

EXAMINING CONTAMINATION RATES AT FLORIDA MATERIALS RECOVERY FACILITIES

March 2020

Prepared for:
Florida Recycling Partnership Foundation

Prepared by:
Dr. Timothy G. Townsend, Principal Investigator
Malak Anshassi, Graduate Research Assistant

University of Florida
Sustainable Materials Management Research Laboratory
Department of Environmental Engineering Sciences
Engineering School of Sustainable Infrastructure and Environment



EXECUTIVE SUMMARY

The Department of Environmental Engineering Sciences at the University of Florida (UF) conducted research on the current and historic state of materials recovery facilities' (MRFs) contamination rates. MRF's across Florida operate to serve communities that institute either single stream (SS) or dual stream (DS) recycling programs. We collected information from these MRFs on the types and masses of waste incoming into and output from the facility. The data was used to quantify historic contamination rates, which is defined in this study as the percent of total inbound mass landfilled.

Approximately 80% of the MRFs are privately owned and operated and 20% are publicly owned but may either be operated by the public organization or contracted out to a private company. In Florida 26 MRFs operate to process municipal solid waste (MSW) recyclables from residential and commercial sectors. Each MRF was contacted to participate in the study and 10 out of the 26 MRFs agreed to provide data either for one year or historically. Results included that the largest, by mass, material category contributing to the total outbound mass were newspaper, mixed paper, cardboard, and glass among all the MRFs. The MRF outbound composition did not greatly differ among DS and SS MRFs. Among all the MRFs there is a gradual increase in the contamination rate from 2007 to 2019. Figure ES1 shows the average annual contamination rate by MRF type. It should be noted that not all MRFs provided annual historic data for the same years, thus in some cases introducing a MRFs data resulted in a spike in the average value. For example, for SS MRFs a MRF only provided one data point for 2019 and its contamination rate was 57% (mainly because they did not market glass); introducing this large value greatly increased the contamination rate. Since all the other MRFs process glass their contamination rate was much less (range from 14-37% for SS MRFs and approximately 18% for DS MRFs). On a historic average basis, the overall contamination rate for all MRFs was 25%, for single stream MRFs was 27%, and for dual stream MRFs was 18%.

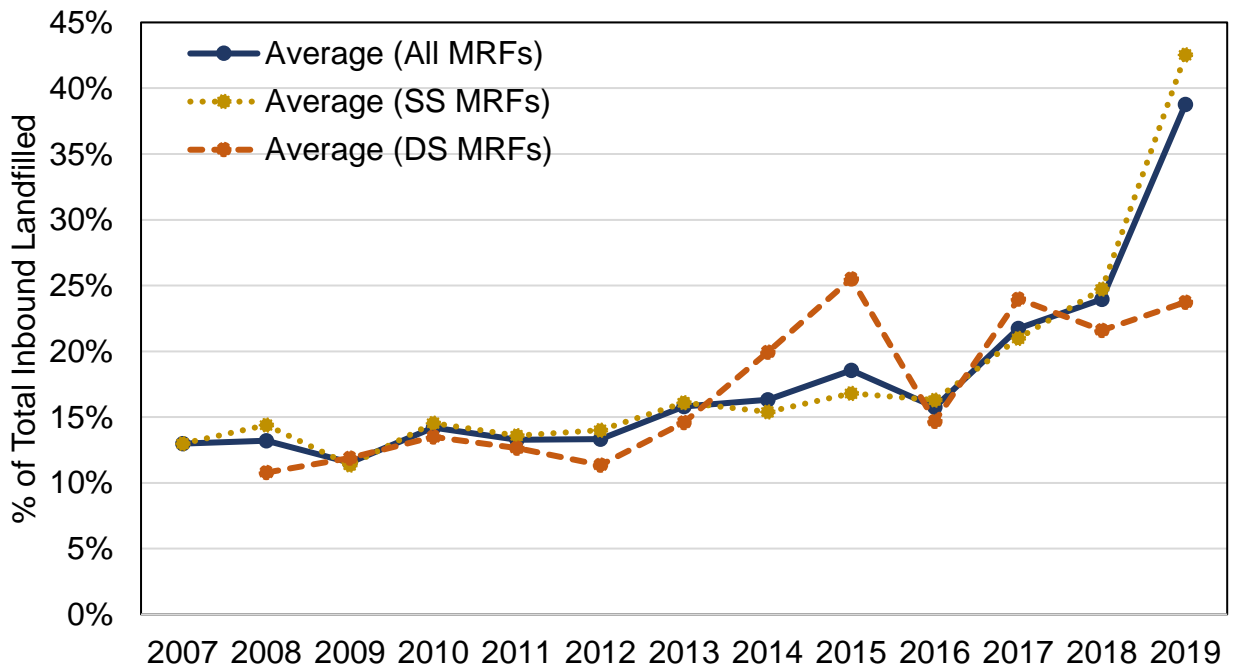


Figure ES1. The estimated average percent of total inbound landfilled for all, SS, and DS MRFs for years 2007 to 2019.

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1 BACKGROUND AND RESEARCH APPROACH

The Department of Environmental Engineering Sciences at the University of Florida (UF) conducted research on the current and historic state of materials recovery facilities' (MRFs) contamination rates. MRF's across Florida operate to serve communities that institute either single stream (SS) or dual stream (DS) recycling programs. As part of this research, we gathered information from these MRFs on the types and masses of waste incoming into and output from the facility. The data was used to quantify historic contamination rates, which is defined in this study as the percent of total inbound mass landfilled.

2 DATA AVAILABILITY

The Florida Department of Environmental Protection (FDEP) considers MRFs to be certified recyclers since they generate more than 600 tons of recoverable material (of which is a type of material tracked by FDEP). FDEP provided a list of all the MRFs in Florida that process residential and/or commercial municipal solid waste (MSW) recyclables (not including construction and demolition debris MRFs). A total of 26 MRFs in Florida process MSW recyclables. Table 1 lists all the MRFs and information regarding whether they are public or privately operated, if they were contacted to participate in the study, whether they responded and provided data, and the type of data they provided. All 26 MRFs were contacted via email and phone call, of which only one did not respond to either form of communication.

Approximately 80% of the MRFs are privately owned and operated and 20% are publicly owned but may either be operated by the public organization or contracted out to a private company. With that in mind, the data collection was more accessible from publicly owned MRFs than private, as seen in Table 1 where all five public MRFs data was received. However, in some cases although the data was provided since some public MRFs contracted with private companies the data set was not complete for historic years. It should be noted that a single private company operated more than one MRF (from the list) and for some cases they provided data for all their MRFs (that operate in Florida) and in other cases they only provided one or two sets of MRF data.

MRF data was received from 10 out of the 26 MRFs. All the MRFs processed both residential and commercial streams and the MRF data was collected for various Florida regions. For example, one MRF processed recyclables from south Florida (i.e., Broward County), while another MRF processed recyclables from the panhandle (i.e., Leon County). Both SS and DS MRFs data was represented in the collected 10 MRFs data. Of the 10 MRFs only two MRFs provided data for a single year (both for 2019) and remaining provided historic data for more than two years. Table 2 shows the exact annual data received for each of the 10 MRFs. For 2018, the data collected from these MRFs represented approximately 20% of the total recycled mass in Florida. This was estimated by summing all the MRFs outbound mass for 2018 and dividing by the sum of the FDEP 2018 reported recycled masses (for newspaper, glass, alum. And steel cans, plastic bottles, cardboard, office paper, other plastics and paper).

Data was provided by each MRF in a spreadsheet form that listed the total inbound mass processed, the individual materials outbound mass, and the region the MRF processed material originated from (this was the type of data requested). The other form the data was received differed among the type of data the MRF tracked and had available (i.e., PDF documents, tonnage report spreadsheets).

Table 1. List of the 26 MRFs in Florida that process recyclables (from MSW) and the corresponding information we gathered for the MRF contamination study. A check mark represents a “yes” and if the cell is left blank then that indicates a “no”.

MRF Identification	MRF Type	Contacted?	Responded?	Data Not Received?	Data Received?	1 year of data available?	More than 1 year of data available?	Source of material type:			
								Residential?	Commercial?	Single Stream?	Dual Stream?
A	Public	✓	✓		✓	✓		✓	✓	✓	
B	Private	✓	No Response	✓							
C	Public	✓	✓		✓	✓		✓	✓	✓	
D	Private	✓	✓		✓		✓	✓	✓	✓	
E	Private	✓	✓	✓							
F	Private	✓	✓	✓							
G	Private	✓	✓	✓							
H	Private	✓	✓	✓							
I	Private	✓	✓	✓							
J	Private	✓	✓	✓							
K	Private	✓	✓		✓		✓	✓	✓	✓	
L	Private	✓	✓	✓							
M	Public	✓	✓		✓		✓	✓	✓		✓
N	Public	✓	✓		✓	✓		✓	✓	✓	
O	Private	✓	✓	✓							
P	Private	✓	✓	✓							
Q	Private	✓	✓	✓							
R	Private	✓	✓	✓							
S	Private	✓	✓		✓		✓	✓	✓	✓	
T	Private	✓	✓		✓		✓	✓	✓	✓	
U	Private	✓	✓		✓		✓	✓	✓	✓	
V	Private	✓	✓	✓							
W	Private	✓	✓	✓							
X	Public	✓	✓		✓		✓	✓	✓		✓

Table 2. List of the 10 MRFs that provided data for the study. A check mark represents that data was provided for that year and if the cell is left blank then data was not provided or available.

MRF	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
<i>MRF SS</i>															
A															✓
C				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D									✓	✓	✓	✓	✓	✓	
K													✓	✓	✓
N															✓
S													✓	✓	
T			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
U								✓	✓	✓	✓	✓	✓	✓	
<i>MRF DS</i>															
M				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
X												✓	✓	✓	✓

3 OUTBOUND MATERIAL COMPOSITION

As part of the data collection process the MRFs provided material specific annual outbound masses. The type of materials processed by each MRF varied, in an effort to minimize these differences to allow for comparability among the MRF data the outbound materials masses were organized into 12 material categories. The 12 material categories and whether that type of material was processed and/or marketed is shown in Table 3. Historically and currently, cardboard, aluminum cans, and HDPE colored were processed and marketed across all MRFs. Mixed paper, glass, steel cans, HDPE natural, PET, and plastics #1-7 were typically processed and/or marketed among the MRFs. Six of the 10 MRFs processed and marketed newspaper, while only 4 did the same for office paper. Another material category not processed by all MRFs was aseptic packaging.

The largest, by mass, material category contributing to the total outbound mass were newspaper, mixed paper, cardboard, and glass among all the MRFs. As seen in Table 4 which presents the average composition of the materials outbound for each MRF. The smallest contributing material was aseptic packaging and office paper. Other materials like aluminum and steel cans, HDPE and PET, etc. contributed similarly to the total outbound mass (Table 4). The average composition for a DS and SS MRF is shown in Figure 1. Results for each MRF are similar to the previously discussed results in Table 4 which showed average composition per MRF. The largest materials processed by both MRF types were fibers (i.e., newspaper, mixed paper, and cardboard) and glass. Table 5 and 6 present the total outbound mass that is fiber and containers, respectively, for each MRF. Figure 2 shows the average DS and SS MRF's historic fiber and container outbound percentage. Fibers typically make up more than half of the total outbound material for both MRFs.

Table 3. List of the 10 MRFs that provided data on the materials they process annually for the study. A check mark represents that data was provided for that year and if the cell is left blank then data was not provided or available.

MRF	Office Paper	Newspaper	Mixed Paper	Cardboard	Glass	Aluminum Cans	Steel Cans	HDPE Colored	HDPE Natural	PET	Plastics #1-7	Aseptic
<i>MRF SS</i>												
A			✓	✓	✓	✓	✓	✓		✓	✓	
C ^a	✓ ^b	✓	✓	✓	✓ ^b	✓	✓	✓	✓	✓	✓ ^c	
D			✓	✓	✓	✓		✓	✓	✓	✓ ^d	
K			✓	✓	✓	✓	✓	✓	✓	✓ ^e	✓	✓
N			✓	✓		✓	✓	✓	✓	✓ ^f	✓	
S		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
T	✓ ^g	✓	✓ ^h	✓	✓	✓	✓	✓	✓	✓	✓	✓ ⁱ
U	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓ ^j
<i>MRF DS</i>												
M		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓ ^k

a: Specific material outbound only provided for years 2008-2011 and 2019.

b: MRF C did not process and/or market material in 2019.

c: MRF C did not process and/or market material in 2008.

d: MRF D did not process and/or market material in 2018.

e: MRF K did not process and/or market material in 2017.

f: MRF N did not process and/or market material in 2017.

g: MRF T did not process and/or market material from 2013-2018.

h: MRF T did not process and/or market material from 2016-2017.

i: MRF T did not process and/or market material from 2007-2010 and 2016-2017.

j: MRF U did not process and/or market material in 2018.

k: MRF X did not process and/or market material from 2017-2019.

Table 4. The average composition of materials outbound for each MRF associated with Table 3. Values shown for MRFs with more than one years' worth of data are a historic average.

Material	MRF SS								MRF DS	
	A	C	D	K	N	S	T	U	M	X
Office Paper		2%					0.3%	0.2%		0.5%
Newspaper		34%				15%	42%	33%	30%	18%
Mixed Paper	17%	15%	55%	27%	50%	9%	9%	5%	26%	1%
Cardboard	41%	14%	13%	10%	31%	26%	15%	37%	15%	52%
Glass	19%	27%	22%	33%		32%	27%	16%	18%	18%
Aluminum Cans	5%	2%	1%	2%	2%	2%	1%	1%	1%	1%
Steel Cans	2%	3%		17%	3%	4%	2%	2%		2%
HDPE Colored	4%	2%	2%	4%	2%	2%	1%	1%	1%	1%
HDPE Natural		2%	1%	1%	2%	1%	1%	1%	1%	1%
PET	8%	6%	5%	7%	7%	7%	3%	3%	5%	4%
Plastics #1-7	4%	1%	1%	2%	3%	2%	0.5%	2%	1%	1%
Aseptic				0.1%			0.04%	0.1%	0.1%	0.3%

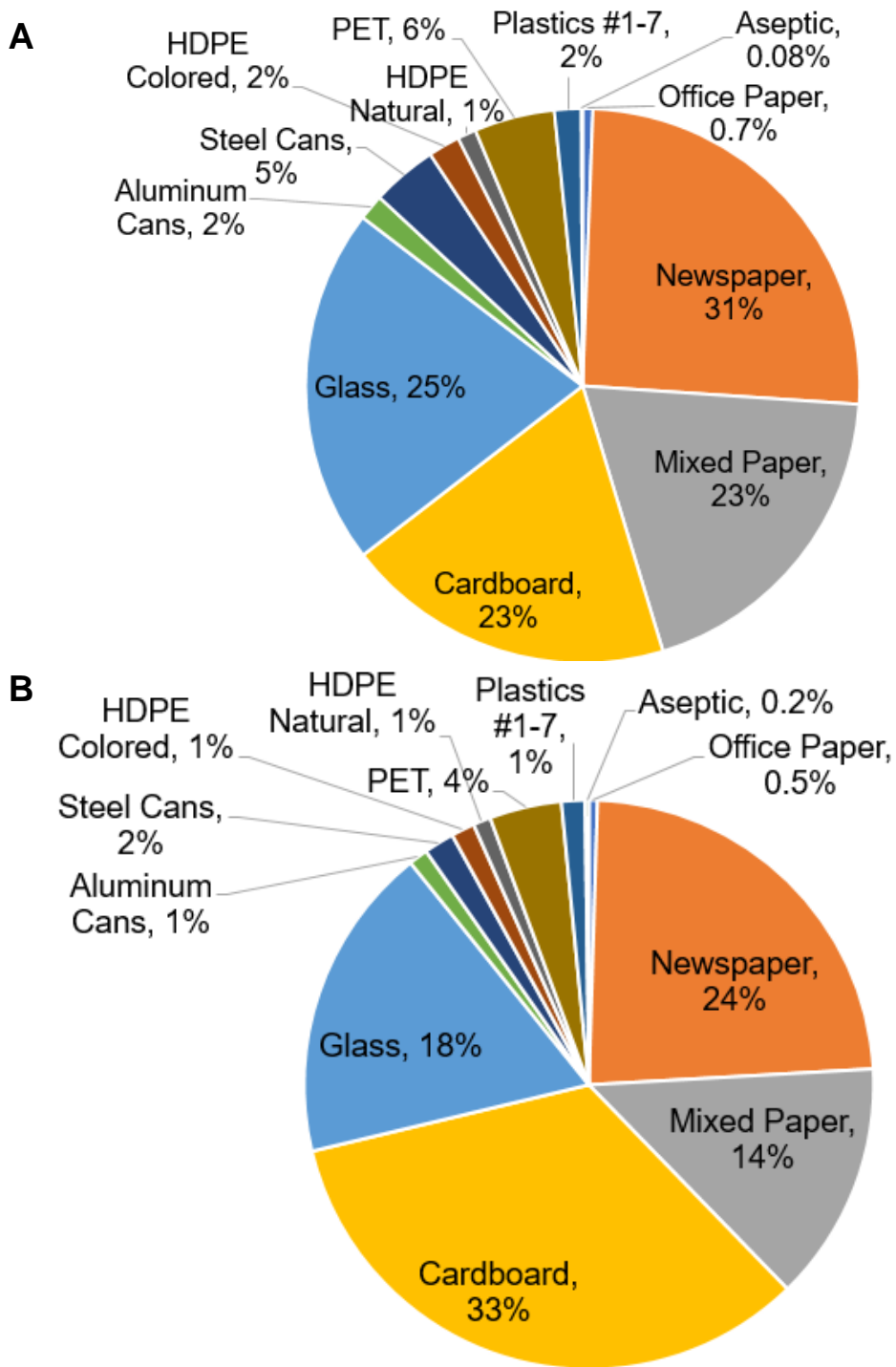


Figure 1. Average outbound material composition based on results in Table 4 for A) SS and B) DS MRFs.

Table 5. The percent of the total outbound mass that is fiber (i.e., office paper, newspaper, mixed paper, cardboard) for SS and DS MRFs.

MRF	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
<i>MRF SS</i>													
A													0.58
C		0.65	0.59	0.58	0.60								0.80
D							0.73	0.75	0.70	0.63	0.66	0.61	
K											0.12	0.50	0.47
N													0.81
S											0.53	0.47	
T	0.82	0.74	0.67	0.65	0.66	0.64	0.59	0.60	0.58	0.60	0.60	0.59	
U						0.74	0.71	0.75	0.74	0.76	0.75	0.75	
<i>MRF DS</i>													
M		0.78	0.75	0.75	0.71	0.70	0.69	0.70	0.73	0.69	0.79	0.63	
X										0.69	0.71	0.72	0.74

Table 6. The percent of the total outbound mass that is containers (i.e., glass, aluminum and steel cans, HDPE colored and natural, PET, plastics #1-7, aseptic) for SS and DS MRFs.

MRF	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
<i>MRF SS</i>													
A													0.42
C		0.35	0.41	0.42	0.40								0.20
D							0.27	0.25	0.30	0.37	0.34	0.39	
K											0.88	0.50	0.53
N													0.19
S											0.47	0.53	
T	0.18	0.26	0.33	0.35	0.34	0.36	0.41	0.40	0.42	0.40	0.40	0.41	
U						0.26	0.29	0.25	0.26	0.24	0.25	0.25	
<i>MRF DS</i>													
M		0.22	0.25	0.25	0.29	0.30	0.31	0.30	0.27	0.31	0.21	0.37	
X										0.31	0.29	0.28	0.26

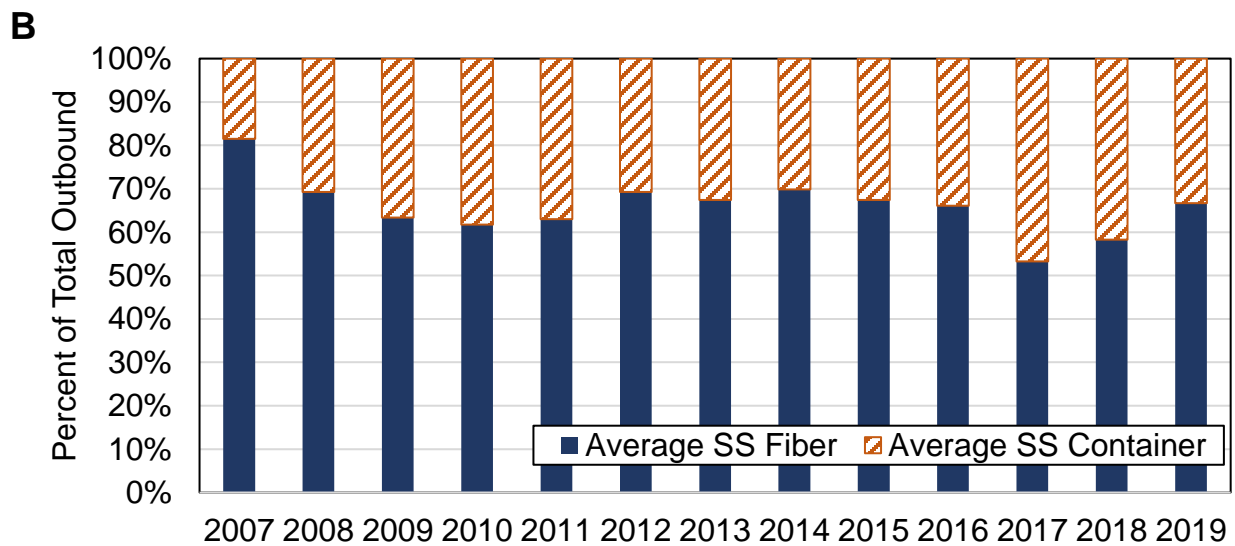
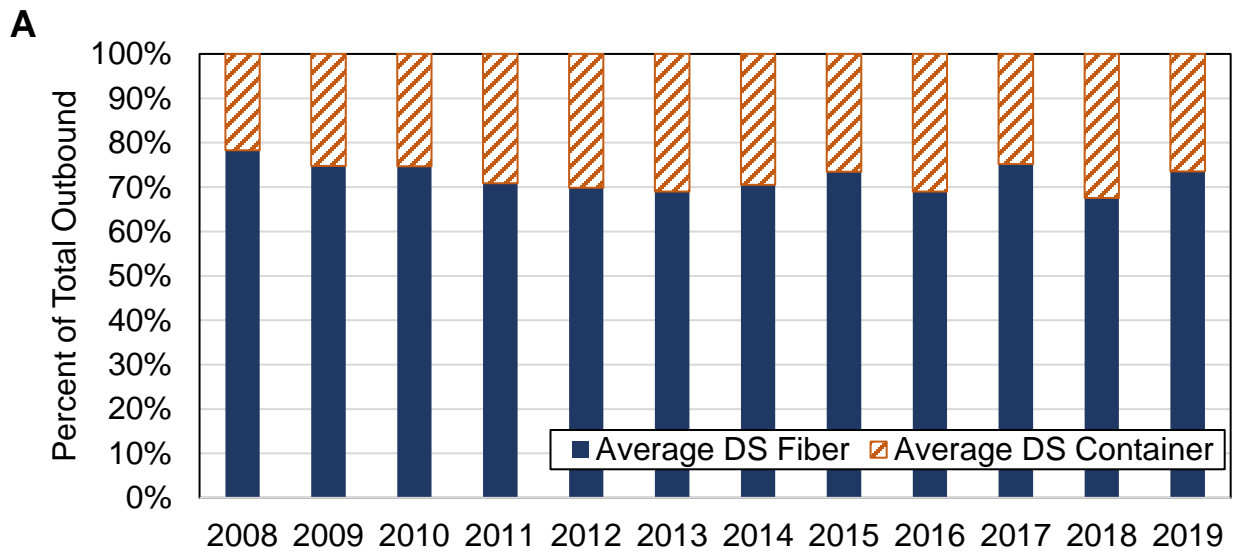


Figure 2. The percent of the total outbound mass that is either fiber (i.e., office paper, newspaper, mixed paper, cardboard) or containers (i.e., glass, aluminum and steel cans, HDPE colored and natural, PET, plastics #1-7, aseptic) for A) SS and B) DS MRFs.

4 CONTAMINATION RATES

The definition of the contamination rate varies among MRFs, for example one MRF may measure the contamination rate based on a composition study, or they may visually inspect a load of incoming recyclables. Other examples include running an entire load or loads of incoming recyclables into an empty MRF and any materials not sorted for market are considered contamination. For the purposes of this study, we defined the contamination rate as the percent of total inbound that is landfilled.

Results for the contamination rate for each MRF historically are shown in Table 7. Among all the MRFs there is a gradual increase in the contamination rate from 2007 to 2019. This is especially evidenced by MRF C and MRF T which both provide data for 2008 and approximately have a contamination rate of 15% that increases to 20% in 2018. Although both MRF C and T are SS a similar observation is noticed for MRF M, a DS MRF (Table 7). The historic average contamination rate for all MRFs is shown in Figure 3, with MRF N having the highest percentage at 57%. We received only one data point for MRF N, 2019, and although they process glass they do not market it and consider it MRF residual. Thus, results for MRF N may not be fully representative of an average MRF. Since all the other MRFs process glass their contamination rate is much less than MRF N, where it ranges from 14-37% for SS MRFs and approximately 18% for DS MRFs. Figure 4 shows the historic average contamination rate for all, SS, and DS MRFs. DS MRFs have a smaller contamination rate (18%) than SS MRFs (27%) and the average contamination rate for years 2007-2019 for the 10 MRFs is 25%.

Figure 5 shows the annual contamination rate for all, SS, and DS MRFs. Overall there is an increase in the contamination rate for all MRFs. The gradual increase in contamination rate from 2012 to 2015 shown for the DS MRF was primarily due to a reduction of fibers and glass outputted. The sharp decrease in contamination rate from 2015 to 2016 shown for the DS MRF is a result of our accounting method. The results from 2008-2015 were from one DS MRF and for years 2016-2019 the results are an average of two DS MRFs. The introduction of the second DS facility data resulted in a decrease in the average. Likewise, the introduction of the MRF N contamination rate caused a spike in both SS and all MRFs results shown in Figure 5 for 2019. Additionally, the 2019 rate was estimated as an average of four MRFs that reported data for only 2019. Thus, the 2019 averaged value does not consider the remaining four facilities that were used to estimate averages for 2007-2018.

Table 7. The percent of inbound landfilled for each MRF type on a historic basis.

MRF	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
<i>MRF SS</i>													
A													37%
C		14%	8%	10%	14%	12%	17%	15%	15%	16%	17%	21%	52%
D							16%	16%	20%	21%	19%	23%	
K											25%	27%	25%
N													57%
S											31%	35%	
T	13%	15%	14%	19%	13%	19%	20%	18%	21%	16%	19%	19%	
U						11%	12%	13%	12%	12%	15%	23%	
<i>MRF DS</i>													
M		11%	12%	13%	13%	11%	15%	20%	26%	21%	35%	19%	
X										8%	13%	24%	24%

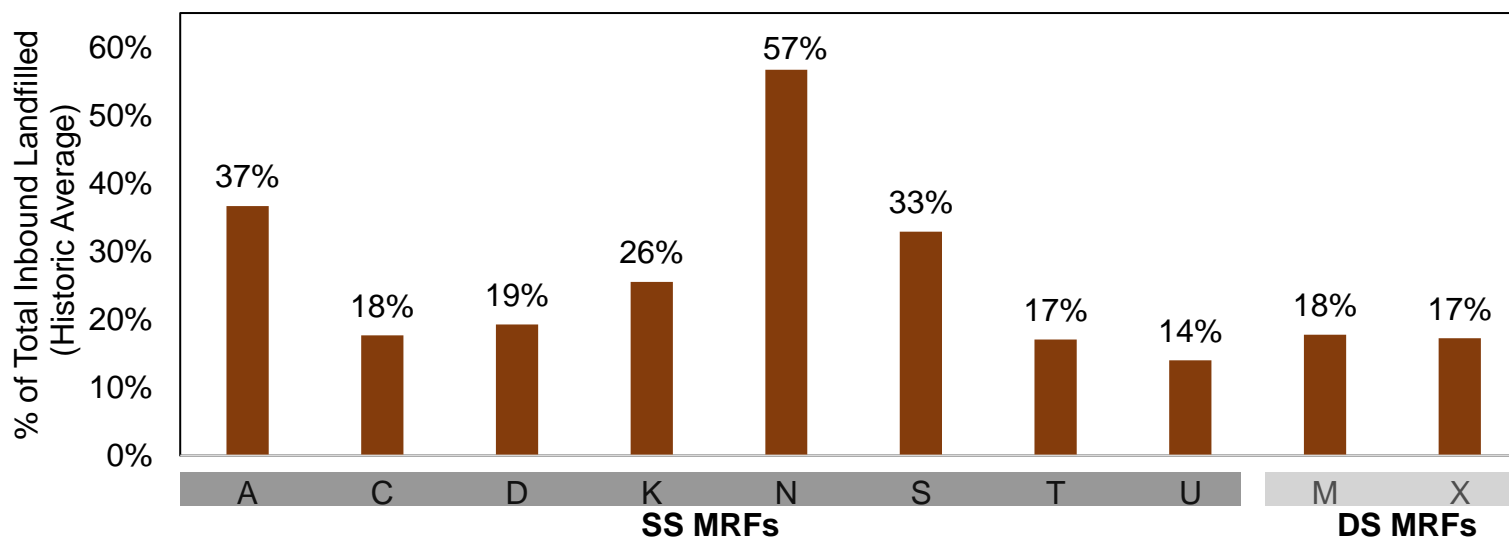


Figure 3. Historic average of the percent of total inbound landfilled for each landfill. Values are based on the averaging for each MRF the annual percent of total inbound landfilled shown in Table 7.

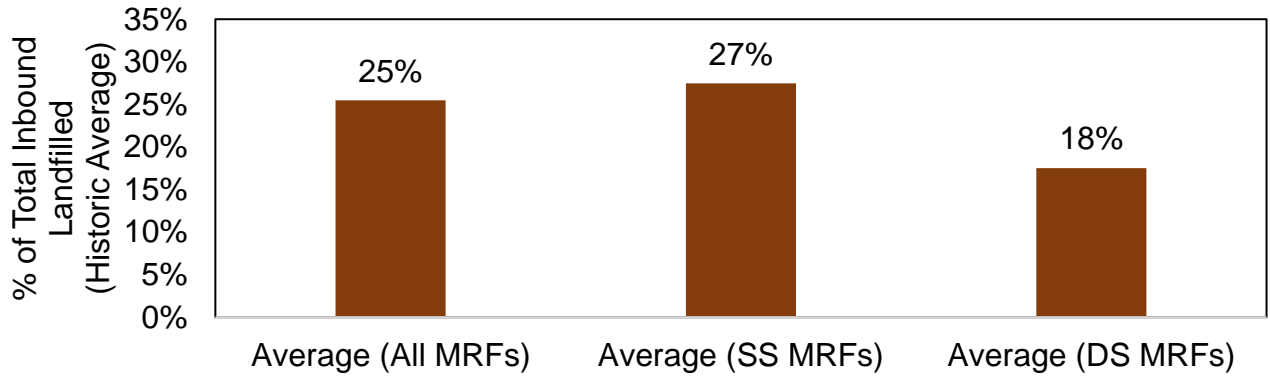


Figure 4. Composite historic average percent of total inbound landfilled based on Figure 3 results for all, SS, and DS MRFs.

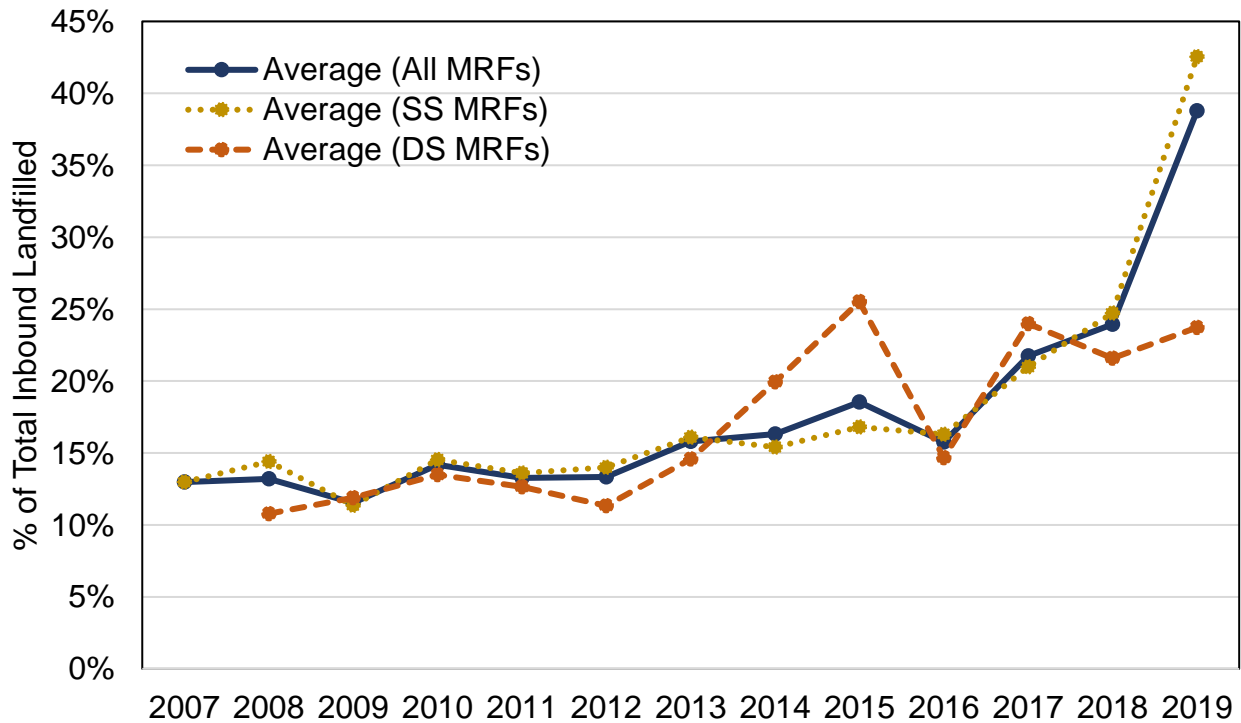


Figure 5. The estimated average percent of total inbound landfilled for all, SS, and DS MRFs for years 2007 to 2019.