SCS ENGINEERS

Waste Characterization Study
Summary of Results
2014/2015

Presented to:

Prince George's County

Department of the Environment
Waste Management Division
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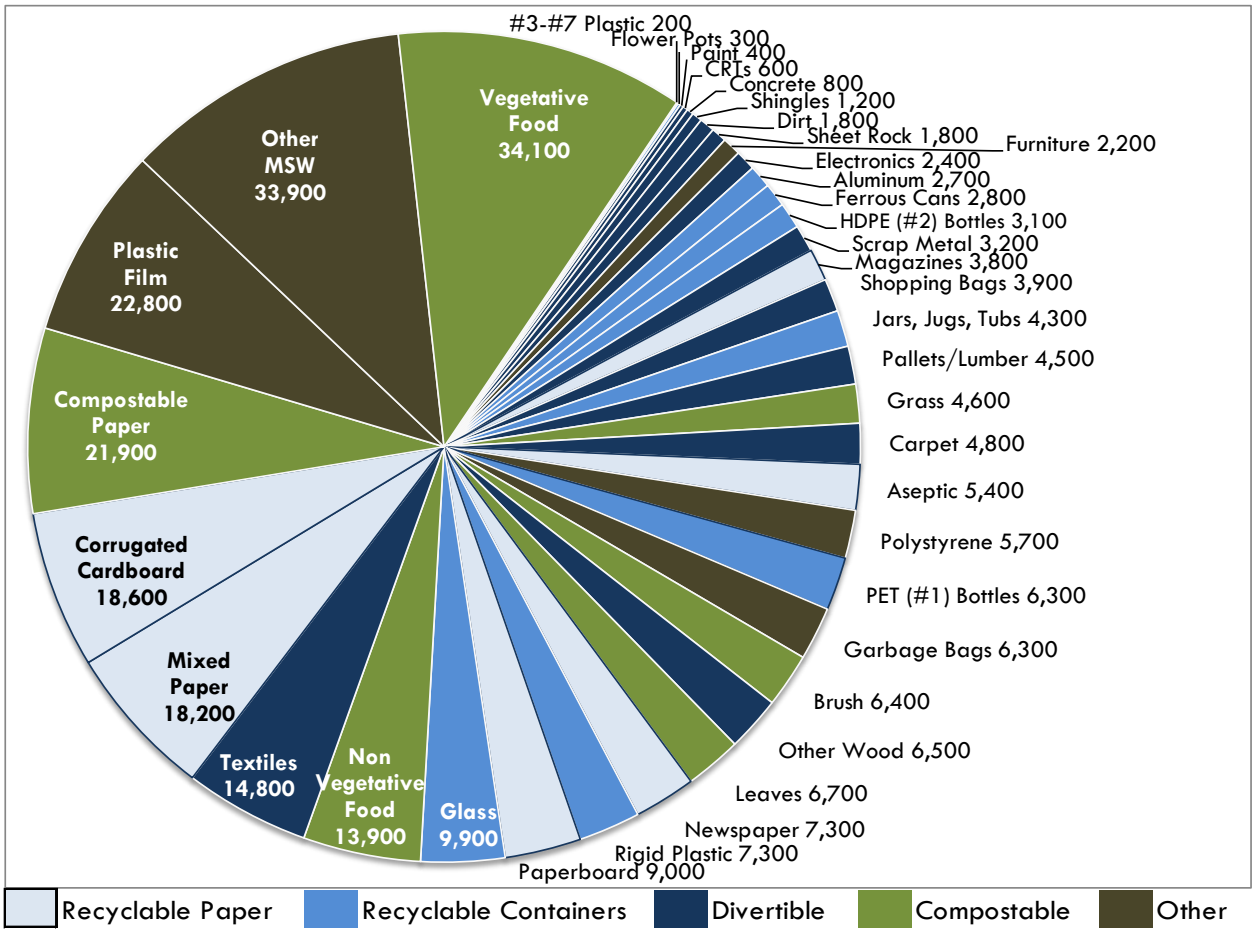
1 EXECUTIVE SUMMARY

Between November 2014 and September 2015, Prince George's County contracted with SCS Engineers to conduct its first waste characterization study of material delivered to the Brown Station Road Sanitary Landfill (the Landfill) for disposal. **Exhibit 1** presents the proportions and tonnages of municipal solid waste (MSW) materials (from smallest tonnage to largest tonnage) that are disposed from residential, commercial, and institutional sources.

Exhibit 1. Proportions and Tonnages of Materials in MSW Disposed Annually MSW in the Brown Station Road Sanitary Landfill



Recyclable Paper and Recyclable Containers combined represent the largest proportion by weight of materials disposed in the Landfill at 99,000 tons per year. These are materials accepted by residential curbside collection programs in the County. Compostable materials, which include Vegetative and Non-Vegetative Food, Compostable Paper, and Yard Trimmings (leaves, grass, and brush), comprise the second greatest proportion of the waste disposed in the Landfill at 87,500 tons per year.

2 INTRODUCTION

Prince George's County of Maryland (the County) contracted with SCS Engineers (SCS) to conduct a waste composition analysis of residential and commercial waste disposed of at the Brown Station Road Sanitary Landfill (the Landfill). The primary objectives of the study are as follows:

- To estimate types and quantities of recyclable and compostable waste components in the waste stream;
- To identify opportunities for greater waste stream diversion; and
- To create a baseline waste composition in order to measure the effectiveness of diversion efforts.

This waste characterization project consists of four sampling events, one for each season of the year, conducted at the Landfill. The data generated by the field activities will be used by the County to develop long-term waste management strategies and to evaluate the effectiveness of current recycling programs. This report presents the data collected during all four seasonal field activities.

The remaining sections of this report are organized as follows:

- Section 2 describes field classification and sampling methods.
- Section 3 presents project data and results gathered from the study.

Appendix A presents the Health and Safety Plan that was in effect during field activities.

3 METHODS

This section summarizes methods used to characterize the waste stream disposed of at the Landfill. Waste sampling and sorting activities for the study took place during four one-week periods in November 2014, January 2015, June 2015, and September 2015. Waste samples were manually sorted into distinct material categories.

WASTE SAMPLING

Waste sorting was performed at the Landfill during the operating hours of the facility. Given the limited size of the data set, it was important that unrepresentative data be avoided. Each day vehicles carrying waste from targeted areas of the County were directed to dump their waste loads near the sorting area. A representative of SCS, with support provided by one of the County's front end loaders, obtained samples from a random portion of each target load (approximately two hundred pounds) for classification (sorting). Two important procedural factors were considered:

- The target vehicle selected for sampling contained MSW that was representative of the type of waste typically generated in that sector; and
- The process of acquiring the waste sample did not, in itself, alter the apparent MSW composition.

After being filled with solid waste, the trash cans were weighed and set aside until at least two hundred pounds from the discharged load had been selected for characterization. This process was repeated until samples had been collected from all of the targeted loads.

To accommodate seasonal changes in the waste stream, four seasonal field samplings were performed:

- **Fall**: November 3 to 7, 2014
- **Winter**: January 19 to 23, 2015
- **Spring**: June 8 to 12, 2015
- **Summer**: September 14 to 18, 2015

Consistent with good practice in such sampling programs, efforts were made to minimize sampling bias or other impacts on the integrity of the database. To this end, field sampling had been coordinated to avoid holidays and other out of ordinary events.

NUMBER AND SOURCE OF WASTE SAMPLES

SCS recognizes that different waste streams have the potential to contain different types of materials in different quantities. In order to understand the composition of the waste currently disposed of at the Landfill, SCS developed a sampling plan based on tonnage reports from the previous year. Waste received at the Landfill comes from four source types:

- **Commercial (**Collected by private haulers)
- **Public Schools** (Collected by the County Board of Education)
- **Residential – Contract (**Collected by private haulers)
- **Residential – Municipal (**Collected by municipal crews or municipal contract)

Exhibit 2 presents the distribution of waste by source that is delivered annually to the Landfill. A total of 50 waste samples were obtained for each of the four seasonal field activities. The number of samples from each source was based on the annual tonnage received at the Landfill.

Exhibit 2. Distribution of Waste by Source Delivered to the Brown Station Road Sanitary Landfill Annually

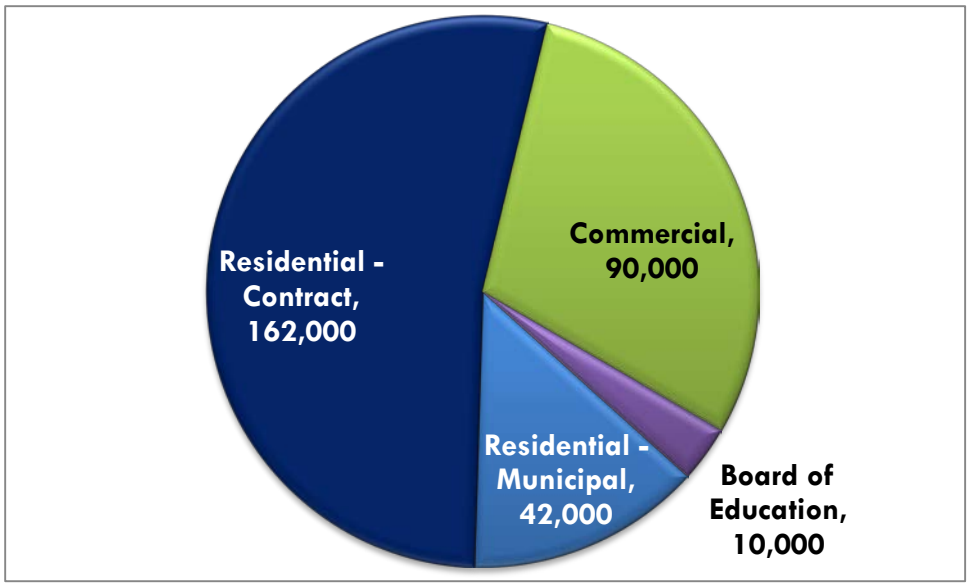


Table 1 outlines the number of waste samples that were targeted from each source for each of the seasonal field activities. Modifications to the sampling plan were made each season as some private haulers or municipalities changed their operation or disposal location. When SCS was not able to locate collection vehicles from a particular hauler or municipality, the number of samples by hauler or municipality were adjusted.

Table 1. Seasonal Sampling Plan

Source	Identification	Estimated Annual Tonnage	Number of Samples	
			Targeted Each Season	Actual for Entire Study
Commercial	Private Hauler (front-load or roll-off vehicle)	90,000	15	63
Public Schools	Board of Education	10,000	2	7
Residential – Contract	Bates	38,900	6	130
	CWI	38,300	6	
	Goode Trash	23,500	4	
	Grayhound Trash	13,500	2	
	Shaw Refuse	9,600	2	
	Bowie Trucking	8,100	1	
	Uneeda	5,900	1	
	J&T	5,200	1	
	Beltsville Refuse	4,900	1	
	Burch Trash	4,500	1	
	Richards Trash	4,000	1	
Residential – Municipal	City of Bowie	17,000	3	
	City of College Park	6,900	1	
	City of Hyattsville	4,400	1	
	New Carrollton	3,500	1	
	City of Laurel	2,700	1	
	City of Greenbelt	1,800		
	City of Cheverly	1,500		
	Berwyn Heights,	1,200		
	City of Mt Rainer	1,200		
	University Park	800		
	Fairmount Heights	500		
	Riverdale Park	100		
	Seat Pleasant	100		
	Upper Marlboro	100		

WASTE SORTING

The sorting and weighing program for samples entailed the use of one sorting crew and an SCS Crew Supervisor. During each day of fieldwork samples were collected from waste loads that were discharged at the Landfill. The basic procedures and objectives for sorting (as described below) were identical for each sample, each day as follows:

1. The sort crew transferred the refuse sample onto the sorting table until the table was full and began sort activities. Large or heavy waste items, such as bags of yard waste, were torn open, examined and then placed directly into the appropriate container for subsequent weighing.

2. Plastic bags of refuse were opened and sort crew members manually segregated each item of waste, according to categories defined in **Table 2** and placed it in the appropriate waste container. These steps were repeated until the entire sample was sorted.

3. At the completion of sorting, each of the waste containers was moved to the scale where a representative of SCS weighed each category and recorded the net weight on the Sort Data Sheet. Measurements were made to the nearest 0.02 pounds.

4. After each waste category had been recorded, the waste was piled near the sorting area and transferred back to the landfill working face by a bobcat.

5. This four-step process was repeated until all of the day's samples taken at the site were characterized. Waste samples were maintained in as-disposed condition or as close to this as possible until the actual sorting began. Proper site layout and close supervision of sampling was maintained to avoid the need to repeatedly handle sampled wastes.

Material Categories

Materials presented in **Table 2** are grouped into five major categories:

- **Recyclable Paper** – Materials in this major category are collected through residential curbside collection programs in the County and municipalities. These materials are also accepted at the County's Material Recovery Facility (MRF).

- **Recyclable Containers** - Materials in this major category are collected through residential curbside collection programs in the County and municipalities. These materials are also accepted at the County's Material Recovery Facility (MRF).

- **Divertible** – Materials in this major category can be diverted from landfill disposal though special programs.

- **Compostable** – Materials in this major category can be included in the County's composting program.

- **Other** – Materials in this major category do not generally have markets established for their recycling or recovery nor can they be included or composted.

Health and Safety

Prior to the start of waste sorting each season, an SCS project manager conducted a health and safety meeting to review the site-specific Health and Safety Plan and the hazards for the hand-sorting of waste to reduce the potential accidents and injuries.

Members of the sorting crew were equipped with high visibility vests, puncture/cut resistant gloves, safety glasses, and Tyvek suits. Fieldwork was conducted in accordance with the Health and Safety Plan in **Appendix A**.

Table 2. Description of Material Categories

Material Categories		Examples
Recyclable Paper	Newspaper/Print (ONP)	Daily, weekly newspapers
	Corrugated Cardboard (OCC)	Packing/shipping boxes
	Magazines/Catalogs/Other Books	TV Guide, periodicals, journals, hard cover books
	Kraft Paper/Boxboard	Grocery/shopping bags, paper grocery bags, soda/cereal boxes
	Office Paper/Junk Mail/Misc. Paper (Mixed Paper)	Copy paper, computer printouts, envelopes, brochures, flyers, junk mail, receipts, notebook paper
	Aseptic/Wax Coated Paper	Milk and juice cartons, juice boxes
Recyclable Containers	PET (#1) Bottles	Plastic water and soda bottles, marked #1
	HDPE (#2) Bottles	Milk and detergent bottles, marked with #2
	Other (#3-#7) Bottles	Prescription bottles, syrup bottles
	Jars, Jugs, Tubs, Trays	Jars/Jugs/Tubs/Trays marked with #1 through #5.
	Flower Pots	Recyclable flower pots, usually marked #5
	Other Rigid Plastic	Storage totes, furniture, toys, not marked with a #
	Ferrous Cans	Pet food cans, soup cans, fruit cans, aerosols
	Aluminum Cans/Foil	Soda, beer cans, and aluminum foil
	Glass Bottles/Jars	Beer, wine, soda bottles, all colors
Divertible	Electronics	Corded electronics, cell phones, appliances, etc.
	CRTs *	Cathode ray tube monitors (CRTs)
	Paint	Latex and oil-based paint
	Scrap Metal	Copper tubing, clothing hangers, machine parts, etc.
	Pallets/Lumber	Forklift pallets, plywood, 2x4's, dimensional lumber
	Other Wood	Tree stumps, wooden chairs, misc. wooden items
	Concrete/Brick/Rock	Gravel, bricks, stones, broken-up asphalt, concrete
	Dirt	Soil, rocky soil, clay, potting soil, silt, dirt
	Sheet Rock	Drywall or gypsum board
	Carpet/Carpet Padding	Vinyl siding used for exterior house siding
	Shingles	Forklift pallets, and other lumber materials
	Textiles *	Clothing, upholstery, fabrics
	Shopping Bags *	Grocery bags and shopping bags comprised of plastic film
Compostable	Compostable Paper	Tissues, napkins, paper towels
	Vegetative Food	Fruits, vegetables and rinds, breads
	Non-Vegetative Food	Meats, Dairy products
	Leaves	Leaves and pine needles
	Grass	Lawn clippings and hay
	Brush	Branches, brush, small sticks and twigs
Other	Furniture	Tables, chairs, couches, other furniture
	Plastic Film *	Tarps, bubble wrap, cellophane chip bags
	Garbage Bags *	Plastic film bags used to contain trash
	Polystyrene	Expanded/regular clamshells, cutlery, cups
	Other MSW	Materials not otherwise categorized including kitty litter, diapers, ceiling tiles, fines, contaminated organics, and indistinguishable/small materials. Additional description of Other MSW is in **Appendix B**.

Note: * indicates materials sorted in June 2015 only.

DATA REDUCTION

There were 200 samples manually sorted during the four field activities. Data recorded on each of the Sort Data Sheets was transcribed to a spreadsheet which calculated mean percentages by weight, standard deviations, and statistical confidence intervals (95 percent confidence interval) for each material category for residential, commercial, and school sources. Derivation of the mean, standard deviation and confidence intervals were as follows:

$$Mean\left(\overline{X}\right) = \sum_{i=1}^{n} x_i * \frac{1}{n};$$

$$Standard\ Deviation\ (s) = \sqrt{\frac{\left(n\sum x^2\right) - \left(\sum x\right)^2}{n(n-1)}}\ ;\ \text{and}$$

$$Upper/Lower\ Confidence\ Interval\ Limits = \overline{X} \pm \left[1.96 * \left(\frac{\sigma}{\sqrt{n}}\right)\right]$$

Where: n = number of samples; and
x = sample percentage.

The mean is the arithmetic average of all data and the standard deviation is a measure of the dispersion in the data. Together, the mean and standard deviation determine the confidence interval. A 95 percent confidence interval contains the true proportion of a material with 95 percent confidence (i.e., similar studies will produce results within the confidence interval 95 percent of the time).

4 SUMMARY OF RESULTS

RESIDENTIAL WASTE COMPOSITION

Exhibit 3 presents a graphic summary of the major material classifications of residential waste based on 130 waste samples collected and sorted in during the four field activities.

Exhibit 3. Residential Waste Composition of Major Material Categories

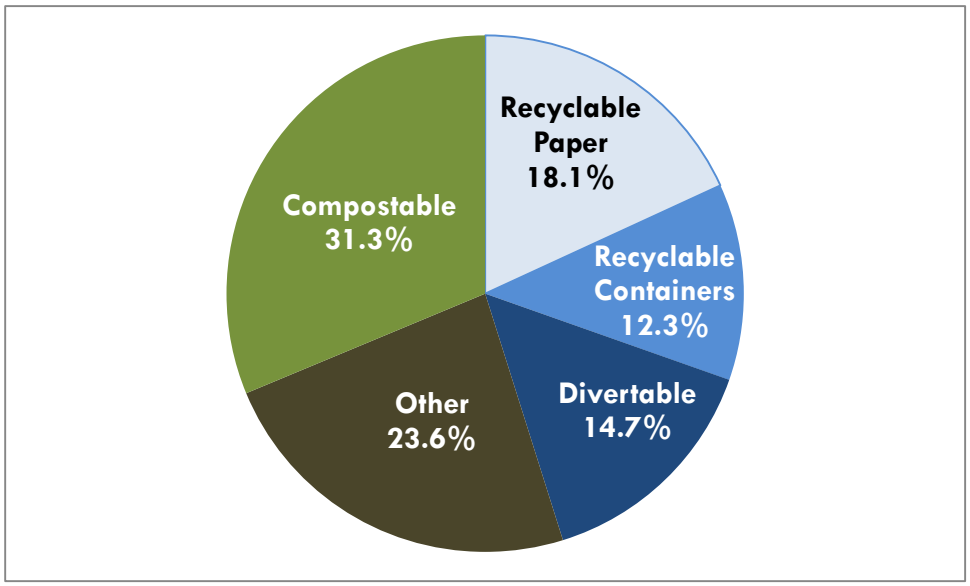


Table 3 presents the annual residential waste composition which includes the mean proportion of each material, its associated standard deviation, and 95 percent confidence intervals. Please note that this composition is based on the waste delivered to the Landfill from commercial sources. The composition does not include recyclable material that is delivered to the County's Material Recovery Facility (MRF) or the yard waste that is managed separately.

The top three materials found in residential waste are:

- **Other MSW** (12.3 percent),
- **Vegetative Food** (11.9 percent), and
- **Compostable Paper** (7.1 percent).

Table 3. Annual Residential Waste Composition

	Material Components	Mean Composition	Standard Deviation	95% Confidence Limits Lower	95% Confidence Limits Upper
Recyclable Paper	Newspaper/print	3.0%	2.9%	2.5%	3.5%
	Corrugated Cardboard	3.4%	4.1%	2.7%	4.1%
	Magazines/Catalogs/ Other Books	1.1%	1.4%	0.8%	1.3%
	Kraft Paper/Paperboard	3.3%	2.1%	3.0%	3.7%
	Office Paper/Junk Mail/Misc. Paper	5.5%	4.1%	4.8%	6.2%
	Aseptic/Wax Coated Paper	1.8%	2.0%	1.4%	2.1%
	Subtotal	**18.1%**			
Recyclable Containers	PET (#1) Bottles	2.0%	1.2%	1.8%	2.2%
	HDPE (#2) Bottles	1.1%	1.0%	0.9%	1.3%
	Other (#3-#7) Bottles	<0.1%	0.2%	<0.1%	<0.1%
	Jars, Jugs, Tubs, Trays	1.3%	0.9%	1.2%	1.5%
	Flower Pots	<0.1%	0.5%	<0.1%	0.2%
	Other Rigid Plastic	2.2%	3.0%	1.7%	2.7%
	Ferrous Cans	1.1%	0.9%	1.0%	1.3%
	Aluminum Cans/Foil	1.0%	0.9%	0.8%	1.1%
	Glass Bottle/Jars	3.4%	2.7%	3.0%	3.9%
	Subtotal	**12.3%**			
Divertible	Electronics	0.9%	1.8%	0.5%	1.4%
	CRTs	<0.1%	<0.1%	<0.1%	<0.1%
	Paint	0.1%	0.9%	<0.1%	0.3%
	Scrap Metal	1.0%	2.5%	0.6%	1.4%
	Pallets/Lumber	0.9%	4.2%	0.1%	1.6%
	Other Wood	2.1%	5.5%	1.1%	3.0%
	Concrete/Brick/Rock	0.3%	3.0%	<0.1%	0.9%
	Dirt	0.7%	2.8%	0.2%	1.2%
	Sheet Rock	0.8%	3.2%	0.2%	1.4%
	Carpet/Carpet Padding	0.7%	2.7%	0.2%	1.2%
	Shingles	0.3%	2.2%	<0.1%	0.7%
	Textiles	5.3%	7.8%	2.6%	8.1%
	Shopping Bags	1.5%	0.9%	1.2%	1.8%
	Subtotal	**14.7%**			
Compostable	Compostable Paper	7.1%	3.9%	6.5%	7.8%
	Vegetative Food	11.9%	6.6%	10.8%	13.1%
	Non-Vegetative Food	5.2%	4.1%	4.5%	5.9%
	Leaves	2.8%	5.2%	1.9%	3.7%
	Grass	1.7%	5.2%	0.8%	2.6%
	Brush	2.5%	7.1%	1.3%	3.7%
	Subtotal	**31.3%**			
Other MSW	Furniture	0.7%	2.9%	0.2%	1.2%
	Plastic Film	6.7%	4.3%	5.9%	7.4%
	Garbage Bags	2.0%	1.8%	1.4%	2.7%
	Polystyrene	1.9%	1.3%	1.6%	2.1%
	Other MSW	12.3%	8.2%	10.9%	13.8%
	Subtotal	**23.6%**			
TOTALS		**100.0%**			

Assessment of Major Waste Categories

Exhibit 4 through **Exhibit 8** present further breakdowns of the major residential waste categories.

Exhibit 4. Residential Recyclable Paper

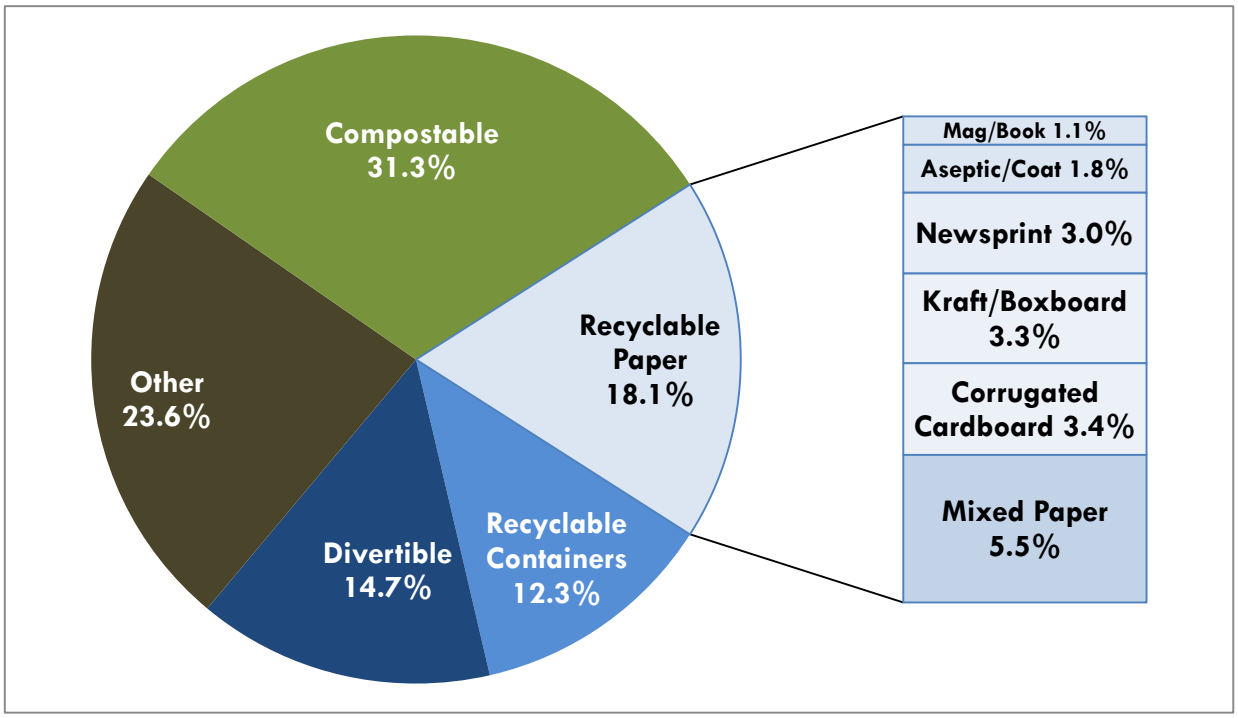


Exhibit 5. Residential Recyclable Containers

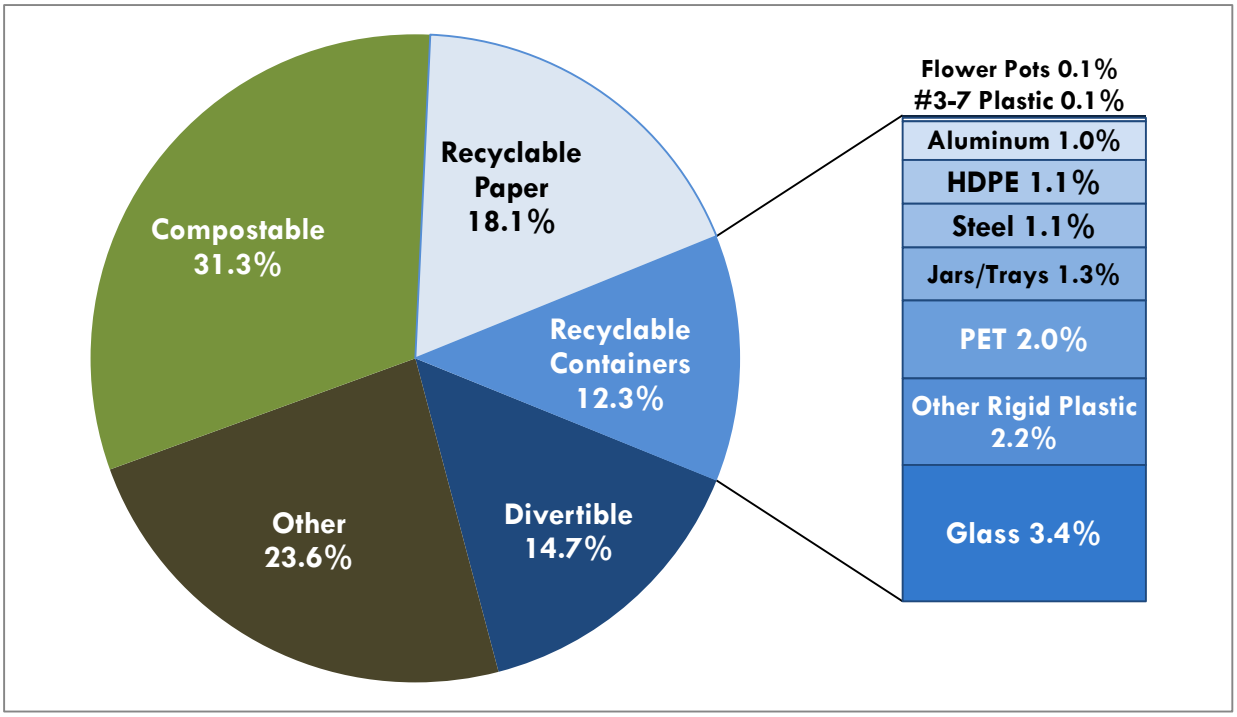


Exhibit 6. Residential Divertible Materials

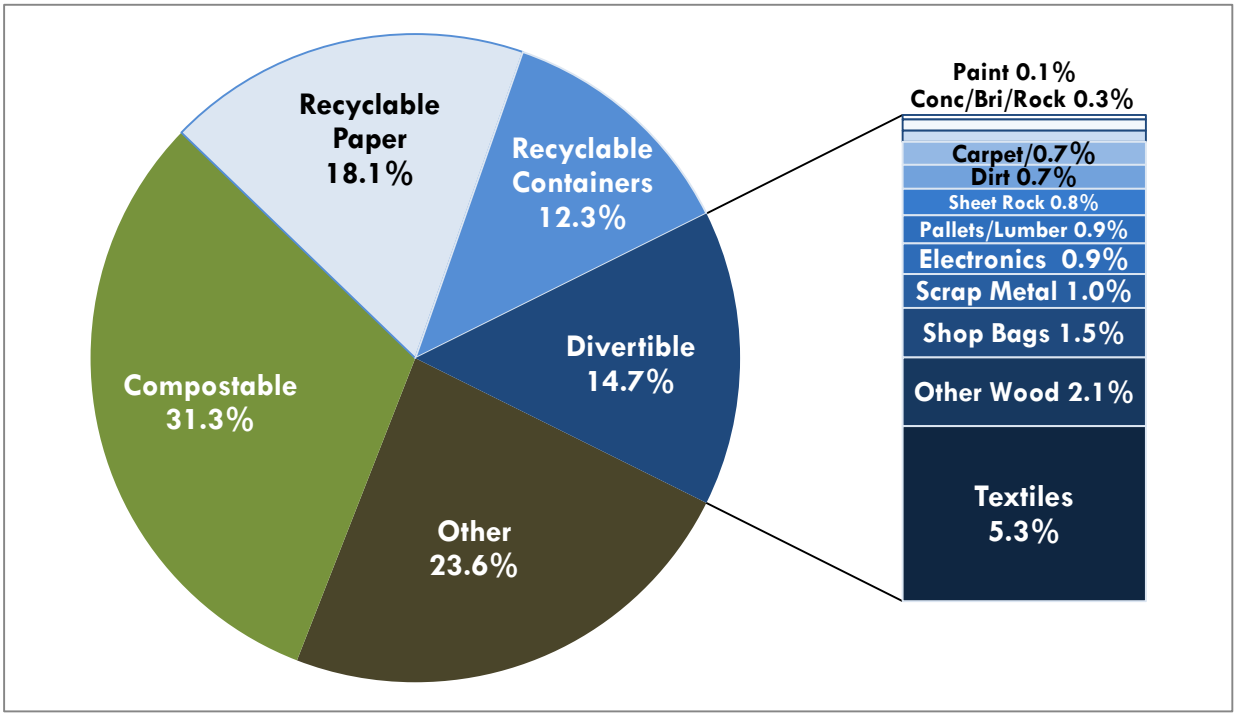


Exhibit 7. Residential Compostable Materials

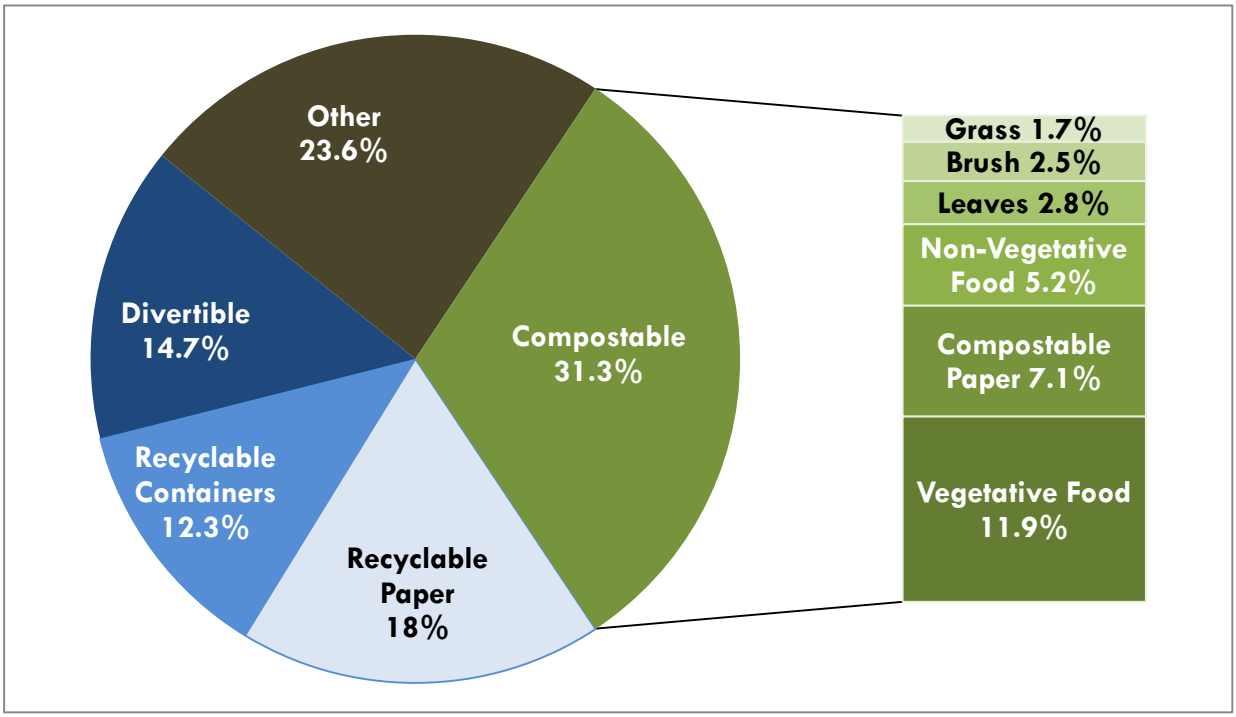
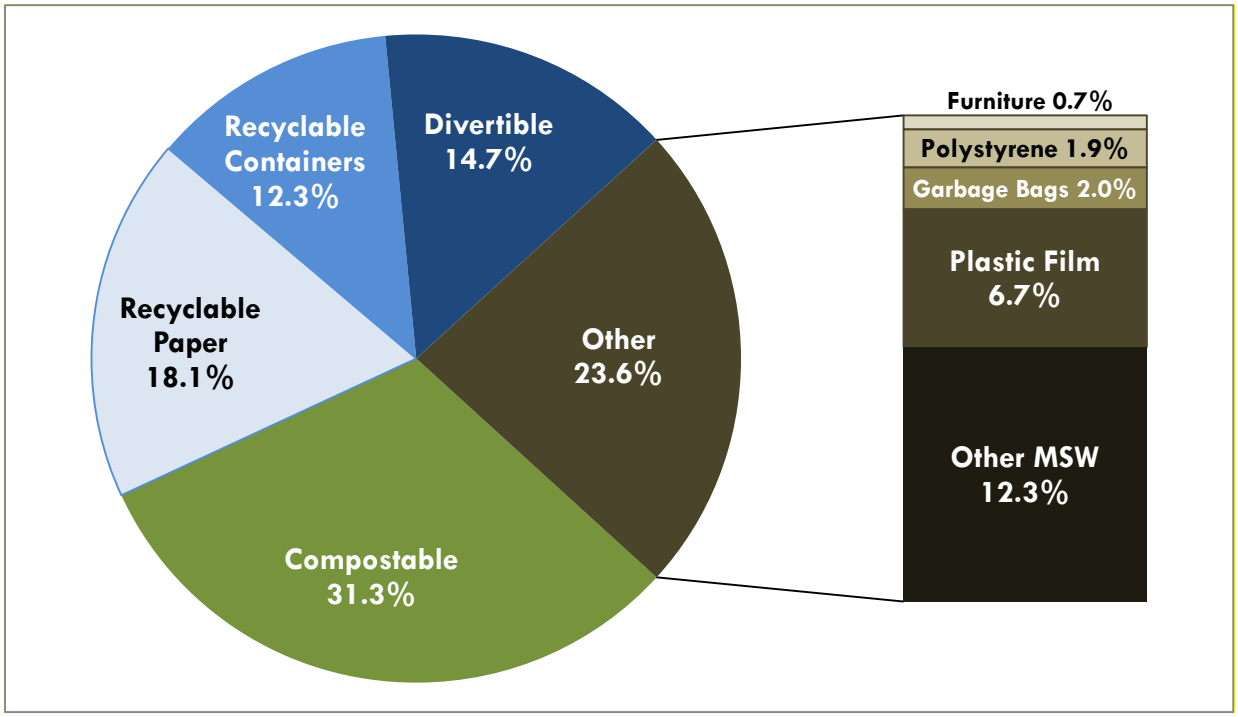


Exhibit 8. Residential Other Materials



Seasonality of Residential Waste

The proportion of some materials varied significantly by season in the residential waste stream. SCS compared the 95 percent confidence intervals for each material by season to note statistically significant differences.

Recyclable Paper

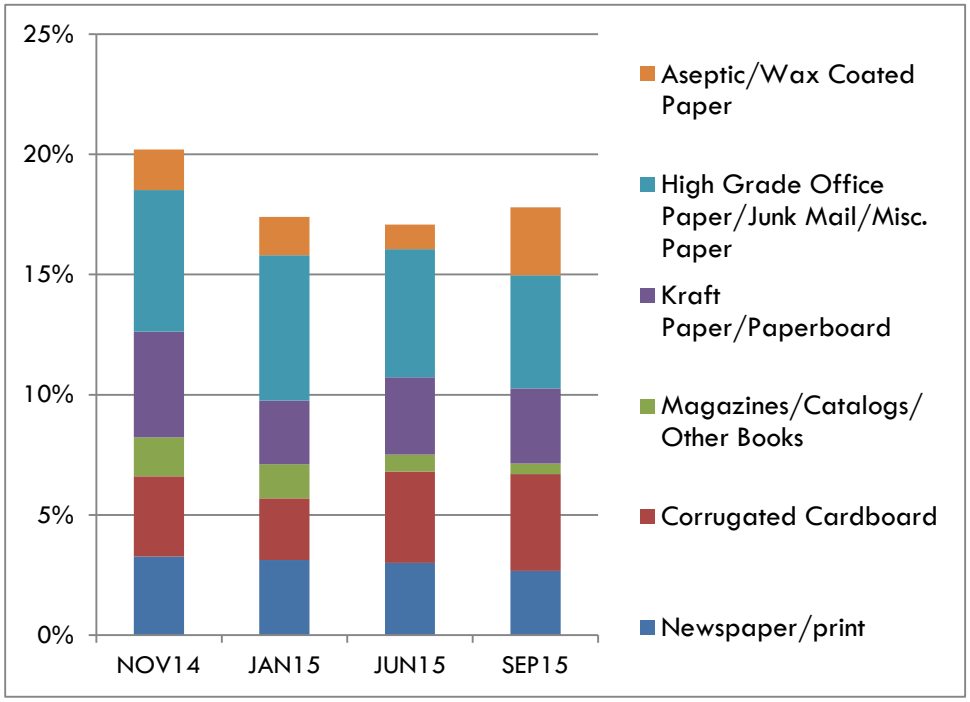
The following materials showed significant seasonal variation:

- **Magazines/Catalogs/Other Books** – The proportion was significantly higher in fall and winter (1.6 and 1.4 percent, respectively) than in spring and summer (0.7 and 0.4 percent, respectively).

- **Kraft Paper/Paperboard** - The proportion was significantly higher in fall (4.4 percent) than in winter, spring, and summer (2.6, 3.2, and 3.1 percent, respectively).

- **Aseptic/Wax Coated Paper** - The proportion was significantly higher in summer (2.8 percent) than in fall, winter, and spring (1.7, 1.6, and 1.9 percent, respectively).

Exhibit 9. Seasonality of Residential Recyclable Paper Materials



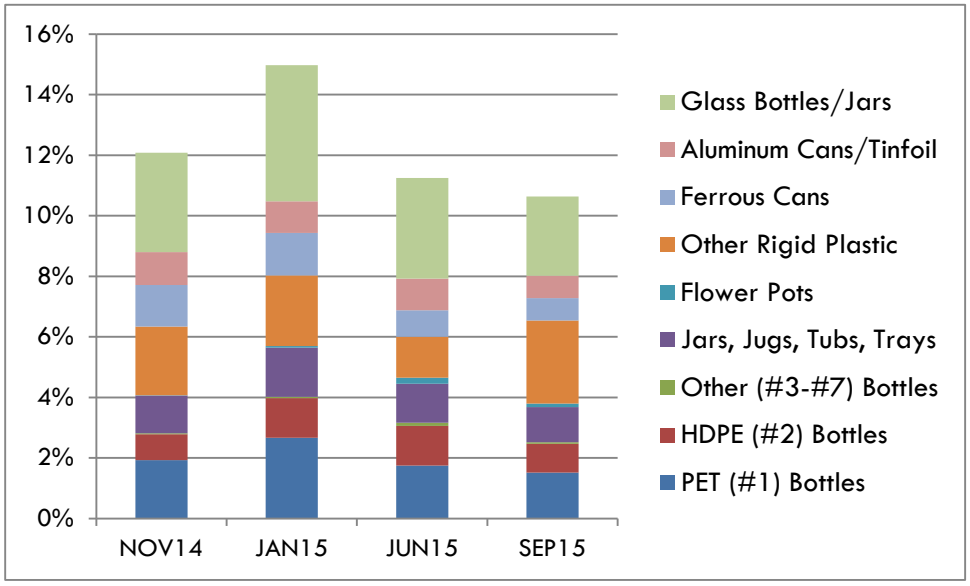
Recyclable Containers

The following materials showed significant seasonal variation:

- **PET (#1) Plastic Bottles** - The proportion was significantly higher in winter (2.7 percent) than in fall, spring, and spring (1.9, 1.7, and 1.5, respectively).

- **Ferrous Cans** - The proportion was significantly higher in fall and winter (1.4 percent each) than in spring and summer (0.9 and 0.7 percent, respectively).

Exhibit 10. Seasonality of Residential Recyclable Containers

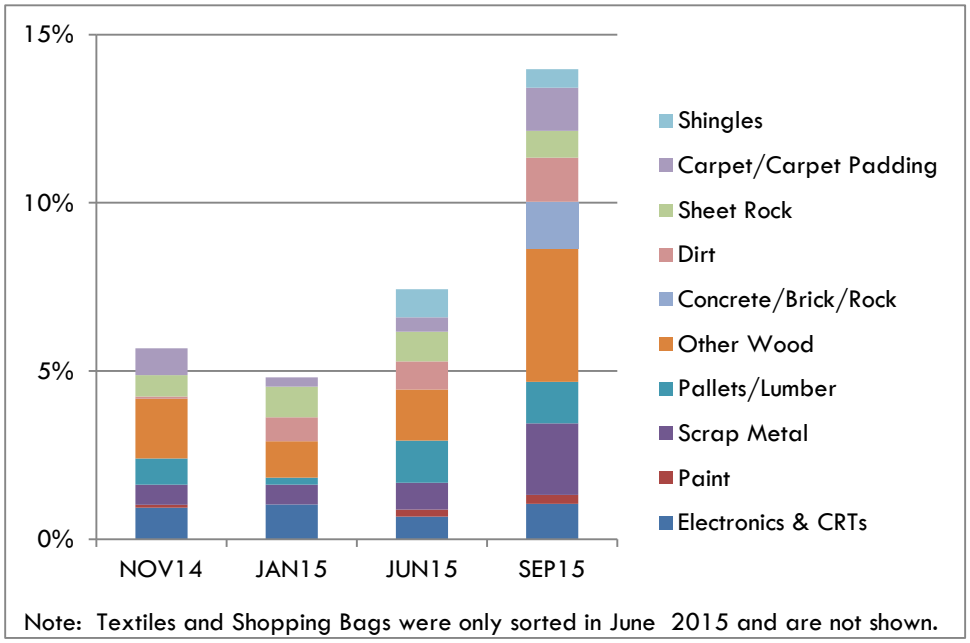


Divertible Materials

The following material showed significant seasonal variation:

- **Shingles** – Even though the proportion is low, this material was more prevalent in residential waste in the spring and summer.

Exhibit 11. Seasonality of Residential Divertible Materials



Even though proportions of Pallets/Lumber, Other Wood, Concrete/Brick/Rock, and Dirt appear to be significantly higher in summer, there is substantial sample-to-sample variability for these materials which prevents concluding the difference is statistically significant.

Compostable Materials

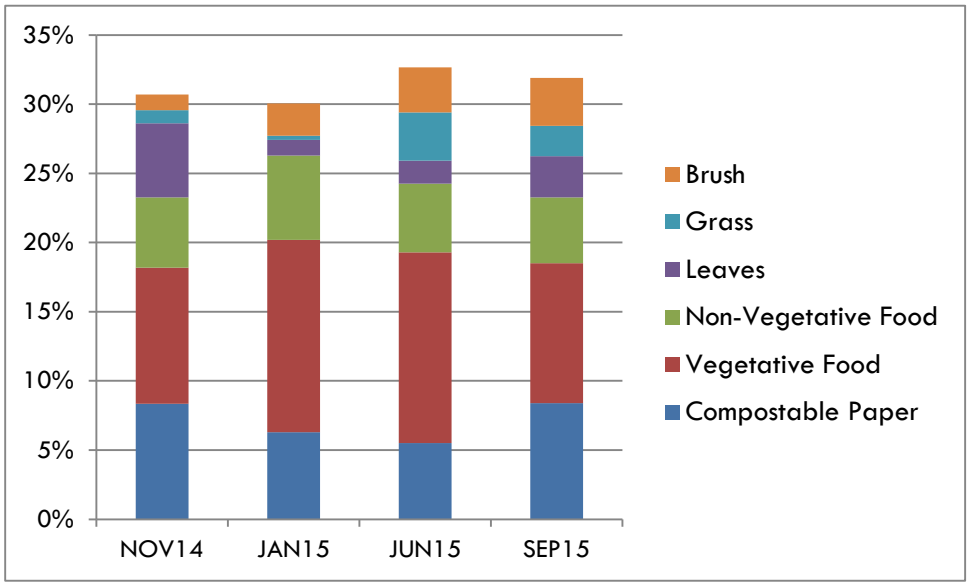
The following materials showed significant seasonal variation:

- **Compostable Paper** - The proportion was significantly higher in fall and summer (8.3 and 8.4 percent, respectively) than in winter and spring (6.3 and 5.5 percent, respectively).

- **Vegetative Food** - The proportion was significantly higher in winter and spring (13.9 and 18.3percent, respectively) than in fall and summer (9.8 and 10.1 percent, respectively).

- **Leaves** - The proportion was significantly higher in fall 5.4 percent) than in winter, spring and summer (1.1, 1.7 and 3.0 percent, respectively).

Exhibit 12. Seasonality of Residential Compostable Materials

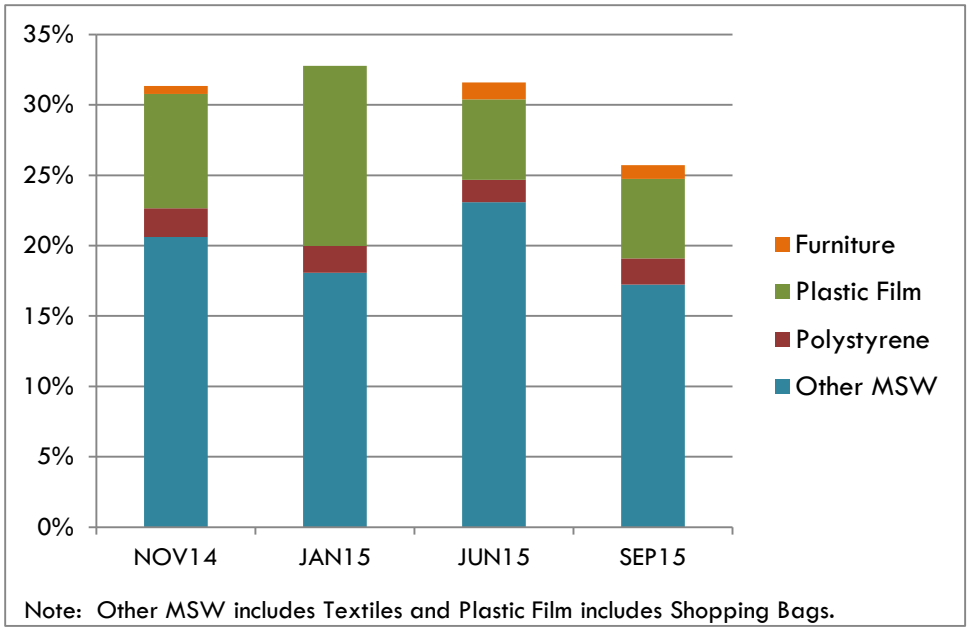


Other MSW

The following material showed significant seasonal variation:

- **Plastic Film** - The proportion was significantly higher in winter (12.8 percent) than in fall, spring and summer (8.1, 5.7, and 5.7 percent, respectively).

Exhibit 13. Seasonality of Residential Other Materials



Note: Other MSW includes Textiles and Plastic Film includes Shopping Bags.

COMMERCIAL WASTE COMPOSITION

Exhibit 14 presents a graphic summary of the major material classifications of commercial waste based on 63 waste samples collected and sorted in during the four field activities.

Exhibit 14. Commercial Waste Composition of Major Material Categories

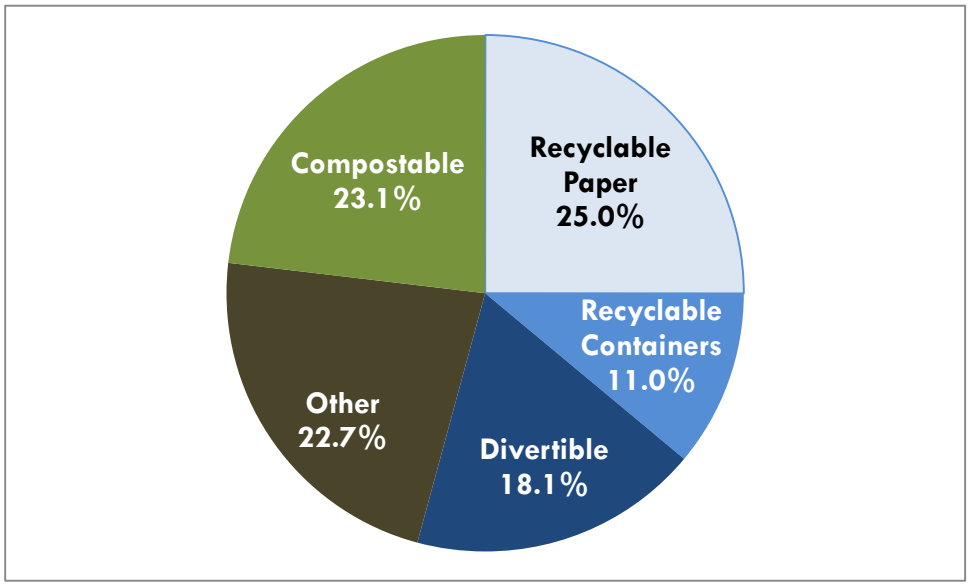


Table 3 presents the annual commercial waste composition which includes the mean proportion of each material, its associated standard deviation, and 95 percent confidence intervals. Please note that this composition is based on the waste delivered to the Brown Station Road Sanitary Landfill from commercial sources. The composition does not include recyclable material that is delivered to the County's Material Recovery Facility (MRF) or the yard waste that is managed separately.

The top three materials found in commercial waste are:

- **Corrugated Cardboard** (11.8 percent),
- **Plastic Film** (9.4 percent). and
- **Vegetative Food** (9.2 percent).

Table 4. Annual Commercial Waste Composition

	Material Components	Mean Composition	Standard Deviation	95% Confidence Limits Lower	95% Confidence Limits Upper
Recyclable Paper	Newspaper/print	1.1%	3.3%	0.3%	2.0%
	Corrugated Cardboard	11.8%	10.7%	9.2%	14.5%
	Magazines/Catalogs/ Other Books	1.7%	8.3%	<0.1%	3.7%
	Kraft Paper/Paperboard	2.1%	1.6%	1.7%	2.5%
	Office Paper/Junk Mail/Misc. Paper	6.6%	7.2%	4.8%	8.4%
	Aseptic/Wax Coated Paper	1.7%	1.6%	1.3%	2.1%
	Subtotal	**25.0%**			
Recyclable Containers	PET (#1) Bottles	2.1%	1.5%	1.7%	2.4%
	HDPE (#2) Bottles	0.7%	0.8%	0.5%	0.9%
	Other (#3-#7) Bottles	<0.1%	0.3%	<0.1%	0.1%
	Jars, Jugs, Tubs, Trays	1.6%	1.4%	1.3%	2.0%
	Flower Pots	<0.1%	0.2%	<0.1%	0.1%
	Other Rigid Plastic	2.9%	4.1%	1.9%	3.9%
	Ferrous Cans	0.5%	0.8%	0.3%	0.7%
	Aluminum Cans/Foil	0.7%	1.0%	0.5%	1.0%
	Glass Bottle/Jars	2.3%	2.2%	1.8%	2.9%
	Subtotal	**11.0%**			
Divertible	Electronics	0.5%	1.4%	<0.1%	1.0%
	CRTs	0.6%	4.2%	<0.1%	2.1%
	Paint	<0.1%	0.5%	<0.1%	0.2%
	Scrap Metal	1.2%	3.7%	0.3%	2.1%
	Pallets/Lumber	3.1%	8.3%	1.0%	5.1%
	Other Wood	2.5%	5.7%	1.1%	3.9%
	Concrete/Brick/Rock	0.2%	1.2%	<0.1%	0.5%
	Dirt	0.4%	1.5%	<0.1%	0.7%
	Sheet Rock	0.2%	1.6%	<0.1%	0.6%
	Carpet/Carpet Padding	3.7%	11.1%	1.0%	6.5%
	Shingles	0.5%	2.9%	<0.1%	1.2%
	Textiles	4.3%	5.4%	1.8%	6.9%
	Shopping Bags	0.8%	1.3%	0.2%	1.5%
	Subtotal	**18.1%**			
Compostable	Compostable Paper	7.3%	5.2%	6.0%	8.6%
	Vegetative Food	9.2%	8.9%	7.0%	11.4%
	Non-Vegetative Food	3.3%	4.0%	2.3%	4.3%
	Leaves	0.8%	2.5%	0.1%	1.4%
	Grass	1.2%	4.6%	<0.1%	2.3%
	Brush	1.3%	3.8%	0.4%	2.3%
	Subtotal	**23.1%**			
Other MSW	Furniture	0.8%	3.6%	<0.1%	1.6%
	Plastic Film	9.4%	6.8%	7.7%	11.0%
	Garbage Bags	2.3%	2.7%	1.0%	3.6%
	Polystyrene	1.9%	1.5%	1.5%	2.2%
	Other MSW	8.3%	10.0%	5.9%	10.8%
	Subtotal	**22.7%**			
TOTALS		**100.0%**			

Assessment of Major Waste Categories

Exhibit 15 through **Exhibit 19** present further breakdowns of the major commercial waste categories.

Exhibit 15. Commercial Recyclable Paper

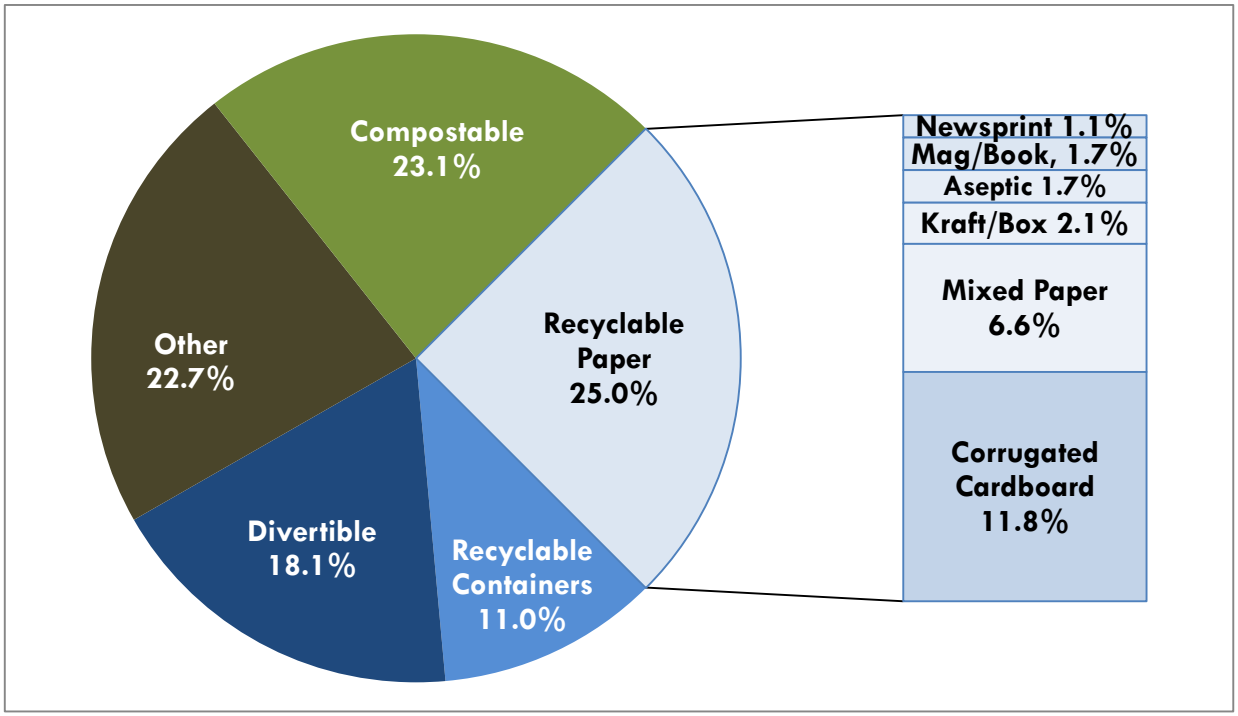


Exhibit 16. Commercial Recyclable Containers

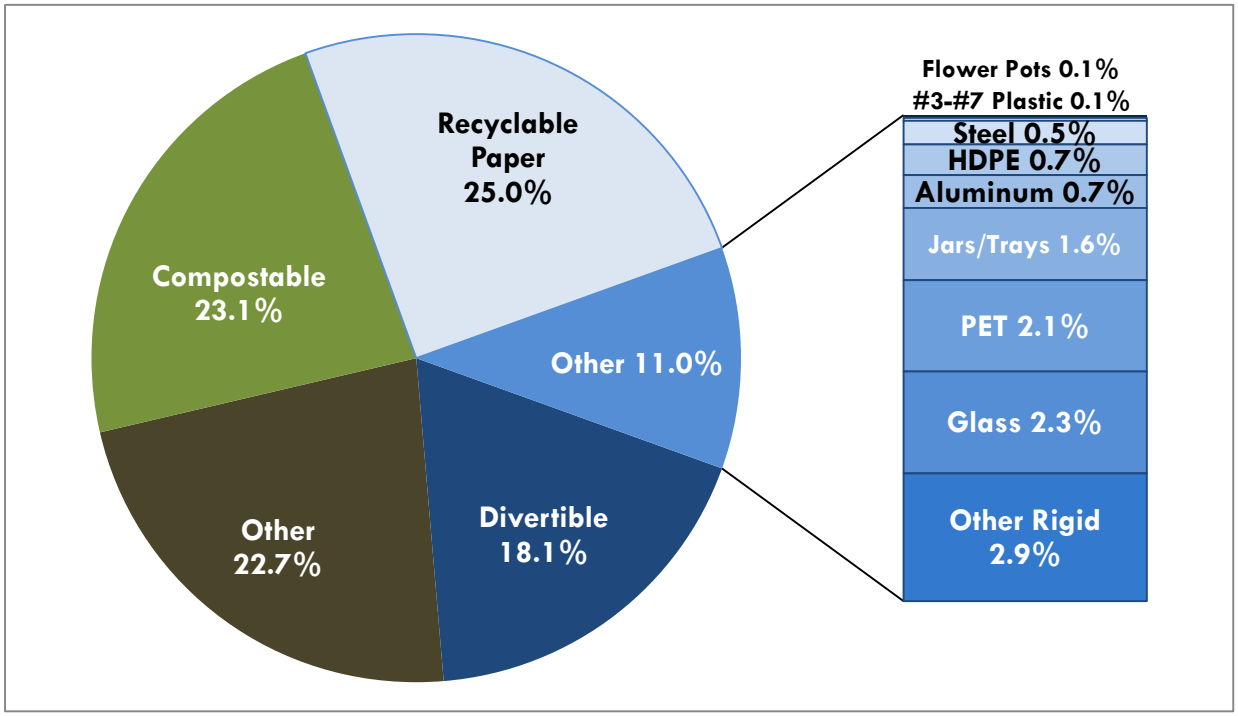


Exhibit 17. Commercial Divertible Materials

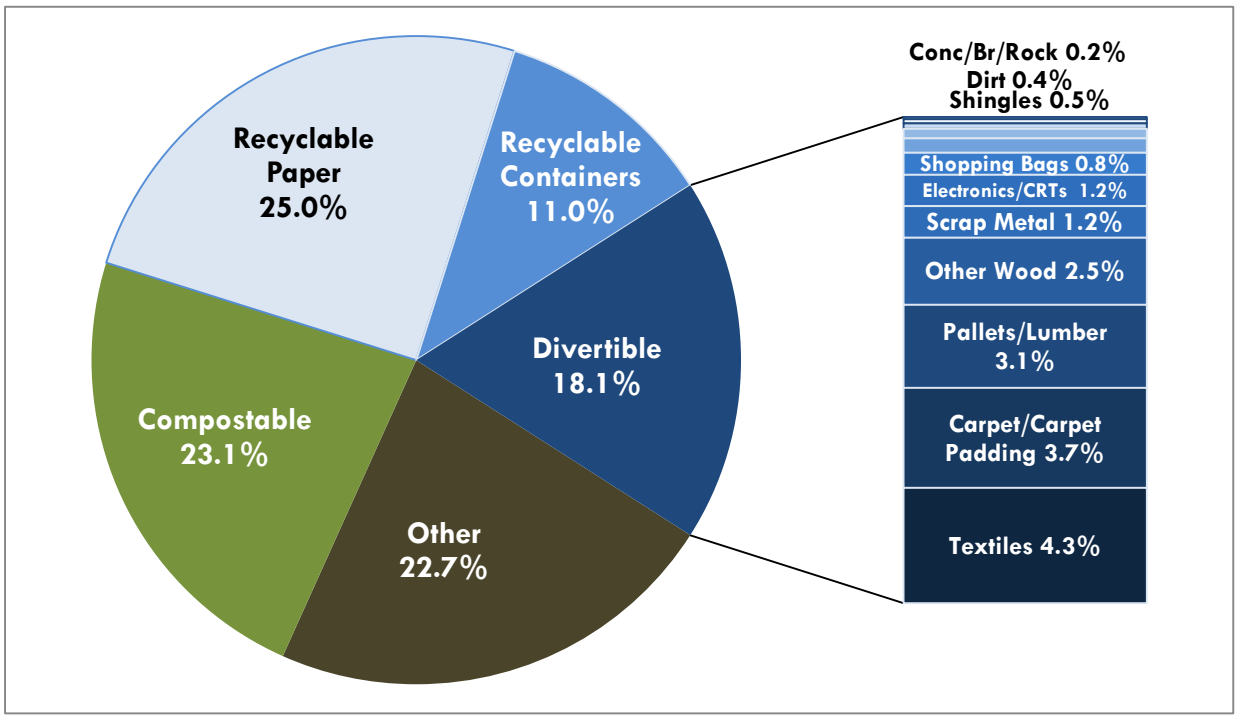


Exhibit 18. Commercial Compostable Materials

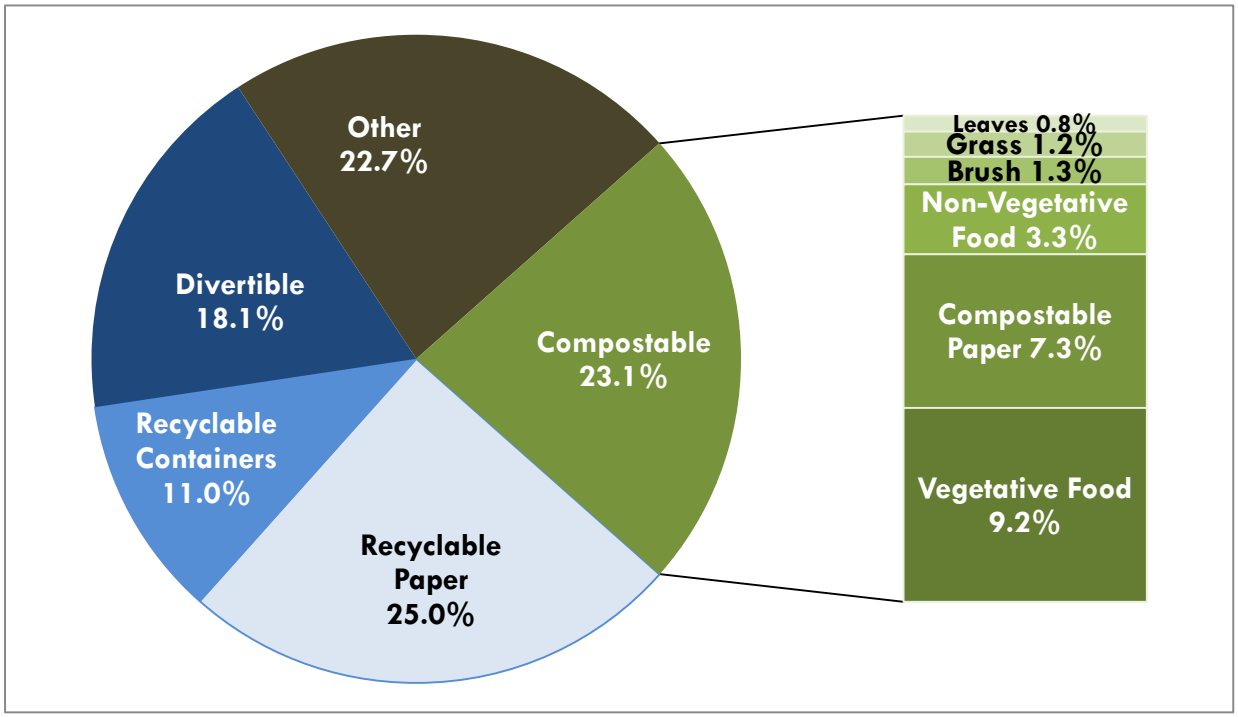
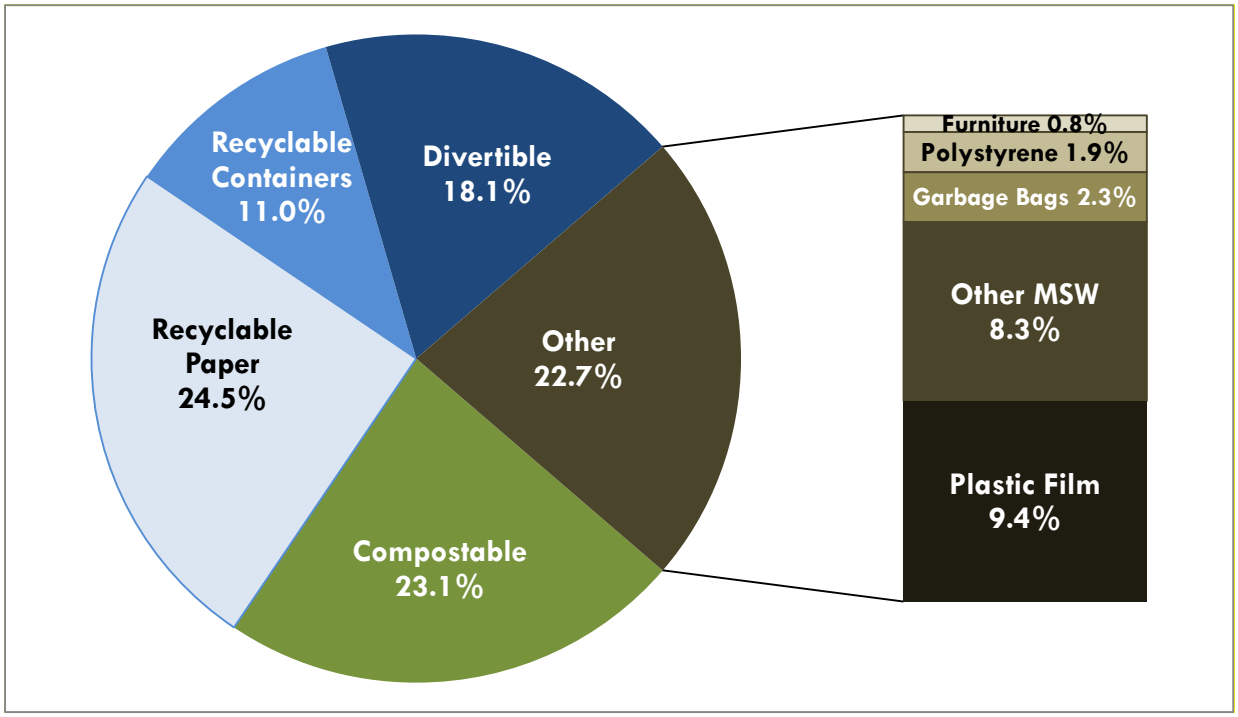


Exhibit 19. Commercial Other Materials



Seasonality of Commercial Waste

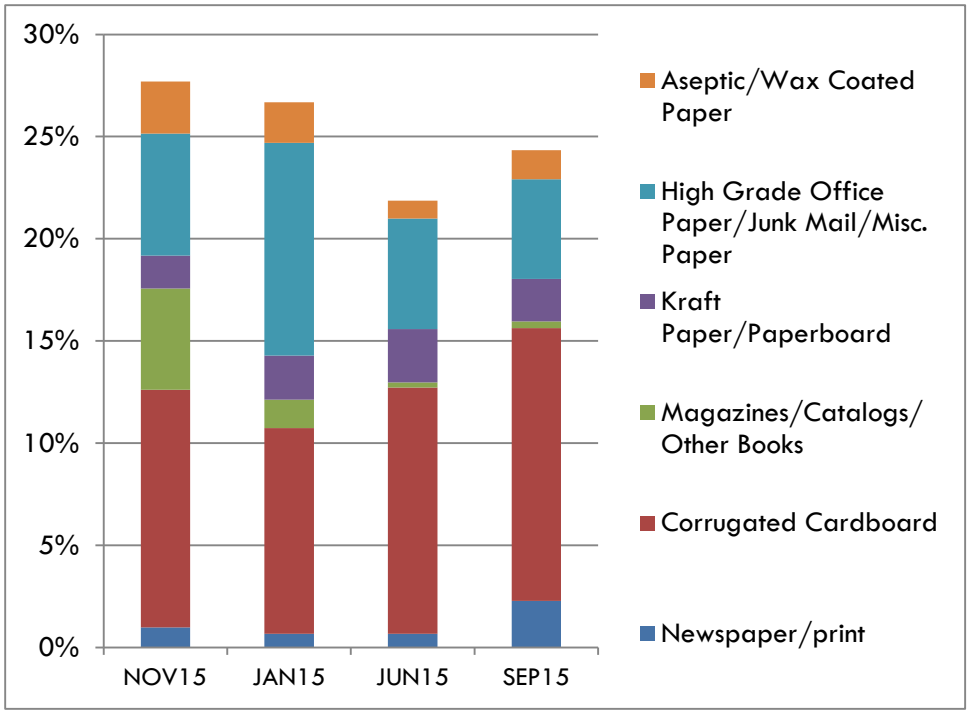
The proportion of some materials varied significantly by season in the commercial waste stream. SCS compared the 95 percent confidence intervals for each material by season to note significant differences.

Recyclable Paper

The following materials showed significant seasonal variation:

- **Magazines/Catalogs/Other Books** – The proportion was significantly higher in fall (5.0 percent) than in winter, spring, and summer (1.4, 0.3, and 0.3 percent, respectively).
- **Aseptic/Wax Coated Paper** – The proportion was significantly higher in fall and winter (2.5 and 2.0 percent, respectively) than in winter (0.9 percent).

Exhibit 20. Seasonality of Commercial Recyclable Paper

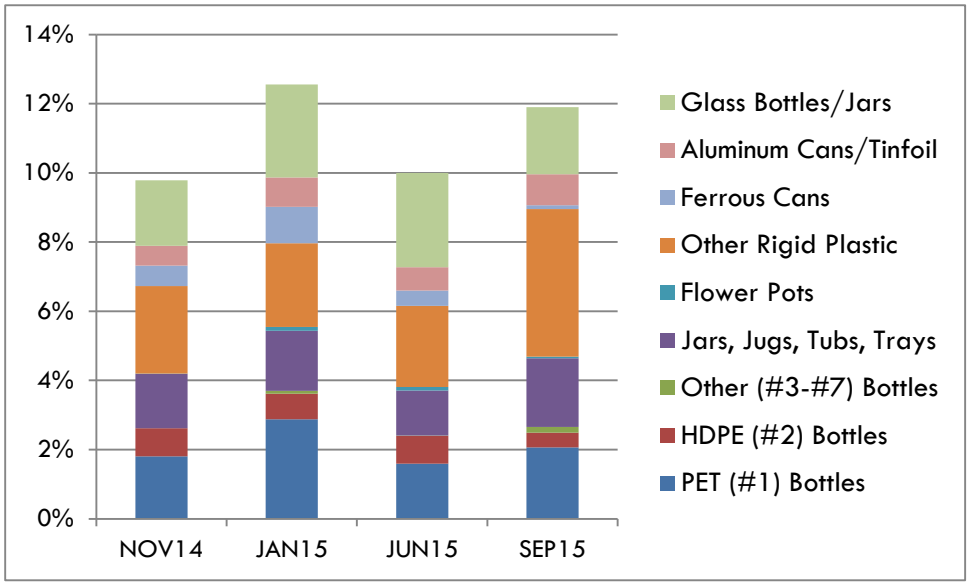


Recyclable Containers

The following material showed significant seasonal variation:

- **Ferrous Cans** - The proportion was significantly higher in fall, winter, and spring (0.6, 1.0, and 0.4 percent, respectively) than in summer (0.1 percent).

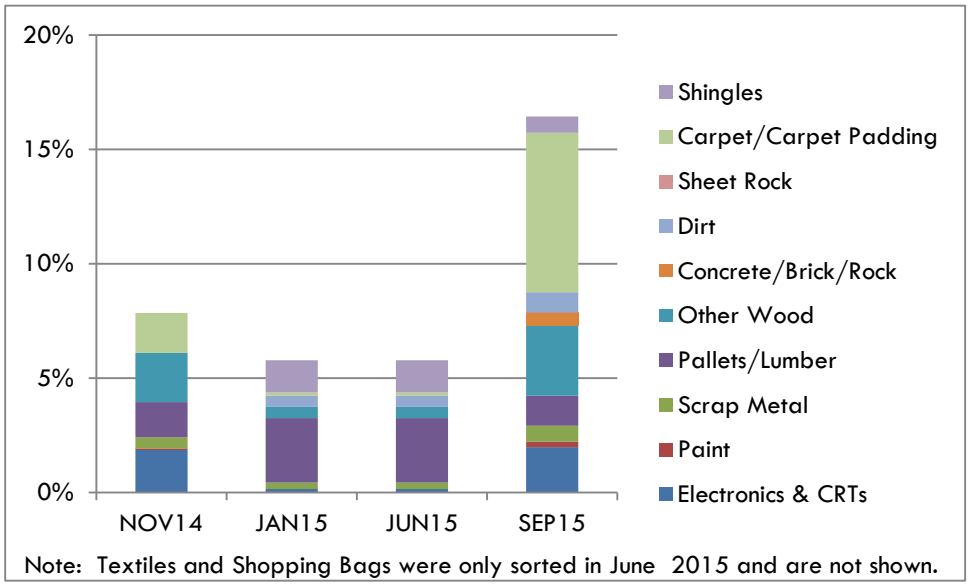
Exhibit 21. Seasonality of Commercial Recyclable Containers



Divertible Materials

Even though proportions of Electronics & CRTs, Pallets/Lumber, Other Wood, Concrete/Brick/Rock, and Carpet/Carpet Padding appear to be significantly higher in summer, there is substantial sample-to-sample variability for these materials which prevents concluding the difference is statistically significant.

Exhibit 22. Seasonality of Commercial Divertible Materials



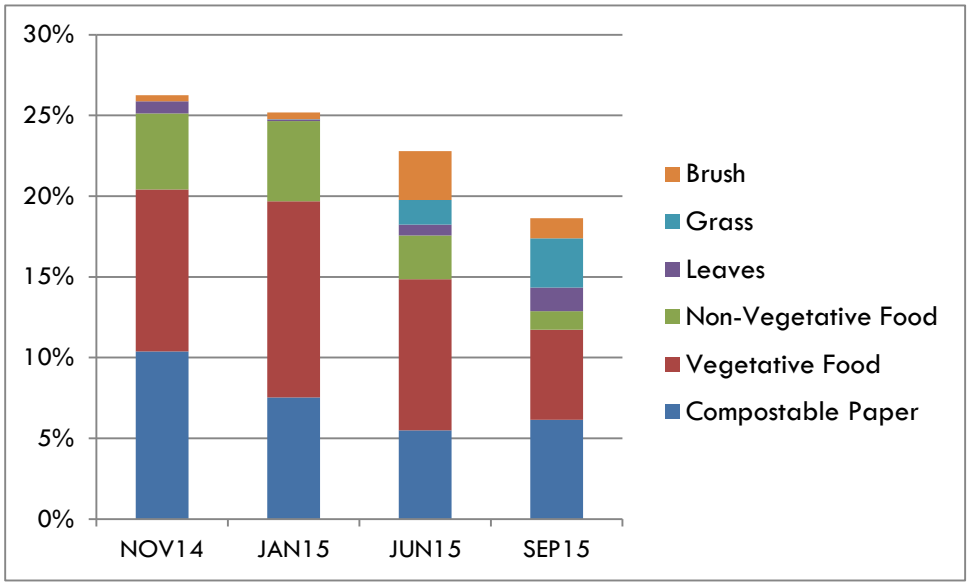
Compostable Materials

The following materials showed significant seasonal variation:

- **Non-Vegetative Food** - The proportion was significantly higher in fall and winter (7.3 and 7.2 percent, respectively) than in summer (2.1 percent).

- **Grass** - The proportion was significantly higher in spring and summer (1.5 and 3.1 percent, respectively) than in fall and winter, spring and summer (<0.1 percent each).

Exhibit 23. Seasonality of Commercial Compostable Materials

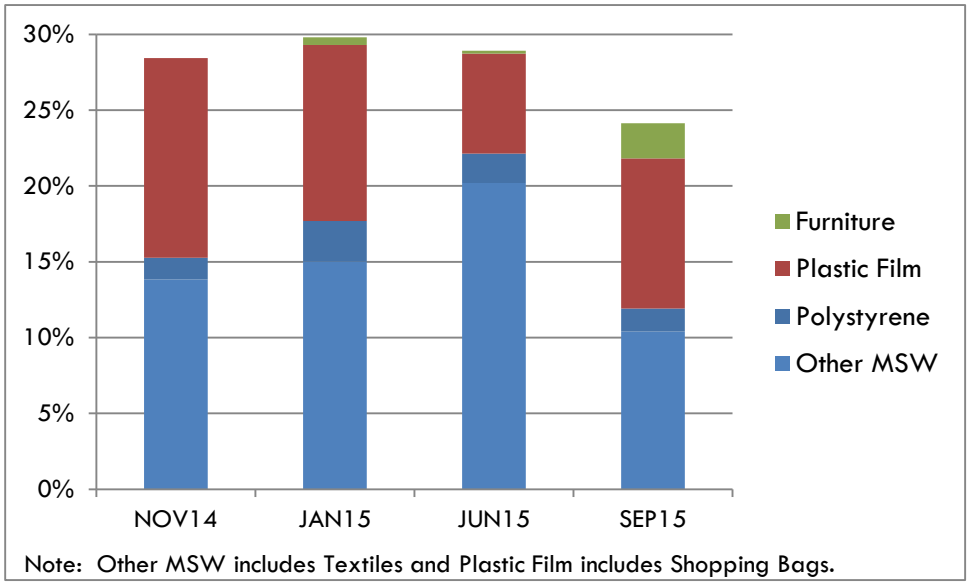


Other MSW

The following material showed significant seasonal variation:

- **Plastic Film** - The proportion was significantly higher in fall and winter (13.2 and 11.5 percent, respectively) than in spring (6.6 percent).

Exhibit 24. Seasonality of Commercial Other MSW



PUBLIC SCHOOL WASTE COMPOSITION

Exhibit 25 presents a graphic summary of the major material classifications of public school waste based on seven waste samples collected and sorted during the four seasonal field activities.

Exhibit 25. Public School Waste Composition of Major Material Categories

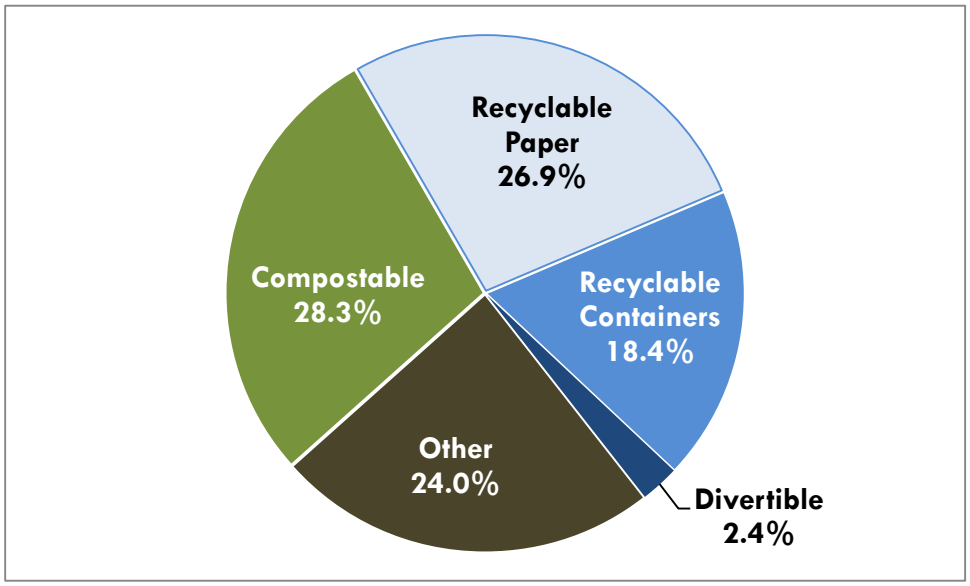


Table 5 presents the annual public school waste composition which includes the mean proportion of each material, its associated standard deviation, and 95 percent confidence intervals. Please note that this composition is based on the waste delivered to the Brown Station Road Sanitary Landfill from public school sources. The composition does not include recyclable material that is delivered to the County's Material Recovery Facility (MRF) or the yard waste that is managed separately.

The top four materials found in public school waste are:

- **Vegetative Food** (14.5 percent),
- **Other MSW** (12.2 percent),
- **Corrugated Cardboard** (10.5 percent), and
- **Office Paper/Junk Mail/Miscellaneous Paper** (10.1 percent).

Table 5. Annual Public School Waste Composition

	Material Components	Mean Composition	Standard Deviation	95% Confidence Limits Lower	95% Confidence Limits Upper
Recyclable Paper	Newspaper/print	0.8%	1.7%	<0.1%	2.1%
	Corrugated Cardboard	10.5%	11.1%	2.3%	18.7%
	Magazines/Catalogs/ Other Books	1.1%	1.7%	<0.1%	2.3%
	Kraft Paper/Paperboard	2.4%	2.4%	0.6%	4.2%
	Office Paper/Junk Mail/Misc. Paper	10.1%	10.9%	2.0%	18.2%
	Aseptic/Wax Coated Paper	2.1%	1.7%	0.9%	3.4%
	Subtotal	**26.9%**			
Recyclable Containers	PET (#1) Bottles	3.6%	3.8%	0.8%	6.4%
	HDPE (#2) Bottles	2.2%	2.7%	0.2%	4.2%
	Other (#3-#7) Bottles	<0.1%	<0.1%	<0.1%	<0.1%
	Jars, Jugs, Tubs, Trays	1.1%	1.1%	0.3%	1.9%
	Flower Pots	<0.1%	<0.1%	<0.1%	<0.1%
	Other Rigid Plastic	2.2%	2.2%	0.6%	3.8%
	Ferrous Cans	0.7%	1.2%	<0.1%	1.6%
	Aluminum Cans/Foil	0.5%	0.5%	0.2%	0.9%
	Glass Bottle/Jars	8.1%	11.0%	<0.1%	16.2%
	Subtotal	**18.4%**			
Divertible	Electronics	<0.1%	<0.1%	<0.1%	<0.1%
	CRTs	<0.1%	<0.1%	<0.1%	<0.1%
	Paint	<0.1%	<0.1%	<0.1%	<0.1%
	Scrap Metal	0.4%	1.2%	<0.1%	1.3%
	Pallets/Lumber	<0.1%	<0.1%	<0.1%	<0.1%
	Other Wood	0.2%	0.6%	<0.1%	0.7%
	Concrete/Brick/Rock	<0.1%	<0.1%	<0.1%	<0.1%
	Dirt	<0.1%	<0.1%	<0.1%	<0.1%
	Sheet Rock	<0.1%	<0.1%	<0.1%	<0.1%
	Carpet/Carpet Padding	0.8%	2.0%	<0.1%	2.3%
	Shingles	<0.1%	<0.1%	<0.1%	<0.1%
	Textiles	0.4%	0.5%	<0.1%	1.1%
	Shopping Bags	0.6%	0.9%	<0.1%	1.8%
	Subtotal	**2.4%**			
Compostable	Compostable Paper	7.4%	3.9%	4.5%	10.3%
	Vegetative Food	14.5%	7.0%	9.3%	19.7%
	Non-Vegetative Food	2.5%	1.4%	1.4%	3.5%
	Leaves	3.2%	4.2%	0.1%	6.3%
	Grass	0.5%	0.8%	<0.1%	1.0%
	Brush	0.2%	0.7%	<0.1%	0.7%
	Subtotal	**28.3%**			
Other MSW	Furniture	1.1%	2.9%	<0.1%	3.2%
	Plastic Film	7.7%	5.9%	3.3%	12.0%
	Garbage Bags	0.6%	0.9%	<0.1%	1.9%
	Polystyrene	2.4%	2.0%	0.9%	3.8%
	Other MSW	12.2%	4.2%	9.1%	15.3%
	Subtotal	**24.0%**			
TOTALS		**100.0%**			

Assessment of Major Waste Categories

Exhibit 26 through **Exhibit 30** present further breakdowns of the major public school waste categories.

Exhibit 26. Public School Recyclable Paper

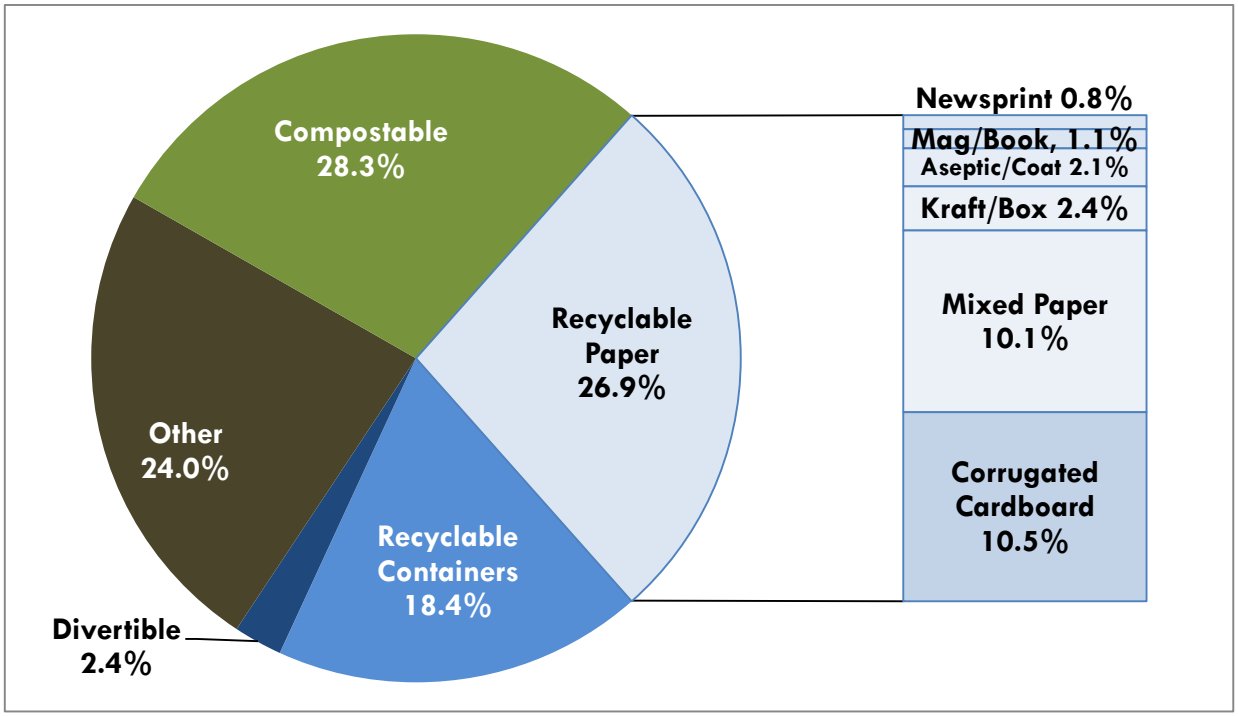


Exhibit 27. Public School Recyclable Containers

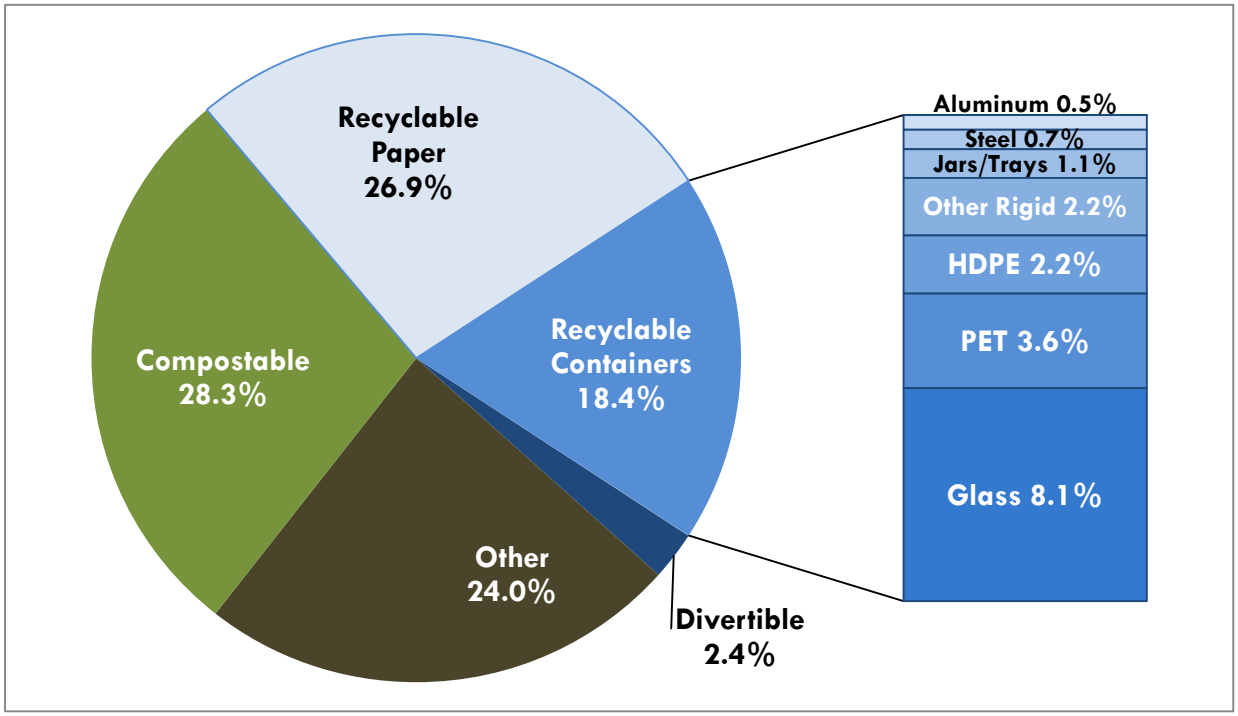


Exhibit 28. Public School Divertible Materials

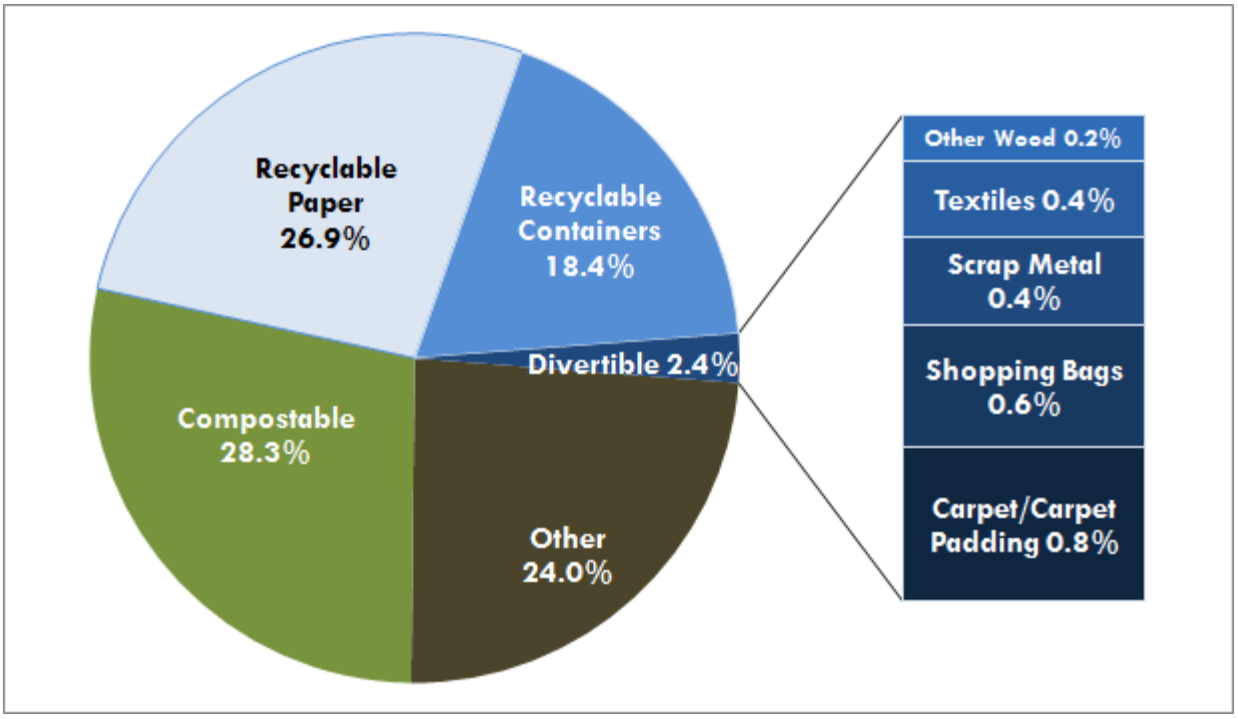


Exhibit 29. Public School Compostable Materials

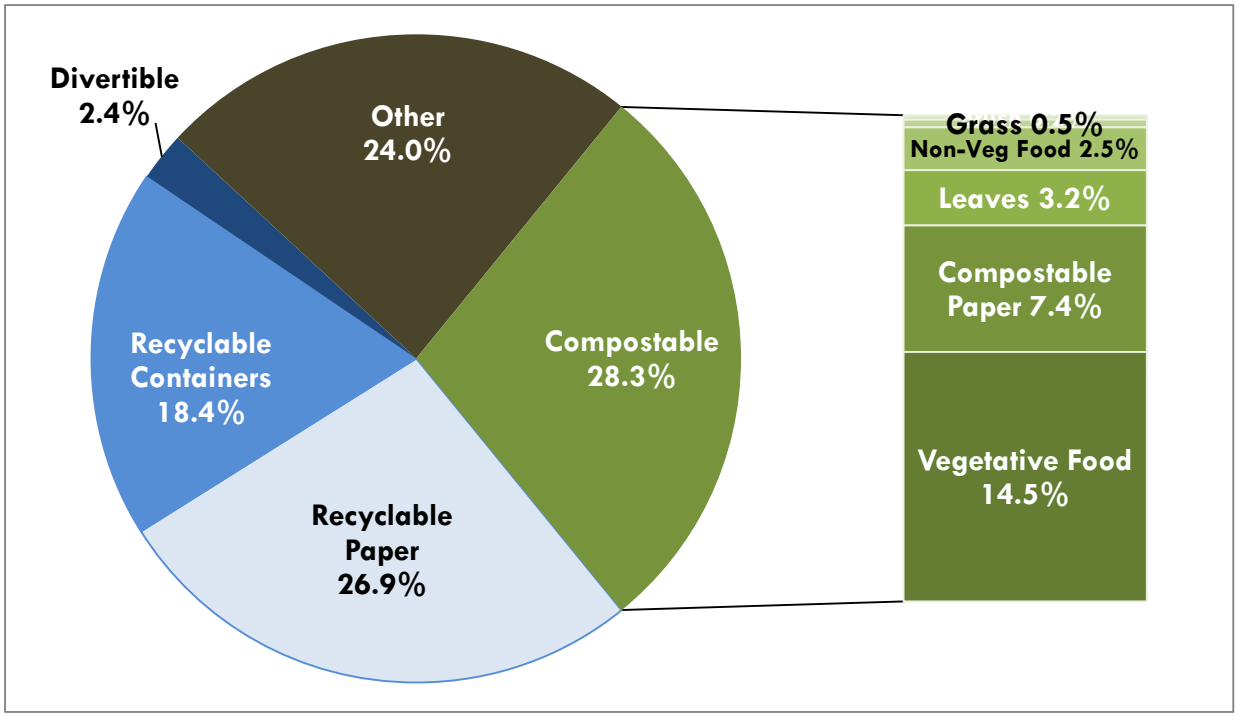
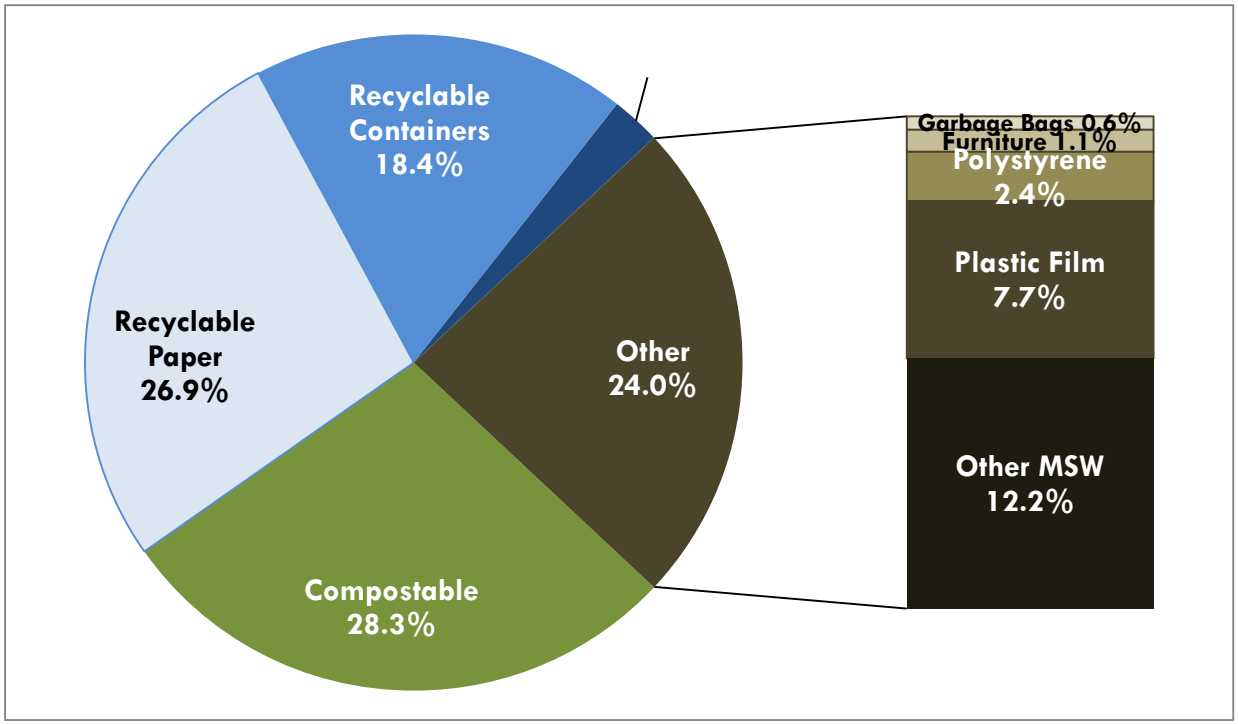


Exhibit 30. Public School Other Materials



Seasonality of School Waste

Because the waste from public schools represents about three percent of the waste delivered to the Landfill, there are not enough samples each season to assess seasonality.

5 ESTIMATED ANNUAL TONNAGE

The composition of waste streams from residential, commercial, and public school sources was used to estimate the tonnage of each material delivered to the Brown Station Road Sanitary Landfill for disposal.

Table 6 presents the estimated tonnages of each material delivered to the landfill by source.

Table 6. Annual Material Tonnages Delivered to the Landfill

Material Components		Source			
		Residential	Commercial	Schools	Total
Recyclable Paper	Newspaper/print	6,200	1,000	<100	7,300
	Corrugated Cardboard	7,000	10,600	1,000	18,600
	Magazines/Catalogs/ Other Books	2,200	1,500	100	3,800
	Kraft Paper/Paperboard	6,800	1,900	200	9,000
	Office Paper/Junk Mail/Misc. Paper	11,200	5,900	1,000	18,200
	Aseptic/Wax Coated Paper	3,600	1,500	200	5,400
	Total Recyclable Paper	**37,000**	**22,500**	**2,700**	**62,200**
Recyclable Containers	PET (#1) Bottles	4,000	1,900	400	6,300
	HDPE (#2) Bottles	2,300	600	200	3,100
	Other (#3-#7) Bottles	100	<100	<100	200
	Jars, Jugs, Tubs, Trays	2,700	1,500	100	4,300
	Flower Pots	200	<100	<100	300
	Other Rigid Plastic	4,500	2,600	200	7,300
	Ferrous Cans	2,300	500	<100	2,800
	Aluminum Cans/Foil	2,000	700	<100	2,700
	Glass Bottle/Jars	7,000	2,100	800	9,900
	Total Recyclable Containers	**25,100**	**9,900**	**1,800**	**36,800**
Divertible	Electronics	1,900	500	<100	2,400
	CRTs	<100	600	<100	600
	Paint	300	<100	<100	400
	Scrap Metal	2,100	1,100	<100	3,200
	Pallets/Lumber	1,700	2,800	<100	4,500
	Other Wood	4,200	2,200	<100	6,500
	Concrete/Brick/Rock	700	100	<100	800
	Dirt	1,500	300	<100	1,800
	Sheet Rock	1,600	200	<100	1,800
	Carpet/Carpet Padding	1,400	3,400	<100	4,800
	Shingles	700	500	<100	1,200
	Textiles	10,900	3,900	<100	14,800
	Shopping Bags	3,100	700	<100	3,900
	Total Divertable	**30,100**	**16,300**	**200**	**46,600**
Compostable	Compostable Paper	14,600	6,600	700	21,900
	Vegetative Food	24,300	8,300	1,500	34,100
	Non-Vegetative Food	10,700	3,000	200	13,900
	Leaves	5,700	700	300	6,700
	Grass	3,400	1,100	<100	4,600
	Brush	5,100	1,200	<100	6,400
	Total Compostable	**63,800**	**20,800**	**2,800**	**87,500**
Other MSW	Furniture	1,400	700	100	2,200
	Plastic Film	13,600	8,400	800	22,800
	Garbage Bags	4,100	2,100	<100	6,300
	Polystyrene	3,800	1,700	200	5,700
	Other MSW	25,200	7,500	1,200	33,900
	Total Other MSW	**48,100**	**20,400**	**2,400**	**70,900**
TOTALS		**204,000**	**90,000**	**10,000**	**304,000**

Appendix A

Health and Safety Plan

Appendix B

Waste Sampling and Sorting Process

The following five steps describe the waste sampling and sorting process using photos. It should be noted that these photos are representative of waste characterization projects conducted in the past five years in various locations in the U.S. and that none of the photos are from the waste characterization project conducted for Prince George's County.

Step 1 – Grab a sample. The picture below is a typical waste sample. Once a waste collection vehicle dumped its contents, SCS handpicked a random sample that weighed 200 pounds. In Prince George's County, SCS directed a front loader to grab a random sample and deliver it to the sorting area. Most samples look like this.

Step 2 – SCS loads the sample onto a sorting table, rips open bag, and six people sort the contents by material type. In the photo below, you can see trash cans for the separated materials.

Step 3 – Typical materials sorted from the trash sample include:

#2 HDPE Bottles

#1 PET Bottles

Corrugated Cardboard

Leaves

Aluminum Cans

Office Paper

Step 4 – Sorting the smaller sized items. It takes about a half hour to sort the easily identifiable materials from the trash sample (examples above in Step 3). The trash sample starts to look like the photo below, where the individual items are small, mixed and hard to distinguish between paper, plastic, foil, food, etc. Once the trash sample looks like this, we try our best to focus on paper, and then plastic, and then food. But it starts to take a long time to sort this fine material.

Step 5 – Calling the sample. The remaining material is scooped into a trash can and weighed. We call this material other waste. It contains materials not otherwise categorized including kitty litter, diapers, ceiling tiles, fines, contaminated organics, and indistinguishable/small materials. Some examples of this material are pictured below.

Below is a table that compares several other waste composition studies. Waste composition studies typically target material for recycling. The "Other Waste" category can be significant but it is believed that this material is difficult to reuse, recycle or divert.

MATERIAL COMPONENTS		SINGLE-FAMILY WASTE COMPOSITIONS												
		Sausalito, CA	Chatham County, NC	Orange County, NC	Huntsville, AL	New Hanover County, NC	Norfolk, VA	Cleveland, OH	Prince William County, VA	Sonoma County, CA	Anne Arundel County, MD	Hamilton County, OH	Wake County, NC	Montgomery County, MD
Population:		7,037	65,976	137,941	183,739	209,234	245,782	390,928	430,289	491,829	550,488	802,038	952,151	1,005,000
Year of Study:		2013	2011	2010	2013	2012	2014	2009	2014	2014	2014	2012	2011	2012
Recyclable Curbside	Corrugated Cardboard	0.6%	1.5%	1.8%	3.1%	5.7%	2.2%	4.2%	2.7%	1.5%	1.3%	3.6%	2.8%	1.1%
	Newspaper/Print	0.6%	3.1%	1.4%	3.2%	2.5%	2.5%	5.0%	2.1%	1.0%	2.5%	3.8%	2.6%	2.2%
	Office Paper	2.5%	15.1%	0.8%	4.3%	5.1%	10.5%	11.1%	1.0%	1.7%	5.0%	1.5%	1.5%	1.1%
	Mixed Paper	4.1%		8.9%	11.0%	5.9%			7.3%	4.3%	5.1%	12.1%	11.7%	9.0%
	PET Bottles	0.6%	3.4%	--	--	2.4%	1.9%	2.4%	1.5%	0.9%	1.5%	1.9%	1.7%	1.0%
	HDPE Bottles	0.4%	1.7%	--	--	1.3%	1.0%	1.4%	0.9%	0.8%	0.9%	1.4%	0.9%	0.6%
	All Plastic Bottles	--	--	2.2%	3.8%	--	--	--	--	--	--	--	--	--
	Other Plastic Containers	2.2%	2.7%	2.6%	3.5%	0.8%	0.0%	0.9%	2.0%	2.6%	2.1%	0.4%	1.8%	1.9%
	Ferrous Metal	1.5%	3.1%	3.5%	3.0%	1.9%	3.3%	3.4%	1.7%	1.5%	1.1%	2.2%	2.8%	2.4%
	Aluminum	0.1%	1.3%	1.3%	1.8%	1.2%		1.7%	1.0%	0.4%	1.2%	1.5%	0.9%	1.0%
	Other Non-Ferrous Metal	1.2%	0.2%	0.7%		--		0.1%	0.0%	1.5%	--	--	0.4%	0.1%
	Glass Bottles/Jars	3.7%	4.5%	3.4%	5.7% [1]	3.4%	3.1%	4.3%	1.8%	3.2%	2.1%	3.7%	2.5%	1.9%
Other Recyclable	Gable Top Cartons/Aseptic	--	0.3%	--	--	0.5%	0.5%	0.3%	0.8%	--	1.3%	--	0.5%	1.7%
	Scrap Metal	--	--	--	--	1.7%	--	--	--	--	1.3%	--	--	--
	Plastic Shopping Bags	0.3%	--	--	--	1.0%	--	--	1.4%	--	--	--	1.9%	0.5%
	Textiles	5.5%	6.7%	6.3%	4.3%	--	--	9.3%	4.0%	3.7%	--	8.2%	7.1%	5.4%
	Carpet	1.1%	--	--		1.3%	--	--	0.5%	0.5%	0.4%	1.3%	--	0.8%
	Electronics	0.8%	1.0%	1.4%	1.4%	1.4%	3.2%	--	0.7%	0.4%	0.9%	1.0%	1.2%	1.6%
	C&D	4.0%	0.3%	8.5%	--	4.2%	4.2%	2.4%	5.3%	11.0%	3.9%	1.1%	1.2%	1.2%
	HHW	0.2%	0.4%	0.4%	0.2%	0.1%	0.0%	0.4%	0.5%	0.1%	0.2% [2]	0.2%	0.0%	0.0%
Compostable	Food	30.7%	14.5%	20.9%	13.8%	--	--	8.3%	10.7%	21.8%	11.8% [3]	7.4%	12.9%	21.5%
	Yard Waste	1.9%	1.1%	2.6%	5.9%	5.2%	9.5%	3.9%	21.3% [4]	3.8%	2.6%	7.2%	2.5%	2.2%
	Compostable Organics	--	--	--	--	--	21.0%	--	--	--	--	--	--	--
	Other Paper	10.6%	8.8%	9.2%	6.9%	--	--	--	6.9%	9.5%	10.6%	8.9%	6.5%	10.7%
Other Waste		27.4%	30.4%	24.0%	28.3%	54.6%	36.9%	40.8%	26.0%	29.9%	44.3%	32.6%	36.5%	32.0%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%