HENNEPIN COUNTY

CITY OF MINNEAPOLIS
RESIDENTIAL WASTE CHARACTERIZATION STUDY
AND RECYCLING ANALYSIS

FINAL REPORT (REISSUE)

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1. INTRODUCTION

1.1 BACKGROUND

The state of Minnesota has long been considered a national leader in the recycling arena. In 2014, Minnesota passed a law that set a goal for metropolitan counties to recycle and compost 75 percent of solid waste by 2030. In 2015, Hennepin County's (County) total recycling rate was 44 percent from the combined residential and commercial sectors. Waste diversion in the City of Minneapolis's (City) residential sector, a significant contributor to the County's waste stream, was well below required County-wide diversion levels.

At the current time, the County has initiated a comprehensive, quantitative evaluation to understand how/whether it is possible to achieve the 75% state-mandated diversion goal if it applied solely to the residential sector of the City of Minneapolis. The County has conceptualized this project to:

(i) Rigorously characterize residential wastes from three areas of the City;
(ii) Identify what materials are actually recyclable or compostable in various programs (both government sponsored and third party);
(iii) Perform an innovative investigation to better quantify whether certain product types are more or less effectively diverted; and,
(iv) Reach defensible conclusions about the strategies and programs that would be needed to maximize diversion. In defining this project, the County has outlined a plan to validate the reasonableness of the state's 75% goal.

The County retained a project team managed by Foth Infrastructure and Environment (Foth) to perform and manage this project. The first phase of the project involved performance of a waste characterization study on the City of Minneapolis residential wastes to identify opportunities to increase diversion in the disposed waste stream. MSW Consultants, LLC developed the sampling plan and study design to meet the County's technical specifications, and subsequently performed the statistical analysis for the waste characterization study phase of the project. MSW Consultants teamed with Foth, Louis Berger and Associates and GHG Analysis to plan and execute the field data collection portion of the study.

This document, also known as the "Sort Report," summarizes the study objectives, design and methodology, the waste composition results, the recycling analysis and conclusions from the waste characterization analysis. The companion "Final Report" is being prepared by Foth and will serve as the master project report, further developing conclusions and recommendations for the County.

1.2 WASTE CHARACTERIZATION OBJECTIVES

The objectives of the residential waste sort were to accomplish the following goals:

- Compare the composition of disposed wastes from three distinct "Waste Load Areas" within the City of Minneapolis to quantify variability in waste composition,
- Quantify and characterize recyclables and organics that remain in the disposed residential waste stream,
- Quantify the amount of disposed wastes that might be diverted in existing governmental and private sector recycling and composting diversion programs,
- Perform an innovative analysis of the product type, or "retail origin," of many plastic products found in the disposed waste stream,
- Describe capture rates (sometimes called "recovery rates") for materials targeted in the City's curbside recycling and organics collection programs, and
- Provide defensible data to be used by the County to realistically assess the feasibility of the City attaining a 75% recycling rate for residentially generated waste.

1.3 REPORT ORGANIZATION

This report records the waste characterization methodology, results and conclusions. The document is organized in the following sections:

- **Section 1 – Introduction:** This section provides an overview of Hennepin County's ambitious project to determine the diversion potential from City of Minneapolis residential waste, and introduces the waste sort phase of the project.
- **Section 2 – Study Design and Methodology:** This section presents an overview of waste disposal and recycling data available from the City and County on which the analysis is based. Also provided in this section is the sampling plan that was developed to guide the study process and to provide statistically defensible data. Finally, this section summarizes the field data collection methods and analytical methods applied in the study.
- **Section 3 – Waste Composition:** This section presents results of the composition of disposed residential waste from the City of Minneapolis, as well as the composition from each of the three Waste Load Areas delineated by the County. Results are presented in both tabular and graphical format to highlight findings of interest. Additionally, results of several detailed subsorts are provided, notably to evaluate the product type or retail origin of various plastic items, and to further break down certain other materials into more granular components. Finally, Minneapolis residential waste composition is compared with other Minnesota residential waste characterization data.
- **Section 4 – Recycling Analysis**: This section provides additional details on the amount and composition of single stream recyclables, compostables and other materials diverted in the City's programs.
- **Section 5 – Conclusions**: This section presents observations and conclusions that can be drawn from the data contained herein. Additional conclusions are provided in the Final Report prepared by Foth.
- **Appendices:** Related documentation and data required for the performance of the residential waste composition study is contained in Appendices. Specific Appendices are shown in the Table of Contents.

2. STUDY DESIGN AND METHODOLOGY

2.1 INTRODUCTION

This section itemizes critical elements of the 2016 study design, including:

- City of Minneapolis waste generation and recycling data used for data analysis and aggregation,
- Staffing and health/safety planning,
- Description of sampling logistics,
- Description of sorting logistics,
- Data recording and chain of custody practices, and
- Data analysis.

2.2 ORIGIN OF SAMPLED WASTES

Most waste characterization studies follow a protocol that allows for random selection from the universe of loads delivered to the hosting disposal facility. This project deviated from an entirely random sampling protocol and instead relied on selection of three routes that are representative of three areas of the City.

Each of the loads contained "single family" (up to 4 units per structure) residential trash. The County estimated each load contained trash from roughly 400 households. As described in more detail below, many samples were taken from each load. For the remainder of this section, the three loads are defined as coming from Waste Load Areas of the City. Of particular importance to the study design, the Waste Load Areas will represent areas within the City with differing demographics and recycling performance attributes.

Table 2-1 identifies the specific routes selected to represent the different Waste Load Areas. Two of the routes are collected by the City, with the third collected by the City's contractor, Minneapolis Refuse, Inc. (MRI). For each Waste Load Area, the table identifies whether or not the area received recycling service during the week sampling was scheduled to take place, and also whether the area was receiving the City's curbside organics collection service at the time of the sampling.

Table 2-1 Summary of Waste Load Areas Selected for Sampling and Sorting

A	B	C	D	E	F
Waste Load Area	City Route Number	Area Receives Recycling Collection on the Week of the Study	Status of Access to Roll-out of City Organics Collection	Collection Provider	Weighting Factor
In 1	0231	No	Active	MRI	40%
2	0001	Yes	Not active	City	25%
3	0010	Yes	Not active	City	35%

The three Waste Load Areas were selected to represent a geographic cross section of the city (north, middle, and south) and to provide insight on how a variety of neighborhood-specific factors affect solid waste management. Although not shown in the table, the selected Waste Load Areas exhibited a range of per-household generation rates. The County is interested in comparing and contrasting waste generation and recycling program performance and potential diversion rates from areas of the City that are shown to be disposing of varying levels of waste in order to determine how program access, public outreach, and even demographic characteristics may influence recycling effectiveness.

Finally, Column F shows the relative weighting factor for each Area based on an analysis by the County that included Census data (economic, social, housing, and demographic) and 2015 waste/recycling

program data. Results of the composition analysis for each of the three Waste Load Areas were weighted as shown in this table to aggregate the data into a City-wide total.

Composition data from each of the three Waste Load Areas was used to estimate the City-wide residential waste composition. The basis for aggregating composition data from the three areas is described in the next section.

2.3 MINNEAPOLIS WASTE GENERATION

In 2015 there were 106,055 households receiving service in the City of Minneapolis residential solid waste program. Multi-unit (more than four (4) households per building) and commercial wastes are not included in this study. Table 2-2 provides annual residential trash, curbside recycling, and organics quantities collected in 2015.

Table 2-2 Minneapolis Residential Waste Generation

Delivered to	Material	Tons	Percent	Percent
Waste to Energy	Refuse	85,613	63.2%	63.2%
Recycling	Single Sort Curbside Recyclables	27,465	20.3%	21.9%
	Mattresses	893	0.7%	
	Appliances/Scrap Metal	706	0.5%	
	Batteries	16	0.0%	
	Electronics	626	0.5%	
Compostable	Source Separated Organics	824	0.6%	14.9%
	Yard Waste	19,336	14.3%	
	Total	**135,481**	**100.0%**	**100.0%**

As shown, the City generated just over 135,000 tons of residential waste in 2015, achieving a 36.8 percent diversion rate (inclusive of recyclables and compostable organics, including yard waste). The average household generates just under 49.1 pounds of waste per week.

Table 2-3 provides the data elements needed to calculate capture rates for targeted recyclable materials. This table contains the estimated composition of the City's residential single stream recyclables. This data has been provided by the County. Although it is likely that the City-wide composition of single stream recyclables may differ slightly within the specific Waste Load Areas, no route-specific data was available to support this hypothesis. As such, it is assumed that all single stream recyclables from each Waste Load Area exhibit the composition shown below.

Table 2-3 City-Wide Composition of Residential Single Stream Recyclables (2015)

Commodity	Tons	Percentage
Newspaper	10,799	39.3%
Mixed Fiber	2,683	9.8%
Corrugated Cardboard	1,966	7.2%
Aseptic	8	0.0%
Aluminum	393	1.4%
Tin	747	2.7%
PET	956	3.5%
HDPE Natural	275	1.0%
HDPE Color	206	0.8%
Plastics #3-#7	195	0.7%
Rigid Plastics	0	0.0%
Glass	8,198	29.9%
Residual	1,038	3.8%
Total	27,465	100.0%

2.4 STAFFING PLAN

The project staffing plan is summarized below:

- **Project Manager**: Foth supplied a Project Manager to participate in and assist with all aspects of the field data collection. The Project Manager was responsible for monitoring the speed and progress of each sampling and sorting team member and assisted when necessary to keep each activity on schedule. The Project Manager served as the liaison between the field data collection team, HERC facility management, and the County. Susan Young of Foth served as Project Manager.

- **Sampling Supervisor**: As the designated truckloads arrive, it was necessary to coordinate with the loader operator and systematically take 17 samples from the tipped load. Samples were carted and labeled for sorting at the Main Sort table. The Sampling Supervisor was responsible for receiving designated loads, preparing and labeling samples, correctly processing the samples at the sort table, and interfacing with the subsort tables once each sample was processed at the Main table. Once all samples were obtained and carted for sorting, the Sampling Supervisor transitioned into another member of the Main Table Sorting Team. Mary Chamberlain of Team member Louis Berger served as the Sampling Supervisor.

- **Sorting Team, Main Sort Table**: GRG Analysis, a Minnesota-based professional sorting crew, provided all sorting for the Main Sort table. GRG's 4-person crew processed all samples on the Main Sort table into the 55 main categories and either (a) weighed out each category and recorded the weight on field forms, and/or (b) systematically transferred sorted materials to the appropriate subsort table for further characterization. Judy Gilow of GRG Analysis served as the sorting team leader for the Main Sort Table.

- **Subsort Managers**: In order to sort 100 percent of each sample within the time constraints and with appropriate accuracy for the multiple subsort specifications, there were two subsort tables, each with a Subsort Manager. One Subsort Manager was responsible for managing all plastic subsorts; and one Subsort Manager was responsible for all other subsorts. Carl Hursh and Natalee Henry from MSW Consultants served as the Subsort Managers.

There were additional MSW Consultants and Foth supervisory personnel on site for set-up and for the first day of sorting to make sure the work site was properly configured, health and safety protocols were in place, and the sampling and sorting methodology was followed.

2.5 SAMPLING PLAN

This section describes the sampling methodology and sampling targets.

2.5.1 SAMPLING LOCATION, TARGETS AND SCHEDULE

Field data collection took place from May 9 through May 14. All field data collection took place at the Hennepin Energy Recovery Center (HERC) at 505 6th Ave N in Minneapolis.

Table 2-4 provides details about the route, date and time specific loads were scheduled to be delivered, and the sampling targets for each of the loads. All loads arrived on or about the scheduled time, and all samples were successfully obtained and processed as shown in this table. As shown, 17 samples were obtained from each load for a total of 51 samples sorted.

Table 2-4 Sampling Details by Waste Load Area

Waste Load Area	City Route Number	Sampling Date	Delivery Time	Weight of Load (tons)	Number of Samples Targeted	Number of Samples Obtained	Average Sample Weight (lbs.)
1	0231	May 9	10:00 am	8.74	17	17	203.9
2	0001	May 10	9:00 am	3.65	17	17	209.7
3	0010	May 11	8:30 am	6.60	17	17	208.5
Total				**18.99**	**51**	**51**	**207.4**

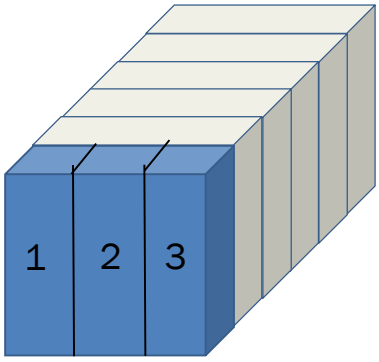
2.5.2 SAMPLE WEIGHT

Consistent with industry standards and the Hennepin County project Request for Proposals (RFP) specifications, samples were pre-weighed to be between 200 and 225 pounds. The average weight of the 51 samples was 207 pounds.

2.5.3 SAMPLING PROCEDURES

Each of the targeted loads was tipped in a designated area at the host facility and a total of 17 samples were obtained with the help of a facility-provided loader. Sample grabs were systematically taken from the front to the back of the load, with the goal of distributing the sample grabs throughout. Figure 2-1 illustrates how samples were systematically obtained using a grid system. Photos of the load tipping and sampling process are contained in Appendix A.

Figure 2-1 Grid Used for Sample Collection



As shown in the Figure, in order to obtain 17 samples the loads were divided lengthwise into roughly six "slices," with each slice divisible into three sections. The Sampling Supervisor worked closely with the HERC loader operator to work through the tipped load from front to back, capturing the 17 targeted samples.

Figure 2-2 Grab Sample in a Loader Bucket

From each grab, a sample weighing at least 200 pounds was extracted from the pile and pre-weighed (to verify that the minimum sample weight had been achieved and to prevent sorting overly large samples, which would diminish sorting productivity). This is shown in Figure 2-2. Pre-weighed samples were loaded into City-provided 95-gallon carts for placement on the sort table, although bulky items were weighed and recorded separately (thereby eliminating the need to sort them at the sort table). In practice, few bulky items were found in the three loads obtained for this study.

Prior to sorting, the Sampling Supervisor photographed each sample, with the sample placard and identification number visible in the picture.

2.6 SORTING PLAN

2.6.1 MATERIAL CATEGORIES

The County provided a comprehensive list of material categories for use in the study. For many of the material categories, the County further identified several subsorts that were necessary. This section summarizes the material categories and subsorts defined by the County.

Table 2-5 summarizes the primary material categories sorted at the Main sort table. Detailed definitions of the primary material categories are contained in Appendix B.

For each primary sort category, Table 2-5 also indicates whether the material is collected in the City of Minneapolis's curbside programs. This is signified by an asterisk in the table. Finally, each material category is classified according to how it could be diverted.

Table 2-5 Primary Material Categories and Recycling/Diversion Methods

Paper	
* Newspaper	Recycling cart
* Office paper	Recycling cart
* Magazines/catalogs	Recycling cart
* Cartons	Recycling cart
* Cardboard / Kraft paper	Recycling cart
* Boxboard / paperboard	Recycling cart
* Mixed recyclable paper	Recycling cart
* Plastic-coated paper	Recycling cart
Non-recyclable paper	Trash
Plastic	
* #1 PET bottles	Recycling cart
* #1 PET non-bottles	Recycling cart
* #2 HDPE bottles	Recycling cart
* #2 HDPE non-bottles	Recycling cart
#3 PVC	Trash
* #5 PP containers	Recycling cart
#6 EPS	Trash
All other packaging containers	Trash
Recoverable film/bags	Recycling drop off
Film: trash bags	Trash
Film: other	Trash
Durable plastic items	Trash
All other plastic	Trash
Metal	
* Steel cans	Recycling cart
* Aluminum cans and foil	Recycling cart
* Other scrap steel	Recycling - Beyond the cart
* Non-ferrous metal	Recycling - Beyond the cart
* Mixed metal	Recycling - Beyond the cart
Glass	
* Food & beverage glass	Recycling cart
Non-recyclable glass	Trash
Organics	
* Food waste	Organics cart
* Compostable paper	Organics cart
* Other compostable	Organics cart
* Yard waste	Yard waste cart
HHW	
HHW	HHW drop off [1]
Electronics	
* Electronics	Recycling - Beyond the cart
C&D Debris [2]	
Clean lumber, pallets, crates	Voucher program
Treated wood, plywood	Voucher program
Gypsum board	Voucher program
Concrete and brick	Voucher program
Carpet & padding	Voucher program
Other C&D	Voucher program
Textiles	
Clothing	Donation
Shoes	Donation
Leather	Donation
All other textiles	Trash
Other Waste	
Small household appliances	Trash
Furniture	Trash
* Mattresses/box springs	Recycling - Beyond the cart
Tires / rubber	Trash
Diapers/feminine hygiene products	Trash
Pet waste	Trash
Fines	Trash
Other not elsewhere classified	Trash
Bulky materials	Trash

* Signifies materials collected in City of Minneapolis curbside programs.

[1] Household hazardous waste (HHW) is collected through a Drop off program; Household batteries that are bagged and placed on top of the recycling cart are collected via the curbside program.

[2] The Voucher Program is a drop-off program for household waste and C & D material generated in households served by the City solid waste program. Very limited recycling of Voucher Waste occurs at this time.

The County identified a number of Plastics to undergo additional sorting. Table 2-6 shows the Plastic material categories from the Main sort table that were transferred to the subsort table. Table 2-6 also shows how these plastics were further subsorted. Definitions of the Plastic subsort categories are shown in Appendix B.

Table 2-6 Plastic Subsort Categories

Material Categories to be Subsorted	Subsort Categories
#1 PET Bottles #1 PET Non-bottles #2 HDPE Bottles #2 HDPE Non-bottles #5 PP Containers #6 EPS All Other Packaging Containers Recoverable Film/Bags	1) Grocery 2) Beauty, Health & Pharmacy 3) Household Essentials 4) Other
Film: Other	1) Flex Packaging 2) Other Packaging 3) Other Film
Durable Plastic Items All Other Plastic	1) Kitchen 2) Tableware 3) Home Décor 4) Home Storage 5) Home Improvement 6) Patio & Garden 7) Automotive 8) Toys 9) Sports, Fitness & Outdoors 10) Other

Finally, the County identified a number of other categories that required more in-depth sorting. Table 2-7 summarizes these additional subsorts. Definitions of these Other Subsort materials are contained in Appendix B.

Table 2-7 Other Subsort Categories

Material Categories to be Subsorted	Subsort Categories
Boxboard/Paperboard Mixed Recyclable Paper Plastic-coated Paper	1) Grocery 2) Mail 3) Other
Compostable Paper	1) Certified Foodware 2) Clearly Compostable 3) Non-packaging, non-food related
Other Compostable	1) Compostable Plastic Foodware 2) Other
HHW	1) Batteries 2) Paints & Solvents 3) Automotive Products 4) Other HHW Items containing Mercury "Count"
Electronics	CRT Count
All Other Textiles	1) Accessories 2) Home 3) Other

In total, there were 18 categories on the Main sort table that required subsorting into a total of 78 additional subcategories.

2.6.2 PROVISION OF EQUIPMENT

Table 2-8 lists the sorting equipment and personal protective equipment (PPE) provided by the sorting team.

Table 2-8 Equipment Needs

Loader (provided by host facility)	Dust Mask (1 Per Person/Day)
Sort Tables (4'x8'base with legs)	Puncture Resistant Gloves (1 Per Person)
18 gallon sort bins	Glove Liners (1 Per Person/Day)
30 gallon sort bins	Safety Glasses (1 Per Person)
40 gallon carry barrels	Work Gloves
Shovels	Sun Block
Brooms	Safety/Medical Kit
Digital Scales (weighs to 0.1 pound)	Clipboards
Replacement Batteries	Digital Cameras
Tarps	Cooler with cold drinks
Plastic sheeting (10'x10')	Cargo Vans
Traffic cones to demark the sort area boundary	Laminated sheets with category lists
Tyvek Suits (1 Per Person/Day) or Coveralls	Port-o-let or restroom access (provided by host facility)

2.6.3 WORK SITE CONFIGURATION AT HERC

Appendix C contains a schematic of the sorting facility that shows the layout of the Main Sort and Subsort tables, scales, and carts containing samples for sorting. This schematic also shows where the Waste Loads were tipped and sampled with the help of a loader operator. A photo journal of the work area is contained in Appendix D.

2.6.4 WORK SITE SET-UP DAY

Given the complexity of the sorting operation, the field data collection team (Project Manager, Sampling Supervisor, Sorting Team, and Subsort Managers) set up the work area and validated sorting procedures one day in advance of the actual study on Sunday, May 8, 2016. In addition to configuring the sort table and scales and labeling bins, the sort team used the set-up day to review material definitions, confirm main sort table and subsort table responsibilities, and confirm the flow of materials.

Key objectives of the training day are itemized below:

- Understand the sorting table configuration and flow of materials from carts to final weigh-out.
- Confirm the sort and subsort category definitions.
- Determine how to most evenly split the sorting requirements between the Main Sort Table and the Subsort tables.
- Discuss the mix of materials requiring subsorting so that appropriate sort bins could be labeled and positioned to hold sorted items by type.
- Gain a sense of the time requirements for weighing out and setting up at the Main Sort and Subsort tables.
- Identify the strengths of the assigned subsort managers and make final assignments of each person to the sort or subsort table where that person's abilities would be best employed.
- Review health and safety requirements with professional staff.

2.6.5 HEALTH & SAFETY

Each of the Team members on this project maintained a Health and Safety Plan governing waste characterization safety and PPE requirements, and followed appropriate health and safety practices. No injuries or incidents were incurred during the project.

HERC facility staff provided a facility safety orientation at 7:00 AM on the first morning of the sort operations, Monday, May 9, 2016. All sort personnel were required to wear hard hats, PPE and hi-visibility apparel while on the tipping floor.

2.6.6 SORTING PROCEDURES – MAIN TABLE

There were three sort tables, each with a particular role and layout:

- The **Main Sort Table** was where the entire sample was first emptied and sorted into approximately 55 categories.
- The **Plastic Subsort Table** received plastic containers, rigid plastics and film plastics to be sorted into sub categories.
- The **Other Subsort Table** received the remainder of materials requiring subsorting including HHW, electronics including CRTs, textiles, clothing, and non-recyclable paper.

The Main Sort Table equipment included a 4' x 6' sorting table supported by two saw horses. The table was surrounded by an assortment of barrels into which materials were be sorted. The sort container bins were labeled according to the Main Sort Table material categories as shown in Appendix E.

Samples were queued by the Sampling Manager at the Main Sort table. The GRG sort crew first lifted and emptied the 95-gallon sample carts onto the table, a task requiring two sorting staff.

After the initial portion of a sample was deposited on the Main sort table, the sort team immediately began identifying and placing the materials in their respective, labeled containers or passing them along the table to the sorter closest to a given sort container. Sorters at the Main sort table specialized in certain material groups, with one team member handling the paper categories, another the plastics, another the glass and metals, and so on. In this way, sorters became highly knowledgeable in a short period of time as to the definitions of individual primary material categories. An example of a sorting table and bins is shown in Figure 2-3.

Figure 2-3 Sort Table and Bins

If materials in the sample were held within a plastic bag, the bag was torn open, its contents unloaded onto the Main sort table, and the bag passed to the end of the table for placement into one of the plastic film sort containers. This sorting process was repeated with sample's second cart until all identifiable sample materials were removed from the screen and placed into their appropriate sorting containers.

Samples were sorted down to the top of a 2-inch screen. All materials passing through this screen were sorted into a category called Supermix (discussed below).

At this point, members of the GRG sort team delivered bins requiring subsorting to the Plastics Subsort table and the Other Subsort table for further characterization. Appendix E contains a schematic of the main sort table that identifies containers that underwent further analysis at a subsort table. All of the remaining sort containers, with contents, were weighed at the Main Sort Table's designated electronic scale, and the weights entered onto a data sheet by the GRG sort team.

As the data were recorded, the contents of the weighed and recorded sample bins were emptied at a designated location for disposal by HERC facility personnel.

2.6.7 SORTING PROCEDURES – SUPERMIX

Supermix from the first four or five samples from each Waste Load Area was stored in a container for subsequent analysis. After roughly 150 pounds of Supermix was accumulated, the entire contents were emptied on the floor and spread into a thin layer. Approximately 25 pounds of Supermix was shoveled from the floor and placed on a Supermix subsort table, where it was further subsorted into major material groups. A screen, with approximately 1-inch squares, was used on the Supermix subsort table to further sort and characterize the Supermix. Appendix F illustrates the process and further characterization of the Supermix

2.6.8 SORTING PROCEDURES – PLASTIC SUBSORTS

One professional staff was assigned to the Plastics Subsort Table. Plastic containers, plastic films and other rigid plastics (including durables) that had been sorted at the Main Sort Table were examined, further sorted at the Plastics Subsort Table and weighed. Items within the individual categories were sorted by resin type into a combination of 5-gallon plastic buckets or 20-gallon recycling bins depending on material volume. A schematic showing the subsort process for each material category is contained in Appendix E.

Each category of plastics was weighed out before subsorting items into another plastics category. Because some non-plastic materials were inadvertently delivered to this table, the Plastic Subsort manager had the ability to weigh and record weights of such incidental items.

The following further describes the sorting details by material category:

- Plastic Bottles were sorted at the Main Sort Table by three resin types (PET, HDPE, PP) and Other Bottles, then subsorted into four subcategories including Grocery, Beauty/Health/Pharmacy, Household Essentials and Other/Unknown.
- Non-Bottle/Jar HDPE plastic were separated into the same four subcategories as plastic bottles above as were four other plastic categories including Non-bottle Polypropylene, Compostable Plastics, and All Other Plastic Containers.
- The Durable Plastics and the Non-Recyclable Plastic categories each required subsorting into 10 categories: Kitchen; Tableware; Home décor; Home storage; Home improvement; Patio & Garden; Automotive; Toys; Sports, fitness and outdoors; and Other/Unknown.

2.6.9 SORTING PROCEDURES – OTHER SUBSORTS

This subsort began with the delivery of three paper categories, HHW, electronics including CRTs, and textiles other than clothing, shoes and leather, from the Main Sort Area to the Other Subsort Table for characterization and weigh-out.

Materials in the subsort containers were deposited onto the sort table then separated into 5-gallon plastic buckets or 20-gallon recycling bins depending on material volume. The sorting buckets and bins were be weighed at the Subsort Table scale and the weights recorded onto the data sheet. After the materials were weighed, the contents of the sorting buckets and bins were disposed in the designated area. This weigh-out process was repeated for the all of the materials categories and product types. A schematic of the Other Subsort table sorting protocol is contained in Appendix E.

The following provides some sorting details by material category:

- The Boxboard and Plastic Coated Paper categories were each sorted into Grocery and Unknown sub-categories.
- Mixed Recyclable Paper was subsorted into three categories: Mail, Grocery and Other/Unknown.
- Compostable paper was separated into Foodware: Certified compostable paper products and Foodware: Not certified, clearly compostable.
- HHW subsorts included Batteries, Paints and solvents, Automotive products, and Other HHW.
- CRTs were to be counted separately, but none were encountered in the Electronics category.
- The Textiles category was sorted into Accessories (handbags, jewelry sunglasses, wallets, watches), Clothing and Home (towel & linens, bedding, curtains, rugs, placemats & cloth napkins, etc.)
- Non-Recyclable Paper required qualitative photographs and descriptions of individual items. Selected samples of non-recyclable paper are shown in Appendix G.

2.7 DATA MANAGEMENT

2.7.1 FIELD FORMS AND DATA RECORDING

Because of the complexity of the field data collection requirements, and because there were multiple team members with individual methodologies, paper-based field forms were used for data recording for this project. The following field forms were developed for this project:

- **Sample Tracking Form**: The Sampling Manager maintained a running tally of the samples obtained from the targeted routes.

- **Labels for Carted Samples**: The Sampling Manager filled out labels to affix to each cart containing sample materials and queued the carts near the Main Sort table for processing.
- **Main Sort Table Weight Data Form**: The GRG sort team was responsible for managing the Main sort weight data form. Completed forms were be transferred from the work area to the project team cargo van on a routine basis throughout the day to prevent data loss.
- **Plastic Subsort Weight Data Form**: The Plastic Subsort Manager was responsible for filling out and storing weight data form for plastic subsorts.
- **Other Subsort Weight Data Form**: The Other Subsort Manager was responsible for filling out and storing weight data form for other subsorts.

These forms are included in Appendix H.

The designated team member responsible for each data form reviewed completed forms to confirm the correct sample identification number. From time to time during the day the Project Manager confirmed when all field forms for an individual sample were completed, and stapled them together along with the sample label. The Project Manager retained completed sample forms and scanned them at Foth's office on a daily basis for transmission to MSW Consultants for data entry.

2.7.2 STATISTICAL METHODS

The following statistical measures have been calculated to determine the overall composition of each Waste Load Area:

- **Sample Mean**: The sample mean, or average, composition is considered the "most likely" fraction for each material category in the waste stream. The sample mean is determined by:
  - (i) summing the weight of each material in each sample;
  - (ii) summing the total weight of all samples, and
  - (iii) dividing the first value by the second value to determine the percent-by-weight composition.

  Note that the sample mean, while a good estimate, is unlikely to be identical to the population mean value. The meaningfulness of the sample mean is enhanced by the following statistical measure.
- **Confidence Intervals**: When a sample of data is obtained, it is analyzed in an attempt to determine certain values that describe the entire population of data under analysis. For example, in a poll of likely voters, the intent of the poll is to determine the percentage of all voters who support a given candidate, not simply the percentage of voters in the poll who support that candidate. The percentage of voters who support a given candidate in the poll can easily vary from sample to sample; but the percentage of all voters who support that candidate is a fixed value. In our sample of incoming loads of waste, we are not primarily interested in the percentage composition of the sampled loads, but rather in trying to determine what the composition of the sampled loads tells us about the composition of all waste generated. A confidence interval is a statistical concept that attempts to indicate the likely range within which the true value lies. The confidence intervals reflect the upper and lower range within which the population mean can be expected to fall. Confidence intervals require the following "inputs:"
- The "level of confidence", or how sure one wants to be that the interval being constructed will actually encompass the population mean;
- The sample mean, around which the confidence interval will be constructed;
- The sample standard deviation, which is used as a measure of the variability of the population from which the sample was obtained; and
- The number of sampling units that comprised the sample (a.k.a. sample size).

Confidence intervals were calculated at a 90 percent level of confidence, meaning that we can be 90 percent sure that the population mean falls within the upper and lower confidence intervals shown. (The converse is also true: that there is a 10 percent chance that the population mean falls outside of the sample mean.) In general, as the number of samples increases, the width of the confidence intervals decreases, although the more variable the underlying waste stream composition, the less noticeable the improvement for adding incremental samples.

A complete set of results was generated for each Waste Load Area. However, a final objective was to aggregate the composition of the three Waste Areas into a Minneapolis City-wide residential waste composition results set. The relative tonnages associated with wastes from each Waste Area stream served as the weighting factors. These weighting factors are shown in Table 2-1.

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3. WASTE COMPOSITION

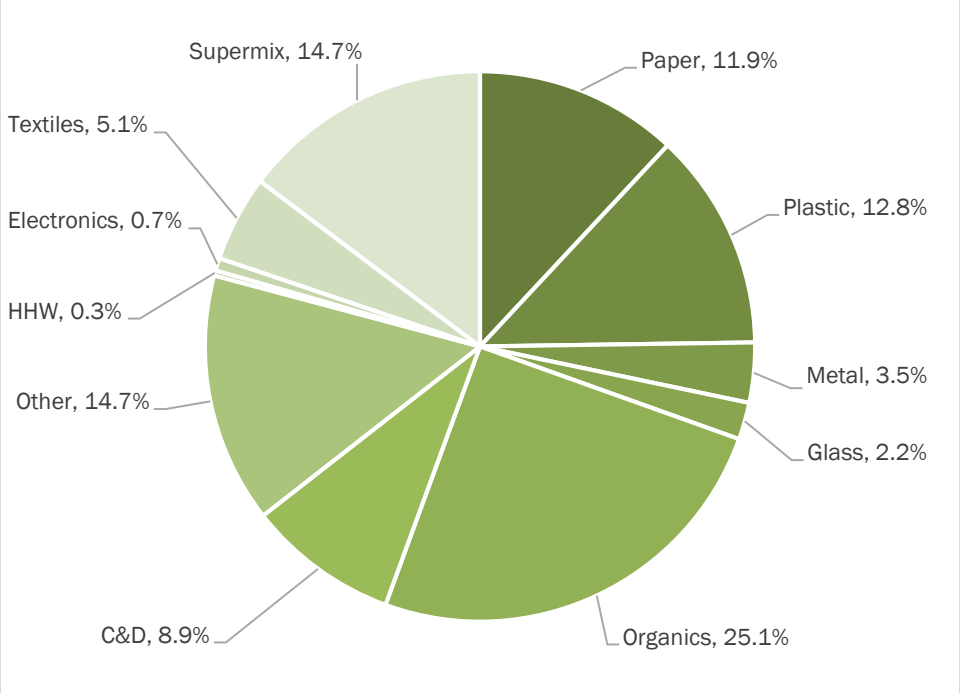
3.1 MINNEAPOLIS RESIDENTIAL WASTE COMPOSITION

This section contains the estimated composition of the City of Minneapolis's aggregate residential waste stream. The following subsections reflect the composition of the 85,613 tons of waste disposed in 2015.

3.1.1 PRIMARY WASTE CHARACTERIZATION RESULTS

Figure 3-1 breaks down the City's 2015 residential waste stream by the major material groups defined for this study. As shown, Organics are the most prevalent material. However, no single material group dominates the City's residential waste stream. This figure has not been adjusted for the additional analysis of Supermix, which further sorted Paper, Plastic, Metal, Glass, and Food Waste from this fraction of the waste having particle sizes below 2 inches.

Figure 3-1 Minneapolis Residential Waste Composition Overview (Unadjusted)
2015



A breakdown of Supermix is shown in Figure 3-2. Because of the small particle size and degree of degradation of materials in this fraction of the sorted waste, sorting was only attempted to the material group level. For example, the Paper in Supermix included all recyclable grades as well as compostable and non-recyclable fibers. The Organics in Supermix included both Food Waste and Yard Waste, and could be considered "clean" for composting.

Figure 3-2 Composition of Supermix

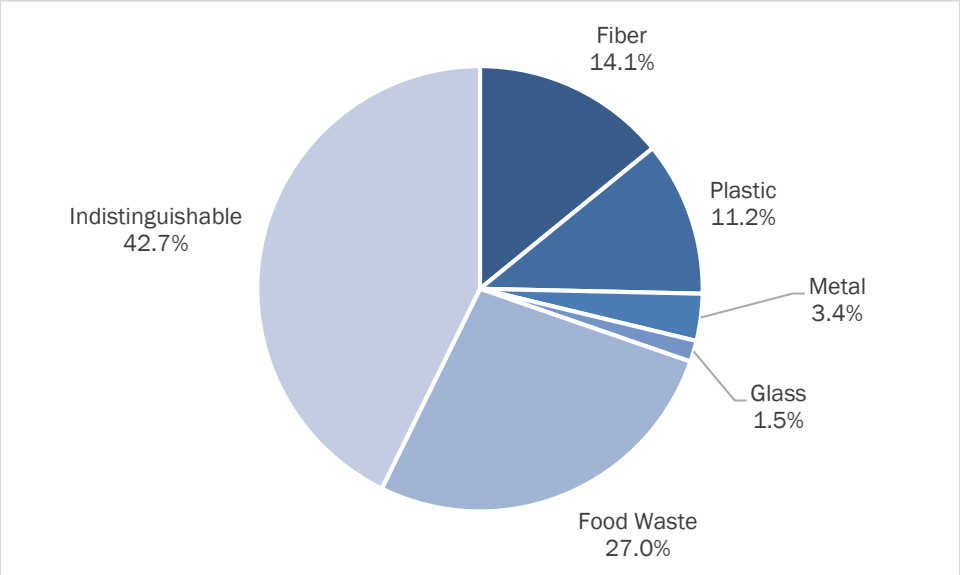


Figure 3-3 shows the adjusted breakdown of Minneapolis residential waste after allocating sorted Supermix to the appropriate material groups. This adjusted figure is more comparable to other waste characterization studies that typically allocate the Supermix and fines to material groups, rather than screening out this fraction as was done in this study.

Figure 3-3 Minneapolis Residential Waste Composition Overview (Adjusted)

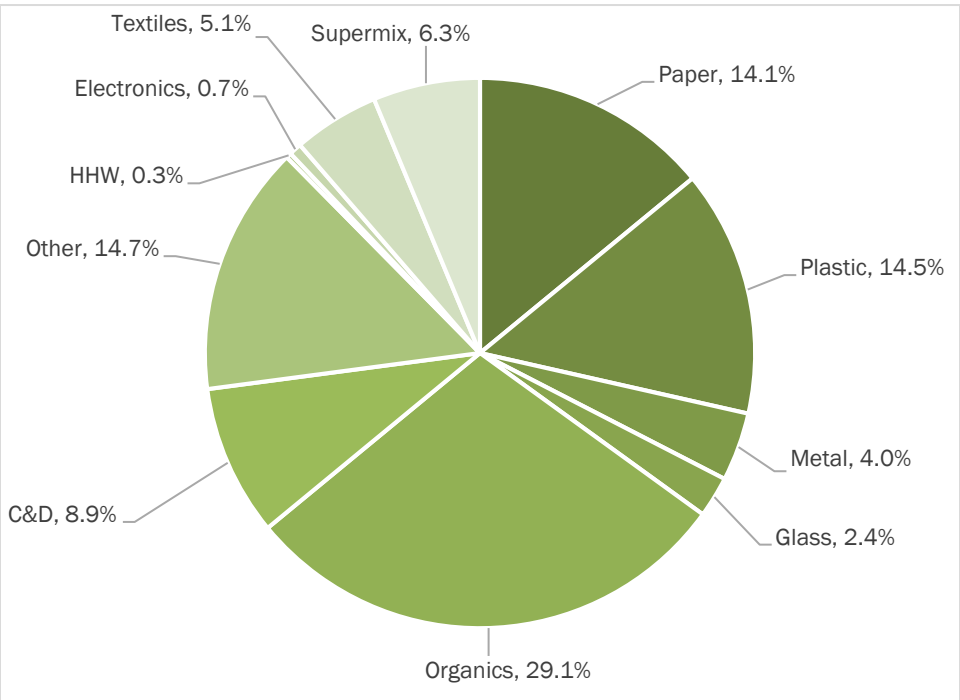


Figure 3-4 identifies the ten most prevalent material categories in Minneapolis residential waste. As shown, Food Waste was found to be the most prevalent material at 15 percent of the stream.

Figure 3-4 Top 10 Most Prevalent Materials in Minneapolis Residential Waste (Adjusted)

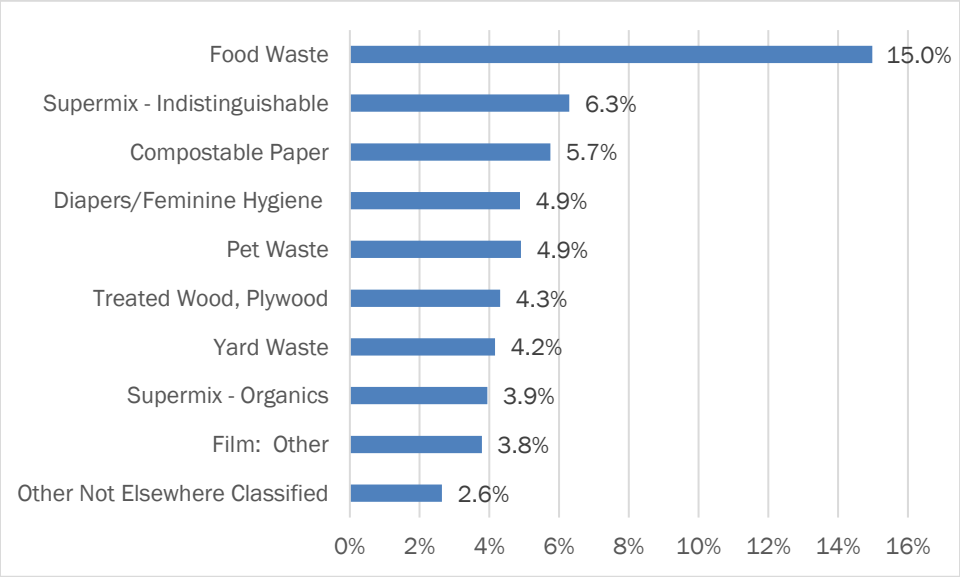


Table 3-1 on the following page provides the detailed statistical profile of the aggregate residential waste stream in Minneapolis. For each material category, the mean percent, confidence intervals, and estimated tonnage are shown. The Citywide residential waste composition results in this table allocate the sorted Supermix back to the appropriate material groups. However, the remaining results by Work Load Area, as well as comparative results, leave Supermix as its own separate material group and do not attempt to allocate Supermix constituents back to their respective material groups.

Table 3-1 Detailed Composition, Minneapolis Residential Waste

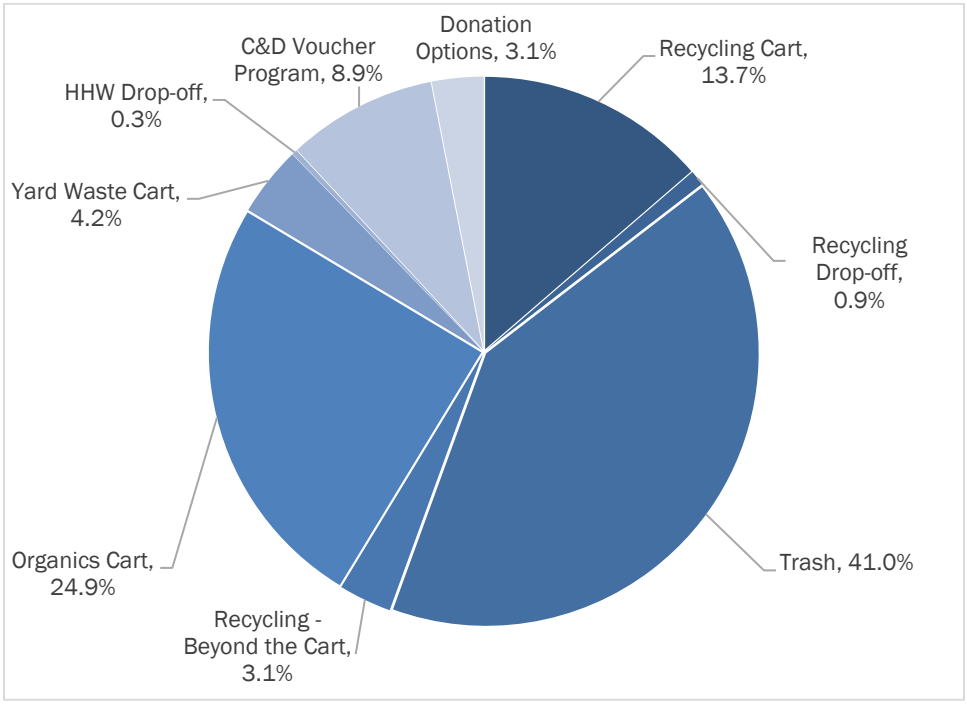
Material Category	Est. Percent	Conf Int (+/-)	Tons	Material Category	Est. Percent	Conf Int (+/-)	Tons
Paper	**14.1%**	**1.0%**	**12,013**	**Glass**	**2.4%**	**0.3%**	**2,055**
Newspaper	1.2%	0.2%	1,014	Food and Beverage Glass	1.6%	0.3%	1,360
Office Paper	0.6%	0.2%	481	Non-recyclable Glass	0.6%	0.2%	502
Magazines / Catalogs	0.8%	0.2%	647	Supermix - Glass	0.2%	*N/A*	194
Cartons	0.1%	0.0%	119	**Organics**	**29.1%**	**2.0%**	**24,905**
Cardboard / Kraft Paper	2.4%	0.5%	2,038	Food Waste	15.0%	1.5%	12,827
Boxboard / Paperboard	1.2%	0.2%	1,024	Compostable Paper	5.7%	0.4%	4,918
Mixed Recyclable Paper	2.4%	0.4%	2,091	Other Compostable Organics	0.2%	0.1%	193
Plastic-coated Paper	0.3%	0.1%	238	Yard Waste	4.2%	1.4%	3,564
Non-recyclable Paper	3.0%	0.5%	2,580	Supermix - Organics	3.9%	*N/A*	3,404
Supermix - Paper	2.1%	*N/A*	1,783	**C&D Debris**	**8.9%**	**1.8%**	**7,598**
Plastic	**14.5%**	**0.9%**	**12,391**	Clean Lumber, Pallets, Crates	0.8%	0.6%	654
#1 PET Bottles	0.8%	0.1%	726	Treated Wood, Plywood	4.3%	0.8%	3,687
#1 PET Non-Bottles	0.2%	0.0%	155	Gypsum Board	0.4%	0.4%	377
#2 HDPE Bottles	0.4%	0.1%	334	Concrete and Brick	0.2%	0.1%	156
#2 HDPE Non-Bottles	0.1%	0.0%	53	Carpet & Padding	1.1%	0.6%	917
#3 PVC	0.0%	0.0%	21	Other C&D	2.1%	0.7%	1,806
#5 PP Containers	0.4%	0.0%	307	**Textiles**	**5.1%**	**0.8%**	**4,334**
#6 EPS	0.4%	0.1%	368	Clothing	2.1%	0.5%	1,832
All Other Packaging Containers	1.3%	0.1%	1,139	Shoes	0.9%	0.3%	742
Recoverable Film / Bags	0.9%	0.1%	769	Leather	0.1%	0.1%	48
Film: Trash Bags	1.1%	0.1%	910	All Other Textiles	2.0%	0.3%	1,712
Film: Other	3.8%	0.5%	3,239	**Other Wastes**	**14.7%**	**1.4%**	**12,584**
Durable Plastic Items	2.7%	0.5%	2,341	Small Household Appliances	0.5%	0.3%	455
All Other Plastic	0.7%	0.2%	612	Furniture	1.1%	0.6%	962
Supermix - Plastic	1.7%	*N/A*	1,417	Mattresses / Box Springs	0.2%	0.3%	158
Metal	**4.0%**	**0.4%**	**3,449**	Tires / Rubber	0.4%	0.4%	371
Steel Cans	0.6%	0.1%	547	Diapers/Feminine Hygiene	4.9%	0.8%	4,179
Aluminum Cans and Foil	0.7%	0.1%	566	Pet Waste	4.9%	1.1%	4,198
Other Scrap Steel	0.9%	0.3%	802	Other Not Elsewhere Classified	2.6%	0.7%	2,261
Non-ferrous Metal	0.3%	0.1%	222	**Supermix**	**6.3%**	**1.2%**	**5,393**
Mixed Metal	1.0%	0.3%	880	Supermix - Indistinguishable	6.3%	*N/A*	5,393
Supermix - Metal	0.5%	*N/A*	431				
Electronics	**0.7%**	**0.3%**	**629**				
Electronics	0.7%	0.2%	629				
Household Hazardous Waste	**0.3%**	**0.2%**	**263**	**Grand Total**	**100.0%**		**85,613**
HHW	0.3%	0.1%	263	***No. of Samples***	***51***		

Figure 3-5 presents the composition of disposed residential waste in terms of the potential for diverting materials from disposal. This figure was developed by assigning a "Diversion Strategy" to each individual constituent in the waste stream. Specifically, each material was defined as one of the following:

- **Recycling Cart**: Includes cardboard, newspaper and other dry recyclable fibers, as well as metal, glass, plastic and aseptic containers targeted in the City's curbside recycling program.
- **Yard Waste Cart**: Includes leaves, grass, prunings and trimmings that can be set out with yard trash.
- **Organics Cart**: Food, compostable papers, and other compostable items can be placed in this cart.
- **Voucher Program**: Includes recoverable C&D debris.
- **Recycling Beyond the Cart**: Includes ferrous and nonferrous scrap metal which is accepted by scrap dealers around the City, and also includes Electronics and mattresses.

- **Recycling Drop-off**: Includes clean film bags which can be dropped off at various retailers within the City that offer take-back programs; and also includes HHW which can be dropped at County facilities.
- **Donation Options**: This category includes only clothing, shoes and leather textile products. It is important to note that no attempt was made to judge the condition of disposed textiles, and as a practical matter a large percentage of these items may have been too worn, too damaged, or too contaminated for donation and recovery.
- **Trash**: All other material categories that could not be assigned to one of the above categories were classified as disposable. While other metro areas may have viable recycling programs for certain of these materials, it is not likely that these items will be readily recoverable in the near future. Note that a range of renovation and construction materials are listed as being not currently recoverable in the residential stream, although they might be divertible had they been collected with other C&D.

Figure 3-5 Recyclability of Minneapolis Disposed Wastes



As shown, if 100 percent of disposed wastes were diverted according to the available recycling and reuse options, 41 percent of the residential waste stream would continue to be destined for disposal.

3.1.2 PLASTIC SUBSORT RESULTS

This study subjected a number of plastics material categories to more detailed subsorting. The following figures summarize the noteworthy results of the subsorts of plastic items in the Minneapolis residential waste stream.

Plastic containers were subsorted into four retail types. Figure 3-6 shows the distribution of retail type for all plastics containers in the aggregate. As shown, almost 73 percent of all plastic containers originated from grocery stores.

Figure 3-6 Distribution of Plastic Containers by Retail Type

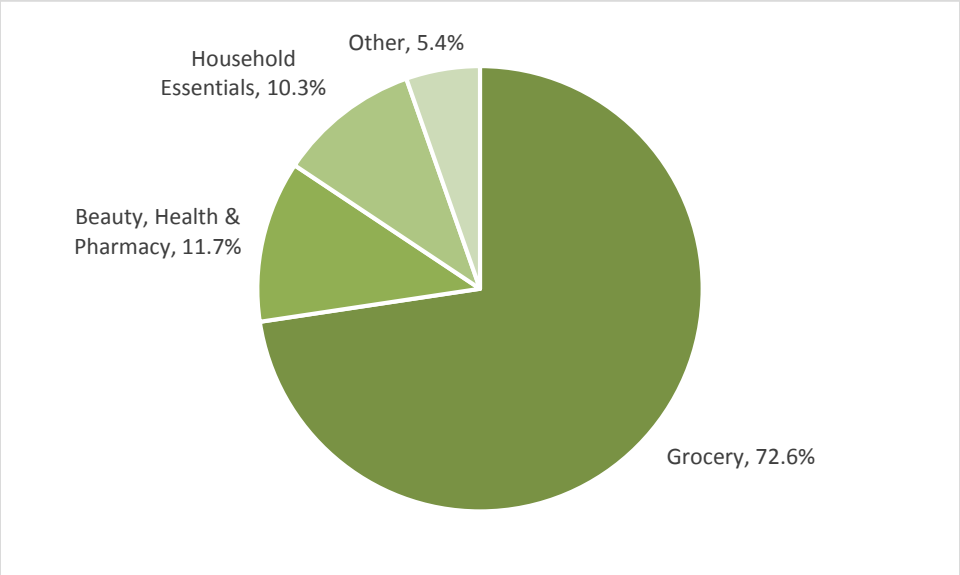
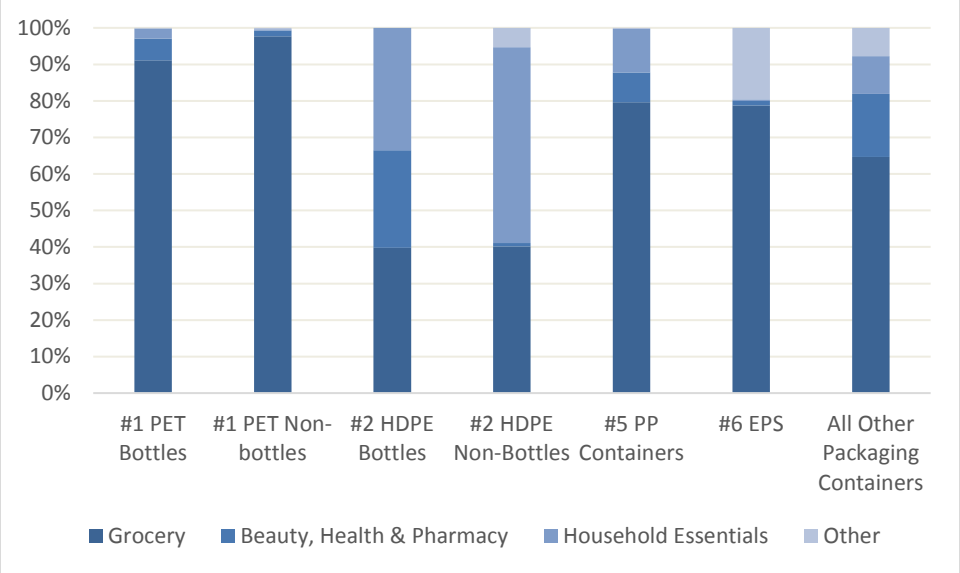


Figure 3-7 shows the distribution of each plastic container category across the four retail categories.

Figure 3-7 Detailed Distribution of Plastic Containers



Other rigid non-container plastics were sorted into 10 retail categories. Figure 3-8 shows the distribution of retail type for all non-container rigid plastics in the aggregate. As shown, there is wide variation in the retail origin of non-container rigid plastics.

Figure 3-8 Distribution of Non-Container Rigid Plastics by Retail Type

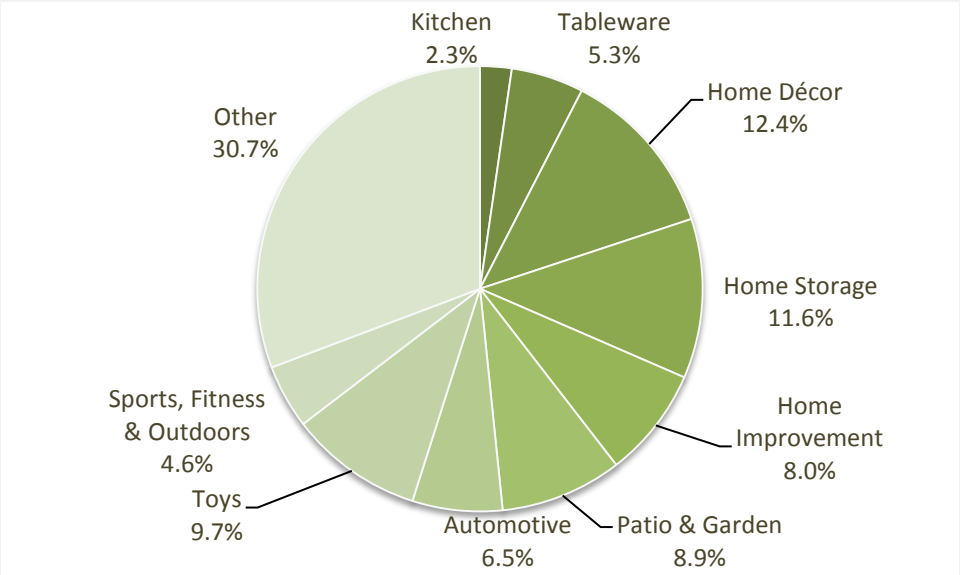


Figure 3-9 shows the distribution of each non-container rigid plastic category by retail type.

Figure 3-9 Detailed Distribution of Non-container Rigid Plastics

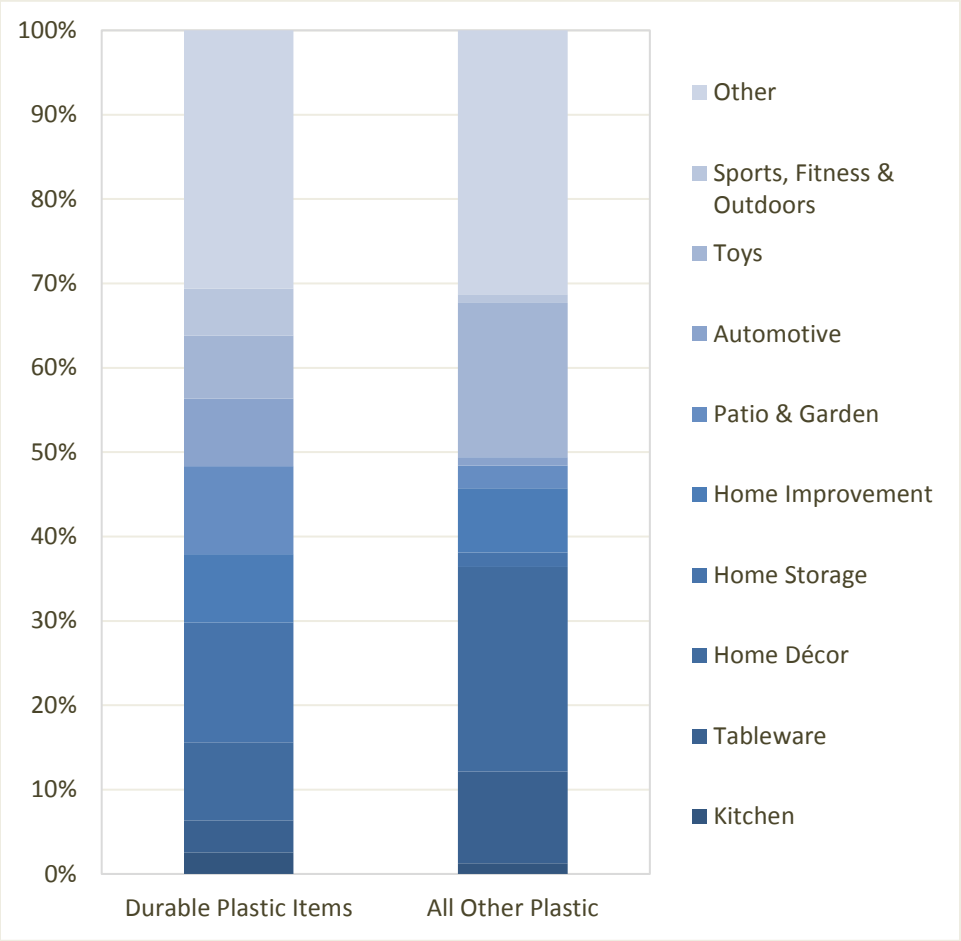
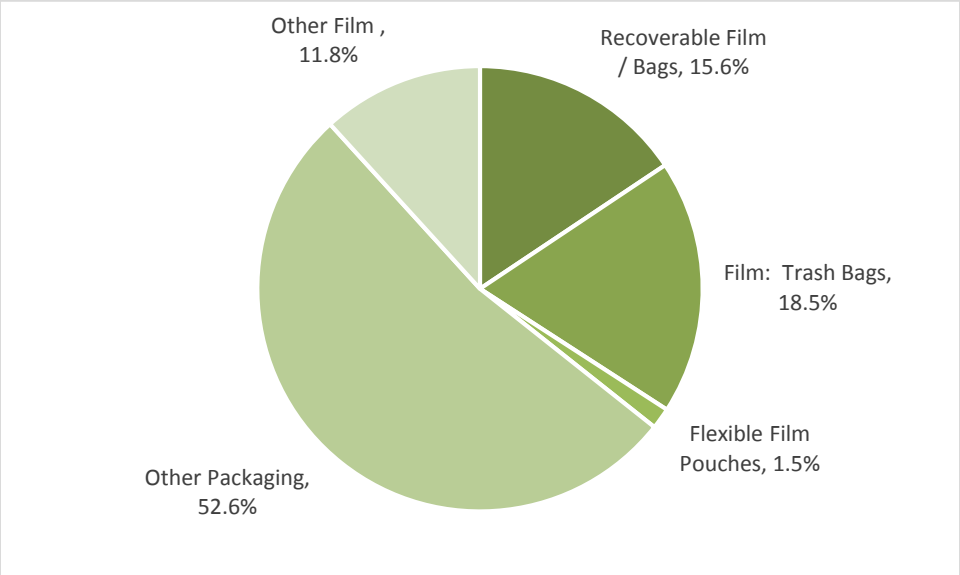


Figure 3-10 focuses on the different types and uses of plastic films found in the disposed waste stream. Over half of the film in the residential waste stream was found to be used in packaging, although only a small fraction was flexible film packaging.

Not shown in this figure is the extent to which plastic films are contaminated in the disposed waste stream. With extremely high surface-to-volume ratios, film plastics are extremely susceptible to contamination by moisture and by particulates. Although no laboratory testing was performed for this study, other studies have found that up to two-thirds of the weight of film plastics sorted from disposed waste is in fact moisture and particulate contamination. For this reason, all of the estimated composition percentages for film plastics in this report should be considered to over-state the actual fraction of films.

Figure 3-10 Breakdown of Plastic Films



3.1.3 OTHER SUBSORT RESULTS

Subsorting was also performed on a number of other categories.

Three categories of recyclable and non-recyclable paper were subsorted into additional categories. Figure 3-11 shows roughly one-quarter each of these types of paper originated from grocery (packaging) and from junk mail, with over half originating from other sources such as bathroom waste paper.

Figure 3-11 Distribution of Other Paper by Source

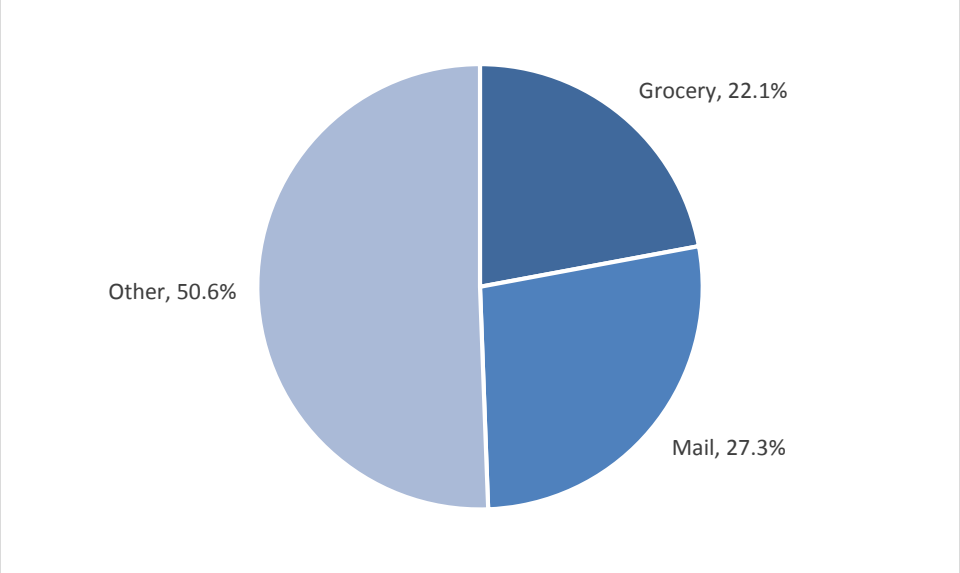


Figure 3-12 Detailed Distribution of Other Paper

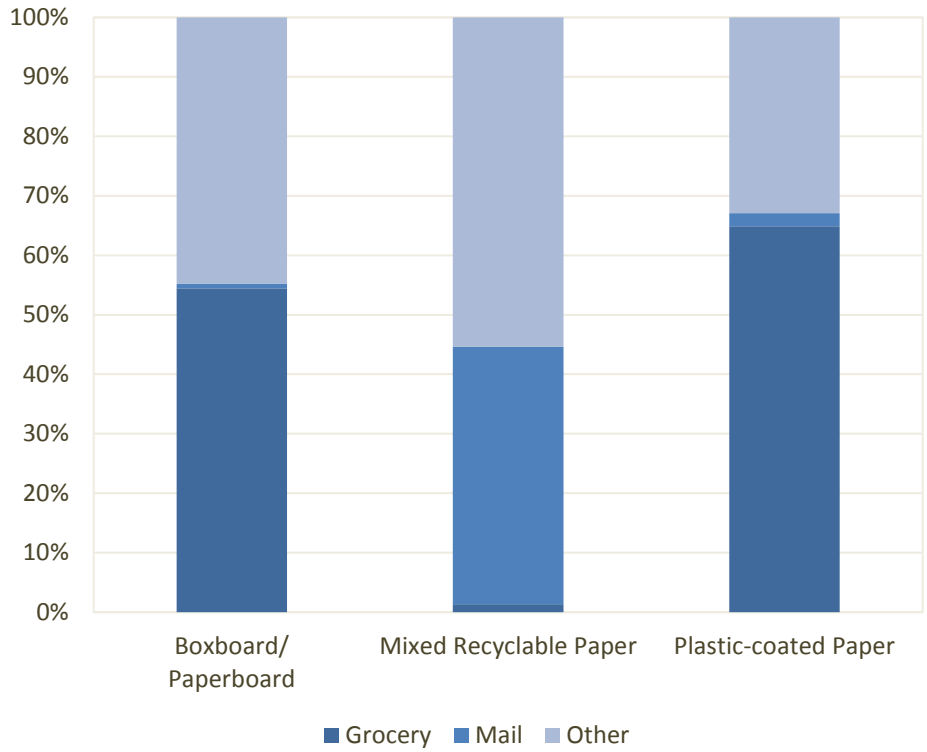
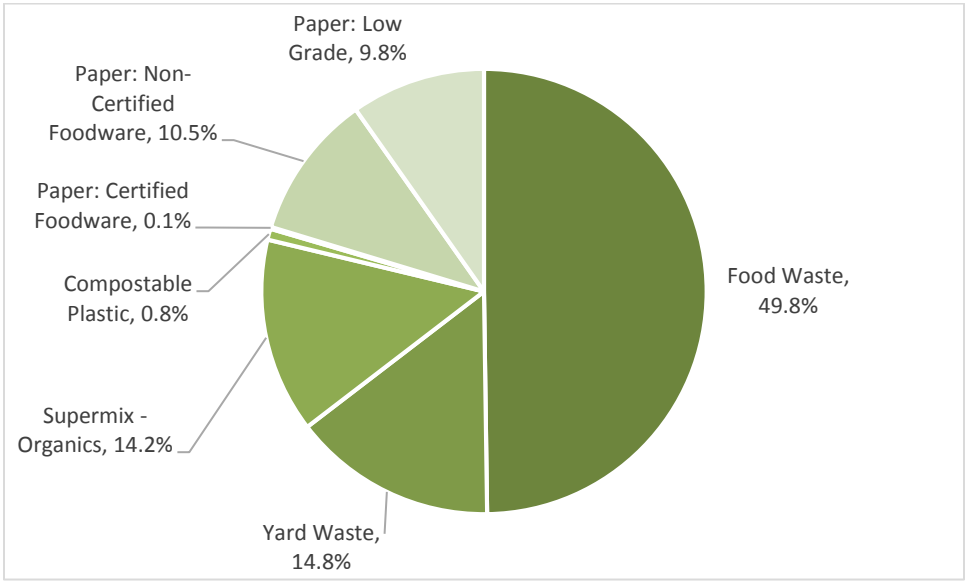


Figure 3-13 focuses on the different types of compostable items found in the disposed waste stream. Not surprisingly, food waste and yard waste are significant. However, compostable paper items, including foodware such as paper plates and low grade papers such as tissues and napkins, are significant. Very little certified compostable foodware was found.

Figure 3-13 Composition of Compostables



Textiles were found to make up 5.1 percent of the residential waste stream. Figure 3-14 focuses on the relative incidence of various types of textile material. As shown, clothing makes up only 41 percent of textiles. Other Textiles, which include household items like blankets, pillows, and other non-clothing items, are virtually as prevalent.

Figure 3-14 Composition of Textiles (All Categories Combined)

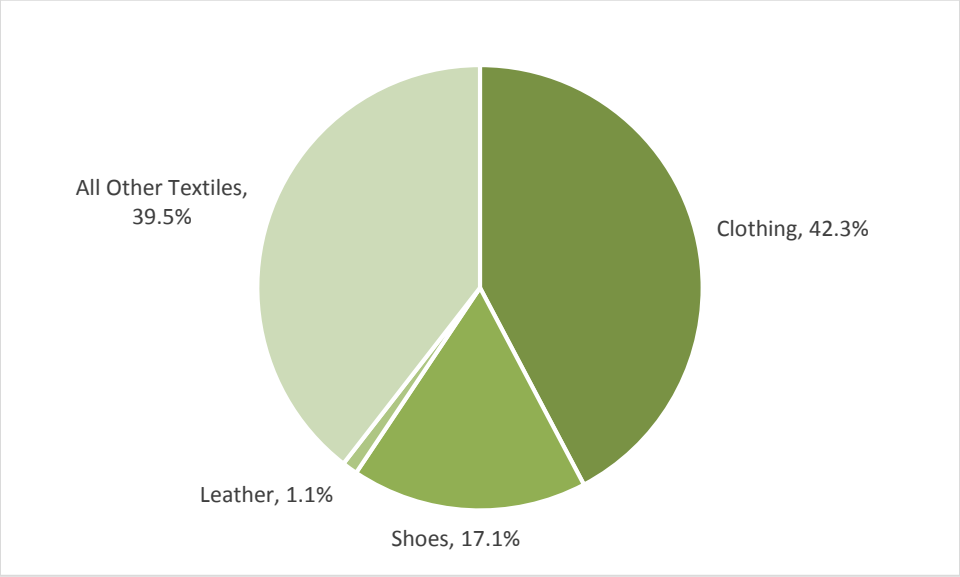
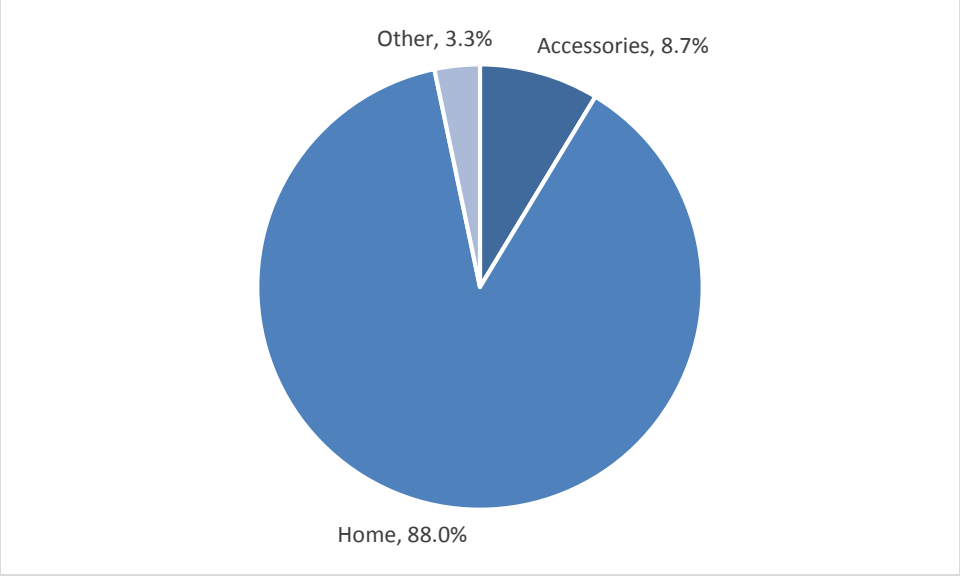


Figure 3-15 shows the origin of textiles in the residential waste stream. Not surprisingly, most textiles are from home uses.

Figure 3-15 Origin of Textiles (All Categories Combined)



As a final note, mercury-containing items and cathode ray tubes were counted during the sort. These counts are summarized in Table 3-2.

Table 3-2 Item Counts

Material	No. of Samples Containing at Least One Item	Total Items Found	Notes
Mercury-containing Items	6	11	All items were CFL bulbs
Cathode Ray Tubes	0	0	

3.2 WASTE LOAD AREA 1 WASTE COMPOSITION

Figure 3-16 shows the breakdown of materials in Waste Area 1. Note that Supermix has not been disaggregated and consequently makes up a significant fraction of the disposed waste from this Area.

Figure 3-16 Waste Load Area 1 Residential Waste Composition Overview

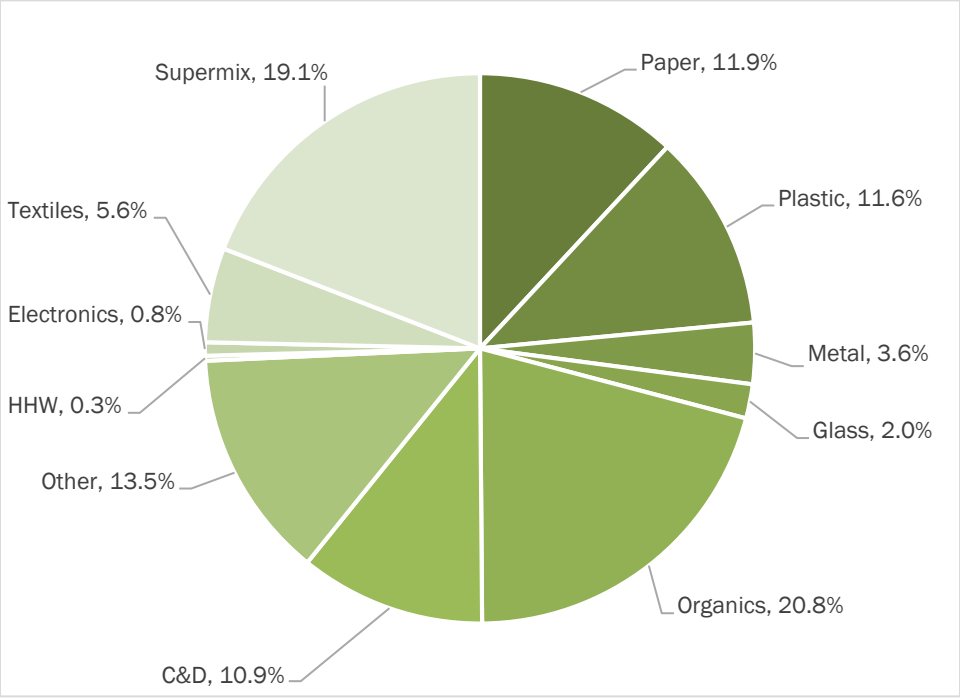


Figure 3-17 shows the ten most prevalent materials in Waste Load Area 1 disposed waste. It is noteworthy that Food Waste from this Area, which had an active curbside Organics collection program, is lower than the overall average.

Figure 3-17 Top 10 Most Prevalent Materials in Waste Load Area 1 Residential Waste

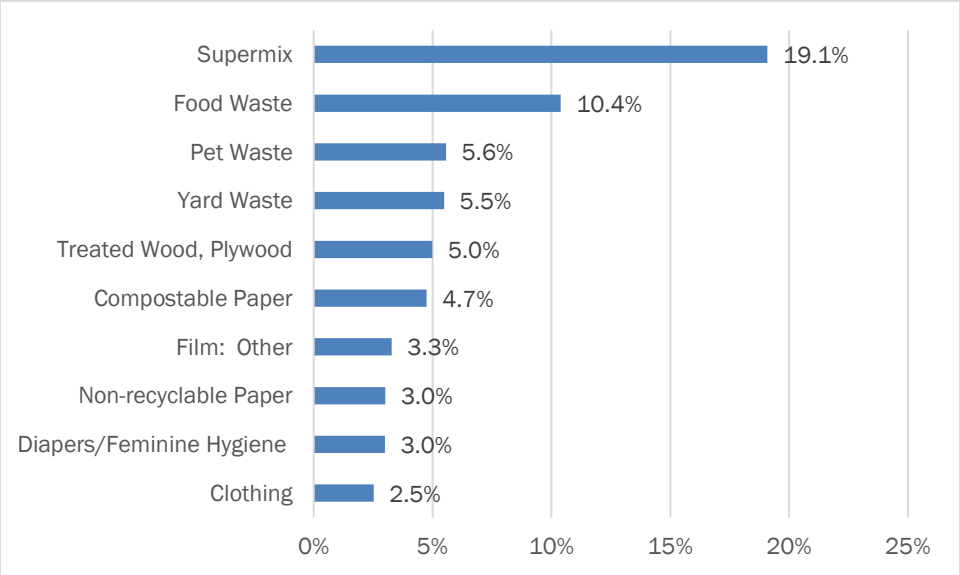


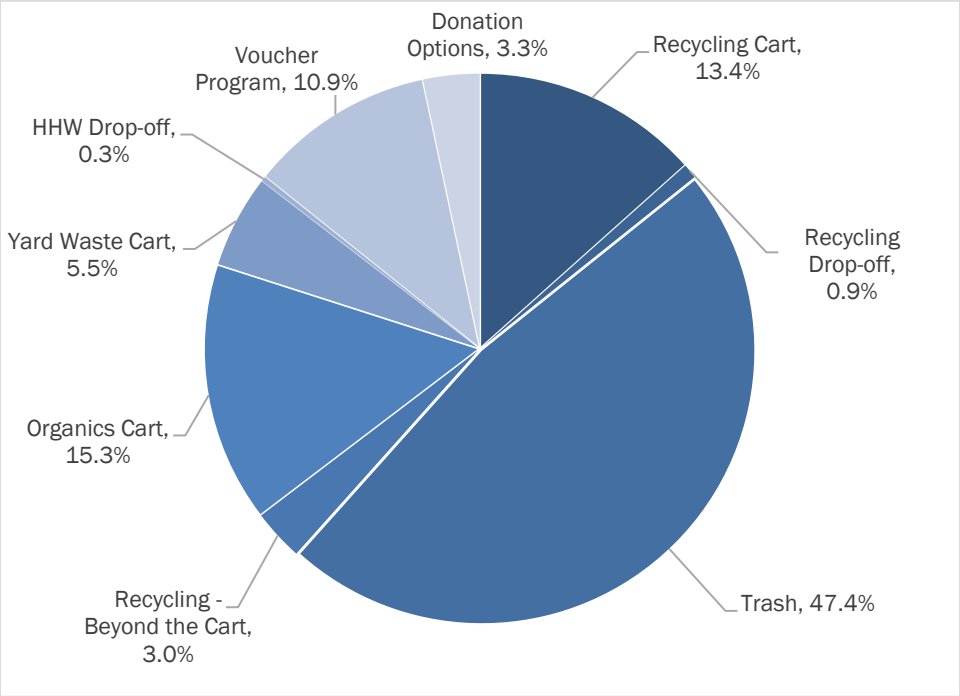
Table 3-3 provides the detailed statistical profile of the waste from Waste Load Area 1. The results from analysis of the sample that was sorted are extrapolated to tonnages representing the contribution of this category of waste behavior to the total City waste generation (See Table 2-1).

Table 3-3 Detailed Composition, Waste Load Area 1 Residential Waste (Extrapolated to City-wide tonnages for this WLA type)

Material Category	Est. Percent	Conf. Int (+/-)	Tons	Material Category	Est. Percent	Conf. Int (+/-)	Tons
Paper	**11.9%**	**1.4%**	**4,084**	**Organics**	**20.8%**	**4.1%**	**7,117**
Newspaper	1.3%	0.3%	461	Food Waste	10.4%	1.3%	3,558
Office Paper	0.7%	0.4%	248	Compostable Paper	4.7%	0.9%	1,626
Magazines / Catalogs	0.6%	0.3%	219	Other Compostable Organics	0.2%	0.1%	54
Cartons	0.1%	0.0%	33	Yard Waste	5.5%	3.0%	1,880
Cardboard / Kraft Paper	2.1%	0.7%	729	**C&D Debris**	**10.9%**	**2.9%**	**3,741**
Boxboard / Paperboard	1.2%	0.4%	395	Clean Lumber, Pallets, Crates	0.8%	0.5%	262
Mixed Recyclable Paper	2.5%	0.6%	852	Treated Wood, Plywood	5.0%	1.0%	1,709
Plastic-coated Paper	0.3%	0.1%	113	Gypsum Board	1.1%	1.0%	377
Non-recyclable Paper	3.0%	0.7%	1,032	Concrete and Brick	0.4%	0.3%	125
Plastic	**11.6%**	**1.3%**	**3,962**	Carpet & Padding	1.3%	1.1%	459
#1 PET Bottles	0.8%	0.1%	272	Other C&D	2.4%	1.4%	808
#1 PET Non-Bottles	0.1%	0.0%	45	**Textiles**	**5.6%**	**1.9%**	**1,901**
#2 HDPE Bottles	0.3%	0.1%	119	Clothing	2.5%	1.1%	863
#2 HDPE Non-Bottles	0.1%	0.0%	22	Shoes	0.8%	0.6%	273
#3 PVC	0.0%	0.0%	17	Leather	0.0%	0.0%	9
#5 PP Containers	0.3%	0.1%	118	All Other Textiles	2.2%	0.7%	756
#6 EPS	0.5%	0.1%	159	**Other Wastes**	**13.5%**	**3.2%**	**4,616**
All Other Packaging Containers	1.4%	0.2%	479	Small Household Appliances	0.4%	0.4%	124
Recoverable Film / Bags	0.9%	0.1%	296	Furniture	1.4%	1.3%	483
Film: Trash Bags	1.0%	0.2%	359	Mattresses / Box Springs	0.0%	0.0%	0
Film: Other	3.3%	0.6%	1,125	Tires / Rubber	0.3%	0.5%	110
Durable Plastic Items	1.9%	0.7%	662	Diapers/Feminine Hygiene	3.0%	0.8%	1,026
All Other Plastic	0.8%	0.2%	290	Pet Waste	5.6%	2.5%	1,907
Metal	**3.6%**	**0.7%**	**1,230**	Fines	0.0%	0.0%	0
Steel Cans	0.7%	0.2%	235	Other Not Elsewhere Classified	2.8%	1.2%	967
Aluminum Cans and Foil	0.7%	0.1%	223	Bulky Materials	0.0%	0.0%	0
Other Scrap Steel	0.8%	0.2%	277	**Supermix**	**19.1%**	**1.9%**	**6,538**
Non-ferrous Metal	0.4%	0.2%	137	Paper	2.6%	*N/A*	893
Mixed Metal	1.0%	0.6%	359	Plastic	2.1%	*N/A*	713
Glass	**2.0%**	**0.4%**	**687**	Metal	0.6%	*N/A*	221
Food and Beverage Glass	1.5%	0.3%	503	Glass	0.3%	*N/A*	90
Non-recyclable Glass	0.5%	0.2%	184	Organics	5.3%	*N/A*	1,817
Electronics	**0.8%**	**0.6%**	**268**	Indistinguishable	8.2%	*N/A*	2,805
Electronics	0.8%	0.5%	268				
Household Hazardous Waste	**0.3%**	**0.4%**	**101**	**Grand Total**	**100%**		**34,245**
HHW	0.3%	0.3%	101	***No. of Samples***	***17***		

Figure 3-18 presents the composition of Waste Load Area 1 waste in terms of the potential for diverting materials from disposal. A discussion of the diversion strategies can be found earlier in this section.

Figure 3-18 Diversion Opportunities for Waste Load Area 1 Disposed Wastes



3.3 WASTE LOAD AREA 2 WASTE COMPOSITION

Figure 3-19 shows the breakdown of materials in Waste Area 2.

Figure 3-19 Waste Load Area 2 Residential Waste Composition Overview

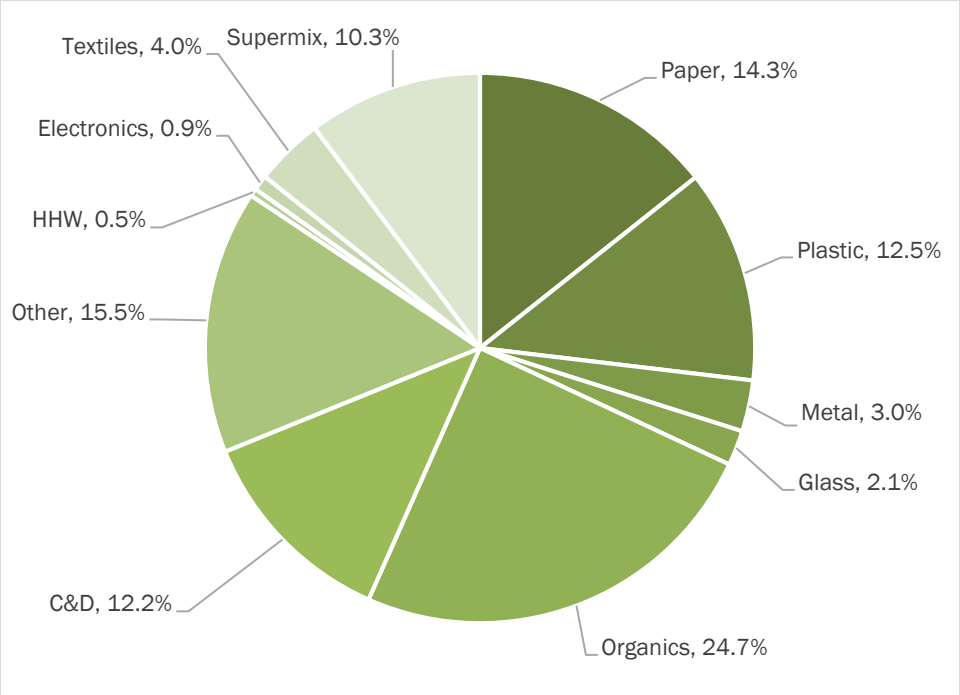


Figure 3-20 shows the ten most prevalent disposed materials in Waste Load Area 2.

Figure 3-20 Top 10 Most Prevalent Materials in Waste Load Area 2 Residential Waste

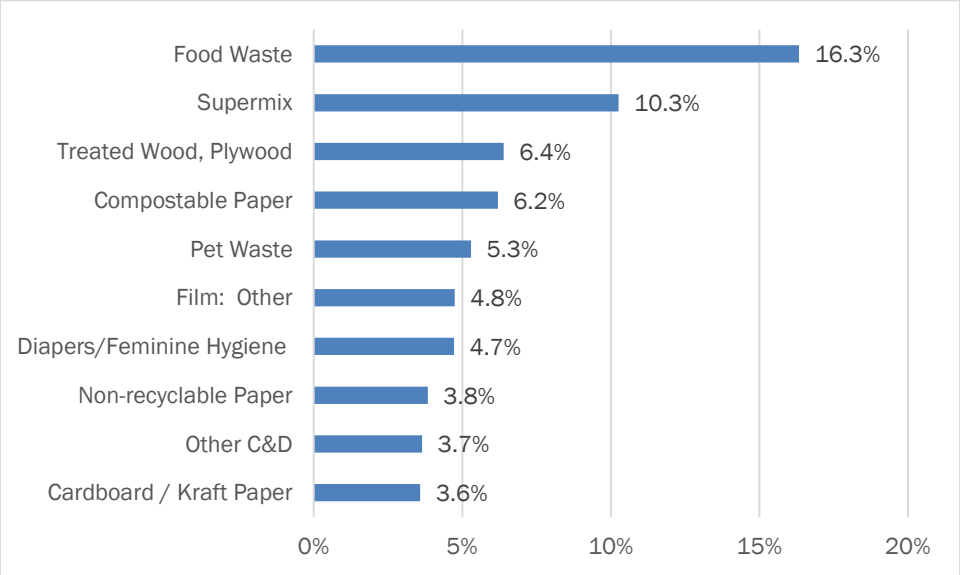


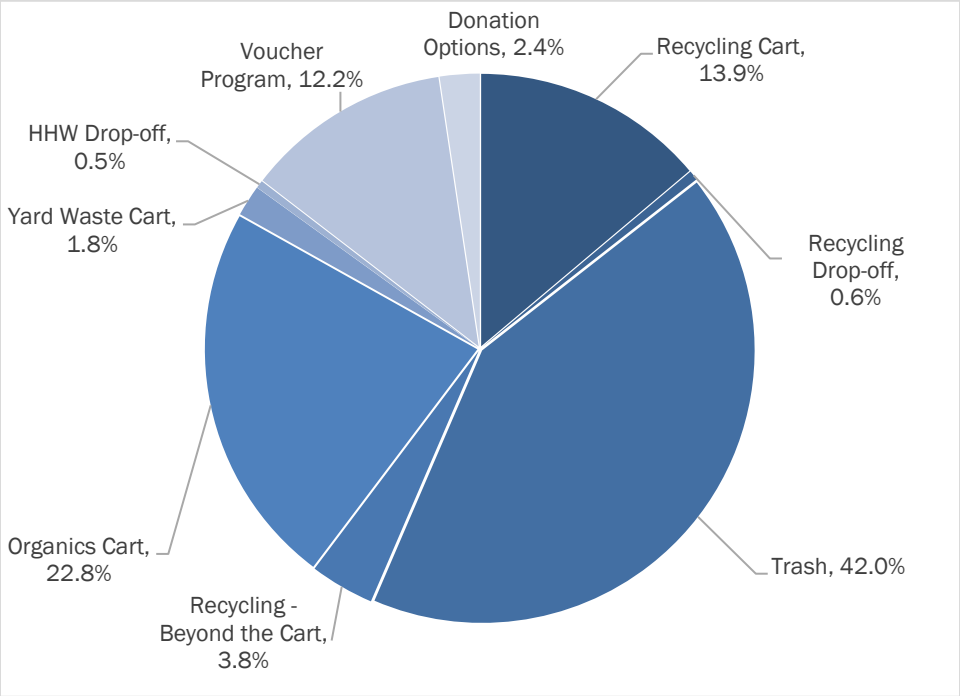
Table 3-4 provides the detailed statistical profile of the waste from Waste Load Area 2. The results from analysis of the sample that was sorted are extrapolated to tonnages representing the contribution of this category of waste behavior to the total City waste generation (See Table 2-1).

Table 3-4 Detailed Composition, Waste Load Area 2 Residential Waste (Extrapolated to City-wide contribution)

Material Category	Est. Percent	Conf. Int (+/-)	Tons	Material Category	Est. Percent	Conf. Int (+/-)	Tons
Paper	**14.3%**	**2.1%**	**3,069**	**Organics**	**24.7%**	**1.8%**	**5,283**
Newspaper	1.1%	0.3%	239	Food Waste	16.3%	1.7%	3,496
Office Paper	0.5%	0.2%	111	Compostable Paper	6.2%	0.5%	1,326
Magazines / Catalogs	1.0%	0.3%	215	Other Compostable Organics	0.3%	0.2%	66
Cartons	0.1%	0.0%	26	Yard Waste	1.8%	0.8%	395
Cardboard / Kraft Paper	3.6%	1.1%	768	**C&D Debris**	**12.2%**	**3.5%**	**2,614**
Boxboard / Paperboard	1.0%	0.2%	220	Clean Lumber, Pallets, Crates	0.2%	0.1%	51
Mixed Recyclable Paper	2.8%	0.7%	610	Treated Wood, Plywood	6.4%	1.8%	1,369
Plastic-coated Paper	0.3%	0.1%	58	Gypsum Board	0.0%	0.0%	1
Non-recyclable Paper	3.8%	1.4%	822	Concrete and Brick	0.1%	0.1%	18
Plastic	**12.5%**	**1.4%**	**2,685**	Carpet & Padding	1.8%	1.5%	393
#1 PET Bottles	0.3%	0.1%	67	Other C&D	3.7%	1.4%	781
#1 PET Non-Bottles	0.3%	0.1%	58	**Textiles**	**4.0%**	**0.9%**	**863**
#2 HDPE Bottles	0.2%	0.1%	53	Clothing	1.3%	0.4%	285
#2 HDPE Non-Bottles	0.0%	0.0%	9	Shoes	1.0%	0.4%	218
#3 PVC	0.0%	0.0%	2	Leather	0.0%	0.0%	2
#5 PP Containers	0.4%	0.1%	76	All Other Textiles	1.7%	0.4%	358
#6 EPS	0.3%	0.1%	60	**Other Wastes**	**15.5%**	**2.3%**	**3,317**
All Other Packaging Containers	1.4%	0.2%	295	Small Household Appliances	1.2%	0.7%	252
Recoverable Film / Bags	0.6%	0.1%	123	Furniture	0.2%	0.4%	52
Film: Trash Bags	0.9%	0.1%	197	Mattresses / Box Springs	0.7%	1.2%	158
Film: Other	4.8%	1.2%	1,017	Tires / Rubber	0.9%	1.1%	187
Durable Plastic Items	2.8%	0.5%	604	Diapers/Feminine Hygiene	4.7%	1.2%	1,010
All Other Plastic	0.6%	0.3%	124	Pet Waste	5.3%	1.9%	1,134
Metal	**3.0%**	**0.6%**	**643**	Fines	0.0%	0.0%	0
Steel Cans	0.4%	0.1%	83	Other Not Elsewhere Classified	2.4%	1.1%	523
Aluminum Cans and Foil	0.4%	0.1%	95	Bulky Materials	0.0%	0.0%	0
Other Scrap Steel	0.8%	0.3%	178	**Supermix**	**10.3%**	**0.8%**	**2,196**
Non-ferrous Metal	0.1%	0.1%	22	Paper	1.0%	*N/A*	211
Mixed Metal	1.2%	0.4%	266	Plastic	0.8%	*N/A*	179
Glass	**2.1%**	**0.5%**	**442**	Metal	0.3%	*N/A*	68
Food and Beverage Glass	1.3%	0.4%	279	Glass	0.0%	*N/A*	0
Non-recyclable Glass	0.8%	0.4%	163	Organics	3.6%	*N/A*	764
Electronics	**0.9%**	**0.4%**	**193**	Indistinguishable	4.6%	*N/A*	974
Electronics	0.9%	0.4%	193				
Household Hazardous Waste	**0.5%**	**0.3%**	**98**	**Grand Total**	**100%**		**21,403**
HHW	0.5%	0.3%	98	***No. of Samples***	***17***		

Figure 3-21 presents the composition of Waste Load Area 2 waste in terms of the potential for diverting materials from disposal.

Figure 3-21 Recyclability of Waste Load Area 2 Disposed Wastes



3.4 WASTE LOAD AREA 3 WASTE COMPOSITION

Figure 3-22 shows the breakdown of materials in Waste Area 3.

Figure 3-22 Waste Load Area 3 Residential Waste Composition Overview

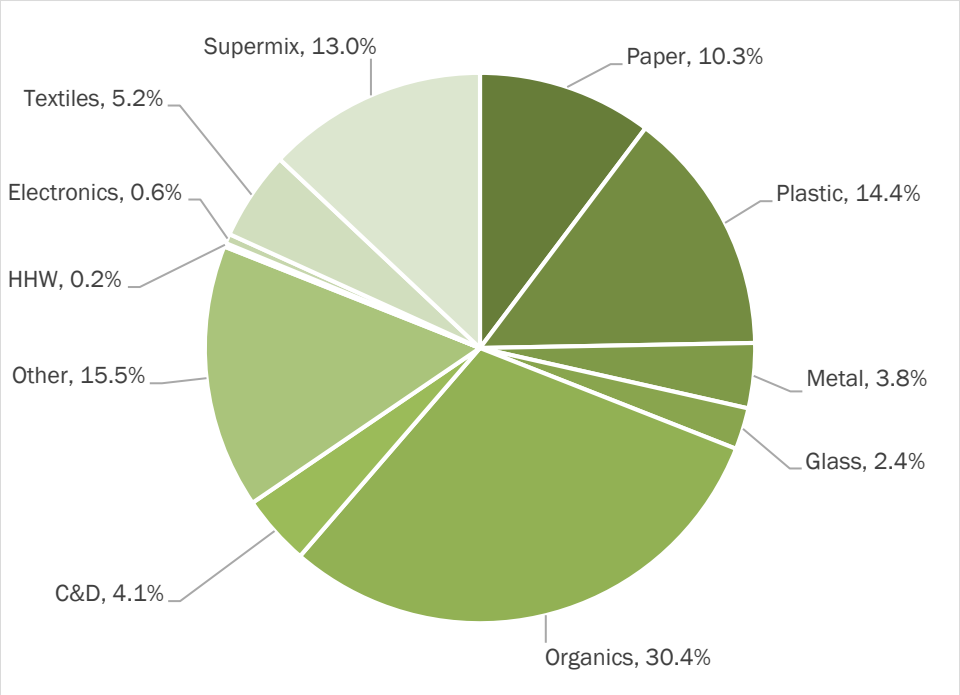


Figure 3-23 shows the ten most prevalent disposed materials in Waste Load Area 3.

Figure 3-23 Top 10 Most Prevalent Materials in Waste Load Area 3 Residential Waste

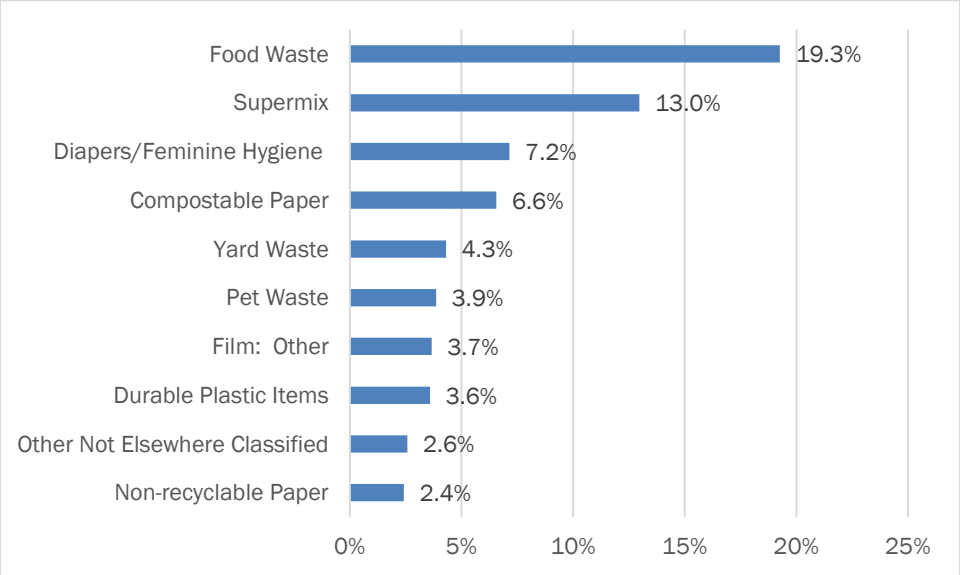


Table 3-5 provides the detailed statistical profile of the waste from Waste Load Area 3. The results from analysis of the sample that was sorted are extrapolated to tonnages representing the contribution of this category of waste behavior to the total City waste generation (See Table 2-1).

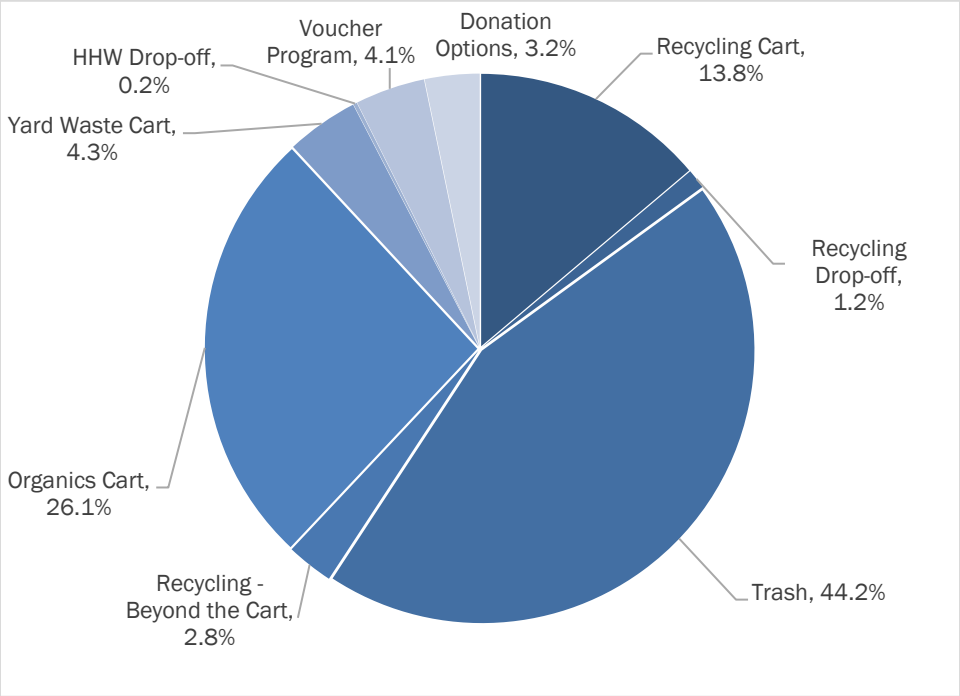
Table 3-5 Detailed Composition, Waste Load Area 3 Residential Waste

(Extrapolated to City-wide contribution)

Material Category	Est. Percent	Conf. Int (+/-)	Tons	Material Category	Est. Percent	Conf. Int (+/-)	Tons
Paper	**10.3%**	**1.0%**	**3,077**	**Organics**	**30.4%**	**2.2%**	**9,101**
Newspaper	1.0%	0.2%	313	Food Waste	19.3%	2.2%	5,773
Office Paper	0.4%	0.1%	122	Compostable Paper	6.6%	0.5%	1,966
Magazines / Catalogs	0.7%	0.4%	212	Other Compostable Organics	0.2%	0.3%	73
Cartons	0.2%	0.1%	60	Yard Waste	4.3%	2.0%	1,289
Cardboard / Kraft Paper	1.8%	0.3%	540	**C&D Debris**	**4.1%**	**2.0%**	**1,243**
Boxboard / Paperboard	1.4%	0.2%	409	Clean Lumber, Pallets, Crates	1.1%	1.5%	341
Mixed Recyclable Paper	2.1%	0.7%	629	Treated Wood, Plywood	2.0%	0.9%	608
Plastic-coated Paper	0.2%	0.1%	67	Gypsum Board	0.0%	0.0%	0
Non-recyclable Paper	2.4%	0.3%	725	Concrete and Brick	0.0%	0.0%	12
Plastic	**14.4%**	**1.7%**	**4,326**	Carpet & Padding	0.2%	0.2%	64
#1 PET Bottles	1.3%	0.1%	388	Other C&D	0.7%	0.4%	216
#1 PET Non-Bottles	0.2%	0.1%	52	**Textiles**	**5.2%**	**0.6%**	**1,570**
#2 HDPE Bottles	0.5%	0.1%	162	Clothing	2.3%	0.5%	684
#2 HDPE Non-Bottles	0.1%	0.1%	22	Shoes	0.8%	0.3%	251
#3 PVC	0.0%	0.0%	2	Leather	0.1%	0.1%	38
#5 PP Containers	0.4%	0.1%	113	All Other Textiles	2.0%	0.4%	598
#6 EPS	0.5%	0.1%	149	**Other Wastes**	**15.5%**	**1.7%**	**4,651**
All Other Packaging Containers	1.2%	0.1%	365	Small Household Appliances	0.3%	0.3%	79
Recoverable Film / Bags	1.2%	0.2%	349	Furniture	1.4%	0.8%	427
Film: Trash Bags	1.2%	0.1%	355	Mattresses / Box Springs	0.0%	0.0%	0
Film: Other	3.7%	0.4%	1,097	Tires / Rubber	0.2%	0.2%	74
Durable Plastic Items	3.6%	1.2%	1,075	Diapers/Feminine Hygiene	7.2%	1.5%	2,143
All Other Plastic	0.7%	0.5%	197	Pet Waste	3.9%	1.2%	1,157
Metal	**3.8%**	**0.9%**	**1,144**	Fines	0.0%	0.0%	0
Steel Cans	0.8%	0.2%	230	Other Not Elsewhere Classified	2.6%	0.5%	771
Aluminum Cans and Foil	0.8%	0.1%	249	Bulky Materials	0.0%	0.0%	0
Other Scrap Steel	1.2%	0.8%	347	**Supermix**	**13.0%**	**1.4%**	**3,887**
Non-ferrous Metal	0.2%	0.1%	63	Paper	2.3%	*N/A*	695
Mixed Metal	0.9%	0.3%	256	Plastic	1.8%	*N/A*	537
Glass	**2.4%**	**0.6%**	**733**	Metal	0.5%	*N/A*	143
Food and Beverage Glass	1.9%	0.5%	577	Glass	0.4%	*N/A*	109
Non-recyclable Glass	0.5%	0.2%	156	Organics	2.7%	*N/A*	795
Electronics	**0.6%**	**0.4%**	**168**	Indistinguishable	5.4%	*N/A*	1,608
Electronics	0.6%	0.4%	168				
Household Hazardous Waste	**0.2%**	**0.1%**	**65**	**Grand Total**	**100%**		**29,965**
HHW	0.2%	0.1%	65	***No. of Samples***	***17***		

Figure 3-24 presents the composition of Waste Load Area 3 waste in terms of the potential for diverting materials from disposal.

Figure 3-24 Recyclability of Waste Load Area 3 Disposed Wastes



3.5 COMPARISON OF WASTE COMPOSITION BY WASTE LOAD AREA

Figure 3-25 and Figure 3-26 compare the percentage composition and disposed tons, respectively, by Waste Load Area.

Figure 3-25 Waste Composition, By Waste Load Area (Percentage)

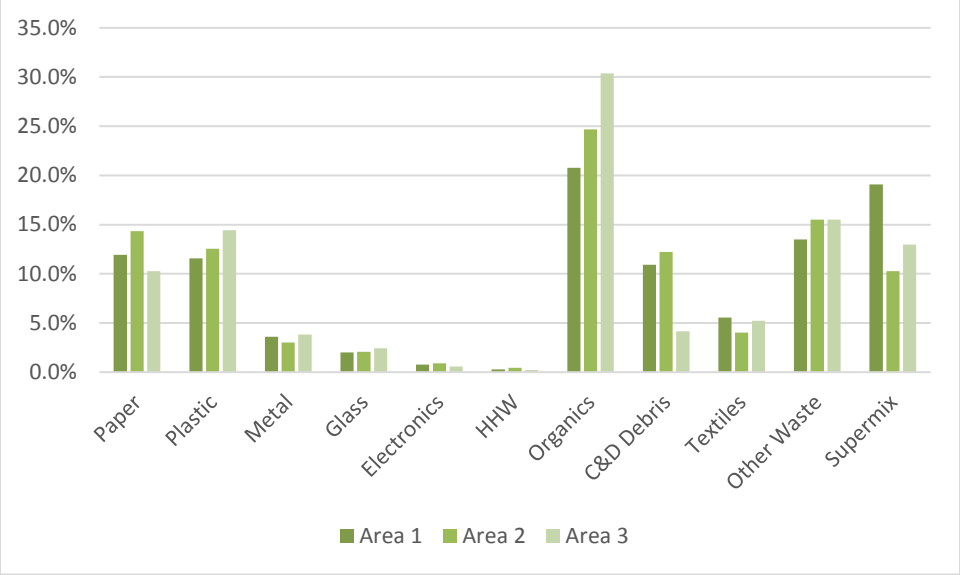


Figure 3-26 Waste Composition, By Waste Load Area (Tons)

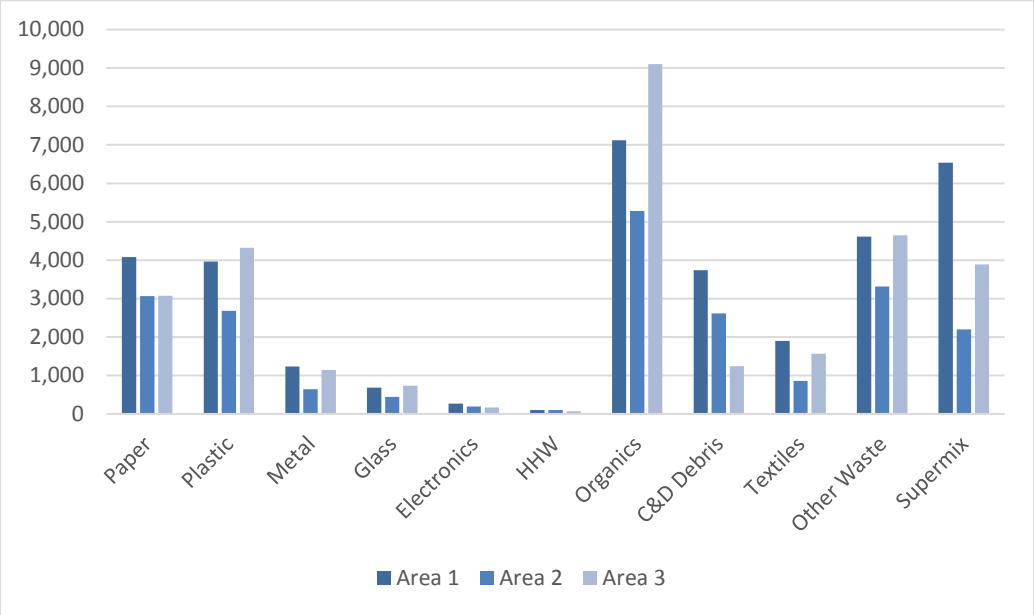


Figure 3-27 compares the percentage composition of recyclables in the waste stream from each Waste Load Area and the City as a whole.

Figure 3-27 Recyclable Materials in Disposed Waste, By Waste Load Area (Percentage)

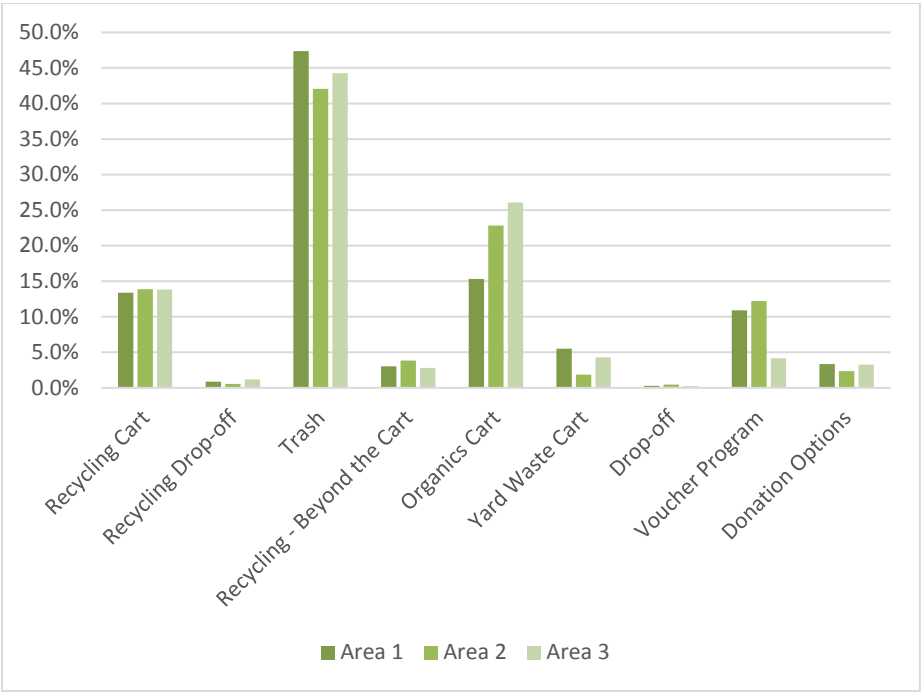


Figure 3-28 provides the same comparison, but uses tons as the basis.

Figure 3-28 Recyclable Materials in Disposed Waste, By Waste Load Area (Tons)

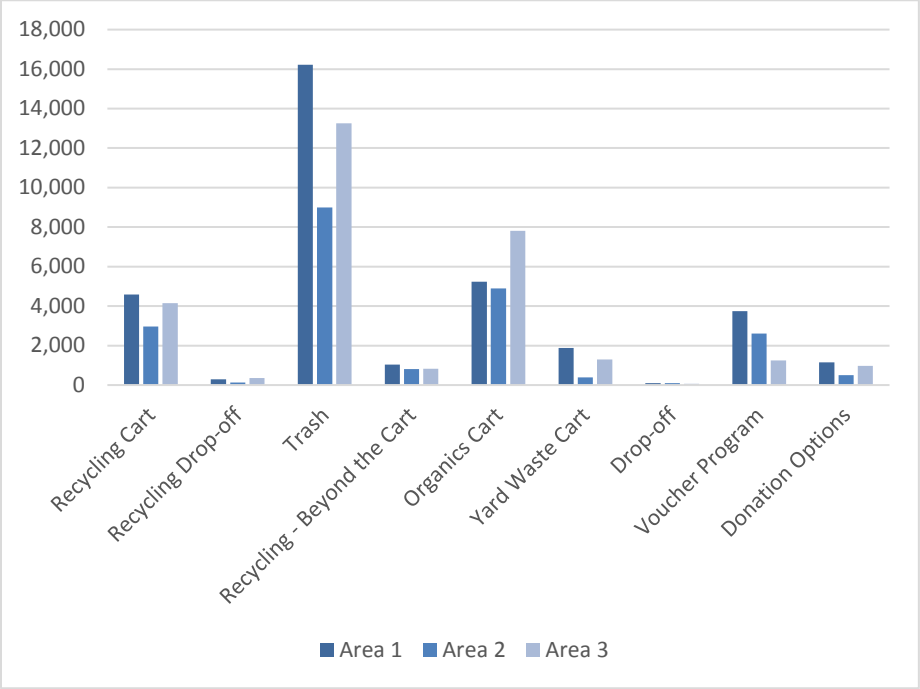


Table 3-6 and Table 3-7 compare the composition percentage, and tonnage, respectively, for all three Areas and the City as a whole.

Table 3-6 Detailed Composition by Waste Load Area (Percentage)

Material Category	Waste Area 1	Waste Area 2	Waste Area 3	City Wide	Material Category	Waste Area 1	Waste Area 2	Waste Area 3	City Wide
Paper	**11.9%**	**14.3%**	**10.3%**	**11.9%**	**Organics**	**20.8%**	**24.7%**	**30.4%**	**25.1%**
Newspaper	1.3%	1.1%	1.0%	1.2%	Food Waste	10.4%	16.3%	19.3%	15.0%
Office Paper	0.7%	0.5%	0.4%	0.6%	Compostable Paper	4.7%	6.2%	6.6%	5.7%
Magazines / Catalogs	0.6%	1.0%	0.7%	0.8%	Other Compostable Organics	0.2%	0.3%	0.2%	0.2%
Cartons	0.1%	0.1%	0.2%	0.1%	Yard Waste	5.5%	1.8%	4.3%	4.2%
Cardboard / Kraft Paper	2.1%	3.6%	1.8%	2.4%	**C&D Debris**	**10.9%**	**12.2%**	**4.1%**	**8.9%**
Boxboard / Paperboard	1.2%	1.0%	1.4%	1.2%	Clean Lumber, Pallets, Crates	0.8%	0.2%	1.1%	0.8%
Mixed Recyclable Paper	2.5%	2.8%	2.1%	2.4%	Treated Wood, Plywood	5.0%	6.4%	2.0%	4.3%
Plastic-coated Paper	0.3%	0.3%	0.2%	0.3%	Gypsum Board	1.1%	0.0%	0.0%	0.4%
Non-recyclable Paper	3.0%	3.8%	2.4%	3.0%	Concrete and Brick	0.4%	0.1%	0.0%	0.2%
Plastic	**11.6%**	**12.5%**	**14.4%**	**12.8%**	Carpet & Padding	1.3%	1.8%	0.2%	1.1%
#1 PET Bottles	0.8%	0.3%	1.3%	0.8%	Other C&D	2.4%	3.7%	0.7%	2.1%
#1 PET Non-Bottles	0.1%	0.3%	0.2%	0.2%	**Textiles**	**5.6%**	**4.0%**	**5.2%**	**5.1%**
#2 HDPE Bottles	0.3%	0.2%	0.5%	0.4%	Clothing	2.5%	1.3%	2.3%	2.1%
#2 HDPE Non-Bottles	0.1%	0.0%	0.1%	0.1%	Shoes	0.8%	1.0%	0.8%	0.9%
#3 PVC	0.0%	0.0%	0.0%	0.0%	Leather	0.0%	0.0%	0.1%	0.1%
#5 PP Containers	0.3%	0.4%	0.4%	0.4%	All Other Textiles	2.2%	1.7%	2.0%	2.0%
#6 EPS	0.5%	0.3%	0.5%	0.4%	**Other Wastes**	**13.5%**	**15.5%**	**15.5%**	**14.7%**
All Other Packaging Containe	1.4%	1.4%	1.2%	1.3%	Small Household Appliances	0.4%	1.2%	0.3%	0.5%
Recoverable Film / Bags	0.9%	0.6%	1.2%	0.9%	Furniture	1.4%	0.2%	1.4%	1.1%
Film: Trash Bags	1.0%	0.9%	1.2%	1.1%	Mattresses / Box Springs	0.0%	0.7%	0.0%	0.2%
Film: Other	3.3%	4.8%	3.7%	3.8%	Tires / Rubber	0.3%	0.9%	0.2%	0.4%
Durable Plastic Items	1.9%	2.8%	3.6%	2.7%	Diapers/Feminine Hygiene	3.0%	4.7%	7.2%	4.9%
All Other Plastic	0.8%	0.6%	0.7%	0.7%	Pet Waste	5.6%	5.3%	3.9%	4.9%
Metal	**3.6%**	**3.0%**	**3.8%**	**3.5%**	Other Not Elsewhere Classifie	2.8%	2.4%	2.6%	2.6%
Steel Cans	0.7%	0.4%	0.8%	0.6%	**Supermix**	**19.1%**	**10.3%**	**13.0%**	**14.7%**
Aluminum Cans and Foil	0.7%	0.4%	0.8%	0.7%	Paper	2.6%	1.0%	2.3%	2.1%
Other Scrap Steel	0.8%	0.8%	1.2%	0.9%	Plastic	2.1%	0.8%	1.8%	1.7%
Non-ferrous Metal	0.4%	0.1%	0.2%	0.3%	Metal	0.6%	0.3%	0.5%	0.5%
Mixed Metal	1.0%	1.2%	0.9%	1.0%	Glass	0.3%	0.0%	0.4%	0.2%
Glass	**2.0%**	**2.1%**	**2.4%**	**2.2%**	Organics	5.3%	3.6%	2.7%	3.9%
Food and Beverage Glass	1.5%	1.3%	1.9%	1.6%	Indistinguishable	8.2%	4.6%	5.4%	6.3%
Non-recyclable Glass	0.5%	0.8%	0.5%	0.6%					
Electronics	**0.8%**	**0.9%**	**0.6%**	**0.7%**					
Electronics	0.8%	0.9%	0.6%	0.7%					
Household Hazardous Was	**0.3%**	**0.5%**	**0.2%**	**0.3%**	**Grand Total**	**100%**	**100%**	**100%**	**100%**
HHW	0.3%	0.5%	0.2%	0.3%	***No. of Samples***	***17***	***17***	***17***	***51***

Table 3-7 Detailed Composition by Waste Load Area (Tons)

Material Category	Waste Area 1	Waste Area 2	Waste Area 3	City Wide	Material Category	Waste Area 1	Waste Area 2	Waste Area 3	City Wide
Paper	**4,084**	**3,069**	**3,077**	**10,231**	**Organics**	**7,117**	**5,283**	**9,101**	**21,501**
Newspaper	461	239	313	1,014	Food Waste	3,558	3,496	5,773	12,827
Office Paper	248	111	122	481	Compostable Paper	1,626	1,326	1,966	4,918
Magazines / Catalogs	219	215	212	647	Other Compostable Organics	54	66	73	193
Cartons	33	26	60	119	Yard Waste	1,880	395	1,289	3,564
Cardboard / Kraft Paper	729	768	540	2,038	**C&D Debris**	**3,741**	**2,614**	**1,243**	**7,598**
Boxboard / Paperboard	395	220	409	1,024	Clean Lumber, Pallets, Crates	262	51	341	654
Mixed Recyclable Paper	852	610	629	2,091	Treated Wood, Plywood	1,709	1,369	608	3,687
Plastic-coated Paper	113	58	67	238	Gypsum Board	377	1	0	377
Non-recyclable Paper	1,032	822	725	2,580	Concrete and Brick	125	18	12	156
Plastic	**3,962**	**2,685**	**4,326**	**10,974**	Carpet & Padding	459	393	64	917
#1 PET Bottles	272	67	388	726	Other C&D	808	781	216	1,806
#1 PET Non-Bottles	45	58	52	155	**Textiles**	**1,901**	**863**	**1,570**	**4,334**
#2 HDPE Bottles	119	53	162	334	Clothing	863	285	684	1,832
#2 HDPE Non-Bottles	22	9	22	53	Shoes	273	218	251	742
#3 PVC	17	2	2	21	Leather	9	2	38	48
#5 PP Containers	118	76	113	307	All Other Textiles	756	358	598	1,712
#6 EPS	159	60	149	368	**Other Wastes**	**4,616**	**3,317**	**4,651**	**12,584**
All Other Packaging Container	479	295	365	1,139	Small Household Appliances	124	252	79	455
Recoverable Film / Bags	296	123	349	769	Furniture	483	52	427	962
Film: Trash Bags	359	197	355	910	Mattresses / Box Springs	0	158	0	158
Film: Other	1,125	1,017	1,097	3,239	Tires / Rubber	110	187	74	371
Durable Plastic Items	662	604	1,075	2,341	Diapers/Feminine Hygiene	1,026	1,010	2,143	4,179
All Other Plastic	290	124	197	612	Pet Waste	1,907	1,134	1,157	4,198
Metal	**1,230**	**643**	**1,144**	**3,018**	Other Not Elsewhere Classifiec	967	523	771	2,261
Steel Cans	235	83	230	547	**Supermix**	**6,538**	**2,196**	**3,887**	**12,621**
Aluminum Cans and Foil	223	95	249	566	Paper	893	211	695	1,799
Other Scrap Steel	277	178	347	802	Plastic	713	179	537	1,428
Non-ferrous Metal	137	22	63	222	Metal	221	68	143	432
Mixed Metal	359	266	256	880	Glass	90	0	109	199
Glass	**687**	**442**	**733**	**1,862**	Organics	1,817	764	795	3,375
Food and Beverage Glass	503	279	577	1,360	Indistinguishable	2,805	974	1,608	5,387
Non-recyclable Glass	184	163	156	502					
Electronics	**268**	**193**	**168**	**629**					
Electronics	268	193	168	629					
Household Hazardous Wast	**101**	**98**	**65**	**263**	**Grand Total**	**34,245**	**21,403**	**29,965**	**85,613**
HHW	101	98	65	263	***No. of Samples***	***17***	***17***	***17***	***51***

3.6 COMPARISON OF RESULTS TO PREVIOUS STUDIES

This section compares the results of this study to the results from the recent Minnesota waste characterization studies shown in Table 3-8.

Table 3-8 Studies Selected for Comparative Analysis

Study	Year Completed	Sector
Ramsey/Washington County	2014	Residential
Minnesota Statewide	2013	Residential and Commercial Combined
HERC	2012	Residential and Commercial Combined
Hennepin County (Rational Energy)	2011	Residential

First and foremost, only the Ramsey/Washington County and Hennepin County studies separately analyzed disposed waste from the residential waste stream; the other two studies reported composition only for the combined residential and commercial waste stream. This is important because commercial

waste characteristics vary significantly from residential waste characteristics. Office buildings, for example, have more paper and much less food and clothing waste than households.

Table 3-9 compares the study results. While many categories aligned relatively well, in some instances it was necessary to consolidate two or more categories. Additionally, not all studies reached the same degree of sorting detail (indicated by "N/A" in the table).

Table 3-9 Comparison of Waste Composition Results

Material Category	2016 Minneapolis *Residential*	2014 Ramsey/WA *Residential*	2011 Hennepin Co *Residential*	2013 Statewide *Combined*	2012 HERC *Combined*
Paper	**14.0%**	**18.0%**	**21.4%**	**24.5%**	**30.6%**
Newsprint (ONP)	1.2%	1.2%	2.4%	1.4%	1.9%
High Grade Office Paper	0.6%	0.7%	2.1%	1.1%	2.0%
Magazines/Catalogs	0.8%	1.2%	N/A	0.7%	1.0%
Old Corrugated Cardboard (OCC)	2.4%	4.6%	1.1%	3.7%	4.0%
Mixed Recyclable Paper	3.7%	8.5%	8.0%	5.4%	5.8%
Non-recyclable Paper	5.4%	1.8%	7.8%	12.1%	15.9%
Plastic	**14.5%**	**15.1%**	**13.8%**	**17.9%**	**14.8%**
#1 PET Beverage Containers	0.8%	0.9%	1.1%	0.8%	1.4%
HDPE Bottles/Jars	0.4%	0.6%	0.9%	0.5%	0.8%
Bag and Film Plastic	5.7%	7.5%	5.4%	6.6%	6.0%
Other Plastic	7.6%	6.1%	6.4%	10.0%	6.8%
Metal	**4.0%**	**5.8%**	**6.3%**	**4.5%**	**3.6%**
Aluminum Beverage Containers	0.7%	0.4%	0.4%	0.4%	0.5%
Steel/Tin (Ferrous) Containers	0.6%	0.7%	3.1%	0.7%	2.0%
Other Metal	2.7%	4.6%	2.8%	3.3%	1.1%
Glass	**2.4%**	**2.4%**	**Not sorted**	**2.2%**	**2.5%**
Container Glass	1.6%	1.9%	N/A	1.8%	2.1%
Other (Non-Container) Glass	0.8%	0.5%	N/A	0.4%	0.4%
Electronics	**0.7%**	**1.4%**	**Not sorted**	**1.2%**	**2.2%**
Electronics & Small Appliances	0.7%	1.4%	N/A	1.2%	2.2%
Organics	**37.4%**	**36.3%**	**25.3%**	**31.0%**	**32.0%**
Yard Waste	4.2%	7.6%	8.7%	2.8%	3.5%
Food Waste	15.0%	20.4%	15.5%	17.8%	17.5%
Wood	5.1%	3.4%	N/A	5.7%	4.3%
Other Organics (incl. Non-Compostable)	13.1%	4.9%	8.9%	4.7%	6.7%
Household Hazardous Waste	**0.3%**	**0.2%**	**Not sorted**	**0.4%**	**0.0%**
HHW	0.3%	0.2%	N/A	0.4%	0.0%
Other Waste	**26.7%**	**20.8%**	**33.2%**	**18.3%**	**14.3%**
Mattresses/Furniture/Appliances/Bulky	1.8%	2.6%	12.1%	3.4%	3.9%
Textiles & Leather	5.1%	7.1%	N/A	4.7%	3.5%
C&D Debris (excl. Wood)	3.8%	7.8%	N/A	2.3%	2.8%
Other Wastes	16.0%	3.3%	21.1%	8.0%	4.1%
Grand Total	**100%**	**100%**	**100%**	**100%**	**100%**
No. of Samples	*51*	*25*	*15*	*180*	*60*

Overall, the Project Team makes the following observations:

- No attempts was made to perform a statistically robust comparison of these results. Such a comparison would take into account the width of the confidence intervals and the confidence level of the results sets as a means to defensibly determine statistical similarity or dissimilarity.
- No analysis is warranted to compare the Minneapolis residential results with the results of the two studies that reflect aggregate residential and commercial waste. These results are not "apples to apples." Remaining bullets compare Minneapolis residential waste composition with Ramsey/Washington County and Hennepin County residential waste composition.
- The Hennepin County study is over five years old and significant changes in the residential waste stream (associated with light-weighting, decreases in printed paper consumption, and changes in the packaging mix) have been widely documented over the ensuing years. This study captured representative samples of inbound residential loads from the entire wasteshed over a one-week period. While this should provide more representative results, only 15 residential samples were obtained, resulting in wide confidence intervals (a high degree of uncertainty). These two factors limit the comparability of these results with the Minneapolis results.
- The Ramsey/Washington County study captured representative samples of inbound residential loads from the entire wasteshed over a one-week period and should be considered more representative of that wasteshed than the Minneapolis results which are based on comprehensively sampling only three loads. This study is recent enough to be relatively comparable to Minneapolis.
- Minneapolis appears to have slightly lower incidence of targeted recyclable materials in their waste stream compared to Ramsey/Washington County residential waste.
- On the surface, Minneapolis would appear to have less food waste. However, this difference is likely due at least in part to a difference in sort methodology between the two studies. The Minneapolis study relied on a 2 inch screen to define Supermix, whereas the Ramsey/Washington County study allowed sorting down to smaller particle sizes, which resulted in additional 2-inch-minus material being allotted to food waste.

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4. RECYCLING ANALYSIS

4.1 INTRODUCTION

A primary objective of this study was to determine the maximum achievable recycling rate within the Minneapolis residential waste stream. This section summarizes the current recycling rate and also analyzes the capture rates of materials targeted for recycling. These terms are defined below:

- **Recycling Rate**: The percentage of all waste generated that is ultimately diverted through recycling. As shown in Section 2 of this report, the City's reported residential recycling rate was 36.8 percent.
- **Capture Rate**: Sometimes called a Recovery Rate, the Capture Rate identifies the percentage of a targeted recyclable material that is actually being recycled through the available recycling infrastructure (and hence "captured" in the recycling program).

There are only two ways to increase the recycling rate for any municipality. First, recycling rates will increase if residents maximize their use of the existing recycling program for currently targeted recyclables. In other words, increasing the capture rate will increase the recycling rate. However, because the capture rate can reach no more than 100 percent, "perfect" capture rates can only increase recycling so much.

The second way to increase the recycling rate is to add new recycling programs over and above the currently available avenues for recycling. The remainder of this section explores the impact of increasing the capture rate on maximizing recycling.

4.2 CURRENT CAPTURE RATE AND RECYCLING RATE

Figure 4-1 shows the capture rates for the materials that are currently targeted in the City's various residential recycling programs. As shown, targeted fiber (newspaper, cardboard, junk mail, etc.) have the highest capture rate, with over 67 percent of the recyclable paper and cardboard generated being recycled. Compostables include recoverable Source-separated Organics (SSO) (food waste, compostable/non-recyclable paper) and yard waste.

Figure 4-1 Current Capture Rates by Recycling Program

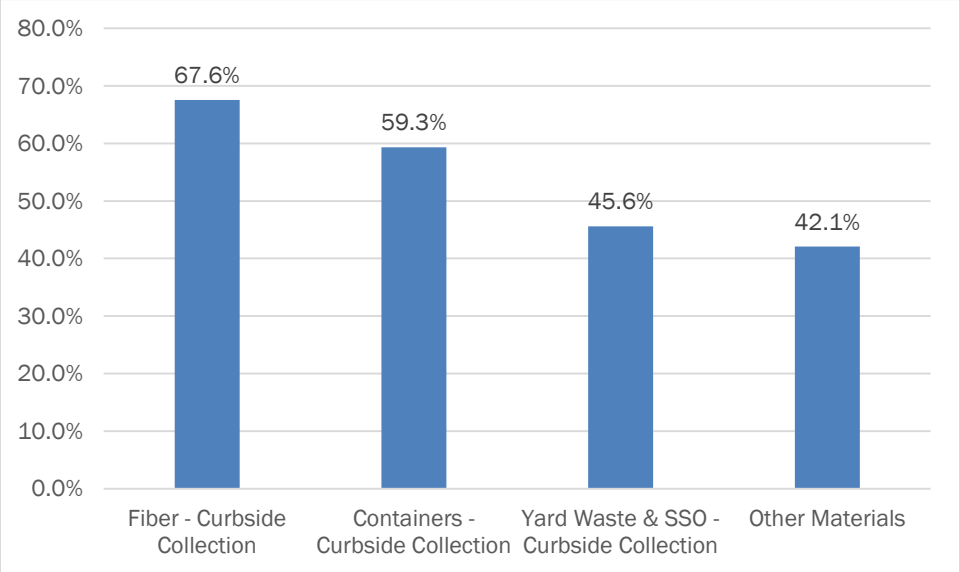

Figure 4-2 illustrates the capture rates for each of the individual commodities in the City's curbside collection programs. This level of detail shows the dramatic differences in capture rates, with excellent capture of newspaper, glass and yard waste; and limited capture of SSO, #3-#7 plastics, and aseptic packaging and cartons.

Figure 4-2 Current Capture Rates by Individual Commodity

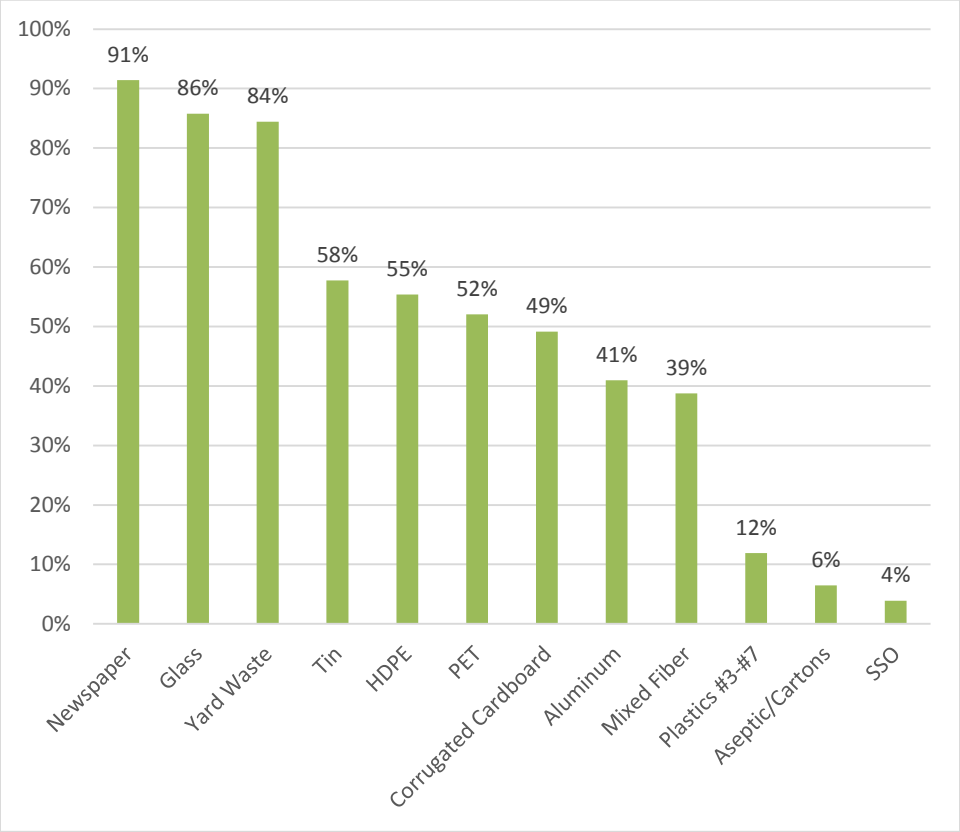

Table 4-1 presents the detailed tabular data that generated the two figures above. This table summarizes the recovery of currently targeted materials, and also itemizes certain materials that could be potentially recovered through other means. This table shows the City's current residential recycling rate of 36.0 percent. Note that this recycling rate omits the residue from the City's single stream processor at the materials recovery facility (MRF), and therefore is slightly lower than the reported recycling rate shown in Section 2 of this report.

Table 4-1 Current Capture Rates and Recycling Rate (2015)

Material	Disposed (tons)	Recycled (tons)	Generated (tons)	Capture Rate
Currently Targeted Materials				
Newspaper	1,014	10,799	11,813	91.4%
Mixed Fiber	4,243	2,683	6,926	38.7%
Corrugated Cardboard	2,038	1,967	4,004	49.1%
Aseptic	119	8	128	6.5%
Aluminum	566	393	959	41.0%
Tin	547	747	1,294	57.7%
PET	882	956	1,837	52.0%
HDPE	387	481	868	55.4%
Plastics #3-#7	1,445	195	1,640	11.9%
Rigid Plastics	2,341	0	2,341	0.0%
Glass	1,360	8,198	9,558	85.8%
Mattresses	158	893	1,051	85.0%
Appliances & Scrap Metal	1,904	706	2,610	27.1%
Electronics	629	626	1,255	49.9%
Tires/Rubber	371	0	371	0.0%
SSO/Supermix Organics	20,485	824	21,309	3.9%
Yard Waste	3,564	19,336	22,900	84.4%
Subtotal Currently Targeted	*42,052*	*48,813*	*90,865*	*53.7%*
Other Divertible Materials				
Clean Lumber, Pallets, Crates	654	N/A	654	0.0%
Treated Wood, Plywood	3,687	N/A	3,687	0.0%
Gypsum Board	377	N/A	377	0.0%
Concrete and Brick	156	N/A	156	0.0%
Carpet & Padding	917	N/A	917	0.0%
Other C&D	1,806	N/A	1,806	0.0%
Clothing	1,832	N/A	1,832	0.0%
Shoes	742	N/A	742	0.0%
Leather	48	N/A	48	0.0%
Recoverable Film Bags	769	N/A	769	0.0%
Subtotal Other Divertible	*10,989*	*0*	*10,989*	*0.0%*
Other Waste				
Other Waste	33,610	16	33,627	0.0%
Total	**86,651**	**48,829**	**135,480**	
Recycling Rate				***36.0%***

4.3 MAXIMUM THEORETICAL RECYCLING RATE

Unless new recycling markets, technologies and programs are created in Minneapolis, the current upper limit on the City's residential recycling rate can be calculated by assuming "perfect" capture of all targeted recyclables. This calculation of perfect capture is theoretical only. This is shown in Table 4-2.

Table 4-2 Maximum Theoretical Recycling Rate Based on Perfect Capture of Targeted Materials

Material	Capture Rate	Recycled	Disposed	Generated
Currently Targeted Materials				
Newspaper	100.0%	11,813	0	11,813
Mixed Fiber	100.0%	6,926	0	6,926
Corrugated Cardboard	100.0%	4,004	0	4,004
Aseptic	100.0%	128	0	128
Aluminum	100.0%	959	0	959
Tin	100.0%	1,294	0	1,294
PET	100.0%	1,837	0	1,837
HDPE	100.0%	868	0	868
Plastics #3-#7	100.0%	1,640	0	1,640
Rigid Plastics	100.0%	2,341	0	2,341
Glass	100.0%	9,558	0	9,558
Mattresses	100.0%	1,051	0	1,051
Appliances & Scrap Metal	100.0%	2,610	0	2,610
Electronics	100.0%	1,255	0	1,255
Tires/Rubber	100.0%	371	0	371
SSO/Supermix Organics	100.0%	21,309	0	21,309
Yard Waste	100.0%	22,900	0	22,900
Subtotal Currently Targeted		*90,865*	*0*	*79,052*
Other Divertible Materials				
Clean Lumber, Pallets, Crates	100.0%	654	0	654
Treated Wood, Plywood	100.0%	3,687	0	3,687
Gypsum Board	100.0%	377	0	377
Concrete and Brick	100.0%	156	0	156
Carpet & Padding	100.0%	917	0	917
Other C&D	100.0%	1,806	0	1,806
Clothing	100.0%	1,832	0	1,832
Shoes	100.0%	742	0	742
Leather	100.0%	48	0	48
Recoverable Film Bags	100.0%	769	0	769
Subtotal Other Divertible		*10,989*	*0*	*10,989*
Other Waste				
Other Waste	0.0%	16	33,610	33,627
Total		**101,870**	**33,610**	**135,480**
Maximum Recycling Rate	***75.2%***			

Based on the best available data, this table indicates that the absolute theoretical maximum recycling rate in Minneapolis is just over 75 percent. However, achieving this rate implies:

- Every Minneapolis resident perfectly sorts their wastes, recyclable paper, recyclable containers, yard waste, and food waste, compostable papers (and other compostable organics) into the City-provided carts for collection;
- Every targeted recyclable and compostable item is clean and free of contamination when it is placed in the appropriate recycling cart;
- All recyclables remain intact and are not degraded during collection in compaction route trucks; nor are recyclables damaged or contaminated during tipping, handling and processing;
- Every Minneapolis resident stores their clean film plastic bags, until they can transport these materials to appropriate drop-off locations for recycling;
- Minneapolis residents separate, store and set out their electronics, tires, and mattresses and other "large items" for set out and the City's programs recover 100 percent of those items;
- Minneapolis residents accumulate all of their scrap metal for delivery to local scrap dealers;
- All residential households undergoing construction or renovation projects utilize the voucher system and dispose all of their C&D debris and the City is able to develop/find markets for these materials; and,
- All households donate their used clothing, shoes and leather items and these items are all in good enough condition to be reused via available charity and thrift store avenues.

In practice, it is not possible to achieve "perfect" recycling.

4.4 MAXIMUM ACHIEVABLE RECYCLING RATE

In practice, a realistic but aggressive capture rate will vary for many reasons. It will be impacted by the individual commodity and based on the recycling strategy. The Project Team, in collaboration with Hennepin County staff, estimated a hypothetical, aggressive long range capture rate for each recycled commodity as a means to estimate the City's maximum achievable recycling rate. It is important to note that these capture rates will take time to reach, and should be considered targets for 2030.

Table 4-3 contains the maximum achievable recycling rate calculation based on these long-range target capture rates.

Table 4-3 Maximum Achievable Recycling Rate (2030 Target Year)

Material	Capture Rate	Recycled	Disposed	Generated
Currently Targeted Materials				
Newspaper	92.0%	10,868	945	11,813
Mixed Fiber	85.0%	5,887	1,039	6,926
Corrugated Cardboard	85.0%	3,403	601	4,004
Aseptic	85.0%	109	19	128
Aluminum	85.0%	815	144	959
Tin	85.0%	1,100	194	1,294
PET	85.0%	1,562	276	1,837
HDPE	85.0%	737	130	868
Plastics #3-#7	25.0%	410	1,230	1,640
Rigid Plastics	5.0%	117	2,224	2,341
Glass	86.0%	8,220	1,338	9,558
Mattresses	95.0%	999	53	1,051
Appliances & Scrap Metal	75.0%	1,958	653	2,610
Electronics	95.0%	1,192	63	1,255
Tires/Rubber	95.0%	353	19	371
SSO/Supermix Organics	40.0%	8,523	12,785	21,309
Yard Waste	95.0%	21,755	1,145	22,900
Subtotal Currently Targeted		*68,009*	*22,856*	*79,052*
Other Divertible Materials				
Clean Lumber, Pallets, Crates	25.0%	164	491	654
Treated Wood, Plywood	10.0%	369	3,318	3,687
Gypsum Board	0.0%	0	377	377
Concrete and Brick	25.0%	39	117	156
Carpet & Padding	10.0%	92	825	917
Other C&D	0.0%	0	1,806	1,806
Clothing	25.0%	458	1,374	1,832
Shoes	25.0%	186	557	742
Leather	5.0%	2	46	48
Recoverable Film Bags	25.0%	192	577	769
Subtotal Other Divertible		*1,501*	*9,488*	*10,989*
Other Waste				
Other Waste	0.0%	16	33,610	33,627
Total		**69,526**	**65,954**	**135,480**
Maximum Recycling Rate	***51.3%***			

As shown, under aggressive capture rate assumptions, it is estimated that the City could achieve a maximum residential recycling rate of just over 51 percent by 2030.

5. CONCLUSIONS

The following conclusions can be drawn from the 2016 study of Minneapolis residential waste composition:

- **Reasonableness of Results**: Because of logistical obstacles, this study relied on one truckload from each of three waste load areas of the City as the basis for disposed waste composition. These three loads were sampled quite extensively, and therefore the disposed wastes from many households was captured in this study. Because of the number of samples, these results are therefore statistically rigorous. However, the samples did not originate from the universe of City of Minneapolis wastes, and therefore the results of this study are less representative of the City's disposed waste stream than if had it been possible to acquire samples from a broader number of routes, with better geographical distribution around the City. Despite these limitations, MSW Consultants believes that the findings are consistent with other studies with more standard sampling methods and form a reasonable basis on which to assess the City's recycling potential.
- **Innovations to Waste Composition Methodology**: This study integrated two innovations in the analysis of waste composition. First, the study incorporated a 2-inch screen to simulate mechanical removal of the smaller particles that might be encountered in a MRF. Treatment of these small particles as being unrecoverable (or at least not being easily recovered) makes for a more realistic depiction of the likely recyclables and compostables that could be diverted by future collection and processing solutions. Second, the study included detailed subsorting of plastics and other recyclables to identify the retail and household origins of the material. MSW Consultants is not aware of any other studies that have attempted such analysis and in this regard the results of this study are breaking new ground.
- **Waste Composition and Capture Rates**: The City's disposed waste stream is reflective of a mature and comprehensive recycling program. Minneapolis is achieving capture rates in excess of 50 percent for traditional fiber and container recyclables, and for some commodities the capture rate exceeds 80 percent. Recycling of Mixed Recyclable Paper, Aseptic/Cartons, Plastic #3-#7 containers, and Aluminum cans appears to be lagging.
- **SSO**: SSO collection is obviously in its infancy and has not begun to contribute significantly to diversion. In fact, Food Waste and Compostable Papers were found to be the first and third most prevalent material categories in disposed residential wastes. As this program expands and matures, meaningful participation should result in increased capture rates for SSO, which should move the needs on overall diversion.
- **Maximum Residential Recycling Potential**: Perhaps the most noteworthy result of this study is the identification of the maximum recycling rate that can reasonably be achieved under aggressive recycling programs and current market conditions. As shown in this study, it seems unlikely that the City can achieve a residential recycling rate in excess of 55 percent even with *aggressive* capture rate assumptions. Further, it is not possible to achieve a 75 percent recycling rate at the current time, and given technical constraints associated with the maximum theoretical recycling rate, such a goal seems unlikely in the foreseeable future even with the prospect of significant new recovery technologies and development of associated markets.

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APPENDIX A

SAMPLING OVERVIEW

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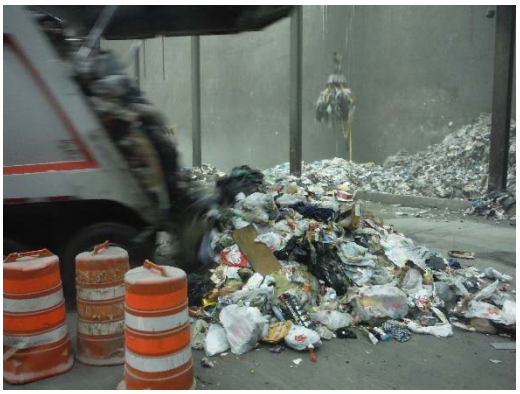
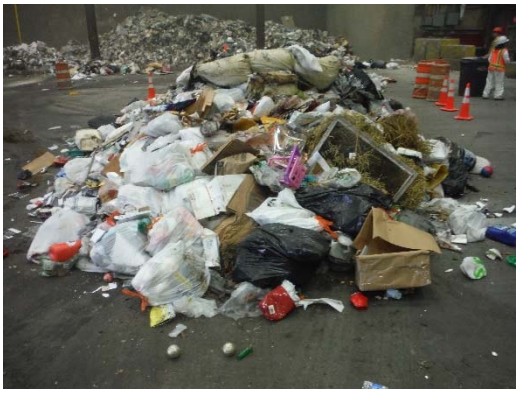
APPENDIX A – SAMPLING OVERVIEW

Trash Tip

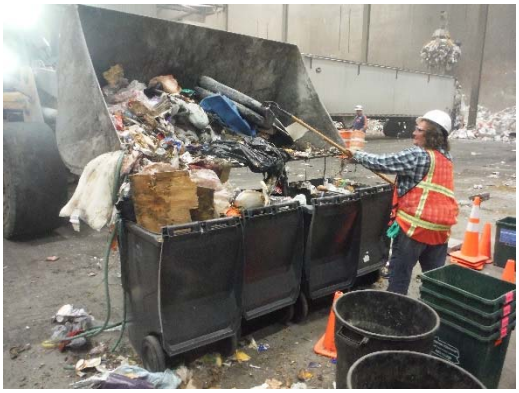


Trash Tip



Sample Perimeter

Sample Perimeter



Taking Samples

Taking Samples

APPENDIX A – SAMPLING OVERVIEW

Carts Queued for Sampling

Sampling Paperwork

Main Table Sort

Plastics Subsort

Other Subsort

Sample Weighing

APPENDIX B

MATERIAL CATEGORIES

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Proposed Sort Categories
Hennepin County Waste Sort

Group	Seq Num	Category - Main	Definition	Recyclable Curbside	Mgmt Method
Paper	1	Newspaper	Printed groundwood newsprint, including glossy advertisements and inserts typically found in newspapers.	Yes	Recycling cart
Paper	2	Office paper	High grade continuous form computer paper, white paper including bond, photocopy, notebook paper, index cards, computer cards, notebook paper, xerographic, typing paper, tablets (yellow and with clear glue binding), manila file folders, nonglossy fax paper, and colored ledger paper primarily found in offices.	Yes	Recycling cart
Paper	3	Magazines/catalogs	Magazines and Catalogs including any "seasonal circular" catalog clearly recognized as such from direct mail (e.g., LL Bean, Nordstrom's, etc.)	Yes	Recycling cart
Paper	4	Cartons	Gable top and aseptic containers. Made mainly from paper in the form of paperboard as well as thin layers of polyethylene. The shelf stable cartons also have a thin layer of aluminum. Products in refrigerated cartons include milk, juice, cream, egg substitutes, soy and grain milk. Products in shelf-stasble cartons include juice, milk, soy and grain milk, soup and broth, and wine. Does not include plastic pouches.	Yes	Recycling cart
Paper	5	Cardboard / Kraft paper	Corrugated cardboard usually has three layers. The center wavy layer is sandwiched between the two outer layers. It 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 subcategory includes Kraft paper that are not excessively contaminated with food or liquid. This category does not include chipboard boxes such as cereal and tissue boxes.	Yes	Recycling cart
Paper	6	Boxboard / paperboard	Uncoated boxboard such as cereal, cracker, shoes boxes, and paper cores (from paper towel, toilet paper, wrapping paper, aluminum foil, and plastic wrap). Does not include heavily soiled, food contaminated, or wet boxes such as refrigerated and frozen food boxes.	Yes	Recycling cart
Paper	7	Mixed recyclable paper	Low grade recyclable paper is a broad category of paper that includes things like mail, phone books, all envelopes (with and without windows), glossy coated paper, paper-back books, construction paper, etc. This category excludes hardcover books or books that light up or play music.	Yes	Recycling cart
Paper	8	Plastic-coated paper	Refrigerated boxes (butter), pop and beer cases, etc. Does not include frozen food boxes.	Yes	Recycling cart
Paper	9	Non-recyclable paper	All other paper that is not recyclable or compostable. Examples include coffee cups, frozen food boxes, plastic-coated take-out containers not accepted for composting, plastic Tyvek envelopes padded with bubble wrap, gift wrap (with glitter, foil, reflective areas or velvet), contaminated paper craft projects (with paint, glue, glitter, etc.), thermal receipt paper, loose shredded paper, blueprint paper, carbon paper, paper used to dispose of chewing gum, hard cover books, paper sprayed with paint heavy glue or tape, cigarette packages, photographs, cardboard with styrofoam glued to side(s), and paper coated with plastic or metal.	No	Trash
Plastic	10	#1 PET bottles	Narrow necked clear and colored plastic containers that bear the label #1 PET or PETE (polyethylene terephthalate).	Yes	Recycling cart
Plastic	11	#1 PET non-bottles	Other thermoform jars, trays, or clam shells that bear the label #1 PET or PETE (polyethylene terephthalate).	Yes	Recycling cart
Plastic	12	#2 HDPE bottles	Natural and pigmented bottles and jars that bear the label #2 HDPE (high-density polyethylene). Examples include dairy products, detergent, fabric softener, bleach, etc.	Yes	Recycling cart

Group	Seq Num	Category - Main	Definition	Recyclable Curbside	Mgmt Method
Plastic	13	#2 HDPE non-bottles	Plastic #2 HDPE plastics. This subcategory excludes bottles and jars.	Yes	Recycling cart
Plastic	14	#3 PVC	Includes rigid plastic packaging coded #3 (PVC) such as rigid plastic piping, fencing, etc., and flexible PVC such as tubing.	No	Trash
Plastic	15	#5 PP containers	This subcategory includes all bottles, jars, tubs, lids, cups, clamshells, trays, etc. that bears the label #5 or "PP".	Yes	Recycling cart
Plastic	16	#6 EPS	Plastic products made of #6 PS expanded polystyrene (Styrofoam). Examples are cold and hot drink cups, packing peanuts, molded shipping packaging, coolers, takeout food trays and clamshells, etc. This subcategory excludes rigid #6 PS packaging.	No	Trash
Plastic	17	All other packaging containers	Means plastic containers that are made of types of plastic other than #1 PET, #2 HDPE, #3 PVC, or #5 PP. Items may be made of #4 LDPE, rigid #6 PS, Other, dual labeled or unlabeled. When marked for identification, these items may bear the number “4,” “6,” “7” or Dual Label #5 - #7 in the triangular recycling symbol. This subcategory includes Keurig coffee containers and plastic containers that do not have the chasing arrows.	No	Trash
Plastic	18	Recoverable film/bags	This category includes shrink film and plastic bag recycling accepted by recycling program run by the Recycling Association of Minnesota. Includes plastic grocery bags, retail bags, dry cleaning bags, newspaper sleeves, cereal bags, bread bags, produce bags, plastic wrap from paper products (pack of paper towels), salt bags, ice bags, stretch/shrink wrap, and 6-pack holder rings. Does not include frozen food bags, bags with strings or rigid handles, soil or mulch bags, zipper bags, bubble wrap, food containers, bottles, bags with plant-based additives or compostable bags. Do not include material that is significantly wet or contaminated with residue.	No	Recycling drop off
Plastic	19	Film: trash bags	Plastic bags used as trash receptables, to collect and contain trash.	No	Trash
Plastic	20	Film: other	Other film means all other plastic film that is not categorized as recoverable film/bags or trash bags. Also includes recoverable film/bags that are highly contaminated. Examples include flexible plastic pouches (containing food, sauces, soup, drinks), pouches with laundry products, frozen vegetable bags, food wrappers such as candy bar wrappers, potato chip bags, yogurt tubes, cheese wrappers, mailing pouches, bank bags, X-ray film, metallized film (such as balloons).	No	Trash
Plastic	21	Durable plastic items	Plastic items other than bottles, containers, or film. These items are made to last for more than one use. Includes bulky items and other smaller items. Examples of bulky items include: crates, buckets (including 5-gallon buckets), baskets, totes, large plastic garbage cans, large tubs, large storage tubs/bins (usually with lids) that don't have sharp corners, flexible (non-brittle) flower pots of 1 gallon size or larger, lawn furniture, large plastic toys, tool boxes, first aid boxes, and some sporting goods. Examples of other durable items include CDs and their cases, plastic housewares such as dishes, cups, and cutlery.	No	Trash

Group	Seq Num	Category - Main	Definition	Recyclable Curbside	Mgmt Method
Plastic	22	All other plastic	Plastic that cannot be put in any other type. These items are usually recognized by their optical opacity. This type includes items made mostly of plastic but combined with other materials. Examples include auto parts made of plastic attached to metal, plastic drinking straws, unlabeled plastic cups, produce trays, unlabeled cookie trays found in cookie packages, plastic strapping, plastic lids, some kitchen ware, toys, window blinds, plastic lumber, insulating foam, imitation ceramics, handles and knobs, plastic string, plastic rigid bubble/foil packaging (as for medications), small (less than 1 gal) plant containers such as nursery pots and plant sixpacks, any unlabeled plastic products, and new Formica, vinyl, or linoleum.	No	Trash
Metal	23	Steel cans	Steel or tin food & beverage containers means rigid containers made mainly of steel that are Bimetal Cans. These items will stick to a magnet and may be tin-coated. This subtype is used to store food, and beverages. Also includes cardboard cans with a steel bottom.	Yes	Recycling cart
Metal	24	Aluminum cans and foil	Containers such as used beverage containers (UBC) and other cans made from aluminum used for containing soda, fruit, juice, sports drinks, iced tea, beer, food, pet food, etc. Also includes clean aluminum foil, trays, and tins (with no food residue).	Yes	Recycling cart
Metal	25	Other scrap steel	Metal composed primarily of iron, plus other scrap ferrous including clothes hangers, sheet metal products, pipes, miscellaneous metal scraps, and other magnetic metal items. This category excludes food and beverage containers.	Yes	Recycling - beyond the cart
Metal	26	Non-ferrous metal	Other non-ferrous means any metal item, other than aluminum cans and foil, that is neither stainless steel nor magnetic. These items may be made of aluminum, copper, brass, bronze, lead, or zinc. Examples include aluminum window frames, aluminum siding, copper wire, brass pipe.	Yes	Recycling - beyond the cart
Metal	27	Mixed metal	Metal that cannot be put in any other type. This subcategory includes items made mostly of metal but combined with other materials and items made of both ferrous metal and non-ferrous metal combined. Examples include insulated wire and finished products that contain a mixture of metals, plastic, and other materials, whose weight is derived significantly from the metal portion of its construction.	Yes	Recycling - beyond the cart
Glass	28	Food & beverage glass	Glass such as clear, brown, green, and blue containers for food, beverage, wine, liquor, and beer.	Yes	Recycling cart
Glass	29	Non-recyclable glass	All other glass that was not originally used for food or beverage containers. Examples including ceramics or pottery, drinking glasses or bowls, glass plates, Pyrex, glass vases or decorative glass items, cooking utensils, ash trays, mirrors, incandescent light bulbs, window glass, plate glass, and fragments. If the glass is broken and not 100% identifiable as food or beverage glass, it belongs to Other Glass.	No	Trash
Organics	30	Food waste	Food preparation wastes, food scraps, and spoiled food. Fruits and vegetables; meat, fish and bones; bakery and dry goods; eggs and eggshells; dairy products; coffee grounds, filters, and tea bags. When feasible, food waste will be removed from containers (e.g., Tupperware, carry-out containers, etc.) and the food waste will be placed in the Food Waste category and the container will be placed in the appropriate category.	Yes	Organics cart

Group	Seq Num	Category - Main	Definition	Recyclable Curbside	Mgmt Method
Organics	31	Compostable paper	Non-recyclable compostable paper. Includes certified compostable paper products; napkins, paper towels, and tissues; uncoated paper plates, cups, and food containers; paper egg cartons; pizza boxes; paper bags and waxed/parchment paper. Does not include fast food wraps, plastic coated paper, coffee cups, cartons, or freezer boxes.	Yes	Organics cart
Organics	32	Other compostable	Includes certified compostable plastics. Also includes houseplant trimmings, cotton balls, hair and nail clippings, Q-tips with paper stems, wood chopsticks, popsicle sticks, toothpicks.	Yes	Organics cart
Organics	33	Yard waste	Yard waste means grass clippings, leaves, branches, sticks, garden waste, brush, stumps, and non-woody plant material such as cut flowers.	Yes	Yard waste cart
HHW	34	HHW	Batteries, paints and solvents, automotive products, mercury-containing items, and other household hazardous waste.	Only batteries	Drop off, batteries sorted separately - bagged, put on top of recycling cart
Electronics	35	Electronics	Electronics include TVs, cable boxes, CD players/stereos, computer monitors and CPUs (towers), computer peripherals (keyboard, mouse, speakers, cables), DVD/Blu-ray players, fax machines, phones, printers and copy/print/fax/scan combination units, radios, receivers, satellite dishes, scanners, and VCRs.	Yes	Recycling - beyond the cart
C&D Debris	36	Clean lumber, pallets, crates	Clean dimensional lumber means unpainted new or demolition dimensional lumber. Includes materials such as 2 x 4s, 2 x 6s, 2 x 12s, and other residual materials from framing and related construction activities. May contain nails or other trace contaminants. This subcategory also includes clean pallets and crates made of lumber used for shipping and packaging.	No	Voucher program
C&D Debris	37	Treated wood, plywood	Wood treated with adhesive, paint, stain, fire retardant, pesticide or preservative. Examples are painted or stained lengths of wood from construction or woodworking activities, particle board, OSB, and plywood.	No	Voucher program
C&D Debris	38	Gypsum board	Interior wall covering made of a sheet of gypsum sandwiched between paper layers. Examples include used or unused broken or whole sheets. Gypsum board may also be called sheetrock, drywall, plasterboard, gypboard, gyproc, or wallboard. Includes painted gypsum board.	No	Voucher program
C&D Debris	39	Concrete and brick	Concrete and brick. Concrete means a hard material made from sand, aggregate, gravel, cement mix, and water. Examples include pieces of building foundations, concrete paving, and concrete/cinder blocks. This category includes concrete with a steel internal structure composed of reinforcing bars (re-bar) or metal mesh.	No	Voucher program
C&D Debris	40	Carpet & padding	Carpet means flooring applications consisting of various natural or synthetic fibers bonded to some type of backing material. This category includes carpet padding.	No	Voucher program
C&D Debris	41	Other C&D	Inerts and other material that cannot be put in any other type. This type may include items from different types combined, which would be very hard to separate. Examples include ceramics, tiles, toilets, sinks, dried paint not attached to other materials, and fiberglass insulation. This type may also include demolition debris that is a mixture of items such as plate glass, tiles, synthetic counter tops, fiber or composite acoustic ceiling tiles.	No	Voucher program
Textiles	42	Clothing	Clothing items made of natural or manmade woven thread, yarn, fabric, or cloth.	No	Donation options
Textiles	43	Shoes	Shoes and boots made of any material, including leather.	No	Donation options
Textiles	44	Leather	Items made of leather other than shoes.	No	Donation options

Group	Seq Num	Category - Main	Definition	Recyclable Curbside	Mgmt Method
Textiles	45	All other textiles	All other items made of natural or manmade woven thread, yarn, fabric, or cloth. This subcategory includes fabric trimmings, draperies, towels, and all natural and synthetic cloth fibers.	No	Trash
Other Waste	46	Small household appliances	Electrically-powered household products with very little or no circuit boards fabricated from metals and plastics not easily separable into individual materials. Examples include hair dryers, toasters, coffee makers, etc.	No	Trash
Other Waste	47	Furniture	Furniture	No	Trash
Other Waste	48	Mattresses/box springs	Mattresses/box springs	Yes	Recycling - beyond the cart
Other Waste	49	Tires / rubber	Tires and rubber means vehicle tires, tubes, and other material mainly made of rubber. Examples include tires from trucks, automobiles, motorcycles, heavy equipment, bicycles, some shoes, and floor mats.	No	Trash
Other Waste	50	Diapers & feminine hygiene products	Diapers & feminine hygiene products	No	Trash
Other Waste	51	Pet waste	Pet waste, including the bag.	No	Trash
Other Waste	52	Fines	Material that is 2" minus.	No	Trash
Other Waste	53	Other not elsewhere classified	Other not elsewhere classified	No	Trash
Other Waste	54	Bulky materials	Bulky items not elsewhere classified (i.e. non-furniture)	No	Trash
Other Waste	55	Supermix	All materials passing through a 2-inch screen	No	Trash

Subsort Examples for Plastic Bottles and Non-Bottle Containers

Grocery	Beauty, health & pharmacy	Household essentials	Other
food gifts	beauty gifts	tissue & toilet paper	
baking	beauty concierge	paper towels	
beverages	fragrances	laundry care	
breakfast & cereal	hair care	cleaning supplies	
candy & gum	makeup	cleaning tools	
canned food & soup	skin care	trash bags	
coffee, tea & cocoa	spa & massage	food storage bags & containers	
condiments, oils & spices	peronal care	paper & disposable plastics	
cookies, chips & snacks	special offer	air fresheners	
emergency food	personal care deals	natural cleaning	
flowers & plants	bath & body	light bulbs	
meal solutions, pasta & grains	eye care	batteries	
	feminine products	pest control	
	men's grooming		
	oral care		
	women's hair removal		
	diet & nutrition		
	first aid, braces & support		
	home health care		
	maternity & prenatal care		
	medicines & treatments		
	medical uniforms and scrubs		
	sexual health		
	sports nutrition		
	vitamins & supplements		

Subsort Examples for Film Plastic

Flexible packaging	Other packaging	Other film
thicker, multi-layer packaging	Thinner, single-layer packaging	
plastic coffee bags (Starbucks and Peet's)	Potato chip bags and similar	
Juice pouches (Capri Sun)	Candy wrappers	
Baby food pouches - may have plastic screw top	Tortilla bags	
Soup pouches	Frozen food bags (vegetables, berries)	
Salad dressing pouches	Nut/snack bags	
Wine pouches	Shrink plastic wrappers (Slim Jim and string cheese wrappers)	
Backpacking meals in pouches	Ziplock bags intended for home use	
Soap refill pouches	Small (2 inch) pouches for condiments	
Laundry detergent pouches	Yogurt tubes	
	Mailing pouches, usually colored or white	
	100% plastic mailing pouches with bubble wrap	

Subsort Examples for Compostable Papers

Certified foodware	Non-certified foodware	Non-packaging
BPI logo	Clearly compostable	Paper towels
Cedar Grove logo	Uncoated paper plates, cups, and food containers	Napkins
Compostable label	Pizza boxes	Tissues
	Paper egg cartons	Wax/parchment paper
	Paper bags	

Subsort Examples for Textiles

Accessories	Home	Other
handbags	towels & linens	
jewelry	bedding	
sunglasses	curtains	
wallets	rugs	
watches	placemats & cloth napkins	

Subsort Examples for Other Compostables

Compostable plastic	Other
BPI logo	houseplant trimmings
Cedar Grove logo	cotton balls
Compostable label	hair and nail clippings
	Q-tips with paper stems
	wood chopsticks
	popsicle stick
	toothpicks

Subsort Examples for Plastic Durables

Kitchen	Tableware	Home décor	Home storage	Home improvement
appliances	dinnerware	candles & candle holders	baskets, bins & containers	electrical
bakeware	drinkware	curtains, blinds & shades	cabinets	flashlights & worklights
cookware	serveware	decorative accents	carts & drawer units	fireplaces
cutlery	flatware	decorative pillows	CD & DVD cases	furnace filters
storage & organization	table accents	decorative shelves	cubbies & cube storage	hardware
tools & gadgets	linens & towels	decorative storage	decorative storage	home exterior
	bar & wine	frames & display boxes	desk organization	home safety & security
		home decor collections	shelving units	ladders & stepstools
		home fragrance	shoe organization	light bulbs
		kids' decor	trash cans & recycling bins	paint
		lamps & lighting		smart home
		mirrors		thermostats
		poufs		tools & tool sets
		rugs		wallpaper
		slipcovers & futon covers		
		throws		
		wall decor		

Patio & garden	Automotive	Toys	Sports, fitness & outdoors	Other
fire pits & heaters	auto care & maintenance	action figures	bikes	
grills & outdoor cooking	auto exterior accessories	arts & crafts	boating & water sports	
lawn & garden	auto interior accessories	building sets & blocks	camping & outdoors	
outdoor cushions	car audio	collectors' toys	coolers & water bottles	
outdoor decor		dolls	exercise & fitness	
outdoor lighting		dress up & pretend play	fan shop	
outdoor pillows		games & puzzles	game room	
outdoor rugs		kids' electronics	helmets & pads	
patio accessories		video games	pools & water slides	
patio furniture		learning toys	outdoor toys	
patio sets		outdoor toys	scooters, skateboards & skates	
patio umbrellas		riding toys	sports equipment	
patio chairs		specialty toys	wearable tech	
patio tables		stuffed animals & plush	accessories	
yard equipment		toy blasters	ellipticals & steppers	
		vehicles & remote control	exercise bikes	
		outdoor toys	fitness trackers	
		bikes	treadmills	
		bouncers	weight training	
		pools & water slides	yoga & pilates	
		riding toys	airbeds, cots & mats	
		scooters, skateboards & skates	camp furniture	
		swingsets, slides & climbers	camp kitchen	
		trampolines	canopies & shelters	
			coolers & water bottles	
			sleeping bags & bedding	
			tents	
			floats & tubes	
			hot tubs & saunas	
			learn to swim	
			maintenance & cleaning	
			pool games	
			swimming pools	
			water slides	

APPENDIX C

WORK SITE LAYOUT

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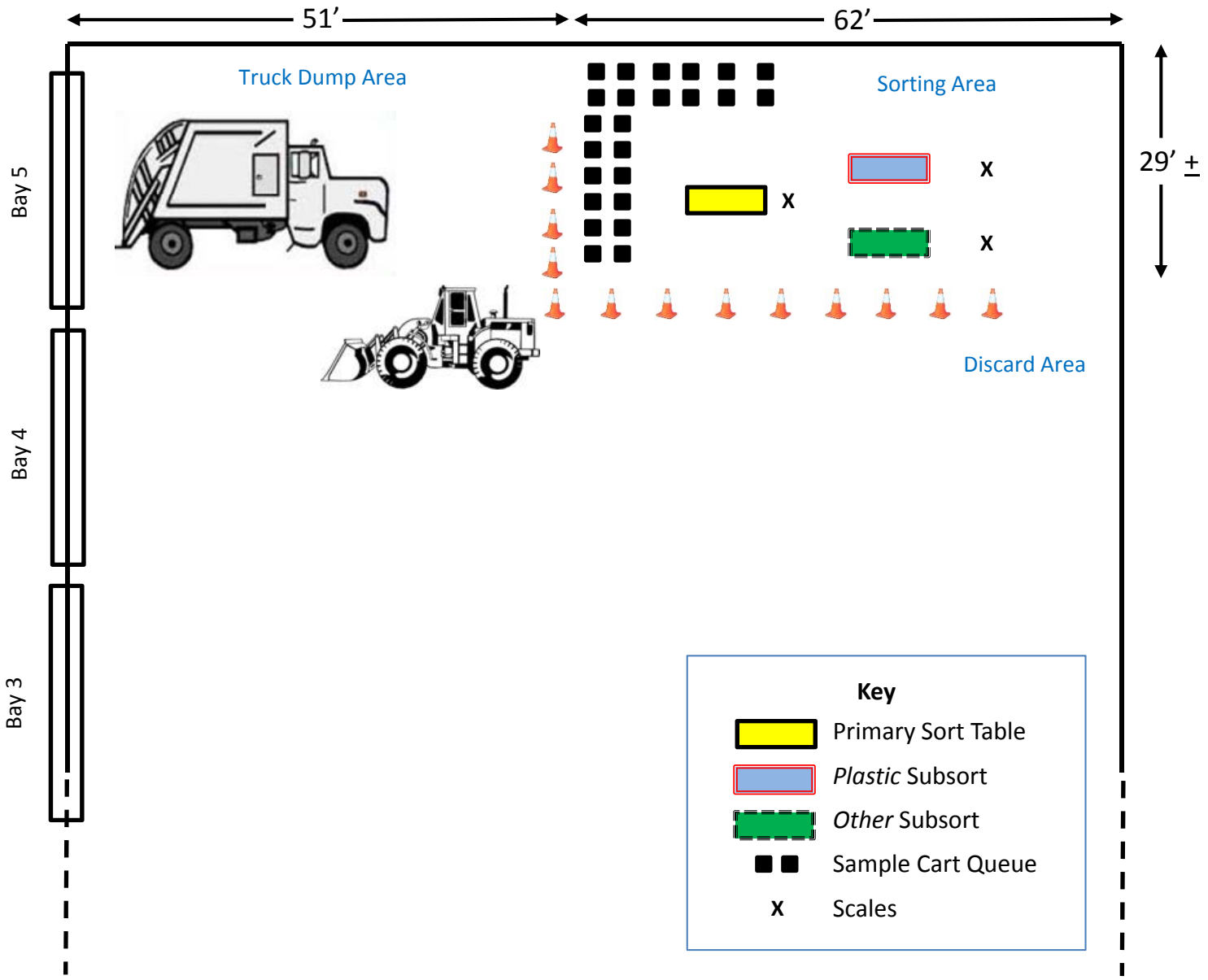
Hennepin Energy Resource Facility
Waste Characterization Work Area Configuration



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APPENDIX D

WORK SITE PHOTO JOURNAL

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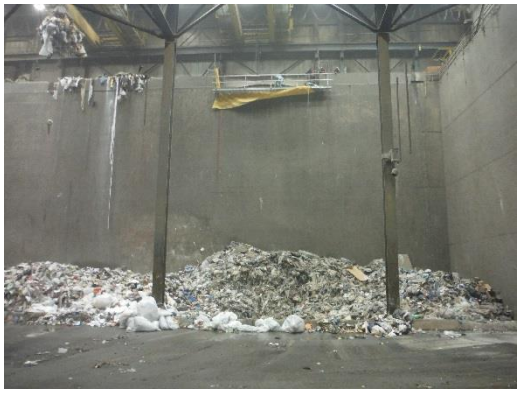
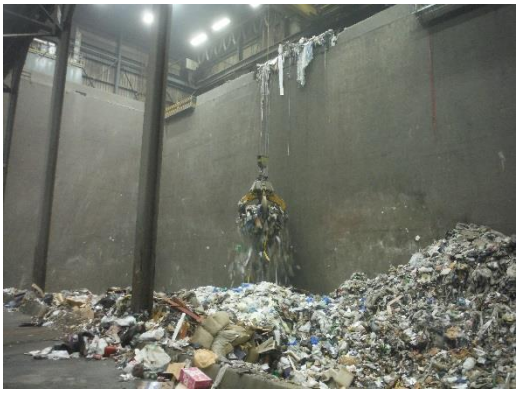
APPENDIX D – WORK SITE



Material Storage Bunker



Grapple Feed

Work Area

Work Area

Work Area

Main Sort Table

APPENDIX D – WORK SITE

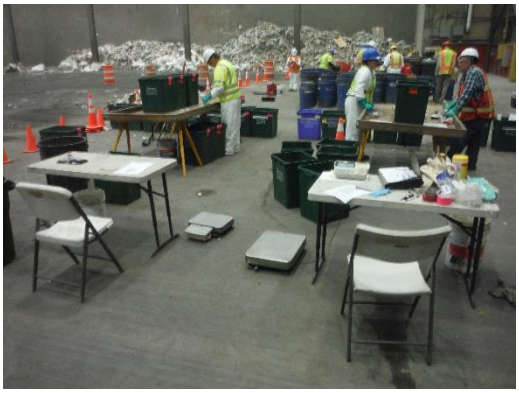
Plastic Subsort Table

Other Subsort Table

Subsort Tables

Tare In

Weight Out



Sample Recording Area

APPENDIX E

SORTING PROCEDURE SCHEMATICS

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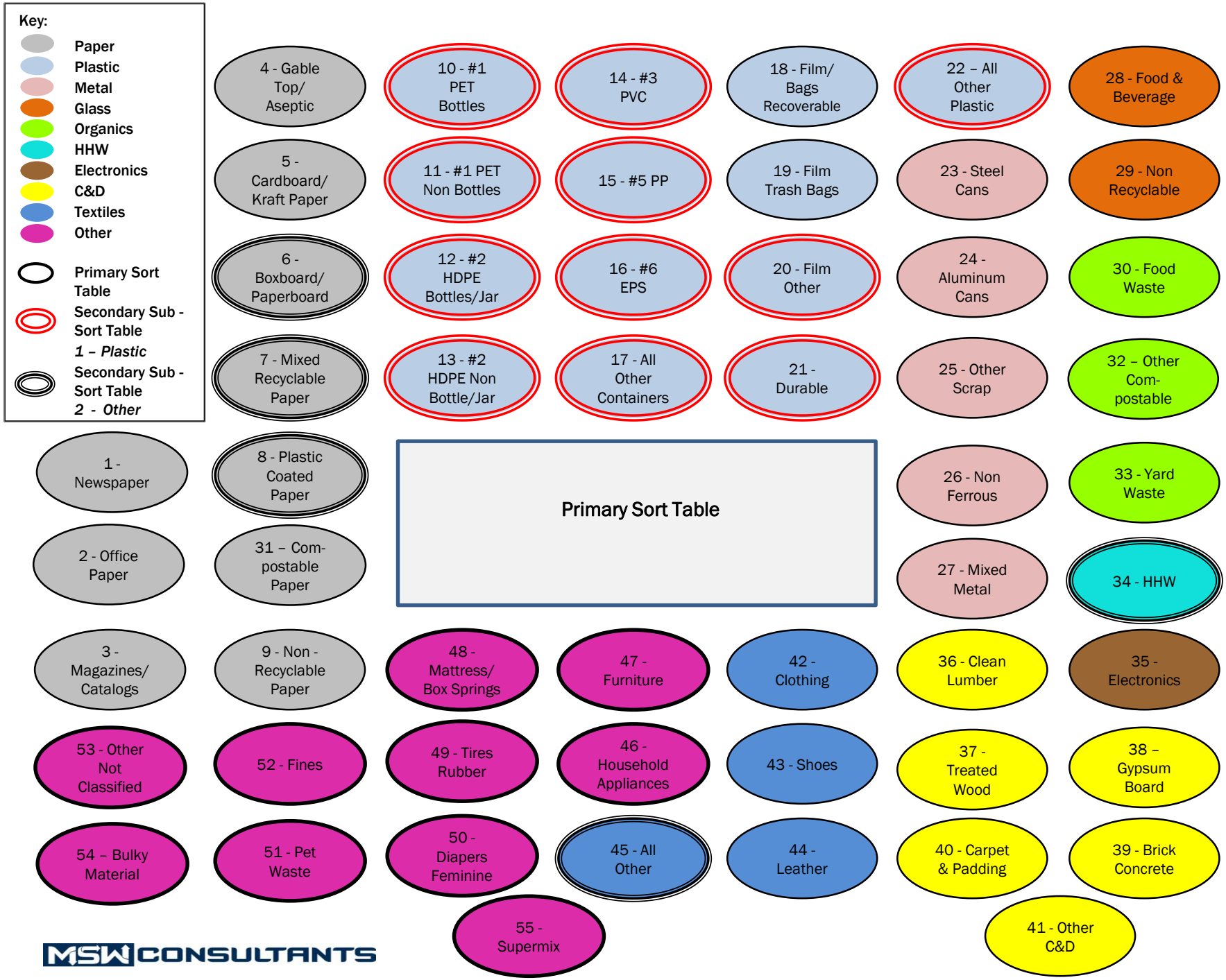
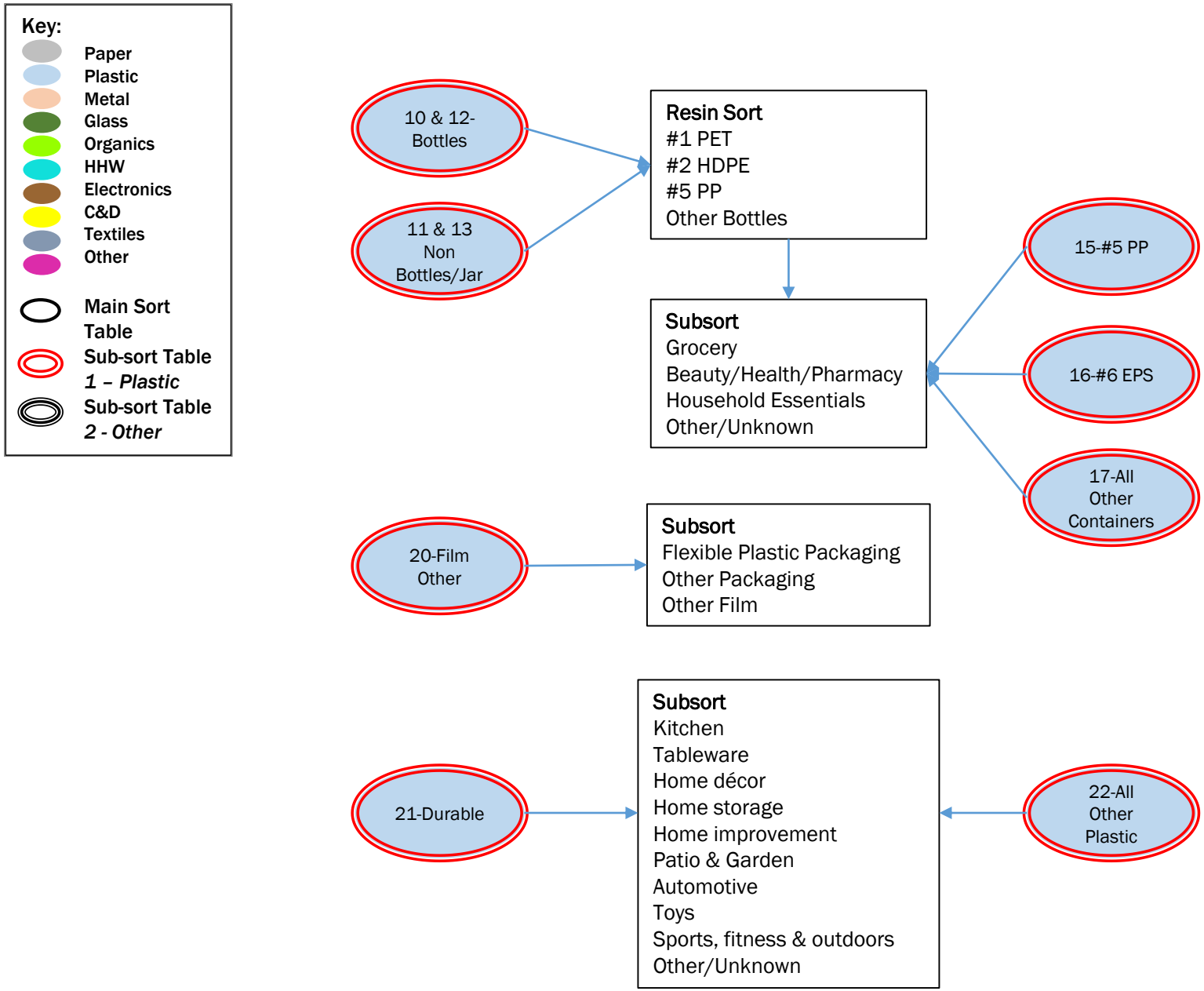
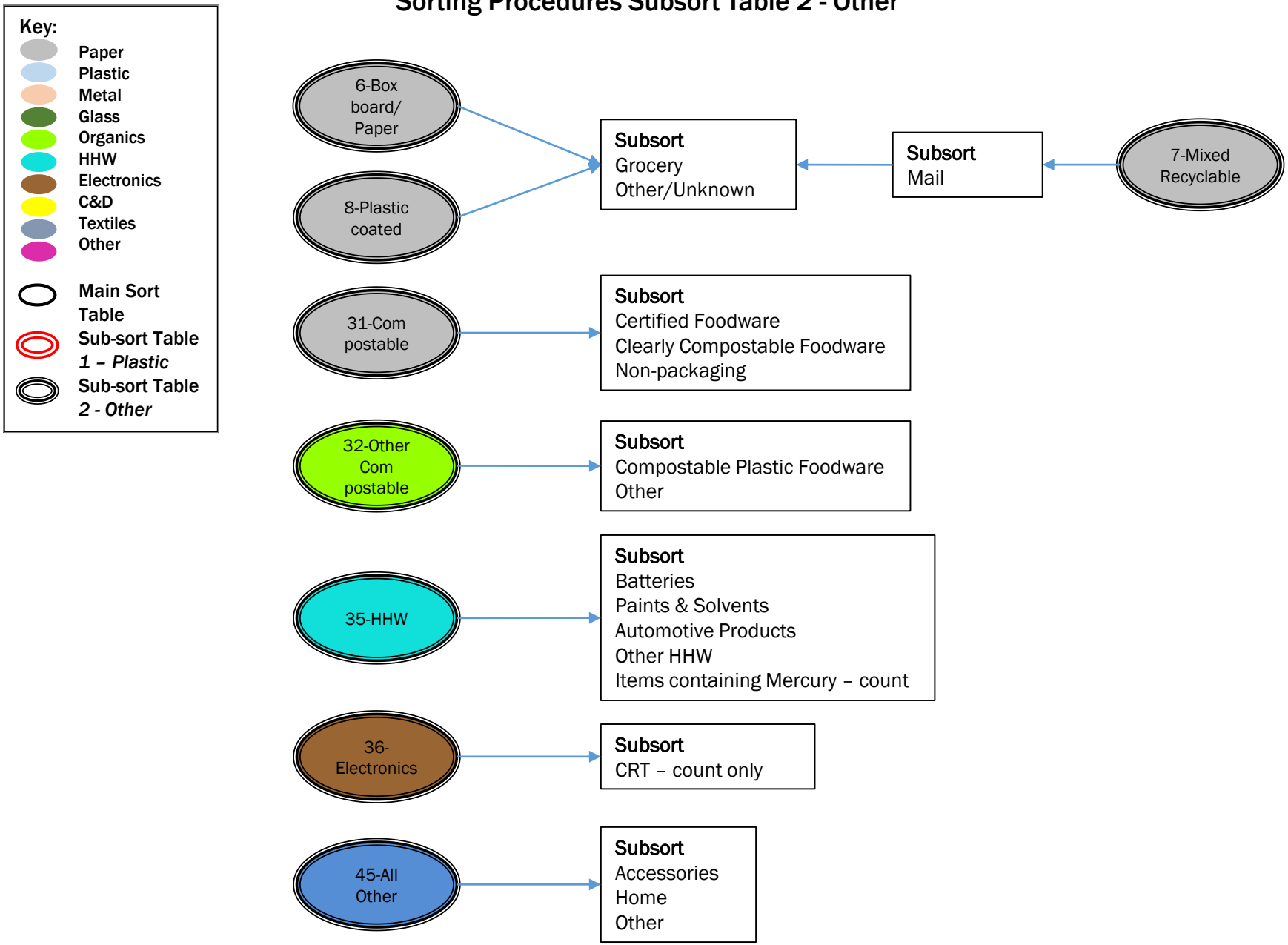

Key:
Paper
Plastic
Metal
Glass
Organics
HHW
Electronics
C&D
Textiles
Other
Primary Sort Table
Secondary Sub - Sort Table
1 – Plastic
Secondary Sub - Sort Table
2 - Other
4 - Gable Top/ Aseptic
10 - #1 PET Bottles
14 - #3 PVC
18 - Film/ Bags Recoverable
22 – All Other Plastic
28 - Food & Beverage
5 - Cardboard/ Kraft Paper
11 - #1 PET Non Bottles
15 - #5 PP
19 - Film Trash Bags
23 - Steel Cans
29 - Non Recyclable
6 - Boxboard/ Paperboard
12 - #2 HDPE Bottles/Jar
16 - #6 EPS
20 - Film Other
24 - Aluminum Cans
30 - Food Waste
7 - Mixed Recyclable Paper
13 - #2 HDPE Non Bottle/Jar
17 - All Other Containers
21 - Durable
25 - Other Scrap
32 – Other Com- postable
1 - Newspaper
8 - Plastic Coated Paper
Primary Sort Table
26 - Non Ferrous
33 - Yard Waste
2 - Office Paper
31 – Com- postable Paper
27 - Mixed Metal
34 - HHW
3 - Magazines/ Catalogs
9 - Non - Recyclable Paper
48 - Mattress/ Box Springs
47 - Furniture
42 - Clothing
36 - Clean Lumber
35 - Electronics
53 - Other Not Classified
52 - Fines
49 - Tires Rubber
46 - Household Appliances
43 - Shoes
37 - Treated Wood
38 – Gypsum Board
54 – Bulky Material
51 - Pet Waste
50 - Diapers Feminine
45 - All Other
44 - Leather
40 - Carpet & Padding
39 - Brick Concrete
55 - Supermix
41 - Other C&D
MSW CONSULTANTS

Sorting Procedures Subsort Table 1 - Plastic



Sorting Procedures Subsort Table 2 - Other



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APPENDIX F

SUPERMIX PHOTO JOURNAL

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APPENDIX F – SUPERMIX

Sort Table

SuperMix Sample

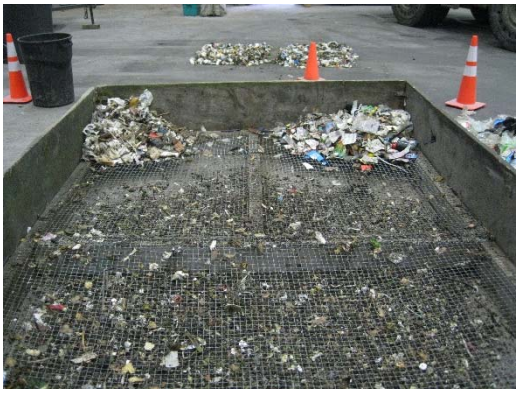
Divide Sample

Sample Divided

Sort

Larger Materials

APPENDIX F – SUPERMIX



Sort Results

Empty SuperMix

SuperMix

Collect SuperMix

Prepare SuperMix for Weighing

Record SuperMix Weight

Refined Sort

Compostable paper

Food

Glass

Metal

Plastic

APPENDIX F – SUPERMIX

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APPENDIX G

NON-RECYCLABLE PAPER EXAMPLES

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APPENDIX G – NON-RECYCLABLE PAPER EXAMPLES

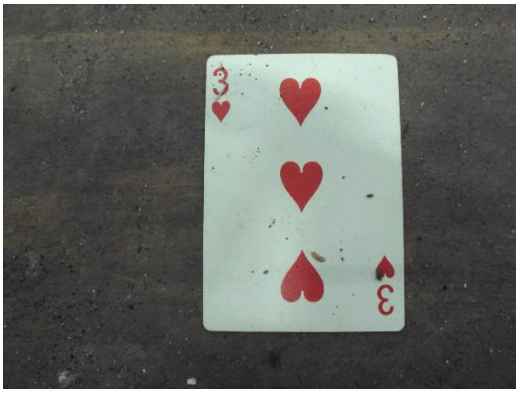
Adhesive backed

Adhesive backed

Blister Pack

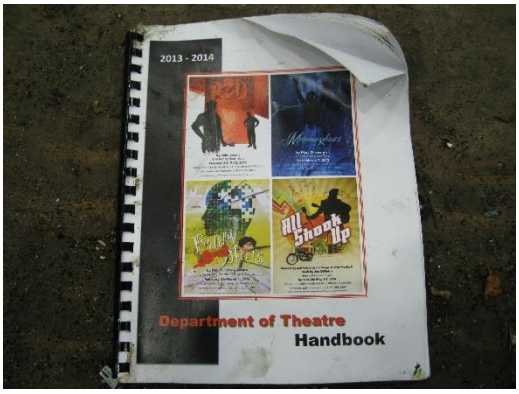
Blister Pack

Coated Paper

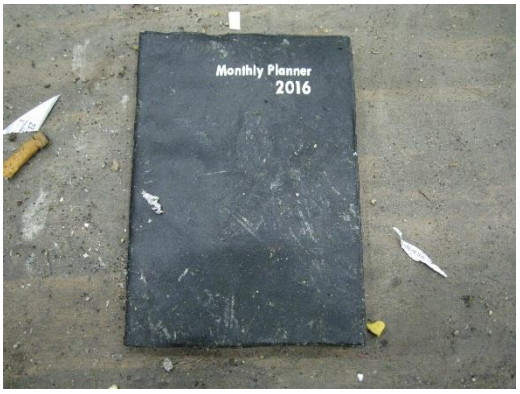


Coated Paper

APPENDIX G - NON-RECYCLABLE PAPER EXAMPLES



Books



Books

Contains Fabric

Contains Fabric – Gift Bag

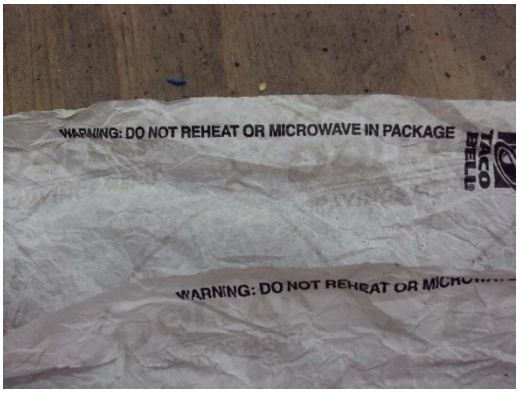
Contains Moisture Barrier

Contains Moisture Barrier

Contains Plastic

Contains Plastic

Do Not Reheat or Microwave



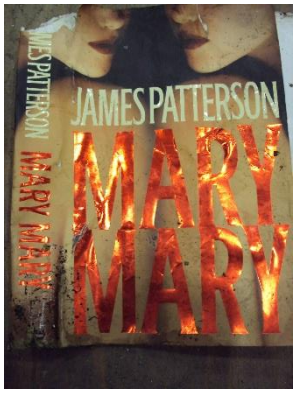
Do Not Reheat or Microwave

Meat Packaging

Meat Packaging

APPENDIX G - NON-RECYCLABLE PAPER EXAMPLES

Metallic Film



Metallic Film

Other

Other

APPENDIX H

FIELD FORMS

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Hennepin County 2016 Waste Sort

Waste Load Area:_____

Route #:_____

Date:_____

Sample: _____ of 17

Cart:_____ of _____

LBS:_____

Sample Prepared by:_____

MSW CONSULTANTS

Hennepin County 2016 Waste Sort

Waste Load Area:_____

Route #:_____

Date:_____

Sample: _____ of 17

Cart:_____ of _____

LBS:_____

Sample Prepared by:_____

MSW CONSULTANTS

Waste Characterization Study - Field Data Sheet

MAIN TABLE

Sample ID:_____ **Crew Chief:** _____

Date: _____ **Time:** _____

	Material Group	Weight (Circle if net weight)	Pre-Wt
1	Newspaper		
2	Office Paper		
3	Magazines / Catalogs		
4	Cartons		
5	Cardboard / Kraft Paper		
6	Boxboard / Paperboard	Other	
7	Mixed Recyclable Paper		
8	Plastic-coated Paper		
9	Non-recyclable Paper		
10	#1 PET Bottles	Plastic	
11	#1 PET Non-bottles		
12	#2 HDPE Bottles		
13	#2 HDPE Non-bottles		
14	#3 PVC		
15	#5 PP Containers	Plastic	
16	#6 EPS		
17	All Other Packaging Containers		
18	Recoverable Film / Bags		
19	Film: Trash Bags		
20	Film: Other		
21	Durable Plastic Items	Plastic	
22	All Other Plastic		
23	Steel Cans		
24	Aluminum Cans and Foil		
25	Other Scrap Steel		
26	Non-ferrous Metal		
27	Mixed Metal		
28	Food and Beverage Glass		
29	Non-recyclable Glass		
30	Food Waste		
31	Compostable Paper	Other	
32	Other Compostable		
33	Yard waste		
34	HHW	Other	
35	Electronics		
36	Clean Lumber, Pallets, Crates		
37	Treated Wood, Plywood		
38	Gypsum Board		
39	Concrete and Brick		
40	Carpet & Padding		
41	Other C&D		
42	Clothing		
43	Shoes		
44	Leather		
45	All Other Textiles	Other	
46	Small Household Appliances		
47	Furniture		
48	Mattresses / Box Springs		
49	Tires / Rubber		
50	Diapers & feminine hygiene products		
51	Pet Waste		
52	Fines		
53	Other Not Elsewhere Classified		
54	Bulky Materials		

PLASTIC SUBSORT TABLE

Sample ID:_____ **Crew Chief:** _____

Date: _____ **Time:** _____

No.	Category	10 #1 PET Bottles	11 #1 PET Non-bottles	12 #2 HDPE Bottles	13 #2 HDPE Non-bottles
P1	Grocery				
P2	Beauty, Health & Pharmacy				
P3	Household Essentials				
P13	Other				

No.	Category	15 #5 PP Containers	16 #6 EPS	17 All Other Packaging Containers	18 Recoverable Film/Bags
P1	Grocery				
P2	Beauty, Health & Pharmacy				
P3	Household Essentials				
P13	Other				

No.	Category	21 Durable Plastic Items	22 All Other Plastic
P4	Kitchen		
P5	Tableware		
P6	Home Décor		
P7	Home Storage		
P8	Home Improvement		
P9	Patio & Garden		
P10	Automotive		
P11	Toys		
P12	Sports, Fitness & Outdoors		
P13	Other		

Notes:

OTHER SUBSORT TABLE

Sample ID:_____ **Crew Chief:** _____

Date: _____ **Time:** _____

No.	Category	6 Boxboard / Paperboard	7 Mixed Recyclable Paper	8 Plastic-coated Paper
01	Grocery			
02	Mail			
014	Other			

No.	Category	31 Compostable Paper	32 Other Compostable
03	Certified Foodware		
04	Clearly Compostable Foodware		
05	Non-packaging		
06	Compostable Plastic Foodware		
014	Other		

No.	Category	34 HHW
07	Batteries	
08	Paints & Solvents	
09	Automotive Products	
010	Other HHW	

No.	Category	35 Electronics
011	CRT Count	

No.	Category	45 All Other Textiles
012	Accessories	
013	Home	
014	Other	

Notes: _____

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