Office of the
Deputy Prime Minister

Creating sustainable communities

Survey of Arisings and Use of Construction, Demolition and Excavation Waste as Aggregate in England in 2003

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October 2004

Capita Symonds Ltd in association with WRc plc

Office of the Deputy Prime Minister: London

The findings and recommendations in this report are those of the consultant authors and do not necessarily represent the views or proposed policies of the Office of the Deputy Prime Minister.

Office of the Deputy Prime Minister
Eland House
Bressenden Place
London SW1E 5DU
Telephone 020 7944 4400
Web site www.odpm.gov.uk

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CHAPTER 1
Executive Summary

Introduction and Background

1.1 Three related surveys were carried out during the first six months of 2004 to establish estimates for the arisings and use of construction and demolition waste (C&D waste) in 2003 in England, and in each of the regions covered by Regional Aggregate Working Parties. The work was commissioned by the Minerals and Waste Planning Division of the Office of the Deputy Prime Minister (ODPM). It was carried out by Capita Symonds Ltd, with the support of WRc plc on issues of statistical design and analysis.

1.2 Three very similar surveys were carried out by the same research team for the same client team two years previously. Two years before that an initial survey had been carried out for the Environment Agency. Both of the earlier surveys contributed to any success which may be attributed to the 2003 survey.

1.3 The three surveys covered operators of crushers and screens, licensed landfills and Paragraph 9&19 registered exempt sites. Between them, these surveys were designed to generate estimates for recycled aggregate and soil, C&D waste used and disposed of at licensed landfills, and C&D waste spread on registered exempt sites. The surveys made a clear distinction between 'hard' C&D waste and excavation waste in order to identify not just the current rate of aggregate recycling, but also the future potential rate.

1.4 The information generated will be used mainly for developing and monitoring planning policy for the provision of aggregates.

Summary of Main Findings

1.5 The estimate for production of recycled aggregate has risen from 36.47 million tonnes in 2001 to 39.60 million tonnes in 2003 (see Table 1 for the regional distribution of the 2003 estimates for recycled aggregate and soil, with the figures for recycled aggregate highlighted). Although the difference between the central estimates for 2001 and 2003 is not statistically significant, additional information provided by respondents points strongly towards the growth being real. Unlike 2001, little or none of the growth is attributed to a better 'detection rate' of mobile crushers, though the population of recycling crushers continues to grow. It is believed that the information relating to the population of crushers is now of very good quality.

Table 1 **Regional estimates for the production of recycled aggregate and soil in England in 2003 (million tonnes)**

Region	Recycled aggregate	Recycled soil	Total recycled aggregate and soil
North West	**4.52 ± 13%**	0.70 ± 19%	5.21 ± 12%
North East	**2.27 ± 13%**	0.33 ± 18%	2.61 ± 12%
Yorkshire & the Humber	**4.44 ± 14%**	0.64 ± 19%	5.08 ± 13%
West Midlands	**4.29 ± 13%**	0.65 ± 18%	4.94 ± 12%
East Midlands	**4.26 ± 14%**	0.62 ± 19%	4.88 ± 12%
East of England	**5.24 ± 17%**	0.72 ± 23%	5.96 ± 15%
London	**5.28 ± 18%**	0.86 ± 25%	6.15 ± 16%
South East	**4.82 ± 14%**	0.70 ± 19%	5.52 ± 12%
South West	**4.47 ± 17%**	0.62 ± 23%	5.09 ± 15%
England	**39.60 ± 13%**	5.85 ± 18%	45.45 ± 10%

1.6 The central estimate for total arisings of CDEW for 2003 is 90.37 million tonnes ± 10% at a confidence level of 90%. This is very close to the equivalent estimate for 2001, and the difference between the central estimates for the two years is not statistically significant.

1.7 As in both previous surveys, very little evidence was found of hard C&D waste which could be recycled into aggregate being landfilled as waste, and only very modest tonnages were identified being used within landfills in an unprocessed form (and then it was mainly for site engineering).

1.8 The greatest element of uncertainty again surrounded the true population of Paragraph 9&19 registered exempt sites, though there was less concern in 2003 about regional differences in the national database of such sites.

1.9 The overall results for arisings of CDEW are given in Table 2, broken down by region, and including the estimates for aggregate and soil recycling already reported in Table 1.

Table 2 **Regional estimates for use/disposal of CDEW in England in 2003 (million tonnes)**

Region	Recycled as agg'gate and soil	Used for landfill engin'ing or rest'n	Used to backfill quarry voids	Used at Para 9&19 sites	Disp'ed of as waste at landfills	Total CDEW
North West	5.21	0.92	1.00	2.89	1.09	11.11
North East	2.61	0.26	0.81	0.84	0.36	4.88
Yorkshire & the Humber	5.08	0.55	2.57	2.75	0.89	11.84
West Midlands	4.94	0.54	1.14	0.78	0.73	8.13
East Midlands	4.88	0.84	1.84	1.10	1.22	9.88
East of England	5.96	0.63	2.06	2.18	1.79	12.62
London	6.15	0.05	0.29	0.58	0.17	7.24
South East	5.52	1.99	2.74	2.91	2.07	15.23
South West	5.09	0.67	0.96	2.41	0.87	10.00
England	45.45	6.45	13.41	16.43	9.19	90.93
Bands (90% confidence)	± 10%	± 31%	± 26%	± 38%	± 19%	± 10%

Current and Future Surveys

1.10 The estimates given above all derive from the three surveys carried out during the first half of 2004. Following an intensive period of preparation (designed above all to understand, refine and improve the survey mailing lists), survey forms were sent in early March to:

- 851 owners and potential hirers of crushers and screens;
- the operators of 1,339 licensed landfills; and
- 413 operators of 569 Paragraph 9&19 registered exempt sites, including a structured sample chosen from a much larger population of operators of small sites.

1.11 By the time the survey process ended and analysis began in earnest (in July 2004) useful information had been received from:

- 360 owners and hirers of recycling crushers, representing 42% of the operators and 49% of the population of recycling crushers;
- the operators of 586 licensed landfills, representing 44% of all landfills and 50% of the landfills in the three most important categories; and
- 157 operators of registered exempt sites, representing 38% of the operators and 37% of the registered exempt sites.

1.12 These response rates were notably higher than the overall result achieved in 2001, and slightly higher than the response rates achieved for the selected target groups used for that survey. Some of this better response rate was probably due to the further simplification achieved in 2003 (achieved by reducing the number of questions, and by consolidating all background information onto the form itself, thus obviating the need for a covering letter). Some minor suggestions for further improvements to the way the questions are asked are put forward in Annex 12, for use in any future surveys.

1.13 The survey of crusher operators tested the concept that machines in urban and rural areas are used to a genuinely different level of intensity, which allowed a different (and better) way of analysing the returns to be used.

1.14 Before any future survey is run, it is highly likely that the regulatory and administrative arrangements applicable to Paragraph 9&19 registered exempt sites will be in place. It is to be hoped that the new (but as yet unknown) reporting arrangements to be applied to such sites will be able to capture the information covered by this survey, making future dedicated surveys of these unnecessary.

1.15 It is also possible that information on landfills might in future be drawn from site returns, rendering a specific CDEW survey unnecessary. In any event, there would be less need for regular surveys on landfills and registered exempt sites than surveys of recycling crushers.

CHAPTER 2
Background to the Study

Aim and Objectives

2.1 This study was commissioned in December 2003 by the Minerals and Waste Planning Division of the Office of the Deputy Prime Minister (ODPM). The aim set out in the invitation to tender was "… to identify and implement an improved method for the collection of reliable data on the arisings, use and potential use of construction and demolition waste as aggregate in England in 2003".

2.2 The data are intended to "… provide a basis for producing reliable estimates at the national and sub-national level that will serve the needs of ODPM, Regional Planning Bodies and Regional Aggregate Working Parties. Specifically, information is required on:

- the amount of construction and demolition waste arising, sub-divided between 'hard' materials and soils;
- the amount of each category crushed or screened for use as aggregate; and
- the scope for further use of construction and demolition waste as aggregate."

2.3 The study was not concerned with those fractions of construction and demolition waste (such as wood, metals and plastics) which are unsuited to processing into aggregate.

2.4 Among the stated objectives were the following:

- to review previous national surveys with regard to methodology and results, to learn appropriate lessons and identify improvements;
- to review and draw on related surveys carried out by industry (the Quarry Products Association (QPA), British Aggregates Association (BAA) and National Federation of Demolition Contractors (NFDC));
- to design and implement an appropriate survey method that takes account of the need for consistency with past surveys and the need to improve on the reliability of past results;
- to analyse the results, produce the required estimates, and comment on their reliability and comparability with previous estimates; and
- to identify any lessons for future surveys.

2.5 The Brief is included in full as Annex 1.

The Project Steering Group and Reporting Arrangements

2.6 The ODPM invited representatives of Central and Local Government and of industry to sit on a Steering Group. The Members of the Steering Group are listed in Annex 2.

2.7 The Steering Group met three times:

- on 5 February 2004, to be briefed about the overall approach, and to comment on the first draft of the survey forms;
- on 19 May 2004, to receive and review initial results; and
- on 3 August 2004, to receive and review the Draft Final Report.

2.8 Capita Symonds issued progress reports at approximately monthly intervals to the ODPM. Where appropriate these were circulated by the ODPM to Steering Group members.

Main Actions and Milestones

2.9 The main completed actions and project milestones were as follows:

- completion of survey of Local Authorities, to update information held on mobile crusher operators authorised by them (in early February 2004);
- updating of survey database of operators of crushers and screens, drawing on information from various sources, including Local Authorities (see above), the Environment Agency and major recycling companies (completed in late February 2002);
- assembly of survey database of licensed landfills and their operators, based on information from the Environment Agency's REGIS database (completed in late February 2002);
- assembly of survey database of Paragraph 9&19 registered exempt sites and their operators, based on information from the Environment Agency's REGIS database (completed in late February);
- approval of survey forms by ODPM (in late February);
- mailing of all survey forms (on 25 and 26 February and 1 March 2004);
- selection of operators for mailing of chase-up letter to non-respondents (on 22, 23 and 26 April 2004);
- preliminary analysis of survey returns and presentation of emerging results to Steering Group members (on 19 May 2004);

- cut-off for receipt of final survey returns to allow for analysis of findings (on 2 July 2004);
- submission of Draft Final Report to ODPM and Steering Group members (in late July 2004);
- presentation of main results to Steering Group members (on 3 August 2004);
- submission of Final Report to ODPM (in late August 2004, with a view to its approval during September).

Key Concepts and Terminology

2.10 All but one of the key concepts and terms used in this report are consistent with those that have been used in earlier reports on the same topic, and identical to those used in the report to the ODPM two years ago ('Survey of Arisings and Use of Construction and Demolition Waste in England and Wales in 2001', ISBN 1 85112 597 3). All of them are defined and/or fully explained in Annex 3. The only new key concept is that of the full-time crusher equivalent. The more important usages are as follows:

- 'C&D waste' means waste materials which arise from the construction or demolition of buildings and/or civil engineering infrastructure, including hard C&D waste and excavation waste, whether segregated or mixed;
- 'hard C&D waste' means either segregated or mixed unprocessed/uncrushed materials (particularly concrete, masonry, bricks, tiles, 'blacktop' etc: see Figure 2.1A);
- 'excavation waste' means naturally occurring soil, stone, rock and similar materials (whether clean or contaminated) which have been excavated as a result of site preparation activities (see Figure 2.1B);
- 'mixed hard C&D and excavation waste' (mixed CDEW) means a physical mixture of the two previous categories (see Figure 2.1C);
- 'crushing' is a mechanical process of breaking concrete, bricks, blocks, tiles and similar hard materials into a more regular aggregate or similar material with a specified distribution of particle sizes;
- 'screening' is a general term covering all systems (including hand picking) for sorting, separating and sizing mixed materials, but primarily refers to the use of powered screens or riddles which are not attached to a crusher;
- a 'full-time crusher equivalent' is a crusher which is under the control of a survey respondent for a full year (irrespective of how often the crusher is used during that period), or any equivalent combination of crushers and time (e.g. two crushers controlled for six months, or three crushers for four months each);
- 'registered exempt sites' are sites which are notified by the site operator as being exempt from waste management licensing (though not exempt from waste regulation) and where this exemption has been placed on the public register by

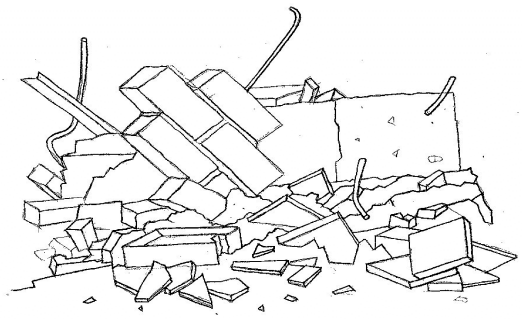
the Environment Agency. This project is concerned in particular with sites exempted under the terms of Paragraphs 9 and/or 19 of Schedule 3 to the Waste Management Licensing Regulations 1994 (SI No.1994/1056);

- 'Paragraph 9 sites' are registered exempt sites where exemption holders are permitted to spread up to 20,000 m^3/ha of soil, rock, ash, sludge, dredgings or C&D waste for land reclamation purposes or agricultural improvement;

- 'Paragraph 19 sites' are registered exempt sites where exemption holders are permitted to store or use C&D waste, excavation waste, ash, clinker, rock, wood or gypsum in connection with recreational or infrastructure projects, excluding land reclamation;

- 'recycling' involves an active processing of the material concerned (such as crushing or screening in the case of recycled aggregates), as opposed to its simple re-use.

Figure 2.1 **Different categories of C&D waste illustrated**

	Figure 2.1A: Hard C&D waste Either segregated or mixed unprocessed/uncrushed materials (particularly concrete, masonry, bricks, tiles, 'blacktop' etc).
	Figure 2.1B: Excavation waste Naturally occurring soil, stone, rock and similar materials (whether clean or contaminated) which have been excavated as a result of site preparation activities.
	Figure 2.1C: Mixed hard C&D and excavation waste (mixed CDEW) A physical mixture of the two categories above.

2.11 There is scope for, and evidence of, confusion over the use of the term 'exempt'. In this report, and as set out above, it refers primarily to sites registered by the Environment Agency as exempt from waste management licensing. Unless stated to the contrary, it does not refer to materials (and areas within landfill sites) which have been agreed with HM Customs & Excise to be exempt from Landfill Tax, or to materials which are exempt from the Aggregates Levy.

Method

2.12 A key assumption used for this project (which is only concerned with those materials which are managed as waste) is that, for both hard C&D and excavation waste, all arisings are recycled (by crushing or screening), or used at landfills, or spread on registered exempt sites, or disposed of to landfill. The linkages between hard C&D and excavation waste arisings and their uses or destinations are illustrated in Figure 2.2 (at the end of this Chapter). This Figure is identical to the equivalent one used two years ago in the previous report to ODPM.

2.13 This project therefore sought to measure total production (i.e. arisings) of CDEW by surveying those facilities which generate and/or use the three component parts, and eliminating any overlaps. The three groups of businesses surveyed were operators of crushers and screens, operators of licensed landfills, and operators of Paragraph 9&19 registered exempt sites. By its nature, this approach will have identified some materials which are beneficially re-used on the (exempt) sites where they first arose. It will not, however, have identified those clean materials which are simply (and legitimately) moved around on construction sites for which no exemption has been registered, and which are not, therefore, being managed as waste. No account is taken of fly tipping *per se*, though any fly tipped material which is cleared up and taken to landfill (or otherwise used) would be measured at that point.

2.14 The survey of operators of crushers and screens was designed to record all recycled aggregate, since materials are only crushed if they are going to be recycled, and can generally only become recycled aggregate if they are crushed or screened. The process of grossing up the survey results (to produce national and regional estimates) relies on the assumption that representative throughputs (expressed as tonnes of recycled aggregate per crusher per year) can be projected onto known populations of recycling crushers.

2.15 It should be acknowledged that this approach works less well for recycled soil, because recycled soil is mainly screened rather than crushed, and screening is not an activity for which an authorisation is required (making it very difficult to establish how many screens are in operation). The recycled soil which was recorded in this survey was material which was also recovered by aggregate recyclers, and is in effect 'bonus information' obtained from such operators. Only a few specialist soil recyclers (who have screens but no crusher, and who recover little or no aggregate) will have been picked up by the survey. The estimate of recycled soil is therefore likely to be an under-estimate.

2.16 The other two surveys (of operators of landfills and registered exempt sites) were designed to record the remaining materials. The survey of landfills was designed to distinguish between materials used for landfill engineering or restoration, materials used to backfill quarries, and any other materials disposed of as waste.

2.17 Although the surveys conducted for this study did not deal directly with demolition or non-exempt construction sites, most C&D waste generated at such sites would have been recorded via mobile crushers and fixed recycling sites, or at the point of final use or disposal. This is less true for excavation waste.

2.18 Although many aspects of the method are described in the Chapters that follow, Annex 4 draws together in one place the main ways in which the method used in 2004 differed from the method used two years before. Some specific elements of the method are set out in Annex 6.

Figure 2.2 **The specific component parts of hard C&D and excavation waste when recycled, re-used or disposed or at landfills**

Arisings	Uses/destinations		Specific component parts	See Note
Production of hard C&D and excavation waste	Recycled	Used as aggregate	Hard C&D/excavation waste crushed and/or screened for use as aggregate	● ✶ ◆
		Used as soil	Excavation waste/mixed CDEW screened for use as soil	✶ ◆
	Re-used	Used for engineering or restoration at licensed landfills (using clean and/or contaminated materials)	Hard C&D waste	●
			Excavation waste	✶
			Mixed CDEW (or unspecified material)	◆
		Used to backfill quarry voids (using mainly clean materials)	Hard C&D waste	●
			Excavation waste	✶
			Mixed CDEW (or unspecified material)	◆
		Spread on Para 9&19 registered exempt sites	Hard C&D waste (excluding road planings)	●
			Clean, unmixed excavation waste	✶
			Mixed CDEW	◆
	Disposed of at licensed landfills		Clean, unmixed hard C&D waste	●
			Mixed and/or contaminated hard C&D waste	●
			Clean excavation waste	✶
			Mixed and/or contaminated excavation waste	✶
			Mixed CDEW and unspecified materials	◆
Note:	Based on arisings as follows: ● = Hard C&D waste ✶ = Excavation waste ◆ = Mixed CDEW			

CHAPTER 3

Preparing the Survey Forms and Address Lists

Preparing the Survey Forms

3.1 One of the outputs of the previous (2001) survey was a set of suggested survey forms for future use. These were generally simpler than the versions used for that survey, and were pared down with a view to getting onto a single A4 sheet of paper both the necessary background information and a very limited number of simple questions which would still be capable of yielding the necessary key information.

3.2 Draft survey forms closely based on those suggestions were tabled and discussed at the first meeting of the project Steering Group. Some small amendments were agreed, and the forms were ready for mailing by late February.

3.3 After the forms were mailed, small amendments to the layout and wording were made in creating a version suitable for sending out by Email to those respondents who preferred to complete the forms electronically. Details of the forms are given in Annex 5.

Preparing the Survey Address Lists

PREPARING THE MAILING LIST OF OPERATORS OF CRUSHERS AND SCREENS

3.4 The starting point was the list of operators of mobile crushers and screens which had been assembled for the two previous surveys of construction and demolition waste carried out by Symonds Group in 1999 and 2001.

3.5 This list was updated by:

- removing the names and addresses of some companies known (mainly as a consequence of the previous survey) not to be involved in the recycling of CDEW;
- sending a letter on behalf of the ODPM to ask Local Authorities to comment on the accuracy of the amended list (by sending them a copy of the existing data for their area);
- amending or adding details to reflect information subsequently provided by Local Authorities;

- supplementing the resultant list with names and addresses drawn from the Environment Agency's register of Paragraph 13 and/or 24 exemptions; and

- supplementing this further with details drawn from the websites of leading aggregate companies where information specifically about recycling sites was included.

3.6 The response from Local Authorities was very good indeed: clear feedback was provided by all but 35 of the 354 Local Authorities in England, and 24 of those 35 had provided information in 2002 (for the 2001 survey). Furthermore, eight of the 11 which did not respond in either 2002 or 2004 had provided information in 2000 (for the 1999 survey). There are, therefore, only three Local Authorities in England from which no information at all has been received over a period of six years.

3.7 Although many of the 319 Local Authorities did identify some changes (in the identity or addresses of some of the operators that they authorise, and in the numbers of machines authorised), there is considerable consistency from year to year. Ninety eight of the 319 reported no crushers authorised in their area, and the other 221 reported authorising 701 crushers between them (some of which are not necessarily used for recycling).

3.8 The purpose of adding names and addresses from the register of Paragraph 13 and/or 24 exemption holders was to bring onto the list some of the companies that rent crushers from those persons and companies whose machines are authorised by Local Authorities, and who may therefore be better placed to provide information on the throughput of those same machines.

3.9 When the process was complete, all entries on the list were allocated to one of the following four categories:

- Group 1: operators who (on the basis of information to hand) were considered to be highly likely to be involved in recycling hard C&D waste into aggregate, and whose equipment was thought to be largely or wholly used for that purpose;

- Group 2: operators who were thought (on the basis of information to hand) to be involved in recycling hard C&D waste into aggregate, but whose equipment was believed to be either primarily used for processing other materials or more lightly used;

- Group 3: operators who were thought (on the basis of information to hand) to be involved in recycling hard C&D waste into aggregate using rented equipment; and

- Group 4: operators who were thought (on the basis of information to hand) not to be involved in recycling hard C&D waste into aggregate, but who it was felt to be worth surveying in order to confirm that diagnosis.

3.10 There was an underlying assumption that the mean throughput (expressed as tonnes per crusher per year) might well prove to be different for machines controlled by operators in each group. Any such stratification (into groups that are genuinely different) helps to improve the precision of the estimates that are derived from the data.

3.11 For each entry, the database recorded the number of crushers believed in advance of the survey to be owned by the operator concerned (and in many cases the number of stand-alone screens as well). Each mobile crusher authorised by a Local Authority can also be associated with a human population density, and this information was included in the mailing list to allow the existence of a link between population density (as a proxy for urban/suburban/rural character) to be tested.

3.12 The final structure of the mailing list is set out in Tables 3.1 and 3.2. Forms were mailed to all operators on 25 February, with responses requested by 9 April (i.e. by Easter weekend).

Table 3.1 **Structure of final mailing list of operators of crushers and screens: number of operators by operator Group and region**

Region	Group 1 Operators	Group 2 Operators	Group 3 Operators	Group 4 Operators	All Operators
North West	58	6	35	2	101
North East	18	7	14	2	41
Yorkshire & the Humber	53	3	46	2	104
West Midlands	46	6	21	0	73
East Midlands	46	8	51	0	105
East of England	77	10	51	0	138
London	46	4	15	0	65
South East	68	7	52	1	128
South West	56	7	32	1	96
England	468	58	317	8	851

3.13 The numbers of screens reported in Tables 3.1 and 3.2 are reported for information only. These numbers are not subsequently used in the calculation of estimates.

Table 3.2 **Structure of final mailing list of operators of crushers and screens: number of machines by operator Group and region**

Region	Crushers (and screens) thought to be owned by Operators, by Group				
	Group 1	Group 2	Group 3	Group 4	All Groups
North West	78 (68)	6 (6)	0 (5)	2 (0)	86 (79)
North East	27 (21)	22 (2)	0 (1)	0 (0)	49 (24)
Yorkshire & the Humber	67 (51)	22 (16)	0 (9)	0 (1)	89 (77)
West Midlands	71 (32)	15 (11)	0 (7)	0 (0)	86 (50)
East Midlands	59 (29)	25 (15)	0 (1)	0 (0)	84 (45)
East of England	94 (38)	12 (8)	0 (5)	0 (0)	106 (51)
London	92 (54)	4 (0)	0 (6)	0 (0)	96 (60)
South East	84 (26)	8 (0)	0 (3)	0 (0)	92 (29)
South West	68 (34)	29 (51)	0 (5)	0 (1)	97 (91)
England	640 (353)	143 (109)	0 (42)	2 (2)	785 (506)

3.14 By late April the overall response rate was about 33%, and 35% for Group 1 and 2 operators (i.e. those thought to own crushers, as opposed to hiring them in). Follow-up survey forms (342 in total) with a different introductory text but identical questions were sent out on 22 April to all non-respondents in Groups 1 and 2. Follow-up forms were not set to Group 3 and 4 operators because they are not thought to own crushers, and any information provided by them is a 'bonus' rather than essential. This resulted in a further surge of returns, as reported in Chapter 4.

PREPARING THE MAILING LIST OF OPERATORS OF LICENSED LANDFILLS

3.15 During 2003 the Environment Agency was involved in extensive updating of arrangements for licensing landfills, in response to the changes being brought about in response to the Landfill Directive. It was therefore decided to rely exclusively on the Agency's REGIS database in creating the survey mailing list (by contrast to 2001-02, when REGIS information had been combined with HM Customs & Excise's database, which is more immediately suited to the creation of a mailing list).

3.16 The full REGIS list as received in early January 2004 contained 2,995 entries. After removing sites that had clearly been closed, duplicate entries (associated with changes in ownership and/or conditions) and inapplicable entries (such as pet cemeteries), the list had 1,339 entries. These can be broken down in several different ways, and the summaries in Tables 3.3 and 3.4 highlight the most relevant characteristics for the purposes of this project.

3.17 The groups and descriptors used in REGIS (either directly, or deduced from the charge code information which is included) are as follows:

- A01: co-disposal sites;
- A02: other special waste sites;
- A03: boreholes;
- A04: household, commercial and industrial waste;
- A05: non-biodegradable waste sites (not construction);
- A06: other waste sites (including construction, demolition and dredgings);
- A07: industrial waste sites;
- A08: lagoons;
- Large: expected to receive more than 75,000 tonnes of any sort of waste per year;
- Medium: expected to receive between 25,000 and 75,000 tonnes of any sort of waste per year;
- Small: expected to receive between 5,000 and 25,000 tonnes of any sort of waste a year;

- Very small: expected to receive less than 5,000 tonnes of any sort of waste a year;
- Unknown size: no tonnage information available (only a few sites).

Table 3.3 **Structure of final mailing list of licensed landfill operators, by landfill type and size (number of landfills)**

Landfill Type	Large	Medium	Small	Very small	Not known	Total
A01: co-disposal	159	17	10	8	0	194
A02: special waste	26	11	8	2	1	48
A03: boreholes	2	0	2	1	0	5
A04: HCIW	107	41	47	15	1	211
A05: non-biodegradable	107	78	134	112	6	437
A06: other waste	74	43	96	68	2	283
A07: Industrial	21	19	66	10	0	116
A08: lagoons	14	3	17	11	0	45
Total	510	212	380	227	10	1,339

3.18 Based on knowledge gained from the 1999 and 2001 surveys, these landfills were then divided into six groups, as follows:

- Group A: 76 large (or size not known) landfills of Type A06;
- Group B: 43 medium landfills of Type A06;
- Group C: 164 small or very small landfills of Type A06;
- Group D: 113 large (or size not known) landfills of Type A05;
- Group E: 294 large (or size not known) landfills of Types A01, A02 or A04;
- Group F: 649 landfills not included in Groups A to E above.

3.19 These groups were defined on the basis of the tonnage of CDEW which they would typically be expected to receive in a year, with Groups A and D expected to receive the most per landfill. This process of stratification is central to obtaining the best achievable estimates and the narrowest feasible confidence limits.

3.20 Survey forms were sent to all operators of licensed landfills on 26 February.

Table 3.4 **Structure of final mailing list of operators of licensed landfills: by landfill Group and region (number of landfills)**

Region	Group A	Group B	Group C	Group D	Group E	Group F	All Groups
North West	6	4	15	4	34	61	124
North East	5	1	6	4	24	22	62
Yorkshire & the Humber	7	3	25	15	41	169	260
West Midlands	5	3	9	20	25	51	113
East Midlands	7	5	12	15	40	89	168
East of England	11	6	21	17	42	90	187
London	3	1	1	4	3	2	14
South East	23	8	19	29	52	69	200
South West	9	12	56	5	33	96	211
England	76	43	164	113	294	649	1,339

3.21 By mid-April the overall response rate from landfill operators was about 37%. It was about 45% for Group A and D operators, but only 25% for Group E operators, these being considered the three most important groups as far as CDEW is concerned. Follow-up survey forms (330 in total) with a different introductory text but identical questions were sent out on 23 April to all non-respondents in Groups A, D and E. This resulted in substantial further returns, which raised the response rate, as reported in Chapter 4.

PREPARING THE MAILING LIST OF OPERATORS OF REGISTERED EXEMPT SITES

3.22 In early January the Environment Agency provided a nationally consolidated list of sites on which exemptions to waste management licensing had been registered. This list contained:

- 1,264 Para 9(1) exemption holders/sites (England & Wales); and
- 7,271 Para 19(2) exemption holders/sites (England & Wales).

3.23 All but two of these exemptions had dates for when they were received and registered by the Agency. A few had dates for when they were deactivated or refused. Preliminary 'screening' procedures were carried out as follows:

- remove exemptions deactivated before 1 January 2003 and those that were refused;
- remove exemptions where both the received and registered dates were before 1 January 2002; and
- remove exemptions in Wales.

3.24 The purpose of these preliminary procedures was to reduce the list to those sites most likely to have been active during 2003. The result was to leave:

- 269 Paragraph 9(1) exemptions; and
- 1,769 Paragraph 19(2) exemptions.

3.25 After combining the two lists and removing obvious duplicates (e.g. where separate Paragraph 9(1) and 19(2) exemptions were held by the same operator for the same site) 1,989 holders/sites were left in the consolidated list.

3.26 All of these exemptions were then reviewed (taking into account the name of the applicant and the name/address of site where the exempt activity was proposed) to identify a sub-set of sites more likely to be large (e.g. quarries, waste operators, house builders, major civil engineering contractors, golf courses and other large leisure projects). The results of this process (and the equivalent figures from two years ago) are shown in Table 3.5.

Table 3.5 **Structure of final list of registered exempt sites, by site size and region (number of sites, 2001 data in brackets)**

Region	Sites that might be large	Sites that are probably small	All sites
North West	67 (91)	323 (135)	390 (226)
North East	21 (22)	64 (80)	85 (102)
Yorkshire & the Humber	71 (34)	153 (107)	224 (141)
West Midlands	17 (37)	109 (89)	126 (126)
East Midlands	27 (47)	88 (125)	115 (172)
East of England	58 (17)	83 (32)	141 (49)
London	16 (10)	8 (13)	24 (23)
South East	74 (51)	187 (167)	261 (218)
South West	41 (102)	582 (510)	623 (612)
England	392 (433)	1,597 (1,362)	1,989 (1,669)

3.27 As in 2001, the list is dominated by a few counties. Those with a total of 50 sites or more are as follows:

- Devon 280 sites (20 that might be large, plus 260 that are probably small);
- Cornwall 232 (6 plus 226);
- West Yorkshire 136 (41 plus 95);
- Cumbria 135 (22 plus 113);
- Kent 129 (36 plus 93);
- Cheshire 99 (16 plus 83);

- Essex 66 (27 plus 42);
- Greater Manchester 66 (22 plus 44);
- Lancashire 64 (6 plus 58);
- South Yorkshire 55 (20 plus 35);
- Somerset 53 (7 plus 46); and
- Shropshire 50 (1 plus 49).

3.28 As well as organising the list according to the type and location of site, operators of multiple sites were identified so that when survey returns were received it would be possible to tell whether the returns reported tallied with the number of sites which the operator was thought to operate.

3.29 The 392 sites that might be large were associated with 315 separate companies or individuals:

- 252 of them with a single potentially large site;
- 27 operators with multiple sites, all of which (totalling 84 sites) were deemed to be potentially large; and
- 36 with a mixture of both potentially large and small sites (totalling 56 potentially large and 79 probably small sites).

3.30 Survey forms were then sent (on 1 March) to all operators with one or more site that might be large, requesting information on all sites operated by them irrespective of size. Forms were also sent to a sample of 98 operators of small sites. This sample was randomly selected from operators with a single site that was thought to be small at the rate of 12 samples per region (except in the case of London, where there were only two qualifying operators, both of whom were selected).

3.31 By late April the overall response rate was about 32%, and follow-up survey forms (283 in total) with a different introductory text, but identical questions, were sent out on 26 April to all non-respondents. The impact of this is reported in Chapter 4.

CHAPTER 4
The Survey Results

The Survey of Crushing and Screening

AVAILABILITY OF PROCESSING FACILITIES

4.1 Because most mobile crushers are authorised by Local Authorities, it is relatively easy to match all crushers to a home location. (Incidentally, the extent to which crushers do actually work within their 'home' areas is explored in Annex 9.)

4.2 For all authorised mobile crushers the home location is taken to be the territory of the authorising Authority or (if this is not confirmed even though a crusher is thought to exist) the Local Authority whose territory includes the operator's mailing address. This in turn allows all crushers to be allocated to a human population density band.

4.3 When this is done for all crushers operated by a Group 1 or 2 operator, the outcome set out in Table 4.1 is obtained. The population density bands that are given there were selected to enable a range of urban/rural splits to be explored.

Table 4.1 **Distribution of crushers operated by Group 1 and 2 operators, by human population density band**

Human population density (persons per km²)	Land area (km²)	Crusher population	Land area (km²) per crusher	Equivalent radius per crusher (km), if evenly distributed
100 or fewer (very rural)	41,214	100	412	11.5
101-250 (rural)	51,824	162	320	10.1
251-1,000 (intermediate)	26,754	220	122	6.2
1,001-2,500 (urban fringe)	7,206	143	50	4.0
2,501 or more (urban)	3,429	158	22	2.6
All areas	130,427	783	166	7.3

4.4 The penultimate column shows the average area of land per crusher, and the final column shows the radius of a circle with the same area. In practice crushers will not be perfectly evenly distributed in rural areas, and some travel distances will exceed those indicated by a considerable margin.

4.5 Nevertheless, this suggests that, even in rural areas, most locations should be within reasonable travel distance of a crusher. Furthermore, even if the figures applicable to

areas with 100 or fewer persons per km^2 are used, and only crushers belonging to Group 1 operators are taken into account, the average area per crusher is 699 km^2, and the equivalent radius is 14.9 km.

4.6 A manual ('pencil and paper') comparison between the theoretical and actual situation, taking the South West region as an example, shows that in reality potential clients in several towns (e.g. Bude, Minehead, Tiverton, Lyme Regis and Shaftesbury) are at least 25 km from a crusher operator, and in some cases up to 40 km (as the crow flies).

4.7 Despite this, the first conclusion is that the overall availability of crushing and screening facilities appears adequate in most (if not absolutely all) areas of England.

4.8 The various population bands set out in Table 4.1 can be grouped into a range of different combinations to distinguish between urban and rural areas, in which the level of recycling activity would be expected to be different. The three combinations which were tested were as follows:

- 100 or fewer, 101 to 1,000, and 1,001 or more;
- 250 or fewer, 251 to 2,500, and 2,501 or more; and
- 1,000 or fewer, and 1,001 or more.

4.9 To be useful, each band needs to have a reasonable sized population of crushers, and there has to be evidence that there are real (non-random) differences between bands. The number of crushers per band is given in both Table 4.1 and Table 4.2. As can be seen, there are only 100 crushers in areas with 100 or fewer persons per km^2. The next smallest population is 158 in areas with 2,501 or more persons per km^2.

4.10 When the average throughput of recycled aggregate per crusher is compared (see Table 4.2), it becomes clear that 250 and 2,500 persons per km^2 are not sensible 'break points', but 1,000 persons per km^2 is. Whereas the average throughput of crushers in areas with fewer than 100 persons per km^2 (63,553 tonnes per year) is apparently different from those of the next two bands (45,880 and 44,008 tonnes per year respectively), there is no clear reason why this should be so, and the difference may well be due to random chance.

4.11 Furthermore, when regional estimates are generated (as described later in this Chapter), the calculation based on two bands (1,000 or fewer, and 1,001 or more) produces an estimate which is more closely correlated with regional population counts and Gross Value Added (the best available measure of economic activity) than the other two. It is therefore concluded that two bands provides the best urban/rural split.

4.12 The actual local authority areas in each English region with a population density of 1,001 or more are listed in Table 4.3 and mapped in Figure 4.1.

Table 4.2 **Distribution of crushers operated by Group 1 and 2 operators and their average throughput, by human population density band**

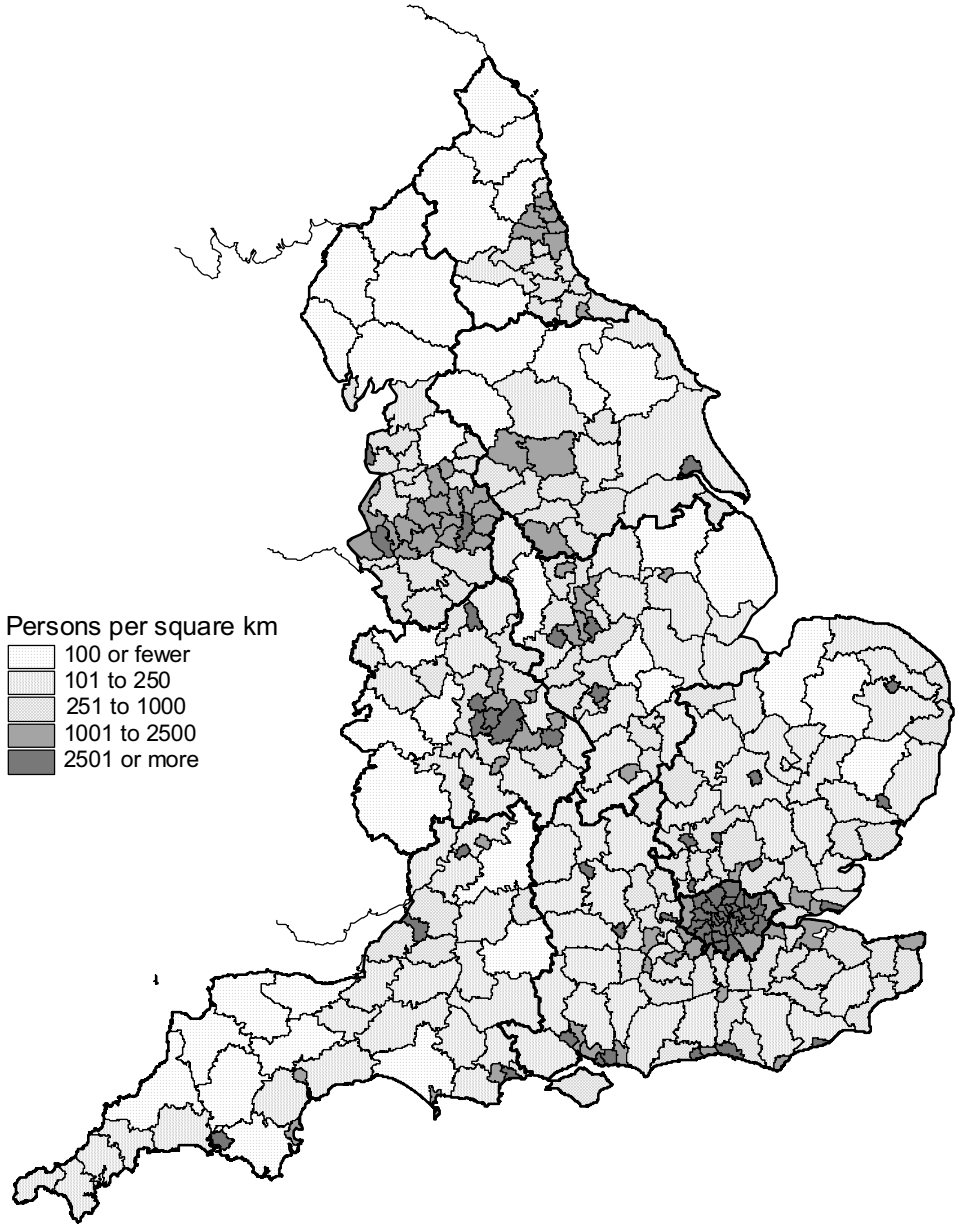
Human population density (persons per km²)	Crusher population	Average throughput (tonnes of recycled aggregate per crusher per year)
100 or fewer (very rural)	100	63,553
101-250 (rural)	162	45,880
251-1,000 (intermediate)	220	44,008
1,001-2,500 (urban fringe)	143	64,132
2,501 or more (urban)	158	55,216
All areas	783	52,876
(1,000 or fewer)	(478)	(49,318)
(1,001 or more)	(305)	(58,858)

Table 4.3 **132 Unitary and Local Authority Districts with a population density of 1,001 or more persons per km²**

Region	Unitary and Local Authority Districts
North West	All of Greater Manchester Metropolitan County (10 MBCs), all of Merseyside Metropolitan County (5 MBCs), Halton, Warrington, Blackburn with Darwen, Hyndburn, Blackpool
North East	All of Tyne & Wear (5 MBCs), Blyth Valley, Middlesbrough
Yorkshire & the Humber	Bradford, Leeds, Sheffield, Kingston-upon-Hull
West Midlands	All of West Midlands Metropolitan County (7 MBCs), Stoke-on-Trent, Cannock Chase, Tamworth, Nuneaton & Bedworth, Redditch, Worcester
East Midlands	Chesterfield, Derby, Erewash, Nottingham, Broxtowe, Ashfield, Mansfield, Lincoln, Leicester, Oadby & Wigston, Northampton
East of England	Norwich, Ipswich, Cambridge, Luton, Watford, Stevenage, Broxbourne, Harlow, Castle Point, Basildon, Southend-on-Sea
Greater London	All of Greater London (33 LBs)
South East	Thanet, Medway, Dartford, Crawley, Epsom & Ewell, Elmbridge, Woking, Spelthorne, Slough, Bracknell Forest, Rushmoor, Reading, Oxford, Southampton, Eastleigh, Fareham, Gosport, Portsmouth, Havant, Adur, Worthing, Brighton & Hove, Eastbourne, Hastings
South West	Cheltenham, Gloucester, Bristol, Exeter, Torbay, Plymouth, Weymouth & Portland, Poole, Bournemouth

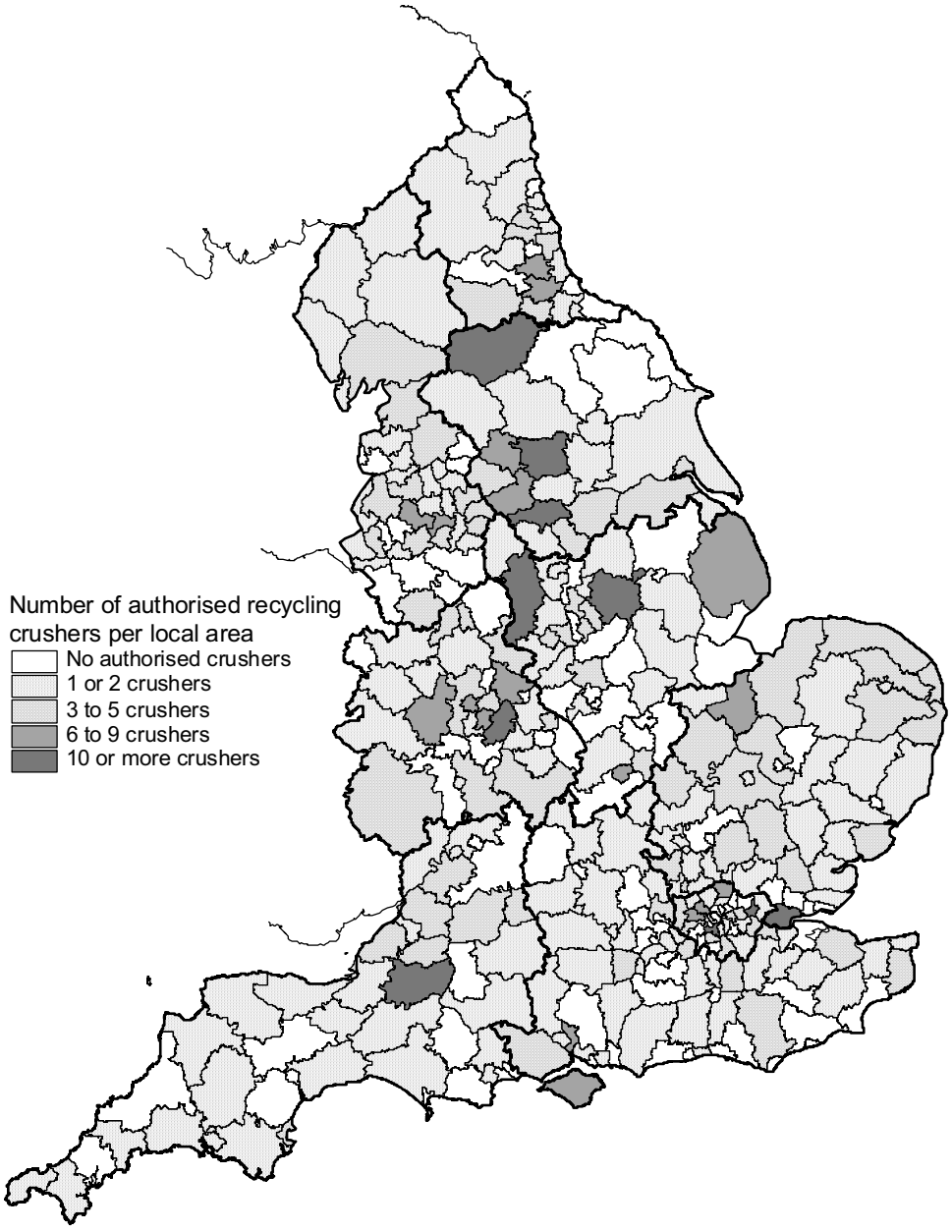
4.13 Figure 4.1 illustrates the human population density in all unitary and local authority districts in England, using the five (unequal) density bands set out in Table 4.2. Figure 4.2 shows how many mobile crushers operated by Group 1&2 operators were thought to be based in each district, and Figure 4.3 expresses the density of those same crushers in terms of square km per machine. The calculations on which Figure 4.3 is based only use the area of the 'host' local authority (i.e. they do not take account of the influence of neighbouring districts with no mobile crushers).

Figure 4.1 **Density of human population by unitary authority and local authority district area**



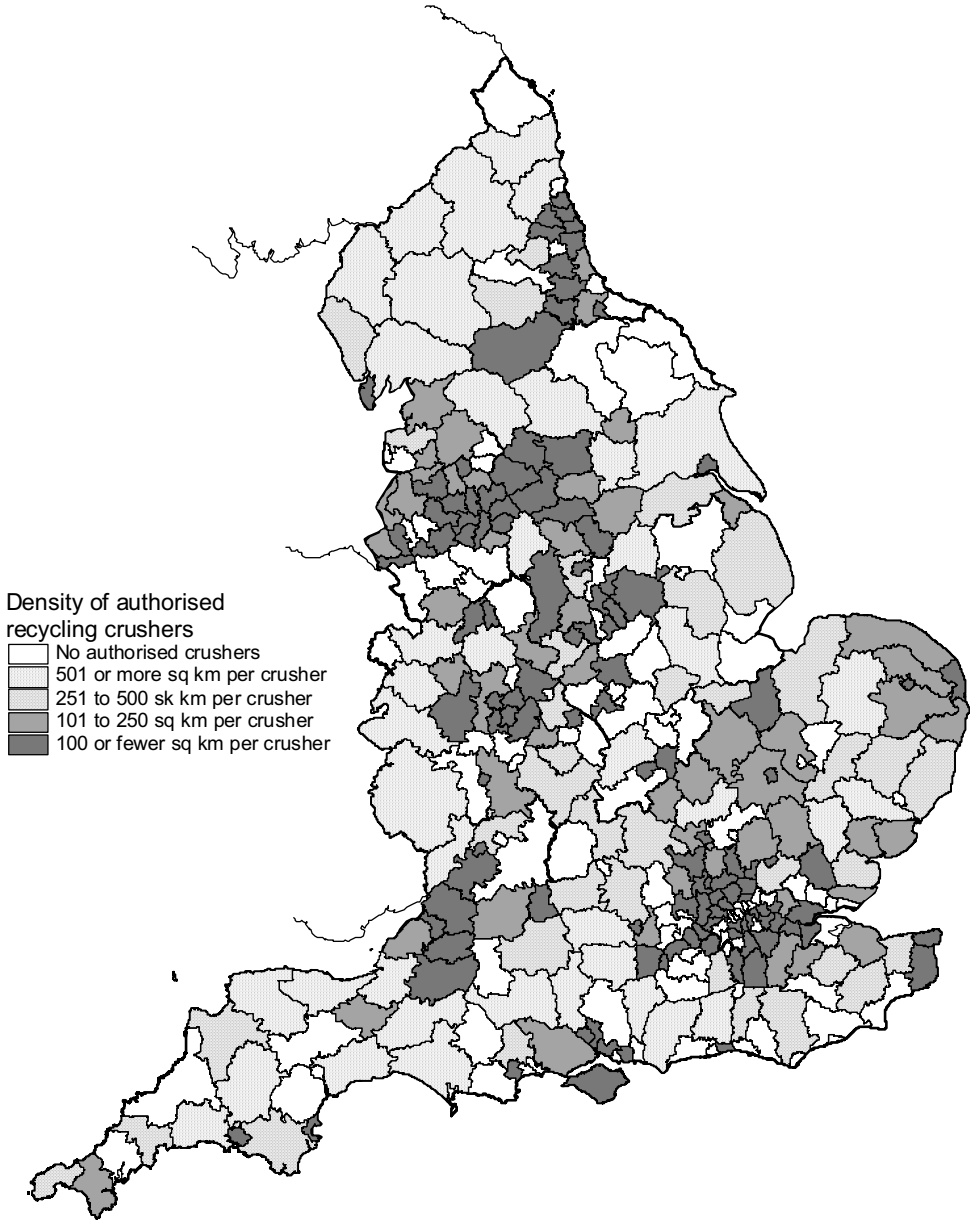
Data source: 2001 Census

Figure 4.2 **Distribution of mobile crushers operated by Group 1&2 operators by unitary authority and local authority district area**



Data source: Final mailing list of operators of crushers and screens

Figure 4.3 **Density of mobile crushers by unitary authority and local authority district area**



Data source: Final mailing list of operators of crushers and screens

SURVEY RESPONSE RATE

4.14 By Friday 2 July, 360 survey forms had been returned by operators of crushers and screens, one of which did not contain any information beyond the fact that the respondent was involved in recycling. That form was therefore returned to the pool of non-respondents for grossing up purposes. Two of the survey forms were 'bonus forms' comprising additional forms which one respondent with a fleet of machines had photocopied to provide information site-by-site rather than consolidated on a single form. The information from these 'bonus forms' is included in the counts below. In addition, nine forms were returned by the Post Office or current occupant of the mailing address as undeliverable.

4.15 One survey form was returned in mid-July after the analysis had been completed. It was from an operator in East of England with two crushers with a throughput slightly above the national average. It would have added less than 100,000 tonnes to the overall estimate had it been included, and it was agreed with the ODPM and the project Steering Group that re-running all calculations to include it would not be justified. The nine forms returned by the Post Office and the late reply are not included in the counts that follow.

4.16 Of the 359 completed forms, 51 operators (who had been thought to have a total of 27 crushers and 14 screens between them) reported that they were not involved in crushing or screening any sort of aggregate or soil material in 2003. This group was made up of:

- 18 from Group 1, thought in advance to have 23 crushers and nine screens;
- four from Group 2, thought in advance to have four crushers and two screens; and
- 29 from Group 3, though in advance to have no crushers and three screens.

4.17 A further 14 operators reported crushing primary aggregate and/or other materials in 2003, but not CDEW. These 14 comprised:

- two from Group 1, thought in advance to have four crushers and four screens between them;
- four from Group 2, thought in advance to have 18 crushers and 18 screens between them;
- eight from Group 3, not thought in advance to have any crushers or screens between them.

4.18 All of the remaining 294 operators reported that they were actively involved in recovering aggregate or soil from CDEW in 2003. Based on the mailing database and the information contained within it, these 294 operators had been thought in advance to own 338 crushers (and 194 stand-alone screens) between them. Their actual survey returns indicate that they own 368 crushers (and 394 stand-alone screens), and that their recycling activities used 397 crushers and 406 screens (excluding machines which were rented out to third parties, and including machines hired in from others). The most important point to draw from these figures is that the actual number of crushers owned (368) was within 10% of the advance estimate (of 338), lending reasonable

comfort to the assertion that the mailing list provides a good estimate of the real world, at least as far as crusher numbers are concerned.

4.19 Part of the reason for the discrepancy can be put down to the process of expansion, by which by the end of 2003 existing operators had more machines than when they were last authorised (up to a year earlier in some cases). This also lends support to the widely held belief that the industry is continuing to expand.

4.20 As set out above, there were 65 operators on the mailing list whose responses show that they were not involved in recycling CDEW in 2003. Most of these (quite reasonably) did not provide the information necessary to have included them in the calculations reported in paragraph 4.18. They are, however, included in the following analysis as 'nil returns'. The assumption underlying their inclusion is that an equal proportion of non-respondents were also not involved in recycling.

4.21 The geographical and 'Group' distribution of the survey returns (using the four Groups outlined in paragraph 3.9) was as shown in Table 4.4.

Table 4.4 **Responses received from operators of crushers and screens, by operator Group and region (numbers mailed in brackets)**

Region	Group 1 Operators	Group 2 Operators	Group 3 Operators	Group 4 Operators	All Operators
North West	27 (of 58)	2 (of 6)	7 (of 35)	0 (of 2)	36 (of 101)
North East	9 (of 18)	5 (of 7)	3 (of 14)	0 (of 2)	17 (of 41)
Yorkshire & the Humber	27 (of 53)	1 (of 3)	15 (of 46)	0 (of 2)	43 (of 104)
West Midlands	14 (of 46)	5 (of 6)	5 (of 21)	0 (of 0)	24 (of 73)
East Midlands	20 (of 46)	2 (of 8)	13 (of 51)	0 (of 0)	35 (of 105)
East of England	43 (of 77)	4 (of 10)	12 (of 51)	0 (of 0)	59 (of 138)
London	18 (of 46)	1 (of 4)	8 (of 15)	0 (of 0)	27 (of 65)
South East	33 (of 68)	4 (of 7)	25 (of 52)	0 (of 1)	62 (of 128)
South West	42 (of 56)	2 (of 7)	12 (of 32)	0 (of 1)	56 (of 96)
England	233 (of 468)	26 (of 58)	100 (of 317)	0 (of 8)	359 (of 851)

4.22 The response rates are broadly similar across all regions for Groups 1 and 3. There is much greater variation in Group 2, reflecting the smaller population numbers. (The most extreme results are 21% for Group 3 in the North East, 83% for Group 2 in the West Midlands.)

4.23 Arguably more important is the proportion of the expected crushers accounted for by the returns (in that a reply from an operator with three crushers yields more information than one from an operator who hires in a crusher for one month a year). As can be seen from the raw data in Table 4.5, the overall response rate (387 out of 783 = 49%) is higher than when it is measured by operators (359 out of 851 = 42%). None of the individual regional response rates for crushers owned by Group 1 operators, or for all crushers, is less than 35%.

Table 4.5 **Responses received from operators of crushers and screens, by expected numbers of crushers, operator Group and region (numbers expected in brackets)**

Region	Crushers owned by Group 1 Operators	Crushers owned by Group 2 Operators	Crushers owned by all Operators
North West	33 (of 78)	2 (of 6)	35 (of 84)
North East	14 (of 27)	18 (of 22)	32 (of 49)
Yorkshire & the Humber	36 (of 67)	18 (of 22)	54 (of 89)
West Midlands	25 (of 71)	14 (of 15)	39 (of 86)
East Midlands	25 (of 59)	8 (of 25)	33 (of 84)
East of England	52 (of 94)	5 (of 12)	57 (of 106)
London	33 (of 92)	1 (of 4)	34 (of 96)
South East	39 (of 84)	5 (of 8)	44 (of 92)
South West	51 (of 68)	8 (of 29)	59 (of 97)
England	308 (of 640)	79 (of 143)	387 (of 783)

4.24 Finally, the same machines can also be divided into the population density bands set out in Table 4.1. This omits the two crushers thought to be owned by Group 4 operators (see Table 3.2). Using this measure, the returns can be expressed as shown in Table 4.6.

Table 4.6 **Responses received from operators of crushers and screens, by expected numbers of crushers, operator Group and population density band (numbers expected in brackets)**

Human population density (persons per km^2)	Crushers owned by Group 1 Operators	Crushers owned by Group 2 Operators	Crushers owned by all Operators
100	29 (of 59)	30 (of 41)	59 (of 100)
101 to 250	63 (of 123)	16 (of 39)	79 (of 162)
251 to 1,000	103 (of 183)	21 (of 37)	124 (of 220)
1,001 to 2,500	52 (of 127)	9 (of 16)	61 (of 143)
> 2,500	61 (of 148)	3 (of 10)	64 (of 158)
All areas	308 (of 640)	79 (of 143)	387 (of 783)
(1,000 or fewer)	(195 of 365)	(67 of 117)	(262 of 482)
(1,001 or more)	(113 of 275)	(12 of 26)	(125 of 301)

4.25 Again, the response rates for each group are broadly comparable, with none being either unreasonably high or low. However, in general the response rates from more rural areas are higher than those from urban centres, with the response rate being 54% (262 out of 482) for areas with 1,000 or fewer persons per km^2, compared to 42% (125 out of 301) in areas with 1,001 or more persons per km^2.

4.26 In addition to the responses from Group 1 and 2 operators, there were 100 responses from Group 3 operators (63 of them reporting that they were involved in recycling in 2003). These operators were thought in advance to own no recycling crushers, but

actually they reported owning 19 crushers between them (an average of 0.19 machines per responding Group 3 operator, or 0.30 machines per responding recycling Group 3 operator). The same group reported operating the equivalent of 45 full-time crushers between them (i.e. including hired-in crusher as well as ones they owned themselves).

4.27 All of this section has been concerned with addressing the question of whether or not the response rates achieved from different groups and sub-groups of the overall population show any signs of being biased towards any group or region. To the extent that there is any bias in the returns, it appears that replies from rural crushers outweigh those from urban ones.

THE CONCEPT OF FULL-TIME EQUIVALENT CRUSHERS

4.28 As can be seen by reference to Annex 5, the survey form covering crushing and screening activity asked operators:

- how many crushers they owned and hired during 2003;
- how many tonnes of CDEW they recycled; and
- how many full-time crusher equivalents they used to generate that tonnage.

4.29 A crusher operated for three months of the year, or one week each month is treated as a quarter of a full-time crusher, and the average throughput per crusher based on full-time crusher equivalents is a much better representation of reality than a calculation based on ownership or pre-survey expectation.

4.30 By way of illustration, three separate operators, all of them thought in advance to own a single crusher, each reported recycling 100,000 tonnes. However, the survey form revealed that the ownership/operational status of the three was quite different, as follows:

- one operator did indeed own and operate a single crusher which was used solely by him (i.e. he had a throughput of 100,000 tonnes per expected crusher, 100,000 tonnes per owned crusher and 100,000 tonnes per full-time crusher equivalent);
- one operator owned one crusher and hired in a second for half of 2003 (i.e. he had 100,000 tonnes per expected crusher, 100,000 tonnes per owned crusher but 66,667 tonnes per full-time crusher equivalent);
- one operator had actually bought a second crusher on 1 January 2003 which he rented out to third parties for three months (i.e. he had 100,000 tonnes per expected crusher, 50,000 tonnes per owned crusher and 57,143 tonnes per full-time crusher equivalent).

4.31 The average throughput per full-time equivalent crusher is clearly useful information, provided that the true population of recycling crushers is known. To reach that population, adjustments have to be made to the population thought in advance to be correct. These adjustments have to do two things:

- to take account of changes in the total crusher population; and

- to remove from the total crusher population those crushers which were not actually involved in recycling.

4.32 The next section compares the effect of grossing up with and without this adjustment being attempted. It is important to bear in mind when comparing methods, that the method chosen must work well at a regional level as well as at the national level.

4.33 The number of full-time equivalent crushers reported by respondents, excluding those working outside England, was 383.

GROSSING UP TO PRODUCE A NATIONAL ESTIMATE

4.34 There are at least three different ways in which the survey results can be grossed up to produce a national estimate, and all three are explored in Annex 7. The approach which is described here uses the preferred method.

4.35 The preferred approach to grossing up:

- exploits the actual knowledge gained from the survey returns about annual tonnage throughputs per full-time crusher, and applies it to an adjusted population of crushers;

- amalgamates the crushers associated with the three groups of operators into a single adjusted population, taking into account the effect of the different 'nil' returns from each group, and the fact that some Group 3 operators owned crushers (and did not just hire them in, as expected prior to the survey);

- breaks the population of crushers into two sub-groups, based on the human population density of the 'home territory' of each crusher (using two density bands: 1,000 or fewer persons per km^2 and 1,001 or more persons per km^2 to define rural and urban crushers respectively); and

- ignores the 3.4% share of recycling attributed by respondents to English-based machines operating outside England.

4.36 As reported in paragraphs 4.16 and 4.17 above, nil returns were sent in by 20 Group 1 operators thought in advance to have had 27 crushers between them, and eight Group 2 operators thought in advance to have had 22 crushers between them. These returns provide the best available evidence for adjusting the population of crushers downwards to take account of non-recyclers who had been incorrectly included in the survey database. (A subsequent adjustment then needs to be done to take account of the fact that some Group 3 operators turned out to own crushers, contrary to prior expectation.)

4.37 In advance, the 233 specific operators from Group 1 who responded to the survey were thought to own 308 recycling crushers between them. The actual returns showed that the owners of 27 of these crushers (8.8%) were not in fact involved in recycling. For Group 2 operators, the equivalent figures are 79 recycling crushers expected, of which 22 (27.8%) were not involved in recycling. For Group 3 operators, as reported above, the true rate of recycling crusher ownership was 0.19 machines per responding operator.

4.38 The overall population of crushers has therefore been reduced by 8.8% (Group 1 crushers) and 27.8% (Group 2 crushers). An upward adjustment is then made to the entire population of Group 3 operators. The adjusted estimate of the overall population of recycling crushers (rounded to the nearest whole number) is therefore as follows:

- 584 recycling crushers owned by Group 1 operators (640 minus 8.8%);
- 103 recycling crushers owned by Group 2 operators (143 minus 27.8%); and
- 60 recycling crushers owned by Group 3 operators (0.19 for each of 317 operators).

4.39 This total adjusted population estimate of 747 recycling crushers is within 5.0% of the pre-survey estimate of 785 (or, more accurately, the 783 in the ownership of Group 1 and 2 operators).

4.40 The same adjustment process can be gone through for any sub-group of crushers (such as rural and urban populations). The equivalent calculation for survey respondents, which generates an estimate of 357, is as follows:

- 281 recycling crushers owned by Group 1 respondents (308 minus 8.8%);
- 57 recycling crushers owned by Group 2 respondents (79 minus 27.8%); and
- 19 recycling crushers owned by Group 3 respondents (0.19 for each of 100 operators).

4.41 The actual numbers of recycling crushers reported by respondents as being owned by them (368) was slightly lower than the number originally expected from those specific respondents (387), but 3.1% higher than the adjusted population estimate of recycling crushers applicable to those same operators (357).

4.42 The grossing-up procedure is illustrated in Table 4.7

Table 4.7 **National estimate of the production of recycled aggregate and soil in England in 2003**

	Rural areas (1,000 or fewer persons/km²)	Urban areas (1,001 or more persons/km²)	Total
Adjusted population of crushers	460	287	747
Number of crushers (i.e. reported full-time equivalents) providing data	240	143	383
Million tonnes of recycled aggregates reported by respondents (England only)	11.86	8.42	20.28
Mean tonnes of recycled aggregate per crusher	49,318	58,858	—
Million tonnes of recycled soil reported by respondents (England only)	1.59	1.40	2.99
Mean tonnes of recycled soil per crusher	6,622	9,765	—
Grossed-up production of recycled aggregate (million tonnes)	22.67	16.93	39.60
Band (90% confidence interval)			± 13%
(Graded:Ungraded ratio)	(65:35)	(72:28)	(68:32)
Grossed-up production of recycled soil (million tonnes)	3.05	2.81	5.85
Band (90% confidence interval))			± 18%
Total estimate of recycled aggregate and soil in England in 2003 (million tonnes)	25.73	19.72	45.45
Band (90% confidence interval)			± 10%

4.43 Although this method of grossing up requires a slightly clumsy adjustment to the overall population of crushers in order to work, it opens the door to much better regional estimates, which is one of the key objectives of the study.

4.44 The equivalent total estimates for 2001 were 36.47 million tonnes of recycled aggregate and 6.81 million tonnes of recycled soil (giving 43.28 million tonnes of recycled material in total).

4.45 Confirmatory evidence that the market for recycled aggregate and soil has grown is provided by the responses to Question 7 on the survey form, which asked respondents to indicate whether their recycling business has grown or shrunk between 2001 and 2003, and offered a range of percentages for them to choose from. Of the 293 active recycling operators who returned survey forms, 165 stated that their business had grown, 41 stated that it had shrunk, 66 stated that it had stayed static, and 21 either did not reply, or indicated that they could not answer (because, for example, they had not been recycling in 2001).

4.46 Applying the direction and magnitude of change reported by each operator to their own returns (taking the mid-point in each range as the best estimate of magnitude) suggests that the overall growth of all respondents' businesses taken together has been just over 20%. (By way of illustration, if a respondent reported recycling 14,000 tonnes in 2003 and a growth of 40% in his business since 2001, that would be consistent with 10,000 tonnes of recycling in 2001.)

4.47 While the details of this calculation (which imply a level of around 43.8 million tonnes of aggregate and 8.2 million tonnes of soil in 2003) should not be regarded as more than indicative, it is certainly consistent with an appreciable rise in recycling between 2001 and 2003. This issue is discussed further in Annex 9.

GROSSING UP TO PRODUCE REGIONAL ESTIMATES

4.48 There are at least four ways of grossing up at a regional level, and these are explored in Annex 7. The preferred method uses the 'population density band' method which was also used to generate the national estimate (see above).

4.49 The way in which the 'population density band' method is used to generate regional estimates is a four-step process, as follows:

- characterise each region according to the percentages of its population of recycling crushers that have their 'home base' in rural and urban districts (using human population density as a proxy for rural/urban character);
- multiply the percentage in each population density band by the national average throughput per crusher for that same density band;
- add the component parts together to get the regional average throughput per crusher;
- apply that average to the regional crusher population.

4.50 The way in which this approach works in practice can be seen by working through the various steps using the North West as a working example. This produces the following results:

- 40.5% of the recycling crushers in the North West are based in rural areas (i.e. those areas with 1,000 or fewer persons per km^2), with 59.5% in more urban areas (i.e. those areas with 1,001 or more persons per km^2);
- the national average throughputs per recycling crusher are 49,318 tonnes of recycled aggregate and 6,622 tonnes of soil in rural areas, and 58,858 tonnes of recycled aggregate and 9,765 tonnes of soil in urban areas (as reported in Table 4.7);
- the 'weighted average' annual throughputs per recycling crusher in the North West are therefore 54,991 tonnes of recycled aggregate and 8,491 tonnes of soil;
- when applied to the adjusted crusher population of 82.12, this produces estimates of 4.52 million tonnes of recycled aggregate and 0.70 million tonnes of recycled soil in the North West.

4.51 The equivalent results for all nine regions of England are presented in Table 4.8. This is the regional breakdown of the national estimate in Table 4.7. Table 4.8 also reports the bands at a confidence interval of 90% for each element of the estimates.

Table 4.8 **Regional estimate No.2 for the production of recycled aggregate and soil in the English regions in 2003 (million tonnes, with bands at 90% confidence intervals)**

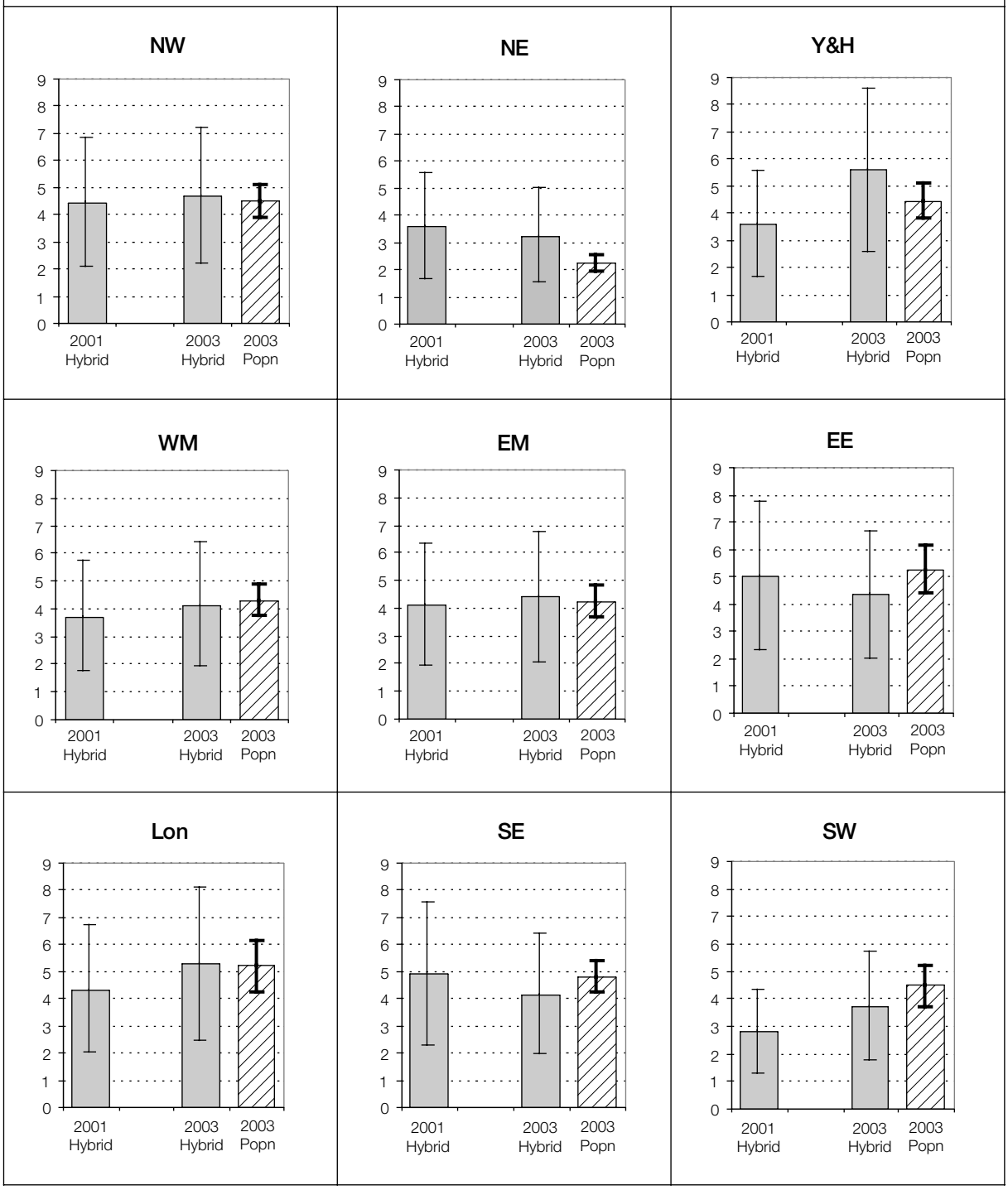
Region	Recycled aggregate	Recycled soil	Total recycled aggregate and soil
North West	4.52 ± 13%	0.70 ± 19%	5.21 ± 12%
North East	2.27 ± 13%	0.33 ± 18%	2.61 ± 12%
Yorkshire & the Humber	4.44 ± 14%	0.64 ± 19%	5.08 ± 13%
West Midlands	4.29 ± 13%	0.65 ± 18%	4.94 ± 12%
East Midlands	4.26 ± 14%	0.62 ± 19%	4.88 ± 12%
East of England	5.24 ± 17%	0.72 ± 23%	5.96 ± 15%
London	5.28 ± 18%	0.86 ± 25%	6.15 ± 16%
South East	4.82 ± 14%	0.70 ± 19%	5.52 ± 12%
South West	4.47 ± 17%	0.62 ± 23%	5.09 ± 15%
England	39.60 ± 13%	5.85 ± 18%	45.45 ± 10%

4.52 Because the method of grossing up has changed between 2001 and 2003 (from the 'hybrid' method to the 'population density band' method: see Annex 7 for further explanations), a direct comparison between estimates derived from the two surveys is not straightforward. It is possible to make direct comparisons between the 'hybrid' method estimates from both surveys (the 2001 estimates are detailed in the previous report, and the 2003 estimates are reported in Annex 7), and this is done in Figure 4.4. However, no conclusions based on these comparisons (i.e. that the 2003 estimate is higher or lower than its 2001 counterpart) should then be projected onto the 'population density band' estimates, which are the preferred regional estimates for 2003, and which use the method which is recommended for future surveys. The two methods use very different approaches, but the 'population density band' method is thought to be more credible.

4.53 As can be seen from Figure 4.4, in all nine regions the 2003 'population density band' estimates (including the upper and lower bands around the central estimate) lie comfortably within the 2003 'hybrid' method confidence intervals. Only in the case of the South West region does the 2003 'population density band' estimate (including the upper and lower bands around the central estimate) lie partly outside the 2001 'hybrid' method confidence interval. The South West includes the local authority (Mendip) with the highest number of authorised mobile crushers in the country (36), many of which are in national fleets which work in both recycling and in quarries. In the absence of returns from some such fleet operators, this has an effect on the regional estimate.

Figure 4.4 **Changes in regional estimates of recycled aggregate production, 2001 to 2003**

The nine charts below show three estimates measured in millions of tonnes, with their accompanying upper and lower bands (at a confidence interval of 90%). The two methods used to generate the estimates were the 'hybrid' method and the (preferred) 'population density band' method. Both methods are described in Annex 7.



The Survey of Licensed Landfills

SURVEY RESPONSE RATE

4.54 By 27 July, 605 survey forms had been returned by operators of licensed landfills, with nine returned by the Post Office or current occupant of the mailing address as undeliverable. It should be noted that this does not mean that the landfill does not exist: it could simply be that the mailing address used was inaccessible (in the case of a site office), or no longer operates (in the case of an office located away from the site). For the purposes of analysis, therefore, undelivered forms are returned to the pool of non-respondents.

4.55 Five of the forms which were returned reported that the site concerned was a waste transfer station rather than a landfill.

4.56 The characteristics of the facilities covered by the 605 completed forms are set out in Table 4.9. The groups into which the landfills are organised are the ones which were set out in paragraph 3.17, as follows:

- Group A: large (or size not known) landfills of Type A06 (sites which take wastes including construction, demolition and dredging waste);
- Group B: medium landfills of Type A06 (see above);
- Group C: small or very small landfills of Type A06 (see above);
- Group D: large (or size not known) landfills of Type A05 (sites which take non-biodegradable waste, but not including construction waste);
- Group E: large (or size not known) landfills of Types A01, A02 or A04 (co-disposal sites; other special waste sites; and household, commercial and industrial waste sites);
- Group F: all other landfills not included in Groups A to E.

4.57 The overall response rates (i.e. all replies which provide some information as a percentage of all mailings) range from 35% (in Group C) to 63% (in Group A). The three groups expected from the outset to account for the largest tonnages of CDEW were A, D and E. The geographical spread of responses, concentrating on these three groups, is reported in Table 4.10.

4.58 Although two individual combinations of landfill group and region (Group D landfills in the South West and Group E landfills in London) did not generate any responses at all, in general the spread of responses was quite even.

4.59 The average tonnages of CDEW per landfill (including nil returns within the calculations) are as follows for each group of reporting landfills:

- 56,906 tonnes for Group A landfills;
- 12,876 tonnes for Group B landfills;

- 3,946 tonnes for Group C landfills;
- 54,269 tonnes for Group D landfills;
- 45,279 tonnes for Group E landfills; and
- 6,295 tonnes for Group F landfills.

Table 4.9 **Responses from operators of licensed landfills, by landfill Group (numbers of landfills)**

	Group A	Group B	Group C	Group D	Group E	Group F	All Groups
Landfills on mailing list	76	43	164	113	294	649	1,339
Form returned by PO as undeliverable	1	0	0	1	2	5	9
Replied with information	48	16	58	64	145	274	605
Replied, but waste transfer stations, not landfills	0	0	0	1	0	4	5
Landfills closed	5	4	28	17	19	105	178
Landfills inactive in 2003	12	3	10	10	15	51	101
Landfills open in 2003	31	9	20	36	111	114	321
Landfills open, and took some CDEW	26	7	19	34	106	78	270
Landfills open, but no CDEW or aggregate	5	2	1	2	4	31	45
Landfills open: no CDEW but some aggregate	0	0	0	0	1	5	6

Table 4.10 **Responses received from operators of licensed landfills, by landfill Group and region (numbers mailed in brackets)**

Region	Group A landfills	Group D landfills	Group E landfills	Other landfills	All landfills
North West	4 (of 6)	2 (of 4)	14 (of 34)	34 (of 80)	54 (of 124)
North East	2 (of 5)	3 (of 4)	18 (of 24)	9 (of 29)	34 (of 62)
Yorkshire & the Humber	5 (of 7)	7 (of 15)	23 (of 41)	70 (of 197)	105 (of 260)
West Midlands	4 (of 5)	14 (of 20)	15 (of 25)	16 (of 63)	49 (of 113)
East Midlands	5 (of 7)	10 (of 15)	11 (of 40)	56 (of 106)	82 (of 168)
East of England	6 (of 11)	8 (of 17)	15 (of 42)	50 (of 117)	79 (of 187)
London	3 (of 3)	2 (of 4)	0 (of 3)	2 (of 4)	7 (of 14)
South East	14 (of 23)	18 (of 29)	29 (of 52)	46 (of 96)	107 (of 200)
South West	5 (of 9)	0 (of 5)	20 (of 33)	63 (of 164)	88 (of 211)
England	48 (of 76)	64 (of 113)	145 (of 294)	348 (of 856)	605 (of 1,339)

GROSSING UP TO PRODUCE A NATIONAL ESTIMATE

4.60 Landfills, unlike crushers, are static, obvious and regulated by a single authority. This makes the process for grossing up much more straightforward: simply increase the tonnages reported in direct proportion to the response rate obtained. The outcome of this procedure for major categories of waste and the main uses/destinations is reported in Table 4.11.

Table 4.11 **National estimate of the amount of CDEW entering landfills in England in 2003 ('000 tonnes, except where stated)**

	Group A	Group B	Group C	Group D	Group E	Group F	All Groups
Landfills on mailing list (no)	76	43	164	113	294	649	1,339
Landfills providing data (no)	48	16	58	64	145	274	605
Grossed up hard C&D waste	93	197	0	874	1,527	173	2,864
Grossed up excavation waste	3,582	41	158	3,865	9,520	2,528	19,694
Grossed up mixed CDEW	650	316	488	1,393	2,265	1,385	6,498
Grossed up used (eng/rest)	113	0	148	24	5,248	920	6,454
Grossed up quarry backfill	3,370	309	220	4,951(1)	2,771(1)	1,789(1)	13,410(2)
Grossed up disposed as waste	841	245	280	1,157(2)	5,293(2)	1,376(2)	9,192(2)
Grossed up total	4,325	554	647	6,132(2)	13,312(2)	4,085(2)	29,055(2)
	± 24%	± 59%	± 49%	± 22%	± 23%	± 23%	± 15%

Note (1): This is what respondents actually reported. In reality, it might be more accurate to classify some of this material as waste deposited in a landfill which may previously have been a quarry.

Note (2): See Note 1. If this material was reclassified, these totals would change.

4.61 The estimated total for England in 2001 was 23.2 million tonnes. This was made up in two different ways, as follows:

- 2.0 million tonnes of hard C&D waste, 19.0 million tonnes of excavation waste and 4.2 million tonnes of mixed (or unspecified) CDEW; and
- 8.7 million tonnes used for landfill engineering or restoration, 10.6 million tonnes used to backfill quarry voids and 3.9 million tonnes disposed of at landfills.

4.62 Whereas the totals in the first bullet point are relatively close to the estimates for 2003, the breakdown by use given in the second bullet point differs appreciably from the estimates for 2003.

4.63 The survey form sent to operators of licensed landfills also asked about various types of non-recycled aggregate used in landfills or disposed of as waste. The estimated total (grossed up) is 3.1 million tonnes (± 39% at a confidence interval of 90%), which is slightly more than 10% of the level of CDEW entering landfills. Like CDEW, this total can also be broken down in two ways: by type of material and by the use to which it is put. The categories coincide with those used in Question 3 on the survey form.

4.64 Broken down by type of material, the 3.1 million tonnes comprises:

- 0.44 million tonnes of purchased primary aggregate (mostly bought by Group E landfills);
- 0.77 million tonnes of primary aggregate dug on site (mostly in Group A and D landfills);
- 0.38 million tonnes of waste from aggregate quarrying (mostly in Group E landfills);
- 1.35 million tonnes of other waste-derived aggregate (mostly in Group D, E and, particularly, Group F landfills);
- 0.15 million tonnes of crushed C&D waste (mostly in Group E landfills).

4.65 Broken down by the use to which it is put, the 3.1 million tonnes comprises:

- 0.87 million tonnes used for landfill engineering, capping and restoration (mostly in Group E and F landfills);
- 1.90 million tonnes used for backfilling quarries (mostly in Group F and Group D landfills);
- 0.33 million tonnes disposed of as waste (almost entirely in Group E landfills).

GROSSING UP TO PRODUCE REGIONAL ESTIMATES

4.66 Table 4.12 reports overall regional estimates for CDEW and aggregate entering landfills, by region. These estimates have been obtained using the 'hybrid' method (which is explained in Annex 7 in the context of crushed and screened material). Briefly, the 'hybrid' method takes all responses as reported, and then applies the national average for each type of landfill to non-responding landfills. Much more detailed regional results are given in Annex 8.

4.67 The weakness of the 'hybrid' method of grossing up is that there is no statistically respectable way of estimating the width of individual confidence bands at the regional level. This was discussed and explained in the report on the 2001 survey (when it was used for both crushers and landfills). Rather than giving bands which are known to be unrealistically narrow, it is suggested that all nine regional bands be assumed to be 2.5-to-3.5 times as wide as their national counterparts. This would mean bands of ± 45% around the regional estimates for CDEW entering landfills which are given in Table 4.12.

Table 4.12 **Regional estimates of CDEW and aggregate entering licensed landfills ('000 tonnes)**

Region	CDEW	Aggregate	Total
North West	3,008	177	3,185
North East	1,426	212	1,639
Yorkshire & the Humber	4,010	585	4,596
West Midlands	2,415	251	2,666
East Midlands	3,902	637	4,539
East of England	4,472	340	4,812
London	518	22	540
South East	6,798	542	7,340
South West	2,505	328	2,833
England	29,055 ± 15%	3,095 ± 40%	32,150 ± 14%

The Survey of Paragraph 9&19 Registered Exempt Sites

SURVEY RESPONSE RATE

4.68 By 2 July, 165 survey forms had been returned by operators of Paragraph 9&19 registered exempt sites, with a further six forms returned by the Post Office or current occupant of the mailing address as undeliverable. It should be noted that these non-responses do not mean that the Registered Exempt site does/did not exist: it could simply be that the mailing address used was inaccessible or has ceased to exist (in the case of a site office), or no longer operates (in the case of an office located away from the site).

4.69 Of the 165 forms with information, eight simply reported that the information requested was not available. These eight returns cannot be treated as 'nil returns', so for analytical purposes they, along with the Post Office returns, have been returned to the pool of non-respondents.

4.70 The 157 forms with useable information (including 'nil' returns) can be broken down into four categories (as established in paragraphs 3.29 and 3.30) as follows:

- 96 from operators thought to have a single potentially large site (38% of the 252 mailed);
- nine from operators thought to have more than one potentially large site (33% of the 27 mailed);
- 16 from operators thought to have a mixture of potentially large and small sites (44% of the 36 mailed); and
- 36 from operators thought to have a single small site (37% of the 98 mailed).

4.71 The distinction between potentially large and small sites was based on an arbitrary 'break point' of 10,000 tonnes in a year (as in the previous survey): sites expected to receive more that 10,000 tonnes a year are described as potentially large, and those expected to receive less are described as probably small.

4.72 It should be stressed that due to the process of applying for and then using exemptions, it was always expected that about half of all sites would generate 'nil returns' (because although an exemption existed, it had either been used prior to 1 January 2003, or had not been started by 31 December 2003).

4.73 Of the 96 operators thought to have a single potentially large site, 58 reported that they had not operated any such site during 2003 (and 40 of these reported that, to the best of their knowledge, they had never registered or benefited from an exemption). Twelve of the other 18 acknowledged that they had indeed held a registration, but not for a site that had received any material during 2003. Of the 38 respondents who reported activity of some sort, 31 did indeed have a single site, while six had two sites each and one operator had three sites.

4.74 The nine operators thought to have multiple potentially large sites comprised six who did indeed have multiple sites active during 2003, two who reported having a single site active during 2003 and one who reported that, to the best of his knowledge, he had never registered or benefited from an exemption. Those operators who did have sites reported fewer active sites (18) than the maximum number expected (24), but all acknowledged having other sites which were either closed prior to the start of 2003, or not yet started by the end of 2003.

4.75 Of the 16 operators thought to have a mixture of potentially large and small sites nine reported activity. For those operators who did have sites, the match between the total number of sites expected (35) and the maximum number reported (37) was very good, but the match between expectations and reports at the level of individual operators was much less good. Five of the six operators who reported no activity reported that, to the best of their knowledge, they had never registered or benefited from an exemption.

4.76 Of the 36 operators thought to have a single small site, 13 reported having a single site active during 2003, but 23 reported that they had not operated any such site during 2003 (and 15 of these reported that, to the best of their knowledge, they had never registered or benefited from an exemption. The other eight all acknowledged that they had indeed held a registration, but not for a site that had received any material during 2003).

4.77 Agreement on the actual number of sites is one thing; but agreement on the match between expected and reported scale is a separate issue. In total the respondents provided information on 114 active sites. Just under half of these (56) matched the pre-survey expectation in terms of number and scale, though the other half (58) represented either sites of an unexpected scale, or additional sites which had not been expected. This very complicated combination of expectations and outcomes is summarised in Table 4.13.

4.78 Table 4.13 shows that initial expectations of the total number of registered exempt sites, and the segmentation of this population into size bands, are reasonably well matched by the information reported by respondents.

Table 4.13 **Responses received from operators of Paragraph 9&19 Registered Exempt sites**

	Single large site operators	Multiple large site operators	Mixed site size operators	Single small site operators	Total
Total number of operators mailed	252	27	36	98	413
Maximum number of large sites expected	252	84	56	0	392
Maximum number of small sites expected	0	0	79	98	177
Number of operators responding	96	9	16	36	157
Number of operators unaware of exemption(s)	40	1	5	15	61
Number of operators aware of exemption(s)	56	8	11	21	96
Maximum number of large sites expected	56	22	18	0	96
Maximum number of small sites expected	0	0	22	21	43
Number of respondents with active sites	38	8	9	13	68
Actual number of sites reported as active	46	18	37	13	114
Large sites both expected and reported as active	15	10	8	0	33
Small sites both expected and reported as active	0	0	11	12	23
'Extra' large sites reported	3	1	11	1	16
'Extra' small sites reported	28 (1)	7	7	0	42

Note (1): Includes seven sites in the range 5,000-9,999 tonnes

GROSSING UP TO PRODUCE A NATIONAL ESTIMATE

4.79 The approach which was taken to grossing up was to include the tonnage spread on unexpected 'extra' sites reported by operators, because these reflect the reality on the ground. Where the 'extra' site was large when it was expected to be small (or *vice versa*) this fact has been ignored. Each additional site has, in effect, been treated as part of its expected counterpart.

4.80 In the case of operators thought to operate a mixture of large and small sites, their sites have been treated as different from other large and small sites. As there is much more variation in the tonnage of material used on large sites, data from large sites in the mixed group needs to be combined with data from the other two groups with sites thought to be large (single site operators and multiple site operators).

4.81 Grossing up is therefore essentially a three-stage process, as follows:

- estimate the average tonnages of different materials used on small sites, using the survey returns provided by the group of operators thought in advance to have small sites only, and apply those averages to all small sites;

- multiply these 'small site averages' by the number of small sites operated by mixed site operators and deduct the resultant estimate from the total tonnage reported by mixed site operators;

- use the remaining tonnage (from both mixed and large site operators) to calculate 'large site' averages, and apply these to all large sites.

4.82 This is essentially the same method as was used for Paragraph 9&19 registered exempt sites in the 2001 survey, though one important change of interpretation has been made this time.

4.83 This difference concerns the treatment of returns from those respondents who reported that they had never knowingly operated a registered exempt site. In 2001, it was assumed that such operators did indeed hold one or more exemptions, but these were never activated/used, and should therefore be treated as 'nil' returns. In 2003 this assumption has been varied, to the effect that it is assumed that the exemptions may well have been used, but the person filling in the form either did not know about the exemption or did not have access to the necessary information. Under this assumption such sites are treated as belonging to non-respondents rather than being treated as 'nil' returns.

4.84 The main justification for this change of interpretation is the improbability that 61 out of 157 respondents (see Table 4.13) could really have been registered by the Environment Agency as holders of an exemption within the last two years without their ever knowing about it. This issue came to light because many more 2003 survey respondents reported that, so far as they were aware, they had never operated a registered exempt site. It appears likely that this was a direct consequence of reducing the amount of background information provided on the survey forms themselves or in the accompanying letters (which were sent with the 2001 survey forms, but not with the 2003 forms).

4.85 The three-stage grossing-up process is set out in Tables 4.14 to 4.16. Because the mixed site operators who responded were thought to have 18 large sites and 22 small ones between them (see Table 4.13), these are the numbers used in the adjustment undertaken in Table 4.15.

Table 4.14 **National estimate of material spread on Paragraph 9&19 Registered Exempt sites thought in advance to be small**

	Reported by 21 sample sites (tonnes)	Average per reporting site (tonnes)	Grossed-up total for 1,597 sites ('000 tonnes)
Clean excavation waste	33,675	1,604	2,560
Utility trench waste	5	0	0
Mixed excavation waste	152	7	12
Uncrushed hard C&D waste	1,180	56	90
Road planings	710	34	54
Processed aggregate	100	5	8
Ash, slag, clinker, dredged materials	0	0	0
Other materials	0	0	0
'Unknown' materials	100	5	8
All materials	35,922	1,711	2,732
Band (90% confidence interval)			± 139%
Total, CDEW only (includes 'unknown')	35,112	1,672	2,670
Band (90% confidence interval)			± 143%

Table 4.15 **Adjustment of values for material spread on Paragraph 9&19 Registered Exempt sites by operators of mixed (large and small) sites**

	Reported (tonnes)	Estimate for 22 small sites (tonnes)	Remainder for 18 large sites (tonnes)
Clean excavation waste	277,328	35,279	242,049
Utility trench waste	166,867	5	166,862
Mixed excavation waste	187,381	159	187,222
Uncrushed hard C&D waste	315,399	1,236	314,163
Road planings	29,519	744	28,775
Processed aggregate	1,500	105	1,395
Ash, slag, clinker, dredged materials	0	0	0
Other materials	1,000	0	1,000
'Unknown' materials	0	105 (1)	- 105 (1)
All materials	978,994	37,633	941,361
Total, CDEW only (includes 'unknown')	946,975	36,784	910,191

Note: (1) The negative estimate reflects the presence of 'unknown' materials on other small sites.

Table 4.16 **National estimate of material spread on Paragraph 9&19 Registered Exempt sites thought in advance to be large**

	Reported by 96 sites (tonnes)	Average per reporting site (tonnes)	Grossed-up total for 392 sites ('000 tonnes)
Clean excavation waste	1,510,415	15,733	6,168
Utility trench waste	210,120	2,189	858
Mixed excavation waste	773,144	8,454	3,157
Uncrushed hard C&D waste	458,658	4,778	1,873
Road planings	35,540	370	145
Processed aggregate	95,037	990	388
Ash, slag, clinker	174,940	1,822	714
Dredged material	4,020	42	16
Other material	7,096	74	29
'Unknown' material	417,137	4,345	1,703
All materials	3,686,107	38,397	15,052
Band (90% confidence interval)			± 36%
Total, CDEW only (includes 'unknown')	3,369,474	35,099	13,759
Band (90% confidence interval)			± 36%

4.86 The national estimate for materials spread on Paragraph 9&19 registered exempt sites is therefore 17.78 million tonnes (± 37% at a confidence interval of 90%) for all materials, and 16.43 million tonnes (± 38% at a confidence interval of 38%) for CDEW only.

4.87 In 2001 the estimate for CDEW spread on all Paragraph 9&19 registered exempt sites in England was 22.40 million tonnes. However, to make a comparison fairer, an approximate adjustment to the 2001 estimate has also been made using the approach used in 2003. On a like-for-like basis, the estimate for CDEW spread on Paragraph 9&19 registered exempt sites in England in 2001 would have been 26.94 million tonnes.

4.88 The 2003 estimate therefore represents a clear fall compared to 2001. The balance of materials has also changed considerably.

GROSSING UP TO PRODUCE REGIONAL ESTIMATES

4.89 The regional estimates combine the numbers of sites reported in Table 3.5 with the national averages reported in Tables 4.14 and 4.16. The result of this process (for CDEW only) is reported in Tables 4.17. More extensive regional estimates can be found in Annex 8.

Table 4.17 **Regional estimates of CDEW spread on Paragraph 9&19 Registered Exempt sites ('000 tonnes, with bands at 90% confidence intervals)**

Region	Sites that might be large	Sites that are probably small	All sites
North West	2,352	540	2,892 ± 40%
North East	737	107	844 ± 38%
Yorkshire & the Humber	2,492	256	2,748 ± 38%
West Midlands	597	182	779 ± 43%
East Midlands	948	147	1,095 ± 39%
East of England	2,036	139	2,175 ± 38%
London	562	13	575 ± 39%
South East	2,597	313	2,910 ± 38%
South West	1,439	973	2,412 ± 58%
England	13,759	2,670	16,429 ± 39%

4.90 In 2001 the estimate for the South West was much higher (and a matter of concern discussed in the report covering that survey). This was due to the considerably higher average tonnage per small site on that occasion.

CHAPTER 5
Findings and Discussion

The Headline National Figures

Table 5.1 **Estimated re-use, recycling and disposal of hard C&D and excavation waste in England in 2003**

		Central estimate ('000 tonnes)	Range (90% confidence limits)
1	Hard C&D/excavation waste crushed and/or screened for use as aggregate	39,597	
2	Excavation waste/mixed CDEW screened for use as soil	5,852	
Sub-total 1: Recycled aggregate and soil		***45,448***	***± 10%***
3	Hard C&D waste used for landfill engineering or restoration	694	
4	Excavation waste used for landfill engineering or restoration	5,318	
5	Mixed CDEW (or unspecified material) used for landfill engineering or restoration	441	
Sub-total 2: Material used for landfill engineering or restoration		***6,454***	***± 31%***
6	Hard C&D waste used to backfill quarry voids	1,314	
7	Excavation waste used to backfill quarry voids	9,832	
8	Mixed CDEW (or unspecified material) used to backfill quarry voids	2,264	
Sub-total 3: Material used to back-fill quarry voids		***13,410***	***± 26%***
9	Hard C&D waste (excluding road planings) spread on registered exempt sites	1,963	
10	Clean, unmixed excavation waste spread on registered exempt sites	8,728	
11	Mixed CDEW spread on registered exempt sites	5,738	
Sub-total 4: Material used at Para.9&19 registered exempt sites		***16,429***	***± 38%***
12	Clean, unmixed hard C&D waste disposed of at landfills	630	
13	Mixed and/or contaminated hard C&D waste disposed of at landfills	225	
14	Clean excavation waste disposed of at landfills	2,759	
15	Mixed and/or contaminated excavation waste disposed of at landfills	2,432	
16	Mixed CDEW and unspecified materials disposed of at landfills	3,146	
Sub-total 5: Material disposed of at landfills		***9,192***	***± 19%***
Total		***90,932***	***± 10%***

5.1 When added together, the national estimates from the three separate surveys reported in Chapter 4 suggest that arisings of CDEW in England in 2003 were 90.93 million tonnes ± 10% at a confidence interval of 90%. More detailed breakdowns of these national estimates, together with the confidence limits applicable to the component parts, can be found in Table 5.1 and in Annex 8. The key components classified according to their eventual **use or destination** were:

- 45.45 million tonnes recycled through crushers and screens;
- 29.06 million tonnes used or disposed of on licensed landfills; and
- 16.43 million tonnes of CDEW spread on registered exempt sites.

5.2 When re-classified according to the **types of arisings**, using the relationships illustrated in Figure 2.2 in Chapter 2, the same total estimate of 90.93 million tonnes breaks down as follows:

- 44.42 million tonnes of 'hard' C&D waste arisings;
- 34.92 million tonnes of excavation waste arisings; and
- 11.59 million tonnes of mixed CDEW arisings.

5.3 One important conclusion reached in 2001 was that the **scope for further recycling** of 'hard' C&D waste for use outside landfills and registered exempt sites appeared to be limited. This remains broadly true as a 'snapshot' of the position in 2003, in that very little easily recyclable material (i.e. clean 'hard' C&D waste) was not recycled. This can be confirmed by reference to lines 3, 6, 9 and 12 in Table 5.1, which between them contribute 4.60 million tonnes. The tonnage of harder-to-recycle mixed CDEW (reported in lines 5, 8, 11 and 16) amounts to 11.59 million tonnes.

5.4 This does not, of course, mean that further growth in recycling is out of the question; it means that the material will have to be more actively 'won'. This is consistent with a second conclusion which was reached in 2001, that "… the key to increasing the proportion of 'hard' C&D waste recycled as aggregate is to **improve on-site separation of these materials** (concrete, bricks, tiles and suchlike) from soil and other potentially deleterious materials in order to make them more accessible to the recycling industry".

5.5 Recycling of CDEW is essentially a market-driven activity, and there is some evidence that the economics of recycling are now encouraging recyclers to employ techniques (such as washing) which increase the recovery rate from mixed CDEW. As discussed in Annex 9, a majority of respondents involved in recycling volunteered the opinion that the Aggregates Levy had contributed to growth in the market for their companies' recycled aggregate.

National Estimates: Comparisons with 2001 and 1999

5.6 The estimated total in Table 5.1 (90.93 million tonnes) would represent an increase of just over 2% compared to the central estimate of 88.89 million tonnes reported in 2001 for England. However, using the same grossing-up method as in 2003 on the 2001 survey returns from operators of registered exempt sites would have pushed the 2001 total up by 4.54 million tonnes (see paragraph 4.87 for details of this adjustment), to a total of 93.43 million tonnes. This would mean that, on a like-for-like basis, the total tonnage would have fallen by just over 2.5% between 2001 and 2003. Neither change would be statistically significant.

5.7 The main difference between the estimates has been in the composition of the overall total, with a fall in the volume of material spread on registered exempt sites which has almost offset the apparent rises in recycling and landfilling.

5.8 It is also worth recalling that the report on the 2001 survey stated that "… on balance it may be safer to conclude that the overall (national) tonnage of hard C&D and excavation waste probably lies towards the lower end of the expected band rather than at or above the mid-point".

5.9 Table 5.2 shows the central estimates and associated bands (at a confidence interval of 90%) for the key headline figures for England in 1999, 2001 and 2003. The confidence intervals for 1999 are indicative only.

5.10 The same numbers are shown graphically in Figure 5.1.

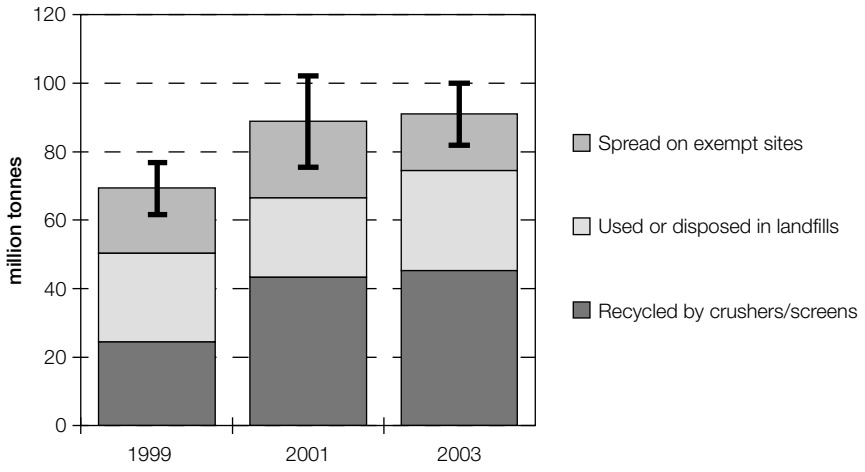
Table 5.2 **Estimates of use/disposal of CDEW arisings in England, 1999-2003 (million tonnes)**

	1999	2001	2003
CDEW recycled through crushers/screens	24.39	43.28	45.45
	± 13%	± 17%	± 10%
CDEW entering landfills	25.80	23.21	29.06
	± 25%	± 26%	± 18%
CDEW spread on Paragraph 9&19 registered exempt sites	19.01	22.40 (1)	16.43
	± 34%	± 43%	± 38%
Total arisings of CDEW in England	69.20	88.89 (2)	90.93
	± 11%	± 15%	± 10%

Notes: (1) This is the unadjusted estimate for CDEW spread on registered exempt sites. The adjusted estimate is 26.94 million tonnes.

(2) See also Note 1. The adjusted total is 93.43 million tonnes.

Figure 5.1 **Estimates of use/disposal of CDEW arisings in England, 1999-2003 (million tonnes)**



5.11 The proportion of CDEW which was recycled in 2003 stands at almost exactly half. Growth (as a proportion) can come from one of two sources:

- faster growth in the 'hard' fraction of C&D waste compared to CDEW as a whole; or
- more efficient separation and/or recovery of the 'hard' fraction (including separation of concrete, bricks and tiles from soil, either by better organisation or by improved technology).

5.12 The proportion of CDEW which was recycled in 2003 was only fractionally higher than in 2001. Although the change was not statistically significant, other information collected from respondents point strongly towards the growth in total tonnage recycled being real.

5.13 The difference in the tonnage of CDEW entering landfills in 2001 and 2003 was not statistically significant, nor was the change in tonnage going to registered exempt sites (in all cases the central estimate for one year lies within the confidence intervals surrounding the other year's central estimate as reported in Table 5.2).

5.14 However, if the central estimates are treated as the best available approximations to the true position, there were changes in the balance between CDEW entering landfills and CDEW used on registered exempt sites.

5.15 During 2003 operators of landfills were deciding whether to adapt or close their facilities in response to the Landfill (England & Wales) Regulations 2002 (which in turn were driven by the Landfill Directive). However, the growth in landfilled CDEW appears to have come almost entirely from material landfilled as waste (up from 3.87 million tonnes in 2001 to 9.19 million tonnes in 2003) rather than material used for site closure and restoration. It must be stressed that these estimates, along with all other estimates applicable to relatively small component parts of the total, come with relatively wide confidence bands around them.

5.16 The drop in material used on registered exempt sites may be linked to a change in the way that the Environment Agency has interpreted the need for construction sites to register for exemptions under Paragraph 19. Whereas most such sites were previously registered with the Agency, some sites which are carrying out simple 'cut and fill' activities using clean site-won excavation waste now appear to be less likely to be required to register an exemption. This observation is anecdotal, and the evidence on which it is based is unrelated to the carrying out of the survey, but comes from a more general exposure to a relatively small number of major construction projects. If it is more widely true, this would have had the effect of reducing the total tonnage of material handled under such exemptions, which is what the survey returns show.

The Reliability of the National Estimates

5.17 The confidence bands quoted above are derived from mathematical processes, and they make no allowance for any errors or unreliability which may have been introduced by the use of incorrect or inadequately justified assumptions. Specifically, the reliability of the total populations (of crushers, landfills and particularly of registered exempt sites), is a cause for some concern.

5.18 This has previously been identified as "… the most likely, and the most serious, source of error". Although the populations were almost certainly better estimated in 2003 than they were in 1999 or 2001, they will still have included some errors.

5.19 By way of illustration, in 1999 the total population of crushers active on C&D waste in England and Wales was estimated prior to the survey to be 493. More detailed preparation, aided by information gleaned on previous occasions, raised the estimated population to 767 machines in 2001 and 783 (for England alone) in 2003. This rising trend reflects both a population which is believed to be genuinely rising, and a better 'detection rate'.

5.20 As on both previous occasions, the greatest uncertainty surrounds the true number of Paragraph 9&19 registered exempt sites. An important decision which affects the total estimate quite strongly is the appropriate way to treat respondents who reported that, to the best of their knowledge, their company had never operated a Paragraph 9 or 19 registered exempt site. Although some of these are probably true 'nil' returns, others are much more likely to be due to the person completing the form being unaware of the work to which the survey form refers. It has been concluded that these cases should be treated as instances of 'information not available' rather than true 'nil' returns. However, it should be acknowledged that this decision has pushed up the estimate of CDEW spread on Paragraph 9&19 registered exempt sites from 10.63 million tonnes to 16.43 million tonnes.

Regional Estimates

5.21 The regional estimates for recyled aggregate and soil are given in Table 5.3 (with the estimates for recycled aggregate highlighted). The bands around these estimates are considerably narrower than the equivalent bands in 2001.

Table 5.3 **Regional estimates for the production of recycled aggregate and soil in England in 2003 (million tonnes)**

Region	Recycled aggregate	Recycled soil	Total recycled aggregate and soil
North West	**4.52 ± 13%**	0.70 ± 19%	5.21 ± 12%
North East	**2.27 ± 13%**	0.33 ± 18%	2.61 ± 12%
Yorkshire & the Humber	**4.44 ± 14%**	0.64 ± 19%	5.08 ± 13%
West Midlands	**4.29 ± 13%**	0.65 ± 18%	4.94 ± 12%
East Midlands	**4.26 ± 14%**	0.62 ± 19%	4.88 ± 12%
East of England	**5.24 ± 17%**	0.72 ± 23%	5.96 ± 15%
London	**5.28 ± 18%**	0.86 ± 25%	6.15 ± 16%
South East	**4.82 ± 14%**	0.70 ± 19%	5.52 ± 12%
South West	**4.47 ± 17%**	0.62 ± 23%	5.09 ± 15%
England	**39.60 ± 13%**	5.85 ± 18%	45.45 ± 10%

5.22 These regional estimates for recycled aggregate have been compared to the regional distribution of human population (using 2001 Census returns) and to the regional estimates for Gross Value Added in 2002 (from the National Statistics website). This shows that the correlation factors are 0.777 (against regional population) and 0.748 (against regional Gross Value Added). These are markedly better correlations than were achieved using the approach to regional grossing up used in 2001 (i.e. the 'hybrid' method). Further details on this can be found in Annex 7.

5.23 The regional estimates for all of the elements that make up total arisings of CDEW are set out in full in Annex 8, and the 'headline figures' are given in Table 5.4. The column headings in Table 5.4 are the same as the sub-total headings in Table 5.1, in abbreviated form.

5.24 Although it would be technically possible to calculate individual confidence bands for each component part of the estimate in each region, and thus for the overall regional estimates for total arisings (as has been done for recycled materials), these would be misleadingly narrow, because of the nature of the 'hybrid' method used for grossing up the regional landfill estimates. It is suggested instead that the bands around all nine regional estimates for CDEW arisings should be assumed to be in the range ± 25-to-35%, which is 2.5-to-3.5 times as wide as the national band given in Table 5.1.

Table 5.4 **Regional estimates for use/disposal of CDEW in England in 2003 (million tonnes)**

Region	Recycled agg. and soil	L'fill eng. or rest'n	B'filling quarry voids	Used at Para 9&19 sites	Disp'ed at l'fills	Total
North West	5.21	0.92	1.00	2.89	1.09	11.11
North East	2.61	0.26	0.81	0.84	0.36	4.88
Yorkshire & the Humber	5.08	0.55	2.57	2.75	0.89	11.84
West Midlands	4.94	0.54	1.14	0.78	0.73	8.13
East Midlands	4.88	0.84	1.84	1.10	1.22	9.88
East of England	5.96	0.63	2.06	2.18	1.79	12.62
London	6.15	0.05	0.29	0.58	0.17	7.24
South East	5.52	1.99	2.74	2.91	2.07	15.23
South West	5.09	0.67	0.96	2.41	0.87	10.00
England	45.45	6.45	13.41	16.43	9.19	90.93

5.25 Using the same approach as is described above in the context of the regional estimates for recycled aggregate, the overall levels of CDEW arisings have been compared with regional human population numbers (from the 2001 census) and regional Gross Value Added estimates for 2002. The resultant correlation coefficients are 0.600 (for total arisings of CDEW compared to population) and 0.469 (for total arisings of CDEW compared to GVA).

5.26 Unlike the coefficients for recycled aggregate alone (which are 0.777 and 0.748 respectively), the coefficients for materials going to landfills and Paragraph 9&19 registered exempt sites are all in the range from 0.196 to 0.400, suggesting that any link is very weak or non-existent.

5.27 However, this is largely because of the particular case of London, which has a large human population and an even larger share of the national GVA, but (because of space constraints) very few landfills. It also appears only to have a few registered exempt sites, though it is not so clear why this should be. When the same correlation coefficients for total arisings of CDEW are re-calculated without the London data, the coefficients rise to 0.851 (population) and 0.878 (GVA). The coefficients for the three (non-London) component parts are all within the range 0.656 to 0.852. This suggests that in regions where there are fewer space constraints, there is a reasonably strong relationship between population, economic activity and the estimates for CDEW arisings given in Table 5.4, giving a fair degree of credibility to those estimates.

Other Incidental Results

5.28 A considerable amount of additional information can be extracted from the survey returns, and particularly from the returns dealing with crushing and screening activity and registered exempt sites. Additional analysis of all three surveys is contained within Annexes 9 to 11. The main findings discussed there are summarised briefly below.

5.29 The proportion of recycled aggregate which is graded has risen since 2001, and now exceeds two thirds of the total.

5.30 The size distribution of recycling crushers (i.e. the proportion of crushers within different throughput size bands) is very similar to the distributions reported in 2001 and 1999.

5.31 Where operators of recycling crushers reported on changes in the size of their businesses since 2001, and where they gave the reasons for such changes, there were some regional differences. The most frequently-mentioned reason for expansion in recycling activity was the Aggregates Levy.

5.32 Most recycling crushers work within the region in which they are authorised (their 'home area'), but the extent to which this is true varies from region to region.

5.33 A majority of recycling crusher operators (60% of the total) only process demolition waste. A further 20% only process demolition waste and 'blacktop'. The remaining 20% process various combinations of demolition waste, 'blacktop', primary aggregate and other waste materials (such as china clay waste and waste glass).

5.34 The extent to which primary aggregate is used within licensed landfills suggests that some landfill operators are obliged to purchase primary aggregate because they cannot get enough CDEW of the right sort.

5.35 The fact that some material described as primary aggregate is dug within landfill sites and then used to backfill quarry voids also suggests that the market for low-grade primary aggregate has shrunk faster than operators' extraction strategies have been able to adapt.

5.36 It also appears that landfills only represent a very small part of the market for recycled aggregate.

5.37 The distribution of CDEW reported as being used on Paragraph 9&19 registered exempt sites was highly skewed: half of the material reported was spread on fewer than 10% of the sites, and three quarters was spread on 17.5% of the sites. This pattern is very similar to what was found by previous surveys.

5.38 The main activities utilising registered exemptions under Paragraphs 9&19 (measured in terms of the tonnage they used) were the backfilling of former quarries and building leisure projects (such as golf courses and fishing lakes).

CHAPTER 6
Conclusions and Recommendations

Conclusions from this Survey

6.1 The 'headline' survey returns suggest that the total tonnage of arisings of CDEW in England was very similar in 2003 and 2001. The 2003 estimate is 90.93 million tonnes ± 10% (at a confidence interval of 90%). This figure does not include any allowance for those fractions of construction and demolition waste (such as wood, metals and plastics) which are unsuited to processing into aggregate.

6.2 The central estimate of the tonnage of CDEW recycled as aggregate grew by just over 7%, from 36.47 million tonnes ± about 20% in 2001 to 39.60 ± 13% in 2003. Although the difference between these estimates is not statistically significant, information gathered from respondents about the changes to their own businesses between 2001 and 2003 points very strongly towards the growth being real.

6.3 The apparent changes in the tonnages of CDEW being sent to landfills and spread on registered exempt sites implied by the relevant central estimates are not statistically significant (in that there is considerable overlap between the confidence intervals applicable to 2001 and 2003).

Recommendations for the Future

6.4 Future surveys should not be run too frequently, because despite the improved survey response rates achieved in 2003 (which were almost certainly at least partly due to the simpler, shorter survey forms used in 2003) there is still some anecdotal evidence of 'survey fatigue', and of active resistance to providing any information not statutorily required. This evidence came from recipients of survey forms who rang the survey telephone helpdesk to register their views, including their unwillingness to participate. It is likely that for every individual prepared to take this step, many others simply 'binned' the survey forms without airing their views publicly.

6.5 Suggested changes to the survey forms for use on future occasions are included as Annex 12. At the time, it will be worth reviewing these drafts carefully to decide whether they should be amended. One possibility, for example, would be to increase the level of detail sought from operators of recycling crushers as regards the materials that they are producing.

6.6 As far as Paragraph 9&19 'registered exempt' sites are concerned these suggestions may be rendered irrelevant by forthcoming changes to the regulatory and administrative

arrangements applicable to such sites. It is to be hoped that the new (but as yet unknown) reporting arrangements to be applied to registered exempt sites will be able to capture the information covered by this survey, possibly in the format set out in Annex 12.

6.7 It is also recommended that, with many landfill licenses having been reviewed over the past two years, and with operators becoming increasingly familiar with the European Waste Catalogue classification codes, the practicality of extracting the necessary information from the regular site returns provided to the Environment Agency should be investigated. Alternatively, it might be possible to circulate an annual survey form based on the proposal in Annex 12 in close conjunction with the site returns.

6.8 Notwithstanding the above, given the limited amount of useful evidence which can be drawn from the surveys of licensed landfills and registered exempt sites, it would be worth considering whether they might be run less frequently than the crusher survey in future.

ANNEX 1
Research Specification

The Collection of Data on the Arisings and Use of Construction and Demolition Waste as an Alternative to Primary Aggregate in England in 2003

INTRODUCTION

1. It is government policy to encourage the use of alternatives instead of quarrying primary aggregate, and there is a related government sustainable development indicator. Construction and Demolition Waste (C&DW) is the main alternative source and, therefore, ODPM requires reliable information on the use of C&DW as aggregate.

2. To date, reasonably reliable national information has been collected, although these data are subject to much statistical uncertainty, while information at the increasingly important regional level is unreliable.

3. Previous surveys were carried out by the Environment Agency with support from DETR for 1999 (Environment Agency, Construction and Demolition Survey, R&D Technical Report P402, May 2001). A similar survey for ODPM was carried out for 2001 (ODPM, Survey of Arisings and Use of Construction and Demolition Waste in England and Wales in 2001, October 2002).

AIM

4. The aim of the project is:

   To identify and implement an improved method for the collection of reliable data on the arisings, use and potential use of C&DW as aggregate in England in 2003.

5. This will provide a basis for producing reliable estimates at the national and sub-national level that will serve the needs of ODPM, RPBs and RAWPS. Specifically, information is required on:

   - the amount of C&DW arising, sub-divided between 'hard' materials and soils;

- the amount of each category crushed or screened for use as aggregate;
- and the scope for further use of C&DW as aggregate.

OBJECTIVES

6. The objectives are as follows:

- to review, briefly, the two recent national surveys (paragraph 3 above) with regard to methodology and results, to learn appropriate lessons and identify improvements;
- to review related surveys carried out by industry – QPA, BAA and NFDC – so that full use can be made of them, possibly after amendment, to avoid duplication and reduce the survey burden on respondents;
- to design an appropriate survey method that takes account of the need for consistency with past surveys and the need to improve on the reliability of past results;
- to carry out the survey;
- to analyse the results and produce the required estimates;
- to produce a commentary on the estimates that includes their reliability and a comparison with previous estimates;
- to identify any lessons for future surveys.

DELIVERABLES

7. The output from the work will be a brief report describing the work carried out, including the conduct of the survey, and presenting and commenting on the results. Twenty copies of the draft final report will be produced. They will be prepared to an adequate standard for review by the Department, eg typescript acceptable, and in a form which allows reproduction. Interim reports will be produced as appropriate. Once agreed with the Department, a final report will be produced in a form suitable for hard copy publication and for publication on the internet.

QUALITY PLAN

8. The proposal should include a quality plan setting out quality assurance procedures. This will include measures to ensure the quality and fitness for purpose of the final report, indicating who will be responsible for editorial control.

PROJECT MANAGEMENT

9. Contact between the contractor and ODPM about the contract should be through the ODPM contract manager. The work will be guided by a Steering Group comprising representatives of ODPM, DEFRA (Waste Policy and Environmental Statistics), QPA, BAA, NFDC, ESA, and EA.

TENDER EVALUATION CRITERIA

10. Tenders will be judged according to:

- understanding of the policies and practical issues, and knowledge of related studies;
- soundness of the proposed method and programme of work;
- the relevant skills and experience of the project team;
- evidence of ability to deliver high quality and timely outputs;
- quality control procedures employed for the research process;
- value for money.

DURATION AND TIMETABLE

11. The Department expects the length of the contract to be about 180 working days. The work should be completed by September 2004. It is likely to be undertaken in early 2004 while memory is fresh.

ODPM

MWP

August 2003

ANNEX 2

Members of the Project Steering Group

Acknowledgement

The members of the project Steering Group, and their alternates where relevant, are listed below. Their advice, guidance and contributions are gratefully acknowledged. Information and comments put forward by members of the Steering Group were taken into account in the preparation for, and analysis of, the surveys. However, the findings and recommendations are those of the study team, as is the responsibility for any errors or omissions.

Public Sector Representatives

OFFICE OF THE DEPUTY PRIME MINISTER

Brian Marker	Minerals and Waste Planning Division (Chairman)
Richard Hilton	Minerals and Waste Planning Division (Contract Manager)
Andrew Lipiński	Minerals and Waste Planning Division (Secretary)

DEPARTMENT OF ENVIRONMENT, FOOD AND RURAL AFFAIRS

Belinda Gordon	Waste Strategy Division
Pat Kilbey	Environmental Protection, Statistics & Information Management
Nick Wyatt	Environmental Protection, Statistics & Information Management

DEPARTMENT OF TRADE AND INDUSTRY

David Hughes	Construction Industry Directorate

ENVIRONMENT AGENCY

Ralph Crouch	Waste Strategy
Alan Bell	Waste Strategy

HM CUSTOMS & EXCISE

Paul Harrison	Analysis Division (Environmental Taxes)

WASTE & RESOURCES ACTION PROGRAMME

John Barritt	WRAP

REGIONAL AGGREGATES WORKING PARTIES

Chris Waite	London and the South East of England RAWPs

LOCAL GOVERNMENT ASSOCIATION

Alice Roberts	LGA
Andy Conn	Wiltshire County Council

Industry Representatives

BRITISH AGGREGATES ASSOCIATION

Peter Huxtable	BAA
Paul Allison	Sherburn Stone Co Ltd

ENVIRONMENTAL SERVICES ASSOCIATION

Andrew Ainsworth	ESA

NATIONAL FEDERATION OF DEMOLITION CONTRACTORS

Christine McFarlane	NFDC
David Coleman	Coleman & Co Ltd

QUARRY PRODUCTS ASSOCIATION

Brian James	QPA
Jerry McLaughlin	QPA

Study Team Members

Andrew Herbert	Capita Symonds
David Knapman	Capita Symonds
Tom Hasler	Capita Symonds
Julian Ellis	WRc

ANNEX 3
Definitions

Working (non-legal) definitions and explanations of key terms used in this study are arranged below in a logical sequence rather than in alphabetical order. The key terms are as follows:

1. Waste
2. Construction and demolition waste
3. Hard C&D waste
4. Excavation waste
5. Mixed hard C&D and excavation waste
6. Production (arisings)
7. Aggregate
8. Graded aggregate
9. Recycling (and re-use)
10. Crushing
11. Screening
12. Full-time crusher equivalents
13. Landfills
14. Registered exempt sites

1. WASTE

'Waste' is any substance or object which the holder discards or intends, or is required, to discard.

For the purposes of this study, materials arising from construction or demolition works which are beneficially used in an unprocessed form on the site on which they arise are not regarded as waste.

2. CONSTRUCTION AND DEMOLITION WASTE

For the purposes of this study, 'construction and demolition waste' (C&D waste) includes hard C&D and excavation waste materials as separately defined below, primarily by reference to Chapter 17 of the European Waste Catalogue. These waste materials arise as a direct result of:

- the total or partial demolition of buildings and/or civil engineering infrastructure; or
- the construction of buildings and/or civil engineering infrastructure.

3. HARD C&D WASTE

'Hard C&D waste' includes both segregated and mixed unprocessed/uncrushed materials listed in Sections 17.01, 17.03 and 17.05 of the European Waste Catalogue (see below), plus the same materials when contaminated (with, for example, asbestos, mercury or PCB).

Category	*Description*
17.01.01	Concrete.
17.01.02	Bricks.
17.01.03	Tiles and ceramics.
17.01.06	Mixtures of, or separate fractions of concrete, bricks, tiles and ceramics containing dangerous substances.
17.01.07	Mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 17.01.06.
17.03.01	Bituminous mixtures containing coal tar.
17.03.02	Bituminous mixtures other than those mentioned in 17.03.01.
17.03.03	Coal tar and tarred products.
17.05.07	Track ballast containing dangerous substances.
17.05.08	Track ballast other than those mentioned in 17.05.07.

4. EXCAVATION WASTE

'Excavation waste' includes both clean and contaminated waste soil, stone and rocks arising from land levelling, civil works and/or general foundations. Such materials are defined in two categories of the European Waste Catalogue: 17.05.03 (soil and stones containing dangerous substances) and 17.05.04 (soil and stones other than those mentioned in 17.05.03).

For the avoidance of doubt, excavation waste generally excludes those excavated materials arising from construction or demolition works which are beneficially used in an unprocessed form on a site which is not a registered exempt site (see below), since such materials are not generally regulated as waste.

5. MIXED HARD C&D AND EXCAVATION WASTE

'Mixed hard C&D and excavation waste' (mixed CDEW) means any mixture of the two previous categories where the proportion of soil and similar materials within the mix is greater than about 10%. Typically it is more likely to exceed 75%.

6. PRODUCTION (ARISINGS)

For the purposes of this study 'production' (or 'arisings') of hard C&D waste is defined as the sum of the following:

- hard C&D waste which is processed by crushing and/or screening for subsequent use, whether sold to a third party or not;
- hard C&D waste which is used without being crushed or screened, either in landfills (for restoration or engineering) or to backfill quarry voids or on sites which are 'registered exempt' (see below);
- unprocessed hard C&D waste which is disposed of as waste in licensed landfills;
- process waste from the crushing and/or screening of hard C&D waste (i.e. crusher fines and similar) which is disposed of as waste in licensed landfills.

For the purposes of this study 'production' (or 'arisings') of excavation waste is defined as the sum of the following:

- excavation waste which is processed by screening (or possibly by crushing) for subsequent use, whether sold to a third party or not;
- excavation waste which is used without being screened or crushed, either in landfills (for restoration or engineering) or to backfill quarry voids or on sites which are 'registered exempt' (see below);
- unprocessed excavation waste which is disposed of as waste in licensed landfills;
- excavation waste soil materials arising from soil and/or mixed C&D waste screening which are disposed of as waste in licensed landfills.

Hard C&D and excavation waste which is used in an unprocessed form (generally at its point of arising) and which is neither spread on 'registered exempt' sites nor disposed of in licensed landfills is therefore excluded from 'production' (or 'arisings').

7. AGGREGATE

'Aggregate' is any hard, granular, non-plastic mainly inert construction material, including bulk fill. It may be derived from primary sources (e.g. quarries and sand pits), secondary sources (e.g. slags and other industrial and mining by-products), or from the recycling of C&D waste through a process of crushing and/or screening (as defined below).

8. GRADED AGGREGATE

'Graded aggregate' is aggregate which has been sorted, selected or mixed (or any combination of these processes) in such a way that it meets an agreed specification covering characteristics such as size distribution and hardness.

9. RECYCLING (AND RE-USE)

'Recycling' involves the processing of waste material so that it can be used as a raw

material, or used without further processing, and ceases to be a waste. 'Re-use' does not involve any processing.

10. CRUSHING

'Crushing' is a mechanical process of breaking irregular over-sized blocks of hard materials into a more regular aggregate or similar material with a predictable distribution of particle sizes. Crushing is used for preparing primary and secondary aggregates as well as for recycled aggregates derived from waste concrete, bricks, blocks, tiles and similar hard C&D waste.

Crushers may be fixed or mobile, though many mobile crushers are in practice permanently located in one place. Many crushers have a built-in screening capability (see below).

11. SCREENING

'Screening' is a general term covering all systems (including hand picking) for sorting, separating and sizing mixed materials, but primarily refers to the use of powered mechanical screens or riddles which are not attached to a crusher.

12. FULL-TIME CRUSHER EQUIVALENTS

A 'full-time crusher equivalent' is a crusher which is under the control of a survey respondent for a full year (irrespective of how often the crusher is used during that period), or any equivalent combination of crushers and time (e.g. two crushers controlled for six months, or three crushers for four months each).

13. LANDFILLS

'Landfills' are sites licensed by the Environment Agency to receive waste materials for final disposal (including site restoration and engineering) under the provisions of the Waste Management Licensing Regulations 1994 (SI No.1994/1056).

14. REGISTERED EXEMPT SITES

'Registered exempt sites' are sites which are notified to the Environment Agency by the site owner or operator as being exempt from waste management licensing by the provisions contained in Schedule 3 to the Waste Management Licensing Regulations 1994 (SI No.1994/1056). Such exemptions are placed on the public record by the Agency. The exemptions only apply if the operation complies with the terms and conditions of the exemption, and does not harm the environment or human health.

For the purposes of this study, the most relevant paragraph numbers are 9, 13, 19 and 24, and particularly Paragraphs 9 and/or 19 which allow for the spreading or use on land or temporary storage of specified (mainly inert) materials.

For the avoidance of doubt, the full wording of Paragraphs 9 and 19 from Schedule 3 (which is entitled 'Activities Exempt from Waste Management Licensing') are reproduced in full below.

Extracts from Schedule 3 to the Waste Management Licensing Regulations 1994 (SI No.1994/1056) ('Activities Exempt from Waste Management Licensing')

Paragraph 9

"9. – (1) Subject to sub-paragraph (3) below, the spreading of waste consisting of soil, rock, ash or sludge, or of waste from dredging any inland waters or arising from construction or demolition work, on any land in connection with the reclamation or improvement of that land if –

(a) by reason of industrial or other development the land is incapable of beneficial use without treatment;

(b) the spreading is carried out in accordance with a planning permission for the reclamation or improvement of the land and results in benefit to agriculture or ecological improvement; and

(c) no more than 20,000 cubic metres per hectare of such waste is spread on the land.

(2) The storage, at the place where it is to be spread, of any such waste which is intended to be spread in reliance upon the exemption conferred by sub-paragraph (1) above.

(3) Sub-paragraph (1) above does not apply to the disposal of waste at a site designed or adapted for the final disposal of waste by landfill."

Paragraph 19

"19. (1) The storage on a site of waste which arises from demolition or construction work or tunnelling or other excavations or which consists of ash, slag, clinker, rock, wood or gypsum, if –

(a) the waste in question is suitable for use for the purposes of relevant work which will be carried on at the site; and

(b) in the case of waste which is not produced on the site, it is not stored there for longer than three months before relevant work starts.

(2) The use of waste of a kind mentioned in sub-paragraph (1) above for the purposes of relevant work if the waste is suitable for use for those purposes.

(3) The storage on a site of waste consisting of road planings which are to be used for the purposes of relevant work carried on elsewhere if –

(a) no more than 50,000 tonnes of such waste are stored at the site; and

(b) the waste is stored there for no longer than 3 months.

(4) In this paragraph, "relevant work" means construction work, including the deposit of waste on land in connection with –

(a) the provision of recreational facilities on that land; or

(b) the construction, maintenance or improvement of a building, highway, railway, airport, dock or other transport facility on that land,

but not including either any deposit of waste in any other circumstances or any work involving land reclamation."

ANNEX 4

Changes in Method Compared to 2001

Introduction

This Annex seeks to put down in one place any substantive differences in method between the surveys of 2001 and 2003.

Differences Prior to Sending out the Survey Forms

Prior to issuing the survey forms, a slightly different approach was taken to segmenting the population of recycling operators and their crushers. By 2003 better information was available (from the 2001 survey as well as from Local Authorities) on the number of crushers thought to be owned by each operator, and on the probability of that operator actually being involved in CDEW recycling. Each operator could therefore be described in terms of a number of crushers as well as a probability of involvement in recycling.

This enabled all operators to be placed in one of four groups. (Groups 1 and 2 were definitely thought to own crushers and to be involved in recycling, with less certainty about their involvement in recycling for those in Group 2. Group 3 operators were thought to rent rather than own a crusher for any recycling in which they are involved. Group 4 were kept on the list 'just in case': they were not thought to be involved in recycling, but were mailed in case the pre-analysis was wrong.)

In practice, Groups 1 and 2 were treated as forming part of the same population. However, leaving the Group 2 'tag' attached to some operators increased the attention given to checking whether they should be left in Group 2 or transferred to Group 4.

A field was also added to the mailing database to record the human population density for the 'home area' of each operator. This is described fully in Chapter 3.

Unlike in 2001, a random sample of crusher operators was not selected prior to mailing the survey forms. The reason that this had been done in 2001 was to create a group that could be more intensively followed up after the main returns had been received in order to test whether or not there was any real difference between those who had responded and those who had not. In 2001 (and in 1999 when a similar but less pre-planned procedure had been carried out) the conclusion was that any differences were not significant (though even among the follow-up group response rates were not very high, the data requested being generally unsuited to telephone chasing). However,

since the follow-up effort had clearly raised the response rate in 2001, it was decided on this occasion to apply the same follow-up effort to all non-respondents from Groups 1 and 2.

The same change was applied to operators of licensed landfills (i.e. a shift away from a pre-selected follow-up sample in favour of chasing up all non-respondents from the highest priority groups of operators).

It is worth noting that after the follow-up survey forms were sent out (roughly a month after the original survey forms), almost all responses received came from the targeted groups, and most of these came in within a month of the follow-up mailing. In other words, most responses that are going to be received are received within one month. This response time appears to have reduced. This may be a function of the survey forms becoming progressively simpler, or it may reflect a change in office practice within the target companies in favour of deciding as mail is received whether to respond or to throw it away, rather than putting it on one side to be dealt with later. It is beyond the scope of this study to judge, but it could be speculated that this reduced response time parallels the wider cultural shift within offices from being attuned to dealing primarily with letters (formal, solid, can be stored) to faxes (demanding, immediate) to Email (instant, ephemeral).

The only sample that was pre-selected was a regionally structured random sample of operators of Paragraph 9&19 registered exempt sites thought in advance to be small. A directly comparable approach had been taken in 2001.

More information was available about Paragraph 9&19 registered exempt sites in 2003, as reported in Chapter 3. This introduced the complication of some operators being thought to operate a mixture of large and small sites. In 2001, segmentation into large and small was done on the basis of the operator's characteristics alone.

Differences in the Survey Forms

All three survey forms were simpler and shorter than in 2001. This was most obvious in the case of the form dealing with crushing and screening, and to a slightly lesser degree in the case of the licensed landfill form. Unlike in 1999 and 2001, covering letters were not sent: all of the information given to operators was on the survey forms themselves. This worked least well for Paragraph 9&19 registered exempt sites, where there was evidence that some recipients were not familiar with the terminology, and did not understand what they were being asked about.

In the specific case of the form dealing with crushing and screening, much of the shortening was achieved by deciding not to re-ask some of the questions that had been covered in 1999 and 2001 (such as the make-up of the incoming waste, the nature of the location where work was carried out, and the age of the crushers concerned). Some of these questions could well be incorporated in future surveys just to check that they have not changed significantly, but they do not need to be asked every time.

The main innovation in 2003 as far as the crushing and screening form was concerned was the introduction of Question 3, which asked how many full-time crusher equivalents and screen equivalents the respondent used. This removed the need to estimate how many crushers the respondent had used to generate the tonnage of

recycled materials reported. In 2001 the approach taken was to use the number of crushers reported by each respondent as being owned by them, except in the case of recyclers who owned no crushers, to each of whom one crusher was allocated.

Had that same approach been taken in 2003, instead of the 397.12 full-time crusher equivalents actually reported, the estimate would have been 400 crushers (338 owned by Group 1 and 2 respondents and 62 'extras' allocated to Group 3 operators (i.e. those who were not thought in advance to own a crusher, but who reported carrying out recycling activities). Whilst the 2003 method undoubtedly gives a clearer and more robust estimate of the true population of recycling crushers and its regional distribution, the almost uncanny coincidence between the two estimates generated by the different methods appears to vindicate the approach used in 2001, and gives confidence that a comparison between the two surveys is fair.

There was very little evidence to suggest that respondents had misunderstood, or had experienced any real difficulty answering, Question 3.

The second innovation introduced in 2003 was the final question (Question7), which asked operators how their own businesses had changed since 2001. Again, there was little evidence that respondents had experienced any difficulty answering the question: the non-response rate was low, and partly accounted for by those who had not been involved in recycling in 2001. It yielded useful information.

The licensed landfill survey form was very similar to the one used in 2001 to chase up non-respondents to the initial mailing, and which had been shown to work well on that occasion. Its main drawback was that it asked for all of the information 'in one go' with no in-built checks. There was evidence that the layout of the answer table caused some respondents some confusion (in that they entered the same data twice: once in the first column indicating that they had been restoring a quarry, and then again in a second column indicating that it was a conventional landfill). This required judgement to be exercised when the data were entered. In some cases the respondents were contacted for further clarification. This confusion could be overcome by limited re-drafting, as proposed in Annex 12.

The question used in 2001 which had asked how far CDEW was being transported prior to landfill was omitted in 2003. It had yielded very clear results in 2001, and it was decided that asking it again so soon was unnecessary, particularly in view of the fact that the information generated was interesting but ancillary to the main thrust of the study. However, it is a question to which future surveys might well return.

An innovation in 2003 was the addition of a parallel question covering the use of primary aggregate, quarrying waste and comparable non-CDEW waste materials. The objective was to discover the extent (if any) to which landfill operators were having to purchase primary aggregate where previously they might have been able to rely on CDEW.

The only significant change on the survey form sent to operators of Paragraph 9&19 registered exempt sites was the omission of the question asking how far CDEW was being transported prior to reaching the registered exempt site. As with the equivalent question on the landfill survey form, it had yielded very clear results in 2001, and it was decided that asking it again so soon was unnecessary.

Differences in the Way in which Information from the Survey Forms was Used

The implications of the change in method for calculating the number of recycling crushers that were responsible for the reported tonnage (brought about by the inclusion of Question 3, as described above) are described in Chapter 4. In practice the total population estimate (to be used for grossing-up purposes) had to be adjusted downwards to take account of non-recyclers.

This slightly untidy adjustment could be avoided in future if non-recyclers could be persuaded to answer Question 3 (which would mean that the true number of non-recycling crushers would then be known, enabling recyclers and non-recyclers to be placed in a single population for grossing-up purposes). A proposal to achieve this is included in Annex 12.

As reported in Chapter 4, human population density in the 'home area' of each crusher was used as a key factor in the grossing-up process. This was a completely new approach compared to 1999 and 2001.

The analysis of the data from registered exempt sites was made more complicated as a consequence of some operators being thought in advance to have a mixture of large and small sites. The actual approach taken is fully described in Chapter 4.

The way in which sites operated by those respondents who reported that they had never knowingly held a Paragraph 9 or 19 exemption was different from 2001. This time they were treated as 'don't knows' rather than 'nil' returns. This had the effect of raising the estimate of the tonnage spread on registered exempt sites. To make a comparison with the 2001 estimate more direct, the 2001 survey returns were re-analysed using the same assumption as in 2003. The outcome of this process is reported in Chapter 4.

ANNEX 5

Main Survey Forms

This Annex contains the main survey forms as sent out in March 2004 (before Symonds Group Ltd had been re-named Capita Symonds Ltd). Changes have been made in order to fit the forms to the report layout, but the wording of the questions remains unchanged. All three forms were printed double-sided on single sheets of A4 paper. All three forms had the logo of the ODPM at the top of the first page with an explanatory comment as follows:

Office of the
Deputy Prime Minister

Creating sustainable communities

This is one of a group of surveys being carried out by Symonds Group Ltd for ODPM to monitor the current availability and use as aggregate of construction, demolition and excavation waste (**CDEW**).

All three forms:

- gave details of a 'Helpdesk' which recipients could telephone if they needed assistance filling in the form;
- offered to send the form by Email if the recipient would prefer to complete it electronically;
- gave details of a FreePost address to which survey forms could be returned;
- explained that survey forms were being sent to other groups of interested parties (e.g. operators of crushers, landfills and exempt sites);
- invited respondents to request a summary of the main results of the survey in due course;
- drew their attention to the ODPM's website, where they could find the report covering the survey conducted in England and Wales in 2001.

These aspects have been deleted from the three extracts that follow.

No additional covering letters or explanatory notes were sent to recipients of the survey forms.

Confidential National Survey of Crushing & Screening Activity in 2003

Please pass this form to the most appropriate person within your company, asking them to complete it and then to return it to the FreePost address given above **by 9th April 2004. All data provided will be treated as confidential, and will be presented in such a way that individual sources cannot be identified**.

We would be very grateful if you would use this survey form to give details of **all materials that you crush and/or screen** using equipment that you own and/or operate, **even if you process no construction, demolition or excavation waste at present**.

Q1: Which of these products did you **produce in 2003?** (Please tick the relevant boxes)	**Primary** (quarried) aggregate	
	Recycled aggregate/soil	
	Both of the above	
	Recycled **'blacktop'**	
	Other (e.g. from ash, slag, china clay, etc)	
	None of the above (*)	

(*) **If you crush nothing at all, tick the box and ignore the remaining questions**, but please return the form.

Q2: How many machines did you use to **recycle aggregate and/or soil** in 2003?	**Crushers** (with or without integral screens)	(owned)	(hired in)
	Stand-alone screens	(owned)	(hired in)

For Q3, it would be very helpful if you could estimate how many full-time machines your answer to Q2 is equivalent to. For example, if you own a crusher or screen and you are the only person/company to use it, please count this as one full-time machine, however much or little you use it. If you hire a crusher for a week every month, please count this as a quarter of a crusher. If you hired a crusher for a five-week period, please count this as one tenth of a crusher, etc etc.

Q3: How many **full-time machines** is your answer to Q2 **equivalent** to?	Crushers	
	Stand-alone screens	

Q4: How many tonnes of **recycled aggregate and/or soil** did you produce in 2003?	**Crushed** with or without screening	
	Screened without any crushing	
	Total of the above	
If you do not keep detailed records, estimated figures or ranges (e.g. 15-20,000 tonnes) would still be very helpful.		

Q5: Please provide your best estimates of the **breakdown** of the total from Q4 (in either tonnes or %) using the following headings:	Graded aggregate	
	Ungraded aggregate (incl. general fill)	
	Clean/usable soil	
	Other usable materials	

Q6: **Where** were your machines active in 2003? Please give your best estimate of the percentages of the total tonnage above in each district/county/city (e.g. '50% London, 25% East Hertfordshire, 20% Brentwood (Essex), 5% South Buckinghamshire'). Please include any work outside England.

Q7: How did your company's **level of C&D waste recycling in 2003** compare with **2001**? Please give your best estimate by ticking the appropriate box below.

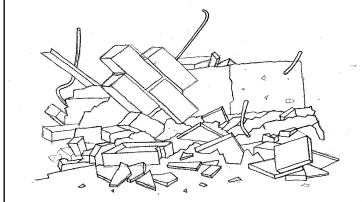
Change (in tonnes)	Over 50% **down**	30 to 50% **down**	10 to 30% **down**	0 to 10% **down**	about the **same**	0 to 10% **up**	10 to 30% **up**	30 to 50% **up**	Over 50% **up**
Compared to 2001, 2003 was:									
What do you think brought about this change?									

Confidential National Survey of Licensed Landfills in 2003

Please pass this form to the most appropriate person within your company, asking them to complete it and then to return it to the FreePost address given above **by 9th April 2004. All data provided will be treated as confidential, and will be presented in such a way that individual sources cannot be identified**.

We would be very grateful if you would complete and return **one survey form for each licensed landfill** that you own/operate (as per the mailing label above), **even if it received no construction, demolition or excavation waste during 2003**. If we have not sent a form for one of you licensed landfills, please let us know.

Q1 The landfill was: (please tick the relevant box.)	**Open** during 2003		Please complete Q2 and Q3
	Inactive throughout 2003		Ignore Q2 and Q3, but please return the form
	Closed by the start of 2003		



hard C&D waste

Excavation Waste

'mixed' materials (CDEW)

With the illustrations above in mind, please complete the Q2 table below.

- You should **not record** any materials that you recycled/reclaimed and then **sent off-site again**.
- There should be **no overlap** between the cells in the table, so all CDEW that you received, and which went into the landfill void space, should be recorded once.
- **Contaminated** here means **mixed with hazardous** materials such as asbestos, oils, chemicals, etc.
- The total tonnage of CDEW will be the total of all cells.

Q2 By completing this table, please indicate how many tonnes of **unprocessed construction, demolition and excavation waste** entered the landfill site during 2003, and what happened to them.

	Landfill in a Quarry	**Other Landfill**		
	Backfilling, capping, restoring	***Disposed of as waste***	***Used in landfill engineering***	***Used in capping and restoration***
Clean hard C&D waste	tonnes	tonnes	tonnes	tonnes
Contaminated hard C&D waste	tonnes	tonnes	tonnes	tonnes
Clean excavation waste	tonnes	tonnes	tonnes	tonnes
Contaminated excavation waste	tonnes	tonnes	tonnes	tonnes
Clean 'mixed' materials	tonnes	tonnes	tonnes	tonnes
Contaminated 'mixed' materials	tonnes	tonnes	tonnes	tonnes
Other C&D/excavation waste (or category unknown)	tonnes	tonnes	tonnes	tonnes

Q3 By completing this table, please indicate how many tonnes of **aggregate** (if any) entered the landfill site during 2003, and what happened to them.

	Landfill in a Quarry	**Other Landfill**		
	Backfilling, capping, restoring	***Disposed of as waste***	***Used in landfill engineering***	***Used in capping and restoration***
Primary aggregate (purchased)	tonnes	tonnes	tonnes	tonnes
Primary aggregate (dug on site)	tonnes	tonnes	tonnes	tonnes
Waste from aggregate quarrying	tonnes	tonnes	tonnes	tonnes
Other waste-derived aggregate (e.g. slags etc)	tonnes	tonnes	tonnes	tonnes
Crushed C&D waste	tonnes	tonnes	tonnes	tonnes

Confidential National Survey of Materials Spread on Registered Exempt Sites in 2003

Please pass this form to the most appropriate person within your company, asking them to complete it and then to return it to the FreePost address given above **by 9th April 2004. All data provided will be treated as confidential, and will be presented in such a way that individual sources cannot be identified**.

We would be very grateful if you would complete this survey form for the 'registered exempt' site(s) that you own/operate, **even if they received no CDEW during 2003**.

Q1 Are any of the following statements true in your case? (Please tick the box(es) if true)	
We had one or more Para 9 or 19 'registered exempt' sites that had **closed before 1 January 2003**.	
We have (or had) one or more Para 9 or 19 exemptions that we had **not started to use by 31 December 2003**.	
To the best of my knowledge, we have **never** operated a Para 9 or 19 'registered exempt' site.	

Q2 Did you operate one or more Para 9 or 19 'registered exempt' sites in England on which inert waste materials were spread during 2003?			
Yes >		How many sites in all?	
No >		Note: If your answer is "No", ignore Q3 and Q4 but **please return the form**. This is important for making the survey as effective as possible.	

Q3 What tonnages of inert wastes were spread on the 'registered exempt' site(s) identified in response to Q2 during 2003? (Please complete the appropriate boxes):

Note: If you operated more than 4 sites, please take a copy of this page and provide the information on that copy.

	Site 1	*Site 2*	*Site 3*	*Site 4*
Total	tonnes	tonnes	tonnes	tonnes
Total includes mixtures of any or all of the following:				
Clean excavation waste	tonnes	tonnes	tonnes	tonnes
Excavation waste from utility trenches	tonnes	tonnes	tonnes	tonnes
Other excavation waste with some demolition waste (or similar) mixed in	tonnes	tonnes	tonnes	tonnes
Uncrushed hard C&D waste/'builder's rubble'/hardcore	tonnes	tonnes	tonnes	tonnes
Road planings	tonnes	tonnes	tonnes	tonnes
Processed/crushed aggregate (*)	tonnes	tonnes	tonnes	tonnes
Ash, slag and/or clinker	tonnes	tonnes	tonnes	tonnes
Dredged materials	tonnes	tonnes	tonnes	tonnes
All/any other materials	tonnes	tonnes	tonnes	tonnes
(*) Please exclude from this answer any primary (quarried) aggregate used for construction.				

Q4 In which county does each of the sites identified in response to Q2 and Q3 fall, and what was being done on the site?

(Please complete by giving the relevant county name(s), and then **ticking** the appropriate box(es) in the subsequent rows):

	Site 1	*Site 2*	*Site 3*	*Site 4*
Activity ↓ / Name of County →				
Road building or other major transport infrastructure development				
Minor infrastructure works (car park, footpath, minor road etc)				
Filling in former dock or similar				
Filling in former quarry void (not a licensed landfill)				
Creation of noise bunds or landscaping				
Building of golf course or other leisure development				
Housing, industrial or similar development				
Drainage or agricultural improvement				
Other (*)				
(*) Please specify here what 'other' was:				

ANNEX 6
Statistical Method

Introduction

This Annex explains how the confidence intervals around the central tonnage estimates derived from the three main surveys (of crushers, landfills and registered exempt sites) were calculated. It also explains how the confidence interval around the grand total derived from all three surveys was calculated.

All of the main figures concerned are set out in Table 5.1.

Crushers

INTRODUCTION

The various grossed-up totals seen in the tables in Annex 7 are all derived from what are called 'ratio' estimates of mean weight per crusher. That is,

Wt/Cr = Σ [weight]/Σ [No of crushers],

with the summations running over all operators.

This means that, once a general formula has been derived for calculating the relative standard error (RSE) of a ratio estimate, it is a straightforward matter to calculate all the required confidence intervals for those tables.

RSE FOR A RATIO ESTIMATE

Suppose that:

n = number of operators in data set,

X_i = number of crushers (possibly non-integral) for operator i,

W_i = tonnes weight (in any specific category) processed by operator i,

A = estimated tonnes weight per crusher,

RSE(A) = RSE for A,

RSE(AvX) = RSE for mean X,

RSE(AvW) = RSE for mean W, and

r = correlation coefficient between the X's and the W's.

Then:

$RSE(A) = \sqrt{[RSE(AvX)^2 + RSE(AvW)^2 - 2r \times RSE(AvX) \times RSE(AvW)]}$

Note that RSE(AvX) is calculated as [St.dev(X)/√n]/Mean(X), and RSE(AvW) likewise.

It may be helpful to see what happens to the RSE(A) formula in the special case in which all the X values are 1 (i.e. where every operator has a single crusher). In that case, $A = \Sigma W_i/\Sigma(1) = \Sigma W_i/n = AvW$, the ordinary straightforward average of W.

Furthermore, as the X's have zero variability, RSE(AvX) = 0, and so the RSE(A) formula just boils down to RSE(AvW) , as would be expected.

Licensed Landfills

NATIONAL TOTALS

The landfills fall into six Groups (A to F) and there are enough samples in each Group (= stratum) to allow the standard method of analysis for stratified sampling to be used. The logic behind this works as follows:

n_i = number of landfills (including 'nil' returns) in sample for Group i,

N_i = number of landfills in population for Group i,

f_i = 'sampling fraction' for Group i ($f_i = n_i/N_i$),

A_i = mean of total tonnage over the n_i landfills for Group i,

s_i = standard deviation of total tonnage over the n_i landfills for Group i,

SE_i = standard error of A_i ,

RSE_i = relative standard error of A_i ,

G_i = grossed-up tonnage estimate for Group i,

$V(G_i)$ = variance of G_i,

Gtot = estimate of overall grossed-up tonnage, and

RSE(G) = relative standard error of Gtot.

Then:

$SE_i = \sqrt{(1 - f_i)} \times s_i/\sqrt{n_i}$

$RSE_i = SE_i/A_i$

$G_i = N_i A_i$,

$V(G_i) = (1 - f_i) \times N_i^2 s_i^2/n_i$,

$Gtot = \Sigma V(G_i)$, and

$RSE(G) = \sqrt{\Sigma V(G_i)}$, the summations running from i = 1 to 6.

NATIONAL SUB-TOTALS

The above RSE calculation can be applied to any individual tonnage component of interest (for example, the tonnage of clean 'hard' C&D waste used in landfill engineering).

If the total tonnage is subdivided into N categories of interest, the sum of the N separate grossed-up tonnage estimates will, of course, be identical to the overall grossed-up total obtained directly by analysing the total tonnage data for each landfill. However, there is no easy way of combining the sub-total variances to obtain the grand total variance. In the simplest case (where N = 2 and the sub-totals are W and Z), then:

$T = W + Z$, and

$Var(T) = Var(W) + Var(Z) + 2r \times StD(W) \times StD(Z)$, where

r is the correlation coefficient between W and Z.

More generally, there is a correlation term for all possible pairs of terms on the right-hand side of the T expression. So with 11 sub-categories (which there are, as can be seen by reference to the components which make up the three sub-totals applicable to landfills in Table 5.1), there are $11 \times 10/2 = 55$ correlation terms in addition to the 11 main variance terms.

This is a practical argument against going to a very fine level of detail.

REGIONAL TOTALS

Within any one region, the sample of landfills (i.e. the number of respondents) in individual Groups is not always large enough to provide reliable estimates for mean tonnage per landfill, let alone standard deviation. It is necessary, therefore, to fall back on the hybrid method, as described in the report of the 2001 survey (see Annex 8 in that report). This still follows the same broad stratified sampling approach as outlined in the section above headed 'National Totals', but with the following simplifications.

For any Group i and Region r,

$G_{ir} = N_{ir} A_{ir}$ is replaced by:

G_{ir} = $n_{ir}A_{ir} + (N_{ir} - n_{ir})\mathbf{A}_i$

(that is, grossing up uses the same national Group i mean for all regions), and

$V(G_{ir})$ = $(1 - f_{ir}) \times N_{ir}^2 s_{ir}^2/n_{ir}$ is replaced by:

$V(G_{ir})$ = $(1 - f_{ir}) \times (\mathbf{N_{ir} - n_{ir}})^2 \mathbf{s}_i^2/n_{ir}$

(that is, grossing up uses the same national Group i standard deviation for all regions).

The arguments in support of the $V(G_{ir})$ expression are not at all robust, and it is essential to emphasize the need to view the resulting confidence intervals with extreme caution. An arbitrary (but conservative) alternative is to apply a confidence interval of three times the national figure to the regional totals.

Paragraph 9&19 Registered Exempt Sites

A revised method (compared to 2001) was used to calculate the confidence intervals for registered exempt sites, to take account of the fact that those operators who reported that they had never to the best of their knowledge held an exemption could not be treated as 'nil' returns. That affected the numbers of added zeros to be inserted in calculating means per site.

The essence of the revised method can be described most simply by reference to the group of operators thought in advance to have a single small site (referred to here as the S category). For grossing-up purposes, the mean is calculated as follows:

AvS = (Total weight summed over all useful operators)/

(number of expected sites for those operators)

To calculate the statistical uncertainty in this, the chosen approach is to rewrite this as the arithmetically equivalent expression:

AvS = (Total wt/**Actual** no of sites) ×

(**Actual** no of sites/**Expected** no of sites).

The first term is the simple average per reported site, obtained by dividing the total reported tonnage by the total number of sites reported (irrespective of the number of sites expected to be operated by those operators). This enables the RSE to be calculated.

The second term combines the number of sites actually reported and the number of sites expected to be operated by that group of respondents (one per respondent in the case of the S category). A second RSE can be calculated from this data set.

The required RSE(AvS) is then just the root-sum-square of the two component RSEs.

Similar adjustments are needed to the calculations dealing with other groups of operators (i.e. those with a single site thought in advance to be large, those with

multiple sites thought in advance to be large, and those with a mixture of sites thought to be large and small). The essence of the process is the same as before, namely:

Step 1: Calculate the RSE for Small sites

Step 2: Calculate the RSE for **individually identifiable** Large sites

Step 3: Combine the two RSEs appropriately from Steps 1&2.

Overall Headline National Figures

The following steps demonstrate how to calculate the confidence interval for the grossed-up estimate of the total re-use, recycling and disposal of CDEW in England in 2003, as presented in Table 5.1:

- Firstly, the grossed up totals for each of the sub-totals, that is, the grossed up totals from crushers, landfills and registered exempt sites needs to be generated. The methods used to calculate these values are presented above.

- When calculating the grossed up total for landfills, the total should be broken down into three further sub-totals, 'material used for landfill engineering or restoration', 'material used to back-fill quarry voids', and 'material disposed of at landfills'.

- The variance of the grossed up total for each of the sub-totals is calculated as above for each of crushers, landfills and registered exempt sites.

- The RSE of each of the sub-total grossed up values is simply the ratio of the square root of the variance and the grossed-up total.

- The 90% confidence interval of each grossed-up sub-total is the RSE for that sub-total multiplied by 1.65.

- To calculate the overall confidence interval, firstly all of the sub-total grossed-up values and their associated variances are summed together, giving an overall grossed-up total and its associated variance. The RSE is the ratio of the square root of the overall variance and the overall grossed-up total. The 90% confidence interval around the overall total is this RSE value multiplied by 1.65 (the 95% confidence interval is the RSE multiplied by 1.96).

ANNEX 7

Options for Grossing up the Crusher Survey Returns

Introduction

The first section of this Annex explores three alternative approaches to grossing up the results of the survey of operators of crushers and screens, and explains why the method used in Chapter 4 has been preferred. The second section uses two of the three methods to develop regional estimates as well.

Grossing up to Produce a National Estimate

The simplest method of grossing up is to rely exclusively on the number of crushers thought in advance to form the survey population, and to ignore evidence of inaccuracies thrown up by the actual survey returns. This approach is followed in Table A7.1. The tonnage contributed by Group 3 operators (who were not thought to own any crushers) is included in this calculation.

Table A7.1 **National estimate No.1 the for production of recycled aggregate and soil in England in 2003**

	All Crushers
Expected population of crushers	783
Number of crushers thought in advance to be owned by respondents	387
Million tonnes of recycled aggregates reported by respondents (England only)	20.28
Mean tonnes of recycled aggregate per expected crusher	52,395
Million tonnes of recycled soil reported by respondents (England only)	2.99
Mean tonnes of recycled soil per expected crusher	7,723
Grossed-up production of recycled aggregate (million tonnes)	41.03
Band (90% confidence interval)	± 20%
(Graded:Ungraded ratio)	(68:32)
Grossed-up production of recycled soil (million tonnes)	6.05
Band (90% confidence interval)	± 26%
Total estimate No.1 for recycled aggregate and soil in England in 2003 (million tonnes)	47.08
Band (90% confidence interval)	± 18%

The second approach to grossing up exploits the actual knowledge gained about throughput per full-time crusher and applies it to an adjusted population of crushers. The adjustment also makes use of the best available information derived from the survey returns.

This second method amalgamates the crushers associated with the three groups of operators into a single adjusted population, taking into account the effect of the nil returns and the ownership of some crushers by Group 3 operators.

As reported in Chapter 4 (under the heading 'Survey Response Rate'), nil returns were sent in by 20 Group 1 operators thought in advance to have had 27 crushers between them, and eight Group 2 operators thought in advance to have had 22 crushers between them. These returns provide the best available evidence for adjusting the population of crushers downwards to take account of non-recyclers who had been incorrectly included in the survey database. (A subsequent adjustment then needs to be done to take account of the fact that some Group 3 operators turned out to own crushers, contrary to prior expectation.)

In advance, the 233 specific operators from Group 1 who responded to the survey were thought to own 308 recycling crushers between them. The actual returns showed that the owners of 27 of these crushers (8.8%) were not in fact involved in recycling. For Group 2 operators, the equivalent figures are 79 recycling crushers expected, of which 22 (27.8%) were not involved in recycling. For Group 3 operators, as reported above, the true rate of recycling crusher ownership was 0.19 machines per responding operator.

The overall population of crushers has therefore been reduced by 8.8% (Group 1 crushers) and 27.8% (Group 2 crushers). An upward adjustment is then made to the entire population of Group 3 operators. The adjusted estimate of the overall population of recycling crushers (rounded to the nearest whole number) is therefore as follows:

- 584 recycling crushers owned by Group 1 operators (640 minus 8.8%);
- 103 recycling crushers owned by Group 2 operators (143 minus 27.8%); and
- 60 recycling crushers owned by Group 3 operators (0.19 for each of 317 operators).

This total adjusted population estimate of 747 recycling crushers is within 5.0% of the pre-survey estimate of 785 (or, more accurately, the 783 in the ownership of Group 1 and 2 operators).

The equivalent calculation for survey respondents, which generates an estimate of 357, is as follows:

- 281 recycling crushers owned by Group 1 respondents (308 minus 8.8%);
- 57 recycling crushers owned by Group 2 respondents (79 minus 27.8%); and
- 19 recycling crushers owned by Group 3 respondents (0.19 for each of 100 operators).

The actual numbers of recycling crushers reported by respondents as being owned by them (368) was slightly lower than the number originally expected from those specific respondents (387), but 3.1% higher than the adjusted population estimate of recycling crushers applicable to those same operators (357).

Table A7.2 applies the average reported throughput per crusher (calculated using only those full-time crusher equivalents reported as working in England) to the adjusted estimate for the total population of recycling crushers.

Table A7.2 **National estimate No.2 for the production of recycled aggregate and soil in England in 2003**

	All Crushers
Adjusted population of crushers	747
Number of crushers (i.e. reported full-time equivalents) providing data	383
Million tonnes of recycled aggregates reported by respondents (England only)	20.28
Mean tonnes of recycled aggregate per crusher	52,876
Million tonnes of recycled soil reported by respondents (England only)	2.99
Mean tonnes of recycled soil per crusher	7,794
Grossed-up production of recycled aggregate (million tonnes)	39.52
Band (90% confidence interval)	± 18%
(Graded:Ungraded ratio)	(68:32)
Grossed-up production of recycled soil (million tonnes)	5.83
Band (90% confidence interval)	± 25%
Total estimate No.2 for recycled aggregate and soil in England in 2003 (million tonnes)	45.34
Band (90% confidence interval)	± 16%

Clearly, the estimates generated by the second method and reported in Table A7.2 are lower than those associated with the first method.

The third method, which is illustrated in Table A7.3, is in effect a variant on the approach embodied in Table A7.2 designed to improve the accuracy of subsequent regional estimates. It breaks the population of crushers into two, based on the human population density of the 'home territory' of each crusher (using two density bands: 1,000 or fewer persons per km^2 and 1,001 or more persons per km^2). Table A7.3 also uses the reported number of full-time crusher equivalents actually reported by those operators who responded to the survey (as in Table A7.2).

The estimates in Table A7.3 are marginally higher than those in Table A7.2, reflecting the slightly different response rates from operators of urban and rural crushers, and the different average throughputs of each.

Table A7.3 **National estimate No.3 for the production of recycled aggregate and soil in England in 2003**

	Rural areas (1,000 or fewer persons/km²)	Urban areas (1,001 or more persons/km²)	Total
Adjusted population of crushers	460	287	747
Number of crushers (i.e. reported full-time equivalents) providing data	240	143	383
Million tonnes of recycled aggregates reported by respondents (England only)	11.86	8.42	20.28
Mean tonnes of recycled aggregate per crusher	49,318	58,858	—
Million tonnes of recycled soil reported by respondents (England only)	1.59	1.40	2.99
Mean tonnes of recycled soil per crusher	6,622	9,765	-
Grossed-up production of recycled aggregate (million tonnes)	22.67	16.93	39.60
Band (90% confidence interval)			± 13%
(Graded:Ungraded ratio)	(65:35)	(72:28)	(68:32)
Grossed-up production of recycled soil (tonnes)	3.05	2.81	5.85
Band (90% confidence interval))			± 18%
Total estimate No.3 for recycled aggregate and soil in England in 2003 (tonnes)	25.73	19.72	45.45
Band (90% confidence interval)			± 10%

All three tables ignore the 3.4% share of recycling attributed by respondents to English-based machines but carried out outside England.

Although the second and third estimates require a slightly clumsy adjustment to the overall population of crushers in order to work, the fact that they generate estimates which are relatively close to the 'purer' first method gives some comfort that the actual adjustments are not unreasonable. The third estimate is the preferred one, because it opens the door to much better regional estimates, which is one of the key objectives of the study.

The equivalent total estimates for 2001 were 36.47 million tonnes of recycled aggregate and 6.81 million tonnes of recycled soil (giving 43.28 million tonnes of recycled material in total).

Confirmatory evidence that the market for recycled aggregate and soil has grown is provided by the responses to Question 7 on the survey form, which asked respondents to indicate whether their recycling business has grown or shrunk between 2001 and 2003, and offered a range of percentages for them to choose from. Of the 293 active recycling operators who returned survey forms, 165 stated that their business had grown, 41 stated that it had shrunk, 66 stated that it had stayed static, and 21 either did not reply, or indicated that they could not answer (because, for example, they had not been recycling in 2001).

Applying the direction and magnitude of change reported by each operator to their own returns (taking the mid-point in each range as the best estimate of magnitude) suggests that the overall growth of all respondents' businesses taken together has been just over 20%. (By way of illustration, if a respondent reported recycling 14,000 tonnes in 2003 and a growth of 40% in his business since 2001, that would be consistent with 10,000 tonnes of recycling in 2001.)

While the details of this calculation (which imply a level of around 43.8 million tonnes of aggregate and 8.2 million tonnes of soil in 2003) should not be regarded as more than indicative, it is certainly consistent with an appreciable rise in recycling between 2001 and 2003. This issue is discussed further in Annex 9.

Grossing up to Produce Regional Estimates

There are at least four ways of grossing up at a regional level:

- applying the national average to all crushers;
- applying the relevant regional averages to all crushers;
- the 'hybrid' method (in which the actual results are supplemented by estimates for non-respondents using the national average, as explained below);
- the 'population density band' method (which is explained below).

The first three of these were discussed and compared in 2002, and the decision taken then was to use the 'hybrid' method, despite its drawbacks. The question, therefore, is whether the 'population density band' method is preferable to the 'hybrid' method.

Briefly, the 'hybrid' method takes actual answers provided by respondents (which vary considerably), and uses the national average to estimate the likely return from non-respondents. This preserves some of the genuine variability encountered, but lacks statistical rigour.

The way in which the 'population density band' method is used to generate regional estimates is as follows:

- characterise each region according to the percentages of its population of recycling crushers that have their 'home base' in rural, intermediate (if appropriate) and urban districts (using human population density as a proxy for rural/urban character);
- multiply the percentage in each population density band by the national average throughput per crusher for that same density band;
- add the component parts together to get the regional average throughput per crusher;
- apply that average to the regional crusher population.

The way in which these two approaches work in practice (taking the North West as the worked example) can be seen below.

The 'hybrid' method applied to the North West region produces the following results:

- the original estimate for the number of crushers in the North West region was 84 (see Table 4.5 in Chapter 4);
- the adjusted (and unrounded) estimate for the population of crushers is 82.14 (78 less 8.8%, plus 6 less 27.8% plus 35 x 0.19) using the adjustments explained above;
- the actual number of full-time crusher equivalents reported in the North West region was 44.37, leaving 37.77 to account for;
- the actual tonnages reported in the North West region were 2,687,221 tonnes of recycled aggregate and 639,558 tonnes of soil (giving averages of 60,566 and 14,415 tonnes per full-time crusher equivalent respectively);
- applying the national averages of 52,876 tonnes of recycled aggregate and 7,794 tonnes of recycled soil per recycling crusher (as reported in Table A7.1) to the 37.77 non-reporting crushers produces estimates of 1,997,278 tonnes of recycled aggregate and 294,408 tonnes of recycled soil;
- adding the reported tonnages to the estimated tonnages generates total regional estimates for the North West of 4,684,499 tonnes of recycled aggregate and 933,966 tonnes of recycled soil.

The results from carrying out the same series of calculations for all nine regions in England are presented in Table A7.4. This is the regional breakdown of the national estimate in Table A7.2. By using the originally expected population of crushers, it would also be possible using the same method to generate a regional breakdown of the national estimate in Table A7.1.

Because the 'hybrid' method is just that, there is no statistically respectable way of calculating confidence intervals around the central estimate with any great rigour.

Table A7.4 **Regional estimate No.1 for the production of recycled aggregate and soil in the English regions in 2003 (million tonnes), using the 'hybrid' method**

Region	Recycled aggregate	Recycled soil	Total recycled aggregate and soil
North West	4.68	0.93	5.62
North East	3.25	0.30	3.55
Yorkshire & the Humber	5.58	0.73	6.31
West Midlands	4.14	0.62	4.76
East Midlands	4.40	0.52	4.92
East of England	4.32	0.63	4.95
London	5.27	0.59	5.86
South East	4.15	1.02	5.17
South West	3.71	0.50	4.21
England	39.51	5.82	45.34

The 'population density band' method applied to the North West produces the following results:

- 40.5% of the recycling crushers in the North West are based in rural areas (i.e. those with 1,000 or fewer persons per km^2), with 59.5% in more urban areas (i.e. those with 1,001 or more persons per km^2);
- the national average throughputs per recycling crusher are 49,318 tonnes of recycled aggregate and 6,622 tonnes of soil in rural areas, and 58,858 tonnes of recycled aggregate and 9,765 tonnes of soil in urban areas (as reported in Table A7.3);
- the 'weighted average' throughputs per recycling crusher in the North West are therefore 54,991 tonnes of recycled aggregate and 8,491 tonnes of soil;
- when applied to the same adjusted crusher population of 82.12 as was used in the 'hybrid' method, this produces estimates of 4.52 million tonnes of recycled aggregate and 0.70 million tonnes of recycled soil in the North West.

The results from carrying out the 'population density band' method for all nine regions of England using density bands of 1,000 persons or fewer per km^2 and 1,001 or more persons per km^2 are presented in Table A7.5. This is the regional breakdown of the national estimate in Table A7.3. Table A7.5 also reports the bands at a confidence interval of 90% for each element of the estimates.

Table A7.5 **Regional estimate No.2 for the production of recycled aggregate and soil in the English regions in 2003 (million tonnes, with bands at 90% confidence intervals)**

Region	Recycled aggregate	Recycled soil	Total recycled aggregate and soil
North West	4.52 ± 13%	0.70 ± 19%	5.21 ± 12%
North East	2.27 ± 13%	0.33 ± 18%	2.61 ± 12%
Yorkshire & the Humber	4.44 ± 14%	0.64 ± 19%	5.08 ± 13%
West Midlands	4.29 ± 13%	0.65 ± 18%	4.94 ± 12%
East Midlands	4.26 ± 14%	0.62 ± 19%	4.88 ± 12%
East of England	5.24 ± 17%	0.72 ± 23%	5.96 ± 15%
London	5.28 ± 18%	0.86 ± 25%	6.15 ± 16%
South East	4.82 ± 14%	0.70 ± 19%	5.52 ± 12%
South West	4.47 ± 17%	0.62 ± 23%	5.09 ± 15%
England	39.60 ± 13%	5.85 ± 18%	45.45 ± 10%

The choice between these two regional estimation methods should be based on the credibility of the respective outcomes, not just the fact that one comes with confidence intervals whereas the other does not. Making such a judgement requires a theoretical basis against which the competing estimates can be judged. In this case first principles suggest that production of recycled aggregate is likely to be linked to the size of the local population and the strength of the local economy (because these are both factors which influence the amount of demolition activity as well as the demand for aggregate). The 'hybrid' method regional estimates and the 'population density band' method regional estimates have therefore been compared to the regional distribution of human population (using 2001 Census returns) and to the regional estimates for Gross Value Added in 2002 (from the National Statistics website). The outcome of the comparisons was as follows:

- the correlation factors applicable to the regional estimates for recycled aggregate derived by the 'hybrid' method are 0.466 (regional population) and 0.421 (regional Gross Value Added);

- for the regional estimates derived by the 'population density band' method they are 0.777 (regional population) and 0.748 (regional Gross Value Added).

In drawing conclusions from this process it should be borne in mind that a correlation of 1.0 represents a 'perfect' relationship (in the sense that the sequence 1, 2, 3 is perfectly related to the sequence 2, 4, 6, by a factor of 2, though not necessarily by any actual cause and effect linkage), while a correlation factor of 0.0 represents a complete absence of relationship. A correlation factor of 0.5 suggests a weak relationship at best.

The correlation factors for the estimates derived from using the two other variants of the 'population density band' method suggested in Chapter 4 (with 'break points' at 250 and 2,500 persons per km^2 for one variant, and at 100 and 1,000 persons per km^2 for the other) were also calculated. For the variant with break points at 250 and 2,500

persons per km^2 the correlation factors were 0.669 (population) and 0.637 (GVA). For the variant with break points at 100 and 1,000 persons per km^2 the correlation factors were 0.755 (population) and 0.706 (GVA).

Taking all of the above into account, the 'regional population density' band method (using bands of 1,000 or fewer and 1,001 and more persons per km^2) has been preferred. The implication of this is that the method set out in Table A7.3 is the preferred method at the national level.

ANNEX 8

Detailed Regional and National Estimates

Table A8.1 (which extends over two pages) provides the detailed regional estimates that complement the national estimates set out in Table 5.1 in the main report.

Table A8.2 takes the sub-totals from Table A8.1 and expresses them as percentages of:

- all arisings of CDEW within the region; and
- the national total for the category concerned.

At the bottom of Table A8.2 are two unrelated indicators which are included for illustrative purposes only. They are:

- the regional human population (from the 2001 census); and
- the regional Gross Value Added figures for 2002 (as issued on 30 April 2004, on the National Statistics website).

All of the numbers are calculated from raw data and rounded. The rounded data may not add up.

Table A8.1 **Regional and national estimates for the re-use, recycling and disposal of hard C&D and excavation waste in England in 2003 ('000 tonnes) – Part 1 of 2**

	NW	NE	Y&H	W Mid	E Mid
Hard C&D/excavation waste crushed and/or screened for use as aggregate	4,517	2,273	4,443	4,290	4,263
Excavation waste/mixed CDEW screened for use as soil	697	333	638	647	619
Sub-total 1: Recycled aggregate and soil	5,214	2,607	5,082	4,937	4,882
Hard C&D waste used for landfill engineering or restoration	126	16	44	30	67
Excavation waste used for landfill engineering or restoration	712	208	476	497	746
Mixed CDEW (or unspecified material) used for landfill engineering or restoration	82	33	31	14	28
Sub-total 2: Material used for landfill engineering or restoration	921	257	552	542	842
Hard C&D waste used to backfill quarry voids	41	99	150	359	74
Excavation waste used to backfill quarry voids	650	598	1,987	679	1,559
Mixed CDEW (or unspecified material) used to backfill quarry voids	310	114	433	103	211
Sub-total 3: Material used to back-fill quarry voids	1,001	811	2,571	1,142	1,845
Hard C&D waste (excluding road planings) spread on registered exempt sites	338	104	348	87	134
Clean, unmixed excavation waste spread on registered exempt sites	1,572	433	1,362	442	566
Mixed CDEW spread on registered exempt sites	981	307	1,038	249	395
Sub-total 4: Material used at Paragraph 9&19 registered exempt sites	2,892	844	2,748	779	1,095
Clean, unmixed hard C&D waste disposed of at landfills	152	48	42	67	76
Mixed and/or contaminated hard C&D waste disposed of at landfills	60	5	19	10	21
Clean excavation waste disposed of at landfills	220	87	290	259	483
Mixed and/or contaminated excavation waste disposed of at landfills	308	62	224	261	313
Mixed CDEW and unspecified materials disposed of at landfills	346	157	313	135	323
Sub-total 5: Material disposed of at landfills	1,087	358	887	731	1,216
Total	11,114	4,877	11,840	8,130	9,879

Table A8.1 **Regional and national estimates for the re-use, recycling and disposal of hard C&D and excavation waste in England in 2003 ('000 tonnes) – Part 2 of 2**

	East	London	SE	SW	England
Hard C&D/excavation waste crushed and/or screened for use as aggregate	5,237	5,278	4,822	4,473	39,597
Excavation waste/mixed CDEW screened for use as soil	723	876	700	617	5,852
Sub-total 1: Recycled aggregate and soil	5,961	6,153	5,522	5,090	45,448
Hard C&D waste used for landfill engineering or restoration	106	7	225	73	694
Excavation waste used for landfill engineering or restoration	483	47	1,630	520	5,318
Mixed CDEW (or unspecified material) used for landfill engineering or restoration	39	2	132	79	441
Sub-total 2: Material used for landfill engineering or restoration	627	55	1,986	672	6,454
Hard C&D waste used to backfill quarry voids	110	22	366	93	1,314
Excavation waste used to backfill quarry voids	1,580	122	1,943	713	9,832
Mixed CDEW (or unspecified material) used to backfill quarry voids	365	144	430	153	2,264
Sub-total 3: Material used to back-fill quarry voids	2,056	288	2,738	959	13,410
Hard C&D waste (excluding road planings) spread on registered exempt sites	282	77	364	229	1,963
Clean, unmixed excavation waste spread on registered exempt sites	1,046	265	1,464	1,578	8,728
Mixed CDEW spread on registered exempt sites	847	233	1,082	605	5,738
Sub-total 4: Material used at Paragraph 9&19 registered exempt sites	2,174	575	2,910	2,412	16,429
Clean, unmixed hard C&D waste disposed of at landfills	101	6	99	39	630
Mixed and/or contaminated hard C&D waste disposed of at landfills	21	2	46	43	225
Clean excavation waste disposed of at landfills	275	28	836	281	2,759
Mixed and/or contaminated excavation waste disposed of at landfills	603	106	372	182	2,432
Mixed CDEW and unspecified materials disposed of at landfills	790	32	719	331	3,146
Sub-total 5: Material disposed of at landfills	1,789	175	2,073	875	9,192
Total	12,608	7,247	15,230	10,007	90,932

Table A8.2 **Regional and national patterns – Part 1 of 2**

	NW	NE	Y&H	W Mid	E Mid
Recycled aggregate and soil as % of CDEW in region	46.9%	53.4%	42.9%	60.7%	49.4%
Material used for landfill engineering or restoration as % of CDEW in region	8.3%	5.3%	4.7%	6.7%	8.5%
Material used to backfill quarry voids as % of CDEW in region	9.0%	16.6%	21.7%	14.0%	18.7%
Material used at Para 9&19 registered exempt sites as % of CDEW in region	26.0%	17.3%	23.2%	9.6%	11.1%
Material disposed of at landfills as % of CDEW in region	9.8%	7.3%	7.5%	9.0%	12.3%
Recycled aggregate and soil as % of Total for England	11.5%	5.7%	11.2%	10.9%	10.7%
Material used for landfill engineering or restoration as % of Total for England	14.3%	4.0%	8.6%	8.4%	13.0%
Material used to backfill quarry voids as % of Total for England	7.5%	6.1%	19.2%	8.5%	13.8%
Material used at Para 9&19 registered exempt sites as % of Total for England	17.6%	5.1%	16.7%	4.7%	6.7%
Material disposed of at landfills as % of Total for England	11.8%	3.9%	9.7%	8.0%	13.2%
All CDEW	12.2%	5.4%	13.0%	8.9%	10.9%
Other indicators (for comparison only)					
Population at 2001 census (million persons)	6,730	2,515	4,965	5,267	4,172
Regional population as % of total for England	13.7	5.1	10.1	10.7	8.5
Regional Gross Value Added in 2002 (£ billion)	93,137	29,531	65,698	72,946	59,060
Regional Gross Value Added as % of total for England	12.0	3.8	8.5	9.4	7.6

Table A8.2 **Regional and national patterns – Part 2 of 2**

	East	London	SE	SW	England
Recycled aggregate and soil as % of CDEW in region	47.3%	84.9%	36.3%	50.9%	50.0%
Material used for landfill engineering or restoration as % of CDEW in region	5.0%	0.8%	13.0%	6.7%	7.1%
Material used to backfill quarry voids as % of CDEW in region	16.3%	4.0%	18.0%	9.6%	14.7%
Material used at Para 9&19 registered exempt sites as % of CDEW in region	17.2%	7.9%	19.1%	24.1%	18.1%
Material disposed of at landfills as % of CDEW in region	14.2%	2.4%	13.6%	8.7%	10.1%
Recycled aggregate and soil as % of Total for England	13.1%	13.5%	12.2%	11.2%	100.0%
Material used for landfill engineering or restoration as % of Total for England	9.7%	0.9%	30.8%	10.4%	100.0%
Material used to backfill quarry voids as % of Total for England	15.3%	2.1%	20.4%	7.1%	100.0%
Material used at Para 9&19 registered exempt sites as % of Total for England	13.2%	3.5%	17.7%	14.7%	100.0%
Material disposed of at landfills as % of Total for England	19.5%	1.9%	22.6%	9.5%	100.0%
All CDEW	13.9%	8.0%	16.7%	11.0%	100.0%
Other indicators (for comparison only)					
Population at 2001 census (million persons)	5,381	7,172	8,001	4,928	49,138
Regional population as % of total for England	11.0	14.6	16.3	10.0	100.0
Regional Gross Value Added in 2002 (£ billion)	90,984	146,927	147,799	69,185	775,267
Regional Gross Value Added as % of total for England	11.7	19.0	19.1	8.9	100.0

ANNEX 9

Survey of Crushing & Screening: Additional Information

Introduction

All data in this Annex come from actual survey returns, not from grossed-up national or regional estimates.

Relationships between Graded and Ungraded Recycled Aggregate and Soil

For England as a whole and for all survey respondents, just over two thirds of recycled aggregate was graded and one third ungraded. In 2001 the ratio was very close to 1:1, whereas in 1999 it had also been more like 2:1.

In round terms, for every tonne of recycled aggregate produced, recyclers generate an additional 150 kg of recycled soil. The following table shows the equivalent figures for the English regions.

Table A9.1 **Relationships between graded and ungraded recycled aggregate and soil, 2003**

Region	Ratio of Graded:Ungraded recycled aggregate	Kg of recycled soil per tonne of recycled aggregate
North West	67:33	238
North East	95:5	85
Yorkshire & the Humber	67:33	112
West Midlands	81:19	153
East Midlands	58:42	73
East of England	66:34	143
Greater London	58:42	83
South East	51:49	345
South West	65:35	119
England	68:32	147

There is no obvious pattern to the regional differences

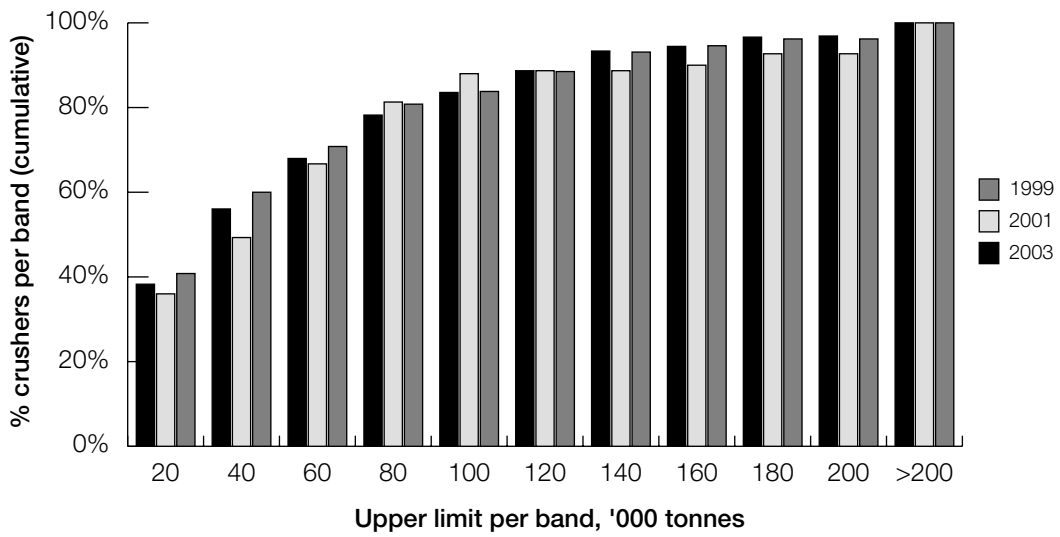
Structure of Crusher Population by Tonnage Throughput

The size distribution of crushers can be measured by adding together all of the full-time crusher equivalents (as defined in Annex 3) which produced defined tonnages of recycled aggregate during 2003. This is the first survey in which the concept of the full-time crusher equivalent has been used, making any comparison with previous survey findings inexact. The method used in 2001 will have tended to overstate the influence of some large crushers by failing to pick up the effect of part-time hired crushers (so that an operator with one owned crusher and a second machine which was hired for half the year, and who processed 90,000 tonnes, would have been recorded as having a single 90,000-tonne machine in 2001, but one and a half 60,000-tonne machines in 2003). Nevertheless, the distribution shows considerable similarity. These data, with those for 1999, are graphed in Figure A9.1

Table A9.2 **Distribution of crusher throughput, 2003 vs 2001**

Tonnes of recycled aggregate produced per full-time crusher equivalent	Full-time crusher equivalents, 2003	% of all active full-time crusher equivalents, 2003	Cumulative % 2003 (England)	Cumulative % 2001 (England and Wales)
1 to 19,999	150.0	38.3%	38.3%	36.0%
20,000 to 39,999	69.7	17.8%	56.0%	49.3%
40,000 to 59,999	46.7	11.9%	68.0%	66.7%
60,000 to 79,999	40.2	10.3%	78.2%	81.3%
80,000 to 99,999	20.9	5.3%	83.6%	88.0%
100,000 to 119,999	20.1	5.1%	88.7%	88.7%
120,000 to 139,999	18.3	4.7%	93.3%	88.7%
140,000 to 159,999	4.3	1.1%	94.4%	90.0%
160,000 to 179,999	8.6	2.2%	96.6%	92.7%
180,000 to 199,999	1.0	0.3%	96.9%	92.7%
200,000 or more	12.2	3.1%	100.0%	100.0%

Figure A9.1 **Cumulative distribution of crusher throughput, 1999 to 2003**



In the report on the 2001 survey, a comparison was made between the pattern of throughput reported by survey respondents and the distribution reported to the NFDC by its members in their annual returns. Because NFDC members report by company rather than by crusher, the survey returns have been re-worked on the same basis. The comparison is shown in Table A9.3 below.

The comparison shows that NFDC members are less likely to fall at either end of the distribution curve (i.e. they are less likely than non-demolition specialists to process either a few tonnes or a very large number. This is logical since very small operators are less likely to be members of the NFDC, and very large operators are more likely to be operators of fixed recycling centres rather than demolition businesses). The NFDC survey reported a steep increase in crushing by its members (both the number of companies, and the average tonnage that they reported).

Table A9.3 **Distribution of throughput per business, 2003 survey vs NFDC members' survey, 2002**

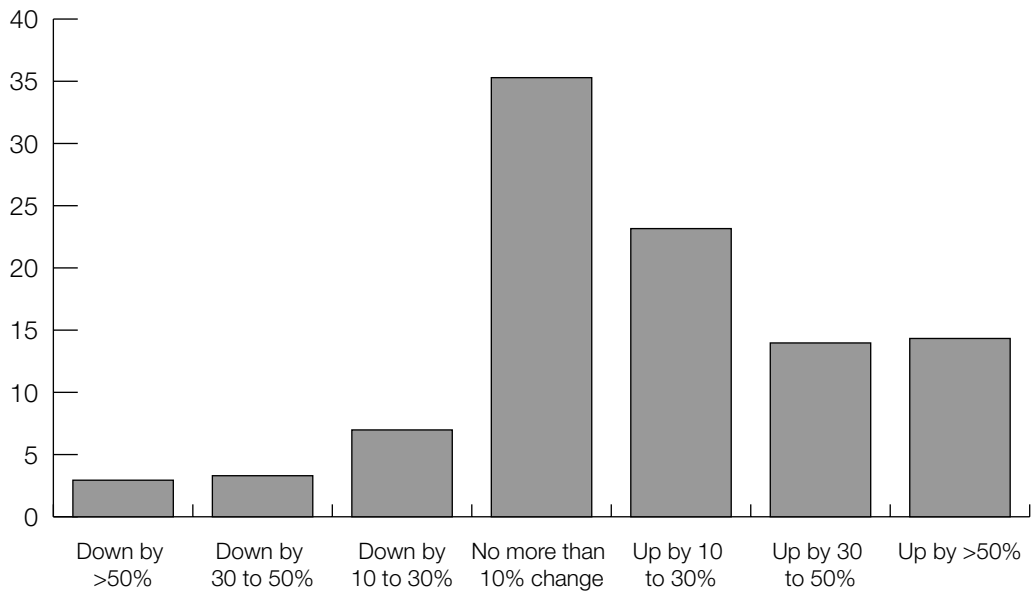
Tonnes of recycled aggregate produced per business	2003 survey	NFDC members, 2002
Companies with non-zero returns for recycled aggregate	281	91
Total tonnes reported	21.01 million	7.91 million
Average tonnes per company	74,711	86,974
1 to 19,999	42.9%	24.2%
20,000 to 39,999	62.1%	47.3%
40,000 to 59,999	73.8%	60.4%
60,000 to 79,999	79.1%	69.2%
80,000 to 99,999	81.9%	75.8%
100,000 to 119,999	85.1%	80.2%
120,000 to 139,999	86.2%	82.4%
140,000 to 159,999	87.9%	84.6%
160,000 to 179,999	88.7%	87.9%
180,000 to 199,999	89.7%	90.1%
200,000 or more	100.0%	100.0%

Change Reported by Operators of Crushers

All operators were asked how much their own recycling business had changed since 2001. The 'headline figures' are reported in Chapter 4, but more detailed results are given below.

Figure A9.2 shows the balance between those who reported growth and those who reported decline. All of those who indicated that their output had grown or declined by 10% or less have been added to those who answered 'no change' to create a band 20 percentage points wide, like most of the others.

Figure A9.2 **Change in recycling reported since 2001**



As can be seen from the regional breakdown in Table A9.4, those operators who reported growth outnumbered the rest in all regions except the West Midlands and the East of England. When measured by the number of full-time crusher equivalents operated by the same respondents, the only region where those reporting growth were in a minority was the East of England. To a large extent this was due to a substantial number of operators reporting no change, and one large operator who did not respond to the particular question.

A statistical analysis of the returns in Table A9.4 (using McNemar's test) shows that it is extremely unlikely that the results reported could be the result of random chance. For England as a whole and for five of the nine regions (North West, Yorkshire & the Humber, East Midlands, South East and South West) the results are significant at a level of 99.9%, for Greater London they are significant at 99%, and for the North East and East of England they are significant at 95%. Only the result for the West Midlands is not significant at 90% (seven operators reporting expansion against five reporting less work, yet those reporting expansion have many more crushers than those reporting less work).

Table A9.4 **Change reported by recycling businesses (and the full-time crusher equivalents operated by them), 2003 vs 2001**

Region	Business had grown since 2001	Business had shrunk since 2001	No change	Information not available (or not relevant)
North West	17 operators (20.75 FTCEs)	2 operators (2.00 FTCEs)	7 operators (11.00 FTCEs)	5 operators (5.25 FTCEs)
North East	10 operators (16.25 FTCEs)	3 operators (2.25 FTCEs)	2 operators (2.10 FTCEs)	0 operators (0.00 FTCEs)
Yorkshire & the Humber	22 operators (30.55 FTCEs)	4 operators (4.25 FTCEs)	7 operators (18.81 FTCEs)	2 operators (3.00 FTCEs)
West Midlands	7 operators (18.00 FTCEs)	5 operators (7.25 FTCEs)	4 operators (5.00 FTCEs)	2 operators (3.00 FTCEs)
East Midlands	19 operators (26.50 FTCEs)	4 operators (3.20 FTCEs)	2 operators (1.10 FTCEs)	3 operators (9.00 FTCEs)
East of England	22 operators (24.54 FTCEs)	11 operators (11.50 FTCEs)	15 operators (16.05 FTCEs)	2 operators (14.00 FTCEs)
Greater London	14 operators (30.20 FTCEs)	2 operators (2.20 FTCEs)	8 operators (11.00 FTCEs)	1 operators (1.00 FTCEs)
South East	26 operators (25.15 FTCEs)	4 operators (3.75 FTCEs)	11 operators (11.50 FTCEs)	5 operators (3.40 FTCEs)
South West	28 operators (33.85 FTCEs)	6 operators (7.25 FTCEs)	10 operators (11.1 FTCEs)	2 operators (1.10 FTCEs)
England	165 operators (225.79 FTCEs)	41 operators (43.65 FTCEs)	66 operators (87.66 FTCEs)	22 operators (39.75 FTCEs)
% for England (operators)	56.1%	13.9%	22.4%	7.5%
% for England (full-time crusher equivalents)	56.9%	11.0%	22.1%	10.0%

Because the returns came only from businesses which were active when the survey forms were sent out (and therefore omitted any businesses that had ceased trading during 2002 or 2003), comparing total tonnages derived from them will tend to overstate the magnitude of the change. At least as important as this is the way in which data from the final column is treated. This column includes a mixture of businesses that were new to recycling (i.e. they had no equivalent production in 2001 against which to compare their 2003 performance) and businesses which either could not or chose not to answer the question (but which would have been producing recycled aggregate in 2001).

It should be recalled that the question dealt with each respondent's whole business (not just recycled aggregate, but soil as well, and not just recycling in England but all recycling work). The analysis in the table above also allocates the full-time crusher equivalents to the region where their owner is based, not to the region where they actually worked (the difference between these is discussed in greater detail below).

Table A9.5 shows the effect of including and excluding the returns from the final column of Table A9.4 in a calculation of regional and national growth rates.

Table A9.5 **Implications of change reported by recycling businesses, 2003 vs 2001**

Region	Calculated growth between 2001 and 2003 using all survey returns	Calculated growth between 2001 and 2003 ignoring respondents who did not answer that question
North West	20.1%	10.0%
North East	15.0%	15.0%
Yorkshire & the Humber	14.9%	13.3%
West Midlands	9.6%	8.7%
East Midlands	54.0%	10.9%
East of England	11.9%	7.7%
Greater London	17.4%	17.3%
South East	38.7%	19.1%
South West	24.7%	23.3%
England	20.2%	13.4%

It is clear that the tonnage produced in 2003 by operators who did not report how much their business had changed since 2001 can have a very big impact on the apparent rate of change in the region as a whole. A comparison between the two estimates for the North East (which had no such non-reporting respondents) and the East Midlands (which had three, one of which was a very large business in 2003) illustrates this point very clearly.

Statistical analysis (using a paired-comparison t-test) lends further support to the contention that the rise in recycling has been genuine: the rise in the final column of Table A9.5 is significant at 99.9%, four regions (Yorkshire & the Humber, Greater London, South East and South West) are significant at 99%, the North West is significant at 95% and the remaining regions are not significant at 90%.

Reasons given for the direction and degree of change varied considerably. Of the 165 operators who reported that their business had expanded, 147 gave a reason (or combination of reasons).

The single most frequently mentioned factor was the Aggregates Levy, which was cited as a reason for expansion by 34 operators (though only one in the West Midlands and only one in the East of England). Many of these 34 cited other factors as well, notably the cost of landfill, and their clients' general awareness of recycled aggregate.

Once those who cited the Aggregates Levy had been removed from the list, there were 23 more respondents who mentioned awareness/acceptance of recycled materials as a major factor in their growth, and a further 14 who specified increased demand for recycled materials.

Once those respondents had also been removed from the list, there were 76 companies left on the list of those that had reported expansion. Six of these companies particularly cited the impact of landfill costs.

Of the remaining 70 companies:

- 20 mentioned new or better equipment or work practices;
- 10 mentioned the importance of company policy as a driver for growth;
- 11 mentioned better local market conditions; and
- 29 mentioned a wide range of other reasons.

Forty one companies reported that their business had declined. Ten of these specifically mentioned that there had been less demolition locally and/or less material suitable for crushing (four of these being from the East of England).

Of the remaining 31:

- seven gave a growth in local competition as the reason for their decline;
- five cited changing company policy; and
- 19 gave a wide range of other reasons (or no reason).

The NFDC's 2002 members' survey also showed a steep rise in recycling activity compared to their own previous surveys. Whilst this is not susceptible to any detailed analysis, it lends further support to the contention that existing recyclers have seen their businesses growing both individually and in aggregate.

The Extent of 'Out-of-Area' Working

Every regional group of respondents can be associated with an estimate of the number of crushers which they were thought in advance of the survey to own, as well as the number of full-time crusher equivalents which they reported using (and the places where they reported using them). Once this has been done, the extent and importance of out-of-area working can be seen.

The second and third columns in Table A9.6 show how many crushers were thought to be owned by recycling respondents, and how many full-time crusher equivalents they actually reported operating during 2003, distributed by region. The final row records how many full-time crusher equivalents were reported to be operating in the region concerned from all of the respondents.

Table A9.6 displays the same basic information in percentage terms. If every operator worked exclusively in his home territory, there would be a series of 100.0's going diagonally down across the table. The extent to which this is not true is a measure of 'out-of-area' working. The percentage figures in the bottom row confirm the extent to which the area identified by the column concerned attracts crushers from other regions. Regions with figures greater than 100% 'import' crushers from elsewhere,

while regions with less than 100% are net 'exporters', on the basis of the returns actually provided by respondents.

It is clear from the evidence contained within these two tables that there is a considerable amount of cross-border working between Yorkshire & the Humber (the 'exporting' region) and the North East (the 'importing' one).

Table A9.6 Comparison of where crushers were expected and where they were reported in 2003, expressed as full-time crusher equivalents

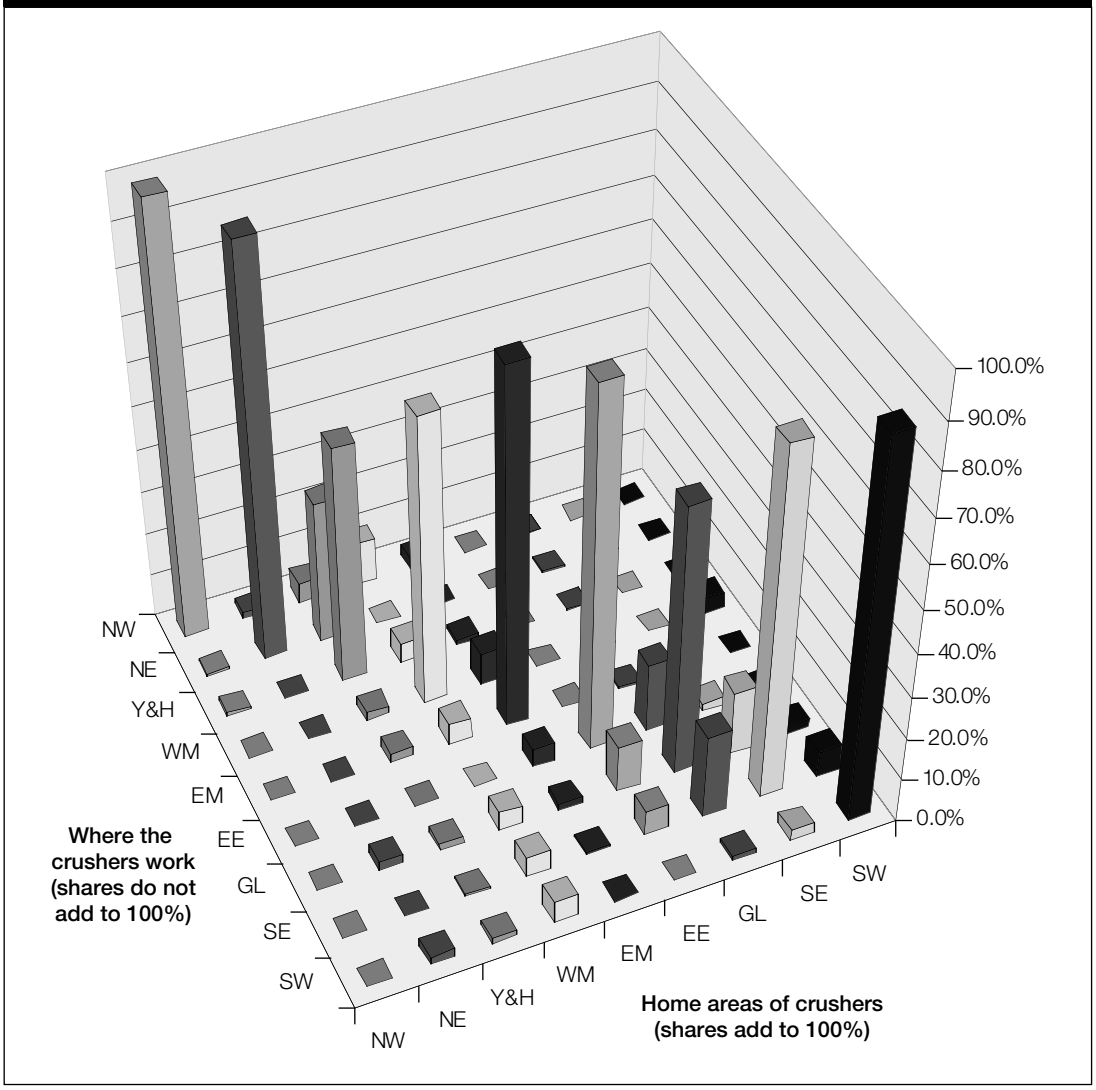
Mailing List Region	Cr. exp-ected	Total FT-ECs	Regions where the crushers actually worked in 2003 (as FTECs)								
			NW	NE	Y&H	WM	EM	EE	GL	SE	SW
NW	35	38.0	37.5	0.2	0.3	0.1	—	—	—	—	—
NE	32	20.1	0.3	19.0	—	—	—	—	0.4	—	0.4
Y&H	54	53.8	2.4	17.9	29.6	1.1	1.2	—	0.8	0.3	0.6
WM	39	31.4	3.2	—	1.4	21.0	1.5	—	1.4	1.4	1.5
EM	33	33.8	0.9	—	0.4	2.6	27.9	1.4	0.5	0.2	—
EE	57	66.1	—	—	—	—	—	55.2	7.2	3.8	—
GL	34	44.4	0.1	0.1	0.1	0.2	0.2	7.0	27.7	8.5	0.4
SE	44	43.5	—	—	—	—	0.2	0.8	6.5	35.1	1.0
SW	59	52.4	—	—	—	2.0	—	0.4	1.1	3.2	45.7
England	387	383.5	44.4	37.2	31.8	26.9	30.9	64.8	45.5	52.4	49.7

Table A9.7 Comparison of where crushers were expected and where they were reported in 2003, expressed as % of reported full-time crusher equivalents

Mailing List Region	Total number of FTCEs	% of FTECs actually working in region in 2003								
		NW	NE	Y&H	WM	EM	EE	GL	SE	SW
NW	38.0	98.8	0.4	0.7	0.1	—	—	—	—	—
NE	20.1	1.5	94.5	—	—	—	—	2.0	—	2.0
Y&H	53.8	4.5	33.2	55.0	2.0	2.2	—	1.5	0.5	1.2
WM	31.4	10.1	—	4.6	66.9	4.8	—	4.3	4.5	4.8
EM	33.8	2.5	—	1.2	7.6	82.5	4.1	1.5	0.6	—
EE	66.1	—	—	—	—	—	83.5	10.8	5.7	—
GL	44.4	0.2	0.2	0.2	0.5	0.5	15.8	62.5	19.2	0.9
SE	43.5	—	—	—	—	0.5	1.8	14.8	80.6	2.3
SW	52.4	—	—	—	3.9	—	0.7	2.1	6.1	87.2
England	383.5	117.6	128.4	61.7	80.9	90.4	106.0	99.6	117.0	98.5

The figures from Table A9.7 are also illustrated graphically in Figure A9.3

Figure A9.3 **Extent of 'home working' vs 'out-of-area working' by crushers in 2003**



The Extent to which Recyclers also do Other Things

Returns were received from 294 active recyclers. The largest single group of these (175 operators, representing 59.5% of the total) indicated that they were involved in aggregate recycling only.

The majority of the remaining 119 (totalling 85 operators, or 28.9% of the total) also reported crushing 'blacktop' (from roads and carparks). This sub-group can be accounted for as follows:

- 58 were involved in crushing demolition waste and 'blacktop' (but no other materials);
- 14 were involved in crushing demolition waste, 'blacktop' and primary aggregate;

- 7 were involved in crushing demolition waste, 'blacktop' and other materials (such as china clay waste and waste glass); and

- 6 were involved in crushing demolition waste, 'blacktop', primary aggregate and other materials (such as china clay waste and waste glass).

The remaining 34 respondents (representing 11.6% of the total) can be broken down into three further groups, as follows:

- 23 were involved in crushing demolition waste and primary aggregate (but no other materials);

- 5 were involved in crushing demolition waste, primary aggregate and other materials (such as china clay waste and waste glass); and

- 6 were involved in crushing demolition waste and other materials (such as china clay waste and waste glass).

ANNEX 10

Survey of Licensed Landfills: Additional Information

Introduction

All data in this Annex come from actual survey returns, not from grossed-up national or regional estimates.

Types of Aggregate Entering Landfills

Eighty five respondents reported accepting a total of 1.53 million tonnes of aggregate or aggregate-type material entered their sites during 2003. This can be broken down as follows:

- 0.21 million tonnes purchased primary aggregate;
- 0.44 million tonnes primary aggregate dug on site;
- 0.18 million tonnes of waste from aggregate quarrying;
- 0.62 million tonnes of other waste-derived aggregate (e.g. slags etc); and
- 0.07 million tonnes of crushed C&D waste (as opposed to the uncrushed material picked up by the questions relating to CDEW).

Primary aggregate was purchased by 49 landfills. Eight of these purchased 10,000 tonnes or more. These sites accounted between them for 56% of the total tonnage, all of it being used for site engineering. Over the 49 landfills as a whole, 93% of the purchased primary aggregate was used for site engineering.

All of the primary aggregate dug on site came from 10 sites. The two largest of these accounted for 84% of the total, all of which was used for backfilling quarry voids.

Waste from aggregate quarrying was reported on 13 sites. Eight of these took 15,000 tonnes or more, and between them accounted for 91% of the total tonnage.

Other waste-derived aggregate was reported on 13 sites. Five of these accounted for 96% of the total, most of which was used as quarry backfill with the balance (of just over 100,000 tonnes) disposed of as waste on one site.

Crushed C&D waste was reported on 28 sites. Twelve of these took more than 1,000 tonnes and accounted for 92% of the total tonnage. Most crushed C&D waste was used for site engineering, but one landfill disposed of more than 25,000 tonnes as waste.

Use of Aggregate on Landfills

As reported above, 85 landfills accepted a total of 1.53 million tonnes of aggregate or aggregate-type material during 2003. This can be broken down by use (or disposal) as follows:

- 0.95 million tonnes used for backfilling quarry voids;
- 0.42 million tonnes used for site engineering, capping or restoration (69% of it for site engineering and 31% for capping and restoration); and
- 0.16 million tonnes disposed of as waste.

Sixteen sites reported using aggregate to backfill quarry voids. Six of these took 93% of the total, all of it either primary material dug on site, quarry waste or other waste-derived aggregate.

Sixty two sites reported using almost 420,000 tonnes of aggregate for site engineering, capping or restoration. The same sites used 1.52 million tonnes of CDEW for the same purposes (the main categories being 0.96 million tonnes of clean excavation waste, 0.30 million tonnes of contaminated excavation waste and 0.14 million tonnes of clean hard C&D waste).

Ten sites disposed of some aggregate as waste, all of them Group E or F landfills. Three of these disposed of more than 15,000 tonnes each, and accounted between them for 91% of the total tonnage.

Conclusions

Based on the figures reported above, it does appear that some landfill operators are obliged to purchase primary aggregate because they cannot get enough CDEW of the right sort.

The fact that some material described as primary aggregate is dug on site and then used to backfill quarry voids suggests that the market for low-grade primary aggregate has shrunk faster than operators' extraction strategies have been able to keep up.

It also appears that landfills only represent a very small part of the market for recycled aggregate.

ANNEX 11

Survey of Paragraph 9 & 19 Registered Exempt Sites: Additional Information

Introduction

All data in this Annex come from actual survey returns, not from grossed-up national or regional estimates.

The Extent to which Large Sites Dominate Survey Returns

Returns covering 114 Paragraph 9&19 registered exempt sites which had been active during 2003 were received. Thirteen of these only accepted materials which are not classified (for the purposes of this study) as unprocessed CDEW (meaning ash, dredgings, road planings and recycled aggregate, this latter category being omitted to avoid double counting, because it would be picked up by the survey of crushing and screening).

In total, the 101 sites that accepted CDEW received 3,441,370 tonnes of CDEW. Table A11.1 shows how heavily concentrated this total tonnage was on the largest sites.

Table A11.1 **Contribution from the largest registered exempt sites, 2003**

No of sites	Selection criteria	Tonnes of CDEW from selected sites (cumulative)	% of total tonnes of CDEW (cumulative)	% of 114 sites (cumulative)
1	Largest single site	350,000	10.2%	0.9%
10	> 100,000 tonnes per site	1,743,275	50.7%	8.8%
20	> 55,000 tonnes per site	2,589,546	75.2%	17.5%
33	> 25,000 tonnes per site	3,121,739	90.7%	28.9%
48	> or = 10,000 tonnes per site	3,337,789	97.0%	42.1%
101	All sites accepting CDEW	3,441,370	100.0%	88.6%

The top 10 sites had the following characteristics:

- four were quarries being backfilled (one also involving a leisure project);
- two were housing or industrial development schemes;
- one was a major transport infrastructure project;
- one was a leisure project (this was the site which took the largest tonnage of all);
- one was a landscaping or noise bund project;
- one was described as 'other' (and was in fact a waste recycling depot).

The 10 next largest sites were made up as follows:

- three leisure projects;
- two quarries being backfilled;
- two landscaping or noise bund projects;
- three other (unspecified) project.

These 20 sites accounted between them for 75.2% of the CDEW reported by all respondents. As can be deduced from the above, the most important categories (in terms of tonnage used) are former quarries being backfilled and leisure projects. After eliminating double counting (associated with one leisure projects being developed on a former quarry), these two categories accounted for 48.1% of the total tonnage reported between them.

The Pattern of Regional Returns

The regional estimates reported in Chapter 4 are based on the principle that the distinction between sites that were thought in advance to be large and those thought in advance to be small should be maintained. The national average tonnages for sites thought in advance to be large (and small) were projected onto the regional populations of sites in the relevant categories.

The information reported in Table A11.2 comes from the actual unadjusted survey returns, and mixes sites thought in advance to be large with those thought to be small. Even so, the similarity in the patterns displayed by the final two columns is quite striking (and certainly much better than random).

Table A11.2 **Regional returns from Paragraph 9&19 registered exempt sites, 2003**

Region	No of sites reporting data	'000 tonnes of CDEW reported	Average tonnes per reporting site	Regional share of total tonnes of CDEW reported	Regional share of CDEW estimated/ reported in Chapter 4
North West	14	560	39,973	16.3%	17.6%
North East	17	158	9,317	4.6%	5.2%
Yorkshire & the Humber	15	518	34,519	15.0%	16.9%
West Midlands	9	292	32,455	8.5%	4.7%
East Midlands	11	479	43,500	13.9%	6.7%
East of England	14	499	35,678	14.5%	13.4%
Greater London	3	130	43,424	3.8%	3.6%
South East	14	451	32,206	13.1%	17.8%
South West	17	354	20,843	10.3%	14.3%
England	114	3,441	30,187	100.0%	100.0%

Although (as explained in Chapter 4) it is impossible to match every return against an expected registered exempt site with complete confidence, a check was carried out on the 48 sites which reported accepting 10,000 tonnes or more. Of these, 35 were in the region where they were expected to be, and of the 13 that were not, nine were reported by a single major company which turned out to have many more sites than expected. These 'unexpected' sites were spread all over the country, and not concentrated in a single region (which would have been a much greater cause for concern had it been the case).

ANNEX 12

Format for Suggested Future Survey Forms

The following are intended to provide starting points from which future survey forms (looking at arisings of CDEW in England in the year XXXX) might be drawn up. They are based closely on the forms used in 2003, but with some modifications discussed in the main text.

If might be decided to include ancillary questions (about, for example, the age structure of crushers, the make-up of the CDEW being crushed and/or screened, or the travel distance of CDEW going to landfills and registered exempt sites). However, it is believed that the questions included in the following draft forms are capable of eliciting the key information about CDEW arisings and use.

It is expected that the first page of all three forms would have to be expanded to include additional explanatory text, and that details of a FreePost return address would be included at some point on the form. In 2003, unlike 1999 and 2001, covering letters were not sent.

If (as appears likely) the way in which exemptions are dealt with has changed by XXXX, the survey form may have to be de-drafted from first principles to reflect the new reality. If, on the other hand, the necessary information can be abstracted direct from Environment Agency records, a survey may not be needed at all.

(Mailing label addressed to operator)

Construction, Demolition & Excavation Waste Survey

Confidential National Survey of Crushing & Screening Activity in XXXX

Explanatory/introductory text, including the proposed closing date etc. It is suggested that the following sentence should be included. **All data provided will be treated as confidential, and will be presented in such a way that individual sources cannot be identified**.

Q1: Which of these products did you **produce in XXXX**? (Please tick the relevant boxes)	**Primary** (quarried) aggregate	
	Recycled aggregate/soil (from crushed concrete, brick, development site excavation waste etc)	
	Recycled **'blacktop'**	
	Other (e.g. from ash, slag, china clay, etc)	(*)
	None of the above	(*)

(*) If one of these is the only box ticked, please complete Questions 2 and 3 and return the form

Q2: How many mobile crushers and screens did you own or hire in XXXX?	**Mobile Crushers** (with or without integral screens)	(owned)	(hired in)
	Stand-alone screens	(owned)	(hired in)

For Q3, please estimate how many full-time machines your answer to Q2 is equivalent to. For example, if you owned a crusher or screen and you are the only person/company to use it, please count this as one full-time machine, however much or little you use it. If you hired a crusher for a week every month, please count this as a quarter of a crusher. If you hired a crusher for a five-week period, please count this as one tenth of a crusher, etc etc.

Q3: How many **full-time machines** is your answer to Q2 **equivalent** to?	Mobile Crushers	
	Stand-alone screens	

Q4: How many tonnes of **recycled aggregate and/or soil** did you produce from construction, demolition or excavation waste in XXXX, under the following headings?	**Graded aggregate**	
	Ungraded aggregate (including general fill)	
	Clean topsoil	
	Other clean/usable soil (not topsoil)	
	Other usable materials (e.g. steel)	
	Waste (e.g. wood, plastic, fines)	
If you do not keep detailed records, estimated figures or ranges (e.g. 15-20,000 tonnes) would still be very helpful.		

Q5: **Where** were your machines active in XXXX? Please give your best estimate of the percentages of the total tonnage above in each district/county/city (e.g. '50% London, 25% East Hertfordshire, 20% Brentwood (Essex), 5% South Buckinghamshire'). Please include any work outside England.

Q6: How did your company's **level of C&D waste recycling in XXXX** compare with **YYYY**? Please give your best estimate by ticking the appropriate box below.

Change (in tonnes)	Over 50% **down**	30 to 50% **down**	10 to 30% **down**	0 to 10% **down**	about the **same**	0 to 10% **up**	10 to 30% **up**	30 to 50% **up**	Over 50% **up**
Compared to YYYY, XXXX was:									
What do you think brought about this change?									

(Mailing label identifying individual landfill)

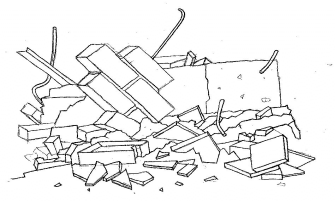
Construction, Demolition & Excavation Waste Survey

Confidential National Survey of Licensed Landfills in XXXX

Explanatory/introductory text, including the proposed closing date etc. It is suggested that the following sentence should be included. **All data provided will be treated as confidential, and will be presented in such a way that individual sources cannot be identified**.

Q1 The landfill was: (please tick the relevant box.)	**Open** to accept waste during XXXX		Please complete Q2 to Q4
	Accepting engineering or restoration materials during XXXX		
	Inactive throughout XXXX		Ignore Q2 to Q4, but please return the form
	Finally closed by the start of XXXX		

Q2 Is the landfill a former quarry which is/was being back-filled with inert material which is exempt from landfill tax? (please tick the relevant box.)	Yes
	No



hard C&D waste

Excavation Waste

'mixed' materials (CDEW)

With the illustrations above in mind, please complete the Q3 table on the next page.

- You should **not record** any materials that you recycled/reclaimed and then **sent off-site again**.

- There should be **no overlap** between the cells in the table, so all CDEW that you received, and which went into the landfill void space, should be recorded once.
- **Contaminated** here means **mixed with hazardous** materials such as asbestos, oils, chemicals, etc.
- The total tonnage of CDEW will be the total of all cells.

Q3 By completing this table, please indicate how many tonnes of **unprocessed construction, demolition and excavation waste** entered the landfill site during XXXX, and what happened to them.

	Used in landfill engineering (roads, bunding, drainage, daily cover etc)	***Used in capping and restoration***	***Disposed of as waste***
Clean hard C&D waste	tonnes	tonnes	tonnes
Contaminated hard C&D waste	tonnes	tonnes	tonnes
Clean excavation waste	tonnes	tonnes	tonnes
Contaminated excavation waste	tonnes	tonnes	tonnes
Clean 'mixed' materials	tonnes	tonnes	tonnes
Contaminated 'mixed' materials	tonnes	tonnes	tonnes
Other C&D/excavation waste (or category unknown)	tonnes	tonnes	tonnes

Q4 By completing this table, please indicate how many tonnes of **aggregate** (if any) entered the landfill site during XXXX, and what happened to them.

	Used in landfill engineering (roads, bunding, drainage, daily cover etc)	***Used in capping and restoration***	***Disposed of as waste***
Primary aggregate (purchased)	tonnes	tonnes	tonnes
Primary aggregate (dug on site)	tonnes	tonnes	tonnes
Waste from aggregate quarrying	tonnes	tonnes	tonnes
Other waste-derived aggregate (e.g. slags etc)	tonnes	tonnes	tonnes
Crushed C&D waste	tonnes	tonnes	tonnes

(Mailing label)

Construction, Demolition & Excavation Waste Survey

Confidential National Survey of Materials Spread on Registered Exempt Sites in XXXX

Explanatory/introductory text, including the proposed closing date etc.

(It appears that more information about what Paragraph 9&19 registered exempt sites are than was provided in 2003/04 should be included, possibly in a covering letter).

It is suggested that the following sentence should be included. **All data provided will be treated as confidential, and will be presented in such a way that individual sources cannot be identified**.

Q1 Are any of the following statements true in your case? (Please tick the box(es) if true)	
We had one or more Para 9 or 19 'registered exempt' sites that had **closed before 1 January XXXX**.	
We have (or had) one or more Para 9 or 19 exemptions that we had **not started to use by 31 December YYYY**. *(NB YYYY refers to the year before XXXX)*	
To the best of my knowledge, we have **never** operated a Para 9 or 19 'registered exempt' site.	

Q2 Did you operate one or more Para 9 or 19 'registered exempt' sites in England on which inert waste materials were spread during XXXX?			
Yes >		How many sites in all?	
No >		Note: If your answer is "No", ignore Q3 and Q4 but **please return the form**. This is important for making the survey as effective as possible.	

Q3 What tonnages of inert wastes were spread on the 'registered exempt' site(s) identified in response to Q2 during XXXX? (Please complete the appropriate boxes):

Note: If you operated more than 4 sites, please take a copy of this page and provide the information on that copy.

	Site 1	*Site 2*	*Site 3*	*Site 4*
Total	tonnes	tonnes	tonnes	tonnes
Total includes mixtures of any or all of the following:				
Clean excavation waste	tonnes	tonnes	tonnes	tonnes
Excavation waste from utility trenches	tonnes	tonnes	tonnes	tonnes
Other excavation waste with some demolition waste (or similar) mixed in	tonnes	tonnes	tonnes	tonnes
Uncrushed hard C&D waste/'builder's rubble'/hardcore	tonnes	tonnes	tonnes	tonnes
Road planings	tonnes	tonnes	tonnes	tonnes
Processed/crushed aggregate (*)	tonnes	tonnes	tonnes	tonnes
Ash, slag and/or clinker	tonnes	tonnes	tonnes	tonnes
Dredged materials	tonnes	tonnes	tonnes	tonnes
All/any other materials	tonnes	tonnes	tonnes	tonnes

(*) Please exclude from this answer any primary (quarried) aggregate used for construction.

Q4 In which county does each of the sites identified in response to Q2 and Q3 fall, and what was being done on the site?

(Please complete by giving the relevant county name(s), and then **ticking** the appropriate box(es) in the subsequent rows):

Note: If you operated more than 4 sites, please take a copy of this page and provide the information on that copy.

		Site 1	***Site 2***	***Site 3***	***Site 4***
Activity ↓	Name of County →				
Road building or other major transport infrastructure development					
Minor infrastructure works (car park, footpath, minor road etc)					
Filling in former dock or similar					
Filling in former quarry void (not a licensed landfill)					
Creation of noise bunds or landscaping					
Building of golf course or other leisure development					
Housing, industrial or similar development					
Drainage or agricultural improvement					
Other (*)					
(*) Please specify here what 'other' was:					

The objective of the survey of operators of crushers and screens, licensed landfill sites and Paragraph 9 and 19 registered exempt sites was to generate estimates for the arisings and use of construction and demolition waste in England in 2003, and for each of the regions covered by the Regional Aggregate Working Parties. The information is required to feed into the revision of Minerals Planning Guidance Note 6 (Guidelines for Aggregates Provision in England) and the monitoring of the national and regional guidelines for aggregates provision (published in June 2003), which set targets for the use of secondary and recycled aggregates.

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