Ohio Statewide Litter Study

Final Report

June, 2004

DAVEY RESOURCE GROUP
A Division of The Davey Tree Expert Company

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Executive Summary

I. Project Overview and Objectives

The Ohio Department of Natural Resources (ODNR) Division of Recycling & Litter Prevention (DRLP) conducted a statewide litter study during the fall of 2003 and the spring of 2004. The objectives of the field research and sampling study included:

- Producing statistically valid data representing the overall annual amount of litter by weight and volume, distribution, and composition of roadside litter throughout the State of Ohio
- Designing and documenting a sampling methodology to permit replication of the study in the future
- Deriving conclusions about littering behavior to guide litter prevention education and future clean-up efforts

As defined in the Ohio Revised Code § 1502.01, *litter* throughout the study means "garbage, trash, waste, rubbish, ashes, cans, bottles, wire, paper, cartons, boxes, automobile parts, furniture, glass, or anything else of an unsightly or unsanitary nature thrown, dropped, discarded, placed, or deposited by a person on public property, on private property not owned by the person, or in or on waters of the state…."

This litter study was conducted in both urban and rural areas on three types of roadways and on interchanges. This final report presents the results of the two sampling events—one in the fall of 2003 and one in the spring of 2004.

II. Summary of Results

The results of the first Ohio Roadside Litter Study are summarized in this section. These findings include the fall 2003 and spring 2004 sampling events. Based on this study, 11,380 tons of litter are deposited annually on Ohio's county, state, interstate, and U.S. routes, and 392 tons of litter are deposited annually on Ohio's interchanges. The total annual estimated roadside litter in Ohio—for all road types and interchanges included in this study—is 11,772 tons.

A. Roadways

In Ohio, on average, 475 (+/- 36) pounds of litter were deposited annually per mile on all roads combined—interstate and U.S. routes, state routes, and county roads. The 90 percent confidence interval was 36 pounds, which is 7.6 percent of the mean. The weighted averages are presented by road type below.

- **1,665** (+/- 418) pounds of litter were deposited per mile on **interstate and U.S. routes** annually with no significant difference between rural and urban.
- **492** (+/- 72) pounds of litter were deposited per mile annually on all **state routes**. Twice as much litter was deposited annually per mile on urban roads compared to rural roads—a statistically significant difference.
- **243** (+/- 62) pounds of litter were deposited per mile annually on all **county roads**. A clear and statistically significant difference existed between rural county roads (200 pounds per mile annually) and urban county roads (738 pounds per mile annually).

Total annual estimated litter generation in Ohio for interstate and U.S. routes, state routes, and county roads was 11,380 tons. This is distributed evenly between interstate and U.S. routes (38 percent), state routes (31 percent), and county roads (31 percent). The estimated volume of roadside litter for all roads was 129,899 cubic yards.

B. Interchanges

In Ohio, an average of 743 pounds of litter was deposited annually on an individual interchange. **Twice as much litter accumulates on rural interchanges annually per mile than on urban interchanges**.

About 21 percent of the total litter weight on interchanges was comprised of cigarette butts. **The majority was on urban interchanges where 25 percent of total tons of litter were cigarette butts.** Only 7 percent of total tons of litter on rural interchanges was cigarette butts.

Total annual estimated litter generation on interchanges in Ohio was 392 tons. Most of this was on urban interchanges (80 percent) compared to rural interchanges (20 percent). **The volume deposited on all interchanges annually was approximately 2,974 cubic yards.**

C. Estimated Volume

An average of 132,873 cubic yards of litter are generated annually on all roads and interchanges. Rural county roads generated a significantly greater volume of litter annually than any other sample type—40,502 cubic yards. Urban interchanges generated the smallest volume of litter annually—only 699 cubic yards.

D. Composition of Roads and Interchanges Combined

Of the total tons of litter generated annually, **plastic items comprised 19 percent, glass items comprised 17 percent, and paper items comprised 16 percent.**

Alcoholic beverage containers, including glass, plastic, metal, and paper, comprised 18 percent of the total annual tons of litter on all roads and interchanges combined.

Non-alcoholic beverage containers comprised 9 percent. When all beverage containers are combined, this is the largest single category in the litter weight analysis (27 percent of total tons annually).

Vehicle debris, including both metal and plastic auto rubber, parts, and tires, comprised 18 percent of the total annual tons of litter on all roads combined. Over one-half of this occurred on interstate and U.S. routes.

Other groups of items that comprised more than four percent of the total tonnage per year on all roads and interchanges combined include the following:

- Cardboard, newspaper, and magazines (7 percent)
- Paper and plastic bags and film (6 percent)
- Other miscellaneous debris [*e.g.*, rocks, mud, sticks, and leaves] (6 percent)
- Construction debris (5 percent)
- Food (4 percent)
- Fast food packaging [including fast food beverage containers] (4 percent)
- Cigarette butts (4 percent)

Introduction

I. Project Overview and Objectives

The Ohio Department of Natural Resources (ODNR) Division of Recycling & Litter Prevention (DRLP) conducted a statewide litter study during the fall of 2003 and the spring of 2004. The objectives of the field research and sampling study included:

- Producing statistically valid data representing the overall annual amount of litter by weight and volume, distribution, and composition of roadside litter throughout the State of Ohio
- Designing and documenting a sampling methodology to permit replication of the study in the future
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As defined in the Ohio Revised Code § 1502.01, *litter* throughout the study means "garbage, trash, waste, rubbish, ashes, cans, bottles, wire, paper, cartons, boxes, automobile parts, furniture, glass, or anything else of an unsightly or unsanitary nature thrown, dropped, discarded, placed, or deposited by a person on public property, on private property not owned by the person, or in or on waters of the state…."

This litter study was conducted in both urban and rural areas on three types of roadways and on interchanges. This final report presents the results of the two sampling events—one in the fall of 2003 and one in the spring of 2004.

Table 1 shows the sample site categories and subcategories along with the number of samples taken in each.

Table 1. Sample Categories and Subcategories

Sample Type		Number of Sample Sites	Number of Samples	Total Number of Samples
Interstate and U.S. Routes	Urban	7	14	28
	Rural	7	14	
State Routes	Urban	7	14	28
	Rural	7	14	
County Roads	Urban	7	14	28
	Rural	7	14	
Interchanges	Urban	7	14	28
	Rural	7	14	

II. Litter Study Schedule Overview

Litter was collected from the 56 sample sites during the initial clean (September 2003), followed by two subsequent sample cleans in the fall (November 2003) and spring (March 2004). Litter from sample cleans was collected, bagged, and transported to a storage and sorting facility. The schedule for fieldwork was designed to minimize complications due to snow and roadside mowing. Table 2 summarizes the approximate dates of the general tasks for the project.

Table 2. Litter Study Schedule

Task	***Dates***
Project Kick-off Meeting	July 24, 2003
Phase I	
Determine Site Suitability	August 11 - 29, 2003
Initial Clean	September 2 - 29, 2003
Fall Clean and Sort	November 3 - 24, 2003
Data Analysis and Report Preparation	December 2003 - February 2004
Report for Phase I	March 2004
Phase II	
Spring Clean and Sort	February 24 – March 26, 2004
Data Analysis and Report Preparation	April - May 2004
Final Report	June 2004

Site Selection

Sample sites were selected randomly. A preliminary field visit was performed in August 2003 to determine sample site suitability. During this visit, the sample site was measured and mapped using global positioning systems (GPS). Digital photos were taken. No litter collection occurred on this visit. The DRLP staff were updated frequently as acceptable sites were identified and mapped.

Initial Clean

During the initial clean, each sample site was thoroughly cleaned and a gross weight of collected litter was recorded. This information provides an approximation of the amount litter present on roadsides at any given point in time. Although no detailed analyses were performed during the initial clean, groups beginning litter removal operations may find information concerning the quantity of litter found and the amount of time required to collect litter at any given time useful. These data are shown in Appendix A.

The initial clean of the sample sites took place between September 2 and September 29, 2003. All litter at each site was collected. Total weights of litter collected and general descriptions of the litter were recorded. A total of 6,094 pounds of litter was collected at the sample sites during the initial clean. Table 3 shows the total weights of litter collected for each sample type during the initial clean.

The day of the initial clean for each sample site was the first day of the accumulation period for that site. Litter collected during the subsequent sample cleans measured how much litter accumulated, providing base data for determining litter composition and generation rates.

Fall Clean and Sort

The fall litter clean and sort occurred between November 3 and November 24, 2003, approximately two months after the initial clean. All litter deposited at each sample site since the initial clean was collected, sorted, counted, and weighed. A total of 1,527 pounds of litter was collected at the sample sites during the fall clean as shown in Table 3.

Spring Clean and Sort

The second and final litter clean and sort in this study occurred approximately three months after the fall clean from February 24 through March 26, 2004. The purpose of this field visit was to collect all litter deposited at each sample site since the fall clean—approximately 16 weeks. All litter collected was sorted, counted, and weighed. A total of 3,035 pounds of litter was collected at the sample site during the spring clean as shown in Table 3.

Table 3. Weight of Collected Litter Samples

Sample Type		Total Sample Weight (pounds)			
		Initial Clean	Fall 2003	Spring 2004	Total
Interstate and U.S. Routes	Urban	937	307	446	**1,690**
	Rural	1,255	224	632	**2,111**
State Routes	Urban	199	77	119	**395**
	Rural	448	130	284	**862**
County Roads	Urban	167	31	71	**270**
	Rural	463	126	216	**805**
Interchanges	Urban	1,354	248	469	**2,017**
	Rural	1,271	383	799	**2,453**
Total		**6,094**	**1,527**	**3,035**	**10,656**

III. Definition of Sample Sites

Interstate and U.S. Routes, State Routes, and County Roads

A sample site is a defined length on one side of an interstate, U.S. route, state route, or county road. One-half of the medians of divided highways were included in the sample site if the median can be accessed safely; medians with walls or other types of barriers were not included. Litter was collected from the edge of pavement or, if present, the fog line (the white line on the edge of the road) to the apparent edge of the right-of-way or until a barrier was encountered, whichever was closest.

Sample sites were 1,500 feet long, except site 42, which was 1,350 feet due to an obstacle that was present at the fall clean. The starting and ending points were denoted by driving two stakes into the ground, flagging both stakes with white flagging tape, and painting a white line on the edge of the pavement. Sample sites also all have a permanent starting point that can be described. Ending points usually had a permanent reference marker, but this was not always feasible.

Interchanges

Interchange sample sites included both sides of one on-ramp and both sides of one off-ramp, on the same side of the roadway. The sample starting point was at the beginning of the on-ramp where the median between the ramp and the road begins. The ending point was at the end of the off-ramp where the median between the ramp and the roadway ends. All litter was collected on both sides of the ramp within 30 feet of the edge of the pavement or until a barrier was encountered, whichever was closest. The length of each ramp was measured (using a measuring wheel) and recorded.

The locations of each sample site are shown on an Ohio map in Figure 1. Table 4 lists the 56 selected sample sites for this study, including the Ohio Environmental Protection Agency (EPA) districts each site falls within. Detailed methods for random site selection, sampling, and sorting are documented in the *Procedures Manual* (Appendix E).

Ohio Department of Natural Resources
Division of Recycling and Litter Prevention

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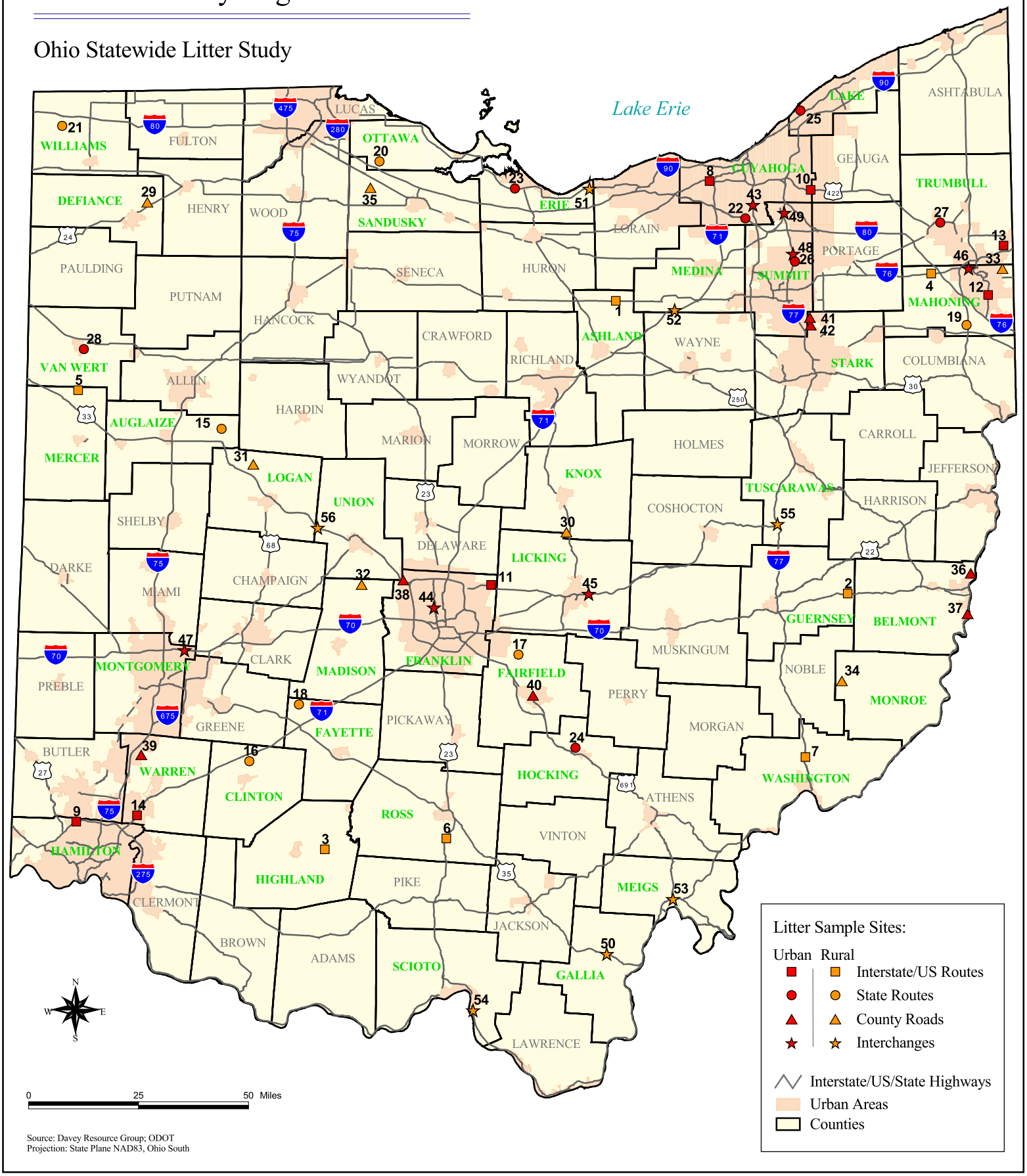


Source: Davey Resource Group; ODOT
Projection: State Plane NAD83, Ohio South

Table 4. Sample Site Locations

Sample Code	County	Site Type	Sample ID	Ohio EPA District[1]
1	Ashland	Rural Interstate or U.S. Route	1.IRUS.R.Ash.224.eb	NWDO
2	Guernsey		2.IRUS.R.Gue.70.eb	NEDO
3	Highland		3.IRUS.R.Hig.50.eb	SWDO
4	Mahoning		4.IRUS.R.Mah.76.wb	NEDO
5	Mercer		5.IRUS.R.Mer.127.sb	NWDO
6	Ross		6.IRUS.R.Ros.23.nb	SEDO
7	Washington		7.IRUS.R.Was.77.nb	SEDO
8	Cuyahoga	Urban Interstate or U.S. Route	1.IRUS.U.Cuy.480.wb	NEDO
9	Hamilton		2.IRUS.U.Ham.275.eb	NEDO
10	Cuyahoga		3.IRUS.U.Cuy.422.wb	NEDO
11	Franklin		4.IRU.S.U.Fra.62.eb	CDO
12	Mahoning		5.IRU.S.U.Mah.680.sb	NEDO
13	Trumbull		6.IRUS.U.Tru.62.eb	NEDO
14	Warren		7.IRUS.U.War.71.nb	SWDO
15	Auglaize	Rural State Route	1.SR.R.Aug.196.sb	NWDO
16	Clinton		2.SR.R.Cli.134.nb	SWDO
17	Fairfield		3.SR.R.Fai.256.eb	CDO
18	Fayette		4.SR.R.Fay.41.nb	CDO
19	Mahoning		5.SR.R.Mah.46.sb	NEDO
20	Ottawa		6.SR.R.Ott.105.wb	NWDO
21	Williams		7.SR.R.Wil.107.eb	NWDO
22	Cuyahoga	Urban State Route	1.SR.U.Cuy.176.nb	NEDO
23	Erie		2.SR.U.Eri.2.eb	NWDO
24	Hocking		3.SR.U.Hoc.664.nb	SEDO
25	Lake		4.SR.U.Lak.91.nb	NEDO
26	Summit		5.SR.U.Sum.8.nb	NEDO
27	Trumbull		6.SR.U.Tru.5.eb	NEDO
28	Van Wert		7.SR.U.Van.116.wb	NWDO
29	Defiance	Rural County Road	1.Co.R.Def.68.eb	NWDO
30	Knox		2.Co.R.Kno.29.wb	CDO
31	Logan		3.Co.R.Log.96.wb	SWDO
32	Madison		4.Co.R.Mad.24.eb	CDO
33	Mahoning		5.Co.R.Mah.Mcg.eb	NEDO
34	Monroe		6.Co.R.Mon.44.sb	SEDO
35	Sandusky		7.Co.R.San.85.wb	NWDO

Table 4. Sample Site Locations (Continued)

Sample Code	County	Site Type	Sample ID	Ohio EPA District[1]
36	Belmont	Urban County Road	1.Co.U.Bel.4.eb	SEDO
37	Belmont		2.Co.U.Bel.46.nb	SEDO
38	Franklin		3.Co.U.Fra.Pos.wb	CDO
39	Warren		4.Co.U.War.121.sb	SWDO
40	Fairfield		5.Co.U.Fai.37.eb	SEDO
41	Stark		6.Co.U.Sta.Cle.nb	NEDO
42	Stark		7.Co.U.Sta.Cle.sb	NEDO
43	Cuyahoga	Urban Interchange	1.Int.U.Cuy.77.sb	NEDO
44	Franklin		2.Int.U.Fra.315.sb	CDO
45	Licking		3.Int.U.Lic.16.wb	CDO
46	Mahoning		4.Int.U.Mah.680.nb	NEDO
47	Montgomery		5.Int.U.Mon.70.eb	SWDO
48	Summit		6.Int.U.Sum.8.nb	NEDO
49	Summit		7.Int.U.Sum.271.sb	NEDO
50	Gallia	Rural Interchange	1.Int.R.Gal.35.eb	SEDO
51	Erie		2.Int.R.Eri.2.wb	NEDO
52	Medina		3.Int.R.Med.71.sb	NEDO
53	Meigs		4.Int.R.Mei.7.sb	SEDO
54	Scioto		5.Int.R.Sci.52.wb	SEDO
55	Tuscarawas		6.Int.R.Tus.77.sb	SEDO
56	Union		7.Int.R.Uni.33.wb	CDO

1 Ohio EPA district offices provide local points of contact throughout Ohio: Northeast District Office (NEDO); Northwest District Office (NWDO); Southeast District Office (SEDO); Southwest District Office (SWDO); and Central District Office (CDO).

Analysis and Results

I. Litter Generation by Weight and Estimated Volume

Definition

Litter generation refers to the quantity of litter accumulated over a defined time and area. The quantity of litter generated annually was estimated for each subcategory of road on a per-unit basis (per mile) and for the entire statewide population of road miles (tons per year). The same was done for interchanges on a per-interchange basis and for the entire population of interchanges in Ohio.

Roadway litter consists primarily of material originating from moving vehicles. This includes litter tossed from vehicles by drivers or passengers, parts that have fallen off vehicles, and litter from uncovered loads or items that have blown out of vehicles. It may also include litter from pedestrians; although, this is believed to be a minor contributor to the litter accumulated since sample sites were typically not pedestrian-friendly (*i.e.*, did not have sidewalks).

Litter from interchanges originates primarily from vehicles that are entering or exiting roadways. It may also include litter deposited from overpasses that has accumulated on the interchange ramps.

Methodology

All composition and deposition estimates of roadside litter were calculated using a **90 percent confidence interval**. This means that there is a 90 percent certainty that the actual quantity is within the calculated range—between the low and high estimates. In the following tables, the low and high values were calculated using the 90 percent confidence interval for each data set.

The **deposition period** for the fall 2003 clean occurred between September and November. The deposition period ranged from 50 to 72 days for the 56 sample sites. The deposition period for the spring 2004 clean occurred between November 2003 and February through March 2004. The deposition period ranged from 97 to 142 days for the 56 sample sites. Data from the fall 2003 and spring 2004 cleans were standardized and reported on an annual basis.

The amount of **litter generated per unit** was calculated for each of the eight site subcategories (as shown in Table 2) based on the total weights of the samples collected and sorted. Weighted averages were used to determine the average generation for the broader site categories—all roads, interstate and U.S. routes, state routes, county roads, and interchanges. The factors used for weighting include the number of road miles or the number of interchanges defined in the universe of sites (Appendix B). The roads data cannot be combined with the interchange data. Roads data were calculated on a per mile basis and interchange data were calculated on a per interchange basis.

To calculate the **total tons of litter generated per year** for each category, the estimated per-unit generation was multiplied by the number of road miles or number of interchanges in the universe (Appendix B). The total tons of litter for roads and interchanges can be combined; however, confidence intervals cannot be calculated because roads data were calculated on a per mile basis and interchange data were calculated on a per interchange basis.

A. Roadways by Weight

Methodology

Roadway litter generation data were analyzed in three ways—pounds of litter generated per mile, litter generated statewide in tons per year, and litter generated per mile driven. Generation per mile driven was determined only for interstate and U.S. routes and state routes. Data on daily vehicle miles driven (DVMD) were obtained by the Ohio Department of Transportation and were not available for Ohio county roads. These DVMD data were combined with other local road data (township roads and municipal roads) and could not be isolated for this analysis.

Results

1. Generation Rates per Mile

Table 5 shows the pounds of litter per mile that accumulates each year in the roadway categories in Ohio. The greatest amount of litter accumulates on interstate and U.S. routes. Nearly three-fourths of one ton of litter, specifically 1,665 pounds, are deposited per mile annually on interstate and U.S. routes in Ohio. State routes accumulate an average of 492 pounds per mile annually, and county roads accumulate an average of 243 pounds per mile annually.

A trend identified in all road categories shows more litter accumulated on a per mile basis annually in urban areas than in rural areas. **A statistically significant difference is indicated in the state routes and county roads categories.** Annually, urban county roads accumulate **738 pounds per mile** compared to 243 pounds per mile on rural county roads, and urban state routes accumulate **924 pounds per mile** compared to 410 pounds per mile on rural state routes. The same trend is seen for interstate and U.S. routes, but these differences are not statistically significant.

Table 5. Quantity of Litter Generated on Roads

Sample Type		Quantity of Litter (pounds per mile per year)		
		Mean	Low	High
Interstate and U.S. Routes		**1,665**	**1,247**	**2,083**
	Rural	1,662	803	2,520
	Urban	1,671	1,260	2,082
State Routes		**492**	**420**	**564**
	Rural	410	293	527
	Urban	924	752	1,095
County Roads		**243**	**181**	**305**
	Rural	200	106	295
	Urban	738	608	867
All Roads Weighted Average		**475**	**439**	**510**

2. Total Generation

The total amount of litter generated annually for each road type was calculated based on the number of miles of road in that category. Therefore, the results were greatly influenced by the number of miles of road in the subcategories. Table 6 shows the total amount of litter (in tons) deposited annually for each road category.

Each year, approximately 11,380 tons of litter are deposited on all of the Ohio roadways included in this study. The litter is somewhat evenly distributed among the three types of roads—interstate and U.S. routes (4,365 tons), state routes (3,474 tons), and county roads (3,540 tons). While rural county roads have the lowest amount of litter per mile per year, the total amount (tons per year) is quite high because there are many more miles of road in this category than in any of the other categories. Urban county roads generate the least amount (857 tons per year), and rural interstate and U.S. routes generate the most (2,933 tons per year).

Table 6. Total Quantity of Litter Generated on Roads Annually

Sample Type		Miles of Road	Quantity of Litter			
			Pounds per Year	Tons per Year		
				Mean	Low	High
Interstate and U.S. Routes			**8,731,280**	**4,365**	**3,270**	**5,462**
	Rural	3,530	5,866,681	2,933	1,418	4,449
	Urban	1,714	2,864,599	1,432	1,080	1,785
State Routes			**6,948,424**	**3,474**	**2,966**	**3,982**
	Rural	11,744	4,812,780	2,406	1,718	3,095
	Urban	2,312	2,135,643	1,068	870	1,266
County Roads			**7,080,707**	**3,540**	**2,638**	**4,443**
	Rural	26,811	5,366,952	2,684	1,416	3,951
	Urban	2,324	1,713,755	857	706	1,008
All Roads			**22,760,410**	**11,380**	**10,524**	**12,236**

3. Generation per Mile Driven

Litter generation rates per mile driven were calculated using daily vehicle miles driven (DVMD) for both interstate and U.S. routes and state routes. Table 7 shows urban roads have less litter deposited per 1,000 miles driven than rural roads. Approximately 0.11 pounds of litter were deposited per 1,000 miles driven on urban interstate and U.S. routes compared to 0.30 pounds per 1,000 miles driven on rural interstate and U.S. routes.

For state routes, the results were similar—0.17 pounds per 1,000 miles driven in urban areas and 0.36 pounds in rural areas. On average, 0.19 pounds of litter are deposited per 1,000 miles driven on interstate and U.S. routes, and 0.27 pounds of litter are deposited per 1,000 miles driven on state routes. One theory for this difference may be that there is a perception that littering in rural areas is less harmful or that the likelihood of being seen or caught by police is higher in urban areas than in rural areas.

Table 7. Quantity of Litter Generated per Mile Driven

Sample Type		kDVMD[1]	Miles Driven per Year (in thousands)[2]	Litter Generated per Year (pounds)[3]	Litter Generated (pounds per 1,000 miles driven)
Interstate and U.S. Routes			**46,346,970**	**8,731,280**	**0.19**
	Rural	53,097	19,380,405	5,866,681	0.30
	Urban	73,881	26,966,565	2,864,599	0.11
State Routes			**26,057,350**	**6,948,424**	**0.27**
	Rural	36,933	13,480,545	4,812,780	0.36
	Urban	34,457	12,576,805	2,135,643	0.17

[1] kDVMD equals daily vehicle miles driven in thousands.

[2] The miles driven per year in thousands was calculated by multiplying kDVMT by 365 days per year.

[3] These data are from Table 5.

B. Roadways by Estimated Volume

Methodology

The volume of all litter collected was estimated as the litter was sorted and weighed in each subcategory. These estimates are based on non-compacted, loose litter. The volumes of the litter collected are only estimates. Generation rates were calculated in cubic yards per mile per year and cubic yards per year.

Results

1. Generation Rates

The volume of litter generated annually per mile of road was **highest for interstate and U.S. routes—6.9 cubic yards per mile per year—and lowest on county roads—1.7 cubic yards per mile per year.** Table 8 shows the estimated litter volume generated annually for all roads.

Table 8. Estimated Volume of Litter Generated on Roads

Sample Type		Estimated Volume of Litter (cubic yards per mile per year)		
		Mean	Low	High
Interstate and U.S. Routes		**6.9**	**5.6**	**8.3**
	Rural	6.6	3.8	9.4
	Urban	7.6	6.0	9.2
State Routes		**3.1**	**2.8**	**3.3**
	Rural	2.8	2.3	3.2
	Urban	4.6	4.0	5.2
County Roads		**1.7**	**1.4**	**2.1**
	Rural	1.5	1.0	2.0
	Urban	4.3	3.7	4.9
All Roads Weighted Average		**2.7**	**2.6**	**2.9**

2. Total Generation

The volume of litter generated annually on roads was **highest for rural county roads—40,502 cubic yards per year—and lowest on urban county roads—9,960 cubic yards per year.** Table 9 shows the estimated litter volume generated annually for all roads.

Table 9. Estimated Volume of Litter Generated on Roads Annually

Sample Type		Estimated Volume of Litter (cubic yards per year)		
		Mean	Low	High
Interstate and U.S. Routes		**36,342**	**29,098**	**43,587**
	Rural	23,310	12,391	33,230
	Urban	13,032	10,325	15,739
State Routes		**43,095**	**39,373**	**46,817**
	Rural	32,579	27,518	37,640
	Urban	10,516	9,130	11,903
County Roads		**50,462**	**40,473**	**60,451**
	Rural	40,502	26,445	54,559
	Urban	9,960	8,546	11,375

C. Interchanges by Weight

Methodology

Interchange litter generation data were analyzed in two ways—pounds of litter generated per interchange and litter generated statewide on interchanges in tons per year.

Results

1. Generation Rates

Table 10 shows urban interchanges generated nearly twice as much litter as rural interchanges—mirroring the trends identified in the roadway data. **Urban interchanges generated 868 pounds per interchange compared to 476 pounds per interchange for rural sites—a statistically significant difference.** The mean litter generation rate for interchanges was 742 pounds per interchange annually.

Table 10. Quantity of Litter Generated on Interchanges

Sample Type		Quantity of Litter (pounds per interchange per year)		
		Mean	Low	High
Interchanges		**742**	**636**	**850**
	Urban	868	652	1,085
	Rural	476	364	587

2. Total Generation

Table 11 indicates that nearly **four times more litter was deposited on urban interchanges (314 tons) as compared to rural interchanges (79 tons) annually.** On average, these data show 393 tons of litter were deposited annually on all interchanges throughout Ohio.

Table 11. Total Quantity of Litter Generated on Interchanges Annually

Sample Type		Total Litter (tons per year)		
		Mean	Low	High
Interchanges		**392**	**336**	**449**
	Urban	313	235	392
	Rural	79	61	98

D. Interchanges by Estimated Volume

Methodology

The volume of all litter collected was estimated as the litter was sorted and weighed in each subcategory. These estimates are based on non-compacted, loose litter. The volumes of the litter collected are only estimates. Generation rates were calculated in cubic yards per interchange per year and cubic yards per year on all interchanges.

Results

1. Generation Rates

Estimated litter volumes generated per interchange annually are shown in Table 12. **Urban interchanges generated significantly more litter annually per interchange (3.2 cubic yards) than rural interchanges (2.1 cubic yards).**

Table 12. Estimated Volume of Litter Generated on Interchanges

Sample Type		Estimated Volume of Litter (cubic yards per interchange per year)		
		Mean	Low	High
Interchanges		**2.8**	**2.5**	**3.2**
	Rural	2.1	1.8	2.4
	Urban	3.2	2.4	3.9

2. Total Generation

Estimated litter volumes generated annually on all interchanges are shown in Table 13. **Urban interchanges generated significantly more litter annually per interchange (2,275 cubic yards) than rural interchanges (699 cubic yards).**

Table 13. Estimated Volume of Litter Generated on Interchanges Annually

Sample Type		Estimated Volume of Litter (cubic yards per year)		
		Mean	Low	High
Interchange		**2,974**	**2,334**	**3,617**
	Rural	699	1,749	2,805
	Urban	2,275	585	812

II. Litter Composition by Weight and Estimated Volume

Definition

Litter composition refers to the types of materials found in the litter samples. The litter was sorted into nine litter type categories—paper, plastic, glass, metal, organic materials, construction and demolition materials, hazardous materials, other materials, and other miscellaneous debris. Each litter type category was further sorted into a total of 63 subcategories; refer to the *Procedures Manual* in Appendix E for definitions of the litter subcategories.

Methodology

The composition estimates and the generation rates were calculated at a 90 percent confidence interval. The averages were also weighted based on the universe of road miles and the number of interchanges (Appendix B). Detailed composition results of the litter type subcategories for all roads and interchanges based on weight are shown in Tables 17-19, 21, 23, and 25 following this section. Detailed composition results of the nine litter type categories based on the estimated volume for all roads and interchanges are shown in Tables 20, 22, 24, and 26 following this section.

A. Composition Overview by Weight and Estimated Volume

1. Weight Results

Interestingly, 84 percent of all items (by weight) were in 35 subcategories. Of the 63 subcategories of litter, no items were observed in any of the samples for four subcategories: *Paper—Alcoholic Beverage Containers*, *Glass—Fast Food*, *Hazardous Materials—Latex Paint,* and *Hazardous Materials—Pesticides/Herbicides*.

The composition results were summarized based on the nine litter type categories for all sample types as shown in Table 14. These results will be discussed in more detail in the following sections; detailed results are shown in Tables 18-20, 22, 24, and 26. Overall, the *Plastic* and *Glass* categories contained the most litter with more than 2,000 tons each. The *Paper*, *Metal*, and *Other* categories contained more than 1,000 tons each. The category containing the least amount of litter was *Hazardous Materials* with only 79 tons.

Table 14. Weight Composition Summary of Litter Type Categories

Type of Litter	Total Weight (tons per year)					
	Interstate and U.S. Routes	State Routes	County Roads	All Roads	Interchanges	Total
Paper	597	489	730	1,816	73	**1,889**
Plastic	852	706	628	2,186	60	**2,245**
Glass	311	668	1,012	1,992	48	**2,039**
Metal	526	369	490	1,385	50	**1,435**
Organic	111	632	74	818	89	**907**
Construction and Demolition	215	201	191	606	26	**632**
Hazardous Material	26	11	41	78	1	**79**
Other	1,454	218	196	1,868	26	**1,893**
Miscellaneous Debris	274	180	179	631	21	**653**
Total	**4,365**	**3,474**	**3,540**	**11,380**	**392**	**11,772**

For the combined roads and interchanges data, several litter type subcategories were consolidated into groups based on similarities (*e.g.*, all beverage containers) to identify trends. Table 15 shows the groups of similar components and the percentage of total tons annually for each group. **Nearly one-half (45 percent) of all litter was comprised of beverage containers (27 percent) and automobile parts (18 percent).** Other significant categories are cardboard, newspaper, and magazines (7 percent) and paper bags and plastic bags and film (6 percent), and construction debris (5 percent). Cigarette butts composed 4 percent of the total litter.

Table 15. Weight Composition Summary of Similar Litter Type Categories for All Roads and Interchanges

Groups of Similar Litter Categories	Tons Per Year	Percent of Total Tons Per Year
Alcoholic Beverage Containers	2,137	18%
Auto Parts	2,084	18%
Non-Alcoholic Beverage Containers	1,097	9%
Cardboard, Newspaper, and Magazines	851	7%
Paper Bags, and Plastic Bags and Film	722	6%
Miscellaneous Debris	653	6%
Construction Debris	632	5%
Food	482	4%
Fast Food (Including Fast Food Beverage Containers)	475	4%
Cigarette Butts	422	4%
Total	**9,554**	**81%**

2. Estimated Volume Results

Table 16 shows the estimated volumes observed for each of the main litter categories. The *Plastic* category contained the highest overall volume for all types of sites sampled. **Overall, plastic items were 37 percent (49,509 cubic yards) of the total volume.** Detailed composition results of the main sample categories for all roads and interchanges are shown in Tables 20, 22, 24, and 26.

Table 16. Estimated Volume Composition Summary of Litter Type Categories

Type of Litter	Total Estimated Volume (cubic yards)					
	Interstate and U.S. Routes	State Routes	County Roads	All Roads	Interchanges	Total
Paper	4,560	5,354	6,312	16,226	472	**16,698**
Plastic	12,098	16,681	19,694	48,474	1,035	**49,509**
Glass	2,199	4,678	5,672	12,549	28	**12,577**
Metal	3,332	4,285	4,139	11,756	192	**11,949**
Organic	869	3,483	490	4,842	658	**5,499**
Construction and Demolition	3,250	3,495	5,312	12,057	153	**12,211**
Hazardous Material	266	414	2,141	2,820	49	**2,869**
Other	7,741	1,593	1,847	11,181	244	**11,424**
Miscellaneous Debris	2,027	3,111	4,856	9,994	143	**10,137**
Total	**36,342**	**43,095**	**50,462**	**129,899**	**2,974**	**132,873**

B. Detailed Composition by Weight and Estimated Volume

1. All Roads and Interchanges

Weight Results

Figure 2 shows the total litter composition for all roads and interchanges sampled. **Overall, 69 percent of the litter collected was in either the *Plastic* (19.1 percent), *Glass* (17.3 percent), *Other* (16.1 percent), or *Paper* (16.0 percent) category.** The *Hazardous Materials* category only contributed to 0.7 percent of the total litter for all sites.

The detailed composition table for all roads and interchanges combined is shown in Table 17. This table shows the total tons for all categories and subcategories, the percent of the total weight for each category and subcategory, and the percent of each subcategory within the main categories. The high and low percents for these total tons data **cannot** be calculated due to the difference in weighting the data for roads (using number of miles) versus weighting the data for interchanges (using quantity of interchanges).

Figure 2. All Roads and Interchanges Weight Composition

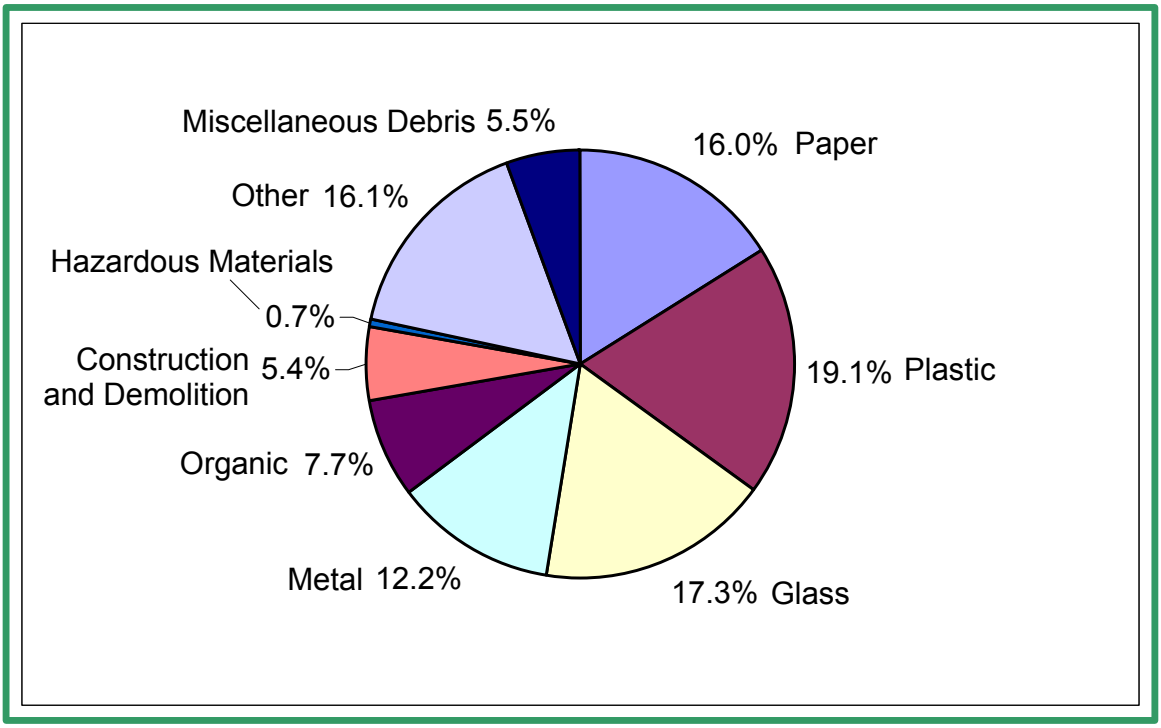


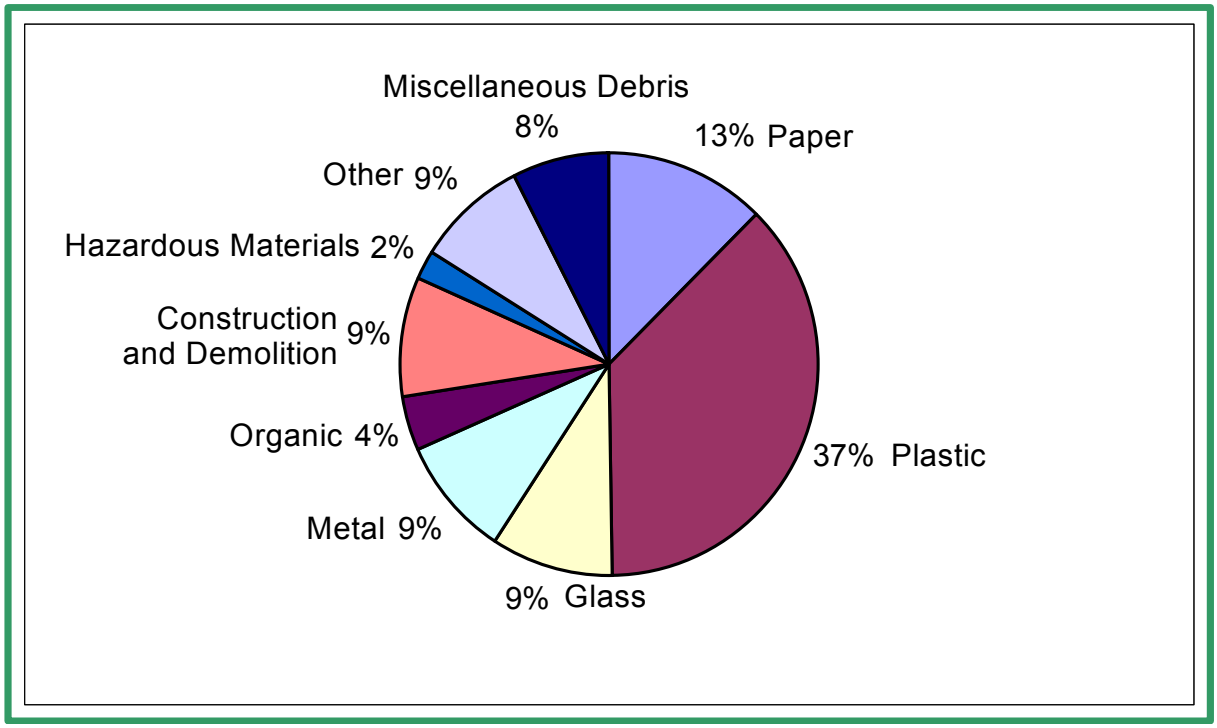
Table 17. All Roads and Interchanges Detailed Weight Composition

Litter Type Categories and Subcategories	Total Tons	% Total Tons	% Category Total
1. Paper	**1,889.40**	**16.0%**	**100%**
1.1a Alcoholic Beverage Containers	0.00	-	-
1.1b Non-Alcoholic Beverage Containers	24.35	0.2%	1.3%
1.2 Fast Food	274.07	2.3%	14.5%
1.3 Other Food	115.71	1.0%	6.1%
1.4 Non-Food	133.42	1.1%	7.1%
1.5 Cardboard	486.89	4.1%	25.8%
1.6 Paper Bags	173.17	1.5%	9.2%
1.7 Newspaper and Magazines	363.74	3.1%	19.3%
1.8 Other Paper	318.05	2.7%	16.8%
2. Plastic	**2,245.39**	**19.1%**	**100%**
2.1a Alcoholic Beverage Containers	58.54	0.5%	2.6%
2.1b Non-Alcoholic Beverage Containers	616.49	5.2%	27.5%
2.2 Fast Food	191.77	1.6%	8.5%
2.3 Other Food	155.84	1.3%	6.9%
2.4 Non-Food	79.76	0.7%	3.6%
2.5 Bags and Films	548.42	4.7%	24.4%
2.6 Auto Parts	275.88	2.3%	12.3%
2.7 Other	318.69	2.7%	14.2%
3. Glass	**2,038.96**	**17.3%**	**100%**
3.1a Alcoholic Beverage Containers	1,676.95	14.2%	82.2%
3.1b Non-Alcoholic Beverage Containers	222.51	1.9%	10.9%
3.2 Fast Food	0.00	-	-
3.3 Other Food	1.01	<0.1%	<0.1%
3.4 Non-Food	0.17	<0.1%	<0.1%
3.5 Auto Parts	0.40	<0.1%	<0.1%
3.6 Other	137.92	1.2%	6.8%
4. Metal	**1,434.66**	**12.2%**	**100%**
4.1a Alcoholic Beverage Containers	401.44	3.4%	28.0%
4.1b Non-Alcoholic Beverage Containers	233.97	2.0%	16.3%
4.2 Fast Food	8.70	0.1%	0.6%
4.3 Other Food	31.29	0.3%	2.2%
4.4 Non-Food	17.59	0.1%	1.2%
4.5 Auto Parts	414.31	3.5%	28.9%
4.6 Other	327.36	2.8%	22.8%
5. Organic	**906.58**	**7.7%**	**100%**
5.1 Foods	482.20	4.1%	53.2%
5.2 Cigarettes	421.77	3.6%	46.5%
5.3 Other	2.61	<0.1%	0.3%
6. Construction and Demolition	**631.81**	**5.4%**	**100%**
6.1 Wood and Lumber	315.74	2.7%	50.0%
6.2 Mineral Aggregates	6.26	0.1%	1.0%
6.3 Roofing Material	89.41	0.8%	14.2%
6.4 Insulation	15.95	0.1%	2.5%
6.5 Dry Wall	7.63	0.1%	1.2%
6.6 Styrofoam	164.22	1.4%	26.0%
6.7 Other	32.60	0.3%	5.2%
7. Hazardous Material	**79.32**	**0.7%**	**100%**
7.1 Latex Paint	0.00	-	-
7.2 Oil-Based Paint	1.51	<0.1%	1.9%
7.3 Oil	7.33	0.1%	9.2%
7.4 Batteries	1.85	<0.1%	2.3%
7.5 Flammable Gas	0.12	<0.1%	0.2%
7.6 Flammable Liquids	19.58	0.2%	24.7%
7.7 Explosives	0.23	<0.1%	0.3%
7.8 Pesticides/Herbicides	0.00	-	-
7.9 Cleaners	14.39	0.1%	18.1%
7.10 Medical Waste	0.51	<0.1%	0.6%
7.11 Other Hazardous Materials	33.80	0.3%	42.6%
8. Other	**1,893.43**	**16.1%**	**100%**
8.1 Textiles and Leather	266.59	2.3%	14.1%
8.2 Carpet	47.87	0.4%	2.5%
8.3 Furniture	36.85	0.3%	1.9%
8.4 Tires	666.93	5.7%	35.2%
8.5 Auto Rubber	726.75	6.2%	38.4%
8.6 Rubber/Latex Toiletries	6.50	0.1%	0.3%
8.7 Other Rubber or Latex	41.13	0.3%	2.2%
8.9 Ceramic/Porcelain	4.64	<0.1%	0.2%
8.10 Toys/Sporting Goods	13.61	0.1%	0.7%
8.11 Miscellaneous Materials	78.53	0.7%	4.1%
8.12 Hygiene Products	4.03	<0.1%	0.2%
9. Other Miscellaneous Debris	**652.79**	**5.5%**	**100%**
Total Tons	**11,772.34**		

Estimated Volume Results

When all data were combined for roads and interchanges, **the *Plastic* category was the largest component, comprising 37 percent of the total estimated litter volume. The second largest category was *Paper*—13 percent of the total.** The *Glass*, *Metal*, *Construction and Demolition*, and *Other* categories each comprised 9 percent of the total estimated volume. Figure 3 shows the estimated volume percent composition of items found on all roads and interchanges. Table 16 (at the beginning of this section) shows the estimated volume in cubic yards for all roads and interchanges combined.

Figure 3. All Roads and Interchanges Estimated Volume Composition



2. All Roads

Weight Results

Figure 4 shows the composition of all roads combined. **Plastic items comprised the highest percentage of litter generated on all roads—19.2 percent.** Slightly more than 50 percent of the total litter generated was composed of paper, plastic, and glass materials. **The *Other* category also contributed largely to the overall amount of litter on Ohio's roads with 16.4 percent; *Tires* and *Auto Rubber* contributed to 74 percent of this category.** The detailed composition for all roads results are shown in Table 18.

Figure 4. All Roads Weight Composition

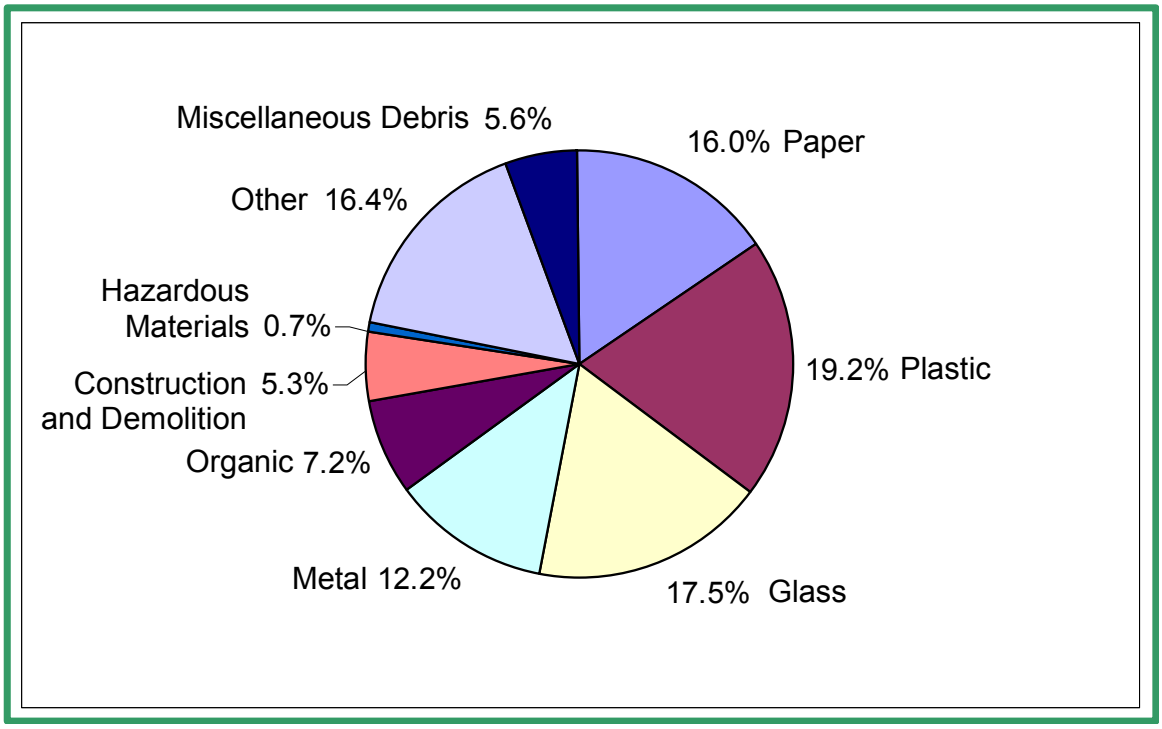


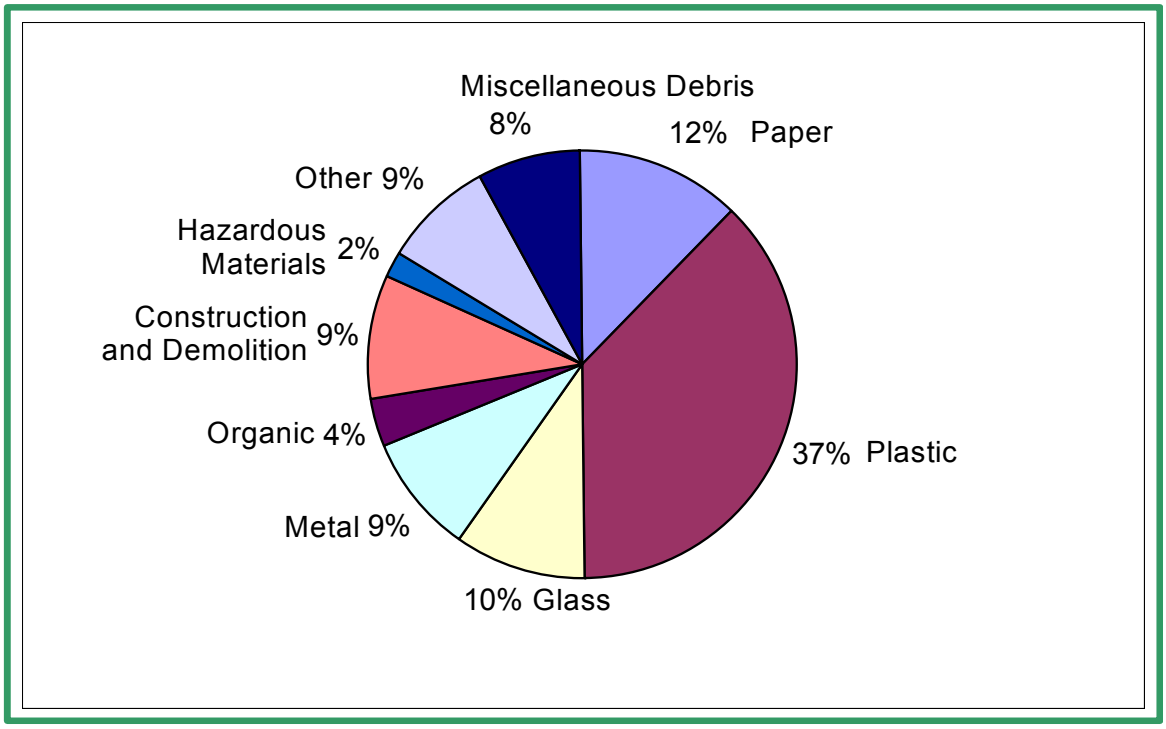
Table 18. All Roads Detailed Weight Composition

Litter Type Categories and Subcategories	Total Tons	% Mean	Low %	High %
1. Paper	**1,816.36**	**16.0%**	**14.4%**	**17.5%**
1.1a Alcoholic Beverage Containers	0.00	-	-	-
1.1b Non-Alcoholic Beverage Containers	24.27	0.2%	0.2%	0.2%
1.2 Fast Food	262.10	2.3%	2.1%	2.5%
1.3 Other Food	113.50	1.0%	0.8%	1.1%
1.4 Non-Food	127.40	1.1%	1.0%	1.3%
1.5 Cardboard	463.97	4.1%	3.4%	4.7%
1.6 Paper Bags	169.44	1.5%	0.8%	2.1%
1.7 Newspaper and Magazines	352.65	3.1%	2.1%	4.1%
1.8 Other Paper	303.03	2.7%	2.4%	2.9%
2. Plastic	**2,185.56**	**19.2%**	**17.8%**	**20.6%**
2.1a Alcoholic Beverage Containers	58.51	0.5%	0.4%	0.6%
2.1b Non-Alcoholic Beverage Containers	605.62	5.3%	4.7%	5.9%
2.2 Fast Food	184.95	1.6%	1.5%	1.8%
2.3 Other Food	151.30	1.3%	1.2%	1.4%
2.4 Non-Food	74.37	0.7%	0.6%	0.7%
2.5 Bags and Films	536.59	4.7%	4.2%	5.3%
2.6 Auto Parts	263.22	2.3%	1.9%	2.7%
2.7 Other	311.00	2.7%	2.4%	3.1%
3. Glass	**1,991.49**	**17.5%**	**15.4%**	**19.6%**
3.1a Alcoholic Beverage Containers	1,635.01	14.4%	12.6%	16.1%
3.1b Non-Alcoholic Beverage Containers	219.66	1.9%	1.7%	2.2%
3.2 Fast Food	0.00	-	-	-
3.3 Other Food	0.94	<0.1%	<0.1%	<0.1%
3.4 Non-Food	0.13	<0.1%	<0.1%	<0.1%
3.5 Auto Parts	0.36	<0.1%	<0.1%	<0.1%
3.6 Other	135.39	1.2%	0.9%	1.4%
4. Metal	**1,385.10**	**12.2%**	**11.1%**	**13.2%**
4.1a Alcoholic Beverage Containers	394.68	3.5%	3.2%	3.7%
4.1b Non-Alcoholic Beverage Containers	227.98	2.0%	1.8%	2.2%
4.2 Fast Food	8.40	0.1%	0.1%	0.1%
4.3 Other Food	30.91	0.3%	0.2%	0.4%
4.4 Non-Food	17.24	0.2%	0.1%	0.2%
4.5 Auto Parts	401.92	3.5%	2.8%	4.2%
4.6 Other	303.97	2.7%	2.2%	3.1%
5. Organic	**817.76**	**7.2%**	**4.8%**	**9.6%**
5.1 Foods	477.31	4.2%	1.8%	6.6%
5.2 Cigarettes	337.87	3.0%	2.6%	3.4%
5.3 Other	2.58	<0.1%	<0.1%	<0.1%
6. Construction and Demolition	**606.33**	**5.3%**	**4.7%**	**5.9%**
6.1 Wood and Lumber	296.50	2.6%	2.2%	3.1%
6.2 Mineral Aggregates	6.01	0.1%	<0.1%	0.1%
6.3 Roofing Material	87.82	0.8%	0.6%	1.0%
6.4 Insulation	15.27	0.1%	0.1%	0.2%
6.5 Dry Wall	7.23	0.1%	<0.1%	0.1%
6.6 Styrofoam	161.48	1.4%	1.1%	1.7%
6.7 Other	32.02	0.3%	0.2%	0.3%
7. Hazardous Material	**78.17**	**0.7%**	**0.5%**	**0.9%**
7.1 Latex Paint	0.00	-	-	-
7.2 Oil-Based Paint	1.51	<0.1%	<0.1%	<0.1%
7.3 Oil	7.10	0.1%	<0.1%	0.1%
7.4 Batteries	1.71	<0.1%	<0.1%	<0.1%
7.5 Flammable Gas	0.00	-	-	-
7.6 Flammable Liquids	19.58	0.2%	0.1%	0.3%
7.7 Explosives	0.23	<0.1%	<0.1%	<0.1%
7.8 Pesticides/Herbicides	0.00	-	-	-
7.9 Cleaners	14.37	0.1%	0.1%	0.2%
7.10 Medical Waste	0.50	<0.1%	<0.1%	<0.1%
7.11 Other Hazardous Materials	33.17	0.3%	0.1%	0.5%
8. Other	**1,867.53**	**16.4%**	**13.3%**	**19.5%**
8.1 Textiles and Leather	256.88	2.3%	1.9%	2.7%
8.2 Carpet	47.11	0.4%	0.2%	0.6%
8.3 Furniture	36.85	0.3%	0.1%	0.5%
8.4 Tires	661.41	5.8%	3.7%	8.0%
8.5 Auto Rubber	721.76	6.3%	4.4%	8.3%
8.6 Rubber/Latex Toiletries	6.13	0.1%	<0.1%	0.1%
8.7 Other Rubber or Latex	39.15	0.3%	0.3%	0.4%
8.9 Ceramic/Porcelain	3.14	<0.1%	<0.1%	<0.1%
8.10 Toys/Sporting Goods	13.38	0.1%	0.1%	0.1%
8.11 Miscellaneous Materials	77.71	0.7%	0.5%	0.9%
8.12 Hygiene Products	4.01	<0.1%	<0.1%	0.1%
9. Other Miscellaneous Debris	**631.82**	**5.6%**	**5.1%**	**6.0%**
Total Tons	**11,380.12**			

Estimated Volume Results

***Plastic* items comprised 37 percent of all litter found when the data from all roads are combined.** *Paper* and *Glass* were the second and third highest categories; they were 12 percent and 10 percent, respectively, of the total estimated volume. However, when the composition was analyzed by weight, the three highest components were more evenly distributed—19 percent *Plastic*, 18 percent *Glass*, and 16 percent *Paper* (see Figure 4). Figure 5 shows the estimated volume percent composition of items found on all roads. Table 16 (at the beginning of this section) shows the estimated volume in cubic yards for all roads combined.

Figure 5. All Roads Estimated Volume Composition



3. *Interstate and U.S. Routes*

Weight Results

Figure 6 illustrates the general composition of litter on interstate and U.S. routes. **The *Other* category contained one-third of the total litter; of this one-third, 86 percent was *Auto Rubber* and *Tires.* Plastic and paper items combined also contribute to one-third of the total litter on these roads.** Compared to the other road types, there was significantly less litter in the *Glass* category and more litter in the *Other* category. Table 19 shows the detailed composition of all subcategories for interstate and U.S. routes.

Figure 6. Interstate and U.S. Routes Weight Composition

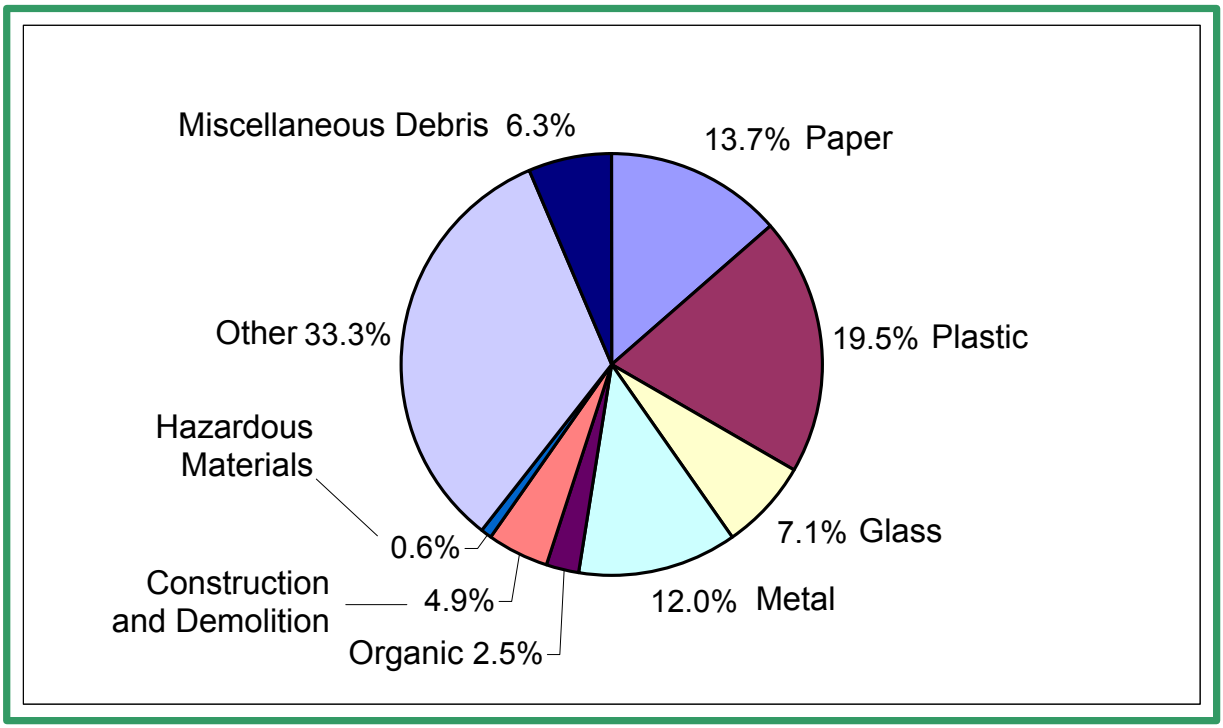


Table 19. Interstate and U. S. Routes Detailed Weight Composition

Litter Type Categories and Subcategories	Rural and Urban Combined				Rural		Urban	
	Tons	% Mean	Low %	High %	Tons	% Mean	Tons	% Mean
1. Paper	**597.06**	**13.7%**			**272.75**	**9.3%**	**324.31**	**22.6%**
1.1a Alcoholic Beverage Containers	0.00	-	-	-	0.00	-	0.00	-
1.1b Non-Alcoholic Beverage Containers	10.54	0.2%	0.2%	0.3%	8.82	0.3%	1.72	0.1%
1.2 Fast Food	83.52	1.9%	1.5%	2.4%	57.29	2.0%	26.23	1.8%
1.3 Other Food	33.25	0.8%	0.4%	1.1%	20.83	0.7%	12.42	0.9%
1.4 Non-Food	46.03	1.1%	0.8%	1.4%	25.67	0.9%	20.36	1.4%
1.5 Cardboard	205.12	4.7%	3.2%	6.2%	63.48	2.2%	141.64	9.9%
1.6 Paper Bags	38.05	0.9%	0.5%	1.2%	17.54	0.6%	20.51	1.4%
1.7 Newspaper and Magazines	62.15	1.4%	0.8%	2.0%	32.02	1.1%	30.13	2.1%
1.8 Other Paper	118.40	2.7%	2.0%	3.4%	47.10	1.6%	71.30	5.0%
2. Plastic	**851.98**	**19.5%**			**476.70**	**16.3%**	**375.28**	**26.2%**
2.1a Alcoholic Beverage Containers	10.00	0.2%	0.1%	0.3%	9.84	0.3%	0.16	<0.1%
2.1b Non-Alcoholic Beverage Containers	112.79	2.6%	1.8%	3.4%	84.24	2.9%	28.55	2.0%
2.2 Fast Food	53.28	1.2%	0.9%	1.5%	32.27	1.1%	21.01	1.5%
2.3 Other Food	55.64	1.3%	0.9%	1.6%	39.63	1.4%	16.01	1.1%
2.4 Non-Food	26.82	0.6%	0.4%	0.8%	13.43	0.5%	13.39	0.9%
2.5 Bags and Films	236.41	5.4%	3.9%	6.9%	106.85	3.6%	129.56	9.0%
2.6 Auto Parts	177.29	4.1%	2.5%	5.6%	72.86	2.5%	104.43	7.3%
2.7 Other	179.75	4.1%	2.9%	5.3%	117.58	4.0%	62.17	4.3%
3. Glass	**311.31**	**7.1%**			**200.97**	**6.9%**	**110.34**	**7.7%**
3.1a Alcoholic Beverage Containers	262.42	6.0%	4.4%	7.6%	173.08	5.9%	89.34	6.2%
3.1b Non-Alcoholic Beverage Containers	28.29	0.6%	0.4%	0.9%	20.23	0.7%	8.06	0.6%
3.2 Fast Food	0.00	-	-	-	0.00	-	0.00	-
3.3 Other Food	0.94	<0.1%	<0.1%	<0.1%	0.00	-	0.94	0.1%
3.4 Non-Food	0.13	<0.1%	<0.1%	<0.1%	0.00	-	0.13	<0.1%
3.5 Auto Parts	0.27	<0.1%	<0.1%	<0.1%	0.27	<0.1%	0.00	-
3.6 Other	19.26	0.4%	0.3%	0.6%	7.39	0.3%	11.87	0.8%
4. Metal	**525.85**	**12.0%**			**351.06**	**12.0%**	**174.79**	**12.2%**
4.1a Alcoholic Beverage Containers	55.86	1.3%	1.0%	1.6%	38.89	1.3%	16.97	1.2%
4.1b Non-Alcoholic Beverage Containers	60.46	1.4%	0.9%	1.8%	49.41	1.7%	11.05	0.8%
4.2 Fast Food	4.06	0.1%	<0.1%	0.2%	2.82	0.1%	1.24	0.1%
4.3 Other Food	8.59	0.2%	0.1%	0.3%	5.79	0.2%	2.80	0.2%
4.4 Non-Food	6.59	0.2%	<0.1%	0.3%	5.29	0.2%	1.30	0.1%
4.5 Auto Parts	242.46	5.6%	2.9%	8.2%	192.87	6.6%	49.59	3.5%
4.6 Other	147.83	3.4%	2.3%	4.5%	55.99	1.9%	91.84	6.4%
5. Organic	**111.29**	**2.5%**			**28.93**	**1.0%**	**82.36**	**5.8%**
5.1 Foods	5.70	0.1%	0.1%	0.2%	2.65	0.1%	3.05	0.2%
5.2 Cigarettes	105.59	2.4%	1.9%	2.9%	26.28	0.9%	79.31	5.5%
5.3 Other	0.00	-	-	-	0.00	-	0.00	-
6. Construction and Demolition	**214.59**	**4.9%**			**99.89**	**3.4%**	**114.70**	**8.0%**
6.1 Wood and Lumber	93.30	2.1%	1.5%	2.8%	46.35	1.6%	46.95	3.3%
6.2 Mineral Aggregates	5.83	0.1%	<0.1%	0.3%	0.03	<0.1%	5.80	0.4%
6.3 Roofing Material	36.54	0.8%	0.5%	1.2%	17.20	0.6%	19.34	1.4%
6.4 Insulation	12.60	0.3%	0.1%	0.4%	9.75	0.3%	2.85	0.2%
6.5 Dry Wall	0.58	<0.1%	<0.1%	<0.1%	0.00	-	0.58	<0.1%
6.6 Styrofoam	49.98	1.1%	0.9%	1.4%	25.26	0.9%	24.72	1.7%
6.7 Other	15.76	0.4%	0.2%	0.6%	1.30	<0.1%	14.46	1.0%
7. Hazardous Material	**25.66**	**0.6%**			**23.34**	**0.8%**	**2.32**	**0.2%**
7.1 Latex Paint	0.00	-	-	-	0.00	-	0.00	-
7.2 Oil Based Paint	1.51	<0.1%	<0.1%	0.1%	0.00	-	1.51	0.1%
7.3 Oil	0.15	<0.1%	<0.1%	<0.1%	0.03	<0.1%	0.12	<0.1%
7.4 Batteries	0.63	<0.1%	<0.1%	<0.1%	0.57	<0.1%	0.06	<0.1%
7.5 Flammable Gas	0.00	-	-	-	0.00	-	0.00	-
7.6 Flammable Liquids	14.78	0.3%	<0.1%	0.7%	14.78	0.5%	0.00	-
7.7 Explosives	0.00	-	-	-	0.00	-	0.00	-
7.8 Pesticides/Herbicides	0.00	-	-	-	0.00	-	0.00	-
7.9 Cleaners	7.96	0.2%	<0.1%	0.4%	7.96	0.3%	0.00	-
7.10 Medical Waste	0.00	-	-	-	0.00	-	0.00	-
7.11 Other Hazardous Materials	0.63	<0.1%	<0.1%	<0.1%	0.00	-	0.63	<0.1%
8. Other	**1,453.76**	**33.3%**			**1,310.73**	**44.7%**	**143.03**	**10.0%**
8.1 Textiles and Leather	127.65	2.9%	1.8%	4.1%	84.87	2.9%	42.78	3.0%
8.2 Carpet	12.61	0.3%	<0.1%	0.5%	3.52	0.1%	9.09	0.6%
8.3 Furniture	3.44	0.1%	<0.1%	0.2%	0.00	-	3.44	0.2%
8.4 Tires	616.53	14.1%	4.1%	24.1%	582.80	19.9%	33.73	2.4%
8.5 Auto Rubber	636.31	14.6%	5.5%	23.6%	605.91	20.7%	30.40	2.1%
8.6 Rubber/Latex Toiletries	4.33	0.1%	<0.1%	0.2%	0.13	<0.1%	4.20	0.3%
8.7 Other Rubber or Latex	13.21	0.3%	0.2%	0.4%	3.52	0.1%	9.69	0.7%
8.9 Ceramic/Porcelain	2.09	<0.1%	<0.1%	0.1%	0.54	<0.1%	1.55	0.1%
8.10 Toys/Sporting Goods	4.10	0.1%	<0.1%	0.2%	0.26	<0.1%	3.84	0.3%
8.11 Miscellaneous Materials	32.97	0.8%	<0.1%	1.5%	28.86	1.0%	4.11	0.3%
8.12 Hygiene Products	0.52	<0.1%	<0.1%	<0.1%	0.32	<0.1%	0.20	<0.1%
9. Other Miscellaneous Debris	**273.67**	**6.3%**			**168.53**	**5.7%**	**105.14**	**7.3%**
Total Tons	**4,365.17**				**2,932.90**		**1,432.27**	

Estimated Volume Results

One-third of the estimated volume of litter on interstate and U.S. routes was composed of plastic items. The *Other* and *Paper* categories were the second and third largest components with 21 percent and 13 percent, respectively. This differs from the percentage of litter types based on weight, where the *Other* category comprised one-third of the litter composition (Figure 6). Figure 7 shows the estimated volume percent composition of items found on interstate and U.S. routes, and Table 20 shows the more detailed estimated volume composition data.

Figure 7. Interstate and U.S. Routes Estimated Volume Composition

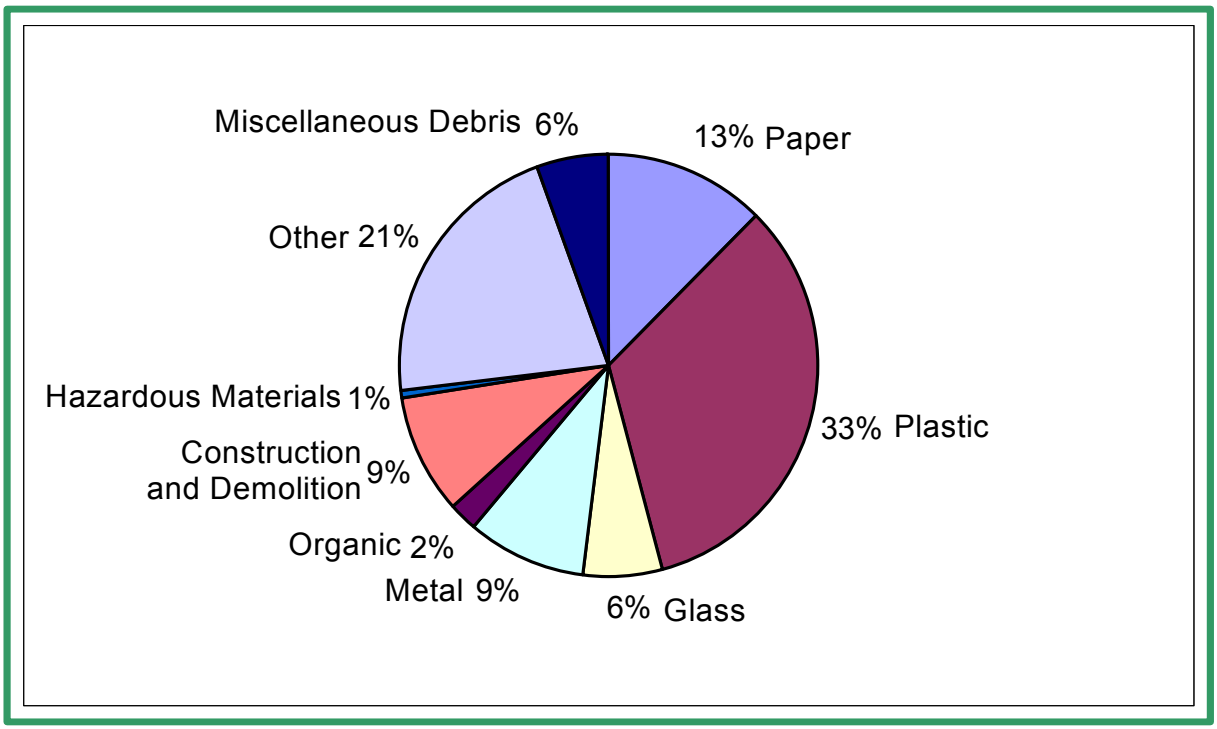


Table 20. Interstate and U.S. Routes Estimated Volume Composition

Litter Type Categories and Subcategories	Rural and Urban				Rural		Urban	
	Cubic Yards	% Mean	Low %	High %	Cubic Yards	% Mean	Cubic Yards	% Mean
1. Paper	4,559.83	12.5%	9.4%	15.7%	2,571.71	11.0%	1,988.12	15.3%
2. Plastic	12,098.48	33.3%	26.9%	39.7%	7,025.68	30.1%	5,072.80	38.9%
3. Glass	2,198.89	6.1%	4.9%	7.2%	1,438.01	6.2%	760.88	5.8%
4. Metal	3,332.11	9.2%	7.1%	11.2%	2,328.08	10.0%	1,004.03	7.7%
5. Organic	869.20	2.4%	1.9%	2.9%	224.82	1.0%	644.38	4.9%
6. Construction and Demolition	3,249.69	8.9%	7.3%	10.5%	1,687.27	7.2%	1,562.42	12.0%
7. Hazardous Waste	265.82	0.7%	0.1%	1.4%	90.32	0.4%	175.50	1.3%
8. Other	7,740.79	21.3%	11.9%	30.7%	6,682.37	28.7%	1,058.42	8.1%
9. Miscellaneous Debris	2,027.32	5.6%	4.7%	6.5%	1,261.83	5.4%	765.49	5.9%
TOTAL	**36,342.13**				**23,310.09**		**13,032.04**	

4. State Routes

Weight Results

The composition results for state routes are shown in Figure 8. The composition of litter found on state routes was similar to the other road types. More than 50 percent of the litter was composed of paper, plastic, and glass. **The outstanding difference was the *Organic* component, which was significantly higher (18.2 percent) than the other road types due to an unusually high percentage of material in the *Foods* subcategory.** Please see Table 21 for the detailed composition of all subcategories for state routes.

Figure 8. State Routes Weight Composition

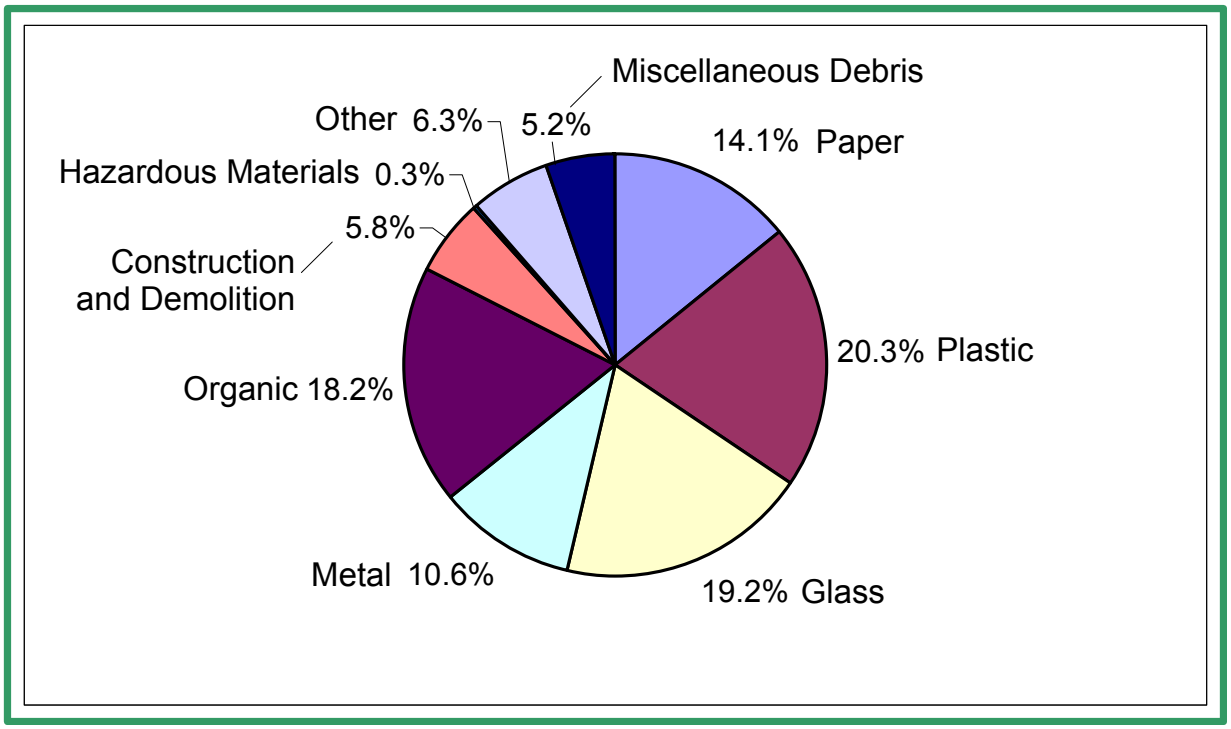


Table 21. State Routes Detailed Weight Composition

Litter Type Categories and Subcategories	Rural and Urban Combined				Rural		Urban	
	Tons	% Mean	Low %	High %	Tons	% Mean	Tons	% Mean
1. Paper	**489.23**	**14.1%**			**299.98**	**12.5%**	**189.25**	**17.7%**
1.1a Alcoholic Beverage Containers	0.00	-	-	-	0.00	-	0.00	-
1.1b Non-Alcoholic Beverage Containers	7.97	0.2%	0.1%	0.3%	5.63	0.2%	2.34	0.2%
1.2 Fast Food	113.70	3.3%	2.6%	3.9%	91.84	3.8%	21.86	2.0%
1.3 Other Food	34.40	1.0%	0.8%	1.2%	18.49	0.8%	15.91	1.5%
1.4 Non-Food	38.30	1.1%	0.8%	1.4%	25.39	1.1%	12.91	1.2%
1.5 Cardboard	96.03	2.8%	1.9%	3.6%	26.77	1.1%	69.26	6.5%
1.6 Paper Bags	17.43	0.5%	0.1%	0.9%	12.81	0.5%	4.62	0.4%
1.7 Newspaper and Magazines	59.91	1.7%	0.9%	2.5%	43.29	1.8%	16.62	1.6%
1.8 Other Paper	121.49	3.5%	2.8%	4.2%	75.76	3.1%	45.73	4.3%
2. Plastic	**705.89**	**20.3%**			**532.39**	**22.1%**	**173.50**	**16.2%**
2.1a Alcoholic Beverage Containers	11.98	0.3%	0.2%	0.5%	5.76	0.2%	6.22	0.6%
2.1b Non-Alcoholic Beverage Containers	246.95	7.1%	5.0%	9.2%	224.51	9.3%	22.44	2.1%
2.2 Fast Food	72.21	2.1%	1.6%	2.6%	60.72	2.5%	11.49	1.1%
2.3 Other Food	52.83	1.5%	1.2%	1.9%	35.29	1.5%	17.54	1.6%
2.4 Non-Food	34.17	1.0%	0.6%	1.4%	21.35	0.9%	12.82	1.2%
2.5 Bags and Films	149.47	4.3%	0.1%	6.0%	97.33	4.0%	52.14	4.9%
2.6 Auto Parts	57.51	1.7%	0.6%	2.7%	35.13	1.5%	22.38	2.1%
2.7 Other	80.77	2.3%	1.6%	3.1%	52.30	2.2%	28.47	2.7%
3. Glass	**668.06**	**19.2%**			**541.95**	**22.5%**	**126.11**	**11.8%**
3.1a Alcoholic Beverage Containers	524.78	15.1%	12.9%	17.3%	410.10	17.0%	114.68	10.7%
3.1b Non-Alcoholic Beverage Containers	83.14	2.4%	1.5%	3.3%	80.22	3.3%	2.92	0.3%
3.2 Fast Food	0.00	-	-	-	0.00	-	0.00	-
3.3 Other Food	0.00	-	-	-	0.00	-	0.00	-
3.4 Non-Food	0.00	-	-	-	0.00	-	0.00	-
3.5 Auto Parts	0.09	<0.1%	<0.1%	<0.1%	0.00	-	0.09	<0.1%
3.6 Other	60.05	1.7%	0.8%	2.7%	51.63	2.1%	8.42	0.8%
4. Metal	**369.31**	**10.6%**			**225.34**	**9.4%**	**143.99**	**13.5%**
4.1a Alcoholic Beverage Containers	115.47	3.3%	2.7%	4.0%	96.18	4.0%	19.29	1.8%
4.1b Non-Alcoholic Beverage Containers	109.23	3.1%	2.6%	3.7%	89.76	3.7%	19.47	1.8%
4.2 Fast Food	3.74	0.1%	0.1%	0.2%	3.00	0.1%	0.74	0.1%
4.3 Other Food	3.13	0.1%	<0.1%	0.1%	2.42	0.1%	0.71	<0.1%
4.4 Non-Food	3.00	0.1%	<0.1%	0.2%	0.09	<0.1%	2.91	0.3%
4.5 Auto Parts	81.91	2.4%	1.3%	3.4%	19.73	0.8%	62.18	5.8%
4.6 Other	52.83	1.5%	0.8%	2.2%	14.15	0.6%	38.68	3.6%
5. Organic	**632.29**	**18.2%**			**440.57**	**18.3%**	**191.72**	**18.0%**
5.1 Foods	448.45	12.9%	<0.1%	26.5%	407.36	16.9%	41.09	3.8%
5.2 Cigarettes	183.67	5.3%	3.3%	7.3%	33.21	1.4%	150.46	14.1%
5.3 Other	0.17	<0.1%	<0.1%	<0.1%	0.00	-	0.17	<0.1%
6. Construction and Demolition	**200.92**	**5.8%**			**128.71**	**5.3%**	**72.21**	**6.8%**
6.1 Wood and Lumber	112.48	3.2%	1.8%	4.7%	64.08	2.7%	48.40	4.5%
6.2 Mineral Aggregates	0.17	<0.1%	<0.1%	<0.1%	0.00	-	0.17	<0.1%
6.3 Roofing Material	45.25	1.3%	0.2%	2.4%	43.33	1.8%	1.92	0.2%
6.4 Insulation	1.26	<0.1%	<0.1%	0.1%	1.24	0.1%	0.02	<0.1%
6.5 Dry Wall	6.65	0.2%	<0.1%	0.4%	0.00	-	6.65	0.6%
6.6 Styrofoam	26.94	0.8%	0.7%	0.9%	16.08	0.7%	10.86	1.0%
6.7 Other	8.17	0.2%	0.1%	0.4%	3.98	0.2%	4.19	0.4%
7. Hazardous Material	**11.26**	**0.3%**			**4.33**	**0.2%**	**6.93**	**0.6%**
7.1 Latex Paint	0.00	-	-	-	0.00	-	0.00	-
7.2 Oil Based Paint	0.00	-	-	-	0.00	-	0.00	-
7.3 Oil	6.94	0.2%	0.1%	0.3%	3.42	0.1%	3.52	0.3%
7.4 Batteries	1.08	<0.1%	<0.1%	0.1%	0.91	<0.1%	0.17	<0.1%
7.5 Flammable Gas	0.00	-	-	-	0.00	-	0.00	-
7.6 Flammable Liquids	0.00	-	-	-	0.00	-	0.00	-
7.7 Explosives	0.00	-	-	-	0.00	-	0.00	-
7.8 Pesticides/Herbicides	0.00	-	-	-	0.00	-	0.00	-
7.9 Cleaners	0.00	-	-	-	0.00	-	0.00	-
7.10 Medical Waste	0.00	-	-	-	0.00	-	0.00	-
7.11 Other Hazardous Materials	3.24	0.1%	<0.1%	0.2%	0.00	-	3.24	0.3%
8. Other	**217.68**	**6.3%**			**119.02**	**4.9%**	**98.66**	**9.2%**
8.1 Textiles and Leather	37.21	1.1%	0.6%	1.5%	11.34	0.5%	25.87	2.4%
8.2 Carpet	28.23	0.8%	<0.1%	1.8%	28.23	1.2%	0.00	-
8.3 Furniture	0.00	-	-	-	0.00	-	0.00	-
8.4 Tires	37.86	1.1%	0.3%	1.9%	0.00	-	37.86	3.5%
8.5 Auto Rubber	77.30	2.2%	0.4%	4.0%	54.64	2.3%	22.66	2.1%
8.6 Rubber/Latex Toiletries	1.69	<0.1%	<0.1%	<0.1%	0.09	<0.1%	1.60	0.1%
8.7 Other Rubber or Latex	21.13	0.6%	0.3%	0.9%	20.26	0.8%	0.87	0.1%
8.9 Ceramic/Porcelain	0.85	<0.1%	<0.1%	0.1%	0.00	-	0.85	0.1%
8.10 Toys/Sporting Goods	3.70	0.1%	<0.1%	0.2%	1.32	0.1%	2.38	0.2%
8.11 Miscellaneous Materials	9.22	0.3%	0.1%	0.4%	2.76	0.1%	6.46	0.6%
8.12 Hygiene Products	0.49	<0.1%	<0.1%	<0.1%	0.38	<0.1%	0.11	<0.1%
9. Other Miscellaneous Debris	**179.59**	**5.2%**			**114.13**	**4.7%**	**65.46**	**6.1%**
Total Tons	**3,474.24**				**2,406.42**		**1,067.83**	

Estimated Volume Results

The largest single litter component based on state routes was in the ***Plastic* category—39 percent of the total litter.** The *Paper* and *Glass* categories were the second and third highest components with 12 percent and 11 percent, respectively. The composition of items based on weight were more equally distributed among the *Plastic*, *Glass*, and *Paper* categories—20 percent, 19 percent, and 14 percent, respectively (Figure 8). Figure 9 shows the estimated volume percent composition of items found on state routes, and Table 22 shows the more detailed estimated volume composition data.

Figure 9. State Routes Estimated Volume Composition

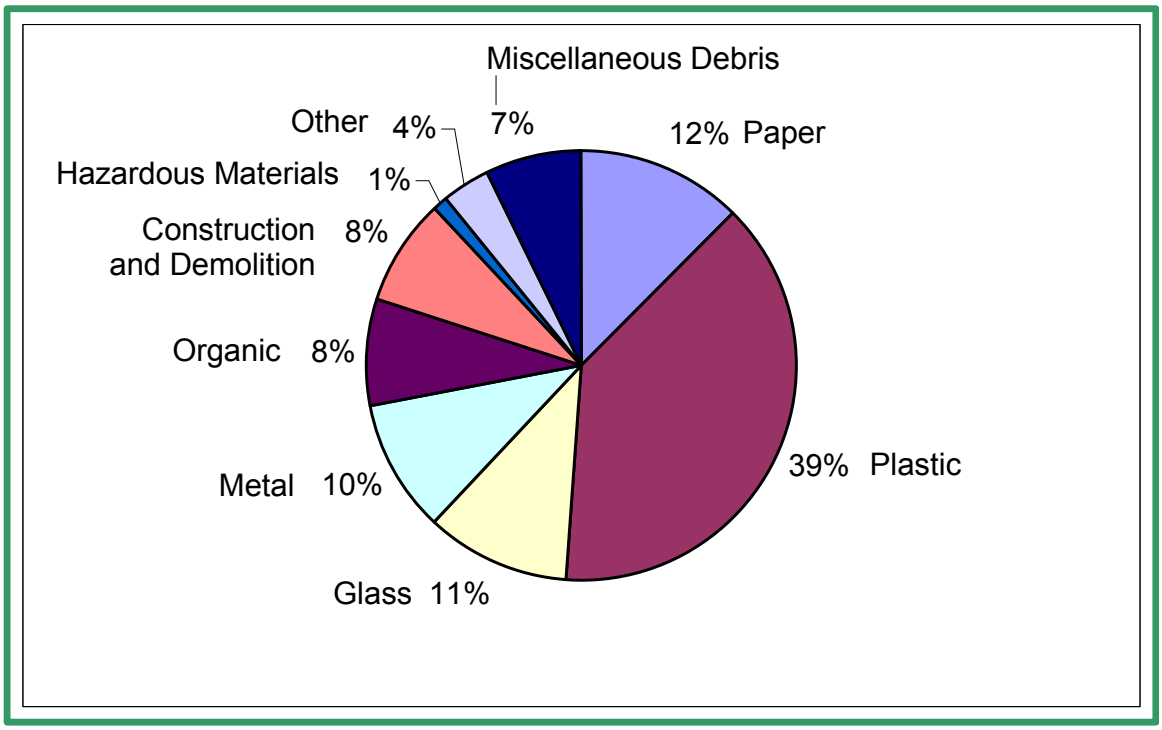


Table 22. State Routes Estimated Volume Composition

Litter Type Categories and Subcategories	Rural and Urban				Rural		Urban	
	Cubic Yards	% Mean	Low %	High %	Cubic Yards	% Mean	Cubic Yards	% Mean
1. Paper	5,354.30	12.4%	11.0%	13.8%	3,845.82	11.8%	1,508.48	14.3%
2. Plastic	16,681.33	38.7%	32.7%	44.7%	13,497.49	41.4%	3,183.84	30.3%
3. Glass	4,678.29	10.9%	8.6%	13.1%	3,939.45	12.1%	738.84	7.0%
4. Metal	4,285.21	9.9%	6.5%	13.4%	3,429.77	10.5%	855.44	8.1%
5. Organic	3,482.62	8.1%	3.0%	13.1%	2,111.64	6.5%	1,370.98	13.0%
6. Construction and Demolition	3,495.44	8.1%	6.5%	9.7%	2,375.18	7.3%	1,120.26	10.7%
7. Hazardous Waste	413.59	1.0%	0.2%	1.7%	0.88	-	412.71	3.9%
8. Other	1,593.08	3.7%	2.2%	5.2%	908.53	2.8%	684.55	6.5%
9. Miscellaneous Debris	3,111.07	7.2%	6.7%	7.7%	2,469.90	7.6%	641.17	6.1%
TOTAL	**43,094.93**				**32,578.66**		**10,516.27**	

5. County Roads

Weight Results

Figure 10 shows the composition results for county roads. Rural county roads comprise the majority of road miles in this study (Appendix B); therefore, these results will carry more weight in the overall analysis. One interesting aspect of the composition data for county roads is that the *Glass* component is a higher percentage (28.6 percent) of the total litter than in any other category. **The majority, 84 percent, of the litter in the *Glass* category was composed of alcoholic beverage containers. The percentage of *Glass* on interstates and U.S. routes was 7.1 percent and 19.2 percent on state routes; the majority of which was also alcoholic beverage containers.** Detailed composition results for county roads are shown in Table 23.

Figure 10. County Roads Weight Composition

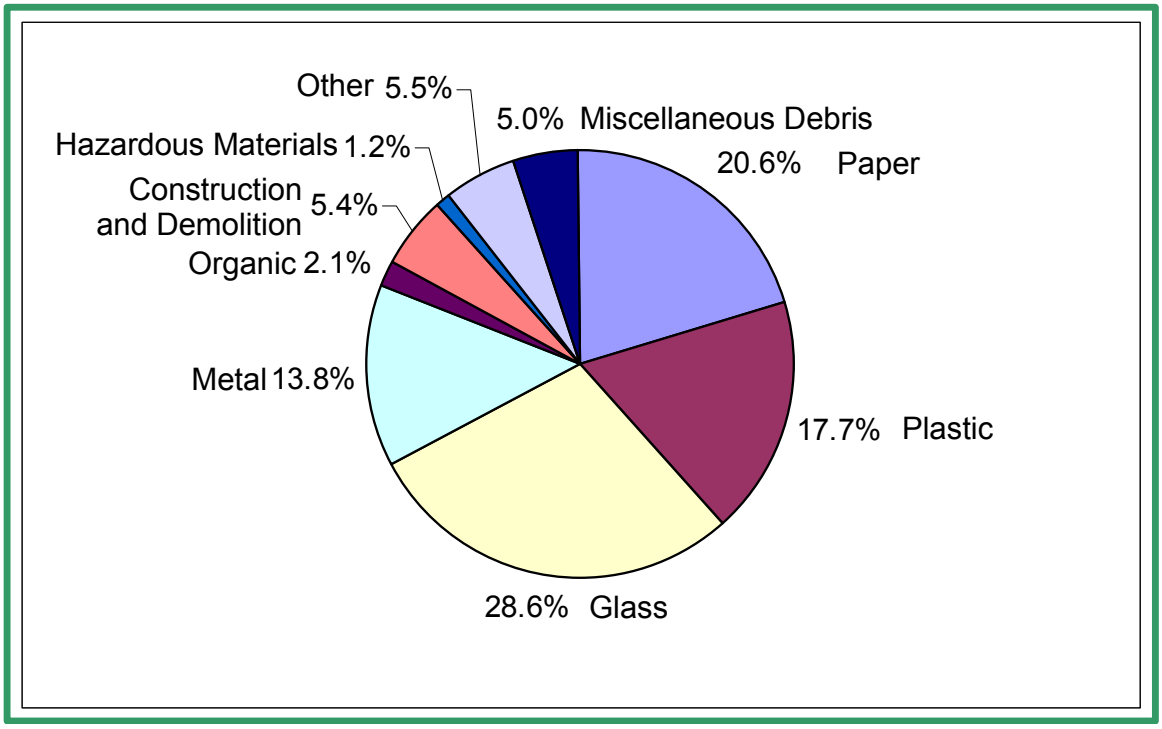


Table 23. County Roads Detailed Weight Composition

Litter Type Categories and Subcategories	Rural and Urban Combined				Rural		Urban	
	Tons	% Mean	Low %	High %	Tons	% Mean	Tons	% Mean
1. Paper	**730.15**	**20.6%**			**589.30**	**22.0%**	**140.85**	**16.4%**
1.1a Alcoholic Beverage Containers	0.00	-	-	-	0.00	-	0.00	-
1.1b Non-Alcoholic Beverage Containers	5.86	0.2%	0.1%	0.3%	5.69	0.2%	0.17	<0.1%
1.2 Fast Food	64.88	1.8%	1.2%	2.5%	43.17	1.6%	21.71	2.5%
1.3 Other Food	45.85	1.3%	0.6%	2.0%	38.32	1.4%	7.53	0.9%
1.4 Non-Food	43.07	1.2%	0.5%	1.9%	35.41	1.3%	7.66	0.9%
1.5 Cardboard	162.82	4.6%	1.9%	7.3%	103.59	3.9%	59.23	6.9%
1.6 Paper Bags	113.96	3.2%	<0.1%	6.8%	112.23	4.2%	1.73	0.2%
1.7 Newspaper and Magazines	230.59	6.5%	1.1%	12.0%	205.80	7.7%	24.79	2.9%
1.8 Other Paper	63.12	1.8%	1.2%	2.4%	45.09	1.7%	18.03	2.1%
2. Plastic	**627.68**	**17.7%**			**447.16**	**16.7%**	**180.52**	**21.1%**
2.1a Alcoholic Beverage Containers	36.53	1.0%	0.5%	1.6%	33.80	1.3%	2.73	0.3%
2.1b Non-Alcoholic Beverage Containers	245.87	6.9%	4.6%	9.3%	190.39	7.1%	55.48	6.5%
2.2 Fast Food	59.45	1.7%	1.2%	2.2%	29.71	1.1%	29.74	3.5%
2.3 Other Food	42.83	1.2%	0.8%	1.6%	31.60	1.2%	11.23	1.3%
2.4 Non-Food	13.39	0.4%	0.2%	0.5%	5.16	0.2%	8.23	1.0%
2.5 Bags and Films	150.71	4.3%	0.1%	6.1%	111.01	4.1%	39.70	4.6%
2.6 Auto Parts	28.43	0.8%	0.5%	1.1%	6.04	0.2%	22.39	2.6%
2.7 Other	50.47	1.4%	0.7%	2.2%	39.45	1.5%	11.02	1.3%
3. Glass	**1,012.10**	**28.6%**			**779.75**	**29.1%**	**232.35**	**27.1%**
3.1a Alcoholic Beverage Containers	847.80	23.9%	14.7%	33.2%	661.39	24.6%	186.41	21.8%
3.1b Non-Alcoholic Beverage Containers	108.23	3.1%	1.8%	4.3%	75.15	2.8%	33.08	3.9%
3.2 Fast Food	0.00	-	-	-	0.00	-	0.00	-
3.3 Other Food	0.00	-	-	-	0.00	-	0.00	-
3.4 Non-Food	0.00	-	-	-	0.00	-	0.00	-
3.5 Auto Parts	0.00	-	-	-	0.00	-	0.00	-
3.6 Other	56.07	1.6%	0.6%	2.6%	43.21	1.6%	12.86	1.5%
4. Metal	**489.82**	**13.8%**			**399.07**	**14.9%**	**90.75**	**10.6%**
4.1a Alcoholic Beverage Containers	223.35	6.3%	5.1%	7.5%	192.13	7.2%	31.22	3.6%
4.1b Non-Alcoholic Beverage Containers	58.29	1.6%	1.2%	2.1%	45.89	1.7%	12.40	1.4%
4.2 Fast Food	0.60	<0.1%	<0.1%	<0.1%	0.00	-	0.60	0.1%
4.3 Other Food	19.18	0.5%	0.1%	1.0%	15.33	0.6%	3.85	0.4%
4.4 Non-Food	7.64	0.2%	0.1%	0.4%	6.48	0.2%	1.16	0.1%
4.5 Auto Parts	77.45	2.2%	0.4%	4.0%	54.58	2.0%	22.87	2.7%
4.6 Other	103.31	2.9%	1.2%	4.7%	84.66	3.2%	18.65	2.2%
5. Organic	**74.18**	**2.1%**			**54.57**	**2.0%**	**19.61**	**2.3%**
5.1 Foods	23.16	0.7%	<0.1%	1.1%	14.77	0.6%	8.39	1.0%
5.2 Cigarettes	48.61	1.4%	0.9%	1.8%	37.39	1.4%	11.22	1.3%
5.3 Other	2.41	0.1%	<0.1%	0.2%	2.41	0.1%	0.00	-
6. Construction and Demolition	**190.84**	**5.4%**			**121.07**	**4.5%**	**69.77**	**8.1%**
6.1 Wood and Lumber	90.73	2.6%	0.8%	4.3%	36.27	1.4%	54.46	6.4%
6.2 Mineral Aggregates	0.00	-	-	-	0.00	-	0.00	-
6.3 Roofing Material	6.03	0.2%	<0.1%	0.3%	0.00	-	6.03	0.7%
6.4 Insulation	1.42	<0.1%	<0.1%	<0.1%	0.00	-	1.42	0.2%
6.5 Dry Wall	0.00	-	-	-	0.00	-	0.00	-
6.6 Styrofoam	84.56	2.4%	0.6%	4.2%	78.68	2.9%	5.88	0.7%
6.7 Other	8.10	0.2%	0.1%	0.4%	6.12	0.2%	1.98	0.2%
7. Hazardous Material	**40.74**	**1.2%**			**35.58**	**1.3%**	**5.16**	**0.6%**
7.1 Latex Paint	0.00	-	-	-	0.00	-	0.00	-
7.2 Oil-Based Paint	0.00	-	-	-	0.00	-	0.00	-
7.3 Oil	0.00	-	-	-	0.00	-	0.00	-
7.4 Batteries	0.00	-	-	-	0.00	-	0.00	-
7.5 Flammable Gas	0.00	-	-	-	0.00	-	0.00	-
7.6 Flammable Liquids	4.80	0.1%	0.1%	0.2%	0.00	-	4.80	0.6%
7.7 Explosives	0.23	<0.1%	<0.1%	<0.1%	0.23	<0.1%	0.00	-
7.8 Pesticides/Herbicides	0.00	-	-	-	0.00	-	0.00	-
7.9 Cleaners	6.42	0.2%	<0.1%	0.4%	6.06	0.2%	0.36	<0.1%
7.10 Medical Waste	0.00	-	-	-	0.00	-	0.00	-
7.11 Other Hazardous Materials	29.29	0.8%	-0.1%	1.8%	29.29	1.1%	0.00	-
8. Other	**196.09**	**5.5%**			**120.32**	**4.5%**	**75.77**	**8.8%**
8.1 Textiles and Leather	92.02	2.6%	0.9%	4.3%	81.03	3.0%	10.99	1.3%
8.2 Carpet	6.26	0.2%	<0.1%	0.4%	0.00	-	6.26	0.7%
8.3 Furniture	33.41	0.9%	<0.1%	2.0%	0.00	-	33.41	3.9%
8.4 Tires	7.03	0.2%	0.1%	0.3%	4.06	0.2%	2.97	0.3%
8.5 Auto Rubber	8.17	0.2%	0.1%	0.4%	4.83	0.2%	3.34	0.4%
8.6 Rubber/Latex Toiletries	0.10	<0.1%	<0.1%	<0.1%	0.00	-	0.10	<0.1%
8.7 Other Rubber or Latex	4.81	0.1%	0.1%	0.2%	2.00	0.1%	2.81	0.3%
8.9 Ceramic/Porcelain	0.20	<0.1%	<0.1%	<0.1%	0.20	<0.1%	0.00	-
8.10 Toys/Sporting Goods	5.58	0.2%	0.1%	0.2%	0.86	<0.1%	4.72	0.6%
8.11 Miscellaneous Materials	35.52	1.0%	0.1%	1.9%	27.34	1.0%	8.18	1.0%
8.12 Hygiene Products	2.99	0.1%	<0.1%	0.2%	0.00	-	2.99	0.3%
9. Other Miscellaneous Debris	**178.57**	**5.0%**			**136.64**	**5.1%**	**41.93**	**4.9%**
Total Tons	**3,540.17**				**2,683.46**	**100%**	**856.71**	**100%**

Estimated Volume Results

The composition of litter on county roads was similar to the composition on state routes; **39 percent of the litter was in the *Plastic* category.** *Glass* was the largest category when the litter composition was based on weight—29 percent of the total weight of litter on county roads (Figure 10). Figure 11 shows the estimated volume percent composition of items found on county roads, and Table 24 shows the more detailed estimated volume composition data.

Figure 11. County Roads Estimated Volume Composition

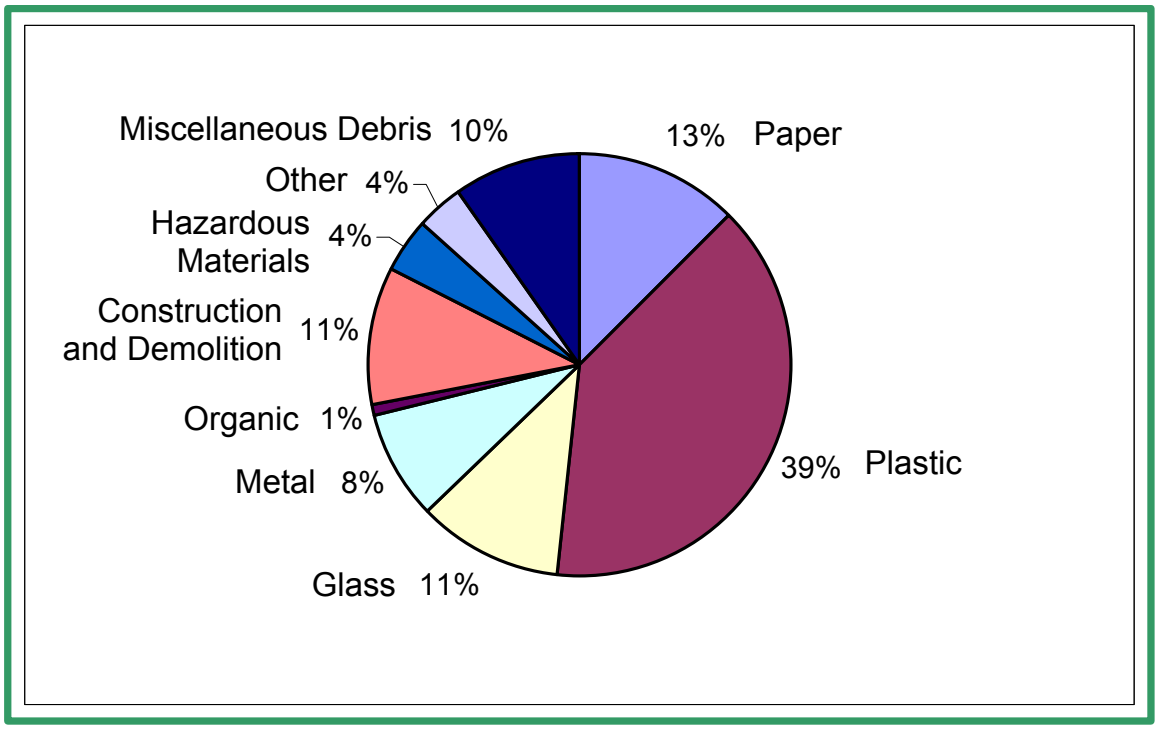


Table 24. County Roads Estimated Volume Composition

Litter Type Categories and Subcategories	Rural and Urban				Rural		Urban	
	Cubic Yards	% Mean	Low %	High %	Cubic Yards	% Mean	Cubic Yards	% Mean
1. Paper	6,311.97	12.5%	8.9%	16.2%	5,218.34	12.9%	1,093.63	11.0%
2. Plastic	19,694.11	39.0%	30.5%	47.6%	15,611.72	38.5%	4,082.39	41.0%
3. Glass	5,671.59	11.2%	7.3%	15.2%	4,363.54	10.8%	1,308.05	13.1%
4. Metal	4,139.03	8.2%	5.1%	11.3%	3,113.57	7.7%	1,025.46	10.3%
5. Organic	490.03	1.0%	0.7%	1.2%	362.49	0.9%	127.54	1.3%
6. Construction and Demolition	5,312.27	10.5%	5.6%	15.4%	4,550.32	11.2%	761.95	7.6%
7. Hazardous Waste	2,140.70	4.2%	< 0.1%	8.8%	2,121.26	5.2%	19.44	0.2%
8. Other	1,846.66	3.7%	2.0%	5.3%	881.06	2.2%	965.60	9.7%
9. Miscellaneous Debris	4,855.67	9.6%	8.1%	11.1%	4,279.49	10.6%	576.18	5.8%
TOTAL	**50,462.03**				**40,501.79**		**9,960.24**	

6. *Interchanges*

Weight Results

Figure 12 shows the litter composition of interchanges. The most dramatic difference in the composition of litter on interchanges compared with the roadway data was that **organic litter comprised 22.6 percent of all litter on interchanges compared to only 7.2 percent on all roads. This was due to the *Cigarettes* subcategory, which contributed to 94 percent of the *Organic* category and was 21 percent of the total litter on interchanges. The majority, 93 percent, of the *Cigarettes* subcategory was generated on urban interchanges.** Another significant difference was that *Tires* and *Auto Rubber* in the *Other* category comprise a small amount of the litter on interchanges (2.7 percent) compared to roads (12.1 percent). Please see Table 25 for the detailed composition results for interchanges.

Figure 12. Interchanges Weight Composition

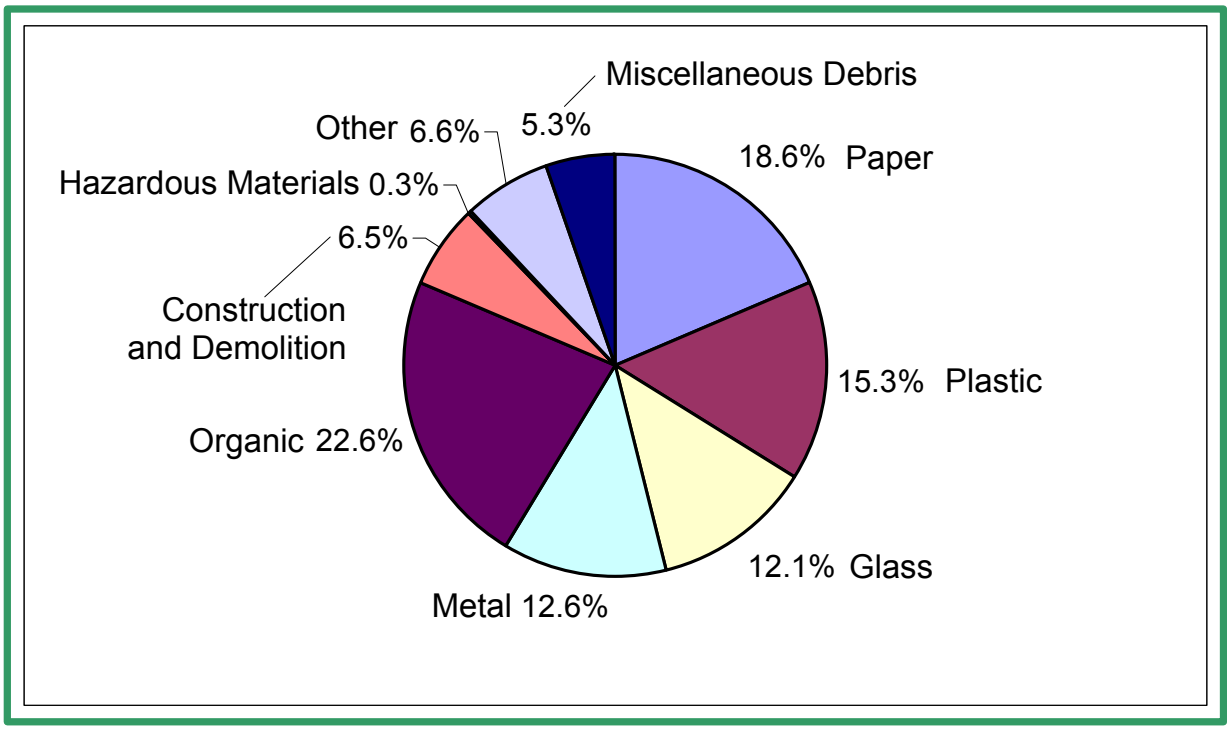


Table 25. Interchanges Detailed Weight Composition

Litter Type Categories and Subcategories	Rural and Urban Combined				Rural		Urban	
	Tons	% Mean	Low %	High %	Tons	% Mean	Tons	% Mean
1. Paper	**73.04**	**18.6%**			**12.45**	**15.7%**	**60.59**	**19.4%**
1.1a Alcoholic Beverage Containers	0.00	-	-	-	0.00	-	0.00	-
1.1b Non-alcoholic Beverage Containers	0.08	<0.1%	<0.1%	<0.1%	0.01	<0.1%	0.07	<0.1%
1.2 Fast Food	11.97	3.1%	2.6%	3.5%	3.29	4.1%	8.68	2.8%
1.3 Other Food	2.21	0.6%	0.4%	0.7%	0.62	0.8%	1.59	0.5%
1.4 Non-Food	6.02	1.5%	1.2%	1.9%	1.20	1.5%	4.82	1.5%
1.5 Cardboard	22.92	5.8%	3.1%	8.6%	2.35	3.0%	20.57	6.6%
1.6 Paper Bags	3.73	1.0%	0.6%	1.3%	0.94	1.2%	2.79	0.9%
1.7 Newspaper and Magazines	11.09	2.8%	1.4%	4.2%	0.10	0.1%	10.99	3.5%
1.8 Other paper	15.02	3.8%	3.1%	4.5%	3.94	5.0%	11.08	3.5%
2. Plastic	**59.84**	**15.3%**			**17.10**	**21.5%**	**42.74**	**13.7%**
2.1a Alcoholic Beverage Containers	0.03	<0.1%	<0.1%	<0.1%	0.02	<0.1%	0.01	<0.1%
2.1b Non-alcoholic Beverage Containers	10.87	2.8%	2.4%	3.2%	3.77	4.7%	7.10	2.3%
2.2 Fast Food	6.82	1.7%	1.4%	2.1%	2.39	3.0%	4.43	1.4%
2.3 Other Food	4.54	1.2%	0.9%	1.4%	1.83	2.3%	2.71	0.9%
2.4 Non-Food	5.39	1.4%	0.3%	2.4%	0.72	0.9%	4.67	1.5%
2.5 Bags and Films	11.83	3.0%	2.4%	3.6%	1.40	1.8%	10.43	3.3%
2.6 Auto Parts	12.66	3.2%	2.2%	4.3%	4.61	5.8%	8.05	2.6%
2.7 Other	7.69	2.0%	1.4%	2.5%	2.35	3.0%	5.34	1.7%
3. Glass	**47.46**	**12.1%**			**11.54**	**14.5%**	**35.92**	**11.5%**
3.1a Alcoholic Beverage Containers	41.94	10.7%	9.1%	12.3%	9.97	12.6%	31.97	10.2%
3.1b Non-alcoholic Beverage Containers	2.85	0.7%	0.6%	0.9%	1.10	1.4%	1.75	0.6%
3.2 Fast Food	0.00	-	-	-	0.00	-	0.00	-
3.3 Other food	0.07	<0.1%	<0.1%	<0.1%	0.00	-	0.07	<0.1%
3.4 Non-food	0.04	<0.1%	<0.1%	<0.1%	0.00	-	0.04	<0.1%
3.5 Auto Parts	0.04	<0.1%	<0.1%	<0.1%	0.00	-	0.04	<0.1%
3.6 Other	2.53	0.6%	0.3%	0.9%	0.48	0.6%	2.05	0.7%
4. Metal	**49.57**	**12.6%**			**14.50**	**18.3%**	**35.07**	**11.2%**
4.1a Alcoholic Beverage Containers	6.76	1.7%	1.4%	2.0%	2.04	2.6%	4.72	1.5%
4.1b Non-alcoholic Beverage Containers	5.99	1.5%	1.3%	1.8%	2.38	3.0%	3.61	1.2%
4.2 Fast Food	0.30	0.1%	<0.1%	0.1%	0.02	<0.1%	0.28	0.1%
4.3 Other food	0.38	0.1%	0.1%	0.1%	0.19	0.2%	0.19	0.1%
4.4 Non-Food	0.35	0.1%	<0.1%	0.2%	0.17	0.2%	0.18	0.1%
4.5 Auto Parts	12.39	3.2%	2.0%	4.3%	2.95	3.7%	9.44	3.0%
4.6 Other	23.39	6.0%	3.8%	8.2%	6.75	8.5%	16.64	5.3%
5. Organic	**88.82**	**22.6%**			**6.74**	**8.5%**	**82.08**	**26.2%**
5.1 Foods	4.89	1.2%	0.9%	1.6%	0.98	1.2%	3.91	1.3%
5.2 Cigarettes	83.90	21.4%	9.1%	33.7%	5.76	7.3%	78.14	25.0%
5.3 Other	0.03	<0.1%	<0.1%	<0.1%	0.00	-	0.03	<0.1%
6. Construction and Demolition	**25.46**	**6.5%**			**7.54**	**9.5%**	**17.92**	**5.7%**
6.1 Wood and Lumber	19.24	4.9%	3.0%	6.8%	6.43	8.1%	12.81	4.1%
6.2 Mineral Aggregates	0.25	0.1%	<0.1%	0.1%	0.24	0.3%	0.01	<0.1%
6.3 Roofing Material	1.59	0.4%	0.2%	0.6%	0.00	-	1.59	0.5%
6.4 Insulation	0.68	0.2%	0.1%	0.2%	0.04	0.1%	0.64	0.2%
6.5 Dry Wall	0.40	0.1%	<0.1%	0.2%	0.00	-	0.40	0.1%
6.6 Styrofoam	2.74	0.7%	0.6%	0.8%	0.67	0.8%	2.07	0.7%
6.7 Other	17.41	4.4%	4.4%	4.5%	17.00	.2%	0.41	0.1%
7. Hazardous Material	**1.15**	**0.3%**			**0.47**	**0.6%**	**0.68**	**0.2%**
7.1 Latex Paint	0.00	-	-	-	0.00	-	0.00	-
7.2 Oil-Based Paint	0.00	-	-	-	0.00	-	0.00	-
7.3 Oil	0.23	0.1%	<0.1%	0.1%	0.00	-	0.23	0.1%
7.4 Batteries	0.14	<0.1%	<0.1%	0.1%	0.08	0.1%	0.06	<0.1%
7.5 Flammable Gas	0.12	<0.1%	<0.1%	0.1%	0.00	-	0.12	<0.1%
7.6 Flammable Liquids	0.00	-	-	-	0.00	-	0.00	-
7.7 Explosives	0.00	-	-	-	0.00	-	0.00	-
7.8 Pesticides/Herbicides	0.00	-	-	-	0.00	-	0.00	-
7.9 Cleaners	0.02	<0.1%	<0.1%	<0.1%	0.02	<0.1%	0.00	-
7.10 Medical Waste	0.01	<0.1%	<0.1%	<0.1%	0.00	-	0.01	<0.1%
7.11 Other Hazardous Materials	0.63	0.2%	<0.1%	0.3%	0.36	0.5%	0.27	0.1%
8. Other	**25.89**	**6.6%**			**5.68**	**7.2%**	**20.21**	**6.5%**
8.1 Textiles and leather	9.71	2.5%	1.7%	3.3%	1.80	2.3%	7.91	2.5%
8.2 Carpet	0.76	0.2%	<0.1%	0.4%	0.00	-	0.76	0.2%
8.3 Furniture	0.00	-	-	-	0.00	-	0.00	-
8.4 Tires	5.52	1.4%	0.5%	2.3%	1.40	1.8%	4.12	1.3%
8.5 Auto Rubber	4.99	1.3%	0.7%	1.8%	1.96	2.5%	3.03	1.0%
8.6 Rubber/Latex Toiletries	0.37	0.1%	<0.1%	0.2%	0.01	<0.1%	0.36	0.1%
8.7 Other Rubber or Latex	1.98	0.5%	0.2%	0.8%	0.12	0.2%	1.86	0.6%
8.9 Ceramic/Porcelain	1.50	0.4%	<0.1%	0.7%	0.29	0.4%	1.21	0.4%
8.10 Toys/Sporting Goods	0.23	0.1%	<0.1%	0.1%	0.02	<0.1%	0.21	0.1%
8.11 Miscellaneous Materials	0.82	0.2%	<0.1%	0.4%	0.08	0.1%	0.74	0.2%
8.12 Hygenic Products	0.02	<0.1%	<0.1%	<0.1%	0.00	-	0.02	<0.1%
9. Other Miscellaneous Debris	**20.97**	**5.3%**			**3.40**	**4.3%**	**17.57**	**5.6%**
Total Tons	**392.20**				**79.42**		**312.78**	**100%**

Estimated Volume Results

Similar to the roads, ***Plastic* was the largest component of litter found on interchanges—35 percent of the total estimated volume.** However, the most notable difference of litter composition on interchanges was the high amount of organic items. **The *Organic* category was the second highest component with 22 percent**; whereas, it ranged from 1 percent to 8 percent on the roads. Similarly, the *Organic* category comprised 23 percent of the total litter weight (Figure 12). *Glass* was only 1 percent of the total estimated litter volume; whereas, it ranged from 6 percent to 11 percent on the roads. Figure 13 shows the estimated volume percent composition of items found on interchanges, and Table 26 shows the more detailed estimated volume composition data.

Figure 13. Interchanges Estimated Volume Composition

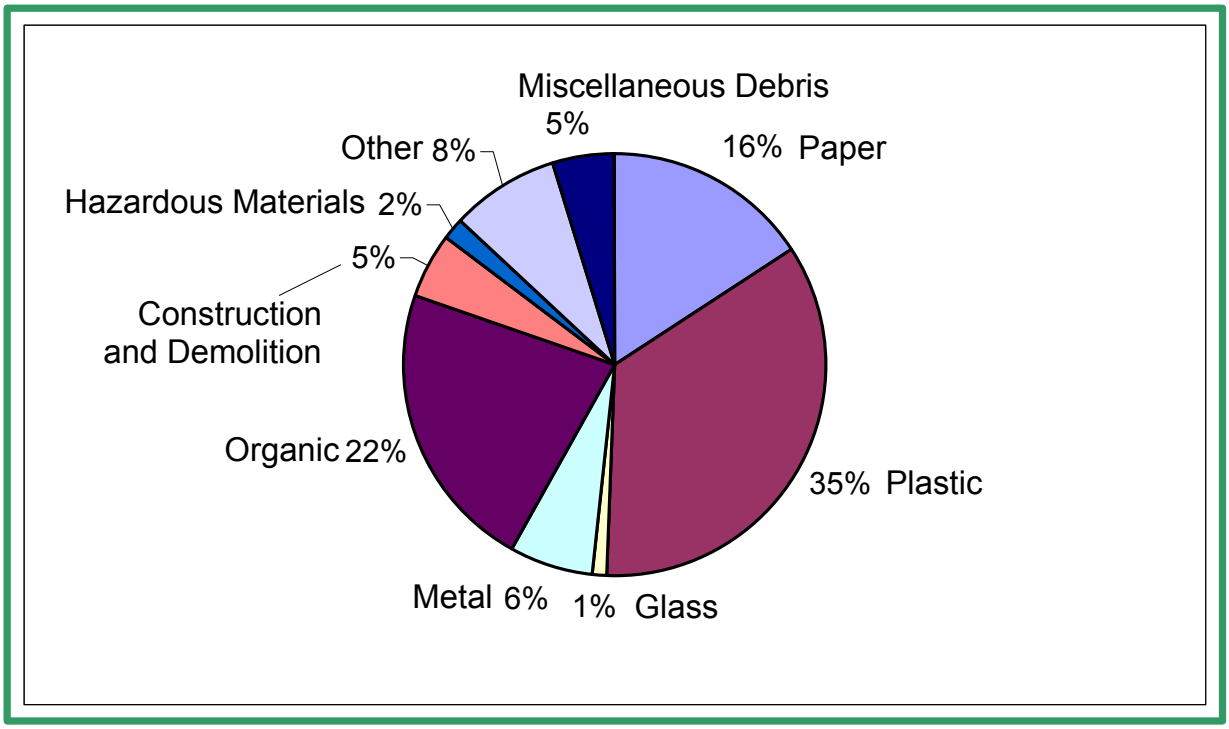


Table 26. Interchanges Estimated Volume Composition

Litter Type Categories and Subcategories	Rural and Urban				Rural		Urban	
	Cubic Yards	% Mean	Low %	High %	Cubic Yards	% Mean	Cubic Yards	% Mean
1. Paper	471.55	15.9%	14.1%	17.6%	134.31	19.2%	337.24	14.8%
2. Plastic	1,035.14	34.8%	30.5%	39.1%	323.55	46.3%	711.59	31.3%
3. Glass	28.23	0.9%	0.6%	1.3%	7.56	1.1%	20.67	0.9%
4. Metal	192.46	6.5%	4.7%	8.2%	47.84	6.8%	144.62	6.4%
5. Organic	657.55	22.1%	9.7%	34.5%	45.17	6.5%	612.38	26.9%
6. Construction and Demolition	153.23	5.2%	4.4%	5.9%	33.31	4.8%	119.92	5.3%
7. Hazardous Waste	48.70	1.6%	0.6%	2.7%	11.13	1.6%	37.57	1.7%
8. Other	243.80	8.2%	6.8%	9.6%	64.87	9.3%	178.93	7.9%
9. Miscellaneous Debris	142.93	4.8%	4.1%	5.5%	30.94	4.4%	111.99	4.9%
TOTAL	**2,973.59**				**698.68**		**2274.91**	

III. Biohazardous Items

Definition

Biologically hazardous items included bottles filled with an unknown liquid that appeared to be human urine, plastic bags containing material that appeared to be human feces, syringes, needles, dead animals, and diapers.

Methods

Biologically hazardous items were not collected and included in the litter data. Descriptions and quantities of these items were recorded on data forms (Appendix E).

Observations

Bottles filled with an unknown liquid that appeared to be human urine were the most frequently identified hazardous item. The most shocking items identified were the 23 bags of what appeared to be human feces, which were most commonly seen on the urban interchange sample sites. A total of 9 diapers and 12 syringes and needles were identified and recorded. Table 27 shows the quantity of biohazardous items observed and recorded.

Table 27. Biohazardous Items (Actual Quantity Observed)

Sample Type		Containers of Urine	Bags of Feces	Syringes and Needles	Dead Animals	Diapers
Interstate and U.S. Routes	Rural	44	1	0	2	1
	Urban	19	1	1	17	0
State Routes	Rural	24	1	0	2	1
	Urban	11	1	2	8	0
County Roads	Rural	0	0	0	1	0
	Urban	11	0	4	1	0
Interchanges	Rural	37	5	5	8	2
	Urban	96	14	0	4	5
Totals		**242**	**23**	**12**	**43**	**9**

Since the available data for the quantity of bags of feces, syringes, needles, dead animals, and diapers were so small and varied across the samples, an analysis to determine the quantity of these items generated throughout the state was not performed. However, the data collected on the containers of urine were analyzed to identity the quantity of this item annually per road mile and per interchange.

Results

The results of this analysis are shown in Table 28. **Significantly more containers of urine were found on rural interstate and U.S. routes—106 per mile annually—than on any other road type.** County roads generated the least amount of this item—20 per mile annually on urban roads. No containers of urine were identified on rural county roads.

Table 28. Quantity of Containers of Urine per Mile of Road

Sample Type		Containers of Urine (number of items per mile per year)		
		Mean	Low	High
Interstate and U.S. Routes	Rural	106	58	154
	Urban	38	20	57
State Routes	Rural	36	14	59
	Urban	24	1	47
County Roads	Rural	0	0	0
	Urban	20	7	34
All Roads (Weighted Average)		**20**	**17**	**23**

Table 29 shows the quantity of containers of urine for interchanges throughout Ohio. This item occurred significantly more frequently on urban interchanges (58 per interchange) than on rural interchanges (21 per interchange).

Table 29. Quantity of Containers of Urine per Interchange

Sample Type		Containers of Urine (number of items per interchange per year)		
		Mean	Low	High
Interchanges	Rural	21	12	30
	Urban	58	43	74
	Weighted Average	**33**	**28**	**39**

Table 30 shows the total amount of containers of urine generated in Ohio annually for all road types and interchanges sampled. Throughout Ohio, 972,372 containers of urine are generated on roads and interchanges annually. The majority of these items are found on rural state routes (425,140 containers annually) and rural interstate and U.S. routes (374,429 containers annually).

Table 30. Total Quantity of Containers of Urine

Sample Type		*Containers of Urine (number of items per year)*		
		Mean	*Low*	*High*
Interstate and U.S. Routes		439,964		
	Rural	374,429	205,004	543,854
	Urban	65,535	33,877	97,194
State Routes		480,210		
	Rural	425,140	162,807	687,474
	Urban	55,070	762	109,378
County Roads		47,179		
	Rural	0	0	0
	Urban	47,179	16,021	78,338
Interchanges		5,019		
	Rural	1,212	0	2,742
	Urban	3,807	1,090	6,523
Total		**972,372**		

Summary and Recommendations

I. Utilization of Study Results

Government agencies and other entities involved in litter prevention throughout Ohio will find the statewide litter study results an excellent source of information for developing and/or enhancing prevention and education efforts.

Information concerning the type and amount of littered materials and/or the type and location of roadways or interchanges where such materials are found in quantity, combined with consideration of the possible sources, knowledge of the proposed program's area, and other relevant factors, will allow development of targeted efforts.

For example, if a county has a number of rural interchanges, it might take into consideration that more litter accumulates on rural interchanges—21.5 percent of which are plastic items[1]. In considering possible prevention efforts, the county litter prevention program could ask gas stations and convenience stores close to the interchanges to display litter prevention posters near the cooler where drinks in plastic bottles are located. It might also want to collaborate with its local law enforcement to increase tickets given for littering in these areas.

II. Results of Special Interest

Many of the results of the statewide litter study were surprising while others were somewhat expected. The *Analysis and Results* section highlights a number of results to consider when developing and revitalizing programs. Presented below are additional results, which indicate some situations of concern based upon the large quantity of the items identified and/or the public health and safety threats certain items pose.

- **Plastic items** comprised the largest percentage of materials on all roads based on weight (19.2 percent[2]) and volume (37 percent[3]).
- **Glass items** comprised the second highest percentage of materials on all roads based on weight (17.5 percent[2]) and the third largest percentage of materials based on estimated volume (10 percent[3]).
- **Alcoholic beverage containers**—including glass, plastic, and metal containers—comprised 18 percent[4] of the total annual tons of litter on all roads and interchanges.
- The percentage of **organic items** was highest on state routes (18.2 percent[5]). Almost 71 percent[6] of the organic items consisted of the *Foods* subcategory. Food items were a larger portion of the organic items found on rural state routes (93 percent[6]) than on urban state routes (21 percent[6]).

[1] Table 25, page 36

[2] Figure 4, page 23

[3] Figure 5, page 25

[4] Table 15, page 18

[5] Figure 8, page 29

[6] Calculated using data from Table 21, page 30 (Dead animals were not included in the *Organic* category, but were considered biohazardous items.)

- **Items in the *Other* category** comprised the greatest percentage of materials on interstates and U.S. routes based on weight (33.3 percent[7]), 86 percent[8] of which was contained in the *Auto Rubber* and *Tires* subcategories.

- **Glass items** comprised the largest percentage of materials on county roads based on weight (28.6 percent[9]). Alcoholic beverage containers comprised 84 percent[10] of this category.

- **Organic items** comprised the largest percentage of materials on interchanges based on weight (22.6 percent[11]), 94 percent[12] of which was contained in the ***Cigarettes* subcategory**. On urban interchanges, the *Cigarettes* subcategory was 93 percent[12] of the organics category, whereas on rural interchanges it was 85 percent[12].

- Of the 23 **bags of human feces**, 61 percent[13] were observed on urban interchanges while 21 percent[13] were observed on rural interchanges.

- An estimated **106 containers of urine per mile**[14] can be found on interstates and U.S. routes annually. Only 20 containers of urine per mile[14] were estimated to occur on county roads annually—the lowest generation rate of all the roads and interchanges.

This statewide litter study establishes the baseline data for Ohio. The Ohio Department of Natural Resources' Division of Recycling & Litter Prevention anticipates that publicizing the results of the study will motivate local governments and litter prevention groups to establish a litter prevention program or reinvigorate their community's existing litter prevention program. The Division of Recycling & Litter Prevention can provide assistance and information to groups developing and revitalizing litter prevention programs. Please contact the Division at (614) 265-6333.

[7] Figure 6, page 26

[8] Calculated using data from Table 19, page 27

[9] Figure 10, page 32

[10] Calculated using data from Table 23, page 33

[11] Figure 12, page 35

[12] Calculated using data from Table 25, page 36

[13] Calculated using data from Table 27, page 38 (These items were biohazardous and, therefore, were not collected. While the observations were recorded and presented in this report, they are simply observations and may not be held to the same level of predictability or accuracy as the other litter study results.)

[14] Table 28, page 39 (These items were biohazardous and, therefore, were not collected. While the observations were recorded, presented in this report, and estimated to obtain state totals, they are simply observations and estimates and may not be held to the same level of predictability or accuracy as the other litter study results.)

Appendix A

Results of Initial Clean

Appendix A: Results of Initial Clean

Definition

During the initial clean, each sample site was thoroughly cleaned and a gross weight of collected litter was recorded. This information provides an approximation of the amount of litter present on roadsides at any given point in time.

Methodology

Although no detailed analyses were performed during the initial clean, the following two important pieces of information that may be of interest to groups beginning litter removal operations:

- First, the amount (weight) of litter to be expected on any given mile of road or any interchange at any given time can be approximated (Tables 31 and 32).
- Second, the amount of time in person-hours required to thoroughly pick up all the litter in any given mile of roadway or interchange can be calculated (Tables 33 and 34).

Results

1. Quantity of Litter Expected at Any Time

Table 31 shows that at any given time more litter per mile is present on interstate and U.S. routes than on state routes and county roads. The weighted average for all roads combined is 303 pounds (plus or minus 36 pounds) of litter per mile. These data only show what can be expected at any given time. A deposition rate cannot be calculated since the date of the last time the site was cleaned is unknown.

Table 31. Quantity of Litter Expected on Any Mile of Road (Both Sides and Median, if Present) at Any Time in Ohio

Sample Type		Quantity of Litter (pounds per mile)		
		Mean	Low	High
All Roads		**303**	**268**	**339**
Interstate and U.S. Routes	Urban	942	431	1,453
	Rural	1,262	914	1,610
State Routes	Urban	200	89	311
	Rural	450	249	651
County Roads	Urban	168	36	300
	Rural	472	333	611

Table 32 indicates that at any time, between 291 and 450 pounds (or an average of 371 pounds) of litter can be found on an interchange. This information, gleaned from the initial clean data, may be useful for planning purposes; it does not identify the deposition rate or the composition of roadside litter.

Table 32. Quantity of Litter Expected on Any Interchange (Both Entrance and Exit Ramps) at Any Time in Ohio

Road Category		Quantity of Litter (pounds per interchange)		
		Mean	Low	High
Interchanges		**371**	**291**	**450**
	Rural	387	229	545
	Urban	363	215	511

2. Person Hours to Collect Litter at Any Time

Table 33 shows that approximately 39 person-hours (*i.e.*, amount of time it takes for one person to clean a site of all litter) are required to collect all the litter on one mile of roadway (both sides and median, if present) at any time for all roads combined. It takes approximately two times longer to clean one mile of interstate and U.S. routes than to clean state routes or county roads. The average cleaning time for all roads is 39 person-hours per mile.

Table 33. Cleaning Time for Roads (Both Sides and Median if Present)

Road Category		Cleaning Time (person-hours per mile)		
		Mean	Low	High
All Roads		**39**	**37**	**41**
Interstate and U.S. Routes	Urban	69	52	86
	Rural	80	68	91
State Routes	Urban	39	33	46
	Rural	56	43	70
County Roads	Urban	30	24	37
	Rural	47	37	57

Table 34 indicates that it takes between 35 and 45 person-hours (an average of 40 hours) to thoroughly clean all litter from both entrance and exit ramps at an interchange at any time.

Table 34. Cleaning Time for Interchanges (Both Entrance and Exit Ramps)

Road Category		Cleaning Time (person-hours per interchange)		
		Mean	Low	High
Interchanges		**40**	**35**	**45**
	Urban	29	20	38
	Rural	46	35	55

Based on the data presented above, the time required for collecting litter can be roughly estimated for planning purposes. The times identified in the above tables only represent the time required to collect and bag the litter; they do not include travel time to or from the site, or time to dispose of collected bagged litter.

Appendix B

Universe of Roads and Interchanges

Appendix B. Universe of Roads and Interchanges

All means, or averages, were weighted. Weighted averages account for the differences in subcategory road miles or numbers of interchanges. An example of a weighted average is as follows: litter generation on rural county roads is estimated to be 200 pounds per mile, while generation on urban county roads is estimated to be 738 pounds per mile. Since there are significantly more rural than urban road miles, a weighted average must be used to calculate the average generation of litter per mile for county roads overall. Using the data in Table 5, the weighted average is equal to: (92% x 200) + (8% x 738), or approximately 243 pounds of litter per mile per year. To calculate the weighted averages for interchanges, the number of interchanges would be used instead of the miles of road.

The averages obtained in this study from the seven samples in each of the eight site subcategories were weighted to account for the number of miles of roads or numbers of interchanges in each subcategory. Table 35 shows how the universe of road miles and numbers of interchanges were distributed among the subcategories. The universe of road miles and interchanges was obtained from the Ohio Department of Transportation.

Table 35. Universe of Roads and Interchanges in Ohio Used to Calculate Weighted Averages (or Means)

Sample Type		Universe (miles)	Percent of Total
Interstate and U.S. Routes		**5,245**	
	Rural	3,530	67%
	Urban	1,714	33%
State Routes		**14,056**	
	Rural	11,744	84%
	Urban	2,312	16%
County Roads		**29,134**	
	Rural	26,811	92%
	Urban	2,324	8%
Total All Roads		**48,435**	
Interstate and U.S. Routes	Rural	3,530	7%
	Urban	1,714	4%
State Routes	Rural	11,744	24%
	Urban	2,312	5%
County Roads	Rural	26,811	55%
	Urban	2,324	5%
Sample Type		***Universe (number)***	***Percent of Total***
Interchanges		**1,056**	
	Rural	334	32%
	Urban	722	68%

Appendix C

Data Standardization and Statistics

Appendix C. Data Standardization and Statistics

Roads and Interchanges

Litter sample data were standardized for analysis. The road sample data in pounds and estimated gallons were standardized to pounds per miles per year and cubic yards per mile per year. Interchange data were standardized to pounds per interchange per year and cubic yards per interchange per year.

Cigarette Butts

The only sub-sampled subcategory of litter was cigarette butts. These data were extrapolated to reflect the entire sample area and subsequently standardized along with the rest of the sample data. See Appendix E for the detailed methods on how the cigarette butt sub-sampling was performed.

Alcoholic Beverage Containers

Beverage containers were further subcategorized into alcoholic and non-alcoholic beverage containers in the spring sampling for the *Paper*, *Plastic*, *Glass,* and *Metal* categories. Since this was not done in the fall, the fall beverage container data for all four categories were adjusted based on the percentage of alcoholic beverage containers found in each category in the spring.

Volume Estimates

The volume of litter was estimated for all subcategories during the spring sample. During the fall sampling, estimates were only made on limited categories based on available conversion factors. Volume estimates were calculated for the fall data based on conversion factors generated from the spring data. The conversion factors were obtained by performing a linear regression analysis of weight to volume for each subcategory.

Appendix D

Data Collection Overview

Appendix D. Data Collection Overview

The process of identifying sites, collecting litter samples, and sorting litter was often long and time-consuming. As the sampling progressed from the initial clean to the fall and spring clean and sorting, several key issues were identified that may be useful to consider for the next statewide litter study.

Site Selection and Initial Clean

For this study, the time was limited between the initial field survey and the initial cleaning of the sample sites. For the next study, it is recommended that more time is taken to identify sites and contact the local and state authorities necessary to verify the acceptability of the site. The agency responsible for maintaining the road, cleaning the roadside, and mowing should clearly understand the need to not mow or clean the site during the sampling period.

During the initial clean, the bags of litter were weighed at the sample site and then closed and left at the site where they were to be collected and disposed of by the local agency responsible for road maintenance. This process worked well and should be repeated.

Collecting and Sorting

Litter was collected using litter pickers and buckets. Litter was transferred from the buckets to the garbage bags periodically as the litter was collected. This process was very efficient as it is much easier to place and carry the litter in the bucket than in plastic garbage bags. In addition, this preserved the integrity of the bags, which tend to tear easily when used directly for collection. It is also strongly recommended that construction grade 3mm-thick trash bags be used to decrease the need for double- and sometimes even triple-bagging the litter.

When collecting litter, it was most efficient to define an eight- to ten-foot-wide corridor for each crewmember to clean. The crew leader was responsible for walking behind the crews to ensure all litter was collected. The area was traversed at least two times by the crew and the crew leaders to ensure that sites were completely cleaned.

Crews wore thick work gloves when collecting the litter; however, for collecting cigarette butts and sorting the litter, thinner latex gloves were more efficient.

During the fall clean, some remote sites were used for sorting, and both field crews took turns sorting. However, during the spring clean, one local sorting site was used throughout the duration of the fieldwork, and only one crew was responsible for sorting all the litter. This was a much more efficient approach than the process used in the fall.

There was a significant amount of miscellaneous debris collected along with the litter such as grass, dirt, stones, and water. Since the pre-sorting weight was being used to compare the individual weights to establish quality control, it was necessary to record the weight of these items to ensure all litter was accounted for. It is strongly recommended that crews are extremely cautious while collecting litter to ensure the least amount of miscellaneous debris is collected. If possible, crews should remove dirt, stones, and especially water from all litter collected prior to bagging it at the site. However, it must be noted that this type of non-litter debris would be picked up by anyone who is collecting litter or routine litter control programs and volunteer projects. Therefore, if this debris is collected, it is then part of the litter and contributes to the volume and weight of litter that must be disposed.

When sorting litter, all litter from one site was placed on the ground on a tarp. This became very tedious and tiring as it was necessary then to bend and kneel to sort the litter. The efficiency of the sorting process increased when the crews built a large make-shift table using saw-horses and plywood. The need to bend and kneel was eliminated and the crews' backs and knees were relieved.

Weighing Materials

A scale that recorded weights to the 0.05 pound was used to weight the litter once it was sorted into the litter type subcategories. Some items, such as cigarette butts or other small, low-weight items, weighed less than 0.05 pounds. It was necessary to weight these items with a gram scale to obtain an accurate weight for these items.

Crew Management

Crew leaders were Davey employees directly supervised by the Davey project manager. The crew leaders and the project manager jointly managed planning and scheduling site visits and sorting times. Several temporary laborers were used throughout collecting and sorting; crew leaders were responsible for supervising these temporary laborers and providing transportation from the temp agency to the work sites.

Consistency of crew leaders was the key component of ensuring that the sites in the field were efficiently located and the same methods and procedures for collecting and sorting were followed throughout the project. Consistency of the temporary laborers was also a key component to ensure efficient time management throughout the collecting and sorting processes. By coordinating closely with the temp agency, individual temporary workers were consistently used throughout the project as much as possible; therefore, training new laborers was kept to a minimum.

Appendix E

Davey Resource Group Personnel

Appendix E: Davey Resource Group Personnel

Ana Burns, M.S.E.S., Project Manager, is a biologist responsible for project management, data analysis, and report writing for ecological surveys, watershed studies, park inventories, and other projects. She has experience in wetlands delineations, lake and watershed management, and forestry. In addition, Ms. Burns has experience in aerial photograph interpretation and geographic information systems (GIS). Projects she has managed include the Mentor Marsh Area Special Area Management Plan, located in Lake County, Ohio (funded by Ohio Department of Natural Resources, Coastal Program) and the East Branch of the Rocky River Greenway Protection Plan, located in Cuyahoga, Medina, and Summit Counties, Ohio (funded by Cleveland Metroparks). She joined Davey Resource Group after working as an environmental planner for a county planning department. In this position, she gained valuable experience in facilitating public participation meetings, developing educational outreach materials, and assisting the Plan Commission and their subcommittees in implementing and enforcing comprehensive plans and zoning ordinances. Ms. Burns also served as the primary liaison for the Historic Preservation Board in her community. Ms. Burns graduated from Indiana University, Bloomington, with a bachelor of science degree in biology, and holds a master of science in environmental science degree from IU's School of Public and Environmental Affairs.

Michael R. Binkley, M.A., has seven years of experience and education with the implementation of GIS for environmental analysis and natural resource management, from data acquisition and database creation, to sophisticated spatial analysis and decision making. Possessing extensive knowledge of the major GIS software packages currently in use as well as the operating systems and platforms on which they are typically based, Mr. Binkley currently supervises GIS operations at Davey. He is also an experienced programmer with emphasis on Visual Basic and GIS programming languages. Mr. Binkley holds a Bachelor's Degree in Conservation of Natural Resources and a Master's Degree in Geography from Kent State University.

Elizabeth Buchanan, Ph.D., Quality Control and Assurance, a biologist and natural resource specialist serves as Senior Scientist and Manager of the Technical Services Group. Dr. Buchanan has over 18 years of experience in environmental consulting and the green industry. Dr. Buchanan has experience in assessment and evaluation of natural areas as related to jurisdictional wetlands, rare, threatened, and endangered species, and habitat quality. She has coordinated teams of scientists on watershed evaluation and management projects and pioneered the development of methodology to evaluate the quality of undeveloped land based on ecological factors for planning purposes. Dr. Buchanan continues to make presentations as a guest lecturer on topics in arboriculture management, sustainable environments, careers in the green industry, wetlands regulations, and related topics.

Deborah Sheeler M.A., has five years of experience and education specializing in GIS Analyses and Natural Hazards research. She is currently a GIS Analyst/Cartographer at Davey, where she focuses on designing, creating and producing maps using advanced GIS software and automated mapping. In addition to geographic analyses and generating maps, she has experience in the field of aerial photography and remote sensing as a graduate teaching assistant and four years experience in monitoring, maintaining and technical support for pen-based computers. Ms. Sheeler has a Master's of Arts degree in geography from Kent State University and a Bachelor's of Science degree in geography from Central Missouri State University with a minor in Earth Science.

Davey Resource Group crew leaders included: Tom Bard, Will Day, Meredith Rockwood, and Joel Scheiferstein.

Additional Davey Resource Group field assistance was provided by: Matt Adams, Cody Lewis, Mike Turner, and Tony Virgalitte.

Appendix F

Procedures Manual

Procedures Manual

Ohio Statewide Litter Study

August, 2003
Revised January, 2004

Conducted by:

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Project Overview and Objectives

The Ohio Department of Natural Resources (ODNR) Division of Recycling & Litter Prevention (DRLP) is conducting a statewide litter study during the fall of 2003 and the spring of 2004. The goals of the study are to:

- Examine litter composition and generation rates statewide
- Determine the sources of litter
- Identify and gain understanding of geographic trends in litter generation
- Gain information to develop effective litter prevention programs and/or campaigns
- Establish a baseline to develop a statewide litter reduction goal

This study uses the definition of litter as set forth in the Ohio Revised Code § 1502.01, which defines litter as "garbage, trash, waste, rubbish, ashes, cans, bottles, wire, paper, cartons, boxes, automobile parts, furniture, glass, or anything else of an unsightly or unsanitary nature thrown, dropped, discarded, placed, or deposited by a person on public property, on private property not owned by the person, or in or on waters of the state…".

This is a full-scale survey. The collected litter is sorted, counted, and weighed by type for each sample site. In addition, the volume of the types of litter is estimated using previously established conversion factors; if no conversion factor exists, then a conversion factor will be established for purposes of this study. The objective includes producing accurate, comprehensive litter data that reflects the overall annual amount by:

- Composition
- Weight
- Volume
- Deposition Rate

Table 1. Sample Site Types

Sample Type	*Total Number of Samples*	*Number of Sub-Samples*
Urban Interstates and U.S. Routes	14 samples	7 samples
Rural Interstates and U.S. Routes		7 samples
Urban State Route	14 samples	7 samples
Rural State Route		7 samples
Urban County Roads	14 samples	7 samples
Rural County Roads		7 samples
Urban Interchanges	14 samples	7 samples
Rural Interchanges		7 samples

Fifty-six sites are sampled to gather litter accumulation and composition data throughout Ohio. Table 1 shows the types and quantity of sample sites for the study. Accuracy is critical to the success of this study. It is better to ask questions than to miss information or make mistakes recording data. Please call the Davey project manager or supervisor (see Appendix B) with questions or if something unexpected happens at the sample site.

Schedule Overview

During the initial clean, litter is collected from the sample sites, followed by two subsequent sample cleans in the fall and spring. Litter from sample cleans is saved, tagged, and transported to a storage and sorting facility. The schedule for fieldwork is designed to minimize complications due to snow and roadside mowing. Table 2 identifies the approximate dates of the general tasks for the project.

Table 2. Schedule

Task	***Approximate Dates***
Project Kick-off Meeting	July 24, 2003
Phase I	
Determine Site Suitability	August 11 – 29, 2003
Initial Clean	September 2 – 29, 2003
Fall Clean and Sort	November 3 – 24, 2003
Data Analysis and Report Preparation	December 2003 – January 2004
Report for Phase I	January 2004
Phase II	
Spring Clean and Sort	February 24 – March 26, 2004
Data Analysis and Report Preparation	April – May 2004
Final Report	June 1, 2004

Site Suitability

A field visit to determine sample site suitability was performed in August, 2003. During this visit, the sample site was measured and mapped using global positioning systems (GPS). Digital photos were taken. No litter collection occurred on this visit. The ODNR DRLP was updated frequently as acceptable sites were identified and mapped.

Initial Clean

The next field visit was performed to clear the sample site of existing litter. The initial clean of the sample sites lasted from September 2 to September 29, 2003. All litter at each site was collected. Total weight of litter collected and a general description of the litter was recorded. The day of the initial clean is the first day of the accumulation period. Litter collected during subsequent sample cleans will measure how much litter has accumulated since the initial clean.

Fall Clean and Sort

The fall sampling litter pick-up occurred between November 3 and November 24, 2003, two months after the initial clean. The purpose of this field visit was to collect all litter deposited at the sample site since the initial clean. All litter collected was sorted, counted, and weighed.

Spring Clean and Sort

The second and final litter clean and sort in this study occurred approximately three months after the fall clean from February 24 through March 26, 2004. The purpose of this field visit was to collect all litter deposited at the sample site since the fall clean—approximately 16 weeks. All litter collected was sorted, counted, and weighed.

Sampling Methodology

Interstates, U.S. Routes, State Routes, and County Roads

A sample site is defined as one side of an interstate, U.S. route, state route, or county road. One-half of the median of divided highways is included in the sample site if the median can be accessed safely; medians with walls or other types of barriers are not be included. Collect litter from the fog line to the apparent edge of the right-of-way or until a barrier is encountered, whichever is closest.

The full half of each roadway consists of that portion which is bound on one side by the private property line and bound on the other by an imaginary line that divides the center median in half. If no center median exists, then use the centerline of the roadway and the site is bound by the private property boundary.

All sites are the same length—1,500 feet. Only one sample site is less than 1,500 feet; site 42 is 1,350 feet. Prior to starting the initial cleaning of the sample sites, it was proposed that sample sites would be no shorter than 500 feet and no longer than 1,500 feet based on the quantity of litter collected. The initial proposal intended to collect litter until over 100 pounds was gathered. Once more than 100 pounds was gathered, litter collection would continue until a permanent ending point was established or 150 pounds was collected. However, upon initiating the initial clean, it was decided to make each site consistent in length.

The starting and ending points are denoted by driving two stakes into the ground, flagging both stakes with white flagging tape, and spray painting a white line on the edge of the pavement. Sample sites all have a permanent starting point. Ending points ideally have a permanent marker, but this is not always feasible.

Measure the distance between the starting and ending points using a measuring wheel. Sample sites are measured during each of the two sampling events (i.e., fall and spring) to ensure the stakes have not been moved.

Interchanges

Interchange sample sites include both sides of one on-ramp and both sides of one off-ramp, on the same side of the roadway. The sample starting point is located on the on-ramp where the median between the ramp and the road begins. The ending point is at the end of the off-ramp where the median between the ramp and the roadway ends. Collect all litter on both sides of the ramp within 30 feet of the edge of the pavement or until a barrier is encountered, whichever is closest, to the edge of the pavement. Measure and record the length of each ramp using a measuring wheel.

Methods to Randomly Select Sites

Interstates, U.S. Routes, State Routes, and County Roads

The sample populations for this study are the number of road miles for each type of sample. First, tabulate this information by County. Then, add the miles of each type of sample and use random numbers to determine the County where the sample site is located.

Once the Counties are identified and approved by ODNR DRLP, the sites are randomly selected within each county using geographic information system (GIS) data from the Ohio Department of Transportation (ODOT). Interstates, U.S. routes, and State roads are identified by the *Mile Post Label* field, and then randomly selected based on those points. County Road sample sites are identified by randomly selecting road arcs from the county road shapefiles provided by ODOT.

Interchanges

Interchanges are randomly selected using GIS. Sites are identified using the ramp data layer provided by ODOT.

Site Visit to Determine Site Suitability

A crew leader or the project manager visits each of the randomly selected sample locations to determine if the site is suitable. Each randomly selected site is 1,500 feet long. Measure and mark the sample site with stakes, flagging, and white spray paint. Identify and map the perimeter of each site using a 12-channel Trimble Pathfinder® Pro XRS differential GPS. Complete the top half of Form B (Appendix A) at the initial site visit to document suitable sample sites.

The field-collected GPS information is compiled and differentially corrected using a desktop computer equipped with Trimble's Pathfinder® Office™ software and GPS data collected from an appropriate base station. The corrected GPS latitude-longitude positions are exported into a compatible coordinate system as a Geographic Information Systems (GIS) shapefile. Site maps are prepared using ArcView software.

Sample Site Criteria

Visit the randomly located sites to determine site suitability and to clearly define the starting point. Each roadway sample is 1,500 feet in length. The starting point must meet these criteria.

1. Starting point will have an identifiable permanent marker (e.g., intersection, edge of bridge, mile marker, or other permanent road sign). Signs and mailboxes may be used if there are no other permanent markers.
2. Starting points must be at the beginning of a roadway stretch that is at least 1,500 feet in length without a steep or vertical embankment, waterway crossing, or tunnel. In rural areas, culverts that collect runoff from the roadway are not considered waterway crossings and are allowed in the sample area.
3. The roadway stretch must be accessible from a location with safe parking and must be able to be sampled safely. Sites with limited site visibility should be avoided.

4. If an adjacent landowner is maintaining the site, move to the closest point where it is apparent the landowner is no longer maintaining the roadway. Avoid segments that are adjacent to people's front yards or places of business.
5. Sample sites will not have curbs. Curbs tend to collect litter and, thus, can bias results.
6. Sample sites will not include areas of construction, flood damage, or other unusual circumstance.

If a mapped randomly selected site is unacceptable due to any one or more of the above reasons, then identify the closest acceptable site for the specific type of sample site.

Determining Sample Site ID Number

All sites have a unique Code Number of 1 through 56. In addition, once a site is deemed acceptable, it is assigned a sample identification number. The number consists of six fields.

Field 1: Sub-sample number of 1 through 7.

Field 2: Type of site defined as:
- Interstates and U.S. Routes = IRU.S.
- State Routes = SR
- County Roads = CR
- Interchanges = I

Field 3: Type of sub-sample defined as:
- Urban = U
- Rural = R

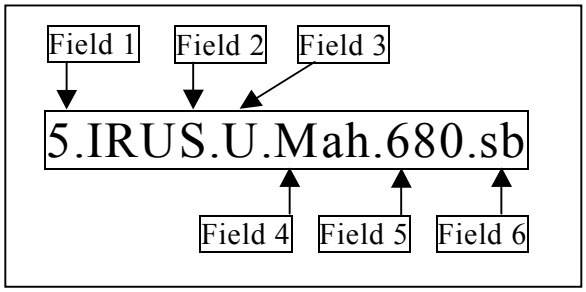

Figure 1: Sample Site ID Number

Field 4: County description defined as the first three letters of the county where the site is located, except for Monroe and Montgomery Counties, which are abbreviated as *Mor* and *Mot*, respectively.

Field 5: Road description. For most Interstates, U.S. Routes, and State Routes, this field is the road number. For County roads, this field may be a short abbreviation of the road name if is not numbered.

Field 6: Road lane designation are abbreviated as:
- Eastbound lane = eb
- Westbound lane = wb
- Northbound lane = nb
- Southbound lane = sb

Verified Sites

Table 3 lists the Ohio Counties where sample sites are located. This table indicates the Code Number and Sample ID for each site. In addition, the Ohio Environmental Protection Agency (EPA) District where each county is located is listed in the table.

Table 3. Sample Site Locations

Sample Code	County	Site Type	Sample ID	Ohio EPA District
1	Ashland	Rural Interstate Route or U.S. Route	1.IRUS.R.Ash.224.eb	NWDO
2	Guernsey		2.IRUS.R.Gue.70.eb	NEDO
3	Highland		3.IRUS.R.Hig.50.eb	SWDO
4	Mahoning		4.IRUS.R.Mah.76.wb	NEDO
5	Mercer		5.IRUS.R.Mer.127.sb	NWDO
6	Ross		6.IRUS.R.Ros.23.nb	SEDO
7	Washington		7.IRUS.R.Was.77.nb	SEDO
8	Cuyahoga	Urban Interstate Route or U.S. Route	1.IRUS.U.Cuy.480.wb	NEDO
9	Hamilton		2.IRUS.U.Ham.275.eb	NEDO
10	Cuyahoga		3.IRUS.U.Cuy.422.wb	NEDO
11	Franklin		4.IRUS.U.Fra.62.eb	CDO
12	Mahoning		5.IRUS.U.Mah.680.sb	NEDO
13	Trumbull		6.IRUS.U.Tru.62.eb	NEDO
14	Warren		7.IRUS.U.War.71.nb	SWDO
15	Auglaize	Rural State Route	1.SR.R.Aug.196.sb	NWDO
16	Clinton		2.SR.R.Cli.134.nb	SWDO
17	Fairfield		3.SR.R.Fai.256.eb	CDO
18	Fayette		4.SR.R.Fay.41.nb	CDO
19	Mahoning		5.SR.R.Mah.46.sb	NEDO
20	Ottawa		6.SR.R.Ott.105.wb	NWDO
21	Williams		7.SR.R.Wil.107.eb	NWDO
22	Cuyahoga	Urban State Route	1.SR.U.Cuy.176.nb	NEDO
23	Erie		2.SR.U.Eri.2.eb	NWDO
24	Hocking		3.SR.U.Hoc.664.nb	SEDO
25	Lake		4.SR.U.Lak.91.nb	NEDO
26	Summit		5.SR.U.Sum.8.nb	NEDO
27	Trumbull		6.SR.U.Tru.5.eb	NEDO
28	Van Wert		7.SR.U.Van.116.wb	NWDO
29	Defiance	Rural County Road	1.Co.R.Def.68.eb	NWDO
30	Knox		2.Co.R.Kno.29.wb	CDO
31	Logan		3.Co.R.Log.96.wb	SWDO
32	Madison		4.Co.R.Mad.24.eb	CDO
33	Mahoning		5.Co.R.Mah.Mcg.eb	NEDO
34	Monroe		6.Co.R.Mon.44.sb	SEDO
35	Sandusky		7.Co.R.San.85.wb	NWDO

Table 3. Sample Site Locations (Continued)

Sample Code	County	Site Type	Sample ID	Ohio EPA District
36	Belmont	Urban County Road	1.Co.U.Bel.4.eb	SEDO
37	Belmont		2.Co.U.Bel.46.nb	SEDO
38	Franklin		3.Co.U.Fra.Pos.wb	CDO
39	Warren		4.Co.U.War.121.sb	SWDO
40	Fairfield		5.Co.U.Fai.37.eb	SEDO
41	Stark		6.Co.U.Sta.Cle.nb	NEDO
42	Stark		7.Co.U.Sta.Cle.sb	NEDO
43	Cuyahoga	Urban Interchange	1.Int.U.Cuy.77.sb	NEDO
44	Franklin		2.Int.U.Fra.315.sb	CDO
45	Licking		3.Int.U.Lic.16.wb	CDO
46	Mahoning		4.Int.U.Mah.680.nb	NEDO
47	Montgomery		5.Int.U.Mon.70.eb	SWDO
48	Summit		6.Int.U.Sum.8.nb	NEDO
49	Summit		7.Int.U.Sum.271.sb	NEDO
50	Gallia	Rural Interchange	1.Int.R.Gal.35.eb	SEDO
51	Erie		2.Int.R.Eri.2.wb	NEDO
52	Medina		3.Int.R.Med.71.sb	NEDO
53	Meigs		4.Int.R.Mei.7.sb	SEDO
54	Scioto		5.Int.R.Sci.52.wb	SEDO
55	Tuscarawas		6.Int.R.TU.S.77.sb	SEDO
56	Union		7.Int.R.Uni.33.wb	CDO

Initial Clean

During the initial clean of a sample site, collect and remove all litter at each site. If an item is too large to remove from the site, mark it with spray paint. Measure and record the total distance of the sample site. Clearly identify the beginning and ending points identified on Form B (Appendix A).

Collecting

The standard collecting procedures are described in the section below titled *Standard Collection Protocols for All Site Visits.*

Special Procedures for Collecting Cigarette Butts

During the initial clean, collect cigarette butts for 100 feet or until 200 cigarette butts are collected, whichever occurs first. Denote the ending point for cigarette butt collection and measure the point where either the 100-foot point is reached or 200 cigarette butts are collected. Measure and record the total distance of the cigarette butt sub-sample site. Clearly identify the ending point distance and location on all data sheets.

Documentation of Initial Clean

Using Form C (Appendix A), document the total weight and record a written general description of the litter collected.

Fall and Spring Cleans

Collecting

The standard collecting procedures are described in the section below titled *Standard Collection Protocols for All Site Visits.* Follow these procedures for the fall and spring litter collection.

Sorting

Transport samples to a sorting area. Litter collected from each sample site is sorted and weighed separately. ***DO NOT combine litter from different sample sites***. First, bundles, glass buckets, and cigarette butts are weighed separately. Next, sort remaining litter into their component categories and subcategories. All sorting data will be recorded on Form E (Appendix A).

Measuring

All measuring is conducted using the proper equipment. Digital bench scales, which measure to 0.05 pounds, are provided to weigh the litter.

After the litter is transported to the designated Davey sorting area, weigh the bags, bundles, glass buckets, and cigarette butts separately. ***Record the total weight of <u>all</u> litter gathered on Form E, and remember to subtract the weight of any containers for the litter, such as plastic bags or buckets.***

Decide which category and subcategory (Appendix B for detailed descriptions) of litter the bundled items, glass, and cigarette butts match. Record the weight and quantity of all three types of items.

Next, sort the remaining bagged litter on a tarp into the categories and subcategories as identified on Form E (Appendix A). Measure and record both the weight and quantity of each subcategory of the litter.

After weighing the litter subcategories, add all the litter components to verify the weight is within 0.5 pounds to the starting weight for the overall litter collection. If you are not within 0.5 pounds, recheck all calculations and reweigh the components.

Dispose of the litter properly. Containers are provided at the sorting area. All clean glass, plastic, aluminum, and paper items (e.g., magazines, cardboard, or office paper) shall be recycled if recycling containers are provided. All remaining litter shall be placed in regular solid waste disposal containers.

Standard Collection Protocols for All Site Visits

Inspecting the Site

It is crucial to follow the precise sample site boundaries as defined on Form B (Appendix A). If you are unable to locate a sample boundary, immediately call the Davey project manager or supervisor (Appendix C). Do not collect litter until the correct location boundaries for the sample site have been positively identified.

Upon arrival at the sample site, inspect the sampling area. Find the boundaries and verify the location of any obstacles that were previously noted on the site map. If there are any changes, mark those on the map and provide a description on Form B (Appendix A). Crew leaders are responsible for indicating the site boundaries clearly to crewmembers. Boundaries may be temporarily marked with cones or flagging while the site work is being performed.

Assessing Site Hazards

If more than ten percent of the sampling area is inaccessible due to construction or a hazard, please call the Davey project manager or supervisor (Appendix C) immediately. The collection of litter will have to be delayed. Examples of hazards and obstacles may include:

- Snow
- Active mowing
- Active or recent spraying
- Accident scenes

Standard Safety Precautions

Standard safety precautions must be followed during the collection of litter. In addition, safety precautions that pertain to handling glass are required at all times including during sorting and measuring of litter. Standard safety precautions are described in Appendix F. All crewmembers must be aware of these precautions and complete Form F located in Appendix F.

Collecting

Collect all litter at the sample site and place it in two-cubic foot capacity recycled-content plastic bags. All items larger than one square inch from each sample site are collected. Smaller items, such as bottle caps and polystyrene peanuts, are collected. **All bags must be clearly labeled with the date, sample ID number, and crew name.**

The following exceptions apply to all sites:

- Items too large for the bags are bundled with twine or duct tape
- Broken glass is collected separately
- Cigarette butts are collected as a 100-foot linear sub-sample or until a minimum of 200 butts are collected (see *Special Procedures for Collecting Cigarette Butts*)

Items to Collect

Collect all items **larger than one square inch**, **including**:

- Broken glass, metal, and plastic pieces greater than one square inch
- Wood or organic materials not originating in the area (e.g., firewood or yard debris)
- All food items, even if biodegradable
- All other litter not posing safety risks for crews

The following items **smaller than one square inch** will be collected:

- Cigarette butts (see *Special Procedures for Collecting Cigarette Butts*)
- Bottle caps and pull tabs
- Polystyrene peanuts

Items to Record, but Not Collect

These items may include hazardous or potentially hazardous materials, such as:

- Containers of unknown liquid that appears to be urine
- Dead animals
- Human and animal waste, including diapers
- Hazardous or potentially hazardous materials, including hypodermic needles
- Tissues used for human waste
- Explosives, knives, and firearms
- Items too large or heavy to be carried safely

If an item is not included in either of these lists and appears to pose a hazard, please seek the advice of the crew leader or project manager before handling the item. If weapons, drugs, or drug paraphernalia are found, document and report them to local law enforcement authorities. Document all items not collected for any reason with digital photographs and written descriptions on Form C (Appendix A).

Special Procedures for Collecting Cigarette Butts

Collection of cigarette butts begins at the starting point. Count butts as they are collected. The cigarette butts sub-sample site is determined at the initial clean. For the fall and spring cleans, first identify the sub-sample site length and clean the same area identified in the initial clean. Cigarette butts are collected separately in a Ziplock bag. The bag shall be labeled following the procedure described below in *Bagging, Tagging, and Bundling Collected Litter,* and **include the total number of butts in the bag.**

Collecting Glass

Broken glass greater than one square inch shall be collected for this study. In order to treat all materials equitably, it is necessary to pick up all glass larger than one square inch. Glass shall be collected in a separate bucket double-lined with trash bags to ensure the safety of the crew. Once the bags are full, they should be tied, labeled clearly, and placed in the designated glass container; buckets are reused.

Disposal of Litter

The initial cleaning of the sample site is designed to clear the area of litter. Litter from this initial clean will not be analyzed, so no special tagging is necessary. Bag litter and bring to a designated disposal site and recycle and/or dispose of properly.

During the fall and spring cleaning, litter will be sorted. Containers will be provided at the sorting area. All clean glass, plastic, aluminum, and paper items (e.g., magazines, cardboard, or office paper) will be recycled. All remaining litter will be placed in regular solid waste disposal containers.

Bagging, Tagging, and Bundling Collected Litter

All items (with the exception of broken glass and cigarette butts) will be collected in the same bag. All litter that can fit in a bag should be put in a bag (e.g., a toaster oven). Litter items that do not fit into a bag but must still be collected (e.g., an eight-foot 2 x 4, a six-foot branch, or a large truck tire), and should be bundled together with the heavy-duty twine or duct tape. Each bundle should be tagged, counted, and labeled.

When your crew is finished with a site, close bags, cover buckets, **count and record the total number of bags, bundles, and buckets, and attach a completed marker tag to each.** Be sure the tag is secure, so that all bags can be easily identified. The loss of a single bag from a site could invalidate the results from the entire site.

Write the information listed below on the tag **with a permanent marker**. You may also want to write the information directly on the bag with a permanent marker, in case the tag gets lost. Attach a tag to each bag, bundle, and bucket in a secure spot.

To complete this tag, fill in the following information:

- Your name
- Date
- Site ID number
- Bag or bundle number (e.g., ***1*** of 14)
- Total number of pieces (i.e., sum of all bags and bundles) for that site (e.g., 1 of ***14***)

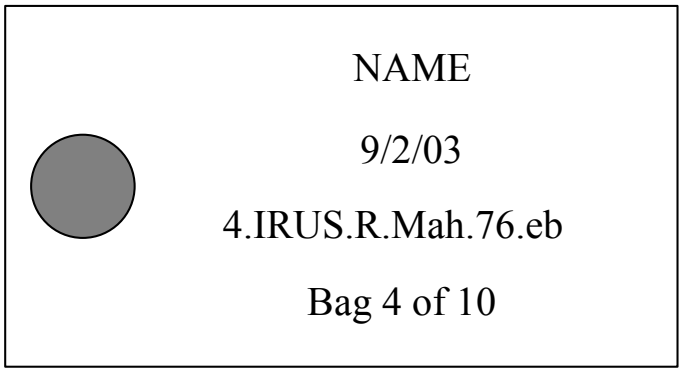

Figure 2: Sample Tag for Bags and Bundles

Next, record the total number of bags, the total number of bundles, and the total number of buckets on Form C (Appendix A).

Bags, bundles, and buckets from a particular site may be separated during transportation and/or storage. The first step in sorting a sample is locating all the bags, bundles, and buckets associated with that sample site. It is critical that each tag contain the piece number as well as the total number of pieces, so the sorting crew can easily and positively identify all bags, bundles, and buckets associated with each site.

Marking Uncollected Litter

Collection crews will work at each site three times. For the study to accurately measure the amount of litter discarded in a certain area over a given length of time, items that are left behind from one collection must be marked so that they are not counted in future collections. Markings must be discreet, so as not to attract attention from passing motorists or pedestrians, but permanent and clear for easy identification by future crews. Mark items with white spray paint. When possible, paint the item in a spot that is not visible from the road. As you paint each item, be sure to inventory that item on Form C (Appendix A). Only the Crew Leader should mark and inventory items. **All items left behind must be inventoried.** During the spring and fall collections, the Crew Leader will check objects to see if they have been marked and counted on a previous visit. The Crew Leader will refer to the litter inventory forms from previous visits to know if items have been left behind. These items will not be recounted.

Quality Control

As litter is collected, the Crew Leader should inspect areas that have been cleaned to be sure crewmembers are picking up all required materials. The Crew Leader should also make sure that the crew is collecting litter to the site boundary, but not beyond it. If re-cleaning is necessary, it is recommended you deploy different crewmembers and have them switch locations, so "new" eyes can look for and find missed litter.

Final Inspection

Before departing a site, be sure to tag all collected items and record how many of each type of bag, bundle, and bucket your crew has collected on Form C (Appendix A). You will need to transport the tagged bundles, bags, and buckets to the designated location indicated by the Project Manager.

General Data Recording and Reporting

Several checklists and data sheets have been compiled to help accurately record data for each site. Copies are included in this manual. Checklists must be marked off before starting work at each sample site. Crew leaders must completely fill out all data sheets for each site visit at all sample sites. **All data forms must be turned into the Davey project manager or supervisor as soon as possible.**

Crew Leader Responsibilities

Crew leaders will be responsible for the following tasks:

1. Training crew to properly collect, sort, and measure the litter for each sample site.
2. Identify and verify the starting point markers at the sample site based on site description and mapping provided by the project manager.
3. Identify and measure the distance to the ending point.
4. Identify any obstacles, barriers, or other abnormal circumstances at the sample site.
5. Before starting litter collection, ensure all safety equipment is properly located on the sample site and other equipment is available and/or being used properly according to Checklist A (Appendix A).
6. Before starting litter collection and after collection is complete, photograph the sample site at the starting point looking toward the ending point. In addition, photograph the following
    - Any abnormalities at the sample site (e.g., obstacles);
    - Large items of litter that will not be removed from the sample site; and
    - Interesting or unusual litter findings at the sample site.
7. Ensure the sample site has been completely cleared of all litter as described in the section above titled *Standard Collection Protocols*.
8. Ensure all measuring and sorting protocols are properly followed. These procedures are described in the section above titled *Fall and Spring Cleans*.
9. Record all data and other required information on the forms provided in Appendix A.
10. Ensure all crewmembers have reviewed the *Standard Safety Precautions* and completed and signed Form F (Appendix F).
11. While in the field collecting litter, please document any litter sighting events on Form D (Appendix A).

Appendix A
Data Recording Forms

Checklist A: Ohio Litter Study Equipment and Safety

Basic Equipment

- ❑ Roadmap to the site
- ❑ Map of sample site
- ❑ Measuring device to confirm site boundaries
- ❑ Multiple copies of all forms in Appendix A
- ❑ Guidelines for sampling public site areas
- ❑ Digital camera
- ❑ Write In the Rain notebook
- ❑ Pencil
- ❑ Field manual

Site Demarcation Tools

- ❑ White spray paint
- ❑ Extra flags for replacements
- ❑ Stakes
- ❑ Flagging
- ❑ Hammer
- ❑ Waterproof pen

Safety Equipment

- ❑ Cones
- ❑ Safety vests
- ❑ *Shoulder Work Ahead* signs
- ❑ Proper protective gloves (2 sets/person)
- ❑ Hand-sanitizing lotion
- ❑ Safety Glasses
- ❑ Safety Belt (Optional)

Collection Equipment

- ❑ Bucket for glass
- ❑ Collection bags
- ❑ Bag identification tags
- ❑ Permanent markers
- ❑ Heavy-duty twine or duct tape for tying together bundles of oversized objects
- ❑ Litter pickers
- ❑ Clipboard
- ❑ Field scales

Form B: Sample Site Documentation

Site #: _____ Date: _____

Intersection Location or Mile Marker #: _____ Site Length: _____

Starting Point Description and Sketch of Site:

Use this form to document the pictures taken at each site.

Date	*Site Number*	*Photo Number*	*File Name*	*Description*

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Form C: Initial Clean and Spring and Fall Sampling Documentation

Sample CODE Number (1 – 56) :_____

Sample Detail Name:_____

Date of Initial Clean-Up:_____

Start Time:_____ **End Time:**_____

Crew Leader:_____ **Total Number on Crew (include leader):**____

Crew Members:_____

Weather:_____ **Temp:**_____

Start and End Points Clearly Marked with two stakes with white flags: YES NO

Location of Cigarette Sub-sample — must be 200 butts or 100 linear feet.

Starting Point of Sample:_____

Length of Sample:_____ Width of Sample:_____

Describe in detail (e.g., where are the most butts found):_____

_____

Stake put in place to mark end: YES or NO NUMBER of Butts Collected:_____

Items not collected: Urine Containers (number): _____ Bags of feces (number): _____

Syringes/Needles (number):_____ Other items too big or unable to collect:_____

_____

_____

PHOTOS: Before and after clean-up viewing all ways; unusual items, buckets, etc.

Photo _____ Photo_____

Photo_____ Photo_____

Photo_____ Photo_____

Photo_____ Photo_____

Photo_____ Photo_____

Photo_____ Photo_____

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Weight Data for Initial Clean-Up:

Bag or Bundle #	Total Wt.	Person Wt.	Weight of BAG		Bag or Bundle #	Total Wt.	Person Wt.	Weight of BAG

Describe Bundles:_____

_____

_____

Generally Describe Litter Collected: _____

_____

_____

Sketch of site, boundary descriptions, and atypical site descriptions (use additional sheet if necessary):

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Form D: Roadway Littering Sighting Form

Date:_____ Time:_____

Where (circle one): Interstate/U.S. Route State Road County Road Interchange

Where (circle one): Urban Rural

General Location Description: _____

Make/Model of Vehicle:_____

What was littered? _____

Who Littered?

Gender (circle one): Male Female

Approximate Age:_____

Race (circle one): Hispanic Caucasian African-American Native American Other____

Additional Comments

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Form E: Litter Component Categories Log

Date:			
Site Number:			
Total Sample Weight (TSW):			
TSW = (weight of bags + bundles) - 0.22 pounds			
Litter Component Categories	***Number of Items***	***Weight of Items***	***Volume of Items***
1. Paper			
1.1 Beverage containers			
1.2 Fast food			
1.3 Other food			
1.4 Non-food			
1.5 Other cardboard			
1.6 Paper bags			
1.7 Newspaper & magazines			
1.8 Other paper			
2. Plastic			
2.1 Beverage containers			
2.2 Fast food			
2.3 Other food			
2.4 Non-food			
2.5 Plastic bags & film			
2.6 Automotive parts			
2.7 Other plastic			
3. Glass			
3.1 Beverage containers			
3.2 Fast food			
3.3 Other food			
3.4 Non-food			
3.5 Automotive parts			
3.6 Other glass			
4. Metal			
4.1 Beverage containers			
4.2 Fast food			
4.3 Other food			
4.4 Non-food			
4.5 Automotive parts			
4.6 Other metal			
5. Organics			
5.1 Food (human & pet)			
5.2 Cigarettes			
5.3 Other			

Litter Component Categories	Number of Items	Weight of Items	Volume of Items
6. Construction & Demolition Litter			
6.1 Wood/lumber/practical			
6.2 Mineral aggregates			
6.3 Roofing			
6.4 Insulation			
6.5 Drywall			
6.6 Other Construction & Demolition Litter			
7. Hazardous Materials			
7.1 Latex paint			
7.2 Oil-based paint			
7.3 Oil			
7.4 Batteries			
7.5 Flammable gas			
7.6 Flammable liquids			
7.7 Explosives			
7.8 Pesticides/herbicides			
7.9 Cleaners/hazardous			
7.10 Medical wastes			
7.11 Other hazardous			
7.12 Dead animals			
8. Other Materials			
8.1 Textiles & leather			
8.2 Carpet			
8.3 Furniture			
8.4 Tires			
8.5 Auto rubber products			
8.6 Rubber and latex toiletries			
8.7 Other rubber of latex			
8.9 Ceramics/porcelain			
8.10 Toys/sporting goods			
8.11 Miscellaneous materials			
8.12 Hygienic products			
9. Miscellaneous Debris (grass, leaves, dirt, stones, etc)			

Appendix B
Descriptions of Litter Subcategories Provided by ODNR, DRLP

1. PAPER

1.1 Beverage containers

Alcoholic: Any paperboard carton or other container of any size (excluding paper cups and packaging materials) designed to contain wine or wine cooler beverages.

Non-alcoholic: Any paperboard carton or other container of any size (excluding paper cups) designed to contain non-alcoholic beverages. This includes such items as juice boxes and milk cartons, but excludes paper used as packaging material.

Unknown: Any paperboard carton or other container of any size (excluding paper cups and packaging material) designed to contain beverages, but whose previous contents are unknown.

1.2 One-time/fast food service items: All paper items used to serve one-time or fast-food service items originating from restaurants, taverns, drive-ins, concessions, the fast-food section of a grocery store, and other such establishments. Examples include paper cups, plates, bowls, wrappings, individual serving condiment packages, cup and beverage holders, napkins or towels, and paper bags known to be from such establishments.

1.3 Other food and beverage packaging: Any paperboard boxes or cartons, wrappings, or other papers designed to hold food or beverages not originating from fast-food service establishments. This includes, but is not limited to, paperboard boxes used to hold 12 or more individual soda pop or beer containers, and wrappings, bags, or boxes used to package gum, chips, crackers or other snack items.

1.4 Non-food packaging

Tobacco products: Paper boxes, wrappings, bags, or other papers used to package cigarettes, cigars, chewing or pipe tobacco, and other tobacco products. Includes individual cigarette packages.

Cleaning agents (non-hazardous): Paper boxes, wrappings, bags, or other papers that contained cleaning agents such as soaps, shampoos, or detergents, that are primarily used for cleaning buildings, places, persons, animals, or things.

Hazardous material packaging: Paper boxes, wrappers, bags, or other papers that contained hazardous items such as pesticide.

Other packaging: Paper boxes, wrappings, bags, or other papers used to package items that are not food, tobacco, cleaning agents, or hazardous, or whose previous contents are unknown.

1.5 Other cardboard/boxboard: Any other corrugated or paper boxes either not used for packaging or whose purpose is unknown.

1.6 Paper bags: All other paper bags (brown, bleached, or colored) not known to be used as packaging materials or serving fast-food items. Examples are hardware store bags and grocery bags.

1.7 Newspapers and magazines: Printed newsprint, including glossy ad slicks and bound or individual pages of magazines.

1.8 Other paper/composite materials: Products made entirely of paper that are not elsewhere described, such as computer paper, envelopes, and paperback books. Products made predominantly of paper, but also including other materials, such as hardback books and photographs.

2. PLASTIC

2.1 Beverage containers

Alcoholic: Plastic bottles or containers of any size designed to contain beer or other malt beverages, wine, wine coolers, vodka, gin, rum, and liqueurs.

Non-alcoholic: Any plastic bottle or container of any size (excluding plastic cups) designed to contain non-alcoholic beverages, such as water, soda pop, juice, and sports drinks.

Unknown: Any plastic bottle or other container of any size (excluding plastic cups and packaging materials) designed to contain beverages, but whose previous contents are unknown.

2.2 One-time/fast food service items: All plastic items (including Styrofoam) used to serve one-time or fast-food service items originating from restaurants, taverns, drive-ins, concessions, the fast-food section of a grocery store, and other such establishments. Examples include plastic cups, lids, straws, utensils, plates, bowls, wrappings, individual-serving condiment packages, any beverage cup holders, and plastic bags known to be from such establishments.

2.3 Other food and beverage packaging: Any plastic containers (including Styrofoam) or film wrappings designed to hold food or beverage items not originating from fast-food service establishments. This includes, but is not limited to, six-ringed beverage holders, yogurt cups, wrappings or bags used to package candy, chips, canned soups, or other snack items.

2.4 Non-food packaging

Tobacco products: Plastic wrappings, bags, or other plastic packaging materials used to package cigarettes, cigars, chewing or pipe tobacco, or other tobacco products.

Cleaning agents (non-hazardous): Plastic boxes, wrappings, bags, or other plastic packaging materials that contained cleaning agents such as soaps, shampoos, or detergents, that are primarily used for cleaning buildings, places, persons, animals, or things.

Hazardous material packaging: Plastic bottles, boxes, or bags that contained hazardous products, such as motor oil bottles.

Other packaging: Paper/plastic boxes, wrappings, bags, or other plastics used to package items that not food, tobacco, cleaning agents; or hazardous materials, or whose previous contents are unknown.

2.5 Plastic bags and film: Plastic films not known to be used for packaging materials or serving food service items. Examples include plastic grocery bags, plastic garbage bags, and tarps.

2.6 Automotive parts: Plastic molding, exterior light covers, and any other plastic part known to be from an automobile.

2.7 Other plastic/composite materials: Products made entirely of plastic that are not elsewhere described, such as multiple-use water bottles. Products made predominantly of plastic, but that also includes other materials such as thermos bottles, insulated cups, and ice chests.

3. GLASS

3.1 Beverage containers

Alcoholic: Any glass bottle or other container of any size designed to contain beer or other malt beverages, wine or wine coolers, vodka, gin, rum, and other liqueurs.

Non-alcoholic: Any glass bottle or other container of any size designed to contain non-alcoholic beverages such as flavored waters, juice, milk or soda pop.

Unknown: Any glass bottle or other container of any size designed to contain a beverage, but whose previous contents are unknown.

3.2 One-time/fast food service items: All glass items used to serve one-time or fast-food service items originating from restaurants, taverns, drive-ins, concessions, fast-food section of a grocery store and other such establishments.

3.3 Other food and beverage packaging: Any glass containers or other glass designed to hold food items not originating from fast-food service establishments. This includes, but is not limited to jam jars, condiment bottles (e.g. mustard), and spices.

3.4 Non-food packaging

Tobacco products: Glass containers or other glass used to contain cigarettes, cigars, chewing tobacco, or other tobacco products.

Cleaning agents (non-hazardous): Glass containers or other glass used to contain cleaning agents such as soaps, shampoos, or detergents that are primarily used for cleaning buildings, places, persons, animals, or other things.

Hazardous material packaging: Glass containers that contained hazardous materials.

Other packaging: Other glass used to package items that are not food, tobacco, cleaning agents, or hazardous materials, or whose previous contents were unknown.

3.5 Automotive parts: Rearview mirrors, lights, or window glass known to be from an automobile or other motorized vehicle.

3.6 Other glass/composite materials: Glass pieces or products made entirely of glass that are nowhere else classified. Products predominantly made from glass but also include other materials.

4. METAL

4.1 Beverage containers

Alcoholic: Any metal can or other container of any size designed to contain beer or other malt beverages, wine or wine coolers, vodka, gin, rum, and other liqueurs.

Non-alcoholic: Any metal can or other container of any size designed to contain non-alcoholic beverages such as juice, milk or soda pop.

Unknown: Any metal can or other container of any size designed to contain beverages, although the type of beverage is unknown.

4.2 One-time/fast food service items: All metal containers or foils used to serve one-time or fast-food service items originating from restaurants, taverns, drive-ins, concessions, the fast-food section of a grocery store, and other such establishments. Examples include foil wrappings, aluminum bowls, and condiment packaging known to be from such an establishment.

4.3 Other food packaging: Any metal container or foil designed to hold food items not originating from fast-food service establishments. Examples include some canned food containers and chocolate bar wrappings.

4.4 Non-food packaging

Tobacco products: Metal containers or foils used to package cigarettes, cigars, chewing tobacco, or other tobacco products.

Cleaning agents (non-hazardous): Metal containers or foils used to contain cleaning agents such as soaps, shampoos, or detergents, that are primarily used for cleaning buildings, places, persons, animals, or things.

Hazardous materials packaging: Metal containers that contained hazardous items, such as oven cleaner.

Other packaging: Other glass used to package items that are not food, tobacco, cleaning agents, or hazardous materials, or whose previous contents were unknown.

4.5 Automotive parts: Any metals known to originate from automobiles. Examples include hubcaps, tailpipes, and wheels.

4.6 Other metal/composite materials: Products made entirely from metal and are not elsewhere described. Predominantly metal products, but containing other materials as well.

5. ORGANICS

5.1 Food (human or pet): Food wastes and scraps including bones, rinds, etc. for human or pet consumption. Excludes the weight of food containers, except when the container weight is negligible compared to the food inside.

5.2 Cigarettes and other tobacco products: All tobacco products including used and unused cigarettes, cigars, chewing tobacco, and pipe tobacco, excluding their packaging, except when the weight is negligible when compared to the weight of the tobacco product.

5.3 Other organics: All organic materials, not elsewhere classified, non-native to the site in which it was collected. This includes yard debris, stumps, firewood, branches, and prunings.

6. CONSTRUCTION AND DEMOLITION LITTER

6.1 Wood/lumber/particleboard: Milled lumber and wood products, including treated, untreated, and painted wood.

6.2 Mineral aggregates: Concrete, cinder blocks, and brick.

6.3 Roofing: Roofing materials, asphalt roofing, shingles, tarpaper, and tiles.

6.4 Insulation: Fiberglass or cellulose insulation.

6.5 Drywall: Gypsum drywall (new or used).

6.6 Other construction/demolition debris: Other construction/demolition materials not elsewhere classified.

7. HAZARDOUS MATERIALS

7.1 Latex paint: Water-based paints.

7.2 Oil-based paint: Oil-based paints, varnishes, stains, and similar products.

7.3 Oil: Motor oil and other fuel oils.

7.4 Batteries: Batteries known to be from automobiles.

7.5 Flammable gas: Propane canisters

7.6 Flammable liquids: Gas, turpentine, and non-chlorinated solvents, including paint strippers and solvents contaminated with other products (such as paints, degreasers, and some other cleaners) if the primary ingredient is (or was) the solvent or an alcohol such as methanol or propanol.

7.7 Explosives: Fireworks, firecrackers, or any potentially explosive material other than fireworks, including gunpowder, unspent ammunition, and picric acid.

7.8 Pesticides/herbicides: Variety of poisons whose purpose is to discourage or kill pests, weeds, or microorganisms. Fungicides and wood preservatives are also included.

7.9 Cleaners (hazardous): Cleaning agents such as drain cleaners and mildew removers. This does not include the packaging unless it is negligible by weight.

7.10 Medical wastes: Needles, syringes, I.V. tubing, and other medical waste materials used in connection with treating a patient (or animal). Also includes medications, ointments, creams, etc. used to heal persons or other animals, but does not include their packaging unless negligible by weight.

7.11 Other hazardous: Other hazardous materials that do not fit into the above categories, including unidentifiable materials, such as non-automotive batteries and adhesives/glue.

8. OTHER MATERIALS

8.1 Textiles and leather: Fabrics and products made from leather and/or textiles, such as clothing, shoes, and purses.

8.2 Carpet: General category of flooring applications consisting of various natural or synthetic fibers bonded to some type of backing material.

8.3 Furniture/mattresses/appliances: Mixed material furniture, mattresses, box springs, and refrigerators.

8.4 Tires: Vehicle tires of all types.

8.5 Auto rubber products: Rubber products that originate from vehicles, such as tire shards.

8.6 Rubber and latex toiletries: Rubber or latex products for grooming or health purposes, such as make-up sponges, gloves, and condoms.

8.7 Other rubber or latex products: Finished products and scrap materials made of rubber, such as bath mats, inner tubes, rubber hoses, and foam rubber.

8.9 Ceramics/porcelain: Finished ceramic or porcelain products such as dishware, toilets, etc.

8.10 Toys/sporting goods: Items such as golf balls, Frisbees, and toy cars.

8.11 Miscellaneous materials: Any other material not otherwise described.

8.12 Hygienic products: Sanitary pads, tampons, etc.

9. MISCELLANEOUS DEBRIS: Any debris that is not considered litter yet was collected with the litter, such as dirt, mud, leaves, grass, rocks, and other materials that adhered to the litter collected.

Appendix C
Davey Resource Group Contact Numbers

Davey Resource Group Contact Phone Numbers

Ana Burns, Project Manager
3728 Fishcreek Road
Stow, Ohio 44224
330-673-5685, ext. 37
800-828-8312
330-328-2376 (cell)
330-673-0860 (fax)
aburns@davey.com

Beth Buchanan, Project Administrator
3728 Fishcreek Road
Stow, Ohio 44224
330-673-5685, ext. 17
800-828-8312
330-322-7306 (cell)
330-673-0860 (fax)
bbuchanon@davey.com

Tom Bard, Crew Leader
3728 Fishcreek Road
Stow, Ohio 44224
330-310-6321 (cell)
440-543-5672 (home)

Will Day, Crew Leader
3728 Fishcreek Road
Stow, Ohio 44224
330-289-3536 (cell)
330-773-4123 (home)

Meredith Rockwell, Crew Leader
3728 Fishcreek Road
Stow, Ohio 44224
330-701-3891 (cell)
330-945-5537 (home)

Davey Tree Corporate Headquarters
Davey Institute
1500 North Manuta Street
Kent, Ohio 44240
800-447-1667

Appendix D
Ohio Department of Transportation, County, and City Contact Information

Code	Sample ID	County	Jurisdiction	Contact Person	Phone Number
1	1.IRUS.R.Ash.224.eb	Ashland	ODOT	Mark Blair	419-281-0513
15	1.SR.R.Aug.196.sb	Auglaize	ODOT	Ted Hemleben	419-738-4214
36	1.Co.U.Bel.4.eb	Belmont	County	Fred Bennet	740-699-2160
37	2.Co.U.Bel.46.nb				
16	2.SR.R.Cli.134.nb	Clinton	ODOT	Chris Beam	937-382-2229
8	1.IRUS.U.Cuy.480.wb	Cuyahoga	ODOT	Jim Mihelich	216-581-2100
10	3.IRUS.U.Cuy.90.wb				
22	1.SR.U.Cuy.176.nb				
43	1.Int.U.Cuy.77.sb				
29	1.Co.R.Def..68.eb	Defiance	County	Gaylon Davis	419-782-4751
23	2.SR.U.Eri.2.eb	Erie	ODOT	Karen Capizzi	419-499-2351
51	2.Int.R.Eri.2.wb	Erie	ODOT	Bill Leach	419-207-7030
17	3.SR.R.Fai.256.eb	Fairfield	ODOT	Troy Dunlap	740-653-5961
40	5.Co.U.Fai.37.eb		Lancaster	Mitchell Nusser	740-687-6668
18	4.SR.R.Fay.41.nb	Fayette	ODOT	Jason Little	740-335-1800
44	2.Int.U.Fra.315.sb	Franklin	Columbus	Ray Browning	614-645-7999
38	3.Co.U.Fra.Pos.wb		Dublin	Bill Grubaugh	614-410-4758
11	4.IRUS.U.Fra.62.eb		New Albany	Mark Nemec	614-855-0076
50	1.Int.R.Gal.35.eb	Gallia	ODOT	Dennis J. Phillips	740-446-1553
2	2.IRUS.R.Gue.70.eb	Guernsey	ODOT	Darrel Fawcett	740-432-7586
9	2.IRUS.U.Ham.275.eb	Hamilton	ODOT	Mike Brown	513-932-3311
3	3.IRUS.R.Hig.50.eb	Highland	ODOT	George Gall	937-393-1833
24	3.SR.U.Hoc.664.nb	Hocking	Logan	Tom Myers	740-385-4060
30	2.Co.R.Kno.29.wb	Knox	County	James Henry	740-397-1500
25	4.SR.U.Lak.91.nb	Lake	Eastlake	Bill Philipps	440-951-1416
45	3.Int.U.Lic.16.wb	Licking	Newark	T. Matheny	740-349-6676
31	3.Co.R.Log.96.wb	Logan	County	Scott Coleman	937-592-2791
32	4.Co.R.Mad.24.wb	Madison	County	David Brand	740-852-9404
33	5.Co.R.Mah.Mcg.eb	Mahoning	County	Richard Marsico	330-799-1581

Code	Sample ID	County	Jurisdiction	Contact Person	Phone Number
4	4.IRUS.R.Mah.76.eb	Mahoning	ODOT	Joseph Maslach Jr.	330-533-3637
12	5.IRUS.U.Mah.680.sb				
19	5.SR.R.Mah.46.sb				
46	4.Int.U.Mah.680.nb				
52	3.Int.R.Med.71.sb	Medina	ODOT	Frank Phillips	330-723-0091
53	4.Int.R.Mei.7.sb	Meigs	ODOT	Brett Jones	740-992-2501
5	5.IRUS.R.Mer.127.sb	Mercer	ODOT	Steve Zehringer	419-586-4269
34	6.Co.R.Mor.44.sb	Monroe	County	Lonnie Tustin	740-472-0760
47	5.Int.U.Mot.70.eb	Montgomery	ODOT	Jeffery Schenerlein	740-472-0921
20	6.SR.R.Ott.105.wb	Ottawa	ODOT	Steve Durnwald	419-898-4134
6	6.IRUS.R.Ros.23.nb	Ross	ODOT	Aaron C. Mitten	740-773-3191
35	7.Co.R.San.85.wb	Sandusky	County	James Moyer	419-334-9731
54	5.Int.R.Sci.52.wb	Scioto	ODOT	Troy Huff	740-259-2071
41	6.Co.U.Sta.Cle.nb	Stark	County	Michael Rehfus	330-477-6781
42	7.Co.U.Sta.Cle.sb				
26	5.SR.U.Sum.8.nb	Summit	Cuyahoga Falls	Becky McCleary	330-971-8201
49	7.Int.U.Sum.271.sb		Macedonia	Jim Crevar	330-468-8373
48	6.Int.U.Sum.8.nb		Stow	Dano Koehler	330-689-2700
13	6.IRUS.U.Tru.62.eb	Trumbull	ODOT	Gregory Solarz	330-637-1921
27	6.SR.U.Tru.5.eb				
55	6.Int.R.TU.S.77.sb	Tuscarawas	ODOT	Jeff Bonomo	330-339-5050
56	7.Int.R.Uni.33.wb	Union	ODOT	Vacant	937-642-1986
28	7.SR.U.Van.116.wb	Van Wert	Van Wert	Vince Hitchcock	419-222-9055
39	4.Co.U.War.121.sb	Warren	County	Neil Tunison	513-695-1364
14	7.IRUS.U.War.71.nb		ODOT	Mike Brown	513-932-3311
7	7.IRUS.R.Was.77.nb	Washington	ODOT	Doug Clifton	740-373-0536
21	7.SR.R.Wil.107.eb	Williams	ODOT	Lee Anderson	419-485-3505

Appendix E
Standard Safety Precautions

Physical Hazards

Physical hazards are inherently present during litter collection and sorting operations. Physical hazards present at the sample site will include:

1. Exposure to moving vehicles associated with working on the roadside;
2. Noise exposure associated with the working on the roadside;
3. Slip-trip-fall hazards associated with operations conducted in the collection activities; and
4. Skeletal-muscular injury hazards resulting from work performed outdoors.

Site workers must also be aware of motor vehicles and other mobile equipment at all times. Motor vehicles and other mobile equipment will always be given the right-of-way.

The following safety precautions must be followed at all times during the collection of litter.

Weather

The weather conditions are an important consideration in planning and conducting the litter collection and sorting activities. Extremely hot or cold weather can cause physical discomfort, loss of efficiency, and personal injury. Of particular importance is heat stress, often resulting when protective clothing decreases the body's natural ventilation process.

Accident Prevention

All on-site personnel will be accountable for site safety and will maintain a safe site at all times.

Assignment of Responsibilities

The on-site crew leader has all health and safety responsibilities including:

1. Ensuring that health and safety requirements are met;
2. Briefing crews on specific duties;
3. Controlling site access;
4. Selecting the proper level of personal protective equipment and clothing, and ensuring its use by all on-site employees; and
5. Monitoring all on-site workers for signs of stress (e.g., heat stress, cold exposure, toxic exposure, and general fatigue).

Personal Protective Equipment (PPE)

Based on an evaluation of potential hazards, crewmembers must wear protective equipment, including long pants, safety shoes, gloves; safety glasses, and hard hats, at all times during collection and sorting of litter. If at any time you feel additional, personal protective equipment is necessary, inform the crew leader and cease any activity that requires additional equipment immediately.

Precautions for Handling Glass

In addition, safety precautions which pertain to handling glass will be required at all times during sorting and measuring of litter.

1. At all times during collection of litter and when handling broken glass, crewmembers must wear protective equipment, including long pants, safety shoes, gloves, safety glasses, and hard hats.
2. When picked up, glass may cut, scrape, or stab a crewmember. Use extra care when picking up glass, or use a litter picker.
3. If dropped, glass may shatter. Be cautious when handling glass and containers with glass.
4. Glass put in bags may break through the bag and cut, scrape, or scratch the bag handler. For that reason, broken glass that is collected should be placed in a plastic bucket that has been provided.
5. When carrying buckets of glass, crewmembers must be cautious, watch their step, and not jostle or swing the bucket. Use a bucket lid to prevent glass from falling out of the bucket. If a lid is not available, do not fill the bucket more than halfway, to minimize the chance of glass falling out of the bucket.

Control of Heat Stress Conditions

Heat Stress Monitoring

The stress of working in a hot environment can cause a variety of illnesses including heat exhaustion or heat stroke—the latter can be fatal. The use of PPE can significantly increase the potential for heat stress to occur. Hazards associated with heat stress include the following:

1. **Heat Rash** may result from continuous exposure to heat or humid air.
2. **Heat Cramps** are caused by heavy sweating with inadequate electrolyte replacement. Heat cramps can cause muscle spasms, and pain in the hands, feet, and abdomen.
3. **Heat Exhaustion** occurs from increased stress on various body organs, including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Heat exhaustion can cause pale, cool, moist skin; heavy sweating; dizziness; nausea; and fainting.
4. **Heat Stroke** is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury or death occur. Competent medical help must be obtained. Heat stroke can cause red, hot, and unusually dry skin. Symptoms include lack of or reduced perspiration, nausea, dizziness, confusion, strong rapid pulse, and coma.

Employees who experience these symptoms should take prompt action. Severe exposures to heat stress conditions can lead to heat stroke.

The on-site crew leader will monitor worker activity and will stop employee work activity when signs of heat stress conditions warrant. Employees shall report any signs and symptoms of heat stress to the on-site crew leader.

Control measures to prevent heat stress include:

1. Adequate intake of fluids, preferably cold water
2. Work/rest regimen with rest periods taken in a cool shaded area

Accident or Injury

Depending on the severity of the injury, treatment may either be given at the site by trained personnel (additional assistance from an emergency medical technician may be required) or the victim may have to be transported to a hospital. First, on-site personnel will be notified of the accident or injury and then call for medical assistance (911). The following information should be provided to the 911 emergency operator upon calling:

1. Name of person calling
2. Phone number of phone calling from
3. Location of incident (address if available)
4. Nature of incident (fire, explosion, cave-in, injury, vehicle accident)
5. When the incident occurred
6. Type of assistance needed (fire, rescue, law enforcement)
7. Number of persons needing assistance
8. Extent of injuries (if known)

Report any incident, no matter how minor, to the on-site crew leader.

Site Evacuation

The on-site crew leader is responsible for determining if circumstances exist which require evacuation and should always assume worse-case conditions until proven otherwise. Evacuation routes from the site shall be established and communicated to all personnel. During an emergency, the on-site crew leader shall ensure that all personnel are evacuated from the site and accounted for. In the event of a fire or other emergencies, action shall be taken to address the emergency following the accounting of all personnel. Personnel will be evacuated up-wind of the site.

Site Inspections

An inspection of the site must be performed initially by the on-site crew leader prior to the initiation of each work day. An evaluation must be conducted with regard to the activity that may generate a hazard within the workspace.

Safety of Third Parties

Site access will be strictly controlled such that only authorized personnel and previously approved visitors will be allowed in work areas. Only the property owner or the on-site crew leader will have the authority to escort third parties on-site.

Emergency Communications

The crew leader at the site will maintain a mobile telephone for emergency communications. The on-site crew leader will use this telephone to report emergencies to local authorities such as medical, fire, and police.

General Site Safety Requirements

Field personnel will comply with all on-site rules, regulations, and procedures as well as all federal, state, and local safety codes, ordinances, and regulations in order to maintain safe working conditions at the job site. All personnel will be responsible for reporting unsafe working conditions to the on-site crew leader.

All questions or inquiries, no matter how small, must be addressed to the on-site crew leader immediately. Prompt reporting is critical so as to provide field personnel the proper information, first aid, or other medical treatment as required.

General Safety Procedures

- There shall be no intoxicating substances of any kind permitted on or near the job site (*e.g.*, alcohol and illegal or illicit drugs). Under no circumstances will anyone known to be under the influence of intoxicating substances be allowed on the job site (violators are subject to dismissal).
- No firearms or other weapons shall be permitted on the job site (violators are subject to dismissal).
- Fighting, scuffling, or horseplay is prohibited while on the job site (violators are subject to dismissal).
- All field personnel must follow all instructions from the on-site crew leader regarding the proper use of personal safety equipment.
- All personnel are responsible for practicing personal hygiene and are expected to wash hands, face, and forearms thoroughly prior to eating and/or drinking to avoid ingestion of hazardous materials.
- No smoking, eating, drinking, or chewing tobacco or gum shall be allowed on the work site. This measure is to decrease the probability of hand-to-mouth transfer and ingestion of hazardous materials.
- Good housekeeping is essential because of the work site conditions. Every effort will be made to ensure the site is maintained in a clean and safe condition at all times.
- No smoking will be allowed on the property at any time.

In summary, personnel should keep the following prudent guidelines during activities in the work areas:

1. Hazard assessment is a continual process;
2. Personnel must be aware of their surroundings and constantly be aware of the chemical, biologic/pathologic, and physical hazards that are present; and
3. Personnel at the site should be aware of other personnel performing tasks so that all activities comply with safety guidelines.

Form F: Standard Safety Precautions

I have reviewed and understand the above Standard Safety Precautions. To ensure my personal safety, I will follow the above listed Standard Safety Precautions while collecting, sorting, measuring, and disposing of litter.

Signature: _____

Print Name: _____ Date:_____

DAVEY
RESOURCE GROUP
A Division of The Davey Tree Expert Company