



2008 PUBLIC SCHOOL WASTE COMPOSITION STUDY

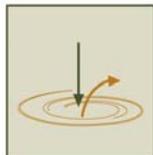
February 2008



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Printed on recycled paper

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**WAKE COUNTY, NORTH CAROLINA
2008 PUBLIC SCHOOL WASTE COMPOSITION STUDY**

February 2008

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SECTION 1.0 INTRODUCTION

1.1 Purpose

Wake County Solid Waste Management Division (SWMD) enlisted Kessler Consulting, Inc. (KCI) to conduct a Waste Composition Study to estimate the composition of solid waste disposed by the Wake County Public School System. Specifically, the study was intended to determine the types and relative amounts of recyclable materials still being disposed of by the students, faculty, and staff of the school system. The results of this study will help SWMD gauge the effectiveness of the County school recycling program and identify actions to increase waste diversion from disposal.

1.2 Background

The Wake County Public School System (WCPSS) currently operates 156 public schools. To reduce the amount of waste being disposed within the school system, SWMD partnered with WCPSS to implement the “Feed the Bin” recycling program. Since its inception in 2004, the “Feed the Bin” recycling program has been phased in, adding approximately 25 schools per semester over the past three years, with the majority of school recycling programs initiated by late 2007.

The following materials are collected for recycling:

- The “Feed the Bin” program accepts various paper grades including brochures, pamphlets, white and colored paper, envelopes, junk mail, letterhead, magazines and catalogs, newspaper, notebook paper, posters, and sticky notes.
- Corrugated cardboard is collected separately from other paper grades.
- Aluminum cans, steel and tin cans, and PET and HDPE plastic bottles are collected commingled in a separate container.
- Expanded polystyrene foam is also recycled in a separate container in some school cafeterias.
- Text books and telephone books are also collected for recycling on a seasonal basis.

As noted above, the goal of the 2008 waste composition study was to determine the amount of recyclable materials still being discarded at County schools. An initial objective of this study

was to measure the progress of the school recycling program in comparison to a visual waste audit conducted in 2004. For the 2008 study, KCI proposed a full waste composition study, which entails manual sorting of waste samples, rather than a visual audit because of the higher level of accuracy achieved. SWMD staff concurred with this approach, and KCI conducted the sorting event during January 14-19, 2008. This report presents the study methodology and results, as well as recommendations for future program improvements.

1.3 Acknowledgments

KCI would like to acknowledge and thank the Wake County staff members who assisted with preparation for the waste composition study: Craig Wittig, Johnny Beal, Rebekah Baker; the staff of the South Wake Transfer Station, specifically Junior Wiseman; and the staff of Waste Industries, Inc. for their assistance during the weeklong sorting event.

SECTION 2.0 METHODOLOGY

2.1 General Considerations

The methodology for this study followed industry-accepted standards for statistical sampling, as outlined in the *ASTM Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste (D5231-92)*. The sampling and sorting activities for the 2008 school waste composition study took place at the South Wake Transfer Station located in southern Wake County, during the week of January 14-19, 2008.

Some waste composition studies make adjustments for moisture content to compensate for liquids absorbed by waste materials. Laboratory methods for estimating moisture content are available, but are usually expensive and may overestimate moisture by removing naturally occurring moisture. In addition, materials received at disposal facilities or material recovery facilities are generally measured on an “as is” basis. Therefore, KCI did not include analysis of or adjustments for moisture content as part of this study.

2.2 Sample Selection

KCI initially considered two approaches for obtaining representative school waste samples for sorting: (1) sampling individual dumpsters at a small number of schools or (2) sampling loads of waste collected from a larger number of schools. Based on discussions with SWMD staff, KCI determined that waste composition data for individual schools was not important to the County because data on the quantity of recyclables recovered at each school was already available. Of greater importance was the waste composition by grade tiers (e.g., elementary, middle, and high schools). Therefore, KCI decided to use the second approach in order to pull waste from a greater number of schools into the sampling mix.

This approach required Waste Industries, Inc., the school system’s contracted waste hauler, to run special routes to collect waste only from designated schools during each day of the sorting event. Using a map of County schools and the waste collection schedule for all schools, KCI developed seven recommended routes for the five-day sorting event. These routes were revised and finalized after being reviewed by SWMD and Waste Industries staff.

The final, approved route schedule included three elementary school routes, two middle school routes, and two high school routes encompassing a total of 64 schools. Appendix A, *Routes Summary*, provides a list of the schools included on each of these routes. A total of 23 representative samples were pulled from the waste collected on these special routes. The sample number was selected in order to achieve reliable results within a 90 percent confidence interval.

2.3 Material Categories

KCI worked with SWMD staff to develop a list of material categories into which the school waste would be sorted. KCI requested a complete list of recyclable materials collected in the school recycling program. KCI included all of these materials in the material categories list, as well as those categories used in the 2004 visual waste audit and other materials of interest to the County for potential recovery or for informational purposes. All other waste was placed in the “Other Non-recyclable Trash” category, including materials such as non-program paper, three-ring binders, chipboard or paperboard, lined writing paper, construction paper, batteries, liquids from partially full beverage containers, textiles, non-program plastics, and other non-recyclable materials. Appendix B, *Material Category Descriptions*, provides the list of material categories utilized in this study and the description of each.

2.4 Sort Preparation

KCI and SWMD staff determined that the most practical sorting location would be at the South Wake Transfer Station. KCI visited the Transfer Station on December 14, 2007 to determine the best location for the sort and to meet with staff from the County and Waste Industries, which also operates the transfer station. To prepare for the sorting event, KCI reviewed with County staff the equipment necessary for conducting the sort. The County, with assistance from Waste Industries, provided the sorting location, a bobcat and operator, tent, and sorting tables. KCI provided all other safety and sorting equipment, as well as all labor.

Several days before the sorting event began, KCI provided Waste Industries’ collection personnel with an information packet containing a daily schedule of the special routes that were requested for the sort and yellow placards to be placed in each vehicle servicing these routes. The placards were used to help scalehouse staff identify these vehicles and direct them to the appropriate area for tipping.

A site safety plan was developed for this study and provided to County staff for review and approval prior to the sorting event. Each morning of the sorting event, sorters were given thorough safety instructions. No injuries or emergencies occurred during the sorting event.

2.5 Sampling and Sorting Procedures

Upon arrival at the scalehouse, vehicles servicing the special school routes were directed by transfer station personnel to proceed to the far side of the transfer station bay. Upon entering the bay, KCI's Sampling Supervisor interviewed the driver to confirm that the truck contained waste from only the schools requested for that particular day. The load was then tipped and representative samples of at least 200 pounds each were pulled and placed on individual tarps for sorting. Figure 2.1 depicts a typical sample ready for sorting.



Figure 2.1 Typical Solid Waste Sample

Waste from each sample was then transferred onto the sorting table and sorted into the previously defined material categories. Figure 2.2 depicts the arrangement of the sorting table and containers, and Figure 2.3 captures the actual sorting activities. After the entire sample was sorted, the Sorting Supervisor weighed and recorded the weights of each container on a data recording form. Tare weights of empty containers, recorded prior to sorting, were subtracted from the weights of the containers after sorting to obtain the net weight of each material category. The Sorting Supervisor also noted any unusual items or large quantities of materials sorted into non-specific categories such as "Other Non-recyclable Trash."

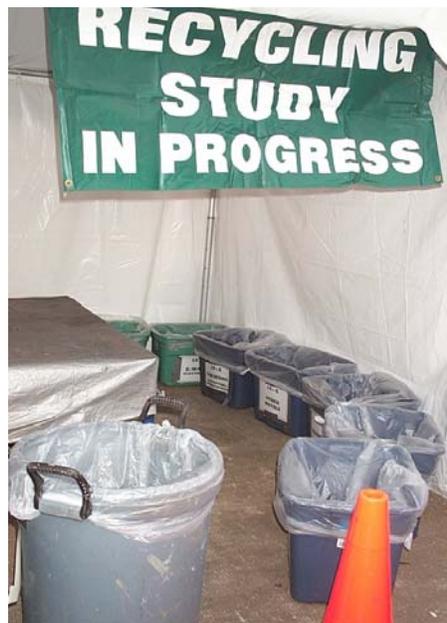


Figure 2.2 Sort Setting

One sample selected for sorting, from the elementary school waste stream, was discarded prior to its completion because of concerns that the sample may have contained waste not generated from a County school.

2.6 Analytical Procedures

After the sorting event, KCI analyzed the data by first calculating the percentage by weight of each material category in each sample. Sample results were combined based on whether the waste came from elementary, middle, or high schools to calculate the percentage by weight for each material category in each grade tier. Confidence intervals were then calculated for each material category using a standard statistical t-test.



Figure 2.3 Sorting Activities

To calculate the overall composition of the WCPSS waste stream, the weighted averages of the three grade tiers were combined using the 2007-08 student populations. Based on student populations, KCI calculated that 49 percent of school waste is generated by elementary schools, 22 percent by middle schools, and 29 percent by high schools. These percentages were used to combine the waste compositions of the three grade tiers to determine the waste composition of the entire school system.

SECTION 3.0 STUDY RESULTS

3.1 Waste Composition Results

Table 3.1 presents the results of the 2008 public school waste composition study for each grade tier, as well as for the overall composition of waste disposed by the WCPSS. The table includes the weighted average of each material category, as well as the lower and upper bounds of the 90 percent confidence interval. The compositions of individual samples are presented in Appendix C, *Individual Sample Results*.

The confidence interval indicates that, with a 90 percent level of confidence, the actual arithmetic mean (the arithmetic mean obtained if an infinite number of samples were sorted) is within the upper and lower limits shown. This provides an understanding of how much variation occurred in the quantity of that material category found in the samples sorted. Generally, the more homogeneous the waste stream and the greater the number of samples sorted, the higher the level of accuracy achieved and the narrower the margin between the upper and lower bounds of the confidence interval.

The wide range between the lower and upper limits for some material categories, such as construction and demolition debris, is because the material is found in the waste stream sporadically. The relatively wide confidence intervals for materials that are included in the school recycling program, such as mixed recyclable paper, are more likely an indication of the variability between school participation in the recycling program.

Figure 3.1 depicts the composition of the waste disposed by the Wake County public school system as a whole, and Figures 3.2, 3.3, and 3.4 depict the waste compositions of elementary, middle, and high schools, respectively. These figures are followed by additional discussion of the results and findings of this study.

Table 3.1: Composition of Waste Disposed by the Wake County Public School System (% by weight)

	Material Categories	Elementary Schools			Middle Schools			High Schools			School System
		Weighted Average	Lower	Upper	Weighted Average	Lower	Upper	Weighted Average	Lower	Upper	Weighted Average
1	Mixed Recyclable Paper	2.9%	1.9%	4.0%	8.9%	2.4%	15.3%	20.0%	12.8%	27.1%	9.2%
2	Newspaper	0.9%	0.1%	1.6%	3.5%	1.3%	5.7%	1.8%	1.0%	2.5%	1.7%
3	Corrugated Cardboard	1.4%	0.5%	2.4%	0.9%	0.3%	1.5%	4.7%	0.7%	8.6%	2.3%
4	Catalogs and Magazines	2.0%	0.8%	3.2%	2.7%	0.4%	5.0%	2.9%	2.0%	3.9%	2.4%
5	Telephone Books	0.3%	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
6	Text Books	0.1%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
7	Aseptic Containers	10.1%	7.3%	12.8%	7.1%	3.4%	10.8%	0.8%	0.3%	1.3%	6.7%
8	HDPE Containers	0.4%	0.2%	0.5%	0.3%	0.1%	0.5%	1.3%	0.3%	2.3%	0.6%
9	PET Containers	1.9%	1.6%	2.3%	3.0%	1.9%	4.1%	3.1%	1.9%	4.4%	2.5%
10	Polystyrene	0.9%	0.6%	1.1%	3.3%	0.9%	5.7%	1.3%	0.0%	2.7%	1.5%
11	Film	6.7%	5.9%	7.4%	6.6%	5.6%	7.7%	4.7%	4.0%	5.4%	6.1%
12	Aluminum Cans	0.3%	0.2%	0.4%	0.5%	0.2%	0.9%	0.5%	0.3%	0.7%	0.4%
13	Tin/Steel Cans	0.3%	0.1%	0.4%	0.3%	0.2%	0.5%	0.5%	0.1%	0.9%	0.3%
14	Scrap Metals	0.0%	0.0%	0.0%	0.6%	0.0%	1.7%	1.5%	0.0%	3.2%	0.6%
15	Glass Containers	0.4%	0.2%	0.6%	0.3%	0.0%	0.6%	0.8%	0.3%	1.4%	0.5%
16	Yard Waste	0.5%	0.1%	0.9%	0.0%	0.0%	0.1%	0.3%	0.0%	0.6%	0.3%
17	Food Waste	20.1%	17.4%	22.9%	12.4%	7.7%	17.1%	4.4%	2.4%	6.4%	13.9%
18	Electronics	0.3%	0.0%	0.7%	0.1%	0.0%	0.1%	0.5%	0.0%	1.2%	0.3%
19	Construction & Demolition (C&D) Debris	0.8%	0.3%	1.3%	2.0%	0.2%	3.8%	1.3%	0.0%	4.6%	1.2%
20	Other Non-recyclable Trash	49.7%	45.8%	53.6%	47.3%	41.8%	52.8%	49.5%	41.6%	57.5%	49.1%
TOTALS		100.0%			100.0%			100.0%			100.0%
Percent of WCPSS Waste Stream		49%			22%			29%			100%

The “Percentage of Waste Stream” figures in the bottom line of the table indicate the assumptions used to combine the three generator types to estimate the overall waste composition. These percentages were estimated by utilizing the 2007-2008 student populations for each grade tier, to determine how much each grade tier contributes to the overall public school waste stream.

Figure 3.1: Composition of Waste Disposed by the Public School System (% by weight)

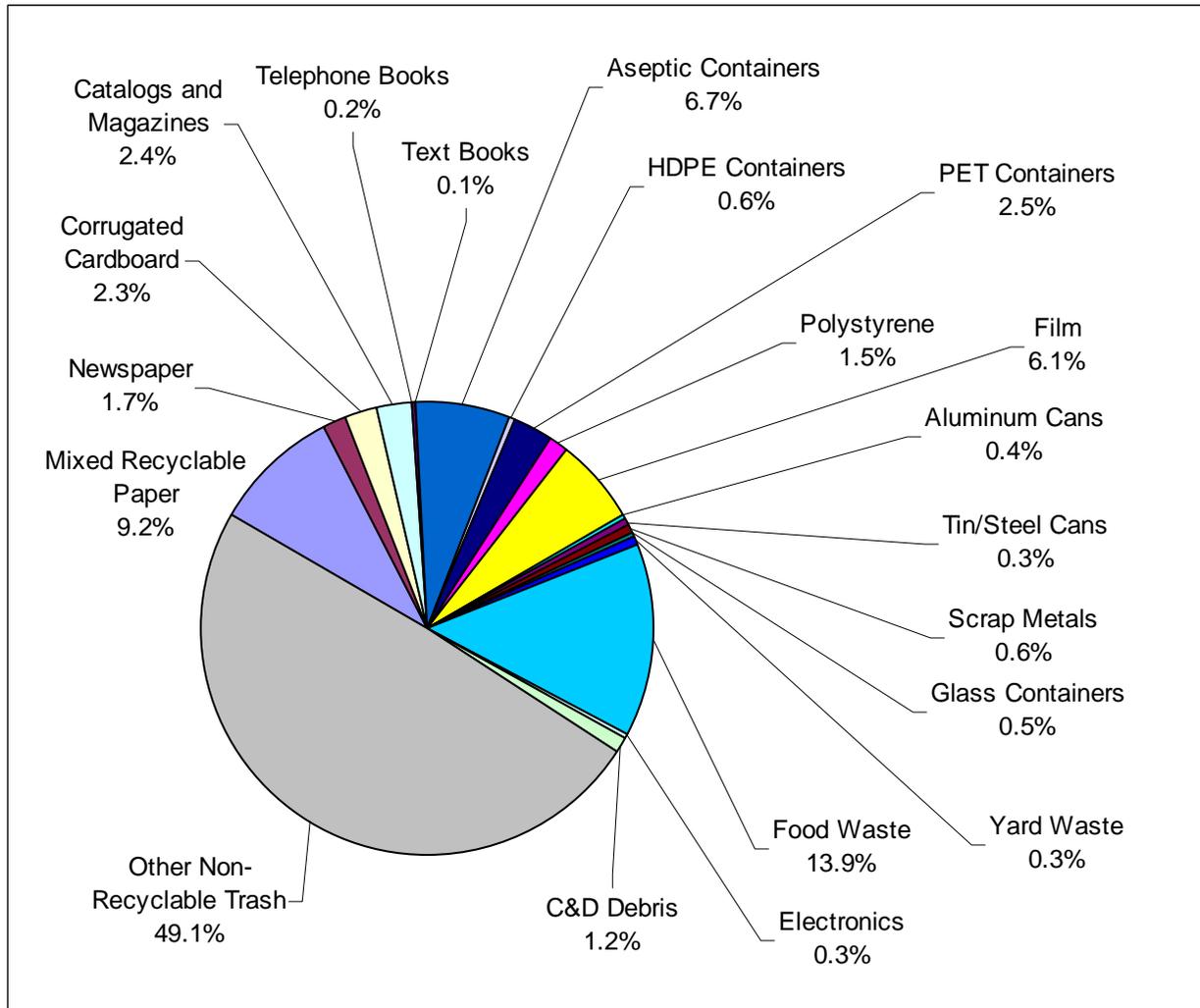


Figure 3.2: Composition of Waste Disposed by Elementary Schools (% by weight)

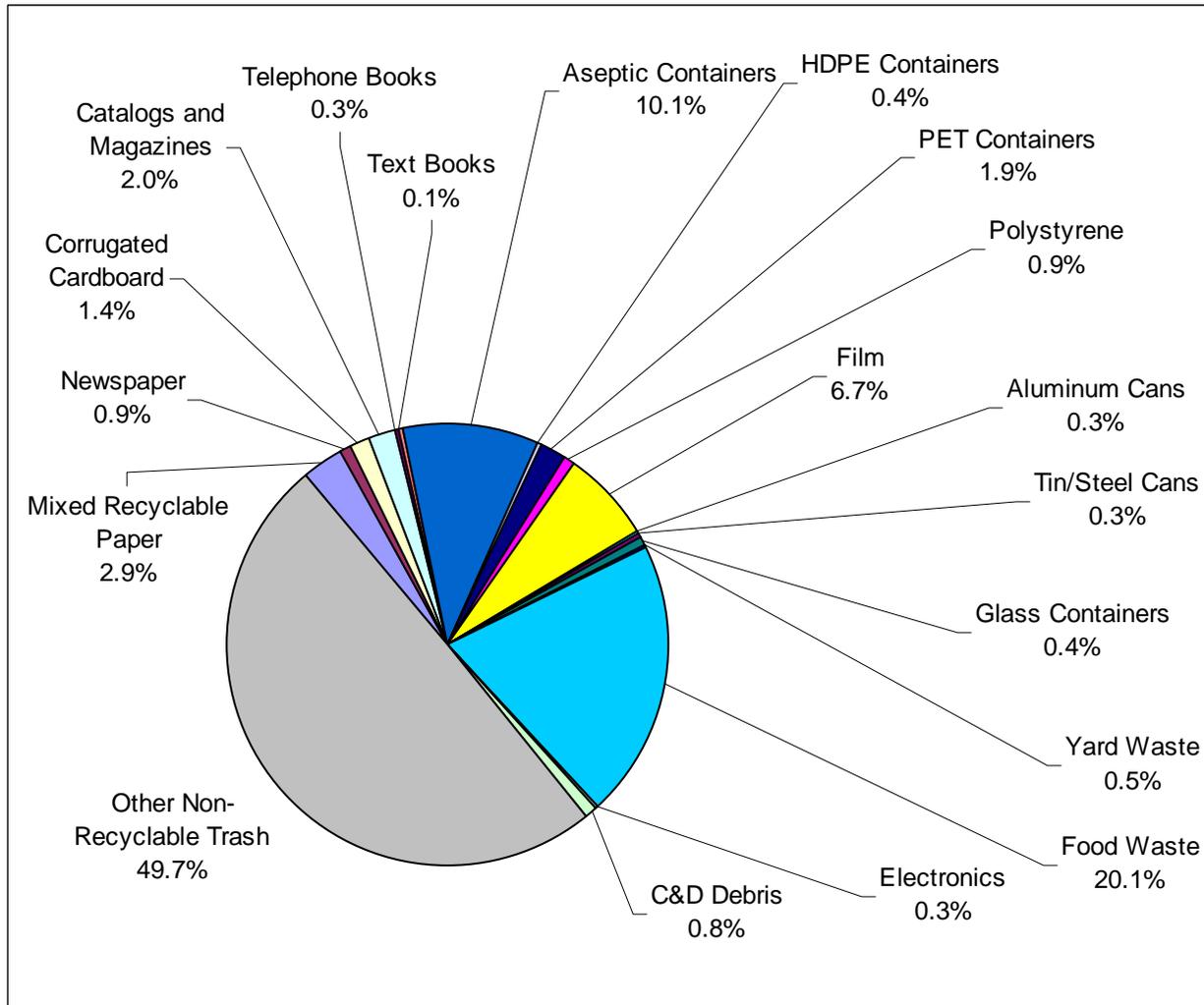


Figure 3.3: Composition of Waste Disposed by Middle Schools (% by weight)

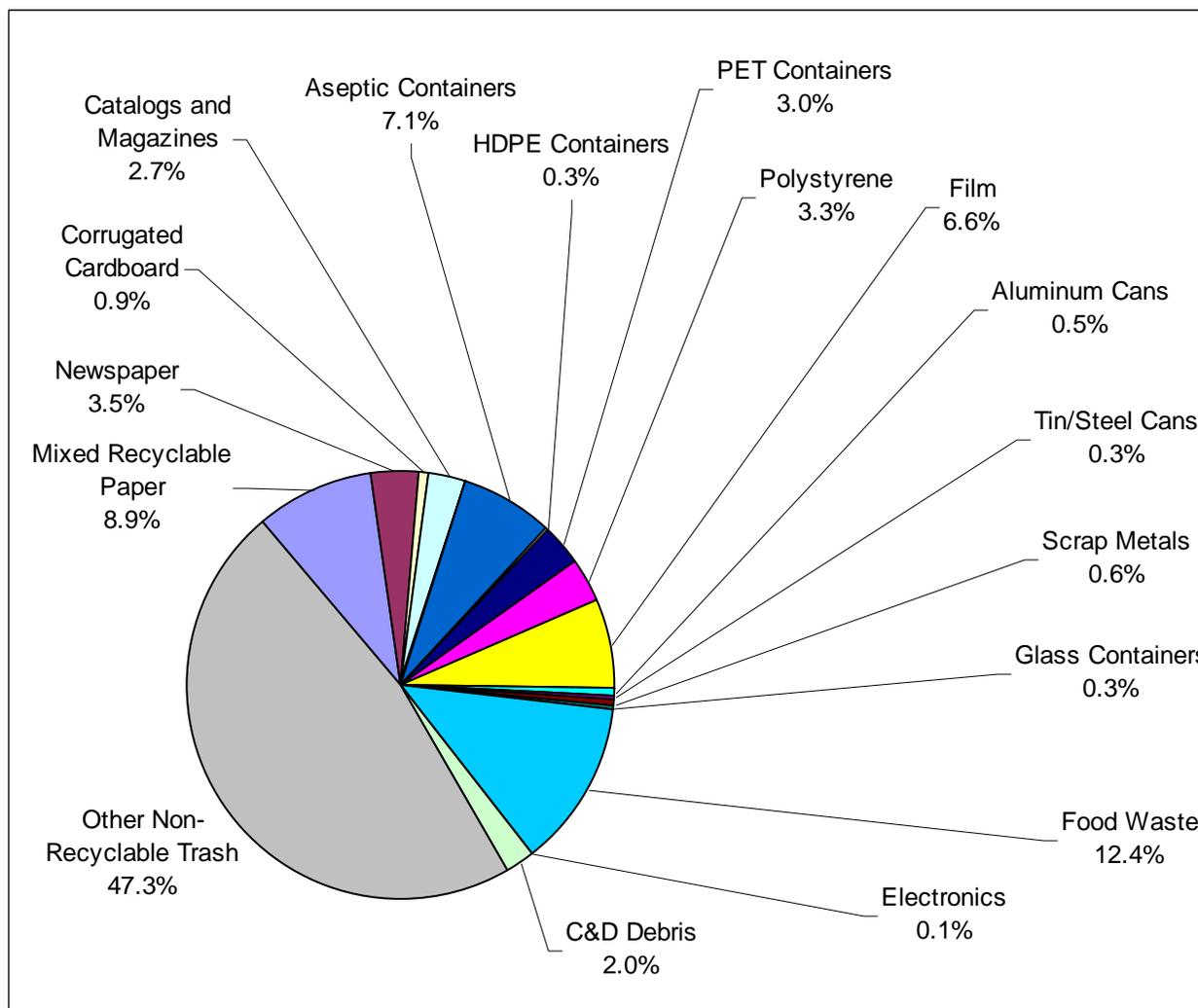
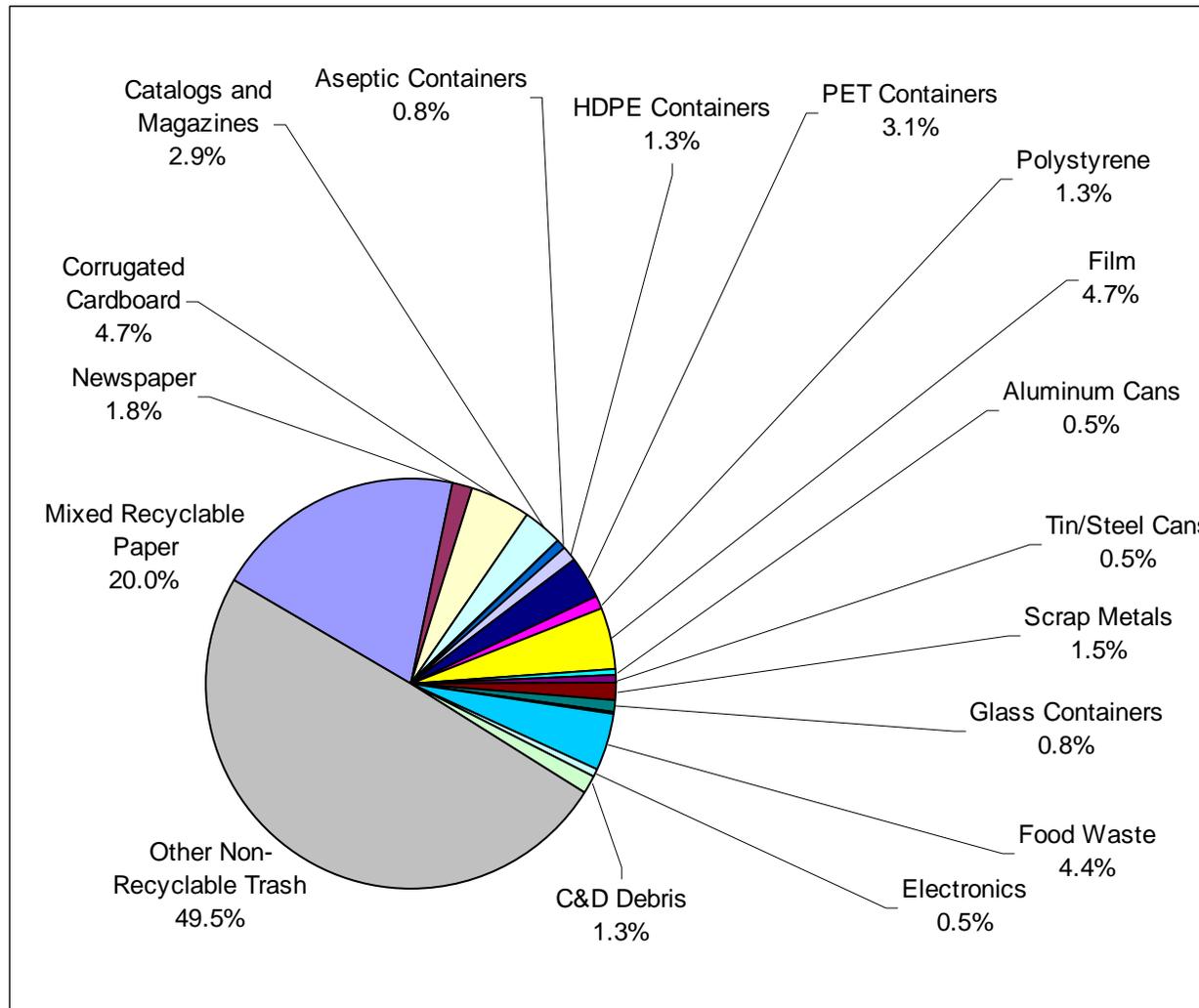


Figure 3.4: Composition of Waste Disposed by High Schools (% by weight)



3.2 Analysis of Recyclable Materials

Table 3.2 shows the percentages by weight of the recyclable materials found in the waste disposed by each grade tier and the school system as a whole. Nearly 22 percent of the waste disposed by the WCPSS consists of materials currently included in the system’s recycling program.

Table 3.2: Recyclable Materials in Public School Waste (% by weight)

	Elementary Schools	Middle Schools	High Schools	School System
Mixed Recyclable Paper	2.9%	8.9%	20.0%	9.2%
Newspaper	0.9%	3.5%	1.8%	1.7%
Corrugated Cardboard	1.4%	0.9%	4.7%	2.3%
Catalogs and Magazines	2.0%	2.7%	2.9%	2.4%
Telephone Books	0.3%	0.0%	0.0%	0.2%
Text Books	0.1%	0.0%	0.0%	0.1%
Recyclable Paper	7.7%	16.0%	29.3%	15.9%
HDPE Containers	0.4%	0.3%	1.3%	0.6%
PET Containers	1.9%	3.0%	3.1%	2.5%
Aluminum Cans	0.3%	0.5%	0.5%	0.4%
Tin/Steel Cans	0.3%	0.3%	0.5%	0.3%
Recyclable Containers	2.9%	4.2%	5.4%	3.9%
Polystyrene	0.9%	3.3%	1.3%	1.5%
Total Recyclables	11.4%	23.5%	36.1%	21.3%

Elementary schools appear to have higher recycling participation as evidenced by the lower percentage of recyclable materials in the elementary school waste stream than the other grade tiers. On a percentage basis, more than twice the amount of recyclable materials was found in middle school waste (24 percent) and more than three times as much in high school waste (36 percent) than in elementary school waste (11 percent). This trend is even more accentuated for recyclable paper.

These results are consistent with where the County’s time and resources have been focused. According to SWMD staff, more recycling outreach and education have been conducted in elementary schools than in middle or high schools. This greater effort is clearly demonstrated in the study results.

Other materials were found in the school waste stream that are not included in the current program, but could potentially be recovered for recycling or composting. Table 3.3 lists the percentages of these materials. Food waste represents the largest component of the waste stream that is not

currently recovered, followed by aseptic containers. Plastic film, e.g., garbage bags, constituted approximately 6 percent of the school waste stream; however, much of it would be too contaminated to recover for recycling.

Table 3.3: Other Recoverable Materials in Public School Waste (% by weight)

	Elementary Schools	Middle Schools	High Schools	School System
Food Waste	20.1%	12.4%	4.4%	13.9%
Aseptic Containers	10.1%	7.1%	0.8%	6.7%

3.3 Comparison with Recycling Data

To further analyze the waste composition data, KCI evaluated the quantity of mixed paper materials recovered from the public schools through the “Feed the Bin” program.¹ Table 3.4 shows the recovery rates for the year beginning February 1, 2007 and ending January 31, 2008. This information further confirms that recycling participation is highest in elementary schools, followed by middle schools, and then high schools.

Table 3.4: Mixed Paper Recovery

	Tons / Year	Pounds / Student / Year*
Elementary	449.8	14.05
Middle	171.1	11.60
High	147.1	7.84
School System	768.0	11.72

*Calculated using the median student population of the 2006-07 and 2007-08 school years.

3.4 2004 Wake County Public School System Visual Waste Audit

In 2004, Wake County conducted a visual audit of the WCPSS waste stream to determine if and how the school recycling program should be continued. At the time, the WCPSS recycling program utilized igloo containers for collecting recyclables and the County was unsure of whether the program should be expanded. The results of the 2004 audit effectively demonstrated that the program was working, and the program was subsequently expanded to all schools.

¹ Although data was available for other types of recovered materials, the accuracy of this data was questionable.

One of the original goals of the 2008 waste composition study was to compare the results with the 2004 study to demonstrate the level of progress over the past four years. As KCI pointed out in the scope of work for the 2008 study, the accuracy achieved by a visual audit would not be sufficient to evaluate the effectiveness of the existing WCPSS recycling program or to compare with other similar studies over time to evaluate progress. KCI, therefore, recommended a true waste sort be conducted of the County's schools.

A waste composition study that involves manual sorting of waste samples is more accurate than a visual waste audit. In addition, the 2004 study conducted visual audits at only 13 schools, 8 of which had some form of recycling program. During the 2008 study, waste was collected from a total of 64 schools and representative samples were pulled and sorted from this waste.

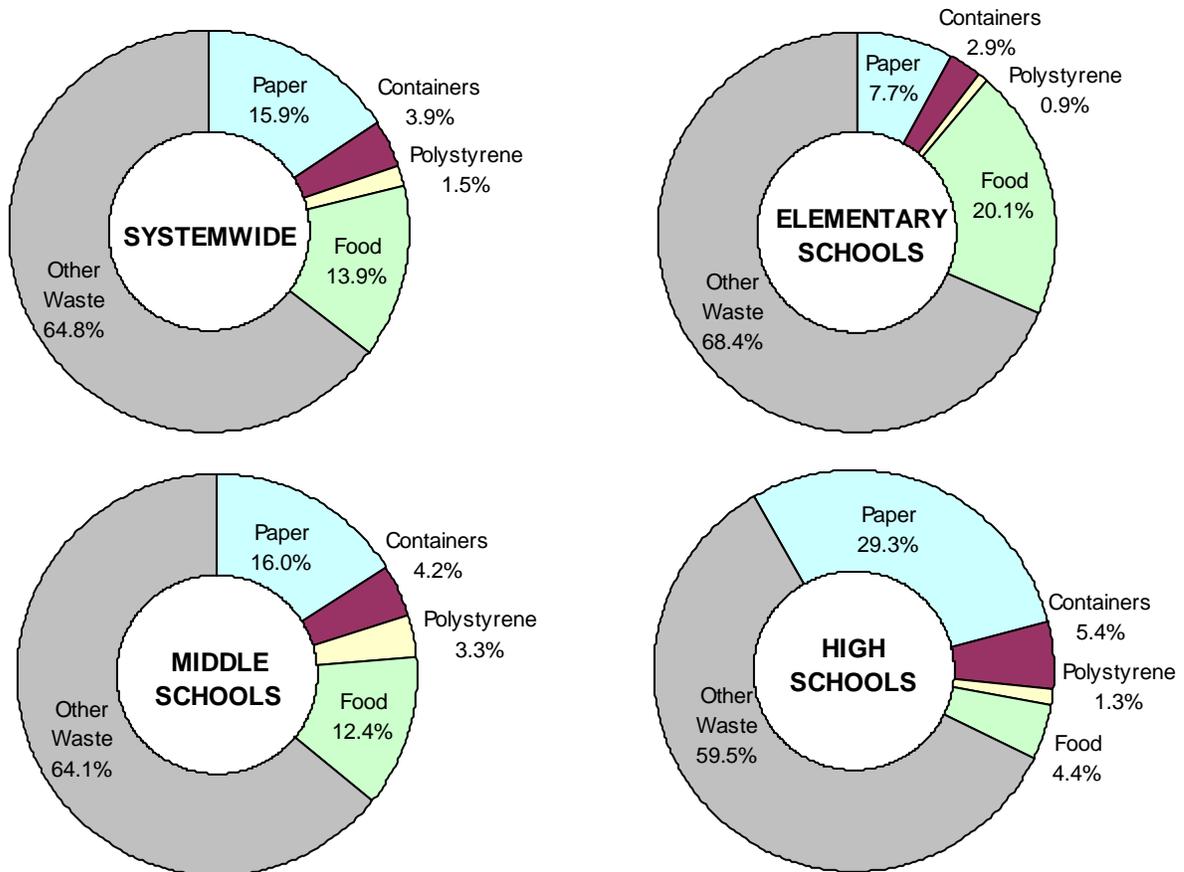
KCI and SWMD staff therefore concurred that comparisons between the study results would not provide meaningful information. KCI recommends that SWMD and WCPSS use the 2008 waste composition study results as a baseline against which to track future program progress.

SECTION 4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

A waste composition study was conducted in January 2008 to evaluate the composition of solid waste disposed by the Wake County Public School System (WCPSS) as an indicator of the effectiveness of its recycling program. Based on the study results, the recycling program in elementary schools appears to be very effective, with opportunities for improvement in middle schools and especially high schools. These results are consistent with where the County has focused its recycling educational efforts to date, which has primarily been in elementary schools.

Approximately 22 percent of the waste disposed by the WCPSS consists of materials that could have been recycled in the system's existing recycling program. This includes recyclable paper (mixed paper, newspaper, corrugated cardboard, catalogs and magazines, telephone books, and text books, 15.9 percent), containers (HDPE and PET containers, aluminum cans, and tin/steel cans, 3.9 percent), and expanded polystyrene foam (not necessarily cafeteria trays, 1.5 percent).



A smaller percentage of recyclables was found in elementary school waste (11 percent) than in middle school waste (24 percent), which in turn had a smaller percentage of recyclables than high school waste (36 percent). These percentages are consistent with the recovery rates for mixed paper over the past year (February 1, 2007 – January 31, 2008), which show elementary schools recovering the highest amount of mixed paper (an average of 14.05 pounds per student per year), followed by middle schools (11.60 pounds per student), and then high schools (7.84 pounds per student).

According to WCPSS staff, some of the high schools in the southern part of the county are used for weekend activities and events, during which recycling is not occurring. This, as well as neighborhood use of school dumpsters, could also contribute to the higher quantities of recyclables in the high school waste stream

To gauge the quantity of paper still being disposed that could potentially be recovered through the “Feed the Bin” program, KCI estimated the tonnage of waste disposed by County schools based on the size of the disposal containers serviced for the sorting event and the weight of the waste they contained. Applying the results of the waste composition study to these waste generation figures indicates that approximately 15,500 additional pounds of mixed paper are potentially available for recovery in high schools each month, 7,400 additional pounds in middle schools, and 7,700 additional pounds in elementary schools.⁵

This study also revealed several other materials that could potentially be recovered for recycling or composting. The two largest material categories of this type are food waste (14 percent of the school system’s waste stream) and aseptic containers (7 percent). Both of these materials are found in higher percentages in elementary schools than in the other grade tiers.

⁵ Elementary schools: 89.7 lbs/cy X 345 cy of disposal capacity/week X 4.33 weeks/month X 5.8% “Feed the Bin” paper in the waste stream = 7,768 lbs of paper/month

Middle schools: 67.5 lbs/cy X 168 cy of disposal capacity/week X 4.33 weeks/month X 15.1% “Feed the Bin” paper in the waste stream = 7,410 lbs of paper /month

High schools: 62.8 lbs/cy X 231 cy of disposal capacity/week X 4.33 weeks/month X 24.71% “Feed the Bin” paper in the waste stream = 15,515 lbs of paper /month

4.2 Recommendations

Based on the study results, a number of opportunities were identified to help maximize waste diversion and increase the effectiveness of the WCPSS recycling program. These recommendations are outlined below.

- (1) **Education and incentives:** The County's recycling education efforts in elementary schools has been effective, and a similar same level of effort should now be placed on middle and high schools. To determine the most effective approach to motivating students of these ages to participate in recycling, the County should consider conducting on-line surveys or focus groups. Developing an educational approach or message geared toward teenagers and not children will be critical to the success of this effort. Incentives and intra- or inter-school competitions might also prove effective. The success of the elementary school recycling program demonstrates the correlation between recycling outreach and increased recovery.
- (2) **Site visits:** SWMD staff should periodically conduct site visits to review how the program operates in individual schools. Site visits should focus on proper placement of containers, clear and accurate signage, and program educational materials. The visits would also provide an opportunity to motivate staff in charge of overseeing or promoting the program within the school and discussing any concerns they may have.
- (3) **Recycling by other facility users:** If other organizations or groups are using school facilities, they should be asked to recycle while on the premises. Special educational materials or hands-on training might initially be necessary to show participants how and where to recycle.
- (4) **Expanding materials recovery:** To further increase materials recovery, the existing recycling vendors and other local recycling vendors should be contracted to determine whether additional materials could be added to the program in the future. Specifically, chipboard/paperboard could potentially be included in either the mixed paper or corrugated cardboard recycling streams, and aseptic containers could potentially be included in either the mixed paper or commingled container stream.
- (5) **Organics recovery:** The County should continue to explore the feasibility of recovering food waste for composting. An organics recovery program could reduce elementary

school waste by more than 30 percent, and perhaps as much as 50 percent if the vendor also accepted other types of biodegradable waste (e.g., contaminated wastepaper and aseptic containers). SWMD staff indicated that several organics composting companies are located in the area, two of which will collect materials.

- (6) **Right-sizing disposal containers:** Based upon the number of disposal containers serviced during the one-week sorting event and quantity of waste collected, KCI estimated the density of the collected waste to be between 63 and 90 pounds per cubic yard. A one-week snapshot such as this is far from definitive, but it is the only information available to KCI to evaluate waste density. Based on KCI's industry experience, as well as on waste density averages published by the Solid Waste Association of North America (SWANA), the density of uncompacted solid waste generally ranges from 100 to 250 pounds per cubic yard. The comparatively low estimated density for uncompacted waste from schools suggests that the County should consider monitoring disposal dumpsters to determine whether the recycling program has reduced the waste disposal stream sufficiently to warrant adjusting the container sizes and/or frequency of collection. If so, this could result in a cost savings to the County.
- (7) **Materials collection and processing:** A financial analysis of the WCPSS recycling program was not within the scope of this project; however, the County should evaluate combining all of the materials currently included in the recycling program into a consolidated contract. The paper contract expires June 2009, so now would be an opportune time to survey local recycling vendors to determine the services each is able to provide. The County would likely need to conduct a competitive procurement for future recycling services; details of the scope of services would be developed based on what local vendors are able to provide and the County's program objectives. Expanding the scope of the contract to include other county recycling programs, such as county government facilities, might enable the County to obtain more cost-effective recycling services, and possibly a share of the market revenue.
- (8) **Program tracking:** To accurately calculate the program's waste diversion or recycling rate, two pieces of information are needed: (1) the quantity of waste being recovered and (2) the quantity of waste being disposed. Regarding the first, the County should continue to work with existing recycling vendors to achieve more accurate tracking and reporting of recovered materials. To accurately estimate the second, KCI recommends that all WCPSS waste be collected and weighed separate from other waste streams for a one-

week period during each quarter of the year. If the County would like to determine recycling rates by grade tier (i.e., elementary, middle, and high schools), waste from each of the three grade tiers would need to be collected and weighed separately. In addition, the County should consider conducting a waste composition study every two to three years to monitor program progress and potential changes in the waste stream.

The results of the waste composition study indicate that Wake County has an effective recycling program in its public school system, particularly in elementary schools. The study results also reveal opportunities for recovering additional recyclables, especially in middle and high schools. Recommendations for various program improvements were drawn from the study, which will also serve as a baseline by which to evaluate future program progress. As the County's student population and waste generation continue to grow, implementing these recommendations can help to further reduce the amount of waste disposed, conserve valuable resources, and preserve disposal capacity.

WAKE COUNTY
2008 PUBLIC SCHOOL WASTE COMPOSITION STUDY

Appendix A – Routes Summary

Elementary Raleigh Route	Elementary North Route	Elementary South Route
<ul style="list-style-type: none"> ▪ Bugg Elementary ▪ Poe Elementary ▪ Fuller Elementary ▪ Hunter Elementary ▪ Conn Elementary ▪ Powell Elementary ▪ Wiley Elementary ▪ Underwood Elementary ▪ Partnership Primary ▪ Olds Elementary ▪ Combs Elementary ▪ Joyner Elementary 	<ul style="list-style-type: none"> ▪ Fox Road Elementary ▪ Wildwood Forest Elementary ▪ Durant Road Elementary ▪ Millbrook Elementary ▪ North Ridge Elementary ▪ Baileywick Elementary ▪ Lead Mine Elementary ▪ Green Elementary ▪ Jeffreys Grove Elementary ▪ York Elementary ▪ Hilburn Drive Elementary ▪ Stough Elementary 	<ul style="list-style-type: none"> ▪ Dillard Drive Elementary ▪ Yates Mill Elementary ▪ Swift Creek Elementary ▪ Farmington Woods Elementary ▪ Briarcliff Elementary ▪ Baucom Elementary ▪ Salem Elementary ▪ Olive Chapel Elementary ▪ Apex Elementary ▪ Oak Grove Elementary ▪ Penny Road Elementary

Middle Schools

North Route

- Moore Square Museum
- Ligon Middle
- Carnage Middle
- East Garner Middle
- North Garner Middle
- East Wake Middle
- East Millbrook Middle
- Durant Road Middle
- Carroll Middle

Middle Schools

South Route

- Lufkin Road Middle
- Apex Middle
- Salem Middle
- East Cary Middle
- Daniels Middle
- Martin Middle
- Centennial Middle
- Dillard Drive Middle

High Schools

North Route

- Knightdale High
- Enloe High
- Millbrook High
- Wake Forest High
- Wakefield High
- Sanderson High
- Leesville High

High Schools

South Route

- Southeast Raleigh High
- Athens Drive High
- Apex High
- Fuquay-Varina High
- Middle Creek High

WAKE COUNTY
2008 PUBLIC SCHOOL WASTE COMPOSITION STUDY

Appendix B – Material Category Descriptions

#	Material Categories	Description of Categories
1	Mixed Paper	Brochures, pamphlets, computer/copy paper, envelopes, manila folders, legal/notebook paper, NCR carbonless paper and checks, junk mail, colored paper, file folders, and posters. *Blueprints allowed for County Offices only *Sticky notes allowed for County Schools only
2	Newspaper	Newspaper (loose, tied or shredded) including other paper normally distributed inside newspaper such as ads, flyers, etc.
3	Corrugated Cardboard (OCC)	Uncoated brown "cardboard" boxes with a wavy core (no plastic liners, waxy coatings). Includes clean pizza boxes.
4	Catalogs and Magazines	All telephone directories, magazines, catalogs, and other printed material on glossy and non-glossy paper.
5	Old Telephone Directories	Phone books, white and yellow pages.
6	Textbooks	Hard and soft covered textbooks.
7	Aseptic Containers	Gable top milk cartons, juice boxes, and other similar containers.
8	HDPE Containers	Clear/natural and pigmented bottles or containers coded HDPE #2 such as milk jugs, detergent bottles, etc.
9	PET Containers	Clear and colored bottles or containers coded PET #1 such as soda bottles, water bottles, etc.
10	Polystyrene	Styrofoam plates, bowls, trays, cups and any other items that can successfully be recycled together,
11	Film	Grocery bags, garbage bags, plastic sheeting, saran wrap, visqueen, etc.

#	Material Categories	Material Descriptions
12	Aluminum Cans	Aluminum soft drink, beer, and some food cans.
13	Tin/Steel Cans	Tin-plated steel cans, usually food containers, and aerosol cans.
14	Other Metals	Scrap aluminum, aluminum foil, and other non-magnetic metal, copper wiring and tubing, brass fixtures. Steel, clothes hangers, sheet metal products, pipes, miscellaneous metal scraps, and other magnetic metal items.
15	Glass Containers	Clear, Brown, and Green glass bottles and containers.
16	Yard Waste	Shrub and brush prunings, household bedding plants, weeds, leaves, grass clippings, and other landscaping and gardening wastes.
17	Food Waste	Meat and vegetable waste (includes coffee grinds and tea bags).
18	Electronics	Electronic devices such as hairdryers, televisions, toasters, computers, etc.
19	C&D Debris	Construction and demolition debris that includes concrete, carpet, drywall, furniture, insulation, ceiling tiles, filters, and treated and untreated lumber, including pallets.
20	Other Non-recyclable Trash	All other wastes not included in the above categories, including construction paper, lined writing paper, carrier stock, contaminated paper, laminated paper, tissues and paper napkins, paper plates and plastic cutlery, wax paper cups, plastic lids and straws, batteries, textiles and mop heads, non-program plastics, liquids from partially full beverage containers, aluminum foil and catering trays, rubber products, lab wastes and medical wrappers, and products that contain combinations of materials such as frozen juice cans, binders, etc. Also includes indistinguishable items less than 1-inch square that are organic or inorganic including kitty litter, sweepings, and hair.

**WAKE COUNTY
PUBLIC SCHOOL WASTE COMPOSITION STUDY
Appendix C - Elementary School Sample Results**

		Elementary Raleigh Area	Elementary Raleigh Area	Elementary North County	Elementary North County	Elementary North County	Elementary North County	Elementary South County	Weighted Avg.					
	Material Categories	Sample #	4	5	18	19	20	21	33	34	35	36	37	
1	MIXED RECYCLABLE PAPER		3.65%	2.52%	2.15%	5.38%	2.18%	1.61%	1.23%	3.57%	7.06%	2.16%	0.30%	2.92%
2	NEWSPAPER		0.68%	0.84%	1.50%	0.26%	4.45%	0.00%	0.02%	0.00%	0.10%	0.38%	0.00%	0.86%
3	CORRUGATED CARDBOARD (OCC)		4.70%	0.75%	0.00%	1.30%	0.43%	0.24%	0.27%	1.27%	4.38%	0.00%	0.27%	1.45%
4	CATALOGS AND MAGAZINES		1.00%	1.70%	6.97%	1.47%	0.95%	1.27%	0.39%	2.07%	5.83%	0.42%	0.87%	2.01%
5	TELEPHONE BOOKS		0.00%	1.93%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.32%
6	TEXTBOOKS		0.80%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.13%
7	ASEPTIC CONTAINERS		10.03%	2.93%	6.46%	9.71%	20.12%	14.61%	11.10%	8.25%	6.22%	17.10%	11.01%	10.07%
8	HDPE CONTAINERS		0.18%	0.93%	0.23%	0.61%	0.21%	0.20%	0.18%	0.51%	0.53%	0.18%	0.08%	0.39%
9	PET CONTAINERS		2.29%	2.48%	1.01%	1.58%	1.36%	1.91%	2.85%	2.22%	1.94%	2.22%	0.70%	1.92%
10	POLYSTYRENE		1.06%	0.45%	0.57%	0.53%	0.99%	0.87%	1.66%	1.27%	0.73%	1.42%	0.45%	0.85%
11	FILM		5.64%	4.95%	6.56%	7.03%	6.11%	7.17%	8.33%	9.56%	9.00%	7.03%	6.93%	6.68%
12	ALUMINUM CANS		0.36%	0.75%	0.14%	0.46%	0.08%	0.20%	0.12%	0.19%	0.07%	0.20%	0.09%	0.31%
13	TIN/STEEL CANS		0.06%	1.02%	0.31%	0.04%	0.00%	0.00%	0.08%	0.21%	0.27%	0.16%	0.11%	0.26%
14	SCRAP METALS		0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
15	GLASS CONTAINERS		0.52%	1.02%	0.76%	0.00%	0.00%	0.00%	0.00%	0.21%	0.19%	0.00%	0.19%	0.36%
16	YARD WASTE		0.14%	2.45%	0.00%	0.51%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.48%
17	FOOD WASTE		17.28%	12.13%	26.15%	27.60%	25.49%	22.60%	18.08%	17.39%	15.19%	22.03%	24.72%	20.13%
18	ELECTRONICS		0.70%	0.00%	0.00%	0.00%	2.02%	0.16%	0.00%	0.00%	0.00%	0.00%	0.00%	0.32%
19	C&D DEBRIS		2.83%	0.89%	1.68%	0.00%	0.35%	0.00%	0.00%	0.32%	0.00%	0.00%	0.00%	0.82%
20	OTHER NON-RECYCLABLE TRASH		48.06%	62.25%	45.49%	43.52%	35.25%	49.15%	55.67%	52.99%	48.50%	46.71%	54.27%	49.71%
	TOTALS		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

**WAKE COUNTY
PUBLIC SCHOOL WASTE COMPOSITION STUDY
Appendix C - Middle School Sample Results**

		Middle Schools North County	Middle Schools North County	Middle Schools North County	Middle Schools South County	Middle Schools South County	Middle Schools South County		
	Material Categories	Sample #	6	7	8	22	23	24	Weighted Avg.
1	MIXED RECYCLABLE PAPER		1.49%	7.16%	3.51%	15.56%	20.23%	4.71%	8.87%
2	NEWSPAPER		2.70%	5.22%	0.07%	7.48%	3.24%	2.22%	3.50%
3	CORRUGATED CARDBOARD (OCC)		0.64%	1.48%	0.53%	0.92%	1.96%	0.00%	0.92%
4	CATALOGS AND MAGAZINES		0.00%	1.65%	0.53%	6.63%	4.91%	2.24%	2.69%
5	TELEPHONE BOOKS		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
6	TEXTBOOKS		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
7	ASEPTIC CONTAINERS		8.65%	6.49%	14.38%	5.82%	1.36%	6.27%	7.11%
8	HDPE CONTAINERS		0.06%	0.27%	0.07%	0.37%	0.52%	0.66%	0.33%
9	PET CONTAINERS		2.99%	2.30%	2.37%	3.73%	1.54%	5.09%	3.01%
10	POLYSTYRENE		8.34%	0.69%	3.99%	1.36%	1.98%	3.77%	3.34%
11	FILM		5.39%	7.55%	7.90%	5.27%	6.22%	7.57%	6.64%
12	ALUMINUM CANS		0.31%	1.21%	0.86%	0.15%	0.23%	0.38%	0.52%
13	TIN/STEEL CANS		0.21%	0.29%	0.26%	0.33%	0.65%	0.19%	0.32%
14	SCRAP METALS		0.04%	0.04%	0.00%	0.04%	3.13%	0.00%	0.55%
15	GLASS CONTAINERS		0.00%	0.58%	0.00%	0.86%	0.44%	0.00%	0.32%
16	YARD WASTE		0.00%	0.00%	0.29%	0.00%	0.00%	0.00%	0.05%
17	FOOD WASTE		22.19%	13.98%	12.49%	10.09%	8.68%	7.33%	12.39%
18	ELECTRONICS		0.00%	0.25%	0.00%	0.00%	0.10%	0.00%	0.06%
19	C&D DEBRIS		3.98%	0.42%	0.00%	0.00%	3.72%	4.03%	2.03%
20	OTHER NON-RECYCLABLE TRASH		43.00%	50.42%	52.77%	41.39%	41.09%	55.55%	47.34%
	TOTALS		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

WAKE COUNTY
PUBLIC SCHOOL WASTE COMPOSITION STUDY
Appendix C - High School Sample Results

		High Schools North County	High Schools North County	High Schools North County	High Schools South County	High Schools South County	High Schools South County		
	Material Categories	Sample #	12	13	14	30	31	32	Weighted Avg.
1	MIXED RECYCLABLE PAPER		18.56%	24.07%	22.65%	23.15%	25.33%	3.42%	19.98%
2	NEWSPAPER		2.91%	2.05%	1.81%	1.28%	0.19%	1.50%	1.75%
3	CORRUGATED CARDBOARD (OCC)		1.92%	2.29%	3.81%	14.12%	3.23%	5.64%	4.66%
4	CATALOGS AND MAGAZINES		2.62%	3.21%	3.06%	3.77%	3.91%	0.87%	2.92%
5	TELEPHONE BOOKS		0.00%	0.06%	0.00%	0.00%	0.00%	0.00%	0.01%
6	TEXTBOOKS		0.00%	0.00%	0.00%	0.19%	0.00%	0.00%	0.02%
7	ASEPTIC CONTAINERS		1.51%	0.58%	0.38%	0.06%	1.08%	1.33%	0.82%
8	HDPE CONTAINERS		2.79%	0.65%	0.87%	0.51%	0.27%	2.60%	1.31%
9	PET CONTAINERS		2.84%	3.00%	2.92%	2.18%	2.26%	5.97%	3.14%
10	POLYSTYRENE		0.83%	0.47%	0.16%	0.56%	4.12%	2.88%	1.30%
11	FILM		5.91%	4.79%	4.35%	4.22%	4.71%	3.56%	4.68%
12	ALUMINUM CANS		0.45%	0.67%	0.56%	0.25%	0.19%	0.77%	0.50%
13	TIN/STEEL CANS		0.00%	0.86%	0.24%	1.21%	0.53%	0.23%	0.48%
14	SCRAP METALS		4.52%	0.00%	0.00%	0.56%	1.20%	3.07%	1.55%
15	GLASS CONTAINERS		1.02%	1.55%	1.32%	0.00%	0.25%	0.26%	0.85%
16	YARD WASTE		0.52%	0.86%	0.00%	0.00%	0.00%	0.28%	0.31%
17	FOOD WASTE		3.03%	5.65%	5.62%	1.34%	7.54%	2.76%	4.41%
18	ELECTRONICS		2.01%	0.00%	0.00%	0.00%	0.59%	0.14%	0.50%
19	C&D DEBRIS		0.00%	0.00%	0.00%	9.49%	0.00%	0.00%	1.26%
20	OTHER NON-RECYCLABLE TRASH		48.57%	49.23%	52.26%	37.14%	44.61%	64.72%	49.54%
	TOTALS		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%