was commissioned for Scottish Government by Zero Waste Scotland. It was delivered by WastesWork, supported by AEA, between March and December 2009.

What was done

Waste composition analysis was carried out in eight of the 32 local authorities in Scotland. The participating local authorities were selected to represent Scotland as a whole, according to a sampling framework based on the following factors; frequency of residual waste collection (weekly or fortnightly), frequency of recycling collection (weekly or fortnightly), population density (urban or rural), and multiple deprivation (more or less deprived). The study was not designed to compare the waste management practices and/or recycling performance of the eight authorities which participated in the project.

The eight local authorities selected were Edinburgh, Glasgow, East Dunbartonshire, Highland, Moray, Orkney Islands, Renfrewshire and South Ayrshire. All those selected agreed to participate in the study. Sampling areas within each local authority were then selected using socio-economic profile data to provide a suitably representative sample of the overall Scottish population and the local authority.

Compositional analyses were conducted in two seasons; spring (April) and autumn (September) 2009. Analyses of the following MSW streams were conducted in all eight participating authorities; residual household collected waste, kerbside collected dry recyclables and green waste, residual waste at household waste recycling centre (HWRC) sites, litter, trade waste collected by local authorities and schools waste. Analyses were also conducted for parks & garden waste and beach cleaning waste where samples were available. Two local authorities provided records of their bulky household collections, and these were used to determine the composition of this stream. Data from the compositional analysis was then used alongside WasteDataFlow records to determine the overall composition of MSW in Scotland and to identify material types that might be targeted for further recycling or composting.

The composition of waste

The study analysed a total of 85 tonnes of municipal waste. The composition of each waste stream, together with an analysis of the overall composition of MSW in Scotland, provides local authorities in Scotland with sufficiently robust information to enable them to further develop their recycling and composting strategies.

The three main waste streams (based on Waste data flow data for 2008/9) that comprised MSW in Scotland are:

- Residual household collected (dustbin) waste – 47% of overall MSW arisings
- Residual waste arisings at household waste recycling centre (HWRC) sites – 8% of overall MSW arisings
- Trade waste collected by local authorities – 8% of overall MSW arisings.

Other waste streams, which include litter and bulky household waste, represent about 5% by weight of overall MSW arisings in Scotland. The remainder was recycled.

Overall composition of MSW in Scotland

Figure E1 shows that the main components of MSW in Scotland are paper & card (21%) and food/kitchen waste (18%); which between them represent approximately 39% by weight of total MSW arisings. The third largest component is garden waste, which represents 13% by weight of the total MSW arisings in Scotland. The overall composition of MSW in Scotland is similar to both that determined in a study in Wales in 2002/03 and the composition determined by the Defra review of compositional analyses (mostly conducted in England) published in 2009. Thus the datasets used to determine the overall composition of MSW in Scotland are considered to be robust.

The overall biodegradable content of municipal solid waste in Scotland is 62.9%. The 95% confidence intervals for the biodegradable content of MSW in Scotland were $\pm 1.5\%$, which means that there is a 95% probability that the biodegradable content of MSW in Scotland is between 61.4% and 64.4%.

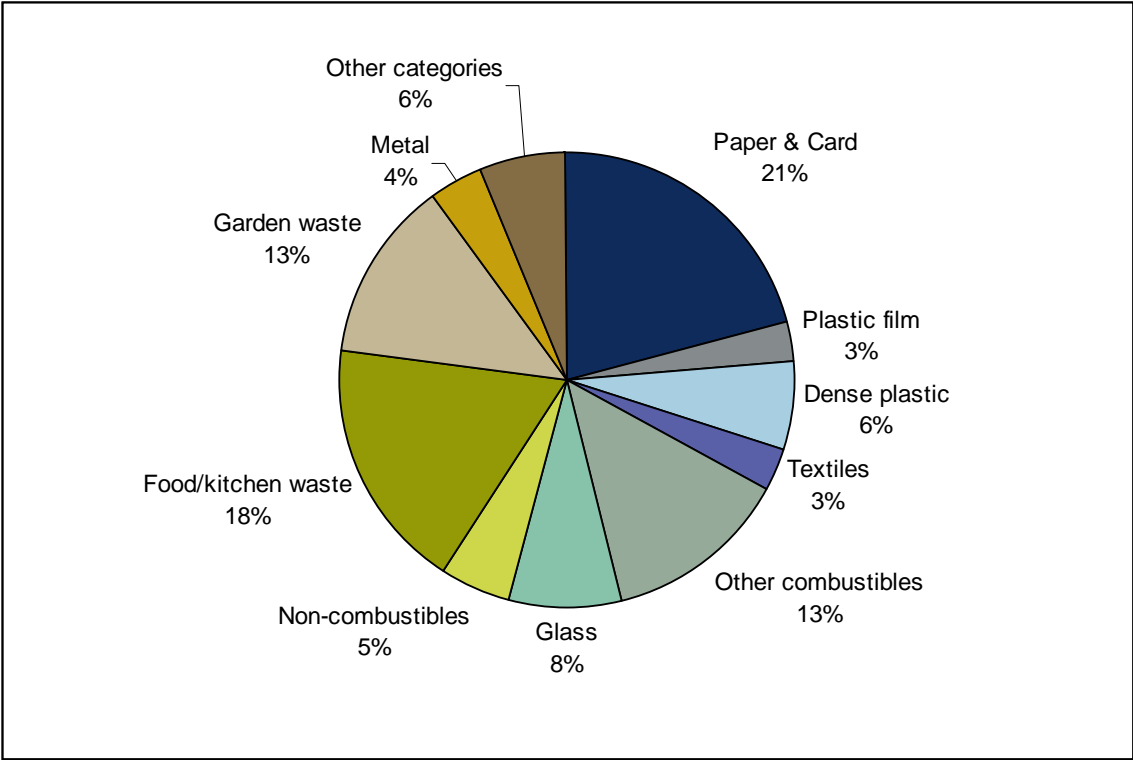


Figure E1: Overall composition (weight %) of MSW in Scotland

The composition of residual waste

Residual waste is of particular interest as this is the material that is currently sent to landfill. Table E1 shows the composition of the main residual waste streams determined from this study. Specific findings include:

- Food/kitchen waste represents about one third (by weight) of the residual household collected (dustbin waste) stream.
- Residual waste arising at household waste recycling centre (HWRC) sites contains about 40% of the 'other combustibles' category. This category includes wood.
- The main components of trade waste collected by local authorities are paper & card and food/kitchen waste. There are differences in the composition of waste produced by different types of business; for example, the proportion of food/kitchen waste is highest in waste from cafes/restaurants and care homes, and the proportion of cardboard is highest in waste from retail premises.
- The main components of bulky household waste are furniture and white goods.
- The main components of waste from schools are paper & card and food/kitchen waste.

Table E1: Composition (percentage by weight) of residual waste in Scotland

	Residual household collected waste	Residual waste arising at household waste recycling centres	Residual trade waste collected by local authorities
Paper & card	15.9	9.6	39.8
Plastic film	4.5	2.2	7.7
Dense plastic	9.2	8.4	9.3
Textiles	4.3	6.4	1.3
Other combustibles	13.1	39.6	5.0
Glass	5.5	3.4	4.3
Other non-combustibles	3.3	11.9	0.9
Food/kitchen waste	31.5	3.8	20.9
Garden waste	2.6	4.6	1.8
Other organics	1.1	0.4	2.3
Metal	4.1	4.2	4.6
Hazardous items	0.9	1.0	0.1
Electrical items	1.5	4.1	0.5
Fines	2.6	0.6	1.5
Total	100.0	100.0	100.0

Current recycling

Contamination of current recycling by non-targeted materials was low. The dry recyclables stream contained small amounts of a number of non-targeted materials such as wood, other (non-packaging) glass, food/kitchen waste and waste electronic and electrical equipment (WEEE). The green waste stream contained less than 1% by weight of food/kitchen waste. The average capture rates that were achieved by the kerbside schemes in Scotland ranged from 67% for newspapers and magazines to 19% for plastic bottles and are comparable to those determined in other studies.

The overall recycling rate achieved at the HWRC sites in Scotland in 2008/09 was 56%. Capture rates for potentially recyclable or compostable materials ranged from over 70% for garden waste, construction and demolition (C & D) waste, WEEE, and metal, to less than 20% for dense plastic and textiles. These are comparable to capture rates determined in other studies.

Opportunities for further recycling

One of the objectives of this study was to provide information on the occurrence of recyclable or compostable materials that are contained within municipal solid waste in Scotland. Table E2 shows that 76% of the overall MSW comprises materials classified as recyclable or compostable, which could potentially be separated for recycling or composting. There may also be carpet that is suitable for recycling within the "other combustibles" category, and approximately 2% by weight of overall MSW is furniture. Some of this furniture and also some of the waste electrical items may be suitable for re-use.

Table E2: Arisings of potentially recyclable or compostable material in MSW in Scotland (as % of overall MSW by weight)

Category	Weight %
Newspapers & magazines	9
Recyclable paper	4
Cardboard boxes and containers	4
Dense plastic bottles	3
Other plastic packaging	2
Textiles and shoes	3
Wood	3
Packaging glass	7
C&D waste (rubble)	4
Metal	3
Food/kitchen waste	18
Garden waste	13
Other (electrical items, oil, batteries)	3
Total	76

The 2009 draft Zero Waste Plan for Scotland sets a target to collect and either recycle or compost 70% of MSW by 2025. The findings from this study suggest approximately three quarters (76%) of MSW in Scotland is made up of potentially recyclable and compostable material. It is important to highlight that the 76% calculated from this study represents what is available for potential capture using recycling and composting collections. Actual capture rates (i.e. the amount of material collected as a proportion of the total available in the waste stream) will vary according to a wide range of technical and socio-economic factors beyond the scope of this work.

In order to highlight opportunities for further recycling and composting it is useful to consider the current availability and capture of recyclable/compostable materials in the different MSW streams. Figure E2 shows the occurrence of materials commonly targeted for recycling or composting. For each material type their occurrence is subdivided according to the four main types of residual waste (that which commonly goes to landfill) and that which is separated for recycling/composting. The key findings from Figure E2 include:

- 67% of newspapers & magazines are currently collected for recycling and 22% are found in residual household collected (dustbin) waste
- 23% of cardboard is collected separately for recycling and a further 45% is found in residual household collected waste
- 20% of plastic bottles are currently recycled and 60% are found in residual household collected waste
- 83% of food/kitchen waste is found in residual household collected waste and a further 9% is in collected trade waste
- 83% of garden waste is currently collected for composting
- 52% of wood is recycled or composted and 27% is found in residual household waste recycling centre (HWRC) waste
- 21% of cardboard arises in the collected trade waste stream.

Local authorities will need to target the residual household collected waste stream, the residual household waste recycling centre (HWRC) stream and the trade waste stream if they wish to maximise the amount of material collected for recycling and composting in the future.

For household waste it is useful to consider waste on a kg per household basis. The average weight of residual household collected waste from samples in this study was 10.2 kg per household per week. As food/kitchen waste represents about 32% by weight of this stream, the typical arisings of food/kitchen waste are estimated at 3.2 kg/household per week. The typical arisings for a number of other potentially recyclable materials that occur in residual household collected waste were:

- newspapers and magazines – 0.4 kg/household per week;
- other paper – 0.7 kg/household per week (although a proportion of this currently can not be recycled);
- cardboard – 0.5 kg/household per week;
- plastic bottles – 0.3 kg/household per week;
- packaging glass – 0.5 kg/household per week; and
- metal cans – 0.2 kg/household per week.

This suggests that there is the potential to capture up to an additional 5 kg/household per week of recyclable or compostable material (including food/kitchen waste) from households through kerbside collection schemes.

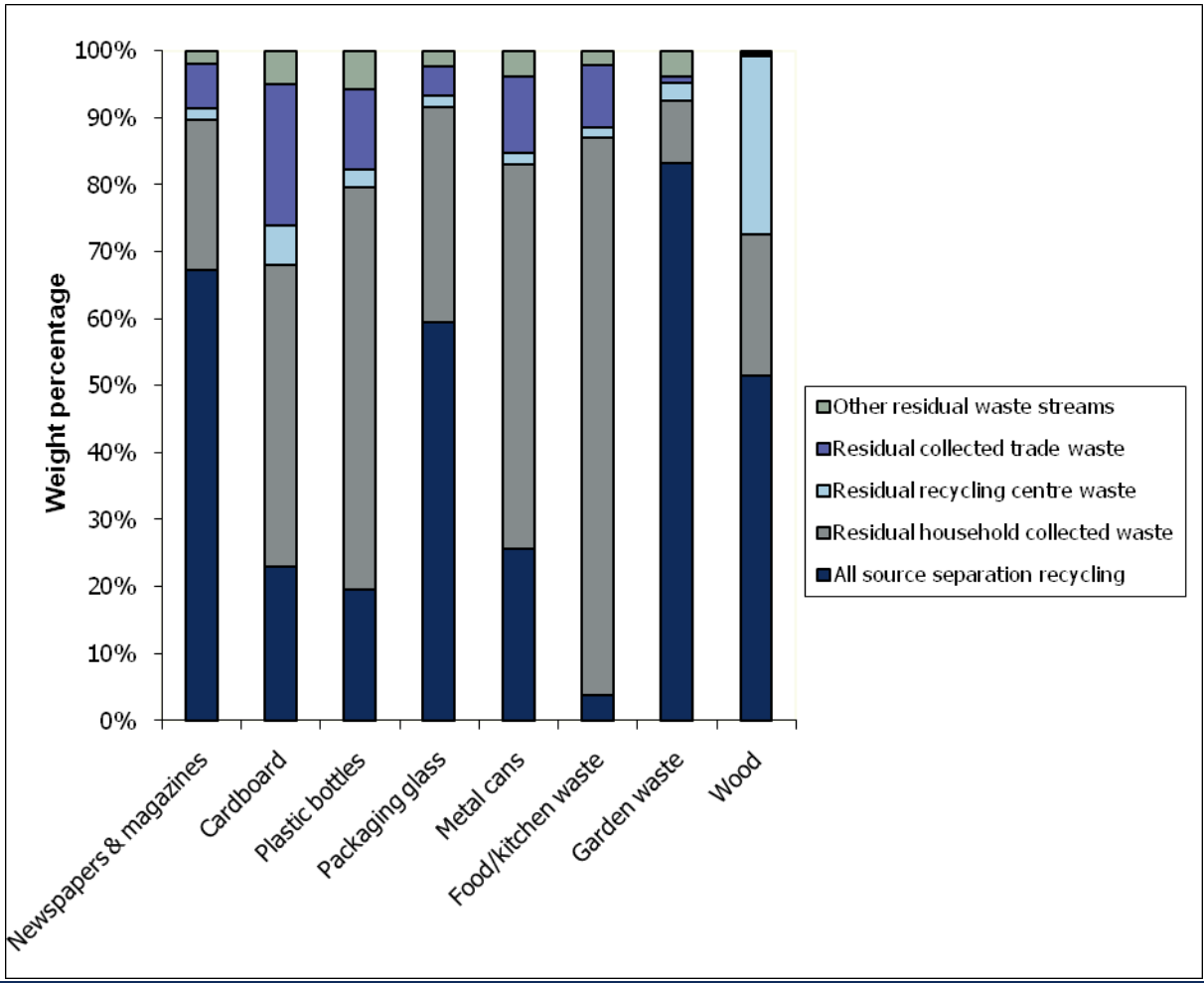


Figure E2: Distribution of the common recycled or compostable material types between MSW streams

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Glossary

ACORN – A Classification of Residential Neighbourhoods
 HHW – Household Hazardous Waste
 HWRC – Household Waste Recycling Centre
 MSW – Municipal Solid Waste
 SEPA – Scottish Environment Protection Agency
 WEEE – Waste Electrical & Electronic Equipment

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1.0 Introduction

Before devolution in 1999, Scotland was almost wholly dependent on landfill to treat its waste. However, since then, Scotland has started on the journey towards treating waste arising from households and business as a resource:

- The recycling and composting rate for municipal waste¹ has increased from around 5% in 2000 to over 34% in 2008/09.
- The total amount of controlled waste sent to landfill has reduced from 10.9 million tonnes in 2000 to 7.4 million tonnes in 2007.
- Progress has been made on meeting European Union targets and Scotland has already achieved the 2009/10 target on reducing the amount of biodegradable municipal waste sent to landfill.

The Scottish government's Zero Waste plan consultation in 2009 sets out proposals for a challenging programme of change over the next 15 years which will continue to move Scotland away from an over-reliance on landfill and maximise the use of unavoidable waste. The plan includes the following targets for 2025:

- infrastructure to collect, recycle and compost 70% of municipal waste (around 2.4 million tonnes). This will include recycling centres, transfer stations, Material Recovery Facilities (MRFs, to process dry recyclates), composting facilities and anaerobic digestion facilities;
- treating no more than 25% of its municipal waste (no more than 850,000 tonnes) in energy from waste facilities;
- landfilling no more than 5% of its municipal waste (no more than 170,000 tonnes).

In developing the new waste plan, the Scottish Government has been looking in more detail at waste statistics in order to:

- ensure appropriate information is available to adequately assess the recycling, composting and treatment facilities required to meet the requirements set by the waste strategy;
- ensure that sufficient suitable facilities are provided to meet the requirements set by both the Landfill Directive and the new Waste Framework Directive; and
- develop more sustainable waste management practices.

However, knowledge about the composition of municipal waste in Scotland is limited. Some local authorities have commissioned or carried out their own analyses of some of the waste streams that make up municipal solid waste (mainly just the residual household collected waste stream) but these have used a variety of methods, and have been designed to suit local needs rather than producing data which could be used to create a national picture for Scotland. Consequently, the Scottish Government identified the need to commission a full-scale waste composition analysis.

A steering group, with representatives from Scottish Government, the Scottish Environmental Protection Agency (SEPA) and Zero Waste Scotland was set up to oversee the project. Also participating in the steering group were the local authorities selected to take part in the study and Waste Aware Scotland and Remade Scotland. The four objectives of this project were to:

- estimate the composition of Scottish municipal solid waste (MSW) as a whole;
- estimate, by physical analysis, the composition of the eight main waste streams that make up MSW;
- provide MSW data specific to each of the eight participating local authorities; and
- use a methodology that will be comparable with similar projects carried out in other parts of the United Kingdom.

The study was commissioned by Zero Waste Scotland on behalf of the Scottish Government, and a consortium of WastesWork and AEA was selected to deliver the study following Zero Waste Scotland's evaluation of competitive tender responses.

The work was managed by WastesWork, supported by AEA as the subcontractor. WastesWork developed the sampling strategy and conducted the analysis work, and AEA collated and reported the results. This report describes how the methodology for obtaining the data was developed, presents the results from the analyses of

¹ *Municipal waste is defined by the Scottish Government as all waste for which a local authority makes arrangements, with a few exceptions, mainly being industrial waste taken for disposal or treatment separately from any other waste (SEPA website). For this study we sampled waste from the list provided in Section 2 below.*

each stream which were conducted, and provides information on the overall composition of MSW in Scotland. The occurrence and capture of recyclable materials is then considered in order to highlight potential opportunities for further recycling and composting. Finally, it considers ways in which an ongoing programme of sampling might be designed and undertaken.

Eight local authorities participated in the study and were selected according to a sampling framework described in section 2.1. The study was designed to provide information on the overall composition of MSW in Scotland, and there was no intention to compare the performance of the eight authorities which participated in the project. This report presents average results for Scotland; more detailed information for each of the eight participating authorities can be found in separate reports supplied to each local authority.

2.0 Development of the approach

The main areas which needed to be considered in developing the methodology to conduct the study were:

- selection of the sampling areas;
- development of a category classification system; and
- development of methodologies for sampling each waste stream.

The streams which were sampled were all of the main municipal waste streams:

- collected household waste, including household waste from flats and tenement blocks;
- commingled materials for recycling/composting where data on the separate amounts does not exist;
- civic amenity (HWRC) waste (the mixed waste stream only);
- litter and street sweepings;
- bulky uplift waste;
- parks and gardens (if a mixed waste stream); and
- trade waste.

The project did not sample either gully emptyings or household clinical waste. SEPA has prepared guidance on analysing household waste (National Methodology for Household Waste Composition Analysis in Scotland), but Zero Waste Scotland had identified three exceptions to this guidance for this specific project:

- The selection of households was to be based on small areas such as street blocks rather than a random selection of households within an area as this is operationally much easier to achieve.
- ACORN (A Classification of Residential Neighbourhoods) was to be used to represent socio-demographic differences rather than council tax band; this will ensure there is comparability between the Scottish study and the studies in England and Wales on which any new estimate of biodegradability that may be produced is likely to be based.
- Sub-categories would be added to the high level categories to make the analysis more useful for policy and strategy purposes.

These exceptions were included in the development of the methodology for this study.

2.1 Selection of sampling areas

Prior to awarding the project, Zero Waste Scotland and the project Steering Group had already carried out some preliminary work on sample selection. The principle factor for the design of the sampling frame was to ensure that the local authorities selected were representative of the types of waste and recycling collection systems used in Scotland at the time of the study. A sampling matrix was then developed that categorised local authorities according to the three factors below:

- waste collection method and collection frequency for both residual waste and recycling;
- urban/rural² location; and
- relative levels of multiple deprivation³.

² For the purposes of this project urban has been defined as a population density of 10 people per hectare or more while rural is less than 10. Whilst this does not consider the more complex SERU 8 classification commonly used in Scotland this approach was seen as a sensible compromise when designing the sample framework

³ Each of Scotland's 32 local authorities were given a relative rank according to the overall level of multiple deprivation in each local authority area using Scottish Index of Multiple Deprivation (SMID) statistics. For the purposes of obtaining a workable

Table 1 shows the eight local authorities which were selected to meet these requirements.

Table 1: Sampling strategy for the eight local authorities selected for this study

Collection frequency		SIMD 17-32	SIMD 1-16
Residual waste	Recycling		
Weekly sack	Fortnightly	Orkney Islands	
Weekly wheeled bin	Weekly	East Dunbartonshire	
Weekly wheeled bin	Fortnightly	Edinburgh Highland	Glasgow Renfrewshire
Fortnightly wheeled bin	Weekly	Moray	
Fortnightly wheeled bin	Fortnightly		South Ayrshire

No authorities in Scotland provide weekly sack and weekly recycling, or fortnightly sack and weekly recycling collections. These collection systems were not included in the sampling matrix. Glasgow and Edinburgh were classified as urban authorities; the other six authorities were classified as rural authorities. Following development of the sampling frame all of the selected authorities agreed to participate in the project.

Table A1 in Appendix A shows the collection systems used in each of the selected authorities, together with the types of dry recyclables that are collected, and the number of household waste recycling centre (HWRC) sites.

Residual household waste is the largest single stream of municipal waste, and so it is important that it is analysed to the highest levels of accuracy. In order to gain a representative picture the selection of sample areas for residual household waste analysis is commonly based on the socio-economic characteristics of households. The ACORN system has become the standard method for profiling the socio-economic characteristics of households. The system was designed to reflect purchasing patterns and uses census data to determine which of five main categories (1 is the most affluent and 5 is the least affluent) each household is placed into. Purchasing patterns significantly influence waste composition, and thus as a tool, the profile very neatly differentiates between householder types in terms of their spending power, number and the age of the occupants. After input from the steering group it was decided to use the ACORN system to select the individual sample areas for household waste in this study.

Table 2 below shows the ACORN Category profile for Scotland. This is the broadest level of profiling, and shows that the dominant ACORN Category is ACORN 5 (hard pressed), with fairly equal concentrations of ACORN Categories 1 and 2 and lower proportions for ACORN 3 and 4.

Table 2: ACORN Category profile for Scotland

ACORN Category profile		No. of households	Data as % for Scotland
1	Wealthy Achievers	480,378	20.6
2	Urban Prosperity	422,142	18.1
3	Comfortably Off	395,964	16.9
4	Moderate Means	189,366	8.1
5	Hard-Pressed	838,510	35.9
	Unclassified	10,500	0.4
	Total	2,336,860	100.0

The second level of ACORN profiling (see Table 3 below) provides a more detailed picture of which household groups need to be included in the sampling. To gain adequate cover of each ACORN category it is important to ensure that different age groups, families with or without children and the different ages of children. The selected sample areas used in the current study are highlighted in green in Table 3.

sample frame for this study, local authorities with a score of 17 or more were simply classified as being "less deprived" and authorities with a score of 16 or less were classified as being "more deprived".

Table 3: ACORN group profile for Scotland based on 2001 Census data, boxes shaded in green show household types sampled in this study

ACORN Category	ACORN Group and description		East. Dunbartonshire	Edinburgh	Glasgow	Highland	Moray	Orkney	Renfrewshire	South Ayrshire	Scotland		Samples analysed
			% of HH	% of HH	% of HH	% of HH	% of HH	% of HH	% of HH	% of HH	No of HH	% of HH	
1	A	Wealthy Executives	16.43	4.02	0.61	7.91	4.61	1.61	6.86	7.06	134033	5.74	2
	B	Affluent Greys	3.94	2.69	0.12	26.72	21.20	49.10	0.96	14.78	201714	8.63	3
	C	Flourishing Families	15.49	2.75	1.22	7.72	8.42	8.85	7.16	5.80	144631	6.19	2
2	D	Prosperous Professionals	5.97	8.11	2.00	1.04	1.11	0.64	1.74	3.62	70176	3.00	1
	E	Educated Urbanites	3.05	35.93	21.71	1.55	0.58	0.21	7.18	5.10	213622	9.14	2
	F	Aspiring Singles	2.66	9.89	6.93	3.39	5.70	6.29	5.78	4.42	138344	5.92	1
3	G	Starting Out	2.76	3.45	1.79	3.20	1.86	1.12	3.33	2.50	59688	2.55	0
	H	Secure Families	16.61	4.09	5.18	7.47	10.50	2.03	12.20	8.68	208383	8.92	2
	I	Settled Suburbia	1.87	0.82	0.34	6.06	7.03	7.08	1.47	4.05	55816	2.39	1
	J	Prudent Pensioners	4.41	2.00	1.04	4.30	4.87	4.13	2.01	3.88	72077	3.08	0
4	K	Asian Communities	0.00	0.01	0.14	0.00	0.00	0.00	0.00	0.00	645	0.03	0
	L	Post-Industrial Families	3.43	2.16	1.75	2.05	2.77	0.61	5.27	3.31	86659	3.71	1
	M	Blue-Collar Roots	5.06	2.01	2.42	3.91	3.97	1.45	7.70	8.41	102062	4.37	2
5	N	Struggling Families	10.28	5.54	8.40	17.36	20.16	12.17	10.35	14.14	377151	16.14	3
	O	Burdened Singles	5.58	7.37	16.73	5.68	5.22	4.47	14.38	8.64	245357	10.50	3
	P	High-Rise Hardship	2.12	8.00	24.25	1.53	1.25	0.24	13.16	5.20	201215	8.61	2
	Q	Inner City Adversity	0.00	0.55	4.37	0.00	0.00	0.00	0.12	0.00	14787	0.63	0
Unclassified			0.36	0.59	1.00	0.10	0.75	0.00	0.32	0.39	10500	0.45	0
Total			100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	2336860	100.0	25

As can be seen from the shaded green boxes in Table 3, the majority of household groups in Scotland were covered by the sampling strategy in the current study. The most commonly occurring household types were sampled the most frequently, e.g. 5.N and 5.O. To provide each participating local authority with a usable level of data three household groups were sampled in each local authority area. The dominant ACORN group in each local authority was identified first. The other two sample areas were then selected to cover the more dominant groups in each local authority area. In some cases the need for a representative national picture meant that less commonly occurring household types for a given local authority area were sampled.

Household waste samples were taken from all types of properties including flats. The research objectives and associated sampling methodology in the current study was not designed to measure the impact of other types of housing or socio-economic classification (e.g. number of persons, employment status, ethnicity).

For each ACORN group, one street containing more than 32 households was identified by the local authority. The housing types were checked using postcode information that was then verified with CACI (ACORN database developers). In total the residual waste from approximately 770 households was collected for each of the two sampling seasons.

2.2 Development of a waste category classification system

The category classification system was based on SEPA guidelines, but in order to develop the sub-category classification required for this study it was necessary to take account of both the level of detail required by the Scottish Government in reporting waste composition, and the cost implications of using a very detailed sub-classification system. The level of detail in the sub-category classifications needed to be sufficient to meet all the requirements for this programme. In addition, any sub-category classification also needed to take account of items in different waste streams. Following discussion with the Steering Group, the 59 category classification normally used by WastesWork was adopted for this study. This is shown in Table B1 in Appendix B.

This category listing enabled each of the following sub-classifications to be identified:

- **A general waste classification** – the 59 category classification is an expansion of an original 12-category classification which covered paper, plastic film, dense plastic, textiles, miscellaneous combustibles, miscellaneous non-combustibles, glass, organics, ferrous metal, non-ferrous metal, and –10 mm fines. This now also contains overall categories for both WEEE and Household Hazardous Waste (HHW).
- **Recyclables** – as the 59-category classification was developed from a classification system designed to assess source separation schemes, it includes categories for all of the main materials collected by local authorities for recycling.
- **Compostables** – the 59-category classification separately identifies the sources of organic material, such as kitchen waste and garden waste contained in household collected waste.
- **Biodegradables** – SEPA and the Scottish Government developed⁴ a list of items in waste which are biodegradable as part of developing procedures for monitoring progress towards meeting the requirements of the Landfill Directive. All of these items are separately identified in the 59-category classification, and so an assessment of the biodegradability of each sample can be determined.
- **Combustibles** – the 59-category classification identifies all combustible materials.

Although a “junk mail” category could also have been included as this is a category which could be targeted in a waste minimisation scheme, experience gained during other waste analysis studies identified the difficulties in positively identifying “junk mail” items. For this reason, these items were included in the “other recyclable paper” category.

Although this detailed category list provides information on a wide range of items, a less comprehensive breakdown using 24 categories (for examples see Tables 5 and 20 in Chapters 4 and 5) was used for the purposes of discussing the results.

2.3 Development of methodology for sampling each waste stream.

The methodology used for sampling and subsequent analysis of each waste stream was based on the SEPA guidance⁵ for household dustbin waste and the protocol for MSW streams developed for the analysis study conducted in Wales in 2002/03. This is described in more detail in Appendix C.

⁴ *Scottish Statutory Instrument 2005 No. 157 - Landfill Allowance Scheme (Scotland) Regulations 2005, and Scottish Executive Guidance: March 2007*

⁵ *National Methodology for Household Waste Composition Analysis in Scotland*

3.0 Practical work

The next chapter outlines the practical work that was conducted during the project. Practical work was conducted by WastesWork over two seasons in 2009; spring (April) and autumn (September). In each season, the fieldwork was carried out over a four-week period by four teams of three analysts. Each team spent two weeks in two participating local authorities; this enabled the fieldwork to cover both alternate weekly or fortnightly collection systems.

The typical amounts of waste which were analysed in each season in each of the eight authorities were:

- household collected waste (residual, dry recyclables and compostables) - 800 kg per sample area or a total of 2,400 kg per authority (3 areas analysed in each authority);
- residual HWRC waste – 2,500 kg;
- trade waste – 300 kg; and
- other waste streams – 200 kg.

The total amount of waste which was analysed was approximately 85 tonnes. As AEA were not involved in the operational procedures for acquiring or sorting samples of waste, they conducted an audit of a number of WastesWork's operations during the first season of the analysis work. This determined that:

- all four WastesWork teams were correctly following the protocols for both health and safety procedures and collection and analysis procedures agreed for this study;
- there was a good level of communication between the teams; and
- all four teams had received suitable training to be able to correctly answer the questions on how to classify specific items.

No areas for potential improvement for the hand-sorting and weighing of the collected samples by any of the four WastesWork teams were identified.

3.1 Household collected waste

The household waste samples were collected on the normal collection day for 32 households in each of the selected sample areas. The teams arrived in their sampling street approximately 30 minutes before the normal collection time. A simple household survey was carried out; this involved noting how full each residual waste/recycling container was, or the number of bags set out. All of the household waste set out for collection (either residual waste, recycling and green waste depending on the scheme in operation) was then transferred into bulk bags, and these were then loaded onto the back of a Luton van with tailgate.



Figure 1: Collection of residual household waste

Once back at the sort site the samples were unloaded and the different materials were weighed on electronic platform scales to determine the total weights collected. The bulk waste, recycling and compost samples were all hand-sorted separately. Samples for hand-sorting were placed on a screen with 10mm apertures to remove fines

(particles less than 10mm in any one dimension irrespective of composition) and initially sorted into the major material categories (e.g. dense plastics, metals, mixed textiles). Sorting at this level of definition continued until each of the samples had been screened. All particles falling through the screen were removed, weighed separately and classified as fines. Secondary sorting was then undertaken. This involved the separation of materials into 59 specified sub-categories. Each sub-category was then weighed on electronic platform scales and the data recorded



Figure 2: Sorting of residual household collected waste

3.2 Residual recycling centre waste

Each of the eight participating local authorities identified a HWRC for inclusion in the sampling. These are shown in Table 4.

Table 4: Household Waste Recycling Centre site in each authority

Authority	HWRC site
Highland	Alness
Orkney	Kirkwall
Edinburgh	Seafield
East Dunbartonshire	Maws Valley
Renfrewshire	Barhill Road
Moray	Forres
Glasgow	Dalsholm Road
South Ayrshire	Troon

The sites in Table 4, above, were all surveyed on a single week day and a single weekend day. Sampling of individual visitors was conducted at the sites in Orkney, Renfrewshire, East Dunbartonshire, Glasgow and South Ayrshire, but space constraints at the sites identified by the other three authorities meant that the authority provided a bulk sample for analysis.

Where the survey was carried out on site, users planning to deposit waste into the residual waste skip were selected using the “next available visitor” approach. Further discussion of this methodology can be found in Appendix C. The supervisor selected the next visitor to the residual waste container when the analysis of the current sample had almost been completed. The typical number of samples which were analysed on any day was between 40 and 50.

Each of those selected users who intended to throw rubbish into the residual skips was asked if they would participate in the survey. If they agreed, the waste they were going to throw into the residual skips was taken from them for hand sorting; they were asked to continue with their recycling. If they did not want to take part in the survey then the next user was selected. Once the visitor had left the site the waste was hand-sorted using the same procedures as those for the kerbside collected waste. Bagged waste that contained food was not tipped

out and sorted on-site, instead it was given its own sort category - 'black sack waste'. Ten of these sacks were later hand-sorted at the sort site to show a more detailed breakdown of their content, including the potentially recyclable element.



Figure 3: Sorting of residual waste at a HWRC site

In areas where it was not possible to carry out the HWRC survey on site the local authority arranged to have a residual waste skip delivered from the HWRC site to the team at their sort site. The contents of the skip were then hand sorted as a bulk sample. For ease of operation the bulky items were hand sorted and weighed off first. Then all sacks were opened and those that did not contain food waste were hand-sorted and the weights added to the sort sheet. Finally all sacks that contained food were weighed and the figure added to the sort sheet. Ten of these sacks were then fully hand-sorted and these weights were recorded on a separate sheet.

3.3 Schools

Each of the eight participating local authorities was asked to identify three schools for inclusion in the survey. Where possible this was two primary schools and one secondary school. The head teachers were telephoned prior to sampling to ask if the school would participate in the survey and to gain information on what time to arrive and who to meet. The samples were collected on the normal waste collection day for the school. Each of the schools bins - residual waste and recycling were weighed, using a trolley jack with scales, and a note was made of the type of bin, size and the material the bin was made of. Health and safety operating reasons meant that it was not possible to empty bins over 660L manually, so a sample of waste (approximately 200 litres) was removed from each bin. The analysis was conducted using the same procedure as that for household collected waste.

3.4 Trade waste

The location of each business identified by each participating local authority was identified on a map and the day and time of normal collection was determined. As with the schools, many businesses use bins that are larger than 660 litres, which means they cannot be manually emptied. Instead the bins were weighed using trolley jack scales and a sample (approximately 200 litres) was then removed from each bin. The analysis was conducted using the same procedure as that for household collected waste.

3.5 Litter

All Scottish local authorities survey their own litter according to a seven-zone system. They also survey each other's litter, and Keep Scotland Beautiful validates the quality of the data. Each local authority was asked to provide litter and sweeping samples according to the seven-zone system over the same two-week sampling period. These samples were hand-sorted using the same procedure as that for household collected waste. If samples were delivered from gully clearance, these were not hand-sorted; the composition was determined through visual inspection.

3.6 Bulky household waste

Two local authorities provided detailed records of their bulky household collections. This was deemed sufficient to derive an overall national picture for this waste stream. For each selected record, the typical weight listed in the FRN list⁶ was allocated to each item. These were then added together to provide an overall composition for bulky household waste. Orkney also provided a sample of material (total weight about 0.5 tonnes) collected by their bulky household service. This was hand-sorted into major categories, such as furniture and WEEE items for comparison purposes.

3.7 Other waste streams

Local authorities were asked to supply samples of park and garden waste and beach cleansing waste. Where samples were provided, they were analysed using the same procedure as that for household collected waste.

⁶ Typical weights for items potentially suitable for reuse. Furniture Reuse Network (www.frn.org.uk), 2009.

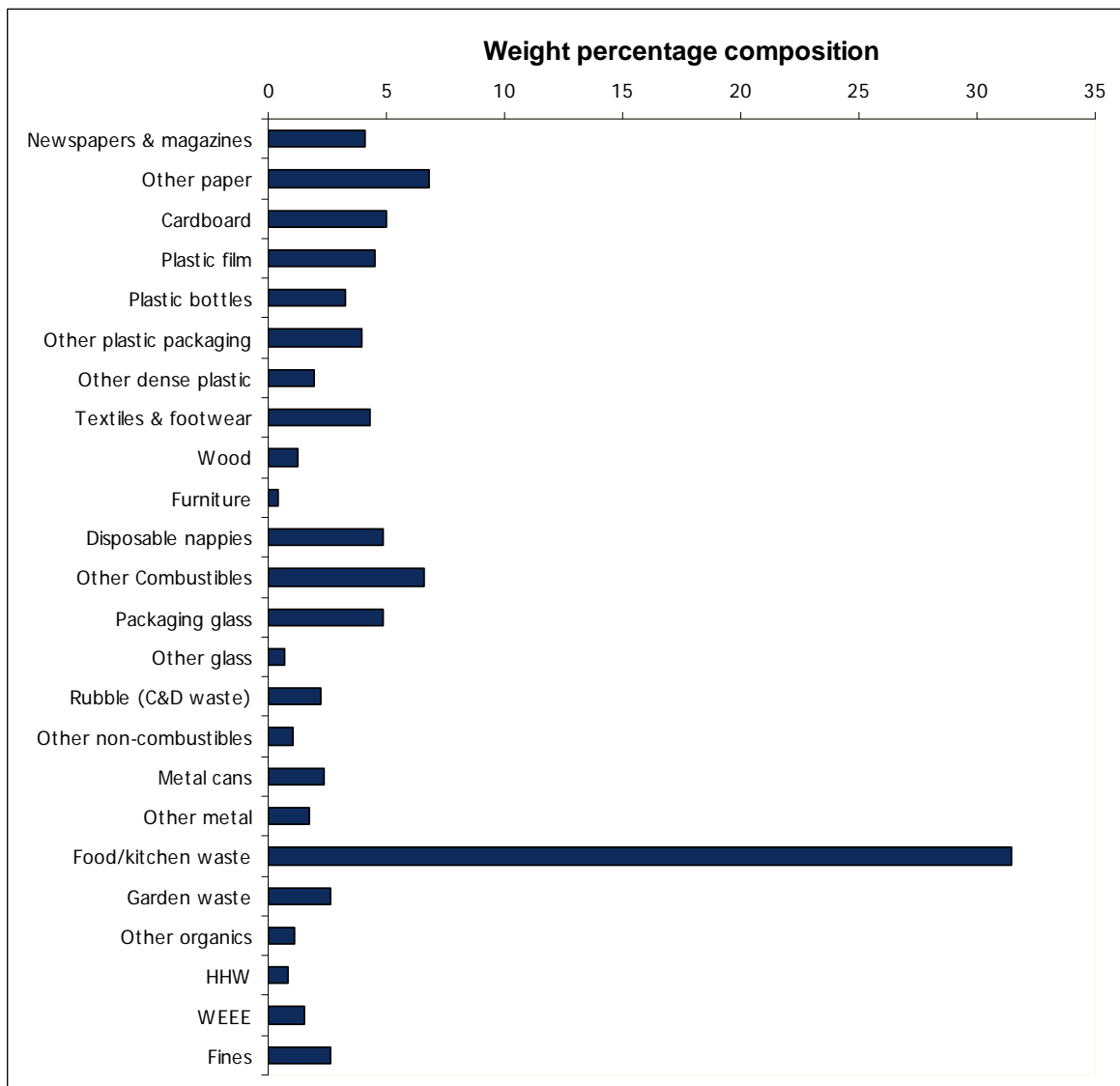
4.0 Composition of individual MSW streams

This chapter presents the results for the composition of each of the MSW waste streams which were analysed during the current study. The results for each of the eight local authorities which participated in the project are presented in separate reports supplied to local authorities. A more detailed category breakdown for each stream is presented in Appendix D. Chapter Five presents information on the overall composition of MSW in Scotland which is calculated by using a combination of compositional data from this study and WasteDataFlow. The compositional analysis results were compared with those from other studies, such as the analysis⁷ of MSW in Wales conducted in 2002/03 in order to assess whether the data obtained was both sensible and robust.

4.1 Residual household collected waste

Figure 4 shows the average composition (% by weight) for residual household collected (dustbin) waste in Scotland. The largest category is food/kitchen waste, which represents almost one third (31.5%). The overall paper & card content was 15.9 percent.

Figure 4: Composition (Wt %) of residual household collected waste in Scotland



⁷ *The Composition of Municipal Solid Waste in Wales. Report by AEA for the Welsh Assembly Government, December 2003.*

Table 5 compares the average results for Scotland with those determined during analyses conducted⁸ in an English County during 2008. It also compares the findings with those from a review⁹ of waste composition analyses¹⁰ (most of the results are from English authorities) which has recently been published by Defra. This shows that the findings for Scotland are similar to those determined for other studies; the two main categories are the food/kitchen waste category, which represents about one third, by weight, of the residual household collected waste stream, and the overall paper & card content, which represents about 16-18% by weight of this waste stream.

Table 5: Composition (Wt %) of residual household collected waste

	Scotland 2009	Undisclosed English County 2008	Defra review March 2009
Newspapers & magazines	4.1	3.9	13
Other paper	6.8	7.3	
Cardboard	5.0	4.8	5
Plastic film	4.5	5.5	14
Plastic bottles	3.3	1.9	
Other plastic packaging	4.0	2.4	
Other dense plastic	2.0	2.6	
Textiles & footwear	4.3	2.9	4
Wood	1.2	0.7	1
Furniture	0.4	0.4	-
Disposable nappies	4.8	6.3	5
Other Combustibles	6.6	2.7	3
Packaging glass	4.8	5.2	5
Other glass	0.7	0.5	
Rubble (C&D waste)	2.2	1.1	2
Other non-combustibles	1.0	0.6	
Metal cans	2.4	1.7	4
Other metal	1.7	1.6	
Food/kitchen waste	31.5	34.4	32
Garden waste	2.6	2.6	6
Other organics	1.1	6.7	2
HHW	0.9	0.4	1
WEEE	1.5	1.1	1
Fines	2.6	2.6	2
Total	100.0	100.0	100

A comparison of the findings from this study and the previous studies mentioned above also show that the weight percentage of other types of recyclable materials are similar:

- Glass bottles – about 5%
- Metal cans – about 2%.

In the current study plastic bottles made up a slightly higher proportion (3.3%) of residual waste when compared to a previous study of an English County (1.3%), although individual local authority samples in the current study ranged from less than 2% to over 6%.

⁸ Unpublished report by WastesWork and AEA, 2009. Consisted of an average of 55 samples from 11 districts and the range of collection systems for residual waste and recycling is similar to that for Scotland as a whole

⁹ Municipal waste composition – A review of municipal waste component analyses. Report by Resource Futures for Defra for project WR0119 (available at www.defra.gov.uk)

¹⁰ The English County results were not included in the Defra study as the data used was collected before this study was conducted

The residual household collected waste stream represents about 45% by weight¹¹ of overall arisings of MSW in Scotland. Variability in the composition of this stream could have a significant impact on the estimates of overall composition of MSW in Scotland. The 95% confidence intervals for the two main categories in the residual household collected waste stream were:

- Food/kitchen waste – 32% ± 2%
- Total paper & card – 15.9% ± 1%.

These confidence limits are considered to be relatively low and suggest an acceptable level of variation in estimates of MSW in Scotland from this study.

The average weight (kg per household per week) of waste in the residual household collected waste stream observed in this study was 10.2 kg per household per week. As food/kitchen waste (see Table 5) represents about 32% by weight of this stream, the typical arisings of food/kitchen waste in this waste stream are estimated at 3.2 kg/household per week.

The average weight (kg per household per week) of a number of other potentially recyclable materials that occurred in the residual household waste were as follows:

- Newspapers and magazines – 0.4 kg/household per week
- Other paper – 0.7 kg/household per week (some of this currently can not be recycled)
- Cardboard – 0.5 kg/household per week
- Plastic bottles – 0.3 kg/household per week
- Packaging glass – 0.5 kg/household per week
- Metal cans – 0.2 kg/household per week.

This suggests that there is the potential to capture up to an additional 5 kg/household per week of recyclable or compostable (including food/kitchen waste) material from households through kerbside collection schemes.

There are a number of factors which can influence waste generation including socio-economic profile of the households, urban or rural location and seasonal variation. The residual household collected waste arisings for each sample area are shown in Appendix E. The potential impact of household socio-economic circumstances and rural/urban comparison were used in the sampling design/strategy in order to try to obtain a more representative picture of national MSW composition. It is therefore inappropriate to draw conclusions on the effects of these variables in isolation from the findings of this study.

A simple comparison of the average spring and autumn results for household residual waste suggested there was no evidence of any significant seasonal variation in composition. A similar finding was determined for each of the other waste streams which were analysed during this survey. The survey conducted on MSW arisings in Wales in 2002/03, which covered all four seasons, also determined that there was no identifiable evidence of any seasonal variation in composition for all categories apart from garden waste.

¹¹2008/09 WasteDataFlow data for Scotland

4.2 Kerbside collected recyclables

Table 6 shows the average composition for the kerbside collected dry recyclables stream and the kerbside collected green waste stream. Although not all of the participating local authorities collect the same dry recyclable materials (see Appendix A, Table A1), newspapers & magazines was the largest category (54% by weight) in the average dry recyclables stream. None of the authorities collected co-mingled garden and food/kitchen waste, and garden waste represented almost 99% of the materials collected through the green waste streams.

Table 6: Average composition (Wt %) of kerbside collected dry recyclables and green waste

	Dry recyclables	Green waste
Newspapers & magazines	54.6	0.0
Other paper	5.1	0.0
Cardboard	8.6	0.0
Plastic film	0.3	0.0
Plastic bottles	1.9	0.0
Other plastic packaging	0.7	0.0
Other dense plastic	0.1	0.0
Textiles & footwear	0.1	0.0
Wood	0.1	0.1
Furniture	0.0	0.0
Disposable nappies	0.0	0.0
Other Combustibles	0.0	0.4
Packaging glass	23.8	0.0
Other glass	0.2	0.0
Rubble (C&D waste)	0.0	0.1
Other non-combustibles	0.0	0.1
Metal cans	3.8	0.0
Other metal	0.1	0.0
Food/kitchen waste	0.1	0.6
Garden waste	0.0	98.7
Other organics	0.2	0.0
HHW	0.0	0.0
WEEE	0.2	0.0
Fines	0.0	0.0
Total	100.0	100.0

Table 6 shows that the dry recyclables stream contained small amounts of non-targeted materials such as wood, other non-packaging glass, food/kitchen waste and WEEE. The green waste stream contained less than 1% by weight of food/kitchen waste.

The monitored collection rates (kg/household/week) for both dry recyclables and green waste in each of the sample areas are shown in Appendix E. It may be desirable to make comparisons of collection rates between the different waste/recycling schemes and sample areas in Appendix E. However, it is important to highlight that the sampling framework developed for this study focused exclusively on obtaining a representative picture of overall MSW composition in Scotland. It is therefore inappropriate to make simple comparisons between the collection rates of the different sample areas used in this study.

The average capture rates¹² achieved by the kerbside schemes in Scotland for a number of potentially recyclable or compostable materials were:

- newspapers and magazines – 67%;
- other paper and card – 26%;
- plastic bottles – 19%;
- glass packaging – 44%;
- metal cans – 22%; and
- garden waste – 80%.

These findings are consistent with those from other studies of kerbside separation schemes conducted over the past 15 years which show that capture rates for newspapers & magazines and glass packaging are higher than those for either metal cans or plastic bottles. They are also comparable to the kerbside capture rates determined in the Defra review of MSW compositional analyses.

4.3 Household recycling centre waste

Figure 5 shows the average weight percentage composition for residual HWRC waste in Scotland. These have been determined after including the results from the 'mixed bagged waste' category used during the hand-sorting procedure for each sample which was analysed. The largest single category is other combustibles (16% by weight) which includes carpets. Wood and furniture each represented about 10% by weight, and garden waste represented about 5% by weight of this waste stream.

¹² Calculated using WasteDataFlow information on the arisings and composition of recyclable or compostable material recovered at the kerbside, WasteDataFlow information on arisings of residual household collected waste, and the average composition of residual household collected waste in Scotland shown in Table 5.

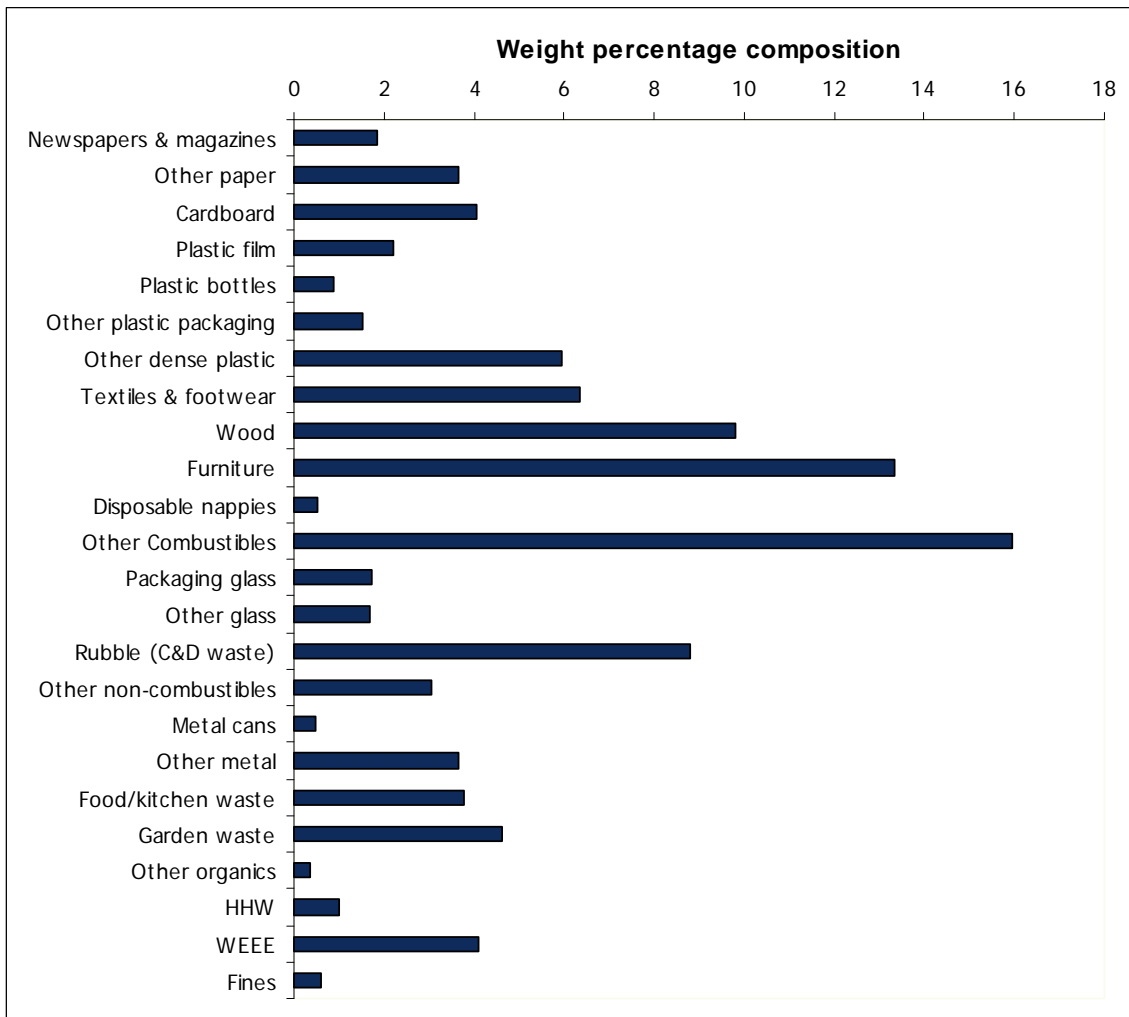


Figure 5: Composition (Wt %) of residual HWRC waste in Scotland

Table 7 compares the results for Scotland with those determined during analyses conducted in an English County during 2008 and from a review of waste composition analyses (mostly English authorities) which has recently been published by Defra. The analyses conducted on this stream in Wales in 2002/03 were on the waste brought to the site, and so can not be compared with these results. All of the results show that the largest category is 'other combustibles' (furniture, carpets and other combustible materials), which represents between a quarter and a third by weight of this waste stream.

Table 7: Composition (Wt %) of residual HWRC waste

	Scotland 2009	Undisclosed English County 2008	Defra review March 2009
Paper	6	8	5
Cardboard	4	3	3
Plastic film	2	3	11
Dense plastic	8	12	
Textiles	6	5	5
Wood	10	7	15
Other combustibles	30	33	27
Glass	3	4	3
C&D waste	9	5	15
Other non-combustibles	3	3	
Garden waste	5	6	10
Other organics	4	6	
Metal	4	2	2
Household hazardous	1	1	1
WEEE	4	1	2
Fines	1	1	1
Total	100	100	100

There were no identifiable differences between weekday and weekend arisings for either the weight or composition of residual HWRC waste in the current study. The MSW survey in Wales also determined that there was no consistent overall difference between weekdays and weekends in the mean weight per visitor of waste brought to the site.

Table 8 shows the average capture rates achieved by the HWRC sites in Scotland. The overall recycling rate achieved at the HWRC sites was 56%, and capture rates for potentially recyclable or compostable materials ranged from over 70% for garden waste, C&D waste, WEEE, and metal, to less than 20% for dense plastic and textiles. These capture rates are comparable to those determined for HWRC sites in the Defra 2009 review of MSW compositional analyses.

Table 8: Average capture rates (Wt %) achieved at HWRC sites in Scotland

	Capture rate (Wt %)
Paper	65
Cardboard	54
Dense plastic	13
Textiles	17
Wood	65
Glass	61
C&D waste	79
Garden waste	87
Metal	70
WEEE	71
Total	56

4.4 Commercial waste collected by local authorities

One of the aims of the current study was to capture the differences in the residual waste produced business which is collected by local authorities. Table 9 shows the number of residual waste samples taken for each of the 9 business categories used in this study. A total of 229 samples of residual waste were analysed for their composition. Sampling did not take account of whether a business recycled or not as the primary goal of this part of the study was to characterise what remains in the residual waste stream.

Table 9 Number of residual waste samples from commercial premises

	Spring	Autumn	Total
Retail	17	17	34
Food (cafes and restaurants)	16	16	32
Care	10	10	20
Hair & Beauty	13	11	24
Health (doctor, dentist, vet)	15	14	29
Leisure	15	11	26
Offices	11	12	23
Manufacturing	11	6	17
Other businesses	11	13	24
Total	119	110	229

Table 10 presents the average composition of residual waste for each business type, and shows, for example, that:

- Retail and office businesses produce a much higher percentage (up to 50%) of paper & card than businesses in the food (e.g. cafes and restaurants) and hair and beauty (e.g. hairdresser) sectors (typically 20%).
- The food/kitchen waste category represents over 45% by weight of waste produced by food and cafe businesses¹³. This is much higher than values produced by hair & beauty, health and manufacturing and other businesses (less than 15%).

Similar findings were determined for the study in Wales in 2002/03. This information can be used by local authorities to target their recycling collection schemes to the most appropriate businesses.

¹³ WRAP has also commissioned separate, UK wide research into the composition of waste from the hospitality sector (hotels, pubs and restaurants), which will compliment the findings for trade waste from the current study. This work is due to be published in 2010, please see <http://www.wrap.org.uk/> for more details

Table 10: Composition (weight %) of residual trade waste produced by eight business categories

	Retail	Food	Care	Hair & Beauty	Health	Leisure	Offices	Manufacturing	Other businesses
Newspapers & magazines	9.4	1.4	3.4	16.3	8.0	3.3	11.3	2.4	8.7
Other paper	15.6	9.6	14.7	9.1	31.0	16.7	28.8	28.1	18.5
Cardboard	29.3	7.9	6.8	6.9	14.2	13.4	9.7	14.7	15.9
Plastic film	11.6	7.1	7.4	6.3	6.8	7.6	5.4	11.1	5.0
Plastic bottles	2.2	3.9	1.9	6.2	2.8	6.3	6.1	2.5	3.0
Other plastic packaging	3.1	4.3	3.5	6.5	4.9	4.7	4.1	6.6	2.7
Other dense plastic	2.4	0.2	0.5	0.3	0.7	1.4	0.7	0.9	1.4
Textiles & footwear	1.1	0.4	1.0	0.5	0.6	1.8	0.2	6.2	1.3
Wood	0.1	0.1	0.8	0.1	0.1	0.5	0.0	0.1	0.0
Furniture	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Disposable nappies	0.1	1.3	4.5	2.7	0.2	0.6	0.4	0.0	0.3
Other Combustibles	1.2	1.8	2.4	12.9	6.3	3.5	1.9	3.0	2.7
Packaging glass	1.1	6.1	3.2	4.1	0.9	8.6	2.1	0.6	8.1
Other glass	0.6	0.1	0.0	0.1	0.0	0.7	0.0	1.3	0.6
Rubble (C&D waste)	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.4
Other non-combustibles	0.1	0.0	0.2	0.0	1.6	0.9	0.2	1.1	1.1
Metal cans	1.3	4.0	2.2	3.4	1.4	3.7	2.0	1.8	4.5
Other metal	3.0	0.4	0.6	4.1	0.3	1.4	1.6	1.7	3.8
Food/kitchen waste	12.5	48.4	42.7	14.2	11.1	17.9	18.2	7.7	11.7
Garden waste	3.4	0.0	2.1	0.0	0.5	1.6	0.0	8.0	4.0
Other organics	0.8	1.2	1.1	5.1	2.4	2.7	3.6	0.8	3.4
HHW	0.1	0.0	0.0	0.1	0.1	0.3	0.4	0.2	0.0
WEEE	0.1	0.0	0.0	0.0	0.8	0.2	2.2	0.0	1.4
Fines	1.0	1.7	0.8	1.0	2.3	2.1	1.1	1.2	1.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Although the analyses enabled the typical composition of wastes produced by different types of businesses to be determined, the data needs to be grossed up in order to determine the overall composition of this waste stream. The method initially developed for grossing up the data was to:

- determine the typical composition of waste from each type of business– (number of samples for each business type shown in Table 9); and
- determine the number of each type of business in each local authority that has a trade waste collection, and use this information to calculate the overall composition of this waste stream.

However, it was not possible to obtain suitable data on the numbers of each types of business whose waste was collected by local authorities. Consequently the estimated composition of residual trade waste shown in Table 11 and Figure 6 are based on our sample alone. These show that:

- The food/kitchen and other paper categories each represent about a fifth of this waste stream.
- The other paper and card categories (newspapers & magazines and card) represent about a fifth of this waste stream.

There are also 13 categories, such as rubble, which each represent less than 2% by weight of this waste stream.

Table 11: Overall composition (Wt %) of collected trade waste

	Weight %
Newspapers & magazines	7.2
Other paper	18.8
Cardboard	13.8
Plastic film	7.7
Plastic bottles	3.5
Other plastic packaging	4.8
Other dense plastic	1.0
Textiles & footwear	1.3
Wood	0.2
Furniture	0.0
Disposable nappies	1.0
Other Combustibles	3.8
Packaging glass	3.9
Other glass	0.4
Rubble (C&D waste)	0.4
Other non-combustibles	0.5
Metal cans	2.7
Other metal	1.9
Food/kitchen waste	20.9
Garden waste	1.8
Other organics	2.3
HHW	0.1
WEEE	0.5
Fines	1.5
Total	100.0

Figure 6: Composition (Wt %) of collected trade waste

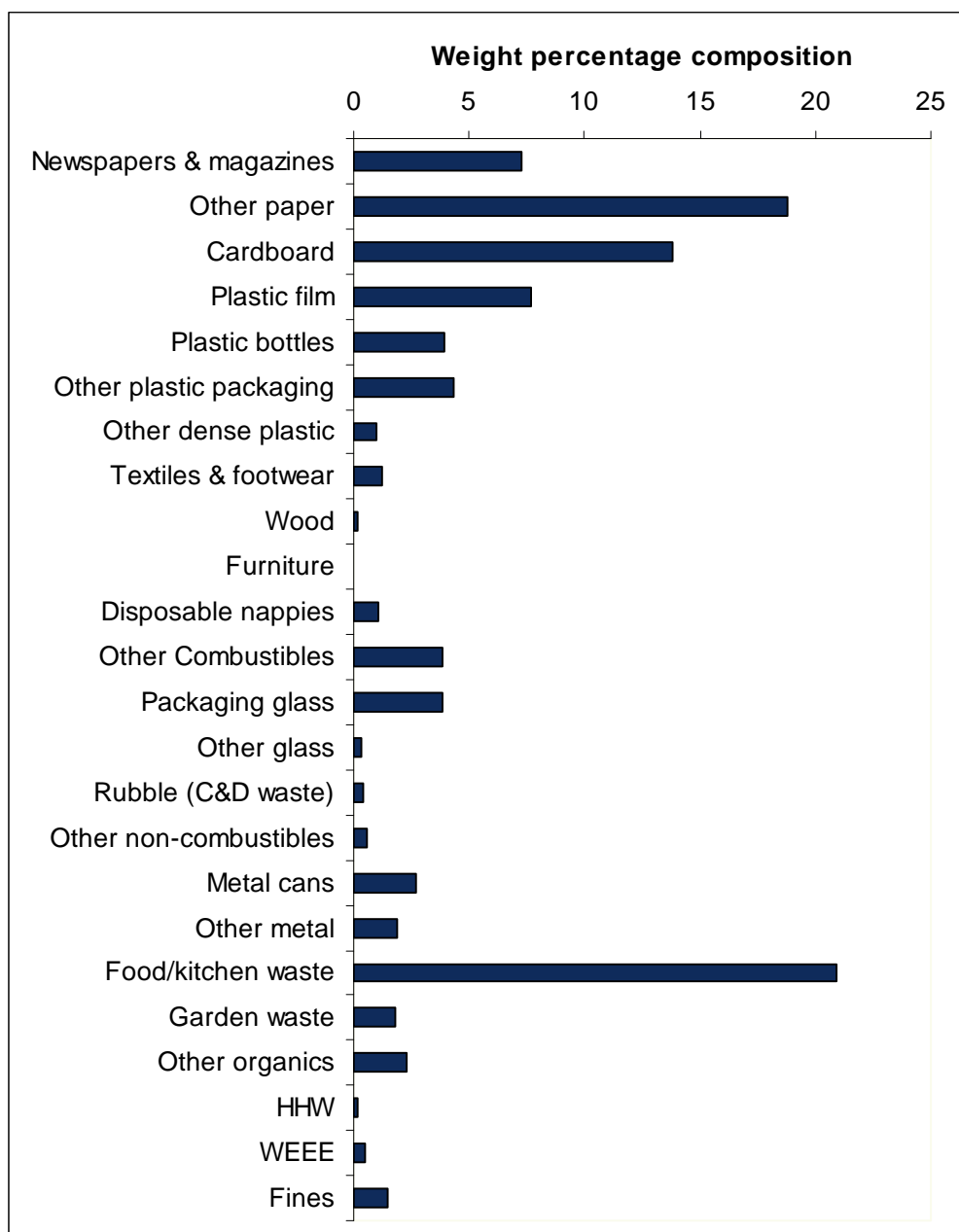


Table 12 compares the current results with those for the composition of collected trade waste determined during the study of composition of MSW in Wales in 2002/03 (Wales 2003), a study¹⁴ conducted in a County in England during 2006, and an analysis of the mixed waste stream from commercial and industrial premises determined¹⁵ in Wales in 2007 (Wales 2007).

¹⁴ Unpublished report by AEA, 2006

¹⁵ Determination of the Biodegradability of Mixed Industrial and Commercial Waste Landfilled in Wales. Report by SLR for Environment Agency Wales, November 2007

Table 12: Comparison of composition (Wt %) of trade waste stream

	Scotland 2009	Wales 2003	Undisclosed English County 2006	Wales 2007
Paper and cardboard	40	41	35	32
Plastic film	8	4	7	7
Dense plastic	9	6	6	8
Textiles	1	2	1	2
Other combustibles	5	6	10	16
Glass	4	4	3	4
Other non-combustibles	1	1	2	6
Food/kitchen waste	21	23	27	13
Other organics	3	4	3	2
Metal	5	5	4	4
Household hazardous	<1	1	0	1
WEEE	<1	1	1	1
Fines	2	1	2	4
Total	100	100	100	100

This shows that there is very little difference in the composition, particularly in terms of the two main categories (paper & card and food/kitchen waste) between the two surveys of trade waste collected by local authorities conducted in Wales and Scotland. However, the analyses of overall trade waste collected in an English County in 2006, and the analysis of the mixed waste stream conducted in 2007 both show that these have lower paper & card content. This is mainly due to the higher concentrations of other combustibles. However all four results show that the two main categories are paper & card and food/kitchen waste, which is a similar finding to that for the residual collected household waste stream.

4.5 Litter

Figure 7 shows the average composition of litter in Scotland. The weight percentage composition for 11 of the 24 categories (which include a number of categories that could be targeted for recycling) is over 5%, and the food/kitchen waste category has the highest weight percentage (14%).

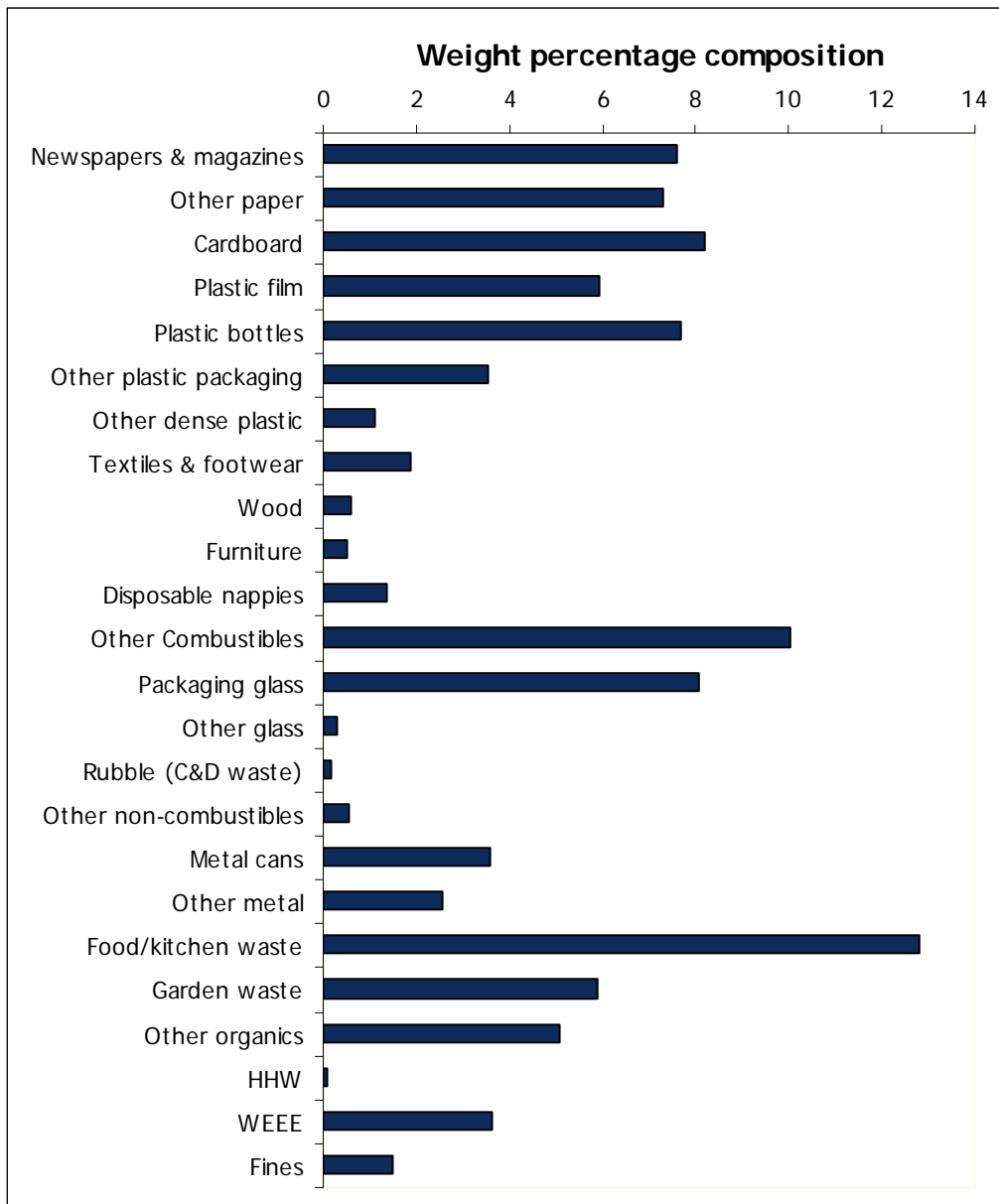


Figure 7: Composition (Wt %) of litter in Scotland

Table 13 compares the results for Scotland with those for analyses conducted in Wales in 2002/03, analyses conducted¹⁶ in an English Unitary Authority in 2005, and analyses conducted¹⁷ in an English County in 2002. The results show that whilst there is a variation in composition, litter typically contains up to 10% by weight of a number of common material types such as newspapers & magazines, glass bottles and metal cans, which could be targeted for recycling.

¹⁶ Unpublished report by AEA, 2005

¹⁷ Unpublished report by AEA, 2002

Table 13: Composition (Wt %) of litter

	Scotland 2009	Wales 2002/03	Undisclosed English Authority 2005	Undisclosed English County 2002	Average
Newspapers & magazines	7.6	9.7	6.8	10.2	8.6
Other paper	7.3	8.8	6.8	5.6	7.1
Cardboard	8.2	12.4	7.0	11.7	9.8
Plastic film	5.9	7.8	6.3	4.7	6.2
Plastic bottles	7.7	6.6	10.3	7.5	8.0
Other plastic packaging	3.6	3.4	2.1	3.4	3.1
Other dense plastic	1.1	2.5	1.8	1.8	1.8
Textiles & footwear	1.9	2.2	1.0	2.8	2.0
Wood	0.6	1.2	0.3	0.5	0.6
Furniture	0.5	0.0	0.0	0.0	0.1
Disposable nappies	1.4	1.1	1.1	0.6	1.0
Other Combustibles	10.0	1.5	3.8	3.7	4.8
Packaging glass	8.1	8.1	18.0	11.5	11.4
Other glass	0.3	0.3	0.5	1.2	0.6
Rubble (C&D waste)	0.2	0.3	1.2	0.3	0.5
Other non-combustibles	0.6	0.5	0.3	1.7	0.8
Metal cans	3.6	6.1	6.2	4.6	5.1
Other metal	2.6	1.8	1.1	1.2	1.7
Food/kitchen waste	12.8	15.0	19.7	8.7	14.1
Garden waste	5.9	2.2	3.1	0.6	2.9
Other organics	5.1	6.3	1.3	12.6	6.3
HHW	0.1	0.3	0.8	0.1	0.3
WEEE	3.6	0.2	0.0	1.0	1.2
Fines	1.5	1.7	0.7	3.9	1.9
Total	100.0	100.0	100.0	100.0	100.0

4.6 Schools waste

Table 14 shows the average composition of waste from both primary and secondary schools in Scotland. The wastes have similar paper and card contents (30-35%) but the waste from primary schools contains a much higher percentage (35%) of food/kitchen waste than that from secondary schools (21%). This may be due to a higher percentage of primary school children making use of the school dinner service, but may also reflect the fact that children at secondary schools may well eat their lunch outside the school.

The analyses indicate that the main categories which could be targeted for recycling or composting are paper & card and food/kitchen waste.

Table 14: Composition (Wt %) of waste from schools

	Primary schools	Secondary schools
Newspapers & magazines	2.3	3.4
Other paper	19.1	23.3
Cardboard	10.6	9.0
Plastic film	5.8	7.9
Plastic bottles	4.5	5.8
Other plastic packaging	4.9	3.6
Other dense plastic	1.1	1.7
Textiles & footwear	0.8	0.6
Wood	0.3	1.2
Furniture	0.0	0.0
Disposable nappies	0.0	0.0
Other Combustibles	1.4	2.4
Packaging glass	0.8	0.7
Other glass	0.0	0.2
Rubble (C&D waste)	0.1	0.6
Other non-combustibles	0.2	0.3
Metal cans	0.9	2.7
Other metal	0.8	1.0
Food/kitchen waste	32.1	20.9
Garden waste	1.9	6.8
Other organics	7.9	4.7
HHW	0.1	0.5
WEEE	1.0	1.0
Fines	3.2	1.8
Total	100.0	100.0

There is no data on the amount of school waste which is collected as it is normally included within the tonnage reported for household waste collections. Consequently, the results from the sample of schools in the current study were not used in the calculation of overall MSW composition.

4.7 Bulky household waste

Figure 8 shows the composition of bulky household waste in 2008/09 based on the data provided by two participating local authorities. The two main categories, both of which represent over 40% by weight of the total arisings, are furniture and WEEE. Nearly all of the WEEE in the records provided is either white goods or televisions.

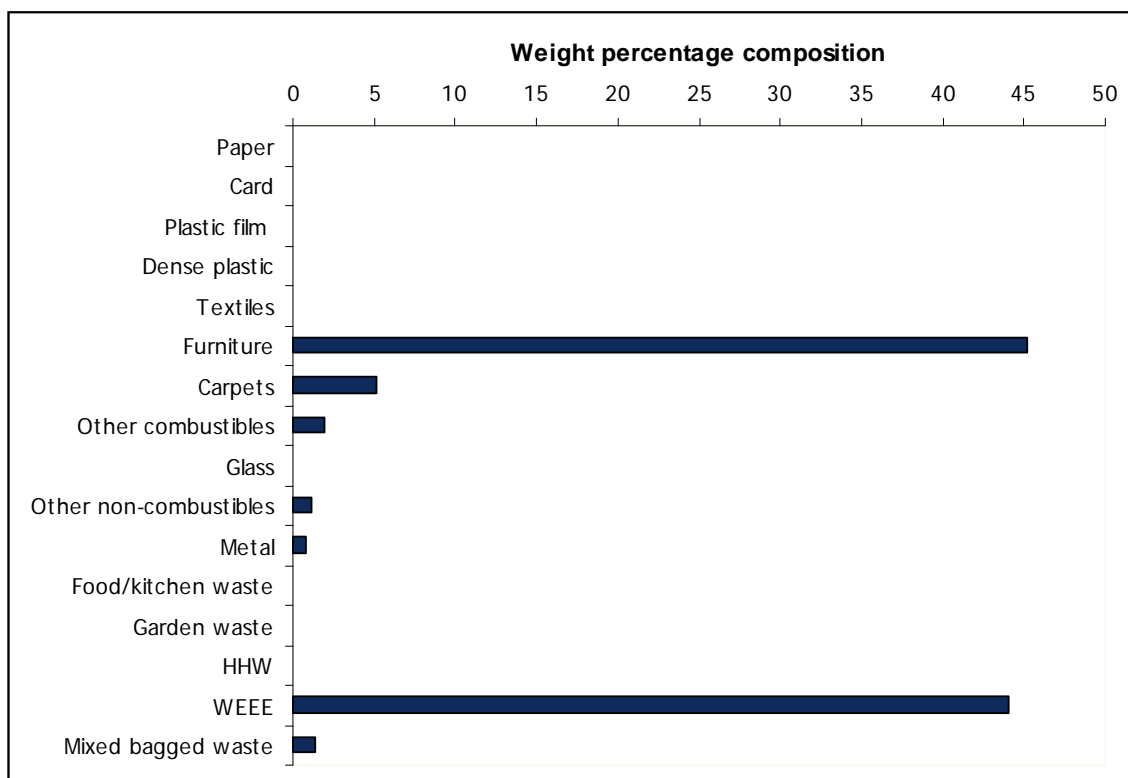


Figure 8: Composition (Wt %) of bulky household waste in Scotland

Table 15 compares the composition of bulky household waste in Scotland with those determined in other studies. All the results show that the two main categories are furniture and WEEE, which could be targeted for either re-use or recycling. A similar finding was determined for the smaller physical sample provided by Orkney. The total arisings of other recyclable categories, such as paper and food/kitchen waste, are less than 3% by weight of this stream.

Table 15: Composition (Wt %) of bulky household waste

	Scotland 2009	Wales 2002/03	English County 2002	English Unitary Authority 2005/06
Paper	-	-	-	-
Card	-	<1	<1	-
Plastic film	-	-	-	-
Dense plastic	<1	1	<1	<1
Textiles	<1	<1	<1	<1
Furniture	45	37	41	49
Carpets	5	7	13	3
Other combustibles	2	14	<1	1
Glass	-	<1	<1	-
Other non-combustibles	1	2	<1	-
Metal	1	1	<1	2
Food/kitchen waste	-	-	-	-
Garden waste	-	<1	-	-
HHW	-	<1	-	<1
WEEE	44	35	44	43
Mixed bagged waste	1	1	<1	1
Total	100	100	100	100

4.8 Other waste streams

Table 16 presents the results for the analysis of park & garden waste and beach cleansing waste. There is no data on the amount of these waste streams which are collected as it is normally included within WasteDataFlow returns as the tonnage for 'other waste streams' (although some authorities do report a grounds waste tonnage). Consequently, the results were not used in the calculation of MSW composition.

No analyses were conducted of the gully sweepings stream. Other analyses (such as that conducted in the study on MSW composition in Wales in 2002/03) indicate that this stream contains about 50% by weight of fine (<10 mm) material, over 45% by weight of organic material (mainly garden waste) and a small amount of packaging materials.

Table 16: Composition (Wt %) of other waste streams

	Park & garden waste	Beach cleaning waste
Newspapers & magazines	8.9	0.5
Other paper	6.1	1.2
Cardboard	7.3	1.0
Plastic film	4.3	8.2
Plastic bottles	7.3	4.7
Other plastic packaging	2.6	4.5
Other dense plastic	1.3	17.2
Textiles & footwear	2.1	6.2
Wood	0.1	2.8
Furniture	0.0	0.0
Disposable nappies	0.0	0.0
Other Combustibles	14.3	4.8
Packaging glass	18.7	5.9
Other glass	1.1	0.1
Rubble (C&D waste)	0.0	0.0
Other non-combustibles	1.7	6.4
Metal cans	3.1	2.7
Other metal	2.0	0.0
Food/kitchen waste	10.8	1.5
Garden waste	2.2	17.1
Other organics	2.7	7.1
HHW	0.0	0.0
WEEE	0.5	0.0
Fines	2.7	8.1
Total	100.0	100.0

5.0 Arisings and overall composition of municipal solid waste

The sampling methodology we developed for the compositional analyses is described in detail in Chapter 2. By sampling waste from a range of local authorities (geography, socio-economics, type and frequency of residual waste and recycling collection) and household types (ACORN framework) we assume the compositional findings are representative of Scotland as whole. The overall composition of MSW in Scotland can therefore be determined by applying the composition of each waste stream from this study (Chapter 4) with Wastedataflow returns on the tonnage arisings of each of these waste streams.

Table 17 shows the tonnage arisings of the waste streams that, between them, comprise the overall MSW stream. The tonnages in Table 17 are derived from the 2008/09 WasteDataFlow¹⁸ information collated by SEPA using the following assumptions:

- Litter and Gully waste each represent 50% of the street cleansing waste category
- The tonnage for collected trade waste excludes any material classified as industrial waste (as SEPA do not classify this as municipal waste)
- The WasteDataFlow tonnages for the following two categories; 'Collected non-household waste: Construction and Demolition', and 'Collected non-household waste: Highways waste', are excluded as SEPA do not classify these waste streams as municipal waste.

Table 17: Tonnage arisings of MSW in Scotland in 2008/09

	Weight (' 000 tonnes)	Wt %
Materials recycled or composted	1,068	32.5
Collected residual household waste	1,534	46.7
Residual HWRC waste	245	7.5
Residual trade waste	259	7.9
Litter	31	1.0
Gully wastes	31	1.0
Bulky waste	66	2.0
Other waste streams	48	1.5
Total	3,283	100.0

Table 18 shows a list of the MSW streams included in the 'Other waste streams' category in Table 17 (which represents 1.5% of the overall MSW stream). The tonnages for each of these streams have been derived from WasteDataFlow information, and the overall composition of this stream has been determined using the assumed compositions for each waste stream shown in Table 18.

Table 18: Other waste streams

Stream	Categories	Wt %
Separately collected asbestos	100% non-combustible	<1
Fly tipped waste	Similar to bulky household waste	14
Grounds waste	Park & garden waste	13
Beach cleansing waste	Beach cleansing waste	1
Other collected household waste	Similar to residual household waste	48
Other collected non-household waste	Similar to trade waste	24
Total		100

The overall composition (based on the 24-category list) of the recycling/composting stream was determined using WasteDataFlow information on reported tonnages of material collected through source separation schemes. The WasteDataFlow information includes figures for co-mingled collections from some authorities; this was converted to tonnages of newspaper & magazines, etc, using the average composition data (see Table 6) for the kerbside collected dry recyclable stream.

¹⁸ There are minor differences between the overall figures for household residual waste and recycling/composting in Table 18 when compared to those published by SEPA. This is a result of minor differences in the way relatively rare components of the household waste stream are considered (e.g. the fraction that goes to mixed biological treatment). The focus of this study was to provide an overall estimate of the composition of the 8 main waste streams that make up MSW.

Table 19 presents the composition of each of the waste streams that comprise MSW, together with the overall composition of MSW.

Table 19: Composition (Wt%) of municipal solid waste in Scotland in 2009

	Material recycled or composted	Residual household collected waste	Residual HWRC waste	Collected trade waste	Litter	Gully waste	Bulky waste	Other MSW waste streams	Municipal solid waste
Weight ('000 tonnes)	1,068	1,534	245	259	31	31	48	66	3,282
Wt %	32.5	46.7	7.5	7.9	0.9	0.9	1.5	2.0	100.0
Category									
Newspapers & magazines	17.8	4.1	1.9	7.2	7.6	0.3	0.0	6.4	8.6
Other paper	6.8	6.8	3.7	18.8	7.3	0.1	0.0	14.3	7.5
Cardboard	3.6	5.0	4.0	13.8	8.2	1.3	0.1	10.9	5.2
Plastic film	0.0	4.5	2.2	7.7	5.9	0.1	0.0	6.1	3.0
Plastic bottles	1.5	3.3	0.9	3.9	7.7	1.8	0.0	3.6	2.5
Other plastic packaging	0.0	4.0	1.5	4.4	3.6	0.3	0.0	3.7	2.4
Other dense plastic	0.0	2.0	6.0	1.0	1.1	0.2	0.3	1.1	1.5
Textiles & footwear	1.5	4.3	6.4	1.3	1.9	0.0	0.1	1.3	3.1
Wood	4.4	1.2	9.8	0.2	0.6	0.0	0.0	0.2	2.8
Furniture	0.5	0.4	13.3	0.0	0.5	0.0	43.5	5.9	2.3
Disposable nappies	0.0	4.8	0.5	1.0	1.4	0.0	0.0	0.7	2.4
Other Combustibles	0.0	6.6	15.9	3.8	10.0	0.0	11.8	6.3	5.0
Packaging glass	12.9	4.8	1.7	3.9	8.1	0.4	0.0	5.3	7.0
Other glass	0.0	0.7	1.7	0.4	0.3	0.0	0.1	0.4	0.5
Rubble (C&D waste)	8.4	2.2	8.8	0.4	0.2	0.0	0.4	0.4	4.5
Other non-combustibles	0.0	1.0	3.1	0.5	0.6	0.6	0.4	1.0	0.8
Metal cans	1.5	2.4	0.5	2.7	3.6	0.6	0.0	2.4	1.9
Other metal	2.4	1.7	3.7	1.9	2.6	0.0	1.7	1.9	2.1
Food/kitchen waste	2.1	31.5	3.8	20.9	12.8	0.3	0.0	16.4	17.7
Garden waste	33.6	2.6	4.6	1.8	5.9	43.0	0.1	1.8	13.1
Other organics	0.0	1.1	0.4	2.3	5.1	0.8	0.0	2.1	0.8
HHW	0.1	0.9	1.0	0.1	0.1	0.0	0.1	0.1	0.5
WEEE	2.8	1.5	4.1	0.5	3.6	0.0	41.3	6.1	2.9
Fines	0.0	2.6	0.6	1.5	1.5	50.0	0.0	1.5	1.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Figure 9 shows the composition of MSW in Scotland. The two largest categories (in weight percentage terms) are food/kitchen waste (18%) and garden waste (13%). The total arisings of paper & card represent 21% by weight of MSW in Scotland.

Figure 9: Composition (Wt %) of municipal solid waste in Scotland

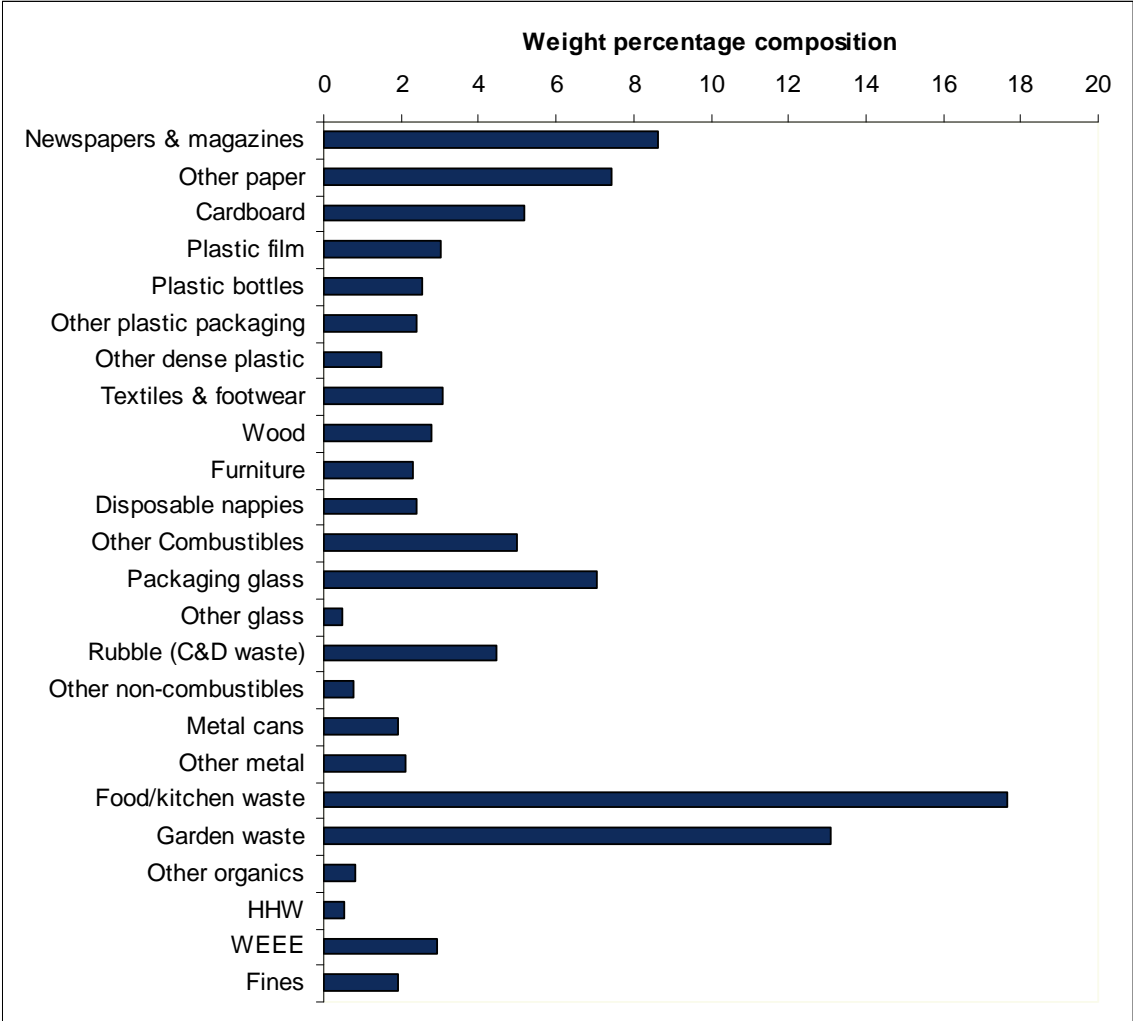


Table 20 compares the composition of MSW in Scotland with that determined in Wales in 2002/03 and the composition determined by the Defra review of compositional analyses (most of these were conducted in England). The MSW compositions are similar. The overall biodegradable content of municipal solid waste in Scotland from this study is 62.9% ($\pm 1.5\%$). Further details on the calculation of biodegradable content and associated confidence intervals can be found in Appendix F.

Table 20: Composition of municipal solid waste

	Scotland 2009	Wales 2003	Defra review March 2009
Paper & card	21.2	21.1	22
Plastic film	3.0	2.8	
Dense plastic	6.4	4.5	10
Textiles	3.1	2.2	3
Other combustibles	12.5	11.7	10
Glass	7.5	5.8	7
Other non-combustibles	5.3	8.0	5
Food/kitchen waste	17.7	15.7	18
Garden waste	13.1	12.7	14
Other organics	0.8	2.1	2
Metal	4.0	5.6	4
HHW	0.5	0.8	1
WEEE	2.9	2.0	2
Fines	1.9	5.0	2
Total	100.0	100.0	100

6.0 Opportunities for further recycling

Table 21 shows that 76% of the arisings¹⁹ of MSW in Scotland are materials classified as recyclable or compostable that could potentially be separated for recycling. MSW in Scotland also contains about 2% by weight of furniture. Some of this, and also some of the WEEE may be suitable for reuse. There may also be potential for additional recycling of carpet.

Table 21: Potentially recyclable or compostable material in MSW in Scotland (% of overall MSW)

Category	Weight %
Newspapers & magazines	9
Other paper	4
Cardboard boxes and containers	4
Dense plastic bottles	3
Other plastic packaging	2
Textiles and shoes	3
Wood	3
Packaging glass	7
C&D waste (rubble)	4
Metal	3
Food/kitchen waste	18
Garden waste	13
Other (WEEE items, oil, batteries)	3
Total	76

The 2009 draft Zero Waste Plan for Scotland sets a target to collect and either recycle or compost 70% of MSW by 2025. The findings from this study suggest approximately three quarters (76%) of MSW in Scotland is made up of potentially recyclable and compostable material. It is important to highlight that the 76% calculated from this study represents what is available for potential capture using recycling and composting collections. Actual capture rates (i.e. the amount of material collected as a proportion of the total available in the waste stream) will vary according to a wide range of technical and socio-economic factors beyond the scope of this work.

In order to highlight opportunities for further recycling and composting it is useful to consider the current availability and capture of recyclable/compostable materials in the different MSW streams. Table 22 provides a breakdown by material types commonly targeted for recycling and their occurrence in the overall MSW stream. Comparisons can be used to highlight any further opportunities for additional capture and recycling of materials. The key findings from Table 22 include:

- 67% of newspapers & magazines are currently collected for recycling and 22% are found in residual household collected (dustbin) waste;
- 23% of cardboard is collected separately for recycling and a further 45% is found in residual household collected waste;
- 20% of plastic bottles are currently recycled and 60% are found in residual household collected waste;
- 83% of food/kitchen waste is found in residual household collected waste and a further 9% is in collected trade waste;
- 83% of garden waste is currently collected for composting;
- 52% of wood is recycled or composted and 27% is found in residual household waste recycling centre (HWRC) waste; and
- 21% of cardboard arises in the collected trade waste stream.

Local authorities will need to target the residual household-collected waste stream, the residual HWRC stream and the trade-waste stream if they wish to further maximise the amount of material collected for recycling and composting in the future.

¹⁹ The percentages of both "other paper" and "other plastic packaging" listed in Table 21 are lower than those shown in Table 19. This is because a proportion of these materials is likely to be unsuitable for recycling so a correction has been applied to account for this.

Table 22: Distribution (Wt %) of recyclable and compostable materials between waste streams

	Material recycled or composted	Residual household collected waste	Residual HWRC waste	Collected trade waste	Litter	Gully waste	Bulky waste	Other MSW waste streams	Municipal solid waste
Newspapers & magazines	67	22	2	7	1	-	-	1	100
Other paper	30	43	4	20	1	-	-	3	100
Cardboard	23	45	6	21	2	-	-	3	100
Plastic film	-	69	6	20	2	-	-	3	100
Plastic bottles	20	60	3	12	3	1	-	2	100
Other plastic packaging	-	77	5	14	1	-	-	2	100
Other dense plastic	-	62	30	5	1	-	-	1	100
Textiles & footwear	15	65	15	3	1	-	-	1	100
Wood	52	21	27	1	-	-	-	-	100
Furniture	7	8	46	-	-	-	38	1	100
Disposable nappies	-	94	2	3	1	-	-	-	100
Other Combustibles	-	62	24	6	2	-	5	2	100
Packaging glass	6 0	32	2	4	1	-	-	1	100
Other glass	-	65	26	6	1	-	-	1	100
Rubble (C&D waste)	61	23	15	1	-	-	-	-	100
Other non-combustibles	-	61	29	5	1	1	1	2	100
Metal cans	26	57	2	11	2	-	-	2	100
Other metal	37	39	13	7	1	-	2	1	100
Food/kitchen waste	4	83	2	9	1	-	-	1	100
Garden waste	83	9	3	1	0	3	-	-	100
Other organics	-	64	3	22	6	1	-	4	100
HHW	8	75	14	1	0	-	-	-	100
WEEE	31	24	10	1	1	-	28	3	100
Fines	-	65	2	6	1	25	-	1	100

7.0 Further work

The study has enabled a considerable amount of data on the arisings and composition of MSW in Scotland to be obtained. Analyses in additional authorities could be conducted, or further sampling conducted in authorities in the sampling groups which represent a significant proportion of households in Scotland, particularly those operating alternate week collections for residual household waste. However, there is likely to be little impact on the findings presented on the current composition of overall MSW in Scotland because of the robust sampling framework employed in this study.

Increasing emphasis on waste minimisation initiatives, such as the household 'Love food, hate waste' campaign, might suggest a reduction in the arisings of potentially recyclable and compostable materials that the Scottish authorities would need to collect in order to meet future recycling targets. As it could be some years before the impacts of any waste minimisation campaign can be clearly identified, a further large-scale waste analysis programme could be conducted in about five years time to obtain updated information on the composition of MSW. This study could attempt to assess the impact of waste minimisation campaigns, determine whether changes in packaging have any impacts for meeting future recycling targets, and identify any further changes which will be required to meet longer-term recycling targets.

Appendix A - Collection systems in the participating authorities

Table A1: Collection systems for household waste and recycling in each area

	HWRC sites	Residual waste collection	Dry recycling collection	Compost collection
Highland	21 sites	240L w/b weekly	Blue box - paper, cans AWC with garden waste	Brown bin - garden only AWC with blue box
Orkney	5 sites	Provided with sacks weekly	Fortnightly same day as waste - glass paper and card	Sacks collected Mar to Oct
Edinburgh	4 sites	240L w/b weekly or sacks in shared bins	Red box - card and cartons Blue box cans and glass bag for paper, bag for textiles red box and blue box AWC	4 weekly in winter and fortnightly at all other times
East Dunbartonshire	1 site	240L w/b weekly	Blue box - paper/card, plastic bottles Black box - cans, aerosols and glass	March to October only
Renfrewshire	6 sites	240L w/b weekly	Fortnightly Blue and Green box textiles, cans, glass, paper and plastic bottles	Fortnightly March to November
Moray	5 sites	240L w/b fortnightly	Weekly blue and orange box collection: paper, card, glass, cans	w/b fortnightly
Glasgow	2 sites	240L w/b weekly or sacks in shared bins	Four weekly blue bin for paper, cans and plastic bottles	w/b fortnightly
South Ayrshire	4 sites	w/b Fortnightly	Monthly blue bin (mixed recycling), fortnightly box collection for glass	w/b Monthly

Appendix B - Detailed category classification

Table B1: Detailed category classification

Primary Category	Secondary Category
Paper	Newspaper, magazines
	Other Recyclable Paper
	Office quality paper
	Non-recyclable Paper
Card	Liquid Cartons and tetrapaks
	Board Packaging
	Thin Card Packaging
	Other Card
Plastic Film	Carrier Bags
	Bin Bags
	Packaging Plastic Film
	Other Plastic Film
Dense Plastic	1. PET drink bottles
	1. Other PET packaging
	2. HDPE drink bottles
	2. Other HDPE
	3. PVC
	5. PP
	6. PS
	6. EPS
	Other dense plastic packaging
	Other dense plastic
Textiles	Reusable Textiles
	Non-reusable Textiles
	Shoes, belts and bags
Glass	Brown Glass Bottles and jars
	Green Glass Bottles and jars
	Clear Glass Bottles and jars
	Other Glass
Miscellaneous Combustibles	Treated wood
	Untreated wood (excluding garden waste)
	Reconstituted wood e.g. MDF
	Soft furniture
	Wooden furniture
	Kitchen units and work tops
	Disposable Nappies
	Other absorbent hygiene products
	Pet excrement and bedding
	Mattresses
	Carpet and Underlay
	Other Miscellaneous Combustibles
	Miscellaneous Non-combustibles
Plaster board	
Other Miscellaneous Non-combustible	
Ferrous Metal	Ferrous food, beverage cans and aerosols
	Other ferrous metal
Non-Ferrous Metal	Non-ferrous food/beverage/cans/aerosols
	Foil
	Other non-ferrous metal
Organic Non-Catering (Garden)	Soft garden waste
	Woody and bulky garden waste
	Soil
Organic Catering (Kitchen)	Raw fruit and vegetable matter
	Raw meat and fish
	Cooked and prepared food
Liquids	Liquids
Fines (<10mm)	particles smaller than 10mm sq aperture
WEEE	list all
HHW	List all
	Total

Appendix C – Development of the methodology for sampling each waste stream

Household dustbin waste

Household waste is complex in its composition because of diverse factors such as geographical location, season, social and economic conditions and methods and frequency of collection. It is practically impossible, as well as physically undesirable; to separate, measure and analyse all the solid waste arisings generated in a local authority. However, the accuracy of waste data has been significantly improved over time with the use of socio-economic profiling tools such as ACORN.

The sample collected for analysis must be sufficient to:

- ensure that the sample is representative of the population (waste stream) as a whole; and
- ensure that a specified precision is achieved.

It should be noted that the amount of sample needed to produce a required precision, reflecting abundance and particle size distribution in the waste stream, for a commonly found material (e.g. paper or glass) would be significantly smaller than that required for a less commonly found material (e.g. batteries). Thus the requirements of the project must be understood from the outset.

Data derived from the National Household Waste Analysis Programme²⁰ showed that, for a sample of household waste with a paper concentration of about 40% by weight, it was necessary to collect a sample weighing about 500kg (that arising from about 50 households per week, assuming a waste generation rate of 10kg per household). This would achieve a relative error of +/- 10%.

The introduction of kerbside recycling schemes has significantly reduced the weight of paper in household residual waste to approximately 20%. In addition, today the average household throws away, recycles or composts approximately 16kg per week. As such, a minimum of 32 households will provide a sample of about 500 kg. This is considered a more than sufficient weight to determine the concentrations of common items e.g. newspaper and magazines, card packaging, plastic bottles, glass bottles and jars, cans, food and garden waste with a reduced relative error.

Residual Recycling Centre Waste

The two approaches for analysing waste at HWRC sites are either to analyse a representative sample of the total waste brought to the site (which will include any items that visitors planned to recycle), or to analyse a representative sample of the residual waste that visitors were planning to place in the 'landfill' container. The second approach was adopted for this study as the arisings of residual HWRC waste are reported by authorities through WasteDataFlow, and this information can then be used to determine the overall MSW composition.

The most suitable HWRC site in each of the eight authorities was identified through liaison with the relevant local authority officers. Although the main aim of the site selection process was to identify sites which would be used by the households which were sampled at the kerbside, the selection process also had to consider the operational procedures for sampling at each site. The analysis of waste brought to a HWRC is usually determined by selecting a number of visitors during a day, analysing each of the selected visitors waste, and then summing these analyses to produce an overall estimate of HWRC waste composition.

A variety of approaches can be taken to the sampling of waste at HWRC sites. On purely statistical grounds, the most effective method is stratified random sampling, in which the sampling is based on predetermined factors (this approach is used for opinion poll surveys). However, for this to be successful for sampling at a HWRC site, information is needed on expected visitor types and arrival patterns, and this will seldom be available beforehand at a sufficient level of detail. Stratified random sampling is also likely to impose appreciable operational difficulties

²⁰ National household waste analysis project – report on composition and weight data. Department of the Environment report CWM 082/94, August 1994.

- a drawback that applies equally to simple random sampling. In practice, therefore, three main options are available:

- 1 systematic sampling of visitors (also termed sampling every 'n-th' vehicle);
- 2 systematic sampling through time; and
- 3 sampling the next available vehicle after the present sample has been completed.

Option one is statistically the most attractive as it provides an unbiased estimate of mean weight per vehicle. Consequently, the protocol states that the best approach is to sample every nth visitor. However, there are operational difficulties with this approach as the limited space at most HWRC sites can make it difficult both to direct a number of visitors to an area where their waste will be unloaded, and to store the waste until it can be analysed. In addition, poor weather may significantly reduce the expected number of visitors, particularly on a week day.

Option two largely reduces these operational problems, but it will introduce a potential bias. Furthermore, clustering problems can still arise as some vehicles may take substantially longer to sample and analyse than the allowed inter-sample time. Thus Option 3 is practically the most attractive, as by definition it avoids any necessity for holding vehicles in a queue or temporarily storing waste. It also makes the most efficient use of sampling effort, as there are no gaps waiting for the next scheduled vehicle or sampling time.

Although option three is the most operationally attractive option, it is more prone to bias, as it reduces the percentage of visitors which are sampled during busy periods. Thus it was necessary to consider whether the practical approach of sampling the next visitor after an analysis has been completed enables a representative sample of waste brought to a HWRC site over a day to be obtained. A simulation model developed as part of the development of the sampling protocol for Wales showed that whilst there is a risk of a modest degree of bias in adopting a sampling strategy based on sampling the "next available visitor", it enables the number of samples taken during the day to be maximised and will thus have an additional benefit in the form of improved precision. This is an important benefit as it outweighs the risk of a possible modest degree of bias. Consequently a sampling procedure based on "next available visitor" was chosen for this study.

Commercial waste collected by local authorities

Commercial waste collected by local authorities ('trade waste') tends to arise from small premises, with the larger businesses tending to make use of the private sector. This waste stream represents up to 10% by weight of MSW in Scotland, and is becoming more important to local authorities because it counts as municipal waste under the Landfill Directive and therefore requires diversion away from landfill. Thus, there is clearly a need to collect information on this stream in order to both increase confidence in the overall composition of MSW in Scotland and to assess the opportunities for recovering recyclable or compostable materials from this stream.

Local authorities collect from a wide range of types of business. As one of the aims of the study was to obtain information on the wastes produced by different types of business, the businesses were grouped into nine principal business types:

- care services;
- food-related (e.g. restaurant, café);
- hairdressers and beauty salons;
- health care (doctor, dentist or vet);
- office-based;
- retail;
- manufacturing;
- clubs/leisure; and
- other businesses.

Following discussion with the Steering Group, 18 businesses in each authority were chosen by council officers for inclusion in the analysis - two for each business type. As analyses were being conducted in eight authorities in two seasons, this meant that 32 samples from each business type would be analysed during the study. Additional addresses for each business type were listed as fall-backs so that the total sample could be achieved for each authority.

Bulky household waste

Records of bulky household collections are held by local authorities. As these cover all collections which are made over a year, they provide a better means for determining the composition of this waste stream than sampling one or two collections during the analysis periods.

Local authorities may well make over 5,000 collections (which may contain just one item or a number of items) per year. Although analysis of about 250 records in each authority would have enabled the frequencies of the main types of items in bulky household waste to be identified at an acceptable level of precision, a more extensive analysis provides more information on the arisings of rarer items. Consequently, a minimum sample size of 500 records over a one-year period was chosen for the analysis.

Other waste streams

These were sampled using the protocol for Wales developed for the 2002/03 survey. For streams, such as schools waste, which were not in this protocol, the most appropriate methodology of those already presented was used.

Appendix D - Composition of MSW waste streams

Table D1: Composition (Wt %) of household collected waste

Primary Category	Secondary Category	Residual waste	Kerbside dry recyclables	Kerbside green waste
Paper	Newspaper, magazines	4.13	54.60	0.00
	Other Recyclable Paper	2.24	3.99	0.00
	Office quality paper	0.31	0.75	0.00
	Non-recyclable Paper	4.28	0.34	0.00
Card	Liquid Cartons and tetrapaks	0.59	0.31	0.00
	Board Packaging	1.22	4.19	0.00
	Thin Card Packaging	2.91	3.81	0.00
	Other Card	0.25	0.31	0.00
Plastic Film	Carrier Bags	1.33	0.10	0.00
	Bin Bags	0.83	0.02	0.01
	Packaging Plastic Film	1.93	0.13	0.01
	Other Plastic Film	0.39	0.02	0.00
Dense Plastic	1. PET drink bottles	1.22	1.05	0.00
	1. Other PET packaging	0.81	0.23	0.00
	2. HDPE drink bottles	0.67	0.70	0.00
	2. Other HDPE	0.49	0.24	0.00
	3. PVC	0.05	0.03	0.00
	5. PP	1.32	0.14	0.01
	6. PS	0.46	0.06	0.00
	6. EPS	0.24	0.02	0.00
	Other dense plastic packaging	1.98	0.16	0.00
	Other dense plastic	1.96	0.13	0.00
Textiles	Reusable Textiles	1.75	0.04	0.00
	Non-reusable Textiles	1.56	0.03	0.00
	Shoes, belts and bags	0.97	0.01	0.00
Glass	Brown Glass Bottles and jars	0.64	2.39	0.00
	Green Glass Bottles and jars	1.21	8.62	0.00
	Clear Glass Bottles and jars	2.98	12.75	0.00
	Other Glass	0.68	0.20	0.00
Miscellaneous Combustibles	Treated wood	0.86	0.02	0.00
	Untreated wood (excluding garden waste)	0.10	0.01	0.05
	Reconstituted wood e.g. MDF	0.29	0.09	0.00
	Soft furniture	0.00	0.00	0.00
	Wooden furniture	0.01	0.00	0.00
	Kitchen units and work tops	0.39	0.00	0.00
	Disposable Nappies	4.84	0.00	0.00
	Other absorbent hygiene products	0.65	0.01	0.00
	Pet excrement and bedding	3.30	0.00	0.41
	Mattresses	0.01	0.00	0.00
	Carpet and Underlay	0.85	0.00	0.00
	Other Miscellaneous Combustibles	1.79	0.04	0.03
Miscellaneous Non-combustibles	Construction and Demolition Waste	2.03	0.00	0.07
	Plaster board	0.20	0.00	0.00
	Other Miscellaneous Non-combustible	1.02	0.03	0.09
Ferrous Metal	Ferrous food, beverage cans and aerosols	1.72	2.65	0.00
	Other ferrous metal	1.17	0.02	0.00
Non-Ferrous Metal	Non-ferrous food/beverage/cans/aerosols	0.63	1.16	0.00
	Foil	0.43	0.03	0.00
	Other non-ferrous metal	0.15	0.00	0.00
Organic Non-Catering (Garden)	Soft garden waste	1.58	0.01	76.60
	Woody and bulky garden waste	0.23	0.00	11.30
	Soil	0.80	0.00	10.83
Organic Catering (Kitchen)	Raw fruit and vegetable matter	14.24	0.03	0.55
	Raw meat and fish	0.93	0.00	0.00
	Cooked and prepared food	16.29	0.12	0.00
Liquids	Liquids	1.11	0.18	0.00
Fines (<10mm)	particles smaller than 10mm sq aperture	2.64	0.02	0.00
WEEE	WEEE	1.50	0.19	0.00
HHW	HHW	0.86	0.02	0.00
	Total	100.00	100.00	100.00

Table D2: Composition of residual waste from HWRC sites

Primary Category	Secondary Category	
Paper	Newspapers & magazines	1.86
	Books	0.83
	Other recyclable paper	1.06
	Non-recyclable Paper	1.77
Card	Liquid Cartons and tetrapaks	0.17
	Board Packaging	2.92
	Thin Card Packaging	0.71
	Other Card	0.24
Plastic Film	Carrier Bags	0.43
	Bin Bags	0.71
	Packaging Plastic Film	0.53
	Other Plastic Film	0.56
Dense Plastic	PET bottles	0.29
	Other PET Packaging	0.13
	HDPE bottles	0.16
	Other HDPE	0.31
	PVC	0.01
	PP	0.44
	PS	0.17
	EPS	0.30
	Other dense plastic packaging	0.61
	Other dense plastic	5.96
Textiles	Reusable Textiles	2.76
	Non-reusable Textiles	1.81
	Shoes, belts and bags	1.78
Glass	Brown Glass Bottles	0.59
	Green Glass Bottles and jars	0.58
	Clear Glass Bottles and jars	0.54
	Other Glass	1.70
Miscellaneous Combustibles	Treated wood	2.92
	Untreated wood (excluding garden waste)	0.90
	Reconstituted wood	6.00
	Soft furniture	1.40
	Wooden furniture	8.14
	Kitchen units and work tops	3.79
	Disposable Nappies	0.51
	Other absorbent hygiene products	0.11
	Pet excrement and bedding	0.76
	Mattresses	4.07
	Carpet and Underlay	9.46
	Other Miscellaneous Combustibles	1.54
Miscellaneous Non-combustibles	Construction and Demolition Waste	6.19
	Plaster board	2.59
	Other Miscellaneous Non-combustible	3.07
Ferrous Metal	Ferrous Food and Beverage Cans	0.30
	Other Ferrous Metal	3.18
Non-Ferrous Metal	Non-ferrous Food and Beverage Cans	0.17
	Foil	0.09
	Other Non-Ferrous Metal	0.41
Organic Non-Catering (Garden)	Soft Garden Waste	1.58
	Bulky garden waste	0.53
	Soil	2.49
Organic Catering (Kitchen)	Raw fruit and vegetable matter	1.65
	Raw meat and fish	0.17
	Cooked and prepared food	1.95
Liquids	Liquids	0.38
Fines (<10mm)	Fines (<10mm)	0.60
WEEE	Large household appliances	1.38
	Small household appliances	0.91
	IT and telecommunications equipment	0.35
	Consumer equipment	0.42
	Lighting equipment	0.29
	Electrical and electronic tools	0.32
	Toys, leisure and sport equipment	0.27
	Monitoring and control instruments	0.13
Hazardous, Clinical and Batteries	Paint & paint related products	0.85
	Engine Oil	0.05
	Batteries	0.07
	Healthcare waste	0.00
	Pesticides and other chemicals for the garden	0.00
	Other	0.04
Total		100.00

Table D3: Composition (Wt %) of other MSW streams

Primary Category	Secondary Category	Litter	Primary Schools	Secondary Schools	Parks & Gardens
Paper	Newspaper, magazines	7.59	2.30	3.42	8.91
	Other Recyclable Paper	3.41	4.64	5.29	2.19
	Office quality paper	0.08	2.51	6.63	0.00
	Non-recyclable Paper	3.82	11.94	11.34	3.95
Card	Liquid Cartons and tetrapaks	0.98	3.38	1.27	1.46
	Board Packaging	1.74	5.12	5.20	0.92
	Thin Card Packaging	3.96	1.95	1.79	3.94
	Other Card	1.52	0.16	0.73	0.94
Plastic Film	Carrier Bags	1.67	0.37	0.53	1.37
	Bin Bags	2.07	2.64	3.48	2.18
	Packaging Plastic Film	1.85	2.16	2.39	0.51
	Other Plastic Film	0.35	0.62	1.50	0.26
Dense Plastic	1. PET drink bottles	5.83	1.97	3.74	5.56
	1. Other PET packaging	0.49	0.74	0.38	0.36
	2. HDPE drink bottles	0.42	0.33	0.41	0.31
	2. Other HDPE	0.24	0.38	0.33	0.02
	3. PVC	0.00	0.91	0.51	0.00
	5. PP	1.41	1.29	1.13	1.41
	6. PS	0.48	1.76	1.01	1.15
	6. EPS	0.72	0.25	0.74	0.17
	Other dense plastic packaging	1.62	1.78	1.17	0.89
Textiles	Other dense plastic	1.13	1.14	1.69	1.33
	Reusable Textiles	0.10	0.07	0.23	0.82
	Non-reusable Textiles	0.65	0.61	0.17	0.53
	Shoes, belts and bags	1.14	0.17	0.15	0.72
Glass	Brown Glass Bottles and jars	0.81	0.04	0.00	2.53
	Green Glass Bottles and jars	2.89	0.06	0.12	5.97
	Clear Glass Bottles and jars	4.39	0.70	0.58	10.25
	Other Glass	0.28	0.02	0.18	1.07
Miscellaneous Combustibles	Treated wood	0.28	0.19	0.43	0.07
	Untreated wood	0.18	0.10	0.76	0.00
	Reconstituted wood e.g. MDF	0.13	0.00	0.05	0.01
	Soft furniture	0.00	0.00	0.00	0.00
	Wooden furniture	0.00	0.00	0.00	0.00
	Kitchen units and work tops	0.52	0.00	0.00	0.00
	Disposable Nappies	1.36	0.01	0.00	0.00
	Other absorbent hygiene products	0.72	0.03	0.03	0.01
	Pet excrement and bedding	8.69	0.07	0.15	13.69
	Mattresses	0.00	0.00	0.00	0.00
	Carpet and Underlay	0.09	0.02	0.00	0.00
	Other Miscellaneous Combustibles	0.52	1.31	2.22	0.64
	Miscellaneous Non-combustibles	Construction and Demolition Waste	0.03	0.12	0.63
Plaster board		0.15	0.01	0.00	0.00
Other Miscellaneous Non-combustible		0.57	0.18	0.35	1.74
Ferrous Metal	Ferrous food, beverage cans and aerosols	1.21	0.79	1.70	0.99
	Other ferrous metal	0.56	0.42	0.49	1.98
Non-Ferrous Metal	Non-ferrous food/beverage/cans/aerosols	2.35	0.12	0.97	2.14
	Foil	0.38	0.32	0.38	0.01
	Other non-ferrous metal	1.63	0.07	0.10	0.00
Organic Non-Catering (Garden)	Soft garden waste	1.28	0.61	1.51	0.15
	Woody and bulky garden waste	0.47	0.34	2.51	0.07
	Soil	4.14	0.94	2.79	1.99
Organic Catering (Kitchen)	Raw fruit and vegetable matter	4.31	14.14	10.35	0.69
	Raw meat and fish	0.82	1.28	0.32	4.94
	Cooked and prepared food	7.69	16.71	10.17	5.21
Liquids	Liquids	5.07	7.87	4.75	2.70
Fines (<10mm)	particles smaller than 10mm sq aperture	1.49	3.21	1.82	2.69
WEEE	WEEE	3.65	1.03	0.96	0.52
HHW	HHW	0.08	0.09	0.47	0.03
Total		100.00	100.00	100.00	100.00

Appendix E – Weight of household waste in sample areas

Table E1: Monitored weight arisings (kg/household per week) in each sample area

		Spring					Autumn				Average			
LA	collections	ACORN	waste	dry recycling	compost	total	waste	dry recycling	compost	total	waste	dry recycling	compost	total
East Dunbartonshire	waste = weekly	1.C.9	9.34	4.35	4.42	18.11	6.74	4.36	6.19	17.29	8.04	4.36	5.31	17.70
	recycling = weekly	3.H.28	10.89	4.18	4.54	19.61	10.86	4.71	1.23	16.80	10.88	4.45	2.89	18.21
	compost = fortnightly	4.M.41	10.41	4.00	4.37	18.78	12.53	2.85	2.16	17.54	11.47	3.43	3.27	18.16
Edinburgh	waste = weekly	2.D.13	12.00	1.48	4.56	18.04	13.22	4.10	6.70	24.02	12.61	2.79	5.63	21.03
	recycling = AWC red/blue b	2.E.19	8.94	1.34	2.85	13.13	13.14	1.17	3.76	18.07	11.04	1.26	3.31	15.60
	compost = fortnightly	5.P.53	8.20	0.63		8.83	3.28	0.35		3.63	5.74	0.49		6.23
Glasgow	waste = weekly	2.E.17	10.32			10.32	6.76	2.56		9.32	8.54	1.28		9.82
	recycling = weekly	5.O.50	3.75			3.75	4.36			4.36	4.06			4.06
		5.P.54	8.50			8.50	13.44			13.44	10.97			10.97
Highlands	waste = weekly	1.B.8	14.01	1.10	5.92	21.03	11.25	2.10	9.13	22.48	12.63	1.60	7.53	21.76
	recycling = fortnightly	3.H.26	15.08	1.69	11.87	28.64	9.60	1.58	12.32	23.50	12.34	1.64	12.10	26.07
	compost = fortnightly	5.N.45	16.39	1.18	4.80	22.37	11.64	1.90	4.84	18.38	14.02	1.54	4.82	20.38
Moray	waste = AWC	1.A.3	7.66	2.88	4.85	15.39	5.91	1.88	4.41	12.20	6.79	2.38	4.63	13.79
	recycling = weekly	4.L.40	7.33	4.00	5.29	16.62	6.04	3.38	2.90	12.32	6.69	3.69	4.10	14.47
	compost = AWC	5.N.46	10.28	3.57	0.91	14.76	7.65	2.35	2.80	12.80	8.97	2.96	1.86	13.78
Orkney	waste = weekly	1.B.6	16.68			16.68	7.80			7.80	12.24			12.24
	recycling = fortnightly	3.I.34	6.38	1.81	0.41	8.60	6.52	1.49	0.95	8.96	6.45	1.65	0.68	8.78
	compost = four weekly	5.N.46	12.19	1.56	4.31	18.06	11.98	0.53	3.67	16.18	12.09	1.05	3.99	17.12
Renfrewshire	waste = weekly	1.C.10	14.65			14.65	10.62			10.62	12.64			12.64
	recycling = fortnightly	2.F.22	12.85			12.85	9.87		3.63	13.50	11.36		1.82	13.18
	compost = fortnightly	5.O.52	13.79			13.79	9.08		3.61	12.69	11.44		1.81	13.24
South Ayrshire	waste = fortnightly	1.A.2	10.00	4.44	5.14	19.58	10.40	5.66	5.34	21.40	10.20	5.05	5.24	20.49
	recycling = mixed 4 weekly	1.B.6	12.45	0.10	1.68	14.23	14.44	5.23	5.43	25.10	13.45	2.67	3.56	19.67
	recycling = glass fortnightly	4.M.43	9.47	3.64	2.61	15.72	9.83	4.13	8.51	22.47	9.65	3.89	5.56	19.10
	compost = 4 weekly	5.N.47	10.66	2.37	0.69	13.72	11.54	5.93	2.59	20.06	11.10	4.15	1.64	16.89

Appendix F – Determination of biodegradable content of MSW

The biodegradable content of MSW in Scotland from this study is calculated as 62.9%. This was calculated using data on the composition of the MSW stream and the assumed biodegradable content of each of the categories of MSW (see Table F1 below). The assumed biodegradable content (expressed as % of each material type) was taken from Scottish landfill allowance regulations (2005) and associated guidance produced in 2007. For a small number of the waste types listed in Table F1 the assumed biodegradable content is not specified in Scottish regulations and guidance. In this case we used the assumed biodegradable content from Environment Agency guidance. The five waste categories where this applies are marked with * in table F1 below. For those waste categories specified in the Scottish guidance the assumed biodegradable content (%) is the same as in the Environment Agency guidance.

Table F1: Biodegradable content of MSW in Scotland

	Composition (Wt %) of MSW in Scotland	Assumed biodegradable content (Wt %)	Biodegradable content (Wt %)
Newspapers & magazines	8.6	100	8.6
Other paper	7.5	100	7.5
Cardboard	5.2	100	5.2
Plastic film	3.0	0	0.0
Plastic bottles	2.5	0	0.0
Other plastic packaging	2.4	0	0.0
Other dense plastic	1.5	0	0.0
Textiles & footwear	3.1	50	1.5
Wood	2.8	100	2.8
Furniture	2.3	50	1.2
Disposable nappies*	2.4	50	1.2
Other Combustibles*	5.0	50	2.5
Packaging glass	7.0	0	0.0
Other glass	0.5	0	0.0
Rubble (C&D waste)	4.5	0	0.0
Other non-combustibles*	0.8	0	0.0
Metal cans	1.9	0	0.0
Other metal	2.1	0	0.0
Food/kitchen waste	17.7	100	17.7
Garden waste	13.1	100	13.1
Other organics	0.8	100	0.8
HHW*	0.5	0	0.0
WEEE	2.9	0	0.0
Fines*	1.9	50	1.0
Total	100.0		62.9

To calculate 95% confidence intervals for the estimate of biodegradable content in Table F1 the variability in composition of residual waste streams was used. The biodegradable content was then determined

using the assumed biodegradable contents for each category shown in Table F1. This showed that the 95% confidence interval for the biodegradable content of MSW in Scotland was ± 1.5 percentage points, which means that there is a 95% probability that the biodegradable content of MSW in Scotland is between 61.4% and 64.4%.

As composition data was taken from a non-random sample frame (e.g ACORN household categories) this variation only represents sampling error. It is recognised that the use of the highly stratified design in this study may have introduced additional non-sampling bias which cannot be accounted for. WasteDataFlow records were not used directly to calculate confidence intervals as the figures reported are absolute values.

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