City of Phoenix
Public Works Department

Characterization of Waste from Single-family Residences

prepared by

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Section 1: Executive Summary

The City of Phoenix contracted with Cascadia Consulting Group to conduct a study estimating the composition of disposed waste from single-family residences and to determine relative amounts of recyclable material in the disposed waste from each of six service areas. Cascadia designed and implemented a waste sampling plan that involved capturing and sorting 283 samples of disposed waste over the course of two seasons.

Cascadia analyzed the waste composition data to estimate the composition of disposed single-family waste citywide, as well as for each service area. The composition of single-family waste at the citywide level is summarized at right.

Key conclusions of the analysis are:

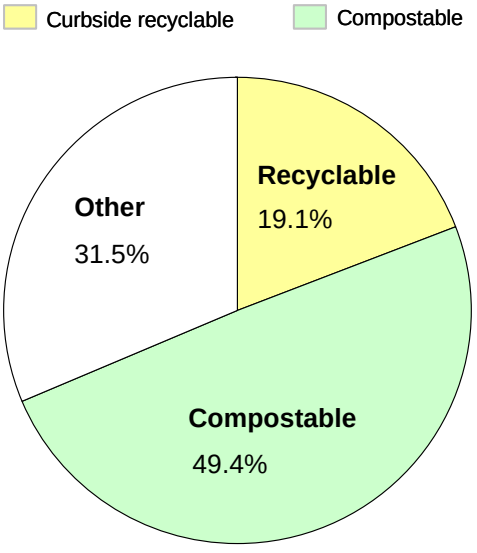
- More than two-thirds of the single-family waste stream consists of material that can be recycled or diverted through standard recycling and composting programs.
- Compostable materials, particularly food and yard waste, account for approximately 215,000 tons of waste disposed annually and comprise nearly half of disposed single-family waste.
- About 83,000 tons of material that could be recycled through the existing curbside collection program is being disposed annually. This is approximately one-fifth of disposed single-family waste.

Cascadia also conducted statistical comparisons of the level of recyclables in single-family waste. Key findings from the comparisons are:

- In areas of the city where participation in curbside recycling is low, the relative amount of recyclables in the disposed waste stream is correspondingly higher.
- Service area 2 has significantly less recyclable material in its disposed waste, compared with other service areas.
- Service area 4 disposes of significantly more recyclable material than other service areas.
- Service area 5 disposes of less material per household and less recyclables per house hold than other service areas.

Composition of Single-Family Residential Waste

Material	Citywide
Paper	**18.3%**
Newspaper	2.7%
Unwaxed OCC / Kraft paper	2.9%
Other recyclable paper	6.7%
Compostable paper	4.5%
Other paper	1.4%
Plastic	**8.3%**
PET (#1) plastic	0.7%
HDPE (#2) plastic	0.7%
Expanded polystyrene	0.5%
Plastic film	3.4%
Other plastic	3.1%
Glass	**2.5%**
Recyclable glass	2.2%
Other glass	0.2%
Metal	**4.4%**
Aluminum cans	0.5%
Tin/steel food cans	1.0%
Other recyclable metals	1.2%
Other metals	1.6%
Organic	**44.9%**
Compostable yard waste	28.1%
Food waste	16.8%
Construction and demolition waste	**7.3%**
Household hazardous waste	**0.4%**
Other materials	**14.0%**
Total	**100.0%**



Section 2: Overview

2.1 Introduction and Background

In order to facilitate the planning of solid waste collection and recycling services, the City of Phoenix engaged Cascadia Consulting Group in conducting a Characterization Study of Residential Solid Waste. The purpose of this study is to provide the City with an accurate characterization of single-family residential MSW disposed by households in each of six *service areas*. Additional objectives are to compare waste composition among geographic service areas and among areas with high and low participation in the curbside recycling program. This information will inform efforts to increase the amount of material diverted through recycling, source reduction, reuse, or other means.

To meet the City's objectives, Cascadia selected and sorted 283 samples of residential waste, which came from six service areas. To account for seasonal variations, the sampling days were divided between winter (dry season) and summer (wet season) sampling periods. Each sorting season consisted of 10 days of waste sorting and either 8 or 9 days of waste sample capture.

The focus of the study included all municipal solid waste that is collected from single-family residences by city-owned trucks or private haulers. The study addressed four main areas of analysis:

1. Based on examination and sorting of waste samples from collection routes located throughout the city, Cascadia developed an overall composition profile of single-family residential waste.
2. With further classification of collection routes as belonging to each of six service areas, Cascadia developed a composition profile for each service area.
3. Collection routes also were classified according to whether they serve areas with high or low participation in curbside recycling services, and Cascadia developed composition profiles that correlate with participation in recycling programs.
4. Statistical comparisons were made to test for differences among service areas and among areas with high and low recycling participation, in order to detect significant differences in the amounts of key recyclables being disposed.

This report presents the results of the four analyses described above, and it gives an overview of the methodology that was used in data collection and analysis. Appendices to this report provide more detailed findings from the data, as well as definitions of the material categories used when characterizing the waste, copies of data collection forms, and detailed descriptions of the process of capturing and sorting waste samples and conducting the statistical analysis.

2.2 Summary of Data Collection and Analysis Activities

Cascadia's subcontractor, Sky Valley Associates, obtained and sorted 283 samples of disposed solid waste from residential collection routes in each of six service areas into which the city is divided. The waste samples were obtained during two seasons – *winter* (January 27 through February 7, 2003) and *summer* (August 1 through August 15, 2003). All samples were obtained from collection trucks that arrived at either 27th Avenue Solid Waste Management Facility or

Skunk Creek Landfill. A map of the service areas and a tally of waste samples are shown below, followed by a description of the steps involved in this waste characterization study.

Figure 1: Map of Service Areas in the City of Phoenix

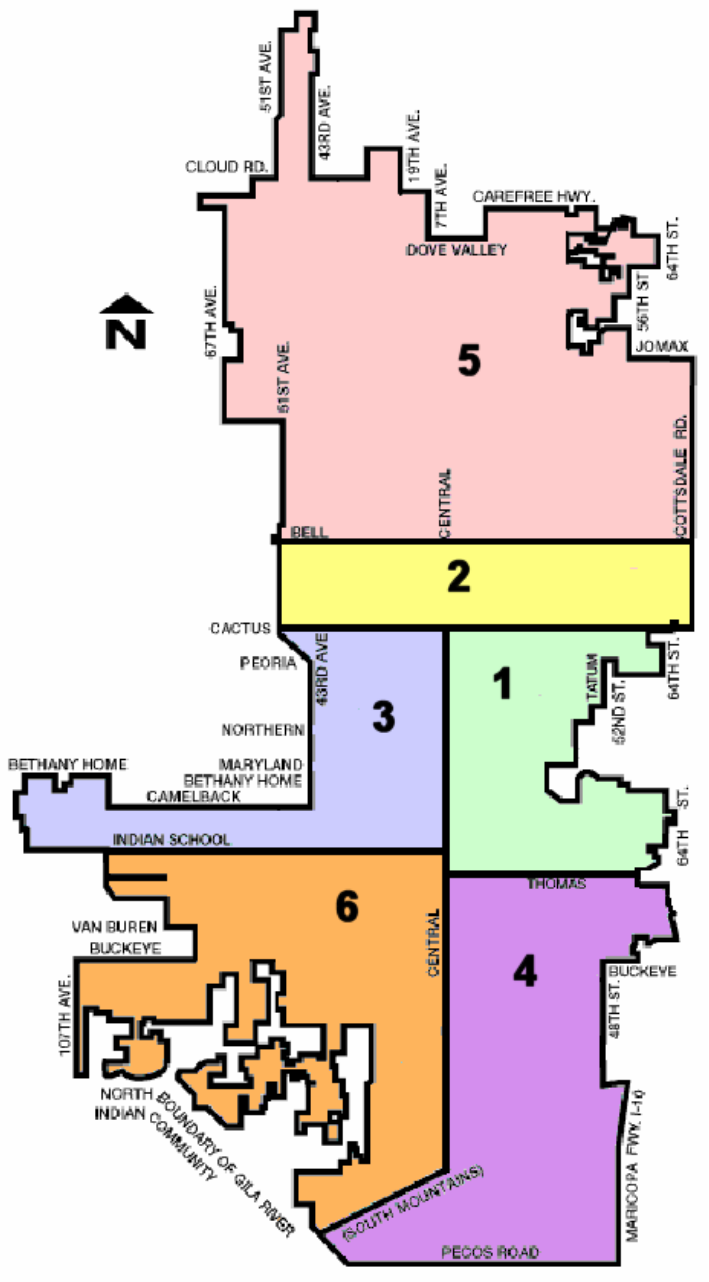


Table 1: Samples per Study Period, by Service Area

Service Area	Winter	Summer	Totals
1	24	22	46
2	24	24	48
3	24	24	48
4	24	23	47
5	24	23	47
6	23	24	47
Totals	**143**	**140**	**283**

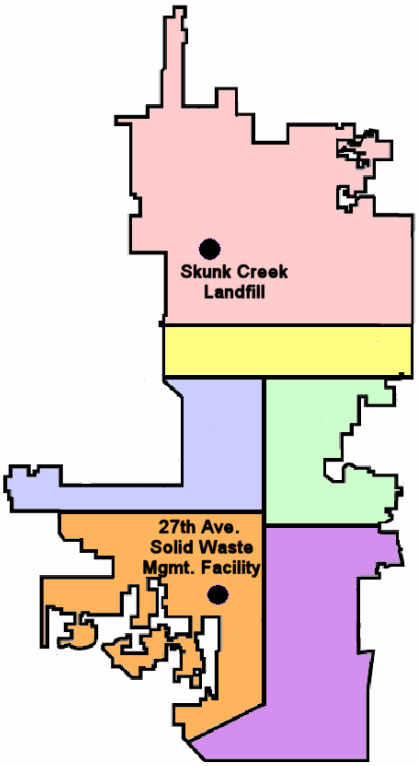
A significant amount of planning and coordination were required for this study to preserve its statistical validity while also attending to the practical considerations that made the study run smoothly and within budget. Careful consideration was given to ensuring that the samples of waste that were chosen for sorting were representative of the single-family residential waste that is disposed in each of the City's service areas. The waste samples themselves were sorted using a meticulous set of procedures designed to promote accuracy. After the samples were sorted, City staff followed the routes from which the samples were obtained, and they noted the incidence of participation in curbside recycling programs on a household-by-household basis. Cascadia then compiled and analyzed the data from the waste sorts to estimate waste composition for each service area and overall, while conducting statistical T-tests for significant differences among subpopulations. A guide to the steps involved in the study is presented below. The detailed methodology of the study is presented in Appendix B.

Step 1: Develop the Sampling Plan

- A list was assembled of all existing collection routes associated with each service area, along with the average number of "trips" (segments of a collection route that the truck travels before it brings its contents to the solid waste facility) associated with each route. The "trip" was the basic unit that that was used to select which waste would be sampled.

- Sampling days were allocated to the two major solid waste facilities in the City – 27th Avenue Solid Waste Management Facility and Skunk Creek Landfill. Then, collection trips that were expected to bring waste to the relevant facility from each service area on each day were identified through a random selection process. Trips were selected and samples were planned in order to assign approximately 23-24 samples per season to each service area and to allow the data collection crew to sort approximately 15 samples per day. A new sampling plan was constructed for each season.

- The City of Phoenix Public Works Department notified drivers of the selected routes and ensured that the correct routes and trips were available for sampling at the expected time and location.



Step 2: Capture and Sort Samples

- A gatekeeper was positioned at the entrance to each facility. The gatekeeper watched all incoming packer trucks in order to identify the pre-selected vehicles that were to provide waste samples. For each vehicle that was identified, the gatekeeper spoke with the driver to verify that the vehicle contained waste from the desired segment of the targeted collection route.

- As each pre-identified vehicle entered the solid waste facility, the sampling crew supervisor verified information with the driver about the waste collected, and the load was tipped on the floor of the facility. A staff member at the facility then used a front loader to scoop a sample of the waste, usually weighing between 200 and 300 pounds, and place it on a tarpaulin for sorting.

- The data collection crew sorted each sample into 89 material categories. For each sample, the weight of each material was recorded on a form and later transferred to a database. Samples were tracked using a numbering system that indicated which collection route and which trip along the route was represented in the truck that delivered the waste.

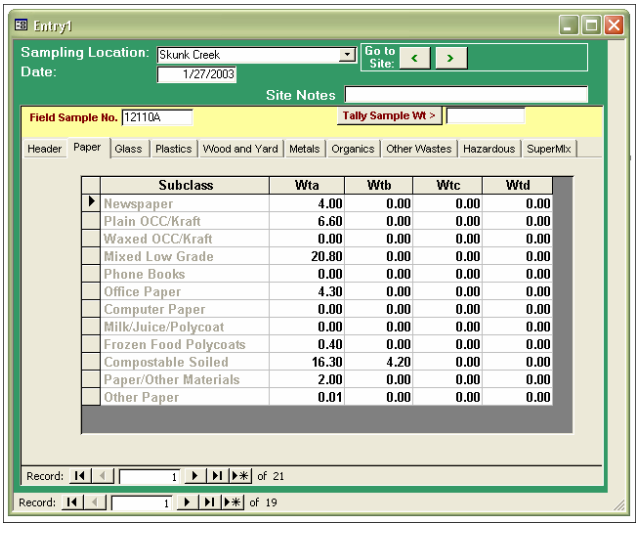
Step 3: Collect Data on Recycling Participation

- For each segment of a collection route that produced a waste sample, City staff observed the recycling set-outs along that segment and counted the number of households that participated in the curbside recycling program, versus the number that did not participate.

Step 4: Analysis and Reporting

- At the end of each data collection season, all data from the sorting activities were entered into a customized database and reviewed for accuracy. At the conclusion of the study, waste composition estimates were calculated city-wide by aggregating sampling data from each service area using a weighted average procedure.

- A waste composition profile was calculated for each service area. Similarly, composition profiles were calculated for the set of neighborhoods with high recycling participation and the set with low recycling



participation that were represented by waste samples. Statistical comparisons were conducted using a modified *t*-test method.

- Waste composition estimates, along with findings about significant differences among subpopulations of the waste stream, and a description of the study methodology, are presented in this report.

Section 3: Sampling Results

The results of the study are presented in this section, starting with waste composition results for the city's overall single-family residential waste stream. Following that, composition findings for the six individual service areas are summarized. These findings highlight the quantity of recyclable and compostable material disposed in each service area. This section concludes with statistical comparisons of the amount of recoverable material that is still disposed in each service area. The amount of recyclables disposed in areas that have high versus low participation in curbside recycling programs are also compared.

For each aspect of the analysis, waste composition was examined at various levels of detail and distinction among the disposed materials.

- The most highly summarized analysis involved examining composition in terms of eight ***material classes***, which include paper, plastic, glass, metal, organic materials, construction and demolition waste, household hazardous waste, and other materials.
- At a much more detailed level, we sorted all samples into 89 ***material components***, each of which belongs to a particular *material class*. The most detailed composition findings shown in this report are expressed in terms of those 89 *material components*.
- Between the level of detail associated with *material classes* and *material components*, we examined waste composition in terms of ***aggregated groups*** of materials. For example, the *aggregated group* called "other recyclable paper" includes the following *material components*: "office paper," "computer paper," "mixed low grade," "phone books," and "milk/juice/polycoat."

In the analyses, tables, pie-charts, and statistical comparisons in this section of the document, we have indicated which level of detail is being considered in each case. Material classes, material components, and aggregated groups of materials are defined thoroughly in Appendix A.

3.1 Citywide Waste Composition Estimates

The pie-chart of Figure 2 shows the portion of the citywide single-family residential waste stream that corresponds to each of eight broad *material classes*. The pie chart also provides notes to indicate the types of *material categories* that belong to each *material class*. A detailed table, Table 2, shows the estimated composition of single-family residential waste citywide. The detailed table is followed by Table 3, which lists the ten *material categories* that occur in greatest amounts (by weight) in Phoenix's single-family residential waste stream.

Figure 2: Composition Summary – Material Classes in Citywide Disposed Single-family Waste

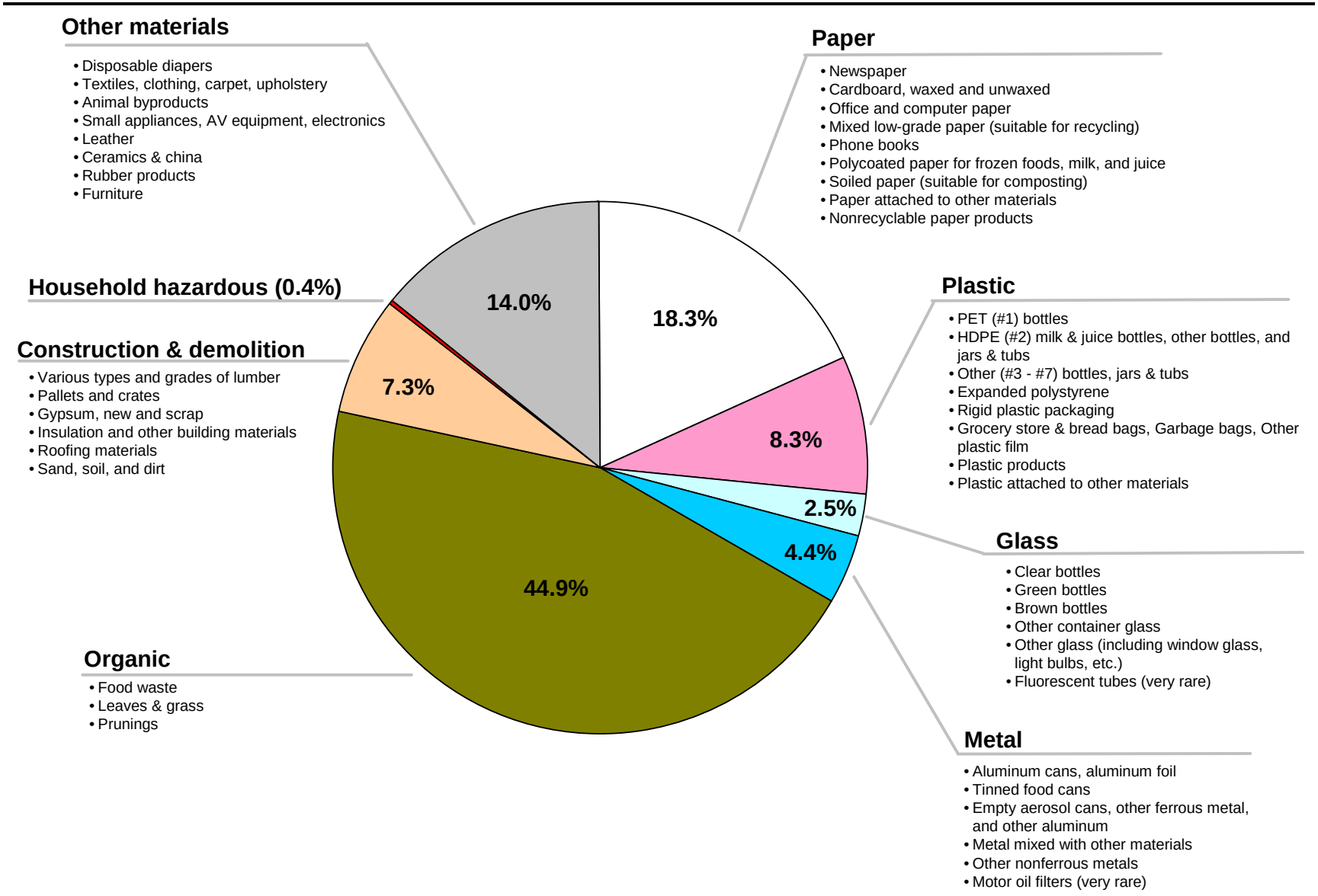


Table 2: Material Categories in Single-family Residential Waste, Citywide

Material	Est. Pct.	+ or –	Est. Tons
Paper	**18.3%**		**79,412**
Newspaper	2.7%	0.2%	11,729
Plain OCC/Kraft	2.9%	0.2%	12,597
Waxed OCC/Kraft	0.1%	0.0%	255
Office Paper	1.2%	0.1%	5,359
Computer Paper	0.0%	0.0%	115
Mixed Low Grade	5.3%	0.2%	22,919
Phone Books	0.1%	0.1%	542
Milk/Juice/Polycoat	0.0%	0.0%	216
Frozen Food Polycoats	0.2%	0.1%	776
Compostable Soiled	4.5%	0.2%	19,682
Paper/Other Materials	1.1%	0.1%	4,884
Nonrecyclable Paper Products	0.1%	0.0%	338
Plastic	**8.3%**		**36,176**
#1 Pop & Liquor	0.2%	0.0%	1,061
#1 Other Bottles	0.5%	0.0%	1,980
#2 Milk & Juice	0.2%	0.0%	1,035
#2 Other Bottles	0.3%	0.0%	1,380
#2 Jars & Tubs	0.1%	0.0%	516
Other Bottles, Jars & Tubs	0.3%	0.0%	1,257
Expanded Polystyrene	0.5%	0.0%	2,061
Other Rigid Packaging	0.8%	0.0%	3,459
Grocery/Store/Bread Bags	0.9%	0.1%	3,909
Garbage Bags	0.9%	0.1%	3,985
Other Plastic Film	1.6%	0.1%	6,757
Plastic Products	1.2%	0.2%	5,017
Plastic/Other Materials	0.9%	0.1%	3,758
Glass	**2.5%**		**10,693**
Clear Beverage/Liquid	0.6%	0.1%	2,642
Green Beverage/Liquid	0.3%	0.1%	1,357
Brown Beverage/Liquid	0.9%	0.1%	4,014
Container Glass	0.4%	0.1%	1,604
Fluorescent Tubes	0.0%	0.0%	3
Other Glass	0.2%	0.1%	1,073
Metal	**4.4%**		**18,994**
Alum. Beverage Cans	0.5%	0.0%	2,052
Alum. Foil/Containers	0.1%	0.0%	647
Other Aluminum	0.0%	0.0%	82
Other Nonferrous	0.0%	0.0%	193
Tinned Food Cans	1.0%	0.1%	4,414
Empty Aerosol Cans	0.1%	0.0%	619
Other Ferrous	0.9%	0.3%	4,034
Motor Oil filters	0.0%	0.0%	50
Mixed Metals/Material	1.6%	0.3%	6,902
Organic	**44.9%**		**195,176**
Leaves & Grass	23.5%	1.6%	102,189
Prunings	4.6%	0.6%	20,069
Food Wastes	16.8%	0.8%	72,918

Material	Est. Pct.	+ or –	Est. Tons
Other Materials	**14.0%**		**61,035**
Textiles/Clothing	3.1%	0.3%	13,384
Carpet/Upholstery	1.6%	0.3%	7,103
Leather	0.3%	0.1%	1,368
Disposable Diapers	3.6%	0.4%	15,511
Animal By-products	2.6%	0.6%	11,165
Rubber Products	0.3%	0.1%	1,302
Tires	0.0%	0.0%	68
Ash	0.1%	0.0%	295
Furniture	0.3%	0.1%	1,113
Mattresses	0.0%	0.0%	34
Small Appliances	0.4%	0.2%	1,748
Audio/Visual Equipment	0.3%	0.1%	1,235
Computer Monitors	0.0%	0.0%	169
Television Sets	0.1%	0.1%	250
Other Computer Equipment	0.1%	0.1%	645
Ceramics/China	0.3%	0.1%	1,360
Non-distinct Fines	0.2%	0.1%	923
Misc. Organics	0.6%	0.1%	2,534
Misc. Inorganics	0.2%	0.1%	828
Hazardous Wastes	**0.4%**		**1,683**
Latex Paint	0.1%	0.1%	497
Hazardous Glue/Adhesives	0.0%	0.0%	32
Non-hazardous Glues	0.0%	0.0%	46
Oil-based Paint/Thinners	0.0%	0.0%	65
Hazardous Cleaners	0.0%	0.0%	54
Pesticides/Herbicides	0.0%	0.1%	194
Dry-cell Batteries	0.1%	0.0%	275
Wet-cell Batteries	0.0%	0.0%	24
Gasoline/Kerosene	0.0%	0.0%	0
Motor Oil/Diesel Oil	0.0%	0.0%	130
Asbestos	0.0%	0.0%	0
Explosives	0.0%	0.0%	0
Other Hazardous	0.0%	0.0%	198
Other Non-hazardous	0.0%	0.0%	168
C&D Wastes	**7.3%**		**31,614**
Dimension Lumber	1.2%	0.4%	5,385
Pallets	0.1%	0.1%	270
Crates/Boxes	0.0%	0.0%	52
Other Untreated Wood	0.5%	0.4%	2,128
Treated Wood	0.4%	0.1%	1,787
Contaminated Wood	0.6%	0.3%	2,570
New Gypsum Scrap	0.0%	0.0%	114
Demo Gypsum Scrap	0.4%	0.2%	1,874
Fiberglass Insulation	0.0%	0.0%	58
Rock/Concrete/Bricks	1.5%	0.5%	6,598
Asphaltic Roofing	0.2%	0.1%	1,013
Other Construction Debris	0.7%	0.3%	2,925
Sand/Soil/Dirt	1.6%	0.4%	6,841
Totals	**100.0%**		**434,783**

Number of Samples: 283

Confidence intervals were calculated at the 90% confidence level.

Table 3: Top Ten Material Categories in Single-Family Residential Waste

Material	Estimated Percent	Cumulative Percent
Leaves & Grass	23.5%	23.5%
Food Wastes	16.8%	40.3%
Mixed Low Grade Paper	5.3%	45.5%
Prunings	4.6%	50.2%
Compostable Soiled Paper	4.5%	54.7%
Disposable Diapers	3.6%	58.3%
Textiles/Clothing	3.1%	61.3%
Plain Corrugated Cardboard and Kraft Paper	2.9%	64.2%
Newspaper	2.7%	66.9%
Animal By-products	2.6%	69.5%

As Table 3 shows, some of the materials that occur in greatest quantity in Phoenix single-family residential waste are yardwastes (leaves and grass, prunings), food, and various grades of paper and cardboard. All of these materials are either recyclable or compostable. Materials occurring in large quantities that are *not* easily recoverable include textiles and clothing, disposable diapers, and animal by-products.

Conclusions

Conclusions regarding the composition of single-family residential waste citywide are presented below.

- ***Organics*** and ***Paper*** are the material classes present in largest amounts in this part of the waste stream. They constitute more than 53% of all single-family residential waste.
- The specific material categories ***Leaves and Grass*** and ***Food*** are the most prevalent of all material categories in single-family residential waste. Together, these materials make up more than 40% of single-family residential waste.
- Seven of the top ten material categories (as shown in Table 3) are recyclable or recoverable. Together, these materials represent more than 60% of single-family residential waste.

3.2 Waste Composition by Service Area

Table 4 on the following page presents waste composition estimates for each service area and for the city as a whole, using *aggregated groups* of materials. The aggregation is used in order to make the table more readable and to focus attention on key recyclable and compostable materials. (Please see page 6 of Appendix A for an explanation of how the detailed material list was translated to the condensed list.) Table 5, which follows, summarizes the recyclable and compostable portions of the single-family waste stream from each service area even more concisely. The pie chart of Figure 3 depicts the relative amounts of disposed materials that are readily recyclable and that are considered suitable for composting programs.

Table 4: Summary of Waste Composition, by Service Area

Material	Service Area 1	2	3	4	5	6	Citywide	+ or –
Paper	**17.7%**	**17.3%**	**17.5%**	**18.8%**	**20.6%**	**18.1%**	**18.3%**	
Newspaper	3.8%	2.3%	2.4%	2.5%	2.8%	2.6%	2.7%	0.2%
Unwaxed OCC / Kraft paper	2.6%	2.2%	2.9%	3.2%	2.8%	3.4%	2.9%	0.2%
Other recyclable paper	6.4%	6.5%	6.1%	7.3%	8.1%	6.2%	6.7%	0.3%
Compostable paper	3.9%	4.6%	4.2%	4.6%	5.3%	4.6%	4.5%	0.2%
Other paper	1.0%	1.6%	2.0%	1.2%	1.6%	1.2%	1.4%	0.1%
Plastic	**7.6%**	**7.1%**	**8.0%**	**9.4%**	**8.0%**	**9.3%**	**8.3%**	
PET (#1) plastic	0.7%	0.5%	0.7%	0.9%	0.6%	0.8%	0.7%	0.0%
HDPE (#2) plastic	0.5%	0.6%	0.6%	0.8%	0.7%	0.7%	0.7%	0.1%
Expanded polystyrene	0.4%	0.4%	0.4%	0.6%	0.3%	0.7%	0.5%	0.0%
Plastic film	3.3%	2.8%	3.6%	3.6%	3.5%	3.3%	3.4%	0.2%
Other plastic	2.7%	2.9%	2.7%	3.4%	3.0%	3.9%	3.1%	0.2%
Glass	**1.5%**	**1.9%**	**2.1%**	**3.4%**	**2.1%**	**3.3%**	**2.5%**	
Recyclable glass	1.3%	1.7%	1.9%	3.2%	1.9%	2.9%	2.2%	0.2%
Other glass	0.2%	0.2%	0.2%	0.2%	0.2%	0.5%	0.2%	0.1%
Metal	**4.4%**	**3.6%**	**4.4%**	**5.2%**	**3.9%**	**4.4%**	**4.4%**	
Aluminum cans	0.4%	0.5%	0.4%	0.6%	0.5%	0.4%	0.5%	0.0%
Tin/steel food cans	0.9%	0.9%	1.1%	1.3%	0.8%	1.0%	1.0%	0.1%
Other recyclable metals	1.6%	0.8%	1.2%	1.7%	1.0%	1.2%	1.2%	0.3%
Other metals	1.6%	1.4%	1.7%	1.7%	1.6%	1.8%	1.6%	0.3%
Organic	**51.6%**	**48.6%**	**49.0%**	**38.1%**	**47.8%**	**37.7%**	**44.9%**	
Compostable yard waste	35.6%	32.6%	31.7%	20.7%	28.9%	22.5%	28.1%	1.7%
Food waste	16.0%	16.0%	17.3%	17.4%	18.9%	15.3%	16.8%	0.8%
Construction and demolition waste	**6.8%**	**8.4%**	**6.2%**	**7.6%**	**4.0%**	**9.7%**	**7.3%**	**1.0%**
Household hazardous waste	**0.2%**	**0.5%**	**0.4%**	**0.3%**	**0.7%**	**0.4%**	**0.4%**	**0.1%**
Other materials	**10.2%**	**12.7%**	**12.5%**	**17.3%**	**12.9%**	**17.0%**	**14.0%**	**0.9%**
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	

Confidence intervals calculated at the 90% confidence level

Key: Material is considered to be recyclable in the existing residential curbside collection program

Material is considered to be compostable in most large-scale composting operations

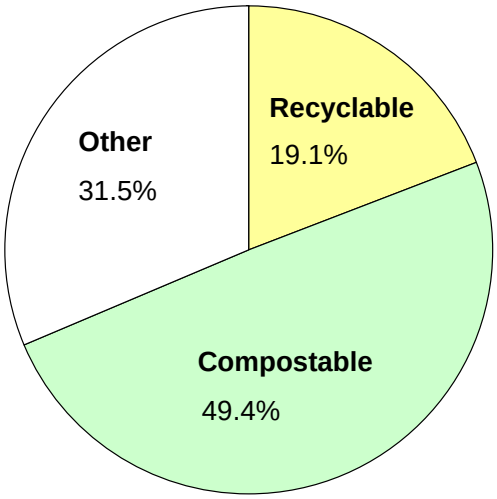
Table 5: Summary of Recyclable and Compostable Material, by Service Area

Category	Service Area 1	2	3	4	5	6	Citywide
Recyclable	**18.6%**	**16.3%**	**17.6%**	**22.1%**	**19.5%**	**19.9%**	**19.1%**
Recyclable papers	12.8%	11.0%	11.4%	12.9%	13.7%	12.3%	12.3%
Recyclable plastics	1.6%	1.4%	1.7%	2.4%	1.6%	2.1%	1.8%
Recyclable glass	1.3%	1.7%	1.9%	3.2%	1.9%	2.9%	2.2%
Recyclable metals	2.9%	2.2%	2.6%	3.5%	2.4%	2.6%	2.7%
Recoverable organics	**55.5%**	**53.2%**	**53.2%**	**42.7%**	**53.1%**	**42.4%**	**49.4%**
Compostable paper	3.9%	4.6%	4.2%	4.6%	5.3%	4.6%	4.5%
Compostable yard waste	35.6%	32.6%	31.7%	20.7%	28.9%	22.5%	28.1%
Food waste	16.0%	16.0%	17.3%	17.4%	18.9%	15.3%	16.8%
Other	**25.9%**	**30.5%**	**29.2%**	**35.3%**	**27.3%**	**37.8%**	**31.5%**
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Key: Material is considered to be recyclable in the existing residential curbside collection program

Material is considered to be compostable in most large-scale composting operations

Figure 3: Relative Amounts of Recyclable and Compostable Materials in Single-family Waste, Citywide



Recyclable and recoverable items make up a large portion of Phoenix single-family residential waste. More than one-sixth of the waste stream is readily recyclable, while nearly half of the waste stream is suitable for recovery in an organics management program.

Comparisons Among Service Areas

A more detailed examination of the concentration of recyclable materials present in the waste stream in each service area shows statistically significant differences among service areas. A summary of the key differences that were found appears below. Statistically significant differences were found by application of the statistical *t*-test, which is described in Appendix E along with a more complete list of all the differences found in levels of recyclables in the waste stream among service areas.

Service area 1 has:

- more *newspaper* than other service areas;
- less *recyclable glass* than other service areas
- less *recyclable polystyrene* and less *combined recyclable plastics* than other service areas

Service area 2 has:

- less *unwaxed OCC* (cardboard) and less *combined recyclable paper* than other service areas
- less *PET (#1) plastic bottles*, less *expanded polystyrene*, and less *combined recyclable plastic* than other service areas
- less *recyclable glass* than other service areas
- **less recyclables, in general, than other service areas**

Service area 3 showed no statistically significant differences when compared to all other service areas in the city.

Service area 4 has:

- more *combined recyclable plastics* than other service areas, as well as more *PET (#1) plastic bottles*, more *HDPE (#2) plastic containers*, and more *expanded polystyrene*.
- more *recyclable glass* than other service areas
- more *combined recyclable metal* and more *tin/steel food cans* than other service areas
- **more recyclables, in general, than other service areas**

Service area 5 has:

- more of *other recyclable paper* and more *combined recyclable paper* than other service areas
- less *expanded polystyrene* than other service areas

Service area 6 has:

- more *unwaxed OCC* (cardboard) than other service areas
- more *expanded polystyrene* and more *combined recyclable plastic* than other service areas
- more *recyclable glass* than other service areas

Building upon the above estimates of waste composition *by percent* for each service area, Table 6 and Table 7 present the estimated amounts of key materials present in the waste of each service area in terms of *tons disposed annually*.

Table 6: Annual Tonnage Estimates of Key Materials Disposed, by Service Area

Material	Service Area 1	2	3	4	5	6	Citywide
Paper	**10,715**	**11,420**	**14,650**	**15,403**	**11,963**	**15,262**	**79,412**
Newspaper	2,297	1,545	1,974	2,069	1,625	2,220	11,729
Unwaxed OCC / Kraft paper	1,589	1,473	2,436	2,598	1,608	2,893	12,597
Other recyclable paper	3,847	4,275	5,113	5,960	4,713	5,242	29,152
Compostable paper	2,382	3,069	3,484	3,764	3,088	3,894	19,682
Other paper	600	1,057	1,642	1,012	929	1,012	6,253
Plastic	**4,583**	**4,719**	**6,660**	**7,686**	**4,679**	**7,848**	**36,176**
PET (#1) plastic	402	307	565	761	346	660	3,041
HDPE (#2) plastic	332	380	534	696	417	571	2,931
Expanded polystyrene	217	238	358	510	182	555	2,061
Plastic film	2,014	1,872	2,970	2,965	2,017	2,813	14,652
Other plastic	1,618	1,921	2,233	2,755	1,717	3,248	13,491
Glass	**910**	**1,223**	**1,721**	**2,805**	**1,228**	**2,805**	**10,693**
Recyclable glass	793	1,116	1,551	2,656	1,088	2,412	9,616
Other glass	118	107	170	149	139	393	1,076
Metal	**2,679**	**2,355**	**3,645**	**4,308**	**2,293**	**3,714**	**18,994**
Aluminum cans	263	338	345	452	307	348	2,052
Tin/steel food cans	523	584	885	1,061	493	868	4,414
Other recyclable metals	949	533	967	1,374	579	980	5,382
Other metals	944	900	1,448	1,421	914	1,518	7,146
Organic	**31,177**	**32,090**	**40,988**	**31,283**	**27,827**	**31,812**	**195,176**
Compostable yard waste	21,492	21,543	26,479	16,976	16,816	18,951	122,258
Food waste	9,684	10,547	14,509	14,307	11,011	12,861	72,918
Construction and demolition waste	**4,103**	**5,530**	**5,211**	**6,263**	**2,322**	**8,184**	**31,614**
Household hazardous waste	**102**	**319**	**303**	**211**	**388**	**359**	**1,683**
Other materials	**6,160**	**8,421**	**10,475**	**14,184**	**7,479**	**14,317**	**61,035**
Total	**60,431**	**66,076**	**83,652**	**82,143**	**58,180**	**84,301**	**434,783**

Key: Material is considered to be recyclable in the existing residential curbside collection program

Material is considered to be compostable in most large-scale composting operations

Table 7: Annual Tonnage Estimates of Recyclable and Compostable Materials, by Service Area

Category	Service Area 1	2	3	4	5	6	Citywide
Recyclable	**11,212**	**10,790**	**14,729**	**18,136**	**11,359**	**16,750**	**82,975**
Recyclable papers	7,733	7,293	9,523	10,627	7,946	10,355	53,478
Recyclable plastics	951	925	1,458	1,967	945	1,787	8,033
Recyclable glass	793	1,116	1,551	2,656	1,088	2,412	9,616
Recyclable metals	1,735	1,455	2,197	2,887	1,379	2,196	11,848
Recoverable organics	**33,559**	**35,159**	**44,472**	**35,047**	**30,916**	**35,706**	**214,858**
Compostable paper	2,382	3,069	3,484	3,764	3,088	3,894	19,682
Compostable yard waste	21,492	21,543	26,479	16,976	16,816	18,951	122,258
Food waste	9,684	10,547	14,509	14,307	11,011	12,861	72,918
Other	**15,661**	**20,127**	**24,451**	**28,960**	**15,906**	**31,845**	**136,950**
Total	**60,431**	**66,076**	**83,652**	**82,143**	**58,180**	**84,301**	**434,783**

Key: Material is considered to be recyclable in the existing residential curbside collection program

Material is considered to be compostable in most large-scale composting operations

Focusing even more on distinctions among service areas, Table 8 and Table 9 present the disposal picture in terms of *pounds of key materials disposed per household* annually. In these analyses, for the purpose of counting, a household is taken to be equivalent to one single-family residential waste collection account.

Table 8: Estimated Pounds of Key Materials Disposed Annually per Household, by Service Area

	Service Area						
Material	**1**	**2**	**3**	**4**	**5**	**6**	**Citywide**
Paper	**474**	**435**	**491**	**510**	**384**	**516**	**468**
Newspaper	102	59	66	68	52	75	69
Unwaxed OCC / Kraft paper	70	56	82	86	52	98	74
Other recyclable paper	170	163	171	197	151	177	172
Compostable paper	105	117	117	125	99	132	116
Other paper	27	40	55	33	30	34	37
Plastic	**203**	**180**	**223**	**254**	**150**	**265**	**213**
PET (#1) plastic	18	12	19	25	11	22	18
HDPE (#2) plastic	15	14	18	23	13	19	17
Expanded polystyrene	10	9	12	17	6	19	12
Plastic film	89	71	100	98	65	95	86
Other plastic	72	73	75	91	55	110	80
Glass	**40**	**47**	**58**	**93**	**39**	**95**	**63**
Recyclable glass	35	43	52	88	35	82	57
Other glass	5	4	6	5	4	13	6
Metal	**119**	**90**	**122**	**143**	**74**	**126**	**112**
Aluminum cans	12	13	12	15	10	12	12
Tin/steel food cans	23	22	30	35	16	29	26
Other recyclable metals	42	20	32	45	19	33	32
Other metals	42	34	49	47	29	51	42
Organic	**1,380**	**1,223**	**1,374**	**1,035**	**892**	**1,075**	**1,150**
Compostable yard waste	951	821	887	562	539	641	721
Food waste	429	402	486	473	353	435	430
Construction and demolition waste	**182**	**211**	**175**	**207**	**74**	**277**	**186**
Household hazardous waste	**5**	**12**	**10**	**7**	**12**	**12**	**10**
Other materials	**273**	**321**	**351**	**469**	**240**	**484**	**360**
Total pounds per account	**2,674**	**2,519**	**2,804**	**2,718**	**1,865**	**2,849**	**2,563**
Number of Accounts	45,193	52,471	59,674	60,445	62,381	59,172	339,336

Key: Material is considered to be recyclable in the existing residential curbside collection program

Material is considered to be compostable in most large-scale composting operations

Table 9: Estimated Pounds of Recyclable and Compostable Materials Disposed Annually per Household, by Service Area

Category	Service Area 1	2	3	4	5	6	Citywide
Recyclable	**496**	**411**	**494**	**600**	**364**	**566**	**489**
Recyclable papers	342	278	319	352	255	350	315
Recyclable plastics	42	35	49	65	30	60	47
Recyclable glass	35	43	52	88	35	82	57
Recyclable metals	77	55	74	96	44	74	70
Recoverable organics	**1,485**	**1,340**	**1,490**	**1,160**	**991**	**1,207**	**1,266**
Compostable paper	105	117	117	125	99	132	116
Compostable yard waste	951	821	887	562	539	641	721
Food waste	429	402	486	473	353	435	430
Other	**693**	**767**	**820**	**958**	**510**	**1,076**	**807**
Total	**2,674**	**2,519**	**2,804**	**2,718**	**1,865**	**2,849**	**2,563**

Key: Material is considered to be recyclable in the existing residential curbside collection program

Material is considered to be compostable in most large-scale composting operations

Conclusions

Key conclusions about the amounts of recyclable and compostable materials in single-family residential waste are presented below. Appendix E presents more detailed findings regarding differences among service areas in the disposal levels of recyclables.

- Citywide, almost 50% of single-family residential waste consists of compostable organic materials, including food, yard waste, and compostable paper.
- Citywide, almost 20% of Phoenix's single-family waste is recyclable under existing curbside collection programs.
- Service Area 2 has a lower concentration of recyclable material in its disposed waste. Specifically, it disposes of relatively less recyclable papers, recyclable plastic, recyclable glass than other areas.
- Service Area 4 has a higher concentration of recyclable material in its disposed waste, including relatively higher levels of plastic, recyclable glass, and tinned food cans.
- Service Area 5 disposes the lowest amount of waste per collection account. Consistent with this, Service Area 5 disposes the lowest amounts of recyclables and compostable organic materials per collection account.

3.3 Analysis of Waste Composition in Relation to Participation in Curbside Recycling

This section examines correlations between participation in curbside recycling service and amounts of recyclables in the disposed waste stream. In order to facilitate these comparisons, City staff undertook observations of residential collection routes during the study's sampling periods, noting the number of active accounts and the number of actual curbside set-outs of recyclables along each route, or portion of a route, that corresponded with a waste sample. Cascadia then grouped collection routes into *quartiles* of participation levels, according to the percent of households that set out recyclables along each route. We then examined the waste composition for the top 25% and the bottom 25% of collection routes, when ranked in order of their level of participation in the curbside recycling program.

Table 10 and Table 11 show waste composition findings for routes that have high and low participation levels in recycling programs. Between the high- and low-participation areas, there are statistically significant differences in the relative amounts of several recycled materials, with the higher concentration of each material lying in the disposed waste of the areas that have lower recycling participation. Low-participation areas dispose of relatively greater amounts of:

- *unwaxed OCC* (cardboard);
- *PET (#1) plastic bottles*, *HDPE (#2) plastic bottles*, *expanded polystyrene*, and *combined recyclable plastic*;
- *recyclable glass*;
- *tin/steel food cans*, *aluminum cans*, and *combined recyclable metal*;
- **all recyclables combined**

Table 10: Key Materials in Disposed Waste, Correlated with Participation in the Curbside Recycling Program

Material	Recycling Participation Level		Citywide	+ or –
	High	Low		
Paper	**18.2%**	**17.8%**	**18.3%**	
Newspaper	2.5%	3.1%	2.7%	0.2%
Unwaxed OCC / Kraft paper	2.1%	3.3%	2.9%	0.2%
Other recyclable paper	7.0%	6.5%	6.7%	0.3%
Compostable paper	5.1%	3.8%	4.5%	0.2%
Other paper	1.5%	1.1%	1.4%	0.1%
Plastic	**6.8%**	**9.1%**	**8.3%**	
PET (#1) plastic	0.5%	0.9%	0.7%	0.0%
HDPE (#2) plastic	0.5%	0.8%	0.7%	0.1%
Expanded polystyrene	0.3%	0.6%	0.5%	0.0%
Plastic film	2.9%	3.6%	3.4%	0.2%
Other plastic	2.5%	3.2%	3.1%	0.2%
Glass	**1.8%**	**2.9%**	**2.5%**	
Recyclable glass	1.7%	2.7%	2.2%	0.2%
Other glass	0.1%	0.3%	0.2%	0.1%
Metal	**3.3%**	**5.2%**	**4.4%**	
Aluminum cans	0.4%	0.6%	0.5%	0.0%
Tin/steel food cans	0.8%	1.2%	1.0%	0.1%
Other recyclable metals	0.8%	1.6%	1.2%	0.3%
Other metals	1.3%	1.8%	1.6%	0.3%
Organic	**52.1%**	**38.4%**	**44.9%**	
Compostable yard waste	33.6%	22.3%	28.1%	1.7%
Food waste	18.5%	16.0%	16.8%	0.8%
Construction and demolition waste	**5.1%**	**11.4%**	**7.3%**	**1.0%**
Household hazardous waste	**0.6%**	**0.3%**	**0.4%**	**0.1%**
Other materials	**12.1%**	**15.0%**	**14.0%**	**0.9%**
Total	**100.0%**	**100.0%**	**100.0%**	

Confidence intervals calculated at the 90% confidence level

Key:
- Material is considered to be recyclable in the existing residential curbside collection program
- Material is considered to be compostable in most large-scale composting operations

Table 11: Amounts of Recyclable and Compostable Materials in Disposed Waste, Correlated with Participation in the Curbside Recycling Program

Category	Recycling Participation Level		Citywide
	High	Low	
Recyclable	**16.6%**	**21.1%**	**19.1%**
Recyclable papers	11.6%	12.8%	12.3%
Recyclable plastics	1.4%	2.3%	1.8%
Recyclable glass	1.7%	2.7%	2.2%
Recyclable metals	2.0%	3.4%	2.7%
Recoverable organics	**57.2%**	**42.2%**	**49.4%**
Compostable paper	5.1%	3.8%	4.5%
Compostable yard waste	33.6%	22.3%	28.1%
Food waste	18.5%	16.0%	16.8%
Other	**26.2%**	**36.7%**	**31.5%**
Total	**100.0%**	**100.0%**	**100.0%**

Key: Material is considered to be recyclable in the existing residential curbside collection program

Material is considered to be compostable in most large-scale composting operations

Conclusions

As expected, the statistical comparisons lead to the conclusion that neighborhoods with high participation in the curbside recycling program generally have a lower concentration of recyclables in their disposed waste.

- High-participation areas dispose of relatively less of *combined recyclable plastics*, *combined recyclable glass*, and *combined recyclable metals* than do areas with low participation. However, they do not dispose of significantly less *combined recyclable paper*.
- **High-participation areas disposed of relatively less recyclables, in general, than do areas with low participation.**

APPENDIX A. Material Definitions

A.1 Detailed Set of 89 Material Categories

Waste samples were sorted by hand into eight material classes, which were further divided into 89 material categories, as defined in this section.

Paper

NEWSPAPER: 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.).

PLAIN OCC/KRAFT PAPER: Old unwaxed/uncoated corrugated container boxes and Kraft paper, and brown paper bags.

WAXED OCC/KRAFT PAPER: Old waxed/coated corrugated container boxes and Kraft paper, and brown paper bags.

OFFICE PAPER: White or lightly colored sulfite/sulfate bond, copy papers, and envelopes.

COMPUTER PAPER: Continuous-feed sulfite/sulfate/ground wood computer printouts and forms of all types, excluding carbonless paper.

MIXED LOW GRADE: Low-grade, potentially recyclable papers, including junk mail, magazines, colored papers, bleached Kraft, boxboard, mailing tubes, carbonless copy paper, and paperback books.

PHONE BOOKS: Telephone directories.

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

FROZEN FOOD POLYCOATS: Bleached and unbleached polycoated frozen/refrigerator packaging, and excluding polycoated milk/ice cream/aseptic containers.

COMPOSTABLE/SOILED PAPER: Paper towels, paper plates, waxed paper, and tissues.

PAPER/OTHER MATERIALS: Predominantly paper with other materials attached (e.g. orange juice cans and spiral notebooks).

NONRECYCLABLE PAPER PRODUCTS: Carbon copy paper, hardcover books, and photographs.

Plastic

PET POP & LIQUOR: Polyethylene trephthelate translucent pop and liquor bottles.

OTHER PET BOTTLES: All other PET bottles not included above.

HDPE MILK & JUICE: High-density translucent polyethylene milk, juice, and beverage containers.

OTHER HDPE BOTTLES: All other HDPE bottles not included above.

OTHER PLASTIC BOTTLES: Plastic bottles not classified in the above-defined PET or HDPE categories; includes #3-#7, unknown bottles, petroleum bottles, and other dark colored bottles.

JARS & TUBS: Wide mouth jars and tubs #1-#7 such as yogurt, cottage cheese, margarine.

EXPANDED POLYSTYRENE: Includes packaging and finished products made of expanded polystyrene.

OTHER RIGID PACKAGING: Rigid plastic packaging #1-#7 and unknown (excluding expanded polystyrene). Includes clamshells, salad trays, lids, cookie tray inserts, plastic spools, and toothpaste tubes.

GROCERY/BREAD BAGS: Bread, grocery, and dry cleaner plastic film bags.

GARBAGE BAGS: Plastic garbage bags.

OTHER FILM: Includes film packaging, excluding grocery/bread and garbage bags. Also includes plastic sheeting, photographic negatives, and shower curtains.

PLASTIC PRODUCTS: Finished plastic products such as toys, toothbrushes, and vinyl hose. Includes fiberglass resin products and materials.

PLASTIC/OTHER MATERIALS: Predominately plastic with other materials attached such as disposable razors, pens, lighters, toys, and 3-ring binders.

Glass

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

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

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

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

FLUORESCENT TUBES: Fluorescent light tubes.

OTHER GLASS: Window glass, light bulbs (except fluorescent tubes), glassware, etc.

Metal

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

ALUMINUM FOIL/CONTAINERS: Aluminum food containers, trays, and foil.

OTHER ALUMINUM: Aluminum products and scrap such as window frames, cookware.

OTHER NONFERROUS: Metals not derived from iron, to which a magnet will not adhere, and which are not significantly contaminated with other metals or materials.

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

EMPTY AEROSOL CANS: Empty, mixed material/metal aerosol cans. (Aerosols that still contain product are sorted according to that material—for instance, solvent-based paint.)

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

OIL FILTERS: Metal oil filters used in cars and other automobiles.

MIXED METALS/MATERIALS: Motors, insulated wire, and finished products containing a mixture of metals, or metals and other materials, whose weight is derived significantly from the metal portion of its construction. White goods are banned from Seattle's disposal. However, segments of large appliances are occasionally found; they are included in this category.

Organic

PALLETS: Wood pallets.

CRATES: Crates, and other packaging lumber/panelboard.

LEAVES AND GRASS: Grass clippings, leaves, and weeds.

PRUNINGS: Cut prunings, 6" or less in diameter, from bushes, shrubs, and trees.

FOOD: Food wastes and scraps, including bone, rinds, etc. Excludes the weight of food containers, except when container weight is not appreciable compared to the food inside.

Construction and Demolition Wastes

DIMENSION LUMBER: Milled lumber.

OTHER UNTREATED WOOD: Compostable prunings or stumps 6" or greater in diameter.

TREATED WOOD: Lumber and wood products that have been painted or treated so as to render them difficult to compost.

CONTAMINATED WOOD: Lumber and wood products, often with adhering concrete or other contaminants that would not compost easily.

NEW GYPSUM SCRAP: New gypsum wallboard scrap.

DEMO GYPSUM SCRAP: Used or demolition gypsum wallboard scrap.

FIBERGLASS INSULATION: Fiberglass building and mechanical insulation, batt or rigid.

ROCK/CONCRETE/BRICKS: Includes rock gravel larger than 2" diameter, Portland cement mixtures (set or unset), and fired-clay bricks.

ASPHALTIC ROOFING: Asphalt shingles, tarpaper of built-up roofing.

CONSTRUCTION DEBRIS: Construction debris (other than wood), which cannot be classified into other component categories, and mixed fine building material scraps.

SAND/SOIL/DIRT: Contains mixed fines smaller than 2" in diameter.

Household Hazardous

LATEX PAINTS: Water-based paints and similar products.

HAZARDOUS ADHESIVES/GLUES: Oil/resin/volatile solvent-based glues and adhesives, including epoxy, rubber cement, two-part glues and sealers, and auto body fillers.

NON-HAZARDOUS ADHESIVES/GLUES: Water-based glues, caulking compounds, grouts, and spackle.

OIL-BASED PAINT/SOLVENT: Solvent-based paints, varnishes, and similar products. Various solvents, including chlorinated and flammable solvents, paint strippers, solvents contaminated with other products such as paints, degreasers and some other cleaners if the primary ingredient is (or was) a solvent, or alcohol such as methanol and isopropanol.

HAZARDOUS CLEANERS: Various acids and bases whose primary purpose is to clean surfaces, unclog drains, or perform other actions.

PESTICIDES/HERBICIDES: Variety of poisons whose purpose is to discourage or kill pests, weeds, or microorganisms. Fungicides and wood preservatives, such as pentachlorophenol, are also included.

DRY-CELL BATTERIES: Dry-cell batteries of various sizes and types as commonly used in households.

WET-CELL BATTERIES: Wet-cell batteries of various sizes and types as commonly used in automobiles.

GASOLINE/KEROSENE: Gasoline, diesel fuel, and fuel oils.

MOTOR OIL/DIESEL OIL: Lubricating oils, primarily used in vehicles but including other types with similar characteristics.

ASBESTOS: Asbestos and asbestos-containing wastes (if this is the primary hazard associated with these wastes).

EXPLOSIVES: Gunpowder, unspent ammunition, picric acid, and other potentially explosive chemicals.

OTHER HAZARDOUS CHEMICALS: Other hazardous wastes that do not fit into the above categories, including unidentifiable materials and medical wastes such as I.V. tubing and patient drapes (Medical wastes that could be considered a bio-hazard were excluded from the sorts.).

OTHER NON-HAZARDOUS CHEMICALS: Non-hazardous soaps, cleaners, medicines, cosmetics, and other household chemicals.

Other Materials

TEXTILES: Fabric materials including natural and synthetic textiles such as cotton, wool, silk, woven nylon, rayon, polyester, and other materials.

CARPET/UPHOLSTERY: General category of flooring applications consisting of various natural or synthetic fibers bonded to some type of backing material.

LEATHER: Finished products or scraps of leather.

DISPOSABLE DIAPERS: Disposable baby diapers and adult protective undergarments.

ANIMAL BY-PRODUCTS: Animal carcasses and wastes, and kitty litter.

RUBBER PRODUCTS: Finished products and scrap materials made of rubber, such as bath mats, inner tubes, rubber hoses, and foam rubber.

TIRES: Vehicle tires of all types.

ASH: Fireplace, burn barrel, or fire pit ash.

FURNITURE: Mixed-material furniture such as upholstered chairs.

MATTRESSES: Mattresses and box springs.

SMALL APPLIANCES: Small electric appliances such as toasters, microwave ovens, power tools, curling irons, and light fixtures.

AUDIO/VISUAL EQUIPMENT: Stereos, radios, tape decks, VCRs, etc.

COMPUTER MONITORS: Computer monitors, laptops, and other items containing a cathode ray tube (CRT).

TELEVISIONS: Television sets containing a cathode ray tube (CRT).

OTHER COMPUTER EQUIPMENT: Computer items such as processors, mice and mouse pads, keyboards, and disk drives that do not contain cathode ray tubes.

CERAMICS/PORCELAIN: Finished ceramic or porcelain products such as dishware, toilets, etc.

NONDISTINCT FINES: Self-defined.

MISCELLANEOUS ORGANICS: Wax, modeling clay, bar soap, cigarette butts, etc.

MISCELLANEOUS INORGANICS: Vacuum cleaner bag contents, and other inorganics not classified elsewhere.

A.2 Aggregated Groups of Materials

In order to facilitate analysis of the amount of recyclable and compostable portions of the waste stream, the list of 89 *material categories* was condensed to a shorter list of 21 *aggregated groups* of materials. Table 12 on the following page indicates how the materials were aggregated.

Table 12: Aggregation of Material Components in the Waste Stream

Material Class	Aggregated Group	Material Components
Paper	Newspaper	Newspaper
	Unwaxed OCC / Kraft paper	Plain OCC/Kraft
	Other recyclable paper	Office Paper
		Computer Paper
		Mixed Low Grade
		Phone Books
		Milk/Juice/Polycoat
	Compostable paper	Compostable Soiled
	Other paper	Waxed OCC/Kraft
		Frozen Food Polycoats
		Paper/Other Materials
		Other Paper
Plastic	PET (#1) plastic	#1 Pop & Liquor
		#1 Other Bottles
	HDPE (#2) plastic	#2 Milk & Juice
		#2 Other Bottles
		#2 Jars & Tubs
	Expanded polystyrene	Expanded Polystyrene
	Plastic film	Grocery/Store/Bread Bags
		Garbage Bags
		Other Plastic Film
	Other plastic	Other Rigid Packaging
		Other Bottles, Jars & Tubs
		Plastic Products
Glass	Recyclable glass	Clear Beverage/Liquid
		Green Beverage/Liquid
		Brown Beverage/Liquid
		Container Glass
	Other glass	Fluorescent Tubes
		Other Glass
Metal	Aluminum cans	Alum. Beverage Cans
	Tin/steel food cans	Tinned Food Cans
	Other recyclable metals	Alum. Foil/Containers
		Other Aluminum
		Empty Aerosol Cans
		Other Ferrous
	Other metals	Other Nonferrous
		Motor Oil filters
		Mixed Metals/Material
Organic	Compostable yard waste	Leaves & Grass
		Prunings
	Food waste	Food Wastes

Material Class	Aggregated Group	Material Components
Construction and Demolition Waste	Construction and Demolition Waste	Pallets
		Crates/Boxes
		Dimension Lumber
		Other Untreated Wood
		Treated Wood
		Contaminated Wood
		New Gypsum Scrap
		Demo Gypsum Scrap
		Fiberglass Insulation
		Rock/Concrete/Bricks
		Asphaltic Roofing
		Other Construction Debris
		Sand/Soil/Dirt
Household Hazardous Waste	Household Hazardous Waste	Latex Paint
		Hazardous Glue/Adhesives
		Non-hazardous Glues
		Oil-based Paint/Thinners
		Hazardous Cleaners
		Pesticides/Herbicides
		Dry-cell Batteries
		Wet-cell Batteries
		Gasoline/Kerosene
		Motor Oil/Diesel Oil
		Asbestos
		Explosives
		Other Hazardous
		Other Non-hazardous
Other Materials	Other materials	Textiles/Clothing
		Carpet/Upholstery
		Leather
		Disposable Diapers
		Animal By-products
		Rubber Products
		Tires
		Ash
		Furniture
		Mattresses
		Small Appliances
		Audio/Visual Equipment
		Computer Monitors
		Television Sets
		Other Computer Equipment
		Ceramics/China
		Non-distinct Fines
		Misc. Organics
		Misc. Inorganics

Material is considered to be recyclable in the existing residential curbside collection program

Material is considered to be compostable in most large-scale composting operations

APPENDIX B. Waste Sampling Methodology

B.1 Overview

The objective of the study was to characterize the municipal solid waste disposed by single-family residential sources in the City of Phoenix. The study employed the sorting of waste samples to derive statistically valid estimates of the composition of single-family residential waste collected from each of six regions (service areas) as well as for the City as a whole. The composition estimates were compared among regions, and data was collected to permit correlation of waste composition estimates with the observed levels of participation in recycling by individual neighborhoods.

This appendix presents the sampling and data collection plan for the study.

B.2 Sampling Populations

The collection system for residential waste divides the City of Phoenix into six distinct service areas. Service areas and the number of samples collected from each are presented in Figure 4 and Table 13 below. After the samples were sorted, City staff followed the routes from which the samples were obtained, and they noted the incidence of participation in curbside recycling programs on a household-by-household basis. From this data, individual routes were categorized as having high, low, or medium levels of recycling participation.

Figure 4: Map of Service Areas in the City of Phoenix

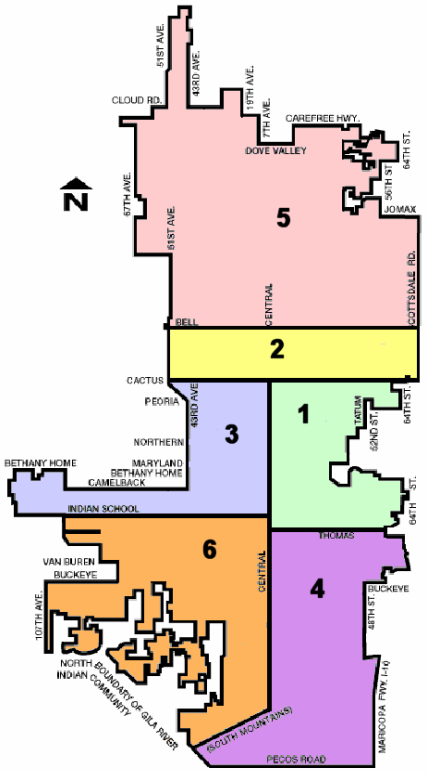


Table 13: Samples per Study Period, by Service Area

Service Area	Winter	Summer	Totals
1	24	22	46
2	24	24	48
3	24	24	48
4	24	23	47
5	24	23	47
6	23	24	47
Totals	**143**	**140**	**283**

B.3 Sample Allocation

Service areas, Collection Routes, and Trips

Each of the six service areas is divided into numerous collection ***routes***, and waste from each route is collected once per week. Typically an individual collection route is served by a single truck on any given waste collection day, although the truck might make numerous ***trips*** throughout the day to service the entire route. Single-family residential waste is collected on Mondays, Tuesdays, Thursdays, and Fridays.

The study was designed to provide statistically valid composition estimates at the level of individual service areas. Findings for the service areas were combined using a weighted averaging method to estimate waste composition city-wide. The sampling method therefore obtained data from each service area that is representative of all the residential waste disposed by that service area. Each truck-full of waste from a service area was given approximately an equal chance of being sampled. Therefore, our sampling plan called for random selection of truck-loads of waste (i.e., ***trips***) from each service area to provide samples for characterization.

Scheduling Activities at Solid Waste Facilities

To account for seasonal variations, the sampling days were divided between two sampling periods: *winter* (January 27 through February 7, 2003), or the dry season, and *summer* (August 1 through August 15, 2003), or the wet season. Each season consisted of two weeks, or ten days of sampling.

Sampling activities were conducted at two of the solid waste disposal facilities that service the City of Phoenix: 27th Avenue Solid Waste Management Facility and Skunk Creek Landfill. Selected collection vehicles from each of the service areas were routed to the most appropriate one of these two facilities.

A sampling and sorting schedule for these facilities was constructed for each sampling season that considered several factors.

- It was determined which days of the week single-family residential waste is normally delivered to each facility from the surrounding communities. Because the Skunk Creek and the 27th Avenue facilities receive approximately equal numbers of single-family residential loads in a typical week, sampling was conducted for an equal number of days at each facility. Selected loads that typically go to the Glendale solid waste facility were diverted to one of the other facilities.

- For each collection route, historical data were examined that showed the number of times loads from the route had been sent to each facility. Most collection routes have a particular facility where the waste is taken *most of the time*. The sampling schedule was designed such that, in most cases, a route would be sent to the facility it typically visits anyway.

- Because the Skunk Creek Landfill receives single-family residential waste primarily from service areas #1, #2, and #5, sampling for those areas were conducted primarily at Skunk Creek. Likewise, the 27th Avenue Solid Waste Facility receives single-family

waste primarily from service areas #3, #4, and #6, so sampling of waste from those areas were conducted primarily at that facility.

- Although single-family residential waste is not collected on Wednesdays, enough samples were acquired ahead of time to permit the sorting crew to work productively on Wednesdays.

B.4 Selection and Scheduling of Particular Loads

Establishing the "Universe" of Loads Available for Sampling

The list of existing collection *routes* was examined in order to develop a comprehensive list of all collection *trips* for single-family residential waste that were expected during each two-week sampling period. A conservative estimate was constructed for the number of trips expected to be associated with each route. In most cases, the average number of trips associated with each route was rounded down to the nearest whole number. The exact procedure for counting the trips expected for each route was as follows:

- If the average number of trips associated with a route was equal to or greater than an integer plus 0.9, then the number of trips was rounded *up* to the next integer. For example, a route that had an average of 2.9 trips associated with it was counted as having 3 trips for planning purposes.
- In all other cases, the number of trips associated with a route was derived by rounding the average number *down* to the next lower integer. For example, a route that had an average of 2.8 trips associated with it was counted as representing 2 trips.

A comprehensive database was constructed, containing a record for each expected collection trip for single-family residential waste. Each record included fields indicating the following.

- A unique code corresponding to the route number combined with the trip number. For example, the first trip of route 66105 was designated as 66105A. The second trip was designated as 66105B, and so forth.
- The day of the week on which the route and trip was scheduled.
- The frequency with which the associated route was directed to each solid waste facility. For example, route 66105 visits the 27th Avenue facility 74% of the time, and it visits the Glendale facility 26% of the time.
- A field indicating the facility to which the trip would be assigned provisionally, pending finalization of a sampling schedule and any necessary re-routes.
- A random number that was assigned to each trip, for use in selecting particular trips for sampling.

Allocating Samples to Particular Days

Winter Season

The following process was used to determine the number of samples to be obtained from each service area, at each facility, on each day of the two-week winter sampling period.

Step 1. First, the total number of trips was calculated for each service area on each day of sampling. The results for the winter season appear in the table below. For the purpose of this planning step, each trip was assigned to either the Skunk Creek facility or the 27th Avenue facility, depending on where the route was directed *most often*. Routes that normally went to the Glendale facility were counted as going to the Skunk Creek facility.

Numbers of Trips Available for Sampling, by Day and Facility

	Skunk Creek		27th Avenue				Skunk Creek		Totals
Service Area	Monday Jan. 27	Tuesday Jan. 28	Thursday Jan. 30	Friday Jan. 31	Monday Feb. 3	Tuesday Feb. 4	Thursday Feb. 6	Friday Feb. 7	
1	23	27					23	23	96
2	19	17					18	20	74
3	2		12	5	30	33	21	21	124
4			38	30	49	19			136
5	29	33					22	30	114
6		2	42	17	36	36		7	140
Totals	73	79	92	52	115	88	84	101	**684**

Step 2. The numbers of trips for each service area were then expressed as a percentage of the total trips for the service area, as shown in the table below. This clarified what portion of the loads from a given service area could be sampled on each day at each facility.

Portion of Loads from Each Service Area that Arrive at Each Facility on Each Day

	Skunk Creek		27th Avenue				Skunk Creek		Totals
Service Area	Monday Jan. 27	Tuesday Jan. 28	Thursday Jan. 30	Friday Jan. 31	Monday Feb. 3	Tuesday Feb. 4	Thursday Feb. 6	Friday Feb. 7	
1	24%	28%					24%	24%	100%
2	26%	23%					24%	27%	100%
3	2%		10%	4%	24%	27%	17%	17%	100%
4			28%	22%	36%	14%			100%
5	25%	29%					19%	26%	100%
6		1%	30%	12%	26%	26%		5%	100%

Step 3. The same ratios shown in the previous table were then applied to the known plan of obtaining 24 samples from each service area during the winter season. The results, shown below, indicate the "ideal" number of samples that would be obtained from each service area on each day, without regard to the logistics of sampling.

Ideal Sample Allocation, Without Regard to Practical Logistics

	Skunk Creek		27th Avenue				Skunk Creek		Totals
Service Area	Monday Jan. 27	Tuesday Jan. 28	Thursday Jan. 30	Friday Jan. 31	Monday Feb. 3	Tuesday Feb. 4	Thursday Feb. 6	Friday Feb. 7	
1	5.8	6.8					5.8	5.8	24
2	6.2	5.5					5.8	6.5	24
3	0.4		2.3	1.0	5.8	6.4	4.1	4.1	24
4			6.7	5.3	8.6	3.4			24
5	6.1	6.9					4.6	6.3	24
6		0.3	7.2	2.9	6.2	6.2		1.2	24
Totals	**18.4**	**19.6**	**16.2**	**9.2**	**20.6**	**15.9**	**20.3**	**23.8**	**144**

Step 4. To determine how many samples to capture on each day from each service area the ideal numbers of samples (above) were compared against the days and locations built into the schedule and against the number of samples the crew could sort in a day (a maximum of 15 per day). Consideration was also given to obtaining enough samples to keep the sorting crew busy on Wednesdays, when no fresh loads would arrive. The final apportioning of samples for the winter sorting period is shown below.

Final Allocation of Samples, by Service Area, Facility, and Day of Week

	Skunk Creek		27th Avenue				Skunk Creek		Totals
Service Area	Monday Jan. 27	Tuesday Jan. 28	Thursday Jan. 30	Friday Jan. 31	Monday Feb. 3	Tuesday Feb. 4	Thursday Feb. 6	Friday Feb. 7	
1	7	7					5	5	24
2	7	7					5	5	24
3			7	4	6	7			24
4			7	6	8	3			24
5	7	7					5	5	24
6			7	4	6	7			24
Totals	**21**	**21**	**21**	**14**	**20**	**17**	**15**	**15**	**144**

In order to avoid presenting the sorting crew with *too many* samples to sort on the final two days of the sampling period (Thursday and Friday, February 6-7), trips originating from service area #3 were not scheduled for those days. Instead, trips from service area #3 were scheduled to be sampled at the 27th Avenue facility on the Thursday and Friday of the previous week.

To each of the numbers calculated for the final allocation of samples, above, two loads from each service area were added on each day to include as contingency loads. This practice ensured that the sampling crew could obtain enough samples on each day, regardless of random delays of vehicles, breakdowns, and other unplanned events. For example, on the Monday of week 1, the schedule *with contingencies* called for nine trips from each of service areas #1, #2, and #5 to be routed to the Skunk Creek facility for possible sampling. Of those trips, only seven from each service area were actually used for sampling.

Summer Season

The same process used for the winter season was used to determine the number of samples on each day of the two-week summer sampling period. This section displays the corresponding numbers for the summer season.

Step 1

Numbers of Trips Available for Sampling, by Day and Facility

	Skunk Creek				27th Avenue				Totals
Service Area	Monday	Tuesday	Thursday	Friday	Monday	Tuesday	Thursday	Friday	
1	26	23	22	25					96
2	28	23	28	30					109
3	34		36		2	37		18	127
4					53	21	46	35	155
5	32	32	27	15					106
6					40	42	38	25	145
Totals	120	78	113	70	95	100	84	78	738

Step 2

Portion of Loads from Each Service Area that Arrive at Each Facility on Each Day

	Skunk Creek				27th Avenue			
Service Area	Monday	Tuesday	Thursday	Friday	Monday	Tuesday	Thursday	Friday
1	27%	24%	23%	26%				
2	26%	21%	26%	28%				
3	27%		28%		2%	29%		14%
4					34%	14%	30%	23%
5	30%	30%	25%	14%				
6					28%	29%	26%	17%

Step 3

Ideal Sample Allocation, Without Regard to Practical Logistics

	Skunk Creek				27th Avenue				Totals
Service Area	Monday	Tuesday	Thursday	Friday	Monday	Tuesday	Thursday	Friday	
1	6	6	5	6					23
2	6	5	6	6					23
3	7		7			7		3	24
4					8	3	7	5	23
5	7	7	6	3					23
6					7	7	6	4	24
Totals	26	18	24	15	15	17	13	12	140

Step 4

Final Allocation of Samples, by Service Area, Facility, and Day of Week

	Skunk Creek					27th Street				Totals
Service Area	Friday August 1	Monday August 4	Tuesday August 5	Thursday August 7	Friday August 8	Monday August 11	Tuesday August 12	Thursday August 14	Friday August 15	
1	3	6	6	5	3					23
2	3	6	5	6	3					23
3		7		8			7		2	24
4						8	4	8	3	23
5	1	7	7	6	2					23
6						7	8	7	2	24
Totals	7	26	18	25	8	15	19	15	7	140

Selection of Individual Trips for Sampling

Previously, a random number had been assigned to each trip in the database of routes and trips. The records for trips matching the criteria for each sampling day (i.e., trips destined for that day's sampling facility and originating from that day's service areas) were placed in order according to their random numbers, and the requisite number of trips was chosen from the top of the list for each service area on each day. An example of the selected trips from service area #1 at the Skunk Creek facility on the Monday of Week 1 of the winter sampling season is shown below. On that day, the goal was to acquire seven samples from service area #1. Nine trips are shown as "candidates" for being sampled, in order to allow for contingencies.

Random Selection of Trips from Service Area #1 on Monday, January 27, 2003

Route and Trip	Random Number	Select for Sampling
12107B	0.082545	YES
12101B	0.198476	YES
12109B	0.209200	YES
12108B	0.301829	YES
12131A	0.339906	YES
12106B	0.340882	YES
12110B	0.345841	YES
12102B	0.389241	YES
12110A	0.398248	YES
12103A	0.440898	no
12101A	0.461205	no
12102A	0.535590	no
12104A	0.543291	no
12107A	0.572064	no
12105B	0.585077	no
12105A	0.643010	no
12111A	0.663138	no
12109A	0.694559	no
12106A	0.722478	no
12111B	0.937802	no
12108A	0.959726	no
12104B	0.964225	no
12103B	0.996691	no

This information was used to develop a set of sampling instructions, as described in the following section.

B.5 Field Procedures

Selection of Vehicles for Sampling

Based on the list of trips selected for sampling, a list was developed for each day of the winter sampling period. An example of the selection list for Monday, January 27 is shown below. The Gatekeeper used the daily *vehicle selection list* to identify targeted vehicles and direct them to the sampling area. Copies of the list were provided to the sampling crew and City staff.

Example of Vehicle Selection List

Monday, Jan. 27 **Skunk Creek**

	Truck #	ETA	Service Area	Route #	Random Cell	
Get any 7			1	12101B	12	Allied
			1	12102B	8	
			1	12106B	4	
			1	12107B	6	
			1	12108B	2	
			1	12109B	2	
			1	12110A	14	
			1	12110B	12	
			1	12131A	2	
Get any 7			2	22101A	12	Waste Mgmt.
			2	22101B	13	
			2	22102B	14	
			2	22103A	7	
			2	22103B	6	
			2	22104A	7	
			2	22105A	13	
			2	22106B	8	
			2	22109B	5	
			2	22117A	8	
Get any 7			5	52114A	8	City
			5	52115A	16	
			5	52116B	4	
			5	52117A	7	
			5	52119A	9	
			5	52119B	11	
			5	52120C	9	
			5	52122A	6	
			5	52123C	9	

On the morning of each sampling day, City staff determined the actual truck assigned to each route, as well as its estimated time of arrival. They communicated this information to the Gatekeeper and the sorting crew. The Gatekeeper stood positioned near the entrance to the MSW facility and directed the targeted loads to the sampling area while keeping track of them on the list. When the desired number of loads from each service area was attained, the Gatekeeper stopped selecting loads from that service area for that day.

The column in the selection list labeled “random cell” refers to the portion of the tipped load that became the actual sample to be sorted.. This is explained more fully in the section below.

Extraction of Waste Samples

When the Gatekeeper encountered one of the designated trucks, he/she interviewed the driver to ensure that it was the correct load, representing the desired route and trip number. The

Gatekeeper then wrote the route and trip number on a large fluorescent placard and placed placard on the windshield of the vehicle. Although the Gatekeeper directed the vehicle's driver to the sorting area, the placard made it easier for the sorting crew to spot the targeted vehicle as it approached.

At the sorting area, the Field Manager collected the placard, recorded the route and trip numbers, and directed the driver to tip the load in an elongated pile on the ground. At this point, the pile was divided into an imaginary 16-cell grid, as shown in the diagram below, and approximately 200-300 pounds of material from the predetermined randomly selected cell (as designated on the *vehicle selection list*) was extracted from the pile using a loader or similar piece of equipment. This material became the actual sample, and it was placed on a tarp and dragged to the sorting area.

After the extracted material was deposited on the tarp, the Field Manager estimated the weight of each sample. If judged to be too light, additional material was pulled from the same cell area until the desired weight was achieved. Samples judged to be excessively heavy were pared down by removing a homogenous slice of material from the tarp.

Sorting of Waste Samples

Once a sample had been selected, extracted from the load, and placed on a clean tarp, it was sorted by hand into the prescribed component categories. (Please refer to Appendix A for the complete list and definitions of the component categories.) Components were placed in plastic laundry baskets to be weighed and recorded. Members of the sorting crew typically specialize in groups of materials, but each is trained in the full list of components. Each crew person directed materials to the appropriate specialist.

The Field Manager monitored the homogeneity of the component baskets as material accumulated. Open laundry baskets allowed the Field Manager to see the material at all times. The Field Manager also verified the purity of each component as it was weighed, before recording the weight on the *sampling form*. (Please refer to Appendix F for a copy of the *sampling form*.)

The waste samples were sorted by hand until no more than a small amount of homogeneous fine material ("supermix") remained. The overall goal was to sort each sample directly into the component categories in order to reduce the amount of indistinguishable fines or miscellaneous categories. If there was some amount of homogeneous fine material, the Field Manager weighed the remaining supermix and estimated the percent of each component material remaining in the supermix.

APPENDIX C. Detailed Waste Composition Results

This appendix contains detailed waste composition tables, first, for the overall city, followed by each of the six service areas.

Table 14: Detailed Composition Estimates – Citywide Single-family Residential Waste

Material	Est. Pct.	+ or –	Est. Tons
Paper	**18.3%**		**79,412**
Newspaper	2.7%	0.2%	11,729
Plain OCC/Kraft	2.9%	0.2%	12,597
Waxed OCC/Kraft	0.1%	0.0%	255
Office Paper	1.2%	0.1%	5,359
Computer Paper	0.0%	0.0%	115
Mixed Low Grade	5.3%	0.2%	22,919
Phone Books	0.1%	0.1%	542
Milk/Juice/Polycoat	0.0%	0.0%	216
Frozen Food Polycoats	0.2%	0.1%	776
Compostable Soiled	4.5%	0.2%	19,682
Paper/Other Materials	1.1%	0.1%	4,884
Nonrecyclable Paper Products	0.1%	0.0%	338
Plastic	**8.3%**		**36,176**
#1 Pop & Liquor	0.2%	0.0%	1,061
#1 Other Bottles	0.5%	0.0%	1,980
#2 Milk & Juice	0.2%	0.0%	1,035
#2 Other Bottles	0.3%	0.0%	1,380
#2 Jars & Tubs	0.1%	0.0%	516
Other Bottles, Jars & Tubs	0.3%	0.0%	1,257
Expanded Polystyrene	0.5%	0.0%	2,061
Other Rigid Packaging	0.8%	0.0%	3,459
Grocery/Store/Bread Bags	0.9%	0.1%	3,909
Garbage Bags	0.9%	0.1%	3,985
Other Plastic Film	1.6%	0.1%	6,757
Plastic Products	1.2%	0.2%	5,017
Plastic/Other Materials	0.9%	0.1%	3,758
Glass	**2.5%**		**10,693**
Clear Beverage/Liquid	0.6%	0.1%	2,642
Green Beverage/Liquid	0.3%	0.1%	1,357
Brown Beverage/Liquid	0.9%	0.1%	4,014
Container Glass	0.4%	0.1%	1,604
Fluorescent Tubes	0.0%	0.0%	3
Other Glass	0.2%	0.1%	1,073
Metal	**4.4%**		**18,994**
Alum. Beverage Cans	0.5%	0.0%	2,052
Alum. Foil/Containers	0.1%	0.0%	647
Other Aluminum	0.0%	0.0%	82
Other Nonferrous	0.0%	0.0%	193
Tinned Food Cans	1.0%	0.1%	4,414
Empty Aerosol Cans	0.1%	0.0%	619
Other Ferrous	0.9%	0.3%	4,034
Motor Oil filters	0.0%	0.0%	50
Mixed Metals/Material	1.6%	0.3%	6,902
Organic	**44.9%**		**195,176**
Leaves & Grass	23.5%	1.6%	102,189
Prunings	4.6%	0.6%	20,069
Food Wastes	16.8%	0.8%	72,918

Material	Est. Pct.	+ or –	Est. Tons
Other Materials	**14.0%**		**61,035**
Textiles/Clothing	3.1%	0.3%	13,384
Carpet/Upholstery	1.6%	0.3%	7,103
Leather	0.3%	0.1%	1,368
Disposable Diapers	3.6%	0.4%	15,511
Animal By-products	2.6%	0.6%	11,165
Rubber Products	0.3%	0.1%	1,302
Tires	0.0%	0.0%	68
Ash	0.1%	0.0%	295
Furniture	0.3%	0.1%	1,113
Mattresses	0.0%	0.0%	34
Small Appliances	0.4%	0.2%	1,748
Audio/Visual Equipment	0.3%	0.1%	1,235
Computer Monitors	0.0%	0.0%	169
Television Sets	0.1%	0.1%	250
Other Computer Equipment	0.1%	0.1%	645
Ceramics/China	0.3%	0.1%	1,360
Non-distinct Fines	0.2%	0.1%	923
Misc. Organics	0.6%	0.1%	2,534
Misc. Inorganics	0.2%	0.1%	828
Hazardous Wastes	**0.4%**		**1,683**
Latex Paint	0.1%	0.1%	497
Hazardous Glue/Adhesives	0.0%	0.0%	32
Non-hazardous Glues	0.0%	0.0%	46
Oil-based Paint/Thinners	0.0%	0.0%	65
Hazardous Cleaners	0.0%	0.0%	54
Pesticides/Herbicides	0.0%	0.1%	194
Dry-cell Batteries	0.1%	0.0%	275
Wet-cell Batteries	0.0%	0.0%	24
Gasoline/Kerosene	0.0%	0.0%	0
Motor Oil/Diesel Oil	0.0%	0.0%	130
Asbestos	0.0%	0.0%	0
Explosives	0.0%	0.0%	0
Other Hazardous	0.0%	0.0%	198
Other Non-hazardous	0.0%	0.0%	168
C&D Wastes	**7.3%**		**31,614**
Dimension Lumber	1.2%	0.4%	5,385
Pallets	0.1%	0.1%	270
Crates/Boxes	0.0%	0.0%	52
Other Untreated Wood	0.5%	0.4%	2,128
Treated Wood	0.4%	0.1%	1,787
Contaminated Wood	0.6%	0.3%	2,570
New Gypsum Scrap	0.0%	0.0%	114
Demo Gypsum Scrap	0.4%	0.2%	1,874
Fiberglass Insulation	0.0%	0.0%	58
Rock/Concrete/Bricks	1.5%	0.5%	6,598
Asphaltic Roofing	0.2%	0.1%	1,013
Other Construction Debris	0.7%	0.3%	2,925
Sand/Soil/Dirt	1.6%	0.4%	6,841
Totals	**100.0%**		**434,783**

Number of Samples: 283

Table 15: Detailed Composition Estimates – Service Area 1

Material	Est. Pct.	+ or –	Est. Tons
Paper	**17.7%**		**10,715**
Newspaper	3.8%	0.9%	2,297
Plain OCC/Kraft	2.6%	0.4%	1,589
Waxed OCC/Kraft	0.1%	0.1%	43
Office Paper	1.4%	0.3%	817
Computer Paper	0.0%	0.1%	23
Mixed Low Grade	4.7%	0.5%	2,825
Phone Books	0.3%	0.2%	160
Milk/Juice/Polycoat	0.0%	0.0%	22
Frozen Food Polycoats	0.2%	0.0%	93
Compostable Soiled	3.9%	0.5%	2,382
Paper/Other Materials	0.7%	0.1%	431
Nonrecyclable Paper Products	0.1%	0.0%	33
Plastic	**7.6%**		**4,583**
#1 Pop & Liquor	0.2%	0.1%	109
#1 Other Bottles	0.5%	0.1%	293
#2 Milk & Juice	0.2%	0.0%	111
#2 Other Bottles	0.3%	0.2%	185
#2 Jars & Tubs	0.1%	0.0%	35
Other Bottles, Jars & Tubs	0.2%	0.1%	123
Expanded Polystyrene	0.4%	0.1%	217
Other Rigid Packaging	0.6%	0.1%	390
Grocery/Store/Bread Bags	0.8%	0.1%	490
Garbage Bags	0.9%	0.1%	532
Other Plastic Film	1.6%	0.4%	992
Plastic Products	1.2%	0.7%	717
Plastic/Other Materials	0.6%	0.3%	388
Glass	**1.5%**		**910**
Clear Beverage/Liquid	0.4%	0.1%	272
Green Beverage/Liquid	0.2%	0.1%	105
Brown Beverage/Liquid	0.4%	0.1%	256
Container Glass	0.3%	0.1%	161
Fluorescent Tubes	0.0%	0.0%	0
Other Glass	0.2%	0.1%	118
Metal	**4.4%**		**2,679**
Alum. Beverage Cans	0.4%	0.1%	263
Alum. Foil/Containers	0.1%	0.0%	71
Other Aluminum	0.0%	0.0%	10
Other Nonferrous	0.0%	0.0%	10
Tinned Food Cans	0.9%	0.2%	523
Empty Aerosol Cans	0.1%	0.0%	54
Other Ferrous	1.3%	0.7%	813
Motor Oil filters	0.0%	0.0%	6
Mixed Metals/Material	1.5%	0.6%	928
Organic	**51.6%**		**31,177**
Leaves & Grass	30.5%	4.8%	18,439
Prunings	5.1%	1.6%	3,054
Food Wastes	16.0%	2.0%	9,684

Material	Est. Pct.	+ or –	Est. Tons
Other Materials	**10.2%**		**6,160**
Textiles/Clothing	2.2%	1.3%	1,333
Carpet/Upholstery	1.0%	0.4%	620
Leather	0.1%	0.1%	80
Disposable Diapers	2.2%	0.6%	1,338
Animal By-products	2.5%	1.1%	1,496
Rubber Products	0.5%	0.4%	275
Tires	0.0%	0.0%	0
Ash	0.0%	0.0%	0
Furniture	0.1%	0.1%	53
Mattresses	0.0%	0.0%	0
Small Appliances	0.6%	0.6%	382
Audio/Visual Equipment	0.2%	0.2%	114
Computer Monitors	0.0%	0.0%	0
Television Sets	0.0%	0.0%	0
Other Computer Equipment	0.0%	0.0%	2
Ceramics/China	0.2%	0.1%	119
Non-distinct Fines	0.0%	0.0%	5
Misc. Organics	0.5%	0.2%	313
Misc. Inorganics	0.1%	0.1%	32
Hazardous Wastes	**0.2%**		**102**
Latex Paint	0.0%	0.0%	22
Hazardous Glue/Adhesives	0.0%	0.0%	1
Non-hazardous Glues	0.0%	0.0%	5
Oil-based Paint/Thinners	0.0%	0.0%	0
Hazardous Cleaners	0.0%	0.0%	16
Pesticides/Herbicides	0.0%	0.0%	0
Dry-cell Batteries	0.1%	0.0%	37
Wet-cell Batteries	0.0%	0.0%	0
Gasoline/Kerosene	0.0%	0.0%	0
Motor Oil/Diesel Oil	0.0%	0.0%	1
Asbestos	0.0%	0.0%	0
Explosives	0.0%	0.0%	0
Other Hazardous	0.0%	0.0%	8
Other Non-hazardous	0.0%	0.0%	13
C&D Wastes	**6.8%**		**4,103**
Dimension Lumber	1.9%	1.7%	1,155
Pallets	0.0%	0.0%	0
Crates/Boxes	0.0%	0.0%	0
Other Untreated Wood	0.1%	0.1%	48
Treated Wood	0.5%	0.5%	317
Contaminated Wood	0.3%	0.2%	203
New Gypsum Scrap	0.0%	0.0%	4
Demo Gypsum Scrap	0.1%	0.1%	73
Fiberglass Insulation	0.1%	0.1%	32
Rock/Concrete/Bricks	1.9%	1.3%	1,134
Asphaltic Roofing	0.6%	0.5%	363
Other Construction Debris	0.4%	0.4%	226
Sand/Soil/Dirt	0.9%	0.7%	549
Totals	**100.0%**		**60,431**

Number of Samples: 46

Table 16: Detailed Composition Estimates – Service Area 2

Material	Est. Pct.	+ or –	Est. Tons
Paper	**17.3%**		**11,420**
Newspaper	2.3%	0.5%	1,545
Plain OCC/Kraft	2.2%	0.4%	1,473
Waxed OCC/Kraft	0.0%	0.0%	2
Office Paper	1.3%	0.2%	864
Computer Paper	0.0%	0.0%	0
Mixed Low Grade	5.1%	0.5%	3,361
Phone Books	0.0%	0.0%	2
Milk/Juice/Polycoat	0.1%	0.0%	48
Frozen Food Polycoats	0.1%	0.1%	86
Compostable Soiled	4.6%	0.6%	3,069
Paper/Other Materials	1.4%	0.3%	936
Nonrecyclable Paper Products	0.1%	0.0%	33
Plastic	**7.1%**		**4,719**
#1 Pop & Liquor	0.2%	0.0%	114
#1 Other Bottles	0.3%	0.1%	192
#2 Milk & Juice	0.2%	0.0%	115
#2 Other Bottles	0.3%	0.1%	166
#2 Jars & Tubs	0.1%	0.1%	99
Other Bottles, Jars & Tubs	0.2%	0.1%	144
Expanded Polystyrene	0.4%	0.1%	238
Other Rigid Packaging	0.7%	0.1%	453
Grocery/Store/Bread Bags	0.7%	0.1%	448
Garbage Bags	0.9%	0.1%	582
Other Plastic Film	1.3%	0.2%	841
Plastic Products	1.3%	0.4%	857
Plastic/Other Materials	0.7%	0.3%	467
Glass	**1.9%**		**1,223**
Clear Beverage/Liquid	0.5%	0.2%	336
Green Beverage/Liquid	0.3%	0.1%	214
Brown Beverage/Liquid	0.5%	0.2%	345
Container Glass	0.3%	0.1%	222
Fluorescent Tubes	0.0%	0.0%	1
Other Glass	0.2%	0.1%	106
Metal	**3.6%**		**2,355**
Alum. Beverage Cans	0.5%	0.1%	338
Alum. Foil/Containers	0.1%	0.0%	74
Other Aluminum	0.0%	0.0%	5
Other Nonferrous	0.0%	0.0%	11
Tinned Food Cans	0.9%	0.1%	584
Empty Aerosol Cans	0.1%	0.0%	64
Other Ferrous	0.6%	0.3%	391
Motor Oil filters	0.0%	0.0%	10
Mixed Metals/Material	1.3%	0.5%	879
Organic	**48.6%**		**32,090**
Leaves & Grass	25.6%	4.6%	16,937
Prunings	7.0%	2.2%	4,606
Food Wastes	16.0%	2.1%	10,547

Material	Est. Pct.	+ or –	Est. Tons
Other Materials	**12.7%**		**8,421**
Textiles/Clothing	2.2%	0.5%	1,438
Carpet/Upholstery	2.0%	0.9%	1,343
Leather	0.1%	0.1%	90
Disposable Diapers	3.1%	0.6%	2,055
Animal By-products	2.6%	1.0%	1,703
Rubber Products	0.2%	0.1%	118
Tires	0.0%	0.1%	31
Ash	0.1%	0.1%	62
Furniture	0.2%	0.2%	123
Mattresses	0.1%	0.1%	34
Small Appliances	0.4%	0.6%	279
Audio/Visual Equipment	0.2%	0.2%	132
Computer Monitors	0.0%	0.0%	0
Television Sets	0.0%	0.0%	0
Other Computer Equipment	0.4%	0.4%	233
Ceramics/China	0.2%	0.2%	128
Non-distinct Fines	0.2%	0.2%	107
Misc. Organics	0.5%	0.2%	328
Misc. Inorganics	0.3%	0.2%	215
Hazardous Wastes	**0.5%**		**319**
Latex Paint	0.2%	0.2%	124
Hazardous Glue/Adhesives	0.0%	0.0%	0
Non-hazardous Glues	0.0%	0.0%	10
Oil-based Paint/Thinners	0.0%	0.0%	0
Hazardous Cleaners	0.0%	0.0%	32
Pesticides/Herbicides	0.0%	0.0%	0
Dry-cell Batteries	0.1%	0.0%	45
Wet-cell Batteries	0.0%	0.1%	24
Gasoline/Kerosene	0.0%	0.0%	0
Motor Oil/Diesel Oil	0.0%	0.0%	0
Asbestos	0.0%	0.0%	0
Explosives	0.0%	0.0%	0
Other Hazardous	0.0%	0.0%	18
Other Non-hazardous	0.1%	0.1%	66
C&D Wastes	**8.4%**		**5,530**
Dimension Lumber	1.0%	0.8%	689
Pallets	0.0%	0.0%	0
Crates/Boxes	0.0%	0.0%	0
Other Untreated Wood	0.5%	0.5%	309
Treated Wood	0.2%	0.1%	139
Contaminated Wood	1.5%	1.7%	999
New Gypsum Scrap	0.0%	0.0%	1
Demo Gypsum Scrap	0.9%	0.9%	566
Fiberglass Insulation	0.0%	0.0%	2
Rock/Concrete/Bricks	1.9%	1.3%	1,270
Asphaltic Roofing	0.2%	0.4%	146
Other Construction Debris	0.3%	0.5%	207
Sand/Soil/Dirt	1.8%	1.1%	1,202
Totals	**100.0%**		**66,076**

Number of Samples: 48

Table 17: Detailed Composition Estimates – Service Area 3

Material	Est. Pct.	+ or –	Est. Tons
Paper	**17.5%**		**14,650**
Newspaper	2.4%	0.5%	1,974
Plain OCC/Kraft	2.9%	0.5%	2,436
Waxed OCC/Kraft	0.2%	0.2%	192
Office Paper	0.9%	0.2%	716
Computer Paper	0.0%	0.0%	1
Mixed Low Grade	5.0%	0.6%	4,197
Phone Books	0.2%	0.1%	135
Milk/Juice/Polycoat	0.1%	0.0%	64
Frozen Food Polycoats	0.3%	0.3%	284
Compostable Soiled	4.2%	0.5%	3,484
Paper/Other Materials	1.3%	0.4%	1,080
Nonrecyclable Paper Products	0.1%	0.1%	86
Plastic	**8.0%**		**6,660**
#1 Pop & Liquor	0.3%	0.1%	209
#1 Other Bottles	0.4%	0.1%	355
#2 Milk & Juice	0.2%	0.0%	196
#2 Other Bottles	0.3%	0.1%	241
#2 Jars & Tubs	0.1%	0.1%	97
Other Bottles, Jars & Tubs	0.3%	0.1%	273
Expanded Polystyrene	0.4%	0.1%	358
Other Rigid Packaging	0.7%	0.1%	573
Grocery/Store/Bread Bags	0.9%	0.1%	745
Garbage Bags	1.0%	0.1%	807
Other Plastic Film	1.7%	0.3%	1,418
Plastic Products	0.9%	0.2%	718
Plastic/Other Materials	0.8%	0.3%	668
Glass	**2.1%**		**1,721**
Clear Beverage/Liquid	0.5%	0.2%	421
Green Beverage/Liquid	0.3%	0.1%	256
Brown Beverage/Liquid	0.7%	0.2%	603
Container Glass	0.3%	0.2%	271
Fluorescent Tubes	0.0%	0.0%	1
Other Glass	0.2%	0.1%	169
Metal	**4.4%**		**3,645**
Alum. Beverage Cans	0.4%	0.1%	345
Alum. Foil/Containers	0.1%	0.0%	111
Other Aluminum	0.0%	0.0%	32
Other Nonferrous	0.0%	0.0%	22
Tinned Food Cans	1.1%	0.2%	885
Empty Aerosol Cans	0.2%	0.0%	137
Other Ferrous	0.8%	0.3%	686
Motor Oil filters	0.0%	0.0%	9
Mixed Metals/Material	1.7%	0.6%	1,416
Organic	**49.0%**		**40,988**
Leaves & Grass	27.2%	3.7%	22,728
Prunings	4.5%	1.4%	3,751
Food Wastes	17.3%	1.7%	14,509

Material	Est. Pct.	+ or –	Est. Tons
Other Materials	**12.5%**		**10,475**
Textiles/Clothing	2.8%	0.6%	2,333
Carpet/Upholstery	1.4%	0.9%	1,143
Leather	0.3%	0.2%	220
Disposable Diapers	3.5%	0.8%	2,944
Animal By-products	2.1%	0.8%	1,736
Rubber Products	0.2%	0.2%	160
Tires	0.0%	0.0%	0
Ash	0.2%	0.2%	137
Furniture	0.1%	0.1%	118
Mattresses	0.0%	0.0%	0
Small Appliances	0.2%	0.2%	179
Audio/Visual Equipment	0.2%	0.2%	155
Computer Monitors	0.1%	0.1%	69
Television Sets	0.0%	0.0%	0
Other Computer Equipment	0.2%	0.2%	154
Ceramics/China	0.3%	0.2%	253
Non-distinct Fines	0.1%	0.1%	65
Misc. Organics	0.8%	0.4%	644
Misc. Inorganics	0.2%	0.2%	165
Hazardous Wastes	**0.4%**		**303**
Latex Paint	0.1%	0.2%	110
Hazardous Glue/Adhesives	0.0%	0.0%	0
Non-hazardous Glues	0.0%	0.0%	15
Oil-based Paint/Thinners	0.0%	0.0%	0
Hazardous Cleaners	0.0%	0.0%	0
Pesticides/Herbicides	0.0%	0.0%	0
Dry-cell Batteries	0.1%	0.0%	54
Wet-cell Batteries	0.0%	0.0%	0
Gasoline/Kerosene	0.0%	0.0%	0
Motor Oil/Diesel Oil	0.1%	0.1%	87
Asbestos	0.0%	0.0%	0
Explosives	0.0%	0.0%	0
Other Hazardous	0.0%	0.0%	24
Other Non-hazardous	0.0%	0.0%	13
C&D Wastes	**6.2%**		**5,211**
Dimension Lumber	0.8%	0.4%	659
Pallets	0.0%	0.0%	0
Crates/Boxes	0.0%	0.0%	0
Other Untreated Wood	1.4%	2.0%	1,190
Treated Wood	0.5%	0.2%	400
Contaminated Wood	0.2%	0.1%	193
New Gypsum Scrap	0.0%	0.0%	25
Demo Gypsum Scrap	0.3%	0.3%	290
Fiberglass Insulation	0.0%	0.0%	0
Rock/Concrete/Bricks	0.2%	0.1%	192
Asphaltic Roofing	0.3%	0.2%	226
Other Construction Debris	0.8%	0.8%	636
Sand/Soil/Dirt	1.7%	0.9%	1,400
Totals	**100.0%**		**83,652**

Number of Samples: 48

Table 18: Detailed Composition Estimates – Service Area 4

Material	Est. Pct.	+ or –	Est. Tons
Paper	**18.8%**		**15,403**
Newspaper	2.5%	0.4%	2,069
Plain OCC/Kraft	3.2%	0.6%	2,598
Waxed OCC/Kraft	0.0%	0.0%	20
Office Paper	1.3%	0.4%	1,058
Computer Paper	0.0%	0.0%	19
Mixed Low Grade	5.8%	0.5%	4,751
Phone Books	0.1%	0.2%	95
Milk/Juice/Polycoat	0.0%	0.0%	37
Frozen Food Polycoats	0.1%	0.0%	112
Compostable Soiled	4.6%	0.6%	3,764
Paper/Other Materials	1.0%	0.2%	855
Nonrecyclable Paper Products	0.0%	0.0%	26
Plastic	**9.4%**		**7,686**
#1 Pop & Liquor	0.4%	0.1%	301
#1 Other Bottles	0.6%	0.1%	460
#2 Milk & Juice	0.3%	0.1%	269
#2 Other Bottles	0.4%	0.1%	293
#2 Jars & Tubs	0.2%	0.1%	133
Other Bottles, Jars & Tubs	0.3%	0.1%	287
Expanded Polystyrene	0.6%	0.1%	510
Other Rigid Packaging	0.9%	0.1%	764
Grocery/Store/Bread Bags	1.1%	0.1%	864
Garbage Bags	1.0%	0.1%	788
Other Plastic Film	1.6%	0.2%	1,313
Plastic Products	1.1%	0.2%	880
Plastic/Other Materials	1.0%	0.4%	824
Glass	**3.4%**		**2,805**
Clear Beverage/Liquid	0.7%	0.2%	586
Green Beverage/Liquid	0.4%	0.1%	349
Brown Beverage/Liquid	1.6%	0.5%	1,324
Container Glass	0.5%	0.1%	396
Fluorescent Tubes	0.0%	0.0%	0
Other Glass	0.2%	0.1%	149
Metal	**5.2%**		**4,308**
Alum. Beverage Cans	0.6%	0.1%	452
Alum. Foil/Containers	0.2%	0.0%	135
Other Aluminum	0.0%	0.0%	18
Other Nonferrous	0.1%	0.1%	43
Tinned Food Cans	1.3%	0.2%	1,061
Empty Aerosol Cans	0.2%	0.1%	157
Other Ferrous	1.3%	1.4%	1,065
Motor Oil filters	0.0%	0.0%	0
Mixed Metals/Material	1.7%	0.6%	1,377
Organic	**38.1%**		**31,283**
Leaves & Grass	16.6%	3.3%	13,637
Prunings	4.1%	1.6%	3,339
Food Wastes	17.4%	2.2%	14,307

Material	Est. Pct.	+ or –	Est. Tons
Other Materials	**17.3%**		**14,184**
Textiles/Clothing	3.6%	0.8%	2,968
Carpet/Upholstery	1.6%	0.5%	1,303
Leather	0.4%	0.1%	344
Disposable Diapers	4.5%	1.2%	3,737
Animal By-products	4.0%	2.9%	3,291
Rubber Products	0.3%	0.2%	265
Tires	0.0%	0.0%	4
Ash	0.1%	0.1%	56
Furniture	0.6%	0.4%	453
Mattresses	0.0%	0.0%	0
Small Appliances	0.3%	0.2%	257
Audio/Visual Equipment	0.2%	0.2%	182
Computer Monitors	0.1%	0.2%	100
Television Sets	0.0%	0.0%	0
Other Computer Equipment	0.1%	0.1%	54
Ceramics/China	0.4%	0.2%	310
Non-distinct Fines	0.2%	0.2%	193
Misc. Organics	0.6%	0.3%	514
Misc. Inorganics	0.2%	0.1%	154
Hazardous Wastes	**0.3%**		**211**
Latex Paint	0.0%	0.0%	0
Hazardous Glue/Adhesives	0.0%	0.0%	29
Non-hazardous Glues	0.0%	0.0%	2
Oil-based Paint/Thinners	0.1%	0.1%	47
Hazardous Cleaners	0.0%	0.0%	0
Pesticides/Herbicides	0.0%	0.0%	9
Dry-cell Batteries	0.0%	0.0%	37
Wet-cell Batteries	0.0%	0.0%	0
Gasoline/Kerosene	0.0%	0.0%	0
Motor Oil/Diesel Oil	0.0%	0.0%	3
Asbestos	0.0%	0.0%	0
Explosives	0.0%	0.0%	0
Other Hazardous	0.1%	0.1%	53
Other Non-hazardous	0.0%	0.0%	32
C&D Wastes	**7.6%**		**6,263**
Dimension Lumber	0.8%	0.4%	618
Pallets	0.2%	0.2%	149
Crates/Boxes	0.1%	0.1%	52
Other Untreated Wood	0.3%	0.2%	264
Treated Wood	0.3%	0.1%	214
Contaminated Wood	0.6%	0.3%	488
New Gypsum Scrap	0.1%	0.1%	47
Demo Gypsum Scrap	0.3%	0.4%	261
Fiberglass Insulation	0.0%	0.0%	15
Rock/Concrete/Bricks	3.0%	1.8%	2,492
Asphaltic Roofing	0.1%	0.0%	45
Other Construction Debris	0.0%	0.1%	38
Sand/Soil/Dirt	1.9%	1.1%	1,581
Totals	**100.0%**		**82,143**

Number of Samples: 47

Table 19: Detailed Composition Estimates – Service Area 5

Material	Est. Pct.	+ or –	Est. Tons
Paper	**20.6%**		**11,963**
Newspaper	2.8%	0.5%	1,625
Plain OCC/Kraft	2.8%	0.4%	1,608
Waxed OCC/Kraft	0.0%	0.0%	0
Office Paper	1.6%	0.3%	950
Computer Paper	0.1%	0.2%	58
Mixed Low Grade	6.3%	0.6%	3,654
Phone Books	0.0%	0.0%	24
Milk/Juice/Polycoat	0.0%	0.0%	28
Frozen Food Polycoats	0.2%	0.0%	89
Compostable Soiled	5.3%	0.6%	3,088
Paper/Other Materials	1.3%	0.2%	766
Nonrecyclable Paper Products	0.1%	0.1%	74
Plastic	**8.0%**		**4,679**
#1 Pop & Liquor	0.2%	0.0%	96
#1 Other Bottles	0.4%	0.1%	250
#2 Milk & Juice	0.2%	0.1%	118
#2 Other Bottles	0.4%	0.1%	214
#2 Jars & Tubs	0.1%	0.1%	85
Other Bottles, Jars & Tubs	0.3%	0.1%	178
Expanded Polystyrene	0.3%	0.1%	182
Other Rigid Packaging	0.9%	0.2%	507
Grocery/Store/Bread Bags	0.8%	0.1%	451
Garbage Bags	0.9%	0.2%	545
Other Plastic Film	1.8%	0.4%	1,021
Plastic Products	1.0%	0.2%	601
Plastic/Other Materials	0.7%	0.3%	430
Glass	**2.1%**		**1,228**
Clear Beverage/Liquid	0.6%	0.2%	325
Green Beverage/Liquid	0.4%	0.1%	210
Brown Beverage/Liquid	0.7%	0.3%	403
Container Glass	0.3%	0.1%	151
Fluorescent Tubes	0.0%	0.0%	2
Other Glass	0.2%	0.1%	138
Metal	**3.9%**		**2,293**
Alum. Beverage Cans	0.5%	0.1%	307
Alum. Foil/Containers	0.2%	0.1%	113
Other Aluminum	0.0%	0.0%	2
Other Nonferrous	0.1%	0.0%	30
Tinned Food Cans	0.8%	0.1%	493
Empty Aerosol Cans	0.2%	0.1%	102
Other Ferrous	0.6%	0.3%	361
Motor Oil filters	0.0%	0.0%	5
Mixed Metals/Material	1.5%	0.5%	879
Organic	**47.8%**		**27,827**
Leaves & Grass	23.4%	3.2%	13,593
Prunings	5.5%	1.9%	3,223
Food Wastes	18.9%	2.2%	11,011

Material	Est. Pct.	+ or –	Est. Tons
Other Materials	**12.9%**		**7,479**
Textiles/Clothing	2.2%	0.6%	1,305
Carpet/Upholstery	1.7%	0.6%	989
Leather	0.2%	0.1%	145
Disposable Diapers	3.4%	0.9%	1,969
Animal By-products	2.5%	0.9%	1,445
Rubber Products	0.4%	0.2%	250
Tires	0.0%	0.0%	0
Ash	0.1%	0.1%	40
Furniture	0.2%	0.2%	93
Mattresses	0.0%	0.0%	0
Small Appliances	0.3%	0.3%	201
Audio/Visual Equipment	0.4%	0.3%	217
Computer Monitors	0.0%	0.0%	0
Television Sets	0.0%	0.0%	0
Other Computer Equipment	0.3%	0.4%	147
Ceramics/China	0.3%	0.3%	194
Non-distinct Fines	0.0%	0.0%	28
Misc. Organics	0.7%	0.2%	386
Misc. Inorganics	0.1%	0.1%	68
Hazardous Wastes	**0.7%**		**388**
Latex Paint	0.2%	0.2%	98
Hazardous Glue/Adhesives	0.0%	0.0%	1
Non-hazardous Glues	0.0%	0.0%	8
Oil-based Paint/Thinners	0.0%	0.0%	2
Hazardous Cleaners	0.0%	0.0%	0
Pesticides/Herbicides	0.3%	0.5%	185
Dry-cell Batteries	0.1%	0.0%	46
Wet-cell Batteries	0.0%	0.0%	0
Gasoline/Kerosene	0.0%	0.0%	0
Motor Oil/Diesel Oil	0.1%	0.1%	39
Asbestos	0.0%	0.0%	0
Explosives	0.0%	0.0%	0
Other Hazardous	0.0%	0.0%	8
Other Non-hazardous	0.0%	0.0%	2
C&D Wastes	**4.0%**		**2,322**
Dimension Lumber	0.6%	0.2%	323
Pallets	0.0%	0.0%	0
Crates/Boxes	0.0%	0.0%	0
Other Untreated Wood	0.1%	0.1%	64
Treated Wood	0.4%	0.6%	256
Contaminated Wood	0.6%	0.4%	336
New Gypsum Scrap	0.0%	0.0%	0
Demo Gypsum Scrap	0.1%	0.1%	67
Fiberglass Insulation	0.0%	0.0%	4
Rock/Concrete/Bricks	0.4%	0.3%	254
Asphaltic Roofing	0.1%	0.1%	66
Other Construction Debris	0.3%	0.5%	191
Sand/Soil/Dirt	1.3%	0.9%	761
Totals	**100.0%**		**58,180**

Number of Samples: 47

Table 20: Detailed Composition Estimates – Service Area 6

Material	Est. Pct.	+ or –	Est. Tons
Paper	**18.1%**		**15,262**
Newspaper	2.6%	0.5%	2,220
Plain OCC/Kraft	3.4%	0.7%	2,893
Waxed OCC/Kraft	0.0%	0.0%	0
Office Paper	1.1%	0.2%	954
Computer Paper	0.0%	0.0%	15
Mixed Low Grade	4.9%	0.5%	4,132
Phone Books	0.1%	0.1%	125
Milk/Juice/Polycoat	0.0%	0.0%	17
Frozen Food Polycoats	0.1%	0.0%	111
Compostable Soiled	4.6%	0.6%	3,894
Paper/Other Materials	1.0%	0.2%	816
Nonrecyclable Paper Products	0.1%	0.1%	85
Plastic	**9.3%**		**7,848**
#1 Pop & Liquor	0.3%	0.0%	231
#1 Other Bottles	0.5%	0.1%	429
#2 Milk & Juice	0.3%	0.0%	226
#2 Other Bottles	0.3%	0.1%	280
#2 Jars & Tubs	0.1%	0.0%	66
Other Bottles, Jars & Tubs	0.3%	0.1%	251
Expanded Polystyrene	0.7%	0.1%	555
Other Rigid Packaging	0.9%	0.1%	772
Grocery/Store/Bread Bags	1.1%	0.1%	911
Garbage Bags	0.9%	0.1%	731
Other Plastic Film	1.4%	0.1%	1,171
Plastic Products	1.5%	0.5%	1,244
Plastic/Other Materials	1.2%	0.5%	981
Glass	**3.3%**		**2,805**
Clear Beverage/Liquid	0.8%	0.2%	702
Green Beverage/Liquid	0.3%	0.1%	224
Brown Beverage/Liquid	1.3%	0.3%	1,084
Container Glass	0.5%	0.1%	402
Fluorescent Tubes	0.0%	0.0%	0
Other Glass	0.5%	0.2%	393
Metal	**4.4%**		**3,714**
Alum. Beverage Cans	0.4%	0.1%	348
Alum. Foil/Containers	0.2%	0.0%	143
Other Aluminum	0.0%	0.0%	14
Other Nonferrous	0.1%	0.1%	76
Tinned Food Cans	1.0%	0.1%	868
Empty Aerosol Cans	0.1%	0.0%	105
Other Ferrous	0.9%	0.3%	717
Motor Oil filters	0.0%	0.0%	20
Mixed Metals/Material	1.7%	0.9%	1,423
Organic	**37.7%**		**31,812**
Leaves & Grass	20.0%	3.6%	16,856
Prunings	2.5%	0.9%	2,095
Food Wastes	15.3%	1.8%	12,861

Material	Est. Pct.	+ or –	Est. Tons
Other Materials	**17.0%**		**14,317**
Textiles/Clothing	4.8%	1.0%	4,007
Carpet/Upholstery	2.0%	0.6%	1,705
Leather	0.6%	0.3%	488
Disposable Diapers	4.1%	0.8%	3,469
Animal By-products	1.8%	0.7%	1,495
Rubber Products	0.3%	0.2%	235
Tires	0.0%	0.1%	34
Ash	0.0%	0.0%	0
Furniture	0.3%	0.3%	273
Mattresses	0.0%	0.0%	0
Small Appliances	0.5%	0.3%	450
Audio/Visual Equipment	0.5%	0.3%	434
Computer Monitors	0.0%	0.0%	0
Television Sets	0.3%	0.5%	250
Other Computer Equipment	0.1%	0.1%	55
Ceramics/China	0.4%	0.2%	356
Non-distinct Fines	0.6%	0.5%	525
Misc. Organics	0.4%	0.1%	349
Misc. Inorganics	0.2%	0.2%	194
Hazardous Wastes	**0.4%**		**359**
Latex Paint	0.2%	0.2%	144
Hazardous Glue/Adhesives	0.0%	0.0%	1
Non-hazardous Glues	0.0%	0.0%	5
Oil-based Paint/Thinners	0.0%	0.0%	16
Hazardous Cleaners	0.0%	0.0%	7
Pesticides/Herbicides	0.0%	0.0%	0
Dry-cell Batteries	0.1%	0.0%	56
Wet-cell Batteries	0.0%	0.0%	0
Gasoline/Kerosene	0.0%	0.0%	0
Motor Oil/Diesel Oil	0.0%	0.0%	0
Asbestos	0.0%	0.0%	0
Explosives	0.0%	0.0%	0
Other Hazardous	0.1%	0.2%	88
Other Non-hazardous	0.0%	0.0%	41
C&D Wastes	**9.7%**		**8,184**
Dimension Lumber	2.3%	1.3%	1,941
Pallets	0.1%	0.2%	121
Crates/Boxes	0.0%	0.0%	0
Other Untreated Wood	0.3%	0.3%	253
Treated Wood	0.5%	0.3%	462
Contaminated Wood	0.4%	0.2%	352
New Gypsum Scrap	0.0%	0.1%	38
Demo Gypsum Scrap	0.7%	0.5%	616
Fiberglass Insulation	0.0%	0.0%	5
Rock/Concrete/Bricks	1.5%	0.9%	1,255
Asphaltic Roofing	0.2%	0.2%	166
Other Construction Debris	1.9%	1.4%	1,627
Sand/Soil/Dirt	1.6%	1.0%	1,349
Totals	**100.0%**		**84,301**

Number of Samples: 47

APPENDIX D. Waste Composition Calculations

D.1 Composition Calculations

The composition estimates represent the **ratio of the components' weight to the total waste** for each noted substream. They were derived by summing each component's weight across all of the selected records and dividing by the sum of the total weight of waste, as shown in the following equation:

$$r_j = \frac{\sum_i c_{ij}}{\sum_i w_i}$$

where:

c	=	weight of particular component
w	=	sum of all component weights
for i	=	1 to n
where n	=	number of selected samples
for j	=	1 to m
where m	=	number of components

The confidence interval for this estimate was derived in two steps. First, the variance around the estimate was calculated, accounting for the fact that the ratio includes two random variables (the component and total sample weights). The **variance of the ratio estimator** equation follows:

$$\hat{V}_{r_j} = \left(\frac{1}{n}\right) \cdot \left(\frac{1}{\overline{w}^2}\right) \cdot \left(\frac{\sum_i \left(c_{ij} - r_j w_i\right)^2}{n-1}\right)$$

where:

$$\overline{w} = \frac{\sum_i w_i}{n}$$

Second, **precision levels** at the 90% confidence interval were calculated for a component's mean as follows:

$$r_j \pm \left(t \cdot \sqrt{\hat{V}_{r_j}}\right)$$

where:

t	=	the value of the t-statistic (1.645) corresponding to a 90% confidence level

For more detail, please refer to Chapter 6 "Ratio, Regression and Difference Estimation" of *Elementary Survey Sampling* by R.L. Scheaffer, W. Mendenhall and L. Ott (PWS Publishers, 1986).

D.2 Weighted Averages

Citywide waste composition estimates were calculated by using a weighted average procedure which assigns a relative importance to each of the city's six service areas that is proportional to the annual tons of single-family residential waste disposed by each service area. Table 21 presents the annual disposed tons and relative weighting factor (percent of total) that was used for each service area when calculating citywide composition estimates.

Table 21: Disposed Tons by Service Area and Weighting Factors in Citywide Composition Estimates

Service Area	Tons Disposed	Percent of Total
1	58,453	14.63%
2	63,913	16.00%
3	64,643	16.18%
4	79,454	19.89%
5	56,275	14.08%
6	76,819	19.23%
Overall	**399,557**	**100.00%**

The City of Phoenix provided the estimate of tonnage disposed by each of the six service areas, based on the period from June 1, 2002 through May 31, 2003.

The **weighted average for an overall composition estimate** was performed as follows:

$$O_j = \left(p_1 * r_{j1}\right) + \left(p_2 * r_{j2}\right) + \left(p_3 * r_{j3}\right) + \ldots$$

where:

p	=	the proportion of tonnage contributed by the noted substream
w	=	the ratio of component weight to the total waste weight in the noted substream
for i	=	1 to m
where m	=	the number of components

The **variance of the weighted average** was calculated:

$$VarO_j = \left(p_1^{\,2} * V_{r_{j1}}\right) + \left(p_2^{\,2} * V_{r_{j2}}\right) + \left(p_3^{\,2} * V_{r_{j3}}\right) + \ldots$$

APPENDIX E. Comparison Calculations

This section presents detailed results of the statistical comparisons among service areas, and among high-recycling-participation areas versus low-recycling-participation areas. In all cases, the statistical *t*-test was performed to detect significant differences in the percentages of recyclable materials in the disposed waste. The comparison methodology of the *t*-test is described in Appendix D.

The *t*-tests that were performed included the following comparisons.

- Comparisons between service areas
    - Service Area 1 and all other service areas
    - Service Area 2 and all other service areas
    - Service Area 3 and all other service areas
    - Service Area 4 and all other service areas
    - Service Area 5 and all other service areas
    - Service Area 6 and all other service areas

- Comparison between high and low participation neighborhoods

In order to control for differences amounts of waste disposed by different groups, the tests described in this appendix measure waste proportions, not actual tonnage. For example, say that newspaper accounts for 5% of a particular service area's disposed waste, and that a total of 1,000 tons of waste was disposed by that service area and 2,000 tons were disposed by another service area. While the amount of newspaper may be different, if the percentage of newspaper is the same, the tests would indicate that there was no statistical difference.

E.1 Comparisons Among Service Areas

The purpose of conducting these comparisons is to identify statistically significant changes (at the 90% confidence level), between service areas, in the percentage of recyclable materials disposed. One specific example is stated as follows:

> Hypothesis: "There is no statistically significant difference, between the Service Area 1 and all other service areas, in the percentage of newspaper disposed by the single-family substream."
>
> Statistics are then employed to look for evidence disproving the hypothesis. A "significant" result means that there is enough evidence to disprove the hypothesis and it can be concluded that there is a true difference between service areas. "Insignificant" results indicate that either (a) there is no true difference, or (b) even though there may be a difference, there is not enough evidence to prove it. Findings are limited by sample size and category. It is also possible that differences exist in waste categories that were not considered in this part of the study.

Statistically significant differences are evident when comparing the results from different service areas. Statistically significant findings can be considered true differences. The probability of observing these results if there had been no actual difference is low : 10% for each test.

The t-statistic is calculated from the data. According to statistical theory, the larger the absolute value of the t-statistic, the less likely that the two populations have the same mean. The p-value describes the probability of observing the calculated t-statistic if there were no true difference between the population means. *For the purposes of this study, only those calculation results with a p-value of less than 0.1 (i.e., less than 10%) are considered to be statistically significant.*

The statistically significant differences for amounts of recyclable materials disposed between each service area and all other service areas are summarized in Table 22. Service Area 2 and Service Area 4 had significantly different amounts of recyclable amounts disposed overall. *All recyclables combined* were significantly lower when compared to all other service areas in Service Area 2 and were significantly higher in Service Area 4. Other findings of significant difference also are indicated in Table 22.

Table 22: Summary of Comparisons Among Service Areas

MATERIAL	ESTIMATED PERCENT (Material Wt/Total Wt)		RESULTS	t-statistic	p-value
Service Area 1	Percent Estimate	*All Other Service Areas*		(Cut-off for statistically valid difference = 0.1)	
All recyclables combined	18.6%	*19.1%*		0.4745	*0.6355*
Recyclable papers	12.8%	*12.3%*		0.6446	*0.5197*
Newspaper	3.8%	*2.5%*	Statistically higher than all other service areas	3.3885	**0.0008**
Unwaxed OCC / Kraft paper	2.6%	*2.9%*		0.7887	*0.4309*
Other recyclable paper	6.4%	*6.8%*		0.9510	*0.3424*
Recyclable plastics	1.6%	*1.9%*	Statistically lower than all other service areas	1.6896	**0.0922**
PET (#1) plastic bottles	0.7%	*0.7%*		0.3351	*0.7378*
HDPE (#2) plastic containers	0.5%	*0.7%*		1.5045	*0.1336*
Expanded polystyrene	0.4%	*0.5%*	Statistically lower than all other service areas	2.0809	**0.0383**
Recyclable glass	1.3%	*2.3%*	Statistically lower than all other service areas	3.0559	**0.0025**
Recyclable metal	2.9%	*2.7%*		0.4217	*0.6736*
Aluminum cans	0.4%	*0.5%*		0.6903	*0.4906*
Tin/steel food cans	0.9%	*1.0%*		1.3921	*0.1650*
Other recyclable metals	1.6%	*1.2%*		0.8732	*0.3833*
Service Area 2					
All recyclables combined	16.3%	*19.5%*	Statistically lower than all other service areas	2.8845	**0.0042**
Recyclable papers	11.0%	*12.6%*	Statistically lower than all other service areas	1.9509	**0.0521**
Newspaper	2.3%	*2.8%*		1.2642	*0.2072*
Unwaxed OCC / Kraft paper	2.2%	*3.0%*	Statistically lower than all other service areas	2.2220	**0.0271**
Other recyclable paper	6.5%	*6.8%*		0.7113	*0.4775*
Recyclable plastics	1.4%	*1.9%*	Statistically lower than all other service areas	3.0119	**0.0028**
PET (#1) plastic bottles	0.5%	*0.7%*	Statistically lower than all other service areas	3.6646	**0.0003**
HDPE (#2) plastic containers	0.6%	*0.7%*		1.2064	*0.2287*
Expanded polystyrene	0.4%	*0.5%*	Statistically lower than all other service areas	2.0891	**0.0376**
Recyclable glass	1.7%	*2.2%*	Statistically lower than all other service areas	1.6876	**0.0926**
Recyclable metal	2.2%	*2.8%*		1.2644	*0.2071*
Aluminum cans	0.5%	*0.5%*		0.6443	*0.5199*
Tin/steel food cans	0.9%	*1.0%*		1.2268	*0.2209*
Other recyclable metals	0.8%	*1.3%*		1.0971	*0.2735*
Service Area 3					
All recyclables combined	17.6%	*19.3%*		1.4982	*0.1352*
Recyclable papers	11.4%	*12.5%*		1.4349	*0.1524*
Newspaper	2.4%	*2.8%*		1.1990	*0.2315*
Unwaxed OCC / Kraft paper	2.9%	*2.8%*		0.1816	*0.8561*
Other recyclable paper	6.1%	*6.9%*		1.6096	*0.1086*
Recyclable plastics	1.7%	*1.8%*		0.5123	*0.6089*
PET (#1) plastic bottles	0.7%	*0.7%*		0.1820	*0.8558*
HDPE (#2) plastic containers	0.6%	*0.7%*		0.3847	*0.7007*
Expanded polystyrene	0.4%	*0.5%*		0.6420	*0.5214*
Recyclable glass	1.9%	*2.2%*		1.0816	*0.2803*
Recyclable metal	2.6%	*2.7%*		0.1876	*0.8514*
Aluminum cans	0.4%	*0.5%*		1.1237	*0.2621*
Tin/steel food cans	1.1%	*1.0%*		0.6498	*0.5163*
Other recyclable metals	1.2%	*1.2%*		0.1872	*0.8517*

Each finding regarding the statistical significance of difference was made at the 90% confidence level.

Table 22: Summary of Comparisons Among Service Areas (continued)

MATERIAL	ESTIMATED PERCENT (Material Wt/Total Wt)		RESULTS	t-statistic	p-value
	Percent Estimate	*All Other Service Areas*		(Cut-off for statistically valid difference = 0.1)	
Service Area 4					
All recyclables combined	22.1%	*18.4%*	Statistically higher than all other service areas	3.3084	**0.0011**
Recyclable papers	12.9%	*12.2%*		0.8624	*0.3892*
Newspaper	2.5%	*2.8%*		0.6835	*0.4949*
Unwaxed OCC / Kraft paper	3.2%	*2.8%*		1.0532	*0.2931*
Other recyclable paper	7.3%	*6.7%*		1.2447	*0.2143*
Recyclable plastics	2.4%	*1.7%*	Statistically higher than all other service areas	4.2920	**0.0000**
PET (#1) plastic bottles	0.9%	*0.6%*	Statistically higher than all other service areas	3.9612	**0.0001**
HDPE (#2) plastic containers	0.8%	*0.6%*	Statistically higher than all other service areas	2.3051	**0.0219**
Expanded polystyrene	0.6%	*0.4%*	Statistically higher than all other service areas	3.5228	**0.0005**
Recyclable glass	3.2%	*1.9%*	Statistically higher than all other service areas	4.0988	**0.0001**
Recyclable metal	3.5%	*2.5%*	Statistically higher than all other service areas	2.0877	**0.0377**
Aluminum cans	0.6%	*0.5%*		1.3362	*0.1826*
Tin/steel food cans	1.3%	*0.9%*	Statistically higher than all other service areas	3.2010	**0.0015**
Other recyclable metals	1.7%	*1.1%*		1.1702	*0.2429*
Service Area 5					
All recyclables combined	19.5%	*18.9%*		0.5391	*0.5903*
Recyclable papers	13.7%	*12.1%*	Statistically higher than all other service areas	1.9281	**0.0549**
Newspaper	2.8%	*2.7%*		0.1823	*0.8555*
Unwaxed OCC / Kraft paper	2.8%	*2.9%*		0.3331	*0.7393*
Other recyclable paper	8.1%	*6.5%*	Statistically higher than all other service areas	3.4046	**0.0008**
Recyclable plastics	1.6%	*1.9%*		1.3487	*0.1785*
PET (#1) plastic bottles	0.6%	*0.7%*		1.4638	*0.1444*
HDPE (#2) plastic containers	0.7%	*0.7%*		0.6141	*0.5396*
Expanded polystyrene	0.3%	*0.5%*	Statistically lower than all other service areas	3.1343	**0.0019**
Recyclable glass	1.9%	*2.2%*		1.0082	*0.3142*
Recyclable metal	2.4%	*2.8%*		0.8257	*0.4097*
Aluminum cans	0.5%	*0.5%*		0.9343	*0.3509*
Tin/steel food cans	0.8%	*1.0%*		1.5992	*0.1109*
Other recyclable metals	1.0%	*1.3%*		0.5989	*0.5497*
Service Area 6					
All recyclables combined	19.9%	*18.8%*		0.9057	*0.3659*
Recyclable papers	12.3%	*12.4%*		0.0989	*0.9213*
Newspaper	2.6%	*2.8%*		0.3218	*0.7479*
Unwaxed OCC / Kraft paper	3.4%	*2.7%*	Statistically higher than all other service areas	2.0152	**0.0448**
Other recyclable paper	6.2%	*6.9%*		1.3356	*0.1828*
Recyclable plastics	2.1%	*1.8%*	Statistically higher than all other service areas	2.2020	**0.0285**
PET (#1) plastic bottles	0.8%	*0.7%*		1.5625	*0.1193*
HDPE (#2) plastic containers	0.7%	*0.7%*		0.1151	*0.9084*
Expanded polystyrene	0.7%	*0.4%*	Statistically higher than all other service areas	4.3792	**0.0000**
Recyclable glass	2.9%	*2.0%*	Statistically higher than all other service areas	2.6514	**0.0085**
Recyclable metal	2.6%	*2.7%*		0.2388	*0.8114*
Aluminum cans	0.4%	*0.5%*		1.1032	*0.2709*
Tin/steel food cans	1.0%	*1.0%*		0.3402	*0.7340*
Other recyclable metals	1.2%	*1.2%*		0.1674	*0.8672*

Each finding regarding the statistical significance of difference was made at the 90% confidence level.

E.2 Comparison Between High and Low Participation Neighborhoods

Based on data on can set-out rates collected by City of Phoenix staff, routes were ordered from greatest to least participation. The highest-participating 25% of routes were designated as being *high participation,* while the lowest-participating 25% were designated as *low participation*. The calculations described in the previous section, for detecting significant differences among service areas, were used to determine whether significant differences exist between the waste composition results for high and low participation neighborhoods.

As shown in Table 23, the amount of all recyclables combined was significantly higher in the disposed waste of the low participation neighborhoods, representing about 21.1% of the waste in low-participation areas, compared to 16.6% in high-participation areas. The amounts of *all recyclable plastics*, *all recyclable glass*, and *all recyclable metal* were higher in the low-participation neighborhoods. Specific materials for which a significant difference was found include *PET (#1) plastic* bottles, *HDPE (#2) plastic bottles*, *expanded polystyrene*, *aluminum cans,* and *tin/steel food cans*.

Table 23: Comparison of Areas with High and Low Participation in the Curbside Recycling Program

MATERIAL	ESTIMATED PERCENT (Material Wt/Total Wt)		RESULTS	t-statistic	p-value
Service Area 1	High participation in recycling (top quartile)	*Low participation in recycling (bottom quartile)*		(Cut-off for statistically valid difference = 0.1)	
All recyclables combined	16.6%	21.1%	Statistically significant difference	3.4839	0.0007
Recyclable papers	11.6%	12.8%		1.4369	0.1532
Newspaper	2.5%	3.1%		1.3040	0.1946
Unwaxed OCC / Kraft paper	2.1%	3.3%	Statistically significant difference	3.1969	0.0018
Other recyclable paper	7.0%	6.5%		0.9204	0.3591
Recyclable plastics	1.4%	2.3%	Statistically significant difference	4.7876	0.0000
PET (#1) plastic bottles	0.5%	0.9%	Statistically significant difference	5.0595	0.0000
HDPE (#2) plastic containers	0.5%	0.8%	Statistically significant difference	2.1485	0.0336
Expanded polystyrene	0.3%	0.6%	Statistically significant difference	4.2532	0.0000
Recyclable glass	1.7%	2.7%	Statistically significant difference	2.8095	0.0057
Recyclable metal	2.0%	3.4%	Statistically significant difference	2.2345	0.0272
Aluminum cans	0.4%	0.6%	Statistically significant difference	2.7695	0.0065
Tin/steel food cans	0.8%	1.2%	Statistically significant difference	3.1453	0.0021
Other recyclable metals	0.8%	1.6%		1.2680	0.2071

Each finding regarding the statistical significance of difference was made at the 90% confidence level.

E.3 Statistical Considerations

The analyses were based on the component percentages, by weight. As described in Appendix D, these percentages are calculated by dividing the sum of the selected component weights by the sum of the corresponding sample weights. T-tests (modified for ratio estimation) were used to examine the variations between service areas.

Normality

The distributions of some of the waste categories are skewed and may not follow a normal distribution. Although t-tests assume a normal distribution, they are very robust to departures from this assumption, particularly with large sample sizes. In addition, most of the selected categories are sums of several individual waste components, which improve our ability to meet the assumptions of normality.

Dependence

There may be dependence between waste types (if a person disposes of material A, they always dispose of material B at the same time).

There is certainly a degree of dependence between the calculated percentages. Because the percentages sum to 100%, if the percentage of material A increases, the percentage of some other material must decrease.

Statistical Method

Identifying statistically significant differences requires a two-step calculation. First, assuming that the two groups to be compared have similar variance, a **pooled sample variance** was calculated:

$$S_{pool}{}^{2} = \frac{\left[(n1-1)\cdot\left(n1\cdot \bar{V}_{r_j 1}^{2}\right)\right] + \left[(n2-1)\cdot\left(n2\cdot \bar{V}_{r_j 2}^{2}\right)\right]}{n1+n2-2}$$

Next, the **t-statistic** was constructed:

$$t = \frac{(r1-r2)}{\sqrt{\frac{S_{pool}{}^{2}}{n1} + \frac{S_{pool}{}^{2}}{n2}}}$$

The **p-value** of the t-statistic was calculated based on (n1+n2 -2) degrees of freedom.

Multiple T-Tests

In all statistical tests, there is a chance of incorrectly concluding that a result is significant. The comparisons required conducting several t-tests (one for each aggregated material category) **each** of which carries that 10% risk of falsely identifying a significant difference where none truly exists.

APPENDIX F. Field Forms

Vehicle Selection Form

Thursday, August 14 **27th St. Transfer Station**

	Truck #	ETA	Service Area	Route #	Random Cell	
Get any 8			4	45116A	15	City
			4	45116C	10	
			4	45104A	1	
			4	45120A	5	
			4	45102A	15	
			4	45113A	13	
			4	45103C	6	
			4	45110A	7	
			4	45112B	11	
			4	45114B	8	
Get any 7			6	65117C	10	Allied
			6	65120A	6	
			6	65112C	5	
			6	65115B	11	
			6	65121A	15	
			6	65121B	3	
			6	65120B	13	
			6	65119C	15	
			6	65119B	14	

Sample Characterization Form

PAPER				
Newspaper				
Plain OCC/Kraft				
Waxed OCC/Kraft				
Mixed Low Grade				
Phone Books				
Office Paper				
Computer Paper				
Milk/Juice/Polycoat				
Frozen Food Polycoats				
Compostable Soiled				
Paper/Other Materials				
Other Paper				

GLASS				
Clear Beverage/Liquid				
Green Beverage/Liquid				
Brown Beverage/Liquid				
Container Glass				
Other Glass				
Fluorescent Tubes				

PLASTICS				
#1 Pop & Liquor				
#1 Other Bottles				
#2 Milk & Juice				
#2 Other Bottles				
#2 Jars & Tubs				
Other Bottles, Jars & Tubs				
Expanded Polystyrene				
Other Rigid Packaging				
Grocery/Store/Bread Bags				
Garbage Bags				
Other Plastic Film				
Plastic Products				
Plastic/Other Materials				

WOOD & YARD WASTES				
Dimension Lumber				
Other Untreated Wood				
Pallets				
Crates/Boxes				
Treated Wood				
Contaminated Wood				
Leaves & Grass				
Prunings				

METALS				
Alum. Beverage Cans				
Alum. Foil/Containers				
Other Aluminum				
Tinned Food Cans				
Other Ferrous				
Other Nonferrous				
Mixed Metals/Material				
Empty Aerosol Cans				
Motor Oil filters				

ORGANICS				
Food Wastes				
Textiles/Clothing				
Carpet/Upholstery				
Leather				
Disposable Diapers				
Animal By-products				
Rubber Products				
Tires				
Ash				
Misc. Organics				

Truck #	Route #	Service Area:
Date:	Location:	Sample ID: