Seattle Public Utilities

2000/01
Litter Composition Study

Final Report

prepared by

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in cooperation with

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1 OVERVIEW

The City of Seattle services over 3,500 litter cans. The garbage deposited in the 900 cans located along city streets and sidewalks is collected by Seattle Transportation (SeaTran), while the Seattle Department of Parks and Recreation collects the garbage deposited in the remaining 2,400 cans located in city parks.

A portion of the garbage deposited in Seattle's litter cans is recyclable material, such as aluminum cans or plastic bottles. In an effort to capture the recyclable materials and reduce the amount of waste collected in litter cans, the City is considering a citywide program that would add additional cans for recyclable materials only.

Currently, "Recyclables Only" cans exist in some city parks. In addition, some "Recyclables Only" cans were placed along city streets as part of a pilot study to test the potential citywide recycling can program. The pilot study began in June 2000 and is still in progress.

To help design and evaluate the citywide recycling can program, the City of Seattle conducted this study to determine the types and quantities of recyclable materials disposed within litter cans.

The primary objectives of the litter can sampling included the following:

- Determining the quantity and types of recyclables deposited in litter cans throughout the city and in selected areas,
- Providing information to help design a citywide recycling can program, and
- Establishing baseline composition data in order to evaluate the effect of future recycling programs.

The number of samples taken throughout this project is listed in Table 1-1. Please see Section 2.1 for a description of each sampling "sector."

Table 1-1: Number of Samples per Season, by Sector (Spring 2000 – Winter 2000)

	Spring	Summer	Autumn	Winter	Total
"Nightlife"	29	33	31	29	**122**
Commercial Downtown	30	33	31	21	**115**
Neighborhood Streetside	30	33	30	32	**125**
Regional Parks	26	29	26	36	**117**
Neighborhood Parks	22	35	24	29	**110**
Total	**137**	**163**	**142**	**147**	**589**

This report provides composition estimates for wastes that were sampled from 589 randomly selected litter cans. These estimates are based on four sampling periods (one period per season) that occurred during the Year 2000. The sampling began in the spring of 2000 and continued through the following winter (overlapping the Streetside Recycling Feasibility study). Cascadia Consulting Group, Inc. served as the primary contractor for this research, Sky Valley Associates performed the fieldwork, and Tamre Cardoso, Ph.D. candidate at the University of Washington, provided the statistical analysis for this study.

This report is organized into five segments: Section 1 provides a brief overview of the project. The basic methodology is outlined in Section 2. Section 3 summarizes the project's overall findings, while the results are examined by sector in Section 4. Section 5 outlines generation and composition results by season, and detailed appendices follow the main body of the report.

2 SUMMARY OF METHODOLOGY

The methodology that was developed for this study involved many steps. These steps are summarized below: Appendix A describes this methodology in more detail.

2.1 Sampling Plan

Cascadia Consulting Group, Inc. developed a sampling plan with cooperation from the staff of Seattle Public Utilities, Seattle Transportation, and Seattle Department of Parks and Recreation. The sampling plan was designed to determine the quantity and composition of recyclables for the entire population of 3,500 litter cans maintained by the city. Because the quantity and types of recyclables were expected to differ depending on the user and the location of the can, all litter cans included in this study were assigned to five sectors. These sectors are outlined below:

- **"Nightlife"** – Areas with relatively high pedestrian traffic after dark. Nightlife cans are located along city streets and within city parks in areas such as Pioneer Square and on Broadway (Capitol Hill).
- **Commercial Downtown** – Shopping, retail, and business areas of downtown Seattle. Cans within these areas are primarily used during the daytime.
- **Neighborhood Streetside** – Outside the Seattle downtown area in neighborhood commercial districts. Neighborhoods such as Fremont and Montlake are examples of such districts.
- **Regional Parks** – Generally large parks with unique, special features or attractions. Examples include Discovery Park and Washington Park Arboretum.
- **Neighborhood Parks** – Parks that provide open space and recreation facilities and are designed to serve the neighborhood they are within. Denny Blaine Park and Ravenna Park are examples.

Once the sectors were defined, the next step was to obtain detailed data from SeaTran and the Parks Department regarding the "universe" of litter cans. For this study, the universe was a list of every litter can in the city. For each of its day and night collection routes, SeaTran provided a list of districts served and the location of every can collected. The can list provided by the Parks Department did not include specific can locations or the days that they are normally collected, because both can locations and collection schedules vary. After the inventories of cans were obtained from SeaTran and the Parks Department, the cans were assigned to one of the five sectors (as described above).

Litter cans were sampled once each quarter of the Year 2000 in intervals of approximately three months. The sample litter cans were randomly selected from the aggregated can lists to fulfill the sampling quota for each of the four seasons. While the specific location of each streetside can was known, similar information was not available for cans within city parks. Therefore city parks cans were selected using a drive-by or walk-through method for each season. (Please see Appendix A for a detailed description of this method.)

2.2 Collection and Sorting of Samples

To minimize the effect of this study on SeaTran and Park personnel, the litter cans were sampled on their normal collection days. Each can's specific collection date depended on when and how often the can was normally collected. Prior to each collection period, SeaTran and the Parks Department were notified about which cans were included in the study, their specific location, and the date that they were to be collected on. Following sample collection, SeaTran and Parks personnel delivered the litter to the South Disposal and Recycling Station (SRDS) to be sorted and weighed.

Each sample was sorted by hand into several component groups. (See Appendix B for the component categories.) The weights of all materials were recorded on tally sheets; examples of these sheets are shown in Appendix D.

3 SUMMARY OF SAMPLING RESULTS

3.1 Overall Results, by Sector

This study focused on the five sectors defined in Section 2.1: nightlife, commercial downtown, neighborhood streetside, regional parks, and neighborhood parks. The overall generation rates and composition estimates, by sector, are detailed in Sections 3.1.1 and 3.1.2.

3.1.1Overall Generation Rates, by Sector

Figure 3-1 illustrates the estimated percentage of litter generated by each of the five sectors during the year 2000. These percentages were determined by weight. As shown, regional parks and neighborhood parks generated the largest quantity of waste deposited in the City's litter cans. Regional parks contributed 32.2% and neighborhood parks 30.4% of the overall waste stream.

Figure 3-1: Overview of Generation Rate Estimates, by Sector

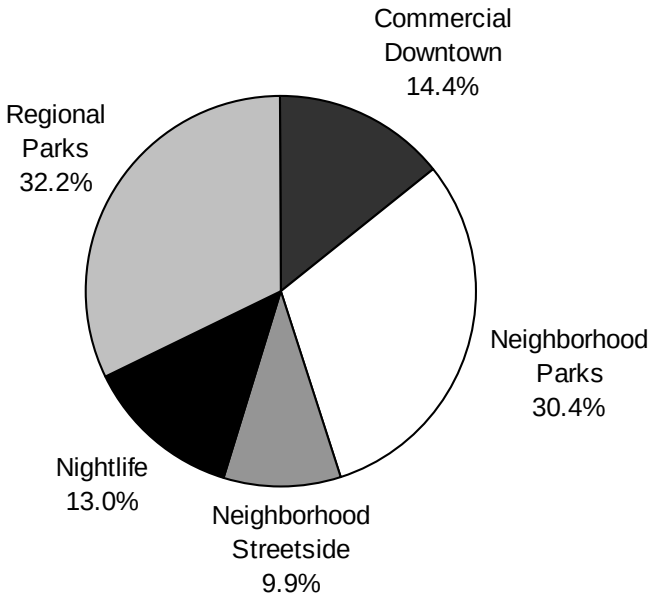


Table 3-1 presents a more detailed look at the waste generated in each of the five sampling categories. Again, regional parks and neighborhood parks generated the largest quantities of waste overall (953.6 and 901.7 tons per year respectively).

Table 3-1: Estimated Waste Generated, by Sector (January – December 2000)

Calculated at a 90% confidence interval

	(Tons per Year)		
	Mean	**Low**	**High**
Overall			
Nightlife	383.8	334.6	429.9
Commercial Downtown	428.0	381.4	494.1
Neighborhood Streetside	294.7	258.9	343.7
Regional Parks	953.6	784.8	1,168.6
Neighborhood Parks	901.7	765.2	1,072.4

3.1.2Overall Composition Results, by Sector

For this study, the waste sampled from litter cans was classified into one of five broad **material categories**: paper, plastic, metal, glass, and non-recyclables. Within these broad material categories, the waste was further divided into various subcategories, called **components**, such as phone books, aluminum cans, container glass, etc. A total of 19 components were identified for this study. Please see Appendix B for a list of these component definitions.

Table 3-2 lists the composition percentages, by weight, of each component in waste sampled from the five sectors. Non-recyclable material made up the largest percentage of waste in each of the five sectors - at least 50% of total waste deposited. The percentage of glass in each sector was relatively constant (ranging between 11.4% for neighborhood parks and 14.4% for regional parks by weight). Furthermore, there was less paper in both regional parks and neighborhood parks than in any of the other sectors. For example, neighborhood parks cans contained only 8.1% paper, while 28.9% of the waste deposited in downtown commercial cans was paper.

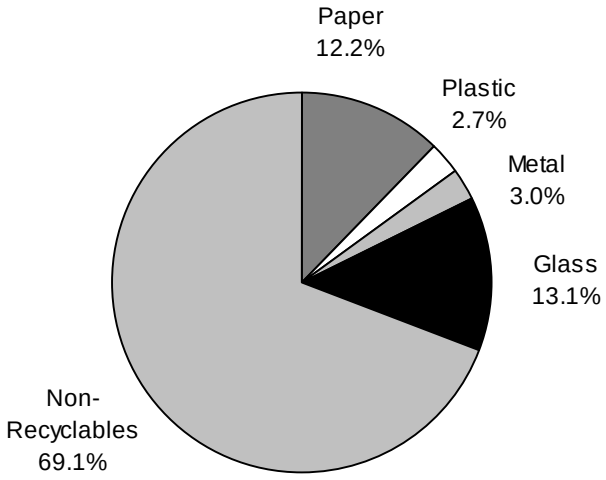
Table 3-2: Estimated Composition by Weight, by Sector (January – December 2000)

	Nightlife		*Commercial Downtown*		*Neighborhood Streetside*		*Regional Parks*		*Neighborhood Parks*	
	Pounds	**Est. Pct.**	**Pounds**	**Est. Pct.**	**Pounds**	**Est. Pct.**	**Pounds**	**Est. Pct.**	**Pounds**	**Est. Pct.**
Paper	**148,721**	**19.4%**	**247,304**	**28.9%**	**117,842**	**20.0%**	**226,283**	**11.9%**	**146,881**	**8.1%**
Newsprint	67,566	8.8%	137,225	16.0%	68,914	11.7%	95,678	5.0%	47,762	2.6%
Corrugated/Kraft, Unwaxed	23,188	3.0%	31,774	3.7%	18,452	3.1%	42,162	2.2%	39,422	2.2%
Phone Books	-	0.0%	-	0.0%	99	0.0%	-	0.0%	-	0.0%
Mixed Low Grade	57,966	7.6%	78,305	9.1%	30,377	5.2%	88,443	4.6%	59,697	3.3%
Plastic	**17,327**	**2.3%**	**23,756**	**2.8%**	**18,136**	**3.1%**	**56,485**	**3.0%**	**41,217**	**2.3%**
PET Bottles	15,364	2.0%	20,488	2.4%	11,478	1.9%	53,644	2.8%	30,616	1.7%
HDPE Bottles	1,963	0.3%	3,268	0.4%	6,658	1.1%	2,841	0.1%	10,601	0.6%
Metal	**42,063**	**5.5%**	**25,624**	**3.0%**	**16,859**	**2.9%**	**510,007**	**3.4%**	**35,449**	**2.0%**
Aluminum Cans	15,657	2.0%	23,346	2.7%	12,382	2.1%	22,970	1.2%	23,851	1.3%
Tin Food Cans	5,279	0.7%	1,923	0.2%	3,671	0.6%	4,138	0.2%	9,470	0.5%
Other Ferrous	21,127	2.8%	355	0.0%	806	0.1%	38,022	2.0%	2,128	0.1%
Glass	**96,737**	**12.6%**	**116,619**	**13.6%**	**82,053**	**13.9%**	**275,372**	**14.4%**	**205,150**	**11.4%**
Clear Beverage	61,680	8.0%	74,536	8.7%	50,861	8.6%	128,927	6.8%	130,417	7.2%
Green Beverage	18,592	2.4%	15,999	1.9%	14,182	2.4%	67,686	3.5%	30,814	1.7%
Brown Beverage	15,764	2.1%	22,538	2.6%	12,039	2.0%	75,466	4.0%	38,400	2.1%
Container Glass	-	0.0%	1,929	0.2%	4,906	0.8%	3,293	0.2%	4,671	0.3%
Mixed Cullet	701	0.1%	1,618	0.2%	65	0.0%	-	0.0%	847	0.0%
Non-Recyclables	**462,713**	**60.3%**	**442,612**	**51.7%**	**354,486**	**60.1%**	**1,283,946**	**67.3%**	**1,374,669**	**76.2%**
Non-Conforming Paper	109,237	14.2%	102,611	12.0%	63,996	10.9%	139,335	7.3%	133,964	7.4%
Non-Conforming Plastic	68,028	8.9%	60,944	7.1%	48,775	8.3%	126,859	6.7%	85,495	4.7%
Non-Conforming Metal	1,690	0.2%	2,657	0.3%	2,301	0.4%	11,943	0.6%	17,124	0.9%
Non-Conforming Glass	717	0.1%	276	0.0%	1,407	0.2%	-	0.0%	2,529	0.1%
Garbage	283,039	36.9%	276,124	32.3%	238,007	40.4%	1,005,809	52.7%	1,135,556	63.0%
Sample Count	**122**		**115**		**125**		**117**		**110**	

3.2 Overall Composition Results

A total of 589 cans were sampled during the year 2000. Overall composition results by broad material category are shown in Figure 3-2. Non-recyclables accounted for nearly 70% of the overall waste stream by weight. Glass and paper comprised the largest percentage of recyclable waste deposited in the City's litter cans (13.1% and 12.2% respectively).

Figure 3-2: Overview of Composition Estimates - Overall



4 COMPOSITION BY SECTOR

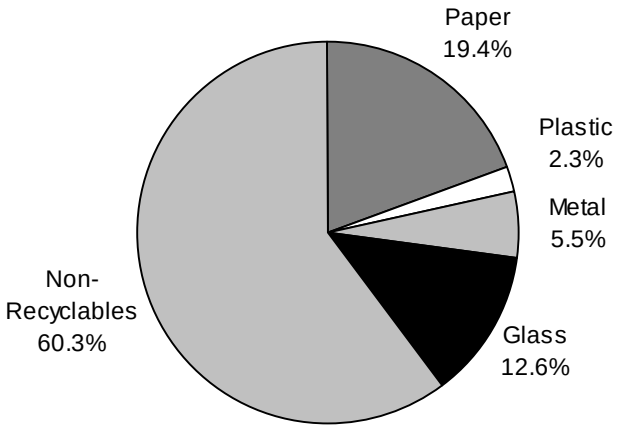
The composition results for each of the five sectors are outlined in Sections 4.1 through 4.5. In each section, a pie graph illustrates the composition by the five broad material categories for that sector. A more comprehensive table that details the percentage of each of the 19 waste components follows the pie graph. The composition of waste deposited in litter cans was estimated for each broad material category and its components based on weight.

4.1 Nightlife

A total of 122 samples were taken from nightlife litter cans. Figure 4-1 depicts the composition of nightlife waste by broad material category. Non-recyclables comprised the largest portion of waste deposited in nightlife cans (60.3% by weight). Paper was the second largest material accounting for nearly 20% of the total nightlife tonnage.

On a more detailed level, lists the composition percentages, by weight, of each component in the nightlife sector. Garbage was the most prevalent component deposited in nightlife litter cans (approximately 36.9%). Non-conforming paper was the second largest component, accounting for 14.2%. Newsprint and non-conforming plastic each comprised approximately 9% of the nightlife tonnage.

Figure 4-1: Composition by Weight - Nightlife
(January – December 2000)



Calculated at a 90% confidence interval

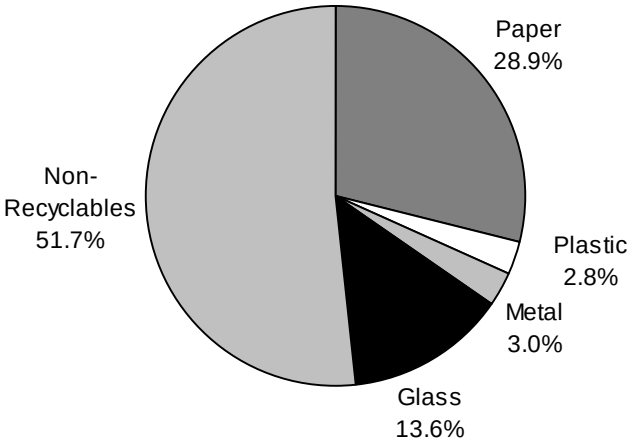
	Mean	Low	High
Paper	**19.4%**		
Newsprint	8.8%	6.8%	11.5%
Corrugated/Kraft, Unwaxed	3.0%	2.4%	3.7%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	7.6%	5.8%	10.0%
Plastic	**2.3%**		
PET Bottles	2.0%	1.6%	2.4%
HDPE Bottles	0.3%	0.2%	0.4%
Metal	**5.5%**		
Aluminum Cans	2.0%	1.7%	2.5%
Tin Food Cans	0.7%	0.3%	1.4%
Other Ferrous	2.8%	0.2%	13.9%
Glass	**12.6%**		
Clear Beverage	8.0%	6.2%	9.9%
Green Beverage	2.4%	1.3%	4.0%
Brown Beverage	2.1%	1.3%	3.1%
Container Glass	0.0%	0.0%	0.0%
Mixed Cullet	0.1%	0.0%	0.3%
Non-Recyclables	**60.3%**		
Non-Conforming Paper	14.2%	12.0%	16.5%
Non-Conforming Plastic	8.9%	7.8%	12.0%
Non-Conforming Metal	0.2%	0.1%	0.4%
Non-Conforming Glass	0.1%	0.0%	0.3%
Garbage	36.9%	31.7%	42.0%
Sample Count	**122**		

4.2 Commercial Downtown

There were 115 samples taken from commercial downtown litter cans. As shown in Figure 4-2, non-recyclables accounted for just over 50%, by weight, while paper comprised nearly one-third (28.9%, by weight) of the waste deposited in commercial downtown cans.

Figure 4-2 also describes the commercial downtown waste in more detail. As in the nightlife sector, garbage was the largest component comprising 32.3% of the commercial downtown tonnage. Newsprint made up approximately 16.0% of the total nightlife waste, and non-conforming paper accounted for approximately 12.0% by weight.

Figure 4-2: Composition by Weight - Commercial Downtown (January – December 2000)



Calculated at a 90% confidence interval

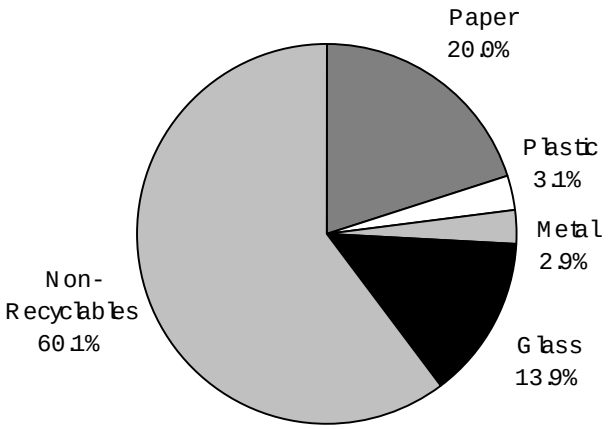
	Mean	Low	High
Paper	**28.9%**		
Newsprint	16.0%	12.5%	21.5%
Corrugated/Kraft, Unwaxed	3.7%	3.1%	4.9%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	9.1%	7.4%	12.3%
Plastic	**2.8%**		
PET Bottles	2.4%	2.0%	2.9%
HDPE Bottles	0.4%	0.3%	0.5%
Metal	**3.0%**		
Aluminum Cans	2.7%	2.3%	3.5%
Tin Food Cans	0.2%	0.1%	0.4%
Other Ferrous	0.0%	0.0%	0.2%
Glass	**13.6%**		
Clear Beverage	8.7%	7.0%	12.1%
Green Beverage	1.9%	1.2%	2.8%
Brown Beverage	2.6%	1.6%	3.7%
Container Glass	0.2%	0.1%	0.6%
Mixed Cullet	0.2%	0.0%	0.7%
Non-Recyclables	**51.7%**		
Non-Conforming Paper	12.0%	10.8%	13.8%
Non-Conforming Plastic	7.1%	6.5%	8.0%
Non-Conforming Metal	0.3%	0.2%	0.5%
Non-Conforming Glass	0.0%	0.0%	0.1%
Garbage	32.3%	28.9%	37.6%
Sample Count	**115**		

4.3 Neighborhood Streetside

A total of 125 neighborhood streetside cans were sampled throughout the year 2000. Approximately 60% of this tonnage, by weight, was non-recyclable (see Figure 4-3). In addition, 20% was paper, and 13.9% was glass.

The detailed composition data for waste deposited in neighborhood streetside cans are listed in Figure 4-3. The three largest components in these cans were identical to those in the commercial downtown cans. Garbage accounted for 40.4%, newsprint made up 11.7%, and finally, non-conforming paper comprised 10.9% of the total neighborhood streetside tonnage by weight.

Figure 4-3: Composition by Weight - Neighborhood Streetside (January – December 2000)



Calculated at a 90% confidence interval

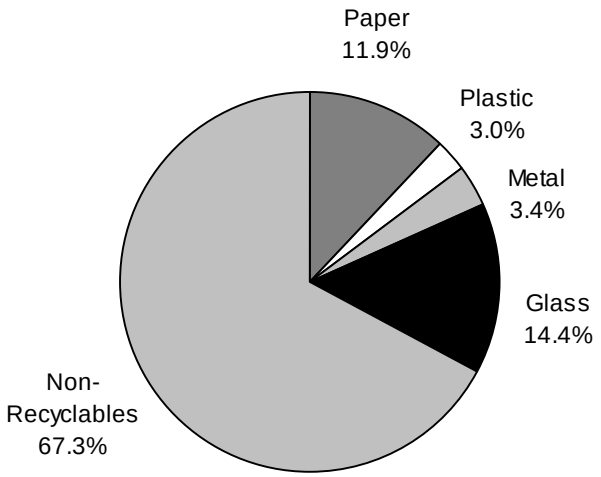
	Mean	Low	High
Paper	**20.0%**		
Newsprint	11.7%	9.2%	14.1%
Corrugated/Kraft, Unwaxed	3.1%	2.5%	4.5%
Phone Books	0.0%	0.0%	0.1%
Mixed Low Grade	5.2%	4.2%	6.2%
Plastic	**3.1%**		
PET Bottles	1.9%	1.6%	2.3%
HDPE Bottles	1.1%	0.5%	3.4%
Metal	**2.9%**		
Aluminum Cans	2.1%	1.4%	4.4%
Tin Food Cans	0.6%	0.4%	1.1%
Other Ferrous	0.1%	0.1%	0.3%
Glass	**13.9%**		
Clear Beverage	8.6%	7.1%	11.0%
Green Beverage	2.4%	1.5%	4.0%
Brown Beverage	2.0%	1.3%	3.3%
Container Glass	0.8%	0.4%	2.1%
Mixed Cullet	0.0%	0.0%	0.0%
Non-Recyclables	**60.1%**		
Non-Conforming Paper	10.9%	9.2%	12.6%
Non-Conforming Plastic	8.3%	7.3%	10.6%
Non-Conforming Metal	0.4%	0.2%	0.8%
Non-Conforming Glass	0.2%	0.0%	0.9%
Garbage	40.4%	35.6%	46.1%
Sample Count	**125**		

4.4 Regional Parks

During the year 2000, 117 regional parks cans were sampled. Figure 4-4 illustrates the composition of regional parks waste by broad material category. The non-recyclable material category accounted for nearly 70% of the total disposed waste in regional parks cans by weight. In addition, glass was found to make up approximately 14.4% of the total regional parks waste.

As with all previously mentioned sampling categories, garbage accounted for the largest percentage of regional parks waste (52.7% by weight). Non-conforming paper was the second largest component comprising 7.3% of the total regional parks tonnage. Clear glass beverage containers followed at 6.8% by weight. See Figure 4-4 for this level of detail.

Figure 4-4: Composition by Weight - Regional Parks (January – December 2000)



Calculated at a 90% confidence interval

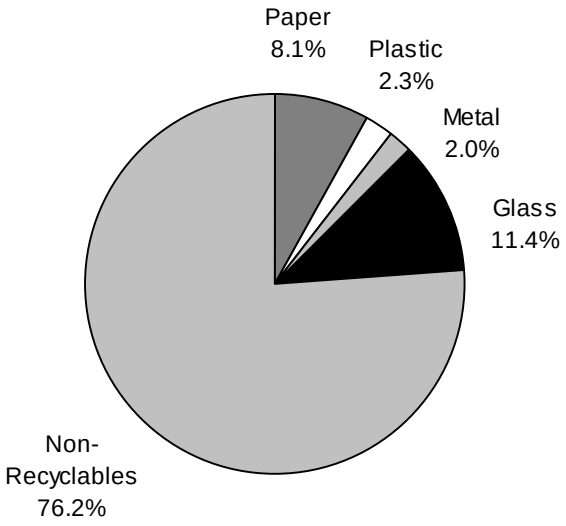
	Mean	Low	High
Paper	**11.9%**		
Newsprint	5.0%	3.3%	7.4%
Corrugated/Kraft, Unwaxed	2.2%	1.6%	2.9%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	4.6%	3.3%	7.0%
Plastic	**3.0%**		
PET Bottles	2.8%	2.3%	4.2%
HDPE Bottles	0.1%	0.1%	0.2%
Metal	**3.4%**		
Aluminum Cans	1.2%	1.0%	1.5%
Tin Food Cans	0.2%	0.1%	0.4%
Other Ferrous	2.0%	0.1%	8.0%
Glass	**14.4%**		
Clear Beverage	6.8%	5.2%	8.5%
Green Beverage	3.5%	2.2%	5.9%
Brown Beverage	4.0%	1.9%	8.4%
Container Glass	0.2%	0.1%	0.5%
Mixed Cullet	0.0%	0.0%	0.0%
Non-Recyclables	**67.3%**		
Non-Conforming Paper	7.3%	6.1%	8.8%
Non-Conforming Plastic	6.7%	5.5%	8.9%
Non-Conforming Metal	0.6%	0.3%	1.3%
Non-Conforming Glass	0.0%	0.0%	0.0%
Garbage	52.7%	48.4%	57.7%
Sample Count	**117**		

4.5 Neighborhood Parks

There were a total of 110 neighborhood parks cans sampled during this study. Approximately 76% of the waste deposited in these litter cans was non-recyclable (see Figure 4-5). Glass was the next largest material accounting for about 11% of the total neighborhood parks tonnage.

Figure 4-5 also lists the detailed composition results for waste disposed in neighborhood parks cans. Congruent with the other four sampling categories, garbage was by far the largest component of the neighborhood parks cans (63.0% by weight). Non-conforming paper and clear glass beverage containers were the next largest components at 7.4% and 7.2% respectively.

Figure 4-5: Composition by Weight - Neighborhood Parks (January – December 2000)



Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**8.1%**		
Newsprint	2.6%	1.6%	4.5%
Corrugated/Kraft, Unwaxed	2.2%	1.7%	2.8%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	3.3%	2.5%	4.7%
Plastic	**2.3%**		
PET Bottles	1.7%	1.3%	2.2%
HDPE Bottles	0.6%	0.3%	1.2%
Metal	**2.0%**		
Aluminum Cans	1.3%	1.0%	1.7%
Tin Food Cans	0.5%	0.3%	0.9%
Other Ferrous	0.1%	0.1%	0.2%
Glass	**11.4%**		
Clear Beverage	7.2%	4.9%	10.2%
Green Beverage	1.7%	1.1%	2.7%
Brown Beverage	2.1%	1.3%	3.6%
Container Glass	0.3%	0.0%	1.0%
Mixed Cullet	0.0%	0.0%	0.2%
Non-Recyclables	**76.2%**		
Non-Conforming Paper	7.4%	5.6%	9.7%
Non-Conforming Plastic	4.7%	3.9%	5.6%
Non-Conforming Metal	0.9%	0.5%	1.9%
Non-Conforming Glass	0.1%	0.0%	0.3%
Garbage	63.0%	56.6%	69.2%
Sample Count	**110**		

5 SEASONAL GENERATION AND COMPOSITION BY SECTOR

5.1 Seasonal Generation by Sector

The generation results for each of the five sampling categories are outlined in the following five sections. Each section contains a table that lists the respective sector's generation rate for each season of the year 2000. Rates are given both in units of mean pounds per day for the average litter can, and in tons per year for the entire sector.

5.1.1 Nightlife

Table 5-1 shows the amount of nightlife waste generated per can per day as well as per year. The greatest amount of nightlife waste accumulated during the spring (110.3 tons per year). Winter accumulation was nearly identical at 105.3 tons per year. The summer and autumn seasons showed a decrease in waste accumulating in nightlife litter cans (86.8 and 81.3 tons per year respectively).

Table 5-1: Waste Generated Per Season - Nightlife
(January – December 2000)

Calculated at a 90% confidence interval

	(Pounds per Can per Day)			*(Tons per Year)*		
	Mean	**Low**	**High**	**Mean**	**Low**	**High**
Nightlife						
Spring	8.3	6.4	10.8	110.3	85.2	142.4
Summer	6.5	5.4	7.8	86.8	72.5	103.4
Autumn	6.4	5.2	8.3	81.3	63.1	99.9
Winter	8.3	6.6	11.0	105.3	83.3	137.3

5.1.2 Commercial Downtown

As shown in Table 5-2, the quantity of waste generated in commercial downtown cans was highest in the spring and summer: 126.4 and 113.3 tons per year respectively. Winter accumulation was lower at 103.0 tons per year, and autumn accumulation was the lowest, at 85.2 tons per year.

Table 5-2: Waste Generated Per Season - Commercial Downtown
(January – December 2000)

Calculated at a 90% confidence interval

	(Pounds per Can per Day)			*(Tons per Year)*		
	Mean	**Low**	**High**	**Mean**	**Low**	**High**
Commercial Downtown						
Spring	8.2	6.0	11.4	126.4	95.6	179.9
Summer	7.4	6.0	9.3	113.3	92.4	141.5
Autumn	6.2	5.0	8.0	85.2	67.7	109.0
Winter	7.6	5.8	9.7	103.0	79.0	130.8

5.1.3 Neighborhood Streetside

The neighborhood streetside generation rates were much lower than the previously mentioned sectors. Table 5-3 outlines the seasonal generation rates for waste deposited in neighborhood

streetside litter cans. The spring (90.4 tons per year), summer (87.6 tons per year) and autumn (70.5 tons per year) seasons each had almost double the amount of waste than was accumulated in the winter (46.2 tons per year).

Table 5-3: Waste Generated Per Season - Neighborhood Streetside (January – December 2000)

Calculated at a 90% confidence interval

	(Pounds per Can per Day)			*(Tons per Year)*		
	Mean	**Low**	**High**	**Mean**	**Low**	**High**
Neighborhood Streetside						
Spring	3.8	2.7	5.0	90.4	66.7	124.8
Summer	3.7	2.8	4.9	87.6	69.5	118.1
Autumn	3.0	2.3	3.8	70.5	55.6	91.7
Winter	1.9	1.4	2.6	46.2	32.6	60.1

5.1.4Regional Parks

As Table 5-4 illustrates, the amount of waste generated in regional parks fluctuated across seasons. The largest quantity was deposited during the summer at a rate of nearly 435 tons per year. The next largest accumulation happened in the winter, with 236 tons per year.

Table 5-4: Waste Generated Per Season - Regional Parks (January – December 2000)

Calculated at a 90% confidence interval

	(Pounds per Can per Day)			*(Tons per Year)*		
	Mean	**Low**	**High**	**Mean**	**Low**	**High**
Regional Parks						
Spring	2.9	2.2	3.8	163.4	127.0	217.0
Summer	7.7	5.4	11.8	434.5	299.3	654.7
Autumn	2.6	2.0	3.3	119.8	91.9	151.0
Winter	5.2	4.0	7.1	236.0	176.2	317.4

5.1.5 Neighborhood Parks

The generation rates for neighborhood parks can be viewed in Table 5-5. Summer was the season of the greatest waste generation in this sector (approximately 385 tons per year). The smallest waste generation rate occurred during the spring (152.2 tons per year).

Table 5-5: Waste Generated Per Season - Neighborhood Parks (January – December 2000)

Calculated at a 90% confidence interval

	(Pounds per Can per Day)			*(Tons per Year)*		
	Mean	**Low**	**High**	**Mean**	**Low**	**High**
Neighborhood Parks						
Spring	2.1	1.5	2.9	152.2	107.2	209.5
Summer	5.4	3.9	7.5	385.3	276.4	538.0
Autumn	2.6	2.0	3.1	169.5	131.0	208.9
Winter	2.9	2.4	3.7	194.6	154.5	243.5

5.2 Seasonal Composition by Sector

Four sampling events, one per season, occurred during the course of this yearlong litter study. The composition results for each of the five sectors are described in Section 5.2.1 through 5.2.5. There are four pie graphs and four accompanying tables in each section. The graphs illustrate the percentage of each of the five broad material categories for each season, and the tables list the percentages of each of the 19 components per season. The relative percent for each component was calculated using the weight of the material, not its volume.

5.2.1 Nightlife

In total, 122 samples were obtained from Nightlife litter cans. Regardless of the season, non-recyclables accounted for a substantial portion of the waste deposited in nightlife litter cans (55.0% in the spring, 59.8% in the summer, 68.1% in the autumn, and 63.3% in the winter by weight). On the other hand, the percentage of metal wasn't constant throughout the year. It was relatively high in the spring compared to the three other seasons (9.4% in the spring compared with about 3% - 4% for all other seasons). Figure 5-1 provides an overview of the composition estimates, by major waste category, for waste deposited in nightlife cans.

As can be observed in Table 5-6 through Table 5-9, the detailed nightlife composition estimates varied some across the seasons. Although garbage contributed a relatively large percentage of waste to the nightlife litter cans, the percent was about 10-15% lower in the spring and summer than in the autumn and winter. Newsprint went from approximately 5.7% in the autumn to 11.5% in the winter. Furthermore, other ferrous metals accounted for 7.4% in the spring but less than 1% in all of the other seasons.

Figure 5-1: Overview of Nightlife Composition Estimates, by Season

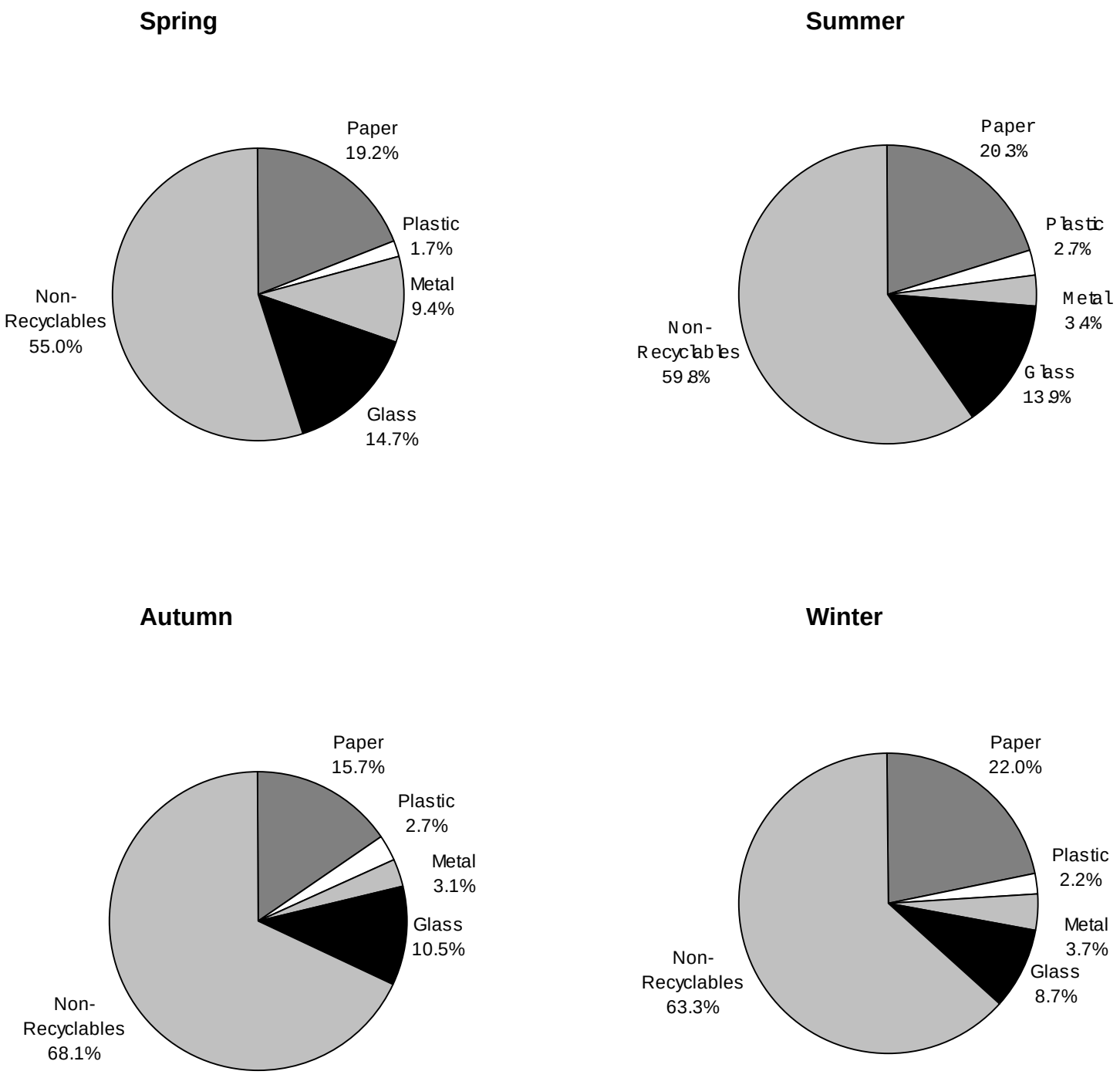


Table 5-6: Composition by Weight - Nightlife (Spring 2000)

Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**19.2%**		
Newsprint	10.2%	5.9%	17.2%
Corrugated/Kraft, Unwaxed	3.4%	2.1%	5.1%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	5.6%	3.5%	9.2%
Plastic	**1.7%**		
PET Bottles	1.3%	0.9%	1.8%
HDPE Bottles	0.4%	0.1%	0.8%
Metal	**9.4%**		
Aluminum Cans	1.8%	1.2%	2.7%
Tin Food Cans	0.2%	0.0%	0.8%
Other Ferrous	7.4%	0.0%	22.9%
Glass	**14.7%**		
Clear Beverage	9.1%	5.2%	12.6%
Green Beverage	3.3%	0.5%	7.7%
Brown Beverage	2.3%	1.0%	4.5%
Container Glass	0.0%	0.0%	0.0%
Mixed Cullet	0.0%	0.0%	0.0%
Non-Recyclables	**55.0%**		
Non-Conforming Paper	13.9%	8.2%	18.0%
Non-Conforming Plastic	12.2%	10.1%	16.5%
Non-Conforming Metal	0.2%	0.0%	0.5%
Non-Conforming Glass	0.2%	0.0%	0.8%
Garbage	28.5%	22.2%	41.2%
Sample Count	**29**		

Table 5-7: Composition by Weight - Nightlife (Summer 2000)

Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**20.3%**		
Newsprint	7.4%	5.2%	10.4%
Corrugated/Kraft, Unwaxed	3.0%	2.1%	4.3%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	9.9%	7.0%	14.6%
Plastic	**2.7%**		
PET Bottles	2.5%	2.0%	3.2%
HDPE Bottles	0.2%	0.1%	0.3%
Metal	**3.4%**		
Aluminum Cans	2.4%	1.6%	3.7%
Tin Food Cans	0.8%	0.2%	2.3%
Other Ferrous	0.1%	0.0%	0.4%
Glass	**13.9%**		
Clear Beverage	9.7%	7.1%	13.7%
Green Beverage	1.5%	0.6%	3.0%
Brown Beverage	2.7%	1.5%	5.3%
Container Glass	0.0%	0.0%	0.0%
Mixed Cullet	0.0%	0.0%	0.0%
Non-Recyclables	**59.8%**		
Non-Conforming Paper	17.9%	14.9%	21.6%
Non-Conforming Plastic	7.8%	6.7%	9.1%
Non-Conforming Metal	0.1%	0.1%	0.3%
Non-Conforming Glass	0.0%	0.0%	0.2%
Garbage	33.8%	26.9%	40.4%
Sample Count	**33**		

Table 5-8: Composition by Weight - Nightlife (Autumn 2000)

Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**15.7%**		
Newsprint	5.7%	3.9%	8.3%
Corrugated/Kraft, Unwaxed	2.3%	1.5%	3.4%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	7.7%	4.1%	15.3%
Plastic	**2.7%**		
PET Bottles	2.5%	2.0%	3.2%
HDPE Bottles	0.2%	0.0%	0.5%
Metal	**3.1%**		
Aluminum Cans	2.3%	1.7%	3.2%
Tin Food Cans	0.5%	0.1%	1.3%
Other Ferrous	0.3%	0.1%	0.7%
Glass	**10.5%**		
Clear Beverage	6.8%	4.3%	9.9%
Green Beverage	1.9%	0.9%	3.5%
Brown Beverage	1.7%	0.6%	5.0%
Container Glass	0.0%	0.0%	0.0%
Mixed Cullet	0.0%	0.0%	0.0%
Non-Recyclables	**68.1%**		
Non-Conforming Paper	10.9%	8.5%	13.8%
Non-Conforming Plastic	6.8%	5.3%	8.2%
Non-Conforming Metal	0.6%	0.3%	1.0%
Non-Conforming Glass	0.0%	0.0%	0.0%
Garbage	49.8%	43.0%	58.4%
Sample Count	**31**		

Table 5-9: Composition by Weight - Nightlife (Winter 2000)

Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**22.0%**		
Newsprint	11.5%	7.2%	17.8%
Corrugated/Kraft, Unwaxed	3.0%	1.8%	4.3%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	7.5%	4.2%	15.1%
Plastic	**2.2%**		
PET Bottles	2.0%	1.3%	2.9%
HDPE Bottles	0.2%	0.1%	0.5%
Metal	**3.7%**		
Aluminum Cans	1.5%	1.1%	2.0%
Tin Food Cans	1.7%	0.3%	5.4%
Other Ferrous	0.6%	0.0%	2.1%
Glass	**8.7%**		
Clear Beverage	4.6%	1.8%	8.5%
Green Beverage	2.7%	0.3%	9.2%
Brown Beverage	0.9%	0.3%	1.8%
Container Glass	0.0%	0.0%	0.0%
Mixed Cullet	0.5%	0.0%	2.4%
Non-Recyclables	**63.3%**		
Non-Conforming Paper	12.5%	9.0%	15.9%
Non-Conforming Plastic	6.2%	4.9%	7.7%
Non-Conforming Metal	0.0%	0.0%	0.1%
Non-Conforming Glass	0.1%	0.0%	0.2%
Garbage	44.5%	33.7%	59.3%
Sample Count	**29**		

5.2.2Commercial Downtown

A total of 115 commercial downtown litter cans were sampled throughout the year 2000. There were 30 cans sampled in the spring, 33 in the summer, 31 in the autumn, and 21 in the winter. As shown in Figure 5-2, approximately half of the waste disposed in these cans each season was non-recyclable (a low of 46.3% in the autumn and a high of 54.3% in the winter by weight). The percentage of paper was about 10% lower in the spring and summer than in the autumn and winter seasons. Further, glass percentages varied a relatively large amount across the seasons: 20.7% in the spring, 13.6% in the summer, 13.3% in the autumn, and 6.5% in the winter.

Table 5-10 through Table 5-13 examine commercial downtown sampling results in more detail. As shown, newsprint nearly doubled in the winter compared with the remaining three seasons (23.1% in the winter versus about 13-14% in the spring, summer, and autumn). Meanwhile, mixed low-grade paper contributed two times as much waste in the autumn (15.7% by weight) as it did in each of the other seasons (7.9% in both the spring and summer, and 7.2% in the winter). However, garbage percentages remained fairly constant over the year with a low of 26.7% in the autumn and a high of 37.7% in the summer.

Figure 5-2: Overview of Commercial Downtown Composition Estimates, by Season

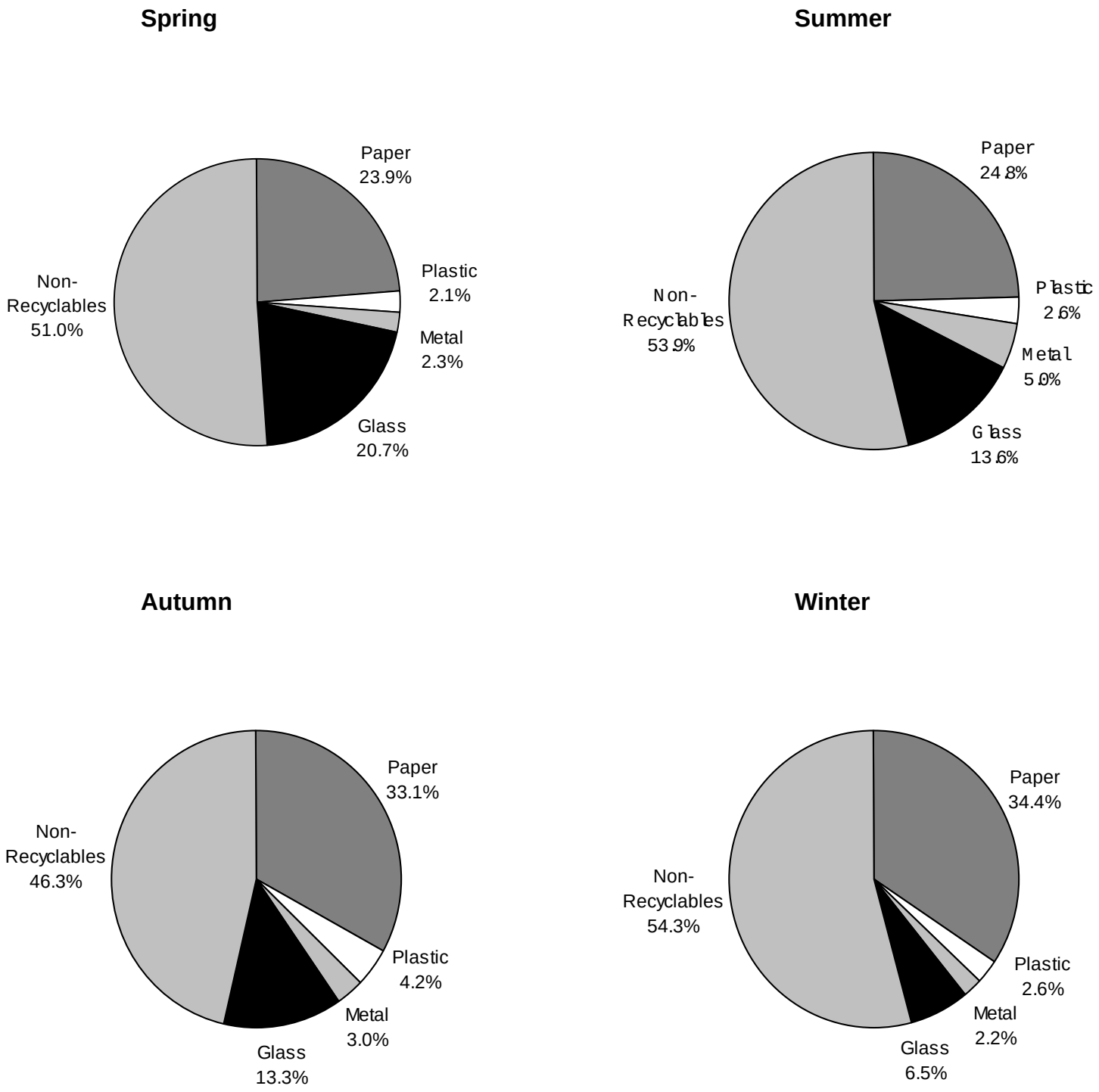


Table 5-10: Composition by Weight - Commercial Downtown (Spring 2000)

Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**23.9%**		
Newsprint	12.6%	8.5%	18.3%
Corrugated/Kraft, Unwaxed	3.4%	2.5%	4.6%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	7.9%	6.2%	9.5%
Plastic	**2.1%**		
PET Bottles	1.8%	1.3%	2.6%
HDPE Bottles	0.3%	0.1%	0.5%
Metal	**2.3%**		
Aluminum Cans	2.0%	1.4%	2.9%
Tin Food Cans	0.1%	0.1%	0.2%
Other Ferrous	0.1%	0.0%	0.3%
Glass	**20.7%**		
Clear Beverage	14.2%	10.0%	20.1%
Green Beverage	2.4%	1.3%	4.2%
Brown Beverage	3.6%	1.8%	5.7%
Container Glass	0.5%	0.0%	1.4%
Mixed Cullet	0.0%	0.0%	0.0%
Non-Recyclables	**51.0%**		
Non-Conforming Paper	14.2%	10.3%	17.0%
Non-Conforming Plastic	8.9%	7.4%	10.4%
Non-Conforming Metal	0.2%	0.0%	0.6%
Non-Conforming Glass	0.1%	0.0%	0.2%
Garbage	27.7%	22.9%	34.7%
Sample Count	**30**		

Table 5-11: Composition by Weight - Commercial Downtown (Summer 2000)

Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**24.8%**		
Newsprint	12.5%	9.2%	16.7%
Corrugated/Kraft, Unwaxed	4.4%	2.7%	7.4%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	7.9%	4.2%	15.0%
Plastic	**2.6%**		
PET Bottles	2.4%	1.8%	3.5%
HDPE Bottles	0.2%	0.1%	0.4%
Metal	**5.0%**		
Aluminum Cans	4.6%	3.3%	7.0%
Tin Food Cans	0.4%	0.2%	1.0%
Other Ferrous	0.0%	0.0%	0.0%
Glass	**13.6%**		
Clear Beverage	8.0%	5.2%	10.9%
Green Beverage	3.9%	1.8%	7.3%
Brown Beverage	1.4%	0.6%	2.7%
Container Glass	0.3%	0.0%	1.4%
Mixed Cullet	0.0%	0.0%	0.0%
Non-Recyclables	**53.9%**		
Non-Conforming Paper	10.1%	7.6%	13.0%
Non-Conforming Plastic	5.9%	4.8%	7.0%
Non-Conforming Metal	0.2%	0.0%	0.6%
Non-Conforming Glass	0.0%	0.0%	0.0%
Garbage	37.7%	32.0%	44.0%
Sample Count	**33**		

Table 5-12: Composition by Weight - Commercial Downtown (Autumn 2000)

Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**33.1%**		
Newsprint	14.5%	7.7%	27.9%
Corrugated/Kraft, Unwaxed	2.8%	2.2%	3.9%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	15.7%	9.0%	27.5%
Plastic	**4.2%**		
PET Bottles	3.6%	2.8%	4.5%
HDPE Bottles	0.6%	0.3%	1.2%
Metal	**3.0%**		
Aluminum Cans	2.9%	2.3%	3.6%
Tin Food Cans	0.1%	0.0%	0.3%
Other Ferrous	0.0%	0.0%	0.0%
Glass	**13.3%**		
Clear Beverage	8.2%	5.0%	11.3%
Green Beverage	1.4%	0.5%	2.7%
Brown Beverage	3.0%	1.0%	6.4%
Container Glass	0.0%	0.0%	0.0%
Mixed Cullet	0.7%	0.0%	2.7%
Non-Recyclables	**46.3%**		
Non-Conforming Paper	12.5%	9.6%	17.9%
Non-Conforming Plastic	6.2%	4.8%	7.9%
Non-Conforming Metal	0.8%	0.4%	1.7%
Non-Conforming Glass	0.0%	0.0%	0.0%
Garbage	26.7%	20.3%	34.9%
Sample Count	**31**		

Table 5-13: Composition by Weight - Commercial Downtown (Winter 2000)

Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**34.4%**		
Newsprint	23.1%	13.9%	34.4%
Corrugated/Kraft, Unwaxed	4.1%	2.7%	7.2%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	7.2%	5.1%	9.7%
Plastic	**2.6%**		
PET Bottles	2.2%	1.6%	2.9%
HDPE Bottles	0.4%	0.2%	0.8%
Metal	**2.2%**		
Aluminum Cans	1.9%	1.5%	2.6%
Tin Food Cans	0.2%	0.0%	0.9%
Other Ferrous	0.0%	0.0%	0.1%
Glass	**6.5%**		
Clear Beverage	3.9%	2.3%	6.1%
Green Beverage	0.1%	0.0%	0.5%
Brown Beverage	2.3%	0.7%	5.6%
Container Glass	0.0%	0.0%	0.0%
Mixed Cullet	0.2%	0.0%	0.7%
Non-Recyclables	**54.3%**		
Non-Conforming Paper	10.7%	9.2%	12.8%
Non-Conforming Plastic	6.8%	5.6%	8.1%
Non-Conforming Metal	0.2%	0.1%	0.4%
Non-Conforming Glass	0.1%	0.0%	0.1%
Garbage	36.5%	26.7%	48.2%
Sample Count	**21**		

5.2.3Neighborhood Streetside

There were a total of 125 neighborhood streetside litter cans sampled for this study. Figure 5-3 depicts the broad material category percentages for each season by weight. Non-recyclables accounted for greater than half of the total neighborhood streetside tonnage in each season - from a low of 55.9% in the spring to a high of 64.3% in the winter. The percentage of paper was higher in the spring and winter (26.2% and 25.7% respectively), but lower in the summer and autumn (14.5% and 17.3% respectively). Moreover, the amount of glass experienced nearly a 10% drop in the winter from that in the other three seasons.

Table 5-14 through Table 5-17 present the seasonal neighborhood streetside composition estimates in more detail. It can be noted that garbage, the largest component of each season's waste, comprised about one-third to one-half of each season's total tonnage (a low of 29.3% in the spring and a high of 47.5% in the summer). The percentage of newsprint was relatively high in the spring and winter (16.9% and 18.1% respectively) as compared to the summer and autumn (6.8% and 8.7% respectively). Non-conforming plastic ranged from 5.8% in the summer to 12.1% in the spring.

Figure 5-3: Overview of Neighborhood Streetside Composition Estimates, by Season

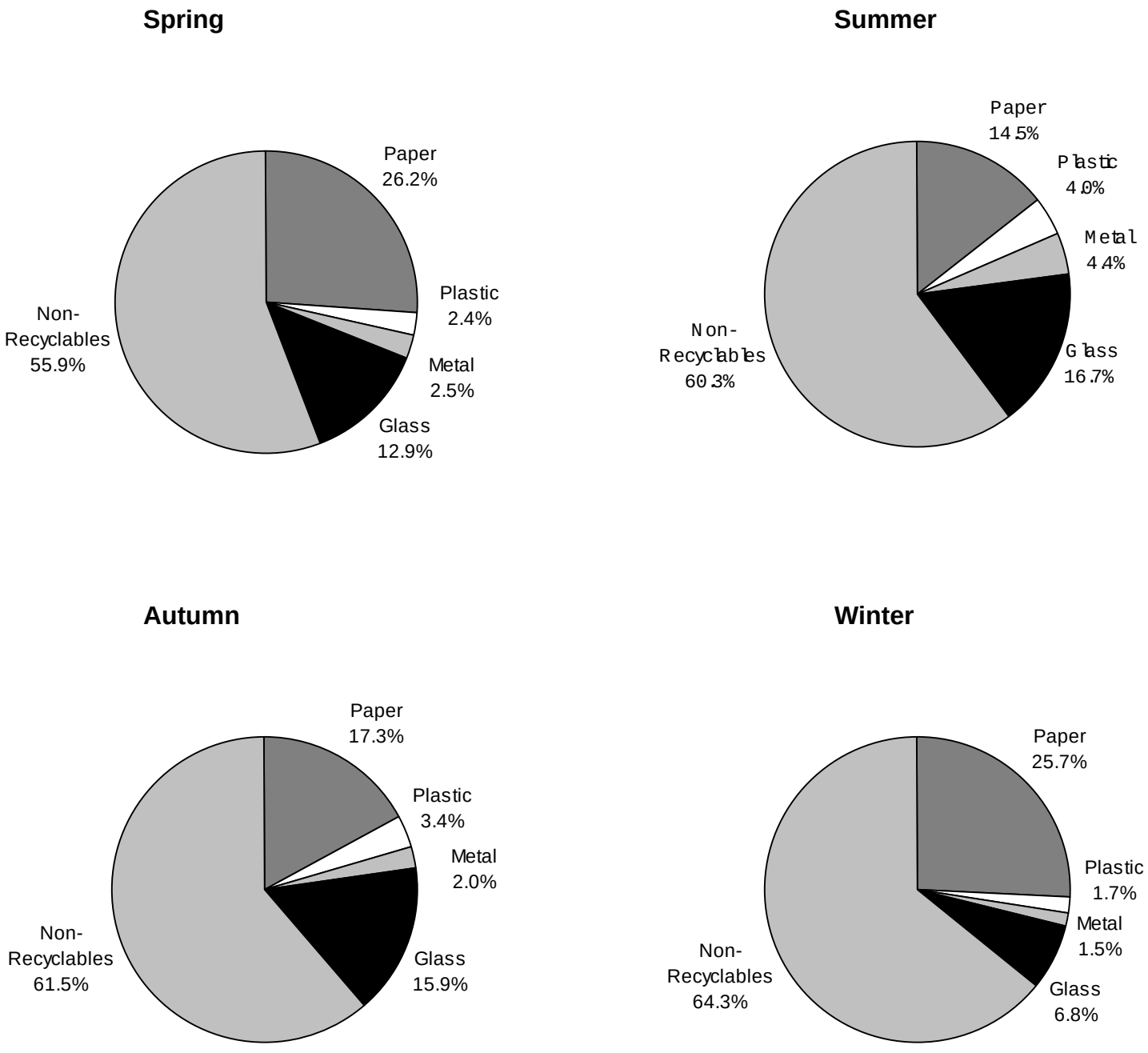


Table 5-14: Composition by Weight - Neighborhood Streetside
(Spring 2000)

Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**26.2%**		
Newsprint	16.9%	12.2%	22.8%
Corrugated/Kraft, Unwaxed	3.2%	2.5%	4.2%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	6.1%	4.5%	8.7%
Plastic	**2.4%**		
PET Bottles	1.9%	1.4%	2.3%
HDPE Bottles	0.5%	0.3%	0.9%
Metal	**2.5%**		
Aluminum Cans	1.8%	1.4%	2.4%
Tin Food Cans	0.7%	0.3%	1.7%
Other Ferrous	0.1%	0.0%	0.2%
Glass	**12.9%**		
Clear Beverage	7.4%	5.1%	9.9%
Green Beverage	2.2%	1.0%	5.4%
Brown Beverage	3.1%	0.9%	7.7%
Container Glass	0.2%	0.0%	0.6%
Mixed Cullet	0.0%	0.0%	0.0%
Non-Recyclables	**55.9%**		
Non-Conforming Paper	13.8%	11.2%	16.8%
Non-Conforming Plastic	12.1%	9.1%	18.7%
Non-Conforming Metal	0.8%	0.2%	2.5%
Non-Conforming Glass	0.0%	0.0%	0.0%
Garbage	29.3%	21.9%	39.7%
Sample Count	**30**		

Table 5-15: Composition by Weight - Neighborhood Streetside (Summer 2000)

Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**14.5%**		
Newsprint	6.8%	4.1%	10.6%
Corrugated/Kraft, Unwaxed	4.0%	2.1%	7.5%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	3.7%	2.6%	4.9%
Plastic	**4.0%**		
PET Bottles	1.6%	1.2%	2.1%
HDPE Bottles	2.4%	0.5%	7.6%
Metal	**4.4%**		
Aluminum Cans	3.1%	1.2%	9.7%
Tin Food Cans	1.0%	0.4%	2.1%
Other Ferrous	0.3%	0.1%	0.7%
Glass	**16.7%**		
Clear Beverage	10.8%	7.7%	16.8%
Green Beverage	3.1%	1.6%	5.5%
Brown Beverage	1.7%	0.8%	3.1%
Container Glass	1.2%	0.0%	4.3%
Mixed Cullet	0.0%	0.0%	0.0%
Non-Recyclables	**60.3%**		
Non-Conforming Paper	6.9%	5.3%	9.7%
Non-Conforming Plastic	5.8%	4.6%	7.1%
Non-Conforming Metal	0.1%	0.0%	0.2%
Non-Conforming Glass	0.0%	0.0%	0.1%
Garbage	47.5%	39.6%	55.8%
Sample Count	**33**		

Table 5-16: Composition by Weight - Neighborhood Streetside (Autumn 2000)

Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**17.3%**		
Newsprint	8.7%	5.6%	11.8%
Corrugated/Kraft, Unwaxed	2.5%	1.7%	3.9%
Phone Books	0.1%	0.0%	0.3%
Mixed Low Grade	5.9%	4.1%	8.2%
Plastic	**3.4%**		
PET Bottles	3.0%	2.0%	4.1%
HDPE Bottles	0.5%	0.2%	0.7%
Metal	**2.0%**		
Aluminum Cans	1.6%	1.1%	2.5%
Tin Food Cans	0.3%	0.2%	0.8%
Other Ferrous	0.0%	0.0%	0.1%
Glass	**15.9%**		
Clear Beverage	9.9%	5.8%	13.6%
Green Beverage	2.8%	0.0%	9.6%
Brown Beverage	2.0%	1.0%	3.1%
Container Glass	1.3%	0.5%	3.0%
Mixed Cullet	0.0%	0.0%	0.0%
Non-Recyclables	**61.5%**		
Non-Conforming Paper	13.8%	10.1%	19.2%
Non-Conforming Plastic	8.9%	7.0%	11.3%
Non-Conforming Metal	0.6%	0.2%	1.1%
Non-Conforming Glass	0.1%	0.0%	0.4%
Garbage	38.1%	29.8%	54.6%
Sample Count	**30**		

Table 5-17: Composition by Weight - Neighborhood Streetside (Winter 2000)

Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**25.7%**		
Newsprint	18.1%	12.4%	23.8%
Corrugated/Kraft, Unwaxed	2.1%	1.5%	2.9%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	5.6%	3.8%	8.2%
Plastic	**1.7%**		
PET Bottles	1.3%	0.8%	1.9%
HDPE Bottles	0.5%	0.2%	0.8%
Metal	**1.5%**		
Aluminum Cans	1.2%	0.8%	2.0%
Tin Food Cans	0.2%	0.0%	0.9%
Other Ferrous	0.0%	0.0%	0.0%
Glass	**6.8%**		
Clear Beverage	4.3%	2.4%	6.2%
Green Beverage	0.8%	0.2%	1.9%
Brown Beverage	1.3%	0.4%	2.5%
Container Glass	0.4%	0.0%	1.0%
Mixed Cullet	0.1%	0.0%	0.3%
Non-Recyclables	**64.3%**		
Non-Conforming Paper	10.3%	7.1%	12.9%
Non-Conforming Plastic	6.7%	5.0%	7.9%
Non-Conforming Metal	0.2%	0.1%	0.5%
Non-Conforming Glass	1.3%	0.0%	5.7%
Garbage	45.8%	36.8%	60.8%
Sample Count	**32**		

5.2.4Regional Parks

Figure 5-4 illustrates the composition, by broad material category, of waste taken from a total of 117 regional parks cans across the four seasons. As shown by this figure, non-recyclable materials accounted for the highest percentage of waste in all seasons (81.6% in the spring, 64.8% in the summer, 59.5% in the autumn, and 68.4% in the winter). Glass ranged from 5.6% in the spring to 20.3% in the autumn, while paper percentages grew from 9.8% in the spring to 16.0% in the winter.

On a more detailed level, Table 5-18 through Table 5-21 track the composition data for each of the 19 components across the four seasons of this study. Garbage made up the largest portion of regional parks waste in all four seasons – from a low of 45.1% in the autumn to a high of 67.8% in the spring. In addition, the percentages of non-conforming paper and non-conforming plastic remained fairly constant across seasons, ranging between 5.3% and 8.3%.

Figure 5-4: Overview of Regional Parks Composition Estimates, by Season

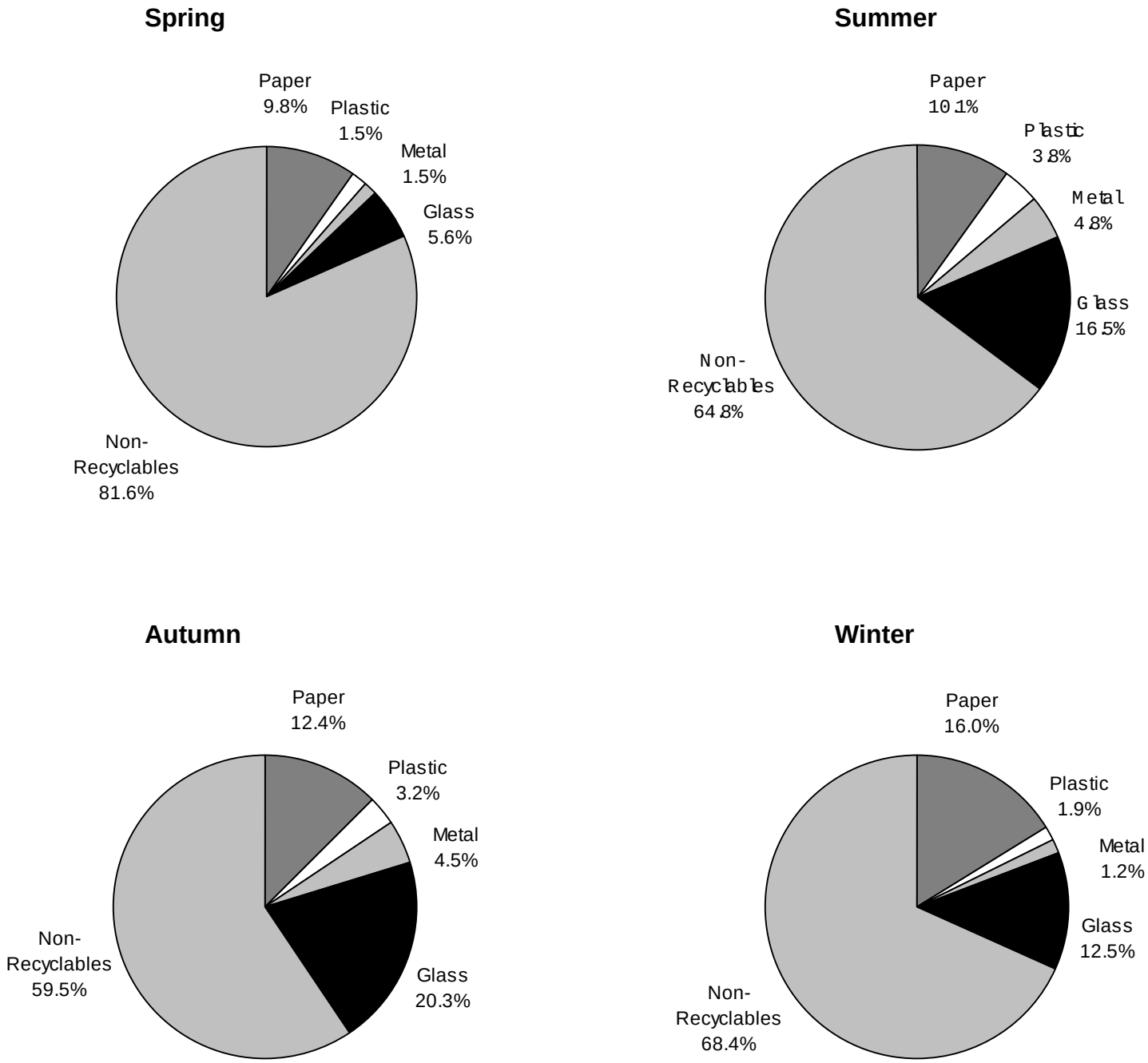


Table 5-18: Composition by Weight - Regional Parks
(Spring 2000)

Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**9.8%**		
Newsprint	4.8%	1.8%	12.1%
Corrugated/Kraft, Unwaxed	2.4%	1.2%	4.0%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	2.7%	1.7%	4.2%
Plastic	**1.5%**		
PET Bottles	1.4%	0.9%	2.2%
HDPE Bottles	0.1%	0.0%	0.3%
Metal	**1.5%**		
Aluminum Cans	1.4%	0.8%	2.8%
Tin Food Cans	0.1%	0.0%	0.3%
Other Ferrous	0.0%	0.0%	0.0%
Glass	**5.6%**		
Clear Beverage	4.1%	2.1%	6.7%
Green Beverage	0.2%	0.0%	0.7%
Brown Beverage	0.9%	0.3%	2.3%
Container Glass	0.3%	0.0%	1.6%
Mixed Cullet	0.0%	0.0%	0.0%
Non-Recyclables	**81.6%**		
Non-Conforming Paper	6.6%	4.9%	9.0%
Non-Conforming Plastic	5.3%	4.0%	6.9%
Non-Conforming Metal	1.9%	0.0%	6.0%
Non-Conforming Glass	0.0%	0.0%	0.0%
Garbage	67.8%	57.3%	75.5%
Sample Count	**26**		

Table 5-19: Composition by Weight - Regional Parks
(Summer 2000)

Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**10.1%**		
Newsprint	2.8%	1.3%	7.3%
Corrugated/Kraft, Unwaxed	2.2%	1.4%	3.6%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	5.1%	3.2%	9.1%
Plastic	**3.8%**		
PET Bottles	3.7%	2.4%	6.0%
HDPE Bottles	0.1%	0.0%	0.2%
Metal	**4.8%**		
Aluminum Cans	1.1%	0.7%	1.5%
Tin Food Cans	0.1%	0.0%	0.4%
Other Ferrous	3.7%	0.0%	11.0%
Glass	**16.5%**		
Clear Beverage	6.7%	4.2%	9.0%
Green Beverage	3.9%	1.7%	8.7%
Brown Beverage	5.7%	1.7%	12.9%
Container Glass	0.2%	0.0%	0.9%
Mixed Cullet	0.0%	0.0%	0.0%
Non-Recyclables	**64.8%**		
Non-Conforming Paper	6.9%	4.9%	9.0%
Non-Conforming Plastic	7.7%	5.7%	12.6%
Non-Conforming Metal	0.1%	0.0%	0.1%
Non-Conforming Glass	0.0%	0.0%	0.0%
Garbage	50.1%	44.2%	55.2%
Sample Count	**29**		

Table 5-20: Composition by Weight - Regional Parks
(Autumn 2000)

Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**12.4%**		
Newsprint	4.9%	2.0%	11.6%
Corrugated/Kraft, Unwaxed	2.2%	1.5%	3.3%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	5.2%	3.7%	7.8%
Plastic	**3.2%**		
PET Bottles	2.7%	2.0%	3.7%
HDPE Bottles	0.5%	0.3%	0.8%
Metal	**4.5%**		
Aluminum Cans	2.3%	1.6%	3.2%
Tin Food Cans	1.3%	0.6%	2.4%
Other Ferrous	0.9%	0.2%	3.6%
Glass	**20.3%**		
Clear Beverage	10.1%	7.2%	13.5%
Green Beverage	4.4%	2.0%	8.0%
Brown Beverage	5.5%	2.8%	9.7%
Container Glass	0.3%	0.0%	1.2%
Mixed Cullet	0.0%	0.0%	0.0%
Non-Recyclables	**59.5%**		
Non-Conforming Paper	8.3%	6.7%	10.9%
Non-Conforming Plastic	5.5%	3.8%	7.0%
Non-Conforming Metal	0.6%	0.2%	1.1%
Non-Conforming Glass	0.0%	0.0%	0.0%
Garbage	45.1%	38.5%	50.1%
Sample Count	**26**		

Table 5-21: Composition by Weight - Regional Parks
(Winter 2000)

Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**16.0%**		
Newsprint	9.3%	5.8%	15.0%
Corrugated/Kraft, Unwaxed	2.3%	1.6%	3.2%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	4.5%	2.0%	9.8%
Plastic	**1.9%**		
PET Bottles	1.7%	1.1%	2.6%
HDPE Bottles	0.2%	0.1%	0.4%
Metal	**1.2%**		
Aluminum Cans	1.0%	0.7%	1.4%
Tin Food Cans	0.1%	0.1%	0.3%
Other Ferrous	0.0%	0.0%	0.0%
Glass	**12.5%**		
Clear Beverage	7.0%	4.4%	10.8%
Green Beverage	4.0%	2.2%	6.5%
Brown Beverage	1.5%	0.7%	2.6%
Container Glass	0.0%	0.0%	0.0%
Mixed Cullet	0.0%	0.0%	0.0%
Non-Recyclables	**68.4%**		
Non-Conforming Paper	8.2%	6.2%	11.6%
Non-Conforming Plastic	5.6%	4.2%	7.4%
Non-Conforming Metal	1.2%	0.4%	2.5%
Non-Conforming Glass	0.0%	0.0%	0.0%
Garbage	53.6%	44.1%	65.5%
Sample Count	**36**		

5.2.5Neighborhood Parks

Figure 5-5 illustrates that non-recyclables accounted for the largest percentage of broad material disposed in neighborhood parks (between 60.2% in the autumn and 82.7% in the summer, by weight). The percentage of glass ranged from a low of 7.4% in the summer to a high of 26.3% in the autumn.

The detailed composition estimates for neighborhood parks are outlined by season in Table 5-22 through Table 5-25. Clear glass beverage containers fluctuated between 4.3% and 16.3% (in the summer and autumn respectively). The percentage of non-conforming paper remained relatively constant and just below 10% throughout the four seasons (from 6.2% in the summer to 9.0% in the spring). Again, garbage was the single largest component of the waste deposited in neighborhood parks cans each season; it ranged between 45.3% in the autumn and 70.8% in the summer.

Figure 5-5: Overview of Neighborhood Parks Composition Estimates, by Season

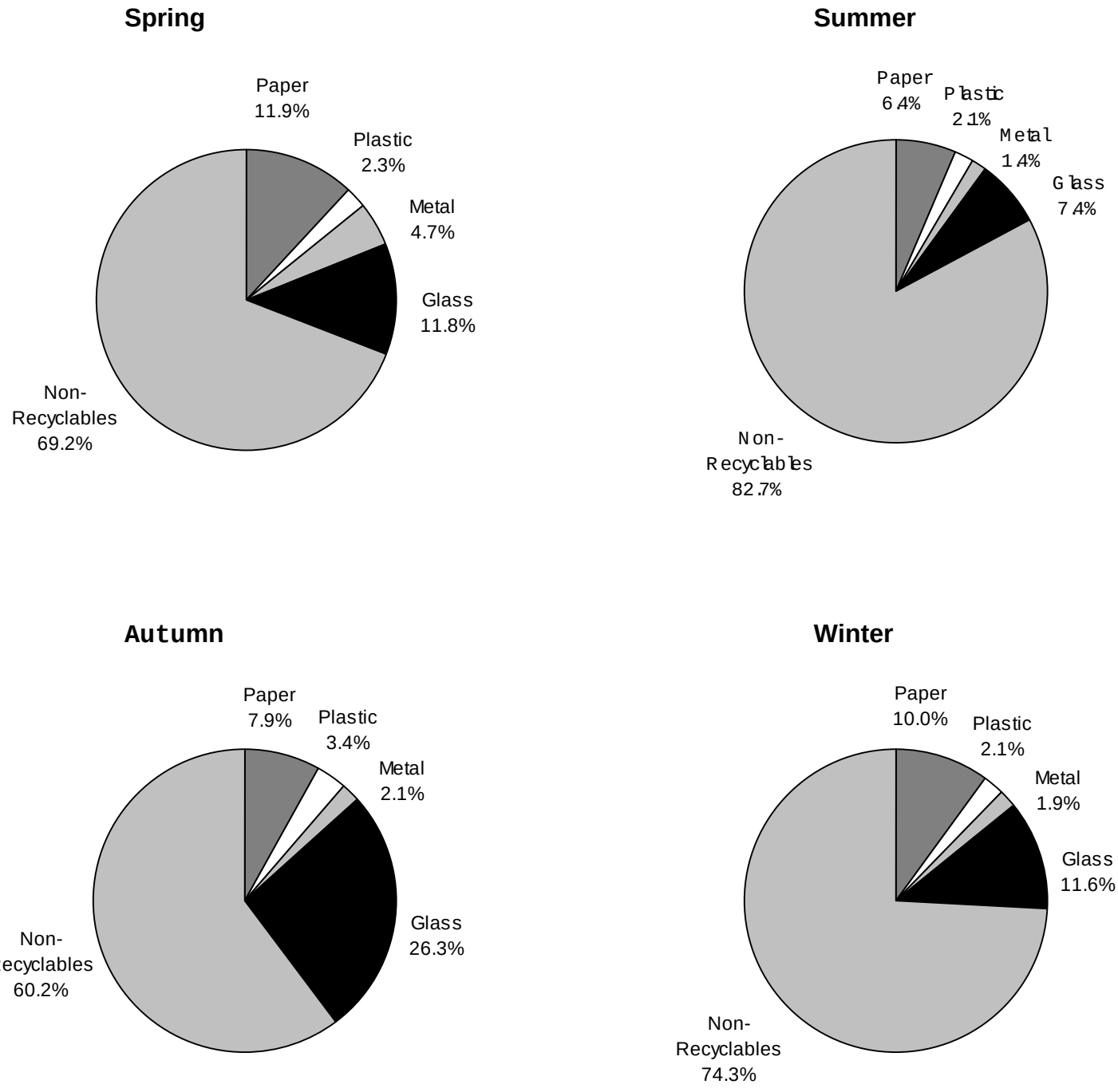


Table 5-22: Composition by Weight - Neighborhood Parks
(Spring 2000)

Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**11.9%**		
Newsprint	4.5%	1.5%	12.0%
Corrugated/Kraft, Unwaxed	2.8%	1.5%	4.2%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	4.7%	3.1%	6.2%
Plastic	**2.3%**		
PET Bottles	2.0%	1.2%	3.0%
HDPE Bottles	0.3%	0.1%	0.7%
Metal	**4.7%**		
Aluminum Cans	3.1%	1.6%	5.7%
Tin Food Cans	1.6%	0.8%	3.3%
Other Ferrous	0.1%	0.0%	0.3%
Glass	**11.8%**		
Clear Beverage	6.9%	4.1%	11.7%
Green Beverage	1.6%	0.6%	3.7%
Brown Beverage	3.0%	0.8%	7.4%
Container Glass	0.3%	0.0%	1.4%
Mixed Cullet	0.0%	0.0%	0.0%
Non-Recyclables	**69.2%**		
Non-Conforming Paper	9.0%	5.8%	12.7%
Non-Conforming Plastic	6.9%	5.2%	9.2%
Non-Conforming Metal	0.6%	0.3%	1.2%
Non-Conforming Glass	0.0%	0.0%	0.0%
Garbage	52.6%	43.2%	62.1%
Sample Count	**22**		

Table 5-23: Composition by Weight - Neighborhood Parks (Summer 2000)

Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**6.4%**		
Newsprint	1.5%	0.4%	4.1%
Corrugated/Kraft, Unwaxed	1.8%	1.3%	2.9%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	3.0%	1.8%	5.8%
Plastic	**2.1%**		
PET Bottles	1.3%	0.8%	2.0%
HDPE Bottles	0.8%	0.4%	1.8%
Metal	**1.4%**		
Aluminum Cans	1.1%	0.6%	1.6%
Tin Food Cans	0.3%	0.1%	0.4%
Other Ferrous	0.1%	0.0%	0.2%
Glass	**7.4%**		
Clear Beverage	4.3%	2.1%	7.1%
Green Beverage	1.5%	0.7%	2.8%
Brown Beverage	1.2%	0.5%	3.2%
Container Glass	0.5%	0.0%	2.0%
Mixed Cullet	0.0%	0.0%	0.0%
Non-Recyclables	**82.7%**		
Non-Conforming Paper	6.2%	3.8%	11.2%
Non-Conforming Plastic	4.9%	3.4%	6.5%
Non-Conforming Metal	0.7%	0.2%	1.7%
Non-Conforming Glass	0.1%	0.0%	0.4%
Garbage	70.8%	61.6%	79.1%
Sample Count	**35**		

Table 5-24: Composition by Weight - Neighborhood Parks (Autumn 2000)

Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**7.9%**		
Newsprint	3.2%	1.6%	5.4%
Corrugated/Kraft, Unwaxed	2.3%	1.5%	3.6%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	2.4%	1.5%	4.1%
Plastic	**3.4%**		
PET Bottles	3.0%	1.9%	4.5%
HDPE Bottles	0.4%	0.2%	0.9%
Metal	**2.1%**		
Aluminum Cans	1.4%	1.0%	2.0%
Tin Food Cans	0.4%	0.2%	0.8%
Other Ferrous	0.3%	0.1%	0.7%
Glass	**26.3%**		
Clear Beverage	16.3%	6.8%	31.8%
Green Beverage	5.4%	2.7%	10.0%
Brown Beverage	4.5%	1.7%	11.1%
Container Glass	0.1%	0.0%	0.3%
Mixed Cullet	0.0%	0.0%	0.0%
Non-Recyclables	**60.2%**		
Non-Conforming Paper	8.9%	6.0%	12.5%
Non-Conforming Plastic	4.6%	3.6%	5.7%
Non-Conforming Metal	1.4%	0.6%	3.5%
Non-Conforming Glass	0.0%	0.0%	0.0%
Garbage	45.3%	35.9%	53.4%
Sample Count	**24**		

Table 5-25: Composition by Weight - Neighborhood Parks (Winter 2000)

Calculated at a 90% confidence interval

	Mean	Low	High
Paper	**10.0%**		
Newsprint	3.7%	1.3%	8.2%
Corrugated/Kraft, Unwaxed	2.5%	1.7%	3.7%
Phone Books	0.0%	0.0%	0.0%
Mixed Low Grade	3.8%	2.4%	5.5%
Plastic	**2.1%**		
PET Bottles	1.8%	1.0%	2.9%
HDPE Bottles	0.3%	0.2%	0.7%
Metal	**1.9%**		
Aluminum Cans	1.1%	0.7%	1.7%
Tin Food Cans	0.7%	0.1%	1.7%
Other Ferrous	0.1%	0.0%	0.5%
Glass	**11.6%**		
Clear Beverage	8.4%	5.2%	13.5%
Green Beverage	0.6%	0.0%	1.8%
Brown Beverage	2.4%	1.0%	5.6%
Container Glass	0.0%	0.0%	0.0%
Mixed Cullet	0.2%	0.0%	0.6%
Non-Recyclables	**74.3%**		
Non-Conforming Paper	8.3%	5.7%	12.6%
Non-Conforming Plastic	3.9%	2.8%	5.3%
Non-Conforming Metal	1.3%	0.1%	5.3%
Non-Conforming Glass	0.3%	0.0%	0.9%
Garbage	60.5%	52.1%	68.7%
Sample Count	**29**		

A SAMPLING METHODOLOGY

Overview

The primary objectives of this study included the following:

- Determining quantity and types of recyclables deposited in litter cans throughout the city and in selected areas,
- Providing information to help design a citywide recycling can program, and
- Establishing baseline composition data in order to evaluate the effect of future recycling programs.

The methodology that was used to sample and sort the wastes collected in litter cans is detailed in the following sections.

Define Sampling Sectors

The sampling plan was designed to determine the quantity and composition of recyclables for the entire population of 3,500 litter cans in the city. Because the quantity and types of recyclables differ depending on the type of user and location of the can, the City also wanted to obtain information for smaller subsets of litter cans. For example, garbage deposited in litter cans in Seattle's Pioneer Square (an area with significant nightlife activity) was thought to be very different than the garbage deposited in neighborhood city park cans. To determine the smaller subsets of cans, the litter cans were first divided into two groups:

1. **Transitory –** Cans used by people in transit (i.e. along sidewalks or near bus stops.) Cans along city streets were placed in this grouping, along with cans in downtown Seattle parks. Cans in downtown Seattle parks were classified as "transitory" because their users tend to be similar to those who use cans along downtown city streets (as opposed to those who use cans in parks outside of the downtown area).
2. **Destination –** Cans in places considered to be destinations (such as ballfields, community centers, or playgrounds). Cans in city parks outside of downtown Seattle were placed in this grouping.

The transitory cans were further divided into three sectors: "Nightlife," "Commercial Downtown," and "Neighborhood Streetside." The "Nightlife" sector included litter cans in areas with relatively high pedestrian traffic after dark. Litter cans in the shopping, retail, and business areas of downtown Seattle were classified as "Commercial Downtown." These cans are primarily used in the daytime. Litter cans in Seattle's neighborhood commercial districts outside of the downtown area were placed in the third sector, "Neighborhood Streetside." Each litter can was assigned to a sector based on its location, as described below.

- **Nightlife** – Litter cans along city streets and within city parks in Seattle's Pioneer Square and Belltown areas, along with cans on Broadway (in Capitol Hill) and University Way (in the University District). Specifically, cans within the following areas were included:

  - Along First and Second Avenues, between Denny Way and Yesler Way (also includes cans east of Second Avenue but not on Third),
  - Between Yesler Way, Fourth Avenue, King Street, and Alaskan Way,
  - Along University Way from Campus Parkway to 55th Street, and
  - Along Broadway.

- **Commercial downtown** – Litter cans along streets and in parks in the retail core of downtown Seattle, in addition to cans along the Waterfront and Western Avenue. The commercial downtown sector was defined as follows:

  - Between Third Avenue and Interstate 5, from Denny Way to Yesler Way,
  - Along the Waterfront, and
  - Along or near Western Avenue.

- **Neighborhood Streetside** – Litter cans outside the Seattle downtown area in neighborhood commercial districts. Streetside litter cans in the following neighborhoods were included in this sector:

  - Aurora Avenue (75th St.-105th St.)
  - Ballard
  - Beach Route
  - Capitol Hill (not including Broadway)
  - Central District
  - Eastlake
  - Fremont
  - Greenwood
  - Haller Lake
  - International District
  - Lake City Way
  - Madison
  - Magnolia
  - Montlake
  - Phinney
  - Queen Anne
  - Rainier Avenue
  - Roosevelt/65th Street
  - University District (including University Way north of 56th Street)
  - Wallingford/45th Street
  - Westlake

The second grouping, destination cans, included cans in parks outside of downtown Seattle. The parks were divided into two sectors, "regional" and "neighborhood," which were defined as follows:

- **Regional Parks** – Regional parks are generally large parks with unique, special features or attractions. Examples include Discovery Park, Washington Park Arboretum, the Olmsted Boulevard System, Kubota Gardens, Greenlake, Volunteer Park and Magnuson Park. Regional parks serve the neighborhoods they are in, while also drawing visitors from far beyond. For example, the Arboretum has the largest collection of woody plants in the northwest; Volunteer Park has a conservatory and Asian Art Museum; Discovery Park includes an Indian cultural center, miles of hiking trails and environmental education programs for adults, school children and families.
- **Neighborhood Parks** – Neighborhood parks provide open space and recreation facilities and are designed primarily to serve the neighborhood in which they lie. Some are for passive use only with benches, trees and grass, while some are designed for active use with athletic fields, play courts, children's play areas and walking/jogging paths. A few are both.

Obtain " Universe" of Cans

Once the above sectors were defined, the next step was to obtain detailed data from Seattle Transportation (SeaTran) and the Parks Department regarding the "universe" of litter cans. For this study, the universe was a list of every litter can in the city.

Cans Serviced by SeaTran

SeaTran has five trucks that collect the garbage deposited in streetside litter cans. Four trucks operate during the night shift and one truck operates during Wednesday's day shift.[1] Each night shift truck operates five days per week and services one route per shift. The day shift truck also services one route. Each route includes 5-7 neighborhood districts such as Capitol Hill, Lower Queen Anne, and North Downtown/Belltown.

The neighborhood districts serviced by SeaTran vary depending on the day of the week. For example, night shift's Truck #3 collects the litter cans in South Downtown and Pioneer Square on Mondays; on Tuesdays, it collects the litter cans in Madison/Montlake, Capitol Hill, and the Central District.

For each of its day and night collection routes, SeaTran provided a list of districts serviced and the location of every can collected. The list of cans was then aggregated into a master list to eliminate duplicates.[2] A summary of the list, including the number of cans in each SeaTran district and their collection schedule, is located in Table A-1.

[1] During the study period, SeaTran revised its route lists. Prior to August 2000, the day shift truck operated every weekday. Most of the cans serviced during the Monday, Tuesday, Thursday, and Friday day shifts were shifted to collection at night. As a consequence, the night shift routes were also revised.

[2] The master list was provided to the City in Microsoft Access format.

Table A-1: SeaTran's Collection Schedule

DISTRICT	Cans	Monday Night	Tuesday Night	Wednesday Night	Thursday Night	Friday Night	Saturday Night	Sunday Night	Wednesday Day
Aurora Avenue	12			X			X		
Ballard	26			X			X		
Beach Route	6								X
Broadway	34	X	X	X	X	X	X	X	
Capital Hill	51		X			X			
Central District	52		X			X			
Eastlake	14								X
Fremont	18			X			X		
Greenlake	3			X					
Greenwood	16			X			X		
Haller Lake	10								X
International District	22	X	X	X	X	X	X	X	
Lake City	26								X
Lower Queen Anne	17	X	X	X	X	X	X	X	
Madison	17		X			X			
Magnolia	10			X			X		
Montlake	6		X			X			
North 45th St.	27			X					
North 65th St.	9			X			X		
North Downtown/Belltown	196	X	X	X	X	X	X	X	
Phinney	7			X			X		
Rainier Ave.	67		X			X			
Roosevelt	7						X		
Roosevelt/65th	5			X			X		
South Downtown/Pioneer Square	104	X	X	X	X	X	X	X	
University District	54	X	X	X	X	X	X	X	
Upper Queen Anne	16			X			X		
Waterfront	24	X	X	X	X	X	X	X	
Western	14	X	X	X	X	X	X	X	
Westlake	4								X
TOTAL NUMBER OF CANS	**874**								

Cans Serviced by Parks Department

The parks in Seattle are divided into approximately eight districts, and the litter cans in each district are managed separately. In addition, Discovery Park and Magnuson Park are managed independently. The Parks Department provided a list of every regional, neighborhood, and downtown city park, as well as the estimated number of litter cans in use during the peak and off-peak seasons for each park.[3] The list also included the district in which each park was located. For a small number of parks, no inventory of cans existed and therefore these parks were not included in the study.

The can list provided by the Parks Department did not include specific can locations or the days that they are normally collected. In many parks, the exact locations of cans often change and consequently no maps have ever been created. For the regional and neighborhood parks, the days of collection vary, depending on factors such as those described below.

- *Park's district:* Each district maintains its own collection schedule.
- *Season:* For example, some cans may be routinely picked up on Mondays, Wednesdays, and Fridays in the summer yet once a week in the winter.
- *Fullness of the can*: Some cans in small parks are only collected when they become full.

[3] The list of city parks and the estimated number of cans within each was submitted to the City in Microsoft Excel format.

- *Method of collection*: Park litter cans are collected either “manually” or with a packer truck. The packer truck typically services cans that are used more frequently and are in easily accessible areas. Other cans are serviced by Parks personnel who manually empty the litter can and dispose of the garbage in a variety of ways (i.e. either walking the bag to the packer truck or placing it in a dumpster). The manually collected cans are not necessarily collected on the same days as cans collected by a packer truck.

After the inventories of cans were obtained from SeaTran and the Parks Department, the cans were assigned to one of the five sectors (as described in the section above). The SeaTran and downtown parks cans were divided among the nightlife, commercial downtown, and neighborhood streetside sectors based on their specific locations. The parks outside of the downtown area were divided into the regional and neighborhood park sectors based on the size and use(s) of the park.

Table A-2 shows the number of cans in each sector by collector (SeaTran or the Parks Department) and the average number of times the cans are collected each week.

Table A-2: Number of Litter Cans and Average Pick-ups Per Can Each Week, by Sector

Category	Collector	Number of Cans		Ave. Pickups per Week	
		Peak	*Non-Peak*	*Peak*	*Non-Peak*
Nightlife		**277**	**277**	**7.00**	**7.00**
	Parks	56	56	7.00	7.00
	SeaTran	221	221	7.00	7.00
Commercial Downtown		**299**	**299**	**7.00**	**7.00**
	Parks	110	110	7.00	7.00
	SeaTran	189	189	7.00	7.00
Neighborhood Streetside	SeaTran	**464**	**464**	**2.38**	**2.38**
Regional Parks	Parks	**1239**	**1001**	**NA**	**NA**
Neighborhood Parks	Parks	**1576**	**1447**	**NA**	**NA**

An Excel spreadsheet was then created that included a record for every can in each sector. The SeaTran cans were listed by district and location, and the park cans were listed by park name and can number (e.g., Alki Beach #1, Alki Beach #2, etc.)

Determine Sampling Dates and Allocate Samples

The next step in developing the sampling plan was to determine when the litter can sampling would occur. In order to capture any seasonal variation, litter cans were sampled once each quarter of the Year 2000 in intervals of approximately three months. The first sampling period occurred in March, and the data from these sorts reflected “spring” litter can composition. The data from the June, September, and December sampling events represented “summer,” “fall,” and “winter” litter can composition respectively.

A total of 30 samples were allocated to each of the five sectors per season, for a total of 600 samples during the entire study period. Because not all of the 150 samples arrived at the sorting location during the first sampling event, an additional five samples were added to each sector per season. Table A-3 illustrates the planned distribution of collected samples per season.

Table A-3: Planned Number of Samples per Quarter, by Sector

Sector	Spring	Summer	Autumn	Winter	Total
"Nightlife"	30	30	30	30	**120**
Commercial Downtown	30	30	30	30	**120**
Neighborhood Streetside	30	30	30	30	**120**
Regional Parks	30	30	30	30	**120**
Neighborhood Parks	30	30	30	30	**120**
Total	**150**	**150**	**150**	**150**	**600**

Two factors affected the selection of the sample collection period. First, weeks with a major holiday - specifically Labor Day and Christmas - were eliminated to avoid any staffing conflicts with the collection, sorting, and/or transfer station personnel. Also, the litter generation and composition were anticipated to be slightly abnormal during a holiday weekend.

The second factor was the sorting crew’s availability during the selected months. Since the sorting crew can sort approximately 50 bags from litter cans a day, three days of sorting were required each quarter. The sorting crew was already scheduled to sort self-haul wastes at the City’s North and South Recycling and Disposal Stations (SRDS and NRDS) during the same months as those selected for the litter can study. The dates for the self-haul waste sorts were randomly selected. To minimize the expense of moving the crew, the sorting days for the litter study were scheduled for three days following the self-haul waste sorts. The litter collection period took place from the week prior to, and through, the selected sorting days. The litter can sort dates are shown in Table A-4.

Table A-4: Litter Can Sampling Calendar

Season	Sorting Dates
Spring	March 30, 31; April 3
Summer	June 23, 24, 25
Autumn	September 16, 17, 18
Winter	December 9, 10, 11

Select Sample Litter Cans

To select the sample litter cans, a computer generated random number was assigned to every can on the aggregated can lists. The 35 cans with the lowest random number in each sector were selected for the study (only 30 were selected in the spring sampling period). Because some parks had multiple litter cans, more than one can may have been selected from the same park (i.e. Alki Beach can #2 and Alki Beach can #52 may have both been selected.) This process was repeated each season.

While the specific location of each streetside can was known, similar information was not available for cans within city parks. For example, there are 130 litter cans at Alki Beach, but the specific location of each can was not documented. To determine which cans were selected for the study, a drive-by or walk-through method was employed. Starting at a park entrance, cans were numbered sequentially. When the number of the pre-selected study can was reached, the location of the can was documented and bright colored tape was placed upon the can in order to help identify the can during the study.

Determine Specific Collection Dates

To minimize the effect of this study on SeaTran and Parks personnel, the litter cans were sampled on their normal collection days. Because some cans are collected on a weekly basis, the collection period lasted up to one week each season.

Each can's specific collection date depended on when and how often the can was normally collected. All cans were sampled the week prior to or during the sorting period.

- Cans collected on a ***weekly basis*** – Collection occurred on the can's normal day and shift.
- Cans collected ***two to three times per week*** – A weekday was randomly selected each quarter to signify the start of the collection period. Each can was sampled on its first regularly scheduled collection day after the specified start date. For example, if the randomly selected weekday was a Wednesday and a can was normally picked up on Mondays and Thursdays, the sample date would be Thursday. Similarly, if a can was picked up on Wednesdays and Fridays, then Wednesday would be the sample day. The randomly selected start dates for each sampling period are as follows:

  - *Spring:* Tuesday, March 28th
  - *Summer:* Wednesday, June 22nd
  - *Fall:* Monday, September 11th
  - *Winter:* Friday, December 1st

- Cans collected ***everyday*** –The specific collection date depended on the sector.

  - *Regional and Neighborhood Parks:* Only a few of the regional and neighborhood parks cans are collected everyday (and this is only during the peak season). Also, it was not known which parks had litter cans collected everyday. Therefore, the sampling date was the randomly selected start shown in the section above.

- *Nightlife and Commercial Downtown:* Because the majority of cans in the nightlife and retail areas are collected everyday, a different method was used for the nightlife and commercial downtown sectors (otherwise nearly all samples for those sectors would have been collected on the same day.) Three collection days were randomly selected per period and the cans were evenly and randomly distributed among those days.

The three randomly selected days per period are shown below in Table A-5. If a Monday was selected then the park cans were collected on Monday during the day and the street cans were collected on Tuesdays during the night shift (Monday night to Tuesday morning).

Table A-5: Selected Days per Quarter for Nightlife and Commercial Downtown Cans Collected Everyday

	Spring	Summer	Autumn	Winter
Monday		X		X
Tuesday				X
Wednesday	X	X		
Thursday	X		X	X
Friday			X	
Saturday		X	X	
Sunday	X			

Collect Samples

Prior to each collection period, SeaTran and the Parks Department were notified as to which cans were included in the study, their specific location and the date on which they were to be collected. For the cans collected by SeaTran, the list of cans was sent electronically and included the specific collection day and shift for each can. Because the normal collection dates of the regional and neighborhood park cans were not known, a memo was circulated among Parks personnel detailing the pick-up schedule. The memo listed the specific sampling dates for different collection schedules. For example, the memo stated that cans normally collected Monday/Wednesday/Friday should be collected on Wednesday, cans normally collected on Tuesday/Thursday should be collected on Thursday, etc. The South Disposal and Recycling Station (SRDS) manager was also given a sampling schedule.

The litter from the park cans were collected by Parks personnel on the selected day and transported to the district office. Each district then brought the litter to the SRDS to be sorted and weighed. Litter from the street cans was collected by personnel in a vehicle separate from the regular collection routes, and then transported to the SRDS.

A bright colored placard (included in Appendix D) was placed either inside the bag or taped to the outside during collection to record the location of the can, the date it was previously collected, and the current date of the pick-up. The placards were given to SeaTran and the Parks Department prior to the collection period.

Sorting Procedures

Each sample was sorted by hand into the component groups. (See Appendix B for the component categories.) The weights of all materials were recorded on tally sheets, shown in Appendix D. Because food waste was often adhered to the bag, the weight of the bag was included as garbage. The weight of a dry bag was then subtracted out during the analyses.

Each sample was sorted to the greatest reasonable level of detail. Rarely, a “supermix” of material (a residue of mixed material, each piece smaller than one half inch) remained after sorting a sample. In these cases, the field supervisor weighed the combined supermix (never totaling more than ten pounds) and visually estimated the percentage of each component material in the supermix.

B COMPONENT CATEGORIES

In the spring and summer sampling periods, the waste collected from litter can samples was sorted by hand into 19 of the 22 component categories listed below. These 19 categories were similar to those used in the 1998/99 Residential Recycling Study.

In the fall and winter seasons, the category "PET Bottles" was split in two (large vs. small). In addition, the categories "Milk/Juice Polycoat" (previously "non-conforming paper") and "Other #1-7 Plastic Bottles, Tubs, and Jars" (previously "non-conforming plastics") were added. A list of all 22 component categories and definitions follows:

Paper

NEWSPRINT: Printed newsprint. (Advertising "slicks" (glossy paper) were included in this category if found mixed with newspaper; otherwise, ad slicks are included with mixed low grade paper.)

CORRUGATED/KRAFT, UNWAXED: Unwaxed/uncoated old corrugated container boxes and Kraft paper, and brown paper bags.

PHONE BOOKS: Telephone directories.

MIXED LOW GRADE: Mixed recyclable papers, including junk mail, magazines, colored papers, bleached Kraft, boxboard, mailing tubes, and paperback books. May also contain white or lightly colored sulfite/sulfate bond, copy papers, computer printouts and envelopes.

MILK/JUICE POLYCOAT: Bleached polycoated milk, ice cream, and aseptic juice containers.

Metal

ALUMINUM CANS: Aluminum beverage cans (UBC) and bi-metal cans made mostly of aluminum.

TIN FOOD CANS: Tinned steel food containers, including bi-metal cans mostly of steel.

OTHER FERROUS: Ferrous and alloyed ferrous scrap metals to which a magnet adheres and which are not significantly contaminated with other metals or materials.

Plastic

PET LARGE BOTTLES: Polyethylene terephthalate bottles (containers with a narrow neck), such as soda pop and other beverage bottles greater than or equal to a 2-liter volume.

PET SMALL BOTTLES: Polyethylene terephthalate bottles (containers with a narrow neck), such as soda pop and other beverage bottles less than a 2-liter volume.

HDPE BOTTLES: High-density translucent polyethylene bottles (containers with a narrow neck), such as milk, juice, and detergent containers.

OTHER #1-7 BOTTLES, TUBS AND JARS: Plastic containers made of types of plastic other than HDPE or PETE. When marked for identification, these items may bear the number "3," "4,"

“5,” or “7” in the triangular recycling symbol. Examples include food containers such as salad dressing bottles, and yogurt and margarine tubs, but excludes all containers marked with a “6,” take out/fast food containers and packaging, and lids.

Glass

CLEAR BEVERAGE: Includes clear pop, liquor, wine, juice, beer, vinegar bottles.

GREEN BEVERAGE: Includes green pop, liquor, wine, beer, lemon juice bottles.

BROWN BEVERAGE: Includes brown pop, beer, liquor, juice, vanilla extract bottles.

CONTAINER GLASS: All glass containers, all colors, holding solid materials such as mayonnaise, non-dairy creamer, facial cream containers.

MIXED CULLET. Broken glass, of any color and type.

Garbage

NONCONFORMING PAPER: Any paper not described above and not meeting the requirements for Seattle’s recycling program, such as tissue, photographs or soiled paper.

NONCONFORMING METAL: Any metal not described above and not meeting the requirements for Seattle’s recycling program, such as products containing a mixture of metals and other materials.

NONCONFORMING PLASTIC: Any plastic not described above and not meeting the requirements for Seattle’s recycling program such as plastic film and bags, toys, and tarps.

NONCONFORMING GLASS: Any glass not described above and not meeting the requirements for Seattle’s recycling program, such as window glass, light bulbs and glassware.

GARBAGE: Any item not described above and not meeting the requirements for Seattle’s recycling program, such as organic wastes, construction debris, soil and hazardous wastes.

The following table summarized the changes to component categories made between the spring/summer and autumn/winter sampling events. (An “X” signifies that the component remains the same from the spring/summer sampling events; an outline border reflects how components were split apart for the autumn/winter sampling events.)

	Spring/Summer	Autumn/Winter
PAPER		
Newsprint	X	X
Corrugated/Kraft, Unwaxed	X	X
Phone Books	X	X
Mixed Low Grade	X	X
NonConforming Paper	X	X
		Milk/Juice Polycoat
PLASTICS		
PET Bottles	X	Large PET Bottles (greater than 24 oz)
		Small PET Bottles (24 oz or smaller)
HDPE Bottles	X	X
NonConforming Plastic	X	X
		Other #1-7 Bottles, Tubs, and Jars
GLASS		
Clear Beverage	X	X
Green Beverage	X	X
Brown Beverage	X	X
Container Glass	X	X
Mixed Cullet	X	X
Nonconforming Glass	X	X
METALS		
Aluminum Cans	X	X
Tin Food Cans	X	X
Other Ferrous	X	X
Nonconforming Metal	X	X
GARBAGE		
Garbage	X	X

C CALCULATIONS

Estimating Pounds of Accumulation

Step 1: Sample records were segregated into subgroups according to their season and sector. For each of the 20 season/sector combinations, the mean daily accumulation per can was calculated, with the associated variances.

From: Sample Weight$_{sample}$,
Days Accumulated$_{sample}$, and
# of Samples$_{season, sector}$,
calculate: (Mean Pounds Per Can Per Day)$_{season, sector}$, with variance

Step 2: The estimates of mean daily accumulation per can were magnified to reflect accumulation for all cans (both sampled and unsampled) within the sector during the season. The variances were similarly magnified.

$$\left[\text{Mean Pounds per Can per Day}_{season, sector} \times \#\,\text{Existing Cans}_{season, sector} \times 91.25\ \text{days}\right] = \text{Total Pounds}_{season, sector}\text{, with variance}$$

Step 3: For a given sector, the seasonal estimates were added to produce an estimate of annual accumulation by that sector, with variance.

$$\sum_{seasons} \text{Total Pounds}_{season, sector} = \text{Total Pounds}_{sector}\text{, with variance}$$

Step 4: The estimates of annual accumulation for all sectors were added to provide an estimate of overall accumulation, with variance.

$$\sum_{sectors} \text{Total Pounds}_{sector} = \text{Overall Total Pounds, with variance}$$

Estimating Percent Composition

Step 5: The relative presence (i.e., the percent) of each material was calculated within a given sector, for a given season. Variance was estimated using the bootstrap resampling method described in the next section.

$$100 \times \frac{\sum_{\text{samples}} \text{Weight}_{\text{material, sample, season, sector}}}{\sum_{\text{samples}} \text{Sample Weight}_{\text{sample, season, sector}}} = \text{Estimated Percent}_{\text{material, season, sector}}\text{, with variance}$$

Step 6: The relative presence (i.e., the percent) of each material was calculated within a given sector, for all seasons combined. Variance was estimated using bootstrap resampling.

$$100 \times \frac{\sum_{\text{seasons}} \left[\left(\text{Total Pounds}_{\text{season, sector, reported}} \right) \sum_{\text{samples}} \text{Weight}_{\text{material, sample, season, sector}} \right]}{\sum_{\text{seasons}} \left[\left(\text{Total Pounds}_{\text{season, sector, reported}} \right) \sum_{\text{samples}} \text{Sample Weight}_{\text{sample, season, sector}} \right]} = \text{Estimated Percent}_{\text{material, sector}}\text{, with variance}$$

Step 7: The relative presence (i.e., the percent) of each material was calculated for all sectors and seasons combined. Variance was estimated using bootstrap resampling.

$$100 \times \frac{\sum_{\text{sectors}} \left\{ \left(\text{Pounds per Year}_{\text{sector, reported}} \right) \sum_{\text{seasons}} \left[\left(\text{Total Pounds}_{\text{season, sector, reported}} \right) \sum_{\text{samples}} \text{Weight}_{\text{material, sample, season, sector}} \right] \right\}}{\sum_{\text{sectors}} \left\{ \left(\text{Pounds per Year}_{\text{sector, reported}} \right) \sum_{\text{seasons}} \left[\left(\text{Total Pounds}_{\text{season, sector, reported}} \right) \sum_{\text{samples}} \text{Sample Weight}_{\text{sample, season, sector}} \right] \right\}}$$

$$= \text{Estimated Percent}_{\text{material, overall}}\text{, with variance}$$

Estimating Variance

Variance estimates were calculated using bootstrap resampling. Data were resampled, with replacement, from groups formed as combinations of sector and season. For each statistic, including composition estimates, 1000 replicate estimates were calculated, yielding a bootstrap distribution from which the standard errors were derived.

Ninety percent confidence intervals were calculated for the bootstrap distributions using bias-corrected and adjusted percentiles (Bca). The BCa method transforms the 0.5 and 0.95 probability values to determine which percentiles of the empirical bootstrap distribution most accurately estimate the percentiles of interest. The BCa confidence limits are reported as the lower and upper bounds of the estimates.

To be consistent with other reports of this type, " +/-" values, based on the 90% confidence intervals, were presented with the results. These values were calculated as:

$$\max(Est - CI_L, CI_U - Est)$$

where max = maximum;
Est = estimated statistic;
CI_L = lower bootstrap confidence bound; and,
CI_U = upper bootstrap confidence bound.

In most cases, the bootstrapped confidence intervals were not symmetric, due to some degree of skewness in the resulting bootstrap distributions. Thus, the reported "+/-" values tend to inflate the confidence intervals on one side (usually the lower bound in these analyses).

D FIELD FORMS

- Tally sheet
- Bag insert for park cans
- Bag insert for road cans

Paper				
Newsprint				
Corrugated/Kraft, Unwaxed				
Phone Books				
Mixed Low Grade				
NonConforming Paper				
Metal				
Aluminum Cans				
Tin Food Cans				
Other Ferrous				
NonConforming Metal				
Plastic				
PET Bottles				
HDPE Bottles				
NonConforming Plastic				
Glass				
Clear Beverage				
Green Beverage				
Brown Beverage				
Container Glass				
Mixed Cullet				
NonConforming Glass				
Garbage				
Garbage				

Sample ID

Sorting Date:

Date bag was collected:

Date bag was perviously collected:

Collection Method (Park Cans Only):

Packer

Manual

Other _____

Seattle Litter Can Study

Sample # 1

Park & Can: Alki Playground #10

Can Location: Middle of the eastern edge of the park, near the crosswalk sign.

1. Current Date of Pick-up: _____
2. Last Date of Pick-up: _____
3. Normal Collection Method (circle one)

   Packer

   Manual

   Other_____

Seattle Litter Can Study

Sample #61

Pick-up Day & Shift: Thursday, Night

Truck Number: 94

District: CAPITOL HILL

Can Location: 15TH AVE & E. OLIVE WAY SWC

PLEASE RECORD:

1. Current Date & Time of Pick-up: _____

2. Last Date & Time of Pick-up: _____