Desktop Waste Characterization Study

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Prepared by

MSW CONSULTANTS

Commissioned by

DISTRICT OF COLUMBIA DEPARTMENT OF PUBLIC WORKS

"The Preferred Choice"

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E 1. OVERVIEW

During the past few years, the District of Columbia has adopted a number of ambitious waste reduction and recycling goals, including as part of the 2013 Sustainable D.C. Plan[a] and the Sustainable Solid Waste Management Act of 2014[b] (the Act), which established a goal of achieving "zero waste" by diverting 80 percent of solid waste across all sectors by 2032 – a goal that was reaffirmed recently by the Sustainable D.C. 2.0 Plan[c] published in 2019. These goals have prompted the District to add new materials to its curbside recycling program, implement product stewardship programs for paint and electronics, rebrand program outreach, reduce recyclables contamination, and begin planning for expanded organics recycling efforts. The Act also requires that DPW develop and publish a Waste Characterization Study (WCS) study every four years. The results of the Desktop Waste Characterization Study are contained herein.

Key objectives of the Desktop WCS included:

- Projecting District-wide waste generation through 2038,
- Estimating compositions for mixed material streams, including refuse, mixed recyclables, and construction and demolition (C&D) debris,
- Establishing baseline per capita generation rates to allow measuring of future progress, and
- Assisting the District in solid waste system planning.

Both municipal solid waste (MSW) and construction and demolition (C&D) debris streams were analyzed as part of this study. MSW generation and composition estimates were further broken down into single-family, multi-family, and non-residential generator sectors.

Waste generation was calculated using a variety of data sources – most of which were provided by the District's Department of Public Works (DPW). As the District's single-family waste collection provider, as well as operator of two transfer stations in the District, DPW had access to accurate and complete data on single-family waste generation. Multi-family and commercial properties are not serviced by DPW, though some waste collected by private haulers is brought to DPW transfer stations. As a result, some estimation was required in order to estimate waste generation from these sectors. Current waste generation estimates were subsequently correlated with population and other demographic indicators to project waste generation through 2038.

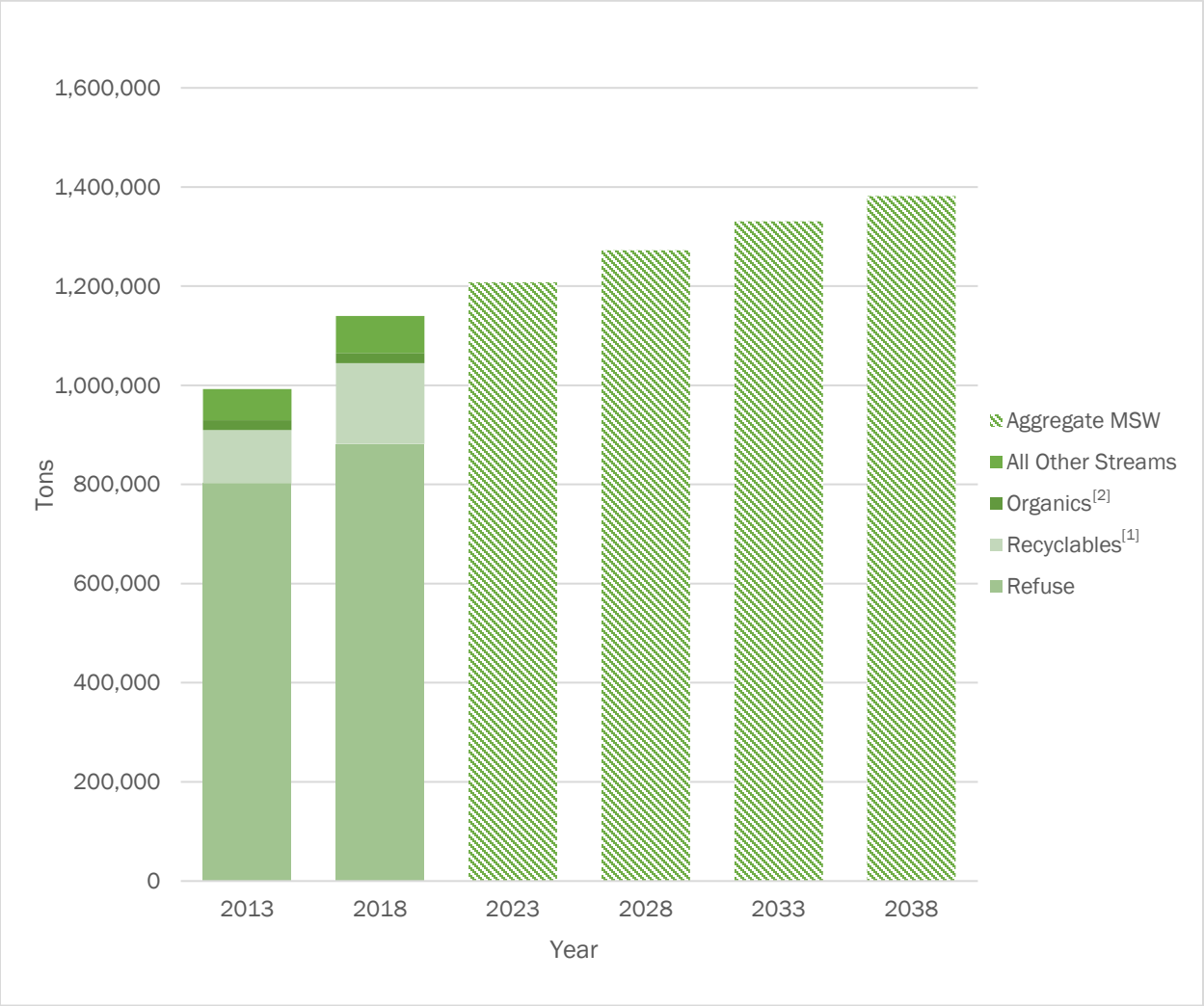
Waste composition estimates were derived from the results of existing studies from comparable jurisdictions. A total of 14 relevant waste composition studies were ultimately filtered from a library of over 180 such studies for use in this analysis. Ultimately, the compositions identified in these 14 studies were used to estimate the District's waste composition.

E 2. KEY RESULTS

Figure E-1 shows historical, current, and projected annual MSW generation through 2038, in five-year increments. The breakdown between refuse, recyclables, organics, and all other streams is shown for years 2013 and 2018. Only the total estimated MSW is depicted for later years, as it is highly possible that waste diversion initiatives will shift tonnage away from refuse and into streams destined for recycling or composting.

E. EXECUTIVE SUMMARY

Figure E-1 Overall MSW Generation by Stream (CY 2013-2038)

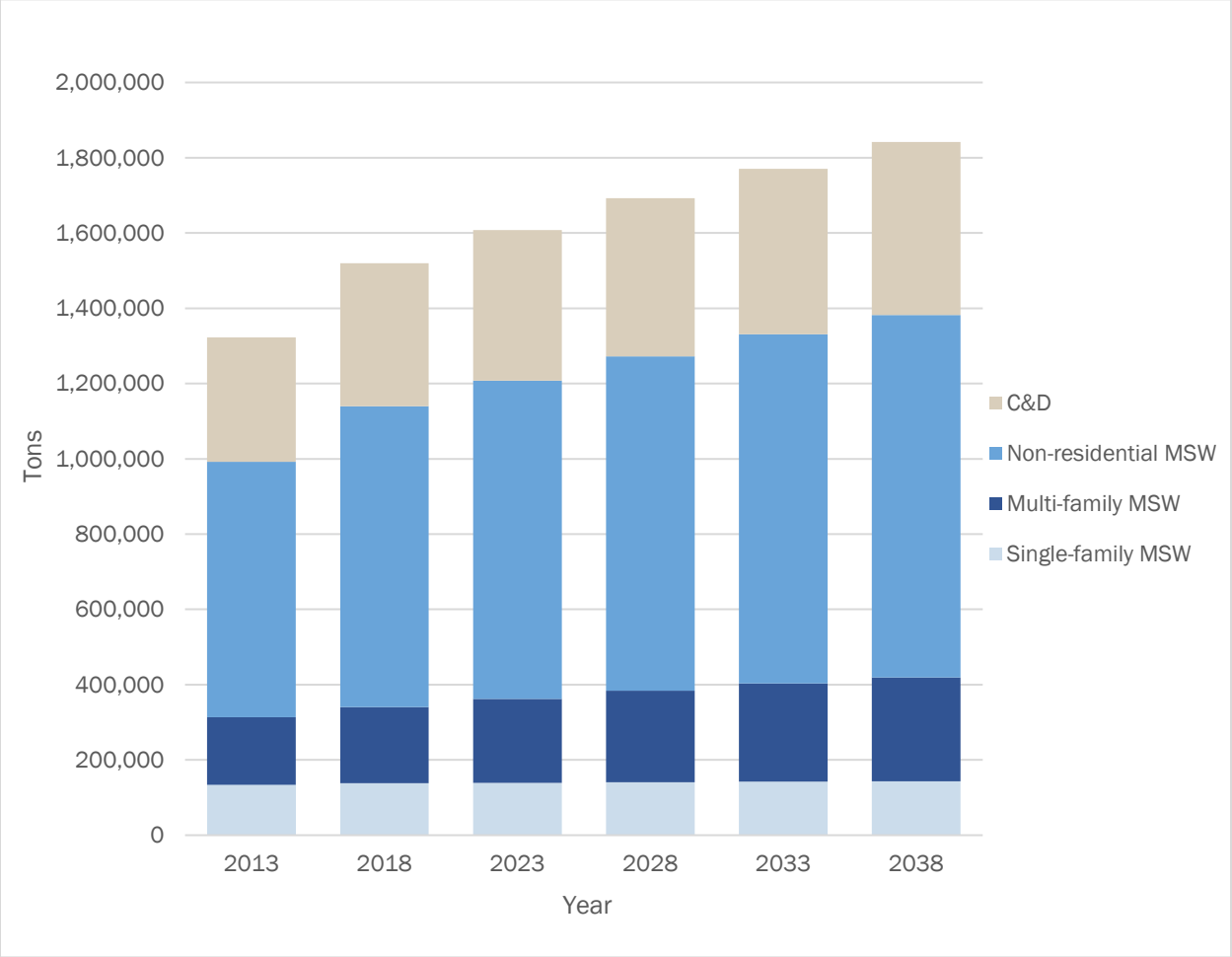


Notes: [1] Includes Mixed Recyclables, Paper, Shredded Paper, Plastic, Textiles, Scrap Metal, and Electronics streams.
[2] Includes Leaves, Holiday Trees, Other Green Waste, Food Waste, and Yard Trimmings streams.

As shown in the above figure, the total estimated MSW generation for 2018 is over 1.1 million tons. This represents a 15 percent increase in generation from the 2013 estimated total. By 2038, the total is estimated to rise to nearly 1.4 million tons.

Figure E-2 shows the aggregate estimated generation of MSW (by sector) and C&D debris. Due to a lack of available data on C&D activities in the District, less precise estimates were made for C&D generation. Instead, a range of values were provided in the form of a low, central, and upper estimate. The central estimate is displayed in Figure E-2.

Figure E-2 Aggregate Waste Generation Projections (CY 2013-2038)



Note: Central estimate displayed for C&D quantities.

As shown above, the non-residential generator sector is responsible for approximately 70 percent of total MSW generation and is driven by the District's role as both a regional employment hub and tourist destination. It is also noteworthy that multi-family MSW generation is expected to increase 54 percent from 2013 to 2038, while single-family MSW generation is expected to increase only 7 percent over the same timeframe. This is due to 95 percent of the future growth in households being projected to occur in the multi-family sector.

Figure E-3 shows the composition of the District's aggregate MSW stream broken down by material group. The composition of the aggregate MSW stream was derived by estimating the composition of wastes and recyclables individually by generator sector and summing the resulting quantities by material category. As shown, Paper, Food, and Plastics are the most prevalent material groups in the District's MSW stream. The body of this report provides more detailed compositions that subdivide refuse streams into 39 categories and mixed recyclables streams into 16 categories.

Figure E-3 Aggregate MSW Generation in the District by Material Group (CY 2018)

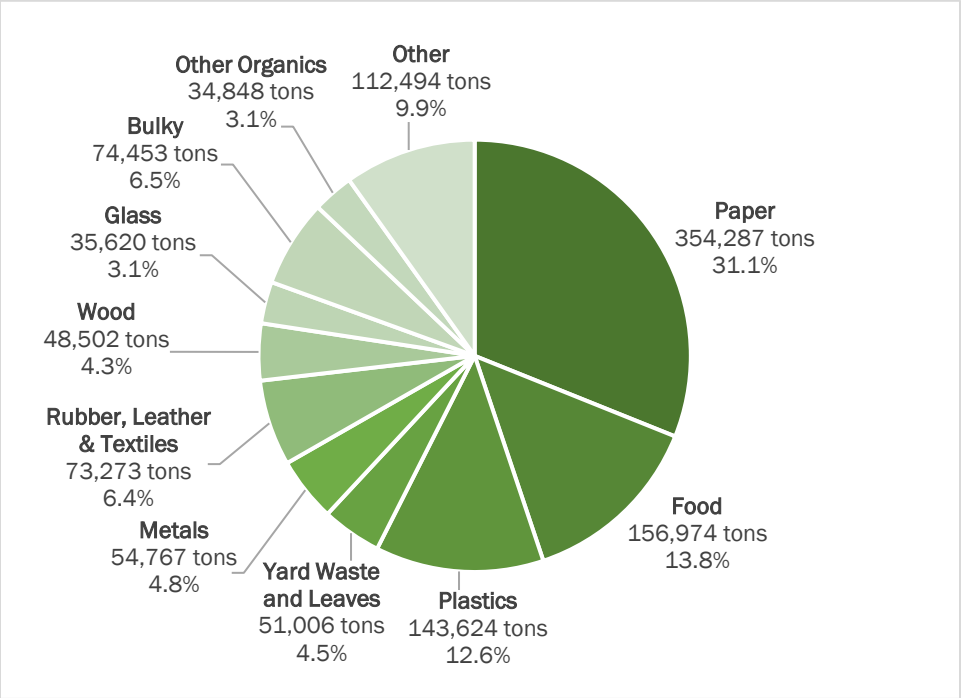
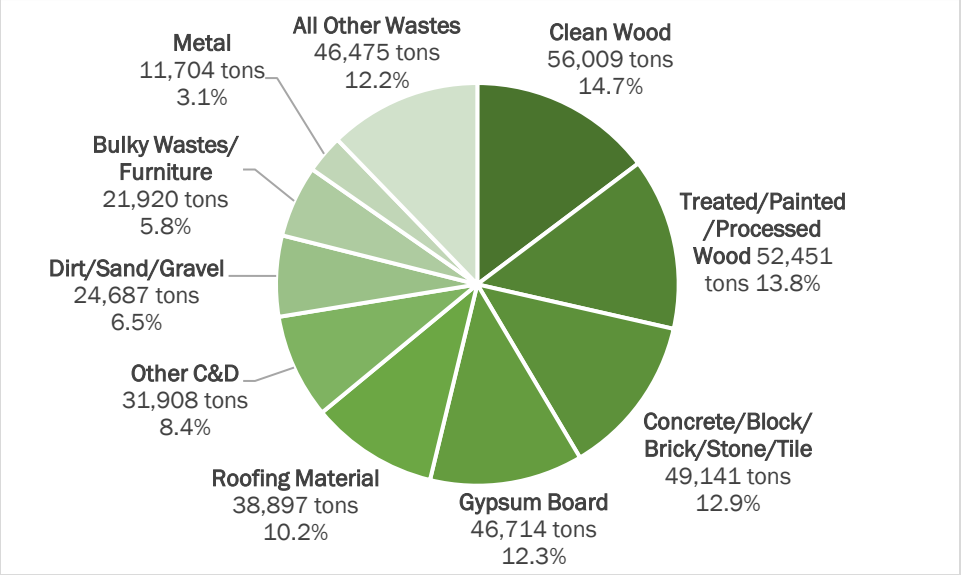


Figure E-4 shows the composition of C&D debris by material group. As shown, the C&D stream is estimated to contain significant fractions of multiple material groups.

Figure E-4 C&D Generation in the District by Material Group (CY 2018)

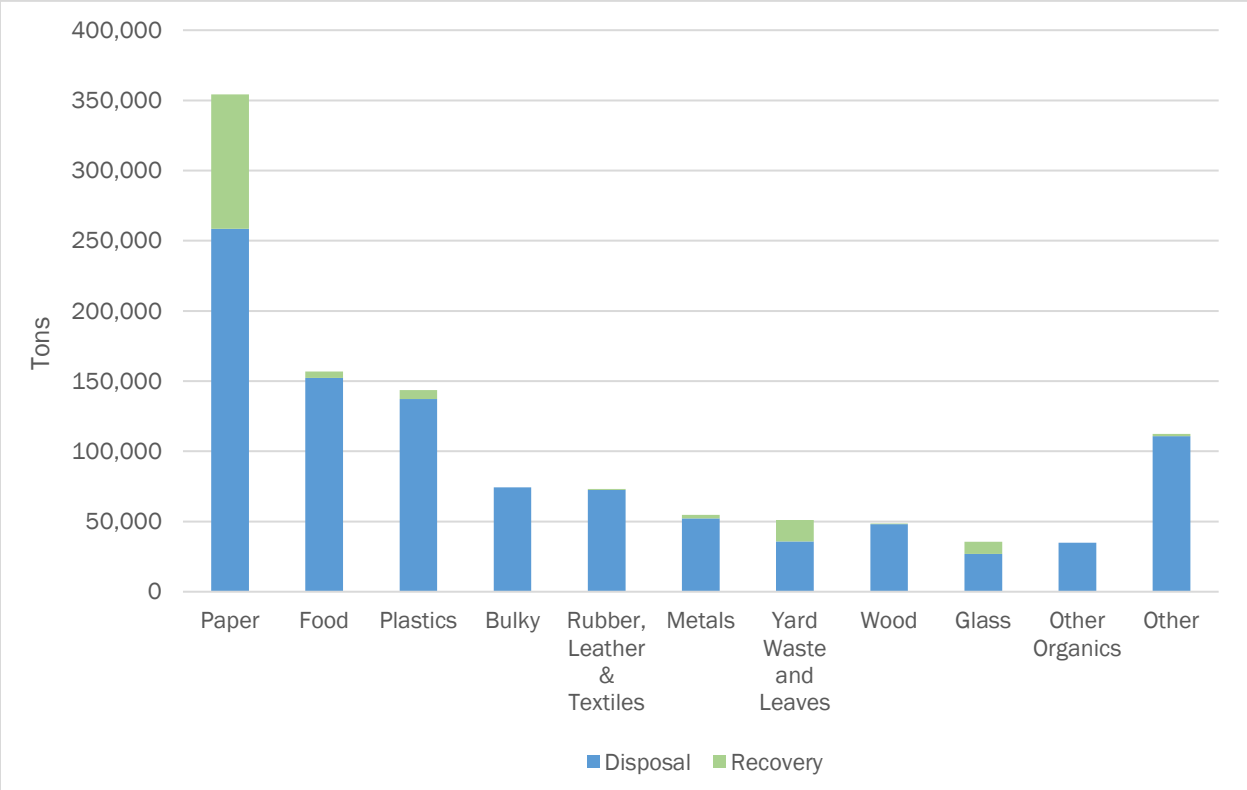


Note: Central estimate displayed for C&D quantities.

Figure E-5 illustrates, for each material group within the MSW stream, the fraction of material that is disposed (in a landfill or waste-to-energy facility) or recovered (via recycling or composting). Meaningful

diversion of paper is currently being achieved in the District. The lesser amounts of other materials being diverted from disposal suggest there are significant opportunities to increase recycling and composting of many constituents in the MSW stream.

Figure E-5 Disposition of MSW by Material Group (CY 2018)



E 3. FULL REPORT

The chapters that follow elaborate on the content included in this executive summary. Extensive methodology is provided throughout in order to validate results and aid in updating this study should the District elect to perform another Desktop WCS. Detailed generation estimates are provided for individual generator sectors and material streams. Detailed composition results for each mixed material stream are provided in tabular and graphical form. The resulting estimated waste generation is ultimately compared to the U.S. Environmental Protection Agency's national MSW generation data to provide validation of the methodology used in this Desktop WCS and also to highlight differences in the District's waste stream compared to the national waste stream. Please note that due to rounding, some numbers in this report may not precisely sum to their respective totals.

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CHAPTER 1 – INTRODUCTION

1.1 OVERVIEW

Our nation's capital, Washington, D.C. (the District), is home to 700,000 people and anchors a population of 6.3 million in the surrounding metropolitan area. The District's residents live across eight wards in approximately 310,000 total households.

The District's Department of Public Works (DPW) provides weekly solid waste and recyclables collections to the approximately 104,000 single-family households (structures with three dwelling units or less), seasonal collections of leaves and holiday trees, scheduled collection of bulky wastes, and drop-off services for recyclables, e-waste, paper shredding, HHW, and residential food scraps. The District's Department of General Services (DGS) manages solid waste and recyclables collections from District government buildings, facilities, and public schools. Multi-family (properties with four dwelling units or more) and commercial properties, such as businesses like restaurants, retail, and office buildings, are required to provide recycling and trash collection services through private haulers. Private hauling companies also provide collection of construction and demolition (C&D) debris.

DPW also oversees the District's mandatory recycling requirements for multi-family and commercial properties and leads overall solid waste management and zero waste planning. This includes public outreach and regulatory oversight of annual reporting requirements (led by the Office of Waste Diversion).

During the past few years, the District has adopted a number of ambitious waste reduction and recycling goals, including as part of the 2013 Sustainable D.C. Plan[a] and the Sustainable Solid Waste Management Act of 2014[b] (the Act), which established a goal of achieving "zero waste" by diverting 80 percent of solid waste across all sectors – a goal that was reaffirmed recently by the Sustainable D.C. 2.0 Plan[c] published in 2019. These goals have prompted the District to clarify and expand the list of acceptable materials to its curbside recycling program, implement product stewardship programs for paint and electronics, rebrand program outreach, reduce recyclables contamination, and begin planning for expanded organics recycling efforts. The Act also requires that DPW develop and publish a Waste Characterization Study (WCS) study every four years.

The District has conducted and published waste sorts in the past which aimed to characterize the residential waste stream and other materials passing through DPW transfer stations. This report represents the first comprehensive District-wide WCS, which was performed as a desktop study[1] in attempt to: 1) estimate the size and composition of the District's citywide solid waste stream, 2) establish baselines to measure future progress in source reduction, per capita generation, and waste diversion, and 3) project future solid waste generation for the next 20 years. Altogether, this data and information will be used to guide long-term planning.

1.2 OBJECTIVES

In addition to fulfilling the requirements in the Act, this study has been developed to support DPW and other District stakeholders in achieving the following objectives:

- **Understanding solid waste stream <u>generation</u>:** This study quantifies the total amount of solid waste generated in the District by major generating sectors, including among residential single-family households, multi-family households, commercial and institutional establishments, and construction and demolition debris generators. The study also compiles historic, current, and projected

[1] A WCS which estimates compositions through analysis of results from existing comparable studies rather than through manual sampling and sorting.

demographic data from authoritative sources that are used to project future waste generation through 2038.

- **Understanding solid waste composition:** This study estimates the composition of various categories of wastes and recyclables that are mixed together when reported by regional haulers and solid waste facilities.
- **Measuring progress:** The study will allow the District to better measure progress towards its Sustainable DC Plan goals and establish a baseline for diversion and per capita generation on solid waste source reduction, recycling diversion and reuse.
- **Inform and support District solid waste system planning:** The findings and analyses from this study will help the District in solid waste program, policy, and infrastructure planning.

1.3 WASTE TYPES

This study attempts to characterize the following waste streams:

- **Municipal Solid Waste (MSW**), which includes garbage, refuse, trash, or any other waste or waste product, including recyclable, compostable, or otherwise reusable material, whether in solid, liquid, semisolid, or contained gaseous state, resulting from an industrial, commercial, residential, or government operation or community activity. It does not include hazardous waste, medical waste, or construction and demolition waste.
- **Construction and Demolition (C&D) Debris**, which includes materials generated during construction, renovation, and demolition projects.

The waste generation portion of the study includes not only materials reported to be destined for disposal, but also materials reported to be captured for recycling, composting, or other processing of source separated or mixed materials. It should be noted that there may be additional quantities of materials generated within the District's business sector, and which are source separated at the point of generation and sold directly (or through a broker) to end markets, which are not captured in this study. Only mixed recyclables and organics collected and delivered to disposal or processing facilities and/or reported to have been handled by permitted solid waste hauling companies are captured in this study. It is believed that this study captures the majority of materials generated.

The study does not attempt to capture a variety of special waste types such as industrial process waste, medical wastes, hazardous wastes, biosolids or sludge. Nor has an attempt been made to quantify the reuse sector (with the exception of the PaintCare program), which is a small but growing component of the waste management system that seeks to repair, refurbish and return still-usable items to the economy via thrift stores, building product reuse centers, and related establishments.

1.4 GENERATOR SECTORS

This study further disaggregates the MSW stream into the following generator sectors:

- **Single-family Residential**, defined in the District as any residential property with 3 or fewer dwelling units (or households),
- **Multi-family Residential**, which includes the remainder of dwelling units in multi-unit apartments and condominiums (4 or more dwelling units), and
- **Non-residential**, which includes organizations such as businesses, governmental and other institutional buildings, and small manufacturing operations.

This study also addresses the Construction and Demolition sector by estimating the order-of-magnitude quantity of C&D debris generated in the District. It should be noted, however, that the far more robust data compiled in this study focuses on MSW from the above sectors due to better availability of detailed data sources.

1.5 COMPOSITION METHODOLOGY OVERVIEW

It is important to note that this study did not entail physical sampling and sortation of the District's solid wastes streams. This is a "desktop" study which estimates the composition of the District's solid waste stream based on mappings of studies from relevant city and county wastesheds which are believed to have comparable waste streams to the District. Waste composition data was selected for comparative analysis based on the following criteria:

- **Study time frame:** Due to the rapid changes occurring to the solid waste stream, such as light-weighting of packaging materials and the conversion from print to digital media, more recent studies are preferred over older studies because these studies reflect the underlying changes in the waste stream;
- **Geographic proximity:** MSW Consultants examined recent solid waste characterization studies from neighboring jurisdictions, including Montgomery and Prince George's Counties in Maryland, and Arlington County, Virginia, as well as the Maryland statewide study from 2016. Solid waste characterization studies from jurisdictions closer to the District were preferred over those farther away due to nearer jurisdictions operating in similar regional economies and similar climates.
- **Similar climate:** To the extent the research for this project ranged further away from the mid-Atlantic region, only cities with four seasons were considered to minimize the impact of different growing seasons and green waste generation on overall waste stream characterization.
- **Population and employment:** The comparative waste characterization studies reviewed focused on more densely populated jurisdictions with populations greater than 220,000.
- **Program and service level similarities:** The majority of the composition studies reviewed and eventually mapped were from jurisdictions who provide similar levels of recycling and trash services and whose programs are relatively comparable in terms of services offered and goals achieved.[2]

Appendix A includes a list of the studies selected, and Appendix C provides extracts of the composition data used for estimation in this study.

1.6 DATA SOURCES

The study has been informed using a number of different data and information sources provided by the District, as well by comparative waste characterization studies from other jurisdictions obtained from MSW Consultants' *WasteInsight*™ library of nearly 350 studies. District-managed data included:

- Solid waste collection and disposal tonnages from District collection services (single-family residential) as well as solid waste tonnages collected from private haulers and processors brought to District-owned solid waste transfer stations,
- Annual waste diversion program reporting on tonnages, recycling, and diversion rates,
- Relevant sections of District Code as well as strategic planning and policy documents,
- Responses to a CY 2013 survey conducted by Arcadis of ten solid waste facilities accepting District-generated waste,
- Results of the CY 2017 and 2018 District-conducted hand sort of residential and commercial recyclables, and
- CY 2017 and 2018 collection and disposal data as reported by private haulers operating in the District via DPW's Solid Waste Collector Registration & Reporting system.

[2] For example, jurisdictions such as Seattle, WA or San Francisco, CA were not used as comparisons due to their aggressive programs targeting waste diversion and recycling which should result in reduced quantities of food waste and targeted recyclables in their refuse stream.

External data sources sought out independently or provided by District staff included:

- U.S. Census data
- Demographic and economic information published by the Metropolitan Washington Council of Governments (MWCOG);
- Reports from other regulatory bodies, including the Commonwealth of Virginia's Department of Environmental Quality (VDEQ), the Maryland Department of the Environment (MDE) and the Pennsylvania Department of Environmental Protection (PADEP).

Data sources are cited throughout this report using superscripted letters enclosed in square brackets (e.g. [a]) that correspond to the list of data sources provided in Appendix A. Additional details and Internet links for some data sources are also included in this section.

1.7 STUDY LIMITATIONS

As noted above, this study did not entail any physical sampling and/or sorting of the District's solid wastes streams. Across the U.S., the majority of local governments and many state agencies that undertake such studies have applied manual sampling and sorting protocols based on one of several industry standard methodologies. Manual sampling and sorting protocols have been found to be effective at capturing the unique aspects of waste and recycling composition for city, county and metro wastesheds. The decision to perform a 'desktop' waste characterization may sacrifice some precision in the composition estimates that a manual sort would provide, however, it does allow many waste streams to be characterized without incurring the substantial costs that a manual sort would require. In the professional opinion of MSW Consultants, this desktop study should provide reasonable planning-level estimates of both the future waste generation and waste composition that is likely to occur in the District.

1.6 REPORT ORGANIZATION

This report is organized into the following chapters:

- **Chapter 2: Waste Generation:** This chapter presents findings and projections on solid waste generation among defined sectors in the District throughout a 20-year planning horizon, including residential single-family, residential multi-family, commercial, and C&D generating sectors. This chapter presents the generation by sector and in aggregate. This chapter also details the methodologies used to arrive at these findings. Results are presented in tabular and graphical format, with analysis as appropriate.
- **Chapter 3: Waste Composition:** This chapter presents MSW Consultants' estimates of the composition of selected mixed waste streams. In particular, this chapter provides composition estimates for single-family and multi-family residential refuse, commercial refuse, residential and commercial mixed recyclables, and C&D debris. The solid waste materials categories and methodologies considered and utilized for estimating waste composition are also detailed in this chapter. Results are presented in tabular and graphical format, with analysis as appropriate.
- **Chapter 4: Conclusions and Recommendations:** This chapter combines the waste generation projections in Chapter 2 with the composition estimates in Chapter 3 to provide a 20-year breakdown of the District's aggregate MSW and C&D streams. This chapter also presents recommendations for the District's consideration when updating this study in the future.
- **Appendices:** This report contains a number of appendices containing supporting and ancillary information, including:
  A. Data sources,
  B. Material categories and definitions, and
  C. Composition data from other waste characterization studies used as a basis for estimation in this study.

CHAPTER 2 – WASTE GENERATION

2.1 INTRODUCTION

Neither the Department of Public Works (DPW) nor MSW Consultants possesses expertise on the estimation and projection of common demographic, economic, and other non-solid waste data that are measured and tracked for purposes of long-term planning. Accordingly, authoritative third parties with such expertise, such as the District's Office of Planning and the U.S. Census Bureau, have been consulted and cited as the basis for demographic data compiled for this report.

Further, MSW Consultants has relied on an extensive series of solid waste reports[d][e][f] compiled by the Department of Public Works (DPW) from 2013 through present which have been used by DPW to measure system performance. In some cases, many years of historical time series data are available. In other cases, only a single year or perhaps several years' worth of data are available.

This chapter summarizes the assembly of the historical and projected demographic and economic time series that are used as waste generation indicators, as well as the available solid waste tonnage data. This chapter further applies certain calculations to disaggregate certain combined tonnages and to estimate other tonnages. Finally, this chapter provides a simple correlation of future waste quantities to projected growth in the underlying demographic data provided by authoritative parties.

2.2 METHODOLOGY

The methodology to estimate and project waste generation followed five primary steps:

- Assembly of demographic and economic data for use as waste generation indicators,
- Compilation of available waste tonnage reports,
- Interpolation and forecasting of waste generation indicators and waste quantities,
- Disaggregation of certain mixed tonnage data into the waste generating sectors targeted in the study, and
- Estimation of planning-level estimates of C&D generation.

These steps are described below.

2.2.1 ASSEMBLY OF DEMOGRAPHIC TIME SERIES AND FORECASTS

The following demographic data were assembled for consideration as waste generation indicators within this report:

- Historical and current total population from the U.S. Census Bureau[g],
- Single-family residential households served by DPW's Collection Division[h],
- Single-family and multi-family persons per household as reported by the Office of Planning[i][j],
- Projected population and household growth based on Metropolitan Washington Council of Governments (MWCOG) forecasts[k],
- Historical and projected total employment as reported by MWCOG[k],
- Historical and current employment by sector from the U.S. Bureau of Labor Statistics[l], and
- Historical and current visitation statistics as reported by Destination DC[m].

All of the data above has been independently prepared by professional organizations with special expertise in compiling and forecasting such data. Accordingly, these data serve as the basis for future projections of the waste stream generated in the District.

However, not all of the assembled demographic data was ultimately found to be complete and useful for this study. U.S. Census population data and projections were complete and informative; and MWCOG housing unit and employment projections were also complete and highly relevant. Alternative demographic indicators, such as the number of annual visitors as reported by Destination DC and employment-by-sector statistics as reported by the U.S. Bureau of Labor Statistics, were researched but not used to form waste generation projections because projections for the indicators were not available through to 2038.

Additionally, construction, demolition, and renovation project activity in the District is tracked to some level by the Washington D.C. Economic Partnership. Table 2-1 summarizes the known projects completed or planned to be completed as of August 2018 and that exceed five million dollars in value. The significant reduction in the number of projects for later years indicates that most future construction, demolition, and renovation activities are not yet known of – preventing the data's use as an indicator for projecting C&D debris. However, the sizeable number and scale of the projects completed in recent years demonstrates that the District is currently experiencing a period of considerable building development.

Table 2-1 Completed and Planned Development (CY 2015-2032)

Status	Year	Number of Projects	Total Size of Projects (sqft)	Total Value of Projects (in million $)
Completed	2015	20	2,764,065	1,532
	2016	41	5,322,934	3,561
	2017	47	6,817,744	13,643
	2018	59	10,229,331	8,073
	2019	44	7,185,743	7,835
Planned	2020	29	3,336,480	4,005
	2021	9	997,426	1,137
	2022	11	1,700,432	4,039
	2023	1	318,708	74
	2025	2	717,000	1,276
	2032	1	170,000	1,000

Source: Washington D.C. Economic Partnership. (2018, August). *DC Development Report.*[n]

In practice, C&D waste generation has been shown to track the broader economy rather than any other particular indicator. In periods of strong economic growth, construction activity leads to significant growth in waste generation; conversely, in economic recessions construction activity drops off, as does C&D waste generation. The same impact is felt within MSW generation, albeit to a lesser extent. It was beyond the ability of this study to project economic cycles for the 20-year planning horizon and to correlate C&D (or MSW) generation to such economic cycles. Rather, C&D waste generation is assumed, for planning purposes, to track overall MSW generation. Although this is a significant simplifying assumption, it will at least maintain the order-of-magnitude estimate of the C&D waste stream for a 20-year planning perspective.

As a final note, generation estimates developed in this study for the District were compared to the quantities of District waste reported by state agencies in Virginia, Maryland, and Pennsylvania to verify they were within reasonable ranges. Exhibit 2-1 contains a detailed summary of the demographic data and projections used in this study.

2.2.2 COMPILATION OF WASTE TONNAGE REPORTS

The following sources of waste tonnage reports were compiled for this project:

- DPW-collected wastes originating within the single-family residential sector, as well as other generator types and neighborhood beautification services (such as illegal dumping removal, street sweeping and dead animal removal, etc.) performed by the District[d],
- Scale weights for wastes collected by third parties and delivered to District-owned solid waste transfer stations[d],
- Surveys of third-party facilities receiving wastes originating in the District as part of a 2013 analysis conducted by Arcadis and sponsored by the District[e], and
- Solid waste collector reports provided by haulers to DPW per the Solid Waste Collector Registration & Reporting requirements[f].

As shown, the District's Department of Public Works was the primary source of data for MSW tonnages. Scale data from the District's transfer stations provided complete quantities of MSW collected by the (solid waste) Collections, Street & Alley, and Bulk divisions under DPW's Solid Waste Management Administration (SWMA). Wastes collected by private haulers and brought to DPW transfer stations were also detailed in the scale data, however, since only a portion of the privately collected waste is sent to the District's two solid waste transfer stations, the exact proportion that this waste tonnage represented is hard to ascertain on its own. Additionally, the scale data did not detail the generator sector of each privately-collected load; thus, it was initially unknown what proportion of privately-collected waste originated from multi-family households vs non-residential establishments. Despite these shortfalls, tonnage data for DPW-managed collection services and solid waste facilities has been routinely collected for the past ten years and is highly trustworthy. For the purposes of this study, only the inbound scale data (as opposed to outbound data) was used.

Less complete data was available for wastes received at third-party facilities, located both within and outside of the District. Though the District implemented a mandatory reporting requirement for private haulers in 2017, full compliance has not yet been achieved; however, the compliance rate in calendar year 2018 improved greatly compared to calendar year 2017. A facility-level survey was conducted by Arcadis in 2013 which included voluntary reporting by 10 of the largest disposal and processing sites in the region for which the District has previously transported waste for disposal or processing. These facility surveys were deemed the most complete source of data available for the third-party facilities' refuse stream, and the hauler reports were deemed the most complete source of data available for all other streams. Additionally, solid waste reports[o][p][q] from neighboring states were reviewed and found to support the generation estimates resulting from the above data.

2.2.3 INTERPOLATION AND FORECASTING

Demographic indicators were necessary to escalate and de-escalate annual MSW quantities in order to fill gaps in historical data and form projections. Data from the U.S. Census Bureau and MWCOG was combined in order to assemble demographic indicators for the required timeframe. The District's Office of Planning was consulted to verify the accuracy of the assembled statistics.

Twenty-year projections were calculated individually for each generator sector using their respective demographic indicators and the estimated 2018 quantities. For single- and multi-family generation sectors, the estimates were escalated using the projected increase in the number of single-family and multi-family households, respectively. For the non-residential sector, the estimates were escalated using the projected increase in employment.

As mentioned previously, a limitation inherent to this type of analysis is that waste generation is closely correlated with the economy. Projection of economic indicators, such as GDP, are beyond the scope of this and most waste generation studies. Other longer-term shifts in the District's material mix, such as the spike

in corrugated cardboard experienced during the last five years due to online ordering, are difficult to predict and, therefore, such forward-looking predictions for changes to consumer behavior or the material(s) those consumables are comprised of themselves are not included in the projections for this study.

2.2.4 DISAGGREGATION OF MIXED TONNAGES INTO GENERATOR SECTORS

Aggregate MSW tonnage data by definition contains waste generated in the single-family, multi-family, and non-residential sector. It was therefore necessary to disaggregate MSW into its respective generator sectors. This was performed through the following steps:

- **Known tonnage**: The single-family MSW tonnage is known. Additionally, the sum of multi-family plus non-residential tonnage is known because MSW from these two generators are collected by private haulers mixed together.
- **Determination of single-family household generation rate**: Because the number of single-family households serviced by DPW are known, it was possible to calculate the refuse and mixed recyclables generation rates for this generator sector. Single-family households were found to have, on average, 2.66 persons per household and generate 1,896 pounds of refuse and 510 pounds of mixed recyclables for calendar year 2018.
- **Estimation of multi-family household generation rate**: Multi-family households were found to be occupied by an average of 2.06 persons per household. It was assumed that multi-family households have a recycling rate that is 40 percent less than single-family households[1], based on the belief that there is less access to recycling within the multi-family sector; and even at multi-family properties that offer recycling, the infrastructure for effective recycling, such as via recycling chutes or conveniently-located drop-off bins, is often limited. Assuming waste generation is relatively consistent on a per-capita basis[2], multi-family households were estimated to generate 1,626 pounds of refuse and 237 pounds of mixed recyclables for calendar year 2018.
- **Calculation of multi-family waste generation**: The total amounts of refuse and mixed recyclables generation from the multi-family sector were calculated by applying the multi-family household generation rates to the number of multi-family households in the District.
- **Net out multi-family tons to determine non-residential generation**: Non-residential refuse and mixed recyclables were therefore determined to be all privately-collected wastes other than the estimated quantities generated in the multi-family sector.

Table 2-2 shows the residential demographic distribution, tonnage distribution, and calculations.

Table 2-2 Residential Demographic and Tonnage Distribution (CY 2018)

Household Type	Households	Persons per Household	Population	Refuse Generation (lbs/HH/year)	Mixed Recyclables Generation (lbs/HH/year)	Refuse Generation (tons/year)	Mixed Recyclables Generation (tons/year)
Single-family (≤3 units)	103,886	2.66	276,648	1,896	510	98,462	26,497
Multi-family (>3 units)	206,534	2.06	425,807	1,626	237	167,862	24,470
Total	**310,420**		**702,455**			**266,324**	**50,967**

Note: Sources for households, persons per household, and population are shown in Exhibit 2-1.

[1] MSW Consultants' professional opinion.

[2] It is acknowledged that single-family households have higher disposable income than multi-family households[r], and that higher income generally equates to higher waste generation. However, the impact of any difference in per capita generation was not factored into these calculations because it is not believed that the impact would significantly change the findings.

In addition to refuse and mixed recyclables, DPW reports also detailed MSW collected as part of other, more-specific material streams. In cases where it was not immediately apparent which generator sector these material streams originated from, MSW Consultants worked with DPW to distribute tonnages to the appropriate generator sectors.

2.2.5 PLANNING-LEVEL C&D GENERATION ESTIMATION

Significantly less data was available for the District's C&D generation. Per the Act, C&D is not considered solid waste in the District, and therefore, haulers are not required to report the quantities they manage. Only 7,342 tons of C&D were observed in the DPW scale data and private hauler reports for CY 2018, indicating that almost all C&D is unreported and managed through third-party facilities.

Data sources such as the number of construction permits as reported by the District's Department of Transportation and the building development report from the Washington D.C. Economic Partnership were researched as potential bases for generation estimation, however, neither source was deemed complete enough to form estimates.

The District's C&D generation was therefore estimated using an MSW to C&D ratio based on published waste generation studies that reported both quantities. The studies examined for this analysis are shown in Table 2-3.

Table 2-3 Waste Composition Studies Reporting MSW and C&D Generation

Jurisdiction	Year	Population (millions)	MSW Generation (million tons)	MSW per Capita	C&D Generation (million tons)	C&D per Capita	Percent of C&D from Total Waste
Chicago, IL	2010	2.70	2.63	0.97	1.77	0.65	40%
Connecticut Statewide	2016	3.58	2.33	0.65	0.88	0.25	27%
Lexington-Fayette County, KY	2014	0.31	0.19	0.62	0.03	0.09	13%
Louisville, KY	2016	0.61	0.63	1.02	0.25	0.41	29%
Massachusetts Statewide	2018	6.90	6.33	0.92	1.02	0.15	14%
Missouri Statewide (All)	2017	6.11	3.86	0.63	0.48	0.08	11%
Missouri Statewide (Large Metro Only)	2017	0.78	1.33	1.69	0.22	0.28	14%
National	2015	308.48	262.43	0.85	169.16	0.55	39%
Seattle, WA	2017	0.69	0.80	1.16	0.52	0.75	39%

Sources: See items [s]-[z] in Appendix A.

As seen in the table above, the percentage of C&D from total waste (MSW and C&D) can vary significantly from as low as 11 percent to as high as 40 percent. Due to this variability, this study included a range of percentages (in the form of a lower, central, and upper estimate) as shown in Table 2-10, rather than a single estimate.

It is acknowledged that this method for estimating C&D is highly simplified and only provides an order-of-magnitude range of the likely amount of C&D debris generated in the District. DPW staff and the consulting team have reviewed the comparable reports and have also observed the significant level of construction and remodeling activity occurring at this time. C&D estimates are included in this report because, over the long term, the C&D stream is expected to provide some of the more significant opportunities for waste diversion and it is appropriate to call this to the attention of the District's solid waste planners and stakeholders. As the first steps to accomplish this, the Sustainable D.C. 2.0 Plan[c]

included two goals: 1) reuse or recycle 50 percent of all commercial construction waste, and 2) reuse five percent of total non-hazardous residential building materials.

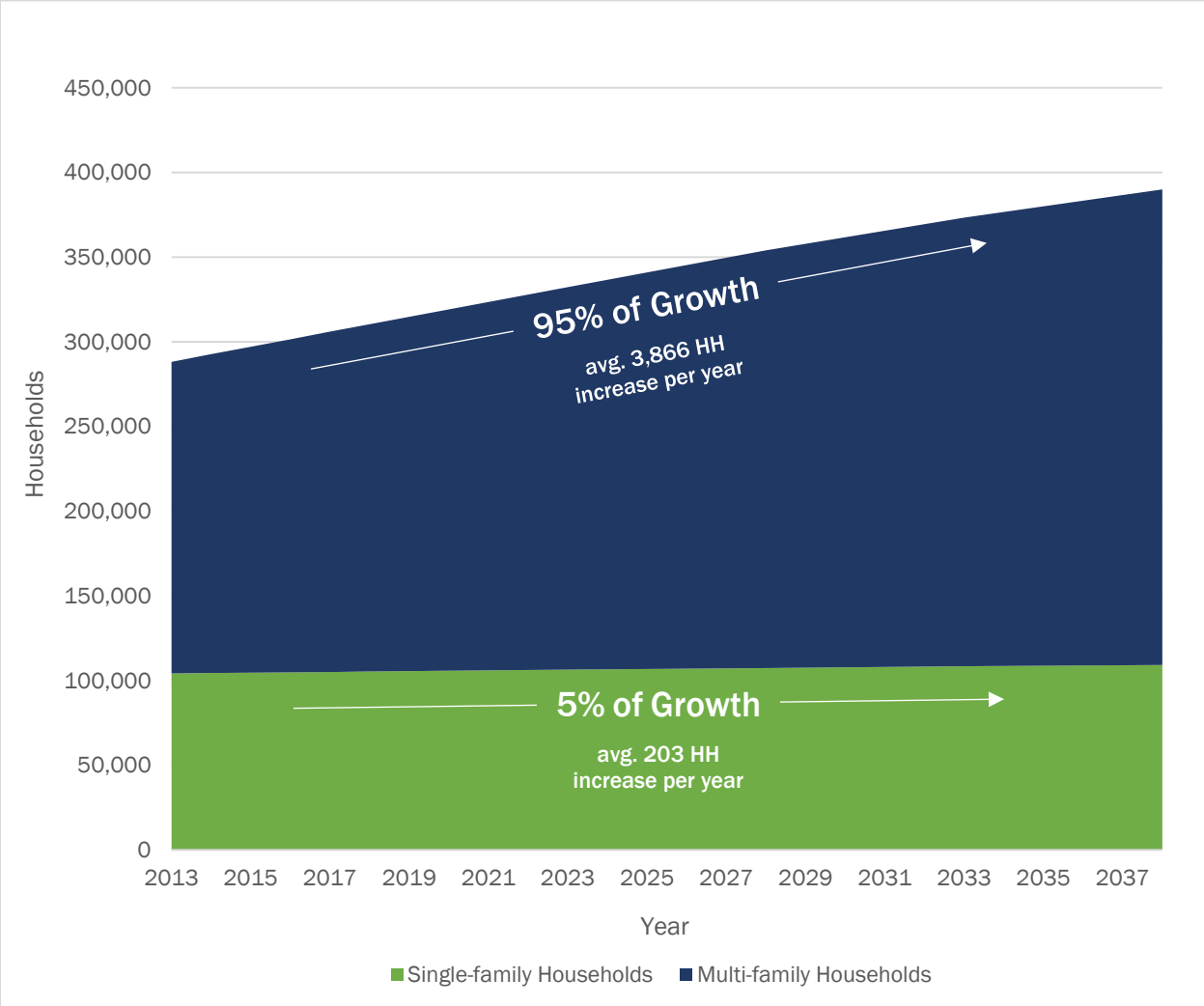
As a final note, state agencies in Virginia, Maryland, and Pennsylvania all report on the quantity of waste tonnage imported from surrounding states, including the District. Available C&D and waste import reports[o][p][q] were reviewed to provide perspective on the C&D generation estimated by this study from within the District.

Future waste characterization reports can be improved if, for example, the District initiates C&D reporting systems or conducts voluntary surveys at surrounding C&D facilities.

2.3 DEMOGRAPHICS

Figure 2-1 shows the projected number of households broken down by single-family (serviced by DPW) and multi-family units. Over the planning period, the number of households increases from under 300,000 to almost 400,000 units. It is important to note that most of this growth (95 percent) is anticipated to be in the multi-family sector and will arise as older dwellings are either demolished for replacement with denser housing, or existing dwellings are subdivided into smaller individual dwellings to accommodate the growth. Due to the built-out nature of the District, opportunities for expanding the single-family (3 or less dwelling units) sector are relatively small. Detailed household data and projections are provided in Exhibit 2-1.

Figure 2-1 Household Projections (CY 2013-2038)



Notes: 95 percent of future growth allocated to multi-family households.[d]
Linear interpolation used between 5-year periods for 2015-2039 totals.
Linear extrapolation used to estimate 2008-2009 household totals under the assumption that growth during 2008-2009 is equal to average growth during 2010-2017.
Sources: See items [g]-[k] in Appendix A.

Multi-family household sizes are typically smaller than single-family households. This report uses 2.06 people per household as the average multi-family household size and 2.66 as the average single-family household size[i][j]. Household sizes are assumed to be constant over time for the purposes of this study. In practice, household sizes will likely increase which will result in increased per household generation, though household size projections were not readily available.

Figure 2-2 shows the projected number of employees working in the District. Figure 2-3 shows the projected number of annual visitors to the District. As shown, projections covering the full planning period were only available for employment.

Figure 2-2 Employment Projections

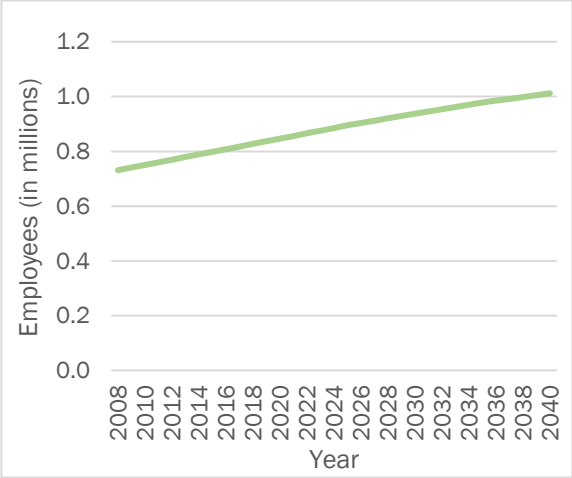


Figure 2-3 Annual Visitor Projections

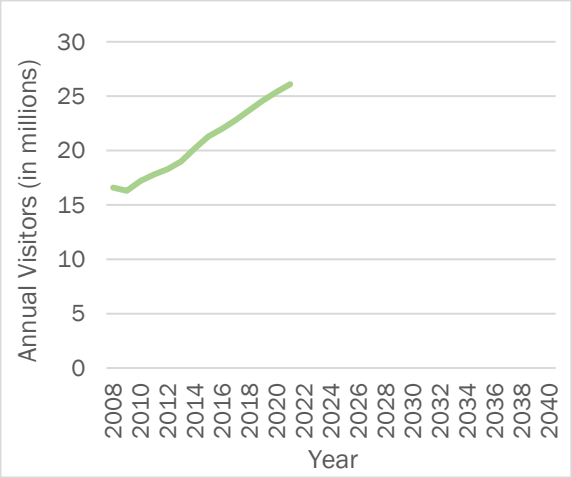


Figure 2-2
Notes: Linear interpolation used between 5-year periods for 2018-2039 totals.
Linear extrapolation used to estimate 2008-2014 employee totals under the assumption that growth during 2008-2014 is equal to growth during 2015-2020.
Source: Metropolitan Washington Council of Governments. (2018). *Round 9.1 Growth Trends to 2045: Cooperative Forecasting in Metropolitan Washington*.[k]

Figure 2-3
Note: Projections for annual visitors were unavailable for years after 2021.
Source: Destination DC. (2017). *2017 Visitor Statistics, Washington D.C.*[m]

Employment is used as the demographic indicator for correlating non-residential MSW in order to capture the impact of the significant commuting population. Projections show overall employment continuing to increase gradually and consistently through 2038. Employment by industry sector data was explored as a demographic indicator to more accurately forecast non-residential MSW generation, however, this exercise would require possession of employment by industry sector estimates projected through 2038 as well as data on the average MSW generation by industry. No such data, in a readily usable format, were found for this study.

Annual visitor data was originally explored as a demographic indicator for projecting non-residential MSW generation due to the expected correlation with retail, restaurant, and other tourism-related waste generation. However, no projections were available beyond 2021, limiting the data's use in projecting waste generation. The data available shows significant increases in tourism since 2009 and this trend is expected to continue for at least the near future. This suggests long-term continuation of increasing waste generation in the District.

2.4 WASTE GENERATION

2.4.1 MUNICIPAL SOLID WASTE (MSW)

Waste generation in the MSW sector was separately projected for residential and non-residential sources. Within the residential sector, waste generation was separately projected for single-family residences and multi-family residences.

Table 2-4 summarizes the generation of single-family MSW separated by material stream. With single-family housing remaining relatively flat, this sector's total generation is projected to increase by only 7 percent over the twenty-year planning period.

Table 2-4 Single-family Generation (CY 2013-2038)

Stream	Historical Tons		Projected Tons			
	2013	2018	2023	2028	2033	2038
Refuse	104,280	98,462	99,500	100,523	101,445	102,231
Mixed Recyclables	18,741	26,497	26,776	27,051	27,299	27,511
Shredded Paper[1]	N/A[2]	168[3]	170	172	173	175
Textiles[4]	N/A[2]	294	297	300	303	305
Scrap Metal[1]	N/A[2]	288[3]	291	294	297	299
Bulky[5]	4,178	4,613	4,661	4,709	4,753	4,789
Leaves	6,089	5,617	5,676	5,735	5,787	5,832
Holiday Trees	218	450	455	460	464	467
Food Waste[1][6]	N/A[2]	414[3]	419	423	427	430
Other Green Waste	608	449	454	459	463	467
Electronics	N/A[2]	270[3][7]	273	276	279	281
Paint[1]	N/A[2]	196[3]	198	200	202	203
Other HHW[1]	N/A[2]	79[3]	80	81	82	82
Total	**134,115**	**137,798**	**139,250**	**140,681**	**141,972**	**143,073**
Increase from 2013	**0%**	**3%**	**4%**	**5%**	**6%**	**7%**
Single-family Households	102,776	103,886	104,981	106,060	107,033	107,863
Annual Tons Per Household	1.31	1.34	1.34	1.34	1.34	1.34
Daily Lbs Per Household	7.18	7.34	7.34	7.34	7.34	7.34

Notes: Waste projections are based on 2018 quantities and are escalated proportionally to the single-family household projections.
[1] Some portion of this stream likely originates from the multi-family sector. For the purposes of this study, the entirety of this stream has been allocated to the single-family generator sector.
[2] Material stream not tracked or reported until after 2013.
[3] 2018 fiscal year quantity. It is expected that this quantity reasonably emulates the calendar year equivalent.
[4] Textiles are collected and managed privately via drop-off bins. Tonnage was distributed between the single and multi-family generator sectors proportionally based on their number of households.
[5] Bulky stream material quantities include only tons collected by DPW's Bulk division.
[6] Food Waste includes material quantities from community composting and DPW's food waste drop-off program.
[7] 2018 data from DPW's Fort Totten electronics recycling collection and reported by manufacturers to comply with eCYCLE DC.

Sources: DC Transfer Station Scale Data[d]
2017-2018 Collector Reports[f]

Between 2013 and 2018, tonnage from the single-family mixed recyclables stream increased 41.4 percent – the result of a 39.9 percent increase in generation per household and a 1.1 percent increase in the number of households. Additional tons may shift from the refuse stream to the mixed recyclables stream over time as participation in the recycling program increases and additional recycling initiatives are implemented. Conversely, changes in packaging and in the global recycling markets may also move in ways that diminish recycling. Consequently, recyclables are escalated only in correlation to the underlying demographic data series.

Additionally, several material-specific diversion programs began in the years between 2013 and 2018, shifting additional tons away from the refuse stream. Examples of these include the PaintCare, eCYCLE, and food waste drop-off programs. Like the mixed recyclables stream, it is expected that these programs

will continue to scale up in quantities managed, though for the purposes of this report, the tonnages are escalated only in correlation to the projected number of single-family households.

Table 2-5 shows the annual multi-family MSW generation separated by collection stream. In contrast to the single-family sector, multi-family waste generation is projected to increase by 54 percent over the planning period commensurate with multi-family housing growth.

Table 2-5 Multi-family Generation (CY 2013-2038)

	Historical Tons		Projected Tons			
Stream	2013	2018	2023	2028	2033	2038
Refuse[1]	156,142	167,862	184,772	201,434	216,459	229,277
Mixed Recyclables[1]	15,708	24,470	26,935	29,364	31,554	33,422
Textiles[2]	N/A[3]	452	498	543	583	618
Bulky[1]	7,539	9,171	10,095	11,005	11,826	12,526
Tires	123	236	260	283	304	322
Leaves	38	8	9	10	11	12
Holiday Trees	71	31	34	37	40	42
Electronics	N/A[3]	129[4]	142	155	167	177
Total	**179,620**	**202,359**	**222,744**	**242,831**	**260,944**	**276,395**
Increase from 2013	**0%**	**13%**	**24%**	**35%**	**45%**	**54%**
Multi-family Households	185,444	206,534	227,339	247,840	266,327	282,097
Annual Tons Per Household	0.97	0.98	0.98	0.98	0.98	0.98
Daily Lbs Per Household	5.31	5.37	5.37	5.37	5.37	5.37

Notes: Estimated quantities.
Waste projections are based on 2018 estimates and are escalated proportionally to the multi-family household projections.
[1] Material quantities estimated based on single-family per household generation rate.
[2] Textiles are collected and managed privately via drop-off bins. Tonnage was distributed between the single and multi-family generator sectors proportionally based on their number of households.
[3] Material stream not tracked and reported until after 2013.
[4] 2018 data from DPW's Fort Totten electronics recycling collection and reported by manufacturers to comply with eCYCLE DC.

Sources: DC Transfer Stations Scale Data[d]
2013 Arcadis Facility Surveys[e]
2017-2018 Collector Reports[f]

All multi-family waste is collected by private haulers. It is estimated that 39 percent of all multi-family MSW is brought to DPW transfer stations, while the remaining 61 percent is brought to third-party facilities. Estimation was required in order to complete historical tons.

Table 2-6 shows the annual aggregate residential MSW generation by material stream.

Table 2-6 Aggregate Residential Generation (CY 2013-2038)

	Historical Tons		Projected Tons			
Stream	2013	2018	2023	2028	2033	2038
Refuse	260,422	266,324	284,272	301,957	317,904	331,508
Mixed Recyclables	34,449	50,967	53,711	56,415	58,853	60,933
Shredded Paper	N/A	168	170	172	173	175
Textiles	N/A	746	795	843	886	923
Scrap Metal	N/A	288	291	294	297	299
Bulky	11,717	13,784	14,756	15,714	16,578	17,315
Tires	123	236	260	283	304	322
Leaves	6,127	5,625	5,686	5,745	5,798	5,844
Holiday Trees	289	481	489	497	504	510
Other Green Waste	608	449	454	459	463	467
Food Waste	N/A	414	419	423	427	430
Electronics	N/A	400	416	431	445	457
Paint	N/A	196	198	200	202	203
Other HHW	N/A	79	80	81	82	82
Total	**313,734**	**340,157**	**361,994**	**383,512**	**402,916**	**419,468**
Increase from 2013	**0%**	**8%**	**15%**	**22%**	**28%**	**34%**
Households	288,220	310,420	332,320	353,900	373,360	389,960
Annual Tons Per Household	1.09	1.10	1.09	1.08	1.08	1.08
Daily Lbs Per Household	5.96	6.00	5.97	5.94	5.91	5.89

Note: Quantities aggregated from Table 2-4 and Table 2-5.

Table 2-7 shows projected non-residential MSW generation by material stream. Non-residential waste generation is projected to increase 42 percent over the planning period. Although there was a large increase in non-residential recycling between 2013 and 2018, future growth in recycling has been correlated to the underlying employment level due to the difficulty in identifying and quantifying future influences.

Table 2-7 Non-residential Generation (CY 2013-2038)

Stream	Historical Tons		Projected Tons			
	2013	2018	2023	2028	2033	2038
Refuse	542,003	615,393	651,463	685,094	715,823	742,816
Mixed Recyclables	13,401	46,049	48,748	51,265	53,564	55,584
Paper	35,462[1]	37,647	39,854	41,911	43,791	45,443
Plastic	154[1]	164	173	182	190	197
Scrap Metal	23,853[1]	25,348	26,834	28,219	29,485	30,596
Bulky	17,781	25,469	26,962	28,354	29,626	30,743
Street Sweepings	18,307	20,146	21,327	22,428	23,434	24,318
Tires	9[1]	11	12	13	13	14
Food Waste	4,071[1]	4,322	4,575	4,812	5,027	5,217
Yard Trimmings	8,360[1]	8,875	9,395	9,880	10,323	10,713
Other Green Waste	453	285	302	317	331	344
Electronics	N/A[2]	1,034[3]	1,094	1,151	1,203	1,248
Other[4]	14,801	14,946	14,964	14,980	14,996	15,009
Total	**678,655**	**799,689**	**845,704**	**888,606**	**927,806**	**962,242**
Increase from 2013	**0%**	**18%**	**25%**	**31%**	**37%**	**42%**
Employees	788,700	827,100	875,580	920,780	962,080	998,360
Annual Tons Per Employee	0.86	0.97	0.97	0.97	0.96	0.96
Daily Lbs Per Employee	4.71	5.30	5.29	5.29	5.28	5.28

Notes: Estimated quantities.
Waste projections are based off 2018 estimates and are escalated proportionally to the employment projections.
[1] To estimate historical tonnage, 2018 values were extrapolated backwards proportional to the employment estimates.
[2] Material stream not tracked and reported until after 2013.
[3] 2018 data from DPW's Fort Totten electronics recycling collection and reported by manufacturers to comply with eCYCLE DC.
[4] Includes 14,639 tons labeled as "LEEDS" in the facility surveys[k]. It is unknown what type of waste this represents. The material quantity is assumed to be constant through the planning period.

Sources: DC Transfer Stations Scale Data[d]
2013 Arcadis Facility Surveys[e]
2017-2018 Collector Reports[f]

Like the multi-family sector, all non-residential waste is collected by private haulers. It is estimated that 36 percent of non-residential MSW is brought to DPW transfer stations while 64 percent is brought to third-party facilities. Estimation was required in order to complete historical tons.

Table 2-8 aggregates the waste generation from the preceding generator sectors into a District-wide total. As shown, in 2013 there is an estimated 992,389 tons of MSW, increasing to 1,381,710 tons by the end of the planning period (2038). This represents a 39 percent increase from 2013 levels, which equates to an average annual growth rate of 1.3 percent. Figure 2-4 shows annual overall MSW generation visually.

It should again be noted that these projections do not take into account the impact of any potential changes to diversion programs or to the District's overall waste management framework that may be implemented in the future. Assuming the District, like many other cities across the U.S., becomes more focused and aggressive in its recycling, organics management, and other measures to reduce waste-to-landfill and waste-

to-energy, it is likely that significant tonnage would shift from the refuse stream to one of the recovered material streams. In Figure 2-4, this would have the effect of shrinking the height of the Refuse bar and increasing the height of the Recyclables and Organics bars. Presumably the District can use the baseline projections of MSW generation when undertaking its solid waste management and/or Zero Waste DC plans.

These projections also do not attempt to incorporate macroeconomic and/or significant cultural or behavioral changes that would impact waste generation, disposal and recycling habits.

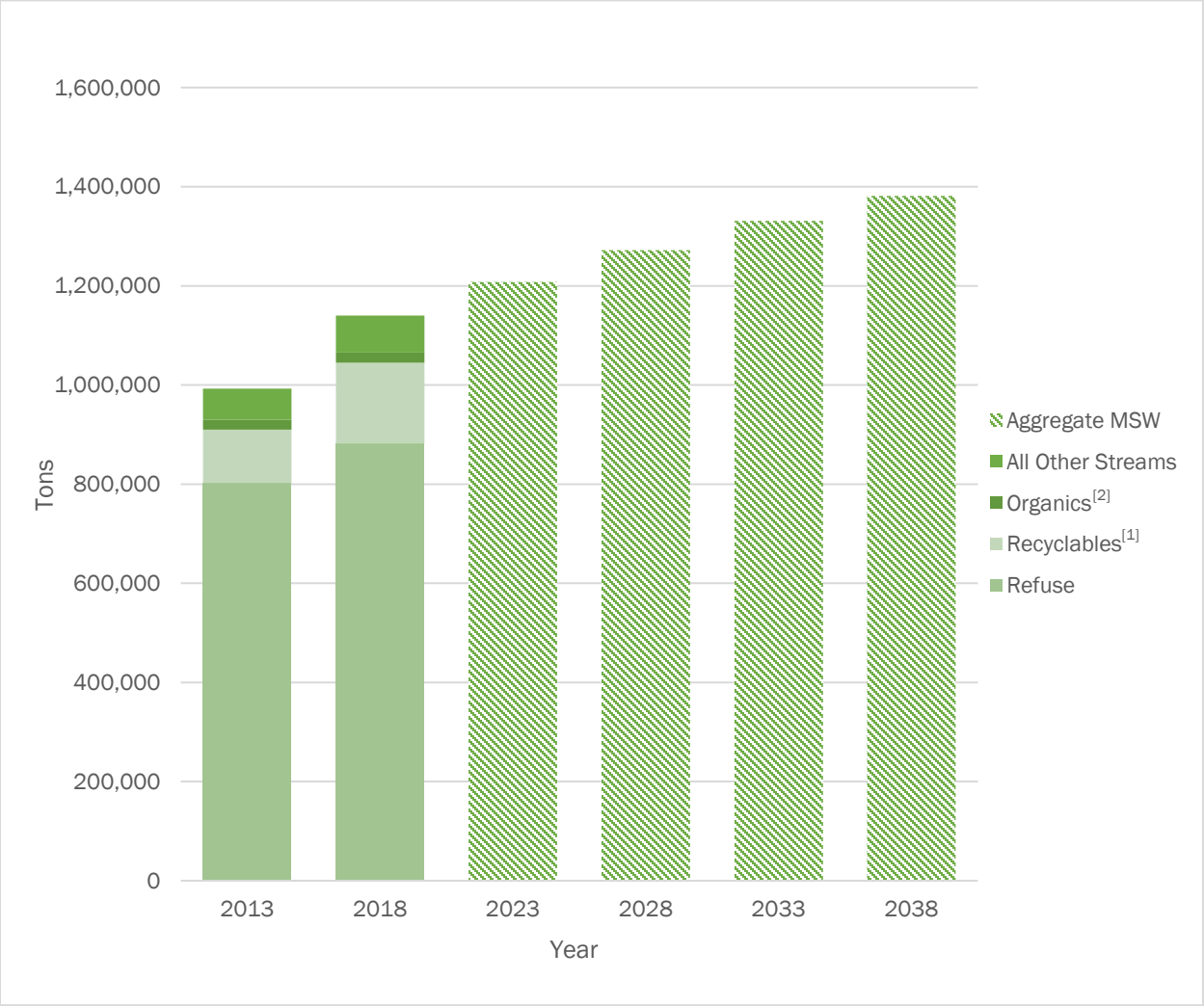
Table 2-8 Overall MSW Generation (CY 2013-2038)

	Historical Tons		Projected Tons			
Stream	2013	2018	2023	2028	2033	2038
Refuse	802,424	881,717	935,735	987,050	1,033,727	1,074,324
Mixed Recyclables	47,850	97,016	102,459	107,680	112,418	116,518
Paper	35,462	37,647	39,854	41,911	43,791	45,443
Shredded Paper	N/A	168	170	172	173	175
Plastic	154	164	173	182	190	197
Textiles	N/A	746	795	843	886	923
Scrap Metal	23,853	25,636	27,125	28,513	29,781	30,895
Bulky	29,498	39,253	41,718	44,068	46,204	48,059
Street Sweepings	18,307	20,146	21,327	22,428	23,434	24,318
Tires	132	247	272	296	317	336
Leaves	6,127	5,625	5,686	5,745	5,798	5,844
Holiday Trees	289	481	489	497	504	510
Food Waste	4,071	4,736	4,994	5,235	5,454	5,647
Yard Trimmings	8,360	8,875	9,395	9,880	10,323	10,713
Other Green Waste	1,061	734	756	776	794	811
Electronics	N/A	1,434	1,510	1,582	1,648	1,705
Paint	N/A	196	198	200	202	203
Other HHW	N/A	79	80	81	82	82
Other	14,801	14,946	14,964	14,980	14,996	15,009
Total	**992,389**	**1,139,846**	**1,207,698**	**1,272,118**	**1,330,722**	**1,381,710**
Increase from 2013	**0%**	**15%**	**22%**	**28%**	**34%**	**39%**
Population	650,431	702,455	764,060	820,160	873,220	921,980
Annual Tons Per Capita	1.53	1.62	1.58	1.55	1.52	1.50
Daily Lbs Per Capita	8.36	8.89	8.66	8.50	8.35	8.21

Note: Quantities aggregated from Table 2-6 and Table 2-7.

The District's per-capita waste generation rate is nearly double the national average (4.51 lbs per person in 2017)[aa] due largely to the significant waste generation in the non-residential sector resulting from the substantial number of daily commuters, tourists, and other visitors. The District's waste generation rate is expected to decrease through the planning period as residents shift from single-family to multi-family housing.

Figure 2-4 Overall MSW Generation by Stream (CY 2013-2038)



Notes: [1] Includes Mixed Recyclables, Paper, Shredded Paper, Plastic, Textiles, Scrap Metal, and Electronics streams.
[2] Includes Leaves, Holiday Trees, Other Green Waste, Food Waste, and Yard Trimmings streams.

2.4.2 CONSTRUCTION AND DEMOLITION DEBRIS

C&D is not included in the District's definition of solid waste, and therefore, haulers are not required to report quantities managed. Only 7,342 tons of C&D debris were identified within hauler reports and DPW transfer station scale data – not including C&D debris mixed with MSW. This is known to be a small fraction of the total C&D debris generated in the District.

Table 2-9 compiles the quantity of C&D debris landfilled that was reported to have been imported from the District (via private hauler) by three surrounding states. All tonnage estimates are based on facility reports to the respective state agency.

Table 2-9 Reported Disposal for District-generated C&D Debris

State	Reporting Agency	Year	Reported C&D Imports from DC (tons)
Pennsylvania	DEP	2018	129
Maryland	MDE	2017	154,933
Virginia	DEQ	2018	155,140
		Total	**310,202**

Note: Pennsylvania report includes only tons received at landfills.
Sources: See items [o], [p], and [q] in Appendix A.

As shown, significant export of C&D for disposal appears to occur only into Virginia and Maryland. Based on a cursory search of published waste quantity data in other states that could potentially receive District-generated waste, MSW Consultants does not believe significant amounts of C&D are being transported to more distant states.

It should be noted that no attempt was made to evaluate the relevant state facility reporting systems nor the accuracy of the reported C&D tonnage from these states. In the professional opinion of MSW Consultants, it is likely that these numbers under-report the C&D quantities originating in the District because C&D debris is likely mixed with MSW and thus would be recorded as MSW, not C&D. However, it is helpful to consider the sum in Table 2-9 as a lower bound for the District's C&D generation.

Based on the compilation of reported C&D exports, and based on the available data from other C&D characterization studies as shown in Table 2-3 earlier in this chapter, Table 2-10 advances a range within which C&D generation likely to fall. This table was estimated by setting the lower bound to equate to the Table 2-9 subtotal, and allowing for higher levels within the ranges of other reported MSW and C&D generation studies.

Table 2-10 Estimated C&D Generation (CY 2013-2038)

Estimate	Proportion of C&D from Total Waste	Historical Tons		Projected Tons			
		2013	2018	2023	2028	2033	2038
Lower Estimate	20%	250,000	280,000	300,000	320,000	330,000	340,000
Central Estimate	25%	330,000	380,000	400,000	420,000	440,000	460,000
Upper Estimate	30%	420,000	490,000	520,000	540,000	570,000	590,000

Note: Total Waste = MSW + C&D.

It should be acknowledged that the table above provides a wide range for the estimated quantity of C&D debris generated in the District. In discussions with District staff, it was agreed that the District is currently experiencing a significant amount of construction, demolition, and renovation activities at the time of this study and such high activity is expected into the foreseeable future. The estimates above therefore reflect the order of magnitude of C&D generation, which over time will likely become more of a focus for the District as it increases its focus on sustainability and waste diversion.

2.4.3 AGGREGATE WASTE

Table 2-11 combines MSW and C&D waste estimates, using the central estimate for C&D debris. As shown, by 2038 the District is projected to generate more than 1.8 million tons of MSW and C&D debris.

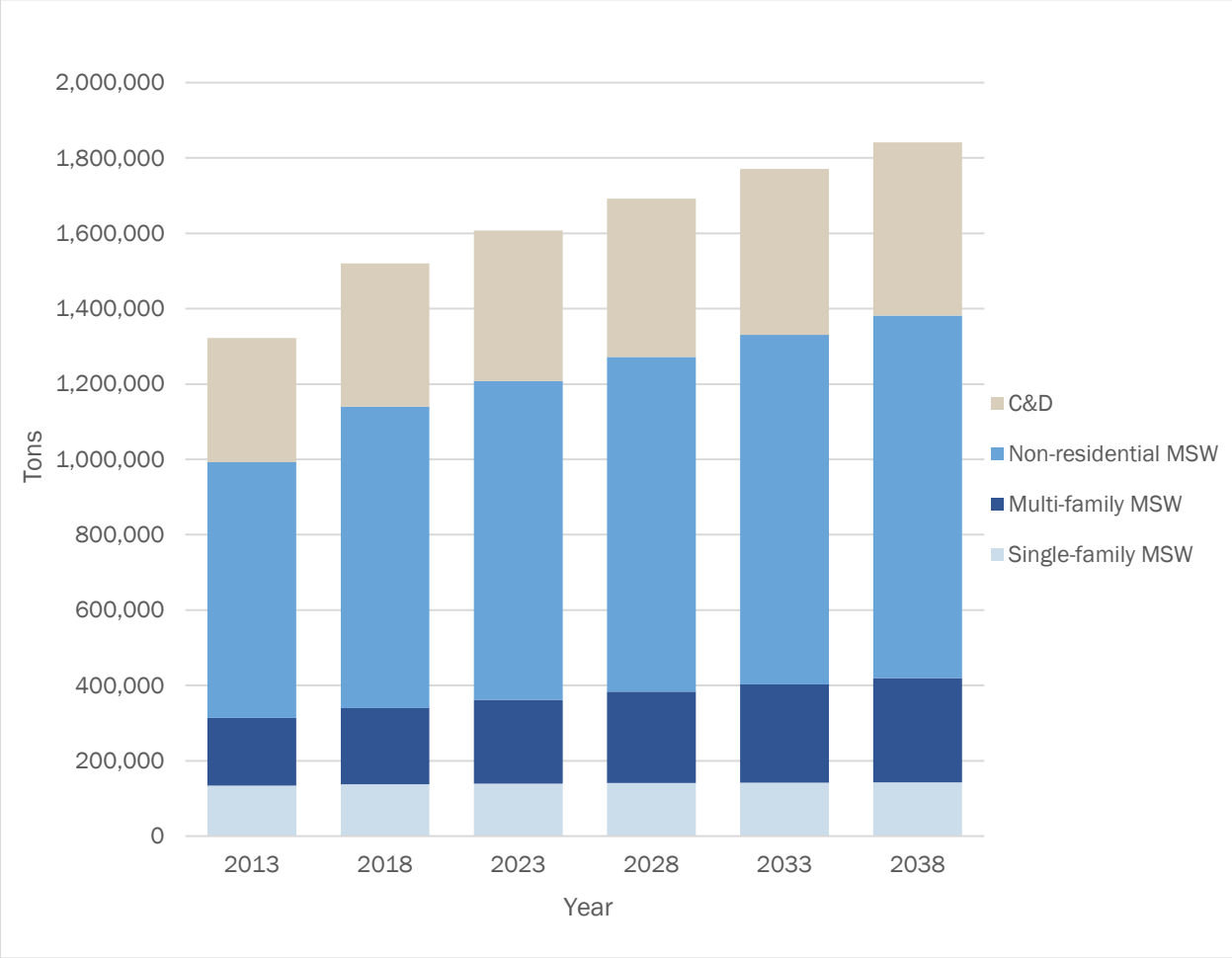
Figure 2-5 shows the current and projected annual waste generation broken down by MSW generator sector and including C&D debris.

Table 2-11 Aggregate Waste Generation (CY 2013-2038)

	Historical Tons		Projected Tons			
Waste Type	**2013**	**2018**	**2023**	**2028**	**2033**	**2038**
MSW	992,389	1,139,846	1,207,698	1,272,118	1,330,722	1,381,710
C&D	330,000	380,000	400,000	420,000	440,000	460,000
Total	**1,322,389**	**1,519,846**	**1,607,698**	**1,692,118**	**1,770,722**	**1,841,710**

Note: Central estimate displayed for C&D quantities.

Figure 2-5 Aggregate Waste Generation Projections (CY 2013-2038)



Note: Central estimate displayed for C&D quantities.

The tables and figures shown in this chapter have been derived from a detailed spreadsheet analysis that compiles all of the referenced source data. This spreadsheet has been provided to the District to serve as a reference document.

CHAPTER 2 EXHIBITS

Exhibit 2-1. Demographic Data and Projections

	Historical						Projected			
Parameter	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2023**	**2028**	**2033**	**2038**
Single-family Population	274,047	274,651	275,288	275,854	276,310	276,648	279,729	282,534	285,187	287,625
Multi-family Population	376,384	387,862	399,966	410,721	419,381	425,807	484,331	537,626	588,033	634,355
Total Population	**650,431**[1]	**662,513**[1]	**675,254**[1]	**686,575**[1]	**695,691**[1]	**702,455**[1]	764,060	820,160	873,220	921,980
Single-family Households	102,776	102,998	103,220	103,442	103,664	**103,886**[2]	104,981	106,060	107,033	107,863
Multi-family Households	185,444	189,662	193,880	198,098	202,316	206,534	227,339	247,840	266,327	282,097
Total Households	288,220	292,660	**297,100**[3]	301,540	305,980	310,420	332,320	353,900	373,360	389,960
Total Employees	779,100	788,700	**798,300**[3]	807,900	817,500	827,100	875,580	920,780	962,080	998,360
Visitors (in millions)	**19.0**[4]	**20.2**[4]	**21.3**[4]	**22.0**[4]	**22.8**[4]	**23.7**[4]	N/A	N/A	N/A	N/A

Notes: Bold quantities were taken directly from an external source. Non-bold quantities were estimated as part of this study.

Linear interpolation was used between 5-year periods for 2018-2038 total households and 2015-2038 total employees. Forecasted data points[3] used in interpolation are not shown.

Linear extrapolation was used to estimate 2013-2014 employee totals under the assumption that growth during 2013-2014 is equal to growth during 2015-2020.

The base year for the single-family vs multi-family household and population proportions was 2017. For all other years, 5% of household and population growth was attributed to single-family. The remaining 95% of growth was attributed to multi-family.[5]

Single-family population for 2017 was calculated by multiplying the number of single-family households with 2.66 persons per household.[6]

Multi-family population and households for 2017 were calculated as the difference after subtracting the respective single-family quantities from their totals.

Sources: [1] U.S. Census Bureau, Population Division. (2018, December). *Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2018.* [g]

[2] Department of Public Works (2020, March). *Waste Characterization Study: Final Changes.* [email].[h]

[3] Metropolitan Washington Council of Governments. (2018). *Round 9.1 Growth Trends to 2045: Cooperative Forecasting in Metropolitan Washington*.[k]

[4] Destination DC. (2017). *2017 Visitor Statistics, Washington D.C.* [Press release].[m]

[5] District of Columbia Office of Planning. (2019, May 9). [Telephone interview].[j]

[6] District of Columbia Office of Planning. (2016, November). *Forecasting the District's Growth: Results and Methodology*.[i]

CHAPTER 3 – WASTE COMPOSITION

3.1 INTRODUCTION

For planning purposes, the District is interested in a detailed accounting of the recyclable, compostable, and other constituents within its waste stream. In particular, the following tonnage data that has been compiled and forecasted in Chapter 2 requires this composition analysis:

- Single-family Refuse,
- Multi-family Refuse,
- Non-residential Refuse,
- Single-family Mixed Recyclables,
- Multi-family Mixed Recyclables,
- Non-residential Mixed Recyclables, and
- Construction and Demolition (C&D) Debris.

Many cities and counties have employed physical sampling and sorting protocols to determine the composition of these material streams, and the District has previously performed limited, although recent, sampling and sorting of its recyclables. However, this study does not include such physical sampling and sorting. Rather, this chapter describes the methodology and results of the desktop analysis that was developed to estimate the composition of the above waste streams within the District. Broadly, the desktop methodology incorporated available physical composition audits performed by the District with composition results from other cities, counties, and regions that have undergone conventional sampling and sorting protocols to determine their material composition; and deriving a reasonable estimate of the District's material composition based on a high level comparison of selected program, state regulatory, demographic, and climate characteristics between the District and its closest comparable jurisdictions that have physical composition data.

The remainder of this chapter describes this methodology in more detail and reports the results of the desktop composition analysis.

3.2 METHODOLOGY

The methodology for determining the composition of the District's mixed material streams followed four basic steps:

- Review waste composition literature (including existing District sort data),
- Identify comparable studies,
- Normalize comparable study waste composition, and
- Derive the District's waste composition.

These steps are described in more detail below.

3.2.1 REVIEW WASTE COMPOSITION LITERATURE

MSW Consultants maintains the industry's most comprehensive database of material composition studies. This database was used to filter the available waste composition studies based on the following preliminary filter:

- No more than five years old,
- Similar geography as the District,
- Urban or dense suburban demographics, and

◆ Waste composition protocol was comprehensive and applied industry standards.

Table 3-1 summarizes the universe of potentially informative material composition studies identified from this filter.

Table 3-1 Material Composition Literature Reviewed

Material Stream	Number of Studies
Residential Refuse	50
Non-residential Refuse	39
Residential Recycling	71
Construction and Demolition Debris	25
Total	**185**

3.2.2 IDENTIFY COMPARABLE STUDIES

It is important to note that not all material composition studies analyze every material stream. Further, in some cases there were not a sufficient number of comparable studies returned from the optimal filter. In those cases, certain criteria were relaxed to expand the pool of potential comparable studies. Table 3-2 summarizes the comparable studies that were ultimately identified for consideration in this desktop analysis. The specific studies are shown in Table 3-3. As shown, most of the studies focused only on a subset of the generator sectors and material streams. It should be noted that the District has previously performed limited, although recent, sampling and sorting of its mixed recyclables and that this data set has been included in the analysis. The underlying material composition data from each of the studies in these tables are included in Appendix C for reference. Internet links for the studies are provided in Appendix A, where available.

Table 3-2 Waste Composition Studies Referenced

Wasteshed	Wasteshed Level	Year	Single-family Refuse	Multi-family Refuse	Commercial Refuse	Residential Mixed Recyclables	Commercial Mixed Recyclables	C&D
Arlington[bb]	County	2018				X		
Chicago[s]	City	2010						X
Connecticut[t]	State	2016						X
District of Columbia[cc]	District	2017-18				X	X	
Davidson[dd]	County	2018			X	X		
Georgia[ee]	State	2010						X
Lexington[u]	County	2014		X				X
Louisville[v]	City	2016		X				X
Maryland[ff]	State	2016	X					
Missouri[x]	State	2017						X
Montgomery[gg]	County	2017		X	X			
Philadelphia[hh]	City	2017	X			X		
Prince George's[ii]	County	2016	X		X			
Seattle[jj]	City	2016						X
	Count		**3**	**3**	**3**	**4**	**1**	**7**

Table 3-3 Summary of Comparative Studies

Material	Generator Sector	Year	Wasteshed	Report Title
Refuse	Residential	2017	Philadelphia, PA	2017 City of Philadelphia Waste Composition Study[hh]
	Residential	2016	Prince George's Co., MD	Prince George's County Waste Composition Study[ii]
	Residential	2016	MD Suburban Areas	2016 Maryland Statewide Waste Characterization Study[ff]
	Residential	2016	Baltimore, MD	2016 Maryland Statewide Waste Characterization Study[ff]
	Residential	2014	Lexington-Fayette County, KY	County-Wide Waste Stream Analysis[u]
	Residential	2016	Louisville, KY	Louisville Metro 2016 Waste Characterization Study[v]
	Residential & Non-residential	2017	Montgomery Co., MD	2017 Waste Characterization Study Summary of Results[gg]
	Non-residential	2018	Davidson Co., TN	Metro Nashville and Davidson County, TN Waste Stream and Recycling Characterization Study[dd]
	Non-residential	2016	Prince George's Co., MD	Prince George's County Waste Composition Study[ii]
Mixed Recyclables	Residential	2018	Arlington Co., VA	2018 Internal Waste Audits[bb]
	Residential	2018	Nashville, TN	Metro Nashville and Davidson County, TN Waste Stream and Recycling Characterization Study[dd]
	Residential	2017	Philadelphia, PA	2017 City of Philadelphia Waste Composition Study[hh]
	Residential & Non-residential	2017-2018	District of Columbia	DC Recycling Sort Data Summary Appendix (2017 vs. 2018)[cc]
C&D Debris	C&D	2017	Kansas City & St. Louis, MO	Statewide Waste Composition Study[x]
	C&D	2016	State of Connecticut	Construction and Demolition Waste Characterization and Market Analysis[t]
	C&D	2016	Seattle, WA	Construction and Demolition Waste Composition Study[jj]
	C&D	2016	Louisville, KY	Louisville Metro 2016 Waste Characterization Study[v]
	C&D	2014	Lexington-Fayette County, KY	County-Wide Waste Stream Analysis[u]
	C&D	2010	State of Georgia	Statewide C&D Debris Characterization Study[ee]
	C&D	2010	Chicago, IL	City of Chicago Waste Characterization Study[s]

Although it was beyond the scope of this study to undertake extensive comparisons of numerous characteristics of these jurisdictions, their waste management and recycling programs, as well as other pertinent criteria, were compiled to determine the reasonableness of including these studies in the desktop analysis. It should also be noted that MSW Consultants maintains a large library of confidential and in-progress waste and recycling composition studies and that in some cases has used such studies in its professional judgment for certain estimates.

Table 3-4 compares the residential curbside recycling programs in each of the jurisdictions used for disposed waste composition analysis. As shown in this table, most of the identified studies targeted the same curbside recyclables, except for Nashville-Davidson, which excludes glass from its program. None of the comparable studies provides significant collection of food scraps.

Table 3-4 Accepted Recyclables in Comparable Mixed Recyclables Studies

Service	Targeted Materials	2018 Arlington County, VA	2017 Philadelphia, PA	2017-2018 District of Columbia	2018 Davidson County, TN Urban
Curbside Recycling	Corrugated Cardboard/Kraft Paper	x	x	x	x
	Newsprint	x	x	x	x
	Poly-Coated Aseptic Containers	x	x	x	x
	Mixed Recyclable Paper	x	x	x	x
	#1 PET Bottles and Containers	x	x	x	x
	#2 HDPE Natural Bottles	x	x	x	x
	#2 HDPE Colored Bottles	x	x	x	x
	Rigid Plastic Containers #3-#7	x	x	x	x
	Glass Bottles and Jars	x[1]	x	x	
	Aluminum Cans	x	x	x	x
	Aluminum Foil/Baking Tins	x	x	x	x
	Steel Cans	x	x	x	x
Organics	Routine Yard Waste Collection	x			
	Seasonal Leaf/Brush Collection	x	x	x	x
	Food Scraps				

Note: [1] Stopped accepting glass bottles/jars in recycling program effective April 25, 2019.

The pool of studies that separately analyzed single-family disposed waste composition and multi-family disposed waste composition is limited. However, due to the significance of the multi-family waste stream in the District, additional research was performed to differentiate single-family and multi-family composition.

Specifically, the following three studies were used to derive differences between single-family and multi-family refuse composition:

- Lexington-Fayette, KY (2014)[u],
- Louisville, KY (2016)[v], and
- Montgomery Co., MD (2017)[gg].

Due to the even further limited set of studies available that differentiated between single and multi-family mixed recyclables streams, the multi-family mixed recyclables composition estimate was derived from adjustments to the single-family recycling stream and based on non-public composition data available to MSW Consultants.

3.2.3 NORMALIZE STUDY RESULTS

The normalization of composition data was instrumental to draw similarities between studies and formulate an idea of what the "average" waste composition looks like by generator sector in the District. The normalization includes the mapping of each study's material categories into a standard material category list representing the District's waste materials. Mapping required a comparison of material category definitions before placement into the new set of categories.

Table 3-5 summarizes the standard material categories into which each of the comparable study results were mapped for refuse, recyclables and C&D. Detailed material categories definitions are included in Appendix B.

Table 3-5 Standard Material Categories

Refuse Categories	Mixed Recyclables Categories	C&D Categories
Paper	**Paper**	**Paper**
Corrugated Cardboard/Kraft Paper	Corrugated Cardboard/Kraft Paper	Corrugated Cardboard/Kraft Paper
Newsprint	Newsprint	Other Paper
Mixed Recyclable Paper	Poly-Coated Aseptic Containers	**Plastics**
Poly-Coated Aseptic Containers	Mixed Recyclable Paper	Clean Recoverable Film
Other Paper (Non-Recyclable)	**Plastics**	Other Plastics
Plastics	#1 PET Bottles and Containers	**Organics**
#1 PET Bottles and Containers	#2 HDPE Natural Bottles	Yard Waste
#2 HDPE Natural Bottles	#2 HDPE Colored Bottles	Land Clearing Debris/Stumps
#2 HDPE Colored Bottles	Rigid Plastic Containers #3-#7	Other Organics
Rigid Plastic Containers #3-#7	All Films and Bags	**Metals**
Expanded Polystyrene	Non-Recyclable Plastics	Appliances
All Films and Bags	**Glass**	Other Ferrous
Other Rigid Plastic	Glass Bottles and Jars	Other Non-Ferrous
Glass	**Metals**	**Glass**
Glass Bottles and Jars	Aluminum Cans	Glass
Other Glass	Aluminum Foil/Baking Tins	**C&D**
Organics	Steel Cans	Wood Pallets and Crates
Food Waste	Scrap Metal	Untreated/Unpainted Lumber
Leaves	**Other**	Treated/Painted/Processed Wood
Yard Waste	Contamination	Engineered Wood
Other Organics		Other Wood
Metals		Carpet
Ferrous/Steel Containers		Carpet Padding
Other Ferrous Metals		Concrete/Block/Brick/Stone/Tile
Aluminum Cans		Asphalt Paving
Other Aluminum		Roofing Material
Other Non-Ferrous Metals		Gypsum Board
Appliances		Dirt/Sand/Gravel
C&D		Remainder/Composite/Other C&D
Wood - Clean		**Other**
Wood - Treated/Mfg		Bulky Wastes/Furniture
Asphalt, Brick, Rock, & Concrete		Mixed MSW
Carpet and Carpet Padding		Other Not Elsewhere Classified
Remainder/Composite/Other C&D		
Other		
Hazardous Materials		
Televisions & CRTs		
Electronics		
Bulky Items		
Tires		
Clothing Textiles		
Non-clothing Textiles		
Diapers and Sanitary Products		
Dirt and Fines		
Other Not Elsewhere Classified		

It should be noted that not all source studies could be perfectly mapped. In limited cases it was necessary to apply deductive reasoning to map certain categories. For example, if a study grouped multiple categories together (e.g., Mixed Recyclable Paper), other composition study data was used to disaggregate the categories. Similarly, in some cases more prevalent constituents were separated from "all other materials," again based on other composition study data.

The standardized study results are shown in the following exhibits included at the end of this chapter:

- Exhibit 3-2 – Standardized Single-family Refuse Study Results,
- Exhibit 3-3 – Standardized Multi-family Refuse Study Results,
- Exhibit 3-4 – Standardized Non-residential Refuse Study Results,
- Exhibit 3-5 – Standardized Single-family Mixed Recyclables Study Results,
- Exhibit 3-5 – Standardized Multi-family Mixed Recyclables Study Results,
- Exhibit 3-6 – Standardized Non-residential Mixed Recyclables Study Results, and
- Exhibit 3-7 – Standardized C&D Debris Study Results.

3.2.4 COMPARE STUDIES AND RECOMMEND COMPOSITION

Comparable study results were placed side by side and the average, minimum and maximum composition for each constituent were calculated. These statistics are also shown in Exhibits 3-2 through 3-7.

Using the comparable study data and knowledge of relevant system characteristics as a basis, MSW Consultants applied deductive reasoning and its professional judgment to estimate the composition of each mixed material stream as it is likely to be generated in the District. For each stream, a study was first selected as the basis for composition estimates. The composition estimates were then adjusted in order to account for differences that might impact waste composition, such as collection technology, accepted recyclables, etc., between the basis study's jurisdiction and the District. As adjustments were made, composition estimates for other categories may increase or decrease to ensure the sum of all composition estimates totals to 100 percent.

It is important to keep in mind the use and limitations of these estimates. In particular, given that this is a desktop study, the composition estimates are intended to provide reasonable projections for use by the District's solid waste and recycling planners. As the District continues to enhance its diversion programs, it will be critical to have a reasonable estimate of the mix of the potentially recoverable, compostable, and non-recoverable items in the District's various waste streams.

It should also be acknowledged that other professional consultants with experience in waste and recycling characterization could develop alternative methods to perform a desktop composition analysis. However, in the professional opinion of MSW Consultants, it is unlikely that other methods would arrive at appreciably different estimates of the District's refuse, recycling and C&D composition based on existing data and available literature.

For each mixed material stream, MSW Consultants estimated the District's underlying composition. The specific rationales for each estimated material stream are itemized below:

Single-family Residential Refuse (Exhibit 3-2):

Philadelphia residential refuse was used as a basis. However, Philadelphia collects bulky wastes within their manual curbside collection program, whereas the District's residential bulk collection division, which utilizes semi-automated vehicles, is separate from its residential curbside collection program. The following adjustments were made based on other studies performed within the region:

- C&D material compositions were reduced to align with MD statewide suburban results,
- "Food Waste" composition was increased to align with MD statewide suburban results,

- "Bulky Items" composition was reduced by half of its value,
- "Glass Bottles and Jars" composition was increased by 0.5 percentage points,
- Plastic categories were collectively increased by 1 percentage point, distributed proportionally,
- "Newspaper" composition was increased by 2.5 percentage points,
- "Corrugated Cardboard" composition was increased by 3 percentage points, and
- The remaining 3.7 percentage points were distributed proportionally among the other fiber categories.

Multi-family Residential Refuse (Exhibit 3-3):

The multi-family refuse composition estimates were based on the single-family refuse composition and adjusted using the background data provided in Table 3-6 which shows a comparison of the single-family and multi-family refuse compositions for selected constituents that differ significantly, from the applicable comparable studies.

Table 3-6 Single vs Multi-family Refuse Compositions of Comparable Studies

	2014 Lexington-Fayette Co., KY			2016 Louisville, KY			2017 Montgomery Co., MD			
Material	Single-family	Multi-family	Dif.	Single-family	Multi-family	Dif.	Single-family	Multi-family	Dif.	Average Dif.
Yard Waste	3.6%	0.2%	-3.4%	9.1%	1.9%	-7.2%	2.6%	2.3%	-0.3%	**-3.6%**
Bulky Items	0.7%	0.0%	-0.7%	2.4%	9.3%	6.9%	N/A	N/A	N/A	**3.1%**
Targeted Recyclables	15.8%	36.6%	20.8%	21.1%	32.9%	11.8%	22.8%	28.9%	6.1%	**12.9%**

Based on the average differences observed in Table 3-6, the following adjustments were made to the District's single-family refuse composition to estimate the multi-family waste composition:

- "Yard Waste" composition was reduced by 3.6 percentage points to reflect that multi-family properties are often serviced by landscapers in the commercial sector, and therefore, yard waste does not appear in the regular refuse stream to the same degree as in single-family,
- "Bulky Items" composition was increased by 3.1 percentage points to reflect the higher incidence of bulk materials due to move-in and move-out activities in the multi-family sector, as well as the use of dumpsters (which can hold bulk items) rather than carts (which cannot) for serving multi-family apartments,
- The incidence of all targeted curbside recyclables was collectively increased by 12.9 percentage points (distributed proportionally) to reflect the lower access to recycling programs as well as the space constraints that often impede recycling in multi-family properties, and
- All other material categories were collectively reduced by 12.4 percentage points (distributed proportionally) to balance for the above adjustments.

Non-residential Refuse (Exhibit 3-4):

Prince George's County non-residential waste composition was used as a basis. Due to several outliers in this result set, the following adjustments were made:

- "Diapers and Sanitary Products" composition was derived by taking an average of Montgomery County and Davidson County, with the differential extracted from "Other Not Elsewhere Classified,"
- "All Film and Bags" composition was derived by taking an average of the other two studies, with the differential added to "Food Waste" (due to high food contamination for this constituent),
- "Other Aluminum" composition was derived by taking an average of the other two studies, with the differential extracted from "Other Not Elsewhere Classified,"

- "Other Organics" composition was derived by taking an average of the other two studies, with the differential extracted from "Other Not Elsewhere Classified,"
- "Other Glass" composition was derived by taking an average of the other two studies, with the differential extracted from "Other Not Elsewhere Classified,"
- "Other Non-Ferrous Metals" composition was derived by taking an average of the other two studies, with the differential extracted from "Other Not Elsewhere Classified,"
- "Tires" composition was derived by taking an average of the other two studies, with the differential extracted from "Other Not Elsewhere Classified,"
- "Bulky Items" composition was derived by halving the value of Davidson County and the differential proportionally extracted from "Corrugated Cardboard" and "Mixed Recyclable Paper," and
- "Televisions & CRTs" and "Electronics" compositions were derived by proportionally reducing the value from Prince George's County by 0.2 percentage points to account for the tons diverted via the District's eCYCLE program, with the differential distributed proportionally to all other categories.

Single-family Mixed Recyclables (Exhibit 3-5):

Due to the District's expansion in educational outreach to single-family residents between 2017 and 2018, the composition estimates from the District's 2018 residential recycling composition study were used as the basis for current composition (rather than an average of 2017 and 2018 composition results). One adjustment was made:

- Eight percentage points of "Unspecified Contamination" were added to "Glass Bottles and Jars" due to the original study sorting mixed cullet into "Residue."

Multi-family Mixed Recyclables (Exhibit 3-6):

The single-family residential composition estimate was adjusted based on non-publicly available data available to MSW Consultants that suggest multi-family recyclables typically exhibit higher degrees of contamination than single-family and that multi-family households typically have less disposable income and therefore less cardboard generated from delivery services. To reflect this, the following adjustments were made:

- "Corrugated Cardboard/Kraft Paper" decreased 7 percentage points,
- Contaminants collectively increased 5 percentage points, distributed proportionally, and
- All other material categories were collectively increased by 2 percentage points (distributed proportionally) to balance for the above adjustments

Non-residential Mixed Recyclables (Exhibit 3-7):

The average of the 2017 and 2018 non-residential composition estimates from the District's recycling composition study were used as the basis. One adjustment was made:

- Four percentage points of "Unspecified Contamination" were added to "Glass Bottles and Jars" due to the original study sorting mixed cullet into "Residue."

C&D Debris (Exhibit 3-8):

The population of C&D composition studies is much smaller than that of waste and recycling composition studies. Therefore, the filters used for comparable studies were relaxed to allow older studies, as well as studies in areas with different climate, state waste management regulations, and local program characteristics. Further review of the available underlying C&D composition data finds that there may be further limitations to any single C&D study as being the best starting point. For planning purposes, the average of all seven studies identified in Table 3-2 is used as a planning-level estimate of the composition of C&D debris in the District.

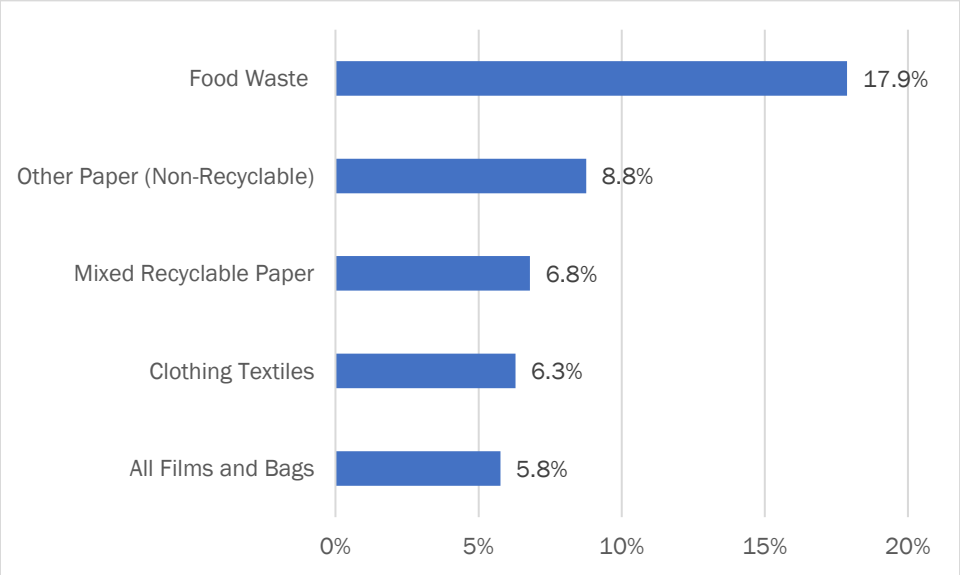
3.3 RESULTS

Graphical and tabular composition data is provided for all of the analyzed material streams.

3.3.1 REFUSE COMPOSITION

Figure 3-1 estimates the top five most prevalent materials estimated in the single-family refuse stream.

Figure 3-1 Top Five Most Prevalent Materials in Single-family Refuse



As the District embarks on a Zero Waste plan, it will delve into many options for increasing diversion of its refuse stream. Accordingly, this report has classified every constituent in the refuse stream according to currently available strategies to recycling or otherwise divert the constituent. The categories of recoverability used for this study include:

- **Curbside Recyclable**: These are materials remaining in the refuse which could have been diverted through the District's curbside mixed recycling program (or a compatible multi-family recycling program). Future program initiatives should attempt to shift these constituents from the refuse stream to the curbside recycling program.
- **Recyclable through Third Party**: Some materials are readily recyclable if they are taken to a third party. Examples include scrap metals and film plastic bags, both of which can be dropped-off at multiple locations throughout the District for recycling.
- **Compostable**: Organics materials that could be composted or digested are included in this category, including food wastes, yard wastes, and low-grade compostable papers. Should the District implement a seasonal or year-round curbside collection program for yard wastes and/or food wastes, it would be expected to shift organics out of the refuse stream to a significant degree.
- **HHW/Textiles/eCYCLE Program**: While not a large portion of the refuse stream, these constituents should be diverted from the usual curbside refuse collection to the District's HHW, textile, or e-waste drop-off program.
- **Not Recoverable**: Theoretically, almost any item can be recycled if it can be source separated and accumulated in high volume. However, this category includes all other materials that are not widely recycled (or are recycled only minimally) in the District of Columbia metropolitan area at the current

time. In the long term, market development and technology advances may shift materials from this outcome to recycling or other diversion.

Figure 3-2 depicts the recoverability of the single-family refuse stream. It is noteworthy that less than 30 percent of single-family waste could potentially be diverted through existing recycling programs. In the absence of a yard waste/food waste collection program, over 70 percent of the single-family stream has no convenient recovery options at this time.

Figure 3-2 Recoverability of Single-family Refuse

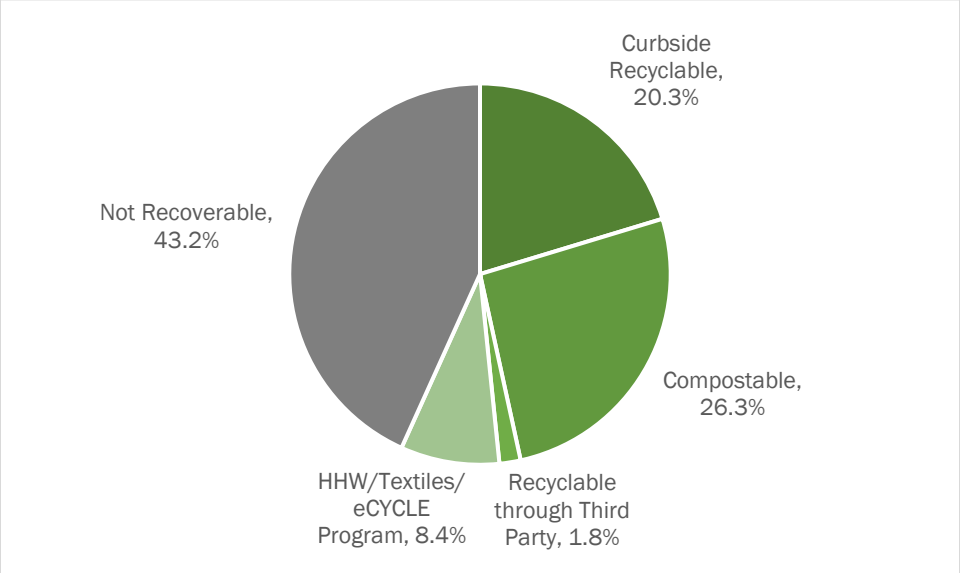


Table 3-7 shows the detailed composition estimate for the single-family refuse stream.

Table 3-7 Detailed Composition of Single-family Refuse

Material Category	Recommended Composition Estimate	Material Category	Recommended Composition Estimate
Paper	**23.4%**	**Organics**	**30.9%**
Corrugated Cardboard/Kraft Paper	4.5%	Food Waste	17.9%
Newsprint	3.2%	Leaves	2.8%
Mixed Recyclable Paper	6.8%	Yard Waste	5.6%
Poly-Coated Aseptic Containers	0.1%	Other Organics	4.7%
Other Paper (Non-Recyclable)	8.8%	**C&D**	**10.3%**
Plastics	**12.2%**	Wood - Clean	1.0%
#1 PET Bottles and Containers	1.3%	Wood - Treated/Mfg	4.7%
#2 HDPE Natural Bottles	0.2%	Asphalt, Brick, Rock, & Concrete	1.8%
#2 HDPE Colored Bottles	0.3%	Carpet and Carpet Padding	2.3%
Rigid Plastic Containers #3-#7	0.7%	Remainder/Composite/Other C&D	0.6%
Expanded Polystyrene	0.9%	**Other**	**17.4%**
All Films and Bags	5.8%	Hazardous Materials	0.3%
Other Rigid Plastic	3.0%	Televisions & CRTs	0.5%
Glass	**2.7%**	Electronics	0.4%
Glass Bottles and Jars	1.8%	Bulky Items	3.4%
Other Glass	0.9%	Tires	0.1%
Metals	**3.1%**	Clothing Textiles	6.3%
Ferrous/Steel Containers	0.6%	Non-clothing Textiles	0.9%
Other Ferrous Metals	1.2%	Diapers and Sanitary Products	3.4%
Aluminum Cans	0.4%	Dirt and Fines	1.5%
Other Aluminum	0.4%	Other Not Elsewhere Classified	0.6%
Other Non-Ferrous Metals	0.3%		
Appliances	0.2%	**Grand Total**	**100.0%**

Figure 3-3 shows the top five most prevalent materials estimated to be in the multi-family refuse stream.

Figure 3-3 Top Five Most Prevalent Materials in Multi-family Refuse

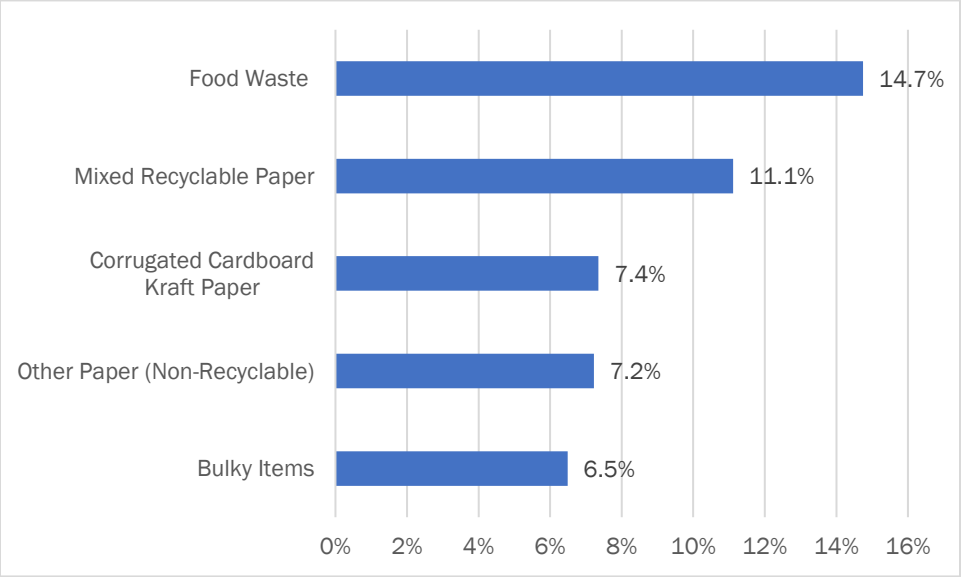


Figure 3-4 estimates the recoverability of the multi-family refuse stream. It is estimated that a slightly higher fraction of the multi-family stream could be recovered in a traditional recycling program.

Figure 3-4 Recoverability of Multi-family Refuse

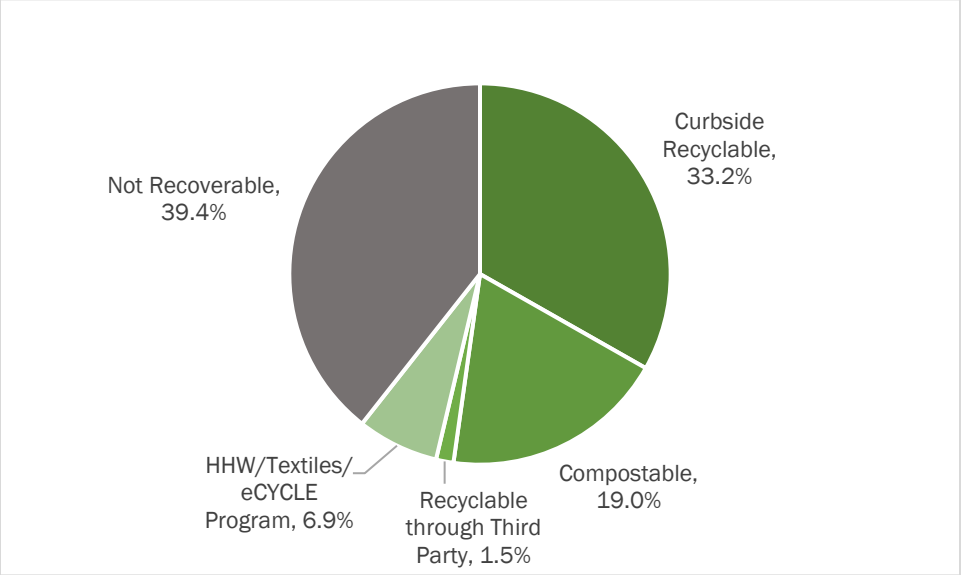


Table 3-8 shows the detailed composition estimate for the multi-family refuse stream.

Table 3-8 Detailed Composition of Multi-family Refuse

Material Category	Recommended Composition Estimate	Material Category	Recommended Composition Estimate
Paper	**31.1%**	**Organics**	**22.9%**
Corrugated Cardboard/Kraft Paper	7.4%	Food Waste	14.7%
Newsprint	5.2%	Leaves	2.3%
Mixed Recyclable Paper	11.1%	Yard Waste	2.0%
Poly-Coated Aseptic Containers	0.2%	Other Organics	3.9%
Other Paper (Non-Recyclable)	7.2%	**C&D**	**8.5%**
Plastics	**12.1%**	Wood - Clean	0.8%
#1 PET Bottles and Containers	2.1%	Wood - Treated/Mfg	3.9%
#2 HDPE Natural Bottles	0.4%	Asphalt, Brick, Rock, & Concrete	1.5%
#2 HDPE Colored Bottles	0.5%	Carpet and Carpet Padding	1.9%
Rigid Plastic Containers #3-#7	1.1%	Remainder/Composite/Other C&D	0.5%
Expanded Polystyrene	0.7%	**Other**	**18.0%**
All Films and Bags	4.8%	Hazardous Materials	0.2%
Other Rigid Plastic	2.5%	Televisions & CRTs	0.4%
Glass	**3.7%**	Electronics	0.3%
Glass Bottles and Jars	2.9%	Bulky Items	6.5%
Other Glass	0.7%	Tires	0.1%
Metals	**3.7%**	Clothing Textiles	5.2%
Ferrous/Steel Containers	1.0%	Non-clothing Textiles	0.7%
Other Ferrous Metals	1.0%	Diapers and Sanitary Products	2.8%
Aluminum Cans	0.7%	Dirt and Fines	1.2%
Other Aluminum	0.7%	Other Not Elsewhere Classified	0.5%
Other Non-Ferrous Metals	0.2%		
Appliances	0.2%	**Grand Total**	**100.0%**

Figure 3-5 estimates the top five most prevalent materials in the non-residential refuse stream.

Figure 3-5 Top Five Most Prevalent Materials in Non-residential Refuse

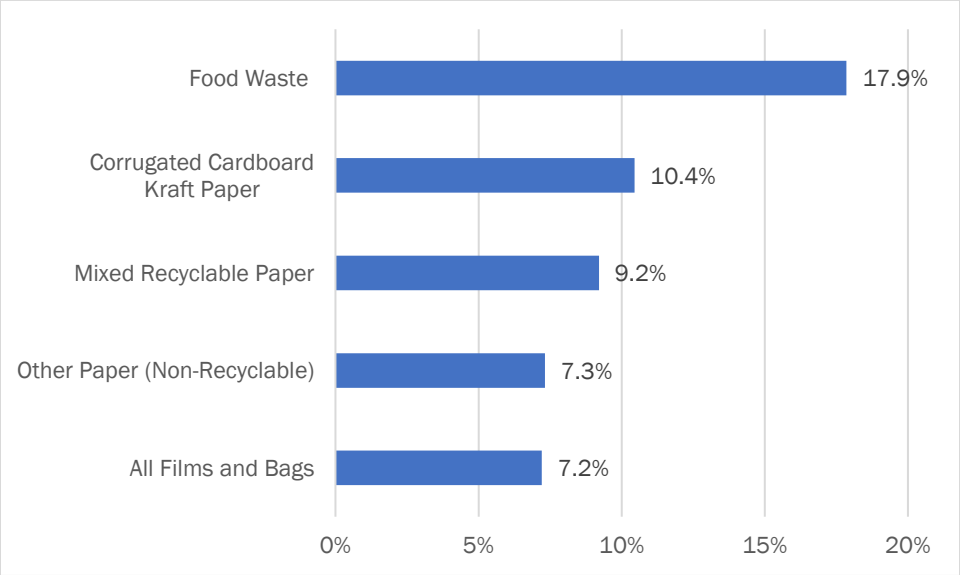


Figure 3-6 estimates the recoverability of the non-residential refuse stream.

Figure 3-6 Recoverability of Non-residential Refuse

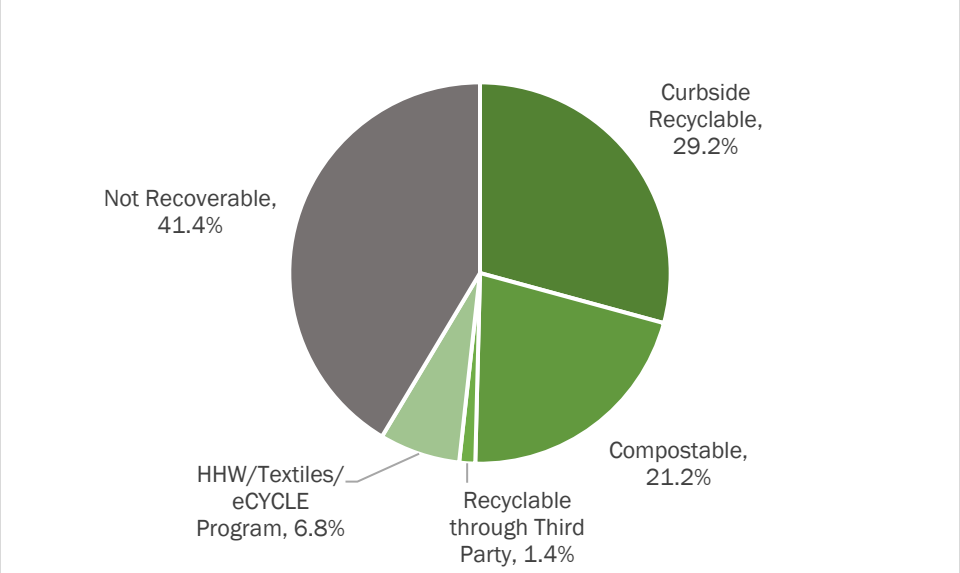


Table 3-9 shows the detailed recommended composition estimate for the non-residential refuse stream.

Table 3-9 Detailed Composition of Non-residential Refuse

Material Category	Recommended Composition Estimate	Material Category	Recommended Composition Estimate
Paper	**29.8%**	**Organics**	**25.0%**
Corrugated Cardboard/Kraft Paper	10.4%	Food Waste	17.9%
Newsprint	1.1%	Leaves	0.8%
Mixed Recyclable Paper	9.2%	Yard Waste	2.5%
Poly-Coated Aseptic Containers	1.7%	Other Organics	3.9%
Other Paper (Non-Recyclable)	7.3%	**C&D**	**10.2%**
Plastics	**16.6%**	Wood - Clean	3.1%
#1 PET Bottles and Containers	2.1%	Wood - Treated/Mfg	2.5%
#2 HDPE Natural Bottles	0.4%	Asphalt, Brick, Rock, & Concrete	0.2%
#2 HDPE Colored Bottles	0.3%	Carpet and Carpet Padding	3.7%
Rigid Plastic Containers #3-#7	0.2%	Remainder/Composite/Other C&D	0.7%
Expanded Polystyrene	1.9%	**Other**	**12.6%**
All Films and Bags	7.2%	Hazardous Materials	0.1%
Other Rigid Plastic	4.5%	Televisions & CRTs	0.5%
Glass	**3.0%**	Electronics	0.4%
Glass Bottles and Jars	2.3%	Bulky Items	3.4%
Other Glass	0.7%	Tires	0.1%
Metals	**2.8%**	Clothing Textiles	4.3%
Ferrous/Steel Containers	0.5%	Diapers and Sanitary Products	1.5%
Other Ferrous Metals	1.2%	Dirt and Fines	0.4%
Aluminum Cans	0.7%	Other Not Elsewhere Classified	1.9%
Other Aluminum	0.3%		
Other Non-Ferrous Metals	0.1%	**Grand Total**	**100.0%**

3.3.2 RECYCLING COMPOSITION

Figure 3-7 estimates the top five most prevalent materials in the single-family mixed recyclables stream. Not surprisingly, corrugated cardboard, mixed paper, and glass are the most prevalent targeted recyclables, and unspecified contaminants also make the top five.

Figure 3-7 Top Five Most Prevalent Materials in Single-family Mixed Recyclables

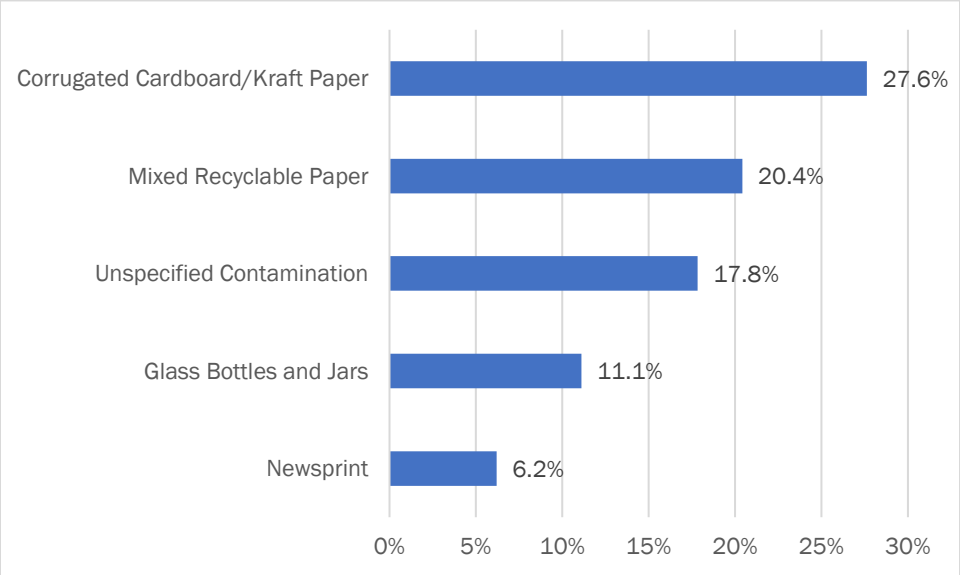
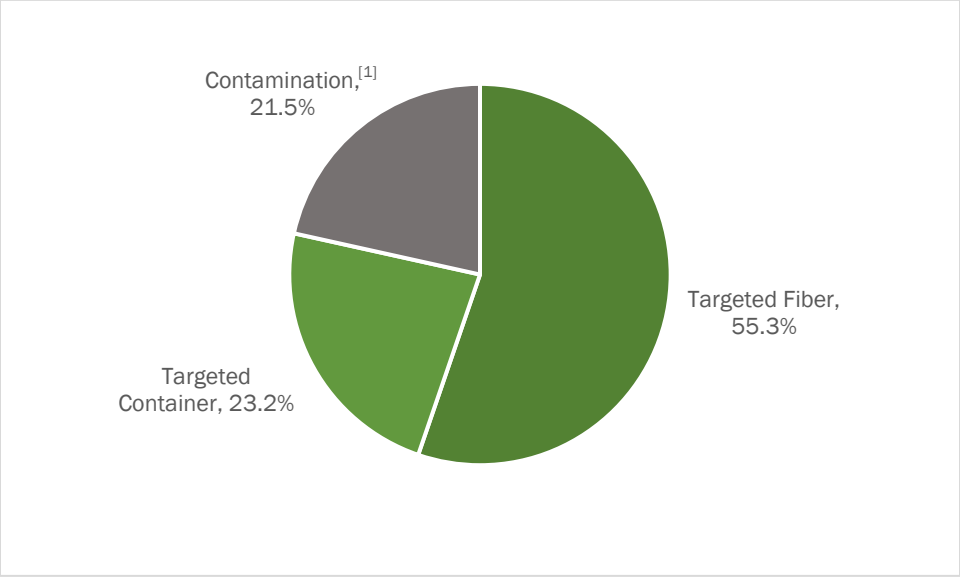


Figure 3-8 shows the estimated breakdown between fibers targeted for recycling according to the Mayor's List of Recyclables[kk] (targeted fibers), containers targeted for recycling according to the Mayor's List of Recyclables[kk] (targeted containers), and contamination in the single-family mixed recyclables stream.

Figure 3-8 Contamination of Single-family Mixed Recyclables



Note: [1] Includes All Films and Bags, Non-Recyclable Plastics, Scrap Metal, and Unspecified Contamination.

Table 3-10 shows the detailed composition estimate for the single-family mixed recyclables stream.

Table 3-10 Detailed Composition of Single-family Mixed Recyclables

Material Category	Recommended Composition Estimate	Material Category	Recommended Composition Estimate
Paper	**55.3%**	**Glass**	**11.1%**
Corrugated Cardboard/Kraft Paper	27.6%	Glass Bottles and Jars	11.1%
Newsprint	6.2%	**Metals**	**3.9%**
Poly-Coated Aseptic Containers	1.0%	Aluminum Cans	2.0%
Mixed Recyclable Paper[1]	20.4%	Aluminum Foil/Baking Tins	0.2%
Plastics	**11.9%**	Steel Cans	1.4%
#1 PET Bottles and Containers	3.9%	Scrap Metal*	0.3%
#2 HDPE Natural Bottles	1.0%	**Other**	**17.8%**
#2 HDPE Colored Bottles	0.6%	Unspecified Contamination*	17.8%
Rigid Plastic Containers #3-#7[2]	3.0%		
All Films and Bags*	1.4%		
Non-Recyclable Plastics*	2.0%	**Grand Total**	**100.0%**

Note: Asterisks (*) denote contaminants.
[1] Also includes paper cups, clamshells, and trays.
[2] Also includes other bulky rigid plastics, such as plastic milk/soda crates, plastic buckets with metal handles, and plastic laundry baskets.

Figure 3-9 estimates the top five most prevalent materials in the multi-family mixed recyclables stream. Because multi-family composition is derived from the single-family composition estimates, the same five materials appear; however, due to the adjustments made to account for multi-family recycling behavior, unspecified contamination surpasses corrugated cardboard as the most prevalent category.

Figure 3-9 Top Five Most Prevalent Materials in Multi-family Mixed Recyclables

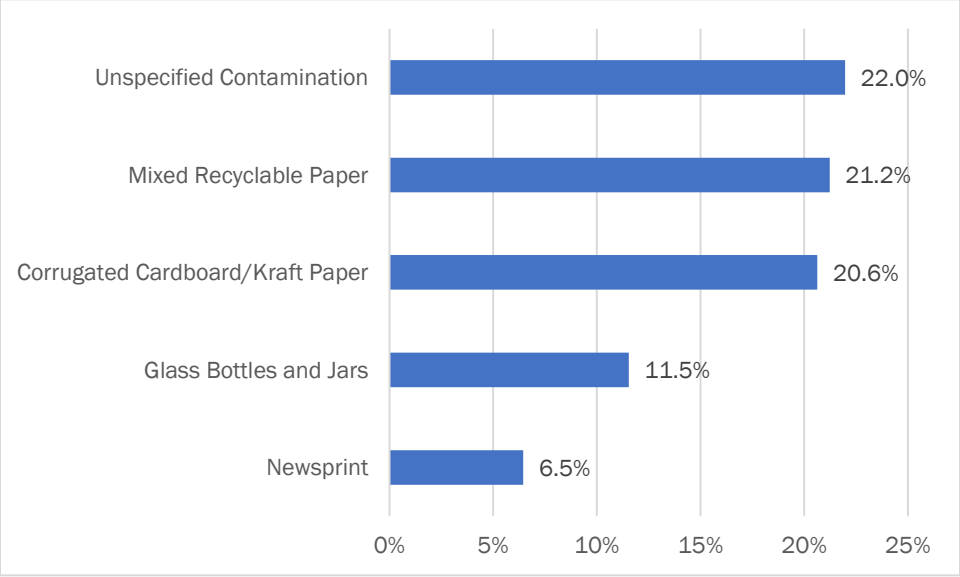
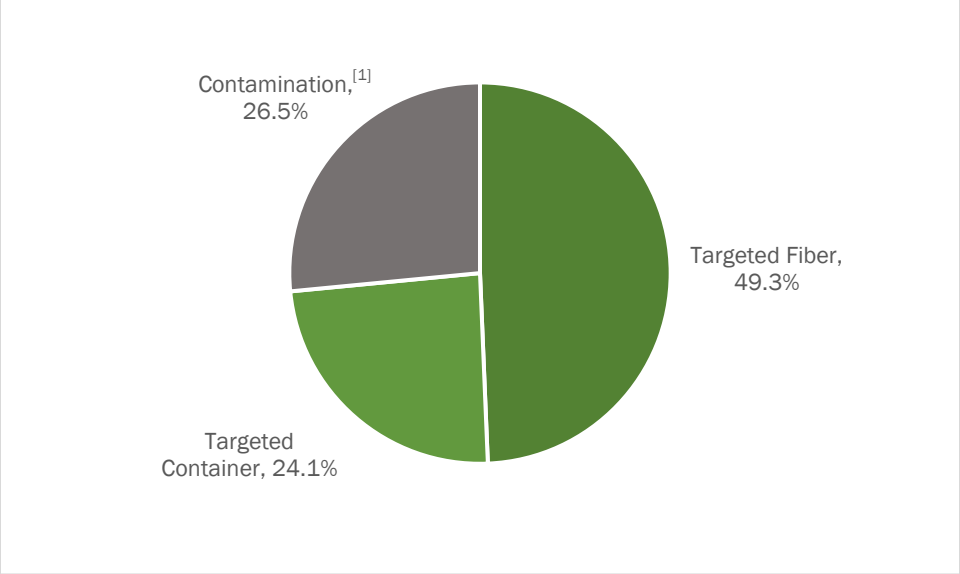


Figure 3-10 shows the estimated breakdown between targeted fibers, targeted containers, and contamination in the multi-family mixed recyclables stream.

Figure 3-10 Contamination of Multi-family Mixed Recyclables



Note: [1] Includes All Films and Bags, Non-Recyclable Plastics, Scrap Metal, and Unspecified Contamination.

Table 3-11 shows the detailed composition estimate for the multi-family mixed recyclables stream.

Table 3-11 Detailed Composition of Multi-family Mixed Recyclables

Material Category	Recommended Composition Estimate	Material Category	Recommended Composition Estimate
Paper	**49.3%**	**Glass**	**11.5%**
Corrugated Cardboard/Kraft Paper	20.6%	Glass Bottles and Jars	11.5%
Newsprint	6.5%	**Metals**	**4.1%**
Poly-Coated Aseptic Containers	1.0%	Aluminum Cans	2.1%
Mixed Recyclable Paper[1]	21.2%	Aluminum Foil/Baking Tins	0.2%
Plastics	**13.0%**	Steel Cans	1.5%
#1 PET Bottles and Containers	4.1%	Scrap Metal*	0.4%
#2 HDPE Natural Bottles	1.0%	**Other**	**22.0%**
#2 HDPE Colored Bottles	0.7%	Unspecified Contamination*	22.0%
Rigid Plastic Containers #3-#7[2]	3.1%		
All Films and Bags*	1.7%		
Non-Recyclable Plastics*	2.5%	**Grand Total**	**100.0%**

Note: Asterisks (*) denote contaminants.
[1] Also includes paper cups, clamshells, and trays.
[2] Also includes other bulky rigid plastics, such as plastic milk/soda crates, plastic buckets with metal handles, and plastic laundry baskets.

Figure 3-11 estimates the top five most prevalent materials in the non-residential mixed recyclables stream. As shown, corrugated cardboard is the dominant constituent in commercial recyclables.

Figure 3-11 Top Five Most Prevalent Materials in Non-residential Mixed Recyclables

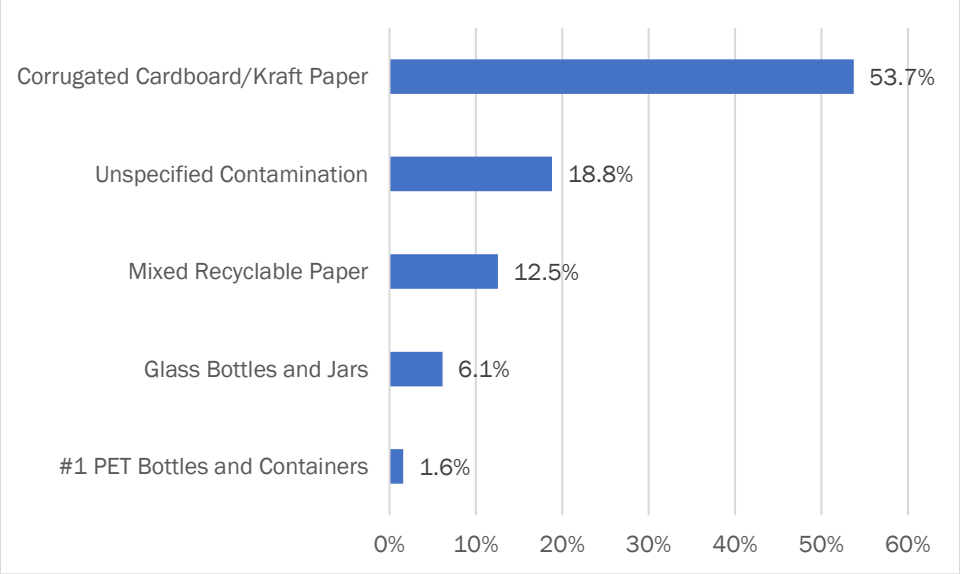
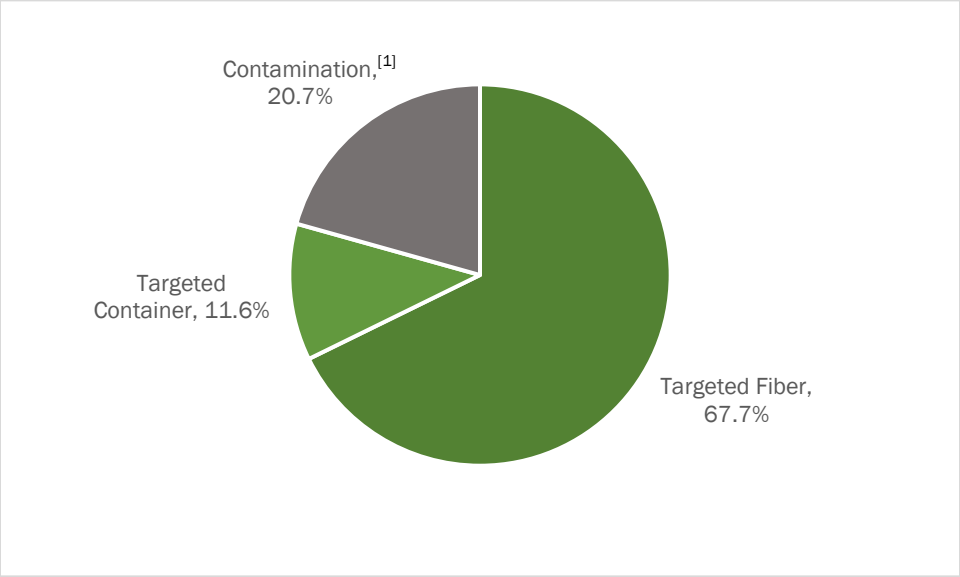


Figure 3-12 breaks down the targeted fiber and containers in non-residential recyclables and shows the estimated contamination rate.

Figure 3-12 Contamination of Non-residential Mixed Recyclables



Note: [1] Includes All Films and Bags, Non-Recyclable Plastics, Scrap Metal, and Unspecified Contamination.

Table 3-12 shows the detailed composition estimate for the non-residential mixed recyclables stream.

Table 3-12 Detailed Composition of Non-residential Mixed Recyclables

Material Category	Recommended Composition Estimate	Material Category	Recommended Composition Estimate
Paper	**67.7%**	**Glass**	**6.1%**
Corrugated Cardboard/Kraft Paper	53.7%	Glass Bottles and Jars	6.1%
Newsprint	1.4%	**Metals**	**1.9%**
Poly-Coated Aseptic Containers	0.1%	Aluminum Cans	0.8%
Mixed Recyclable Paper[1]	12.5%	Aluminum Foil/Baking Tins	0.1%
Plastics	**5.4%**	Steel Cans	0.6%
#1 PET Bottles and Containers	1.6%	Scrap Metal*	0.5%
#2 HDPE Natural Bottles	0.8%	**Other**	**18.8%**
#2 HDPE Colored Bottles	0.5%	Unspecified Contamination*	18.8%
Rigid Plastic Containers #3-#7[2]	1.1%		
All Films and Bags*	1.2%		
Non-Recyclable Plastics*	0.1%	**Grand Total**	**100.0%**

Note: Asterisks (*) denote contaminants.
[1] Also includes paper cups, clamshells, and trays.
[2] Also includes other bulky rigid plastics, such as plastic milk/soda crates, plastic buckets with metal handles, and plastic laundry baskets.

3.3.3 CONSTRUCTION & DEMOLITION DEBRIS COMPOSITION

Figure 3-13 estimates the top five most prevalent materials in the C&D stream. Several of these constituents are highly recoverable if they can be source separated at the construction site; and at least some fraction of all of the top five can be potentially recovered and diverted away from landfill or waste-to-energy facility via a commercial processor of C&D debris.

Figure 3-13 Top Five Most Prevalent Materials in C&D

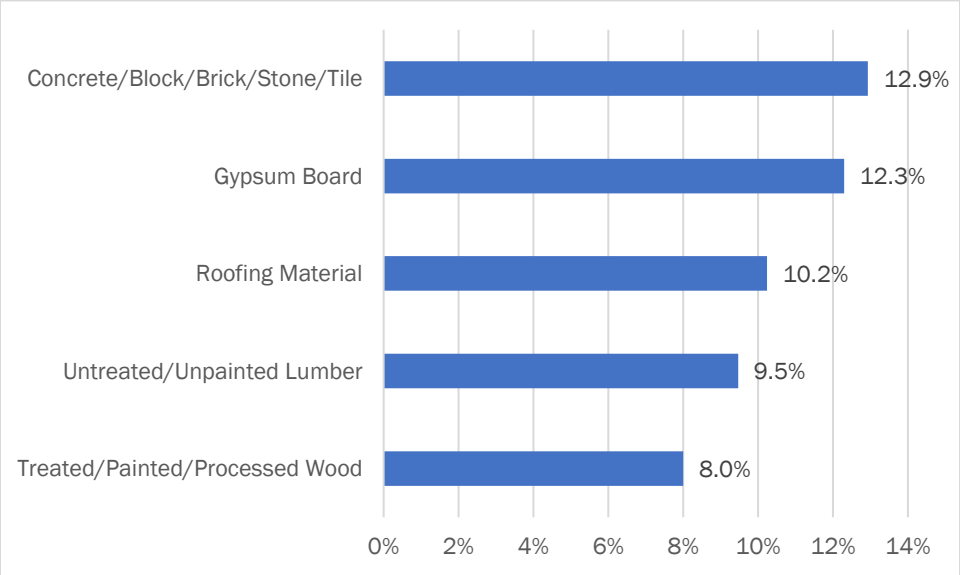


Figure 3-14 shows a summary of the estimated composition of the C&D stream.

Figure 3-14 Composition of C&D

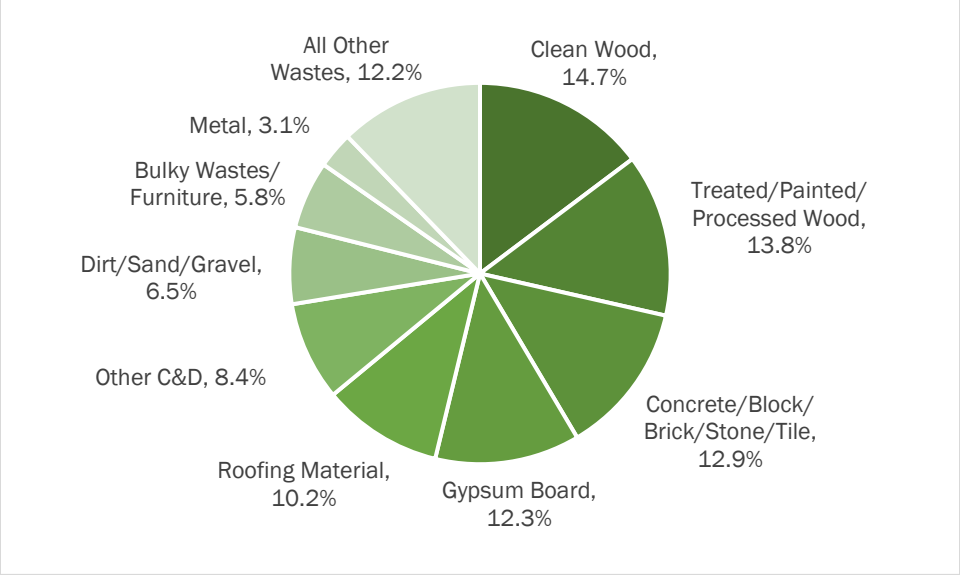


Table 3-13 shows the detailed composition estimate for the C&D stream.

Table 3-13 Detailed Composition of C&D

Material Category	Recommended Composition Estimate	Material Category	Recommended Composition Estimate
C&D	**78.9%**	**Paper**	**3.3%**
Wood Pallets and Crates	5.3%	Corrugated Cardboard/Kraft Paper	2.6%
Untreated/Unpainted Lumber	9.5%	Other Paper	0.7%
Treated/Painted/Processed Wood	8.0%	**Plastics**	**1.9%**
Engineered Wood	5.4%	Clean Recoverable Film	0.2%
Other Wood	0.4%	Other Plastics	1.7%
Carpet	2.4%	**Glass**	**0.8%**
Carpet Padding	0.2%	Glass	0.8%
Concrete/Block/Brick/Stone/Tile	12.9%	**Organics**	**2.0%**
Asphalt Paving	0.9%	Yard Waste	0.8%
Roofing Material	10.2%	Land Clearing Debris/Stumps	0.4%
Gypsum Board	12.3%	Other Organics	0.8%
Dirt/Sand/Gravel	6.5%	**Other**	**10.0%**
Remainder/Composite/Other C&D	4.9%	Bulky Wastes/Furniture	5.8%
Metals	**3.1%**	Mixed MSW	2.9%
Appliances	0.0%	Other Not Elsewhere Classified	1.4%
Other Ferrous	2.5%		
Other Non-Ferrous	0.6%	**Grand Total**	**100.0%**

CHAPTER 3 EXHIBITS

Exhibit 3-1. Comparison of Collection Programs for MSW Composition Studies

						Refuse Collection		Recycling Collection			Yard Waste Collection		Bulky Collection	
Wasteshed	Population	Population Density	Average Annual Temp.	Median Household Income	Percent with Bachelor's or Higher	Frequency	Truck Technology	Frequency	Container(s)	Truck Technology	Frequency	Truck Technology	Frequency	Truck Technology
Philadelphia, PA	1,584,138	11,380	55.9	$40,649	27%	Weekly	Manual	Weekly	Bins	Manual	Seasonal	Manual	Weekly	Manual
Prince George's County, MD	909,308	1,789	57.5	$78,607	32%	Weekly	Manual	Weekly	Carts/Bins	Manual	Weekly	Manual	On-Call	Manual
Baltimore, MD	602,495	7,672	58.5	$46,641	30%	Weekly	Automated	Weekly	Bins, Personal Containers	Manual	Weekly	Manual	On-Call	Manual
Montgomery County, MD	1,052,567	1,978	54.0	$103,178	58%	Weekly	Manual	Weekly	Cart for Fiber, Bin for Containers	Manual	Weekly	Manual	On-Call	Manual
Nashville, TN	669,053	1,243	59.3	$53,419	39%	Weekly	Automated	Monthly	Carts	Automated	Quarterly	Automated	Drop-Off	N/A
Arlington County, VA	237,521	7,994	58.2	$112,138	74%	Weekly	Semi-Auto.	Weekly	Carts	Semi-Auto.	Weekly	Semi-Auto.	On-Call	Manual
Lexington-Fayette, KY	323,780	1,025	55.6	$53,013	42%	Weekly	Automated	Weekly	Carts	Automated	Weekly	Automated	Weekly	N/A
Louisville, KY	620,118	1,837	58.2	$49,439	29%	Weekly	Automated	Weekly	Carts	Automated	Weekly	Manual	Monthly	Manual
Washington D.C.	**702,455**	**9,857**	**55.7**	**$77,649**	**57%**	**Weekly**	**Semi-Auto.**	**Weekly**	**Carts**	**Semi-Auto.**	**Seasonal**	**Manual**	**On-Call**	**Manual**

Exhibit 3-2. Standardized Single-family Refuse Study Results

Municipality:	2017 Philadelphia, PA	2016 Prince George's County, MD	2016 Maryland Statewide Suburban	2016 Maryland Statewide Urban				Recommended Composition
Collection Method:	Manual	Manual	Mix	Manual	Average	Min.	Max.	Estimate
Paper	**14.2%**	**25.2%**	**24.7%**	**17.6%**	**20.4%**	**14.2%**	**25.2%**	**23.4%**
Corrugated Cardboard Kraft Paper	1.5%	6.7%	5.0%	3.6%	4.2%	1.5%	6.7%	4.5%
Newsprint	0.7%	3.0%	1.8%	0.8%	1.6%	0.7%	3.0%	3.2%
Mixed Recyclable Paper	5.2%	6.6%	7.8%	6.5%	6.5%	5.2%	7.8%	6.8%
Poly-Coated Aseptic Containers	0.1%	1.8%	0.0%	0.0%	0.5%	0.0%	1.8%	0.1%
Other Paper (Non-Recyclable)	6.7%	7.1%	10.1%	6.8%	7.7%	6.7%	10.1%	8.8%
Plastics	**11.2%**	**18.9%**	**13.6%**	**14.8%**	**14.6%**	**11.2%**	**18.9%**	**12.2%**
#1 PET Bottles and Containers	1.2%	2.0%	1.8%	1.9%	1.7%	1.2%	2.0%	1.3%
#2 HDPE Natural Bottles	0.2%	0.7%	0.3%	0.2%	0.4%	0.2%	0.7%	0.2%
#2 HDPE Colored Bottles	0.3%	0.4%	0.5%	0.4%	0.4%	0.3%	0.5%	0.3%
Rigid Plastic Containers #3-#7	0.6%	0.2%	0.1%	0.0%	0.2%	0.0%	0.6%	0.7%
Expanded Polystyrene	0.8%	1.9%	0.8%	0.9%	1.1%	0.8%	1.9%	0.9%
All Films and Bags	5.3%	10.2%	5.1%	6.3%	6.7%	5.1%	10.2%	5.8%
Other Rigid Plastic	2.8%	3.5%	5.0%	5.0%	4.1%	2.8%	5.0%	3.0%
Glass	**2.2%**	**3.4%**	**3.4%**	**2.9%**	**3.0%**	**2.2%**	**3.4%**	**2.7%**
Glass Bottles and Jars	1.3%	3.4%	3.0%	2.4%	2.5%	1.3%	3.4%	1.8%
Other Glass	0.9%	0.0%	0.4%	0.5%	0.5%	0.0%	0.9%	0.9%
Organics	**29.7%**	**24.1%**	**26.4%**	**35.9%**	**29.0%**	**24.1%**	**35.9%**	**30.9%**
Food Waste	16.7%	17.1%	17.9%	15.4%	16.8%	15.4%	17.9%	17.9%
Leaves	2.8%	2.8%	0.4%	1.1%	1.8%	0.4%	2.8%	2.8%
Yard Waste	5.6%	4.2%	3.3%	14.5%	6.9%	3.3%	14.5%	5.6%
Other Organics	4.7%	0.0%	4.8%	4.8%	3.6%	0.0%	4.8%	4.7%
Metals	**3.1%**	**3.1%**	**3.4%**	**3.4%**	**3.3%**	**3.1%**	**3.4%**	**3.1%**
Ferrous/Steel Containers	0.6%	1.1%	1.1%	1.0%	0.9%	0.6%	1.1%	0.6%
Other Ferrous Metals	1.2%	1.0%	1.1%	1.1%	1.1%	1.0%	1.2%	1.2%
Aluminum Cans	0.4%	1.0%	0.6%	0.6%	0.6%	0.4%	1.0%	0.4%
Other Aluminum	0.4%	0.0%	0.3%	0.3%	0.3%	0.0%	0.4%	0.4%
Other Non-Ferrous Metals	0.3%	0.0%	0.4%	0.4%	0.3%	0.0%	0.4%	0.3%
Appliances	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.2%
C&D	**18.9%**	**5.1%**	**10.3%**	**4.9%**	**9.8%**	**4.9%**	**18.9%**	**10.3%**
Wood - Clean	1.9%	0.9%	1.0%	0.2%	1.0%	0.2%	1.9%	1.0%
Wood - Treated/Mfg	6.2%	2.1%	4.7%	0.9%	3.5%	0.9%	6.2%	4.7%
Asphalt, Brick, Rock, & Concrete	0.8%	0.3%	1.8%	0.5%	0.8%	0.3%	1.8%	1.8%
Carpet and Carpet Padding	3.1%	0.7%	2.3%	2.7%	2.2%	0.7%	3.1%	2.3%
Remainder/Composite/Other C&D	6.9%	1.1%	0.6%	0.6%	2.3%	0.6%	6.9%	0.6%
Other	**20.8%**	**20.1%**	**18.1%**	**20.4%**	**19.9%**	**18.1%**	**20.8%**	**17.4%**
Hazardous Materials	0.3%	0.1%	0.5%	0.4%	0.3%	0.1%	0.5%	0.3%
Televisions & CRTs	0.5%	0.1%	0.0%	0.0%	0.1%	0.0%	0.5%	0.5%
Electronics	0.4%	0.9%	0.2%	1.0%	0.6%	0.2%	1.0%	0.4%
Bulky Items	6.8%	0.7%	1.5%	0.6%	2.4%	0.6%	6.8%	3.4%
Tires	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
Clothing Textiles	6.3%	5.3%	6.5%	10.2%	7.1%	5.3%	10.2%	6.3%
Non-clothing Textiles	0.9%	0.0%	0.0%	0.0%	0.2%	0.0%	0.9%	0.9%
Diapers and Sanitary Products	3.4%	0.0%	4.7%	4.3%	3.1%	0.0%	4.7%	3.4%
Dirt and Fines	1.5%	0.7%	3.3%	3.4%	2.2%	0.7%	3.4%	1.5%
Other Not Elsewhere Classified	0.6%	12.3%	1.3%	0.6%	3.7%	0.6%	12.3%	0.6%
Totals	**100.0%**	**100.0%**	**100.0%**	**100.0%**				**100.0%**
# of Samples	**229**	**130**	**49**	**28**				

Exhibit 3-3. Standardized Multi-family Refuse Study Results

	Single-family Recommended Composition Estimate	Multi-family Recommended Composition Estimate
Paper	**23.4%**	**31.1%**
Corrugated Cardboard Kraft Paper	4.5%	7.4%
Newsprint	3.2%	5.2%
Mixed Recyclable Paper	6.8%	11.1%
Poly-Coated Aseptic Containers	0.1%	0.2%
Other Paper (Non-Recyclable)	8.8%	7.2%
Plastics	**12.2%**	**12.1%**
#1 PET Bottles and Containers	1.3%	2.1%
#2 HDPE Natural Bottles	0.2%	0.4%
#2 HDPE Colored Bottles	0.3%	0.5%
Rigid Plastic Containers #3-#7	0.7%	1.1%
Expanded Polystyrene	0.9%	0.7%
All Films and Bags	5.8%	4.8%
Other Rigid Plastic	3.0%	2.5%
Glass	**2.7%**	**3.7%**
Glass Bottles and Jars	1.8%	2.9%
Other Glass	0.9%	0.7%
Organics	**30.9%**	**22.9%**
Food Waste	17.9%	14.7%
Leaves	2.8%	2.3%
Yard Waste	5.6%	2.0%
Other Organics	4.7%	3.9%
Metals	**3.1%**	**3.7%**
Ferrous/Steel Containers	0.6%	1.0%
Other Ferrous Metals	1.2%	1.0%
Aluminum Cans	0.4%	0.7%
Other Aluminum	0.4%	0.7%
Other Non-Ferrous Metals	0.3%	0.2%
Appliances	0.2%	0.2%
C&D	**10.3%**	**8.5%**
Wood - Clean	1.0%	0.8%
Wood - Treated/Mfg	4.7%	3.9%
Asphalt, Brick, Rock, & Concrete	1.8%	1.5%
Carpet and Carpet Padding	2.3%	1.9%
Remainder/Composite/Other C&D	0.6%	0.5%
Other	**17.4%**	**18.0%**
Hazardous Materials	0.3%	0.2%
Televisions & CRTs	0.5%	0.4%
Electronics	0.4%	0.3%
Bulky Items	3.4%	6.5%
Tires	0.1%	0.1%
Clothing Textiles	6.3%	5.2%
Non-clothing Textiles	0.9%	0.7%
Diapers and Sanitary Products	3.4%	2.8%
Dirt and Fines	1.5%	1.2%
Other Not Elsewhere Classified	0.6%	0.5%
Totals	**100.0%**	**100.0%**

Exhibit 3-4. Standardized Non-residential Refuse Study Results

Material Category	2018 Montgomery County, MD	2018 Davidson County, TN Urban	2016 Prince George's County, MD	Average	Min.	Max.	Recommended Composition Estimate
Paper	**18.8%**	**28.3%**	**32.3%**	**26.5%**	**18.8%**	**32.3%**	**29.8%**
Corrugated Cardboard Kraft Paper	3.1%	11.2%	11.8%	8.7%	3.1%	11.8%	10.4%
Newsprint	0.4%	0.5%	1.1%	0.7%	0.4%	1.1%	1.1%
Mixed Recyclable Paper	6.7%	6.8%	10.4%	8.0%	6.7%	10.4%	9.2%
Poly-Coated Aseptic Containers	1.6%	0.1%	1.7%	1.1%	0.1%	1.7%	1.7%
Other Paper (Non-Recyclable)	7.0%	9.7%	7.3%	8.0%	7.0%	9.7%	7.3%
Plastics	**14.4%**	**16.5%**	**21.9%**	**17.6%**	**14.4%**	**21.9%**	**16.6%**
#1 PET Bottles and Containers	2.4%	1.7%	2.1%	2.1%	1.7%	2.4%	2.1%
#2 HDPE Natural Bottles	0.2%	0.4%	0.4%	0.3%	0.2%	0.4%	0.4%
#2 HDPE Colored Bottles	0.1%	0.7%	0.3%	0.4%	0.1%	0.7%	0.3%
Rigid Plastic Containers #3-#7	0.2%	1.3%	0.2%	0.6%	0.2%	1.3%	0.2%
Expanded Polystyrene	0.1%	0.9%	1.9%	1.0%	0.1%	1.9%	1.9%
All Films and Bags	6.8%	7.6%	12.5%	9.0%	6.8%	12.5%	7.2%
Other Rigid Plastic	4.6%	3.9%	4.5%	4.3%	3.9%	4.6%	4.5%
Glass	**1.4%**	**5.1%**	**2.3%**	**2.9%**	**1.4%**	**5.1%**	**3.0%**
Glass Bottles and Jars	1.3%	3.9%	2.3%	2.5%	1.3%	3.9%	2.3%
Other Glass	0.1%	1.2%	0.0%	0.4%	0.0%	1.2%	0.7%
Organics	**26.5%**	**15.6%**	**15.8%**	**19.3%**	**15.6%**	**26.5%**	**25.0%**
Food Waste	17.8%	12.7%	12.5%	14.3%	12.5%	17.8%	17.9%
Leaves	0.0%	0.0%	0.8%	0.3%	0.0%	0.8%	0.8%
Yard Waste	1.8%	2.1%	2.5%	2.1%	1.8%	2.5%	2.5%
Other Organics	6.9%	0.8%	0.0%	2.6%	0.0%	6.9%	3.9%
Metals	**2.6%**	**3.1%**	**2.4%**	**2.7%**	**2.4%**	**3.1%**	**2.8%**
Ferrous/Steel Containers	0.1%	0.6%	0.5%	0.4%	0.1%	0.6%	0.5%
Other Ferrous Metals	1.9%	1.6%	1.2%	1.6%	1.2%	1.9%	1.2%
Aluminum Cans	0.2%	0.6%	0.7%	0.5%	0.2%	0.7%	0.7%
Other Aluminum	0.3%	0.2%	0.0%	0.2%	0.0%	0.3%	0.3%
Other Non-Ferrous Metals	0.1%	0.1%	0.0%	0.1%	0.0%	0.1%	0.1%
C&D	**11.5%**	**14.4%**	**10.2%**	**12.0%**	**10.2%**	**14.4%**	**10.2%**
Wood - Clean	2.1%	0.0%	3.1%	1.7%	0.0%	3.1%	3.1%
Wood - Treated/Mfg	6.3%	0.0%	2.5%	2.9%	0.0%	6.3%	2.5%
Asphalt, Brick, Rock, & Concrete	0.1%	0.0%	0.2%	0.1%	0.0%	0.2%	0.2%
Carpet and Carpet Padding	2.9%	0.4%	3.7%	2.3%	0.4%	3.7%	3.7%
Remainder/Composite/Other C&D	0.1%	14.0%	0.7%	4.9%	0.1%	14.0%	0.7%
Other	**10.9%**	**17.1%**	**15.0%**	**14.3%**	**10.9%**	**17.1%**	**12.6%**
Hazardous Materials	0.7%	1.1%	0.1%	0.6%	0.1%	1.1%	0.1%
Televisions & CRTs	0.0%	0.8%	0.6%	0.5%	0.0%	0.8%	0.5%
Electronics	0.1%	1.0%	0.5%	0.5%	0.1%	1.0%	0.4%
Bulky Items	0.0%	6.8%	0.8%	2.5%	0.0%	6.8%	3.4%
Tires	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
Clothing Textiles	3.5%	4.8%	4.3%	4.2%	3.5%	4.8%	4.3%
Diapers and Sanitary Products	1.6%	1.4%	0.0%	1.0%	0.0%	1.6%	1.5%
Dirt and Fines	2.2%	1.2%	0.4%	1.3%	0.4%	2.2%	0.4%
Other Not Elsewhere Classified	2.7%	0.0%	8.3%	3.7%	0.0%	8.3%	1.9%
Totals	**100.0%**	**100.0%**	**100.0%**				**100.0%**
# of Samples	**120**	**83**	**63**				

Exhibit 3-5. Standardized Single-family Mixed Recyclables Study Results

Municipality:	2018 Arlington County, VA	2017 Philadelphia, PA	2017 Washington D.C. Residential	2018 Washington D.C. Residential	2018 Davidson County, TN Urban (no glass)				Recommended Composition Estimate
Collection Method:	Semi-Auto.	Manual	Semi-Auto.	Semi-Auto.	Semi-Auto.	Average	Min.	Max.	
Paper	**57.0%**	**40.2%**	**47.6%**	**55.3%**	**71.7%**	**54.1%**	**40.2%**	**71.7%**	**55.3%**
Corrugated Cardboard/Kraft Paper	17.6%	15.8%	28.1%	27.6%	28.4%	22.5%	15.8%	28.4%	27.6%
Newsprint	11.4%	8.4%	9.6%	6.2%	10.3%	9.9%	6.2%	11.4%	6.2%
Poly-Coated Aseptic Containers	0.9%	0.4%	0.4%	1.0%	0.4%	0.5%	0.4%	1.0%	1.0%
Mixed Recyclable Paper	27.2%	15.6%	9.6%	20.4%	32.6%	21.2%	9.6%	32.6%	20.4%
Plastics	**11.4%**	**12.7%**	**11.0%**	**11.9%**	**11.4%**	**11.6%**	**11.0%**	**12.7%**	**11.9%**
#1 PET Bottles and Containers	3.9%	4.7%	3.9%	3.9%	4.2%	4.2%	3.9%	4.7%	3.9%
#2 HDPE Natural Bottles	1.3%	1.0%	1.7%	1.0%	0.8%	1.2%	0.8%	1.7%	1.0%
#2 HDPE Colored Bottles	0.9%	1.4%	1.1%	0.6%	1.2%	1.2%	0.6%	1.4%	0.6%
Rigid Plastic Containers #3-#7	1.5%	1.1%	2.1%	3.0%	1.3%	1.5%	1.1%	3.0%	3.0%
All Films and Bags	1.8%	1.8%	2.0%	1.4%	2.0%	1.9%	1.4%	2.0%	1.4%
Non-Recyclable Plastics	2.1%	2.7%	0.2%	2.0%	1.9%	1.7%	0.2%	2.7%	2.0%
Glass	**20.1%**	**26.9%**	**13.4%**	**11.1%**	**0.0%**	**15.1%**	**0.0%**	**26.9%**	**11.1%**
Glass Bottles and Jars	20.1%	26.9%	13.4%	11.1%	0.0%	15.1%	0.0%	26.9%	11.1%
Metals	**3.2%**	**4.9%**	**2.9%**	**3.9%**	**4.2%**	**3.8%**	**2.9%**	**4.9%**	**3.9%**
Aluminum Cans	1.3%	1.3%	1.2%	2.0%	1.7%	1.4%	1.2%	2.0%	2.0%
Aluminum Foil/Baking Tins	0.0%	0.1%	0.1%	0.2%	0.1%	0.1%	0.0%	0.2%	0.2%
Steel Cans	1.5%	2.2%	1.1%	1.4%	1.6%	1.6%	1.1%	2.2%	1.4%
Scrap Metal	0.3%	1.3%	0.5%	0.3%	0.8%	0.7%	0.3%	1.3%	0.3%
Other	**8.4%**	**15.4%**	**25.1%**	**17.8%**	**12.4%**	**15.3%**	**8.4%**	**25.1%**	**17.8%**
Unspecified Contamination	8.4%	15.4%	25.1%	17.8%	12.4%	15.3%	8.4%	25.1%	17.8%
Totals	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**				**100.0%**
# of Samples	**1***	**180**	**24**	**18**	**42**				

** Includes the one-time sorting of 5,831 pounds of residential single stream recycling material.*

Exhibit 3-6. Standardized Multi-family Mixed Recyclables Study Results

	Single-family Recommended Composition Estimate	Multi-family Recommended Composition Estimate
Paper	**55.3%**	**49.3%**
Corrugated Cardboard/Kraft Paper	27.6%	20.6%
Newsprint	6.2%	6.5%
Poly-Coated Aseptic Containers	1.0%	1.0%
Mixed Recyclable Paper	20.4%	21.2%
Plastics	**11.9%**	**13.0%**
#1 PET Bottles and Containers	3.9%	4.1%
#2 HDPE Natural Bottles	1.0%	1.0%
#2 HDPE Colored Bottles	0.6%	0.7%
Rigid Plastic Containers #3-#7	3.0%	3.1%
All Films and Bags	1.4%	1.7%
Non-Recyclable Plastics	2.0%	2.5%
Glass	**11.1%**	**11.5%**
Glass Bottles and Jars	11.1%	11.5%
Metals	**3.9%**	**4.1%**
Aluminum Cans	2.0%	2.1%
Aluminum Foil/Baking Tins	0.2%	0.2%
Steel Cans	1.4%	1.5%
Scrap Metal	0.3%	0.4%
Other	**17.8%**	**22.0%**
Unspecified Contamination	17.8%	22.0%
Totals	**100.0%**	**100.0%**
# of Samples		

Exhibit 3-7. Standardized Non-residential Mixed Recyclables Study Results

Material Category	2017 Washington D.C. Commercial	2018 Washington D.C. Commercial	Average	Min.	Max.	Recommended Composition Estimate
Paper	**67.5%**	**68.0%**	**67.7%**	**67.5%**	**68.0%**	**67.7%**
Corrugated Cardboard/Kraft Paper	59.4%	48.0%	53.7%	48.0%	59.4%	53.7%
Newsprint	2.0%	0.8%	1.4%	0.8%	2.0%	1.4%
Poly-Coated Aseptic Containers	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Mixed Recyclable Paper	6.0%	19.0%	12.5%	6.0%	19.0%	12.5%
Plastics	**7.1%**	**3.6%**	**5.4%**	**3.6%**	**7.1%**	**5.4%**
#1 PET Bottles and Containers	2.1%	1.1%	1.6%	1.1%	2.1%	1.6%
#2 HDPE Natural Bottles	1.2%	0.4%	0.8%	0.4%	1.2%	0.8%
#2 HDPE Colored Bottles	0.8%	0.2%	0.5%	0.2%	0.8%	0.5%
Rigid Plastic Containers #3-#7	1.4%	0.9%	1.1%	0.9%	1.4%	1.1%
All Films and Bags	1.6%	0.8%	1.2%	0.8%	1.6%	1.2%
Non-Recyclable Plastics	0.1%	0.2%	0.1%	0.1%	0.2%	0.1%
Glass	**7.7%**	**4.6%**	**6.1%**	**4.6%**	**7.7%**	**6.1%**
Glass Bottles and Jars	7.7%	4.6%	6.1%	4.6%	7.7%	6.1%
Metals	**2.4%**	**1.5%**	**1.9%**	**1.5%**	**2.4%**	**1.9%**
Aluminum Cans	0.9%	0.7%	0.8%	0.7%	0.9%	0.8%
Aluminum Foil/Baking Tins	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Steel Cans	1.0%	0.2%	0.6%	0.2%	1.0%	0.6%
Scrap Metal	0.4%	0.6%	0.5%	0.4%	0.6%	0.5%
Other	**15.3%**	**22.3%**	**18.8%**	**15.3%**	**22.3%**	**18.8%**
Unspecified Contamination	15.3%	22.3%	18.8%	15.3%	22.3%	18.8%
Totals	**100.0%**	**100.0%**				**100.0%**
# of Samples	**16**	**12**				

Exhibit 3-8. Standardized C&D Study Results

Material Category	2010 Georgia Statewide	2016 Louisville, KY	2014 Lexington, KY	2016 Connecticut Statewide	2017 Missouri Statewide Large Metro - Demo.	2017 Missouri Statewide Large Metro - Constr.	2010 Chicago, IL	2016 Seattle, WA	Average	Min.	Max.	Recommended Composition Estimate
Paper	**1.4%**	**4.8%**	**5.8%**	**5.3%**	**1.2%**	**4.2%**	**1.8%**	**2.1%**	**3.3%**	**1.2%**	**5.8%**	**3.3%**
Corrugated Cardboard/Kraft Paper	0.8%	2.9%	5.1%	5.1%	1.0%	3.5%	1.7%	1.0%	2.6%	0.8%	5.1%	2.6%
Other Paper	0.6%	1.9%	0.7%	0.2%	0.3%	0.8%	0.2%	1.1%	0.7%	0.2%	1.9%	0.7%
Plastics	**0.8%**	**0.9%**	**1.1%**	**1.1%**	**7.5%**	**2.0%**	**0.4%**	**1.1%**	**1.9%**	**0.4%**	**7.5%**	**1.9%**
Clean Recoverable Film	0.2%	0.0%	0.1%	0.4%	0.0%	0.2%	0.1%	0.5%	0.2%	0.0%	0.5%	0.2%
Other Plastics	0.6%	0.9%	1.0%	0.7%	7.5%	1.8%	0.3%	0.6%	1.7%	0.3%	7.5%	1.7%
Organics	**1.7%**	**0.4%**	**5.1%**	**3.1%**	**0.2%**	**2.7%**	**0.6%**	**1.8%**	**2.0%**	**0.2%**	**5.1%**	**2.0%**
Yard Waste	1.3%	0.4%	3.1%	0.0%	0.1%	0.4%	0.3%	0.6%	0.8%	0.0%	3.1%	0.8%
Land Clearing Debris/Stumps	0.4%	0.0%	0.0%	2.3%	0.0%	0.0%	0.0%	0.5%	0.4%	0.0%	2.3%	0.4%
Other Organics	0.0%	0.0%	2.0%	0.8%	0.1%	2.3%	0.2%	0.7%	0.8%	0.0%	2.3%	0.8%
Metals	**3.1%**	**1.1%**	**2.3%**	**3.8%**	**3.0%**	**4.0%**	**4.7%**	**2.7%**	**3.1%**	**1.1%**	**4.7%**	**3.1%**
Appliances	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%
Other Ferrous	2.9%	0.9%	2.3%	1.8%	2.7%	2.4%	4.6%	2.0%	2.5%	0.9%	4.6%	2.5%
Other Non-Ferrous	0.1%	0.1%	0.0%	2.1%	0.2%	1.5%	0.0%	0.6%	0.6%	0.0%	2.1%	0.6%
Glass	**0.5%**	**0.8%**	**0.7%**	**0.9%**	**0.4%**	**0.0%**	**1.8%**	**1.7%**	**0.8%**	**0.0%**	**1.8%**	**0.8%**
Glass	0.5%	0.8%	0.7%	0.9%	0.4%	0.0%	1.8%	1.7%	0.8%	0.0%	1.8%	0.8%
C&D	**89.1%**	**86.1%**	**71.7%**	**61.5%**	**63.0%**	**82.0%**	**90.3%**	**87.5%**	**78.9%**	**61.5%**	**90.3%**	**78.9%**
Wood Pallets and Crates	1.9%	5.7%	15.0%	7.1%	1.0%	4.1%	2.4%	5.0%	5.3%	1.0%	15.0%	5.3%
Untreated/Unpainted Lumber	5.8%	13.0%	7.8%	9.6%	3.6%	9.7%	12.9%	13.3%	9.5%	3.6%	13.3%	9.5%
Treated/Painted/Processed Wood	3.6%	15.7%	6.4%	12.5%	4.6%	1.1%	5.9%	14.3%	8.0%	1.1%	15.7%	8.0%
Engineered Wood	4.5%	8.9%	3.9%	6.2%	2.7%	7.1%	2.0%	7.7%	5.4%	2.0%	8.9%	5.4%
Other Wood	0.0%	0.4%	0.7%	0.5%	1.9%	0.1%	0.0%	0.0%	0.4%	0.0%	1.9%	0.4%
Carpet	1.4%	2.6%	4.1%	3.6%	2.8%	3.1%	0.5%	1.1%	2.4%	0.5%	4.1%	2.4%
Carpet Padding	0.2%	0.4%	0.1%	0.1%	0.2%	0.1%	0.0%	0.3%	0.2%	0.0%	0.4%	0.2%
Concrete/Block/Brick/Stone/Tile	22.9%	7.5%	16.4%	3.2%	20.4%	4.4%	27.2%	1.4%	12.9%	1.4%	27.2%	12.9%
Asphalt Paving	2.5%	1.1%	0.0%	0.0%	0.8%	0.0%	2.4%	0.2%	0.9%	0.0%	2.5%	0.9%
Roofing Material	19.5%	15.4%	4.8%	10.4%	8.5%	9.2%	4.1%	10.0%	10.2%	4.1%	19.5%	10.2%
Gypsum Board	6.9%	11.3%	8.1%	6.3%	13.0%	28.1%	10.2%	14.4%	12.3%	6.3%	28.1%	12.3%
Dirt/Sand/Gravel	11.0%	1.7%	2.6%	0.0%	1.8%	10.1%	21.0%	3.9%	6.5%	0.0%	21.0%	6.5%
Remainder/Composite/Other C&D	8.9%	2.6%	1.8%	2.0%	1.7%	4.9%	1.8%	15.9%	4.9%	1.7%	15.9%	4.9%
Other	**3.4%**	**5.9%**	**13.1%**	**24.2%**	**24.7%**	**5.1%**	**0.5%**	**3.1%**	**10.0%**	**0.5%**	**24.7%**	**10.0%**
Bulky Wastes/Furniture	0.3%	2.4%	4.1%	16.8%	20.2%	1.8%	0.2%	0.5%	5.8%	0.2%	20.2%	5.8%
Mixed MSW	2.4%	3.4%	7.8%	0.0%	3.6%	3.3%	0.0%	2.3%	2.9%	0.0%	7.8%	2.9%
Other Not Elsewhere Classified	0.6%	0.1%	1.2%	7.4%	0.9%	0.1%	0.3%	0.3%	1.4%	0.1%	7.4%	1.4%
Totals	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**				**100.0%**
# of Visual Surveys	**786**	**71**	**111**	**267**	**31**	**38**	**351**	**428**				

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CHAPTER 4 – CONCLUSIONS & RECOMMENDATIONS

4.1 TWENTY-YEAR WASTE PROJECTIONS

This chapter applies the estimated waste composition derived in Chapter 3 to the projected waste generation presented in Chapter 2, so that the District has a detailed estimate of its waste stream for the planning period. This chapter, in effect, expands the mixed material streams (refuse, mixed recyclables) into their individual constituents, and then re-combines all constituents into a District-wide snapshot of MSW generation. The detailed projections are contained in the following exhibits included at the end of this chapter:

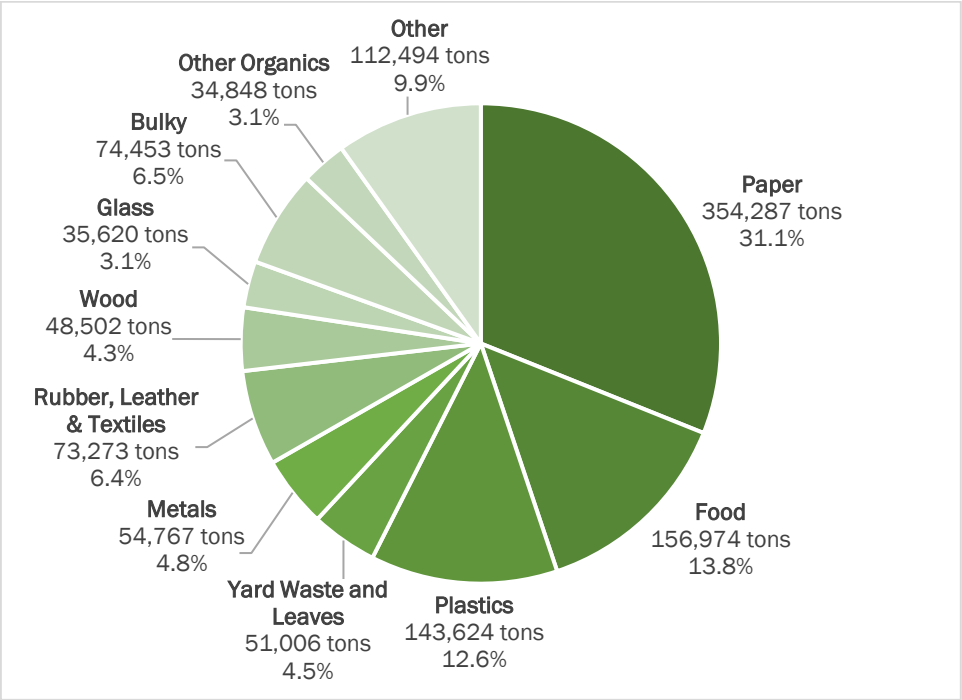
- Exhibit 4-1 – Disaggregated Single-family Refuse Projections,
- Exhibit 4-2 – Disaggregated Multi-family Refuse Projections,
- Exhibit 4-3 – Disaggregated Non-residential Refuse Projections,
- Exhibit 4-4 – Disaggregated Single-family Mixed Recyclables Projections,
- Exhibit 4-5 – Disaggregated Multi-family Mixed Recyclables Projections, and
- Exhibit 4-6 – Disaggregated Non-residential Mixed Recyclables Projections.

C&D debris generation and composition has also been projected as part of this study. However, the composition of the C&D stream was shown in Chapter 3 and because this composition remains static throughout the planning period, no C&D summary data is repeated in this section.

4.2 AGGREGATE MSW GENERATION

Figure 4-1 presents the aggregate composition of all MSW generated in the District. This pie chart combines MSW destined for recycling, composting, waste-to-energy, and landfilling.

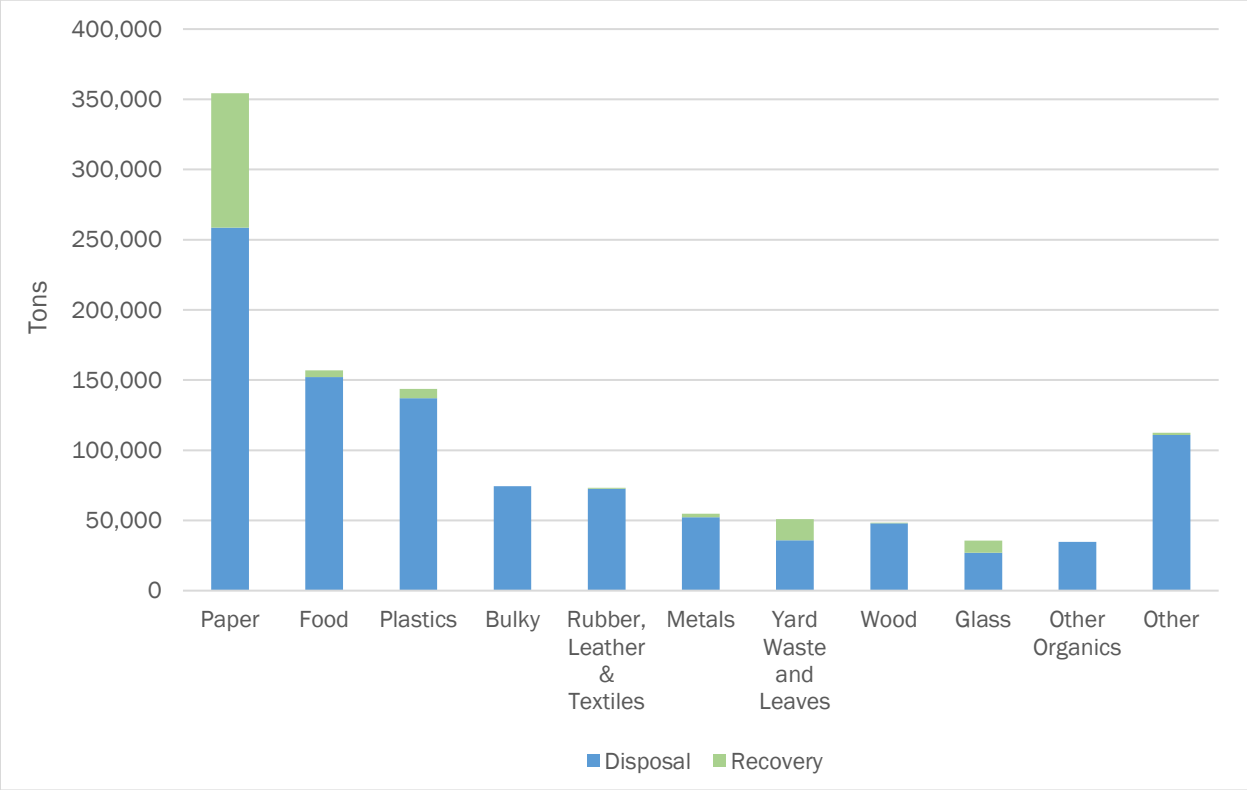
Figure 4-1 Aggregate MSW Generation in the District by Material Group (CY 2018)



4. CONCLUSIONS & RECOMMENDATIONS

The disposition (whether a material is disposed of or recovered via recycling/composting) of each material group is shown in Figure 4-2. Dispositions were determined according to the stream that the material was identified in. For example, all material in the refuse stream is assumed to be disposed, while all the material in the mixed recyclables stream is assumed to be recovered.

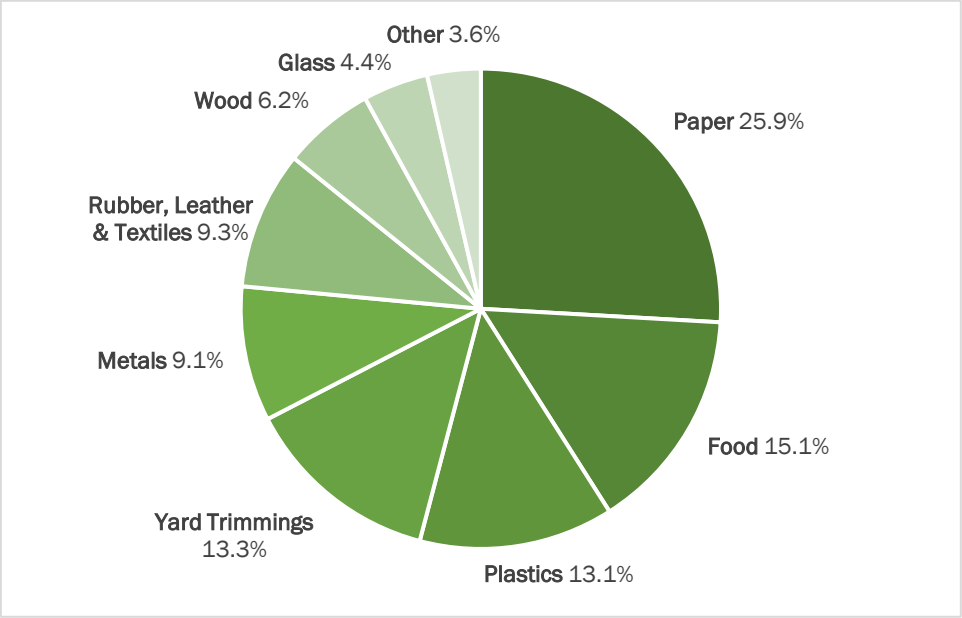
Figure 4-2 Disposition of Generated MSW by Material Group (CY 2018)



In practice, the quantities shown in the above figure may not translate perfectly into how much material is actually recovered, as it does not account for possibilities such as material loss at transfer stations or rejection of contaminated materials at processing facilities. For this reason, this study does not include a calculated diversion rate.

In an effort to evaluate the reasonableness of the above findings, Figure 4-3 shows the U.S. EPA's estimated waste generation for the U.S. as a whole. This figure provides some context to the District estimates.

Figure 4-3 MSW Generation in the U.S. (CY 2017)



Source: U.S. EPA. (2019). *Advancing Sustainable Materials Management: 2017 Fact Sheet*.[aa]

Some of the differences between the District's estimated waste generation and the EPA's estimate for the U.S. as a whole appear to have logical explanations:

- **Less yard waste in the District**: Though there is significant green space relative to other cities, an urban area such as the District would be expected to generate less yard waste than the nation as a whole.
- **Less metal in the District**: If industrial activity in the District is lower than the national average, then it would seem plausible that less metal is generated.
- **More paper and cardboard in the District**: The District is home to a highly active newspaper industry, and its economy is believed to be less industrial and more office/retail oriented than the nation as a whole. The District also has a higher than average household income level, which lends itself to higher than average use of online ordering and results in more corrugated cardboard compared to the national average. These factors would suggest that the District would generate more paper.

Other differences stem from the differences in methodology between the EPA data, which uses a materials flow approach[1], and the desktop composition analysis derived in this report, which uses comparable physical composition studies as the basis. In particular, the significantly higher fraction of "other" waste in the District's waste stream comes from frequently occurring constituents such as bulky wastes, certain C&D debris that ends up in the MSW stream, and even diapers/sanitary products. All of these are major components of the typical physical sort of the MSW stream yet are largely absent from the EPA estimates.

[1] The U.S. EPA estimates the generation and composition of MSW for the nation as a whole using a *materials flow* methodology. The materials flow methodology uses a mass balance approach, gathering data about the production of packaging, durable goods, food products, and other products that become wastes from industry associations, key businesses, and other industry sources, as well as from governments sources such as the Department of Commerce and the U.S. Census Bureau. These data are used to estimate the tons of material generated, discarded and recycled. EPA's method differs significantly from the methodology use to estimate the District's MSW characterization, but nonetheless serves as a useful benchmark.

Finally, there are some similarities, including similar estimated proportions of food waste and plastics.

In the professional opinion of MSW Consultants, this comparison suggests that the waste generation estimate for the District which has been derived in this report is reasonable in light of this national benchmark.

Furthermore, the District published a Compost Feasibility Study[II] in April 2017 that included estimates of organic waste generation broken down by generator sector. The study utilized a "bottom-up" approach to estimating waste generation: first estimating the generation rate of organic waste per household or organization type, then applying those generation rates to the estimated number of households/organizations. By contrast, this study utilized a "top-down" approach in which the quantity of total waste for each generator sector was compiled first; compositions estimates were then applied to the totals to yield generation estimates of each material type. Table 4-1 compares the organic waste generation estimates derived in this study with those of the Compost Feasibility Study.

Table 4-1 Organic Waste Generation in the District

	Desktop WCS Estimates (CY 2018)				
Generator	Food	Yard Waste and Leaves	Wood[1]	Total	Compost Feasibility Study Estimate (CY 2017)
Single-family	18,015	14,321	1,410	**33,746**	21,056 to 59,221
Multi-family	24,757	7,162	1,381	**33,301**	17,962 to 47,761
Non-residential	114,202	29,523	19,129	**162,854**	127,792[2]
Total	**156,974**	**51,006**	**21,920**	**229,900**	**166,810 to 234,774**

Notes: [1] Excludes tons categorized as treated wood.
[2] Composed of 13,427 tons resulting from landscaper activities and 114,365 tons of food waste.

As seen in the table above, this study's estimates for single- and multi-family organics generation fall near the center of the ranges provided by the Compost Feasibility Study. Additionally, non-residential food waste estimates between both studies are within 200 tons of each other. This study does estimate about 35,000 additional tons of yard and wood waste occurring in the non-residential sector. One possible explanation of this difference is that that the Compost Feasibility Study did not include untreated lumber which is responsible for the 19,129 tons of non-residential wood estimated in this study. Additionally, it is likely that some fraction of the yard waste and leaves that this study allocates to the non-residential sector is the result of landscaper activities at single-family homes.

4.3 CONCLUSIONS

The following conclusions can be drawn from this research and analysis:

- **Complexity of the Waste Management System**: Like any large city, the District has an expansive waste management system comprised of public sector and private sector participants. As providers of curbside collection to the single-family residential sector, and as managers of the Fort Totten and Benning Road Solid Waste Transfer Stations, DPW actively manages approximately 44 percent of the District's total MSW and maintains accurate data for this subset of the market. Further, like many local governments, the District maintains regulatory oversight of the hauling community and is in the process of bolstering its enforcement mechanisms and data management systems. Data availability and accuracy are more elusive for the portion of waste management services provided by third parties operating within the District, but despite the size of the system, the number of players, and the export market dynamics within which the District operates, progress is being made to better record and measure important system metrics.

- **Strengths of Desktop Characterization**: This desktop waste characterization study focused on assembling the available demographic and waste tonnage data in order to estimate waste generation based on several important data sources available from the 2013-2018 time period. This process required the involvement of multiple departments within the District, including the Department of Public Works, Office of Planning, and District Department of Transportation (DDOT), as well as other well-known regional organizations including the Washington DC Economic Partnership, Metropolitan Washington Council of Governments, and surrounding state solid waste agencies. The outreach to, and input from, these organizations was critical in deriving the best available estimates of waste generation, and it is likely that most of the steps undertaken in this study will need to be updated in future studies.
- **Weaknesses of Desktop Characterization**: The use of other studies to estimate the District's MSW composition, while cost-effective, will generalize the estimated composition when compared to the performance of a direct physical characterization study. As stated previously, such generalization does not diminish the usefulness of desktop study results for planning purposes.
- **MSW Data Availability**: The District has long maintained accurate records about the single-family residential sector by virtue of collecting from this generator. Further, a significant fraction of wastes is delivered to District-owned facilities. However, gaps still exist in tracking MSW destined for disposal (or incineration), recycling, and composting. The Solid Waste Collector Registration & Reporting System promises to significantly improve data comprehensiveness, assuming the hauling community ultimately participates to the full degree. However, it is likely that some recycling and/or organics diversion which takes place outside the commercial hauling network – such as business to broker paper recycling, scrap metal yards, and small composting programs centered on neighborhood gardens – will remain beyond any measurement system for the foreseeable future.
- **C&D Data Availability**: As mentioned throughout this report, the C&D sector is the least well-known due to the lack of reporting and the degree to which this material stream is handled outside of the District's purview.

4.4 RECOMMENDATIONS

MSW Consultants offers the following recommendations for consideration by the District as it embarks on a solid waste master planning process and also as it returns to update this waste characterization study as required by the Act:

- **Continue Updating This Report**: The District is obligated by the Act to update this research every four years. Importantly, as this data gains more uniformity with successive iterations, it will serve as an important measuring stick for progress towards any number goals within the District's soon-to-be-developed solid waste management plan.
- **Continue Auditing Mixed Recyclables**: The District has not performed extensive physical composition analysis, with one exception: on a small scale, it has audited the composition of its recyclables. Given the sensitivity of recycled material revenues to global markets and the increasing cost of high contamination, routine monitoring of the composition of its supply of recyclables is critical to maintaining a fair processing agreement and delivering a clean stream to maximize revenue.
- **Establish Diversion Performance Metrics:** The District should consider pursuing additional studies focused on establishing methodology and baseline estimates for important diversion performance metrics, such as recycling and capture rates. Focusing first on the single-family generator sector will ease this analysis due to DPW's access to comprehensive data on waste generation in this sector. The results of these studies will allow the District to better track its progress towards the waste diversion goals described in the Act.

4. CONCLUSIONS & RECOMMENDATIONS

- **Entrench and Expand Reporting Systems**: The District's recently implemented Solid Waste Collector Registration & Reporting System for MSW takes a big step towards more complete data. The District should commit to using and enforcing this reporting system in the near term due to the importance of this data for managing the District's waste stream. However, it will be important to minimize the regulatory impact of expanding this system if such additional reporting is seen as being a regulatory imposition that increases costs for businesses with no tangible benefit. Additionally, future studies would benefit from increased C&D data availability, such as through a hauler reporting system or facility-level surveys. Finally, the District may be able to incrementally disaggregate reported data from its own transfer stations, for example by weighing drop-off recyclables, drop-off yard waste and public space tonnage before combining with other like materials.
- **Consider Physical MSW Composition Analysis for Future Studies**: Although it is more costly and may incur some logistical challenges in the District's export market, physical composition analysis of the Districts MSW and C&D stream would provide invaluable insight into the actual make-up of the materials currently being discarded.
- **Investigate Reciprocal Reporting Arrangements**: Surrounding state agencies were consulted to obtain imported tonnage data for C&D debris. Given the District's reliance on export processing and disposal facilities, the District should coordinate wherever possible at least with Maryland and Virginia as it improves and expands its waste management reporting systems.

CHAPTER 4 EXHIBITS

Exhibit 4-1. Disaggregated Single-family Refuse Projections

	Recommended Composition Estimate	Annual Tonnage Estimates				
		2018	2023	2028	2033	2038
Paper	**23.4%**	**23,018**	**23,261**	**23,500**	**23,716**	**23,899**
Corrugated Cardboard Kraft Paper	4.5%	4,428	4,475	4,521	4,562	4,597
Newsprint	3.2%	3,149	3,183	3,215	3,245	3,270
Mixed Recyclable Paper	6.8%	6,691	6,762	6,831	6,894	6,947
Poly-Coated Aseptic Containers	0.1%	129	130	131	133	134
Other Paper (Non-Recyclable)	8.8%	8,621	8,712	8,802	8,882	8,951
Plastics	**12.2%**	**11,990**	**12,117**	**12,241**	**12,354**	**12,449**
#1 PET Bottles and Containers	1.3%	1,285	1,298	1,312	1,324	1,334
#2 HDPE Natural Bottles	0.2%	214	216	219	221	222
#2 HDPE Colored Bottles	0.3%	321	325	328	331	333
Rigid Plastic Containers #3-#7	0.7%	642	649	656	662	667
Expanded Polystyrene	0.9%	856	865	874	882	889
All Films and Bags	5.8%	5,674	5,734	5,793	5,846	5,891
Other Rigid Plastic	3.0%	2,998	3,029	3,060	3,088	3,112
Glass	**2.7%**	**2,654**	**2,682**	**2,710**	**2,735**	**2,756**
Glass Bottles and Jars	1.8%	1,770	1,788	1,807	1,823	1,838
Other Glass	0.9%	884	894	903	911	918
Organics	**30.9%**	**30,473**	**30,794**	**31,111**	**31,396**	**31,640**
Food Waste	17.9%	17,600	17,786	17,969	18,133	18,274
Leaves	2.8%	2,747	2,776	2,805	2,830	2,852
Yard Waste	5.6%	5,507	5,565	5,622	5,674	5,718
Other Organics	4.7%	4,618	4,667	4,715	4,758	4,795
Metals	**3.1%**	**3,046**	**3,078**	**3,110**	**3,139**	**3,163**
Ferrous/Steel Containers	0.6%	590	596	602	607	612
Other Ferrous Metals	1.2%	1,179	1,192	1,204	1,215	1,224
Aluminum Cans	0.4%	393	397	401	405	408
Other Aluminum	0.4%	393	397	401	405	408
Other Non-Ferrous Metals	0.3%	295	298	301	304	306
Appliances	0.2%	197	199	201	202	204
C&D	**10.3%**	**10,182**	**10,289**	**10,395**	**10,490**	**10,572**
Wood - Clean	1.0%	960	970	980	989	997
Wood - Treated/Mfg	4.7%	4,635	4,684	4,732	4,776	4,813
Asphalt, Brick, Rock, & Concrete	1.8%	1,751	1,769	1,787	1,804	1,818
Carpet and Carpet Padding	2.3%	2,220	2,244	2,267	2,287	2,305
Remainder/Composite/Other C&D	0.6%	616	622	629	634	639
Other	**17.4%**	**17,098**	**17,278**	**17,456**	**17,616**	**17,753**
Hazardous Materials	0.3%	295	298	301	304	306
Televisions & CRTs	0.5%	491	497	502	506	510
Electronics	0.4%	393	397	401	405	408
Bulky Items	3.4%	3,341	3,376	3,411	3,442	3,469
Tires	0.1%	98	99	100	101	102
Clothing Textiles	6.3%	6,191	6,256	6,320	6,378	6,428
Non-clothing Textiles	0.9%	884	894	903	911	918
Diapers and Sanitary Products	3.4%	3,341	3,376	3,411	3,442	3,469
Dirt and Fines	1.5%	1,474	1,490	1,505	1,519	1,530
Other Not Elsewhere Classified	0.6%	590	596	602	607	612
Totals	**100.0%**	**98,462**	**99,500**	**100,523**	**101,445**	**102,231**

Exhibit 4-2. Disaggregated Multi-family Refuse Projections

	Recommended Composition Estimate	Annual Tonnage Estimates				
		2018	2023	2028	2033	2038
Paper	**31.1%**	**52,255**	**57,519**	**62,706**	**67,384**	**71,374**
Corrugated Cardboard Kraft Paper	7.4%	12,342	13,585	14,810	15,915	16,857
Newsprint	5.2%	8,778	9,663	10,534	11,320	11,990
Mixed Recyclable Paper	11.1%	18,650	20,529	22,380	24,049	25,473
Poly-Coated Aseptic Containers	0.2%	359	395	430	462	490
Other Paper (Non-Recyclable)	7.2%	12,127	13,348	14,552	15,638	16,563
Plastics	**12.1%**	**20,266**	**22,307**	**24,319**	**26,133**	**27,680**
#1 PET Bottles and Containers	2.1%	3,581	3,941	4,297	4,617	4,891
#2 HDPE Natural Bottles	0.4%	597	657	716	770	815
#2 HDPE Colored Bottles	0.5%	895	985	1,074	1,154	1,223
Rigid Plastic Containers #3-#7	1.1%	1,790	1,971	2,148	2,309	2,445
Expanded Polystyrene	0.7%	1,205	1,326	1,446	1,553	1,645
All Films and Bags	4.8%	7,981	8,785	9,577	10,292	10,901
Other Rigid Plastic	2.5%	4,216	4,641	5,060	5,437	5,759
Glass	**3.7%**	**6,177**	**6,799**	**7,412**	**7,965**	**8,437**
Glass Bottles and Jars	2.9%	4,933	5,430	5,919	6,361	6,738
Other Glass	0.7%	1,244	1,369	1,493	1,604	1,699
Organics	**22.9%**	**38,407**	**42,276**	**46,089**	**49,527**	**52,459**
Food Waste	14.7%	24,757	27,251	29,708	31,924	33,815
Leaves	2.3%	3,864	4,253	4,637	4,983	5,278
Yard Waste	2.0%	3,290	3,621	3,948	4,242	4,494
Other Organics	3.9%	6,496	7,151	7,796	8,377	8,873
Metals	**3.7%**	**6,184**	**6,807**	**7,421**	**7,975**	**8,447**
Ferrous/Steel Containers	1.0%	1,643	1,809	1,972	2,119	2,245
Other Ferrous Metals	1.0%	1,659	1,826	1,990	2,139	2,266
Aluminum Cans	0.7%	1,096	1,206	1,315	1,413	1,496
Other Aluminum	0.7%	1,096	1,206	1,315	1,413	1,496
Other Non-Ferrous Metals	0.2%	415	456	498	535	566
Appliances	0.2%	276	304	332	356	378
C&D	**8.5%**	**14,322**	**15,765**	**17,186**	**18,468**	**19,562**
Wood - Clean	0.8%	1,351	1,487	1,621	1,742	1,845
Wood - Treated/Mfg	3.9%	6,520	7,177	7,824	8,407	8,905
Asphalt, Brick, Rock, & Concrete	1.5%	2,463	2,711	2,955	3,175	3,363
Carpet and Carpet Padding	1.9%	3,123	3,438	3,748	4,027	4,266
Remainder/Composite/Other C&D	0.5%	866	953	1,039	1,117	1,183
Other	**18.0%**	**30,251**	**33,298**	**36,301**	**39,009**	**41,318**
Hazardous Materials	0.2%	415	456	498	535	566
Televisions & CRTs	0.4%	691	761	829	891	944
Electronics	0.3%	553	609	663	713	755
Bulky Items	6.5%	10,900	11,998	13,080	14,055	14,887
Tires	0.1%	138	152	166	178	189
Clothing Textiles	5.2%	8,708	9,585	10,450	11,229	11,894
Non-clothing Textiles	0.7%	1,244	1,369	1,493	1,604	1,699
Diapers and Sanitary Products	2.8%	4,700	5,173	5,639	6,060	6,419
Dirt and Fines	1.2%	2,073	2,282	2,488	2,674	2,832
Other Not Elsewhere Classified	0.5%	829	913	995	1,069	1,133
Totals	**100.0%**	**167,862**	**184,772**	**201,434**	**216,459**	**229,277**

Exhibit 4-3. Disaggregated Non-residential Refuse Projections

	Recommended Composition Estimate	Annual Tonnage Estimates				
		2018	2023	2028	2033	2038
Paper	**29.8%**	**183,286**	**194,030**	**204,046**	**213,198**	**221,238**
Corrugated Cardboard Kraft Paper	10.4%	64,296	68,065	71,578	74,789	77,609
Newsprint	1.1%	6,788	7,185	7,556	7,895	8,193
Mixed Recyclable Paper	9.2%	56,668	59,989	63,086	65,916	68,401
Poly-Coated Aseptic Containers	1.7%	10,490	11,105	11,678	12,202	12,662
Other Paper (Non-Recyclable)	7.3%	45,045	47,685	50,147	52,396	54,372
Plastics	**16.6%**	**102,387**	**108,388**	**113,983**	**119,096**	**123,587**
#1 PET Bottles and Containers	2.1%	12,958	13,718	14,426	15,073	15,641
#2 HDPE Natural Bottles	0.4%	2,592	2,744	2,885	3,015	3,128
#2 HDPE Colored Bottles	0.3%	1,728	1,829	1,923	2,010	2,086
Rigid Plastic Containers #3-#7	0.2%	1,234	1,306	1,374	1,436	1,490
Expanded Polystyrene	1.9%	11,724	12,411	13,052	13,637	14,152
All Films and Bags	7.2%	44,384	46,985	49,411	51,627	53,574
Other Rigid Plastic	4.5%	27,767	29,395	30,913	32,299	33,517
Glass	**3.0%**	**18,199**	**19,266**	**20,260**	**21,169**	**21,967**
Glass Bottles and Jars	2.3%	14,192	15,024	15,800	16,508	17,131
Other Glass	0.7%	4,007	4,242	4,461	4,661	4,837
Organics	**25.0%**	**153,976**	**163,001**	**171,416**	**179,104**	**185,858**
Food Waste	17.9%	109,880	116,321	122,326	127,812	132,632
Leaves	0.8%	4,936	5,226	5,496	5,742	5,959
Yard Waste	2.5%	15,426	16,331	17,174	17,944	18,621
Other Organics	3.9%	23,733	25,124	26,421	27,606	28,647
Metals	**2.8%**	**16,967**	**17,961**	**18,889**	**19,736**	**20,480**
Ferrous/Steel Containers	0.5%	3,085	3,266	3,435	3,589	3,724
Other Ferrous Metals	1.2%	7,405	7,839	8,243	8,613	8,938
Aluminum Cans	0.7%	4,319	4,573	4,809	5,024	5,214
Other Aluminum	0.3%	1,541	1,631	1,716	1,793	1,860
Other Non-Ferrous Metals	0.1%	616	653	686	717	744
C&D	**10.2%**	**62,940**	**66,629**	**70,068**	**73,211**	**75,972**
Wood - Clean	3.1%	19,129	20,250	21,295	22,250	23,090
Wood - Treated/Mfg	2.5%	15,426	16,331	17,174	17,944	18,621
Asphalt, Brick, Rock, & Concrete	0.2%	1,234	1,306	1,374	1,436	1,490
Carpet and Carpet Padding	3.7%	22,831	24,169	25,417	26,557	27,558
Remainder/Composite/Other C&D	0.7%	4,319	4,573	4,809	5,024	5,214
Other	**12.6%**	**77,638**	**82,189**	**86,432**	**90,308**	**93,714**
Hazardous Materials	0.1%	617	653	687	718	745
Televisions & CRTs	0.5%	3,132	3,316	3,487	3,643	3,781
Electronics	0.4%	2,610	2,763	2,906	3,036	3,151
Bulky Items	3.4%	20,959	22,187	23,333	24,379	25,299
Tires	0.1%	308	326	343	359	372
Clothing Textiles	4.3%	26,533	28,089	29,539	30,864	32,027
Diapers and Sanitary Products	1.5%	9,247	9,789	10,294	10,756	11,161
Dirt and Fines	0.4%	2,468	2,613	2,748	2,871	2,979
Other Not Elsewhere Classified	1.9%	11,764	12,453	13,096	13,683	14,199
Totals	**100.0%**	**615,393**	**651,463**	**685,094**	**715,823**	**742,816**

Exhibit 4-4. Disaggregated Single-family Mixed Recyclables Projections

	Recommended Composition Estimate	Annual Tonnage Estimates				
		2018	2023	2028	2033	2038
Paper	**55.3%**	**14,641**	**14,795**	**14,947**	**15,084**	**15,201**
Corrugated Cardboard/Kraft Paper	27.6%	7,320	7,398	7,474	7,542	7,601
Newsprint	6.2%	1,644	1,662	1,679	1,694	1,707
Poly-Coated Aseptic Containers	1.0%	265	268	271	273	275
Mixed Recyclable Paper	20.4%	5,411	5,468	5,524	5,575	5,618
Plastics	**11.9%**	**3,156**	**3,190**	**3,222**	**3,252**	**3,277**
#1 PET Bottles and Containers	3.9%	1,034	1,045	1,056	1,066	1,074
#2 HDPE Natural Bottles	1.0%	255	257	260	262	264
#2 HDPE Colored Bottles	0.6%	170	172	173	175	176
Rigid Plastic Containers #3-#7	3.0%	796	804	812	820	826
All Films and Bags	1.4%	371	375	379	383	386
Non-Recyclable Plastics	2.0%	530	536	542	547	551
Glass	**11.1%**	**2,942**	**2,973**	**3,004**	**3,031**	**3,055**
Glass Bottles and Jars	11.1%	2,942	2,973	3,004	3,031	3,055
Metals	**3.9%**	**1,034**	**1,045**	**1,056**	**1,066**	**1,074**
Aluminum Cans	2.0%	542	548	553	558	563
Aluminum Foil/Baking Tins	0.2%	42	42	43	43	43
Steel Cans	1.4%	371	375	379	383	386
Scrap Metal	0.3%	80	80	81	82	83
Other	**17.8%**	**4,723**	**4,773**	**4,822**	**4,866**	**4,904**
Unspecified Contamination	17.8%	4,723	4,773	4,822	4,866	4,904
Totals	**100.0%**	**26,497**	**26,776**	**27,051**	**27,299**	**27,511**

Exhibit 4-5. Disaggregated Multi-family Mixed Recyclables Projections

	Recommended Composition Estimate	Annual Tonnage Estimates				
		2018	2023	2028	2033	2038
Paper	**49.3%**	**12,074**	**13,290**	**14,489**	**15,569**	**16,491**
Corrugated Cardboard/Kraft Paper	20.6%	5,048	5,556	6,057	6,509	6,894
Newsprint	6.5%	1,578	1,737	1,894	2,035	2,156
Poly-Coated Aseptic Containers	1.0%	255	280	305	328	348
Mixed Recyclable Paper	21.2%	5,193	5,717	6,232	6,697	7,093
Plastics	**13.0%**	**3,190**	**3,511**	**3,828**	**4,114**	**4,357**
#1 PET Bottles and Containers	4.1%	993	1,093	1,191	1,280	1,356
#2 HDPE Natural Bottles	1.0%	244	269	293	315	334
#2 HDPE Colored Bottles	0.7%	163	179	196	210	223
Rigid Plastic Containers #3-#7	3.1%	764	841	916	985	1,043
All Films and Bags	1.7%	423	465	507	545	577
Non-Recyclable Plastics	2.5%	604	664	724	778	825
Glass	**11.5%**	**2,824**	**3,108**	**3,389**	**3,641**	**3,857**
Glass Bottles and Jars	11.5%	2,824	3,108	3,389	3,641	3,857
Metals	**4.1%**	**1,007**	**1,108**	**1,208**	**1,299**	**1,375**
Aluminum Cans	2.1%	520	572	624	671	710
Aluminum Foil/Baking Tins	0.2%	40	44	48	52	55
Steel Cans	1.5%	356	392	428	460	487
Scrap Metal	0.4%	91	100	109	117	124
Other	**22.0%**	**5,375**	**5,916**	**6,450**	**6,931**	**7,341**
Unspecified Contamination	22.0%	5,375	5,916	6,450	6,931	7,341
Totals	**100.0%**	**24,470**	**26,935**	**29,364**	**31,554**	**33,422**

Exhibit 4-6. Disaggregated Non-Residential Mixed Recyclables Projections

	Recommended Composition Estimate	Annual Tonnage Estimates				
		2018	2023	2028	2033	2038
Paper	**67.7%**	**31,197**	**33,025**	**34,730**	**36,288**	**37,656**
Corrugated Cardboard/Kraft Paper	53.7%	24,741	26,191	27,543	28,778	29,864
Newsprint	1.4%	640	678	713	745	773
Poly-Coated Aseptic Containers	0.1%	46	49	51	53	55
Mixed Recyclable Paper	12.5%	5,770	6,108	6,423	6,711	6,964
Plastics	**5.4%**	**2,471**	**2,616**	**2,751**	**2,874**	**2,983**
#1 PET Bottles and Containers	1.6%	732	775	815	852	884
#2 HDPE Natural Bottles	0.8%	357	377	397	415	430
#2 HDPE Colored Bottles	0.5%	238	252	265	276	287
Rigid Plastic Containers #3-#7	1.1%	527	557	586	613	636
All Films and Bags	1.2%	549	581	611	639	663
Non-Recyclable Plastics	0.1%	69	73	77	80	83
Glass	**6.1%**	**2,824**	**2,989**	**3,144**	**3,285**	**3,408**
Glass Bottles and Jars	6.1%	2,824	2,989	3,144	3,285	3,408
Metals	**1.9%**	**893**	**945**	**994**	**1,039**	**1,078**
Aluminum Cans	0.8%	361	383	402	420	436
Aluminum Foil/Baking Tins	0.1%	28	29	31	32	34
Steel Cans	0.6%	274	290	305	319	331
Scrap Metal	0.5%	229	243	255	267	277
Other	**18.8%**	**8,665**	**9,173**	**9,646**	**10,079**	**10,459**
Unspecified Contamination	18.8%	8,665	9,173	9,646	10,079	10,459
Totals	**100.0%**	**46,049**	**48,748**	**51,265**	**53,564**	**55,584**

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APPENDIX A

LIST OF DATA SOURCES

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APPENDIX A – LIST OF DATA SOURCES

[a] Sustainable DC. (2013). **Sustainable DC Plan.**
http://www.sustainabledc.org/about/sustainable-dc-plan/

[b] Code of the District of Columbia. (2014). **Sustainable Solid Waste Management Amendment Act of 2014.**
https://code.dccouncil.us/dc/council/code/titles/8/chapters/10A/

[c] Sustainable DC. (2019). **Sustainable DC 2.0 Plan.**
http://www.sustainabledc.org/wp-content/uploads/2019/04/sdc-2.0-Edits-V5_web.pdf

[d] DPW. (2019). **DC Transfer Station Data 2008-2018**: Contains all scale transactions for all waste transferred at the District's Ft. Totten and Benning Road Solid Waste Transfer Stations between calendar years 2008 through 2018. Data pulled from DPW's Compuweigh system. Inbound quantities were used for waste generation estimates.

[e] DPW. (2013). **Arcadis Facility Surveys**: A facility-level survey conducted by Arcadis in 2013 which included voluntary reporting by ten of the District's largest disposal and processing sites in the region, for which the District has previously transported waste for disposal or processing. These surveys attempted to establish a District-wide baseline for waste generation. All ten facilities are still active as of 2019. The ten facilities included:

- Acme Biomass - Brookeville, MD
- Covanta Alexandria - Alexandria, VA
- Covanta Fairfax - Lorton, VA
- Federal IPC Trash Transfer Station - Washington D.C.
- King and Queen Landfill - Plymouth, VA
- King George Landfill - King George, VA
- Middle Peninsula Landfill - Glenns, VA
- Northeast Transfer Station - Washington D.C.
- Old Dominion Landfill - Henrico, VA
- Olive St. MRF - Capitol Heights, MD

[f] DPW. (2019). **2017-2018 Collector Reports**: Solid waste collector reports provided by haulers to DPW per the Solid Waste Collector Registration & Reporting requirements. Full compliance in these reports has not yet been achieved, although the compliance rate in calendar year 2018 improved greatly compared to calendar year 2017.

[g] U.S. Census Bureau, Population Division. (2018). **Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2018**: Total population estimates for the District.
https://data.census.gov/cedsci/table?q=DP05&g=0400000US11&tid=ACSDP1Y2018.DP05

[h] DPW. (2020). **Waste Characterization Study: Final Changes [email]**: Number of single-family residential households (3 or less dwelling units) served by the Solid Waste Collection Division. This number (103,886 for CY 2018) was used as the single-family household count to correspond with the tons received at the DPW transfer stations from the Solid Waste Collection Division. Other sources of single-family household estimates may differ due to varying definitions of a single-family household. The number of single-family homes is based on a list of addresses maintained by DPW for where containers have been delivered, combined with data for number of households per address from the District's Master Address Repository, accessed in March 2020.

[i] District of Columbia Office of Planning. (2016). **Forecasting the District's Growth: Results and Methodology:** Provides persons per household for single-family and multi-family households, in addition to other analysis of MWCOG data. The reported single-family persons per household of 2.663 was used in this study. The reported multi-family persons per household of 1.651 was not used in this study; instead, in order to align the U.S. Census Bureau population estimates and the MWCOG household estimates, the multi-family persons per household was calculated based on the now fixed single-family persons per household along with the number of households and populations of the District.

https://planning.dc.gov/sites/default/files/dc/sites/op/publication/attachments/Forecasting%20DC%20Growth%202015-2045%20-%20Results%20and%20Methodology%20-%20FINAL_011217.pdf

[j] District of Columbia Office of Planning. (2019). **Telephone Interview:** Discussed various topics related to demographic data including single and multi-family household growth rates, single and multi-family household sizes, and development and renovation activity. The Office of Planning recommended 5 percent of total household growth be attributed to single-family dwellings and the remaining 95 percent attributed to multi-family dwellings. Additionally, the Office agreed that household sizes of 2.66 persons per household for single-family and 2.06 persons per household for multi-family were reasonable, though exact estimates were not available.

[k] Metropolitan Washington Council of Governments (MWCOG). (2018). **Round 9.1 Growth Trends to 2045: Cooperative Forecasting in Metropolitan Washington**: Provides extensive data and analysis for regional planning-level activities including projected total population, total households, and total employment for the District in five-year increments between 2015 and 2045. https://www.mwcog.org/documents/2018/10/17/cooperative-forecasts-employment-population-and-household-forecasts-by-transportation-analysis-zone-cooperative-forecast-demographics-housing-population/

[l] U.S. Bureau of Labor Statistics. (2019). **District of Columbia - May 2018 OES State Occupational Employment and Wage Estimates**: Employment by sector data for May 2018. Similar tables are available for years 1997-2017. https://www.bls.gov/oes/current/oes_dc.htm

[m] Destination DC. (2017). **2017 Visitor Statistics, Washington D.C.**: Provides information related to the District's hospitality industry including number of annual tourists estimated between 2012 and 2021. https://washington.org/press/dc-information/washington-dc-visitor-research

[n] Washington D.C. Economic Partnership (WDCEP). (2018). **WDCEP Development Report**: List of large-scale construction projects completed or planned for completion between 2015 and 2032, along with the square footage and value of each project.

[o] Virginia Department of Environmental Quality (VDEQ). (2019). **2019 Annual Solid Waste Report for CY2018**: Virginia's annual solid waste report which, among other data, detailed the amount of C&D received from the District. https://www.deq.virginia.gov/Portals/0/DEQ/Land/SolidWaste/SWIA/2019%20Annual%20Solid%20Waste%20Report%20for%20CY2018%20-%20FINAL.pdf?ver=2019-06-20-105457-813

[p] Maryland Department of the Environment (MDE). (2019). **PIA Request for C&D Waste Tonnages [email]**: Documents resulting from a Public Information Act request. Included spreadsheets showing the amount of C&D imported from other jurisdictions for years 2015-2017.

[q] Pennsylvania Department of Environmental Protection (PADEP). (2019). **Solid Waste Disposal Information**: Database of facility-level disposal data, including the amount of C&D received from the District for calendar year 2018. http://www.depgreenport.state.pa.us/powerbiproxy/powerbi/Public/DEP/WM/PBI/Solid_Waste_Disposal_Information

[r] Howell, Kathryn, George Mason University School of Public Policy, Center for Regional Analysis. (2014). **Multifamily Housing in the Washington, DC Region: Demand and Supply Trends**: Research paper on multi-family housing in the District. Found that "residents living in multifamily households are more likely to have incomes of less than half of the regions area median income." http://cra.gmu.edu/pdfs/studies_reports_presentations/Multifamily%20Housing%20in%20the%20DC%20Region_Final.pdf

[s] Prepared for Chicago Department of Environment. (2010). **Waste Characterization Study.** https://www.chicago.gov/content/dam/city/depts/doe/general/RecyclingAndWasteMgmt_PDFs/WasteAndDiversionStudy/WasteCharacterizationReport.pdf

[t] Prepared for the Connecticut Department of Energy and Environmental Protection (CT DEEP), Bureau of Materials Management and Compliance Assurance. (2016). **Construction and Demolition Waste Characterization and Market Analysis.**

https://portal.ct.gov/DEEP/Waste-Management-and-Disposal/Solid-Waste-Management-Plan/Comprehensive-Materials-Management-Strategy

[u] Prepared for Lexington-Fayette Urban County Government. (2014). **County-wide Waste Stream Analysis.**

[v] Prepared for Louisville Metro Government. (2016). **Louisville Metro 2016 Waste Characterization Study.** https://louisvilleky.gov/sites/default/files/public_works/pdf_files/10_year_waste_composition_study.pdf

[w] Prepared for Massachusetts Department of Environment Protection (MassDEP). (2018). **Massachusetts Materials Management Capacity Study.** https://www.mass.gov/files/documents/2019/02/19/capstudy.pdf

[x] Prepared for Missouri Department of Environmental Resources. (2018). **Statewide Waste Composition Study.** https://dnr.mo.gov/env/swmp/docs/20162017wastesortcharreport.pdf

[y] U.S. Environmental Protection Agency, Office of Resource Conservation and Recovery. (2018). **Construction and Demolition Debris Generation in the United States, 2015.** https://www.epa.gov/sites/production/files/2018-09/documents/construction_and_demolition_debris_generation_in_the_united_states_2015_final.pdf

[z] Seattle Public Utilities. (2018). **2017 Recycling Rate Report.** http://www.seattle.gov/Documents/Departments/SPU/Documents/2017AnnualRecyclingReport06292018Final.pdf

[aa] U.S. Environmental Protection Agency. (2019). **Advancing Sustainable Materials Management: 2017 Tables and Figures.** https://www.epa.gov/sites/production/files/2019-11/documents/2017_facts_and_figures_fact_sheet_final.pdf

[bb] Prepared for the Arlington County, VA, Department of Environmental Services, Solid Waste Bureau. (2018). **Project Wrap-up Report for Spring 2018 Multi-family, Commercial, and Institutional Waste Audits [technical memo].**

[cc] Washington D.C. (2018). **Residential Recycling Program: 2017-2018 Benchmarking, Trends, and Goals.** https://zerowaste.dc.gov/sites/default/files/dc/sites/zerowaste/Residential%20Recycling%20Report%202017-2018.pdf

[dd] Prepared for the Metro Nashville Public Works and Tennessee Department of Environment & Conservation. (2018). **Metro Nashville and Davidson County, TN Waste Stream and Recycling Characterization Study.** https://www.nashville.gov/Portals/0/SiteContent/pw/docs/recycle/MasterPlan/Nashville%20Waste%20and%20Recycle%20Characterization%20Study_Final.pdf

[ee] Prepared for the Georgia Department of Natural Resources (GDNR), Sustainability Division. (2010). **Statewide Construction and Demolition Debris Characterization Study** https://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/CandDStudy.pdf

[ff] Prepared for the Northeast Maryland Waste Disposal Authority, Maryland Department of the Environment (MDE). (2017). **2016 Maryland Statewide Waste Characterization Study.** https://mde.maryland.gov/programs/LAND/SolidWaste/Documents/2016%20Maryland%20Statewide%20WCS%20Study.pdf

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[hh] Prepared for City of Philadelphia, PA. (2017). **City of Philadelphia 2017 Residential Composition Study.**

[ii] Prepared for Prince George's County, MD. (2016). **Waste Characterization Study Summary of Results 2014/2015.**

https://www.princegeorgescountymd.gov/DocumentCenter/View/17262/Waste-Characterization-Report---FINAL-2016JUN07?bidId=

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[kk] DPW. (2018). **Mayor's List of Recyclables and Compostables.** https://dpw.dc.gov/sites/default/files/dc/sites/dpw/page_content/attachments/Mayors%20List%20of%20Recyclables%20and%20Compostables.pdf

[ll] RRS. (2017). **District of Columbia Compost Feasibility Study**. https://dpw.dc.gov/sites/default/files/dc/sites/dpw/page_content/attachments/DC%20Compost%20Feasibility%20Study_vf_0417.pdf

APPENDIX B

WASTE COMPOSITION STUDY SOURCE DATA

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APPENDIX B – MATERIAL CATEGORIES AND DEFINITIONS

Below are the material categories and definitions used in the refuse, mixed recyclables, and C&D stream characterizations. Please note that these definitions may differ from those in the Mayor's List of Recyclables or definitions used for program requirements.

Refuse Categories

Category	Description
Paper	CORRUGATED CARDBOARD/KRAFT PAPER: Corrugated boxes or paper bags made from Kraft paper. Uncoated Corrugated Cardboard has a wavy center layer and is sandwiched between the two outer layers and does not have any wax coating on the inside or outside. Examples include entire cardboard containers, such as shipping and moving boxes, computer packaging cartons, and sheets and pieces of boxes and cartons. This type does not include chipboard. Examples of Kraft paper include paper grocery bags, un-soiled fast food bags, department store bags, and heavyweight sheets of Kraft packing paper.
	NEWSPRINT: Paper chiefly used for printing newspapers – i.e. uncoated groundwood paper.
	MIXED RECYCLABLE PAPER: Paper other than the paper mentioned above, which can be recycled. Examples include high-grade office paper, magazines/catalogs, manila folders, manila envelopes, index cards, white envelopes, notebook paper, carbonless forms, junk mail, chipboard and uncoated paperboard, phone directories, non-glossy catalogs, offshore cardboard and deep-toned or fluorescent dyed paper.
	POLY-COATED ASEPTIC CONTAINERS: Aseptic containers (multi-layered packaging that contains shelf-stable food products such as apple juice, soup, soy/rice milk, etc.) and "gable top" cartons (non-refrigerated items such as granola and crackers; refrigerated items such as milk, juice, egg substitutes, etc.). Rigid food and beverage cartons are usually paper-based, may be any shape, and may include a plastic pour spout as part of the carton.
	OTHER PAPER (NON-RECYCLABLE): Items made mostly of paper but combined with large amounts of other materials such as plastic, metal, glues, foil, and moisture. Examples include plastic-coated corrugated cardboard, cellulose insulation, sepia, onionskin paper, foiled-lined fast food wrappers, frozen juice containers, carbon paper, blueprints, self-adhesive notes, softcover and hardcover books, and photographs.
Plastics	#1 PET BOTTLES AND CONTAINERS: Clear or colored PET beverage bottles and containers (which originally contained non-hazardous materials). When marked for identification, such items contain the number —1 in the center of the triangular recycling symbol and may also bear the letters —PETE or—PET. A PET container usually has a small dot left from the manufacturing process, not a seam. PET non-beverage containers consist of jars, or rectangular containers used for produce, egg cartons, etc.
	#2 HDPE NATURAL BOTTLES: Natural HDPE bottles or containers (which originally contained non-hazardous material) that are cloudy white, allowing light to pass through it. When marked for identification, such containers bear the number —2 in the triangular recycling symbol, and may also bear the letters—HDPE.
	#2 HDPE COLORED BOTTLES: Natural HDPE bottles or containers (which originally contained non-hazardous material) that are or a solid color, preventing light from passing through it. When marked for identification, such containers bear the number —2 in the triangular recycling symbol, and may also bear the letters—HDPE.
	PLASTIC CONTAINERS #3-#7: Plastic containers made of types of plastic other than HDPE or PET that did not formerly contain hazardous materials. Items may be made of PVC, PP, or PS. When marked for identification, these items may bear the number 3, 4, 5, 6, or 7 in the triangular recycling symbol. This subtype also includes unmarked plastic containers.

APPENDIX B – MATERIAL CATEGORIES AND DEFINITIONS

Category	Description
	EXPANDED POLYSTYRENE "STYROFOAM": “Styrofoam” products including food and non-food packaging and finished products made of expanded polystyrene including cups, plates, trays, clamshells, etc.
	ALL FILMS AND BAGS: Includes all film plastic such as shopping bags, grocery bags, trash bags, shrink wrap, plastic food and candy wrappers, as well as large-scale packaging or transport packaging such as dry cleaning bags, shrink-wrap, mattress bags, furniture wrap, and film bubble wrap. Other items include sandwich bags, zipper-closeable bags, produce bags, frozen vegetable bags, newspaper bags, painting tarps, shower curtains, mailing pouches, bank bags, X-ray film, metallized film (wine containers and balloons), and plastic food wrap.
	OTHER RIGID PLASTIC : Plastic that cannot be put in any other type or subtype, including injection molded tubs and lids and items comprised mostly of plastic but combined with other materials. Examples include auto parts made of plastic attached to metal, plastic drinking straws, foam packing blocks (does not include Styrofoam blocks), plastic strapping, new plastic laminate (e.g., Formica), vinyl, linoleum, plastic lumber, imitation ceramics, handles and knobs, some kitchen ware, plastic string (as used for hay bales), and plastic rigid bubble/foil packaging (as for medications); CD’s, and rigid plastic housewares, such as mop buckets, dishes, cups, and cutlery. Also includes durable plastic items that are made to last for a few months up to many years. These include the plastics used in children toys, furniture, plastic landscape ties, buckets, crates, pallets, sporting goods, etc.
Glass	GLASS BOTTLES AND JARS: Includes glass bottles and jars for beverages, foods and non-food items
	OTHER GLASS : Glass that is not a bottle or jar. Includes items made mostly of glass but combined with other materials. Examples include Pyrex, Corningware, crystal, plate glass, window and door glass, , ceramics, porcelain, and other glass tableware, mirrors, non-fluorescent light bulbs, auto windshields, laminated glass, or any curved (non-container) glass.
Metals	FERROUS/STEEL CONTAINERS : Rigid containers made mainly of steel, such as food and beverage containers. These items will stick to a magnet and may be tin-coated.
	OTHER FERROUS METALS: Includes any iron or steel item that is Magnetic and not mixed with other materials. Does not include "Ferrous/Steel containers". Examples include empty or dry paint cans, structural steel beams, boilers, clothes hangers, pipes, some cookware, security bars, scrap ferrous items, and galvanized items such as nails and flashing.
	ALUMINUM CANS: Beverage containers made from aluminum, including cat food containers.
	OTHER ALUMINUM: This category includes all other aluminum products such as lawn chairs, tables, carts, house siding, rain gutters, window frames, cookware, flatware, aluminum foil, other miscellaneous utensils, and die cast aluminum auto or machine parts.
	OTHER NON-FERROUS METALS: Non-Magnetic metals such as brass, bronze, silver, lead copper, and zinc. Stainless steel house wares are also part of this category.
	APPLIANCES: Stoves, refrigerators, dishwashers and all other large and small household appliances including fragments.
Organics	FOOD WASTE : Food material resulting from the processing, storage, preparation, cooking, handling, or consumption of food. This type includes material from industrial, commercial, or residential sources. Examples include discarded meat scraps, dairy products, eggshells, fruit or vegetable peels, and other food items from homes, stores and restaurants. This type includes apple pomace and other processed residues or material from canneries, wineries or other industrial sources.
	LEAVES: Leaves.

APPENDIX B – MATERIAL CATEGORIES AND DEFINITIONS

Category	Description
	YARD WASTE: Grass clippings and woody plant material 4 inches or less in diameter from any public or private landscapes. Examples include branches, prunings, shrubs, and whole plants. This subtype does not include woody material greater than 4 inches in diameter.
	OTHER ORGANICS: Organic material that cannot be put in any other type or subtype. This type includes items made mostly of organic materials but combined with other materials. Examples include cork, hemp rope, hair, cigarette butts, full vacuum bags, sawdust, and animal feces. Also includes manure and soiled bedding materials from domestic, farm, wild, or ranch animals. Examples include manure and soiled bedding from animal production operations, racetracks, riding stables, animal hospitals, laboratories, zoos, nature centers, and other sources.
C&D	WOOD - CLEAN : Wood that does not contain an adhesive, paint, stain, fire retardant, pesticide or preservative. Includes such items as pallets, skids, spools, packaging materials, bulky wood waste or scraps from newly-built wood products. Does not include land clearing debris (tree stumps, trunks, branches) or yard waste.
	WOOD –TREATED/MFG: Wood that contains an adhesive, paint, stain, fire retardant, pesticide or preservative. Includes painted or stained lengths of wood from construction or woodworking activities, plywood, particle board, Oriented Strand Board (OSB), manufactured wood products, and wood treated with preservatives.
	ASPHALT, BRICK, ROCK, & CONCRETE : Includes chunks of asphalt pavement, brick, and concrete from construction activities and demolition of buildings, roads, and bridges and similar sources. Asphalt pavement also includes other black or brown, tar-like material mixed with aggregate and used as a paving material. Brick also includes masonry brick, landscaping or walkway brick. Concrete also includes pieces of building foundations, concrete paving, and cinder blocks.
	CARPET AND CARPET PADDING : Flooring applications consisting of various natural or synthetic fibers which maybe bonded to some type of backing material. Includes the plastic, foam, felt, or other material used under carpet to provide insulation and padding.
	REMAINDER/COMPOSITE/OTHER C&D: Construction and demolition material that cannot be put in any other type or subtype. This type may include items from different types combined, which would be very hard to separate. Includes ceiling tiles, dirt, dust or ash generated from construction and demolition activities. Also includes HVAC ducting, fiberglass and other types of insulation, asphalt roofing materials, drywall, and plaster building products.
Other	HAZARDOUS MATERIALS: This category includes paints/solvents, flammable liquids, pesticides/herbicides and fertilizers, corrosives, bio-hazards, medical wastes and sharps, electrical ballasts, compact fluorescent bulbs (CFLs) and other fluorescent lighting, all types of batteries, vehicle and equipment fluids, and any other hazardous material not otherwise described. Also includes empty glass or plastic containers that formerly contained hazardous materials.
	TELEVISIONS AND COMPUTER MONITORS (CRTS): Stand-alone display system containing a CRT or any other type of display primarily intended to receive video programming via broadcast. Examples also include non-CRT units such as plasma and LCD monitors.
	ELECTRONICS : Any electronic product containing a circuit board including cell phones, computers and related accessories, printers, radios, and stereos. DOES NOT include electronics with intact or broken CRTs.
	BULKY FURNITURE WITH METAL FRAMES : All bulky furniture with "non-crushable" metal frames. Metal-framed chairs, couches, desks, and other oversized items made of multiple materials. Does not include wood-framed furniture.

APPENDIX B – MATERIAL CATEGORIES AND DEFINITIONS

Category	Description
	BULKY ITEMS : Products made from multiple materials and large in size, which are meant for extended use. Includes mattresses, and bulky furniture with "crushable" wood frames, along with chairs, couches, desks, and other oversized items made of multiple materials.
	TIRES: Continuous solid or pneumatic rubber covering intended for use on any type of vehicle (including bicycles), or trailer to be used in tandem with any type vehicle and other rubber products.
	CLOTHING TEXTILES: Natural or man-made textile materials such as cottons, wools, silk, nylon, or polyester used for clothing. Also includes rubber and leather materials used for clothing such as belts and footwear.
	NON-CLOTHING TEXTILES: Natural or man-made textile materials such as cottons, wools, silk, nylon, or polyester used for non-clothing purposes.
	DIAPERS AND SANITARY PRODUCTS: Child and adult diapers and sanitary products.
	DIRT AND FINES: Any materials passing through the 1/2 inch screen on the sorting table that cannot be categorized.
	OTHER NOT ELSEWHERE CLASSIFIED: Any other type of waste not listed in any other sort category. Includes cosmetics, liquid soaps, and shampoos.

APPENDIX B – MATERIAL CATEGORIES AND DEFINITIONS

Mixed Recyclables Categories

Category	Description
Paper	CORRUGATED CARDBOARD/KRAFT PAPER: Corrugated boxes or paper bags made from Kraft paper. Uncoated Corrugated Cardboard has a wavy center layer and is sandwiched between the two outer layers and does not have any wax coating on the inside or outside. Examples include entire cardboard containers, such as shipping and moving boxes, computer packaging cartons, and sheets and pieces of boxes and cartons. This type does not include chipboard. Examples of Kraft paper include paper grocery bags, un-soiled fast food bags, department store bags, and heavyweight sheets of Kraft packing paper.
	NEWSPRINT: Paper chiefly used for printing newspapers – i.e. uncoated groundwood paper.
	POLY-COATED ASEPTIC CONTAINERS: Aseptic containers (multi-layered packaging that contains shelf-stable food products such as apple juice, soup, soy/rice milk, etc.) and "gable top" cartons (non-refrigerated items such as granola and crackers; refrigerated items such as milk, juice, egg substitutes, etc.). Rigid food and beverage cartons are usually paper-based, may be any shape, and may include a plastic pour spout as part of the carton.
	MIXED RECYCLABLE PAPER[1]: Paper other than the paper mentioned above, which can be recycled. Examples include high-grade office paper, magazines/catalogs, manila folders, manila envelopes, index cards, white envelopes, notebook paper, carbonless forms, junk mail, chipboard and uncoated paperboard, phone directories, non-glossy catalogs, offshore cardboard and deep-toned or fluorescent dyed paper.
Plastics	#1 PET BOTTLES AND CONTAINERS: Clear or colored PET beverage bottles and containers (which originally contained non-hazardous materials). When marked for identification, such items contain the number —1 in the center of the triangular recycling symbol and may also bear the letters —PETE or—PET. A PET container usually has a small dot left from the manufacturing process, not a seam. PET non-beverage containers consist of jars, or rectangular containers used for produce, egg cartons, etc.
	#2 HDPE NATURAL BOTTLES: Natural HDPE bottles or containers (which originally contained non-hazardous material) that are cloudy white, allowing light to pass through it. When marked for identification, such containers bear the number —2 in the triangular recycling symbol, and may also bear the letters—HDPE.
	#2 HDPE COLORED BOTTLES: Natural HDPE bottles or containers (which originally contained non-hazardous material) that are or a solid color, preventing light from passing through it. When marked for identification, such containers bear the number —2 in the triangular recycling symbol, and may also bear the letters—HDPE.
	PLASTIC CONTAINERS #3-#7[2]: Plastic containers made of types of plastic other than HDPE or PET that did not formerly contain hazardous materials. Items may be made of PVC, PP, or PS. When marked for identification, these items may bear the number 3, 4, 5, 6, or 7 in the triangular recycling symbol. This subtype also includes unmarked plastic containers.
	ALL FILMS AND BAGS: Includes all film plastic such as shopping bags, grocery bags, trash bags, shrink wrap, plastic food and candy wrappers, as well as large-scale packaging or transport packaging such as dry cleaning bags, shrink-wrap, mattress bags, furniture wrap, and film bubble wrap. Other items include sandwich bags, zipper-closeable bags, produce bags, frozen vegetable bags, newspaper bags, painting tarps, shower curtains, mailing pouches, bank bags, X-ray film, metallized film (wine containers and balloons), and plastic food wrap.

[1] Because the District accepts paper cups, clamshells, and trays as part of its curbside recycling program, paper cups, clamshells, and trays identified in the District's recycling sorts are allocated to "Mixed Recyclable Paper," whereas they may be allocated to "Compostable Paper," "Non-recyclable Paper," or otherwise "Contamination" in other studies.

APPENDIX B – MATERIAL CATEGORIES AND DEFINITIONS

Category	Description
	NON-RECYCLABLE PLASTICS[2]: All other plastic items that are not recyclable. Examples include auto parts made of plastic attached to metal, plastic drinking straws, foam packing blocks, plastic strapping, new plastic laminate (e.g., Formica), vinyl, linoleum, plastic lumber, imitation ceramics, handles and knobs, some kitchen ware, plastic string (as used for hay bales), and plastic rigid bubble/foil packaging (as for medications); CD's, and rigid plastic housewares, such as mop buckets, dishes, cups, and cutlery. Also includes durable plastic items that are made to last for a few months up to many years. These include the plastics used in children toys, furniture, plastic landscape ties, buckets, crates, pallets, sporting goods, etc.
Glass	GLASS BOTTLES AND JARS: Includes glass bottles and jars for beverages, foods and non-food items
Metals	ALUMINUM CANS: Beverage containers made from aluminum, including cat food containers.
	ALUMINUM FOIL/BAKING TINS: Foils, molds, and baking tins made from aluminum that are commonly used for baking.
	STEEL CANS: Rigid containers made mainly of steel, such as food and beverage containers. These items will stick to a magnet and may be tin-coated.
	SCRAP METAL: All other metals not targeted for recycling by the Washington D.C. list of approved recyclables, as well as items composed of aluminum or steel in forms other than those listed above.
Other	UNSPECIFIED CONTAMINATION: All other materials not targeted for recycling by the Washington D.C. list of approved recyclables.

[2] Because the District accepts bulky rigid plastics as part of its curbside recycling program, bulky rigid plastics identified in the District's recycling sorts are allocated to "Plastic Containers #3-#7," whereas they may be allocated to "Non-recyclable Plastics" in other studies.

APPENDIX B – MATERIAL CATEGORIES AND DEFINITIONS

C&D Categories

	Description
Paper	CORRUGATED CARDBOARD/KRAFT PAPER: Corrugated boxes or paper bags made from Kraft paper. Uncoated Corrugated Cardboard has a wavy center layer and is sandwiched between the two outer layers and does not have any wax coating on the inside or outside. Examples include entire cardboard containers, such as shipping and moving boxes, computer packaging cartons, and sheets and pieces of boxes and cartons. This type does not include chipboard. Examples of Kraft paper include paper grocery bags, un-soiled fast food bags, department store bags, and heavyweight sheets of Kraft packing paper.
	OTHER PAPER: Consists of all non-corrugated and non-Kraft paper products such as newspaper, magazines, catalogs, office, computer, polycoated gable top, aseptic juice boxes, paperboard boxes, direct mail, books soiled and unsoiled tissues, paper towels, napkins, file folders, carbonless paper forms, and tissue paper.
Plastics	CLEAN RECOVERABLE FILM: Any recyclable polyethylene (high density, low density, linear low density) film plastic including sheet plastic, shrink wrap, and some tarps.
	OTHER PLASTICS: All other plastic materials including plastic bottles, jars and containers; rigid plastic components; expanded foam plastics; and non-recyclable film plastics.
Organics	YARD WASTE: Plant material from any public or private landscapes. Examples include leaves, grass clippings, seaweed, plants, prunings, shrubs.
	LAND CLEARING DEBRIS/STUMPS: Limbs, logs, and stumps generated by removing vegetation from public or private land by mechanical or manual means.
	OTHER ORGANICS: Combustible materials including wax, bar soap, cigarette butts, feminine hygiene products, vacuum cleaner bag contents, leather, briquettes, and fireplace, burn barrel, and fire-pit ash, and other organic materials not classified elsewhere.
Metals	APPLIANCES: Nonhazardous, not predominantly metal electric appliances such as toasters, microwave ovens, power tools, curling irons, and light fixtures.
	OTHER FERROUS: Ferrous and alloyed ferrous scrap materials originated from residential commercial, or institutional sources which are attracted to a magnet. Includes rebar, empty paint cans; includes HVAC ducting (galvanized and ungalvanized).
	OTHER NON-FERROUS: Non-magnetic metals such as aluminum, brass, bronze, silver, lead copper, zinc, and stainless steel.
Glass	GLASS: Clear, green, and brown glass food and beverage containers. Miscellaneous glass products such as mirrors, leaded crystal, eyeglasses, and blown glass such as light bulbs, auto glass, windows, TV tubes heat resistant cookware (Pyrex), pottery, ceramic plates and drinking glasses. Also includes broken container glass (mixed glass).
Wood	WOOD PALLETS AND CRATES: Wood pallets and crates used for shipping or storage of goods, whether painted, unpainted, or made of engineered lumber.
	UNTREATED/UNPAINTED LUMBER: Non-treated processed wood for building, manufacturing, landscaping, packaging. Examples include dimensional lumber, lumber cutoffs, wood scraps, and wood siding. May contain nails or other trace contaminants.
	TREATED/PAINTED/PROCESSED WOOD: Wood that has had an external coating applied, been pressure treated, chemically treated (with copper etc.) or treated with creosote. Examples include railroad ties, marine timbers and pilings, landscape timbers, and telephone poles. Wood that has an external coating applied. Examples include painted or stained dimensional lumber, lumber cutoffs, wood scraps, wood shake roofing, and wood siding. Plywood is manufactured from thin sheets of cross-laminated veneer. (Chipboard) engineered wood products formed by breaking down softwood into wood fibers and wood particles, combining them with wax or a resin, and forming panels by applying high temperature and pressure. Examples include carpentry, and wood veneers.
	ENGINEERED WOOD: Broad category to include Plywood (layers of wood glued together), Oriented Strandboard (OSB) - a layered, mat-formed panel product made of strands, flakes or wafers sliced from small diameter, round wood logs and bonded under heat and pressure; and Medium Density Fiber (MDF) and Particle Board - manufactured lumber sheeting made of glued wood fibers or particles.
	OTHER WOOD: All other items that are predominantly wood.

APPENDIX B – MATERIAL CATEGORIES AND DEFINITIONS

	Description
C&D	CARPET: Flooring applications consisting of various natural or synthetic fibers bonded to some type of backing material.
	CARPET PADDING: Includes plastic, foam, felt, and other materials used under carpet to provide insulation and padding.
	CONCRETE/BLOCK/BRICK/STONE/TILE: Hard material made from concrete, brick, or rock. This category includes concrete mixed with or without rebar attached (e.g. building foundations, concrete paving, and cinder blocks), landscaping rock, paving stones, brick, and tile.
	ASPHALT PAVING: Asphalt paving including street, sidewalk, driveway, and some sports courts.
	ROOFING MATERIAL: All materials used for roofing of buildings. Includes asphalt shingles, cedar shake, composite shingles and tar paper.
	GYPSUM BOARD: Gypsum wallboard or interior wall covering made of a sheet of gypsum sandwiched between paper layers. Includes used or unused, broken or whole sheets. Gypsum board may also be called sheetrock, drywall, plasterboard, gypsum board, gyproc.
	DIRT/SAND/GRAVEL: Materials made of dirt, sand, and gravel. This category is often left over from land clearing activities. This subtype also includes non-hazardous contaminated soil, pathway gravel and other natural or mechanically crushed materials.
	REMAINDER/COMPOSITE/OTHER C&D: Any other material that cannot be put in any other type or subtype.
Other	BULKY WASTES/FURNITURE: Large composite items that are not defined separately. Examples include all sizes and types of furniture, base components, along with mattresses.
	MIXED MSW: Household and job site waste that is bagged or loose and consists primarily of municipal solid waste. Examples include bagged garbage, beverage containers, food wastes, and other refuse generated on construction sites by non-C&D activities (i.e., consumption by on-site staff), as well as bagged MSW deposited by third parties in C&D roll off containers.
	OTHER NOT ELSEWHERE CLASSIFIED: All other wastes not listed above.

APPENDIX C

WASTE COMPOSITION STUDY SOURCE DATA

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APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Detailed Composition of Philadelphia Disposed Residential Refuse, 2017

Material Category	Est. Percent	Conf. Int (+/-)	Tons	Material Category	Est. Percent	Conf. Int (+/-)	Tons
Paper	**14.2%**	**0.7%**	**70,014**	**Metal**	**3.1%**	**0.5%**	**15,400**
Corrugated Cardboard/Kraft Paper	1.5%	0.3%	7,366	Ferrous/Steel Containers	0.6%	0.1%	2,988
Newsprint	0.7%	0.1%	3,516	Other Ferrous Metals	1.2%	0.4%	5,887
High Grade Office Paper	0.2%	0.1%	884	Aluminum Beverage Containers	0.4%	0.0%	1,803
Magazines/Catalogs	0.4%	0.1%	2,085	Other Aluminum	0.4%	0.0%	1,978
Mixed Recyclable Paper	4.6%	0.5%	22,494	Other Non-Ferrous Metals	0.3%	0.1%	1,577
Poly-Coated Aseptic Containers	0.1%	0.0%	586	Appliances	0.2%	0.1%	1,168
Compostable Paper	5.6%	0.3%	27,443	**C&D**	**19.0%**	**2.0%**	**93,475**
Other Paper (Non-Recyclable)	1.1%	0.2%	5,639	Wood - Clean	1.9%	0.4%	9,208
Plastic	**11.2%**	**0.5%**	**55,009**	Wood – Treated/Mfg	6.2%	0.8%	30,655
#1 PET Bottles and Containers	1.2%	0.1%	6,134	Asphalt, Brick, Rock, & Concrete	0.8%	0.3%	4,121
#2 HDPE Natural Bottles	0.2%	0.0%	1,085	Carpet and Carpet Padding	3.1%	0.8%	15,320
#2 HDPE Colored Bottles	0.3%	0.0%	1,343	Remainder/Composite C&D	6.9%	1.3%	34,171
Plastic Containers #3-#7	0.6%	0.0%	2,871	**Other**	**20.6%**	**1.7%**	**101,550**
Plastic Tubs and Lids	0.2%	0.0%	1,184	Hazardous Materials	0.3%	0.1%	1,366
Expanded Polystyrene	0.8%	0.1%	3,795	Televisions & CRTs	0.5%	0.3%	2,220
All Films and Bags	5.3%	0.2%	25,909	Electronics	0.4%	0.1%	1,934
Other Rigid Plastic	2.6%	0.2%	12,688	Bulky Furniture w/Metal Frames	0.8%	0.4%	3,739
Glass	**2.2%**	**0.3%**	**10,719**	Bulky Items	6.0%	1.4%	29,619
Glass Bottles and Jars	1.3%	0.2%	6,488	Tires	0.1%	0.1%	648
Other Glass	0.9%	0.2%	4,231	Textiles	6.3%	0.7%	30,942
Organics	**29.8%**	**1.5%**	**146,775**	Rubber & Leather Products	0.9%	0.2%	4,301
Food Waste	16.7%	1.1%	82,499	Diapers and Sanitary Products	3.4%	0.4%	16,577
Leaves and Grass	5.0%	0.8%	24,533	Dirt and Fines	1.5%	0.4%	7,233
Brush, Prunings and Trimmings	3.4%	0.7%	16,582	Other Inorganic	0.6%	0.1%	2,970
Remainder/Composite Organic	4.7%	0.7%	23,160				
				Grand Total	**100%**		**492,943**
				No. of Samples	***229***		

** Philadelphia, PA (2017). MSW Consultants. "City of Philadelphia 2017 Residential Composition Study."*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Montgomery County, MD Single-Family Municipal Waste Composition

Material Category	Est. Percent	Material Category	Est. Percent
Paper	**25.7%**	**Organics**	**38.3%**
Newspapers/Magazines/Catalogs/Books	4.4%	Food Waste - Vegetative	15.1%
Corrugated Cardboard	4.7%	Food Waste - Non-Vegetative	4.0%
Paperboard	1.8%	Clothing/Linens/Textiles/Leather	4.2%
Aseptic/Coated Paper Containers	1.6%	Carpets/Rugs/Carpet Padding	1.0%
Office Paper	2.2%	Automobile Tires	0.2%
Carryout Paper Bags	0.5%	Diapers & Sanitary Products	3.2%
Other Recyclable Mixed Paper	2.5%	Fines	2.4%
Non-Recyclable Paper	8.0%	Miscellaneous Organics	8.2%
Plastic	**16.6%**	**Yard Waste**	**2.3%**
PET (#1) Bottle Bill Bottles	2.7%	Grass/Leaves	1.9%
Other PET (#1) Bottles	0.2%	Brush/Pruning	0.4%
#1 PET Thermoforms	0.9%	**Wood**	**2.6%**
HDPE (#2) Narrow Neck Bottles-Natural	0.6%	Lumber	1.0%
HDPE (#2) Narrow Neck Bottles-Colored	0.4%	Pallets	0.1%
#3-#7 Bottles	0.1%	Other Wood	1.5%
Banned Polystyrene	0.2%	**Inorganic**	**6.0%**
Other Polystyrene	0.7%	Concrete/Brick/Rock	0.6%
Plastic Flower Pots	0.1%	Sheet Rock	0.0%
Other Plastic Containers/Tubs	2.3%	Latex Paints	0.3%
Film Plastic - Shopping Bags	1.0%	Fluorescent Lamps	0.0%
Film Plastic - Other	5.4%	Electronics	1.7%
Other Rigid Plastic	2.0%	Miscellaneous Inorganic	3.4%
Metal	**4.3%**	**Household hazardous**	**0.1%**
Ferrous/Bi-metal Cans	1.1%	Lead-Acid Batteries	0.1%
Other Ferrous	1.8%	Other Rechargeable Batteries	0.0%
Aluminum Cans	0.9%	Other Batteries	0.0%
Aluminum Tins/Foil	0.3%	HW Containers	0.0%
Other Non-Ferrous	0.2%	Other Hazardous	0.0%
Glass	**4.3%**		
Clear Glass	2.0%		
Brown Glass	1.1%		
Green Glass	1.1%	**Grand Total**	**100.0%**
Non-container Glass	0.1%	***No. of Samples***	***20***

** Montgomery County, MD (2018). SCS Engineers. "2017 Waste Characterization Study Summary of Results."*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Montgomery County, MD Multi-Family Municipal Waste Composition

Material Category	Est. Percent	Material Category	Est. Percent
Paper	**23.1%**	**Organics**	**36.1%**
Newspapers/Magazines/Catalogs/Books	2.2%	Food Waste - Vegetative	14.2%
Corrugated Cardboard	4.7%	Food Waste - Non-Vegetative	3.6%
Paperboard	2.3%	Clothing/Linens/Textiles/Leather	4.9%
Aseptic/Coated Paper Containers	1.2%	Carpets/Rugs/Carpet Padding	1.0%
Office Paper	1.2%	Automobile Tires	0.6%
Carryout Paper Bags	0.5%	Diapers & Sanitary Products	2.8%
Other Recyclable Mixed Paper	3.3%	Fines	2.1%
Non-Recyclable Paper	7.7%	Miscellaneous Organics	6.9%
Plastic	**15.7%**	**Yard Waste**	**2.6%**
PET (#1) Bottle Bill Bottles	2.0%	Grass/Leaves	1.0%
Other PET (#1) Bottles	0.1%	Brush/Pruning	1.6%
#1 PET Thermoforms	0.7%	**Wood**	**6.8%**
HDPE (#2) Narrow Neck Bottles-Natural	0.6%	Lumber	1.6%
HDPE (#2) Narrow Neck Bottles-Colored	0.5%	Pallets	0.9%
#3-#7 Bottles	0.1%	Other Wood	4.3%
Banned Polystyrene	0.1%	**Inorganic**	**8.5%**
Other Polystyrene	0.6%	Concrete/Brick/Rock	1.1%
Plastic Flower Pots	0.1%	Sheet Rock	1.4%
Other Plastic Containers/Tubs	1.7%	Latex Paints	0.2%
Film Plastic - Shopping Bags	0.7%	Fluorescent Lamps	0.1%
Film Plastic - Other	5.7%	Electronics	2.8%
Other Rigid Plastic	2.8%	Miscellaneous Inorganic	2.9%
Metal	**4.0%**	**Household hazardous**	**0.5%**
Ferrous/Bi-metal Cans	0.7%	Lead-Acid Batteries	0.1%
Other Ferrous	2.0%	Other Rechargeable Batteries	0.1%
Aluminum Cans	0.5%	Other Batteries	0.1%
Aluminum Tins/Foil	0.2%	HW Containers	0.1%
Other Non-Ferrous	0.6%	Other Hazardous	0.1%
Glass	**2.6%**		
Clear Glass	1.6%		
Brown Glass	0.4%		
Green Glass	0.1%	**Grand Total**	**100.0%**
Non-container Glass	0.5%	***No. of Samples***	***40***

** Montgomery County, MD (2018). SCS Engineers. "2017 Waste Characterization Study Summary of Results."*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Maryland Statewide Urban/Residential Waste Composition

Material Category	Est. Percent	Conf. Int (+/-)	Tons	Material Category	Est. Percent	Conf. Int (+/-)	Tons
Paper	**17.6%**	**1.7%**	**41,750**	**Organics**	**35.9%**	**3.5%**	**84,943**
Newsprint	0.8%	0.2%	1,832	Food Waste	15.4%	1.9%	36,442
Corr. Cardbd/Kraft Pap. (Uncoated)	3.6%	1.2%	8,498	Grass	8.4%	3.8%	20,002
Magazines	0.6%	0.3%	1,479	Leaves	1.1%	0.8%	2,706
Paperboard	2.1%	0.4%	5,002	Brush/Prunings/Trimmings	6.1%	2.9%	14,421
(High Grade) Office Paper	0.7%	0.4%	1,575	Other/Non-Compostable	4.8%	1.7%	
Books	0.5%	0.3%	1,162	**C&D Debris**	**4.9%**	**2.3%**	**11,669**
Other Recyclable Paper	2.6%	0.5%	6,203	Wood - Clean Lumber	0.2%	0.3%	507
Compostable Paper	6.0%	0.7%	14,100	Wood - Painted/Treated	0.8%	0.8%	1,842
Non-Recyclable Paper	0.8%	0.2%	1,899	Wood - Pallets	0.0%	0.0%	48
Plastic	**14.8%**	**1.9%**	**35,071**	Non-C&D Wood	0.1%	0.0%	149
PET(#1) Bottles/Jars	1.9%	0.3%	4,396	Drywall/Gypsum Board	0.6%	0.9%	1,492
PET(#1) Other	0.0%	0.0%	117	Concrete/Brick/Rock/Other C&D	0.5%	0.5%	1,186
HDPE(#2) Bottles - Natural	0.2%	0.1%	556	Carpet, Carpet Padding, & Rugs	2.7%	1.9%	6,446
HDPE(#2) Color Bottle/All Non-Bot.	0.4%	0.1%	1,007	**Household Hazardous Waste**	**0.4%**	**0.2%**	**874**
#3 thru #7 Bottles	0.0%	0.0%	12	Medical Waste & Sharps	0.2%	0.1%	401
Plastic Packaging #3 - #7	1.4%	0.2%	3,259	Batteries - Lead Acid	0.0%	0.0%	0
Durable Plastic Products #3 - #7	2.5%	1.6%	5,875	Batteries - Other Rechargeable	0.0%	0.0%	0
Expanded Polystyrene "Styrofoam"	0.9%	0.2%	2,196	Batteries - All Other	0.0%	0.0%	77
Clean Film & Clean Shopping Bags	0.5%	0.2%	1,236	Other Hazardous Waste/HHW	0.2%	0.1%	396
Contaminated Film/Other Film	5.8%	0.5%	13,647	**Electronics**	**1.0%**	**0.7%**	**2,278**
Remainder/Composite Plastic	1.2%	0.2%	2,770	Computers/Related Elec. Prods.	1.0%	0.6%	2,278
Metal	**3.4%**	**0.9%**	**8,110**	**Other Wastes**	**19.1%**	**3.4%**	**45,139**
Aluminum Cans & Containers	0.6%	0.1%	1,484	Textiles & Leather Products	10.2%	2.4%	24,216
Other Aluminum	0.3%	0.1%	668	Diapers & Sanitary Products	4.3%	1.3%	10,191
Other Non-Ferrous	0.4%	0.2%	880	Bulky Items	0.6%	0.9%	1,337
Tin/Steel Containers	1.0%	0.2%	2,364	Tires	0.0%	0.0%	0
Other Ferrous	1.1%	0.8%	2,714	Other/Not Classified	0.6%	0.5%	1,426
Glass	**2.9%**	**1.3%**	**6,917**	Supermix - Fines & Dirt	3.4%	1.1%	7,969
Clear Glass Containers	1.1%	0.4%	2,631				
Brown Glass Containers	1.0%	1.1%	2,257				
Green Glass Containers	0.3%	0.2%	734	**Grand Total**	**100%**		**236,750**
Non-Container/Other Glass	0.5%	0.2%	1,295	***No. of Samples***	***28***		

** Northeast Maryland Waste Disposal Authority (2017). MSW Consultants. "2016 Maryland Statewide Waste Characterization Study."*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Prince George County Annual Residential Waste Composition

Material Category	Est. Percent	Material Category	Est. Percent
Recyclable Paper	**18.1%**	**Divertible**	**14.7%**
Newspaper/print	3.0%	Electronics	0.9%
Corrugated Cardboard	3.4%	CRTs	0.1%
Magazines/Catalogs/Other Books	1.1%	Paint	0.1%
Kraft Paper/Paperboard	3.3%	Scrap Metal	1.0%
Office Paper/Junk Mail/Misc. Paper	5.5%	Pallets/Lumber	0.9%
Aseptic/Wax Coated Paper	1.8%	Other Wood	2.1%
Recyclable Containers	**12.3%**	Concrete/Brick/Rock	0.3%
PET #1 Bottles	2.0%	Dirt	0.7%
HDPE #2 Bottles	1.1%	Sheet Rock	0.8%
Other #3-#7 Bottles	0.1%	Carpet/Carpet Padding	0.7%
Jars, Jugs, Tubs, Trays	1.3%	Shingles	0.3%
Flower Pots	0.1%	Textiles	5.3%
Other Rigid Plastic	2.2%	Shopping Bags	1.5%
Ferrous Cans	1.1%	**Compostable**	**31.2%**
Aluminum Cans/Foil	1.0%	Compostable Paper	7.1%
Glass Bottle/Jars	3.4%	Vegetative Food	11.9%
Other MSW	**23.6%**	Non-Vegetative Food	5.2%
Furniture	0.7%	Leaves	2.8%
Plastic Film	6.7%	Grass	1.7%
Garbage Bags	2.0%	Brush	2.5%
Polystyrene	1.9%		
Other MSW	12.3%	**Grand Total**	**100.0%**
		No. of Samples	***130***

** Prince George's County, MD (2016). SCS Engineers. "Waste Characterization Study Summary of Results 2014/2015."*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Montgomery County, MD Commercial Municipal Waste Composition

Material Category	Est. Percent	Material Category	Est. Percent
Paper	**18.8%**	**Organics**	**34.9%**
Newspapers/Magazines/Catalogs/Books	0.4%	Food Waste - Vegetative	14.8%
Corrugated Cardboard	2.5%	Food Waste - Non-Vegetative	3.0%
Paperboard	1.7%	Clothing/Linens/Textiles/Leather	3.5%
Aseptic/Coated Paper Containers	1.6%	Carpets/Rugs/Carpet Padding	2.9%
Office Paper	1.4%	Automobile Tires	0.0%
Carryout Paper Bags	0.6%	Diapers & Sanitary Products	1.6%
Other Recyclable Mixed Paper	3.6%	Fines	2.2%
Non-Recyclable Paper	7.0%	Miscellaneous Organics	6.9%
Plastic	**14.3%**	**Yard Waste**	**1.8%**
PET (#1) Bottle Bill Bottles	1.8%	Grass/Leaves	1.8%
Other PET (#1) Bottles	0.1%	Brush/Pruning	0.0%
#1 PET Thermoforms	0.5%	**Wood**	**8.4%**
HDPE (#2) Narrow Neck Bottles-Natural	0.2%	Lumber	2.1%
HDPE (#2) Narrow Neck Bottles-Colored	0.1%	Pallets	1.4%
#3-#7 Bottles	0.1%	Other Wood	4.9%
Banned Polystyrene	0.1%	**Inorganic**	**2.7%**
Other Polystyrene	0.2%	Concrete/Brick/Rock	0.0%
Plastic Flower Pots	0.0%	Sheet Rock	0.0%
Other Plastic Containers/Tubs	1.1%	Latex Paints	0.0%
Film Plastic - Shopping Bags	0.6%	Fluorescent Lamps	0.0%
Film Plastic - Other	6.2%	Electronics	0.0%
Other Rigid Plastic	3.3%	Miscellaneous Inorganic	2.7%
Metal	**2.4%**	**Household hazardous**	**0.0%**
Ferrous/Bi-metal Cans	0.0%	Lead-Acid Batteries	0.0%
Other Ferrous	1.9%	Other Rechargeable Batteries	0.0%
Aluminum Cans	0.2%	Other Batteries	0.0%
Aluminum Tins/Foil	0.3%	HW Containers	0.0%
Other Non-Ferrous	0.0%	Other Hazardous	0.0%
Glass	**1.1%**		
Clear Glass	1.1%		
Brown Glass	0.0%		
Green Glass	0.0%	**Grand Total**	**100.0%**
Non-container Glass	0.0%	***No. of Samples***	***120***

** Montgomery County, MD (2018). SCS Engineers. "2017 Waste Characterization Study Summary of Results."*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Davidson County, TN Composition Profile of Landfilled Metro ICI MSW

Material Category	Est. Percent	Material Category	Est. Percent
Paper	**22.8%**	**Organics**	**26.4%**
Newsprint	0.3%	Yard Waste - Compostable; leaves, grass, branches <0	0.0%
High Grade Office Paper	0.5%	Yard Waste - Woody; branch >0.5"	0.0%
Magazines/Catalogs	1.3%	Food Scraps	19.3%
Uncoated OCC	1.6%	Bottom Fines and Dirt	1.4%
Kraft	0.0%	Diapers	5.5%
Boxboard	3.2%	Other Organic	0.2%
Mixed Paper - Recyclable	3.7%	**Inorganics**	**11.7%**
Compostable Paper and "other" paper	12.2%	Televisions	0.0%
Milk and Juice cartons/boxes, coated	0.0%	Computer Monitors	0.0%
Plastics	**14.6%**	Computer Equipment/ Peripherals	0.0%
#1 PET Bottles/Jars	2.6%	Electronic Equipment	1.3%
#1 Other PET Containers & Packaging	0.1%	Household bulky items, batteries, tires, fluorescents, other misc. inorganics	10.4%
#2 HDPE Bottles/Jars - Clear	0.4%	**Metals**	**3.8%**
#2 HDPE Bottles/ Jars - Color	0.3%	Aluminum Beverage Containers	0.8%
#2 Other HDPE Containers & Packaging	0.0%	Other Aluminum	0.6%
#6 Expanded Polystyrene Packaging (EPS)	1.9%	Ferrous containers (bi-metal cans)	0.8%
#3-#7 Other - All	2.1%	Aerosol cans	0.4%
Other Rigid Plastic Products	0.9%	Other Ferrous	1.2%
Grocery & Merchandise Bags	1.4%	Other Non-Ferrous	0.0%
Trash Bags	2.2%	Other Metal	0.0%
Commercial & Industrial Film	0.4%	**Textiles**	**12.3%**
Other Film	1.8%	Carpet and carpet padding	0.0%
Remainder/ Composite Plastic	0.5%	Clothing and other textiles	12.3%
Glass	**4.8%**	**Household Hazardous**	**0.2%**
Glass Bottles and Jars - clear	3.0%	Household Hazardous Waste materials	0.2%
Glass Bottles and Jars - brown	0.4%	**C&D**	**3.2%**
Glass Bottles and Jars - green	1.4%	Construction and Demolition materials	3.2%
Glass Bottles and Jars - blue	0.0%		
Flat Glass	0.0%	**Grand Total**	**100.0%**
Other Glass	0.0%	***No. of Samples***	***3***

** Davidson County, TN (2018). CDM Smith. "Metro Nashville and Davidson County, TN Waste Stream and Recycling Characterization Study."*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Davidson County, TN Composition Profile of Landfilled Urban ICI MSW

Material Category	Est. Percent	Material Category	Est. Percent
Paper	**28.3%**	**Organics**	**18.2%**
Newsprint	0.5%	Yard Waste - Compostable; leaves, grass, branches <0.	2.1%
High Grade Office Paper	1.2%	Yard Waste - Woody; branch >0.5"	0.0%
Magazines/Catalogs	0.8%	Food Scraps	12.7%
Uncoated OCC	10.5%	Bottom Fines and Dirt	1.2%
Kraft	0.7%	Diapers	1.4%
Boxboard	3.0%	Other Organic	0.8%
Mixed Paper - Recyclable	1.8%	**Inorganics**	**8.6%**
Compostable Paper and "other" paper	9.7%	Televisions	0.8%
Milk and Juice cartons/boxes, coated	0.1%	Computer Monitors	0.0%
Plastics	**16.5%**	Computer Equipment/ Peripherals	0.2%
#1 PET Bottles/Jars	1.4%	Electronic Equipment	0.8%
#1 Other PET Containers & Packaging	0.3%	Household bulky items, batteries, tires, fluorescents, other misc. inorganics	6.8%
#2 HDPE Bottles/Jars - Clear	0.4%	**Metals**	**3.1%**
#2 HDPE Bottles/ Jars - Color	0.6%	Aluminum Beverage Containers	0.6%
#2 Other HDPE Containers & Packaging	0.1%	Other Aluminum	0.2%
#6 Expanded Polystyrene Packaging (EPS)	0.9%	Ferrous containers (bi-metal cans)	0.5%
#3-#7 Other - All	1.3%	Aerosol cans	0.1%
Other Rigid Plastic Products	2.0%	Other Ferrous	1.2%
Grocery & Merchandise Bags	0.6%	Other Non-Ferrous	0.1%
Trash Bags	2.7%	Other Metal	0.4%
Commercial & Industrial Film	2.1%	**Textiles**	**5.2%**
Other Film	2.2%	Carpet and carpet padding	0.4%
Remainder/ Composite Plastic	1.9%	Clothing and other textiles	4.8%
Glass	**5.1%**	**Household Hazardous**	**1.1%**
Glass Bottles and Jars - clear	1.8%	Household Hazardous Waste materials	1.1%
Glass Bottles and Jars - brown	0.9%	**C&D**	**14.0%**
Glass Bottles and Jars - green	1.1%	Construction and Demolition materials	14.0%
Glass Bottles and Jars - blue	0.1%		
Flat Glass	1.2%	**Grand Total**	**100.0%**
Other Glass	0.0%	***No. of Samples***	***83***

** Davidson County, TN (2018). CDM Smith. "Metro Nashville and Davidson County, TN Waste Stream and Recycling Characterization Study."*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Prince George County Annual Commercial Waste Composition

Material Category	Est. Percent	Material Category	Est. Percent
Recyclable Paper	**25.0%**	**Divertible**	**18.1%**
Newspaper/print	1.1%	Electronics	0.5%
Corrugated Cardboard	11.8%	CRTs	0.6%
Magazines/Catalogs/Other Books	1.7%	Paint	0.1%
Kraft Paper/Paperboard	2.1%	Scrap Metal	1.2%
Office Paper/Junk Mail/Misc. Paper	6.6%	Pallets/Lumber	3.1%
Aseptic/Wax Coated Paper	1.7%	Other Wood	2.5%
Recyclable Containers	**11.0%**	Concrete/Brick/Rock	0.2%
PET #1 Bottles	2.1%	Dirt	0.4%
HDPE #2 Bottles	0.7%	Sheet Rock	0.2%
Other #3-#7 Bottles	0.1%	Carpet/Carpet Padding	3.7%
Jars, Jugs, Tubs, Trays	1.6%	Shingles	0.5%
Flower Pots	0.1%	Textiles	4.3%
Other Rigid Plastic	2.9%	Shopping Bags	0.8%
Ferrous Cans	0.5%	**Compostable**	**23.1%**
Aluminum Cans/Foil	0.7%	Compostable Paper	7.3%
Glass Bottle/Jars	2.3%	Vegetative Food	9.2%
Other MSW	**22.7%**	Non-Vegetative Food	3.3%
Furniture	0.8%	Leaves	0.8%
Plastic Film	9.4%	Grass	1.2%
Garbage Bags	2.3%	Brush	1.3%
Polystyrene	1.9%		
Other MSW	8.3%	**Grand Total**	**100.0%**
		No. of Samples	***63***

** Prince George's County, MD (2016). SCS Engineers. "Waste Characterization Study Summary of Results 2014/2015."*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Detailed Composition of Philadelphia Curbside-Collected Recyclables

Material Category	Est. Percent	Conf. Int (+/-)	Tons	Material Category	Est. Percent	Conf. Int (+/-)	Tons
Paper	**45.3%**	**1.5%**	**49,220**	**Metal**	**4.9%**	**0.3%**	**5,321**
Corrugated Cardboard/Kraft Paper	15.8%	1.2%	17,146	Ferrous/Steel Containers	2.2%	0.1%	2,425
Newsprint	8.4%	0.8%	9,080	Other Ferrous Metals	0.8%	0.2%	896
High Grade Office Paper	0.7%	0.2%	752	Aluminum Beverage Containers	1.3%	0.1%	1,389
Magazines/Catalogs	3.2%	0.4%	3,436	Other Aluminum	0.1%	0.0%	160
Mixed Recyclable Paper	11.7%	0.8%	12,679	Other Non-Ferrous Metals	0.3%	0.1%	278
Poly-Coated Aseptic Containers	0.4%	0.0%	398	Appliances	0.2%	0.1%	173
Compostable Paper	3.7%	0.4%	3,973	**C&D**	**0.4%**	**0.2%**	**444**
Other Paper (Non-Recyclable)	1.6%	0.3%	1,755	Wood - Clean	0.1%	0.0%	61
Plastic	**12.8%**	**0.5%**	**13,868**	Wood – Treated/Mfg	0.2%	0.1%	208
#1 PET Bottles and Containers	4.7%	0.2%	5,151	Asphalt, Brick, Rock, & Concrete	0.0%	0.0%	27
#2 HDPE Natural Bottles	1.0%	0.1%	1,111	Carpet and Carpet Padding	0.0%	0.0%	18
#2 HDPE Colored Bottles	1.4%	0.1%	1,516	Remainder/Composite C&D	0.1%	0.1%	129
Plastic Containers #3-#7	0.7%	0.1%	800	**Other**	**4.5%**	**0.5%**	**4,893**
Plastic Tubs and Lids	0.4%	0.1%	407	Hazardous Materials	0.1%	0.0%	161
Expanded Polystyrene	0.2%	0.0%	265	Televisions & CRTs	0.0%	0.0%	29
All Films and Bags	1.8%	0.1%	1,952	Electronics	0.3%	0.2%	277
Other Rigid Plastic	2.5%	0.2%	2,665	Bulky Furniture w/Metal Frames	0.0%	0.0%	0
Glass	**28.3%**	**1.5%**	**30,786**	Bulky Items	0.0%	0.0%	3
Glass Bottles and Jars	26.9%	1.5%	29,240	Tires	0.0%	0.1%	49
Other Glass	1.4%	0.3%	1,546	Textiles	0.6%	0.1%	635
Organics	**3.8%**	**0.4%**	**4,084**	Rubber & Leather Products	0.2%	0.1%	170
Food Waste	2.9%	0.3%	3,131	Diapers and Sanitary Products	0.6%	0.2%	686
Leaves and Grass	0.0%	0.0%	51	Dirt and Fines	2.3%	0.3%	2,445
Brush, Prunings and Trimmings	0.1%	0.0%	65	Other Inorganic	0.4%	0.1%	438
Remainder/Composite Organic	0.8%	0.2%	836				
				Grand Total	**100%**		**108,615**
				No. of Samples	***180***		

** Philadelphia, PA (2017). MSW Consultants. "City of Philadelphia 2017 Residential Composition Study."*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Arlington County Residential materials Intended For Recycling - Annual Summary

Material Category	Percent	Material Category	Percent
Paper and Cardboard	**57.3%**	**Metal**	**2.9%**
Newspaper	11.4%	Aluminum Cans	1.3%
Cardboard	17.6%	Tin/Steel Cans (including aerosol cans)	1.5%
Mixed Paper	27.2%	Aluminum foil and trays	0.0%
Milk & Juice Containers	0.9%	Scrap Metals/Small Appliances	0.1%
Compostable Paper	0.3%	**C&D**	**0.0%**
Textiles	**0.2%**	Dirt	0.0%
Textiles	0.2%	**Trash**	**10.0%**
		Pots and pans	0.2%
Plastic	**9.2%**	Plastics #6	0.5%
Plastic Bags	1.7%	Flexible plastics	0.1%
Plastics #1	3.9%	Non-recyc. plastics & Empty Contam. Plastics	1.4%
Plastics #2 CLEAR	1.3%	Other Glass	0.0%
Plastics #2 COLORED	0.9%	Fluorescent Light Bulbs/Tubes	0.0%
Plastics #3, 4, 5, 7	1.5%	Batteries	0.0%
Glass	**20.1%**	Ceramics	0.2%
Glass Bottles/Jars	20.1%	Styrofoam	0.2%
		Wood	0.1%
Organics	**0.1%**	Miscellaneous Trash	7.3%
Clean Food Waste	0.0%	**Household Hazardous**	**0.2%**
Contaminated Food Waste	0.0%	Latex Paint	0.1%
Leaves, brush, prunings, plants	0.0%	Special Wastes	0.0%
Grass/Sod	0.1%		
Electronics	**0.2%**	**Total**	**100%**
Electronics/Computers	0.2%	***Pounds Sorted***	***5,832***

** Arlington County, VA (2018). "Materials Intended For Trash - Annual Summary."*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Davidson County, TN Composition Profile of Recovered Metro Residential Materials

Material Category	Est. Percent	Material Category	Est. Percent
Paper	**74.8%**	**Organics**	**1.9%**
Newsprint	10.9%	Yard Waste - Compostable; leaves, grass, branches <0.	0.2%
High Grade Office Paper	5.5%	Yard Waste - Woody; branch >0.5"	0.0%
Magazines/Catalogs	12.4%	Food Scraps	1.1%
Uncoated OCC	25.9%	Bottom Fines and Dirt	0.3%
Kraft	1.9%	Diapers	0.1%
Boxboard	8.3%	Other Organic	0.2%
Mixed Paper - Recyclable	6.3%	**Inorganics**	**0.8%**
Compostable Paper and "other" paper	3.2%	Televisions	0.0%
Milk and Juice cartons/boxes, coated	0.4%	Computer Monitors	0.0%
Plastics	**11.6%**	Computer Equipment/ Peripherals	0.0%
#1 PET Bottles/Jars	3.6%	Electronic Equipment	0.2%
#1 Other PET Containers & Packaging	0.7%	Household bulky items, batteries, tires, fluorescents, other misc. inorganics	0.6%
#2 HDPE Bottles/Jars - Clear	0.9%	**Metals**	**4.2%**
#2 HDPE Bottles/ Jars - Color	1.1%	Aluminum Beverage Containers	1.6%
#2 Other HDPE Containers & Packaging	0.1%	Other Aluminum	0.1%
#6 Expanded Polystyrene Packaging (EPS	0.4%	Ferrous containers (bi-metal cans)	1.5%
#3-#7 Other - All	1.3%	Aerosol cans	0.1%
Other Rigid Plastic Products	0.8%	Other Ferrous	0.6%
Grocery & Merchandise Bags	0.3%	Other Non-Ferrous	0.1%
Trash Bags	0.4%	Other Metal	0.2%
Commercial & Industrial Film	0.0%	**Textiles**	**0.9%**
Other Film	1.3%	Carpet and carpet padding	0.0%
Remainder/ Composite Plastic	0.7%	Clothing and other textiles	0.9%
Glass	**4.0%**	**Household Hazardous**	**0.1%**
Glass Bottles and Jars - clear	1.6%	Household Hazardous Waste materials	0.1%
Glass Bottles and Jars - brown	1.6%	**C&D**	**1.6%**
Glass Bottles and Jars - green	0.7%	Construction and Demolition materials	1.6%
Glass Bottles and Jars - blue	0.0%		
Flat Glass	0.1%	**Grand Total**	**100.0%**
Other Glass	0.0%	***No. of Samples***	***44***

** Davidson County, TN (2018). CDM Smith. "Metro Nashville and Davidson County, TN Waste Stream and Recycling Characterization Study."*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Davidson County, TN Composition Profile of Recovered Urban Residential Materials

Material Category	Est. Percent	Material Category	Est. Percent
Paper	**74.9%**	**Organics**	**1.7%**
Newsprint	10.3%	Yard Waste - Compostable; leaves, grass, branches <0.	0.0%
High Grade Office Paper	5.8%	Yard Waste - Woody; branch >0.5"	0.0%
Magazines/Catalogs	12.7%	Food Scraps	1.1%
Uncoated OCC	26.4%	Bottom Fines and Dirt	0.3%
Kraft	2.0%	Diapers	0.1%
Boxboard	8.2%	Other Organic	0.2%
Mixed Paper - Recyclable	5.9%	**Inorganics**	**0.8%**
Compostable Paper and "other" paper	3.2%	Televisions	0.0%
Milk and Juice cartons/boxes, coated	0.4%	Computer Monitors	0.0%
Plastics	**11.4%**	Computer Equipment/ Peripherals	0.0%
#1 PET Bottles/Jars	3.5%	Electronic Equipment	0.2%
#1 Other PET Containers & Packaging	0.7%	Household bulky items, batteries, tires, fluorescents, other misc. inorganics	0.6%
#2 HDPE Bottles/Jars - Clear	0.8%	**Metals**	**4.2%**
#2 HDPE Bottles/ Jars - Color	1.1%	Aluminum Beverage Containers	1.7%
#2 Other HDPE Containers & Packaging	0.1%	Other Aluminum	0.1%
#6 Expanded Polystyrene Packaging (EPS)	0.4%	Ferrous containers (bi-metal cans)	1.5%
#3-#7 Other - All	1.3%	Aerosol cans	0.1%
Other Rigid Plastic Products	0.8%	Other Ferrous	0.6%
Grocery & Merchandise Bags	0.3%	Other Non-Ferrous	0.0%
Trash Bags	0.4%	Other Metal	0.2%
Commercial & Industrial Film	0.0%	**Textiles**	**0.9%**
Other Film	1.3%	Carpet and carpet padding	0.0%
Remainder/ Composite Plastic	0.7%	Clothing and other textiles	0.9%
Glass	**4.1%**	**Household Hazardous**	**0.1%**
Glass Bottles and Jars - clear	1.6%	Household Hazardous Waste materials	0.1%
Glass Bottles and Jars - brown	1.7%	**C&D**	**1.6%**
Glass Bottles and Jars - green	0.7%	Construction and Demolition materials	1.6%
Glass Bottles and Jars - blue	0.0%		
Flat Glass	0.1%	**Grand Total**	**100.0%**
Other Glass	0.0%	***No. of Samples***	***42***

** Davidson County, TN (2018). CDM Smith. "Metro Nashville and Davidson County, TN Waste Stream and Recycling Characterization Study."*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

2017 District of Columbia Aggregate Curbside Single Stream Recycling Audit Results

Material Category	Est. Percent	Material Category	Est. Percent
Paper	**47.8%**	**Plastics**	**8.9%**
OCC	28.1%	PET Bottles	3.6%
News (ONP)	9.6%	PET Cups and Clamshells	0.3%
Mixed Paper	9.4%	HDPE Bottles	2.8%
Paper Cups	0.1%	PP Cups & Clamshells	0.4%
Paper Containers and Trays	0.1%	PS Cups & Clamshells	0.4%
Paper Bags	0.0%	Rigid Plastics	1.3%
Cartons (Aseptic)	0.4%	Other Plastics	0.2%
Glass	**13.4%**	**Residue**	**27.2%**
Glass Containers	5.4%	Residue - Plastic Film	2.0%
Glass Fines	8.0%	Residue - Other	25.2%
Metal	**2.9%**		
Aluminum Cans & Foil	1.3%		
Steel Cans	1.1%	**Grand Total**	**100.0%**
Scrap Metal	0.5%	***No. of Samples***	***40***

** District of Columbia (2017). "D.C. Recycling Characterization Study."*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

2018 District of Columbia Curbside Single Stream Recycling Audit Results

Material Category	Est. Percent	Material Category	Est. Percent
Paper	**55.2%**	**Plastics**	**10.5%**
OCC	26.2%	PET Bottles	2.3%
News (ONP)	6.2%	PET Cups and Clamshells	1.6%
Mixed Paper	19.9%	HDPE Bottles	1.6%
Paper Cups	0.1%	PP Cups & Clamshells	0.8%
Paper Containers and Trays	0.4%	PS Cups & Clamshells	0.5%
Paper Bags	1.4%	Rigid Plastics	1.7%
Cartons (Aseptic)	1.0%	Other Plastics	2.0%
Glass	**11.1%**	**Residue**	**19.2%**
Glass Containers	3.1%	Residue - Plastic Film	1.4%
Glass Fines	8.0%	Residue - Other	17.8%
Metal	**3.9%**		
Aluminum Cans & Foil	2.2%		
Steel Cans	1.4%	**Grand Total**	**100.0%**
Scrap Metal	0.3%	***No. of Samples***	***30***

** District of Columbia (2018). "D.C. Recycling Characterization Study."*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Statewide Aggregate Composition of C&D Disposed in Georgia October 2008 - September 2009

Material Category	Est. Percent	Material Category	Est. Percent
C&D Aggregate	**25.4%**	**C&D Other**	**26.2%**
Unpainted Concrete	13.7%	Clean Gypsum Board	5.3%
Painted Concrete	1.2%	Painted/Demolition Gypsum	1.5%
Unpainted Asphalt Paving	2.4%	Acoustic Ceiling Tiles	0.2%
Painted Asphalt Paving	0.0%	Rock and Gravel	0.7%
Unpainted Brick and Other Aggregates	7.8%	Dirt and Sand	10.3%
Painted Brick and Other Aggregates	0.2%	Fiberglass Insulation	0.1%
C&D Wood	**15.7%**	Expanded Polystyrene Insulation	0.2%
Clean Dimensional Lumber	5.3%	Unpainted Remainder/Composite C&I	6.1%
Unpainted Large Structural Wood	0.5%	Painted Remainder/Composite C&D	1.7%
Painted Large Structural Wood	0.0%	**C&D Roofing**	**19.5%**
Clean Engineered Wood	4.5%	Composition Roofing	17.9%
Standard Size Wood Pallets	1.5%	Other Asphalt Roofing	1.5%
Painted/Stained Wood	3.5%	**Metal**	**3.1%**
Other Treated Wood	0.1%	Major Appliances	0.0%
Creosote-treated Wood	0.0%	HVAC Ducting	0.0%
Other Wood Pallets and Crates	0.4%	Other Ferrous	2.8%
Glass	**0.5%**	Other Non-Ferrous	0.1%
Glass Bottles and Containers	0.0%	Remainder/Composite Metal	0.1%
Flat Glass	0.4%	**Organics**	**1.7%**
Remainder/Composite Glass	0.2%	Yard Trimmings	1.3%
Paper	**1.4%**	Branches and Stumps	0.4%
Uncoated Corrugated Cardboard/Kraft Paper	0.8%	**E-Waste/HHW**	**0.2%**
Other Recyclable Paper	0.3%	E-Waste	0.0%
Cellulose Insulation	0.0%	Asbestos Labeled Bags	0.0%
Remainder/Composite Paper	0.3%	Other HHW	0.2%
Plastic	**1.3%**	**Other Materials**	**2.4%**
Recyclable Plastic Containers	0.0%	Carpet	1.4%
HDPE Buckets	0.1%	Carpet Padding	0.2%
Expanded Polystyrene Packaging	0.0%	Wood Furniture	0.3%
Non-Bag Commercial and Industrial Packaging Fil	0.1%	Plastic Furniture	0.0%
Tyvek	0.0%	Mattresses and Box Springs	0.1%
Other Film	0.1%	Tires	0.0%
Plastic Siding/Decking	0.0%	Remainder/Composite Other Material	0.4%
Plastic Pallets	0.0%	**Total MSW**	**2.4%**
Durable Plastic Items	0.2%	Mixed MSW	2.4%
Plastic Piping	0.7%		
Remainder/Composite Plastic	0.1%	**Grand Total**	**100%**
		No. of Visual Surveys	***786***

** Georgia Statewide (2010). RW Beck, Inc. "Statewide C&D Debris Characterization Study."*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Louisville, KY 2016 Detailed C&D Waste Composition

Material Category	Est. Percent	Material Category	Est. Percent
Paper	**4.8%**	**C&D Materials**	**42.5%**
Corrugated Cardboard/Kraft Paper	2.9%	Carpet	2.6%
Remainder Composite Paper	1.9%	Carpet Padding	0.4%
Plastic	**0.9%**	Concrete/Block/Brick/Stone/Tile	7.5%
HDPE (#2) Buckets	0.2%	Asphalt Paving	1.1%
Clean Recoverable Film	0.0%	Roofing Material	15.4%
Remainder/Composite/Other Plastic	0.7%	Ceiling Tiles	0.5%
Metal	**1.1%**	Clean Gypsum Board	4.1%
Appliances	0.1%	Painted Gypsum Board	7.2%
Other Ferrous	0.9%	Dirt/Sand/Gravel	1.7%
Other Non-Ferrous	0.1%	Insulation	0.2%
Organics	**0.4%**	Remainder/Composite/Other C&D	1.8%
Yard Waste	0.4%	**Glass**	**0.8%**
Remainder/Composite/Other Organic	0.0%	All Glass	0.8%
Wood	**44.3%**	**Other Wastes**	**5.5%**
Pallets and Crates	5.7%	Bulky Wastes/Furniture	1.6%
Untreated/Unpainted Lumber	13.0%	Tire	0.0%
Treated/Painted/Processed Wood	15.7%	All HHW	0.1%
Engineered Wood	8.9%	Fines/Mixed Residue	0.6%
Wood Furniture	0.8%	Mixed MSW	2.8%
Other Wood	0.4%	Tires	0.0%
Electronics	**0.0%**	Remainder/Composite Other Material	0.4%
Electronics	0.0%		
Items with CRTs	0.0%	**Grand Total**	**100%**
		No. of Visual Surveys	***71***

** Louisville Metro Government, KY (2016). MSW Consultants. "Louisville Metro 2016 Waste Characterization Study.*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

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APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Lexington-Fayette, KY 2014 C&D Waste Composition

Material Category	Est. Percent	Material Category	Est. Percent
Paper	**5.8%**	**Organics**	**9.3%**
OCC/Kraft Paper	5.1%	Yard Waste	3.1%
R/C and Other Paper	0.7%	Carpet	4.1%
Plastic	**1.1%**	Carpet Padding	0.1%
HDPE Buckets	0.0%	R/C and Other Organics	2.0%
Clean Recoverable Film	0.1%	**Metal**	**2.3%**
R/C and Other Plastic	1.0%	Appliances	0.0%
C&D Materials	**69.4%**	Other Ferrous Metals	2.2%
Concrete/Brick/Rock	16.4%	HVAC Ducting	0.1%
Asphalt Paving	0.0%	**Glass**	**0.7%**
Roofing Materials	4.8%	Glass	0.7%
Ceiling Tiles	0.1%	**Other Wastes**	**11.2%**
Pallets and Crates	15.0%	Electronics	0.6%
Untreated/Unpainted Lumbe	7.8%	Items with CRTs	0.2%
Treated Lumber	0.5%	Bulky Items	2.2%
Painted /Stained Lumber	5.9%	Tires	0.3%
Plywood	1.4%	Lead acid batteries	0.0%
OSB	1.6%	Vehicle and Equipment Fluids	0.0%
MDF and Particle Board	0.9%	Paint and Paint Related Wast	0.1%
Wood Furniture	1.9%	Other Hazardous	0.0%
Other Wood	0.7%	Fines/Mixed Residue	0.4%
Clean Gypsum Board	6.0%	Mixed MSW	7.4%
Painted Gypsum Board	2.1%		
Dirt, Sand, and Gravel	2.6%		
Insulation	0.5%	**Grand Total**	**100%**
R/C and Other C&D	1.2%	***No. of Visual Surveys***	***111***

** Lexington-Fayette Urban County, KY (2014). MSW Consultants. "County-Wide Waste Stream Analysis."*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Connecticut Statewide 2016 Statistical Analysis of Waste Load Quantitative Estimates

Material Category	Est. Percent	Material Category	Est. Percent
Plastics	**1.1%**	**Shingles**	**10.4%**
Plastic Pipe	0.4%	Asphalt Roofing Post-Consumer Tear Off Waste	9.6%
Vinyl Siding	0.3%	Asphalt Roofing New Construction Waste	0.8%
Other Plastics	0.4%	**Ceramics**	**0.7%**
Packaging Waste	**6.2%**	Toilets	0.2%
Old Corrugated Cardboard (OCC)	5.1%	Sinks	0.1%
Plastic Film/Shrink Wrap	0.4%	Other	0.5%
Strapping	0.0%	**Gypsum**	**6.3%**
HDPE Buckets	0.1%	Clean New Construction Gypsum Wallboard Scra	2.2%
Other Paper Packaging	0.2%	Renovation & Demolition Gypsum	4.1%
Other Plastic Packaging	0.2%	**ABC**	**3.2%**
Other Packaging Waste	0.2%	Asphalt/Brick/Concrete/Aggregates	3.2%
Other	**30.1%**	**Wood**	**38.1%**
Carpet	3.6%	Clean Dimensional Lumber	9.6%
Carpet Pad	0.1%	Clean Oriented Strand Board (OSB)	1.3%
Mattresses/Box Springs	0.8%	Pallets & Crates	7.1%
Tires	0.1%	Plywood	3.4%
Fiberglass Insulation	0.6%	Manufactured Wood	1.5%
Glass (Windows, Mirrors, etc.)	0.9%	Treated Wood	1.2%
Textiles	0.8%	Painted/Stained Wood	11.2%
Fines	1.0%	Land Clearing/Leaves/Brush	2.3%
Other Oversized MSW (Furniture, etc.	16.0%	Other Wood	0.5%
Other	6.2%		
Metal	**3.8%**		
Ferrous	1.8%	**Grand Total**	**100%**
Non-Ferrous	2.1%	***No. of Visual Surveys***	***267***

** State of Connecticut (2016). Green Seal Environmental, Inc. "Construction and Demolition Waste Characterization and Ma*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Missouri Statewide 2017 Construction Waste Composition by Demographic Origin

Material Category	Large Metro		Small Metro		Rural	
	Percent	Tons	Percent	Tons	Percent	Tons
MSW/Other Waste	**7.6%**	**6,766**	**9.6%**	**1,867**	**3.0%**	**222**
Flattened OCC	2.7%	2,428	4.3%	840	0.1%	9
Unflattened OCC	0.8%	667	0.7%	131	0.1%	4
R/C and Other Paper	0.8%	673	*Not Found*		0.1%	6
All Glass	*Not Found*		0.5%	92	0.2%	12
Electronics	0.0%	29	*Not Found*		0.3%	19
Items with CRTs	0.0%	35	*Not Found*		0.0%	2
Tree Trunks	*Not Found*		*Not Found*		*Not Found*	
Fines/Mixed Residue	1.8%	1,588	*Not Found*		0.7%	51
Mixed MSW	1.5%	1,344	4.1%	803	1.6%	118
Agricultural Waste	*Not Found*		*Not Found*		*Not Found*	
Plastic	**2.0%**	**1,776**	**1.3%**	**246**	**0.5%**	**39**
Plastic Bottles (Recyclable)	0.0%	6	0.0%	9	*Not Found*	
HDPE Buckets (stacked)	0.1%	49	0.0%	8	*Not Found*	
HDPE Buckets (unstacked)	0.1%	59	0.1%	15	0.0%	1
Clean Recoverable Film	0.2%	211	0.0%	8	0.1%	9
R/C and Other Plastic	1.6%	1,451	1.1%	206	0.4%	28
Metal	**4.0%**	**3,545**	**9.2%**	**1,785**	**1.4%**	**108**
Appliances	0.1%	61	*Not Found*		*Not Found*	
Other Ferrous Metals	2.4%	2,100	4.8%	926	1.3%	94
Other Non-ferrous Metal	1.5%	1,330	4.4%	859	0.2%	13
HVAC Ducting	0.1%	54	*Not Found*		0.0%	1
Organics	**2.7%**	**2,378**	**0.6%**	**119**	**1.4%**	**102**
Leaves/Grass/Mixed Yard Waste	0.4%	358	0.6%	119	1.3%	94
Branches/Limbs	*Not Found*		*Not Found*		0.0%	3
R/C and Other Organics	2.3%	2,020	*Not Found*		0.1%	4
Gypsum Board	**28.1%**	**24,948**	**20.9%**	**4,054**	**2.9%**	**216**
Clean Gypsum Board	13.6%	12,063	3.8%	739	0.1%	9
Painted Gypsum Board	14.5%	12,885	17.1%	3,315	2.8%	206
Roofing Materials	**9.2%**	**8,199**	**0.0%**	**0**	**0.3%**	**24**
Roofing Materials	9.2%	8,199	*Not Found*		0.3%	24
Dirt/Sand/Gravel	**10.1%**	**8,956**	**0.0%**	**0**	**16.9%**	**1,266**
Dirt/Sand/Gravel	10.1%	8,956	*Not Found*		16.9%	1,266
Other C&D	**8.0%**	**7,126**	**3.6%**	**706**	**4.7%**	**350**
Carpet	3.1%	2,739	0.9%	169	0.3%	20
Carpet Padding	0.1%	76	*Not Found*		0.1%	5
Asphalt Paving	*Not Found*		*Not Found*		*Not Found*	
Ceiling Tiles	0.2%	139	*Not Found*		*Not Found*	
Insulation	1.4%	1,241	1.1%	205	0.9%	70
R/C and Other C&D	3.3%	2,930	1.7%	332	3.4%	255
Special Wastes	**1.5%**	**1,347**	**0.6%**	**124**	**1.3%**	**100**
Bulky Wastes/Furniture	1.5%	1,342	0.6%	124	0.2%	18
Tires - Cut	*Not Found*		*Not Found*		1.1%	82
Tires - Whole	*Not Found*		*Not Found*		*Not Found*	
All HHW	0.0%	5	*Not Found*		*Not Found*	
Contaminated Soil	*Not Found*		*Not Found*		*Not Found*	
Wood	**22.3%**	**19,815**	**41.7%**	**8,080**	**8.2%**	**612**
Pallets - Standard	2.4%	2,098	3.0%	584	0.4%	29
Pallets/Crates/Heavy	1.8%	1,557	*Not Found*		*Not Found*	
Untreated/Unpainted Lumber	9.7%	8,635	24.9%	4,820	5.5%	410
Treated/Painted/Processed Wood	1.1%	953	4.0%	772	0.9%	64
Engineered Wood	7.1%	6,297	9.5%	1,831	1.4%	105
Wood Furniture	0.2%	214	*Not Found*		0.1%	4
Other Wood	0.1%	61	0.4%	73	*Not Found*	
Concrete/Brick/Rock	**4.4%**	**3,942**	**12.3%**	**2,386**	**59.4%**	**4,441**
Concrete/Block/Brick/Stone/Tile	4.4%	3,942	12.3%	2,386	59.4%	4,441
Grand Total	**100.0%**	**88,798**	**100.0%**	**19,367**	**100.0%**	**7,480**
No. of Samples	***38***		***7***		***15***	

Confidence intervals calculated at the 90% confidence level.

Percentages for materials may not exactly equal category subtotals due to rounding.

** Missouri Department of Natural Resources (2018). MSW Consultants. "Statewide Waste Composition Study."*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Missouri Statewide 2017 Demolition Waste Composition by Demographic Origin

	Large Metro		Small Metro		Rural	
Material Category	**Percent**	**Tons**	**Percent**	**Tons**	**Percent**	**Tons**
MSW/Other Waste	**6.1%**	**15,518**	**10.9%**	**9,852**	**4.5%**	**738**
Flattened OCC	0.8%	2,133	0.3%	314	0.5%	86
Unflattened OCC	0.1%	296	0.2%	165	0.3%	53
R/C and Other Paper	0.3%	676	*0.0%*	39	1.1%	174
All Glass	*0.4%*	945	0.8%	709	0.1%	14
Electronics	0.8%	2,099	*1.1%*	1,033	0.4%	62
Items with CRTs	0.1%	190	*0.9%*	785	0.3%	50
Tree Trunks	*Not Found*		*Not Found*		*Not Found*	
Fines/Mixed Residue	1.7%	4,295	*4.8%*	4,364	Not Found	
Mixed MSW	1.9%	4,885	2.7%	2,442	1.8%	299
Agricultural Waste	*Not Found*		*Not Found*		*Not Found*	
Plastic	**7.5%**	**18,977**	**0.5%**	**467**	**4.9%**	**807**
Plastic Bottles (Recyclable)	Not Found		Not Found		*Not Found*	
HDPE Buckets (stacked)	Not Found		Not Found		*Not Found*	
HDPE Buckets (unstacked)	0.0%	31	0.0%	26	0.0%	6
Clean Recoverable Film	0.0%	107	0.0%	18	0.1%	15
R/C and Other Plastic	7.4%	18,840	0.5%	424	4.8%	787
Metal	**3.0%**	**7,531**	**5.8%**	**5,252**	**2.8%**	**461**
Appliances	Not Found		*0.3%*	313	*0.0%*	1
Other Ferrous Metals	2.5%	6,242	5.1%	4,651	2.5%	414
Other Non-ferrous Metal	0.2%	617	0.3%	288	0.3%	46
HVAC Ducting	0.3%	672	*Not Found*		Not Found	
Organics	**0.2%**	**570**	**5.9%**	**5,362**	**18.8%**	**3,109**
Leaves/Grass/Mixed Yard Waste	0.1%	355	0.8%	756	Not Found	
Branches/Limbs	*Not Found*		*0.3%*	291	0.1%	11
R/C and Other Organics	0.1%	216	*4.8%*	4,315	18.7%	3,098
Gypsum Board	**13.0%**	**32,988**	**7.4%**	**6,708**	**6.3%**	**1,042**
Clean Gypsum Board	2.3%	5,764	0.7%	589	0.0%	5
Painted Gypsum Board	10.8%	27,224	6.8%	6,119	6.3%	1,037
Roofing Materials	**8.5%**	**21,430**	**5.3%**	**4,808**	**14.8%**	**2,450**
Roofing Materials	8.5%	21,430	*5.3%*	4,808	14.8%	2,450
Dirt/Sand/Gravel	**1.8%**	**4,438**	**12.2%**	**11,032**	**8.6%**	**1,415**
Dirt/Sand/Gravel	1.8%	4,438	*12.2%*	11,032	8.6%	1,415
Other C&D	**5.5%**	**13,956**	**4.4%**	**4,010**	**4.1%**	**678**
Carpet	2.8%	7,207	1.8%	1,672	0.4%	73
Carpet Padding	0.2%	402	*0.6%*	547	0.1%	11
Asphalt Paving	*0.8%*	2,144	*Not Found*		*Not Found*	
Ceiling Tiles	0.3%	633	*0.3%*	273	*0.1%*	24
Insulation	0.7%	1,788	1.1%	968	0.8%	136
R/C and Other C&D	0.7%	1,783	0.6%	551	2.6%	434
Special Wastes	**16.9%**	**42,711**	**8.5%**	**7,680**	**8.3%**	**1,368**
Bulky Wastes/Furniture	16.8%	42,613	8.3%	7,545	8.3%	1,368
Tires - Cut	*Not Found*		*0.1%*	135	Not Found	
Tires - Whole	*0.0%*	30	*Not Found*		*Not Found*	
All HHW	0.0%	68	*Not Found*		*Not Found*	
Contaminated Soil	*Not Found*		*Not Found*		*Not Found*	
Wood	**17.1%**	**43,284**	**27.0%**	**24,461**	**19.3%**	**3,190**
Pallets - Standard	1.0%	2,631	0.8%	704	0.7%	114
Pallets/Crates/Heavy	Not Found		*0.1%*	80	*0.1%*	12
Untreated/Unpainted Lumber	3.6%	9,147	2.7%	2,468	3.1%	519
Treated/Painted/Processed Wood	4.6%	11,647	12.8%	11,605	7.5%	1,238
Engineered Wood	2.7%	6,742	3.3%	3,004	6.3%	1,038
Wood Furniture	3.3%	8,374	*3.3%*	2,989	1.4%	223
Other Wood	1.9%	4,744	4.0%	3,610	*0.3%*	47
Concrete/Brick/Rock	**20.4%**	**51,628**	**12.0%**	**10,886**	**7.7%**	**1,267**
Concrete/Block/Brick/Stone/Tile	20.4%	51,628	12.0%	10,886	7.7%	1,267
Grand Total	**100.0%**	**253,032**	**100.0%**	**90,517**	**100.0%**	**16,524**
No. of Samples	***31***		***45***		***33***	

Confidence intervals calculated at the 90% confidence level.

Percentages for materials may not exactly equal category subtotals due to rounding.

** Missouri Department of Natural Resources (2018). MSW Consultants. "Statewide Waste Composition Study."*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Chicago Waste Composition Profile - C&D

Material Category	Est. Percent	Material Category	Est. Percent
Paper	**1.8%**	**Organic**	**21.3%**
Newsprint	0.0%	Yard Waste - Compostable	0.0%
High Grade Office Paper	0.1%	Yard Waste - Woody	0.3%
Magazines and Catalogs	0.0%	Food Scraps	0.0%
Uncoated OCC/Kraft	1.7%	Bottom Fines & Dirt	21.0%
Boxboard	0.0%	Diapers	0.0%
Mixed Paper - Recyclable	0.0%	Other Organic	0.0%
Compostable Paper	0.0%	**Glass**	**1.8%**
Other Paper	0.0%	Recyclable Glass Bottles & Jars	0.0%
Plastic	**0.4%**	Flat Glass	1.5%
#1 PET Bottles/Jars	0.0%	Other Glass	0.3%
#1 Other PET Containers	0.0%	**Metal**	**4.7%**
#2 HDPE Bottles/Jars - Clear	0.0%	Aluminum Beverage Containers	0.0%
#2 HDPE Bottles/Jars - Color	0.0%	Other Aluminum	0.0%
#2 Other HDPE Containers	0.0%	HVAC Ducting	0.0%
#6 Exp. Polystyrene Packaging	0.0%	Ferrous Containers (Tin Cans)	0.0%
#3-#7 Other - All	0.0%	Other Ferrous	4.6%
Other Rigid Plastic Products	0.1%	Other Non-Ferrous	0.0%
Grocery & Merchandise Bags	0.0%	Other Metal	0.0%
Trash Bags	0.0%	**Beverage Containers**	**0.0%**
Commercial & Industrial Film	0.0%	Milk & Juice Cartons/Boxes - Coated	0.0%
Other Film	0.1%	Water Bottles	0.0%
Other Plastic	0.0%	**C&D**	**68.8%**
Inorganic	**0.5%**	Clean Dimensional Lumber	12.9%
Televisions	0.1%	Clean Engineered Wood	2.0%
Computer Monitors	0.0%	Wood Pallets	2.4%
Computer Equipment/Peripherals	0.0%	Painted Wood	2.1%
Electronic Equipment	0.1%	Treated Wood	3.8%
White Goods - Refrigerated	0.0%	Concrete	8.4%
White Goods - Not Refrigerated	0.0%	Reinforced Concrete	4.2%
Other Household Batteries	0.0%	Asphalt Paving	2.4%
Tires	0.1%	Rock & Other Aggregates	8.3%
Household Bulky Items	0.2%	Bricks	6.3%
Flourescent Lights/Ballasts	0.1%	Clean Unpainted Gypsum Board	9.7%
Household Hazardous Materials	**0.0%**	Painted Gypsum Board	0.5%
Lead-acid Batteries	0.0%	Composition Shingles	2.7%
Latex Paint	0.0%	Other Roofing	1.4%
Oil Paint	0.0%	Plastic C&D Materials	0.0%
Plant/Organism/Pest Control/Growth	0.0%	Ceramics/Porcelain	0.5%
Used Oil/Filters	0.0%	Other C&D	1.2%
Other Automotive Fluids	0.0%	**Textiles**	**0.8%**
Mercury-Containing Items	0.0%	Carpet	0.5%
Sharps & Infectious Waste	0.0%	Carpet Padding	0.0%
Ash, Sludge, & Industrial Wastes	0.0%	Clothing	0.2%
Sewage Solids	0.0%	Other Textiles	0.1%
Other HHW	0.0%		
		Grand Total	**100%**
		No. of Visual Surveys	***351***

** Chicago, IL (2010). CDM Smith. "Waste Characterization Study."*

APPENDIX C – WASTE COMPOSITION STUDY SOURCE DATA

Seattle Composition by Weight - Overall Disposed C&D (July 2013 - June 2014)

Material Category	Est. Percent	Material Category	Est. Percent
Paper	**2.1%**	**Insulation**	**0.9%**
OCC	1.0%	Cellulose Insulation	0.0%
Other Recyclable Paper	0.9%	Fiberglass Insulation	0.2%
Remainder/Composite Paper	0.2%	Rigid Foam Wall Insulation	0.7%
Plastic	**1.9%**	**Metal**	**2.7%**
Clean Plastic Sheeting and Agriculture Film	0.3%	Major Appliances	0.1%
Dirty Plastic Sheeting and Agriculture Film	0.2%	HVAC Ducting	0.1%
Plastic Piping	0.8%	Rebar	0.0%
Expanded Polystyrene Block Packaging	0.2%	Studs (Steel Framing)	0.5%
Vinyl Exterior Siding	0.0%	Other Ferrous Metals	0.8%
Plastic Lumber	0.0%	Other Non-Ferrous	0.6%
Durable Plastic Items	0.1%	Remainder/Composite Metal	0.6%
Other Plastic	0.2%	**Gypsum Wallboard**	**14.4%**
Remainder/Composite Plastic	0.1%	Clean Gypsum Board	4.5%
Glass	**1.7%**	Painted/Demolition Gypsum Board	9.9%
Flat Window Glass	0.7%	**Other C&D**	**8.7%**
Other Glass	0.3%	Carpet/Carpet Tiles	1.1%
Remainder/Composite Glass	0.7%	Carpet Pad (Foam and Felt)	0.3%
Organics	**1.3%**	Celing Tiles	0.0%
Leaves and Grass	0.6%	Cement Fiber Board Siding (Exterior)	0.0%
Branches and Stumps	0.5%	Remainder/Composite Building Materials	7.3%
Remainder/Composite Organics	0.2%	**Roofing**	**10.0%**
Wood	**40.3%**	Composition Roofing	6.7%
Clean Dimensional Lumber	6.8%	Single Ply Roofing Membrane	0.6%
Clean Engineered Wood	7.7%	Other Asphalt Roofing	2.7%
Pallets and Crates	5.0%	**Hazardous Waste**	**0.2%**
Other Recyclable Wood	6.5%	Paint	0.0%
Painted/Stained Wood	13.1%	Solvents and Paint Thinners	0.0%
Creosole-treated Wood	0.5%	Asbestos Containing Items	0.2%
Other Treated Wood	0.7%	Mercury Containing Items	0.0%
Aggregates	**12.4%**	Remainder/Composite HHW	0.0%
Concrete	3.2%	**Bulky Items and Textiles**	**1.0%**
Asphalt Paving	0.2%	Furniture	0.5%
Brick	2.2%	Mattresses	0.0%
Rock and Gravel	0.7%	Textiles	0.5%
Dirt and Sand	3.9%	Tires	0.0%
Ceramics	0.8%	Remainder/Composite Bulky Items & Textiles	0.0%
Other Aggregates	1.4%	**Mixed Residue/MSW**	**2.4%**
E-Waste	**0.0%**	Other MSW	2.3%
Small Consumer Electronics	0.0%	Fines	0.1%
Computer Related Electronics	0.0%		
Televisions/Other Items with CRTs	0.0%	**Grand Total**	**100%**
Remainder/Composite Electronics	0.0%	***No. of Visual Surveys***	***428***

** Seattle, WA (2017). Cascadia Consulting Group. "Construction and Demolition Waste Composition Study."*

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