MUNICIPAL SOLID WASTE

Introduction

For the purposes of this study municipal solid waste (MSW) is defined as residential, institutional, or commercial waste which is disposed in small containers or plastic bags. This is a somewhat simplistic definition but is inclusive enough to cover most of the materials found in the MSW component. MSW is normally collected in packer trucks that collect from residential, institutional, and commercial generators. In many cases the same truck will collect MSW from all three generators in the same load. MSW is generally delivered to the landfill in packer trucks or transfer trailers. Some rural landfills still receive MSW in open top trucks or trailers.

Methodology

The materials within the MSW component are difficult to characterize because the items are small, and in most cases they are concealed within plastic trash bags. Therefore MSW must be hand sorted into material categories in order to gain accurate data. The results of that characterization (the percentage of all materials that make up the MSW component) were applied to MSW loads observed at the landfills. The methodology used to characterize the materials in the MSW component is described below.

Sampling

Samples of MSW were taken from commercial waste haulers at a landfill or transfer station in each of the 19 solid waste management districts throughout Missouri. Three seasonal sorts were conducted at each facility. A map of the solid waste management districts is on page 95 and a map of sort locations is on page 96. Samples were selected at random and analyzed during three seasonal waste sorts conducted over a two-year period at each location. The randomly selected waste haulers served only residential, institutional, and commercial accounts. No construction and demolition wastes, sewage sludge, bulky items, combustion ash, industrial process waste, or "other waste" was sampled.

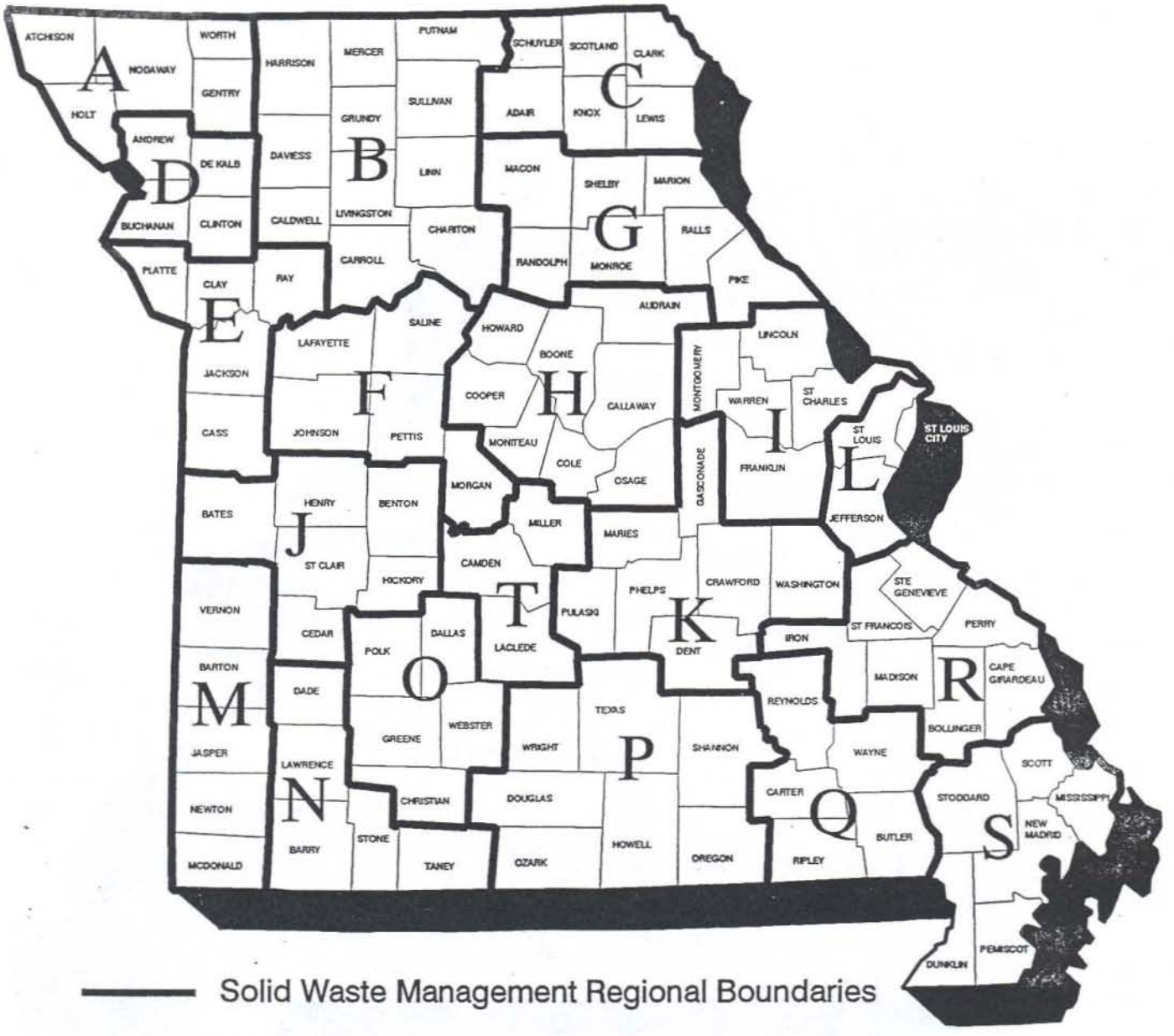
Each sample consisted of 25 bags of waste chosen at random. Bagged waste was selected for two reasons. First, the equipment needed to select scoop loads of waste, and buildings that such equipment could enter and deposit the waste, was non existent at virtually all of the sort locations. Second, and more important, bagged waste provided a more representative sample of the MSW component.

Between February 1996 and October 1997, 632 samples of waste were sorted into 26 material categories and 16 "other waste" categories. The categories are listed on page 97. The bags of MSW were taken to a sorting area where they were opened and the materials sorted into identical 20-gallon containers. After all materials were sorted from a sample the 20-gallon containers were weighed, volumes estimated, and the data recorded. The chart on the following page depicts the summary of all samples. All weights are in pounds, all volumes in cubic feet, and the composition was estimated by the waste hauler. For further information on the MSW sorts see *The Missouri Waste Composition Study: MSW Phase I.*

MSW Sample Summary

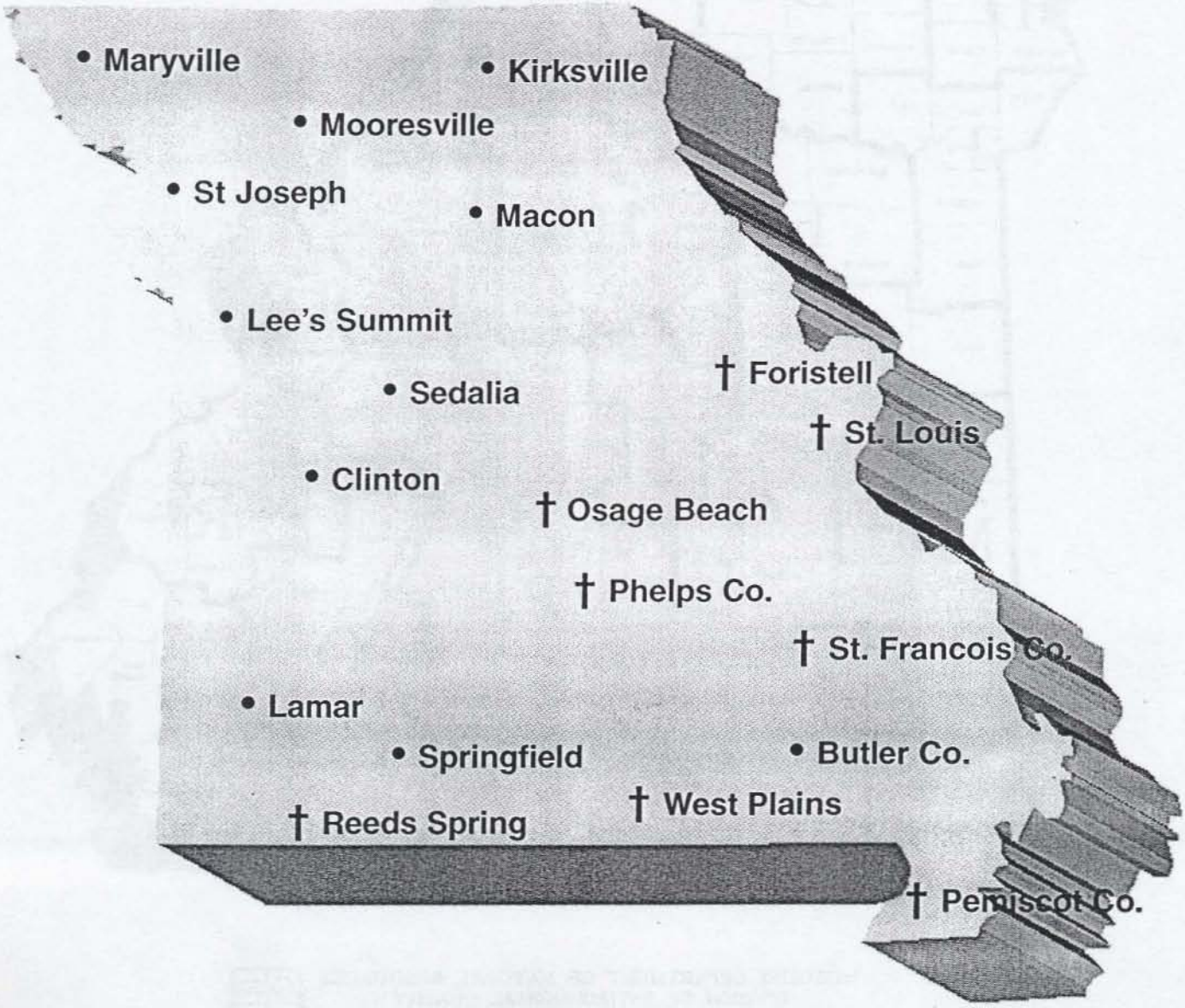
Location	Number of Samples	Total of all Samples Weight	Volume	Composition Res.	Comm.
Dist. A: Maryville	34	7,368	1,854	98%	2%
Dist. B: Mooresville	32	8,179	1,535	55%	45%
Dist. C: Kirksville	24	5,539	1,150	66%	34%
Dist. D: St. Joseph	30	7,162	1,613	87%	13%
Dist. E: Lee's Summit	35	8,486	1,640	86%	14%
Dist. F: Sedalia	29	6,186	1,296	70%	30%
Dist. G: Macon	24	5,786	1,199	70%	30%
Dist H: Columbia	Conducted by the University of Missouri. Results on page 113				
Dist. I: Foristell	36	7,849	1,760	86%	14%
Dist. J: Clinton	28	6,342	1,331	71%	29%
Dist. K: Phelps Co.	33	6,590	1,491	87%	13%
Dist. L: St. Louis	40	7,149	1,642	100%	0%
Dist. M: Lamar	38	8,064	1,774	53%	47%
Dist. N: Reeds Spring	40	9,282	2,032	43%	57%
Dist. O: Springfield	32	7,078	1,547	90%	10%
Dist. P: West Plains	34	7,384	1,623	60%	40%
Dist. Q: Butler Co.	32	8,145	1,685	84%	16%
Dist. R: St. Francois Co.	39	8,854	1,877	87%	13%
Dist. S: Pemiscot Co.	40	8,342	1,831	81%	19%
Dist. T: Osage Beach	32	6,797	1,517	77%	23%
TOTAL	**632**	**140,581**	**30,399**	**78%**	**22%**

SOLID WASTE MANAGEMENT REGIONS OF MISSOURI



MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL QUALITY
SOLID WASTE MANAGEMENT PROGRAM

Missouri Waste Composition Study
Sort Locations



† Transfer Stations • Landfills

Sort Categories

The following categories, and sub categories were used during the waste sorts at all locations. The "Other Waste" category was separated into the sub categories listed and recorded separately.

Paper

Cardboard and Kraft Paper- Non waxed corrugated cardboard (OCC), box board, and Kraft paper.
Newsprint-. Printed groundwood paper.
Magazines- Periodicals, or bound printed material including glossy and plain paper stocks.
High Grade Paper- Paper that is recyclable and consistently has a positive market value
Mixed Paper- All paper that does not fit into the categories specified above

Glass

Clear Glass Containers- Clear glass that originally contained food or beverage.
Brown Glass Containers- Brown glass which originally contained food or beverages.
Green and Blue Glass Containers- Green or blue cast glass which originally contained food or beverage.
Other Glass- Glass that was not originally a food or beverage container and glass broken beyond recognition.

Metals

Aluminum Cans- All aluminum beverage containers.
Other Aluminum- All aluminum except beverage containers.
Ferrous Food Cans- Any steel food containers, including pet food cans and aerosol cans.
Other Ferrous- Ferrous and alloyed ferrous scrap to which a magnet attracted.
Other Non-Ferrous- All nonmagnetic metals that are not recognizable as aluminum.
Oil Filters- Used and new oil filters for automobiles.

Plastics

PET (#1)- Beverage bottles composed of polyethylene terephthalate. Other containers clearly labeled PET (#1).
HDPE (#2)- High-density polyethylene containers..
Plastic Film- Includes all flexible plastic film regardless of resin content.
Other Plastic- Includes: PVC (#3), LDPE (#4), PP (#5), PS (#6), other plastics or mixed resins (#7), and unidentifiable plastics.

Organics

Food Waste- Putrescibles. Material capable of being decomposed by microorganisms with sufficient rapidity as to cause nuisances from odors and gases.
Wood Waste- Includes small wooden furniture, wooden tool handles, boards, plywood and particleboard.
Textiles- All woven fabric, natural or synthetic, either in bulk or made into usable items.
Disposable Diapers- Adult or infant disposable diapers, clean or soiled.
Other Organics- Those items which do not fall into any other category and which are composed of carbon-based material.

Inorganics

Fines- All matter not sorted into specific categories that are too small or mixed to be categorized.
Other Inorganics- Those items which do not fall into any other category and are composed of inert materials.

Other Potentially Hazardous MSW Waste

Items that are potentially hazardous to solid waste handlers or ecosystems: These items include over-the-counter medicine (OTC), prescription medication (Rx), beauty/hygiene products, beauty/hygiene aerosol products, household cleaning products, household cleaning aerosol products, aerosol cans, sharps/blades, syringes and needles, hardware/shop products, gardening/yard products, disposable razors, alkaline batteries, miscellaneous hazardous or toxic items. Definition of each of these items is on page 121.

Results

Three seasonal waste sorts were scheduled at each of the sort locations. A tent was erected at each site and all waste was transported to the tent where it was sorted into material categories. Weather was a factor at several of the waste sorts. High winds, heavy rains, snow and ice caused some sort activities to be shortened, but only one sort (round one at District G) was cancelled due to weather. The sorting dates are listed in the table below:

Location	First Round Sorting dates	Second Round Sorting dates	Third Round Sorting dates
Dist. A: Maryville	3/18-3/20/96	6/24-6/26/96	10/21-10/23/96
Dist. B: Mooresville	3/17-3/18/97	6/11-6/12/97	9/15-9/17/97
Dist. C: Kirksville	3/24-3/25/97	6/16-6/17/97	9/8-9/10/97
Dist. D: St. Joseph	3/10-3/11/97	6/9-6/10/97	9/18/9/20/97
Dist. E: Lee's Summit	3/25-3/2796	7/1-7/3/96	10/28-10/30/96
Dist. F: Sedalia	3/6-3/7/97	5/21-5/22/97	9/22-9/24/97
Dist. G: Macon	Cancelled	6/10-6/12/96	10/7-10/9/96
Dist H: Columbia	Conducted by the University of Missouri.		Results on page 113
Dist. I: Foristell	3/31-4/1/97	6/23-6/24/97	9/2/9/4/97
Dist. J: Clinton	4/1/-4/3/96	7/8-7/10/96	11/4-11/6/96
Dist. K: Phelps Co.	4/7-4/8/97	5/15-5/16/97	9/29-10/1/97
Dist. L: St. Louis	3/11-3/13/96	6/17-6/19/96	9/30-10/2/96
Dist. M: Lamar	4/8-4/10/96	7/15-7/17/96	11/11-11/13/96
Dist. N: Reeds Spring	2/12-2/14/96	5/20-5/22/96	9/9-9/11/96
Dist. O: Springfield	2/5-2/7/96	5/13-5/15/96	9/3/-9/5/96
Dist. P: West Plains	2/10-2/11/97	5/5-5/6/97	10/6-10/8/97
Dist. Q: Butler Co.	2/3-2/4/97	4/28-4/29/97	10/13-10/15/97
Dist. R: St. Francois Co.	2/26-2/28/96	6/3-6/5/96	9/23-9/25/96
Dist. S: Pemiscot Co.	2/19-2/21/96	5/28-5/30/96	9/16-9/18/96
Dist. T: Osage Beach	2/24-2/25/97	5/19-5/20/97	9/25-9/27/97

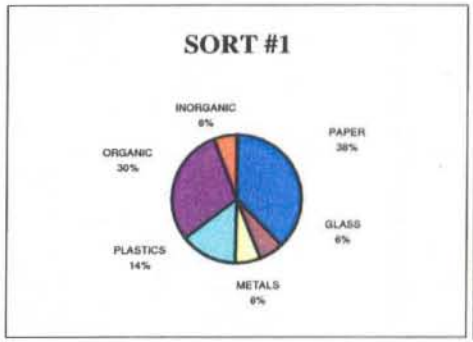
Seasonal Changes in the Waste Component

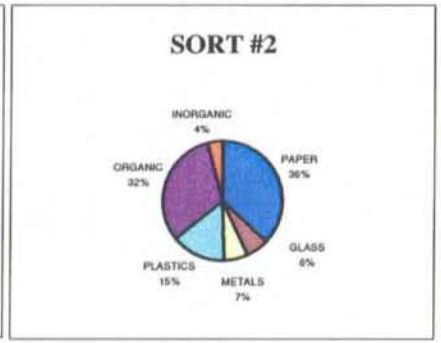
The table on page 99 reflects the percentage of materials found in the MSW (by weight) component during the three seasonal sorts. The seasonal sort average is based on the total weight of that material, divided by the total weight sorted during that round. The average of all sorts is the total weight of each material, divided by the total weight of all materials sorted during the entire study. The pie charts on page 101 compares the percentages in each major category found during each of the seasonal sorts and the bar graph illustrates the average percentage of each material found during the sorting process.

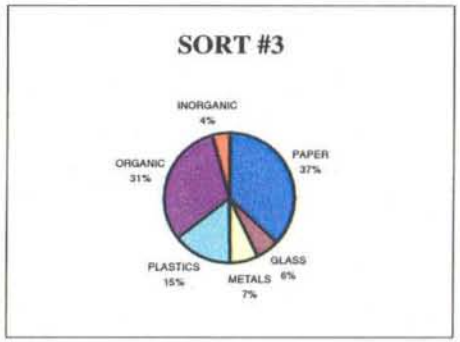
Seasonal Results by Weight

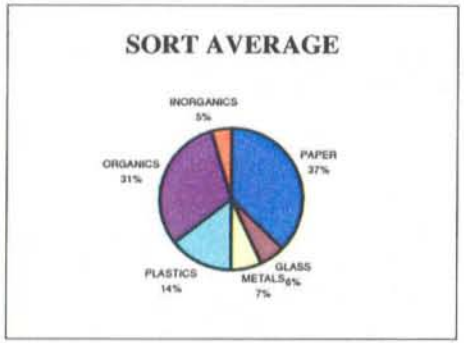
CATEGORY	SORT # 1 WT.	SORT # 2 WT.	SORT #3 WT.	AVERAGE WT.
Cardboard	6.6%	6.8%	6.6%	6.7%
Newsprint	7.4%	8.0%	8.3%	7.9%
Magazines	3.5%	3.4%	4.3%	3.7%
High Grade	3.2%	3.8%	3.6%	3.6%
Mixed	17.1%	15.1%	14.2%	15.5%
PAPER TOTALS	**37.8%**	**37.1%**	**36.9%**	**37.3%**
Clear	3.2%	3.2%	3.1%	3.2%
Brown	1.5%	1.7%	1.5%	1.5%
Green	0.5%	0.4%	0.4%	0.4%
Other	0.5%	0.6%	0.6%	0.6%
GLASS TOTALS	**5.7%**	**5.9%**	**5.7%**	**5.8%**
Alum. Cans	1.4%	1.6%	1.6%	1.5%
Other Alum	0.7%	0.8%	0.8%	0.8%
Non ferrous	0.2%	0.3%	0.2%	0.2%
Food Cans	3.4%	2.7%	3.3%	3.1%
Ferrous	1.0%	1.1%	1.3%	1.1%
Oil Filters	0.2%	0.1%	0.1%	0.1%
METAL TOTALS	**6.9%**	**6.6%**	**7.2%**	**6.9%**
PET # 1	1.7%	1.6%	1.7%	1.7%
HDPE # 2	1.9%	2.0%	2.4%	2.1%
Film	4.0%	3.7%	3.5%	3.7%
Other Plastic	6.6%	7.2%	6.9%	6.9%
PLASTIC TOTALS	**14.1%**	**14.7%**	**14.5%**	**14.4%**
Food Waste	18.0%	18.9%	19.2%	18.7%
Wood Waste	0.8%	0.7%	0.9%	0.8%
Textiles	3.6%	4.4%	3.9%	4.0%
Diapers	4.7%	3.9%	3.9%	4.2%
Other Organics	2.5%	3.8%	3.3%	3.2%
ORGANIC TOTALS	**29.6%**	**31.7%**	**31.2%**	**30.8%**
Fines	4.4%	2.5%	2.9%	3.3%
Other Inorganics	1.5%	1.6%	1.4%	1.5%
INORGANIC TOTALS	**5.9%**	**4.1%**	**4.4%**	**4.8%**
SORT TOTALS	**100%**	**100%**	**100%**	**100%**

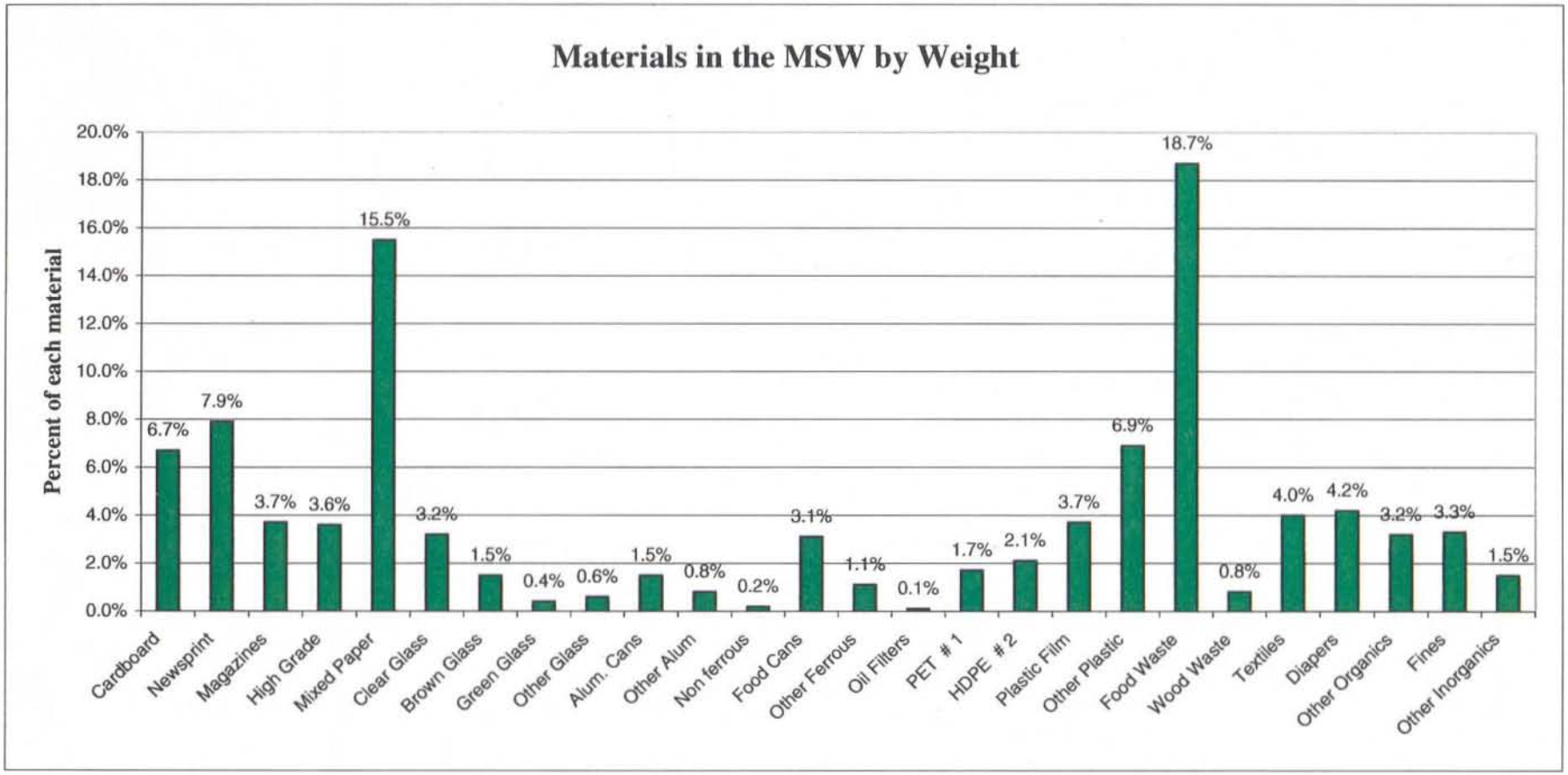
Municipal Solid Waste Composition By Weight











Chronological Changes in the Waste Component

Just as society changes over time, the waste component also changes. In 1987 The Missouri Environmental Improvement and Energy Resources Authority (EIERA) conducted the *Statewide Resource Recovery Feasibility and Planning Study*. Part of that study involved conducting two seasonal waste sorts for MSW at four Missouri landfills. The four landfills were the City of Springfield, the City of Lee's Summit, the City of Columbia, and the City of Willow Springs. Many communities and solid waste management districts have used the results of those 1987 waste sorts. However several changes have taken place in the solid waste environment since 1987.

As part of the *Missouri Waste Composition Study,* waste sorts were conducted at the City of Springfield, and the City of Lee's Summit landfill's in 1996. The University of Missouri conducted an independent waste characterization study at the City of Columbia's landfill in 1996 (results on page 113), and the City of Willow Spring's landfill is closed.

One result of the 1987 EIERA study was the passage of Senate Bill 530 in 1990. This bill contained legislation pertaining to landfill permitting requirements, set state-wide goals for solid waste recovery and reduction, banned certain items from Missouri landfills, set up a solid waste management fund, and provided for the development of Solid Waste Management Districts.

Many of the items, which were in the MSW component in 1987, are not present today. Major appliances (white goods), waste oil, whole tires, lead acid batteries, and yard waste or clippings have been banned from Missouri landfills and transfer stations. Programs have since been implemented to dispose of these items in a more responsible manner. In 1987 yard waste comprised 8.3% of the waste component (this actually varied from 1% at a rural location to 17% in the suburbs). For comparative purposes the 1987 yard waste percentages were added to the "other organics" sub category. In 1987 white goods were counted as other ferrous, lead acid batteries were counted as other waste, and tires were counted as other organics.

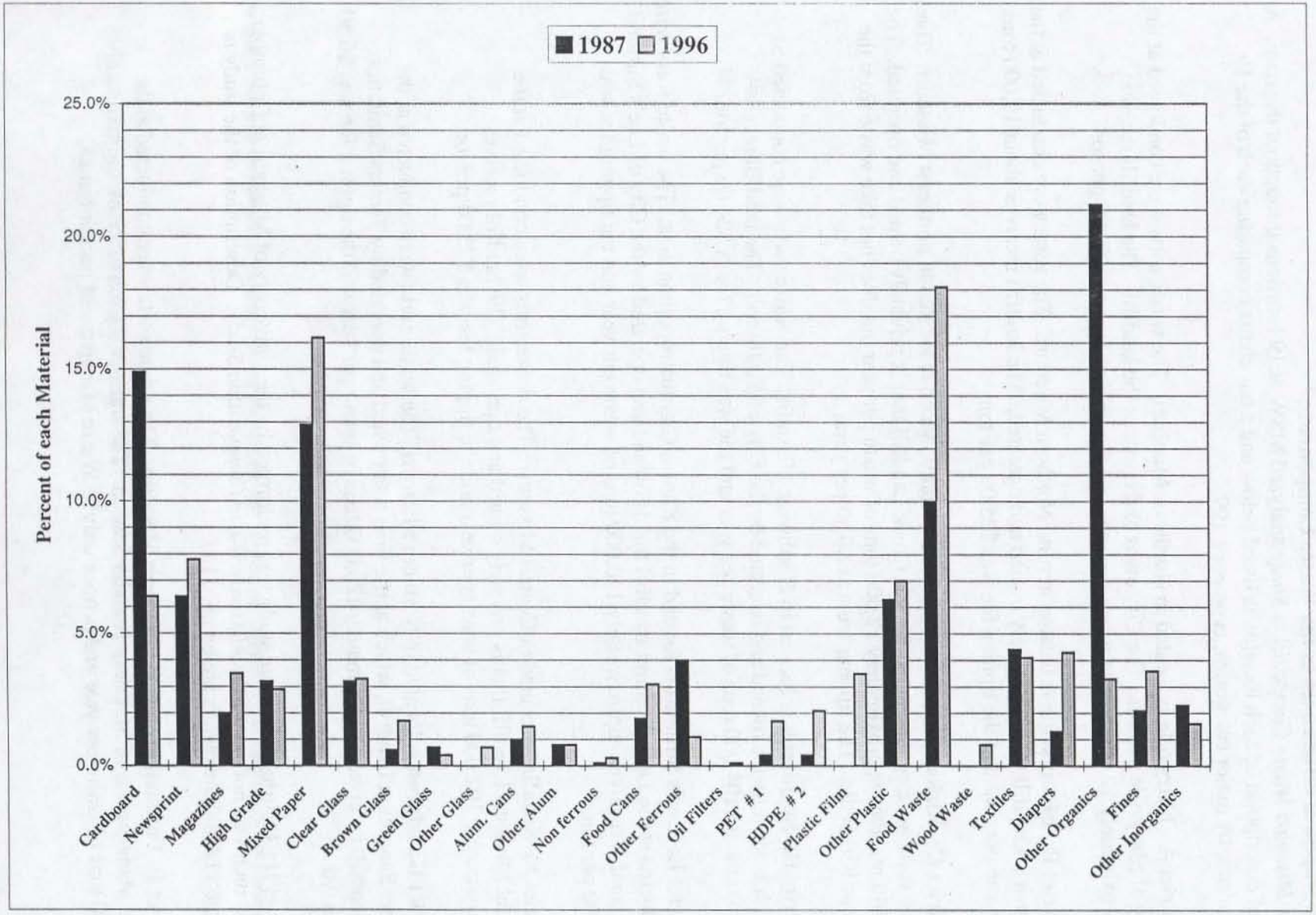
Changes in technology, products, and packaging also change over time and the waste component reflects these changes. The Table on page 104 and the chart on page 105 illustrate the changes in the waste stream between 1987 and 1996.

- Cardboard is about one half of what it was in 1987. This is probably a result of increased cardboard recycling and a difference in sampling procedures between the two studies.
- All plastic resins have increased. PET and HDPE have increased 500% during the past 10 years. Other plastics (plastic film included) have increased by 50%.
- The increase in food waste (120%) is probably a result in different sampling procedures between the two studies. The 1987 study put food-contaminated paper into the other organics category rather than the food waste category. The growth of fast food restaurants may also have some affect on this increase.
- The increase in disposable diapers (188%) is probably a result of society's preference of disposable baby diapers over cloth, and the increased usage of adult diapers among the elderly.
- The decrease in the 1987 "other organics" category reflects the ban on yard waste and tires, and a separate category to measure wood waste.

Changes in the Waste Stream Over Time

CATEGORY	1987 EIERA % wt.	1996-97 Missouri % wt.
Cardboard	15.1%	6.7%
Newsprint	6.6%	7.9%
Magazines	1.7%	3.7%
High Grade	3.2%	3.6%
Mixed	12.7%	15.5%
PAPER TOTALS	**39.4%**	**37.3%**
Clear	3.0%	3.2%
Brown	0.8%	1.5%
Green	0.7%	0.4%
Other	N/A	0.6%
GLASS TOTALS	**4.5%**	**5.8%**
Alum. Cans	1.0%	1.5%
Other Alum	0.5%	0.8%
Non ferrous	0.1%	0.2%
Food Cans	2.0%	3.1%
Ferrous	3.5%	1.1%
Oil Filters	N/A	0.1%
METAL TOTALS	**7.0%**	**6.9%**
PET # 1	0.4%	1.7%
HDPE # 2	0.3%	2.1%
Film	N/A	3.7%
Other Plastic	7.1%	6.9%
PLASTIC TOTALS	**7.7%**	**14.4%**
Food Waste	8.3%	18.7%
Wood Waste	N/A	0.8%
Textiles	3.9%	4.0%
Diapers	1.5%	4.2%
Other Organics	21.6%	3.2%
ORGANIC TOTALS	**35.3%**	**30.8%**
Fines	2.9%	3.3%
Other Inorganics	2.9%	1.5%
INORGANIC TOTALS	**5.8%**	**4.8%**
TOTAL	**99.6%**	**100.0%**

Changes in MSW Composition 1987-1997



Geographical differences in the Waste Component

The *Missouri Waste Composition Study* analyzed MSW at 19 locations throughout the state. A brief description of each location is listed below and a bar charts comparing each of the 19 locations, by major categories, is on page 109

District A: **Maryville** is located in Northeast Missouri. The waste sorts were conducted at the City of Maryville landfill. The City owns and operates the landfill. The landfill receives approximately 12,000 tons of waste per year and the tipping fee was $60.00 per ton.

District B: Mooresville is located in rural Northern Missouri. The sorts were conducted at the Farmer's Landfill that is privately owned and operated. The landfill receives about 19,000 tons of waste per year and the tipping fee was $25.00 per ton.

District C: Kirksville is located in Adair County, which is located in northeast Missouri. The waste sorts were conducted at the Rye Creek Landfill that is privately owned and operated. The landfill receives approximately 12,000 tons of waste per year but does not take waste from the City of Kirksville. The tipping fee was $6.50 per yard.

District D: St. Joseph is located in Northwest Missouri. The waste sorts were conducted St. Joseph landfill that is owned and operated by the City of St. Joseph. The landfill receives approximately 104,000 tons of waste per year and the was tipping fee is $24.00 per ton.

District E: Lee's Summit is located in the Kansas City metropolitan area. The waste sorts were conducted at the Lee's Summit Landfill that is owned and operated by the City of Lee's Summit. The landfill receives approximately 110,000 tons of waste per year and the tipping fee was $23.00 per ton.

District F: Sedalia is located in Central Missouri. The waste sorts were conducted at the Central Missouri Landfill that is privately owned and operated. The landfill receives approximately 102,000 tons of waste per year and the tipping fee was $25.00 per ton.

District G: Macon is located in Northern Missouri. The waste sorts were conducted at the Teeters Sanitation Landfill, which at the time was owned and operated by Teeters Sanitation. The landfill receives approximately 120,000 tons of waste per year and the tipping fee was $6.50 per cu. yd.

District H: Columbia's waste study was performed by the University of Missouri at Columbia and as such was not part of the *Missouri Waste Composition Study*. Description of the study is on page 112 and the results are on pg. 113.

District I: Foristell is located in Eastern Missouri. The waste sorts were conducted at the Waste Management of St. Louis Transfer Station. The transfer station receives approximately 57,000 tons of waste per year and is open only to Waste Management packer trucks.

District J: Clinton is located in West Central Missouri. The waste sorts were conducted at the Ellis Scott landfill that was owned and operated by USA Waste Inc. The landfill receives approximately 55,000 tons of waste per year and the tipping fee was $23.25 per ton.

District K: Phelps County is located in Central Missouri. The waste sorts were conducted at the Phelps County Transfer Station that is owned by the County. The transfer station receives approximately 50,000 tons of waste per year and the tipping fee was $43.81 per ton.

District L: St. Louis is located in Eastern Missouri. The waste sorts were conducted at the South St. Louis Transfer Station that is owned by the City but operated by Allied Waste. The transfer station receives approximately 177,000 tons of waste and fees are assessed internally.

District M: Lamar is located in Southwest Missouri. The waste sorts were conducted at the Lamar Landfill that is owned and operated by BFI Inc. The landfill receives approximately 170,000 tons of waste per year and the tipping fee was $22.75 per ton.

District N: Reeds Spring is located in Southwest Missouri. The waste sorts were conducted at the Reed's Spring Transfer station that is operated by American Disposal. The transfer station receives approximately 66,000 tons of waste per year and the tipping fee was $44.00 per ton.

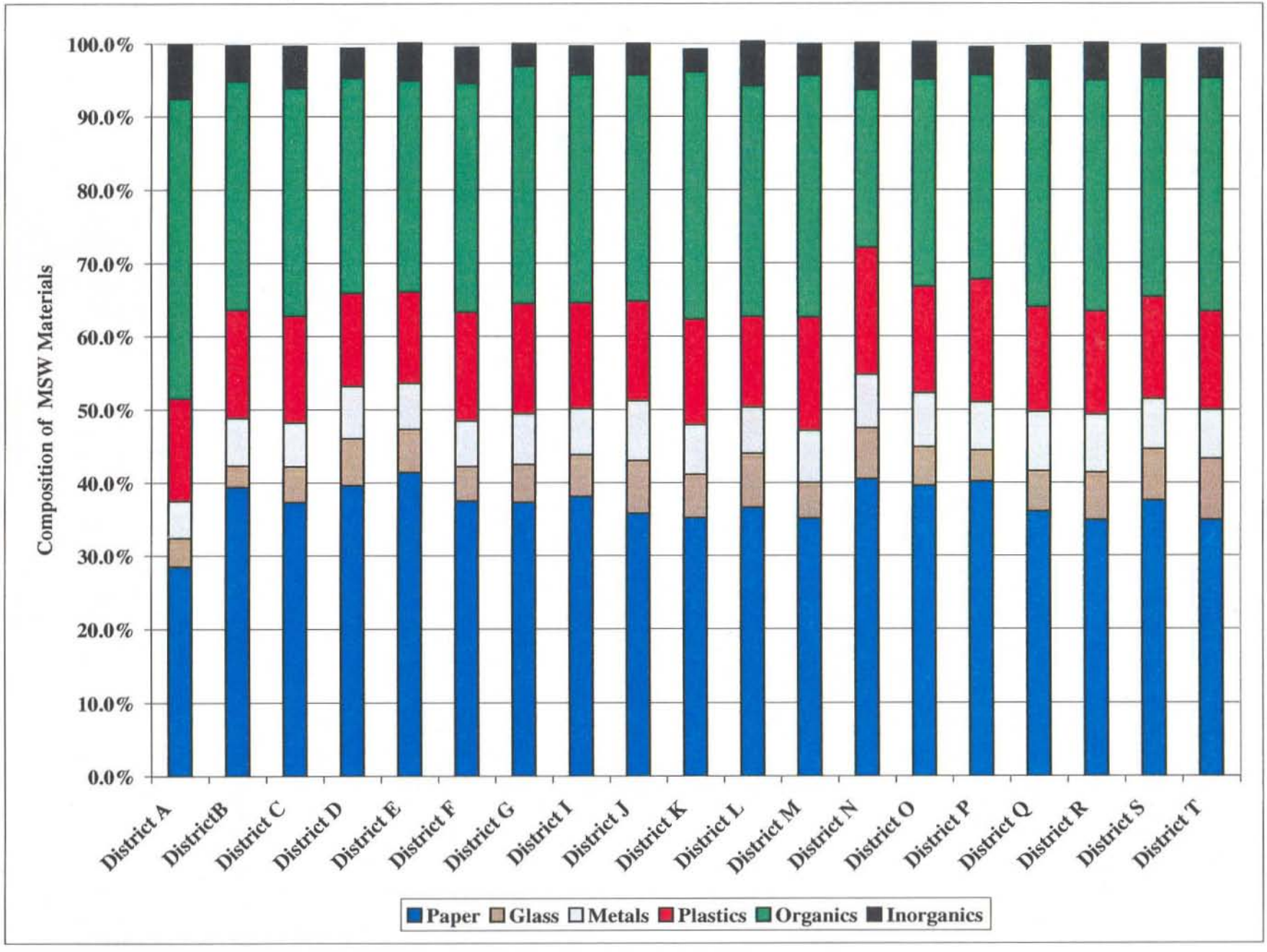
District O: Springfield is located in Southwest Missouri. The waste sorts were conducted at the City of Springfield landfill that is owned and operated by the City. The landfill receives approximately 100,000 tons of waste per year and the tipping fee was $27.50 per ton.

District P: West Plains is located in South Central Missouri. The waste sorts were conducted at the West Plains Transfer Station. The transfer station is owned and operated by the City. It receives approximately 12,000 tons of waste per year and the tipping fee was $40.00 per ton.

District Q: Butler County is located in the Southeastern Missouri. The waste sorts were conducted at the Butler County Landfill that is operated by Allied Waste. The landfill receives approximately 120,000 tons of waste per year and the tipping fee was $32.00 per ton.

District R: St. Francois County is located in Eastern Missouri. The waste sorts were conducted at the St. Francois Co. Transfer Station that is owned and operated by the County. The transfer station receives approximately 20,000 tons of waste per year and the tipping fee was $42.00 per ton.

District S: Pemiscot County is located in Southeast Missouri. The waste sorts were conducted at the Pemiscot County Transfer Station that is owned and operated by the County. The transfer station receives approximately 15,000 tons of waste per year and the tipping fee was $32.50 per ton.

District T: Osage Beach is located at the Lake of the Ozarks in Central Missouri. The waste sorts were conducted at the Modern Sanitation Transfer Station. The transfer station receives approximately 20,000 tons of waste per year and the tipping fee was $44.00 per ton.

Composition of MSW Within Each Solid Waste Management District