2012

Location, demographic, lifestyle and behavioural influences on household participation in Bournemouth Borough Council's kerbside recycling scheme

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Location, demographic, lifestyle and behavioural influences on household participation in Bournemouth Borough Council's kerbside recycling scheme

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Abstract

Bournemouth Borough Council (BBC) is performing well in recycling and currently has a recycling rate of 63.9%, but there is still room for BBC to improve the efficiency of the existing 'Big Bin' dry kerbside recycling collection scheme and increase the recycling rate further. The aim of the study was to identify the socio-economic groups which participate the least or contaminate the most in BBC's kerbside recycling scheme. A participation survey was carried out over three consecutive collection cycles for three recycling rounds 'RW1, RW2 and RW5' to measure how many times each individual household set out their recycling bin for collection. The results from the participation survey were used to calculate the participation rate (PR), set out rate (SOR) and contamination rate (CR) for the different socio-economic groups in Bournemouth. The PR's, SOR's and CR's of the affluent, intermediate and deprived socio-economic groups were also compared. The overall PR for the three recycling rounds surveyed was 96.2% and each socio-economic group had a PR above 90%, a SOR above 79% and a CR below 4.4%. There was a significant difference between the socio-economic groups CR's, with the affluent groups having lower CR's compared to the deprived groups. This study highlights which socio-economic groups BBC should target where improvements to the scheme will have the most impact.

Note: Bournemouth Borough Council was awarded highly commended as local authority team of the year at the National Recycling Awards 2012.

Introduction

A participation survey was undertaken to determine the usage and performance of Bournemouth Borough Council's (BBC's) kerbside dry recycling collection scheme. BBC is already performing well in recycling; however the survey was conducted to identify opportunities for improvement in order to increase the efficiency of the kerbside recycling scheme and the recycling rate (WRAP, 2010a).

The participation survey measured how many times each individual household in Bournemouth set out their recycling bin for collection over three consecutive collection cycles (WRAP, 2010a). The survey results were used to calculate the participation rate (PR), set out rate (SOR) and contamination rate (CR) for different socio-economic groups within the borough of Bournemouth.

The PR is the proportion of households that take part in the kerbside recycling scheme by setting out their recycling bin at least once in three consecutive collection opportunities (Shaw et *al*., 2007; WRAP, 2010a; 2010b; 2008). The SOR is the proportion of households that set out their recycling bin on one collection opportunity (WRAP, 2010a; 2010b). The CR is the proportion of households on one collection opportunity that set out their recycling bin containing items which are not accepted in the kerbside recycling scheme (WRAP, 2008).

The current study identifies the socio-economic groups in Bournemouth with the lowest PR's and highest CR's and informs BBC on which groups to target in order to increase participation and lower the schemes contamination levels. The study also compares the PR's, SOR's and CR's between affluent, intermediate and deprived socio-economic groups, as previous literature has highlighted that affluent areas tend to have higher PR's than deprived areas (Bridgewater and Parfitt, 2010; Davis *et al*., 2006; Martin *et al*., 2006; Morton, 2004; WRAP, 2010a; 2010c).

Studies (Bridgewater and Parfitt, 2010; Davis *et al*., 2006; Martin *et al*., 2006) have indicated that socio-economic factors affect the performance of kerbside recycling schemes and the propensity to recycle varies between different socio-economic areas. Low PR's are associated with deprived areas and younger households or households with young children, whereas high recycling PR's are associated with affluent areas and elderly people (Davis *et al*., 2006; Martin *et al*., 2006; Morton, 2004; WRAP, 2010a; 2010c). Thus, affluent households tend to have higher PR's than deprived households (Bridgewater and Parfitt, 2010; Martin *et al*., 2006; Morton, 2004; WRAP, 2010a; 2010c).

Recycling may not be a top priority for households in areas with higher levels of socio-economic deprivation (Pocock *et al*., 2008; WRAP, 2010c). Deprived households are likely to be less committed to recycling due to having other priorities imposed on them and may contaminate more as a result (Pocock *et al*., 2008; WRAP, 2010h). On the other hand, retired households or elderly households without children have more time to recycle, compared to younger households or households with young children which have limited time and storage availability (Martin *et al*., 2006; WRAP, 2010c).

Other reasons for non participation in kerbside recycling schemes may be the lack of space to locate a recycling container, particularly for recycling boxes which tend to be kept inside, the visual appearance of the recycling container (wheelie bin/ kerbside box/ sack), resistance to change or the use of other local recycling facilities (Abbott *et al*., 2011; Cotterill *et al*., 2008; McDonald and Oates, 2003; Pocock *et al.,* 2008).

Households are more likely to set out their recycling container if other households in their street frequently participate (Cotterill *et al*., 2008; Tucker, 1999). Shaw (2008) found that the recycling behaviour of clustered households is influenced by the social interactions and recycling actions of their immediate neighbours, with highest influences on households in contiguous cul-de-sac blocks and diminishing influences on households in linear orientated blocks with increasing length. Harder *et al*., (2006) found that "the lower the number of households located on a road, the higher the PR", thus short roads tend to have higher PR's.

Bournemouth Borough Council (BBC)

BBC is a UA and collected and disposed of 88,802.27 tonnes of Municipal Solid Waste (MSW) in 2010/11 compared to 89, 356.29 tonnes in 2009/10 (BBC, 2011a; 2011l; 2011j; WasteDataFlow, 2011). The proportion of MSW sent to landfill in Bournemouth has decreased from 33,784.94 tonnes in 2009/10 (37.8%) to 15,992.30 tonnes in 2010/11 (18.0%), which is much lower than the current national average of 43.4% (DEFRA, 2011e; WasteDataFlow, 2011).

In September 2006, BBC introduced the 'Big Bin, Little Bin' (BB/LB) kerbside recycling scheme which replaced the former blue bag scheme (BBC, 2010). The 240 litre 'Big Bin' is used for dry recycling and collected fortnightly, whereas the 140 litre 'Little Bin' is for residual waste and collected weekly, however some properties have 240 litre/ 660 litre/ 1,100 litre communal bins (BBC, 2011g; 2011j). The targeted recyclables allowed in the 'Big Bin' include paper, cardboard, plastic bottles, cans, aerosols, food and drinks cartons and glass (BBC, 2011a; 2010).

The collected co-mingled recyclables must be dry and have a CR below 5% in order to be accepted at the MRF and prevent BBC from being fined (BBC, 2011a; 2011e). Therefore, BBC operates a contamination procedure where the recycling crew check each recycling bin for contamination before collection. If the recycling bin contains any items which are not accepted for recycling, such as textiles and garden waste then a yellow 'contamination sticker is placed on the bin lid and the bin will not be emptied for recycling (BBC, 2011e; 2011k).

The amount of residual household waste Bournemouth residents throw away is reducing each year (BBC, 2011m). BBC is now currently ranked first in the UK out of more than 200 waste collection and disposal authorities for its recycling and waste management, as Bournemouth residents throw out the least amount of residual waste annually per person (174.5kg) compared to all the other authorities (BBC, 2012b; WasteDataFlow, 2011).

Bournemouth's MSW trend

Ninety percent of BBC's MSW is household waste (BBC, 2011a). The trend of MSW generated in Bournemouth stopped following the increasing national waste trend in 2002/03 and began to decrease at an average of 3.3% per year (BBC, 2011g). Figure 1 shows that the amount of MSW produced in Bournemouth has continued to decrease over the past five years and may be starting to plateau (BBC, 2011a; 2011n).
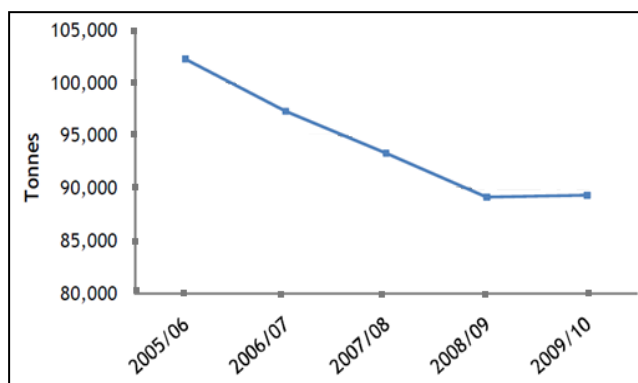

Figure 1: The trend in the amount of MSW produced in Bournemouth over the last five years (BBC, 2011a).

The reduction in the amount of MSW generated over the past five years may be due to the introduction of the 'BB/LB' scheme, the limited capacity of the 'Little Bin' residual waste container, reduced consumption of materials due to the current economic conditions and greater awareness of waste prevention and minimisation (BBC, 2011a; 2011g; 2011j). However, the trend of MSW and household waste is expected to rise in Bournemouth by 0.5% per annum, alongside population growth predicted to rise to 170,600 by 2031 and the recovery of the economy. Therefore, BBC will need to develop more waste reduction and recycling initiatives and maintain the current waste collection and disposal services it provides, in order to ensure that the decreasing trend in household waste will be maintained in the future (BBC, 2011a; 2011f; 2011l).

Bournemouth's increasing recycling rate

BBC's household waste recycling rate (including re-use and composting) has increased over the last seven years (see figure 2; BBC, 2011e).
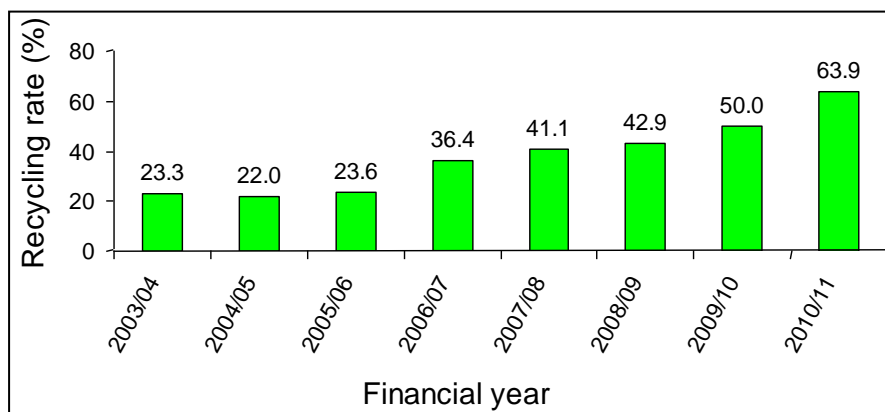

Figure 2: BBC's household waste recycling rate for the financial year 2003/04 to 2010/11(BBC, 2011a; 2011e; WasteDataFlow, 2011).

The introduction of the 'BB/LB' kerbside scheme in September 2006 contributed to a significant increase in BBC's recycling rate from 23.6% in 2005/06 to 36.4% in 2006/07, within just half a year of the new scheme being in operation (BBC, 2011a; 2011j; 2011n; 2011o). In 2009/10 the official recycling rate was 50.0%, making BBC the fifth highest performing Unitary Authority (UA) in England (BBC, 2011e; 2011g). Since April 2010, household residual waste collected from the kerbside has been taken to a Mechanical biological treatment (MBT) facility in Canford in Poole to recover recyclable and biodegradable materials and this has helped to raise the recycling rate from 50.0% in 2009/10 to 63.9% in 2010/11 (BBC, 2011e; 2011l; 2011m; 2012b; WasteDataFlow, 2011).

The increase in BBC's recycling rate from 23.6% to 63.9% can be attributed to the following (BBC, 2011e; 2011m; 2010):

- the introduction of the 'BB/LB' scheme
- success of the garden waste collection scheme
- introducing new items to be recycled in the 'Big Bin'
- increased usage of bring sites
- improvements to Millhams Community Recycling Centre
- continued communications with Bournemouth residents
- the recovery of recyclable or biodegradable material from the residual waste stream via MBT
- increased education and awareness of recycling

Bournemouth's current recycling rate
BBC's official recycling rate is currently fourth (after the top performing council South Oxfordshire) out of all the LA's in the UK and has already met the national household waste recycling target of 50% by 2020 (BBC, 2011e; 2011l; 2011m; 2011n; DEFRA, 2007b; Roberts, 2011). BBC's official recycling rate for 2010/11 was 63.9%, exceeding the national average of 41.2% and the rates of the neighbouring LA's (see table 1; BBC, 2011e; 2011j; 2011l; 2012b; DEFRA, 2011e; 2007b; WasteDataFlow, 2011).

Table 1: The 2010/11 household waste recycling rate for BBC and the neighbouring LA's in Dorset (Roberts, 2011).

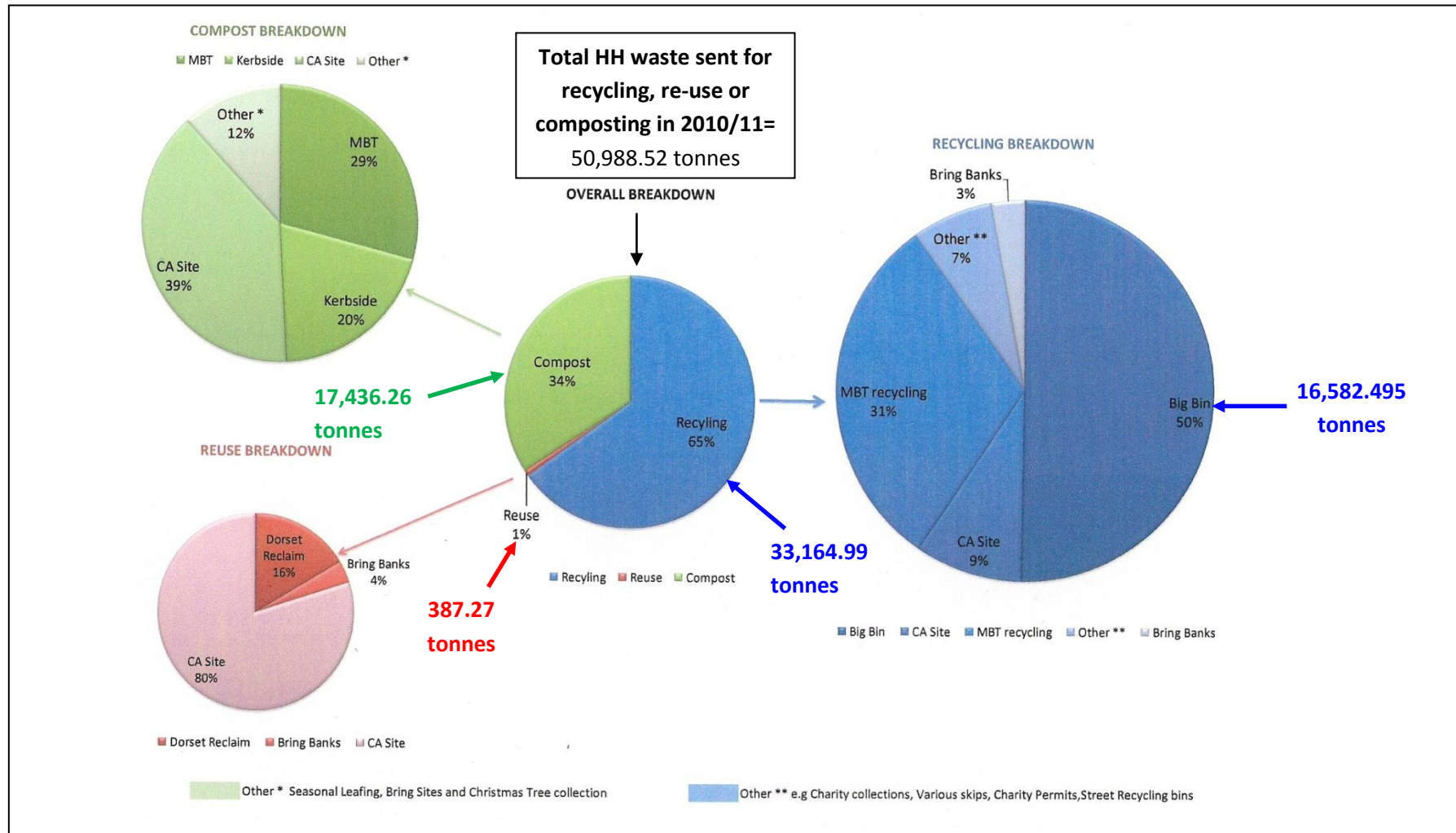| Recycling rate for 2010/11:	
Bournemouth Borough Council (BBC)	64%
Dorset County Council	53%
East Dorset District Council	42%
Poole Borough Council	40%
Christchurch Borough Council	34%
North Dorset District Council	34%
West Dorset District Council	34%
New Forest District Council	31%
Purbeck District Council	32%

Figure 3: Percentage breakdown of household waste sent for recycling, composting or re-use in 2010/11 (WasteDataFlow, 2011).

BBC collected 79,764.16 tonnes of household waste in 2010/11 and 63.9% of this was sent for re-use, recycling or composting (50,988.52 tonnes) (BBC, 2011l; 2012; WasteDataFlow, 2011). Of the 50,988.52 tonnes, 65% was sent for recycling (33,164.99 tonnes), 34% was sent for composting (17,436.26 tonnes) and 1% was sent for re-use (387.27 tonnes) (Roberts, 2011; WasteDataFlow, 2011).

Figure 3 shows that 50% of the 33,164.99 tonnes of household waste collected for recycling in 2010/11 was provided by the 'Big Bin' kerbside recycling scheme (16,582.495 tonnes). Therefore, the 'Big Bin' scheme contributes approximately 32.5% towards the total household waste tonnage sent for recycling, composting or re-use in 2010/11 (50,988.52 tonnes) (WasteDataFlow, 2011).
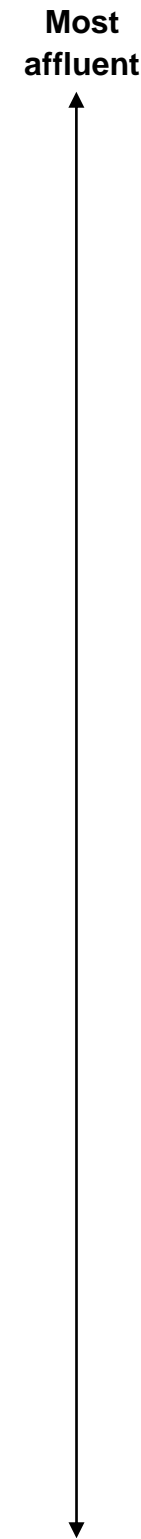
Mosaic
Mosaic is a socio-demographic classification tool which provides detailed and accurate data based on the 2001 census data on the demographics, behaviours and lifestyles of UK citizens (Experian, 2009a).

The Mosaic Public Sector tool is a three-tier classification system which can be used at an individual, household or postcode level to allocate all consumers in the UK to a supergroup, group or type (Experian, 2011a). The citizens of the UK are classified into 69 household types which comprise 15 socio-economic groups which may be aggregated into seven supergroups (see table 2; Experian, 2009a).

The Mosaic Public Sector citizen classification was used to obtain the socio-economic group and supergroup for all the households monitored in the current participation survey. However, not all the postcodes were recognised by Mosaic and therefore a few households could not be assigned a group or supergroup (see Methodology).

The Mosaic socio-economic group data was combined with the data gathered from the participation survey to give a better insight into the socio-economic and socio-cultural behaviour of UK citizens (Experian, 2009a).   Table 2 presents the definitions derived from the Mosaic Public Sector classification system for each socio-economic group and supergroup. The socio-economic groups A to D are classified in the affluent category, groups E to H are in the intermediate category and groups I to O are in the deprived category.

Table 2: Definitions of the Mosaic socio-economic groups and supergroups (Experian, 2011a)

	Mosaic socio-economic group	Mosaic group definition	Mosaic socio-economic supergroup	Mosaic supergroup definition	Category classification
Most affluent ↑	A	Residents of isolated rural communities	A	Rural and small town inhabitants	Affluent
	B	Residents of small and mid-sized towns with strong local roots			
	C	Wealthy people living in the most sought after neighbourhoods	B	Affluent households	
	D	Successful professionals living in suburban or semi-rural homes			
	E	Middle income families living in moderate suburban semis	C	Middle income families	Intermediate
	F	Couples with young children in comfortable modern housing			
	G	Young, well-educated city dwellers	D	Young people starting out	
	H	Couples and young singles in small modern starter homes			
	I	Lower income workers in urban terraces in often diverse areas	E	Lower income residents	Deprived
	J	Owner occupiers in older-style housing in ex-industrial areas			
	K	Residents with sufficient incomes in right-to-buy social housing			
	L	Active elderly people living in pleasant retirement locations	F	Elderly occupants	
	M	Elderly people reliant on state support			
	N	Young people renting flats in high density social housing	G	Social housing tenants	
Most deprived ↓	O	Families in low-rise social housing with high levels of benefit need			

Hypothesis
The literature indicated that socio-economic factors influence householders recycling behaviour, for example participation in kerbside recycling schemes and can affect the performance of kerbside recycling schemes. Bridgewater and Parfitt, (2010), Davis *et al.*, (2006), Martin *et al.*, (2006) report that the propensity to recycle varies between different socio-economic areas and that the more deprived areas would recycle the least. There is opportunity to explore these statements further within the context of BBC's kerbside recycling scheme; hence the following hypotheses were tested:

H_0: There is no significant difference between the Mosaic socio-economic group PR's, SOR's or CR's in the affluent, intermediate or deprived category.
H_A: There is a significant difference between the Mosaic socio-economic group PR's, SOR's or CR's in the affluent, intermediate or deprived category.

H_0 represents the null hypothesis and H_A represents the alternative hypothesis.

Objectives
In order to test the hypotheses, it was necessary to complete the following objectives:

- To determine the overall PR for Bournemouth's recycling kerbside collection.
- To compare the PR, SOR and CR for the different socio-economic groups and supergroups.
- To weight the survey results to make them more representative of Bournemouth.
- To identify the socio-economic groups with the lowest PR's and highest CR's which need to be targeted for improvement.
- To test whether there was a significant difference between the affluent, intermediate and deprived socio-economic groups PR's, SOR's and CR's.
- To compare the PR and SOR results for each socio-economic group with a probability model.
- To compare the PR by street architecture type.
- To compare each socio-economic group with the National GreenAware type proportions for that socio-economic group.

Methodology

General location and sampling sites
Bournemouth is a large town situated on the central south coast of England within the county of Dorset (see figure 4).

Figure 4: National and regional map of the location of Bournemouth (Google Maps, 2012; Ordnance Survey, 2011).

The borough of Bournemouth is surrounded by Christchurch, Poole and East Dorset districts and forms part of the South East Dorset conurbation (BBC, 2011o). Bournemouth is made up of 18 electoral wards (see figure 5 and table 3) and covers an area of 17 square miles; predominantly urban with rural and Green Belt land situated on the northern and eastern outskirts (BBC, 2011n; 2011o). The estimated resident population is 168,100 (including 8,155 students), which is projected to increase to 179,700 by 2033 (BBC, 2011h; 2011j; 2011p).

Figure 5 shows the site location for each day of the three recycling collection rounds surveyed (RW1, RW2 and RW5). The Methodology section details the reasons why these sampling sites were chosen.
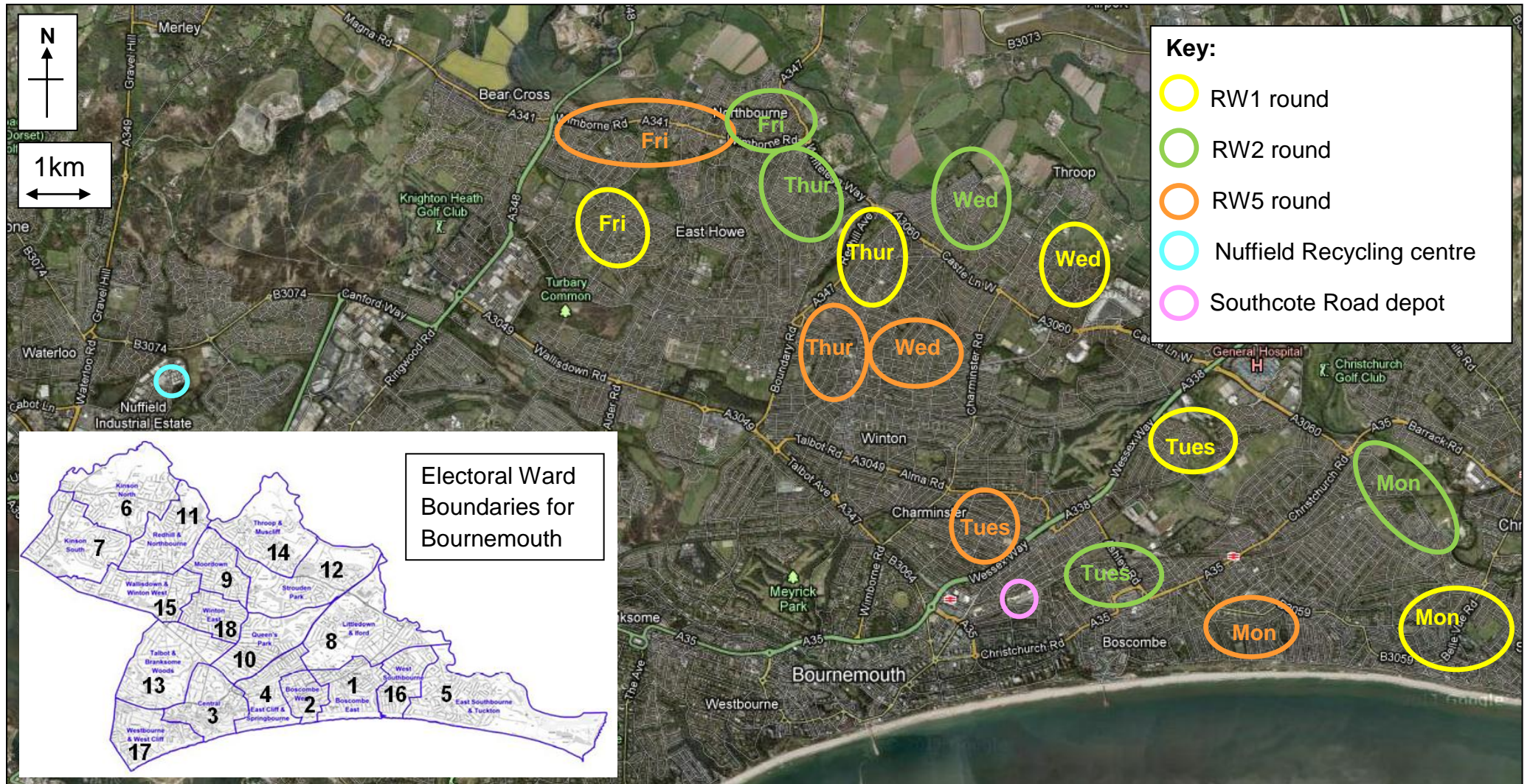
Figure 5: Map of the RW1, RW2 and RW5 recycling collection round sites for Week 2 (BBC, 2011o; Google Maps, 2012).

Table 3: List of electoral wards in Bournemouth in alphabetical order and details of the electoral wards that RW1, RW2 and RW5 collection rounds cover (BBC, 2011o).

No.	Ward	Round
1	Boscombe East	RW5 Monday
2	Boscombe West	RW2 Tuesday, RW5 Monday
3	Central Bournemouth	-
4	East Cliff & Springbourne	RW1 Tuesday, RW2 Tuesday, RW5 Tuesday
5	East Southbourne & Tuckton	RW1 Monday RW2 Monday
6	Kinson North	RW2 Thursday, RW2 Friday, RW5 Friday
7	Kinson South	RW1 Friday
8	Littledown & Iford	RW1 Tuesday, RW2 Monday
9	Moordown	RW1 Thursday, RW5 Wednesday
10	Queen's Park	RW5 Tuesday
11	Redhill & Northbourne	RW1 Thursday, RW2 Wednesday, RW2 Thursday, RW5 Friday
12	Strouden Park	RW2 Wednesday
13	Talbot & Branksome Woods	RW5 Thursday
14	Throop & Muscliff	RW1 Wednesday, RW2 Wednesday
15	Wallisdown & Winton West	RW5 Thursday
16	West Southbourne	RW2 Monday
17	Westbourne & West Cliff	-
18	Winton East	RW5 Wednesday, RW5 Thursday

Socio-economics of Bournemouth

Figure 6 shows the spatial distribution of the Mosaic socio-economic groups in Bournemouth (BBC, 2011o). The socio-economic group with the largest proportion of households is group G 'young, well-educated city dwellers' representing 21.6% of the total households in Bournemouth (Experian, 2011a). Group L 'active elderly people living in pleasant retirement locations' represents the second largest proportion of Bournemouth households with 15.6%, followed by group H 'couples with young singles in small modern starter homes' with 11.8% and then group B 'residents of small and mid-sized towns with strong local roots' with 9.61% (Experian, 2011a). There were no households for the socio-economic group A 'residents of isolated rural areas' monitored in the participation survey, due to group A only representing 0.03% of Bournemouth households (Experian, 2011a).
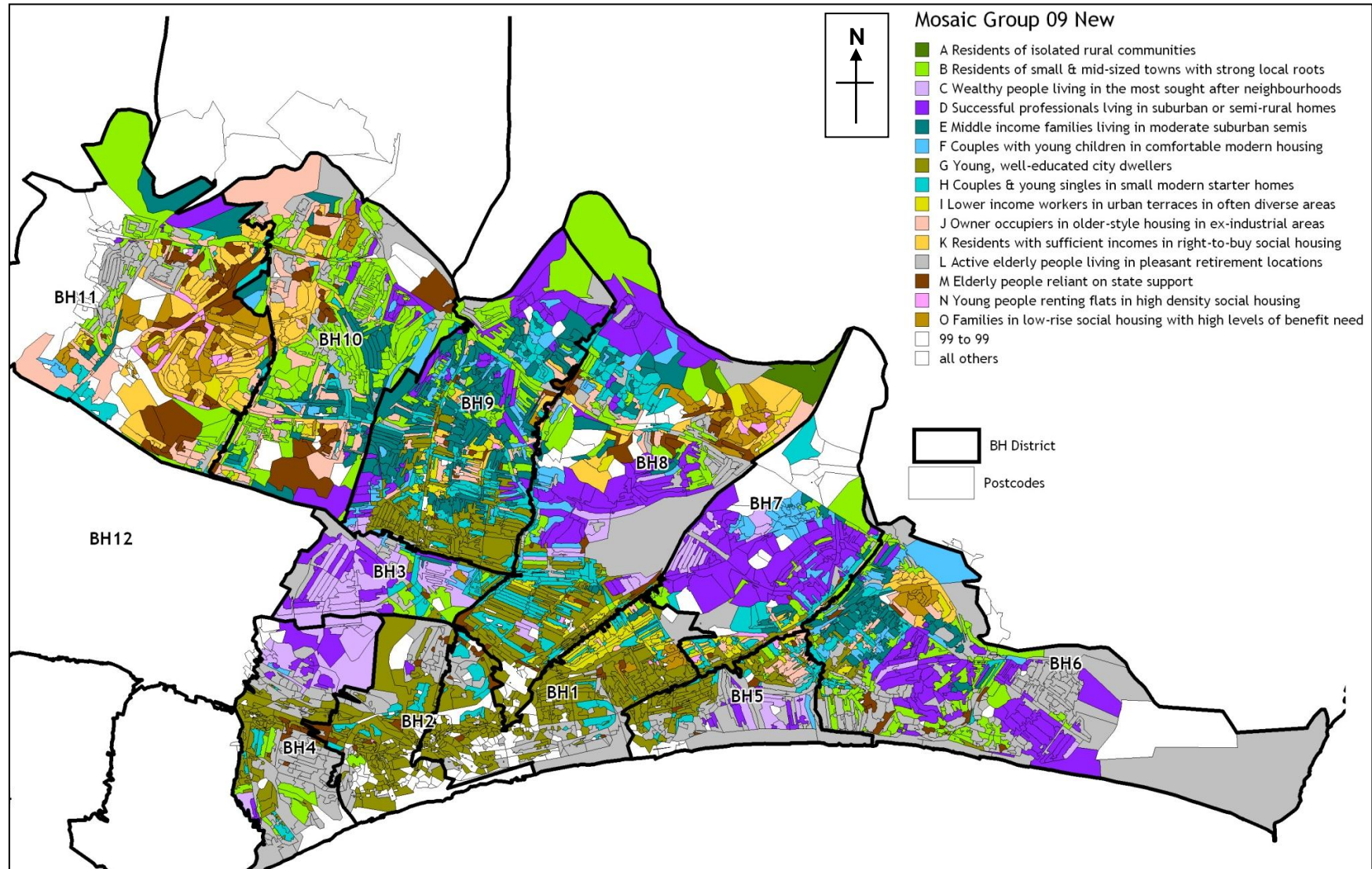
Figure 6: The distribution of the Mosaic socio-economic groups in Bournemouth. Note: The white shading on the map represents the properties which have not been assigned a Mosaic socio-economic group (BBC, 2011e).

Street services
The Council's Street services department based at the Southcote Road depot in Bournemouth (see figure 5) has the responsibility for the collection of rubbish and recycling (BBC, 2011q). Loaders and drivers are employed by the Council to collect and dispose of household refuse, recycling and green waste.   There are six recycling rounds (RW1 to RW6) plus a multi-recycling round (RM1). Household kerbside recycling collection is fortnightly and each recycling round has ten set routes; five routes for week one and five routes for week two (BBC, 2011a). The multi-recycling round wagon is smaller and collects the kerbside recycling bins which are inaccessible to the recycling wagons. The recyclables are collected co-mingled and are deposited at the Nuffield Recycling Centre in Poole (shown in figure 5; BBC, 2011a; 2011r).   BBC's recyclables are combined with the recyclables belonging to the Borough of Poole and then transported by 'Viridor' waste contractors to the MRF in Crayford in Kent to be sorted and reprocessed (BBC, 2011r; Viridor, 2012).

There are approximately 86,170 households in Bournemouth and 99.7% (85,880) receive fortnightly kerbside recycling collections (WasteDataFlow, 2011).   The remaining properties that do not have access to recycling provision are in town centre locations with no space for recycling bins or are at risk from constant contamination by passers-by, resulting in the recycling bins being removed (Lamb, 2011; Personal Communication).

Sampling approach
The participation survey was a pilot, undertaken to monitor the performance and determine the usage of the dry recycling kerbside collection scheme provided by BBC. The participation survey involved monitors counting the number of households taking part in the scheme over three consecutive collections (WRAP, 2010b). The survey was carried out to identify which socio-economic groups as defined by Mosaic have the lowest PR's and highest CR's, to enable efforts to increase the level of participation and reduce contamination to be focused on specific groups (WRAP, 2010h).   BBC had never undertaken a participation survey before and a 17% sample or 14,659 properties were surveyed during the course of the current study, representing a significant acquisition of data. A risk assessment, learning agreement and project proposal was prepared for BBC and the University of Plymouth prior to the participation survey.

Round-based sampling
A collection round-based sampling strategy was selected because the recycling crews have a set route to follow each day. The Recycling Operations Manager at BBC identified three kerbside recycling rounds 'RW1, RW2 and RW5' to be sampled for collection week two, representing 25% of the recycling rounds. These rounds were chosen for health and safety reasons, for example the most sensible and experienced recycling crews were chosen. The Mosaic profiling tool was not used to choose the rounds to be sampled, because none of the recycling rounds were completely representative of all the different socio-economic group proportions in Bournemouth and this is shown by figure 6. Figures 7, 8 and 9 show the detailed route maps for each day of the three rounds surveyed.
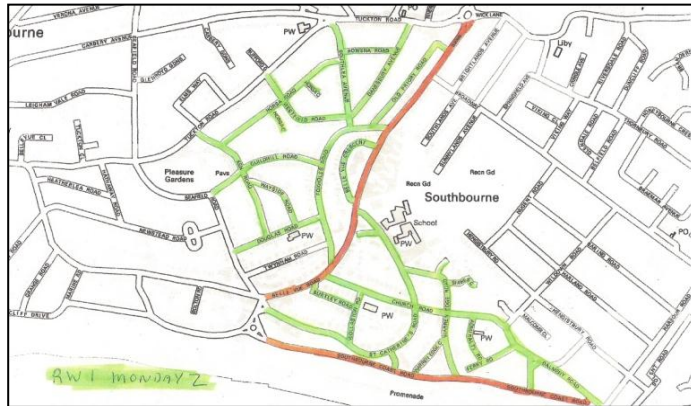
(a) **RW1** Monday route, week 2
Ward: East Southbourne & Tuckton

(b) **RW1** Tuesday route, week 2
Ward: East Cliff & Springbourne, Littledown & Iford

(c) **RW1** Wednesday route, week 2
Ward: Throop and Muscliff

(d) **RW1** Thursday route, week 2
Ward: Moordown, Redhill & Northbourne

(e) **RW1** Friday route, week 2
Ward: Kinson South

Figure 7 (a)-(e): Detailed route maps for the collection round 'RW1'

(a) RW2 Monday route, week 2
Ward: Littledown & Iford, East Southbourne
& Tuckton, West Southbourne

(b) RW2 Tuesday route, week 2
Ward: Boscombe West, East Cliff &
Springbourne

(c) RW2 Wednesday route, week 2
Ward: Redhill & Northbourne,
Throop & Muscliff, Strouden Park

(d) RW2 Thursday route, week 2
Ward: Kinson North, Redhill & Northbourne

(e) RW2 Friday route, week 2
Ward: Kinson North

Figure 8 (a)-(e): Detailed route maps for the collection round 'RW2'
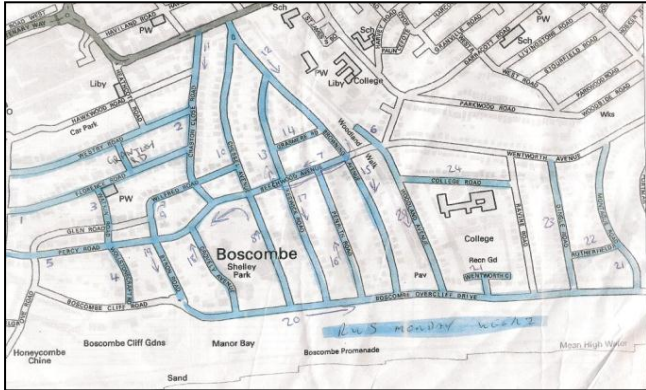
(a) RW5 Monday route, week 2
Ward: Boscombe East, Boscombe West
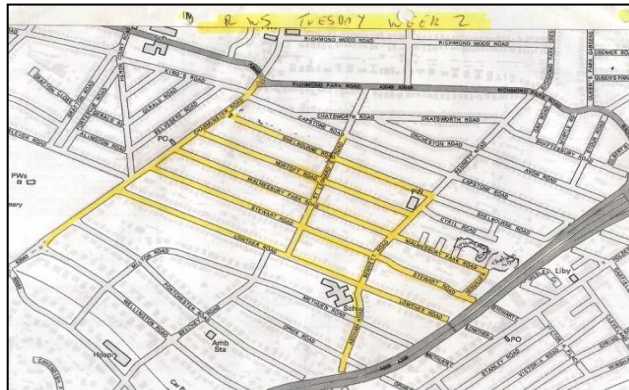
(b) RW5 Tuesday route, week 2
Ward: East Cliff & Springbourne, Queens Park

(c) RW5 Wednesday route, week 2
Ward: Moordown, Winton East
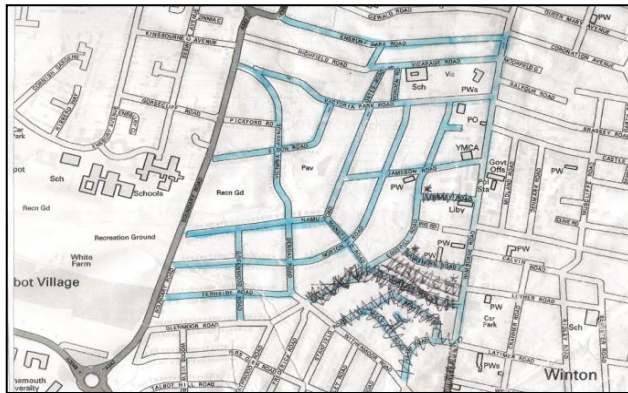
(d) RW5 Thursday route, week 2
Ward: Talbot & Branksome Woods, Wallisdown & Winton West, Winton East

(e) RW5 Friday route, week 2
Ward: Kinson North, Redhill & Northbourne

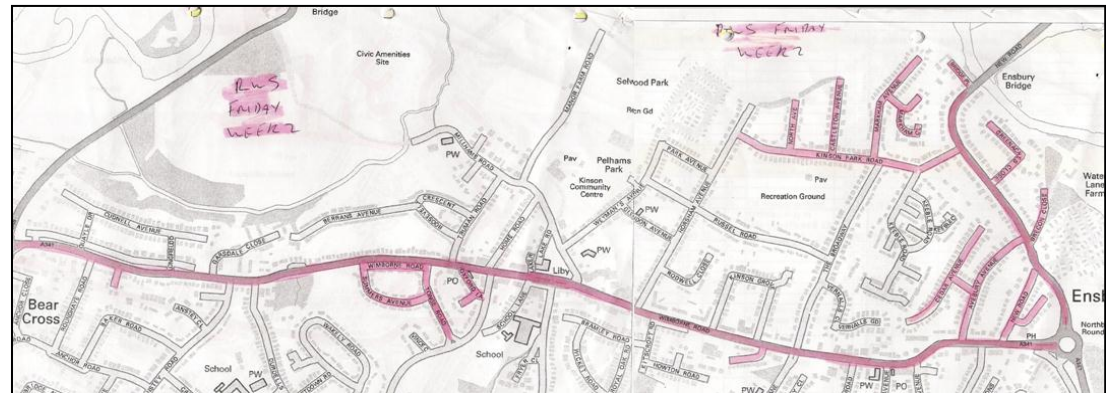**Figure 9 (a)-(e):** Detailed route maps for the collection round 'RW5'

Mosaic

The Mosaic socio-demographic profiling tool was used to provide detailed information for Bournemouth. Reports were produced for each recycling round identifying the socio-economic group (A to O) for each postcode for each road being surveyed. Figure 10 shows how the postcodes were allocated a socio-economic group using Mosaic derived data.

Postcode	MosaicType09	GroupLetter	SuperGroup	Group Description
BH1 4AY	33	G	D	Young, well-educated city dwellers
BH1 4BA	36	H	D	Couples and young singles in small modern starter homes
BH1 4BD	33	G	D	Young, well-educated city dwellers
BH1 4BE	33	G	D	Young, well-educated city dwellers
BH1 4BH	33	G	D	Young, well-educated city dwellers
BH1 4EF	57	M	F	Elderly people reliant on state support
BH1 4EG	67	O	G	Families in low-rise social housing with high levels of benefit need
BH1 4LT	99	99	99	

Note: some postcodes may not be recognised by Mosaic and will not have a group letter.

Figure 10: Stages in the procedure for applying Mosaic report data of the socio-economic groups 'A to O' to each postcode sampled in the current survey (WRAP, 2010b).

Undertaking the participation survey

The survey was undertaken during the six week period of the authors work placement in June and July 2011 over three consecutive fortnightly collections. The target area was Bournemouth and the target population was all the households included within the 'RW1, RW2 and RW5' kerbside recycling collection rounds for week two (WRAP, 2010i). Three monitors were appointed to survey one recycling round including the author and two apprentices from BBC. The monitors accompanied their assigned recycling crew and carried out the participation survey following the procedure shown in figure 11.

A participation survey guidance sheet was prepared using WRAPs best practice guidelines for LA kerbside recycling participation surveys and provided to each monitor (WRAP, 2010b). A standardised method to fill out the survey sheets was agreed. The survey sheets were filled out by using codes to ensure uniformity; a '1' was used for a recycling bin set out on the kerbside, a '0' was for no recycling bin set out on the kerbside and a 'C' was for a contaminated recycling bin set out on the kerbside.   The monitors were debriefed after each participation survey round, which enabled the monitors to raise any concerns they had about carrying out the survey.   The completed survey sheets were quality checked after each round each day to ensure there was no missing data or inconsistencies.

Put on the personal protective equipment e.g. steel toe-capped boots and fluorescent high visibility vest. Read through risk assessment. Provide a photo identification badge and letter of authority to each monitor.

Collect the prepared participation survey sheets (in alphabetical order) attached to a clipboard, which include a contents page of the road names for the round and a route map.

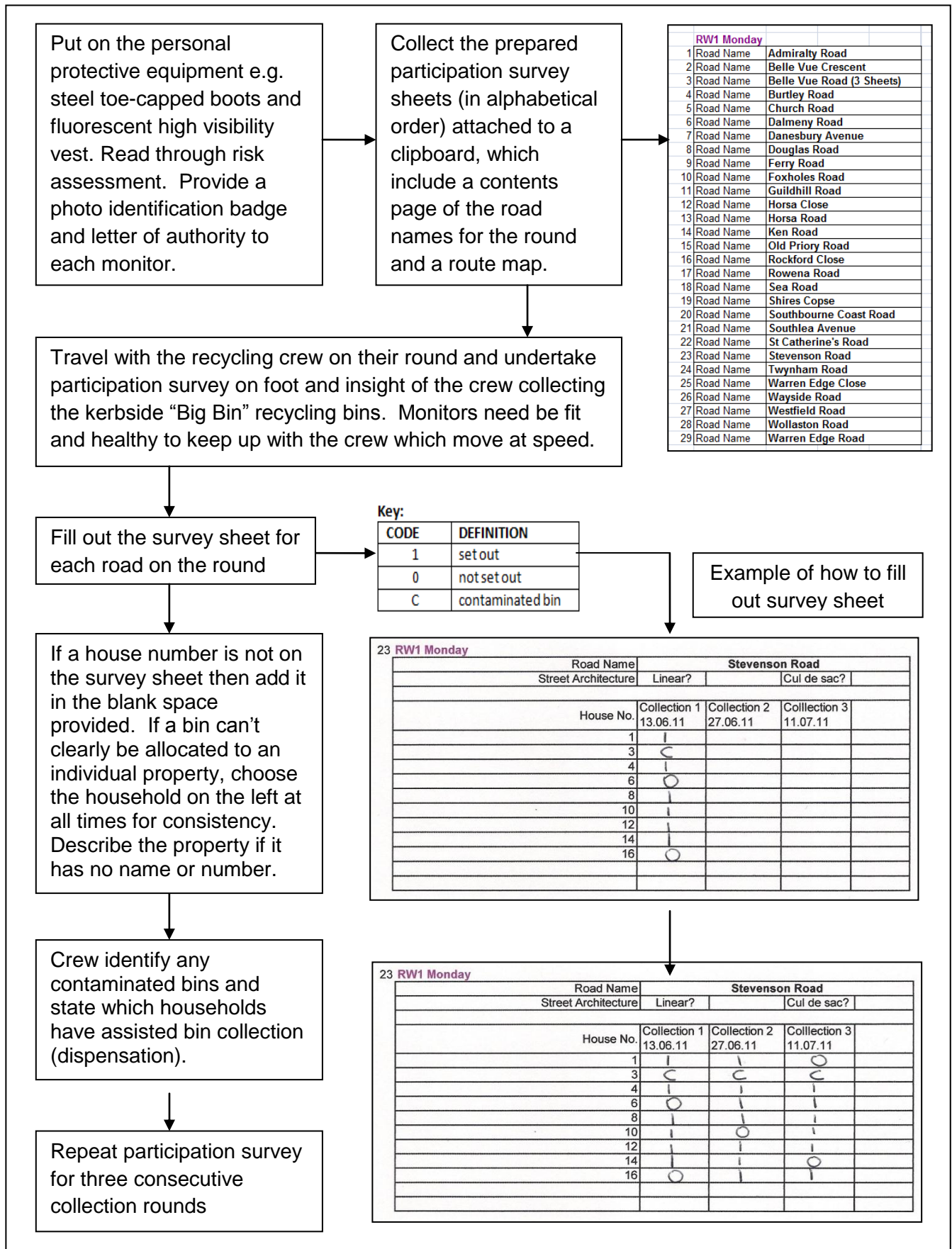| RW1 Monday		
1	Road Name	Admiralty Road
2	Road Name	Belle Vue Crescent
3	Road Name	Belle Vue Road (3 Sheets)
4	Road Name	Burtley Road
5	Road Name	Church Road
6	Road Name	Dalmeny Road
7	Road Name	Danesbury Avenue
8	Road Name	Douglas Road
9	Road Name	Ferry Road
10	Road Name	Foxholes Road
11	Road Name	Guildhill Road
12	Road Name	Horsa Close
13	Road Name	Horsa Road
14	Road Name	Ken Road
15	Road Name	Old Priory Road
16	Road Name	Rockford Close
17	Road Name	Rowena Road
18	Road Name	Sea Road
19	Road Name	Shires Copse
20	Road Name	Southbourne Coast Road
21	Road Name	Southlea Avenue
22	Road Name	St Catherine's Road
23	Road Name	Stevenson Road
24	Road Name	Twynham Road
25	Road Name	Warren Edge Close
26	Road Name	Wayside Road
27	Road Name	Westfield Road
28	Road Name	Wollaston Road
29	Road Name	Warren Edge Road

Travel with the recycling crew on their round and undertake participation survey on foot and insight of the crew collecting the kerbside "Big Bin" recycling bins. Monitors need be fit and healthy to keep up with the crew which move at speed.

Fill out the survey sheet for each road on the round

Key:

CODE	DEFINITION
1	set out
0	not set out
C	contaminated bin

Example of how to fill out survey sheet

If a house number is not on the survey sheet then add it in the blank space provided. If a bin can't clearly be allocated to an individual property, choose the household on the left at all times for consistency. Describe the property if it has no name or number.

Crew identify any contaminated bins and state which households have assisted bin collection (dispensation).

Repeat participation survey for three consecutive collection rounds

Figure 11: The procedure for data collection for a participation survey (WRAP, 2010c).

Data entry and processing
The raw datasets for each round surveyed were collected at the end of the round, verified then entered into an Excel spreadsheet. Formulae (shown in figure 12) were applied to the complete datasets to calculate the PR, average SOR and average CR for each road**.**

Participation rate (%):

$$\frac{\text{No. households recorded as setting out at least once in a defined period}}{\text{No. households monitored in that period}} \times 100$$

Set out rate (%):

$$\frac{\text{No. households recorded as setting out on a given day}}{\text{No. households monitored on that day}} \times 100$$

Contamination rate (%):

$$\frac{\text{No. households recorded as setting out a contaminated bin on a given day}}{\text{No. households recorded as setting out on that day}} \times 100$$

Figure 12: The formula to calculate the PR, SOR and CR (WRAP, 2010b).

The raw dataset was grouped by road name, street architecture (linear, cul-de-sac or crescent road layout), Mosaic group (A to O) and Mosaic supergroup (A to G). The PR, average SOR and average CR were calculated for the raw data by road, by street architecture, by the Mosaic group and supergroup for all the rounds combined and for each round separately.

Advantages and limitations of sampling approach
The participation survey was carried out over three consecutive collections because not all households participate in the kerbside recycling scheme on every occasion (WRAP, 2010a). Thus, it was most likely that households who use the scheme will participate at least once within this period due to storage issues of the recyclables. This also allows enough time to account for households being away on holiday or specific household behaviour, such as households that only put their recycling bin out when it is completely full.

The kerbside recycling collection scheme is subject to seasonal variations such as bank holidays and the Christmas period. The participation survey was carried out in June and July to avoid the summer holiday period. This helped to ensure that the data collected was typical of the kerbside recycling collection

and the summer holiday period would not bias the results collected (WRAP, 2010b).

Collection round-based sampling was the most practical and realistic method to monitor kerbside recycling participation.   It would be impractical operationally to monitor households at random or in clusters because the crews have to follow a set route for each round. By using round-based sampling, the tonnage data for each collection round is able to be combined with the participation data, increasing the value of the results (WRAP, 2010i).

The monitors travelled with the recycling crew to undertake the survey as this ensured it was carried out in the most efficient way. It avoided problems, such as the crew changing the route of the round to suit their own needs; the crew finishing streets before the monitor arrived; multiple collection vehicles finishing off the collection round due to wagon breakdown; or problems with the monitor finding the location where the crew restart the round after tipping off.   By travelling and staying in sight of the crew there was less chance for the monitor to lose data or miss any kerbside recycling bins which had late set outs or assisted collections (WRAP, 2010b).

The monitors were trained and used a standardised recording method to undertake the participation survey which ensured that the data was recorded consistently and minimised any data collection errors (WRAP, 2010i). The raw data was collected from the monitors after each round each day for a quality check and verification that the data collected was correct.   There were contingency plans in case the wagon broke down or a monitor was taken ill. One of the monitors was on annual leave for one week and another monitor had to be fully trained and equipped to undertake the survey (WRAP, 2010b).

There may be some sampling error with the results because not all of the households in Bournemouth were monitored for the participation survey. The sample sizes of households monitored for each round in the participation survey correspond well with the WRAP sample size recommendation of 1100 households. This reduces the sampling error to ± 3% and keeps the cost of sampling low (WRAP, 2010i).

A limitation of this methodology is that the Mosaic profiling tool was not used initially to help select the recycling collection rounds comprising a range of socio-economic household types. The three recycling rounds chosen to be surveyed (RW1, RW2 and RW5) were not completely representative of Bournemouth's socio-economic groups, but it should be noted that it is unlikely that any of the recycling rounds would be representative of Bournemouth. Overall the results were weighted to become more representative of Bournemouth and prevent bias (WRAP, 2010i).

A potential limitation in using Mosaic to produce reports detailing the socio-economic groups (A to O) for each property surveyed was that some postcodes may not be recognised. However, nearly all the properties in the survey were recognised by Mosaic (99.8%) and only 27 properties were not recognised by postcode, due to the latest version of Mosaic being based on 2001 Census data.   There are now currently 86,170 properties in Bournemouth however

Mosaic is only based on 73,802, thus Mosaic will not recognise the unclassified postcodes of the new properties (Experian, 2011a; WasteDataFlow, 2011).

Results and discussion

Presentation of data introduction
This section presents the current participation survey results by Mosaic socio-economic group and supergroup for the combined three recycling rounds surveyed (RW1, RW2 and RW5) and for each individual round. The survey results by Mosaic group and supergroup were tested for normality and were statistically analysed using either the student 't'-test or the Mann-Whitney test according to the datasets normality. The statistical tests were used to test the null hypotheses and analyse the results in relation to the literature. The survey results were also weighted, analysed by street architecture, applied to a probabilistic model and compared to Mosaic GreenAware data for England.

Properties recognised by Mosaic
During the course of the study a total of 14,659 properties were sampled, as stated in the Methodology. Table 4 summarises the number of properties surveyed for each recycling round 'RW1, RW2 and RW5' and the number of properties not recognised by Mosaic for each round. Only 27 properties out of the 14,659 properties sampled (i.e. 0.2% of the total) were not recognised by Mosaic, thus these properties could not be assigned a socio-economic group and were excluded from the Mosaic survey results (see Methodology).

Table 4 (a) – (d): Total number of properties sampled, including the total number of properties surveyed for each recycling round per day and the number of properties not recognised by Mosaic.

(a)

ALL rounds	Total properties	No. properties not recognised by MOSAIC	% properties not recognised	% properties recognised	Properties in MOSAIC survey
RW1	4914	5	0.1	99.9	4909
RW2	5157	16	0.3	99.7	5141
RW5	4588	6	0.1	99.9	4582
Grand Total	**14659**	**27**	**0.2**	**99.8**	**14632**

(b)

RW1	Total properties	No. properties not recognised by MOSAIC	% properties not recognised	% properties recognised	Properties in MOSAIC survey
Monday	826	5	0.6	99.4	821
Tuesday	884	0	0.0	100.0	884
Wednesday	1292	0	0.0	100.0	1292
Thursday	1022	0	0.0	100.0	1022
Friday	890	0	0.0	100.0	890
Total	**4914**	**5**	**0.1**	**99.9**	**4909**

(c)

RW2	Total properties	No. properties not recognised by MOSAIC	% properties not recognised	% properties recognised	Properties in MOSAIC survey
Monday	1332	2	0.2	99.8	1330
Tuesday	683	0	0.0	100.0	683
Wednesday	998	0	0.0	100.0	998
Thursday	1118	5	0.4	99.6	1113
Friday	1026	9	0.9	99.1	1017
Total	**5157**	**16**	**0.3**	**99.7**	**5141**

(d)

RW5	Total properties	No. properties not recognised by MOSAIC	% properties not recognised	% properties recognised	Properties in MOSAIC survey
Monday	731	4	0.5	99.5	727
Tuesday	1055	1	0.1	99.9	1054
Wednesday	1181	0	0.0	100.0	1181
Thursday	1005	0	0.0	100.0	1005
Friday	616	1	0.2	99.8	615
Total	**4588**	**6**	**0.1**	**99.9**	**4582**

Tonnage of recyclables

Overall 927.8 tonnes of co-mingled recyclables were collected by BBC's kerbside recycling scheme for the three weeks surveyed, with RW1, RW2 and RW5 contributing 442.0 tonnes (47.6%) towards the total tonnage (see table 5).

Table 5: The recycling net weight in tonnes for the three weeks surveyed.

Recycling round	Week one net weight (tonnes)	% proportion of total for week one	Week two net weight (tonnes)	% proportion of total for week two	Week three net weight (tonnes)	% proportion of total for week three	All net weight (tonnes)	% proportion of total for all weeks
RW1	49.4	15.9	49.6	16.0	51.7	16.9	150.7	**16.2**
RW2	50.4	16.2	50.6	16.3	45.4	14.9	146.5	**15.8**
RW5	49.2	15.8	47.6	15.3	48.0	15.7	144.8	**15.6**
RW3	48.3	15.5	49.4	15.9	47.0	15.4	144.7	**15.6**
RW4	40.8	13.1	40.0	12.9	38.3	12.5	119.2	**12.8**
RW6	42.4	13.6	41.2	13.3	43.1	14.1	126.7	**13.7**
RM1	31.2	10.0	31.8	10.3	32.3	10.6	95.4	**10.3**
Total	**311.8**	**100.0**	**310.1**	**100.0**	**305.9**	**100.0**	**927.8**	**100.0**

During the current study period; RW1 collected the largest amount of recyclables out of the three rounds surveyed over the three weeks with 150.7 tonnes, even though RW2 contains 243 more properties than RW1.

Mosaic group and supergroup definitions

As shown in table 2; the Mosaic socio-economic groups or supergroups are classified into the categories; affluent, intermediate and deprived. Groups A to D (supergroup A to B) are defined as affluent, groups E to H (supergroup C to D) are defined as intermediate and groups I to O (supergroup E to G) are defined as deprived. See table 6 for the Mosaic socio-economic supergroup definitions and table 7 for the group definitions.

Table 6: The Mosaic socio-economic supergroups classified as affluent, intermediate or deprived.

Mosaic supergroup and definition	Category classification
A = rural and small town inhabitants (A + B)	Affluent
B = affluent households (C + D)	
C = middle income families (E + F)	Intermediate
D= young people starting out (G + H)	
E = lower income residents (I, J + K)	Deprived
F = elderly occupants (L + M)	
G = social housing tenants (N + O)	

Table 7: The Mosaic socio-economic groups classified as affluent, intermediate or deprived.

Mosaic group and definition	Category classification
A = residents of isolated rural communities	Affluent
B = residents of small and mid-sized towns with strong local roots	
C = wealthy people living in the most sought after neighbourhoods	
D= successful professionals living in suburban or semi-rural homes	
E =middle income families living in moderate suburban semis	Intermediate
F = couples with young children in comfortable modern housing	
G= young, well-educated city dwellers	
H= couples and young singles in small modern starter homes	
I = lower income workers in urban terraces in often diverse areas	Deprived
J = owner occupiers in older-style housing in ex-industrial areas	
K = residents with sufficient incomes in right-to-buy social housing	
L = active elderly people living in pleasant retirement locations	
M = elderly people reliant on state support	
N = young people renting flats in high density social housing	
O = families in low-rise social housing with high levels of benefit need	

Survey results by Mosaic group

Table 8 to 11 highlight the proportional variation between the number of properties surveyed and the total number of properties in Bournemouth within each Mosaic group, as well as the PR, SOR and CR for each group for the three rounds combined and each individual round. Figures 13 to 16 summarise the PR, average SOR and average CR for each group for the three rounds combined and each individual round.

Table 8: The PR, SOR and CR for each Mosaic socio-economic group for round **RW1, RW2 and RW5 combined.** (Note: The table shows the proportion of each socio-economic group sampled in the survey compared to the actual proportion of the socio-economic groups in Bournemouth).

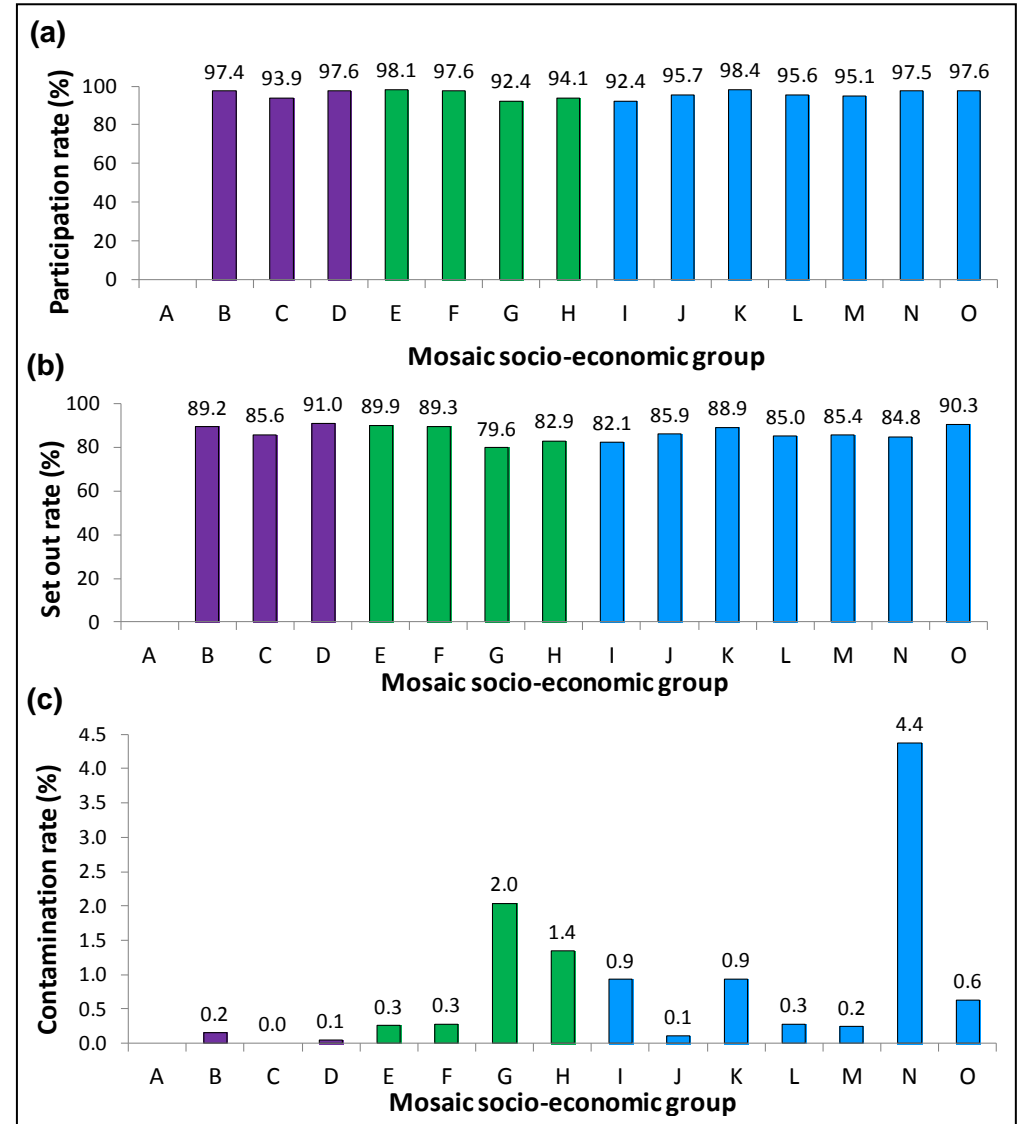| ALL by MOSAIC group (all recognised)	No. Properties	Mosaic group	Participation rate (%)	Set out rate (%)	Contamination rate (%)	% proportion for ALL by MOSAIC group	% proportion for Bournemouth by MOSAIC group	% variation
	0	A	0.0	0.0	0.0	0.0	0.0	0.0
	2579	B	97.4	89.2	0.2	17.6	9.6	-8.0
	396	C	93.9	85.6	0.0	2.7	2.1	-0.6
	1547	D	97.6	91.0	0.1	10.6	6.6	-3.9
	2175	E	98.1	89.9	0.3	14.9	8.0	-6.8
	670	F	97.6	89.3	0.3	4.6	3.2	-1.3
	1331	G	92.4	79.6	2.0	9.1	21.6	12.5
	1788	H	94.1	82.9	1.4	12.2	11.8	-0.4
	394	I	92.4	82.1	0.9	2.7	3.6	0.9
	696	J	95.7	85.9	0.1	4.8	4.0	-0.7
	681	K	98.4	88.9	0.9	4.7	4.3	-0.4
	1259	L	95.6	85.0	0.3	8.6	15.6	7.0
	327	M	95.1	85.4	0.2	2.2	5.7	3.5
	81	N	97.5	84.8	4.4	0.6	0.9	0.4
	708	O	97.6	90.3	0.6	4.8	2.8	-2.0
Total	14632					100.0	100.0	0.0
Mean			96.0	86.4	0.8			
Standard deviation			2.1	3.4	1.2			
Range			6.0	11.4	4.4			

Figure 13 (a) - (c): The PR, SOR and CR for each Mosaic socio-economic group for round **RW1, RW2 and RW5 combined**. (Note: purple is affluent, green is intermediate and blue is deprived).

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Table 9: The PR, SOR and CR for each Mosaic socio-economic group for round **RW1**. (Note: The table shows the proportion of each socio-economic group sampled for RW1 in the survey compared to the actual proportion of the socio-economic groups in Bournemouth).

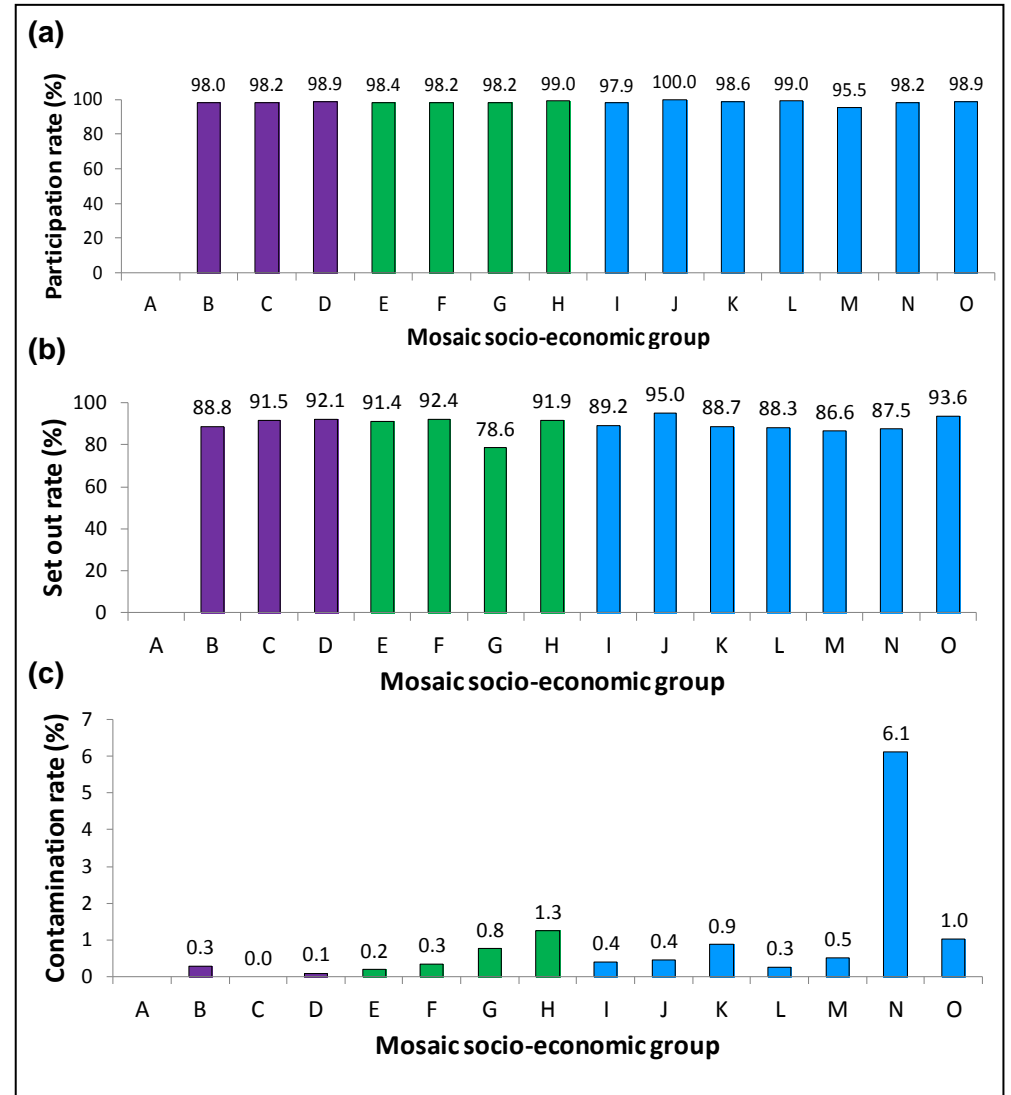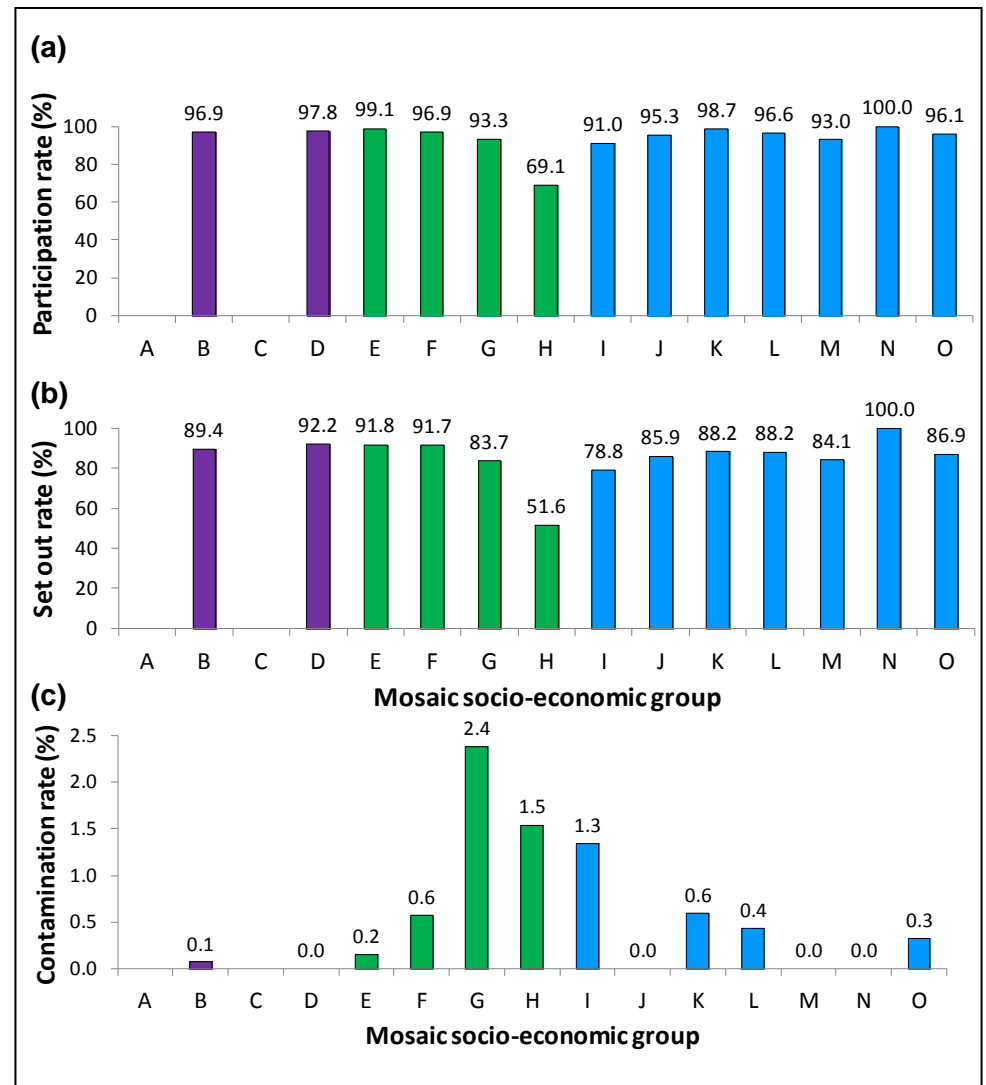| RW1 by MOSAIC group (all recognised)	No. Properties	Mosaic group	Participation rate (%)	Set out rate (%)	Contamination rate (%)	% proportion for RW1 by MOSAIC group	% proportion for Bournemouth by MOSAIC group	% variation
0		A	0.0	0.0	0.0	0.0	0.0	0.0
	809	B	98.0	88.8	0.3	16.5	9.6	-6.9
	220	C	98.2	91.5	0.0	4.5	2.1	-2.4
	784	D	98.9	92.1	0.1	16.0	6.6	-9.3
	756	E	98.4	91.4	0.2	15.4	8.0	-7.4
	330	F	98.2	92.4	0.3	6.7	3.2	-3.5
	56	G	98.2	78.6	0.8	1.1	21.6	20.5
	781	H	99.0	91.9	1.3	15.9	11.8	-4.1
	96	I	97.9	89.2	0.4	2.0	3.6	1.7
	80	J	100.0	95.0	0.4	1.6	4.0	2.4
	216	K	98.6	88.7	0.9	4.4	4.3	-0.2
	295	L	99.0	88.3	0.3	6.0	15.6	9.6
	154	M	95.5	86.6	0.5	3.1	5.7	2.6
	56	N	98.2	87.5	6.1	1.1	0.9	-0.2
	276	O	98.9	93.6	1.0	5.6	2.8	-2.8
Total	**4909**					100.0	100.0	0.0
Mean			**98.4**	**89.7**	**0.9**			
Standard deviation			**1.0**	**4.0**	**1.5**			
Range			**4.6**	**16.4**	**6.1**			

Figure 14 (a) - (c): The PR, SOR and CR for each Mosaic socio-economic group for round **RW1.** (Note: purple is affluent, green is intermediate and blue is deprived).

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Table 10: The PR, SOR and CR for each Mosaic socio-economic group for round **RW2**. (Note: The table shows the proportion of each socio-economic group sampled for RW2 in the survey compared to the actual proportion of the socio-economic groups in Bournemouth).

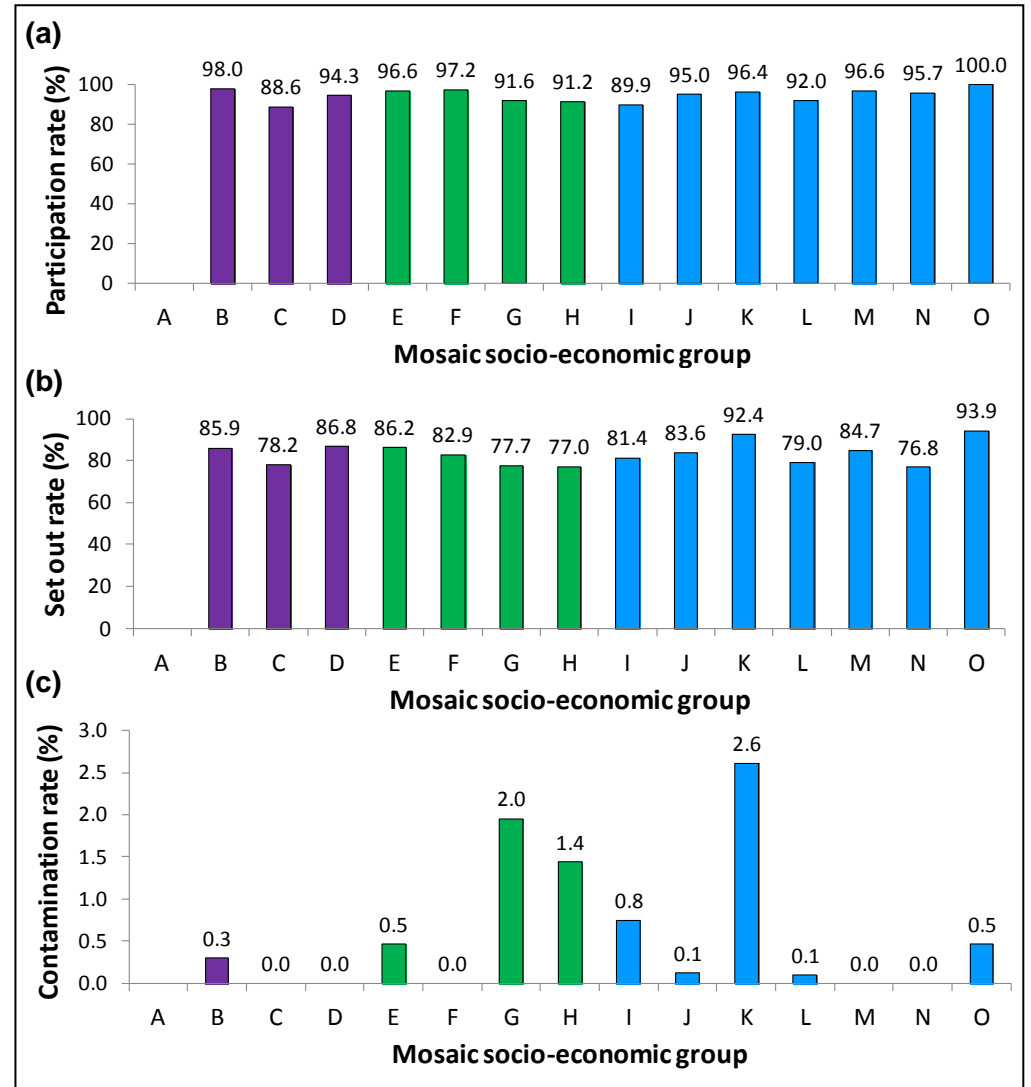| RW2 by MOSAIC group (all recognised)	No. Properties	Mosaic group	Participation rate (%)	Set out rate (%)	Contamination rate (%)	% proportion for RW2 by MOSAIC group	% proportion for Bournemouth by MOSAIC group	% variation
	0	A	0.0	0.0	0.0	0.0	0.0	0.0
	1522	B	96.9	89.4	0.1	29.6	9.6	-20.0
	0	C	0.0	0.0	0.0	0.0	2.1	2.1
	448	D	97.8	92.2	0.0	8.7	6.6	-2.1
	745	E	99.1	91.8	0.2	14.5	8.0	-6.5
	128	F	96.9	91.7	0.6	2.5	3.2	0.8
	418	G	93.3	83.7	2.4	8.1	21.6	13.5
	42	H	69.1	51.6	1.5	0.8	11.8	11.0
	189	I	91.0	78.8	1.3	3.7	3.6	-0.1
	295	J	95.3	85.9	0.0	5.7	4.0	-1.7
	382	K	98.7	88.2	0.6	7.4	4.3	-3.2
	529	L	96.6	88.2	0.4	10.3	15.6	5.3
	86	M	93.0	84.1	0.0	1.7	5.7	4.0
	2	N	100.0	100.0	0.0	0.0	0.9	0.9
	355	O	96.1	86.9	0.3	6.9	2.8	-4.1
Total	**5141**					100.0	100.0	0.0
Mean			**94.1**	**85.6**	**0.6**			
Standard deviation			**8.0**	**11.4**	**0.7**			
Range			**31.0**	**48.4**	**2.4**			

Figure 15 (a) - (c): The PR, SOR and CR for each Mosaic socio-economic group for round **RW2**. (Note: purple is affluent, green is intermediate and blue is deprived).

Table 11: The PR, SOR and CR for each Mosaic socio-economic group for round **RW5**. (Note: The table shows the proportion of each socio-economic group sampled for RW5 in the survey compared to the actual proportion of the socio-economic groups in Bournemouth).

RW5 by MOSAIC group (all recognised)	No. Properties	Mosaic group	Participation rate (%)	Set out rate (%)	Contamination rate (%)	% proportion for RW5 by MOSAIC group	% proportion for Bournemouth by MOSAIC group	% variation
	0	A	0.0	0.0	0.0	0.0	0.0	0.0
	248	B	98.0	85.9	0.3	5.4	9.6	4.2
	176	C	88.6	78.2	0.0	3.8	2.1	-1.8
	315	D	94.3	86.8	0.0	6.9	6.6	-0.2
	674	E	96.6	86.2	0.5	14.7	8.0	-6.7
	212	F	97.2	82.9	0.0	4.6	3.2	-1.4
	857	G	91.6	77.7	2.0	18.7	21.6	2.9
	965	H	91.2	77.0	1.4	21.1	11.8	-9.3
	109	I	89.9	81.4	0.8	2.4	3.6	1.2
	321	J	95.0	83.6	0.1	7.0	4.0	-3.0
	83	K	96.4	92.4	2.6	1.8	4.3	2.4
	435	L	92.0	79.0	0.1	9.5	15.6	6.1
	87	M	96.6	84.7	0.0	1.9	5.7	3.8
	23	N	95.7	76.8	0.0	0.5	0.9	0.4
	77	O	100.0	93.9	0.5	1.7	2.8	1.1
Total	4582					100.0	100.0	0.0
Mean			94.5	83.3	0.6			
Standard deviation			3.3	5.5	0.8			
Range			11.4	17.1	2.6			

Figure 16 (a) - (c): The PR, SOR and CR for each Mosaic socio-economic group for round **RW5**. (Note: purple is affluent, green is intermediate and blue is deprived).

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Variation of the survey results

A negative variation in the number of properties in Bournemouth within each Mosaic group indicates that the survey results are over representative of Bournemouth, a positive variation indicates that the results are under representative and no variation is directly representative of Bournemouth. For example, the proportion of group B properties surveyed is higher (17.6%) than the proportion of group B properties in Bournemouth (9.6%), thus group B has a negative variation and was over-represented within the current survey (see table 8).

Analysis of the results for the three rounds combined by group

Table 8 shows the PR, SOR and CR for each socio-economic group for the three rounds combined. The results show that **all** groups (A to O) have high PR's (>90%), high SOR's (>79%) and low CR's (0.0% to 4.4%). The standard deviations for the mean PR and SOR are small, whereas, the standard deviation for the mean CR is comparatively high due to groups N and H having higher CR's compared to the other groups (see figure 17).
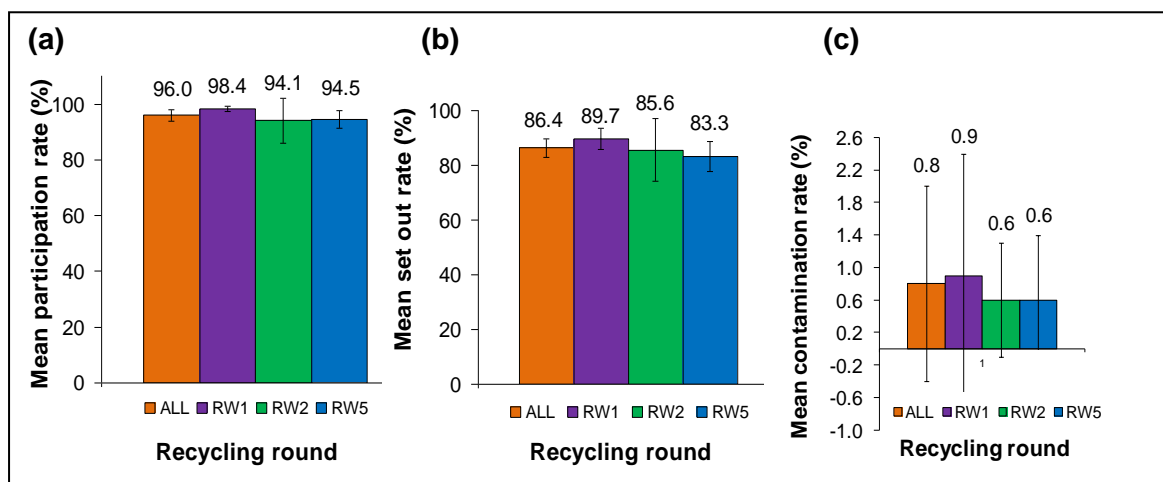
Figure 17 (a) – (c): Mean PR, SOR and CR including standard error bars by group for RW1, RW2 and RW5 combined and for each individual round.

Participation rate (PR)

Figure 13 presents the PR, SOR and CR for each socio-economic group for the three recycling rounds combined. The group with the highest PR (98.4%) was group K 'residents with sufficient incomes in right-to-buy social housing' classified as deprived, followed by group E 'middle income families living in moderate suburban semis' classified as intermediate (98.1%). The groups with the lowest PR's (92.4%) were group I 'lower income workers in urban terraces in often diverse areas' classified as deprived and group G 'young well-educated city dwellers' classified as intermediate (see figure 13a).

Set out rate (SOR)

Group D 'successful professionals living in suburban or semi-rural homes' classified as affluent had the highest SOR of 91.0%. Whilst, the second highest SOR (90.3%) was group O 'families in low-rise social housing with high levels of benefit need' classified as deprived. The group with the lowest SOR was group G classified as intermediate with 79.6% (see figure 13b).

<u>Contamination rate (CR)</u>
Group D in the affluent category had the lowest CR of 0.0%, however group C classified as affluent and group J classified as deprived had low CR's of 0.1%. Whereas, the group with the highest CR was the deprived group N 'young people renting flats in high density social housing' with 4.4% (see figure 13c).

Analysis of the results for each individual round
The mean PR and SOR for each round are high and have low standard deviations, whilst the mean CR's are also very low but have large standard deviations (see figure 17).

The group with the highest PR (100.0%) and SOR was group J for RW1, group N for RW2 and group O for RW5 which are all classified as deprived. The group with the lowest SOR for each individual round was either from the intermediate or deprived category. However, the group with the lowest PR for round RW1 was group M in the deprived category, for RW2 was group H in the intermediate category and for RW5 was group C in the affluent category.

For each round, the group with the highest CR was either from the deprived or intermediate category. The group with the highest CR was group N for RW1 with 6.1%, group G for RW2 with 2.4% and group K for RW5 with 2.6% (see figure 14, 15 and 16).

Comparison with the literature
The literature (Bridgewater and Parfitt, 2010; Davis *et al*., 2006; Martin *et al*., 2006; Morton, 2004; WRAP, 2010a; 2010c) indicated that the affluent areas would have higher recycling PR's compared to those observed in deprived areas. However, the results for the three recycling rounds combined and each individual round do not support the previous literature which would indicate that the groups classified as affluent tend to have higher PR's than groups classified as deprived (Bridgewater and Parfitt, 2010; Davis *et al*., 2006; Martin *et al*., 2006; Morton, 2004; WRAP, 2010a; 2010c).

For the current study; this may be due to the individual recycling rounds in Bournemouth not covering all of the socio-economic groups or as a result of BBC having overall high PR's and SOR's for each group, thus intergroup differences are less likely to be apparent (See Statistical test results).

Survey results by Mosaic supergroup
Table 12 to 15 highlight the PR, SOR and CR for each supergroup for the three rounds combined and each individual round and summarises the proportional variation between the number of properties in Bournemouth and the number surveyed within each supergroup. Figures 18 to 21 highlight the PR, SOR and CR for each supergroup for the three rounds combined and each individual round.

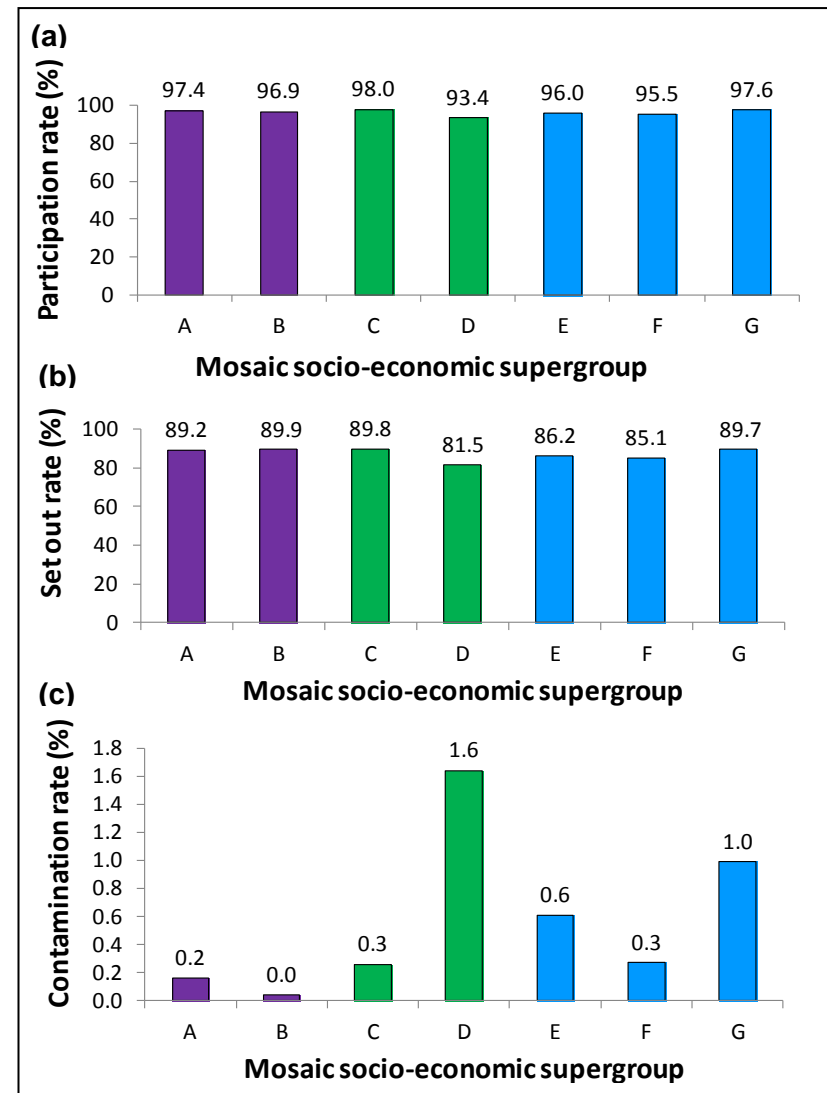**Table 12:** The PR, SOR and CR for each Mosaic socio-economic supergroup for round **RW1, RW2 and RW5 combined.** (Note: The table shows the proportion of each socio-economic supergroup sampled in the survey compared to the actual proportion of the socio-economic supergroups in Bournemouth).

All by MOSAIC supergroup (all recognised)	No. Properties	Mosaic supergroup	Participation rate (%)	Set out rate (%)	Contamination rate (%)	% proportion for ALL by MOSAIC supergroup	% proportion for Bournemouth by MOSAIC super group	% variation
	2579	A	97.4	89.2	0.2	17.6	9.6	-8.0
	1943	B	96.9	89.9	0.0	13.3	8.7	-4.6
	2845	C	98.0	89.8	0.3	19.4	11.3	-8.2
	3119	D	93.4	81.5	1.6	21.3	33.4	12.1
	1771	E	96.0	86.2	0.6	12.1	11.9	-0.2
	1586	F	95.5	85.1	0.3	10.8	21.3	10.5
	789	G	97.6	89.7	1.0	5.4	3.7	-1.7
Total	**14632**					100.0	100.0	0.0
Mean			**96.4**	**87.3**	**0.6**			
Standard deviation			**1.6**	**3.2**	**0.6**			
Range			**4.6**	**8.4**	**1.6**			

Figure 18 (a) – (c): The PR, SOR and CR for each Mosaic socio-economic supergroup for round **RW1, RW2 and RW5 combined.** (Note: purple is affluent, green is intermediate and blue is deprived).

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Table 13: The PR, SOR and CR for each Mosaic socio-economic supergroup for round **RW1**. (Note: The table shows the proportion of each socio-economic supergroup sampled for RW1 in the survey compared to the actual proportion of the socio-economic supergroups in Bournemouth).

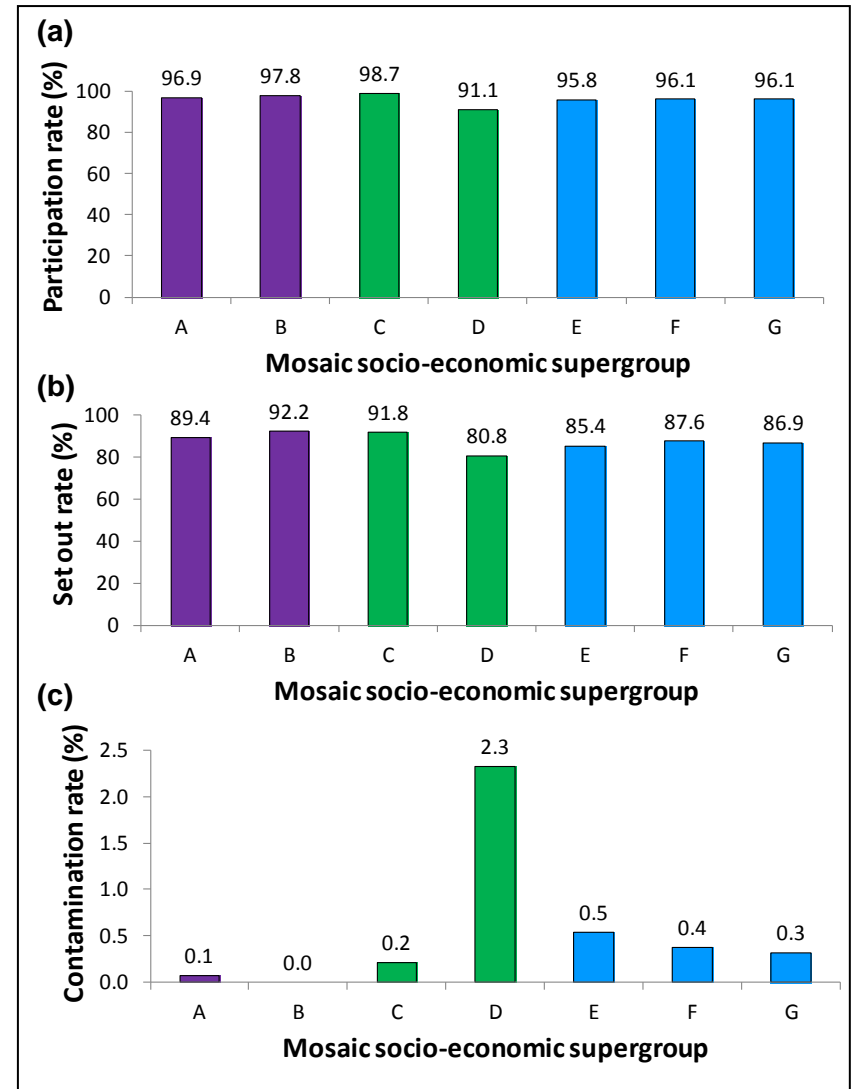| RW1 by MOSAIC supergroup (all recognised)	No. Properties	Mosaic supergroup	Participation rate (%)	Set out rate (%)	Contamination rate (%)	% proportion for RW1 by MOSAIC supergroup	% proportion for Bournemouth by MOSAIC supergroup	% variation
	809	A	98.0	88.8	0.3	16.5	9.6	-6.8
	1004	B	98.7	92.0	0.1	20.5	8.7	-11.8
	1086	C	98.3	91.7	0.2	22.1	11.3	-10.8
	837	D	98.9	91.0	1.2	17.1	33.4	16.4
	392	E	98.7	90.1	0.7	8.0	11.9	3.9
	449	F	97.8	87.7	0.3	9.1	21.3	12.2
	332	G	98.8	92.6	1.8	6.8	3.7	-3.0
Total	4909					100.0	100.0	0.0
Mean			98.5	90.5	0.7			
Standard deviation			0.4	1.8	0.6			
Range			1.2	4.9	1.8			
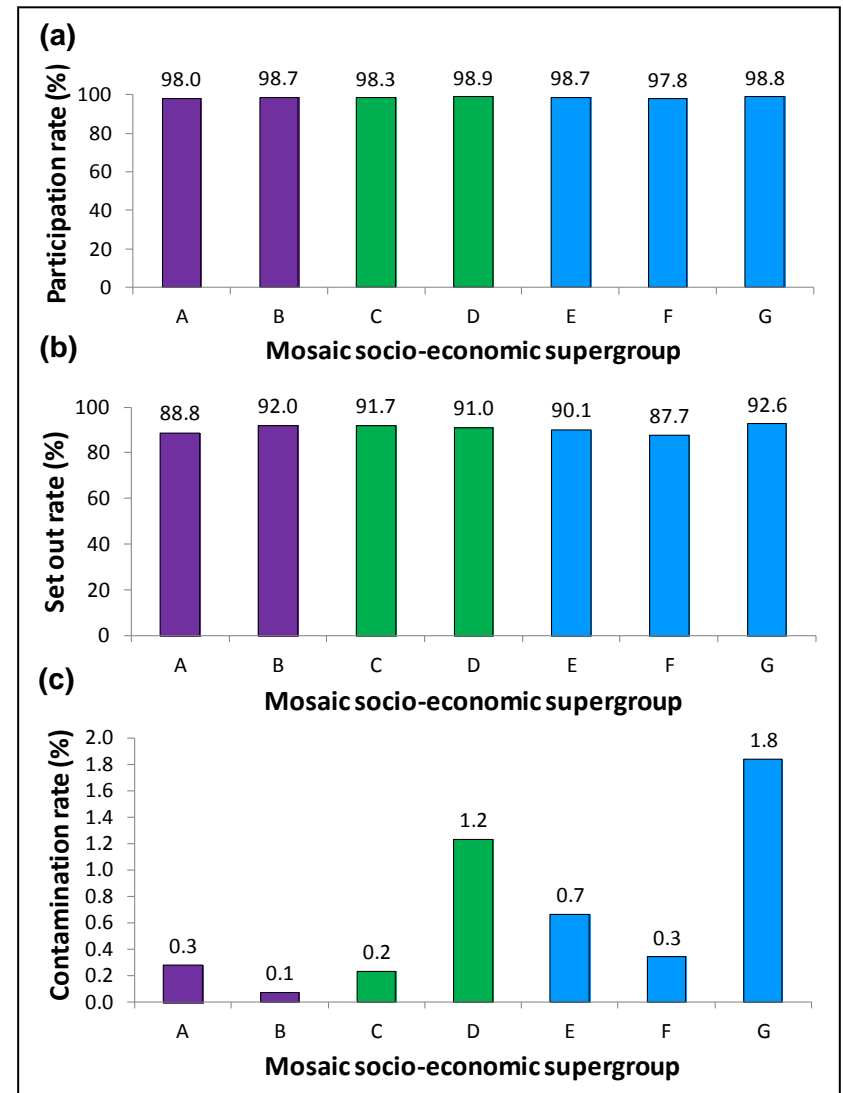
Figure 19 (a) to (c): The PR, SOR and CR for each Mosaic socio-economic supergroup for round **RW1**. (Note: purple is affluent, green is intermediate and blue is deprived).

Table 14: The PR, SOR and CR for each Mosaic socio-economic supergroup for round **RW2**. (Note: The table shows the proportion of each socio-economic supergroup sampled for RW2 in the survey compared to the actual proportion of the socio-economic supergroups in Bournemouth).

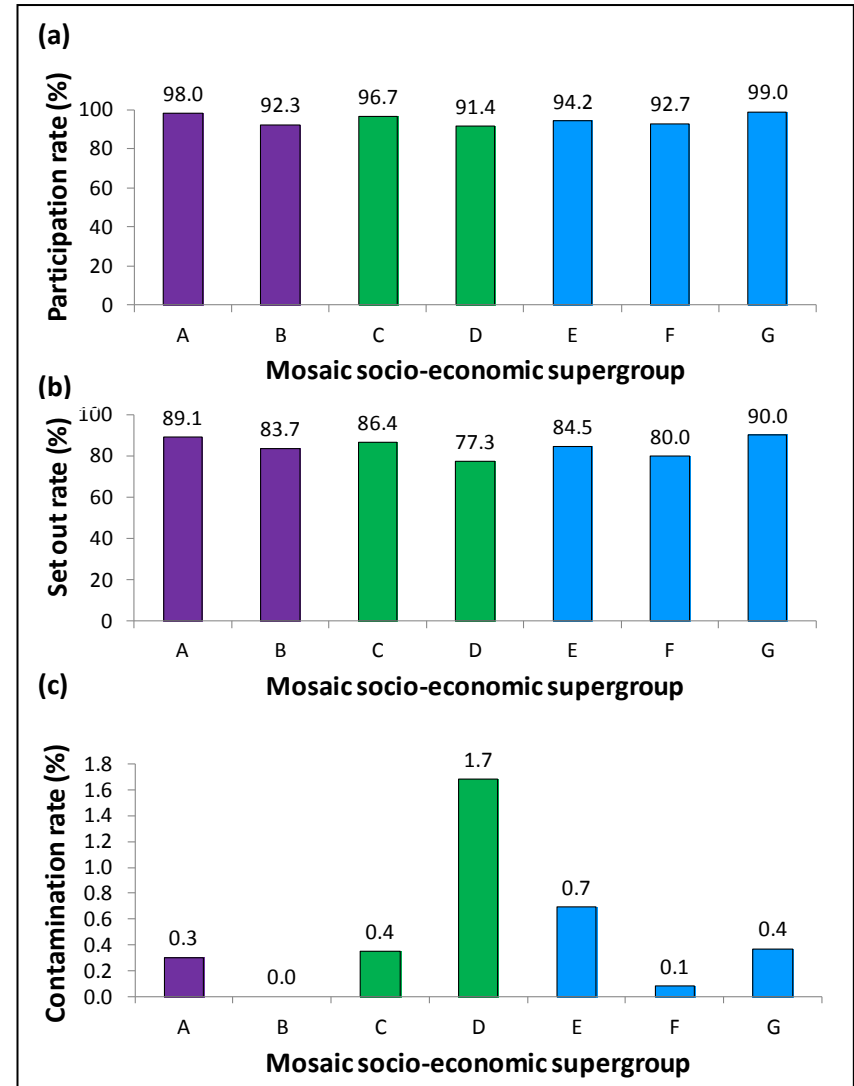| RW2 by MOSAIC supergroup (all recognised)	No. Properties	Mosaic supergroup	Participation rate (%)	Set out rate (%)	Contamination rate (%)	% proportion for RW2 by MOSAIC supergroup	% proportion for Bournemouth by MOSAIC super group	% variation
	1522	A	96.9	89.4	0.1	29.6	9.6	-20.0
	448	B	97.8	92.2	0.0	8.7	8.7	0.0
	873	C	98.7	91.8	0.2	17.0	11.3	-5.7
	460	D	91.1	80.8	2.3	8.9	33.4	24.5
	866	E	95.8	85.4	0.5	16.8	11.9	-4.9
	615	F	96.1	87.6	0.4	12.0	21.3	9.3
	357	G	96.1	86.9	0.3	6.9	3.7	-3.2
Total	5141					100.0	100.0	0.0
Mean			96.1	87.7	0.5			
Standard deviation			2.4	3.9	0.8			
Range			7.7	11.4	2.3			

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Figure 20 (a) to (c): The PR, SOR and CR for each Mosaic socio-economic supergroup for round **RW2**. (Note: purple is affluent, green is intermediate and blue is deprived).

Table 15: The PR, SOR and CR for each Mosaic socio-economic supergroup for round **RW5**. (Note: The table shows the proportion of each socio-economic supergroup sampled for RW5 in the survey compared to the actual proportion of the socio-economic supergroups in Bournemouth).

RW5 by MOSAIC supergroup (all recognised)	No. Properties	Mosaic super group	Participation rate (%)	Set out rate (%)	Contamination rate (%)	% proportion for RW5 by MOSAIC supergroup	% proportion for Bournemouth by MOSAIC super group	% variation
	248	A	98.0	89.1	0.3	5.4	9.6	4.2
	491	B	92.3	83.7	0.0	10.7	8.7	-2.0
	886	C	96.7	86.4	0.4	19.3	11.3	-8.1
	1822	D	91.4	77.3	1.7	39.8	33.4	-6.3
	513	E	94.2	84.5	0.7	11.2	11.9	0.7
	522	F	92.7	80.0	0.1	11.4	21.3	9.9
	100	G	99.0	90.0	0.4	2.2	3.7	1.6
Total	**4582**					100.0	100.0	0.0
Mean			**94.9**	**84.4**	**0.5**			
Standard deviation			**3.0**	**4.6**	**0.6**			
Range			**7.6**	**12.7**	**1.7**			

Figure 21 (a) to (c): The PR, SOR and CR for each Mosaic socio-economic supergroup for round **RW5**. (Note: purple is affluent, green is intermediate and blue is deprived).

Analysis of the results for the three rounds combined by supergroup
All of the supergroups (A to G) have high PR's (>90%), high SOR's (>80%) and low CR's (0.0% to 1.6%). The mean PR and SOR have a small standard deviation, whereas the mean CR has a high standard deviation due to supergroup D and G having comparatively higher CR's compared to the other supergroups (see figure 22).
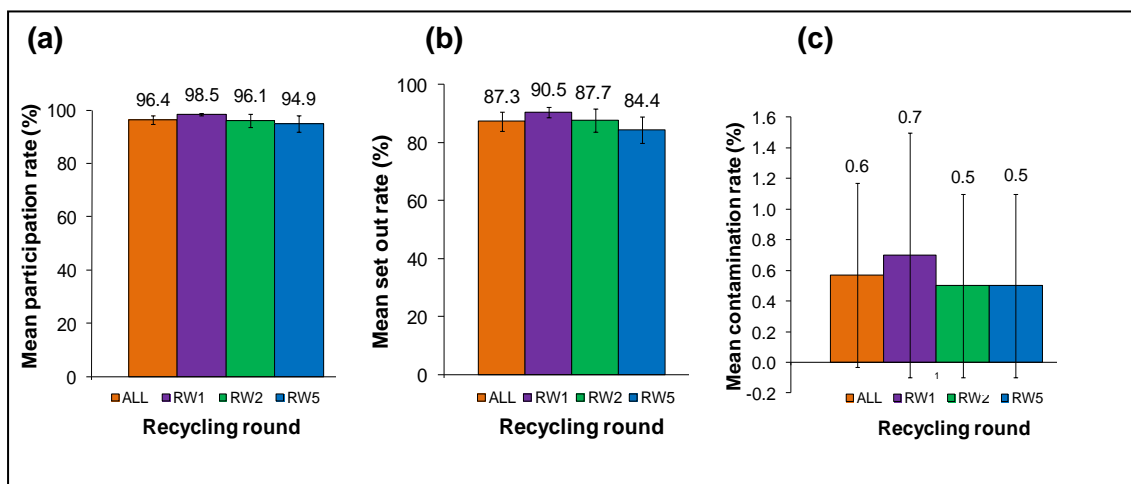

Figure 22 (a) – (c): Mean PR, SOR and CR including standard error bars by supergroup for RW1, RW2 and RW5 combined and for each individual round.

Participation rate (PR)
The socio-economic supergroup with the highest PR (98.0%) was supergroup C 'middle income families' from the intermediate category, whilst the second highest PR (97.6%) was supergroup G 'social housing tenants' classified as deprived. Supergroup D 'young people starting out' classified as intermediate had the lowest PR of 93.4% (see figure 18a).

Set out rate (SOR)
Supergroup B 'affluent householders' classified as affluent has the highest SOR of 89.9% and supergroup D classified as intermediate has the lowest SOR of 81.5% (see figure 18b).

Contamination rate (CR)
Supergroup D classified as intermediate has the highest CR of 1.6%, followed by supergroup G classified as deprived with 1.0%. Whereas, the supergroups with the lowest CR's were supergroup A with 0.2% and B with 0.0% which are both classified as affluent (see figure 18c).

Analysis of the results for each individual round
Figure 22 shows the mean PR and SOR for each round are high and have low standard deviations, whilst the mean CR's are also very low but have large standard deviations. The supergroup with the highest and lowest PR's were classified as either intermediate or deprived. For RW1 and RW5 the supergroup with the highest SOR was classified as deprived, but for RW2 was classified as affluent. Whereas, the supergroup with the highest CR was either

from the deprived or intermediate category and the supergroups with the lowest CR were all classified as affluent (see figure 19, 20 and 21).

Comparison with the literature
The supergroup results do not conform with the literature findings that affluent areas tend to have high PR's and deprived areas have low PR's (Bridgewater and Parfitt, 2010; Davis *et al.*, 2006; Martin *et al.*, 2006; Morton, 2004; WRAP, 2010a; 2010c). This could be due to all of the supergroups having high PR's within a narrow range (93.4% to 98.0%), thus there is not a clear visible difference between the BBC supergroup results (see Statistical test results).

Weighting the survey results
The number of properties surveyed for each Mosaic socio-economic group is not proportional to the total number of properties for each group in Bournemouth. WRAP (2010i) recommends 'weighting' to transform non representative data of a target area into representative data which provides more value for data analysis. The PR, SOR and CR for all of the socio-economic groups and supergroups for the three recycling rounds combined and for each individual round were weighted, to ensure the survey results were more representative of Bournemouth and the Mosaic socio-demographic group proportions.

Table 16 and figure 23 highlight the weighted PR's, SOR's and CR's by group for the three recycling rounds combined and each individual round. Table 17 and figure 24 show the weighted results by supergroup.

Overall for the three rounds surveyed; the weighted group PR is 95.3%, SOR is 85.2% and CR is 0.8% and the weighted supergroup PR is 95.5%, SOR is 85.5% and CR is 0.8%. The weighted group and supergroup results confirm that BBC's PR and SOR for the three rounds surveyed and each individual round are very high and the CR is very low (<1%).

Table 16: The weighted PR, SOR and CR by group for the three rounds combined and for each individual round.

Round	No. properties	Weighted number participating	Weighted participation rate (%)	Weighted setting out	Weighted set out rate (%)	Weighted number contaminating	Weighted contamination rate (%)
ALL	14632	13,941	95.3	12,464	85.2	123	0.8
RW1	4909	4829	98.4	4305	87.7	29	0.6
RW2	5141	4656	90.6	4177	81.2	45	0.9
RW5	4582	4295	93.7	3752	81.9	38	0.8

Table 17: The weighted PR, SOR and CR by supergroup for the three rounds combined and for each individual round.

Round	No. properties	Weighted number participating	Weighted participation rate (%)	Weighted setting out	Weighted set out rate (%)	Weighted number contaminating	Weighted contamination rate (%)
ALL	14632	13,972	95.5	12,515	85.5	112	0.8
RW1	4909	4834	98.5	4428	90.2	34	0.7
RW2	5141	4880	94.9	4425	86.1	50	1.0
RW5	4582	4289	93.6	3754	81.9	34	0.7
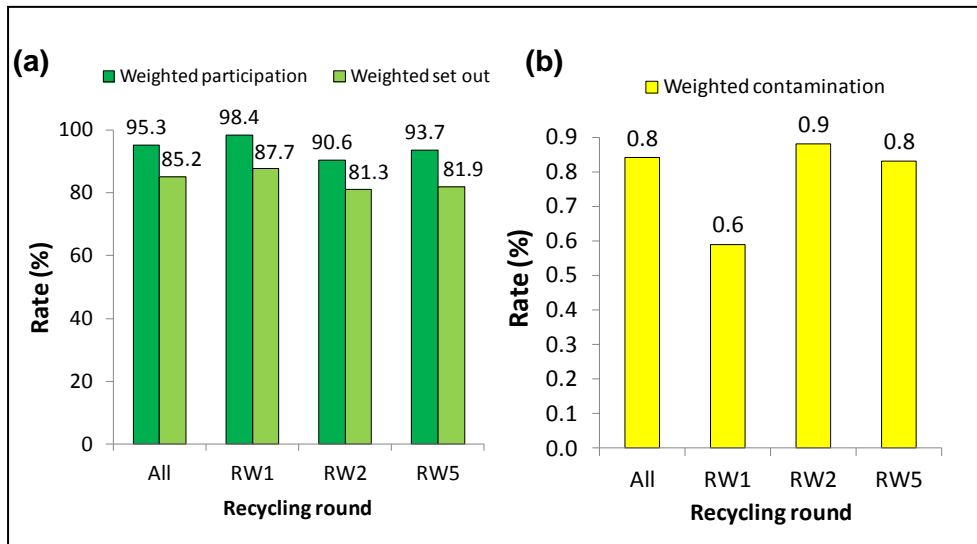
Figure 23 (a) – (b): The weighted PR, SOR and CR by group for the three rounds combined and each individual round.
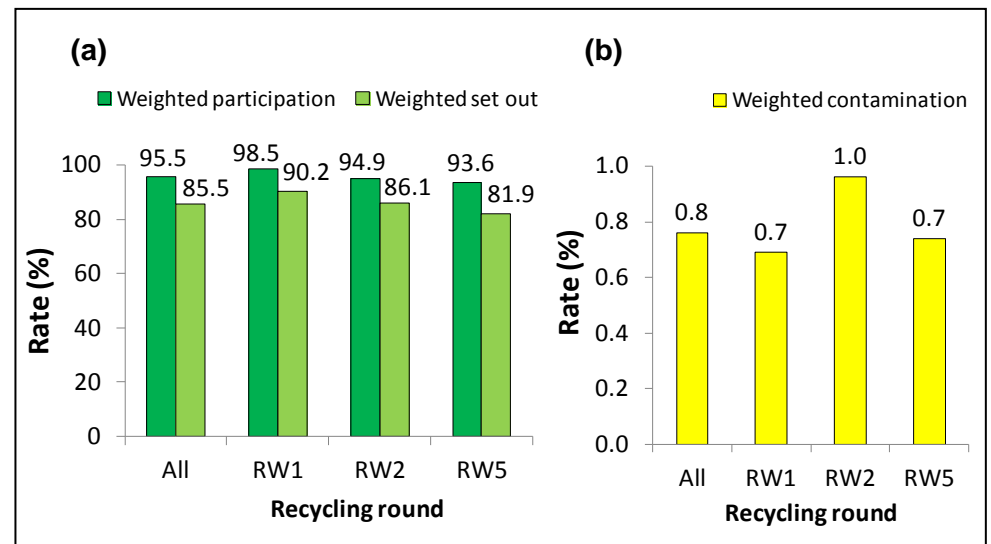

Figure 24 (a) – (b): The weighted PR, SOR and CR for by supergroup for the three rounds combined and each individual round.

Statistical tests
The Mosaic socio-economic groups and supergroups for the three rounds combined were split up into the classification categories 'affluent, intermediate and deprived'. The PR, SOR and CR results were analysed for all three combinations of the classification categories to test the hypotheses. The combinations of the three categories for analysis are:

- Affluent and intermediate
- Affluent and deprived
- Intermediate and deprived

The normal distribution of the Mosaic socio-economic group and supergroup results for the three rounds combined were tested using the Kolmogorov-Smirnov normality test using Minitab 16 (Daly *et al.*, 1995; Davidson, 2008). The datasets with normal distribution were statistically tested using the two sample student 't'-test (Daly *et al.*, 1995; Davidson, 2008) whilst the non-normal datasets were tested using the Mann-Whitney test (Freund and Wilson, 1993; Groeneveld, 1988).

Tables 18 and 19 show the mean ± standard deviation of the group and supergroup survey results classified into the affluent, intermediate or deprived category for the PR, SOR and CR.

Table 18: The mean PR, SOR and CR including the standard deviation for the affluent, intermediate and deprived category for the three rounds combined by group.

ALL by MOSAIC group (all recognised)	Normality of dataset	Affluent (B, C + D) mean (%)	Intermediate (E, F, G + H) mean (%)	Deprived (I, J, K, L, M, N + O) mean (%)
PR	Nonnormal	96.3 ± 2.1	95.5 ± 2.7	96.0 ± 2.0
SOR	Normal	88.6 ± 2.8	85.4 ± 5.0	86.0 ± 2.7
CR	Nonnormal	0.1 ± 0.1	1.0 ± 0.9	1.1 ± 1.5

Table 19: The mean PR, SOR and CR including the standard deviation for the affluent, intermediate and deprived category for the three rounds combined by supergroup.

ALL by MOSAIC supergroup (all recognised)	Normality of dataset	Affluent (A + B) mean (%)	Intermediate (C + D) mean (%)	Deprived (E, F + G) mean (%)
PR	Normal	97.1 ± 0.4	95.7 ± 3.3	96.3 ± 1.1
SOR	Normal	89.5 ± 0.5	85.6 ± 5.8	87.0 ± 2.4
CR	Normal	0.1 ± 0.1	1.0 ± 1.0	0.6 ± 0.4

Statistical test results
From the statistical analysis for the three rounds combined by group and supergroup it was apparent that there is no significant difference between the PR's or SOR's in the affluent, intermediate or deprived category. However, there is a significant difference between the CR's in the affluent and deprived category.

Overall, the BBC PR's do not conform with the literature which indicated that the affluent areas tend to have high PR's and the deprived areas tend to have low PR's (Bridgewater and Parfitt, 2010; Davis *et al*., 2006; Martin *et al*., 2006; Morton, 2004; WRAP, 2010a; 2010c). The PR's for each group are all high and within a narrow range as a result of the majority of Bournemouth's residents participating in the scheme. Hence, any difference between the affluent and deprived groups PR's is likely to be obscure as there is little deviation between the socio-economic group spectrum. Although the CR's for each group or supergroup are low, the CR's in the intermediate or deprived category are higher than the rates in the affluent category and the statistical test confirmed there is a significant difference. Table 20 shows that group G and H in the intermediate category and group I, K and N in the deprived category had the highest CR's for the three rounds combined.

Table 20: The Mosaic groups and supergroups with the highest CR's.

Mosaic group	CR (%)	Mosaic supergroup	CR (%)	Category
G: young, well-educated city dwellers	2.0	**D:** Young people starting out	1.6	Intermediate
H: couples and young singles in small modern starter homes	1.4			
I: lower income workers in urban terraces in often diverse areas	0.9	**E:** Lower income residents	0.6	Deprived
K: residents with sufficient incomes on right-to-buy social housing	0.9			
N: young people renting flats in high density social housing	4.4	**G:** Social housing tenants	1.0	

GreenAware
The households within each Mosaic group can be classified into ten different Mosaic GreenAware types (see table 21).

Table 21: The GreenAware types and definitions (Experian, 2009b).

GreenAware type	Definition
01: Eco-evangelist	A conviction of green beliefs and eco-friendly behaviours are let down by a reluctance to give up their accustomed lifestyles.
02: Convinced consumers	There is a strong willingness to change behaviours and a high awareness of green concepts, although convenience is often an issue.
03: Green but doubtful	Despite being well informed they remain unconvinced about green issues, although they are surprisingly responsible with their behaviours.
04: Confused but well-behaved	These have an extreme concern for climate change and are willing to demonstrate green behaviours, but are held back by a lack of information.
05: Doing their best	These are concerned about environmental issues despite a lack of information; they would enact more if not for the perceived high costs involved.
06: Sceptical libertarians	Believe that they are contributing, but have scepticism of ecological arguments meaning that their primary motivation is to save money.
07: Too busy to change	Have a relatively high level of knowledge but is financial incentives that encourage their moderate efforts.
08: Why should I bother?	Their lack of strong opinions and limited knowledge has led to them being eco-villains, who would respond only through compulsion and incentives.
09: Constrained by price	These have an inclination to do more but demonstrate a lack of green behaviours, dependent on an extreme lack of finances and information.
10: Wasteful but unconvinced	These have a disposable and wasteful attitude, fuelled by a lack of education, limited finances and a reluctance to give up their lifestyle.

Table 22 shows the percentage proportion of each GreenAware type within each Mosaic group based on UK data rather than local data for Bournemouth. The percentage proportions coloured and highlighted in bold show the GreenAware types which are over-represented within the Mosaic groups. Over-representation means that the Mosaic groups based on UK data have higher proportions of the GreenAware types than the proportions expected for these groups.

Table 22: GreenAware Mosaic group proportions based on UK Index Data. Note: The circles represent the GreenAware type with the highest proportion within each Mosaic group (Experian, 2011b).

GreenAware type	Affluent Mosaic groups				Intermediate Mosaic groups				Deprived Mosaic groups						
	% A	% B	% C	% D	% E	% F	% G	% H	% I	% J	% K	% L	% M	% N	% O
Type 01: Eco-evangelists	0.3	1.0	20.3	1.1	2.8	4.8	46.6	18.9	9.3	1.0	0.5	4.6	0.3	12.0	0.2
Type 02: Convinced consumers	6.2	4.1	10.9	5.9	6.7	4.5	18.3	8.2	1.8	2.6	0.7	1.4	0.1	1.1	0.1
Type 03: Green but doubtful	23.3	35.6	12.2	18.3	12.4	5.1	4.4	2.4	1.2	24.7	2.5	64.6	11.5	0.2	0.1
Type 04: Confused but well-behaved	0.7	4.0	0.6	0.3	3.3	0.3	3.7	1.4	12.5	14.0	27.5	11.8	76.3	18.3	30.9
Type 05: Doing their best	42.4	13.3	18.7	26.7	20.0	19.7	2.4	9.0	1.2	8.8	1.7	4.9	0.4	0.1	0.1
Type 06: Sceptical libertarians	15.2	26.5	18.9	33.9	20.4	12.9	2.9	4.2	2.0	12.2	3.9	7.9	0.6	0.3	0.1
Type 07: Too busy to change	10.7	8.2	17.5	13.0	21.6	45.2	3.6	18.1	2.2	12.0	1.7	2.2	0.3	0.2	0.2
Type 08: Why should I bother?	0.2	1.1	0.3	0.1	2.6	0.5	10.1	7.2	15.2	2.3	8.4	0.2	1.0	16.4	10.9
Type 09: Constrained by price	1.0	4.5	0.5	0.7	9.0	5.6	2.4	17.1	28.4	20.0	42.8	1.7	5.7	8.4	25.8
Type 10: Wasteful and unconvinced	0.1	1.8	0.2	0.1	1.2	1.4	5.6	13.5	26.3	2.6	10.4	0.7	3.8	43.0	31.7
Total (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

The survey PR's for each Mosaic group do not reflect the GreenAware classification types. For example the survey PR's all the groups are high even though group E, F and H classified as intermediate have a high proportion of the GreenAware type 07: too busy to change and group I, N and O classified as deprived have a high proportion of type 10: wasteful and unconvinced (see table 22).

The survey results also showed that group G and H in the intermediate category and Group I, K and N in the deprived category had the highest CR's. The highest GreenAware type proportion within the national Mosaic groups G and H is type 01: eco-evangelists. Nationally, 46.6% of households within group G are classified as Eco-evangelists and 18.3% are convinced consumers, thus this Mosaic group would not be expected to have a high CR. The high CR for group H may be due to a high proportion of households within the national group classified as too busy to change (18.1%).

Table 22 shows that group I, K and N have high proportions of the GreenAware types; wasteful and unconvinced, constrained by price, confused but well-behaved and why should I bother?. Thus, these groups would be expected to contaminate more than the other groups due to their Green Awareness type proportions. Group N had the highest CR for Bournemouth and this may be explained by the national Mosaic group having high proportions of the

GreenAware type wasteful and unconvinced (43.0%), confused but well-behaved (18.3%) and why should I bother? (16.4%).

Applying the results to a probabilistic model
Figure 25 presents the model which compares the set out rate of the recycling bin 'Big Bin' to the proportion of households participating in recycling (the participation ratio). This model was adapted from the probabilistic model presented in Shaw *et al.*, (2007).
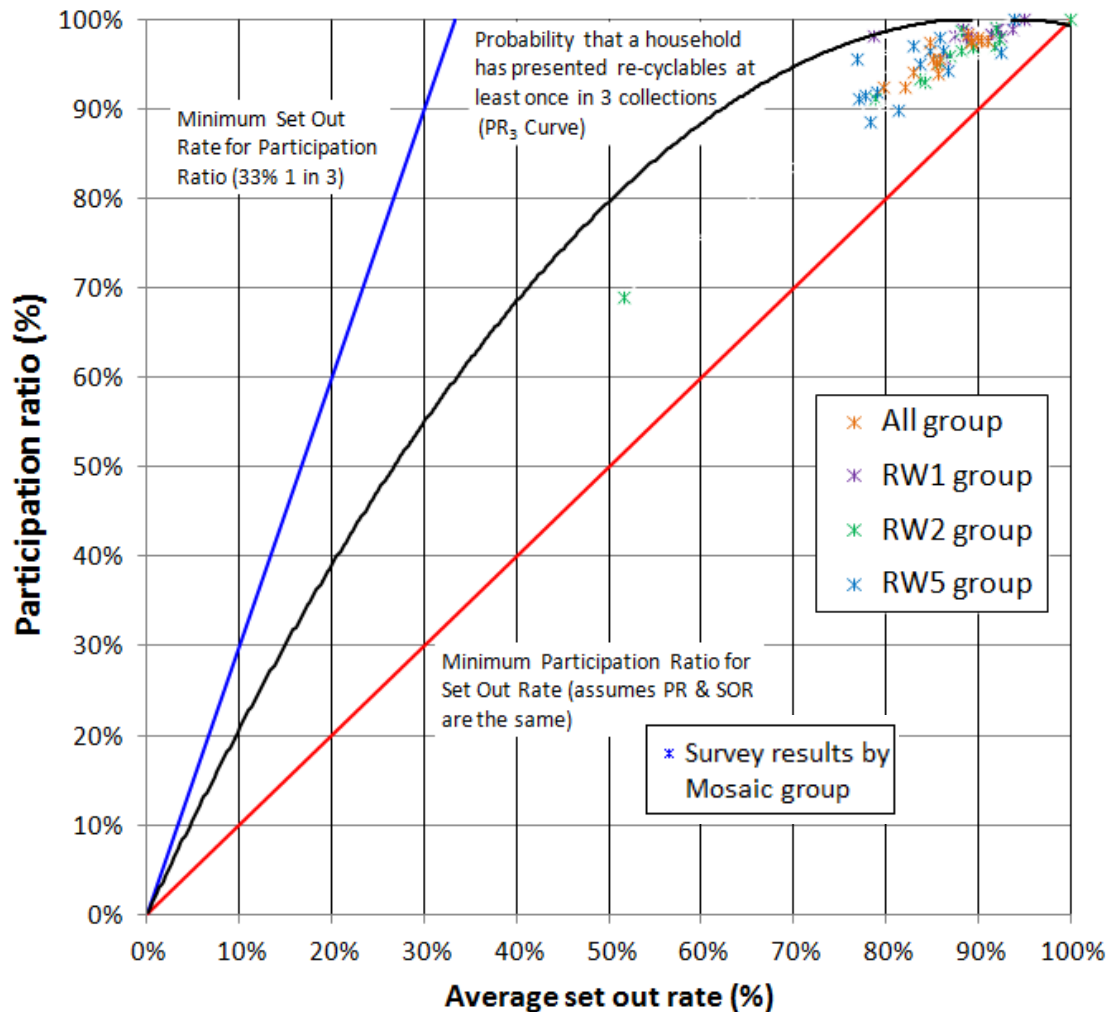

Figure 25: Average set out and participation ratio survey results by group for the three rounds combined and each individual round compared to probabilistic model outputs.

The red line for "minimum participation ratio for set out rate" assumes the SOR and PR are the same and that all participants use the scheme with maximum possible frequency. For example all householders who set out their recycling bin 'Big Bin' do so on every occasion (Shaw *et al.*, 2007). Whereas, the blue line "minimum set out for participation ratio" assumes participants use the scheme with minimum possible frequency. For example, if every participant only set out once over three collections, the SOR would be 33.3% and the

corresponding PR would be 100%. Therefore if the SOR is 30% over three collections, the associated PR will be 90% (Shaw *et al.*, 2007).

The PR_j curve (black line) is the probability that a given household has presented recyclables at least once over three collections, thus PR_j is PR_3. The PR_3 curve was plotted using the set out rate for each Mosaic socio-economic group for the three rounds combined and the calculated PR_3 probability (highlighted in grey in table 23; Shaw *et al.*, 2007).

The PR_3 probability was calculated using the following equation, where 'S' is the set out probability: $Pr_3 = 1 - (1-S)^3$. The equation assumes that all households are identical in relation to their probability of set out and non-set out. If the set out rate for a group of households is 40%, then the probability of a recycling bin being set out by an individual household is 0.4 for a random set out distribution, thus the set out probability is 0.4 (40÷100) (Shaw *et al.*, 2007).

Table 23 shows the calculated PR_3 probability for each Mosaic socio-economic group for the three rounds combined and the PR_3 probability percentage.

Table 23: The PR, SOR, calculated set out probability, calculated PR_3 probability and PR_3 probability percentage for each Mosaic socio-economic group for the three rounds combined.

Mosaic group	Survey participation rate (%)	Survey set out rate (%)	Set out probability	PR_3 probability	PR_3 probability (%)
A	0.00	0.00	0.0000	0.0000	0.00
B	97.36	89.16	0.8916	0.9987	99.87
C	93.94	85.61	0.8561	0.9970	99.70
D	97.61	91.04	0.9104	0.9993	99.93
E	98.07	89.92	0.8992	0.9990	99.90
F	97.61	89.25	0.8925	0.9988	99.88
G	92.41	79.64	0.7964	0.9916	99.16
H	94.07	82.89	0.8289	0.9950	99.50
I	92.39	82.06	0.8206	0.9942	99.42
J	95.69	85.87	0.8587	0.9972	99.72
K	98.38	88.89	0.8889	0.9986	99.86
L	95.55	85.01	0.8501	0.9966	99.66
M	95.11	85.42	0.8542	0.9969	99.69
N	97.53	84.77	0.8477	0.9965	99.65
O	97.60	90.25	0.9025	0.9991	99.91

The relationship of PR to SOR indicates recycling behaviours and can be used to identify households as either frequent, infrequent or non recyclers. If the PR and SOR falls below the PR_3 curve and within the 'minimum participation ratio for set out rate' boundary then it would infer that relatively few households participate in the recycling scheme, but those participating set out relatively frequently. Whilst, if the PR and SOR falls above the PR_3 curve this would indicate that a high proportion of households participate in the scheme but set out less frequently (Shaw *et al.*, 2007).

The plotted data on the probabilistic model (figure 25) represents Bournemouth's PR and SOR for each socio-economic group for all three rounds combined and each individual round. All of the plotted results are positioned in-between the PR_3 curve and the 'minimum participation ratio for set out rate' boundary, which indicates that Bournemouth households are setting out their bin more frequently than just once over three collections (Shaw *et al.*, 2007).

The current survey results are evenly clustered due to each group having a high PR and SOR, reflecting a high degree of consistency and commonality between the three rounds surveyed. However, the plotted data point for group H for RW2 deviates from the clustered results due to having a lower PR and SOR compared to the other groups (see figure 25). The deviation may be due to under-representation of group H as only 42 properties were surveyed in RW2. Overall the BBC survey results show that Bournemouth households set their recycling bin out at a higher frequency than the frequency predicted by the probability model (PR_3 curve). Therefore, a large proportion of households in Bournemouth can be classified as frequent recyclers. Bournemouth's PR's and SOR's are high which indicates that the obstacle to higher recycling performance is the availability or mode of use of the kerbside recycling facilities rather than lack of participation (Shaw *et al.*, 2007).

The impacts of street architecture on the PR
Previous studies (Harder *et al.*, 2006; Shaw, 2008) have highlighted that recycling behaviour may be influenced by street architecture. These studies reported that short roads or cul-de-sac blocks with fewer or more clustered households on the road have higher PR's compared to long linear orientated blocks which contain more households.

Table 24 shows the PR, SOR and CR classified by street architecture for the three rounds combined and each individual round surveyed. Figure 26 highlights that all of the PR's for each street architecture type were above 90% and all the SOR's were above 80%.

Table 24: The PR, SOR and CR for crescent, cul-de-sac and linear street architecture.

ALL by Street Architecture	No. Properties	Street architecture	Participation rate (%)	Set out rate (%)	Contamination rate (%)
	888	Crescent	97.4	89.5	0.6
	2929	Cul-de-sac	98.4	91.3	0.4
	10842	Linear	95.5	85.6	0.6
Total	14659				
RW1 by Street architecture	No. Properties	Street architecture	Participation rate (%)	Set out rate (%)	Contamination rate (%)
	299	Crescent	99.0	92.9	0.5
	1475	Cul-de-sac	98.8	93.0	0.6
	3140	Linear	92.3	89.5	0.5
Total	4914				
RW2 by street architecture	No. Properties	Street architecture	Participation rate (%)	Set out rate (%)	Contamination rate (%)
	549	Crescent	96.5	87.6	0.6
	1084	Cul-de-sac	98.4	90.7	0.2
	3524	Linear	95.8	87.5	0.4
Total	5157				
RW5 by street architecture	No. Properties	Street architecture	Participation rate (%)	Set out rate (%)	Contamination rate (%)
	40	Crescent	97.5	90.0	0.0
	370	Cul-de-sac	96.5	86.4	0.1
	4178	Linear	93.2	81.1	0.9
Total	4588				
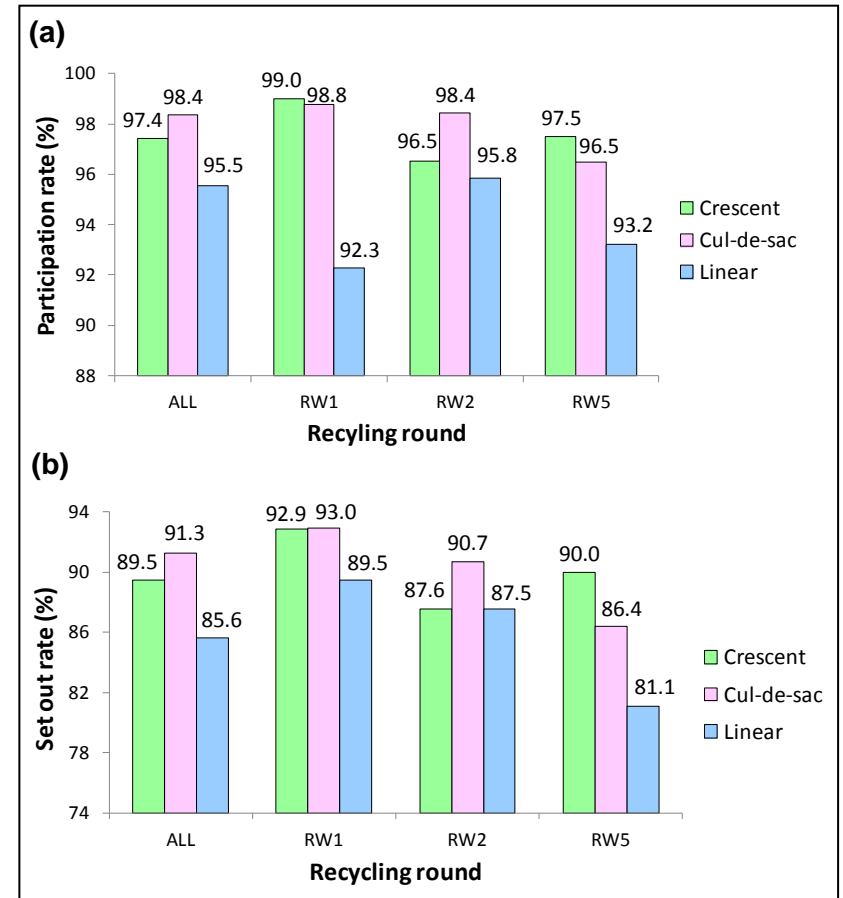
Figure 26 (a) – (b): The PR and SOR for the three recycling rounds combined by street architecture compared to the PR and SOR for each individual round surveyed.

The full data sample (14,659 properties surveyed) was used for the street architecture analysis, however Bournemouth's street architecture mostly consists of linear roads, thus less crescent and cul-de-sac type street architecture were surveyed.

The street architecture type with the highest PR for the three rounds combined was cul-de-sac (98.4%), followed by crescent (97.4%) and then linear (95.5%). The results for each individual round also show that the crescent and cul-de-sac street architecture have higher PR's than the linear street architecture.

Statistical analysis (two sample student t-test with 95% confidence limits for normally distributed data) indicated that there is a significant difference between the PR's for 'cul-de-sac and linear' street types and for 'crescent and linear' street types, but not a statistical difference between the PR's for 'crescent and cul-de-sac' street types (Brereton, 2007; Hammer and Harper, 2006; Hine, 1975). Therefore, the PR results link to the literature that cul-de-sac or shorter roads with more clustered or fewer households have higher PR's than longer or linear orientated block roads (Harder *et al.*, 2006; Shaw, 2008).

Summary
Overall, 14,103 properties out of the 14,659 properties surveyed in the current study participate in Bournemouth's kerbside recycling scheme, giving a PR of 96.2%. The high PR's and low CR's indicate that BBC's kerbside recycling scheme is successful and performing well and this is reflected by BBC's high recycling rate of 63.9%.

This study has shown that:

- The weighted PR's, SOR's are high and the CR's are low.
- The PR's and SOR's are high and the CR's are low for each socio-economic group or supergroup.
- The CR's in the intermediate or deprived category are higher than the CR's in the affluent category.
- Group G and H in the intermediate category and group I, K and N in the deprived category had the highest CR's for the three rounds combined.
- There is a significant difference between the CR's classified in the affluent and deprived category.

Conclusions

Conclusions and future work
The overall PR for the total 14,659 properties surveyed within the three recycling rounds for Bournemouth (RW1, RW2 and RW5) was 96.2%. For the three rounds combined; the overall weighted PR was 95.3%, SOR was 85.2% and CR was 0.8% by group and the overall weighted PR was 95.5%, SOR was 85.5% and CR was 0.8% by supergroup. The high weighted PR's and SOR's confirm that the majority of Bournemouth households participate in the 'Big Bin' kerbside recycling scheme and set out their recycling bin frequently. Whereas, the low weighted CR's indicate that most households are using the scheme correctly and only a minority of households are placing items into their recycling bins which are not accepted for recycling.

The survey results by Mosaic group for the three rounds combined indicate that **all** the Mosaic socio-economic groups (A to O) had high PR's above 90%, high SOR's above 79% and low CR's below 4.4%. The literature (Bridgewater and Parfitt, 2010; Davis *et al.*, 2006; Martin *et al.*, 2006; Morton, 2004; WRAP, 2010a; 2010c) indicated that the affluent groups would have higher PR's than the deprived groups, but this is not the case for Bournemouth, due to the majority of Bournemouth residents participating in the scheme no matter what socio-economic group they are classed as.

There was no significant difference between the Mosaic socio-economic group PR's and SOR's in the affluent, intermediate or deprived category, but there was a significant difference between the group CR's in the affluent and deprived category.

The groups classified as affluent had lower CR's than the groups classified as intermediate or deprived. In particular group N classified as deprived had the highest CR of 4.4%, however group G, H, I and K also had high CR's compared to the other groups.

Recommendations for BBC
The survey results reflect that BBC's kerbside recycling scheme is successful due to the high PR's and low CR's (WRAP, 2008). The scheme contributes 32.5% towards Bournemouth's high recycling rate of 63.9%, which is the fourth highest recycling rate in the UK (BBC, 2011l; WasteDataFlow, 2011). The results confirm that currently there is no need for BBC to change the existing recycling and residual kerbside schemes to an alternate weekly collection.

The survey results have highlighted that BBC does not need to focus on targeting the individual socio-economic groups to participate in the scheme, but should consider focusing on targeting and monitoring the groups with the higher CR's (G, H, I, K and N). BBC should develop appropriate (low or no cost) communication campaigns to educate the households within these five groups about which items are not currently accepted in the recycling bin and why, in order to lower the CR's (WRAP, 2010c; 2010h). For example, BBC could use face to face communication methods to directly address the contamination problem, such as door to door canvassing, however there is also potential for the collection crews to educate and engage with the households (BBC, 2011e; WRAP, 2010a).

BBC's kerbside recycling scheme could be improved further by increasing the schemes capture rate of recyclable materials by the addition of more items e.g. rigid plastics into the recycling bin and educating residents about the full range of items which are accepted (BBC, 2011e; 2011j). This would reduce the amount of potentially recyclable materials being recovered from the residual waste stream and improve BBC's recycling rate (BBC, 2012a; 2011e; WRAP, 2010a).

The outcome of BBC's Municipal Waste Management Strategy consultation is that BBC is going to maintain and improve the existing services. As a result, the findings of the current survey can be used to guide BBC on which groups to focus on targeting in order to lower the CR's and improve the kerbside recycling scheme. BBC's ongoing priority will be to educate, raise awareness and promote initiatives to

tackle waste prevention, enhance recycling and increase the recycling rate in order to divert more material from the waste stream (BBC, 2011e; 2011g).

In light of the current financial conditions; BBC is going to apply for government grants and work closely with local businesses, other local authorities and the voluntary sector to ensure that the efficiency of the existing waste management services is maintained (BBC, 2011e; 2011i; 2011q). However, BBC has a new incentive to improve the recycling rate further due to the increasing prices for recyclable materials and having recently secured a revised three year contract with 'Viridor' to continue to recycle at the MRF in Kent, which will approximately save the council over £800,000 a year (BBC, 2012a).

Limitations of the study
The main limitation of the study was that a round-based sampling approach had to be adopted due to the recycling crews having set collection routes. However, it was essential for the monitors to undertake the participation survey with the crew in order to obtain the most reliable data. The three rounds chosen to sample were not representative of Bournemouth's Mosaic group proportions, but this was the case for all the other recycling rounds, thus the results were weighted to ensure they were more representative.

Another limitation was that only 98.8% of the sample could be analysed by Mosaic as the postcodes of 27 properties were not recognised. However, this is a very minor proportion of the total 14,659 properties sampled. There was also a change of monitor for RW2, due to the original monitor being on leave. However this should not have affected the results due to the uniform data collection method and detailed briefing for all the monitors carrying out the survey. Overall, the most practical sample method was chosen to collect the data within the six week work placement.

Further study
The current results can be applied to the most up-to-date Mosaic data as soon as the latest version is published and the 2011 census data is available. Therefore, the postcodes of the 27 properties which were not recognised in the current study may be able to be classified to a Mosaic group. The results could also be compared to the GreenAware data for each socio-economic group for Bournemouth rather than compared to national data.

BBC's participation survey results (PR, SOR and CR) could be compared to the results of other UK local authorities with similar socio-economic group proportions to Bournemouth. This would complement the current study and determine whether the PR's, SOR's and CR's for other local authorities are more variable than the results for Bournemouth. However, this would depend on whether internal participation survey data from other UK local authorities could be obtained and if they have undertaken a participation survey recently.

If the participation survey was repeated for the whole of Bournemouth, then the PR and SOR for each street architecture type could be compared and statistically tested to determine whether street architecture influences householders recycling behaviour.

There is also potential for BBC to carry out a new study involving waste composition analysis to monitor and determine the capture rate of the kerbside recycling scheme (WRAP, 2010h). This will be useful to give BBC an indication of what materials are still available in the residual waste stream which could potentially be recycled, what materials are in the recycling stream but are not targeted and how well the scheme is performing (WRAP, 2010a; 2010h).

Acknowledgements

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Abbreviations and definitions

BBC = Bournemouth Borough Council
BB/LB = Big Bin, Little bin
CR = Contamination rate
DEFRA = Department for Environment Food and Rural Affairs
LA = Local Authority
MBT = Mechanical Biological Treatment
MRF = Materials Recycling Facility
MSW= Municipal Solid Waste
PR = Participation rate
RM1 = Multi-recycling round
RW1 = Recycling wheelie one round
RW2 = Recycling wheelie two round
RW5 = Recycling wheelie five round
SOR= Set out rate
WRAP = The Waste and Resources Action Programme
UA = Unitary Authority

Glossary

Big Bin	A 240 litre recycling bin provided to each household within the Borough of Bournemouth (BBC, 2011a).
Bring site	A local waste collection point provided by local authorities for recycling a range of household materials and items (BBC, 2011a).
Capture Rate	The quantity of a particular recyclable target material that is captured by the kerbside recycling scheme (WRAP, 2010h).
Co-mingled	The recyclables are mixed together in the recycling bin (BBC, 2011a).
Contamination rate (CR)	The proportion of households that put out a contaminated kerbside recycling bin on one collection opportunity (WRAP, 2008).
Crescent	A semi circular road shape.
Cul de sac	A dead end, close, or no through road.
Dispensation	Assisted collection of the recycling bin to the kerbside.
Household waste	Waste generated by households that is collected from the kerbside by the Council or deposited at a bring site (BBC, 2011a).
Late set outs	Where a householder puts out their recycling bin when they hear the recycling wagon coming (WRAP, 2010b).
Linear	A straight road shape.
Little Bin	A 140 litre residual waste bin provided to each household within the Borough of Bournemouth (BBC, 2011a).
Loader	A person employed by the LA to collect and dispose of household refuse, recycling or green waste (BBC, 2011a).
Local authority (LA)	Local government responsible for delivering local council, police and fire services funded from Council Tax and Government grants (BBC, 2011q).
Mosaic	A socio-demographic classification tool based on the 2001 census data on the demographics, behaviours and lifestyles of UK citizens (Experian, 2009a).
Municipal solid waste (MSW)	All the waste that a LA or agents acting on their behalf are responsible for (BBC, 2011a).
Participation rate (PR)	The proportion of households that take part at least once in the kerbside recycling collection scheme over a defined period of time (WRAP, 2010b).
Recyclables	Household items which are currently acceptable to be recycled (BBC, 2011e).
Recycling rate	The proportion of household waste recycled, re-used or composted out of the total proportion of household waste collected for a financial year (BBC, 2011e).
Set out rate (SR)	The proportion of households that put out the kerbside recycling bin on one collection opportunity (WRAP, 2010b).
Unitary authority (UA)	A LA with responsibility for the collection, treatment and disposal of MSW (BBC, 2011a).
Viridor	Waste contractor/ recycling and waste management company responsible for reprocessing and disposing of waste (Viridor, 2012).
Wagon	A vehicle designed to collect and store refuse/ recyclates/ garden waste.
Waste	"Any substance or object which the holder discards or intends or is required to discard" (BBC, 2011a; European Council, 2008).
Weighting	A process to make results more representative of the target area (WRAP, 2010i)
WRAP	WRAP is a non-profit company, backed by Government funding who work with LA's, businesses and individuals to help them reap the benefits of reducing waste, develop sustainable products and use resources efficiently (BBC, 2011a).