# 2021 MIAMI-DADE COUNTY WASTE COMPOSITION STUDY

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Prepared for:
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Miami-Dade County

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# EXECUTIVE SUMMARY

The University of Florida (UF) conducted a municipal solid waste garbage waste composition study of two Miami-Dade County waste streams, garbage and trash. Miami-Dade County considers municipal solid waste collected from single-family households to be “garbage”, and bulky items to be “trash”. The purpose of the garbage waste composition study was to measure and analyze the material composition of the disposed municipal solid waste (MSW) garbage stream generated by single-family homes in the unincorporated areas and nine municipalities which the County services. The purpose of the visual trash estimation study was to measure and analyze the percentage of yard trash in the County’s bulky waste stream.

A one-season waste composition study was conducted from May 17-21, 2021, at the South Dade Landfill working face, the 58$^{th}$ Street truck wash near the Resource Recovery Facility, and the Northeast Transfer Station tipping floor. Forty samples of garbage were hand sorted, and 40 material categories were assessed. The resulting average mass percentage per material provides an estimate of that material’s presence in the overall County-serviced waste stream (only single-family residential households).

When assessing the data in terms of the 40 material categories examined by the waste study, the leading categories were food waste (16.7%), leaves and vegetation (11.6%), other paper (non-recyclable) (9%), and other organics (4%). When the materials were grouped into seven major categories (paper, plastic, metal, glass, organics, construction and demolition [C&D], and miscellaneous), the category comprising the greatest mass was organics. Organics includes food waste and yard trash (38%), miscellaneous items, which includes textiles and hazardous waste (20.1%), and paper products (18.9%). A notable fraction of the miscellaneous category consisted of residuals; these materials represented 11.7% of the total waste stream. When recyclable and non-recyclable materials were separated within the seven major categories, notable categories and their average mass percentages include recyclable paper (10.0%), other paper (non-recyclable) (9.0%), recyclable plastic (2.7%), non-recyclable plastic (10.9%), potentially recyclable organics (13.5%), and non-recyclable organics (24.7%).

During the same week as the waste composition study, trash samples were visually inspected. Trash samples differ from garbage samples in the County in that the former consist of bulky waste that can be set in piles curbside twice a year for the County to collect separately from regular garbage collection, which is collected weekly in roll carts. The students visually examined the loads of 33 County-run trucks and, on average, 36.2% by volume of the loads was yard trash.

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## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ASTM | American Society for Testing Materials |
| C&D | Construction and demolition debris |
| EPA | U.S. Environmental Protection Agency |
| FDEP | Florida Department of Environmental Protection |
| MSW | Municipal solid waste |
| UF | University of Florida |

## UNITS OF MEASURE

| | |
|---|---|
| cyd | cubic yards |
| lbs | pounds |
| tons | US short tons = 2,000 pounds |

# 1 INTRODUCTION

Miami-Dade County contains within its boundaries approximately 2.7 million residents, divided among unincorporated zones and 34 incorporated municipalities (US Census Bureau, 2019). The Miami-Dade County government (the County) collects municipal solid waste from approximately 350,000 single-family homes in unincorporated zones and in nine of the 34 municipalities (Aventura, Cutler Bay, Doral, Miami Gardens, Miami Lakes, Opa-Locka, Palmetto Bay, Pinecrest, and Sunny Isles Beach). The County considers municipal solid waste collected from single-family households to be "garbage", and bulky items (e.g., yard trash, white goods, furniture) to be "trash". This report focuses solely on the single-family garbage and trash waste streams collected by County vehicles, as requested by the County.

The County distinguishes between garbage and trash. Garbage is common household waste, generally sourced from the kitchen and bathroom, and collected curbside in roll carts twice weekly. Trash is also known as bulky waste. Residents are allotted 50 cubic yards of curbside trash collection per year, which can be collected in one 50-cubic yard trash pick-up or split into two collections of up to 25 cubic yards.

The County owns three transfer stations (Northeast Transfer Station, West Transfer Station, and South Dade Transfer Station), two landfills (North Dade Landfill and South Dade Landfill), and a waste-to-energy plant (Resource Recovery Facility). All facilities manage both garbage and trash, except North Dade Landfill which only manages Class III waste. Waste from other sources, such as the municipalities from where the County does not collect, may be brought to these facilities, but the material composition of those waste streams was not studied in this report.

To examine the composition of the County's collected single-family municipal solid waste (MSW), the University of Florida (UF) planned and conducted a one-season waste composition study to hand sort garbage and a one-season visual study of trash. The one-season garbage study occurred May 17-21, 2021, at the South Dade Landfill working face(shortened as South Dade Landfill), the 58$^{th}$ Street truck wash near the Resource Recovery Facility (Resource Recovery), and the Northeast Transfer Station tipping floor (Northeast Transfer Station).

The purpose of hand sorting garbage samples is to manually separate the waste into material components, which can then be weighed. This process results in average mass percentages for each material category which are then used to estimate each material's presence in the County's single-family garbage stream. We used elements of the American Society for Testing Materials (ASTM)'s Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste, referred to as ASTM D5231, to guide the sample distribution, sorting, and analysis methodologies (ASTM International, 2016).

The visual trash study also occurred during the week of May 17-21, 2021, at the West Transfer Station and Northeast Transfer Station. The purpose of the visual trash estimation study was to measure and analyze the percentage of yard trash in the County's bulky waste stream.

# 2 WASTE COMPOSITION SORT METHODOLOGY

## *2.1 Sample Pulling Methodology*

Prior to the sort, UF established a plan for how many samples were to be "pulled" (i.e., taken) and from which areas of the County. A total of 40 samples were taken which is the typical number of samples sorted in a week. As mentioned in Section 1, the 40 samples consisted of single-family residential garbage collected by the County and sourced from unincorporated zones and Aventura, Cutler Bay, Doral, Miami Gardens, Miami Lakes, Opa-Locka, Palmetto Bay, Pinecrest, and Sunny Isles Beach. This total service area is divided into seven service areas, 1-7 by the Department of Solid Waste Management (DSWM).

For each service area, UF was provided the number of houses and the disposal site of that area's garbage. UF calculated the percentage each area's households comprised of the total region's collected households and then multiplied each percentage by the 40 available samples to find the number of samples to be pulled for each area, as seen in Table 1.

**Table 1.** The number of households and disposal site for each garbage service area.

| Area | Households | Disposal Site | Percentage out of Total Collected Households | Preliminary Number of Samples to Be Pulled |
|---|---|---|---|---|
| 1 | 48,645 | Northeast Transfer Station | 15% | 6 |
| 2 | 42,607 | | 13% | 5 |
| 3 | 53,084 | West Transfer Station/Resource Recovery | 16% | 7 |
| 4 | 49,736 | | 15% | 6 |
| 5 | 44,554 | South Dade Landfill/West Transfer Station | 14% | 6 |
| 6 | 43,963 | South Dade Landfill | 14% | 5 |
| 7 | 40,735 | | 13% | 5 |
| **TOTAL** | **323,324** | | **100%** | **40** |

Because multiple areas bring their waste to a single site, the number of samples to be sorted per site was summed, as seen in Table 2. Sampling did not occur at the West Transfer Station due to limited space at the facility. Areas 1 and 2 were collected and sorted at Northeast Transfer Station. Areas 3 and 4 were collected and sorted at Resource Recovery. Areas 5, 6, and 7 were collected and sorted at South Dade Landfill.

**Table 2.** Condensed sample locations and number of samples pulled.

| Sampling Location | Preliminary Number of Samples to Be Pulled |
|---|---|
| Northeast Transfer Station | 11 |
| Resource Recovery | 13 |
| South Dade Landfill | 16 |

Due to logistical challenges, namely the effort and time needed to transport, unload, and set up equipment at each site, UF rounded up or down each site's samples to multiples of 8, which was the average amount of samples able to be sorted in one day. Three samples that should have been collected at from the Northeast Transfer Station was sampled at the Resource Recovery as seen in Table 3.

**Table 3.** Revised sample location and number of samples pulled.

| Sampling Location | Number of Samples Pulled |
|---|---|
| Northeast Transfer Station | 8 |
| Resource Recovery | 16 |
| South Dade Landfill | 16 |

UF calculated the number of samples originating from each collection area, based on information from Tables 1 and 3, as shown in Table 4. The percentage of households in each area out of the total households disposing at each disposal site was calculated and then multiplied by the number of samples to be pulled at each disposal site. For example, Area 1's households comprised 54% of the waste disposed of at Northeast Transfer Station. UF multiplied the 54% by the 8 samples to be sorted at Northeast Transfer Station which resulted in 4 samples, i.e., 4 of the day's samples were to be from Area 1. Note, due to rounding, the number of samples pulled at South Dade Landfill was 15 instead of 16. An extra sample was added to Area 5 as it contained the most households among Areas 5-7.

**Table 4.** Final calculated sample breakdown per area, pre-sort.

| Area | Households | Disposal Site | Percent out of Total Collected Households | Percentage of Households Disposing at Each Facility | Percent Area's Households Comprise at Disposal Facility | Number of Samples Pulled Per Facility | Number of Samples to be Pulled Per Area |
|---|---|---|---|---|---|---|---|
| 1 | 48645 | Northeast Transfer Station | 15% | 28% | 54% | 8 | 4 |
| 2 | 42607 | | 13% | | 46% | | 4 |
| 3 | 53084 | Resource Recovery | 16% | 31% | 52% | 16 | 8 |
| 4 | 49736 | | 15% | | 48% | | 8 |
| 5 | 44554 | South Dade Landfill | 14% | 41% | 34% | 16 | 6 |
| 6 | 43963 | | 14% | | 34% | | 5 |
| 7 | 40735 | | 13% | | 32% | | 5 |

Based on the previous calculations and considerations, UF established a sample pulling schedule for the County, as shown below in Table 5. Note that County waste trucks do not operate on Wednesdays, which is why Wednesday, May 19 was not included in the schedule. Because of the challenges of waste collection in a heavily populated area, the County preferred to select the trucks themselves. The County selected the trucks to sample based on the following pulling schedule as well as logistical constraints.

**Table 5.** Sample pulling schedule.

| Date to Pull Samples | Service Area Origin of Samples | Number of Samples from Service Area | Disposal Site |
|---|---|---|---|
| Friday 5/14/21 | 7 | 5 | South Dade Landfill |
| Monday 5/17/21 | 6 | 5 | South Dade Landfill |
| Monday 5/17/21 | 5 | 6 | South Dade Landfill |
| Tuesday 5/18/21 | 4 | 8 | Resource Recovery |
| Tuesday 5/18/21 | 3 | 8 | Resource Recovery |
| Thursday 5/20/21 | 1 | 4 | Northeast Transfer Station |
| Thursday 5/20/21 | 2 | 4 | Northeast Transfer Station |

A UF student and County official assisted with the sample pulling along with various operators and supervisors from the different facilities. The following information was recorded per sample: the truck number, the route number, the date and time pulled, the area of origin, the driver's name, the roll cart numbers associated with each sample, and any additional observations or notes.

Each facility had slight variations in the method of pulling the samples, based on the availability of equipment and operators. At South Dade Landfill, each selected truck dumped part of their load on the tipping floor in separate piles. When roll carts and the operator were available, the waste was mixed with a front-end loader and dropped into four empty 96-gallon roll carts. Because no scale was available for use at the three facilities, we estimated that four roll carts per sample would be sufficient to hold the 200-300 pounds needed. The roll carts were then marked with the truck number and stored until needed for the sort. One of the selected trucks dumping its waste can be seen in Figure 1.

**Figure 1.** A selected truck dumps waste at South Dade Landfill.

At Resource Recovery, samples were also dumped in individual piles. The first three samples were mixed and dropped into roll carts using a truck-mounted clamshell bucket, as seen in Figure 2 below. The clamshell bucket was later replaced with a front-end loader when the latter became available. The roll carts were then marked with the truck number and stored until needed for the sort.


**Figure 2.** A truck-mounted clamshell bucket loads a sample into roll carts at Resource Recovery.

At Northeast Transfer Station, trucks dumped part of their load onto the tipping floor in individual piles. The waste in each pile was immediately mixed and dropped into the empty roll carts by two front loaders, as seen in Figure 3 below. The roll carts were then marked with the truck number and stored until needed for the sort.

**Figure 3.** Front loaders dump a sample into roll carts at Northeast Transfer Station.

The sampling schedule described in Table 5 was mostly followed. Due to time constraints, the team sorted 7 samples instead of 8 samples on Monday, May 17 at South Dade Landfill. The sample that could not be sorted was discarded, and an extra sample was added to Northeast Transfer Station. Additionally, the County selected a few trucks that differed from the sample selection schedule due to logistical challenges. Because of this, the team sorted 9 and 7 samples from Areas 3 and 4, respectively, instead of 8 each. UF does not believe that either of these changes had a significant impact on the results. The final sampling tally is provided below in Table 6.

**Table 6.** Pre-sort and achieved sample breakdown, per area.

| Area | Pre-Sort Sample Plan | # of Samples Sorted |
|---|---|---|
| 1 | 4 | 5 |
| 2 | 4 | 4 |
| 3 | 8 | 9 |
| 4 | 8 | 7 |
| 5 | 6 | 5 |
| 6 | 5 | 5 |
| 7 | 5 | 5 |

## *2.2 Sorting Methodology*

To begin a sample, students located the roll carts with the desired truck number written on the side and hen loaded waste material from the roll carts into black bins. Note, the bin color was only important to the team while sorting as the different colored bins had different weights. Each black bin was weighed on the scale, which has a 0.1-pound precision, and then dumped onto the sorting table. Black bins were filled, weighed, and dumped until the cumulative weight of the sample, without the weight of the bins, was a minimum of 200 pounds.

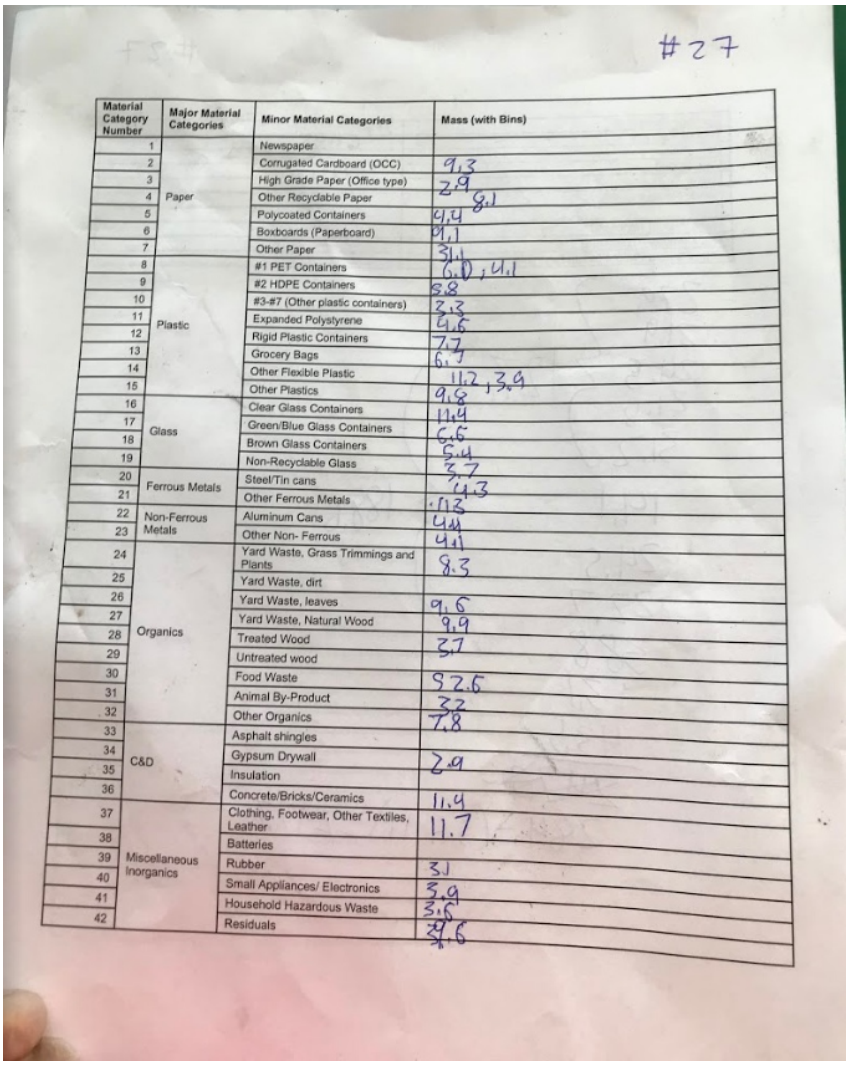
The sorting table had a screen top with 2-inch by 2-inch openings. Any material that fell through the screen was considered residuals. The sample was hand sorted into 39 material categories, not including residuals, with each material category having its own grey bin. Sometimes materials required multiple bins due to large quantities. Figure 4 shows the sorting table with the material category bins surrounding the table.

**Figure 4.** The sorting table and the material bins.

Table 7, on pages 13-14, lists the 40 material categories, including residuals, and common items included in each category. The items listed in the table do not comprise a comprehensive list but rather are commonly seen items. Table 7 lists both major and minor categories. Major categories are broad material titles, such as paper, plastic, glass, metal, organics, construction and demolition (C&D) debris, and miscellaneous. Within each major category are minor categories, which are more specific. For example, within the major category of paper are the minor categories of newspaper, corrugated

cardboard, office paper, and non-recyclable paper, among others. Two categories, leaves and yard trimmings/plants, were originally separate categories but were combined early in the sort because of material composition similarities. The combined category is called leaves and vegetation. Two other categories, treated wood and untreated wood, were also combined at the beginning of the sort due to difficulties distinguishing one from another during the sort. The combined category is called treated and untreated wood. All data analyses use the combined categories.

Once the sample was fully sorted, each grey material bin was weighed on the UF-owned scale, and the combined mass of the waste and the bin was recorded. The waste was then disposed in a designated location. An example of a data sheet can be seen in Figure 5. For each data point, the mass of the grey bin was subtracted out when the results were calculated. The residuals were also gathered and disposed of in a designated location. The mass of residuals was later back calculated by subtracting out the mass of all other material categories from the total sample mass.



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| Material Category Number | Major Material Categories | Minor Material Categories | Mass (with Bins) |
|---|---|---|---|
| 1 | Paper | Newspaper | |
| 2 | | Corrugated Cardboard (OCC) | 9.3 |
| 3 | | High Grade Paper (Office type) | 2.9 |
| 4 | | Other Recyclable Paper | 8.1 |
| 5 | | Polycoated Containers | 4.4 |
| 6 | | Boxboards (Paperboard) | 9.1 |
| 7 | | Other Paper | 3.4 |
| 8 | Plastic | #1 PET Containers | 6.0, 4.1 |
| 9 | | #2 HDPE Containers | 8.8 |
| 10 | | #3-#7 (Other plastic containers) | 3.3 |
| 11 | | Expanded Polystyrene | 4.6 |
| 12 | | Rigid Plastic Containers | 7.7 |
| 13 | | Grocery Bags | 6.7 |
| 14 | | Other Flexible Plastic | 11.2, 3.9 |
| 15 | | Other Plastics | 9.8 |
| 16 | Glass | Clear Glass Containers | 11.4 |
| 17 | | Green/Blue Glass Containers | 6.6 |
| 18 | | Brown Glass Containers | 5.4 |
| 19 | | Non-Recyclable Glass | 3.7 |
| 20 | Ferrous Metals | Steel/Tin cans | 4.3 |
| 21 | | Other Ferrous Metals | .513 |
| 22 | Non-Ferrous Metals | Aluminum Cans | 4.4 |
| 23 | | Other Non- Ferrous | 4.1 |
| 24 | Organics | Yard Waste, Grass Trimmings and Plants | 8.3 |
| 25 | | Yard Waste, dirt | |
| 26 | | Yard Waste, leaves | 9.6 |
| 27 | | Yard Waste, Natural Wood | 9.9 |
| 28 | | Treated Wood | 3.7 |
| 29 | | Untreated wood | |
| 30 | | Food Waste | 52.6 |
| 31 | | Animal By-Product | 3.2 |
| 32 | | Other Organics | 7.8 |
| 33 | C&D | Asphalt shingles | |
| 34 | | Gypsum Drywall | 2.9 |
| 35 | | Insulation | |
| 36 | | Concrete/Bricks/Ceramics | 11.4 |
| 37 | Miscellaneous Inorganics | Clothing, Footwear, Other Textiles, Leather | 11.7 |
| 38 | | Batteries | |
| 39 | | Rubber | 3.1 |
| 40 | | Small Appliances/ Electronics | 3.9 |
| 41 | | Household Hazardous Waste | 3.5 |
| 42 | | Residuals | 4.6 |

**Figure 5.** Example of a data sheet.

**Table 7**. List of garbage material categories sorted and examples of each category.

| Material Category Number | Major Material Categories | Minor Material Categories | Description of Material Category | Examples |
|---|---|---|---|---|
| 1 | Paper | Newspaper | Newspaper | N/A |
| 2 | | Corrugated Cardboard (OCC) | Corrugated cardboard with a wavy core, uncoated. Items coated or with waxy coatings are included. | Packaging boxes |
| 3 | | High Grade Paper (Office Type) | Clean, high grade paper | Printer paper, manilla folders, books, colored paper |
| 4 | | Other Recyclable Paper | Glossy and non-glossy paper | Magazines, catalogs, kraft brown paper bags, junk mail, mail with plastic windows |
| 5 | | Polycoated Aseptic Containers | Paper cartons with a waxy coating | Ice cream cartons, milk cartons |
| 6 | | Boxboards (Paperboard) | Stiff paper made from recycled paper products | Cereal boxes, tissue boxes |
| 7 | | Other Paper (Non-Recyclable) | Paper soiled with food or grease, bathroom related paper, any paper that does not fit into previous paper categories | Paper towels, napkins, pizza boxes, wet paper, takeout paper food containers |
| 8 | Plastic | #1 PET Containers | Translucent and clear jars and bottles with a neck with a #1 PET label | Water bottles, soda bottles |
| 9 | | #2 HDPE Containers | Translucent and colored jars and bottles with a neck with a #2 HDPE label | Laundry detergent bottles |
| 10 | | #3-#7 (Other Plastic Containers) | Translucent and clear jars and bottles with a neck with a #3-#7 label | Medicine bottles, other containers |
| 11 | | Expanded Polystyrene | Styrofoam (cups, food containers and packaging) | Cups, food containers and packaging |
| 12 | | Other Rigid Plastic Containers | Containers without necks | Usually food related, including butter and yogurt containers and lids, fast food plastic cups and containers |
| 13 | | Grocery Bags | Bags with two handles | Grocery store bags |
| 14 | | Other Flexible Plastic | Flexible plastic and plastic bags that are not grocery bags | Household garbage bags, chip bags, Ziploc bags, saran wrap, plastic flexible packaging |
| 15 | | Other Plastics | Any plastic item that does not fit in previous plastic categories | Plastic utensils, toys, non-food containers, hoses, CDs |
| 16 | Glass | Clear Glass Containers | Clear bottles and jars | N/A |
| 17 | | Green/Blue Glass Containers | Green bottles and jars | N/A |
| 18 | | Brown Glass Containers | Brown bottles and jars | N/A |
| 19 | | Glass (Non-Recyclable) | Glass that is not a beverage bottle or food container | Mirrors, drinking glasses, windowpanes, broken glass |

**Table 7.** List of garbage material categories sorted and examples of each category, continued.

| Material Category Number | Major Material Categories | Minor Material Categories | Description of Material Category | Examples |
|---|---|---|---|---|
| 20 | Metals | Steel/Tin Cans | Steel/tin cans that are ferrous (magnetic) | Soup cans, aerosol cans |
| 21 | | Other Ferrous Metals | Scrap metal that is ferrous (magnetic) | Car parts, metal frames |
| 22 | | Aluminum Cans | Cans (nonferrous/non-magnetic) | Soda cans |
| 23 | | Other Non- Ferrous | Scrap metal that is non-ferrous (non-magnetic) | Aluminum foil, aluminum dishes |
| 24 | Organics | Leaves and Vegetation | Bags or loose grass trimmings, flowers, shrubs, leaves | N/A |
| 25 | | Yard Waste (Dirt) | Bagged or loose dirt | N/A |
| 26 | | Yard Waste (Natural Wood) | Branches, stumps. If branches and leaves are together, the item will be placed in the bin of the material contributing the most mass. | N/A |
| 27 | | Treated and Untreated Wood | Material that looks to be painted, glazed, or treated | Furniture components, wood pallets, plywood, wood planks |
| 28 | | Food Waste | Edible and food scraps, including k-cups, loose coffee grounds, tea bags, liquids from bottles | Produce, cooked food, raw meat, k-cups, loose coffee grounds, tea bags, liquids from bottles |
| 29 | | Animal By-Product | Pet waste | Cat litter, rabbit bedding, pet excretions |
| 30 | | Other Organics | Any organic material that does not fit in any other organic categories | Diapers, feminine sanitary products, urine pads, cigarettes, candles, hair |
| 31 | C&D | Asphalt Shingles | Asphalt items | Asphalt pavement and roofing |
| 32 | | Gypsum Drywall | Gypsum drywall items | Drywall boards or pieces of drywall |
| 33 | | Insulation | Insulation | Fiberglass, cellulose insulation |
| 34 | | Concrete/Bricks/Ceramics | Concrete, bricks, and ceramic items | Items from C&D activities, home items (bowls, ceramic figurines, tiles) |
| 35 | Miscellaneous Inorganics | Clothing, Footwear, Other Textiles, Leather | Items that are worn or used for home decoration | Clothing, footwear, curtains, sheets, blankets, wallets, fashion bags, belts, pillows, carpet, leather clothing, and scrap leather |
| 36 | | Batteries | Batteries used in household electronics | AA, AAA |
| 37 | | Rubber | Rubber items | Tires, gloves |
| 38 | | Small Appliances/ Electronics | Electrical or battery-operated appliances and devices | Blenders, coffee makers, gaming systems, computer components, hair dryers |
| 39 | | Household Hazardous Waste | Containers full of cleaning supplies | Containers holding any liquid or solid pesticides, herbicides, bleach, or pool cleaners |
| 40 | | Residuals | Material that falls through screened table | Items smaller than 2”x 2” |

# 3 TRASH VISUAL ESTIMATION METHODOLOGY

Students observed trash trucks, each considered a sample, dumping loads to estimate the average volume of yard trash per load. On May 18, three students conducted observations at the West Transfer Station. On May 19, two students conducted observations at the same transfer station. On May 21, two students observed at Northeast Transfer Station. The students observed County trash vehicles during their time on site. At the West Transfer Station, the students stood behind a concrete barrier and watched the truck dump into the surge pit. Figure 6 shows the view of the trucks from the student perspective. At Northeast Transfer Station, the students stood a safe distance away while the truck dumped onto the tipping floor but then were allowed to approach the load to make closer observations. Figure 7 shows students observing the trash load at Northeast Transfer Station. A total of 33 trucks were observed. Table 8 provides the number of trash samples per site.

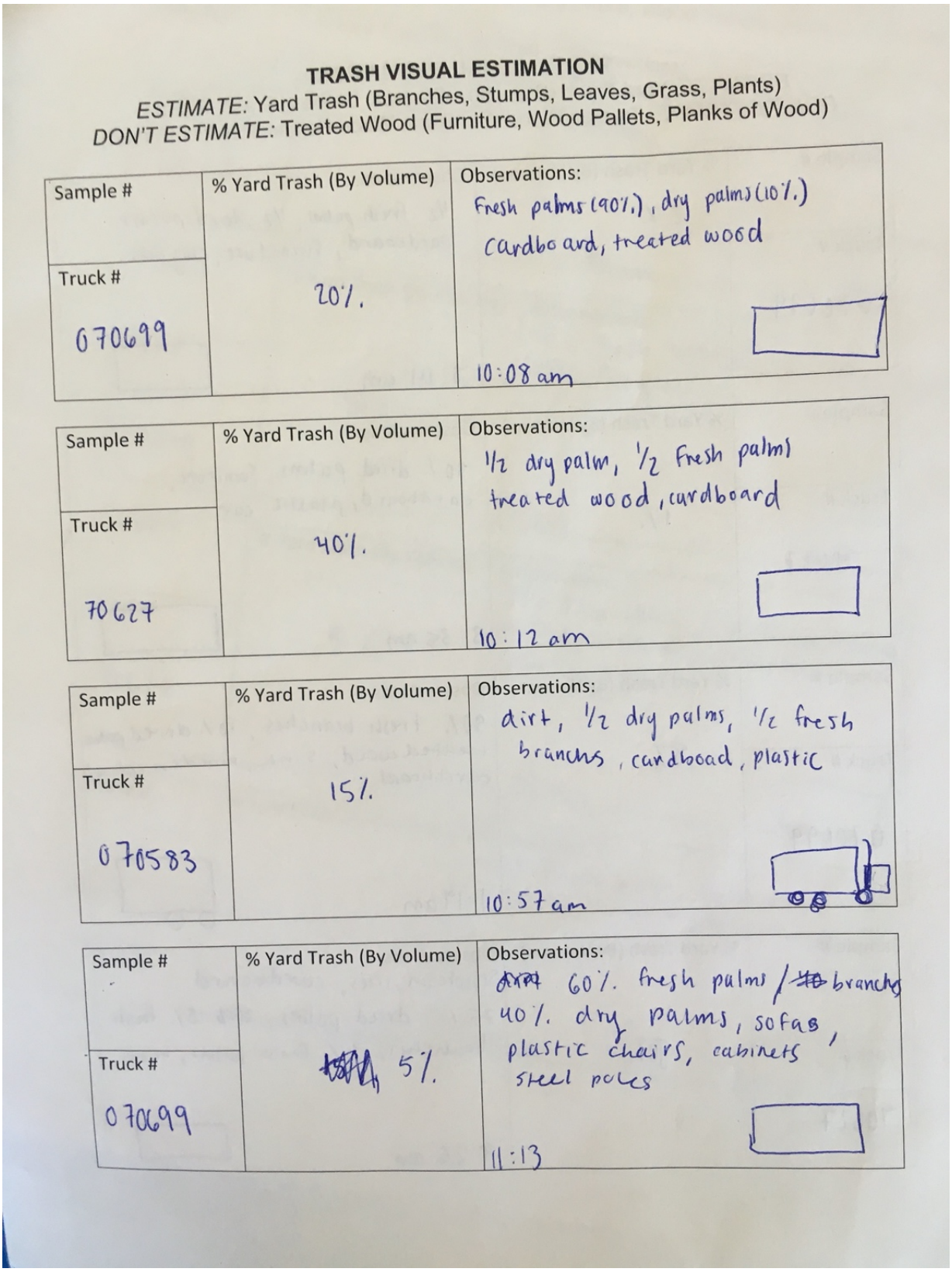
**Figure 6.** County trash truck dumps waste into the West Transfer Station surge pit.

**Figure 7.** Students observe a trash sample at Northeast Transfer Station.

**Table 8.** Number of trash samples visually estimated per location.

| Disposal Site | Number of Samples Visually Estimated |
|---|---|
| West Transfer Station | 31 |
| Northeast Transfer Station | 2 |

For each truck, students recorded the truck number, the time, and a percentage estimate of the yard trash volume out of the total truck volume. Unfortunately, due to safety concerns and time constraints the load was not spread out to get a better view of the materials. Each truck was assumed to be 100% full. Additionally, the students often wrote notes about the yard trash in each load, including if the material was fresh or dried and percentage estimates of minor yard trash categories, such as palm fronds, stumps, branches, and leaves within the present volume of yard trash. Items such as wood pallets, wood furniture, and all other trash items were not estimated. Figure 8 shows a trash truck data sheet.



**TRASH VISUAL ESTIMATION**

*ESTIMATE:* Yard Trash (Branches, Stumps, Leaves, Grass, Plants)
*DON'T ESTIMATE:* Treated Wood (Furniture, Wood Pallets, Planks of Wood)

| Sample # | % Yard Trash (By Volume) | Observations: |
|---|---|---|
| Truck # 070699 | 20%. | Fresh palms (90%), dry palms (10%.) cardboard, treated wood 10:08 am |

| Sample # | % Yard Trash (By Volume) | Observations: |
|---|---|---|
| Truck # 70627 | 40%. | 1/2 dry palm, 1/2 Fresh palms treated wood, cardboard 10:12 am |

| Sample # | % Yard Trash (By Volume) | Observations: |
|---|---|---|
| Truck # 070583 | 15%. | dirt, 1/2 dry palms, 1/2 fresh branchs, cardboad, plastic 10:57 am |

| Sample # | % Yard Trash (By Volume) | Observations: |
|---|---|---|
| Truck # 070699 | ~~5%~~ | ~~60%~~ 60%. fresh palms / ~~40~~ branchs 40%. dry palms, sofas, plastic chairs, cabinets steel poles 11:13 |

**Figure 8.** Trash truck estimation data sheet.

# 4 WASTE COMPOSITION SORT RESULTS

## *4.1 Calculating Material Mass Percentages and Results*

Average mass percentages were calculated for the list of 40 materials assessed throughout 40 garbage samples. The average mass percentage for each original material was calculated using Equations 1 and 2, sourced from the ASTM D5231 methodology (ASTM International, 2016). In these equations, each material is represented by variable *i*. For each of the 40 samples, each material's mass fraction percentage was calculated using Equation 1. After the individual sample mass fraction percentage was calculated for a material, the average of the material's mass fraction percentages was calculated across 40 samples (Equation 2) to obtain a material average mass percentage.

$$mf_i = \frac{w_i}{\sum_{i=1}^{j} w_i} * 100 \qquad \text{Eq. 1}$$

Where:
$mf_i = mass\ fraction\ of\ material\ category\ i\ in\ a\ sample$
$w_i = mass\ of\ material\ category\ i\ in\ a\ sample$
$j = number\ of\ material\ categories$

$$\bar{\mathrm{m}}f_i = (\frac{1}{n}\sum_{k=1}^{n}(mf_i)_k) \qquad \text{Eq. 2}$$

Where:
$\bar{\mathrm{m}}f_i = mean\ mass\ of\ material\ category\ i$
$n = number\ of\ samples$

## *4.2 Non-condensed Categories Results*

Table 9 presents the average mass percentage for each of the 40 material categories from 40 samples, and Figure 9 displays the same data in a pie chart. Approximately 49% of the total sampled waste consisted of four material categories including food waste (16.7%), residuals (11.7%), leaves and vegetation (11.6%), and other paper (non-recyclable) (9%).,. Note that the food and residuals categories were based on 39 samples rather than 40 because in Sample 8, the food and residual data points were abnormally low and high, respectively. UF therefore omitted these outliers. Figures 10-13 provides examples of material bins.

Food, which includes solid food and liquids, was an average 16.7% by mass. The category of leaves and vegetation contributed an average 11.6% of the total mass. This category included the bulk of the total yard waste collected (which includes the leaves and vegetation category as well as the natural wood category) and commonly required an extra bin to hold the total waste. This high inflow of leaves and plants into the MSW stream may be because of the convenience for residents to place vegetation in curbside roll carts rather than disposing of waste at the TRCs or waiting for their infrequent bulky waste pickup (curbside collected trash). Most of this category consisted of palm fronds, which are much larger and thicker than tree and shrub leaves.

The category of other paper (non-recyclable) contributed an average of 9.0% by mass. The category consists of paper items that the County does not recycle, such as

tissues, napkins, and paper-based take-out containers. Residuals constituted an average of 11.7%, which is a typical value for the category based on previously conducted waste composition studies around the state and country. Residuals are any material small enough to fall through the screened tabletop and are commonly small, heavy items such as glass, food, and wet paper.

**Table 9.** Average mass composition of the 40 assessed materials.

| Material | Average Mass Percentage |
|---|---|
| Newspaper | 0.1% |
| Corrugated Cardboard (OCC) | 3.3% |
| High Grade Paper (Office Type) | 0.6% |
| Other Recyclable Paper | 3.2% |
| Polycoated Containers | 0.3% |
| Boxboards | 2.5% |
| Other Paper (Non-Recyclable) | 9.0% |
| #1 PET Bottles and Containers | 1.6% |
| #2 HDPE Bottles and Containers | 1.0% |
| #3-#7 Bottles and Containers | 0.2% |
| Polystyrene | 0.9% |
| Rigid Plastic Containers (Non-Recyclable) | 2.2% |
| Grocery Bags | 1.1% |
| Other Flexible Plastic | 3.8% |
| Other Plastic | 2.8% |
| Clear Glass | 2.2% |
| Green and Blue Glass | 1.1% |
| Brown Glass | 0.6% |
| Glass (Non-Recyclable) | 0.8% |
| Steel/Tin cans | 0.6% |
| Other Ferrous Metals | 1.1% |
| Aluminum Cans | 0.5% |
| Other Non-Ferrous Metals | 0.7% |
| Leaves and Vegetation | 11.6% |
| Yard Waste (Dirt) | 1.0% |
| Yard Waste (Natural Wood) | 1.9% |
| Treated and Untreated Wood | 1.4% |
| Food Waste | 16.7% |
| Animal By-Product | 1.7% |
| Other Organics | 4.0% |
| Asphalt Shingles | 0.2% |
| Gypsum Drywall | 0.4% |
| Insulation | 0.1% |
| Concrete, Bricks, Ceramics | 1.1% |
| Clothing, Footwear, Other Textiles, Leather | 4.9% |
| Batteries | 0.1% |
| Rubber | 0.6% |
| Small Appliances, Electronics | 1.3% |
| Hazardous Waste | 0.9% |
| Residuals | 11.7% |
| **Sum** | **99.9%[a]** |

a= Sum does not equal 100% due to rounding.

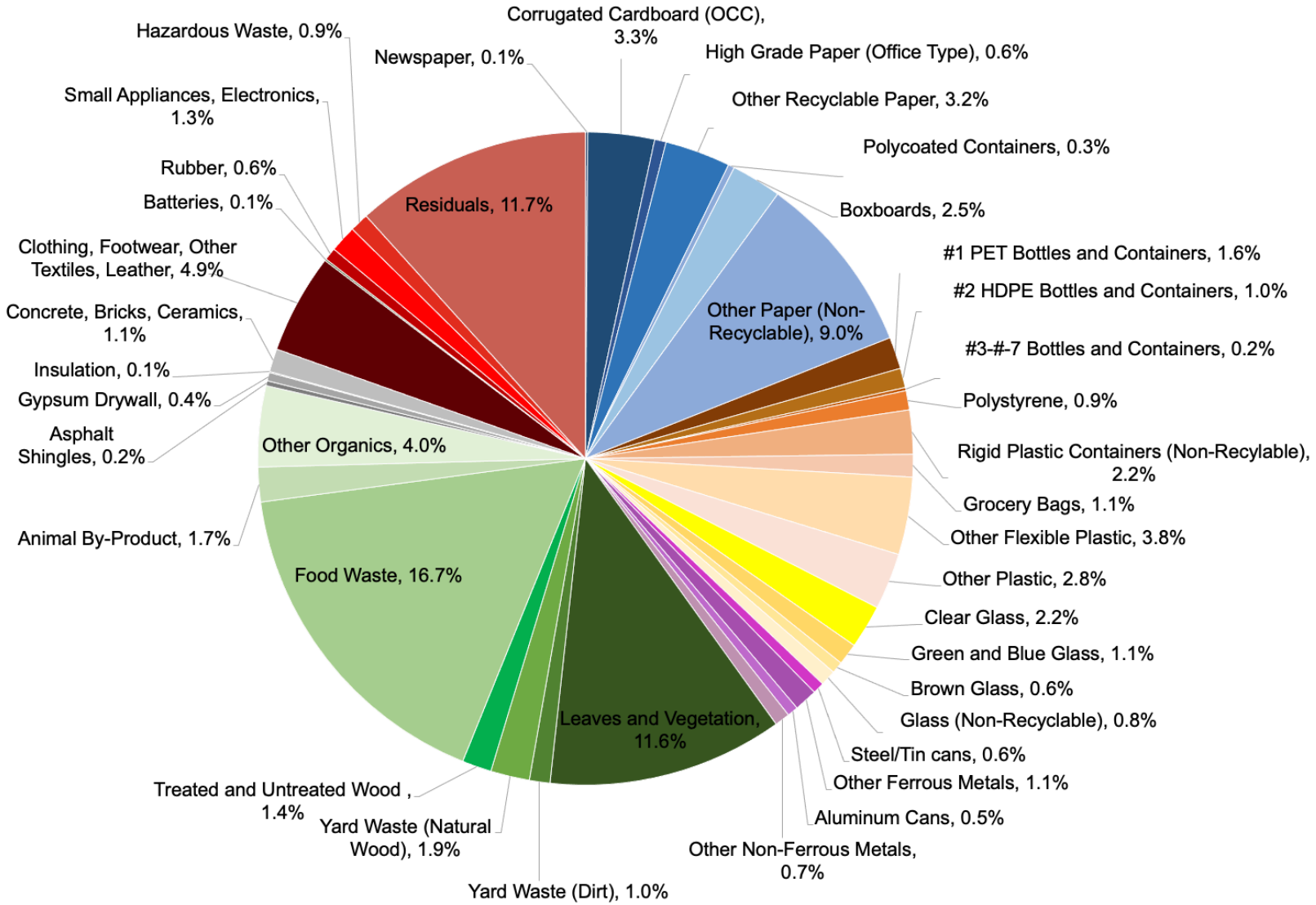



**Figure 9.** Pie chart of average mass composition of the 40 assessed materials.

**Figure 10.** Picture of bin from material category leaves and vegetation.

**Figure 11.** Picture of bin from material category other paper.

**Figure 12.** Picture of bin from material category flexible plastic.

**Figure 13.** Picture of bin from material category food waste.

UF determined which materials are within a minimum 90% confidence level and 10% precision. By using Equation 3, sourced from ASTM D5231, UF calculated the minimum number of samples, “n”, required for a material to meet the 90% confidence level and 10% precision threshold. For each material category, UF used the average mass percentage and standard deviation of the 40 sample data points in Equation 3. Additionally, UF used a 10% precision and the student t-statistic associated with both a 90% confidence level and a degree of freedom of 39. The degree of freedom is the total number of samples conducted minus one. The required number of samples per material was calculated in this manner and compared to 40, the number of samples conducted in the study.

$$n = \left(\frac{t^{*} \cdot s}{e \cdot x}\right)^{2} \qquad \text{Eq. 3}$$

Where

$n = number\ of\ samples$
$t^{*} = student\ t\ statistic\ corresponding\ to\ the\ desired\ level\ of\ confidence$
$s = estimated\ standard\ deviation$
$e = desired\ level\ of\ precision$
$x = estimated\ mean$

For each material, if the number of samples conducted was more than the number of samples required to meet a 90% confidence level, one can have at least 90% confidence that the results for the material are well representative of the material in the overall County waste stream within a 10% precision. When sorting MSW into an expansive material list, most materials are expected to not meet a 90% confidence level.

This is because many materials are generally found in low mass quantities and the presence of these materials may vary among samples. Of the material categories, other paper (non-recyclable), #1 PET bottles and containers, #2 HDEP bottles and containers, grocery bags, other flexible plastic, and food waste can be viewed with a minimum of a 90% confidence level. Assessing the data at a lower confidence level or allowing for a larger precision does not lessen the integrity of the results and is suitable for different uses of the data.

## *4.3 Condensed Categories Results*

To view the data in a different way, UF condensed the list of 40 material categories into seven major material categories: paper, plastic, glass, metals, organics, C&D, and miscellaneous, as seen in Table 10 and Figure 14. Condensed categories are helpful for assessing similar materials as one overarching group as opposed to viewing each material individually. Also, condensed categories are useful when comparing results to other waste composition studies since different studies commonly use different minor category titles. For each sample and each condensed category, the data points of related minor categories were summed together to create a condensed mass percentage. For example, in each sample, we joined the clear glass, green and blue glass, brown glass, and non-recyclable glass data points to create a singular glass data point. The 40 data points for each condensed category were then averaged to create new average mass percentages.

The three leading categories were organics (38.0%), miscellaneous (20.1%), and paper (18.9%). Organics comprised the largest mass percentage, which is expected as the category contains two of the heaviest minor categories: food waste and leaves and vegetation. C&D was the lowest average mass percentage at 1.9%, which was expected as residents commonly bring their C&D waste to TRCs or place the waste in their curbside collected trash (bulky waste pickup). When the materials are condensed, the categories of paper, plastic, organics, and miscellaneous can be viewed with a 90% confidence level.

**Table 10.** Average mass percentages of the condensed material list.

| **Material** | **Average Mass Percentage** |
|---|---|
| Paper | 18.9% |
| Plastic | 13.6% |
| Glass | 4.6% |
| Metals | 2.2% |
| Organics | 38.0% |
| C&D | 1.9% |
| Miscellaneous | 20.1% |
| **Sum** | **99.3%[a]** |

a= Sum does not equal 100% due to rounding.

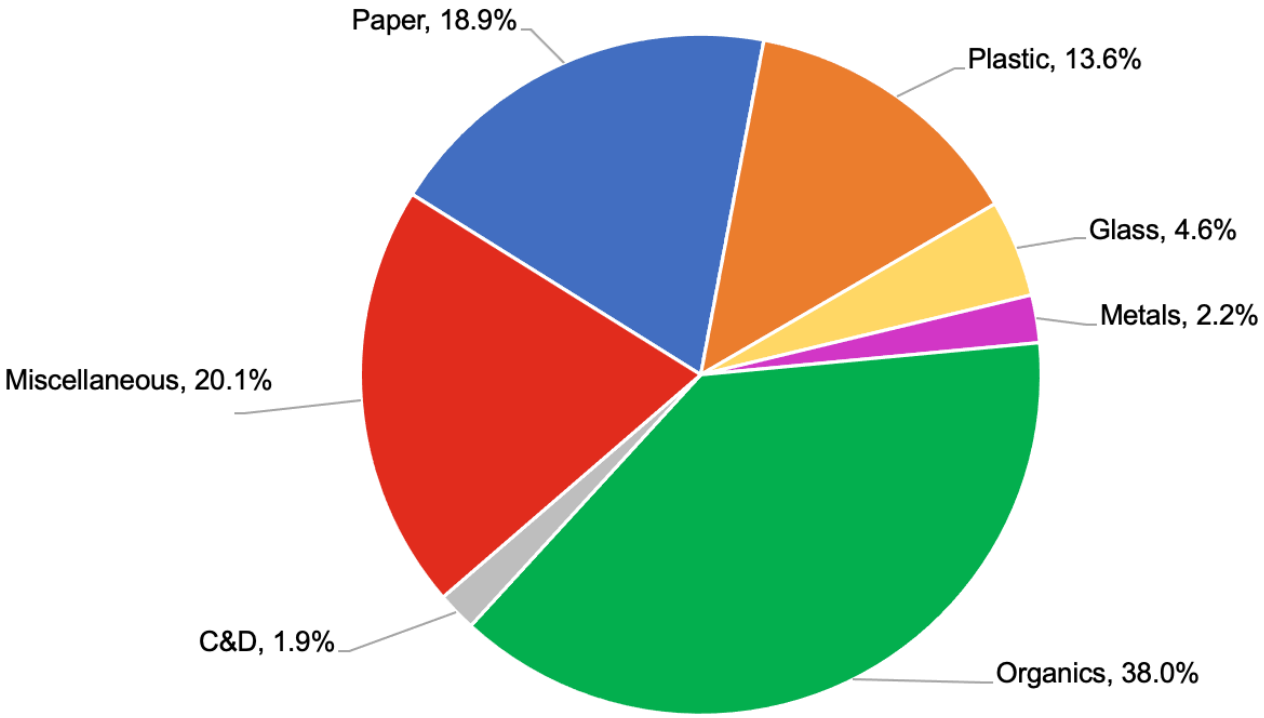



**Figure 14**. Pie chart of average mass composition of the 40 assessed materials.

Next, UF compared the 2021 waste composition results to the 2010 County waste composition study results (HDR, 2010) using the condensed list of seven materials in Table 11. The leading four materials by mass in the 2010 data were organics (26.2%), paper (28.5%), miscellaneous (16.3%), and plastic (15.0%). These same four categories are the leading categories in the 2021 data, just in a different order. The organics category had the largest increase from 2010 to 2021, with a change of 11.8%.

**Table 11.** 2010 and 2021 comparison of the seven major categories.

| Material | 2010 | 2021 | Difference |
|---|---|---|---|
| Paper | 28.5% | 18.9% | -9.6% |
| Plastic | 15.0% | 13.6% | -1.4% |
| Glass | 5.4% | 4.6% | -0.8% |
| Metals | 3.5% | 2.2% | -1.3% |
| Organics | 26.2% | 38.0% | 11.8% |
| C&D | 5.3% | 1.9% | -3.4% |
| Miscellaneous | 16.3% | 20.1% | 3.8% |
| **Sum** | **100.1%[a]** | **99.3%[a]** | **N/A** |

a= Sum does not equal 100% due to rounding.

## *4.4 Potentially Recyclable Results*

UF analyzed the mass percentages of materials the County accepts for recycling but were found in the garbage samples. The County uses a single-stream system and provides one roll cart for single-family residents within the unincorporated zones and 9

municipalities, listed in Section 1. Recycling is collected once every two weeks. The County categorizes recyclable materials into five categories, as listed in Table 12. It is worth noting that the County recycles all plastic bottles regardless of number.

**Table 12.** Five recyclable categories by the County.

| Material | Examples |
|---|---|
| Paper | Clean and dry newspapers, magazines, catalogs, telephone books, printer paper, copier paper, mail, and all other office paper without wax liners. |
| Cardboard | Packing boxes, cereal boxes, gift boxes, and corrugated cardboard. |
| Cans | Steel and aluminum food and beverage containers and aluminum cans. |
| Cartons | Aseptic polycoated drink boxes, juice cartons, and milk cartons. |
| Plastic and Glass Bottles and Jars (with Necks) | Milk, water, detergent, soda, and shampoo bottles, and glass bottles. |

We analyzed the presence of materials eligible for recycling in terms of the seven major material categories (paper, plastic, metal, glass, organics, C&D, and miscellaneous). Paper, plastic, metal, glass, and organics categories each split into a recyclable and non-recyclable subcategory. There are no recyclable subcategories for C&D and miscellaneous categories as the County does not accept and recycle any of the minor categories within these major categories. The mass percentage results for each recyclable and non-recyclable major category in Miami-Dade County are shown in Table 13a and 13b. In these tables the results are compared to those in Alachua County to provide a sense of the difference in percent recyclables in a dual stream (as opposed to Miami-Dade County which has single stream recycling). For most categories, Alachua County has a smaller presence of recyclable materials in their disposal stream. To be able to provide a more accurate comparison yard waste removed (since this is collected separately in Alachua County at the residential curb) as seen in Table 13b. Figure 15 below visualizes the Miami-Dade County results as a pie graph. Recyclable paper, non-recyclable paper, recyclable plastic, non-recyclable plastic, non-recyclable organics, and non-recyclable miscellaneous can be viewed with a 90% confidence level.

**Table 13. a)** Mass averages of recyclable and non-recyclable major categories.

| Material | Miami-Dade County Residential Single-Family Average Mass Percentage | *Alachua County Residential Single-Family Average Mass Percentage |
|---|---|---|
| Recyclable Paper | 10% | 4.9% |
| Recyclable Plastic | 2.7% | 2.7% |
| Recyclable Glass | 3.8% | 2.9% |
| Recyclable Metals | 1.1% | 2.2% |
| Potentially Recyclable Organics (Yard Trash) | 13.5% | 1.5% |
| Non-Recyclable Paper | 9.0% | 19% |
| Non-Recyclable Plastic | 10.9% | 15% |
| Non-Recyclable Glass | 0.8% | |
| Non-Recyclable Metals | 1.9% | 2.1% |
| Non-Recyclable Organics | 24.7% | 23.8% |
| Non-Recyclable C&D | 1.9% | 5% |
| Non-Recyclable Miscellaneous | 19.6% | 21% |
| **Sum** | **100%** | **100%** |

*Results from *2021 Alachua County, Florida: 2020-2021 Waste Composition Study and Sustainable materials Management Evaluation* Report and assuming same acceptable categories in Table 12.

**Table 13. b)** Mass averages of recyclable and non-recyclable major categories, normalized by removing yard trash

| Material | Miami-Dade County Residential Single-Family Average Mass Percentage | *Alachua County Residential Single-Family Average Mass Percentage |
|---|---|---|
| Recyclable Paper | 11.6% | 5.0% |
| Recyclable Plastic | 3.1% | 2.7% |
| Recyclable Glass | 4.4% | 2.9% |
| Recyclable Metals | 1.3% | 2.2% |
| Potentially Recyclable Organics (Yard Trash) | | |
| Non-Recyclable Paper | 10.4% | 19.3% |
| Non-Recyclable Plastic | 12.6% | 15.2% |
| Non-Recyclable Glass | 0.9% | |
| Non-Recyclable Metals | 2.2% | 2.1% |
| Non-Recyclable Organics | 28.6% | 24.2% |
| Non-Recyclable C&D | 2.2% | 5.1% |
| Non-Recyclable Miscellaneous | 22.7% | 21.3% |
| **Sum** | **100%** | **100%** |

Although not currently accepted and recycled into a new organic product, yard trash was included as a potentially recyclable organic material in this analysis l. The yard trash value consists of the leaves and vegetation and natural wood categories combined. Dirt is not included as it was assumed the material would fall through screens during processing and not contribute to the final recycled product. The potentially recycled yard trash value provides the County an estimate of the yard trash within the garbage stream

that could be recycled if a mulching or composting facility is pursued. The yard trash value was 13.5%. Note that other organic materials, such as food, can be and are recycled in other counties but are included here as non-recyclable organics (24.7%) because the County does not currently accept and recycle these materials.

Recyclable paper and non-recyclable paper average mass percentages were comparable at 10.0% and 9.0%, respectively. Residents generally receive large quantities of junk mail and magazines, which contribute to the recyclable paper percentage. The average mass percentages of plastics had a larger difference with the recyclable plastics at 2.7% and non-recyclable plastics at 10.9%. Note, the only plastic materials eligible for recycling are plastic bottle and jars, which are generally lightweight.

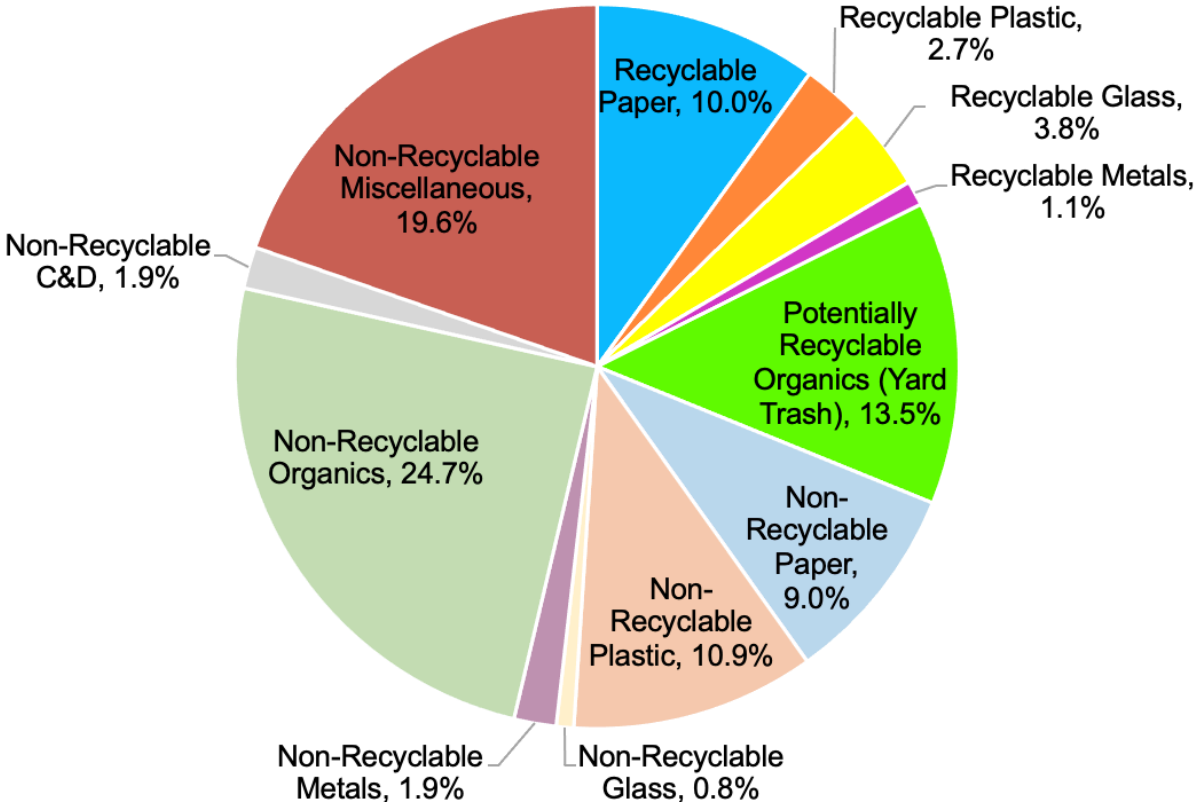



**Figure 15**. Pie chart of recyclable and non-recyclable major categories. See Table 13 for Miami-Dade County data.

Next, in Table 14, the 2021 waste composition results was compared to the 2010 results (HDR, 2010) using the condensed list of seven major materials and the paper, plastic, metal, glass, and organics categories split into recyclable and non-recyclable subcategories. Nearly all the recyclable material categories comprised smaller percentages in the later study as compared to the former. For example, the recyclable paper subcategory decreased from 15% by mass in 2010 to 10% by mass in 2021. The potentially recyclable organics, which includes yard trash, stands as an exception as it

increased from 10.4% by mass in 2010 to 13.5% by mass in 2021. Two other categories, non-recyclable organics and non-recyclable miscellaneous, also increased in relative material presence.

**Table 14.** 2010 and 2021 comparison of the seven major categories split into recyclable and non-recyclable subcategories.

| Material | 2010 | 2021 | Difference |
|---|---|---|---|
| Recyclable Paper | 15.0% | 10.0% | -5.0% |
| Non-Recyclable Paper | 13.5% | 9.0% | -4.5% |
| Recyclable Plastic | 3.5% | 2.7% | -0.8% |
| Non-Recyclable Plastic | 11.5% | 10.9% | -0.6% |
| Recyclable Glass | 4.9% | 3.8% | -1.1% |
| Non-Recyclable Glass | 0.4% | 0.8% | -0.4% |
| Recyclable Metals | 2.0% | 1.1% | -0.9% |
| Non-Recyclable Metals | 1.4% | 1.9% | -0.5% |
| Potentially Recyclable Organics (Yard Trash) | 10.4% | 13.5% | 3.1% |
| Non-Recyclable Organics | 15.7% | 24.7% | 9.0% |
| Non-Recyclable C&D | 5.3% | 1.9% | -3.4% |
| Non-Recyclable Miscellaneous | 16.3% | 19.6% | 3.3% |
| **Sum** | **100.0%** | **99.8%** | **N/A** |

When comparing waste composition study results, it is important to be aware of differences in local solid waste management practices and waste composition methodologies. For example, some areas, such as the County, use incineration, whereas others landfill the entirety of their MSW. Areas with incineration might have larger mass percentages of certain materials, such as yard waste, in their waste stream because the waste is ultimately being recycled into electricity. Therefore, less emphasis might be placed on waste diversion or recycling certain materials. Some counties or municipalities have bans on the disposal of certain materials, depending on local regulations and solid waste programs. Lastly, waste composition studies use a wide range of material category titles and thus one must pay close attention to the individual material items included in each category and how material categories are condensed. This awareness is important to accurately compare the mass percentages of similar materials.

# 5 TRASH VISUAL ESTIMATION RESULTS

To analyze the truck volume estimates, the individual student estimations were averaged for each sample. This calculation resulted in an estimate that trash truck loads are 36.2%-yard trash by volume. Ideally, percentage estimates by volume can be converted into a mass percentage with a known vehicle volume, known mass of the sample, and a density factor. The County provided an average truck volume of 31 cubic yards (cyd). The County provided scale house data for each truck the students observed which included the net mass of the truck's waste. As yard trash densities vary among geographic regions and seasons, ideally one would separate out the yard trash in each load and divide the mass by the total mass of the load to calculate a County specific density factor. This option was unfeasible due to high traffic volume and lack of sorting space.

The next option was to use available yard trash density factors, as seen in Table 15. These density factors were sourced from bulky waste composition study reports. Multiple density factors were identified, but the two density factors from the California Integrated Waste Management Board's sponsored document, Method of Visual Characterization of Disposed Waste from Construction and Demolition Activities Visual Composition Study (Cascadia Consulting Group, 2006) and the United States Environmental Protection Agency's Volume-to-Weight Conversion Factors document (US EPA, 2016) were the most encompassing of different yard trash items. The two density factors were averaged and resulted in an average density factor of 188.5 pounds (lbs/cyd).

**Table 15.** Yard trash density factors used in initial yard trash mass estimates within trash loads.

| Source | Density Factor Category Title | Density (lbs/cyd) |
|---|---|---|
| Oregon Department of Environmental Quality/ US EPA | Uncompacted mix yard waste | 250 |
| California Integrated Waste Management Board | Pruning, trimmings, branches, stumps | 127 |
| **Average** | | **188.5** |

Applying the average density factor resulted in unrealistic values of yard trash percentages by mass. As seen in Table 16, the mass of yard trash was overestimated in some cases as designated by the red highlighting in the far most right column. In one case, a truck's total trash mass was 3,680 lbs, and the yard trash was estimated to be 100% by volume of the load. Using the averaged density factor, the resulting yard trash mass was 5,843.5 tons, or 158% by mass of the total available mass, which is unrealistic. The given value for truck volume of 31 cyd could have also resulted in some loads being overestimated. Therefore, this method was not pursued. .

**Table 16.** Calculating converting yard trash estimates by volume to yard trash estimates by mass. Red highlighting indicates the mass estimate was over 100%.

| Yard Trash Percentage by Volume | Volume of Truck (cyd) | Volume of Yard Trash (cyd) | Mass of Yard Trash (lbs) | Mass of Total Trash per Truck (lbs) | Percentage Yard Trash by Mass |
|---|---|---|---|---|---|
| 100.0% | 31 | 31.0 | 5,843.5 | 3,400 | 171.9% |
| 85.0% | 31 | 26.4 | 4,967.0 | 5,500 | 90.3% |
| 100.0% | 31 | 31.0 | 5,843.5 | 7,080.00 | 82.5% |
| 27.5% | 31 | 8.5 | 1,607.0 | 9,760 | 16.5% |
| 5.7% | 31 | 1.8 | 331.1 | 6,020 | 5.5% |
| 6.3% | 31 | 2.0 | 370.1 | 10,840 | 3.4% |
| 60.0% | 31 | 18.6 | 3,506.1 | 7,140 | 49.1% |
| 70.0% | 31 | 21.7 | 4,090.5 | 4,080 | 100.3% |
| 100.0% | 31 | 31.0 | 5,843.5 | 5,160 | 113.2% |
| 100.0% | 31 | 31.0 | 5,843.5 | 3,680 | 158.8% |
| 85.0% | 31 | 26.4 | 4,967.0 | 6,660 | 74.6% |
| 4.0% | 31 | 1.2 | 233.7 | 6,620 | 3.5% |
| 68.3% | 31 | 21.2 | 3,993.1 | 3,320 | 120.3% |
| 17.7% | 31 | 5.5 | 1,032.4 | 12,180 | 8.5% |
| 0.8% | 31 | 0.2 | 43.8 | 5,680 | 0.8% |
| 15.0% | 31 | 4.7 | 876.5 | 5,700 | 15.4% |
| 5.0% | 31 | 1.6 | 292.2 | 6,760 | 4.3% |
| 0.0% | 31 | 0.0 | 0.0 | 400 | 0.0% |
| 3.0% | 31 | 0.9 | 175.3 | 5,280 | 3.3% |
| 7.5% | 31 | 2.3 | 438.3 | 7,140 | 6.1% |
| 1.5% | 31 | 0.5 | 87.7 | 8,160 | 1.1% |
| 3.0% | 31 | 0.9 | 175.3 | 9,360 | 1.9% |
| 9.0% | 31 | 2.8 | 525.9 | 10,860 | 4.8% |
| 77.5% | 31 | 24.0 | 4,528.7 | 11,320 | 40.0% |
| 20.0% | 31 | 6.2 | 1,168.7 | 12,300 | 9.5% |
| 11.0% | 31 | 3.4 | 642.8 | 8,720 | 7.4% |
| 37.5% | 31 | 11.6 | 2,191.3 | 6,200 | 35.3% |
| 42.5% | 31 | 13.2 | 2,483.5 | 9,620 | 25.8% |
| 45.0% | 31 | 14.0 | 2,629.6 | 5,060 | 52.0% |
| 12.5% | 31 | 3.9 | 730.4 | 6,660 | 11.0% |
| 2.5% | 31 | 0.8 | 146.1 | 10,300 | 1.4% |
| 9.0% | 31 | 2.8 | 525.9 | 5,700 | 9.2% |
| 50.0% | 31 | 15.5 | 2,921.8 | 6,080 | 48.1% |
| **Average= 36.2%** | | | | | |

The last method, which was the one chosen, was to assume that the yard trash percentage by volume is comparable to the yard trash percentage by mass. Our resulting estimate is that trash trucks are, on average, 36.2%-yard trash by mass.

# 6 CONCLUSIONS

A one-season waste composition study was conducted during May 2021 at South Dade Landfill, Resource Recovery, and Northeast Transfer Station in which garbage was hand sorted. This garbage was generated by single-family homes serviced by the County. Forty samples were sorted, and 40 material categories were assessed. The resulting average mass percentage per material provides an estimate of that material's presence in the overall single-family County serviced waste stream.

Of the 40 material categories, the four materials with the highest average mass percentages were food waste (16.7%), residuals (11.7%), leaves and vegetation (11.6%), and other paper (non-recyclable) (9.0%). When the materials were condensed into seven major categories (paper, plastic, metal, glass, organics, C&D, and miscellaneous) with recyclable and non-recyclable subcategories provided when applicable, notable categories and their average mass percentages include recyclable paper (10.0%), other paper (non-recyclable) (9.0%), recyclable plastic (2.7%), non-recyclable plastic (10.9%), potentially recyclable organics (13.5%), and non-recyclable organics (24.7%).

Trash trucks were also studied by visual observation to estimate the amount of yard waste in bulky trash loads. Yard waste was found to make up an average volume of 36.2% of the total trash disposed. Due to a lack of reliable density factors, we extrapolate this value to estimate an average 36.2%-yard waste by mass.

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