Solid Waste Authority of Central Ohio

Waste Characterization Study

Final Report

November 2019

SWACO
FROM WASTE TO RESOURCES

PREPARED BY

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Executive Summary

Study Objective and Overview

The objective of the Solid Waste Authority of Central Ohio (SWACO) 2018-19 waste characterization study was to collect and analyze data on the composition and characteristics of materials disposed of in SWACO's waste stream. This study focused on waste from the Commercial and Residential sectors originating throughout the SWACO service area, which includes waste originating from communities and businesses located within Franklin County. The waste composition and recoverability results presented in this study are not representative of sectors that are excluded from the sampling universe, such as self-hauled waste and special waste.

The findings from this study provide SWACO with detailed data on the composition and quantities of materials disposed in the portions of the waste stream covered in this study, by material class and recoverability category. This data can inform SWACO's planning, programs, education, and policies and help guide the focus on specific materials for waste diversion.

Study Methodology

Cascadia Consulting Group (Cascadia) and Mid-Atlantic Solid Waste (MSW) worked as a team to complete four seasons of fieldwork for this study in November 2018, February 2019, May 2019, and August 2019. Sampling occurred over five weekdays each season. Cascadia designed a sampling plan for achieving statistically valid results and developed a sampling schedule that allocated samples by sector, facility, and season based on data provided by SWACO about the distribution of vehicles by sector type among the three facilities.

Cascadia sampled waste that was delivered to SWACO's Morse Road and Jackson Pike transfer facilities as well as waste direct-hauled to the Franklin County Sanitary Landfill. Cascadia randomly selected a time within normal operating hours for each facility to collect each sample. During the designated sampling time, the sampling manager was stationed at the scalehouse or an area where the vehicles arrived at the facility, surveying vehicle drivers until they reached a vehicle that met the sample selection criteria. The sampling manager worked with the driver of each vehicle and a loader operator at the facility to obtain a 200- to 250-pound sample from a randomly-selected portion of the load for hand sorting. The study included 20 residential samples and 25 commercial samples each season across the four seasons of the study for a total of 180 samples.

Collected samples were sorted into 64 material types. Each material type fell into one of eleven broad material classes: **Fiber, Plastics, Glass, Metals, Organics, Textiles, Bulky and Durable Goods, Electronics, Hazardous Waste, Construction and Demolition Debris,** and **Other Materials**. Each material type was also classified according to their recoverability, using seven recoverability groups: **Current Standard Recycle**, **Potential Recycle**, **Current Compostable**, **Potential Compostable**, **Current Other Recoverable**, **Potential Other Recoverable**, and **Non-Recoverable**.

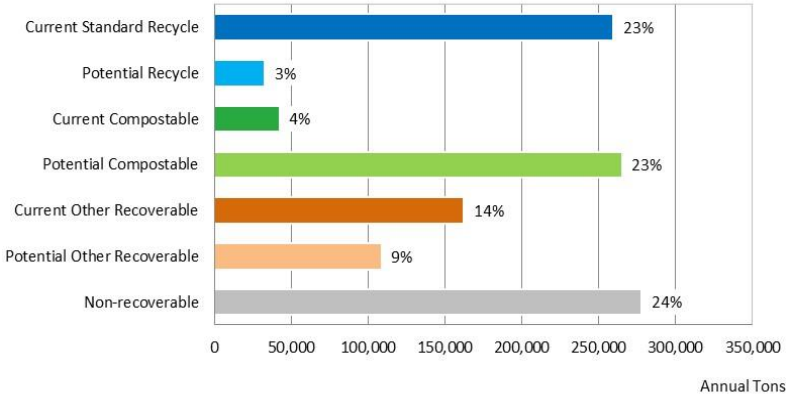
Waste Composition and Recoverability

OVERALL WASTE COMPOSITION KEY FINDINGS

This section describes the quantities and composition of material disposed in SWACO's overall combined waste stream from the Commercial and Residential sectors. This excludes portions of the waste stream not included in the definitions of commercial and residential waste. A total of 180 samples were characterized in the study.

As shown in **Figure 1,** 41 percent (464,609 tons) of SWACO's overall disposed waste stream is recoverable through programs, services, and processing that are currently available today, and over one-third (35%) of disposed waste has the potential to be recovered in the future.

Figure 1. Recoverability by Category – Overall



The largest recoverability categories in SWACO's overall waste profile are materials that are potentially compostable (23%), such as food scraps, and materials that are currently accepted in curbside and common commercial recycling programs (23%), such as corrugated cardboard and other fibers ("Current Standard Recycle"). About 14 percent of overall waste can currently be recovered through programs other than standard residential curbside and commercial recycling collection programs. Non-recoverable materials comprise 24 percent of the overall waste.

As shown in **Table 1**, eight of the top ten most prevalent disposed materials are currently or potentially recoverable. Together they represent approximately 50 percent of overall waste disposed in waste streams covered by this study.

The three most prevalent material types, *food scraps* (14.7%), *corrugated cardboard* (10.4%), and *other compostable fiber* (7.7%), are all either currently or potentially recoverable through recycling and composting programs.

Together they represent nearly one-third of overall waste disposed in SWACO's jurisdiction.

Table 1. Top Ten Material Types – Overall

Material	Est. Percent	Est. Tons
Food Scraps	14.7%	168,797
Corrugated Cardboard	10.4%	118,989
Other Compostable Fiber	7.7%	88,457
Other Plastic Film – Non-Recyclable	5.6%	64,604
Wood Pallets	4.1%	47,082
Magazines, Newspaper, Office & Printing Paper, Mail	3.4%	38,954
Other Recyclable Paper	3.3%	38,258
Wood Lumber & Products, Treated	3.2%	36,204
Plastic Durable & Bulky Items	3.1%	35,536
Yard Waste	3.1%	35,424
Total for Top Materials	**58.5%**	**672,307**

COMMERCIAL SECTOR KEY FINDINGS

This section describes the quantities and composition of material disposed in SWACO's commercial sector. The final analysis included a total of 100 commercial samples. Approximately one-quarter (25%) of SWACO's commercial waste can currently be recovered through common commercial recycling programs ("Current Standard Recycle"), representing the largest recoverability category in the commercial sector, while over one-fifth (23%) can potentially be recovered through composting programs. Non-recoverable materials represent approximately 22 percent of commercial waste.

As shown in **Table 2,** the three most prevalent disposed material types are *food scraps* (14.9%), *corrugated cardboard* (14.6%), and *other compostable fiber* (7.8%), which are all either currently or potentially recoverable. Together they represent approximately 37 percent of commercial waste disposed in SWACO's jurisdiction.

RESIDENTIAL SECTOR KEY FINDINGS

This section describes the quantities and composition of material disposed in SWACO's residential sector. The final analysis included a total of 80 residential samples. Approximately 38 percent (174,913 tons) of SWACO's residential waste is recoverable through programs, services, and processing that is currently available and over one-third (35%) has the potential to be recovered in the future. Of currently and potentially recoverable materials, potentially compostable (23%) and current standard recyclable (19%) materials (i.e. material currently collected in curbside programs) make up the largest recoverability categories. Non-recoverable materials represent approximately 27 percent of residential waste.

As shown in **Table 3,** the three most prevalent disposed material types, *food scraps* (14.4%), *other compostable fiber* (7.6%), and *yard waste* (5.8%), are all potentially or currently compostable. Together they represent approximately 28 percent of residential waste disposed in SWACO's jurisdiction.

The most prevalent disposed material type in both the commercial and residential sectors is *food scraps*. *Corrugated cardboard* makes up 14.6% of commercial waste, while it composes 3.9% of residential waste.

Table 2. Top Ten Material Types – Commercial

Material	Est. Percent	Est. Tons
Food Scraps	14.9%	102,767
Corrugated Cardboard	14.6%	101,128
Other Compostable Fiber	7.8%	53,746
Wood Pallets	6.5%	44,810
Other Plastic Film – Non-Recyclable	5.7%	39,295
Wood Lumber & Products, Treated	3.7%	25,319
Plastic Durable & Bulky Items	3.4%	23,413
Other Recyclable Paper	3.2%	21,805
Furniture	2.9%	20,116
Magazines, News, Office/Printing, Mail	2.9%	20,030
Total for Top Materials	**65.4%**	**452,429**

Table 3. Top Ten Material Types – Residential

Material	Est. Percent	Est. Tons
Food Scraps	14.4%	66,030
Other Compostable Fiber	7.6%	34,711
Yard Waste	5.8%	26,363
Other Plastic Film – Non-Recyclable	5.5%	25,310
Disposable Diapers	4.3%	19,896
Magazines, News, Office/Printing, Mail	4.1%	18,924
Corrugated Cardboard	3.9%	17,861
Clothing	3.7%	16,985
Other Recyclable Paper	3.6%	16,453
Animal By-Products	3.4%	15,394
Total for Top Materials	**56.3%**	**257,927**

Capture Rate of Residential Recyclables

Data from the waste characterization study was combined with data provided by Rumpke on the tons of residential materials recycled to calculate the capture rate of residential recyclables. The capture rate of residential recyclables is defined as the percentage of total tons of current standard recyclable materials generated in SWACO's combined residential disposal and recycling streams that are currently collected from residents for recycling.

As shown in **Table 4**, SWACO's residential sector has a capture rate of approximately 40 percent, meaning that of all the current standard recyclable material generated by residents in SWACO's disposal and recycling streams, 40 percent is currently being captured for recycling. The materials with the highest capture rates are *glass bottles & jars* (53.3%), *recyclable mixed paper* (44.0%), and *corrugated cardboard* (38.2%). The materials with the lowest capture rates are *aluminum cans* (15.4%), *#1 & #2 plastic bottles & jugs* (24.7%), and *steel cans* (27.9%).

Table 4. Curbside Recycling Capture Rate – Residential

Material	Tons Disposed	Tons Recycled	Total Generation (Tons Disposed + Recycled)	Capture Rate
Corrugated Cardboard	17,861	11,030	28,891	38.2%
Recyclable Mixed Paper	35,971	28,224	64,195	44.0%
#1 & #2 Plastic Bottles & Jugs	12,599	4,141	16,740	24.7%
Glass Bottles & Jars	10,348	11,796	22,144	53.3%
Steel Cans	3,791	1,469	5,260	27.9%
Aluminum Cans	4,481	815	5,296	15.4%
Overall	**85,052**	**57,475**	**142,527**	**40.3%**

Market Value of Recyclables

Data from the waste characterization study was combined with recent market prices provided by SWACO to estimate the market value of current standard recyclable materials found in SWACO's waste stream. As shown in **Table 5**, 259,491 tons of material in the overall waste stream currently has the potential to be captured for recycling and sold in commodity bales, representing $23,280,923. The material types that represent the highest value are *aluminum cans* ($7,920,028), *#1 PET bottles & jugs* ($4,249,869), and *corrugated cardboard* ($4,164,619).

Table 5. Value of Disposed Recyclables

Material	Market Prices	Residential Sector		Commercial Sector		Overall	
	Per Ton	Tons	Value	Tons	Value	Tons	Value
Corrugated Cardboard	$ 35	$ 17,861	$ 625,146	$ 101,128	$ 3,539,473	$ 118,989	$ 4,164,619
Magazines, Newspaper, Office/Printing, Mail	$ 0	$ 18,924	$ 0	$ 20,030	$ 0	$ 38,954	$ 0
Other Recyclable Paper	$ 0	$ 16,453	$ 0	$ 21,805	$ 0	$ 38,258	$ 0
Aseptic Containers & Gable Top Cartons	$ 48	$ 595	$ 28,258	$ 849	$ 40,306	$ 1,443	$ 68,564
#1 PET Bottles & Jugs	$ 230	$ 8,620	$ 1,982,686	$ 9,857	$ 2,267,183	$ 18,478	$ 4,249,869
#2 HDPE Natural Bottles & Jugs	$ 1,080	$ 1,874	$ 2,023,681	$ 1,701	$ 1,837,307	$ 3,575	$ 3,860,988
#2 HDPE Colored Bottles & Jugs	$ 300	$ 2,105	$ 631,425	$ 1,967	$ 590,127	$ 4,072	$ 1,221,553
Glass Bottles & Jars	$ (10)	$ 10,348	$ (103,483)	$ 9,827	$ (98,267)	$ 20,175	$ (201,749)
Steel Cans	$ 100	$ 3,791	$ 379,057	$ 3,223	$ 322,349	$ 7,014	$ 701,405
Aluminum Cans	$ 1,080	$ 3,862	$ 4,171,313	$ 3,471	$ 3,748,714	$ 7,333	$ 7,920,028
Aerosol Containers	$ 1,080	$ 619	$ 668,659	$ 580	$ 626,887	$ 1,200	$ 1,295,546
Total		**$ 85,052**	**$ 10,406,742**	**$ 174,439**	**$ 12,874,081**	**$ 259,491**	**$ 23,280,823**

SWACO 2018-19 Waste Characterization Study Final Report

Study Objective and Overview

The objective of the Solid Waste Authority of Central Ohio (SWACO) 2018-19 waste characterization study was to collect and analyze data on the composition and characteristics of materials disposed of in SWACO's waste stream. This study focused on waste from the Commercial and Residential sectors originating throughout the SWACO service area, which includes waste originating from communities and businesses located within Franklin County.

The findings from this study provide SWACO with detailed data on the composition, quantities, and characteristics of materials disposed in the portions of the waste stream covered in this study, by material class and recoverability category. This data can inform SWACO's planning, programs, education, and policies and help guide the focus on specific materials for waste diversion.

Cascadia Consulting Group (Cascadia) and Mid-Atlantic Solid Waste (MSW) worked as a team to complete four seasons of fieldwork for this study. The findings presented in this report represent the combined results of the waste characterization data collected from all four seasons.

This report also provides an analysis of the capture rate of recyclable materials to provide a benchmark estimate of the portion of recyclable materials that are currently being recycled in SWACO's jurisdiction.

Additionally, this report describes the current market value of recyclable materials that are being disposed of in SWACO's commercial and residential disposed waste streams.

In shaping the study methodology and fieldwork activities for SWACO, our team relied on four key principles to ensure that data were statistically reliable, representative of SWACO's targeted generating sectors, and—most importantly—accurate.

- **Careful planning and coordination.** We strived to ensure that sampling operations were efficient and that the required data were collected with minimal disruption to operations at disposal facilities. Our team worked closely with SWACO staff, haulers, and facilities to develop and implement a thorough, efficient, and cost-effective data collection plan.

- **Selection of waste for sampling that is representative.** We achieved statistical representativeness by carefully coordinating with SWACO staff to develop a sampling plan which

ensured that selected loads were statistically representative of the entire population or sub-population of materials being studied.

- **Consistent, accurate, and efficient sorting and characterization methods.** The combined knowledge of our experienced team members ensured that each task efficiently delivered reliable results. Our experienced field supervisors "hit the ground running" to obtain characterization data accurately, quickly, and cost-efficiently.

- **Statistically-appropriate analyses and error-free calculations.** We used industry standard statistical protocols to ensure that we continue our track record of producing accurate and statistically reliable reports. We used industry leading QA/QC protocols to ensure error-free calculations.

The following **Study Methodology** section describes the study procedures, from designing the study parameters to implementing fieldwork and data collection protocols, to collecting and hand-sorting samples. The **Waste Composition and Recoverability** section provides an analysis of the compositions of the waste stream by sector. The **Capture Rate of Residential Recyclables** describes the capture rate of recyclable materials in SWACO's residential waste stream and the **Market Value of Recyclables** section describes the market value of recyclable materials that are currently entering the garbage stream. Detailed composition results for each sector are presented in **Appendix D. Detailed Composition Tables**.

Study Methodology

DEFINITION OF UNIVERSE

The SWACO waste characterization study covered two waste sectors, defined in **Table 6** below. Loads selected for sampling were screened through vehicle surveys to ensure they met the definitions for the representative sector. There are waste streams generated within SWACO's jurisdiction that were not included as a part of the study, such as self-hauled waste and special waste. These sectors make up a relatively small amount of the overall waste stream received each year at SWACO facilities. The waste composition and recoverability results presented in this study are not representative of sectors that are excluded from the sampling universe definitions below.

Table 6. Waste Sector Definitions and Boundaries

Waste Sector	Definition
Commercial	Any MSW load that originated within SWACO boundary hauled by a franchised/certified/permitted/municipal hauler that the driver identifies as containing waste primarily from sources other than single-family residences. This sector can generally be described as "business waste." This includes commercial businesses, retail businesses, industrial waste, loads collected from front-load containers, loads in roll-off containers (loose or compacted), and mixed loads of both residential and non-residential materials, as long as the load is primarily non-residential. This does not include loads generated at construction/demolition sites.
Residential[1]	Any MSW load hauled by a municipal hauler (e.g. City of Columbus) or a franchised/certified/permitted/municipal hauler that the driver identifies as containing entirely single-family residential MSW or commingled single-family/multifamily MSW that originated within the SWACO boundary. These loads are typically collected on a defined route, from a defined geographic area, and on a regular schedule. This does not include MSW collected in roll-off containers (compacted or loose) from residences.

[1] While the primary focus of the study is on the overall waste stream generated from within SWACO's jurisdiction, residential waste that originated from within the City of Columbus was identified as such during the collection of samples to ensure that representative samples were collected and to provide the City of Columbus with a residential data set specific to their city. The defined Residential waste stream, which includes all points of origin within SWACO's jurisdiction, is designed to be representative of the residential sector as a whole within SWACO's jurisdiction and will be the focus of the study results in the main body of this report.

NUMBER, SIZE, AND ALLOCATION OF SAMPLES

Cascadia sampled waste that was delivered to SWACO's Morse Road and Jackson Pike transfer facilities as well as waste direct-hauled to the Franklin County Sanitary Landfill. Consistent with industry literature and best practices, Cascadia collected samples that weighed between 200 and 250 pounds. The Cascadia team's sampling expertise ensured that representative and random samples that met sampling weight targets were acquired consistently throughout the project.

Cascadia collected samples by waste sector for the four seasons as shown in **Table 7** below.

Table 7. Sample Allocation

Sector	Samples (Season 1)	Samples (Season 2)	Samples (Season 3)	Samples (Season 4)	Total Samples
City of Columbus Residential	10	10	10	10	40
Rest of Authority Residential	10	10	10	10	40
Commercial	25	25	25	25	100
TOTALS	**45**	**45**	**45**	**45**	**180**

Using these seasonal and sample targets as an outline, our team designed a sampling schedule that collected samples from all three facilities on all weekdays. The sampling schedule for the four seasons are summarized in **Table 8** in the section titled **Sampling Schedule.**

Commercial Waste

The study's sampling target for commercial waste was 100 samples, divided evenly across four seasons. The Cascadia team estimated that this level of sampling would lead to relative error rates (a key indicator of data quality) of less than 20% for key recoverable materials in SWACO's commercial waste. Cascadia hand-sorted 25 samples of commercial waste in each of the four seasons of fieldwork completed, for a total of 100 commercial samples. We used a systematic selection process implemented by SWACO staff (at Jackson Pike Transfer Facility) or the Cascadia team sampling manager (at Morse Rd. Transfer Facility and the Franklin County Sanitary Landfill) to select commercial loads for sampling. Field staff randomly selected a 200- to 250-pound sample of waste from each of the selected loads and hand-sorted the selected samples into specified material types.

Residential Waste

Based on the same method as Commercial Waste, the study's sampling target for residential waste was 80 samples, divided evenly across four seasons, for a total of 20 residential samples per season. Of those, 10 samples were from the City of Columbus (Columbus) residential and 10 were from loads of residential waste originating from any point of origin within SWACO's jurisdiction other than from within the City of Columbus. As with commercial waste, the Cascadia team used a systematic selection process implemented by SWACO staff or the Cascadia team's sampling manager to select residential loads for sampling at the three main facilities. Field staff randomly selected a 200- to 250-pound sample of waste from each of the selected loads and hand-sorted the selected samples into specified material types.

MATERIAL TYPES AND DEFINITIONS

Material Types and Material Class Groups

In collaboration with SWACO, Cascadia developed a list of 64 material types and detailed definitions that we used to separate samples for measurement. Each material type fell into one of eleven broad material classes: **Fiber, Plastics, Glass, Metals, Organics, Textiles, Bulky and Durable Goods, Electronics, Hazardous Waste, Construction and Demolition Debris,** and **Other Materials**. The final material list and detailed definitions are included in **Appendix A. Material List and Definitions.**

Material Recoverability Groups

To identify additional diversion opportunities, material types were classified according to their recoverability, using seven recoverability groups:

- **Current Standard Recycle** – Materials that are currently accepted in residential curbside and multifamily recycling programs within SWACO's service area or are commonly recycled through commercial sector collection programs. For example, corrugated cardboard and aluminum cans fall into this category.
- **Potential Recycle** – Materials for which recycling technologies, programs, and/or markets exist, but are either not well developed or not currently utilized at scale. These materials are believed to have the potential to be accepted in curbside recycling programs or common commercial programs in the future. For example, other #1 PET packaging and #5 polypropylene packaging are included in this category.
- **Current Compostable** – Materials that are currently accepted in compost programs where available. Yard waste is included in this category.
- **Potential Compostable** – Materials for which composting technologies, programs, and/or markets exist, but are either not well developed or not currently utilized at scale. These materials are believed to have the potential to be accepted in compost programs in the future. Food scraps falls within this category. While some food scrap collection and composting programs currently exist in SWACO's region, their availability is not widespread.
- **Current Other Recoverable** – Materials that can be recovered through programs, markets, or streams other than current standard curbside or commercial recycle programs, such as special collections for scrap metal and appliances, private textile donation acceptance for reuse/recycling, and store take-back of recyclable plastic film.
- **Potential Other Recoverable** – Materials for which programs, markets, and streams for recovery other than current standard curbside or commercial recycle programs exist but are either not well developed or not currently utilized at scale. For example, mattresses and small appliances fall into this category.
- **Non-Recoverable** – Materials that are not readily recyclable or face other market, technology, or programmatic related barriers. Medical waste is an example of a material that falls into this category.

Each material type was assigned to one of the recoverability groups by Cascadia and SWACO staff based on the definitions listed above. **Appendix A. Material List and Definitions** also shows how the study's defined material types are categorized into each material recoverability group.

In addition to the previously identified recoverability groups, for the final season SWACO requested that the Cascadia team sort plastic film materials into additional sub-types to obtain a deeper analysis of this category. The additional plastic film material types and definitions are listed in **Appendix A. Material List and Definitions** as **Season 4 Plastic Film Material Subtypes**. Results of the sub-analysis of plastic film materials is presented as part of the **Overall Waste Composition** in **Plastic Film Composition – Season 4 Sub-Analysis**.

SAMPLING SCHEDULE

Cascadia completed the first season of fieldwork in November 2018, the second season in February 2019, the third season in May 2019, and the fourth season in August 2019. As shown in **Table 8**, Cascadia designed a sampling schedule that allocated samples by sector, facility, and season to achieve the sampling targets for each sector, based on data provided by SWACO about the distribution of vehicles by sector type among the three facilities.

Sampling occurred over five weekdays each season. To the extent possible, Cascadia designed a sampling schedule that achieved an even distribution of samples over each week that provided representative, reliable samples from all areas of SWACO's jurisdiction. In Season 1, Cascadia designed a sampling schedule that adjusted for the holiday collection schedule in City of Columbus due to Veterans' Day. Based on a variety of factors that affected the team in the field during the first season, including the Veterans' Day holiday, the amount of time the sort crew experienced between collecting samples, and the amount of time spent delivering samples from the facilities to the sort crew at Jackson Pike, we adjusted the sampling schedule midway through the week to ensure the team completed sampling and sorting activities in an efficient, timely, and high-quality manner by the fifth day of fieldwork.

Table 8. Sampling Numbers by Season, Facility, and Sector

Facility	A	B	C	A	B	C	A	B	C	A	B	C	Total
Sector	Season 1			Season 2			Season 3			Season 4			
City of Columbus Residential	3	7	0	2	8	0	2	8	0	2	8	0	**40**
Rest-of-Authority Residential	0	0	10	0	0	10	0	0	10	0	0	10	**40**
Commercial	7	6	12	9	5	11	9	5	11	9	5	11	**100**
TOTALS	**10**	**13**	**22**	**11**	**13**	**21**	**11**	**13**	**21**	**11**	**13**	**21**	**180**

A=Morse Road, B=Jackson Pike, C=Franklin County Landfill

SELECTION OF LOADS

SWACO provided staff at the Jackson Pike Transfer Facility to survey and select incoming vehicles for sampling. At the Morse Road Transfer Facility and Franklin County Sanitary Landfill, a sampling manager from Cascadia or MSW conducted the vehicle selection process.

The project team used a systematic selection procedure to identify vehicles for sampling. Because the study involved selecting a small number of loads for sampling each day relative to the number of trucks arriving at the facility, Cascadia randomly selected a time within normal operating hours for each facility to collect each sample. This eliminated the need to survey every truck, thereby limiting the potential for slowdowns at the scale or landfill face and also limited the amount of time sampling managers stood in close proximity to active truck traffic. The timeframe within which vehicle selection occurred differed at

each facility. We based our timeframe for vehicle selection on the general times vehicles from different sectors arrived at the facility and to ensure the sort crew received their samples earlier in the day, giving them ample time to sort through the samples.

For each sampling day, Cascadia prepared a *Vehicle Selection Sheet* for each facility that was used by the vehicle surveyor to guide vehicle selection. For each sample, the vehicle surveyor began surveying trucks at the designated time, selecting the first truck determined to meet the specified sample criteria.

Once a vehicle was selected for sampling, the surveyor recorded details about the selected load on the *Vehicle Selection Sheet*, which was linked to sample data via a unique sample ID assigned to the load on a *Sample Placard*. The surveyor placed the *Sample Placard* on the vehicle's windshield or dashboard to identify it as a vehicle intended for sampling and directed the driver to the sampling area. Information recorded on the *Vehicle Selection Sheet* for each selected load included:

- Waste sector
- Load origin (municipality)
- Vehicle type
- Hauler
- Route and/or truck number
- Driver comments
- Other pertinent information

The vehicle selection process was different at each facility to best accommodate each facility's unique layout and operations. Sampling times were adjusted in the field to ensure that all loads could be intercepted and sorted during the time available.

When a selected vehicle arrived at the tipping area at each facility, the facility's sampling manager, who may have also been the vehicle surveyor, reviewed the load information with the driver, including waste sector and vehicle type, and confirmed this matched what was recorded on the *Sample Placard*. As required, the sampling manager also noted any unusual circumstances associated with the load or the sample.

Bulky Items in the Load

After the first season of fieldwork, SWACO noted the absence of specific bulky items and electronics in the samples the crew sorted. To capture data on the presence of bulky items and electronic devices in the waste stream, we added an additional step to the sampling procedure in the second season. From the second season onward, the sampling manager at each facility noted the presence of bulky items and electronics in the truck's load as part of their data collection procedure. They communicated clearly with the load operator and staff on the tip floor that they would walk onto the floor after the truck dumped its load and visually survey the entire load for the seven materials under the Bulky Items and Electronics categories on the materials list. They recorded the presence of these materials on the load's *Sample Placard*. The placard was delivered to the sort crew, along with the sample. The Crew Chief entered this data into the database under the sample ID for the sample taken from that vehicle's load.

The following sections describe the vehicle selection process at each facility.

Selection of Loads at Morse Road Transfer Facility

A Cascadia sampling manager selected vehicles and collected samples. At each of the randomly selected times for sample selection, the sampling manager was stationed at the scalehouse, surveying incoming vehicles to determine the origin and sector of the load. If there was a line at the scalehouse, the sampling manager walked down the line surveying vehicles until they reached a vehicle that met the sample selection criteria. Once a vehicle was selected for sampling, the sampling manager recorded the details about the selected load from the driver and placed a *Sample Placard* that indicated the selected sample's unique ID on the corresponding vehicle's windshield or dashboard. The sampling manager instructed the driver to wave their placard in the air once they pulled around the building and were in line to dump their load, letting the load operator know that their vehicle was selected for sampling. The loader operator directed the vehicle to dump in Bay 4. This bay was closest to the sampling manager's designated sample collection area. The sampling manager walked through the transfer station building to meet the loader operator on the tip floor and collect the sample.

Selection of Loads at Jackson Pike Transfer Facility

A SWACO staff member was stationed at the scalehouse at each of the designated sampling times, surveying the vehicles that arrived. If there was a line at the scalehouse, the surveyor walked down the line surveying vehicles until they reached a vehicle that met the sample selection criteria. Once a vehicle was selected for sampling, the surveyor recorded details about the selected load and placed a *Sample Placard* indicating the selected sample's unique ID on the corresponding vehicle's windshield or dashboard and directed the vehicle to the sampling area at the facility's tip floor. The vehicle surveyor communicated with the sort crew through radio when a selected vehicle was on its way to the tip floor. The selected vehicle was directed to dump in Bay 1, which was the bay closest to the sorting area.

Selection of Loads at Franklin County Sanitary Landfill

Vehicle selection and sample collection at Franklin County Sanitary Landfill occurred at the entrance to the working face of the landfill. During designated sample selection times, the sampling manager was stationed near the top of the hill near the entrance of the work face area, a sufficient distance from the tip area to catch all incoming vehicles for surveying without impeding activity at the tip area or placing staff near working vehicles. As there are two inbound lanes at the scalehouse and not all vehicles speak to the scalehouse attendant, setting up a single entry-point on the face of the landfill facilitated an efficient process for the sampling manager to survey and count vehicles. The sampling manager set up orange traffic cones near the top of the hill to funnel vehicles into a single line past

their station. This enabled the sampling manager to survey every vehicle that arrived at the landfill to determine the origin and sector of the load. Once a vehicle had been selected for sampling, the sampling manager recorded pertinent information about the selected vehicle load and directed the vehicle to dump its load on the side of the tip area. Once the load was on the ground, the sampling manager proceeded with sample collection immediately to avoid blocking access or creating congestion around the tipping area.

DATA COLLECTION FORMS

Data collection forms developed for this study included:

- *Vehicle Selection Sheets* for each facility and each day of sampling activity. The form listed the sample targets, vehicle selection instructions, and the designated start times for selection of each sample. Vehicle selection staff also used these forms to track pertinent information about loads from vehicles selected for sampling.
- *Sample Placards* to flag vehicles selected for sampling. The *Sample Placards* are brightly colored paper signs with the sample number pre-printed on the front along with information about the load origin and sector. The scalehouse surveyors placed *Sample Placards* in the windshield of selected vehicles so they may be quickly identified when they arrive at the tipping area. The sampling manager collected the placard from the driver and used the placard to record the presence of bulky items and electronics in the vehicle's load.

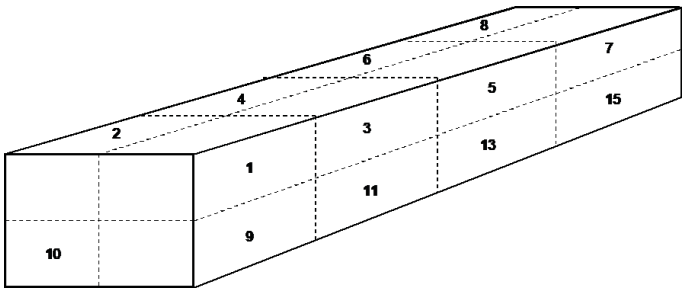
Examples of the data collection forms are included in **Appendix B. Data Collection Forms**.

SAMPLE SELECTION AND SORTING PROTOCOLS

A sampling manager was assigned to each facility for this study. The sampling manager obtained a 200- to 250-pound sample from vehicles for hand sorting. Our team worked with the driver of each vehicle and a loader operator at the facility to secure a sample by extracting a randomly-selected portion from the tipped load using the following procedure.

- The vehicle driver dumped the selected load in an elongated pile. The sampling manager selected a sample from this pile using an imaginary 16-cell grid (shown in **Figure 2**) superimposed over the dumped material.The sampling manager used a randomly-generated number (1-16) that was pre-printed on the *Sample Placard* to determine from which cell to extract a sample.

Figure 2. 16-Cell Grid



- At Jackson Pike Transfer Facility, the loader driver extracted a sample from the selected cell under direction from the sampling manager and deposited the sample on a clean tarp for sorting.
- At Morse Road Transfer Facility and Franklin County Sanitary Landfill, the sampling manager had at least two 96-gallon carts set up and open. The loader operator extracted a sample from the selected cell and delivered it to the sampling manager. The load operator either deposited the sample onto the floor for the sampling manager to place into the carts or lowered the sample until it was directly above the carts. The sampling manager then used a rake to deposit the material into the carts. The sampling manager weighed the carts on a scale to ensure that the sample fell within the target weight range of 200 to 250 pounds. If the sample was underweight, the sampling manager scooped additional material into the carts until it fell within the target weight range. Once the sampling manager determined that the sample met the target weight requirement, they communicated to the loader operator that they were done with the load. The sampling manager then wheeled the carts away so that they were out of the way of the activity on the tip floor.
- *Bulky items in the sample*: When a bulky item, like a TV, mattress, or piece of furniture, was included (in part or whole) with a selected sample, the item was set aside at the sampling site. The field crew weighed the bulky item and noted a description of the item and its material composition. The actual weight and volume contribution of the bulky item to the total sample size was calculated as a percentage and incorporated into the sample characterization during the data entry and analysis phases.

After the Morse Road Transfer Facility and Franklin County Sanitary Landfill sampling managers achieved their daily sampling target, they loaded their samples into box trucks and transported them to the sort team, located at the Jackson Pike Transfer Facility, for hand sorting.

Once the sample was acquired and transported to Jackson Pike, the material was manually sorted into the prescribed material categories. Plastic 18-gallon bins with sealed bottoms were used to contain the separated materials. A picture of the sorting table and bins is shown below.

Sorting began with the Field Manager photographing the sample using a digital camera. The *Sample Placard* that identified each sample was positioned to be visible in each photograph.

Sorters were trained to specialize in certain material groups. For example, one sorter handled the paper categories while another handled the plastics, another handled the glass, and so on. In this way, sorters became highly knowledgeable in a short period of time about the definitions of individual material categories. They were also sorting into clearly labeled bins located within reach.

The Crew Chief monitored the bins as each sample was sorted, rejecting materials that were improperly classified. Open bins allowed the Crew Chief to see the material at all times. The Crew Chief also verified the purity of each component during the weigh-out (discussed below). The materials were sorted to a particle size of 2-inches or less by hand, until no more than a small amount of homogeneous fine material ("mixed residue") remained. The remaining debris smaller than two inches was manually sorted to the appropriate categories based on the best judgment of the Crew Chief—most often a combination of Other Paper, Other Organics, Food Waste, or Fines.

The project team believes that the weigh-out and data recording process is a critical part of the sort. The Crew Chief was singularly responsible for overseeing all weighing and data recording of each sample. Once each sample was sorted, the weigh-out was performed. Each bin containing sorted materials from the just-completed samples were carried over to a digital scale. The Crew Chief verified the purity of each material as it was weighed and recorded all data in a handheld rugged tablet computer.

The crew ensured that the sorting workspace was left in good condition. Our field crew took steps to reduce or eliminate the risk of litter and led a thorough clean-up effort each day that included the following steps:

- Organizing and stowing sorting supplies in a designated location.
- Preparing all waste and recycling sorted throughout the day for disposal or recycling.
- Sweeping and cleaning the sort area to prevent windblown litter.
- Removing and properly disposing of any single-use personal protective equipment.
- Checking out with the facility manager each day.

At the end of each sorting day, the Data Manager also conducted a quality control review of the data entered in the handheld tablet. Reviewing the data at the end of each day allowed the Data Manager to identify any anomalies and resolve them with the Field Manager while the day's work was still fresh.

The *Vehicle Selection Sheets* were collected at the end of each day and the data was entered into a vehicle tracking tool on Excel. The weights of the samples leaving Morse Road Transfer Facility and Franklin County Sanitary Landfill, and the total sample weights sorted at Jackson Pike Transfer Facility, were entered into Excel tables and emailed to the transfer station supervisor at the end of each day, allowing them to track how much weight left each facility and was delivered to Jackson Pike Transfer Facility.

Waste Composition and Recoverability

A total of 180 samples were characterized in the study. This section describes the composition and recoverability of SWACO's overall combined waste stream from Commercial and Residential sectors, as well as sector-specific results for Commercial and Residential waste. Detailed composition tables are included in **Appendix D. Detailed Composition Tables**. Results for the City of Columbus Residential subsector are presented in **Appendix E. City of Columbus Residential Subsector**.

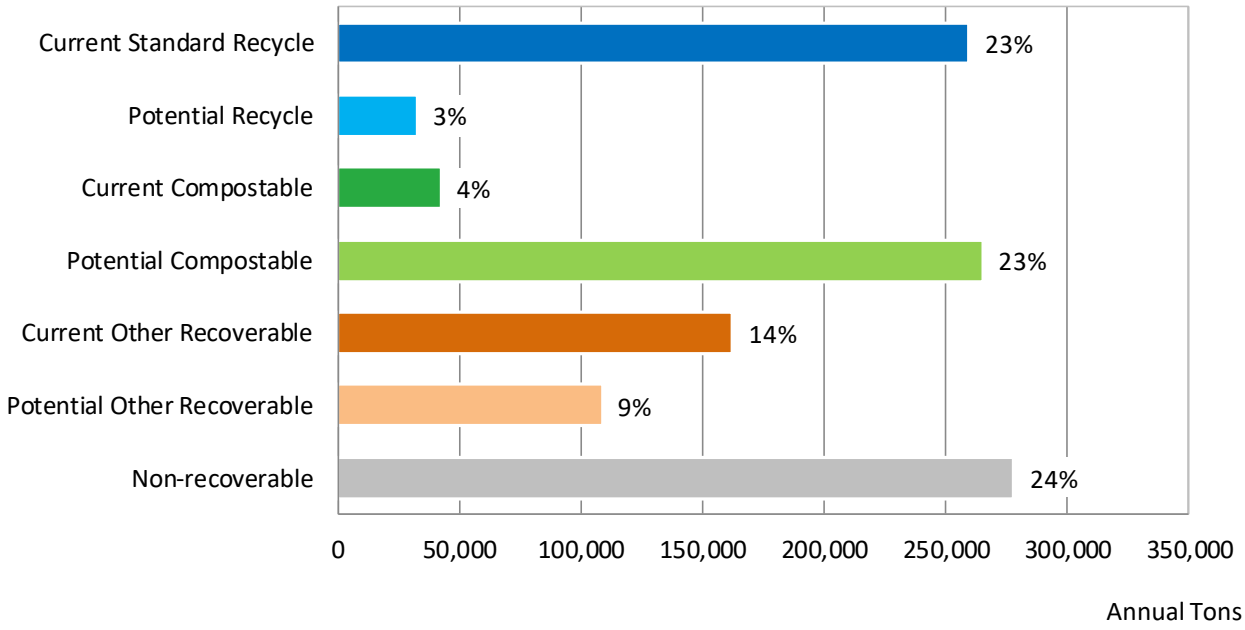
OVERALL WASTE COMPOSITION

This section describes the quantities and composition of material disposed in SWACO's overall waste stream. The overall waste stream describes the sectors that were defined in the **Definition of Universe** section and excludes portions of the waste stream not included in the definitions. A total of 180 samples were characterized for the final analysis. The overall waste composition is the weighted average of each sector and subsector's mean composition. The weighting process assigns a relative importance to the composition from each sector and subsector (the strata) based on the tons disposed annually by each stratum. This process is used to correct for the fact that the composition of the commercial waste has a greater influence on the overall composition than the residential waste because there is relatively more commercial waste disposed (691,378 tons vs. 457,900 tons per year).

Key Findings

As shown in **Figure 3**, 41 percent (464,609 tons) of SWACO's overall disposed waste stream is recoverable through programs, services, and processing that are currently available today, and over one-third (35%) of disposed waste has the potential to be recovered in the future.

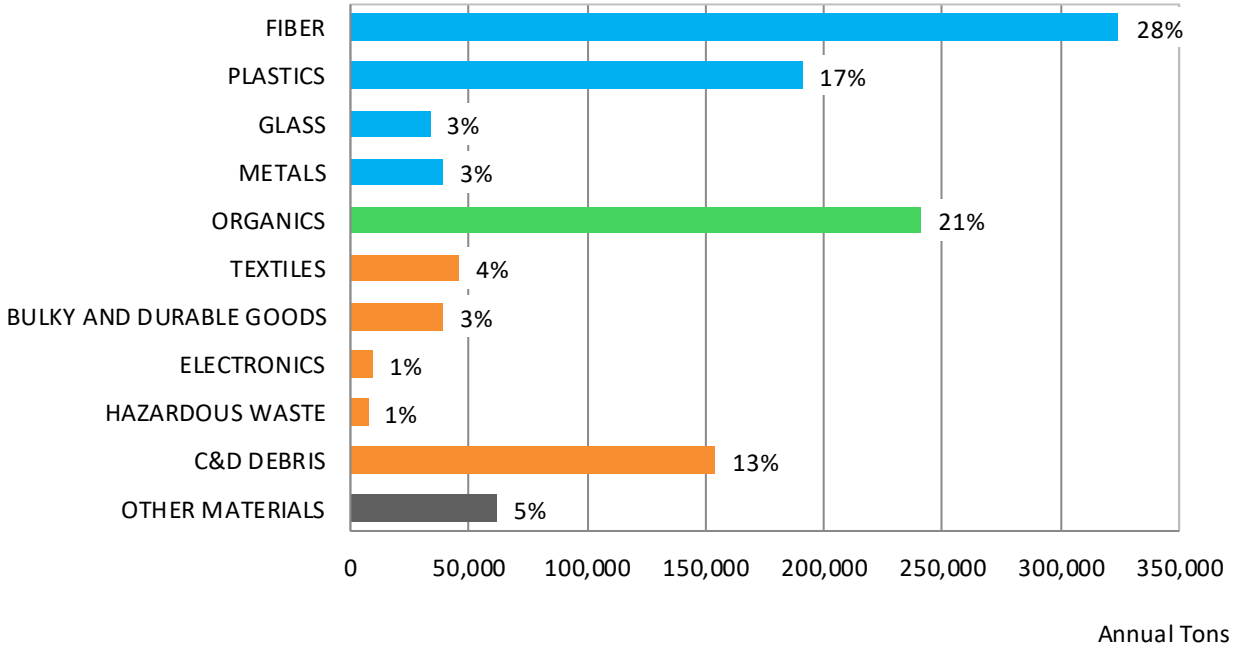
Figure 3. Recoverability by Category – Overall



The largest recoverability categories in SWACO's overall waste profile are materials that are potentially compostable (23%), such as food scraps, and materials that are currently accepted in standard curbside and commercial recycling programs (23%), such as corrugated cardboard and other fibers ("Current Standard Recycle"). About 14 percent of overall waste can currently be recovered through programs other than standard curbside and commercial collection programs, and 9 percent of waste has the potential to be recovered through other similar programs. Non-recoverable materials comprise 24 percent of the overall waste.

The waste composition data are presented by material class in **Figure 4**. **Fiber** (28%) and **Organics** (21%) are the two most prevalent material classes, together representing approximately half of the overall disposed waste covered by this study. The **Fiber** material class includes potentially compostable fiber. The next two most prevalent material classes are **Plastics** (17%) and **C&D Debris** (13%).

Figure 4. Annual Tons by Material Class – Overall



The ten most prevalent disposed materials, representing approximately 59 percent of overall disposed waste, are listed in **Table 9.** Eight of the top ten most prevalent materials are currently or potentially recoverable. Together they represent approximately 50 percent of overall waste disposed in waste streams covered by this study. As shown, the three most prevalent material types, *food scraps* (14.7%), *corrugated cardboard* (10.4%), and *other compostable fiber* (7.7%), are all either currently or potentially recoverable through recycling and composting programs. Together they represent nearly one-third of overall waste.

Three of the top ten material types are current standard recyclable and all are within the **Fiber** class: *corrugated cardboard* (10.4%)*; magazines, newspaper, office & printing paper, mail* (3.4%); *other recyclable paper* (3.3%). Together, they represent approximately 17 percent of overall waste.

Food scraps, which represents the most prevalent component (14.7%) of overall waste, was sorted into three subtypes, representing the following composition percentages: *edible food scraps – non-packaged* (6.5%); *edible food scraps – packaged* (4.1%); *non-edible food scraps* (4.1%). The composition for each of the three *food scraps* subtypes is presented along with other detailed composition results in **Table 18** of **Appendix D. Detailed Composition Tables**.

Table 9. Top Ten Material Types – Overall

Material	Est. Percent	Est. Tons
Food Scraps	14.7%	168,797
Corrugated Cardboard	10.4%	118,989
Other Compostable Fiber	7.7%	88,457
Other Plastic Film – Non-Recyclable	5.6%	64,604
Wood Pallets	4.1%	47,082
Magazines, Newspaper, Office & Printing Paper, Mail	3.4%	38,954
Other Recyclable Paper	3.3%	38,258
Wood Lumber & Products, Treated	3.2%	36,204
Plastic Durable & Bulky Items	3.1%	35,536
Yard Waste	3.1%	35,424
Total for Top Materials	**58.5%**	**672,307**

Bulky and Durable Goods and Electronics in Sampled Loads

As discussed in the **Selection of Loads** section, the sampling manager at each facility recorded the presence of **Bulky and Durable Goods** and **Electronics** in each selected vehicle's load for Seasons 2-4. The purpose of this was to note whether material types in these categories were observed in sampled loads, even if the materials were not included in the selected sample itself.

As shown in **Table 10**, *other electronics* was the most prevalent material type in loads and was observed in 36% of selected vehicle loads in Seasons 2-4. *Furniture* was the second most prevalent material type, observed in 21% of loads, followed by *small appliances*, which was observed in 19% of loads.

Table 10. Observed Bulky and Durable Goods and Electronics in Selected Loads

Material	# Samples Material is Present*	Percent
Other Electronics	49/135	36%
Furniture	29/135	21%
Small Appliances	25/135	19%
Mattresses and Box Springs	21/135	16%
Large Appliances	7/135	5%
Tires	4/135	3%
CRT TVs and Monitors	2/135	1%

*The field crew recorded the presence of bulky and electronic material types in Seasons 2-4, which consisted of a total of 135 samples. Season 1 is excluded from this analysis.

Plastic Film Composition – Season 4 Sub-Analysis

In Season 4, the field crew sorted the plastic film materials into additional material subtypes to gain a deeper understanding of the composition of plastic film being disposed in the waste streams covered by this study.

In Season 4, the crew sorted plastic film that had been classified as *other plastic film – non-recyclable/contaminated* in previous seasons into clean and contaminated subtypes to analyze how much of it was classified as non-recyclable due to contamination either at the point of disposal or after it had been collected and combined with the other waste materials in a collection vehicle, versus the amount of material classified as non-recyclable because the film plastic was a material type that is not generally recyclable. The material types and definitions are found in **Season 4 Plastic Film Material Subtypes.**

Table 11 shows the plastic film material types that were used Seasons 1-3, and as presented in the detailed composition tables. These are the high-level plastic film material types that show the composition of film that can be recovered, based on the state of the plastic film at the time the sort crew sorted the material. The most prevalent plastic film material type is *other plastic film – non-recyclable* (5.6%), followed by *other plastic film – recyclable* (1.3%), and *plastic bags – recyclable* (0.1%).

Table 11. Plastic Film Composition – Original (Seasons 1 – 3) Categories

	Est. Percent	Est. Tons
Plastic Bags – Recyclable	0.1%	1,436
Other Plastic Film – Recyclable	1.3%	14,872
Other Plastic Film – Non-Recyclable/Contaminated	5.6%	64,604

Table 12 breaks down the plastic film material types into clean and contaminated designations. Materials were sorted into *plastic bags* and *other plastic film – recyclable, clean* if they were clean and considered recoverable when the crew sorted them. If materials that were *plastic bags* or *other plastic film – recyclable* were contaminated during the sort, they were sorted into the corresponding *contaminated* material type. The resulting analysis provides a breakdown of clean plastic film that can be recovered compared to contaminated plastic film that cannot be recovered at the time of sorting (after the material has been collected and potentially compacted in a collection vehicle).

Because plastic film materials were sorted into subtypes in Season 4 only, the composition results for film varied slightly from the overall results from the full four-season analysis. To align the results for the plastic film subtypes with the overall estimated composition and tonnage of plastic film, the relative proportions of the three new subtypes of non-recyclable/contaminated plastic film in Season 4 were applied to the estimated tons of *other plastic film – non-recyclable/contaminated* calculated as part of the overall composition analysis.

As shown, much of the material originally classified as *other plastic film – non-recyclable/contaminated* is a recyclable type of film plastic but is classified as non-recyclable due to contamination either at the point of disposal or after it has been collected by a truck and mixed with other waste materials. Less than half of the material was classified as *other plastic film – non-recyclable* (2.2%) due to the type of plastic film material.

Table 12. Plastic Film Composition – Clean/Contaminated

	Est. Percent	Est. Tons
Plastic Bags – Recyclable, Clean	**0.1%**	**1,436**
Other Plastic Film – Recyclable, Clean	**1.3%**	**14,872**
Other Plastic Film – Non-Recyclable/Contaminated	**5.6%**	**64,604**
Plastic Bags – Recyclable, Contaminated	*0.6%*	*6,812*
Other Plastic Film – Recyclable, Contaminated	*2.8%*	*32,629*
Other Plastic Film – Non-Recyclable	*2.2%*	*25,163*

Table 13 shows the composition of plastic film that is recyclable by definition, rather than by whether the film was clean or contaminated at the time of sorting. It shows the total composition of *plastic bags* and *recyclable plastic film* that can be recovered, regardless of whether the plastic was clean or contaminated.

It is important to note that these modified groupings likely result in an overestimation of tons of *plastic bags – recyclable* and of *other plastic film – recyclable* because contaminated films is substantially heavier than clean film due to the moisture, grit, debris, and other contaminants present in the material.

It is also important to note that the source of contamination is unknown, so it is not possible to determine whether material classified as contaminated was clean during its use and at the point of disposal (suggesting it could be recovered for recycling if diverted from disposal) or if it was contaminated during use and therefore with no potential for recycling as currently defined.

Table 13. Plastic Film Composition – Recyclable/Non-recyclable by Material Type

	Est. Percent	Est. Tons
Plastic Bags – Recyclable	**0.7%**	**8,248**
Plastic Bags – Recyclable, Clean	*0.1%*	*1,436*
Plastic Bags – Recyclable, Contaminated	*0.6%*	*6,812*
Other Plastic Film – Recyclable	**4.1%**	**47,501**
Other Plastic Film – Recyclable, Clean	*1.3%*	*14,872*
Other Plastic Film – Recyclable, Contaminated	*2.8%*	*32,629*
Other Plastic Film – Non-Recyclable	**2.2%**	**25,163**
Other Plastic Film – Non-Recyclable	*2.2%*	*25,163*

COMMERCIAL SECTOR

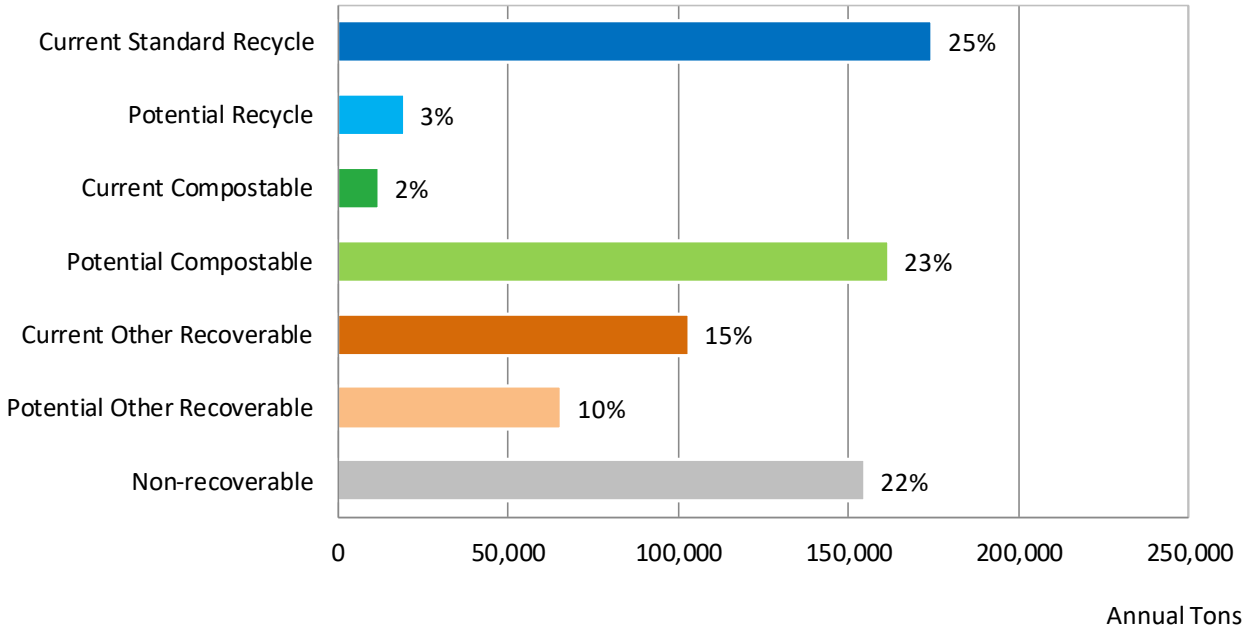
This section describes the quantities and composition of material disposed in SWACO's commercial sector. The final analysis included a total of 100 commercial samples.

Key Findings

As shown in **Figure 5**, approximately 42 percent (289,695 tons) of SWACO's commercial waste is recoverable through programs, services, and processing that is currently available today, and over one-third (36%) of disposed waste is potentially recoverable in the future.

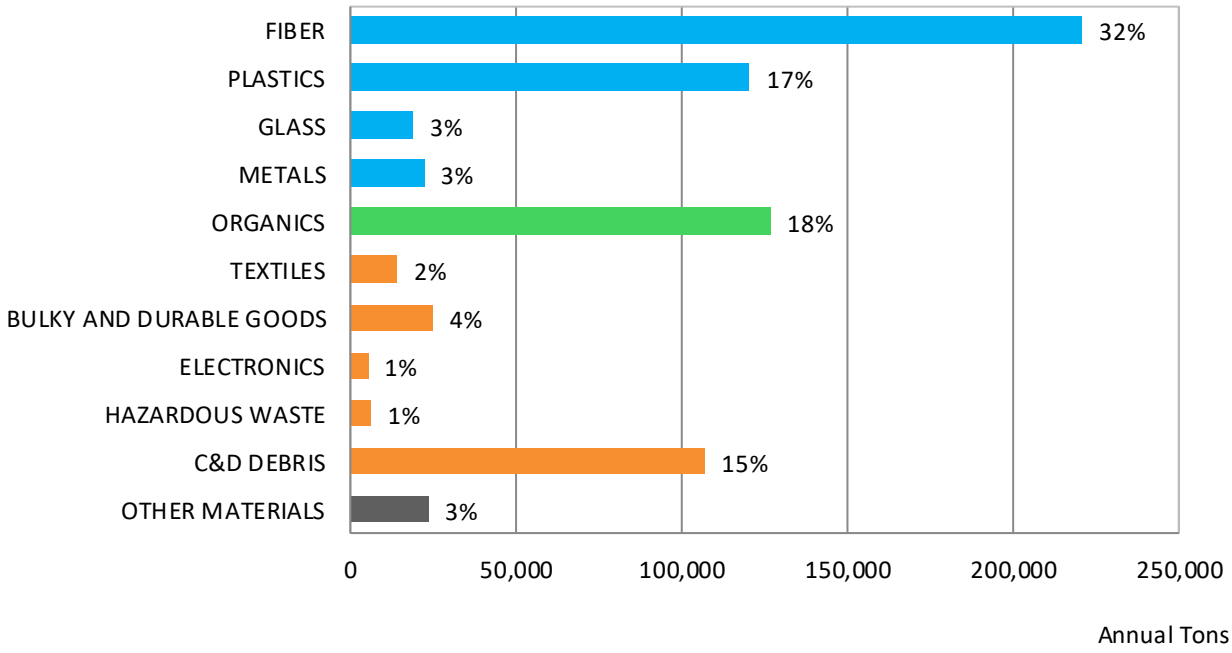
Approximately one-quarter (25%) of SWACO's commercial waste can currently be recovered through common commercial recycling programs ("Current Standard Recycle"), representing the largest recoverability category in the commercial sector, while over one-fifth (23%) can potentially be recovered through composting programs. Approximately 15 percent of overall waste can currently be recovered through collection programs other than traditional commercial collection and one-tenth (10%) has the potential to be recovered through other similar programs. The remainder (22%) of commercial waste consists of non-recoverable materials.

Figure 5. Recoverability by Category – Commercial



The waste composition data are presented by material class in **Figure 6**. **Fiber** (32%) and **Organics** (18%) are the two most prevalent material classes, together representing approximately one-half of commercial waste. The **Fiber** material class includes potentially compostable fiber. The next two most prevalent material classes are **Plastics** (17%) and **C&D Debris** (15%).

Figure 6. Annual Tons by Material Class – Commercial



The ten most prevalent disposed materials are listed in **Table 14**, on the following page**.** The three most prevalent material types are *food scraps* (14.9%), *corrugated cardboard* (14.6%), and *other compostable fiber* (7.8%), which are all either currently or potentially recoverable. Together they represent approximately 37 percent of commercial waste disposed in SWACO's jurisdiction.

Three of the top ten material types are current standard recyclable and all are within the **Fiber** class: *corrugated cardboard* (14.6%); *other recyclable paper* (3.2%); *magazines, newspaper, office & printing paper, mail* (2.9%). Together, they represent about 21 percent of commercial waste.

Food scraps, which represents the most prevalent component (14.9%) of commercial waste, was sorted into three subtypes, representing the following composition percentages of overall waste: *edible food scraps – non-packaged* (7.2%); *non-edible food scraps* (4.0%); *edible food scraps – packaged* (3.6%). The composition for each of the three *food scraps* subtypes is presented along with other detailed composition results in **Table 19** in **Appendix D. Detailed Composition Tables**.

Table 14. Top Ten Material Types – Commercial

Material	Est. Percent	Est. Tons
Food Scraps	14.9%	102,767
Corrugated Cardboard	14.6%	101,128
Other Compostable Fiber	7.8%	53,746
Wood Pallets	6.5%	44,810
Other Plastic Film – Non-Recyclable	5.7%	39,295
Wood Lumber & Products, Treated	3.7%	25,319
Plastic Durable & Bulky Items	3.4%	23,413
Other Recyclable Paper	3.2%	21,805
Furniture	2.9%	20,116
Magazines, Newspaper, Office & Printing Paper, Mail	2.9%	20,030
Total for Top Materials	**65.4%**	**452,429**

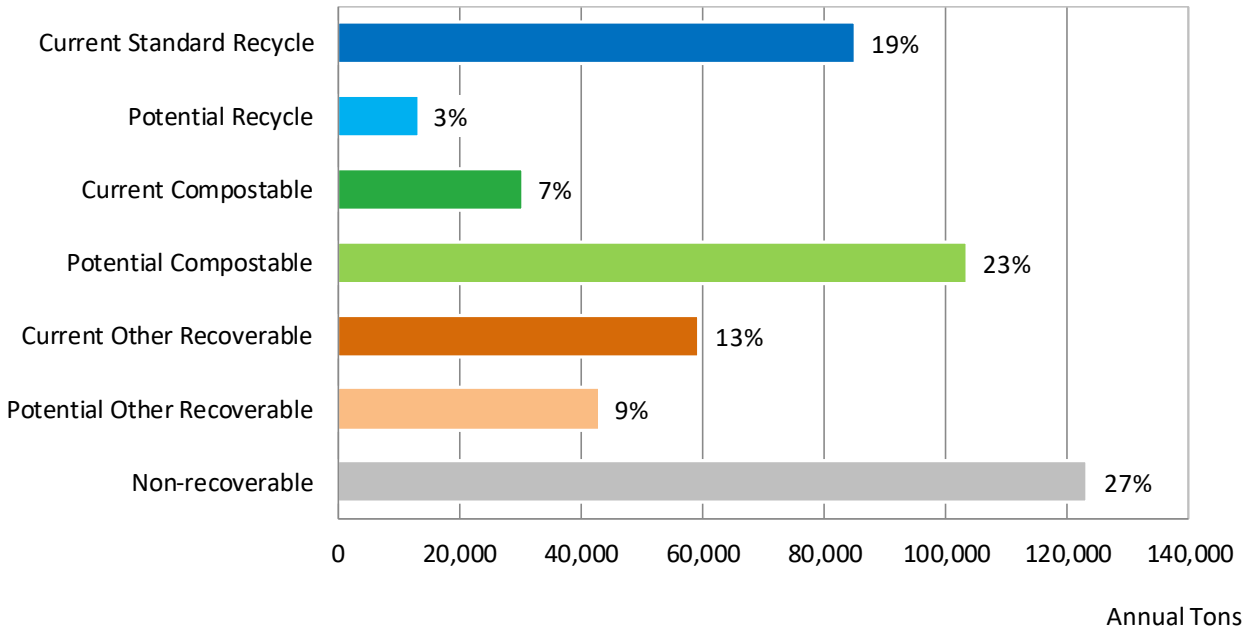
RESIDENTIAL SECTOR

This section describes the quantities and composition of material disposed in SWACO's residential sector. The residential waste composition is the weighted average of all 80 residential samples collected and characterized for this study, including 40 samples from residential loads from the City of Columbus and 40 samples from residential loads from other areas within Franklin County. To calculate the waste composition of the residential sector, the same weighting method was used as for the overall waste composition, assigning a relative importance to the composition from each subsector (the strata) based on the tons disposed annually by each stratum.

Key Findings

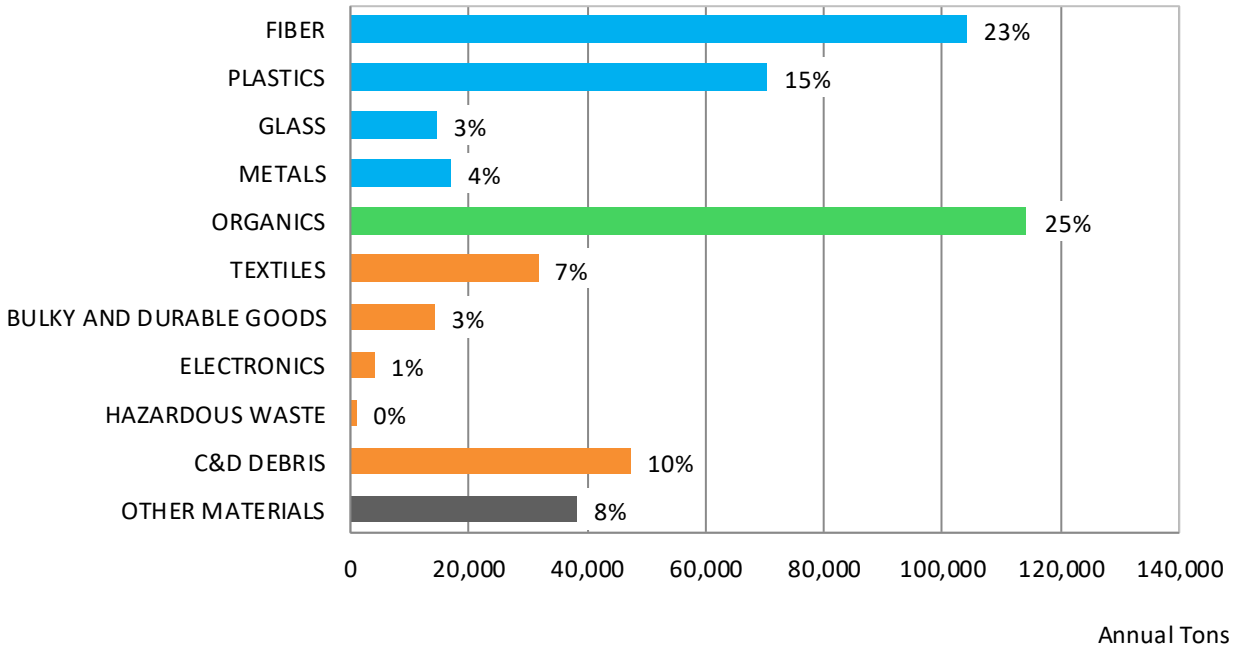
As shown in **Figure 7**, approximately 38 percent (174,913 tons) of SWACO's residential waste is recoverable through programs, services, and processing that is currently available and over one-third (35%) has the potential to be recovered in the future. Of currently and potentially recoverable materials, potentially compostable (23%) and current standard recyclable (19%) materials (i.e. material that can be currently collected in curbside programs) make up the largest recoverability categories. Non-recoverable materials represent approximately 27 percent of residential waste.

Figure 7. Recoverability by Category – Residential



The waste composition data are presented by material class in **Figure 8**. **Organics** (25%) and **Fiber** (23%) are the two most prevalent material classes, together representing nearly one-half of residential waste. The **Fiber** material class includes potentially compostable fiber.

Figure 8. Annual Tons by Material Class – Residential



The ten most prevalent disposed materials are listed in **Table 15**, on the following page**.** As shown, the three most prevalent material types, *food scraps* (14.4%), *other compostable fiber* (7.6%), and *yard waste* (5.8%), are all potentially or currently compostable. Together they represent approximately 28 percent of residential waste disposed in SWACO's jurisdiction.

Three of the top ten material types are current standard recyclable and all are within the **Fiber** class: *magazines, newspaper, office & printing paper, mail* (4.1%); *corrugated cardboard* (3.9%); *other recyclable paper* (3.6%). Together, they represent approximately 12 percent of residential waste.

Food scraps, which represents the most prevalent component (14.4%) of residential waste, was sorted into three subtypes, representing the following composition percentages of overall waste: *edible food scraps – non-packaged* (5.3%); *edible food scraps – packaged* (4.8%); and *non-edible food scraps* (4.3%). The composition for each of the three *food scraps* subtypes is presented along with other detailed composition results in **Table 20** in **Appendix D. Detailed Composition Tables**.

Table 15. Top Ten Material Types – Residential

Material	Est. Percent	Est. Tons
Food Scraps	14.4%	66,030
Other Compostable Fiber	7.6%	34,711
Yard Waste	5.8%	26,363
Other Plastic Film – Non-Recyclable	5.5%	25,310
Disposable Diapers	4.3%	19,896
Magazines, Newspaper, Office & Printing Paper, Mail	4.1%	18,924
Corrugated Cardboard	3.9%	17,861
Clothing	3.7%	16,985
Other Recyclable Paper	3.6%	16,453
Animal By-Products	3.4%	15,394
Total for Top Materials	**56.3%**	**257,927**

Capture Rate of Residential Recyclables

The following section describes the capture rate of recyclable materials in SWACO's residential waste stream. The capture rate of residential recyclables is defined as the percentage of total tons of current standard recyclable materials generated in SWACO's combined residential disposal and recycling streams that are currently collected through curbside collection programs from residents for recycling.

Data on the tons of materials collected for recycling were compiled by SWACO and provided to Cascadia for this analysis.

As shown in **Table 16**, SWACO's residential sector has a capture rate of approximately 40 percent, meaning that of all the current standard recyclable material generated by residents in SWACO's disposal and recycling streams, 40 percent is currently being captured for recycling. The materials with the highest capture rates are *glass bottles & jars* (53.3%), *recyclable mixed paper* (44.0%), and *corrugated cardboard* (38.2%).

The materials with the lowest capture rates are *aluminum cans* (15.4%), *#1 & #2 plastic bottles & jugs* (24.7%), and *steel cans* (27.9%).

Table 16. Residential Curbside Recycling Capture Rate

Material	Tons Disposed	Tons Recycled	Total Generation (Tons Disposed + Recycled)	Capture Rate
Corrugated Cardboard	17,861	11,030	28,891	38.2%
Recyclable Mixed Paper	35,971	28,224	64,195	44.0%
#1 & #2 Plastic Bottles & Jugs	12,599	4,141	16,740	24.7%
Glass Bottles & Jars	10,348	11,796	22,144	53.3%
Steel Cans	3,791	1,469	5,260	27.9%
Aluminum Cans	4,481	815	5,296	15.4%
Overall	**85,052**	**57,475**	**142,527**	**40.3%**

Market Value of Recyclables

This section provides an analysis of the market value of current standard recyclable materials found in SWACO's waste stream to provide data on the potential economic value of these recyclable materials if they are diverted from disposal for recycling. Commodity prices fluctuate as markets for materials shift. This analysis represents the value of disposed recyclables based on market prices provided by SWACO as of October 2019.

As shown in **Table 17**, 259,491 tons of material in the overall waste stream currently has the potential to be captured for recycling and sold in commodity bales, representing $23,280,923. The material types that represent the highest value are *aluminum cans* ($7,920,028), *#1 PET bottles & jugs* ($4,249,869), and *corrugated cardboard* ($4,164,619).

Of the sectors analyzed as part of this study, the commercial waste sector has the highest disposed tons (174,439 tons) that can be captured for recycling and sold in commodity bales, representing

$12,874,081. The material types that represent the highest value are *aluminum cans* ($3,748,714), *corrugated cardboard* ($3,539,473), and *#1 PET bottles & jugs* ($2,267,183).

In the residential waste sector, 85,052 tons of material have the potential to be captured for recycling and solid in commodity bales, representing $10,406,742. The material types that represent the highest value are *aluminum cans* ($4,171,313), *#2 HDPE natural bottles & jugs* ($2,023,681), and *#1 PET bottles & jugs* ($1,982,686).

Table 17. Value of Disposed Recyclables

Material	Market Prices	Residential Sector		Commercial Sector		Overall	
	Per Ton	Tons	Value	Tons	Value	Tons	Value
Corrugated Cardboard	$35	17,861	$625,146	101,128	$3,539,473	118,989	$4,164,619
Magazines, Newspaper, Office/Printing, Mail	$0	18,924	$0	20,030	$0	38,954	$0
Other Recyclable Paper	$0	16,453	$0	21,805	$0	38,258	$0
Aseptic Containers & Gable Top Cartons	$48	595	$28,258	849	$40,306	1,443	$68,564
#1 PET Bottles & Jugs	$230	8,620	$1,982,686	9,857	$2,267,183	18,478	$4,249,869
#2 HDPE Natural Bottles & Jugs	$1,080	1,874	$2,023,681	1,701	$1,837,307	3,575	$3,860,988
#2 HDPE Colored Bottles & Jugs	$300	2,105	$631,425	1,967	$590,127	4,072	$1,221,553
Glass Bottles & Jars	($10)	10,348	($103,483)	9,827	($98,267)	20,175	($201,749)
Steel Cans	$100	3,791	$379,057	3,223	$322,349	7,014	$701,405
Aluminum Cans	$1,080	3,862	$4,171,313	3,471	$3,748,714	7,333	$7,920,028
Aerosol Containers	$1,080	619	$668,659	580	$626,887	1,200	$1,295,546
Total		**85,052**	**$10,406,742**	**174,439**	**$12,874,081**	**259,491**	**$23,280,823**

APPENDIX A. MATERIAL LIST AND DEFINITIONS

Category	*Definition*	*Recoverability Category*
Fiber		
1. Corrugated Cardboard	Uncoated corrugated container boxes. Includes clean pizza boxes.	Current Standard Recycle
2. Magazines, Newspaper, Office/Printing Paper, Mail	Magazines, newspaper, office/printing/writing paper, mail and envelopes. These materials would be sorted into Sorted Residential Paper (SRP) ISRI grade #56.	Current Standard Recycle
3. Other Recyclable Paper	Other recyclable paper and paperboard. Includes kraft paper bags, containerboard, construction paper, receipts, towel/tissue roll cores, paperback books, and telephone directories. These materials would be sorted into Mixed Paper (MP) ISRI grade #54. Does not include fiber-based food service packaging of any kind.	Current Standard Recycle
4. Aseptic Containers and Gable Top Cartons	Liquid packaging board containers. Includes gable top cartons commonly used for milk and juice and aseptic containers of any size commonly used for soup, juice, and milk alternatives. These materials would be sorted into ISRI grade #52.	Current Standard Recycle
5. Polycoated Fiber-based Food Service Packaging (Potentially Recyclable)	Fiber-based polycoated food service packaging. Examples include polylined paper cups for hot and cold beverages, coffee sleeves, and takeout cartons, both clean and food-soiled.	Potential Recycle
6. Non-polycoated Fiber-based Food Service Packaging (Potentially Compostable)	Fiber-based non-polylined/polycoated food service packaging. Examples include French fry cartons, uncoated fiber-based boats or clamshells, and food-soiled pizza boxes.	Potential Compostable
7. Other Compostable Fiber	Fiber-based items that are food-soiled or constructed of fiber grade or condition not considered recyclable but are acceptable for composting. Examples include napkins and paper towels, shredded paper, and molded pulp packaging such as egg cartons.	Potential Compostable
8. Other Fiber – Non-Recyclable/Non-Compostable	Predominantly paper with other materials attached (e.g. orange juice cans), polycoated items not considered food service packaging (e.g. ice cream cartons, frozen food boxes), waxed OCC, and other non-recyclable papers such as bathroom/facial tissue, carbon copy paper, hardcover books, and photographs.	Non-recoverable

Plastics		
9. #1 PET Bottles and Jugs	Clear or colored polyethylene terephthalate (PET) bottles and jugs. When marked for identification, it bears the number "1" in the triangular recycling symbol and may also bear the letters "PET." These may contain beverages (such as soda, juice, water, and other beverages), food (ketchup, peanut butter, mayonnaise, mustard), and household products (shampoo, cleaning products).	Current Standard Recycle
10. Other #1 PET Packaging	Clear or colored polyethylene terephthalate (PET) containers, such as frozen food trays, retail packaging and other rigid items. Excludes bottles and jugs. When marked for identification, it bears the number "1" in the triangular recycling symbol and may also bear the letters "PET." Examples include berry clamshells and pre-washed salad greens containers.	Potential Recycle
11. #2 HDPE Natural Bottles and Jugs	HDPE bottles and jugs that are a cloudy white color, allowing light to pass through it. When marked for identification, it bears the number "2" in the triangular recycling symbol and may also bear the letters "HDPE." Examples include milk jugs and water jugs.	Current Standard Recycle
12. #2 HDPE Colored Bottles and Jugs	HDPE bottles and jugs that are a solid color, preventing light from passing through it. When marked for identification, it bears the number "2" in the triangular recycling symbol and may also bear the letters "HDPE." Examples include detergent bottles, some hair-care bottles, empty motor oil, empty antifreeze, and other empty vehicle fluid containers marked with the number "2".	Current Standard Recycle
13. Other #2 HDPE Packaging	Natural or colored HDPE containers and packaging that do not fit into the two HDPE categories above. Excludes bottles and jugs. These containers bear the number "2" in the triangular recycling symbol and may also bear the letters "HDPE."	Potential Recycle
14. # 5 PP Packaging	Polypropylene plastic packaging that bear the number “5” in the triangular recycling symbol and may also bear the letters “PP”. Examples include plastic cups, yogurt tubs, and take-out containers.	Potential Recycle

15. Other Rigid Plastic Containers, Packaging and Small Products	Other bottles, tubs, jars, cups, and other containers (up to 2 gal.) and small single-resin products not included in categories above. May be labeled PVC (#3), LDPE (#4), PS (#6), or Other (#7). Includes acceptable small rigid plastics that cannot be identified by resin. Examples include baby wipe containers, flower pots, household cleaner bottles, prescription bottles, and cosmetic containers. This material type does not include expanded polystyrene, which is categorized separately.	Potential Recycle
16. Expanded Polystyrene	Includes food and non-food packaging, products, and blocks made of expanded polystyrene. Excludes rigid foam insulation, which is categorized as "other C&D materials."	Potential Other Recoverable
17. Plastic Bags – Recyclable	Clean polyethylene film bags commonly used for grocery, produce, merchandise, dry cleaner, and newspaper that were not contaminated with food, liquid or grit during use. Also includes clean zippered sandwich and storage bags.	Current Other Recoverable
18. Other Plastic Film – Recyclable	Case wrap, pallet wrap and industrial plastic film and bags that were not contaminated with food, liquid, or grit during use. Includes clean plastic sheeting, bubble wrap or air pillows used for shipping/packing, clean trash bags, and mattress packaging.	Current Other Recoverable
19. Other Plastic Film – Non-Recyclable	Includes other plastic film items that cannot be recycled, such as candy bar wrappers, pre-washed salad bags, and chip bags. Also includes plastic bags of all types that were contaminated with food, liquid or grit during use.	Non-recoverable
20. Plastic Durable/Bulky Items	Finished plastic products made entirely of plastic made to last for more than one use and generally larger than a soccer ball. These items may bear the numbers 1 through 7 in the triangular recycling symbol. Examples include toys, milk crates, plastic pallets, plastic clothes hangers, storage tubs, barrels, and buckets, and plastic lawn furniture.	Potential Other Recoverable
21. Other Plastic – Non-Recyclable	Plastic that cannot be put in any other material type, typically items made mostly of plastic but combined with other materials. Examples include disposable razors, pens, lighters, toys, and 3-ring binders.	Non-recoverable

Glass		
22. Glass Bottles and Jars	Glass bottles and jars of all colors. Includes whole containers and fragments of 2'' or greater.	Current Standard Recycle
23. Other Glass and Ceramics	Non-container glass and ceramics. Includes Pyrex, Conring ware, crystal and other glass tableware, flat glass and other predominantly glass items (such as windows, auto windshields, bus shelter and other safety glass, mirrors), as well as ceramic/porcelain items other than ceramic figures (e.g. toilets), which are categorized as other C&D materials. Includes incandescent and halogen light bulbs but not mercury-containing light components, which are categorized as household hazardous waste.	Non-recoverable
Metals		
24. Steel Cans	Steel food containers and other non-pressurized bi-metal cans made mostly of steel.	Current Standard Recycle
25. Aluminum Cans	Aluminum beverage cans (UBC) and other non-pressurized bi-metal cans made mostly of aluminum.	Current Standard Recycle
26. Aerosol Containers	Empty, mixed material/metal aerosol cans. (Aerosols that still contain product are sorted according to that material—for instance, solvent-based paint.)	Current Standard Recycle
27. Ferrous Metal Scrap	Ferrous and alloyed ferrous scrap metals to which a magnet adheres and which are not significantly contaminated with other metals or materials. Examples include small metal cast iron pans, empty paint cans, metal lids and caps, and pots and pans.	Current Other Recoverable
28. Non-Ferrous Metal Scrap	Metals not derived from iron, to which a magnet will not adhere, and which are not significantly contaminated with other metals or materials. Includes aluminum food containers, trays, foil, and other aluminum products such as window frames and cookware.	Current Other Recoverable
29. Other Metal – Non-Recyclable	Items that are predominately metal with other materials attached such as motors, insulated wire, and finished products containing a mixture of metals, or metals and other materials. Does not include large appliances, which are categorized under bulky items.	Non-recoverable

Organics		
30. Edible Food Scraps – Non-Packaged	The components of food that, in a particular food supply chain, are intended to be consumed by humans, and is not enclosed in original glass, plastic, paper, or other packaging as sold or distributed. Examples include vegetables, fruits, eggs, eggs in shell, fresh meat, cooked meat, and meat scraps. Edible food that appears to have been packaged by the consumer (e.g. in a Ziploc bag, takeout container, or reusable container) is included here.	Potential Compostable
31. Edible Food Scraps – Packaged	The components of food that, in a particular food supply chain, are intended to be consumed by humans, and is enclosed in original glass, plastic, paper, or other packaging as sold or distributed.	Potential Compostable
32. Non-Edible Food Scraps	The non-edible portions of food material. Examples include fruit peels, vegetable peelings and potato skins, pits, cores, juiced oranges, egg shells, bones, gristle and meat trimmings, fish skins, and seafood shells.	Potential Compostable
33. Yard Waste	Plant materials from a yard, garden, or landscaped area. Examples include grass clippings, leaves, weeds, plants, branches, prunings, and stumps from bushes, shrubs, and trees.	Current Compostable
34. Other Compostable Organics	Other organic material that is compostable and cannot be put in any other material type. Examples include toothpicks, wooden coffee stirrers, and wooden chopsticks.	Current Compostable
35. Animal By-Products	Animal carcasses not resulting from food storage or preparation, animal wastes, and kitty litter.	Non-recoverable
36. Other Organics – Non-Compostable	Combustible materials including wax and cigarette butts, briquettes; fireplace, burn barrel and fire pit ash; feminine hygiene products; and other organic materials not classified elsewhere.	Non-recoverable
Textiles		
37. Clothing	All clothing items made of natural and synthetic thread, yarn, fabric, or cloth.	Current Other Recoverable
38. Non-Clothing Textiles	All non-clothing items made of thread, yarn, fabric, or cloth. Examples include fabric trimmings, drapes, area rugs, pillows, non-leather hats and handbags, and stuffed toys.	Current Other Recoverable

	This category does not include cloth-covered furniture or mattresses.	
39. Shoes/Leather/Rubber	Shoes of all material types, leather shoes and other items made of leather (or appearing to be leather), rubber products and scrap materials such as bath mats, inner tubes, rubber hoses, and foam rubber pieces, not including mattresses.	Current Other Recoverable
Bulky and Durable Goods		
40. Mattresses and Box Springs	Mattresses of all types and sizes, including foam, futon, and structured mattresses and box springs.	Potential Other Recoverable
41. Large Appliances	Large appliances. Examples include washing machines, clothes dryers, hot water heaters, stoves, and refrigerators. Does not include electronics, such as televisions and stereos.	Current Other Recoverable
42. Small Appliances	Small electric appliances such as toasters, microwave ovens, power tools, curling irons, and light fixtures.	Potential Other Recoverable
43. Furniture	Mixed-material furniture such as upholstered chairs. Furniture that is made purely of one material, such as plastic or metal, would be categorized according to that material (e.g., plastic durable/bulky items or wood lumber and products, treated).	Potential Other Recoverable
44. Tires	Includes tires from trucks, automobiles, motorcycles, heavy equipment, lawn mowers, and bicycles.	Current Other Recoverable
Electronics		
45. CRT TVs and Monitors	Televisions and computer monitors containing cathode-ray tubes (CRTs).	Current Other Recoverable
46. Other Electronics	Non-CRT displays, computer items such as laptops, processors, monitors, and disk drives, audio/visual equipment including stereos, radios, tape decks; computer peripherals; cellphones; and all electronics-associated cords.	Current Other Recoverable
Hazardous Waste		
47. Latex/Water-based Paint	Water-based paints and similar products in liquid form. Excludes empty paint containers and paint that is outweighed by that of the container.	Current Other Recoverable
48. Oil-based paint	Solvent-based paints, varnishes, and similar products. Excludes empty paint containers and	Current Other Recoverable

	paint that is outweighed by that of the container.	
49. Medical Products	Materials typically discarded in a health care setting such as I.V. tubing and patient drapes, specimen containers, and Petri dishes. Also includes sharps (needles, lancets) and pharmaceuticals.	Non-recoverable
50. Pesticides/Herbicides	Variety of poisons with the purpose of discouraging or killing insects, weeds, or microorganisms. Fungicides and wood preservatives, such as pentachlorophenol, are also included.	Non-recoverable
51. Batteries	Batteries of all sizes and types. Includes single-use dry-cell alkaline and button cell batteries, rechargeable batteries, and automotive batteries.	Current Other Recoverable
52. Other Potentially Harmful Wastes	Includes fluorescent tubes and bulbs, corrosives, caustic acids, cleaning chemicals, gasoline, motor oil and other flammable fuels/oils, explosives, anti-freeze, adhesives/glues, putties/fillers/sealers, personal care/cosmetics (not including containers unless product cannot be easily separated), and all other potentially harmful wastes that do not fit the above categories.	Non-recoverable
Construction and Demolition Debris		
53. Carpet	General category of flooring applications consisting of various natural or synthetic fibers bonded to some type of backing material designed to be firmly attached to the floor. Does not include area rugs or doormats.	Potential Other Recoverable
54. Carpet Padding	Foam material used under carpet to provide insulation and cushioning.	Potential Other Recoverable
55. Wood Lumber and Products, Treated	Painted/treated lumber and wood products, including all engineered wood such as plywood and particle board. Includes cabinets and shelving made entirely with wood.	Non-recoverable
56. Wood Lumber, Untreated	Clean dimensional lumber (only including trace amounts of paint, nails, and other contaminants).	Current Other Recoverable
57. Wood Pallets	Untreated wood pallets, whole and broken.	Current Other Recoverable
58. Paving, Concrete, Bricks, and Other Aggregates	Asphalt paving (black or brown, tar-like material mixed with aggregate used as a paving material); concrete (hard material made from sand, aggregate, gravel, cement mix, and water) including pieces with a steel internal structure	Current Other Recoverable

	composed of reinforcing bars (re-bar) or metal mesh; bricks (single units of ceramic materials used in masonry construction) and other aggregates such as stone and rock, masonry tile, and clay roofing tiles.	
59. Asphalt Shingles	Roofing material composed of fiberglass or organic felts saturated with asphalt and covered with inert aggregates as well as attached roofing tar and tar paper.	Current Other Recoverable
60. Gypsum	Interior wall covering made of gypsum sandwiched between paper layers. Examples include broken or whole sheets, unused or used/painted.	Current Other Recoverable
61. Other C&D Materials	Other construction and demolition debris not classified elsewhere. For example, fiberglass insulation, rigid foam insulation, acoustic ceiling tiles, cement board, ceramic fixtures, non-shingle asphaltic roofing, roofing and water-repelling membranes. This category may include items from different categories combined, which would be difficult to separate, and demolition debris that is a mixture of materials such as tile attached to drywall attached to studs or laminate countertops attached to a sink and plumbing. Also includes fines such as sand, soil, dirt, and gravel associated with C&D loads.	Non-recoverable
Other Materials		
62. Disposable Diapers	Diapers made from a combination of fibers, synthetic, and/or natural, and made for the purpose of single use. This includes disposable baby diapers, adult protective undergarments, and feminine hygiene products.	Non-recoverable
63. Fines	Mixed MSW fines smaller than 2” in diameter.	Non-recoverable
64. Other Materials	Other materials not classified elsewhere.	Non-recoverable

Season 4 Plastic Film Material Subtypes

Plastic Film	
Plastic Bags – Recyclable (Clean)	Clean polyethylene film bags commonly used for grocery, produce, merchandise, dry cleaner, and newspaper that were not contaminated with food, liquid or grit during use. Also includes clean zippered sandwich and storage bags.
Plastic Bags – Recyclable (Contaminated)	Polyethylene film bags (such as those in the category above) that have been contaminated with food, liquid or grit during use. [*NOTE: In the composition tables, this material is included in the category "Other Plastic Film – Non Recyclable"*]
Other Plastic Film – Recyclable (Clean)	Case wrap, pallet wrap and industrial plastic film and bags that were not contaminated with food, liquid, or grit during use. Includes clean plastic sheeting, bubble wrap or air pillows used for shipping/packing, clean trash bags, and mattress packaging.
Other Plastic Film – Recyclable (Contaminated)	Other plastic film that is classified as recyclable (such as that in the category above) but that has been contaminated with food, liquid, or grit during use. [*NOTE: In the composition tables, this material is included in the category "Other Plastic Film – Non Recyclable"*]
Other Plastic Film – Non-Recyclable	Includes other plastic film items that cannot be recycled, such as candy bar wrappers, pre-washed salad bags, and chip bags. [*NOTE: In the composition tables and full analysis results presented elsewhere in the report, this category also includes polyethylene film bags and other plastic film that classified as recyclable that were contaminated with food, liquid or grit during use*.]

APPENDIX B. DATA COLLECTION FORMS

Figure 9. Vehicle Selection Sheet

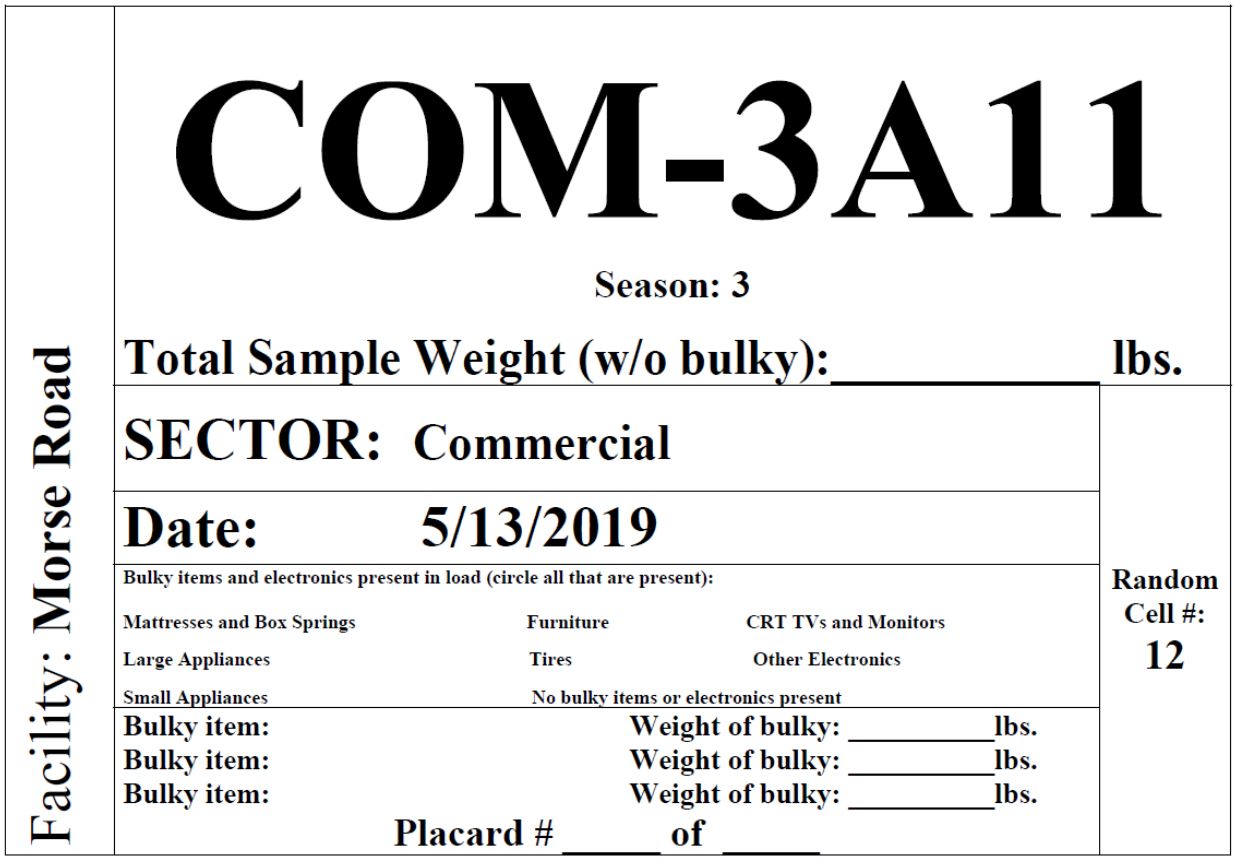
Solid Waste Authority of Central Ohio Waste Characterization Study 2018
Vehicle Selection Sheet

Facility: Morse Road
Date: Monday, November 12, 2018
Season: 1
Sampling Targets: Columbus Res = 0
ROA Res = 0
Com = 2

Instructions
1. At the assigned sampling time, begin surveying vehicles that come in. Ask the driver which sector their load is from (City of Columbus Residential, Rest-of-Authority Residential, or Commercial).
2. When you reach the first vehicle from your targeted sector, you will sample it.
3. Ask the driver questions to collect all of the information below about the sample (confirm sector, jurisdiction, route #, truck #, vehicle type, and hauler).
4. Provide the driver with a placard with the corresponding sample ID. Instruct them to place the placard on their windshield and give it to the sampling manager inside the facility.

Sampling Time	Sample ID	Sector (City of Columbus Res / Rest-of-Authority Res / Commercial)	Jurisdiction (City the load originated from)	Route #	Truck #	Vehicle Type (Packer Truck / Compactor Debris Box / Loose Debris Box)	Hauler	Notes
7:45 AM	COM-1A11	Commercial						
9:15 AM	COM-1A12	Commercial						

Figure 10. Sample Placard



APPENDIX C. DESCRIPTION OF CALCULATIONS

Method for Obtaining Tonnage Data

Cascadia required annual tonnage information to complete the analysis. SWACO provided Cascadia with the following tonnage information from calendar year 2018 to support the analysis:

- City of Columbus residential garbage tonnage
- Rest of Authority residential garbage tonnage
- Commercial garbage tonnage

Description of Calculations and Statistical Procedures

Because we understand the importance of accurate information, we protected data integrity during each step—collection, review, entry, calculation, and analysis. Our forms were easy to use, and our data-entry protocols virtually eliminated errors. Task 3 included three steps, described below:

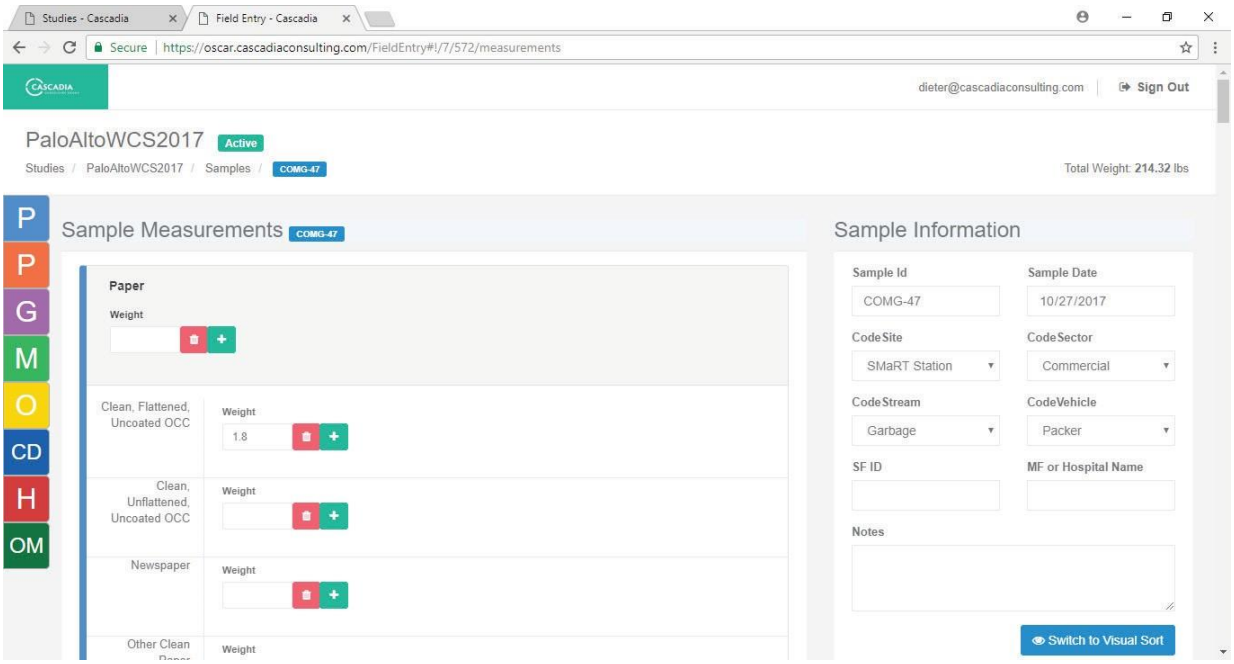
1. Create customized database
2. Determine annual quantities
3. Conduct composition analysis

STEP 1. CREATE CUSTOMIZED DATABASE

The Cascadia team used a custom cloud-based database on rugged handheld tablets to enter and manage the data collected during waste sorting. The Field Manager inspected the entered data onsite to prevent erroneous entries. The tablet data entry offered several important advantages:

- The template contained built-in logic and error checking to prevent erroneous entries.
- The template summed sample weights in real time, so the Field Manager could confirm achievement of weight targets for every sample.
- The tablet is automatically synced to cloud storage, preventing data loss and reducing transcription errors.

A typical data entry screen for our hand-sort characterization data is shown below.



Steps taken to ensure the integrity of data during entry, analysis, and reporting included:

- Performing in-field, onsite, and desktop QA/QC to identify and resolve errors.
- Performing additional QA/QC during analysis and reporting to ensure that reported findings were accurate and representative of collected data.
- Encoding the composition analysis formulae so that statistical protocols were consistently applied to different data sets.

STEP 2. DETERMINE ANNUAL QUANTITIES

To develop a complete analysis of all material disposed, it was necessary to determine the annual tonnages of City of Columbus residential, Rest of Authority residential, and commercial waste generated within SWACO's jurisdiction and disposed at the three included facilities. SWACO provided Cascadia with tonnage data broken down by sector to support the analysis.

STEP 3. CONDUCT COMPOSITION ANALYSIS

Using industry standard statistical methods that we have used in material characterization studies nationwide, Cascadia calculated detailed composition and quantity estimates. All estimates were presented along with confidence intervals at the industry standard 90% confidence level. The waste composition formulae that Cascadia used for each stratum and the overall appear below.

Estimating Waste Composition

Waste composition estimates were calculated using a method that gave equal weighting or "importance" to each sample within a given stratum. Confidence intervals (error ranges) were calculated based on assumptions of normality in the composition estimates.

In the descriptions of calculation methods, the following variables are used frequently:

- *i* denotes an individual sample;
- *j* denotes the material type;
- c_j is the weight of the material type *j* in a sample;
- *w* is the weight of an entire sample;
- r_j is the composition estimate for material *j* (*r* stands for *ratio*);
- *s* denotes a particular stream or substream of the waste stream; and
- *n* denotes the number of samples in the particular group that is being analyzed at that step.

Estimating the Composition

For a given stratum (that is, for the samples belonging to the same generator type collected by the same hauler type), the composition estimate denoted by r_j represents the ratio of the component's weight to the total weight of all the samples in the stratum. This estimate was derived by summing each component's weight across all of the selected samples belonging to a given stratum and dividing by the sum of the total weight of waste for all of the samples in that stratum, 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; and
- for *j* = 1 to *m*, where *m* = number of components.

For example, the following simplified scenario involves three samples. For the purposes of this example, only the weights of the component *carpet* are shown.

	Sample 1	Sample 2	Sample 3
Weight (*c*) of *carpet* (in lbs)	5	3	4
Total Sample Weight (*w*) (in lbs)	80	70	90

$$r_{Carpet} = \sum \frac{5+3+4}{80+70+90} = 0.05$$

To find the composition estimate for the component *carpet*, the weights for that material are added for all selected samples and divided by the total sample weights of those samples. The resulting composition is 0.05, or 5%. In other words, 5% of the sampled material, by weight, is *carpet*. This finding is then projected onto the stratum being examined in this step of the analysis.

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 included two random variables (the component and total sample weights). The variance of the ratio estimator equation follows:

$$\mathrm{Var}(r_j) \approx \left(\frac{1}{n}\right)\left(\frac{1}{\overline{w}^2}\right)\left(\frac{\sum_i \left(c_{ij} - r_j w_i\right)^2}{n-1}\right)$$

where:

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

(For more information regarding Equation 2, refer to *Sampling Techniques, 3rd Edition* by William G. Cochran [John Wiley & Sons, Inc., 1977].)

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

$$r_j \pm \left(z\sqrt{\mathrm{Var}(r_j)}\right)$$

where *z* = the value of the *z*-statistic (1.645) corresponding to a 90% confidence level.

Composition results for strata were then combined, using a weighted averaging method, to estimate the composition of larger portions of the waste stream. For example, waste from City of Columbus was combined with the Rest of Authority to estimate the composition for SWACO's overall residential waste stream. The relative tonnages associated with each stratum served as the weighting factors. The calculation 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 waste stratum (the weighting factor);
- *r* = ratio of component weight to total waste weight in the noted waste stratum (the composition percent for the given material component); and
- for *j* = 1 to *m*, where *m* = number of material components.

For example, the above equation is illustrated here using three waste strata.

	Stratum 1	**Stratum 2**	**Stratum 3**
Ratio (r) of *carpet*	5%	10%	10%
Tonnage	25,000	100,000	50,000
Proportion of tonnage (*p*)	14.3%	57.1%	28.6%

To estimate the larger portions of the waste stream, the composition results for the three strata are combined as follows.

$$O_{Carpet} = (0.143 * 0.05) + (0.571 * 0.10) + (0.286 * 0.10) = 0.093 = 9.3\%$$

Therefore, 9.3% of this examined portion of the waste stream is *carpet*.

The variance of the weighted average was calculated as follows:

$$\mathrm{Var}(O_j) = \left(p_1^2\ \mathrm{Var}(r_{j1})\right) + \left(p_2^2\ \mathrm{Var}(r_{j2})\right) + \left(p_3^2\ \mathrm{Var}(r_{j3})\right) + \ldots$$

Estimating the Composition of SWACO's Overall Disposed Waste Stream

Composition results for all substreams were combined, using a weighted averaging method, to estimate the composition of SWACO's overall waste stream included in this study. The relative tonnages associated with each substream served as the weighting factors.

The calculation 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 waste sector (the weighting factor);
- r = ratio of component weight to total waste weight in the noted waste sector (the composition percent for the given material component); and
- for j = 1 to m, where m = number of material components.

The following scenario illustrates the above equation. This example involves the component *carpet* in three waste sectors.

	Substream 1	**Substream 2**	**Substream 3**
Ratio of *carpet* (*r*)	0.05	0.10	0.15
Proportion of Tonnage (*p*)	50%	25%	25%

$$O_{Carpet} = (0.50 * 0.05) + (0.25 * 0.10) + (0.25 * 0.15) = 0.0875$$

So, it is estimated that 0.0875 or 8.75% of the entire waste stream is composed of *carpet*.

The variance of the weighted average was calculated as follows:

$$\mathrm{Var}(O_j) = \left(p_1^2\ \mathrm{Var}(r_{j1})\right) + \left(p_2^2\ \mathrm{Var}(r_{j2})\right) + \left(p_3^2\ \mathrm{Var}(r_{j3})\right) + \ldots$$

APPENDIX D. DETAILED COMPOSITION TABLES

Table 18. Detailed Composition – Overall

Material	Estimated Percent	+/-	Estimated Tons	Material	Estimated Percent	+/-	Estimated Tons
FIBER	**28.3%**	**2.0%**	**324,740**	**TEXTILES**	**4.0%**	**0.7%**	**46,176**
Corrugated Cardboard	10.4%	1.6%	118,989	Clothing	1.8%	0.4%	21,017
Magazines, Newspaper, Office & Printing Paper, Mail	3.4%	0.6%	38,954	Non-Clothing Textiles	1.5%	0.3%	17,492
Other Recyclable Paper	3.3%	0.4%	38,258	Shoes, Leather, Rubber	0.7%	0.1%	7,667
Aseptic Containers & Gable Top Cartons	0.1%	0.0%	1,443	**BULKY AND DURABLE GOODS**	**3.4%**	**1.4%**	**39,515**
Polycoated Fiber-based Food Service Packaging	0.9%	0.1%	10,032	Mattresses & Box Springs	0.4%	0.3%	4,958
Non-polycoated Fiber-based Food Service Packaging	0.7%	0.1%	7,775	Large Appliances	0.1%	0.2%	1,379
Other Compostable Fiber	7.7%	0.7%	88,457	Small Appliances	0.6%	0.3%	6,346
Other Fiber – Non-Recyclable/Non-Compostable	1.8%	0.4%	20,832	Furniture	2.1%	1.3%	24,141
PLASTICS	**16.6%**	**1.3%**	**190,857**	Tires	0.2%	0.3%	2,690
#1 PET Bottles & Jugs	1.6%	0.2%	18,478	**ELECTRONICS**	**0.8%**	**0.5%**	**9,636**
Other #1 PET Packaging	0.3%	0.2%	3,669	CRT TVs & Monitors	0.2%	0.2%	1,980
#2 HDPE Natural Bottles & Jugs	0.3%	0.0%	3,575	Other Electronics	0.7%	0.4%	7,656
#2 HDPE Colored Bottles & Jugs	0.4%	0.1%	4,072	**HAZARDOUS WASTE**	**0.7%**	**0.3%**	**7,593**
Other #2 HDPE Packaging	0.1%	0.0%	891	Latex & Water-based Paint	0.0%	0.0%	60
#5 PP Packaging	0.9%	0.2%	10,522	Oil-based Paint	0.0%	0.0%	103
Other Rigid Plastic Containers, Packaging & Small Products	0.7%	0.2%	7,825	Medical Products	0.5%	0.3%	5,644
Expanded Polystyrene	0.6%	0.1%	6,881	Pesticides & Herbicides	0.0%	0.0%	27
Plastic Bags – Recyclable	0.1%	0.0%	1,436	Batteries	0.0%	0.0%	459
Other Plastic Film – Recyclable	1.3%	0.5%	14,872	Other Potentially Harmful Wastes	0.1%	0.1%	1,300
Other Plastic Film – Non-Recyclable	5.6%	0.5%	64,604	**C&D DEBRIS**	**13.4%**	**2.5%**	**154,103**
Plastic Durable & Bulky Items	3.1%	1.0%	35,536	Carpet	2.2%	1.2%	25,314
Other Plastic – Non-Recyclable	1.6%	0.4%	18,495	Carpet Padding	0.5%	0.4%	5,572
GLASS	**2.9%**	**0.8%**	**33,902**	Wood Lumber & Products, Treated	3.2%	0.8%	36,204
Glass Bottles & Jars	1.8%	0.2%	20,175	Wood Lumber, Untreated	1.1%	0.5%	13,090
Other Glass & Ceramics	1.2%	0.7%	13,727	Wood Pallets	4.1%	1.5%	47,082
METALS	**3.4%**	**0.6%**	**39,548**	Paving, Concrete, Bricks, & Other Aggregates	0.2%	0.2%	2,535
Steel Cans	0.6%	0.1%	7,014	Asphalt Shingles	0.0%	0.0%	35
Aluminum Cans	0.6%	0.1%	7,333	Gypsum	0.3%	0.2%	2,901
Aerosol Containers	0.1%	0.0%	1,200	Other Construction & Demolition Materials	1.9%	0.8%	21,370
Ferrous Metal Scrap	1.2%	0.6%	14,186	**OTHER MATERIALS**	**5.4%**	**0.8%**	**62,195**
Non-Ferrous Metal Scrap	0.5%	0.1%	5,798	Disposable Diapers	2.2%	0.4%	25,137
Other Metal – Non-Recyclable	0.3%	0.2%	4,018	Fines	2.2%	0.2%	25,787
ORGANICS	**21.0%**	**2.0%**	**241,014**	Other Materials	1.0%	0.7%	11,271
Edible Food Scraps – Non-Packaged	6.5%	1.1%	74,302				
Edible Food Scraps – Packaged	4.1%	0.7%	47,312	**Current Standard Recycle**	**22.6%**	1.8%	**259,491**
Non-Edible Food Scraps	4.1%	0.8%	47,184	**Potential Recycle**	**2.9%**	0.4%	**32,939**
Yard Waste	3.1%	0.8%	35,424	**Current Compostable**	**3.7%**	0.8%	**42,681**
Other Compostable Organics	0.6%	0.2%	7,257	**Potential Compostable**	**23.1%**	2.0%	**265,029**
Animal By-Products	1.8%	0.7%	20,341	**Current Other Recoverable**	**14.1%**	1.9%	**162,437**
Other Organics – Non-Compostable	0.8%	0.7%	9,195	**Potential Other Recoverable**	**9.5%**	2.0%	**108,750**
				Non-recoverable	**24.2%**	1.8%	**277,951**
Sample Count			180	**Totals**	**100.0%**		**1,149,278**

Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.

Table 19. Detailed Composition – Commercial

Material	Estimated Percent	+/-	Estimated Tons
FIBER	**31.9%**	**3.1%**	**220,691**
Corrugated Cardboard	14.6%	2.6%	101,128
Magazines, Newspaper, Office & Printing Paper, Mail	2.9%	0.8%	20,030
Other Recyclable Paper	3.2%	0.6%	21,805
Aseptic Containers & Gable Top Cartons	0.1%	0.0%	849
Polycoated Fiber-based Food Service Packaging	0.8%	0.2%	5,605
Non-polycoated Fiber-based Food Service Packaging	0.7%	0.2%	5,097
Other Compostable Fiber	7.8%	1.1%	53,746
Other Fiber – Non-Recyclable/Non-Compostable	1.8%	0.5%	12,432
PLASTICS	**17.4%**	**2.0%**	**120,461**
#1 PET Bottles & Jugs	1.4%	0.3%	9,857
Other #1 PET Packaging	0.4%	0.3%	2,547
#2 HDPE Natural Bottles & Jugs	0.2%	0.1%	1,701
#2 HDPE Colored Bottles & Jugs	0.3%	0.1%	1,967
Other #2 HDPE Packaging	0.1%	0.1%	576
#5 PP Packaging	0.9%	0.3%	6,329
Other Rigid Plastic Containers, Packaging & Small Products	0.7%	0.3%	4,642
Expanded Polystyrene	0.5%	0.1%	3,635
Plastic Bags – Recyclable	0.1%	0.1%	806
Other Plastic Film – Recyclable	1.8%	0.7%	12,643
Other Plastic Film – Non-Recyclable	5.7%	0.7%	39,295
Plastic Durable & Bulky Items	3.4%	1.6%	23,413
Other Plastic – Non-Recyclable	1.9%	0.7%	13,050
GLASS	**2.8%**	**1.1%**	**19,183**
Glass Bottles & Jars	1.4%	0.3%	9,827
Other Glass & Ceramics	1.4%	1.1%	9,356
METALS	**3.2%**	**1.0%**	**22,416**
Steel Cans	0.5%	0.1%	3,223
Aluminum Cans	0.5%	0.2%	3,471
Aerosol Containers	0.1%	0.0%	580
Ferrous Metal Scrap	1.4%	0.9%	9,408
Non-Ferrous Metal Scrap	0.5%	0.2%	3,357
Other Metal – Non-Recyclable	0.3%	0.3%	2,376
ORGANICS	**18.3%**	**2.9%**	**126,637**
Edible Food Scraps – Non-Packaged	7.2%	1.8%	50,071
Edible Food Scraps – Packaged	3.6%	1.0%	25,119
Non-Edible Food Scraps	4.0%	1.2%	27,578
Yard Waste	1.3%	0.7%	9,062
Other Compostable Organics	0.5%	0.3%	3,216
Animal By-Products	0.7%	0.6%	4,947
Other Organics – Non-Compostable	1.0%	1.2%	6,645
TEXTILES	**2.1%**	**0.6%**	**14,371**
Clothing	0.6%	0.2%	4,032
Non-Clothing Textiles	0.9%	0.4%	6,531
Shoes, Leather, Rubber	0.6%	0.2%	3,808
BULKY AND DURABLE GOODS	**3.6%**	**2.1%**	**25,141**
Mattresses & Box Springs	0.1%	0.2%	794
Large Appliances	0.0%	0.0%	-
Small Appliances	0.5%	0.4%	3,477
Furniture	2.9%	2.1%	20,116
Tires	0.1%	0.2%	755
ELECTRONICS	**0.8%**	**0.7%**	**5,462**
CRT TVs & Monitors	0.3%	0.4%	1,980
Other Electronics	0.5%	0.6%	3,482
HAZARDOUS WASTE	**0.9%**	**0.5%**	**6,414**
Latex & Water-based Paint	0.0%	0.0%	15
Oil-based Paint	0.0%	0.0%	57
Medical Products	0.7%	0.5%	5,182
Pesticides & Herbicides	0.0%	0.0%	-
Batteries	0.0%	0.0%	181
Other Potentially Harmful Wastes	0.1%	0.1%	979
C&D DEBRIS	**15.5%**	**3.8%**	**106,841**
Carpet	1.6%	1.7%	11,171
Carpet Padding	0.5%	0.5%	3,149
Wood Lumber & Products, Treated	3.7%	1.2%	25,319
Wood Lumber, Untreated	1.1%	0.6%	7,269
Wood Pallets	6.5%	2.5%	44,810
Paving, Concrete, Bricks, & Other Aggregates	0.3%	0.3%	1,780
Asphalt Shingles	0.0%	0.0%	-
Gypsum	0.3%	0.3%	2,064
Other Construction & Demolition Materials	1.6%	1.2%	11,277
OTHER MATERIALS	**3.4%**	**1.2%**	**23,761**
Disposable Diapers	0.8%	0.3%	5,241
Fines	1.5%	0.3%	10,427
Other Materials	1.2%	1.2%	8,093
Current Standard Recycle	**25.2%**	2.8%	**174,439**
Potential Recycle	**2.8%**	0.6%	**19,699**
Current Compostable	**1.8%**	0.8%	**12,278**
Potential Compostable	**23.4%**	3.1%	**161,610**
Current Other Recoverable	**14.9%**	2.9%	**102,978**
Potential Other Recoverable	**9.5%**	3.0%	**65,754**
Non-recoverable	**22.4%**	2.6%	**154,620**
Sample Count			100
Totals	**100.0%**		**691,378**

Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.

Table 20. Detailed Composition – Residential

Material	Estimated Percent	+ / -	Estimated Tons
FIBER	**22.7%**	**1.7%**	**104,048**
Corrugated Cardboard	3.9%	0.7%	17,861
Magazines, Newspaper, Office & Printing Paper, Mail	4.1%	0.8%	18,924
Other Recyclable Paper	3.6%	0.5%	16,453
Aseptic Containers & Gable Top Cartons	0.1%	0.0%	595
Polycoated Fiber-based Food Service Packaging	1.0%	0.2%	4,427
Non-polycoated Fiber-based Food Service Packaging	0.6%	0.1%	2,678
Other Compostable Fiber	7.6%	0.7%	34,711
Other Fiber – Non-Recyclable/Non-Compostable	1.8%	0.7%	8,400
PLASTICS	**15.4%**	**1.0%**	**70,396**
#1 PET Bottles & Jugs	1.9%	0.2%	8,620
Other #1 PET Packaging	0.2%	0.1%	1,121
#2 HDPE Natural Bottles & Jugs	0.4%	0.1%	1,874
#2 HDPE Colored Bottles & Jugs	0.5%	0.1%	2,105
Other #2 HDPE Packaging	0.1%	0.0%	315
#5 PP Packaging	0.9%	0.1%	4,193
Other Rigid Plastic Containers, Packaging & Small Products	0.7%	0.1%	3,183
Expanded Polystyrene	0.7%	0.1%	3,246
Plastic Bags – Recyclable	0.1%	0.0%	630
Other Plastic Film – Recyclable	0.5%	0.6%	2,229
Other Plastic Film – Non-Recyclable	5.5%	0.5%	25,310
Plastic Durable & Bulky Items	2.6%	0.7%	12,123
Other Plastic – Non-Recyclable	1.2%	0.2%	5,445
GLASS	**3.2%**	**1.0%**	**14,719**
Glass Bottles & Jars	2.3%	0.3%	10,348
Other Glass & Ceramics	1.0%	0.9%	4,371
METALS	**3.7%**	**0.4%**	**17,132**
Steel Cans	0.8%	0.1%	3,791
Aluminum Cans	0.8%	0.1%	3,862
Aerosol Containers	0.1%	0.0%	619
Ferrous Metal Scrap	1.0%	0.4%	4,777
Non-Ferrous Metal Scrap	0.5%	0.1%	2,441
Other Metal – Non-Recyclable	0.4%	0.2%	1,642
ORGANICS	**25.0%**	**2.2%**	**114,377**
Edible Food Scraps – Non-Packaged	5.3%	0.8%	24,231
Edible Food Scraps – Packaged	4.8%	0.7%	22,193
Non-Edible Food Scraps	4.3%	0.6%	19,606
Yard Waste	5.8%	1.7%	26,363
Other Compostable Organics	0.9%	0.4%	4,041
Animal By-Products	3.4%	1.6%	15,394
Other Organics – Non-Compostable	0.6%	0.2%	2,549

Material	Estimated Percent	+ / -	Estimated Tons
TEXTILES	**6.9%**	**1.5%**	**31,805**
Clothing	3.7%	1.0%	16,985
Non-Clothing Textiles	2.4%	0.5%	10,961
Shoes, Leather, Rubber	0.8%	0.3%	3,859
BULKY AND DURABLE GOODS	**3.1%**	**1.3%**	**14,374**
Mattresses & Box Springs	0.9%	0.7%	4,165
Large Appliances	0.3%	0.5%	1,379
Small Appliances	0.6%	0.5%	2,869
Furniture	0.9%	0.4%	4,026
Tires	0.4%	0.7%	1,935
ELECTRONICS	**0.9%**	**0.4%**	**4,174**
CRT TVs & Monitors	0.0%	0.0%	-
Other Electronics	0.9%	0.4%	4,174
HAZARDOUS WASTE	**0.3%**	**0.1%**	**1,179**
Latex & Water-based Paint	0.0%	0.0%	45
Oil-based Paint	0.0%	0.0%	46
Medical Products	0.1%	0.0%	462
Pesticides & Herbicides	0.0%	0.0%	27
Batteries	0.1%	0.0%	279
Other Potentially Harmful Wastes	0.1%	0.1%	321
C&D DEBRIS	**10.3%**	**2.4%**	**47,262**
Carpet	3.1%	1.4%	14,143
Carpet Padding	0.5%	0.6%	2,423
Wood Lumber & Products, Treated	2.4%	0.8%	10,885
Wood Lumber, Untreated	1.3%	0.8%	5,821
Wood Pallets	0.5%	0.4%	2,272
Paving, Concrete, Bricks, & Other Aggregates	0.2%	0.2%	755
Asphalt Shingles	0.0%	0.0%	35
Gypsum	0.2%	0.2%	837
Other Construction & Demolition Materials	2.2%	1.2%	10,092
OTHER MATERIALS	**8.4%**	**1.0%**	**38,434**
Disposable Diapers	4.3%	0.8%	19,896
Fines	3.4%	0.5%	15,361
Other Materials	0.7%	0.4%	3,177
Current Standard Recycle	**18.6%**	1.3%	**85,052**
Potential Recycle	**2.9%**	0.3%	**13,240**
Current Compostable	**6.6%**	1.7%	**30,403**
Potential Compostable	**22.6%**	1.5%	**103,419**
Current Other Recoverable	**13.0%**	2.0%	**59,458**
Potential Other Recoverable	**9.4%**	1.9%	**42,996**
Non-recoverable	**26.9%**	2.2%	**123,332**

Sample Count			80
Totals	**100.0%**		**457,900**

Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.

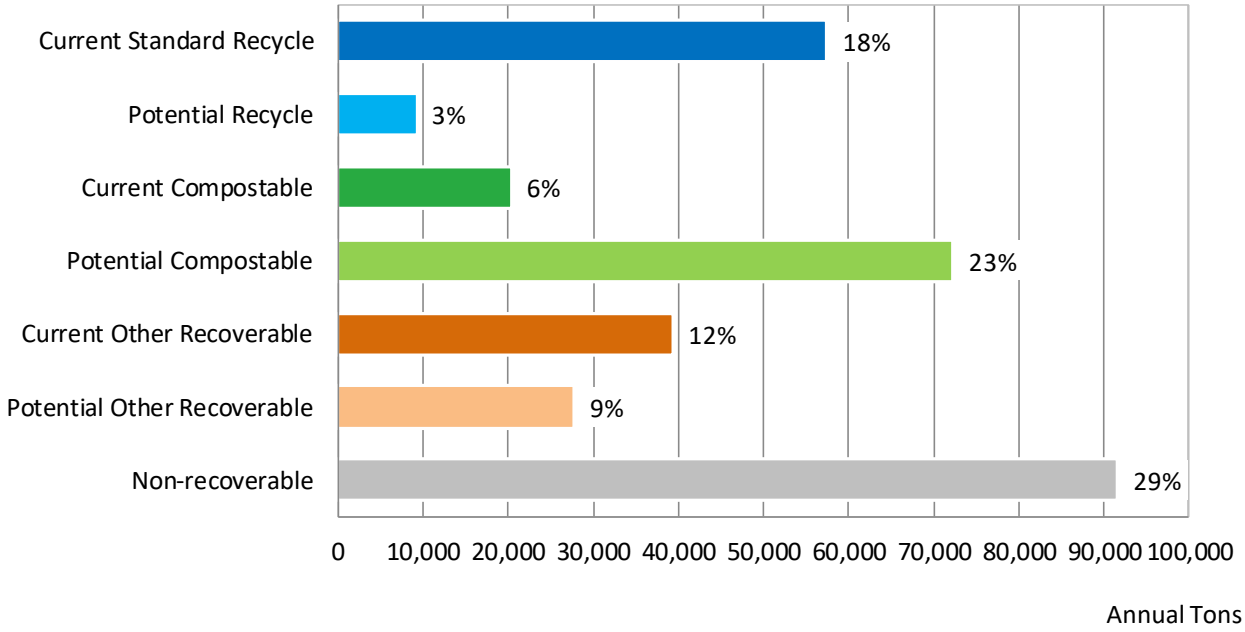
APPENDIX E. CITY OF COLUMBUS RESIDENTIAL SUBSECTOR

This section describes the quantities and composition of residential material disposed in the City of Columbus. The final analysis included a total of 40 City of Columbus residential samples.

Key Findings

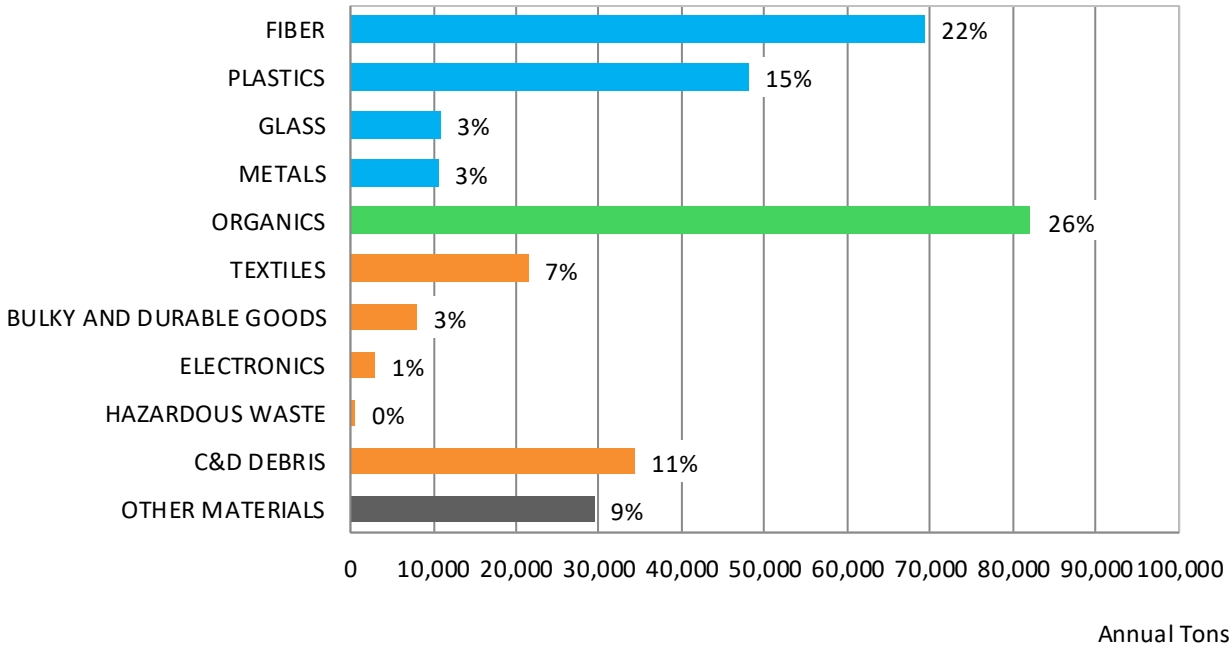
As shown in **Figure 11**, approximately 37 percent (117,116 tons) of City of Columbus residential waste is currently recoverable and over one-third (34%) has the potential to be recovered. Of currently and potentially recoverable materials, potentially compostable (23%) and current standard recyclable (18%) materials make up the largest recoverability categories. Non-recoverable materials make up approximately 29 percent of City of Columbus residential waste.

Figure 11. Recoverability by Category – City of Columbus Residential



The waste composition data are presented by material class in **Figure 12**. **Organics** (26%) and **Fiber** (22%) are the two most prevalent material classes, together representing nearly one-half (48%) of City of Columbus residential waste. The **Fiber** material class includes potentially compostable fiber.

Figure 12. Annual Tons by Material Class – City of Columbus Residential



The ten most prevalent disposed materials are listed in **Table 21.** As shown, the four most prevalent material types are *food scraps* (14.9%), *other compostable fiber* (7.2%), *yard waste* (5.7%), and *other plastic film – non-recyclable* (5.7%). Together they represent nearly 34 percent of City of Columbus residential waste disposed in SWACO's jurisdiction.

Food scraps, which represents the most prevalent component (14.9%) of residential waste, was sorted into three subtypes, representing the following composition percentages of overall waste: *edible food scraps – non-packaged* (5.6%); *edible food scraps – packaged* (4.8%); and *non-edible food scraps* (4.5%).

Table 21. Top Ten Material Types – City of Columbus Residential

Material	Est. Percent	Est. Tons
Food Scraps	14.9%	47,499
Other Compostable Fiber	7.2%	22,980
Yard Waste	5.7%	18,239
Other Plastic Film – Non-Recyclable	5.7%	17,978
Disposable Diapers	4.7%	14,874
Animal By-Products	3.9%	12,349
Corrugated Cardboard	3.8%	12,110
Fines	3.8%	12,072
Magazines, Newspaper, Office & Printing Paper, Mail	3.7%	11,793
Clothing	3.7%	11,618
Total for Top Materials	**57.1%**	**181,514**

Detailed composition results are presented in **Table 22** on the following page.

Table 22. Detailed Composition – City of Columbus Residential

Material	Estimated Percent	+/-	Estimated Tons
FIBER	**21.8%**	**2.1%**	**69,209**
Corrugated Cardboard	3.8%	0.8%	12,110
Magazines, Newspaper, Office & Printing Paper, Mail	3.7%	1.1%	11,793
Other Recyclable Paper	3.5%	0.6%	11,036
Aseptic Containers & Gable Top Cartons	0.1%	0.0%	360
Polycoated Fiber-based Food Service Packaging	1.0%	0.2%	3,096
Non-polycoated Fiber-based Food Service Packaging	0.6%	0.1%	1,753
Other Compostable Fiber	7.2%	0.9%	22,980
Other Fiber – Non-Recyclable/Non-Compostable	1.9%	0.9%	6,081
PLASTICS	**15.1%**	**1.3%**	**48,016**
#1 PET Bottles & Jugs	2.0%	0.3%	6,274
Other #1 PET Packaging	0.2%	0.1%	784
#2 HDPE Natural Bottles & Jugs	0.4%	0.1%	1,328
#2 HDPE Colored Bottles & Jugs	0.4%	0.1%	1,354
Other #2 HDPE Packaging	0.1%	0.1%	227
#5 PP Packaging	0.9%	0.1%	2,868
Other Rigid Plastic Containers, Packaging & Small Products	0.7%	0.1%	2,291
Expanded Polystyrene	0.7%	0.1%	2,374
Plastic Bags – Recyclable	0.1%	0.0%	436
Other Plastic Film – Recyclable	0.7%	0.8%	2,120
Other Plastic Film – Non-Recyclable	5.7%	0.7%	17,978
Plastic Durable & Bulky Items	2.2%	0.9%	6,908
Other Plastic – Non-Recyclable	1.0%	0.1%	3,073
GLASS	**3.4%**	**1.4%**	**10,916**
Glass Bottles & Jars	2.3%	0.4%	7,277
Other Glass & Ceramics	1.1%	1.2%	3,638
METALS	**3.4%**	**0.5%**	**10,681**
Steel Cans	0.8%	0.1%	2,689
Aluminum Cans	0.9%	0.1%	2,771
Aerosol Containers	0.1%	0.0%	430
Ferrous Metal Scrap	0.7%	0.4%	2,151
Non-Ferrous Metal Scrap	0.5%	0.1%	1,431
Other Metal – Non-Recyclable	0.4%	0.3%	1,210
ORGANICS	**25.8%**	**3.0%**	**82,106**
Edible Food Scraps – Non-Packaged	5.6%	1.0%	17,724
Edible Food Scraps – Packaged	4.8%	0.8%	15,363
Non-Edible Food Scraps	4.5%	0.8%	14,412
Yard Waste	5.7%	2.2%	18,239
Other Compostable Organics	0.7%	0.5%	2,150
Animal By-Products	3.9%	2.3%	12,349
Other Organics – Non-Compostable	0.6%	0.3%	1,868
TEXTILES	**6.8%**	**2.0%**	**21,527**
Clothing	3.7%	1.3%	11,618
Non-Clothing Textiles	2.4%	0.7%	7,673
Shoes, Leather, Rubber	0.7%	0.3%	2,236
BULKY AND DURABLE GOODS	**2.6%**	**1.3%**	**8,115**
Mattresses & Box Springs	0.3%	0.4%	1,055
Large Appliances	0.0%	0.0%	-
Small Appliances	0.8%	0.7%	2,466
Furniture	0.8%	0.4%	2,696
Tires	0.6%	1.0%	1,898
ELECTRONICS	**1.0%**	**0.5%**	**3,053**
CRT TVs & Monitors	0.0%	0.0%	-
Other Electronics	1.0%	0.5%	3,053
HAZARDOUS WASTE	**0.2%**	**0.1%**	**661**
Latex & Water-based Paint	0.0%	0.0%	1
Oil-based Paint	0.0%	0.0%	-
Medical Products	0.1%	0.0%	252
Pesticides & Herbicides	0.0%	0.0%	14
Batteries	0.1%	0.0%	169
Other Potentially Harmful Wastes	0.1%	0.1%	226
C&D DEBRIS	**10.8%**	**3.1%**	**34,248**
Carpet	3.4%	1.9%	10,846
Carpet Padding	0.5%	0.7%	1,488
Wood Lumber & Products, Treated	1.9%	1.0%	6,030
Wood Lumber, Untreated	1.4%	1.1%	4,344
Wood Pallets	0.2%	0.3%	614
Paving, Concrete, Bricks, & Other Aggregates	0.2%	0.3%	749
Asphalt Shingles	0.0%	0.0%	-
Gypsum	0.3%	0.3%	812
Other Construction & Demolition Materials	2.9%	1.7%	9,366
OTHER MATERIALS	**9.3%**	**1.4%**	**29,439**
Disposable Diapers	4.7%	1.0%	14,874
Fines	3.8%	0.6%	12,072
Other Materials	0.8%	0.6%	2,493
Current Standard Recycle	**18.1%**	1.5%	**57,422**
Potential Recycle	**2.9%**	0.4%	**9,266**
Current Compostable	**6.4%**	2.3%	**20,390**
Potential Compostable	**22.7%**	2.0%	**72,232**
Current Other Recoverable	**12.4%**	2.6%	**39,305**
Potential Other Recoverable	**8.8%**	2.3%	**27,833**
Non-recoverable	**28.8%**	3.0%	**91,523**
Sample Count			40
Totals	**100.0%**		**317,971**

Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.