



October 10, 2016

Marcus Zbinden
Environmentalist III
Carver County Department of Environmental Services
Carver County Courthouse
600 4th Street East
Chaska, Minnesota 55318-2102

Re: Carver County Residential Recycling Measurement Study

Dear Mr. Zbinden:

Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) is pleased to provide Carver County (County) with this report to present the results of the Carver County Residential Recycling Measurement Study (Study). The purpose of the Study was to develop a reliable tool to measure the current amount of residential recycling taking place throughout the County and to monitor recycling rate changes in the future. By developing a repeatable data collection method, this Study will provide valuable recycling rate information that can be used by the County to prioritize future spending and resource allocations.

PARTICIPATION & SET-OUT RATE ASSESSMENT

Through a series of discussions with County staff, Burns & McDonnell developed a data collection approach that would meet the data gathering needs of the Study. The key elements being calculated through the data collection were set-out and participation rates. For the purpose of this Study, these rates are defined as follows:

Set-out Rate: The percentage of households that put out their recycling container during a single collection opportunity.

Participation Rate: The percentage of households that took part at least once over three consecutive collection opportunities (this serves to capture those households that did not put out their container every time).

To accurately calculate these recycling rates and explore a variety of factors that have the potential to impact them, Burns & McDonnell compiled the following list of necessary information to be gathered during the Study:

- Parcel ID number
- Date of collection opportunity
- Set-out
- Hauler

Marcus Zbinden
 Carver County Department of Environmental Services
 October 10, 2016
 Page 2

- City
- City Size
- Collection Frequency (weekly vs. biweekly)
- Collection Type (open vs. organized)

While some of this information could be supplemented into the data during the final analysis, the majority (Parcel ID, date, hauler, city and the set-out information) was collected in the field by County staff and volunteers from the Master Recycler’s program. These data collectors worked in teams of two, with one driver to follow the truck and one passenger to enter data along the route.

A total of 13 routes were selected for sampling. These 13 routes included at least one in each of the County’s 11 cities. With the largest populations in Chaska and Chanhassen, two routes were selected in each to provide a larger sample size for the data analysis. Additionally, the routes were carefully chosen to observe all five haulers that operate within the County – Elite Waste Disposal (Elite), Randy’s Environmental Services (Randy’s), Republic Services (Republic), Suburban Waste Services (Suburban) and Waste Management (WM). The final route selection is included in Table 1 below.

Table 1: Sampling Routes

Hauler	City	Number of Households Sampled	Total Number of Households on Route
Elite	New Germany	122	148
Waste Management	Hamburg	164	201
Suburban	Cologne	141	296
Elite	Mayer	409	652
Waste Management	NYA	167	400
Suburban	Carver	102	300
Randy’s	Watertown	209	598
Elite	Victoria	182	768
Republic	Waconia	189	985
Republic	Chaska	135	1786
Waste Management	Chaska	182	1035
Suburban	Chanhassen	142	275
Waste Management	Chanhassen	171	377

Marcus Zbinden
Carver County Department of Environmental Services
October 10, 2016
Page 3

Due to the amount of data being gathered in the field, the County's Geographic Information System (GIS) staff developed a data entry application that would utilize GIS in an effort to streamline the data collection process. To enter a data point into the application, users simply had to select which hauler they were following, pick a parcel to associate the data entry with and enter the size of the recycling container. The application automatically logged the date and associated the parcel ID with the appropriate city. Users also had the option to enter garbage and yard waste container sizes if time allowed. By allowing users to log data points directly to the County's database as they went, this application saved a considerable amount of time and allowed the County to efficiently collect the necessary information for all 13 routes.

Prior to the Study, Burns & McDonnell lead a training session for the volunteers and several County staff members who would be using the GIS application. During the training, volunteers were given basic background information on the purpose and goals of the Study, briefed on important safety information and given an opportunity to test the application. The training session also provided an opportunity for volunteers and County staff to coordinate schedules to ensure all routes were covered.

Data Collection Challenges

The initial data collection process identified a number of obstacles that will need to be addressed or considered during future data collection and analysis. On several occasions, drivers began their route before volunteers and County staff arrived to meet up with them, resulting in data collectors missing the households at the beginning of a specified route. It was also found to be difficult to keep up with the trucks, as automated recycling cart collection allowed some trucks to move from house to house faster than data collectors could enter the necessary information into the GIS application. In some cases, it appeared that rushing to keep up with a truck even led to some data points not being properly associated with a specific parcel. Taking breaks during a route also proved to be problematic due to data collectors missing households that were measured on previous collection opportunities. All of these challenges resulted in parcels being eliminated during the final data analysis due to insufficient data.

Analysis of the initial data and further discussions with data collectors revealed further logistics challenges that were not initially apparent in the field. The most influential of these was difficulty in knowing which houses were part of a specified collection route, specifically in open collection communities. While following a certain hauler in these areas, it was difficult to distinguish whether a house with no containers at the curb should be counted in that route as a non-set-out or if it was part of a different hauler's route altogether. This likely led to houses being missed during that collection opportunity. Most of the eliminated data came from open

Marcus Zbinden
Carver County Department of Environmental Services
October 10, 2016
Page 4

collection communities in both the initial data collection and the data validation (76% and 82% respectively). These statistics indicate that confusion about which houses were part of a hauler's collection route likely played a role in increasing participation and set-out rates in open collection communities.

All of the key challenges identified in the first round of data collection can be improved through increased experience and training for data collectors and expanding communications with haulers. As the data collectors become more familiar with the application, data collection speeds and accuracy will improve. When repeating this Study in the future, it will be important to continue training any new data collectors and provide opportunities for those previously involved in the Study to use the application again as a refresher. Input from application users can also be used in the future to make adjustments to the application to improve its usability. Furthermore, haulers most likely have little to no experience participating in this type of study and could benefit from increased coordination and communication with the County. Initially, County staff considered collecting data while riding directly with the haulers in the collection trucks. While this option was not pursued over the course of the Study, it may be beneficial to revisit this idea in the future. With limited resources and staff availability, it isn't feasible to follow a hauler from start to finish during longer routes. As such, learning from the hauler exactly which houses are on their route is crucial and will be an important step to improve the accuracy of future data collection.

Data Validation

While reviewing the results of the initial data collection and discussing the data collection challenges with County staff, it was noted that the calculated participation rates were unexpectedly high. Due to this observation, Burns & McDonnell recommended collecting an additional subset of data to validate the results. For this data validation, County staff repeated the data collection process for an additional three collection opportunities in two small areas of the County. The areas selected came from Mayer and Chaska to account for varying City Sizes as well as varying Haulers and Collection Types. The data collected during this process was then analyzed and compared to the initial data to confirm its reliability.

PARTICIPATION AND SET-OUT RATE RESULTS

To analyze the data, Burns & McDonnell created an Excel model (model) which allows users to directly input the raw data generated from the County data collection application. This raw data is substantiated by the model to eliminate any duplicate data points and any parcel IDs which did not have sufficient data to calculate a participation rate (three data points). The model then

Marcus Zbinden
 Carver County Department of Environmental Services
 October 10, 2016
 Page 5

calculates participation and set-out rates and automatically summarizes them in a series of graphs and tables. The results are also organized by Hauler, City, City Size, Collection Frequency and Collection Type to allow users to easily review the data. The summary graphs and tables for the initial data collection and the data validation can be found in Appendix A and Appendix B respectively.

During the initial data collection period, recycling rates were found to be high across all communities and routes, with 89% set-out and 98% participation in the County as a whole. Larger cities appeared to have slightly higher recycling rates than small and medium sized cities. It was also evident that while participation rates for both weekly and biweekly recycling were very strong (96% and 98% respectively), the set-out rates were much lower for weekly collection. This may be attributed to households not generating enough recyclables on a weekly basis to warrant weekly collection.

The results of the data validation proved to be very similar to the initial data collection, with 80% set-out and 98% participation in the County as a whole. A side-by-side comparison of the two data sets for Mayer and Chaska can be found in Table 2 below. The most substantial difference can be seen in the decreased set-out rates as compared to the initial data results. This decreased set-out rate is likely due to better data gathering techniques during the data validation. Looking through the initial data set, it is evident that a number of households only had one or two data points and were therefore eliminated as they could not be used to calculate participation rates. During the data validation however, an emphasis was put on ensuring each household had three valid data points to be used in the final results. It is likely that during the initial data collection period, households that should have been counted as non-set-outs were passed altogether on one or two of the three collection opportunities. Had these points been recorded, the initial set-out rates would have been slightly lower, better matching the data validation results.

Table 2: Comparison of Data Sets

City	Initial Data		Data Validation	
	Set-Out	Participation	Set-Out	Participation
Mayer	95%	100%	81%	99%
Chaska	91%	99%	79%	97%

Marcus Zbinden
Carver County Department of Environmental Services
October 10, 2016
Page 6

Participation rates appear to remain consistent between the initial data collection and the data validation. However, based on the results of the data validation process, the realistic set-out rates may be 10-15% lower than the rates presented in the initial data set. These results should be verified during future data collection and analysis.

RECYCLING QUANTITIES AND CHARACTERIZATION

Haulers provided total tonnage collected and the number of scheduled stops for eight of the 13 routes. The set-out rate calculated for the portion of the route sampled was then applied to the entire route to estimate how many households along the route had set-out. The total tonnage divided amongst these households determined a recycling quantity per household, which could be annualized to reflect the average recycling of a single household over the course of a year. Results for the eight routes ranged from 264 – 855 pounds per household per year with a weighted average of approximately 520 pounds per household per year. Quantities observed in similar counties across the country generally range between 400 – 700 pounds per household per year. Single stream communities in particular (such as Carver County) tend to fall in the upper end of this range. While the weighted average calculated in Carver County is similar to what has been observed in comparable counties, the wide range suggests that a detailed study on recycling quantities would be beneficial.

In 2013, Burns & McDonnell conducted a study for the Minnesota Pollution Control Agency (MPCA) on waste characterization across the state of Minnesota and published a report on the findings. Several tables from that report detailing typical recycling characterization are included in Appendix C. From these tables, it is evident that in Minnesota, organics account for the largest quantity of recyclable material sent to landfills each year. Approximately 31% of the waste stream were organics, including yard waste, wood, food waste and other organic materials. Food waste alone accounted for 17.8%. Based on these findings, providing greater organics recycling alternatives for residents within the County should increase waste diversion rates.

Within the current recycling program, paper – particularly boxboard and old corrugated cardboard (OCC) – is likely one of the most commonly missed recyclable materials. According to the 2013 Waste Characterization Report, 24.5% of recyclable materials found in the waste stream were some form of paper. More specifically, 9.8% was compostable paper, 3.7% OCC, 3.4% mixed recyclable paper and 1.6% boxboard. This indicates that increased education and efforts aimed specifically at recovering more paper would be the most efficient way to increase recycling quantities within the existing recycling program.

Marcus Zbinden
Carver County Department of Environmental Services
October 10, 2016
Page 7

RECOMMENDATIONS & NEXT STEPS

The results of this study demonstrate that the participation in Carver County's residential recycling program is very strong. Based on this, the most efficient way to improve recycling rates is to focus on specific target materials and increasing the quantities of these target materials being set-out for collection. Based on the 2013 Waste Characterization Report by Burns & McDonnell, organics and paper most likely make up the largest quantity of recyclable materials currently found in the County's waste stream. Specifically targeting these two materials should be central in future improvements to the residential recycling program. Impacts of targeting these materials could be further increased by making compostable products more readily available to consumers. Promoting a transition to these compostable products and educating consumers on proper disposal and composting can significantly improve future waste diversion.

Going forward, it is Burns & McDonnell's recommendation that the County conduct a detailed recycling characterization study to better understand which materials should be targeted to improve recycling rates. Having this information specific to the County will serve to help in making decisions about funding and resource allocations in the future. Additionally, this Study was designed to be repeated periodically to monitor the progress in recycling rates as the County further develops its residential recycling program. Annual data collection would be optimal to monitor these developments. Continued development of the GIS application and overall data collection methods is recommended to improve the efficiency and accuracy of these future studies.

Sincerely,

A handwritten signature in black ink, appearing to read 'Kari Andrist'.

Kari Andrist, EIT
Assistant Environmental Engineer

A handwritten signature in black ink, appearing to read 'Matt Evans'.

Matt Evans, PE
Senior Civil Engineer

Attachments:

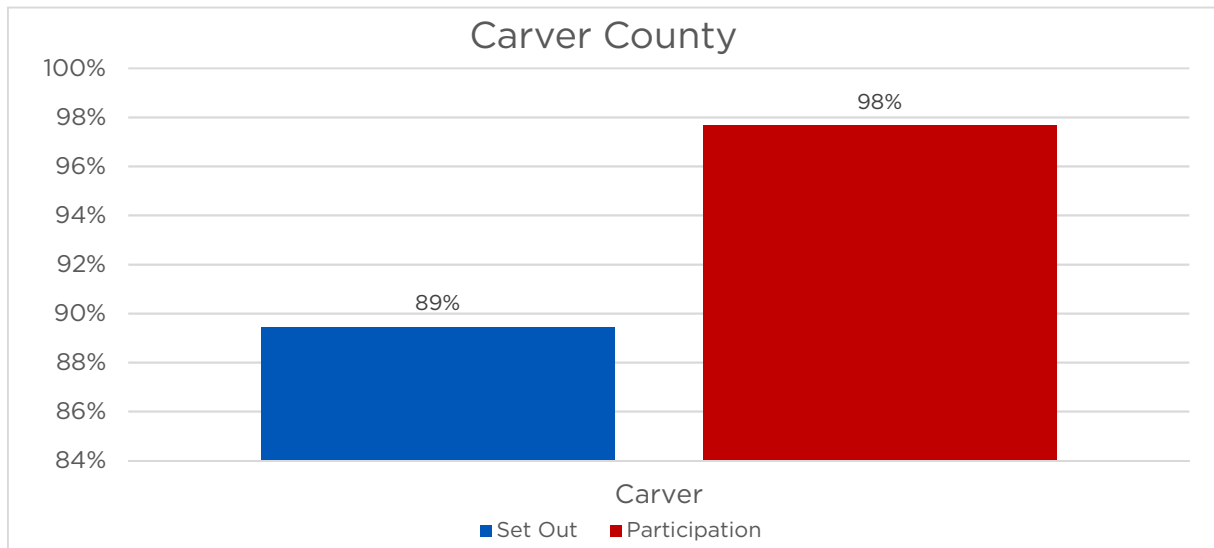
- Appendix A - [Route Characteristics Guide](#)
- Appendix B - [Initial Data Collection Results](#)
- Appendix C - [Data Validation Results](#)
- Appendix D - [2013 Waste Characterization Study Tables](#)

APPENDIX A - ROUTE CHARACTERISTICS GUIDE

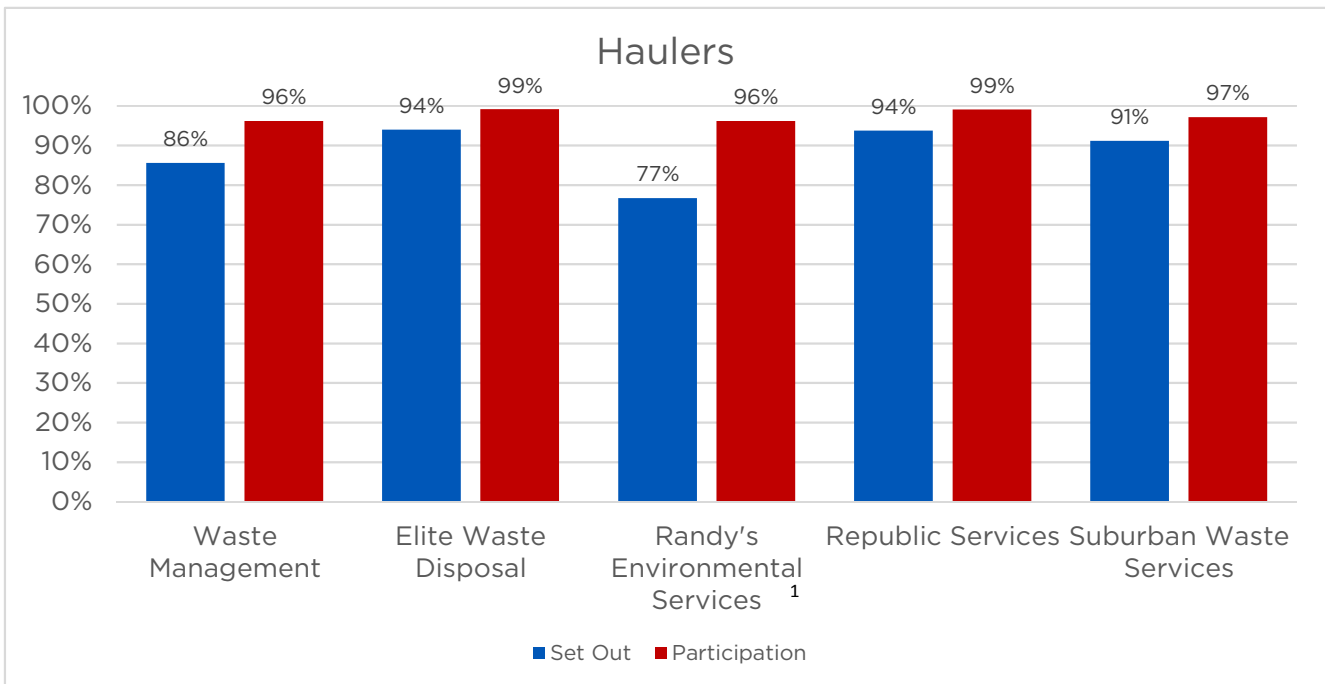
City	Hauler	City Size	Collection Frequency	Collection Type
Carver	Suburban	Medium	Biweekly	Open
Chanhassen	Suburban	Large	Biweekly	Open
Chanhassen	Waste Management	Large	Biweekly	Open
Chaska	Republic	Large	Biweekly	Open
Chaska	Waste Management	Large	Biweekly	Open
Cologne	Suburban	Small	Biweekly	Open
Hamburg	Waste Management	Small	Biweekly	Organized
Mayer	Elite	Small	Biweekly	Organized
New Germany	Elite	Small	Biweekly	Organized
NYA	Waste Management	Medium	Biweekly	Open
Victoria	Elite	Medium	Biweekly	Open
Waconia	Republic	Medium	Biweekly	Open
Watertown	Randy's	Medium	Weekly	Organized

APPENDIX B - INITIAL DATA COLLECTION RESULTS

County	Total Households	Set Out	Participation
Carver	2317	89%	98%

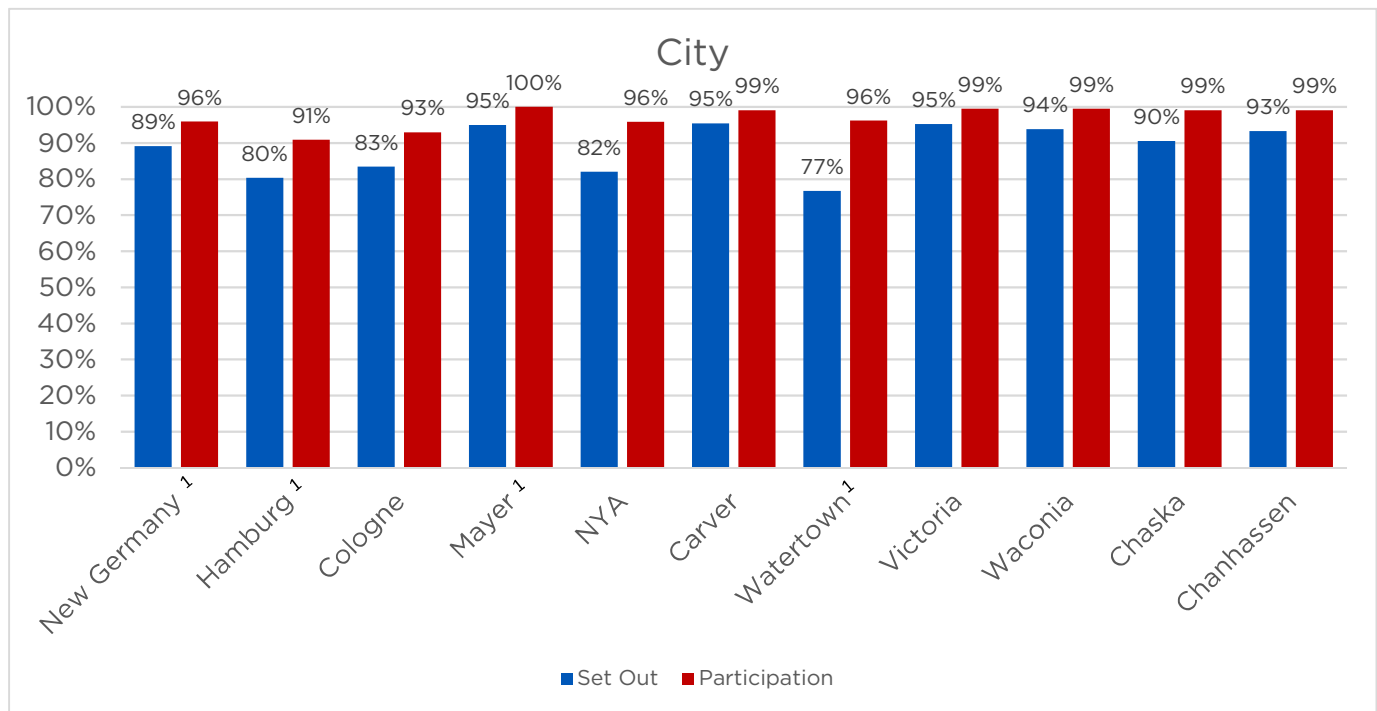


Hauler	Total Households	Set Out	Participation
Waste Management	684	86%	96%
Elite Waste Disposal	713	94%	99%
Randy's Environmental Services ¹	209	77%	96%
Republic Services	324	94%	99%
Suburban Waste Services	387	91%	97%



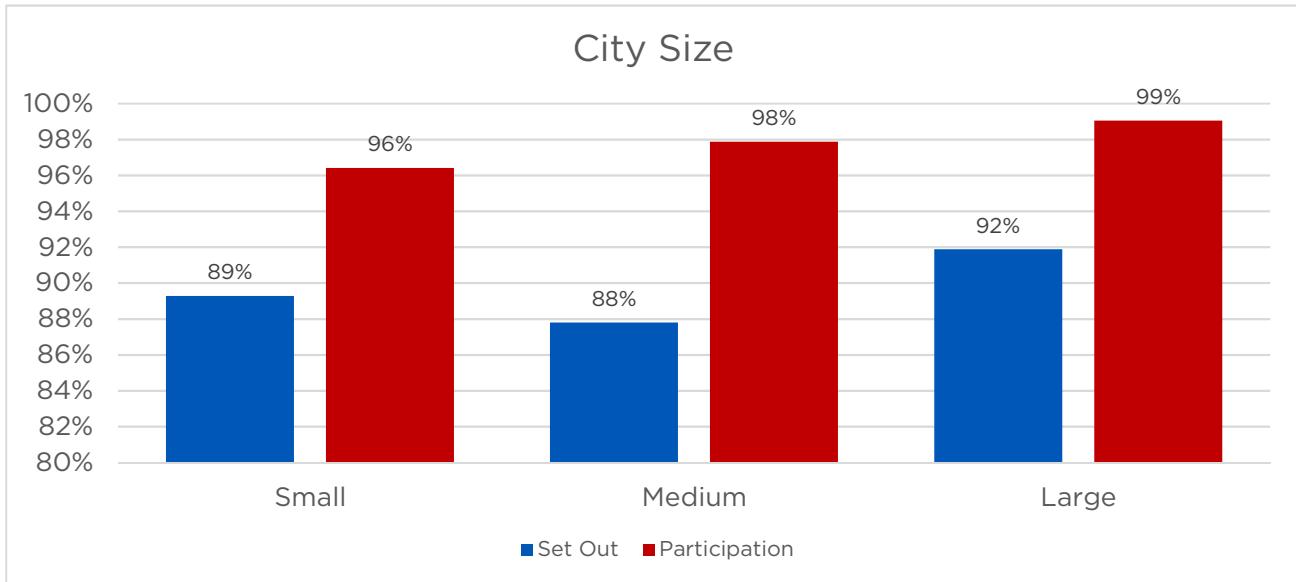
¹ - Weekly collection route

City	Total Households	Set Out	Participation
New Germany ¹	122	89%	96%
Hamburg ¹	164	80%	91%
Cologne	141	83%	93%
Mayer ¹	409	95%	100%
NYA	167	82%	96%
Carver	102	95%	99%
Watertown ¹	209	77%	96%
Victoria	182	95%	99%
Waconia	189	94%	99%
Chaska	319	90%	99%
Chanhassen	313	93%	99%

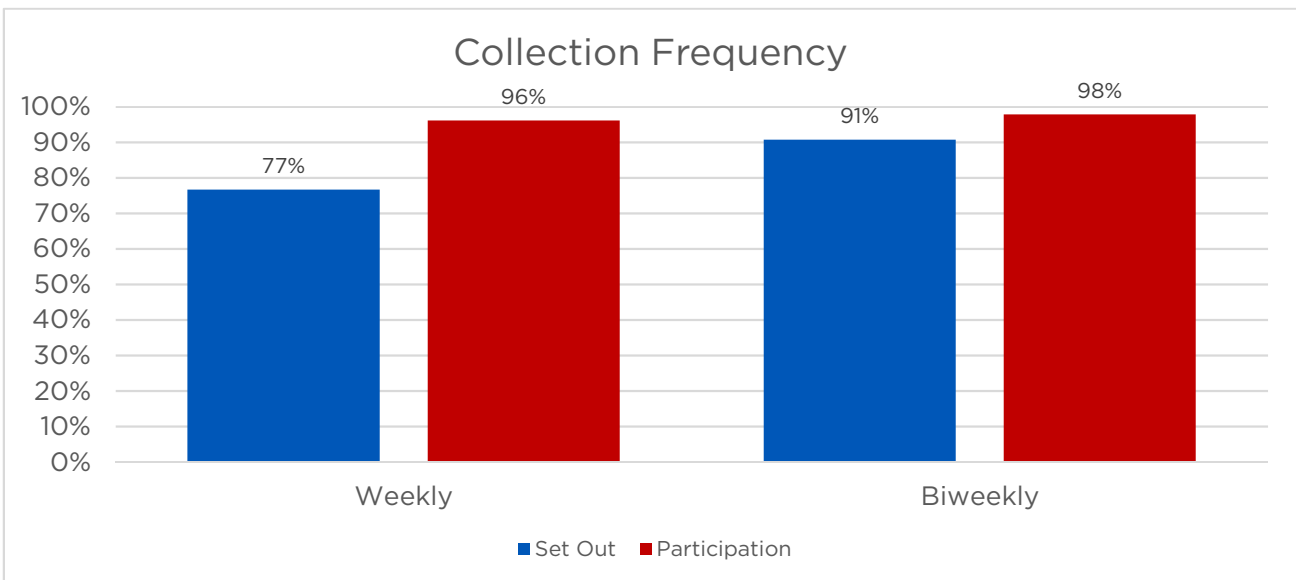


¹ - Cities with organized collection

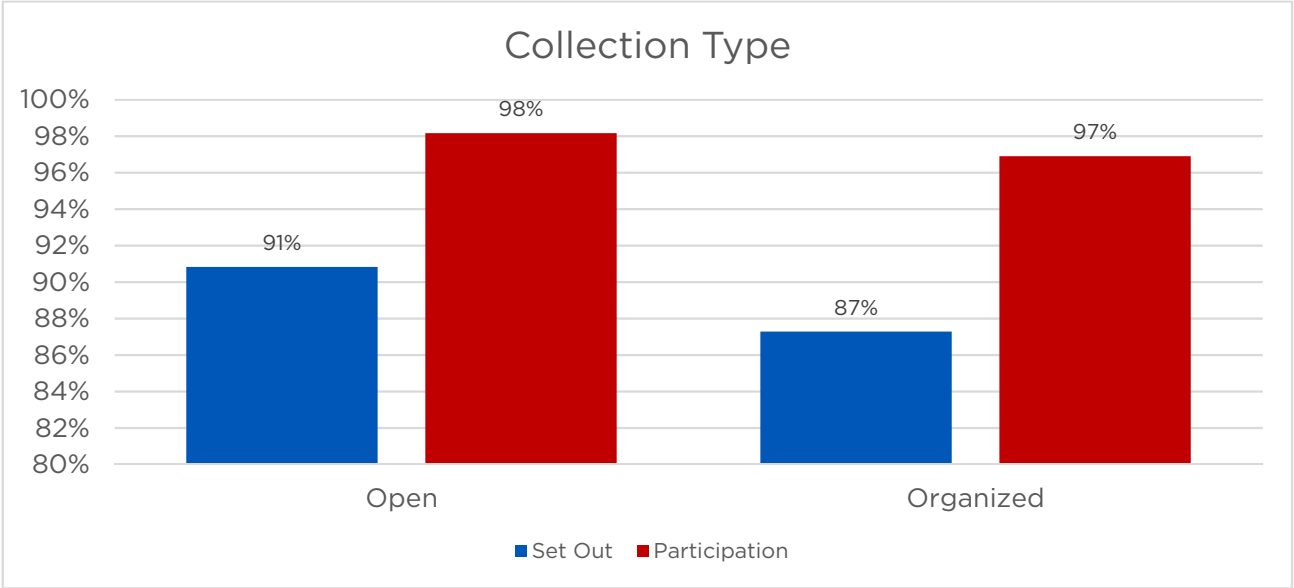
City Size	Total Households	Set Out	Participation
Small	836	89%	96%
Medium	849	88%	98%
Large	632	92%	99%



Collection Frequency	Total Households	Set Out	Participation
Weekly	209	77%	96%
Biweekly	2108	91%	98%

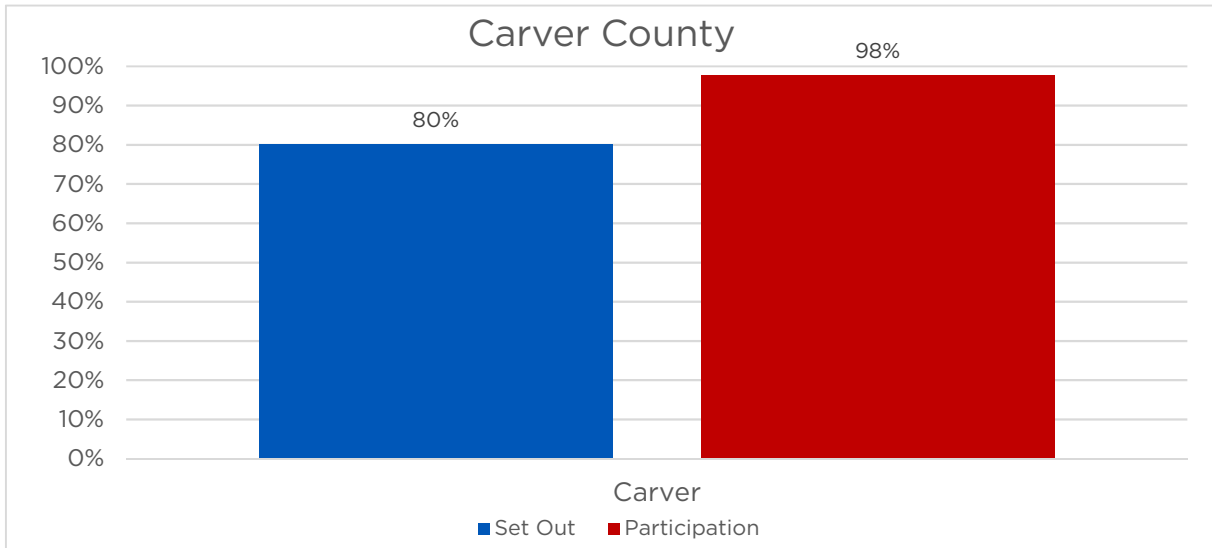


Collection Type	Total Households	Set Out	Participation
Open	1413	91%	98%
Organized	904	87%	97%

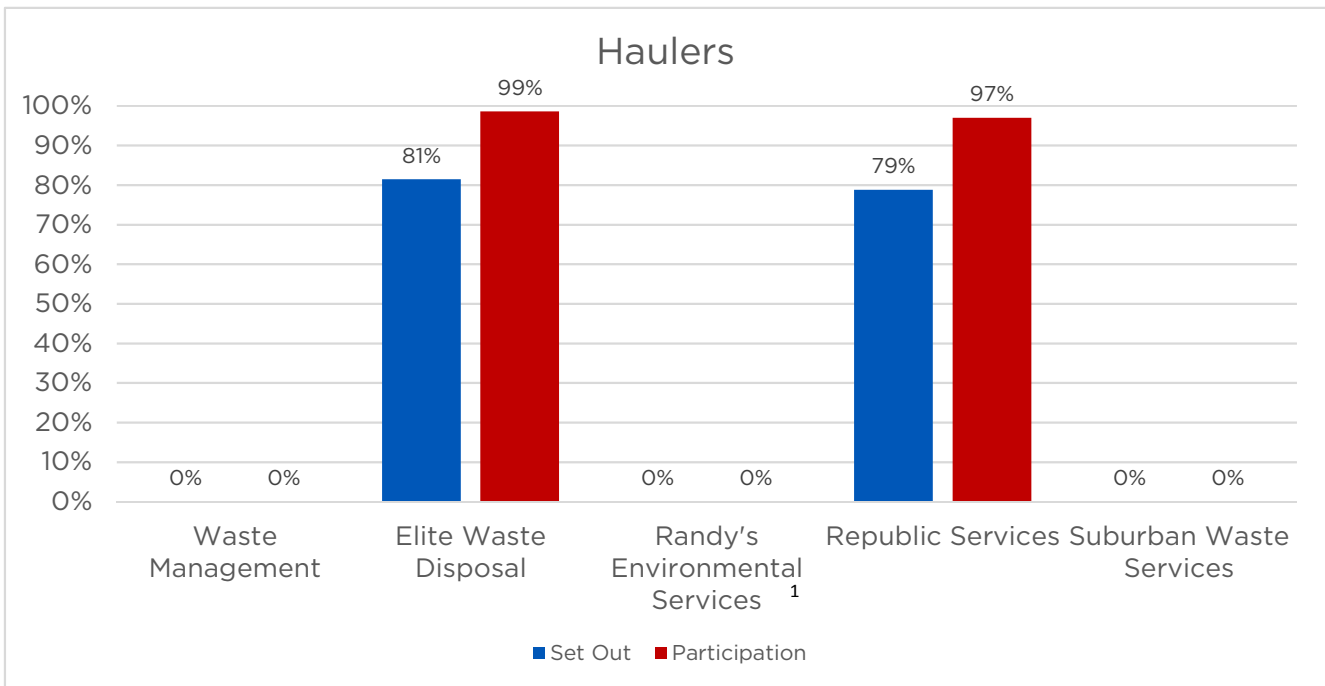


APPENDIX C - DATA VALIDATION RESULTS

County	Total Households	Set Out	Participation
Carver	136	80%	98%

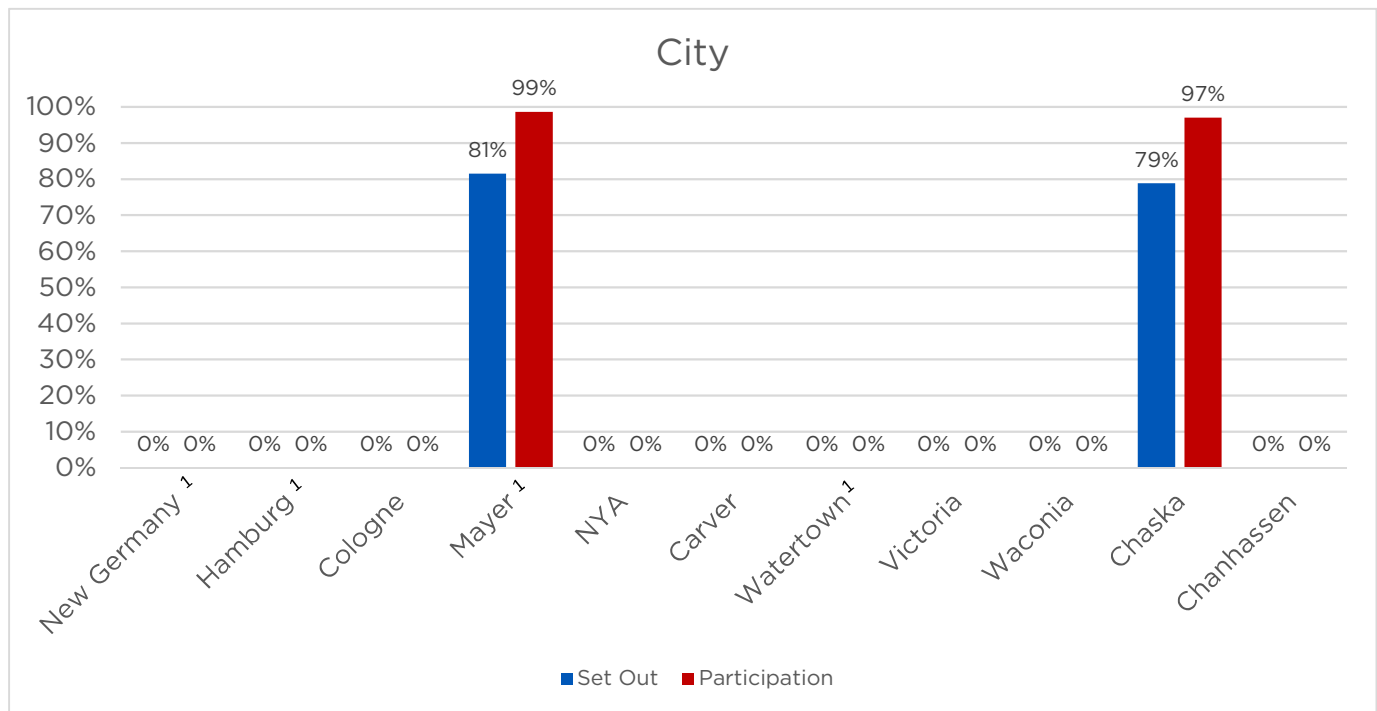


Hauler	Total Households	Set Out	Participation
Waste Management	0		
Elite Waste Disposal	70	81%	99%
Randy's Environmental Services ¹	0		
Republic Services	66	79%	97%
Suburban Waste Services	0		



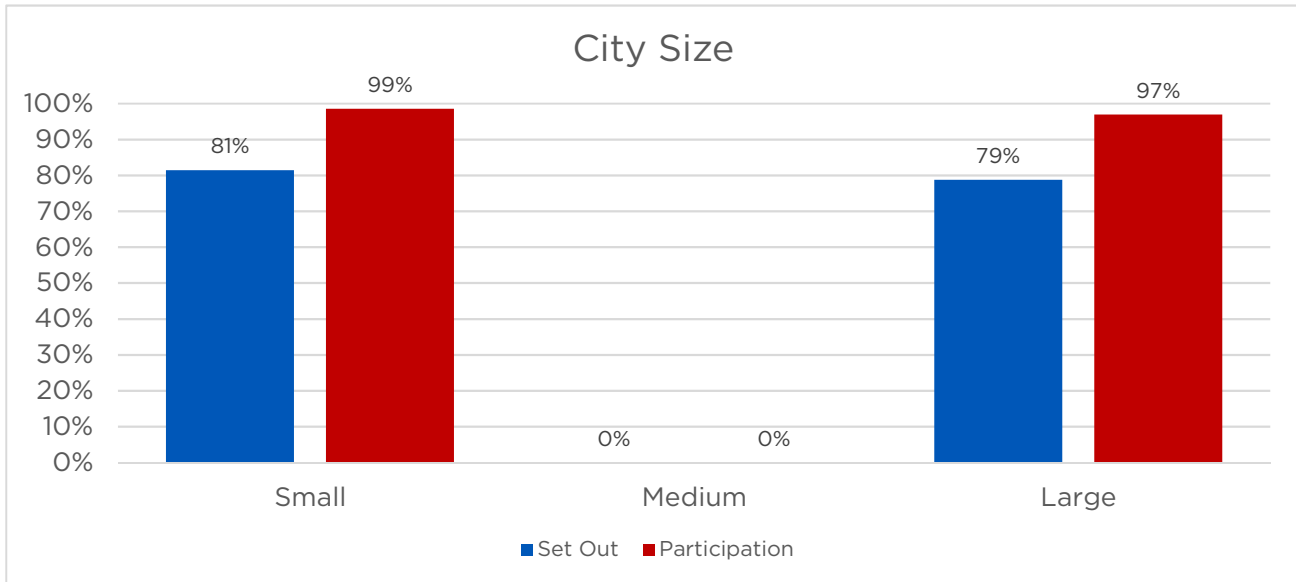
¹ - Weekly collection route

City	Total Households	Set Out	Participation
New Germany ¹	0		
Hamburg ¹	0		
Cologne	0		
Mayer ¹	70	81%	99%
NYA	0		
Carver	0		
Watertown ¹	0		
Victoria	0		
Waconia	0		
Chaska	66	79%	97%
Chanhassen	0		

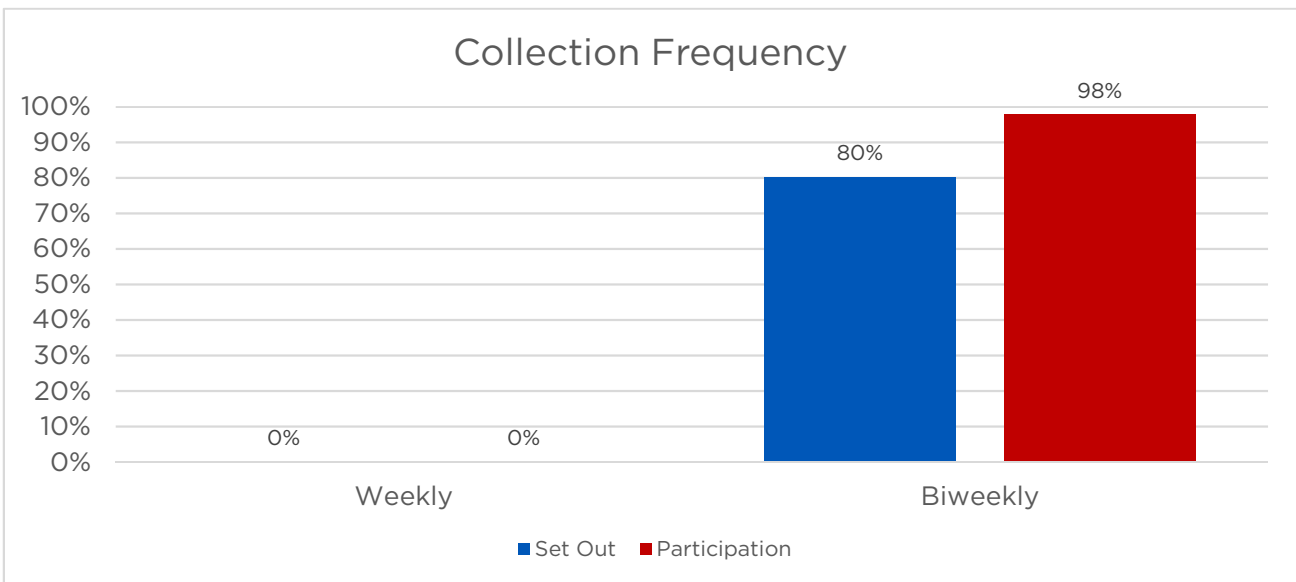


¹ - Cities with organized collection

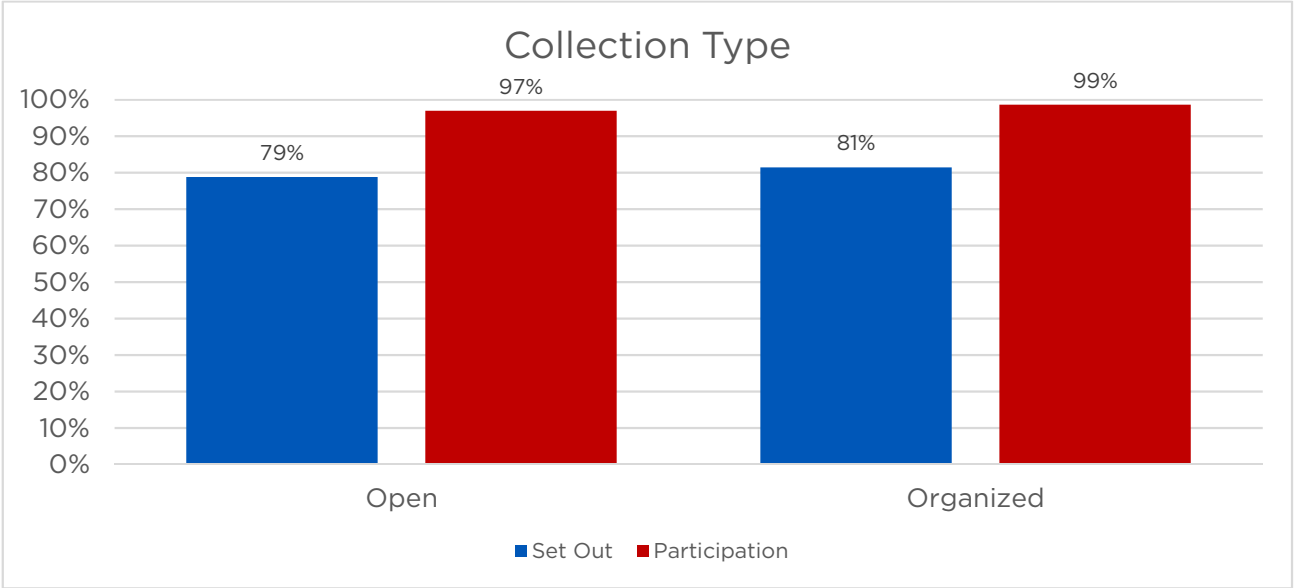
City Size	Total Households	Set Out	Participation
Small	70	81%	99%
Medium	0		
Large	66	79%	97%



Collection Frequency	Total Households	Set Out	Participation
Weekly	0		
Biweekly	136	80%	98%



Collection Type	Total Households	Set Out	Participation
Open	66	79%	97%
Organized	70	81%	99%



APPENDIX D - 2013 WASTE CHARACTERIZATION STUDY TABLES

Table ES-1: Minnesota Statewide Aggregate Composition (by Weight)

Material	Mean	Conf Int. (90%)		Material	Mean	Conf Int. (90%)	
		Lower	Upper			Lower	Upper
PAPER				METAL			
Newsprint (ONP)	1.4%	1.1%	1.7%	Aluminum Beverage Containers	0.4%	0.4%	0.5%
High Grade Office Paper	1.1%	0.7%	1.6%	Other Aluminum	0.7%	0.3%	1.0%
Magazines/Catalogs	0.7%	0.5%	1.0%	Steel/Tin (Ferrous) Containers	0.7%	0.4%	1.0%
Phone Books	0.1%	0.0%	0.3%	Other Metal	2.7%	1.8%	3.5%
Gable Top/Aseptic Containers/Cartons	0.3%	0.2%	0.4%	<i>Subtotal Metal</i>	4.5%	3.5%	5.4%
OCC and Kraft Bags	3.7%	3.1%	4.2%				
Boxboard	1.6%	1.4%	1.8%	GLASS			
Compostable Paper	9.8%	8.7%	10.8%	Beverage Container Glass	1.3%	0.9%	1.8%
Mixed Recyclable Paper	3.4%	2.8%	4.1%	Glass Containers	0.5%	0.2%	0.8%
Non-Recyclable Paper	2.3%	1.4%	3.2%	Other (Non-Container) Glass	0.4%	0.2%	0.6%
<i>Subtotal Paper</i>	24.5%	22.4%	26.5%	<i>Subtotal Glass</i>	2.2%	1.6%	2.9%
PLASTIC				ELECTRONICS			
#1 PET Beverage Containers	0.8%	0.7%	0.9%	Laptops	0.0%	0.0%	0.0%
Other PET (e.g. jars and clamshells)	0.5%	0.5%	0.6%	Computer Monitors		<i>not found</i>	
HDPE Bottles/Jars	0.5%	0.4%	0.6%	Televisions	0.0%	0.0%	0.1%
Other HDPE	0.6%	0.3%	0.8%	Printers	0.1%	0.0%	0.2%
PVC - #3	0.0%	0.0%	0.1%	All Other Electronic Items	1.1%	0.7%	1.4%
Polystyrene - #6	1.0%	0.8%	1.2%	<i>Subtotal Electronics</i>	1.2%	0.8%	1.6%
LDPE (Rigids) - #4	0.1%	0.0%	0.1%				
Polypropylene - #5	0.6%	0.5%	0.7%	ORGANIC			
Other #7 Plastics	0.1%	0.0%	0.2%	Yard Waste	2.8%	1.6%	3.9%
PLA & Compostable Plastics	0.0%	0.0%	0.1%	Food Waste	17.8%	15.2%	20.3%
Bag and Film Film Plastic	6.6%	5.9%	7.3%	Wood	5.7%	4.3%	7.2%
Other Plastic (nonpackaging)	7.1%	5.6%	8.6%	Other Organic Material	4.7%	3.8%	5.6%
<i>Subtotal Plastic</i>	17.9%	16.3%	19.5%	<i>Subtotal Organic</i>	31.0%	28.4%	33.6%
HHW				OTHER WASTES			
Batteries	0.1%	0.0%	0.1%	Mattresses/Box Springs	0.4%	0.0%	0.8%
Mercury Containing Lamps	0.0%	0.0%	0.0%	Appliances & Furniture	3.0%	1.6%	4.3%
Paint Containers	0.2%	0.0%	0.5%	Textiles & Leather	4.7%	3.8%	5.5%
Oil Containers & Filters	0.0%	0.0%	0.0%	Carpet	2.3%	1.5%	3.1%
Smoke Detectors	0.0%	0.0%	0.0%	Sharps and Infectious Waste	0.0%	0.0%	0.0%
Other HHW	0.2%	0.0%	0.4%	Other Not Elsewhere Classified	8.0%	6.1%	9.8%
<i>Subtotal HHW</i>	0.4%	0.0%	0.8%	<i>Subtotal Other Wastes</i>	18.3%	15.3%	21.2%
Note: Subtotals for the mean percentages may not equal the sum of the mean percentages due to rounding. Confidence intervals for primary categories and subcategories are calculated independently.							

Lyon County Regional Landfill - 2013 Waste Composition Results

Material	Mean	Conf Int. (90%)		Material	Mean	Conf Int. (90%)		
		Lower	Upper			Lower	Upper	
PAPER	22.7%	19.6%	25.7%	METAL	3.9%	3.1%	4.8%	
1 Newsprint (ONP)	1.5%	1.0%	2.0%	29 Aluminum Beverage Containers	0.5%	0.4%	0.6%	
2 High Grade Office Paper	1.3%	0.7%	1.9%	30 Other Aluminum Steel/Tin (Ferrous)	0.5%	0.2%	0.7%	
3 Magazines/Catalogs	0.8%	0.5%	1.1%	31 Containers	0.7%	0.5%	0.9%	
4 Phone Books	0.0%	0.0%	0.1%	32 Other Metal	2.2%	1.4%	3.1%	
5 Gable Top/Aseptic Containers/Cartons	0.6%	0.3%	0.9%	GLASS	3.0%	0.4%	5.6%	
6 OCC and Kraft Bags	3.2%	2.3%	4.1%	33 Beverage Container Glass	0.8%	0.5%	1.2%	
7 Boxboard	2.6%	2.1%	3.1%	34 Glass Containers	0.4%	0.3%	0.6%	
8 Compostable Paper	8.2%	6.7%	9.8%	35 Other (Non-Container) Glass	1.7%	0.0%	4.2%	
9 Mixed Recyclable Paper	3.0%	2.2%	3.8%	ELECTRONICS	1.3%	0.7%	1.8%	
10 Non-Recyclable Paper	1.5%	1.0%	1.9%	36 Laptops	0.0%	0.0%	0.1%	
PLASTIC	17.7%	15.7%	19.7%	37 Computer Monitors		<i>not found</i>		
11 #1 PET Beverage Containers	0.8%	0.6%	1.1%	38 Televisions	0.1%	0.0%	0.4%	
12 Other PET (e.g. jars and clamshells)	0.5%	0.4%	0.6%	39 Printers	0.1%	0.0%	0.3%	
13 HDPE Bottles/Jars	0.6%	0.5%	0.8%	40 All Other Electronic Items	0.9%	0.5%	1.4%	
14 Other HDPE	0.7%	0.3%	1.1%	ORGANIC	30.9%	26.5%	35.3%	
15 PVC - #3	0.1%	0.0%	0.1%	41 Yard Waste	1.8%	1.0%	2.6%	
16 Polystyrene - #6	1.4%	0.6%	2.3%	42 Food Waste	15.6%	11.9%	19.3%	
17 LDPE (Rigids) - #4	0.1%	0.0%	0.3%	43 Wood	6.6%	3.1%	10.0%	
18 Polypropylene - #5	0.7%	0.3%	1.1%	44 Other Organic Material	7.0%	4.4%	9.6%	
19 Other #7 Plastics	0.0%	0.0%	0.0%	OTHER WASTES	20.2%	14.5%	26.0%	
20 PLA & Compostable Plastics		<i>not found</i>		45 Mattresses/Box Springs		<i>not found</i>		
21 Bag and Film Film Plastic	6.3%	5.3%	7.4%	46 Appliances & Furniture	2.7%	1.1%	4.4%	
22 Other Plastic (nonpackaging)	6.3%	5.2%	7.5%	47 Textiles & Leather	5.7%	3.9%	7.4%	
HHW	0.3%	0.0%	0.5%	48 Carpet	1.5%	0.4%	2.6%	
23 Batteries	0.1%	0.0%	0.1%	49 Sharps and Infectious Waste		<i>not found</i>		
24 Mercury Containing Lamps		<i>not found</i>		Other Not Elsewhere		<i>not found</i>		
25 Paint Containers	0.1%	0.0%	0.2%	50 Classified	10.4%	6.0%	14.7%	
26 Oil Containers & Filters		<i>not found</i>		Total	100.0%			
27 Smoke Detectors		<i>not found</i>						
28 Other HHW	0.1%	0.0%	0.3%					
					<i>No. of Samples</i>	<i>30</i>		