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# Roadside Litter in Florida

## 2002

**FLORIDA CENTER FOR  
SOLID AND HAZARDOUS WASTE MANAGEMENT**

2207-D NW 13<sup>th</sup> Street  
Gainesville, FL 32609

for

**THE FLORIDA LEGISLATURE**

and

**FLORIDA DEPARTMENT OF  
ENVIRONMENTAL PROTECTION**

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## EXECUTIVE SUMMARY

This report presents the results of Florida's sixth statewide roadside litter survey conducted by the Florida Center for Solid and Hazardous Waste Management (the Center). From January to mid-March 2002, the Center surveyed 10 roadside sites in each of Florida's 67 counties, for a total of 670 sites. The survey counted 38,100 large and small litter items and classified them into 87 categories. The survey covered 134,000 linear feet, or more than 25 miles of roadway. Taking into account the total area of the 670 sites, the large litter survey covered 2,832,750 square feet along Florida's roadways.

In 1993, the Florida Legislature established a 50% litter reduction goal for the period of 1994 through 1997. The Legislature directed the Center to develop a scientifically reliable methodology and to conduct annual surveys to measure the state's progress toward the litter reduction goal. Previous reports have presented the results of the surveys conducted from 1994 through 2001. To assist in the development of the survey, the Legislature further directed that the Center appoint and work with a broad-based work group, not to exceed seven members, from the university system, business, government, and the environmental community.

Although they are not the only places where litter accumulates, roadsides are a useful indicator of the amount of litter in the environment. However, the frequent mowing of Florida's roadsides has a mulching effect on litter, and it would be impractical to attempt to count every small piece of paper, glass, hard plastic, or polystyrene foam. Therefore, items or pieces of items four square inches or larger in size were classified as "large litter," and items or pieces under four square inches were classified as "small litter." Most of the small litter items identified are broken or mulched pieces of large litter. Cigarette butts accounted for 24-33% of small litter items during the first five years of the roadside litter survey, and in 2002 this was about the same (25.92%). Of the two classifications, large litter warrants more concern. Not only are large litter items more visible along the roadside, they also tend to become "small litter" when mowed.

### Major Large Litter Categories

Adherence to a uniform system of litter identification is essential because of the need to compare the data collected in the annual surveys. Through pilot surveys, the Center identified 73 categories of large litter. For purposes of comparison, two of those were grouped together and the resulting 72 large litter categories were grouped into eight major categories:

- Beverage Containers
- Non-Beverage Containers
- Product Packaging
- Outer Packaging
- Take-Out Food Items
- Printed Paper Items (includes newspapers, books, magazines, etc.)
- Debris Items (includes construction, vehicle, and home items, etc.)
- Miscellaneous Items

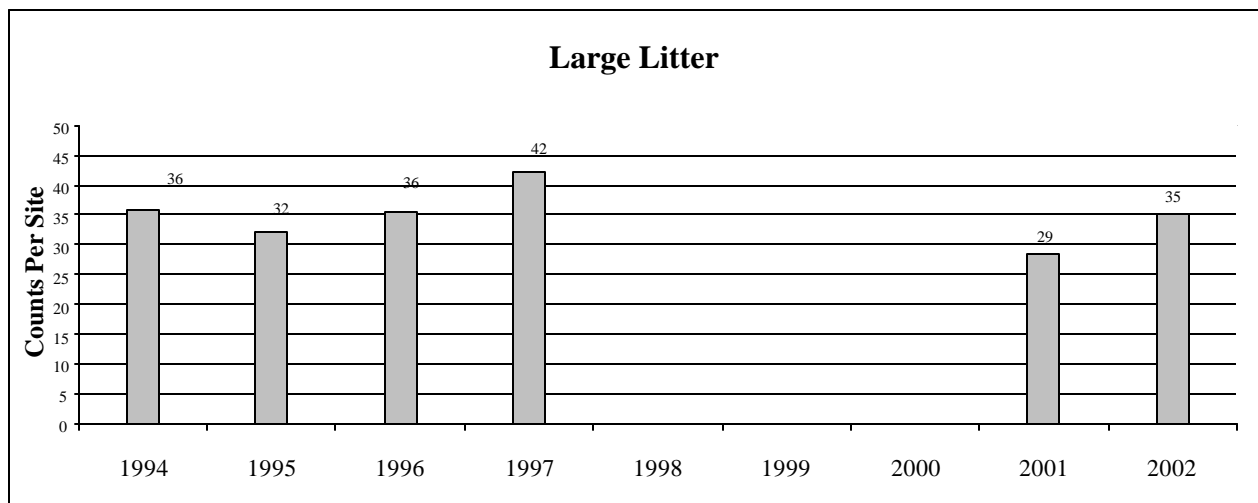
(Complete descriptions of the categories and percentages of total litter in 2002 are presented in Section 3.4).

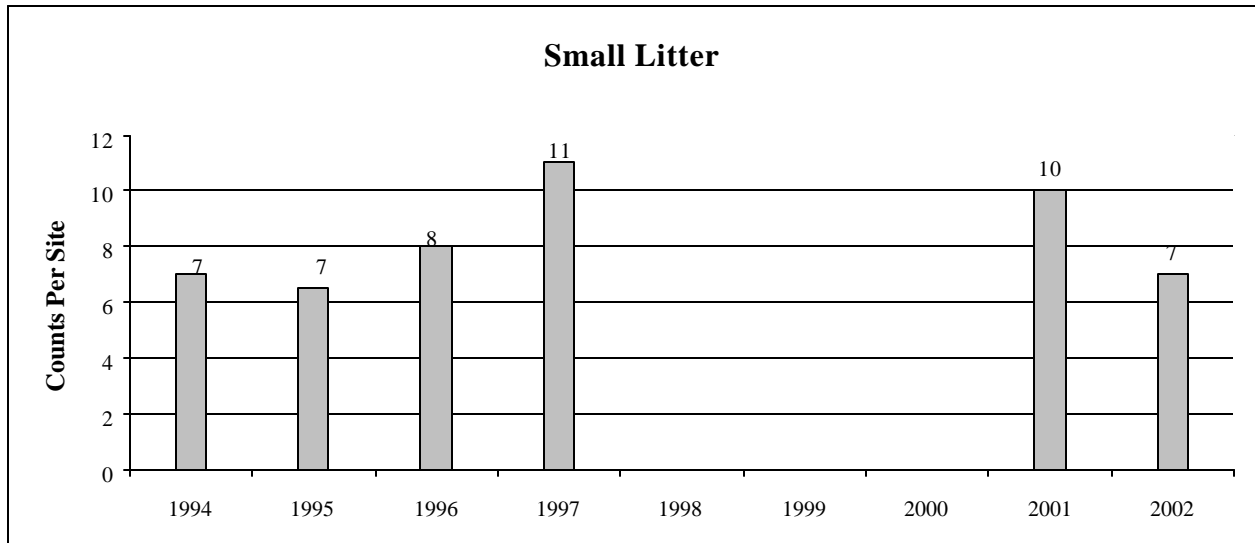
Following the baseline survey in 1994, surveys conducted in 1995 and 1996 suggested that the amount of litter on Florida's roadsides remained fairly constant. In 1997, the survey indicated a statistically significant (17-18%) increase in the amount of large litter items found on Florida's roadsides. After three years in which no roadside survey was conducted, the 2001 survey found an estimated 15-16% decrease in large litter from 1995. However, the current survey results show an estimated 4-18% increase from 1995 to 2002, a 2-14% increase from 1996 to 2002, a 38-65% decrease from 1997 to 2002, and a 17-30% increase from 2001 to 2002.

Small litter has increased 29-31% from 1995 to 2001 but from 1995 to 2002, small litter increased an estimated 5%, which was not statistically significant. Comparisons to other previous surveys show a 10-31% decrease from 1996 to 2002, a 38-65% decrease from 1997 to 2002, and a 22-46% decrease from 2001 to 2002.

Small litter counts vary more due to smaller survey areas and therefore fewer total items in the statistical database. The figure below graphs the year-to-year changes in large and small litter counts per site.

Statistical Summary of Annual Litter Counts





For information on litter research in the U.S., go to the following websites:

[http://www.dot.ca.gov/hq/env/stormwater/ongoing/litter\\_management/index.htm](http://www.dot.ca.gov/hq/env/stormwater/ongoing/litter_management/index.htm)

<http://www.dot.ca.gov/dist11/facts/litter.htm>

[http://www.dontmesswithtexas.org/education\\_detail.php?report\\_id=5](http://www.dontmesswithtexas.org/education_detail.php?report_id=5)

[http://www.dontmesswithtexas.org/education\\_detail.php?report\\_id=4](http://www.dontmesswithtexas.org/education_detail.php?report_id=4)

<http://www.ecy.wa.gov/biblio/0007022.html>

<http://www.jcci.org/NR20020116.htm>

<http://www.ci.columbia.mo.us/dept/pubw/BevCom/beverage.htm>

<http://www.bottlebill.org/USA/states-newyork.htm>



# 1. INTRODUCTION

## 1.1 OVERVIEW

This report presents the results of the sixth Florida Roadside Litter Survey. The survey was conducted by the Florida Center for Solid and Hazardous Waste Management (the Center) for the State of Florida and was funded through the Florida Department of Environmental Protection (FDEP). The first five roadside litter surveys and additional litter surveys conducted from 1993 through 2001 can be viewed on the Center's website ([www.floridacenter.org](http://www.floridacenter.org)).

Litter is part of a complex solid waste problem that affects Florida's environment and economy. Litter is generated by a variety of sources including motorists and pedestrians. It collects in and around areas such as parking lots, vacant lots, loading docks, commercial refuse storage areas (dumpsters), construction sites, residential neighborhoods, streets, shorelines, and roadsides. Although litter collects in many places, most litter surveys conducted in the United States, used roadside litter as an indicator of the amount of litter in the environment. The Center based its methodology on roadside litter because roadsides serve as a good collection point, are easy to access and measure, and they provide a standardized, statistically valid sample.

The 2002 survey report has been expanded to provide more details on the survey development, descriptions of procedural considerations, and refinements in the methodology. Chapter 3 presents the results with additional explanatory notes and Chapter 4 presents the data analysis. Chapter 5 discusses the survey and the results in the larger context of all six surveys to date, as well as related litter surveys and research information collected by the Center. The Appendix contains the Roadside Litter Survey Procedures Manual. It presents more detailed accounts of the procedures used to conduct the survey.

## 1.2 BACKGROUND

In 1988, the Florida Legislature revised the Florida Solid Waste Disposal Act and changed the way the state managed solid waste. The new Act established an Advance Disposal Fee: a one-cent fee at the retail level on all rigid containers that had not achieved a recycling rate of 50% in the state. As part of a 1993 rewrite of the 1988 Solid Waste Management Act, the Legislature revised the Advance Disposal Fee and, among other goals, established a target of reducing litter by 50% from January 1, 1994 through January 1, 1997.

The Legislature designated the Center as the entity responsible for measuring progress toward the litter reduction goal. The Center entered into a contract with the FDEP in 1993 for the development of the methodology and for conducting the first survey. The Legislature has funded surveys of litter in Florida since 1993.

The Legislature also established Keep Florida Beautiful, Inc. (KFB) to assist in implementing the Florida Solid Waste Management Act. KFB is a working public-private partnership, and is the organization designated by the State to coordinate Florida's efforts to reduce litter and marine debris. As a state affiliate of Keep America Beautiful, Inc., KFB's primary mission is to work with affiliate

organizations at the local level to encourage individuals, organizations, and businesses to prevent littering and clean up their communities.

In 1993, the Florida Legislature directed the Center to conduct annual litter surveys to measure progress towards reducing litter. The first four roadside litter survey reports, from 1994 to 1997, also included surveys of marine debris. The surveys conducted by the Center in 1994, 1995, and 1996 showed no perceptible change in the amount of litter. When the 1997 survey showed an increase in litter, the Center and FDEP collaborated to devise strategies for controlling litter that have been successful elsewhere, partnering with others interested in these issues, and producing scientific appraisals of the nature and scope of litter as a part of the larger effort to manage solid waste in the state.

Therefore, different types of surveys were performed from 1998 through 2000. The 1998 survey defined the problem of litter in Florida and its impact on neighborhoods and businesses. It reviewed cleanup strategies in Florida and compared these strategies to those in other states. The 1999 survey entailed survey interviews with businesses, local government solid waste management staff, and Keep America Beautiful affiliate staff. The survey was conducted in the ten largest urban areas of Florida. It assessed costs and management efforts while identifying the major litter concerns for area businesses. The 2000 study was composed of three surveys: it surveyed Florida's Water Management District administrators and large rural landholders regarding the scope and effects of illegal dumping, it analyzed the costs of managing and controlling litter and illegal dumping in three sample cities across the state, and it reported on trials of the new KAB litter measurement system conducted in seven Florida cities.

In the 2000-2001 research year, the FDEP requested that the Center again conduct the roadside litter survey in order to update the status of roadside litter in Florida and add to the existing database. Accordingly, the previous roadside surveys were replicated in as much detail as possible. That survey indicated a significant decrease in large litter and a small decrease in small litter when compared to the 1997 results.

## **2. ROADSIDE LITTER SURVEY METHODOLOGY**

This chapter summarizes the methodology and outlines some of the procedures used to collect the data for the 2002 Roadside Litter Survey. The Appendix of this report provides a more detailed description of survey procedures, including the materials and forms used in gathering the data and step-by-step explanations of the procedures. In a multiyear survey, the methodology must be followed strictly to ensure that the database is comparable for year-to-year comparisons to be made. The Center has continuously revised and updated the existing Roadside Litter Survey Procedures Manual (Appendix) since the 1994 and 1995 surveys. In 2001 and again in the 2002 survey, substantial revisions have added a great deal of detail to the Manual with the intent of providing a record that future researchers can follow.

### **2.1 DEVELOPMENT OF THE METHODOLOGY**

The first phase in the development of the methodology, summarized here, was described in detail in the 1994 Florida Litter Study report. That report is available on the Web at <http://www.floridacenter.org>.

An Advisory Committee reviewed the formation of the methodology at several junctures during the pilot study and prior to the first roadside data gathering. They made recommendations for improvements as required by the Legislature. The requirement was that a seven-member Advisory Committee be established to advise the Center throughout the initial development. This was intended to provide a means to collect input from representatives of business, industry, local government, and environmental interest groups. The original Advisory Committee consisted of the following:

Chair:

Ivan Lawyer, Executive Director, Business and Industry Recycling Program, Goldenrod

Members:

Dwight Adams, Chair, Sierra Club National Solid Waste Committee, Gainesville

Doug Bruce, Carlton Fields law firm, Tallahassee

Chet England, Group Director, Quality and Food Safety, Burger King Corp., Miami

Mark Ferrulo, Consumer Advocate, Florida Public Interest Research Group, Tallahassee

C.E. (Buddy) Rogers, Jr., Vice President, Coca-Cola Enterprises, Hollywood

Norm Thomas, Alachua County Assistant Public Works Director, Gainesville

Center researchers initially reviewed available literature and existing studies to determine the best possible methods for conducting the Florida litter survey. This review indicated that there are two approaches for documenting litter. One approach is to document "accumulated litter," which is litter at a site at the time a count is made. Another approach is to measure "fresh litter," which is litter that accumulates along the roadside shortly after the accumulated litter has been cleaned from the site. There are several practical disadvantages to measuring fresh litter:

- Measuring fresh litter requires considerable effort, as sites have to be cleaned and then recleaned at periodic intervals.
- Measurements of fresh litter are subject to a higher degree of variability as there are fewer litter items to count.

After pilot studies were conducted to test the feasibility of each method, the Center designed a methodology that measures accumulated litter.

During the first year of the survey, the Center selected the county as the geographic unit in which random sites would be located. Researchers and the Advisory Committee reasoned that it is important to sample the litter level throughout the state and thereby gain an understanding of how litter affects the diverse regions of the state. If the Center had used a population-based site selection approach, sites would have been concentrated in urban areas with large populations, and many rural areas of the state would not have been surveyed.

In 1994, the survey sample consisted of four sites in each of Florida's 67 counties, for a total of 268 sites. After the data analysis of the 1994 results was completed, project statisticians recommended increasing the number of survey sites to reduce statistical variability to an acceptable level. Therefore, the survey was expanded in 1995 to ten survey sites in each county, for a total of 670 sites each survey year. New sites were selected randomly each survey year. This amended methodology has been followed in each subsequent year.

## **2.2 SURVEY TECHNICIAN HIRING AND TRAINING**

Prior to the 1994 survey, the Center determined that hiring and training paid employees rather than relying on volunteers would help to ensure quality and consistency in the collection of the data. In 2002, the Center hired eight survey technicians and three project coordinators as temporary employees for approximately 10 weeks to conduct the roadside survey. Three staff members from previous surveys returned to provide experience and continuity while serving as staff trainers, project coordinators, and quality control technicians. Two of the project coordinators held the same position in 2001 and worked as survey technicians in 1997. The project manager served in this position for the two consecutive years.

As in the past, the project staff conducted six days of survey training. Trainees were provided material on survey methods, procedures, forms, and litter identification. Trainees visited selected urban and rural sites in and around Gainesville to practice locating and setting up sites, identifying litter, using the equipment, and other necessary field skills.

## **2.3 EQUIPMENT AND SUPPLIES**

Early each research year the project staff conducts an inventory of equipment. The inventory list includes over 40 items at a total cost of over \$7,000. Each surveyor is issued the necessary quantities of 32 separate categories of items needed to conduct the survey. The project coordinators carry extra



tape recorders, safety cones, and other equipment to distribute in the field when necessary. The Appendix contains a complete equipment list and a description of additional practical considerations.

## 2.4 SURVEY SCHEDULE

The survey plan was to survey all 67 counties of the state in nine weeks using eight Survey technicians and three project coordinators (also referred to as QCs). Each surveyor was assigned one county per week to survey. Eight counties per week were surveyed, and each QC was assigned a cluster of two to four adjacent counties in which he or she would conduct quality control surveys and provide field support for the surveyors. The order in which counties were surveyed is listed in full in the Appendix.

As in the past, Center researchers scheduled the first surveys in nearby rural counties. Experience has shown that conducting the first surveys in nearby counties allows researchers to sharpen their survey skills in areas with little traffic and, typically, lower litter levels. Less travel time means they can use more field time to become familiar with the survey system. Also, in nearby counties additional monitoring for quality control is possible. Survey technicians are able to gain the experience they will need for urban sites, densely littered sites, and longer travel distances later in the survey.

A number of considerations affect the survey order of counties:

- County order in previous surveys: To maintain consistency and minimize unknown or unforeseen variables, researchers followed a county survey pattern as close as possible to that of the previous surveys. This is to avoid subtle differences in the data collection.
- Seasonal climate conditions: All five of the previous Florida Roadside Litter surveys were conducted from mid-January through completion in March or April. This season (winter/early spring) was chosen in the early surveys because there is typically mild to cool weather that provides the best conditions for roadside litter surveys. Because the grass grows more slowly during this season, there is less mowing activity and thus less mulching of larger litter into small litter. Milder weather also means there is a lower probability of torrential rains, hurricanes, roadside flooding, and strong winds than in summer and fall.
- Seasonal events: Certain events may cause short-term anomalies in both litter rates and the ease with which surveys can be conducted. Heavier traffic patterns in certain areas at specific times may increase the litter count and alter the data.
- Staffing: The availability of survey personnel in any given week can alter that week's survey plan and affect the scheduling of the rest of the survey. Technician preferences for counties in which they will conduct surveys are honored when possible.

## 2.5 SITE SELECTION

With assistance from Info Tech, Inc., a statistical consulting firm in Gainesville, Florida, the Center adopted a computerized method of obtaining random numbers to select sites. This method

provided a consistent and statistically useful random sample and has been followed in each subsequent repetition of the survey, including the 2002 survey.

Info Tech, Inc. used SAS® statistical software to construct random number lists that would yield two coordinates, one for a horizontal map measurement and one for a vertical map measurement. Research assistants plotted site points on Florida Department of Transportation General Highway Maps using these coordinates. The coordinates were generated in ¼-inch increments to enable easy location on the maps using a ruler.

In addition to the measurements, a random direction (N, S, E, or W) was generated. Thus, if a random point did not fall directly on a hard-surfaced numbered or named road, then the designated direction (N, S, E, or W) was followed from the random point to the first hard-surfaced numbered or named road. This procedure was repeated for each site. Although ten sites were to be surveyed in each county, eight or more additional sites were selected as potential replacements for sites that are rejected due to field conditions.

The site selection procedure included several precautions to avoid bias in site location due to a surveyor selecting either clean or littered sites for the survey. Site plotters wrote directions to each site to ensure that surveyors would not drive by and unintentionally preview any of the first ten sites. The locations of replacement sites did not appear on the surveyor's map, and the surveyor was unaware of their locations. Those sites were photocopied from the master map, and cutouts of each site were placed in sealed envelopes to be opened one at a time in numerical order as needed after the surveyor had visited the first ten sites. These procedures ensured that the surveyors would approach each site with no previous knowledge of the condition of the site.

## **2.6 SITE LOCATION**

To locate survey sites, surveyors followed the directions on the site direction sheet. The directions begin with a named or numbered intersection near the site as a reference point. From the reference point, surveyors recorded the mileage needed to arrive at the designated roadside survey site. Surveyors used hazard lights (emergency flashers) when approaching a site to gain the attention of following traffic so that they could pull off safely onto the roadside. If the surveyor could not pull off the road because of a curb, the surveyor would continue to drive and look for a place to pull off within the next mile. If it was not possible to pull off the road within one mile of the original starting point, the site was rejected. (See Section 2.8 for a list of site rejection criteria.) The revised mileage to the site was documented if the site was moved from the original mileage location due to a curb.

If the written site description did not match the location of the site dot plotted on the map, or if the surveyor could not locate the site using the directions given, he or she called a QC or the project manager for assistance in locating the site. There are a number of circumstances that may cause sites to be difficult or impossible to locate:

- Roads may have been rerouted or otherwise altered since the last revision of the official map.

- Road signs may not be present.
- Roads may have been renamed or renumbered. In many cities and towns, local names are posted on street signs, and the official FDOT numerical designation is not present until the highway leaves the incorporated area.
- Field locations may not correspond exactly to map features due to map scale inaccuracies or differences in the mileage reading obtained using an electronic measuring wheel on a map. These considerations can cause the written directions to misrepresent the plotted dot by several tenths of a mile or more.

Before rejecting the site as not found, the surveyor attempted to match features on the map with field landmarks to locate the site. When consulted, a QC or the project manager also used the map to attempt to locate the site using known roads, intersections, and natural or topographical features (bridges, streams, etc.). Since the site was randomly plotted on a county map roadway, the location represented by the plotted dot is presumed to be the actual location. The plotted dot supersedes the written directions and is the controlling delineator of the location of the site if the two together do not identify the same point.

## **2.7 SITE SIZE**

Daniel Syrek, a California-based researcher who has conducted numerous litter studies and who conducted a litter survey in Florida in 1989, reported that the average roadside width in Florida was 18 feet. However, using a fixed width for all sites would result in a bias against sites having widths either more or less than 18 feet. Many urban sites, for example, have a curb and gutter configuration, sidewalks, buildings, or private property features that restrict the public right-of-way to a narrower section than that found along rural roadways. Also, some litter items, such as plastic bags and paper, tend to blow beyond the standard site width and become trapped in a landscape feature such as a fence or a line of tall grass, weeds, trees, or brush at the edge of a mowed right-of-way. Any such feature that stops, catches, or confines the movement of blowing litter is defined as a catch point.

To accurately account for differences in litter accumulation associated with site width, one-half of the sites in the survey have a fixed width of 18 feet and one-half of the sites vary in width from 1 to 40 feet. The width is measured from the edge of the paved surface where the pavement meets the grass or soil. The presence of a litter catch point, such as a fence or a mow line, determines the width of the variable sites. The maximum site width for a variable site is 40 feet if there is no catch point and there is accessible public right-of-way up to that width.

Prior to the first year of the survey, it was determined that a site length of 200 feet along one side of a road would provide adequate data for the survey. The decision to survey only one side of the road was based on concerns about surveyor safety associated with crossing a highway or a median.

## **2.8 SITE REJECTION CRITERIA**

The allowable reasons for a surveyor to reject a site are termed “site rejection criteria.” Once at the site, any of the following factors can cause the site as described in the original directions either to be REJECTED or moved to an alternate location:

1. Road or right-of-way construction is occurring on the site; or, construction immediately before or after the site may interfere with the survey or the quality control survey.
2. Surveyor security and safety concerns: The surveyor determines the site is unsafe for survey due to dangers posed by traffic or other factors.
3. Site is located on a bridge or there is a guardrail too close to the traffic lanes to allow for safe pulloff and parking. In this case the site is moved exactly one mile from the original location, traveling in the same direction. If the site cannot be accessed at the one-mile distance, the site is rejected.
4. Highway cleanup or mowing crews are at the site or within one mile of the site.
5. There are bags of collected litter on or within one mile of the site, indicating a cleanup has just occurred.
6. A majority of the site is submerged in water.
7. The site is located on an interstate highway within one mile of an interchange.
8. The designated right-of-way is completely paved, leaving no grassy or unpaved area for survey.
9. County solid waste collection containers (typically, dumpsters or other designated collection point) are within one-tenth mile of the site.
10. The site is within one mile of the entrance to a county or regional landfill.
11. There is a curb, soft or steep shoulder, washout, or other shoulder condition making pulloff and parking impossible or unsafe. In this instance, the site location is moved in the direction of travel to where access can be gained, but no more than one mile from the original site description. The new distance is calculated using the odometer and recorded. If the site cannot be accessed within the one-mile distance, the site is rejected.
12. Site cannot be found.
13. The site is too narrow for a fixed site.

## **2.9 SITE CHARACTERISTICS**

In addition to recording the number and type of litter items on the site, surveyors record information about grass height, catch point, number of lanes, and highway divider. Grass height is estimated as an average overall of the site and recorded in 3-inch ranges. Catch points are areas where litter accumulates, such as a fence, hedge, mow line, or ditch. Chapter 3, Section 3.6.9, discusses the criterion for catch point classification in greater detail. Surveyors record whether the site is part of an adopted road program (such as Adopt-A-Highway, Adopt-A-County Road, etc.) and whether the site is currently adopted. The name of an adopting group or individual must be present on the adopted road sign for it to be considered a currently adopted site. Also, whether the site is residential, urban, rural, or industrial, if a traffic signal is visible from the site (within one mile), and if there is a fast-food or convenience store within one mile of the site. Surveyors later transcribed onto the data sheet this descriptive data along with the litter count.

## **2.10 VISUAL RATING OF THE SITE**

The visual rating was first incorporated into the Florida Litter Study in the 2001 survey. The Keep America Beautiful organization has adopted this type of rating system to measure litter and the Center began to collect data that would permit a comparison of the visual rating of a site to the number and type of litter items found in an actual count. An observer viewing the roadside from a moving vehicle usually conducts this type of visual rating. Therefore, surveyors were instructed to assign a visual rating according to the site's overall appearance before measuring or walking through the site. The four-point scale rates the site from least littered (1) to most littered (4). A value of "1" reflects a clean site that is free of litter or contains one or two pieces at most, while a value of "4" is assigned to sites that are extremely littered – the site is covered with litter or may contain an illegal dumpsite that includes numerous or large pieces of litter. Ratings of "2" and "3" describe a modest to considerable amount of litter on the site.

## **2.11 SITE SETUP**

Once a site was accepted, the surveyor documented the site's exact location by noting the mileage from the reference point and any additions to the driving directions. This document would allow the exact same site to be located in the future. Using a hand-held electronic global positioning system (GPS) instrument, surveyors recorded the latitude and longitude of the site.

To prevent bias that might result from a subjective determination of litter survey site lines, once the survey vehicle was safely pulled off and stopped, technicians measured forward a standardized, predetermined distance to the actual data site. The starting point was marked by painting an X on the edge of the roadway opposite the front driver-side tire of the surveyor's vehicle. Surveyors then measured exactly 50 feet from the X, parallel to the road in the same direction the vehicle had been traveling. The survey site began 50 feet in front of the vehicle. From this point, a midpoint was marked at 100 feet farther along the road and an endpoint at 200 feet. Data collection began 50 feet from the vehicle and the total length of the site was always 200 feet.

Surveyors delineated the survey site by painting a large red dot at the beginning point, a 6-inch line perpendicular to the road at the midpoint, and a large paint dot at the endpoint of the site. The width of the site was measured from each of the three marks according to the site type conventions described in Section 2.7 above. Steel (fence post) stakes were placed at the outer boundary opposite each of the three painted markings. In the absence of a boundary catch point, a string was stretched along the stakes to establish a distinct, visible outer boundary. The string allowed surveyors to accurately judge whether a litter item was within the site.

## **2.12 LITTER CLASSIFICATION**

One of the primary goals of this survey was to identify the composition of litter. The Center's methodology makes a distinction between large litter and small litter. Items or pieces of items greater than or equal to four square inches are large litter. Items or pieces smaller than four square inches are

classified as small litter. Large litter items or pieces are generally the primary concern because they are more visible and tend to become small litter when mulched by roadside mowing or otherwise broken into pieces. Large, identifiable litter is shredded by mowers into small bits that may be identifiable only by material type. In addition to broken or mulched pieces of larger litter, types of small litter of concern are cigarette butts (particularly the filter portions), bottle caps, polystyrene foam peanuts, straws, and other small items.

This methodology mirrors a survey conducted in Oregon where litter was measured in various pre-established sizes. In general, large litter pieces are much easier to assign to a category than are small litter items. Flat wooden templates in round, square, and rectangular shapes, each four square inches in size, were fastened together on a plastic wire tie loop to aid the field staff in determining whether an item was large litter or small litter.

Litter composition changes over time as the materials and types of product packaging change with variations in marketing and technological advances. The 2001 litter survey found a new use of product container material - plastic beer bottles. These bottles could be classified by product as a "beer bottle" or by material as a "sports/other plastic bottle." For this survey, they were classified as beer bottles. Consumer trends also affect the types and quantities of litter. For example, plastic retail bags have largely replaced paper grocery bags, and increased consumption of bottled water in individual portion plastic bottles has increased litter in that category. These illustrate the need to periodically review and revise litter categories as material usage and packaging practices change.

### **2.13 LARGE LITTER SURVEY**

Large litter was surveyed over the entire site. While walking through the site in a serpentine fashion, the surveyor tape recorded a description of each piece of litter observed on the site that was equal to or larger than four square inches in size to determine the size. Large litter on each site was surveyed twice by making two separate passes: the first pass starts at the beginning point nearest the vehicle, and the second pass returned to the beginning point from the far end of the site. This method provided a check on the surveyor's accuracy. Items not visible on the first pass because of natural lighting conditions or the lay of the grass might be visible on the second pass in the opposite direction. Pass one and two are later recorded on the data sheet and in the computer database. When large litter totals are finally calculated, an item-by-item average was taken of the number of items counted on the two passes.

### **2.14 SMALL LITTER SURVEY**

Surveying small litter over the entire site would have taken considerable time and would have dramatically increased the cost of conducting the survey. Prior to conducting the first survey in 1994, Center staff determined that data on small litter quantity and composition could be accurately collected by surveying three 1-foot by 15-foot transects within the site.

Transects were located at the beginning point, midpoint, and endpoint of the site. Using a 1-foot by 5-foot PVC frame, the surveyor placed the 1-foot edge of the frame along the roadway's edge at the

site's beginning point and recorded the small litter that was inside the frame. The surveyor then flipped the frame away from the road lengthwise and again surveyed the 1-foot by 5-foot area within the frame for small litter. The surveyor then flipped the frame lengthwise again and surveyed the small litter within it, for a total area of 15 square feet from the road edge to the outer edge of the right-of-way. The procedure was repeated at the midpoint and endpoint of the site. If a transect was less than 15 feet wide, a flip was eliminated to accommodate the site width. The Appendix describes this process in greater detail.

## **2.15 LITTER CATEGORIES**

Seventy-two categories of large litter were identified for the 1994 survey. Those categories have been used in each subsequent year because adherence to a uniform system of litter identification permits comparison of the data collected in different annual surveys. However, as noted above, changes in packaging practices over time have caused some items to shift so that they no longer fit neatly in the same category. In addition to the plastic beer bottles found for the first time in 2001, in 2002 an aluminum liquor bottle was found. Wine and liquor had only been in glass or plastic previously. A broken bottle that has glass pieces attached to the label or enough pieces laying in close proximity to show the shape of the bottle or permit it to be identified as one item is counted as a single item.

Fourteen categories of small litter were identified. Most of the small litter categories are based on material type because of the difficulty of identifying a very small piece of what in many cases was a larger item. For example, a piece of a glass bottle or container smaller than four square inches was identified as a "glass piece," unless it was found with enough other pieces to fit the large litter description above.

### **2.15.1 Large Litter Categories**

Table 2.1 lists the 72 categories of large litter items and includes examples of the common items within each category. The categories are listed in the order in which they appear on the data sheets. The examples listed are not all-inclusive but are intended to clarify the procedure used to categorize items based on their original intended use.

### **2.15.2 Small Litter Categories**

Small litter items were identified based on the following categories:

Aluminum pieces	Plastic pieces (hard plastic)
Bottle caps	Plastic film
Candy wrappers	Polystyrene peanuts
Cigarette butts	Polystyrene pieces
Glass pieces	Rubber/tire pieces
Metal pieces (other than aluminum)	Straws
Paper pieces	Other material

Table 2.1 Examples of Litter Items for the 72 Large Litter Categories

**BEVERAGES**

Beer cans

beer, malt liquor, or malt beverage

Beer bottles

beer, malt liquor, or malt beverage; include plastic bottle (2001/2002)

Soda cans

carbonated beverages such as cola, ginger ale, etc.

Soda glass bottles

carbonated beverages such as cola, ginger ale, etc.

Soda plastic bottles

carbonated beverages such as cola, ginger ale, etc.

Sports/other cans

fruit or vegetable juices, iced teas, health shakes, health drinks, chocolate drinks, bottled water, etc.

Sport/other glass bottles

fruit or vegetable juices, iced teas, health shakes, health drinks, chocolate drinks, bottled water, etc.

Sports/other plastic bottles (NOT HDPE)

fruit or vegetable juices, iced teas, health shakes, health drinks, chocolate drinks, bottled water, etc.

Wine/liquor glass bottles

wine, wine coolers, liquor, and pre-mixed, pre-packaged liquor drinks such as whiskey and lemonade

Wine/liquor plastic bottles

wine, wine coolers, liquor, and pre-mixed, pre-packaged liquor drinks such as whiskey and lemonade

Milk jugs/water/juice (HDPE)

clear or yellow HDPE containers that hold milk, juice, tea, water, etc.

Gable top container

paper cartons that contain milk, tea, orange juice, some candies, etc.

Foil pouch

pouches made of a combination of plastic and foil that contain fruit drinks, etc.

Aseptic box

drink boxes made of a combination of paper, plastic, and foil that contain fruit juice, punch, milk, health drinks, etc.

Broken glass container

any broken glass beverage container

Six pack plastic ring

plastic rings holding beer, soda, or other containers together

**CUPS**

Plastic disposable

any plastic cups not intended for reuse

Plastic reusable

thick plastic cups intended for reuse such as souvenir cups often with pictures on sides of cup

Polystyrene foam cups

cups from restaurants, take-out food, convenience stores, etc., composed of various types of polystyrene foam

Paper

cups from restaurants, take-out food, convenience stores, etc., composed primarily of paper

Plastic lids

various types of plastic lids used on beverage cups or other containers

**BAGS**

Plastic retail

bags from retail, convenience, grocery stores, etc.

Paper retail

large paper bags, grocery, office supply store, clothing store, other

Paper small

small paper bags, fast food, restaurant, convenience store, other

Feed

animal feed or litter bags composed of paper, plastic, or a mix of the two



Table 2.1 Continued

**BAGS Continued**

Ice

plastic ice bags

Zipper/sandwich

plastic bags that are pleated or zip-sealed sandwich bags

Plastic other

any other plastic bags such as garbage bags, bread bags, newspaper bags

Paper other

any other paper bags

**CONTAINERS**

Corrugated cardboard boxes

corrugated cardboard boxes such as pizza boxes, storage boxes, etc.

Paperboard boxes

any container composed of a low-density paperboard material such as cereal, pastry, or deli boxes, chicken buckets, french fry cartons, egg cartons, etc.

Paper beverage casing

beverage cases of either paperboard or corrugated cardboard such as 12, 18, or 24 pack casings

Polystyrene foam clam-shell

polystyrene foam clam-shell container such as egg cartons, restaurant carryout, hamburger boxes, etc.

Plastic clam-shell

plastic clam-shell container such as restaurant carryout and hamburger boxes

Plastic jars/bottles/boxes

plastic containers used to contain a wide variety of products such as peanut butter, pill bottles, oil bottles, etc.

Glass jars/bottles

glass containers used to contain a wide variety of products

Cans - steel

steel cans containing food as well as other products such as household paint or chemicals

Cans - aluminum

aluminum cans containing food as well as other products such as household paint or chemicals; include liquor bottle (2002)

Lids

any screw on, pop down, or metal lid to a bottle, jar, can, aerosol can, etc.

Aerosol can

aerosol cans used to contain air freshener, paint, hair spray, hair mousse, etc.

**FOOD WRAPS**

Paper

paper wraps such as take-out food wrappers, freezer paper, etc.

Paper/foil composite

primarily food wraps that are paper and foil combined such as some hamburger wrappers

**TRAYS**

Polystyrene foam

meat, fruit, bakery trays, etc.

Paper

any tray made of a heavy paper or paperboard such as produce trays

**FAST FOOD EXTRAS**

Condiments packages

catsup, mustard, duck sauce, etc.

Utensils

plastic spoons, forks, knives, etc.

**PLATES**

Paper

take-out food or picnic plates, etc.

Polystyrene foam

take-out food or picnic plates, etc.

Plastic

take-out food or picnic plates, etc.

Table 2.1 Continued

<b>PACKAGING</b>	<b>TOBACCO</b>								
<p><u>Snacks</u> any snack food packaging such as chip bags, gum wrappers, candy bar wrappers, cookie bags, etc. Sports power gel (2002)</p>	<p><u>Cigarette/cigar</u> cigarette/cigar-related items such as cigarette/cigar boxes, cartons, packages, films from packages, cigar wrappers</p>								
<p><u>Plastic</u> plastic packaging not mounted to paper where, during manufacturing, the product is placed in and the plastic sealed around the whole product such as shrink wrap packaging on batteries or soft drinks, ramen noodles, cookie trays, etc., includes convenience foods in zip-lock packaging, bubble wrap (2002)</p>	<p><u>Dip/chew/snuff</u> containers, pouches, snuff boxes, and other related non-smokable products/packaging</p>								
<p><u>Paper</u> paper packaging that is used for either the package itself such as cookie or sugar bags or as packing material such as crinkled paper used inside a box to cushion contents; price tags, clothing tags (2002)</p>	<p><b>OTHER</b></p>								
<p><u>Plastic/paper combo</u> a combination of paper and plastic packaging such as battery packaging or mounting hardware for pictures</p>	<p><u>Foil/pie tins</u> foil food wraps, ready-made pie tins</p>								
<p><u>Polystyrene foam</u> polystyrene foam packing used as cushioning material to protect products (not polystyrene foam peanuts)</p>	<p><u>Miscellaneous</u> The following material types classify items whose original use cannot be identified:</p> <table border="0" style="margin-left: 40px;"> <tr> <td><u>paper</u></td> <td><u>plastic film</u></td> </tr> <tr> <td><u>paperboard</u></td> <td><u>polystyrene foam</u></td> </tr> <tr> <td><u>cardboard</u></td> <td><u>glass</u></td> </tr> <tr> <td><u>plastic</u></td> <td></td> </tr> </table>	<u>paper</u>	<u>plastic film</u>	<u>paperboard</u>	<u>polystyrene foam</u>	<u>cardboard</u>	<u>glass</u>	<u>plastic</u>	
<u>paper</u>	<u>plastic film</u>								
<u>paperboard</u>	<u>polystyrene foam</u>								
<u>cardboard</u>	<u>glass</u>								
<u>plastic</u>									
<p><u>Foil</u> sealable foil wrap used for packaging, toner wrapping, toaster pastry wrappers, etc.</p>	<p><u>Construction debris</u> construction related materials such as lumber, insulation material, road construction materials, PVC piping, tarps, etc.</p>								
<p><b>PAPER</b></p>	<p><u>Vehicle debris</u> parts of a vehicle such as reflectors, name plates, hubcaps, etc., but NOT tire pieces</p>								
<p><u>Towel/napkin</u> paper towel, napkins, tissue</p>	<p><u>Tires</u> whole tires, pieces of tires, or innertube pieces</p>								
<p><u>Lottery</u> lottery tickets and ticket forms</p>	<p><u>Home items</u> clothing, keys, jewelry, tools, cassette tapes, videos, dishes, toys, cigarette lighters, matches, etc. Paper oil funnel, CDs (2002)</p>								
<p><u>Newspapers/books/magazines/advertisements</u> pieces or entire items</p>									
<p><u>Stationery/school/business</u> letters, school papers, handwritten receipts, cash register receipts, business cards, etc.</p>									

## **2.16 SITE DOCUMENTATION - GPS AND PHOTOGRAPHS**

The Global Positioning System (GPS) coordinates or fix of each site gives a precise location and further documents that the site was visited for the survey.

Three photographs were taken at specific points of each site to give different views of the length and width. These provide documentation of the site and are used weekly by project management staff to monitor field performance and provide a visual record of site characteristics. The photos have been useful later to confirm site characteristics such as catch points, road or site type, etc.

## **2.17 DATA TRANSCRIPTION, ENTRY, AND ANALYSIS**

Surveyors transcribed their tape-recorded site data onto paper data sheets either in the evening of the survey day or when they returned to the office later that week. The survey tapes are kept on file as a permanent record of the original data collection.

Information on the data sheets was proofread, summed, and then entered into a FoxPro 6.0 database. The data entries in the database were printed out and proofed against the original data sheets to check the accuracy of the data entry. The database manager compiled weekly reports with tables and graphs comparing the large and small litter totals of all sites subject to QC review. Large differences were further analyzed by review with the survey technician and the QC and the reasons were documented. For example, weather changes or a long time interval between the two surveys could be intervening variables that would cause a difference in the counts. Graphs of the differences for each week of the survey were posted at the weekly survey team meeting so surveyors could see how their performances compared to those of their co-workers. Once all data was entered into the database, the data manager conducted further reviews of the database, compiled tables of rankings, calculated raw totals and percentages, and constructed tables of results for various combinations of items, materials, and uses as have been reported in previous reports.

The Center subcontracted with Info Tech, Inc., a statistical consulting firm, for the analysis of the data. They conducted a further review to assure that all data were present and correctly entered by category. The results and the analyses are presented and discussed in Chapters 3, 4, and 5 of this report.

## **2.18 QUALITY CONTROL**

Quality Control (QC) procedures are incorporated into every aspect of the survey. The Appendix discusses specific procedures employed in each of the following areas: plotting the sites, equipment and supplies, surveyor training, survey and documentation checking, and data entry. The Center employed three experienced quality control technicians to ensure the accuracy and reliability of the survey. Examples of quality control measures are:

- Quality control staff made certain that all surveyors were supplied with uniform equipment. All of the measuring wheels were calibrated for accuracy and the small litter frames were built to or checked for the required dimensions to assure that all of the survey site measurements are precise.
- Surveyors were required to pass eye exams prior to training to ensure that they were able to adequately see the litter for this visual counting method.
- Quality control staff made certain that all surveyors performed the surveys according to the methodology.

Quality control procedures in the field data collection ensured that sites were located as they were plotted on the county map, that site selection and rejection procedures were followed, and that the site setup and litter item surveys were conducted uniformly and consistently. Any site surveyed by a field technician was subject to an accuracy check by a quality control technician. Sites for quality control were chosen in a random fashion based upon certain criteria and several practical considerations. In the 2002 survey, QC surveys were conducted on one fixed and one variable site in each county, or 20% of all sites surveyed. This is the usual practice due to differences in the application of the methodology with each of these site types. A conscious effort was made to randomly alternate which sites in the one-to-ten order were chosen for QC so that each site theoretically stood an equal chance of QC, and the surveyor would have no knowledge of which sites might be chosen. Quality control technicians visited at least two of the 10 sites in each county within 24 hours of the original site survey, and resurvey counts were conducted as soon as possible after the survey. For a valid quality control check, it is important that the control surveys be conducted without prior notice to the original surveyor and only after the initial survey has been completed. The quality control technician checked the location and dimensions of the site (evident from the paint dots used to mark the site) and performed large and small litter surveys.

Some variations in litter counts can be expected due to factors such as weather (especially wind and rain), mowing, and newly accumulated litter. The QCs reviewed total counts each week to identify unusually large differences between the original survey and the QC counts. Formula: QC count minus survey technician count divided by the QC count times 100 equals the percent difference.

$$\frac{QC - ST}{QC} \times 100 = \% \text{ difference}$$

In the first week, average large litter counts per surveyor ranged from 4% to 21% differences from QC counts and small litter difference counts ranged from 0% to 67%. The 67% difference was a difference in count of two pieces of small litter in each of the two sites compared. Comparisons of small litter counts can be extremely misleading as an indicator of survey accuracy because the small sample size magnifies the appearance of small count differences. Most survey differences over the nine weeks of the data collection were below 15% for large litter and below 20% for small litter. These were consistent with the usual standards in prior years of the survey. The percentages of difference in the final litter counts during the 2002 survey were deemed acceptable.

The transcription of the collected data also was checked. QCs re-transcribed the taped data for at least one site per week per surveyor for the first several weeks and compared it with the surveyor's data sheet for accuracy of transcription, litter categorization, and methodology. In the first several weeks

of the survey, it is especially important to listen to the data taping procedure and re-transcribe the recorded data from at least one site per survey technician weekly, and more if resources permit. Once it is apparent that surveyors have mastered taping and transcription, tapes are periodically spot-checked, as indicated by general surveyor performance.

Once the data sheets were reviewed to make sure that they were complete, they were filed for data entry. A printout by site was generated and checked against the original data sheet. Any errors were marked and corrected in the database and another printout proofed to assure that all errors were corrected.



### 3. RESULTS

The 2002 survey counted 30,317 large litter items and 7,783 small litter items. Surveyors visited 10 sites in each Florida county for a total of 670 sites. The survey covered 134,000 linear feet, or more than 25 miles of roadway. Taking into account the total area of the 670 sites, the large litter survey covered approximately 2,832,750 square feet along Florida's roadways and the small litter survey covered 28,745 square feet.

This chapter presents the 2002 roadside survey results in several formats. Figures 3.1-3.4 present summary statistics for the roadside litter surveys conducted by the Center from 1994 to 2002, inclusive. These figures provide a convenient visual comparison of the results of the six surveys to date. Separate figures illustrate litter density and litter counts for both large and small litter.

Except for Figures 3.1-3.4, Tables and graphs throughout this chapter follow the convention of listing the 2002 results followed by results in the same category from previous years. Results for small litter follow large litter, and results for site characteristics follow small litter.

Figure 3.1 Statistical Summary of Large Litter Density

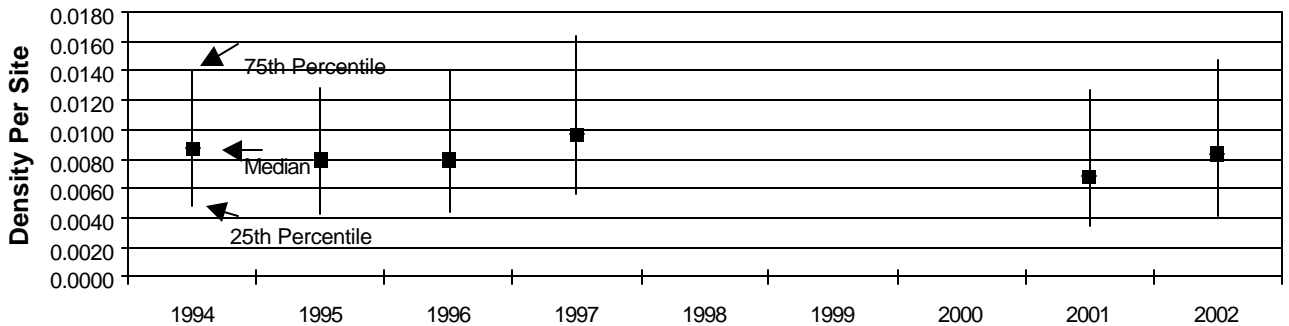


Figure 3.2 Statistical Summary of Large Litter Counts

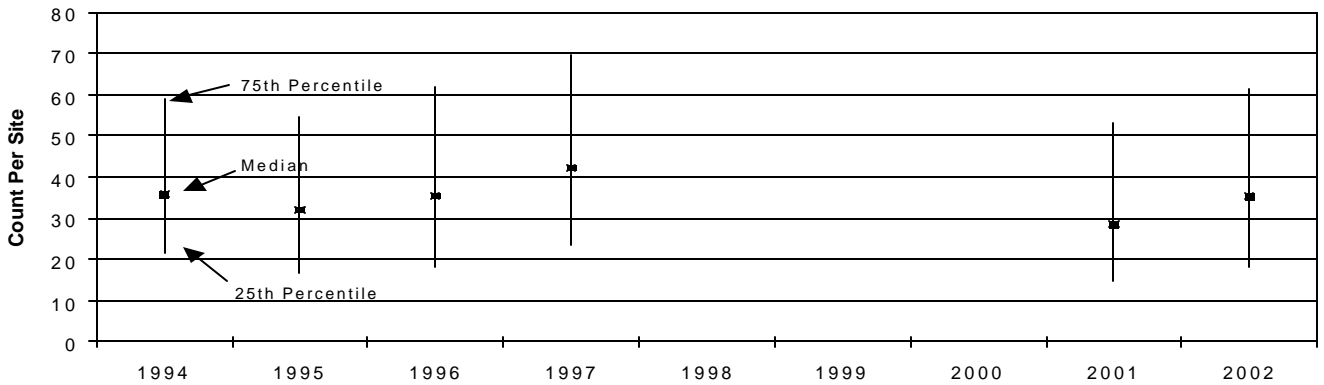


Figure 3.3 Statistical Summary of Small Litter Density

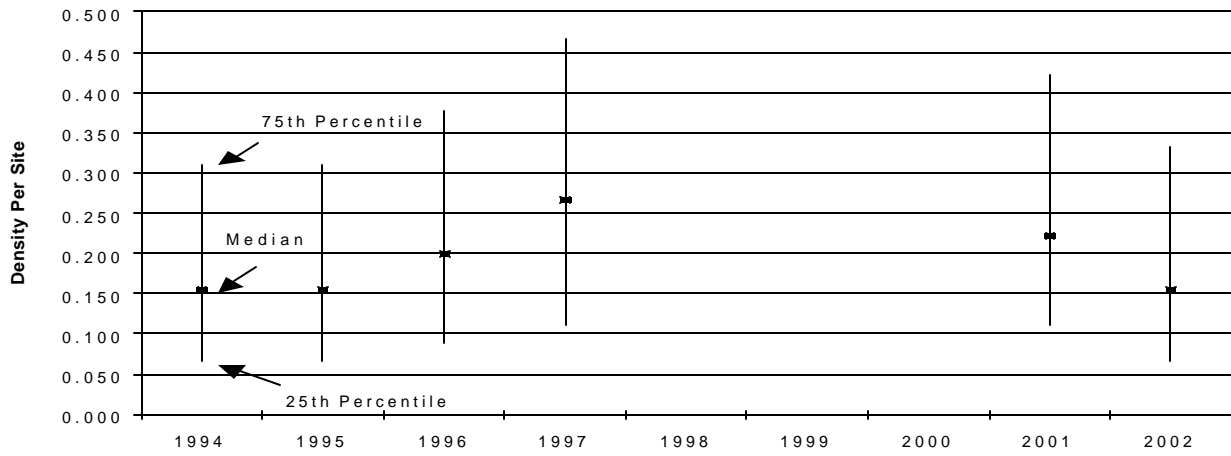
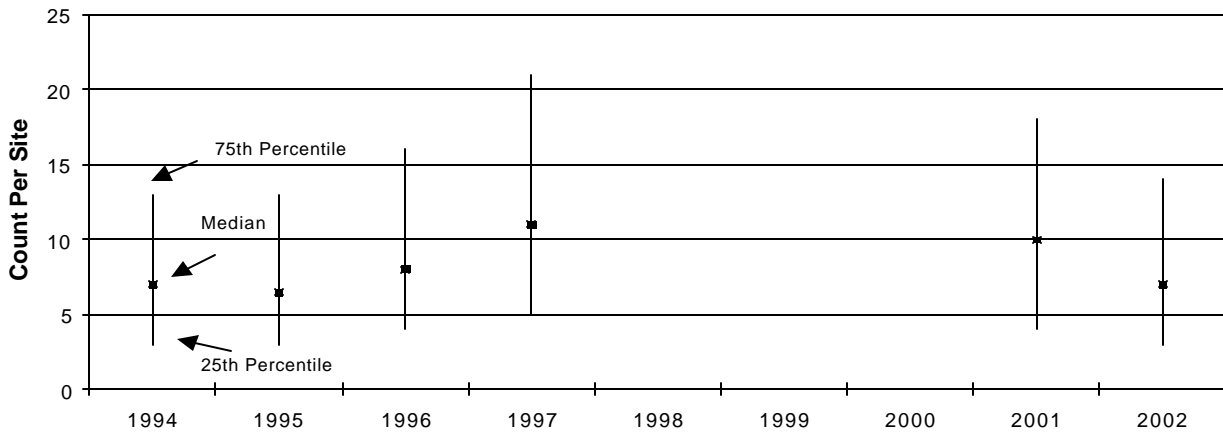


Figure 3.4 Statistical Summary of Small Litter Counts



### 3.1 LARGE LITTER RESULTS: DISTRIBUTION BY ITEM

Since the first survey, vehicle debris and tire pieces have been counted separately, making a total of 73 large litter categories counted. However, in reporting the results for each year, the data for these two similar categories are added together, making a total of 72 large litter categories in the tables.



Table 3.1 presents, in descending order, the distribution of the large litter items identified in the 2002 survey. The table displays summary data for the six years of the study to allow for comparisons. However, the differences for each category from year to year were not statistically analyzed. Without such analyses, no conclusions should be drawn as to the statistical significance of an increase or decrease for any given category. The table includes the following information:

- The first column ranks large litter by the classification name in descending order according to the averaged total number of items found in that category in 2002.
- The second column lists, in descending order, the numerical average of each classification category according to the total count in 2002. To achieve a high level of accuracy, the methodology requires surveying each site twice. The two sets of data are recorded as "Pass 1" and "Pass 2," and the two counts are averaged. The average is rounded to one decimal point. For example, the averaged Pass 1 and Pass 2 count of miscellaneous paper for all sites is 2276.5 items.
- The third column presents the percentage of the total of large litter items for each category in 2002. For example, vehicle and tire debris accounted for 14.04% of all large litter items in 2002.
- The remaining columns represent the percentages of total large items for each category in the five previous years of the survey.

Table 3.1 Distribution of Large Litter Items

RANKING BY LARGE LITTER CATEGORY	Average items, passes 1 & 2 2002	% of total large litter items					
		2002	2001	1997	1996	1995	1994
1 Vehicle and tire debris	4256.0	14.04	17.43	11.87	9.89	11.80	9.05
2 Construction debris	2445.0	8.06	4.86	6.07	6.16	5.38	3.83
3 Misc. paper	2276.5	7.51	5.99	4.38	6.05	5.39	10.13
4 Snack packages	1698.0	5.60	4.62	6.15	6.62	6.96	6.46
5 Beer cans	1556.5	5.13	5.94	5.38	5.38	6.60	8.97
6 Misc. plastic	1131.0	3.73	4.29	2.54	1.80	2.90	2.67
7 Cigarette/cigar	1111.5	3.67	3.15	4.58	4.05	4.93	4.65
8 Misc. plastic film	1099.0	3.63	2.21	3.75	3.44	4.43	3.01
9 Home items	1064.0	3.51	3.52	4.07	3.82	3.55	2.02
10 Towels/napkins	959.5	3.16	5.38	5.31	4.74	4.46	3.13
11 Plastic packaging	932.5	3.08	1.97	2.52	2.29	1.08	0.68
12 Soda cans	898.0	2.96	2.72	2.55	2.05	2.68	2.57
13 Beer bottles	805.5	2.66	3.51	2.80	3.22	2.99	2.01
14 Newspaper/books/mags/adver	596.0	1.97	1.75	2.13	2.45	2.24	2.60
15 Misc. paperboard	585.0	1.93	1.37	1.09	1.32	1.79	1.64
16 Polystyrene foam cups	570.5	1.88	1.60	2.64	3.00	2.78	3.43
17 Misc. polystyrene foam	566.5	1.87	2.23	1.17	1.45	1.79	1.49
18 Stationary/school/business paper	557.5	1.84	1.75	2.40	2.31	2.03	1.45
19 Paper packaging	542.5	1.79	1.26	1.49	0.89	0.50	1.09
20 Plastic jars/bottles/boxes	483.5	1.59	0.95	1.47	0.89	1.10	0.73
21 Paper cups	479.5	1.58	1.70	2.71	3.00	3.09	3.04
22 Aluminum cans	463.0	1.53	1.01	0.66	0.22	0.32	0.32
23 Plastic disposable cups	425.0	1.40	1.26	0.85	1.01	0.89	0.92
24 Plastic cup lids	423.0	1.40	1.50	1.34	1.40	1.44	1.71
25 Misc. cardboard	322.0	1.06	1.44	1.41	1.62	1.30	1.04
26 Sports/other plastic bottles	245.5	0.81	1.03	1.02	1.75	0.58	0.72
27 Paperboard boxes	238.0	0.79	0.95	1.35	1.08	0.99	1.48
28 Soda plastic bottles	234.0	0.77	1.74	0.83	0.99	0.77	1.10
29 Plastic other bags	227.5	0.75	0.77	0.81	1.11	0.96	0.93
30 Aluminum foil/pie tins	211.5	0.70	0.39	0.77	0.65	0.41	0.37
31 Paper beverage casing	210.0	0.69	0.46	1.20	1.53	1.10	0.74
32 Lottery tickets	179.0	0.59	0.72	0.85	0.72	0.82	0.56
33 Broken glass containers	145.0	0.48	0.46	0.44	0.40	0.27	1.28
34 Paper food wraps	144.0	0.47	0.43	0.68	0.82	0.74	0.65
35 Plastic retail bags	140.0	0.46	0.72	0.57	0.96	0.65	0.60
36 Dip/chew/snuff	135.0	0.45	0.42	0.43	0.47	0.39	0.42
37 Foil packaging	132.5	0.44	1.34	0.48	0.34	0.19	0.56
38 Paper small bags	128.0	0.42	0.36	0.73	0.97	1.13	1.03
39 Zipper/sandwich bags	118.0	0.39	0.29	0.52	0.51	0.58	0.48
40 Corrugated cardboard boxes	114.5	0.38	0.38	1.28	1.20	0.39	0.91
41 Paper/foil composite food wraps	111.0	0.37	0.45	0.26	0.38	0.56	0.50
42 Glass jars/bottles	110.0	0.36	0.27	0.40	0.04	0.26	0.03
43 Container lids	109.5	0.36	0.31	0.51	0.45	0.38	0.19
44 Plastic/paper combo packaging	97.0	0.32	0.24	0.16	0.22	0.30	0.24
45 Condiment packages	96.5	0.32	0.59	0.82	0.34	0.44	1.00

RANKING BY LARGE LITTER CATEGORY	Average items, Passes 1&2	% of total large litter items					
		2002	2001	1997	1996	1995	1994
46 Polystyrene foam packaging	89.0	0.29	0.49	0.11	0.18	0.50	0.40
47 Sports/other cans	86.5	0.29	0.09	0.18	0.27	0.26	0.50
48 Utensils	78.0	0.26	0.30	0.19	0.18	0.17	0.19
49 Milk jugs/water/juice(HDPE)	71.5	0.24	0.23	0.26	0.36	0.30	0.72
50 Steel cans	67.0	0.22	0.27	0.31	0.39	0.31	0.39
51 Polystyrene foam plates	52.5	0.17	0.10	0.10	0.13	0.09	0.10
52 Polystyrene foam clam shell	42.0	0.14	0.09	0.20	0.28	0.32	0.23
53 Wine/liquor glass bottles	41.0	0.14	0.15	0.24	0.23	0.23	0.21
54 Misc. glass	40.0	0.13	0.10	0.13	0.07	0.09	0.04
55 Plastic reusable cups	38.0	0.13	0.29	0.32	0.32	0.31	0.23
56 Sports/other glass bottles	37.5	0.12	0.20	0.40	0.96	0.49	0.58
57 Paper other bags	36.5	0.12	0.24	0.37	0.42	0.12	0.10
58 Foil pouches	32.0	0.11	0.02	0.02	0.04	0.08	0.03
59 Ice bags	31.0	0.10	0.15	0.21	0.29	0.38	0.33
60 Soda glass bottles	29.5	0.10	0.26	0.31	0.51	0.64	1.69
61 Paper retail bags	29.0	0.10	0.38	0.11	0.26	0.13	0.41
62 Wine/liquor plastic bottles	24.5	0.08	0.04	0.03	0.04	0.09	0.06
63 Six pack rings	23.0	0.08	0.10	0.11	0.14	0.18	0.18
64 Plastic clam shell	18.5	0.06	0.06	0.09	0.06	0.05	0.05
64 Polystyrene foam trays	18.5	0.06	0.41	0.14	0.20	0.10	0.13
66 Feed bags	11.5	0.04	0.07	0.14	0.05	0.12	0.10
67 Gable top containers	10.5	0.03	0.05	0.46	0.49	0.58	0.55
68 Plastic plates	9.5	0.03	0.04	0.01	0.02	0.02	0.03
69 Aerosol cans	7.5	0.02	0.03	0.02	0.03	0.03	0.06
70 Aseptic box	7.0	0.02	0.02	0.03	0.03	0.02	0.08
71 Paper trays	6.5	0.02	0.06	0.04	0.05	0.02	0.08
72 Paper plates	5.5	0.02	0.05	0.03	0.04	0.02	0.08
<b>TOTALS</b>	<b>30317.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

### 3.2 LARGE LITTER RESULTS: COMPARATIVE RANKINGS, 1994-2002

Table 3.2 lists each of the 72 items of large litter ranked for 2002 by total number of pieces in descending order, number one being the item with the highest count. The remaining columns give the rank for the same items in previous years. This table provides an easy way to compare the rankings of particular items from year to year. For example, vehicle and tire debris have been the most frequently counted items in each year except for the first.

Examples of items that have moved up on the list in 2002 compared to earlier years include: construction debris, miscellaneous plastic and plastic film, plastic packaging, miscellaneous paperboard, paper packaging, plastic jars/bottles/boxes, aluminum cans, plastic disposable cups, aluminum foil/pie tins, plastic retail bags, dip/chew/snuff, foil packaging, glass jars/bottles, plastic/paper combo packaging, and sports/other cans.

Table 3.2 Comparative Rankings for Large Litter Items, 1994-2002

<b>LARGE LITTER CATEGORY</b>	<b>2002 Rank</b>	<b>2001 Rank</b>	<b>1997 Rank</b>	<b>1996 Rank</b>	<b>1995 Rank</b>	<b>1994 Rank</b>
Vehicle and tire debris	1	1	1	1	1	2
Construction debris	2	5	3	3	5	6
Misc. paper	3	2	7	4	4	1
Snack packages	4	6	2	2	2	4
Beer cans	5	3	4	5	3	3
Misc. plastic	6	7	14	17	12	11
Cigarette/cigar packages	7	10	6	7	6	5
Misc. plastic film	8	13	9	9	8	10
Home items	9	8	8	8	9	14
Towels/napkins	10	4	5	6	7	8
Plastic packaging	11	14	15	15	22	35
Soda cans	12	11	13	16	14	13
Beer bottles	13	9	10	10	11	15
Newspaper/books/mags/adver	14	16	17	13	15	12
Misc. paperboard	15	22	26	23	17	18
Polystyrene foam cups	16	19	12	12	13	7
Misc. polystyrene foam	17	12	25	21	18	19
Stationary/school/business paper	18	15	16	14	16	21
Paper packaging	19	24	18	32	39	24
Plastic jars/bottles/boxes	20	28	19	33	24	32
Paper cups	21	18	11	11	10	9
Aluminum cans	22	27	36	55	47	51
Plastic disposable cups	23	25	29	27	27	29
Plastic cup lids	24	20	22	22	19	16
Misc. cardboard	25	21	20	19	20	25
Sports/other plastic bottles	26	26	27	18	33	34
Paperboard boxes	27	29	21	26	25	20
Soda plastic bottles	28	17	30	28	29	23
Plastic other bags	29	30	32	25	26	28
Aluminum foil/pie tins	30	41	33	36	40	49
Paper beverage casing	31	35	24	20	23	31
Lottery tickets	32	31	28	35	28	40
Broken glass containers	33	36	42	43	52	22
Paper food wraps	34	38	35	34	30	36
Plastic retail bags	35	43	63	53	59	46
Dip/chew/snuff	36	39	43	40	43	45
Foil packaging	37	23	40	48	56	39
Paper small bags	38	44	34	29	21	26
Zipper/sandwich bags	39	48	38	37	36	44
Corrugated cardboard boxes	40	42	23	24	42	30
Paper/foil composite food wraps	41	37	51	45	35	42
Glass jars/bottles	42	49	44	68	53	71
Container lids	43	45	39	41	44	56

<b>LARGE LITTER CATEGORY</b>	<b>2002 Rank</b>	<b>2001 Rank</b>	<b>1997 Rank</b>	<b>1996 Rank</b>	<b>1995 Rank</b>	<b>1994 Rank</b>
Plastic/paper combo packaging	44	52	57	56	51	52
Condiment packages	45	33	31	47	41	27
Polystyrene foam packaging	46	34	62	59	37	47
Sports/other cans	47	62	56	52	54	43
Utensils	48	46	55	58	58	57
Milk jugs/water/juice	49	54	50	46	50	33
Steel cans	50	50	49	44	49	48
Polystyrene foam plates	51	60	64	61	63	62
Polystyrene foam clam shell	52	61	54	51	46	54
Wine/liquor glass bottles	53	56	52	54	55	55
Misc. glass	54	58	60	62	64	69
Plastic reusable cups	55	47	47	49	48	53
Sports/other glass bottles	56	55	45	31	38	38
Paper other bags	57	53	46	42	61	61
Foil pouches	58	72	71	67	66	70
Ice bags	59	57	53	50	45	50
Soda glass bottles	60	51	48	38	32	17
Paper retail bags	61	43	63	53	59	46
Wine/liquor plastic bottles	62	69	69	69	65	67
Six pack rings	63	59	61	60	57	58
Plastic clam shell	64	64	65	63	67	68
Polystyrene foam trays	65	40	58	57	62	59
Feed bags	66	63	59	64	60	60
Gable top containers	67	66	41	39	34	41
Plastic plates	68	68	72	72	72	72
Aerosol cans	69	70	70	71	68	66
Aseptic box	70	71	68	70	70	63
Paper trays	71	65	66	65	69	64
Paper plates	72	67	67	66	71	65

### **3.3 LARGE LITTER ITEMS BY MATERIAL TYPE**

To allow for comparisons based on material type, the 72 large litter categories were grouped according to seven material types: aluminum, composite, glass, mixed, paper, plastic, and steel.

"Mixed" and "composite" items consist of a combination of material types. "Mixed" items are defined as those in which the materials are not bonded together. Examples of mixed items include cigarette/cigar packaging, some vehicle debris items, and foil/paper food wrap. "Composite" items are defined as those in which the materials are bonded together. Examples of composite items include aseptic boxes and foil/plastic pouches. Table 3.3 shows the large litter items that comprise each of the material types.

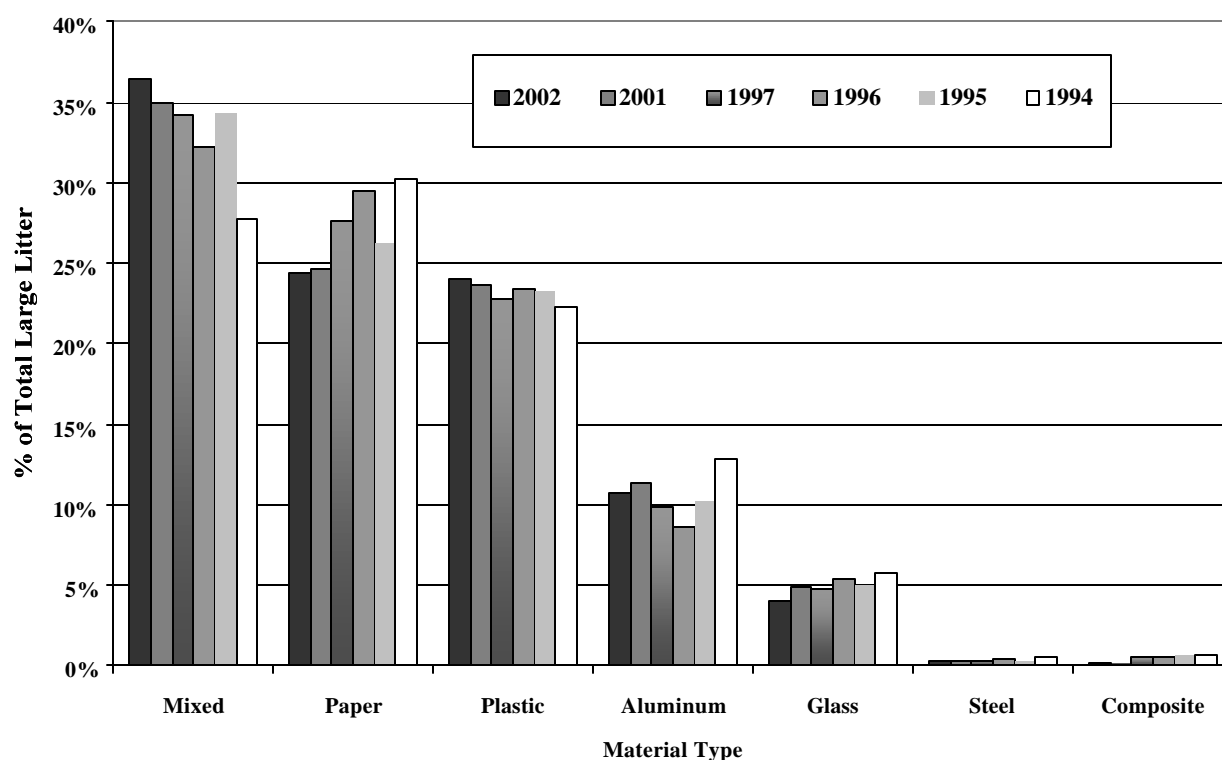
Table 3.3 Classification of Large Litter Items by Material Type

<p style="text-align: center;">ALUMINUM</p> <p>Aluminum cans Beer cans Foil packaging Foil/pie tins Soda cans</p> <p style="text-align: center;">COMPOSITE</p> <p>Aseptic boxes Foil pouches Gable top containers</p> <p style="text-align: center;">GLASS</p> <p>Beer bottles Broken glass containers Glass jars/bottles Misc. glass Soda glass bottles Sports/other glass bottles Wine/liquor glass bottles</p> <p style="text-align: center;">MIXED</p> <p>Cigarette/cigar Construction debris Dip/chew Feed bags Paper/foil food wrap Home items Lids Snack packages Sports/other cans Vehicle debris</p> <p style="text-align: center;">PAPER</p> <p>Corrugated cardboard boxes Lottery Misc. cardboard Misc. paper Misc. paperboard Newspaper/books/mags/adver Paper beverage casings Paper cups Paper food wrap Paper grocery bags Paper other bags Paper packaging Paper plates Paper small bags</p>	<p>Paper trays Paperboard boxes Stationary/school/business Towels/napkins</p> <p style="text-align: center;">PLASTIC</p> <p>Condiments Ice bags Milk jugs/water/juice (HDPE) Misc. film Misc. plastic Misc. polystyrene foam Plastic clam shells Plastic disposable cups Plastic grocery bags Plastic jars/bottles/boxes Plastic lids Plastic other bags Plastic packaging Plastic plates Plastic reusable cups Plastic/paper combo packaging Polystyrene foam clam shells Polystyrene foam cups Polystyrene foam packaging Polystyrene foam plates Polystyrene foam trays Six pack rings Soda plastic bottles Sports/other plastic bottles Utensils Wine/liquor plastic bottles Zipper/sandwich bags</p> <p style="text-align: center;">STEEL</p> <p>Aerosol cans Steel cans</p>
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Graphs in Figures 3.5 and 3.6 show the large litter results according to material type and major litter category.

Figure 3.5 compares the material type results for 2002 with the results of the surveys from previous years. Once again, these increases and decreases in litter items by material type have not been statistically analyzed; therefore, no conclusions should be drawn as to the statistical significance of an increase or decrease for a given material type. The data are provided in this format to allow for anecdotal comparisons only.

Figure 3.5 Large Litter Items by Material Type



As shown in the graph above, the material types, ranked from highest to lowest percentage, are: mixed, paper, plastic, aluminum, glass, steel, and composite. Paper, glass, and steel product categories have decreased as a percentage of the whole over the years while plastic and mixed categories have increased. Aluminum products are down from the totals in 2001 and 1994 but up from the middle three years of the survey.

Table 3.4 below shows the actual percentages for the material types presented in Figure 3.5. (Totals may not equal 100% due to rounding.) Material types ranked for 2002 from most to least are: mixed, paper, plastic, aluminum, glass, steel, and composite.

Table 3.4 Large Litter Items by Material Type

Year	Mixed	Paper	Plastic	Aluminum	Glass	Steel	Composite
2002	36.39	24.44	24.04	10.76	3.99	0.24	0.16
2001	34.91	24.66	23.69	11.40	4.95	0.30	0.09
1997	34.25	27.58	22.78	9.84	4.72	0.33	0.50
1996	32.17	29.46	23.34	8.63	5.42	0.42	0.56
1995	34.33	26.26	23.22	10.20	4.98	0.34	0.68
1994	27.70	30.20	22.30	12.80	5.80	0.50	0.70

### 3.4 LARGE LITTER ITEMS BY MAJOR CATEGORY

As an additional way of examining litter trends, the 72 large litter categories were classified into eight “major categories” organized according to material usage. A percentage of total large litter was calculated for each major category. The categories and percentages are:

Non-Beverage Containers include jars, bottles, boxes, cans, and lids, which are not related to any type of beverage. Non-beverage containers accounted for 4.08% of large litter items in 2002.

Outer Packaging includes bags or boxes into which items from stores or restaurants are placed. Examples are: plastic other bags, plastic retail bags, paper small bags, corrugated cardboard boxes, and paper other bags. Outer packaging accounted for 2.23% of large litter items in 2002.

Printed Paper Items include newspapers, books, magazines, advertisements, school or business papers, and lottery tickets. Printed paper items accounted for 4.40% of large litter items in 2002.

Product Packaging includes all types of packaging associated with a product when it is removed from the shelf at a retail store. Examples are: cigarette packages, plastic packaging, paper packaging, paperboard boxes, and paper beverage casings. Product packaging accounted for 12.83% of large litter items in 2002.

Beverage Containers include all types of containers sealed by the manufacturer and used for beverages, including aluminum cans, glass and plastic bottles, gable-top containers, foil pouches, and aseptic drink boxes. Beverage containers accounted for 13.94% of large litter items in 2002.

Miscellaneous Items include all items that cannot be specifically identified or categorized, such as items made of paper, paperboard, cardboard, plastic, plastic film, polystyrene foam, and glass. Miscellaneous items accounted for 19.86% of large litter items in 2002.

Debris Items include construction debris, vehicle debris, tire pieces, and home items (appliances, furniture, clothing, etc.). Debris items accounted for 25.61% of large litter items in 2002.



Take-Out Food Items include snack packaging, cups, lids, utensils, plates, trays, napkins, and other items associated with food that may be consumed in a vehicle or away from the home. These items are largely disposable and made of plastic, paper, or polystyrene. This category does not include bags, which are included in the outer packaging category. Take-out food items accounted for 17.07% of large litter items in 2002.

Figure 3.6 shows the distribution of litter by major category for the six years of the survey. For 2002, the categories are ranked in the following decreasing order of occurrence: debris, miscellaneous, take-out food, beverage containers, product packaging, printed paper, non-beverage containers, and outer packaging.

Differences in major category percentages during the six years have not been statistically analyzed; therefore, no conclusions should be drawn as to the statistical significance of an increase or decrease in a given major category. The data are provided in this format to allow for anecdotal comparisons only.

Figure 3.6 Large Litter Items by Major Category

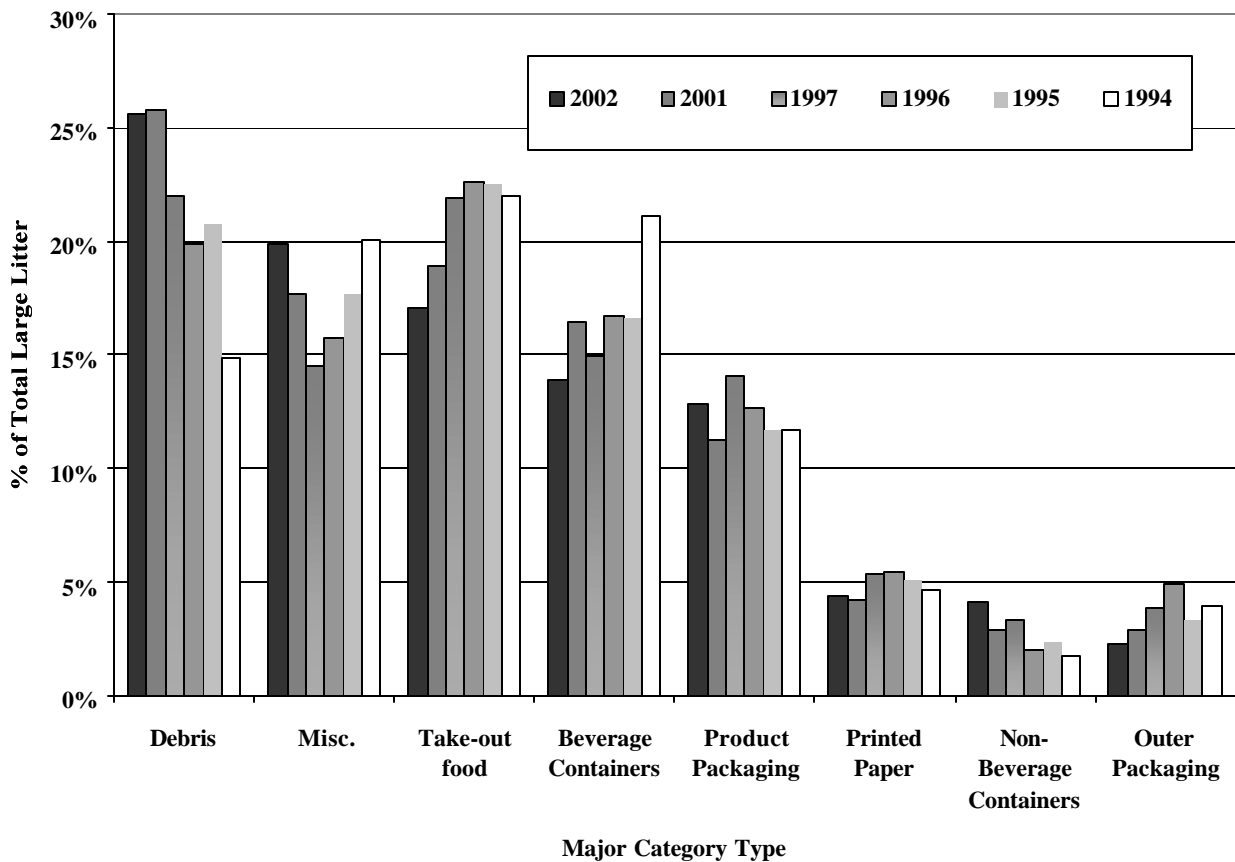


Table 3.5 below shows the actual percentages for the major categories presented in Figure 3.6. (Totals may not equal 100% due to rounding.) The items comprising each major category are described in more detail in the tables that follow. The tables present each large litter item's percentage within the major category and each large litter item's percentage of total large litter. (For a comparison of 1994-2002 results for specific items, see Table 3.1.)

Table 3.5 Large Litter Items by Major Category

Year	Debris	Misc.	Take-out Food	Beverage Containers	Product Packaging	Printed Paper	Non-Beverage Containers	Outer Packaging
2002	25.61	19.86	17.07	13.94	12.83	4.40	4.08	2.23
2001	25.81	17.63	18.93	16.46	11.28	4.22	2.84	2.85
1997	22.01	14.47	21.88	14.95	14.07	5.38	3.37	3.87
1996	19.87	15.75	22.59	16.72	12.69	5.48	2.03	4.92
1995	20.73	17.70	22.48	16.59	11.65	5.09	2.39	3.37
1994	14.90	20.02	21.96	21.07	11.72	4.61	1.72	3.98

### 3.4.1 Take-Out Food

Figure 3.7 and Table 3.6 present the results for take-out food items. Take-out food encompasses more than just drive-up fast food. It includes packaging and serving ware for a wide variety of prepared, ready-to-eat food and drinks that may be consumed in a vehicle or in locations away from the home. (This table does not include bags, which are part of the outer packaging category.) All of the take-out food items as a whole accounted for less than one-sixth of all large litter in 2002. Snack packages are the largest component of take-out food litter items (32.81%), followed by towels/napkins (18.54%), polystyrene foam cups (11.02%), and paper cups (9.26%).

Figure 3.7 Distribution of Take-Out Food Items

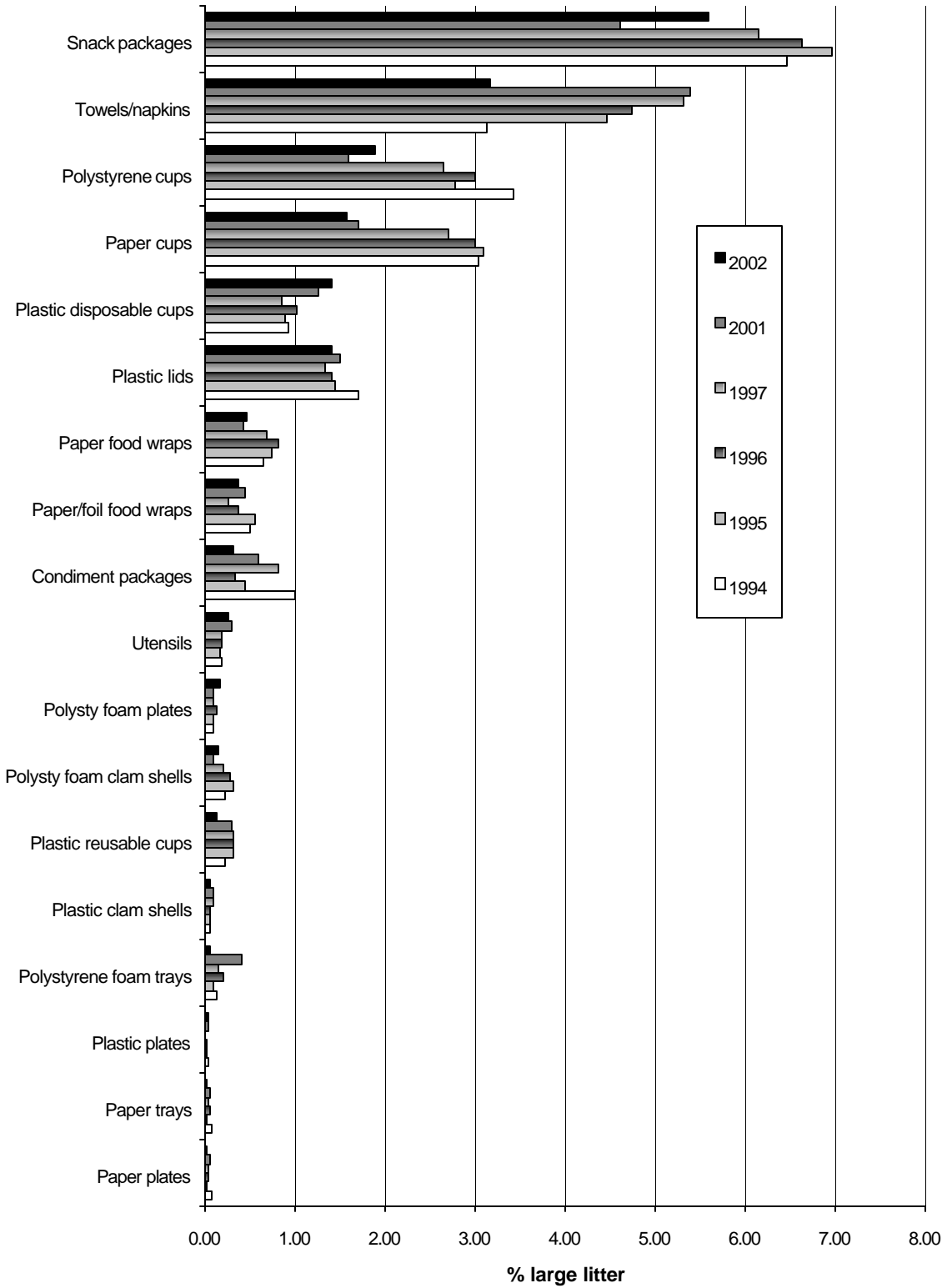


Table 3.6 Distribution of Take-Out Food Items

<b>TAKE-OUT FOOD ITEM</b>	<b>2002 % of total Take-out Food items</b>	<b>2002 % of large litter</b>	<b>2001 % of large litter</b>	<b>1997 % of large litter</b>	<b>1996 % of large litter</b>	<b>1995 % of large litter</b>	<b>1994 % of large litter</b>
Snack packages	32.81	5.60	4.62	6.15	6.62	6.96	6.46
Towels/napkins	18.54	3.16	5.38	5.31	4.74	4.46	3.13
Polystyrene cups	11.02	1.88	1.6	2.64	3.00	2.78	3.43
Paper cups	9.26	1.58	1.7	2.71	3.00	3.09	3.04
Plastic disposable cups	8.21	1.40	1.26	0.85	1.01	0.89	0.92
Plastic lids	8.17	1.40	1.5	1.34	1.40	1.44	1.71
Paper food wraps	2.78	0.47	0.43	0.68	0.82	0.74	0.65
Paper/foil food wraps	2.14	0.37	0.45	0.26	0.38	0.56	0.50
Condiment packages	1.86	0.32	0.59	0.82	0.34	0.44	1.00
Utensils	1.51	0.26	0.3	0.19	0.18	0.17	0.19
Polystyrene foam plates	1.01	0.17	0.1	0.10	0.13	0.09	0.10
Polystyrene foam clam shells	0.81	0.14	0.09	0.20	0.28	0.32	0.23
Plastic reusable cups	0.73	0.13	0.29	0.32	0.32	0.31	0.23
Plastic clam shells	0.36	0.06	0.09	0.09	0.06	0.05	0.05
Polystyrene foam trays	0.36	0.06	0.41	0.14	0.20	0.10	0.13
Plastic plates	0.18	0.03	0.04	0.01	0.02	0.02	0.03
Paper trays	0.13	0.02	0.06	0.04	0.05	0.02	0.08
Paper plates	0.11	0.02	0.05	0.03	0.04	0.02	0.08
<b>TOTAL</b>	<b>100.00</b>	<b>17.07</b>	<b>18.93</b>	<b>21.88</b>	<b>22.59</b>	<b>22.46</b>	<b>21.96</b>

### 3.4.2 Beverage Containers

Figure 3.8 and Table 3.7 present the results for beverage container items. This category is comprised of all types of containers sealed by the manufacturer and used for beverages, including aluminum cans, glass bottles, plastic bottles, gable-top containers, foil pouches, and aseptic boxes. The beverage container category is approximately 14% of all large litter, its lowest level in all years. Beer cans, the largest component in this category, accounted for 36.84% of the beverage containers identified, followed by soda cans (21.26%), beer bottles (19.07%), and sports/other plastic bottles (5.81%).

Figure 3.8 Distribution of Beverage Container Items

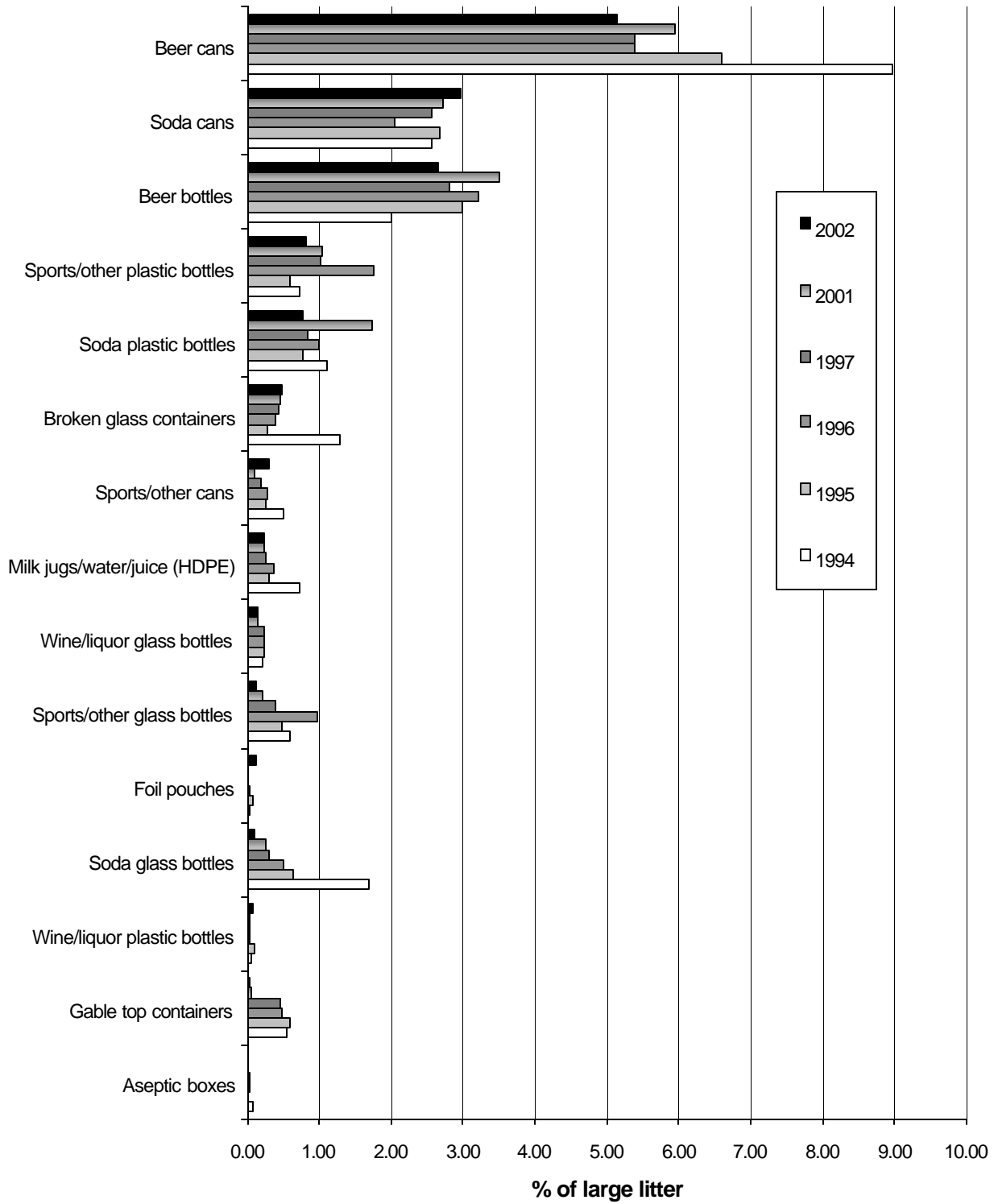


Table 3.7 Distribution of Beverage Container Items

<b>BEVERAGE CONTAINER ITEM</b>	<b>2002 % of total Beverage container items</b>	<b>2002 % of large litter</b>	<b>2001 % of large litter</b>	<b>1997 % of large litter</b>	<b>1996 % of large litter</b>	<b>1995 % of large litter</b>	<b>1994 % of large litter</b>
Beer cans	36.84	5.13	5.94	5.38	5.38	6.60	8.97
Soda cans	21.26	2.96	2.72	2.55	2.05	2.68	2.57
Beer bottles	19.07	2.66	3.51	2.80	3.22	2.99	2.01
Sports/other plastic bottles	5.81	0.81	1.03	1.02	1.75	0.58	0.72
Soda plastic bottles	5.54	0.77	1.74	0.83	0.99	0.77	1.10
Broken glass containers	3.43	0.48	0.46	0.44	0.40	0.27	1.28
Sports/other cans	2.05	0.29	0.09	0.18	0.27	0.26	0.50
Milk jugs/water/juice (HDPE)	1.69	0.24	0.23	0.26	0.36	0.30	0.72
Wine/liquor glass bottles	0.97	0.14	0.15	0.24	0.23	0.23	0.21
Sports/other glass bottles	0.89	0.12	0.20	0.40	0.96	0.49	0.58
Foil pouches	0.76	0.11	0.02	0.02	0.04	0.08	0.03
Soda glass bottles	0.70	0.10	0.26	0.31	0.51	0.64	1.69
Wine/liquor plastic bottles	0.58	0.08	0.04	0.03	0.04	0.09	0.06
Gable top containers	0.25	0.03	0.05	0.46	0.49	0.58	0.55
Aseptic boxes	0.17	0.02	0.02	0.03	0.03	0.02	0.08
<b>TOTAL</b>	<b>100.00</b>	<b>13.94</b>	<b>16.46</b>	<b>14.95</b>	<b>16.72</b>	<b>16.58</b>	<b>21.07</b>

### 3.4.3 Miscellaneous

Figure 3.9 and Table 3.8 present the results for miscellaneous items, which include all large litter items that could not be identified. This category includes items of paper, paperboard, cardboard, plastic, plastic film, polystyrene foam, and glass, and accounts for about 20% of all large litter. This is higher than all years except the first.

Figure 3.9 Distribution of Miscellaneous Items

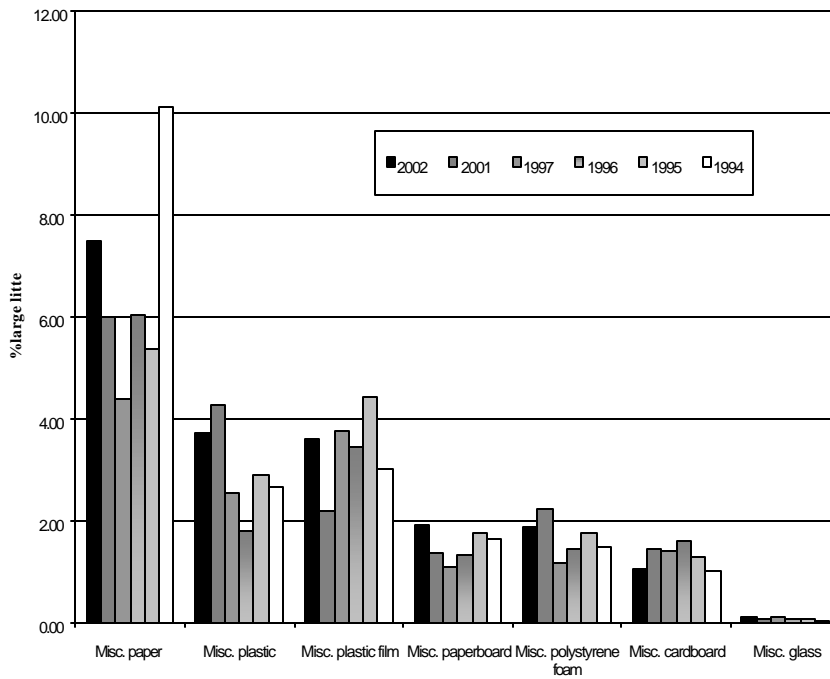


Table 3.8 Distribution of Miscellaneous Items

MISCELLANEOUS ITEM	2002 % of total Miscellaneous Items	2002 % of large litter	2001 % of large litter	1997 % of large litter	1996 % of large litter	1995 % of large litter	1994 % of large litter
Misc. paper	37.82	7.51	5.99	4.38	6.05	5.39	10.13
Misc. plastic	18.79	3.73	4.29	2.54	1.8	2.9	2.67
Misc. plastic film	18.26	3.63	2.21	3.75	3.44	4.43	3.01
Misc. paperboard	9.72	1.93	1.37	1.09	1.32	1.79	1.64
Misc. polystyrene foam	9.41	1.87	2.23	1.17	1.45	1.79	1.49
Misc. cardboard	5.35	1.06	1.44	1.41	1.62	1.3	1.04
Misc. glass	0.66	0.13	0.1	0.13	0.07	0.09	0.04
<b>TOTAL</b>	<b>100.00</b>	<b>19.86</b>	<b>17.63</b>	<b>14.47</b>	<b>35.71</b>	<b>37.64</b>	<b>39.96</b>

### 3.4.4 Debris

Figure 3.10 and Table 3.9 present the results for debris items. The debris category combines three large litter subcategories: vehicle and tire pieces, construction debris, and home items. Vehicle and tire items consist of items such as broken reflectors, headlights, inner tubes, and tire pieces. Construction debris consists of any materials related to the construction industry such as insulation, wood, and drywall mud buckets. The home item category covers such items as clothing, keys, jewelry, tools, cassette tapes, CDs, and furniture pieces. The debris category comprises over one-fourth of all large litter. Vehicle and tire debris accounted for two-thirds of the debris items identified in this survey.

Figure 3.10 Distribution of Debris Items

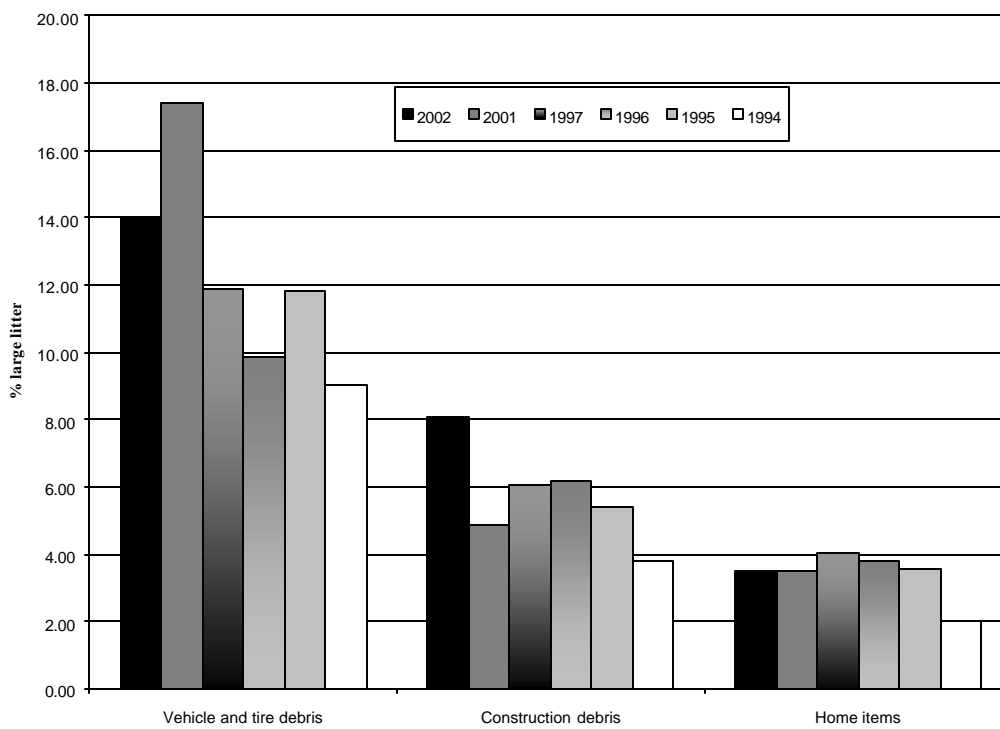


Table 3.9 Distribution of Debris Items

DEBRIS ITEM	2002 % of total Debris Items	2002 % of large litter	2001 % of large litter	1997 % of large litter	1996 % of large litter	1995 % of large litter	1994 % of large litter
Vehicle and tire debris	54.81	14.04	17.43	11.87	9.89	11.80	9.05
Construction debris	31.49	8.06	4.86	6.07	6.16	5.38	3.83
Home items	13.70	3.51	3.52	4.07	3.82	3.55	2.02
TOTAL	100.00	25.61	25.81	22.01	19.87	20.73	14.90



### 3.4.5 Product Packaging

Figure 3.11 and Table 3.10 present the results for product packaging items. This category consists of all types of packaging associated with a product at the time it is removed from the shelf at a retail store and is just under 13% of all large litter. Cigarette and cigar packages accounted for 28.62% of packaging items, followed by plastic packaging (24.01%) and paper packaging (13.97%).

Figure 3.11 Distribution of Product Packaging Items

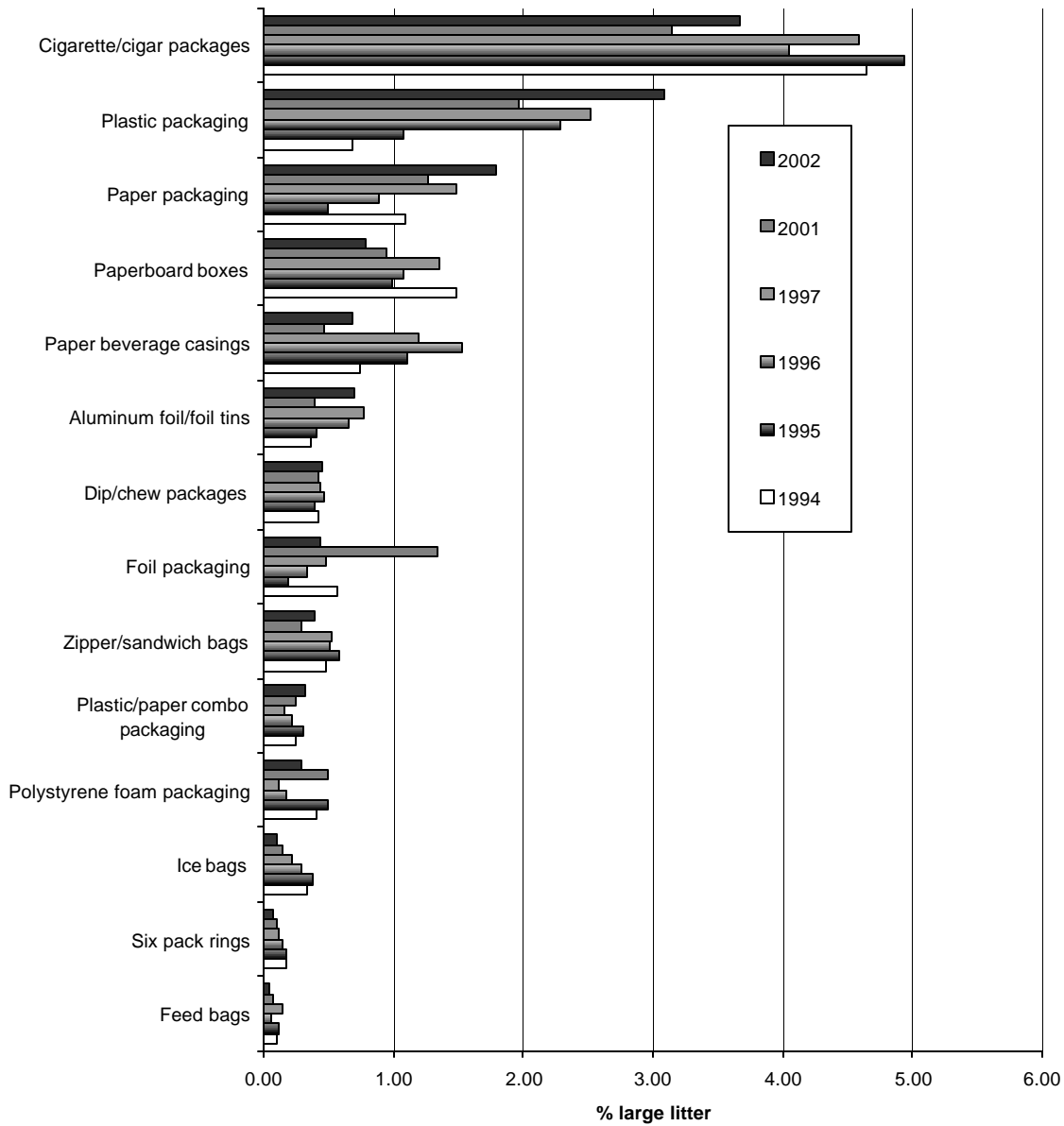


Table 3.10 Distribution of Product Packaging Items

<b>PRODUCT PACKAGING ITEM</b>	<b>2002 % of total Product Packaging Items</b>	<b>2002 % of large litter</b>	<b>2001 % of large litter</b>	<b>1997 % of large litter</b>	<b>1996 % of large litter</b>	<b>1995 % of large litter</b>	<b>1994 % of large litter</b>
Cigarette/cigar packages	28.62	3.67	3.15	4.58	4.05	4.93	4.65
Plastic packaging	24.01	3.08	1.97	2.52	2.29	1.08	0.68
Paper packaging	13.97	1.79	1.26	1.49	0.89	0.50	1.09
Paperboard boxes	6.13	0.79	0.95	1.35	1.08	0.99	1.48
Aluminum foil/foil tins	5.45	0.70	0.39	0.77	0.65	0.41	0.37
Paper beverage casings	5.41	0.69	0.46	1.20	1.53	1.10	0.74
Dip/chew packages	3.48	0.45	0.42	0.43	0.47	0.39	0.42
Foil packaging	3.41	0.44	1.34	0.48	0.34	0.19	0.56
Zipper/sandwich bags	3.04	0.39	0.29	0.52	0.51	0.58	0.48
Plastic/paper combo packaging	2.50	0.32	0.24	0.16	0.22	0.30	0.24
Polystyrene foam packaging	2.29	0.29	0.49	0.11	0.18	0.50	0.40
Ice bags	0.80	0.10	0.15	0.21	0.29	0.38	0.33
Six pack rings	0.59	0.08	0.10	0.11	0.14	0.18	0.18
Feed bags	0.30	0.04	0.07	0.14	0.05	0.12	0.10
<b>TOTAL</b>	<b>100.00</b>	<b>12.83</b>	<b>11.28</b>	<b>14.07</b>	<b>12.69</b>	<b>11.65</b>	<b>11.72</b>

### 3.4.6 Printed Paper

Figure 3.12 and Table 3.11 present the results for printed paper items identified in the survey, which include newspapers, books, magazines, advertisements, school papers, business papers, and lottery tickets. Newspapers, books, magazines, and advertisements together account for 44.73% of the printed paper items identified and comprise just under 2% of all large litter. Lottery ticket paper is at the lowest level since the first year of the survey.

Figure 3.12 Distribution of Printed Paper Items

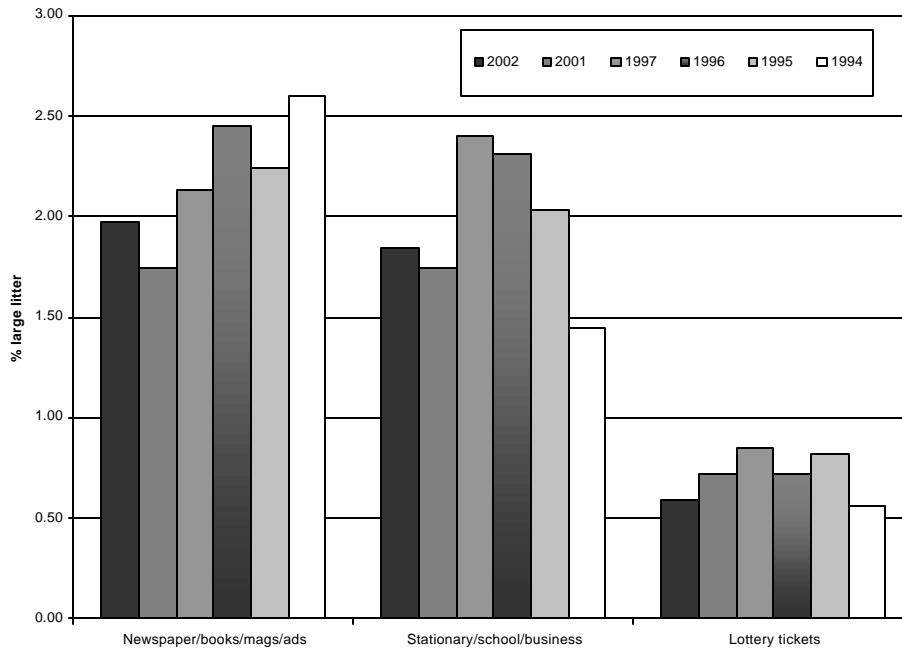


Table 3.11 Distribution of Printed Paper Items

PRINTED PAPER ITEM	2002 % of total Printed Paper Items	2002 % of large litter	2001 % of large litter	1997 % of large litter	1996 % of large litter	1995 % of large litter	1994 % of large litter
Newspaper/books/mags/ads	44.73	1.97	1.75	2.13	2.45	2.24	2.60
Stationary/school/business	41.84	1.84	1.75	2.40	2.31	2.03	1.45
Lottery tickets	13.43	0.59	0.72	0.85	0.72	0.82	0.56
<b>TOTAL</b>	<b>100.00</b>	<b>4.40</b>	<b>4.22</b>	<b>5.38</b>	<b>5.48</b>	<b>5.09</b>	<b>4.61</b>

### 3.4.7 Outer Packaging

Figure 3.13 and Table 3.12 present the results for outer packaging items, which consist of the bags or boxes into which items from stores or restaurants are placed. There may be some overlap between this category and the product-packaging category. For example, a cardboard box may have contained an off-the-shelf item, such as a small appliance. However, for the purposes of this survey, all cardboard items were categorized as outer packaging. Paper bags represent another example of possible overlap. Many paper bags used specifically to hold take-out food items were categorized generically as "paper bags."

At just over 2% of all large litter, this category is down from last year and at its lowest level in all years of the study. It is also the lowest of all of the eight major categories. As a percentage of all large litter, plastic other bags and plastic retail bags were down some from all previous years.

Figure 3.13 Distribution of Outer-Packaging Items

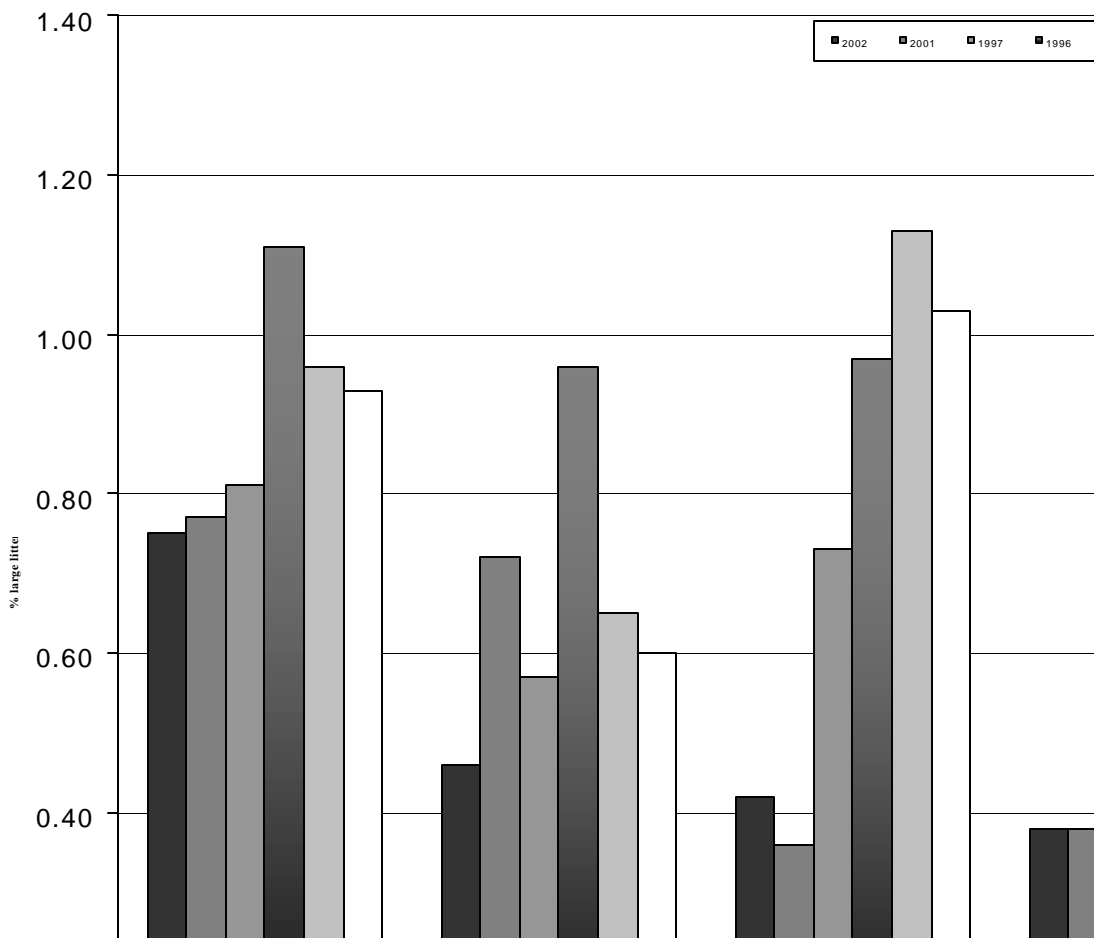


Table 3.12 Distribution of Outer Packaging Items

OUTER PACKAGING ITEM	2002 % of total Outer Packaging Items	2002 % of large litter	2001 % of large litter	1997 % of large litter	1996 % of large litter	1995 % of large litter	1994 % of large litter
Plastic other bags	33.68	0.75	0.77	0.81	1.11	0.96	0.93
Plastic retail bags	20.73	0.46	0.72	0.57	0.96	0.65	0.60
Paper small bags	18.95	0.42	0.36	0.73	0.97	1.13	1.03
Corrugated cardboard boxes	16.95	0.38	0.38	1.28	1.20	0.39	0.91
Paper other bags	5.40	0.12	0.24	0.37	0.42	0.12	0.10
Paper retail bags	4.29	0.10	0.38	0.11	0.26	0.13	0.41
TOTAL	100.00	2.23	2.85	3.87	4.92	3.38	3.98

### 3.4.8 Non-Beverage Containers

Figure 3.14 and Table 3.13 present the results for non-beverage container items, which include all jars, bottles, boxes, cans, and lids that are unrelated to containing any type of beverage. Items in this category are just over 4% of large litter but at the highest level ever. Plastic jars/bottles/boxes and aluminum cans increased over last year and every previous year.

Figure 3.14 Distribution of Non-Beverage Container Items

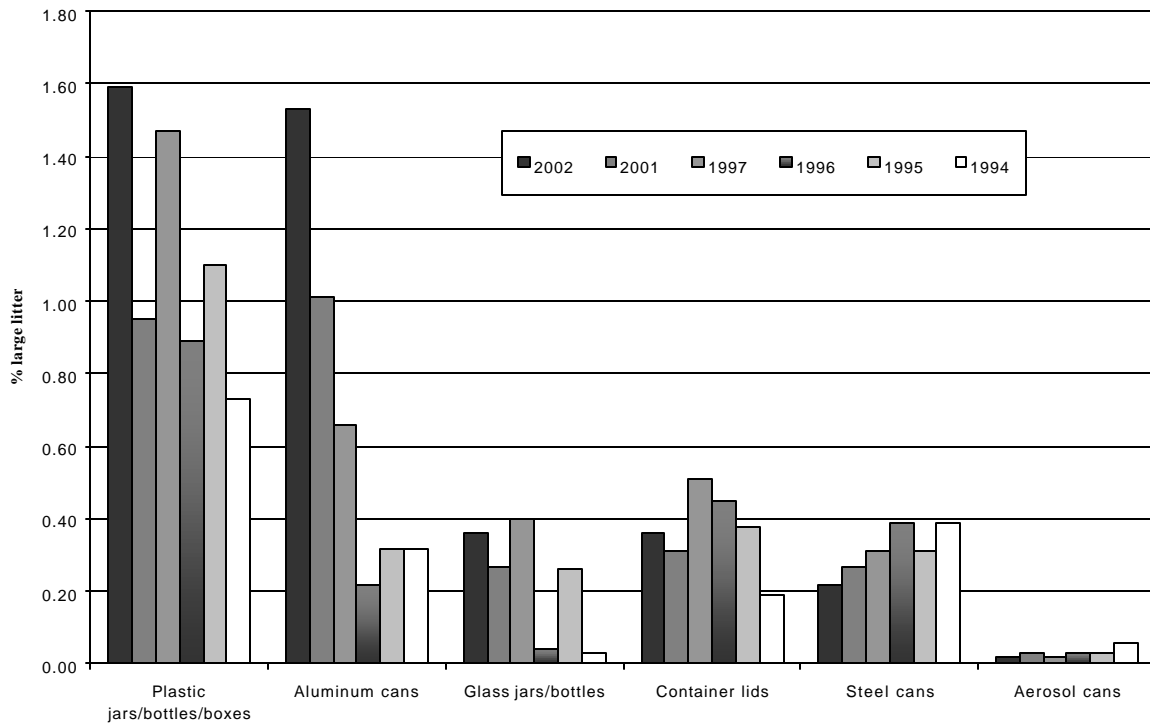


Table 3.13 Distribution of Non-Beverage Container Items

<b>NON-BEVERAGE CONTAINER ITEM</b>	<b>2002 % of total Non- Beverage Container Items</b>	<b>2002 % of large litter</b>	<b>2001 % of large litter</b>	<b>1997 % of large litter</b>	<b>1996 % of large litter</b>	<b>1995 % of large litter</b>	<b>1994 % of large litter</b>
Plastic jars/bottles/boxes	38.98	1.59	0.95	1.47	0.89	1.10	0.73
Aluminum cans	37.32	1.53	1.01	0.66	0.22	0.32	0.32
Glass jars/bottles	8.87	0.36	0.27	0.40	0.04	0.26	0.03
Container lids	8.83	0.36	0.31	0.51	0.45	0.38	0.19
Steel cans	5.40	0.22	0.27	0.31	0.39	0.31	0.39
Aerosol cans	0.60	0.02	0.03	0.02	0.03	0.03	0.06
<b>TOTAL</b>	<b>100.00</b>	<b>4.08</b>	<b>2.84</b>	<b>3.37</b>	<b>2.02</b>	<b>2.40</b>	<b>1.72</b>

### 3.5 SMALL LITTER RESULTS: DISTRIBUTION BY ITEM

Figure 3.15 and Table 3.14 present the results of the small litter survey. For this part of the survey, three transects one-foot wide and up to 15 feet long were surveyed. The small litter survey documented 7,783 pieces of litter smaller than four square inches. Cigarette butts accounted for just over one-fourth of the small litter items (25.92%), up slightly from all but the first year. Plastic film increased over every previous year.

Figure 3.15 Distribution of Small Litter Items

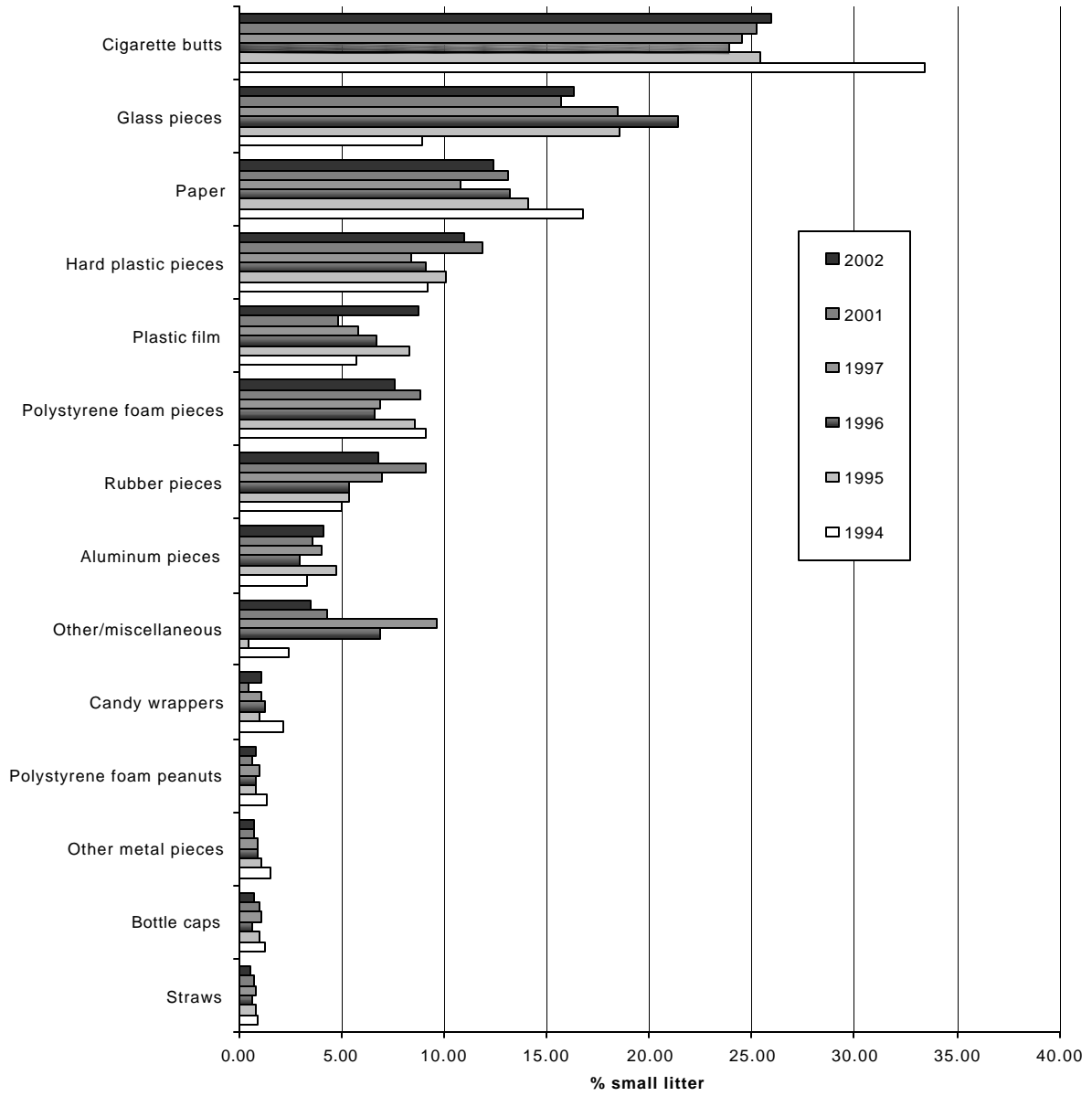


Table 3.14 Distribution of Small Litter Items

<b>SMALL LITTER ITEM</b>	<b>2002 Total number of items</b>	<b>2002 % of small litter</b>	<b>2001 % of small litter</b>	<b>1997 % of small litter</b>	<b>1996 % of small litter</b>	<b>1995 % of small litter</b>	<b>1994 % of small litter</b>
Cigarette butts	2017	25.92	25.28	24.49	23.86	25.37	33.45
Glass pieces	1269	16.30	15.73	18.48	21.44	18.56	8.89
Paper	964	12.39	13.07	10.79	13.18	14.06	16.75
Hard plastic pieces	853	10.96	11.85	8.37	9.09	10.04	9.20
Plastic film	680	8.74	4.81	5.79	6.64	8.25	5.70
Polystyrene foam pieces	589	7.57	8.82	6.81	6.59	8.55	9.13
Rubber pieces	528	6.78	9.11	6.96	5.31	5.37	4.99
Aluminum pieces	320	4.11	3.53	3.99	2.93	4.74	3.35
Other/miscellaneous	269	3.46	4.28	9.58	6.83	0.46	2.39
Candy wrappers	81	1.04	0.47	1.02	1.22	1.01	2.15
Polystyrene foam peanuts	59	0.76	0.64	1.01	0.80	0.77	1.36
Other metal pieces	58	0.75	0.73	0.85	0.85	1.04	1.48
Bottle caps	57	0.73	0.93	1.09	0.66	0.95	1.24
Straws	39	0.50	0.74	0.77	0.61	0.82	0.92
<b>TOTAL</b>	<b>7783</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>

### 3.5.1 Small Litter Results: Comparative Rankings, 1994-2002

Table 3.15 presents the comparative rankings of each small litter category for the six years of the study.

Table 3.15 Comparative Rankings for Small Litter Items, 1994-2002

<b>SMALL LITTER CATEGORY</b>	<b>2002 Rank</b>	<b>2001 Rank</b>	<b>1997 Rank</b>	<b>1996 Rank</b>	<b>1995 Rank</b>	<b>1994 Rank</b>
Cigarette butts	1	1	1	1	1	1
Glass pieces	2	2	2	2	2	5
Paper	3	3	3	3	3	2
Hard plastic pieces	4	4	5	4	4	3
Plastic film	5	7	8	6	6	6
Polystyrene foam pieces	6	6	7	7	5	4
Rubber pieces	7	5	6	8	7	7
Aluminum pieces	8	9	9	9	8	8
Other/miscellaneous	9	8	4	5	14	9
Candy wrappers	10	14	11	10	10	10
Polystyrene foam peanuts	11	13	12	12	13	12
Other metal pieces	12	12	13	11	9	11
Bottle caps	13	10	10	13	11	13
Straws	14	11	14	14	12	14



### 3.6 SITE CHARACTERISTICS

Each of the following characteristics is a category of recorded data because it is a variable that potentially could affect the accumulation of litter:

1. Site type: land use in the area
2. Number of highway lanes
3. Road type, i.e., county, state, or interstate
4. Whether a road was divided or undivided
5. Whether a site was part of an adopted road program
6. If in the adopted road program, is the site currently adopted?
7. Whether a site was within one mile of a fast-food or convenience store
8. Whether there was a traffic signal within view of the site, within one mile
9. Grass height
10. Whether there was a catch point in or at the edge of a site.

These variables were analyzed to determine whether they were statistically significant factors in the amount of litter at a particular site. The following sections describe each site characteristic and present the number of sites and the percentage of total sites for each characteristic for the 1994-2002 surveys. Unlike the preceding figures and tables, categories and results for 2002 are not ranked in the following figures and tables. Rather, the site characteristics are listed in the same order as in previous reports. Finally, Figure 3.26 on page 56 shows the approximate locations of the 2002 survey sites.

#### 3.6.1 Site Type: Land Use Characteristics

The site type distribution is presented in Figure 3.16 and Table 3.16. The four site type classifications are defined as follows:

1. Rural: Sites along roads through primarily agricultural, forested, or undeveloped land. There may be scattered residences, farm buildings, or even a business or industrial property in the area. The site will still be classified as rural if the site is in a primarily rural area. However, if the site is directly in front of or close enough to a business or industry that the litter on the site reflects that usage more than the primarily rural areas around it, it is classified as business or industrial, as the case may be.
2. Urban/Business: Sites in areas having a significant concentration of businesses.
3. Residential: Sites in areas where the primary land use is for either single or multiple unit housing.
4. Industrial: Sites located in industrial parks or in areas where the primary activity is industry.

Figure 3.16 Site Type Distribution

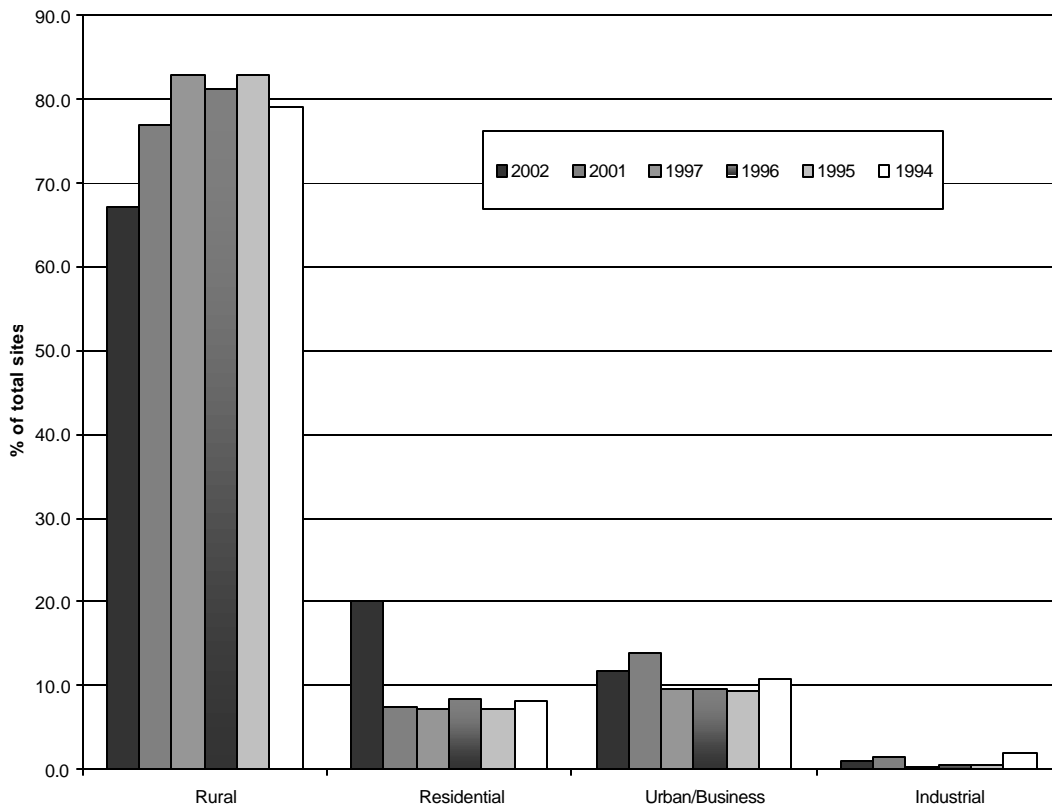


Table 3.16 Site Type Distribution

SITE TYPE	2002 Number of Sites	2002 % of Total Sites	2001 % of Total Sites	1997 % of Total Sites	1996 % of Total Sites	1995 % of Total Sites	1994 % of Total sites
Rural	450	67.2	77.0	82.8	81.3	82.8	79.1
Urban/Business	79	11.8	14.0	9.7	9.7	9.3	10.8
Residential	134	20.0	7.5	7.2	8.4	7.3	8.2
Industrial	7	1.0	1.5	0.3	0.6	0.6	1.9

### 3.6.2 Number of Lanes

Figure 3.17 and Table 3.17 present the site distribution by number of highway lanes at the location of the site. Only through lanes were included in this count, not turning lanes. Eight-lane roads were not in the database until 1997 when five sites were located on eight-lane roads. There were slightly more sites on two-lane roads this year with over 80% of the sites located on two-lane roads. There was a slight decrease in the number of sites on six-lane roads.

Figure 3.17 Distribution by Number of Lanes

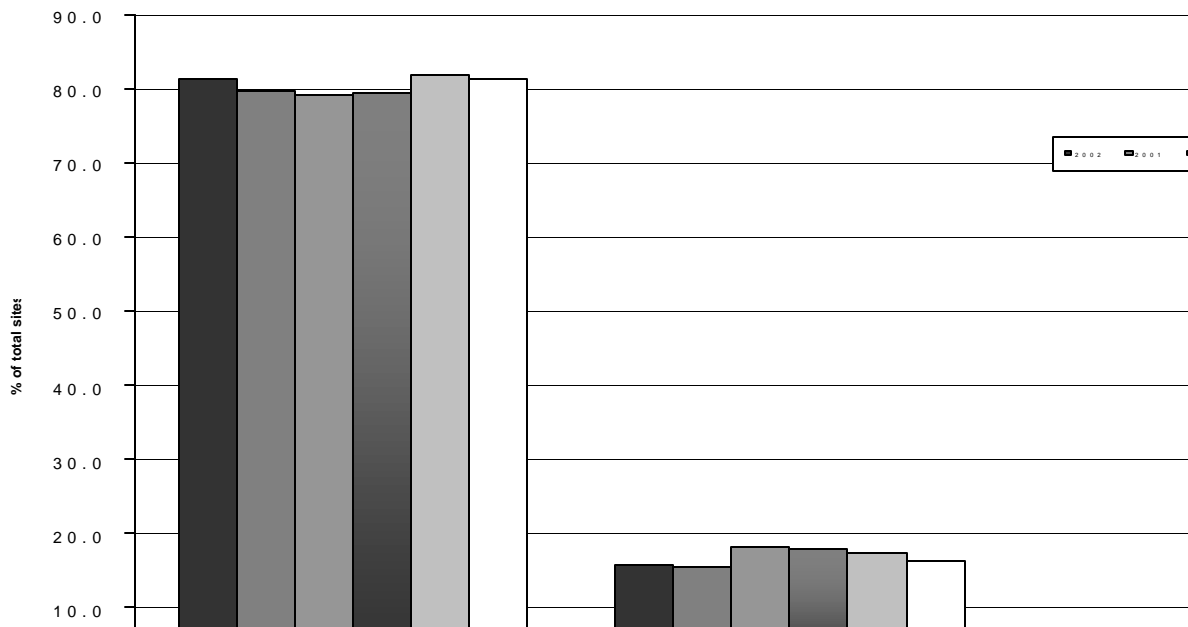


Table 3.17 Distribution by Number of Lanes

NUMBER OF LANES	2002	2002	2001	1997	1996	1995	1994
	Number of Sites	% of Total Sites	% of Total Sites	% of Total Sites	% of Total Sites	% of Total Sites	% of Total Sites
2	544	81.2	79.7	79.1	79.4	81.9	81.4
4	105	15.7	15.5	18.1	17.8	17.3	16.4
6 or more	21	3.1	4.8	2.8	2.8	0.8	2.2

### 3.6.3 Divided Roads

Figure 3.18 and Table 3.18 present the distribution of sites on divided and undivided roads. Consistent with each of the previous surveys, more than 80% of the sites were located on undivided roads.

Figure 3.18 Divided Roads Distribution

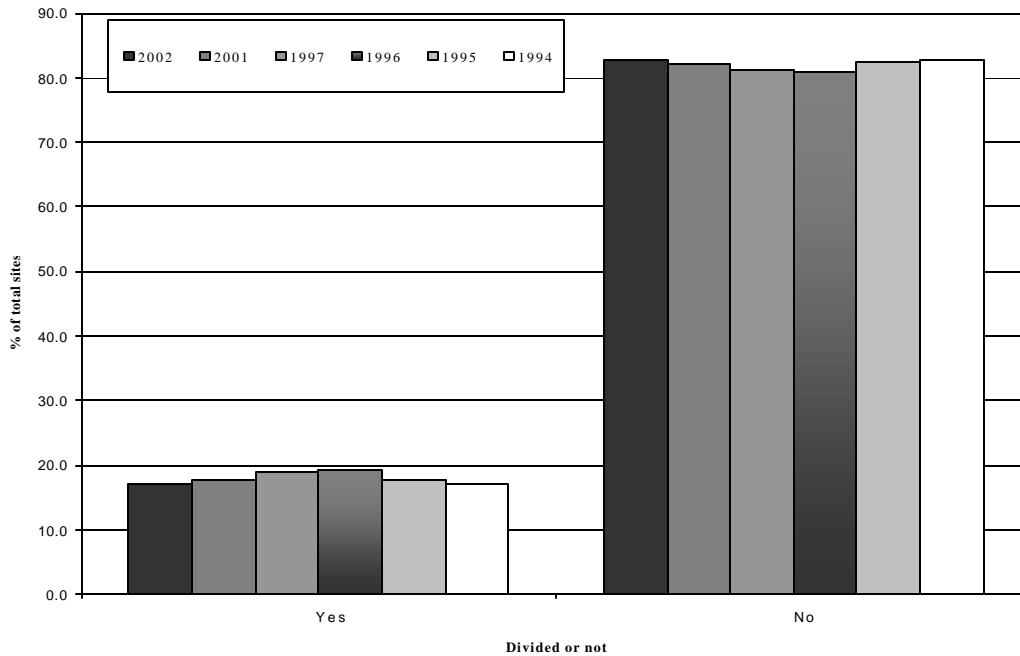


Table 3.18 Divided Roads Distribution

DIVIDED ROAD?	2002 Number of Sites	2002 % of Total Sites	2001 % of Total Sites	1997 % of Total Sites	1996 % of Total Sites	1995 % of Total Sites	1994 % of Total Sites
Yes	115	17.2	17.8	18.8	19.1	17.6	17.2
No	555	82.8	82.2	81.2	80.9	82.4	82.8

### 3.6.4 Adopted Road Programs

Figure 3.19 and Table 3.19 present the distribution of roadside survey sites located along roads receiving only normal public maintenance and cleanup versus those within roadside segments designated as “adopted” roads. Various governmental units and public/private partnerships (such as the state highway department, county public works departments, and the local Keep Florida Beautiful [KFB] affiliates) sponsor programs throughout Florida such as Adopt-A-Highway, Adopt-A-Road, and Adopt-A-Street. Through these programs, volunteers assume responsibility for collecting litter from their assigned adopted sites on a regular basis. On state and county highways outside of urban areas, adopted sites are two miles long on both sides of the highway and a sign marks the beginning of the site for traffic approaching from either direction. In urban areas, sites are one mile in length. For the purposes of this survey, no distinction was made between Adopt-A-Highway and other similar litter cleanup programs. All such sites are recorded as adopted road sites.

At 7.8% (52 of 670) of the survey sites, surveyors noted a sign within two miles of the site indicating that the site was within a designated adopted area. This is over two and one-half times as many adopted sites as in 2001, but is still below the 10-11% range found in each of the four years prior to that.

Figure 3.19 Distribution of Normal Maintenance versus Adopted Sites

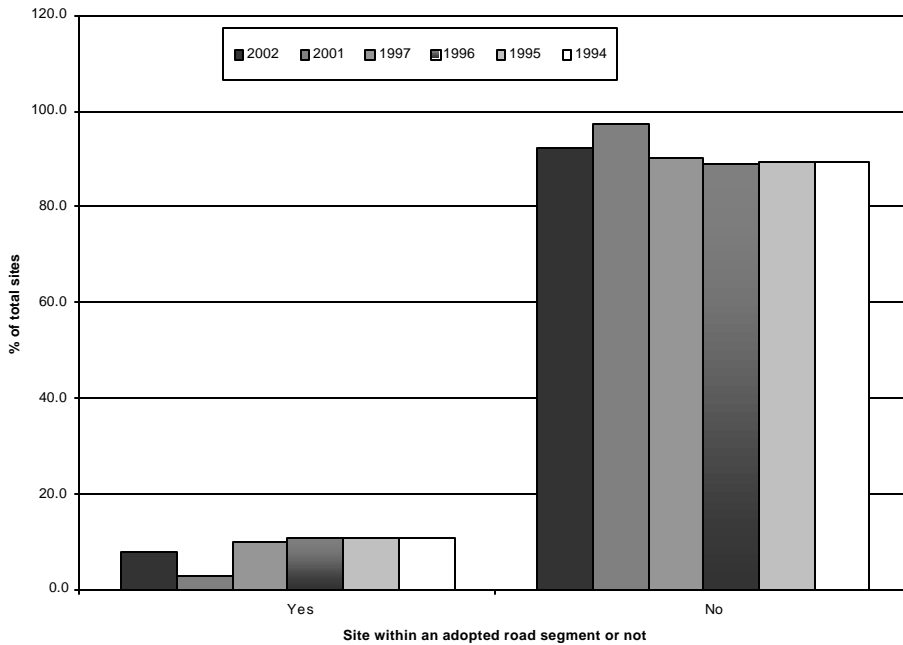


Table 3.19 Distribution of Normal Maintenance versus Adopted Sites

<b>SITE WITHIN AN ADOPTED ROAD SEGMENT?</b>	<b>2002 Number of Sites</b>	<b>2002 % of Total Sites</b>	<b>2001 % of Total Sites</b>	<b>1997 % of Total Sites</b>	<b>1996 % of Total Sites</b>	<b>1995 % of Total Sites</b>	<b>1994 % of Total Sites</b>
Yes	52	7.8	2.8	9.9	11.0	10.8	10.8
No	618	92.2	97.2	90.1	89.0	89.2	89.2

### 3.6.5 Sites Currently Adopted

Beginning in 2001 and again in 2002, researchers recorded whether signage indicated that the site area was "currently" adopted. As described above, state, county, and local governments sponsor volunteer road adoption cleanup programs through their transportation, public works, parks, streets and drains, or other departments, often in cooperation with the local KFB. Each may have slightly different procedures for its programs. Researchers began to notice in past surveys that some road segments with a sign designating them as adopted roads have no attached sign showing the name of a group responsible for that area. Some even have a sign saying "Your Name Here" or "Adopt This Site." These areas are designated but not currently adopted. Litter counts on sites such as these could be expected to be more like the counts on roads where no such program is in place.

Beginning in 2001, the litter survey began collecting data on how many sites in the adopted roads program were currently adopted. Of the 52 sites shown in the table above as occurring within an adopted road segment, 37 also had signs listing the name of the volunteer group responsible for that site as a percent of total sites. This was more than a 100% increase over 2001.

Figure 3.20 Distribution of Sites Currently Adopted

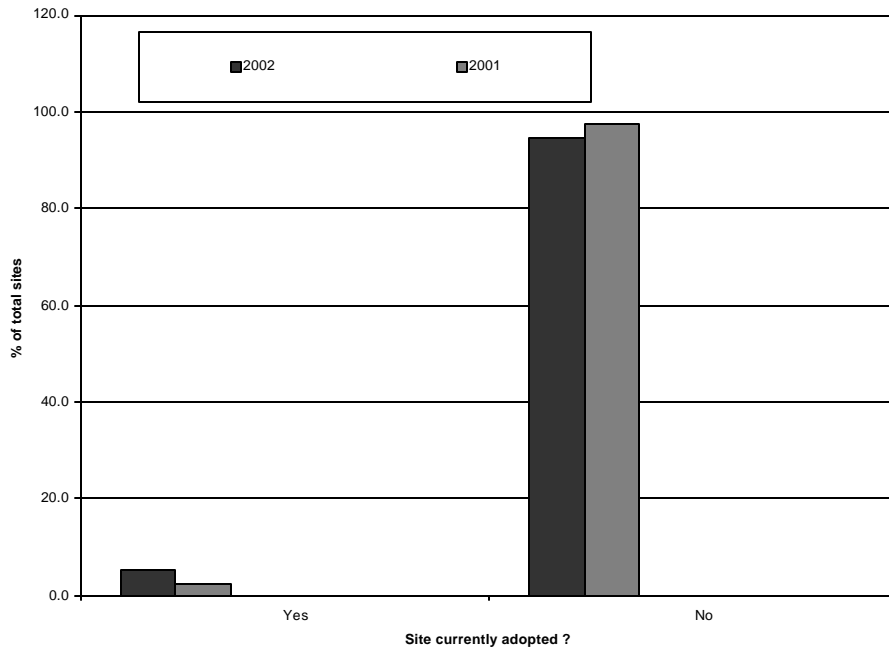


Table 3.20 Distribution of Sites Currently Adopted

<b>SITE CURRENTLY ADOPTED?</b>	<b>2002 Number of Sites</b>	<b>2002 % of Total Sites</b>	<b>2001 % of Total Sites</b>	<b>1997 % of Total Sites</b>	<b>1996 % of Total Sites</b>	<b>1995 % of Total Sites</b>	<b>1994 % of Total Sites</b>
Yes	37	5.5	2.4				
No	633	94.5	97.6				

### 3.6.6 Fast-Food or Convenience Store within One Mile

Sites were classified as to whether they were within one mile of a fast-food or convenience store so that it could be determined whether a significant difference in the amount of litter was found on such sites. Figure 3.21 and Table 3.21 show the number and percentage of these sites. In 2002, 17.3% of the sites surveyed were within one mile of a fast-food or convenience store. This is a slight increase from the previous four years.

Figure 3.21 Distribution of Sites Within One Mile of a Fast-Food or Convenience Store

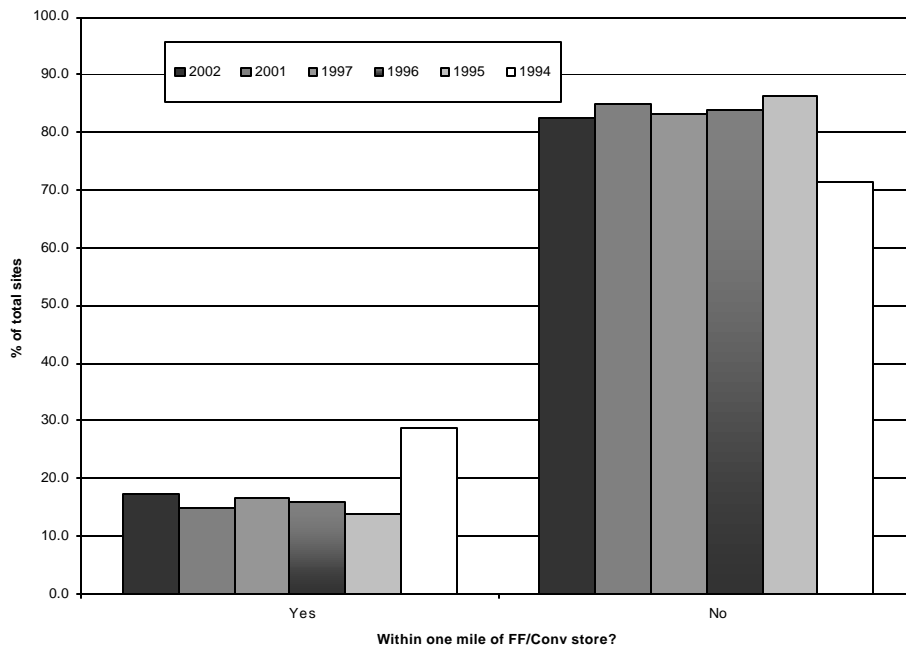


Table 3.21 Distribution of Sites Within One Mile of a Fast-Food or Convenience Store

<b>WITHIN ONE MILE OF FF/CONV STORE?</b>	<b>2002 Number of Sites</b>	<b>2002 % of Total Sites</b>	<b>2001 % of Total Sites</b>	<b>1997 % of Total Sites</b>	<b>1996 % of Total Sites</b>	<b>1995 % of Total Sites</b>	<b>1994 % of Total Sites</b>
Yes	116	17.3	14.9	16.7	16.0	13.7	28.7
No	554	82.7	85.1	83.3	84.0	86.3	71.3

### 3.6.7 Visible Traffic Signal within One Mile

Litter researchers have observed that when traffic comes to a stop, drivers are more likely to litter at that location, especially cigarette butts and packaging and food and drink packaging. Also, litter from trucks tends to dislodge and fly out as vehicles decelerate and accelerate. To test whether the amount of litter was greater in areas near roadway intersections, surveyors recorded whether sites were located within one mile of a visible traffic signal. The 2001 survey had fewer such sites (10% of total), but this year the number increased to nearly 14%, in the middle of the 12-16% range of previous surveys, as shown in Figure 3.22 and Table 3.22.

Figure 3.22 Distribution of Sites within One Mile of a Visible Traffic Signal

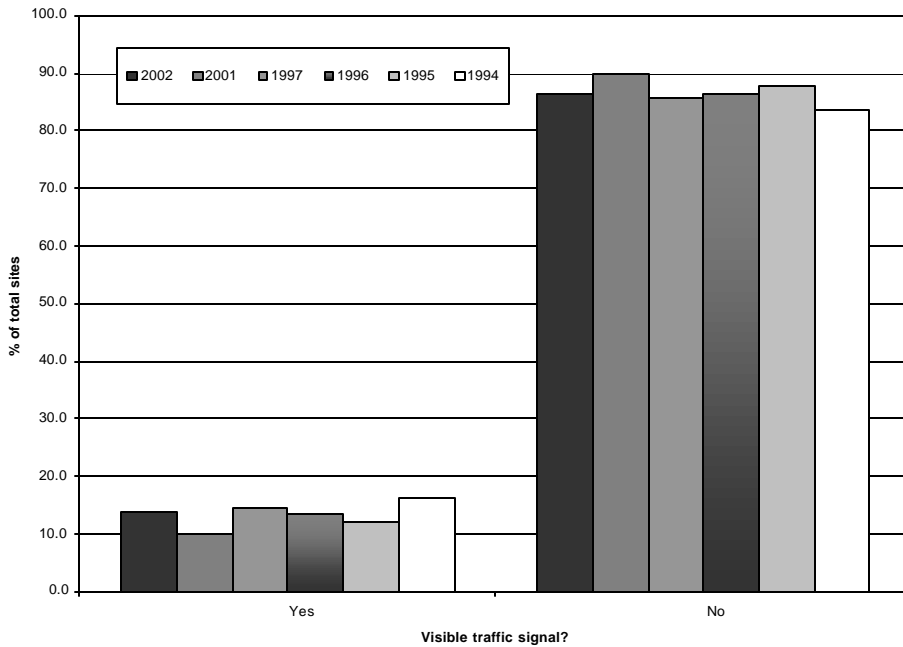


Table 3.22 Distribution of Sites within One Mile of a Visible Traffic Signal

VISIBLE TRAFFIC SIGNAL?	2002 Number of Sites	2002 % of Total Sites	2001 % of Total Sites	1997 % of Total Sites	1996 % of Total Sites	1995 % of Total Sites	1994 % of Total Sites
Yes	92	13.7	10.1	14.5	13.6	12.1	16.4
No	578	86.3	89.9	85.5	86.4	87.9	83.6

### 3.6.8 Grass Height

Figure 3.23 and Table 3.23 present the distribution of sites by grass height. Taller grasses tend to trap and hide more litter while lower grass may indicate frequent mowing and smaller pieces of litter mulched by the mower. Mulched litter decomposes faster but is less identifiable for survey. “Under three inches” also includes roadside areas of dirt, sand, and gravel. Lightweight litter like paper and polystyrene tends to blow off those areas, leaving only heavier items like rubber, glass, etc. In 2002, a little over half the sites had less than three inches of grass, similar to the number of sites in the 3-6 inch category in all previous years. Grasses over six inches have remained fairly constant at 10-15% of the sites in all years to date.



Figure 3.23 Distribution of Sites by Grass Height

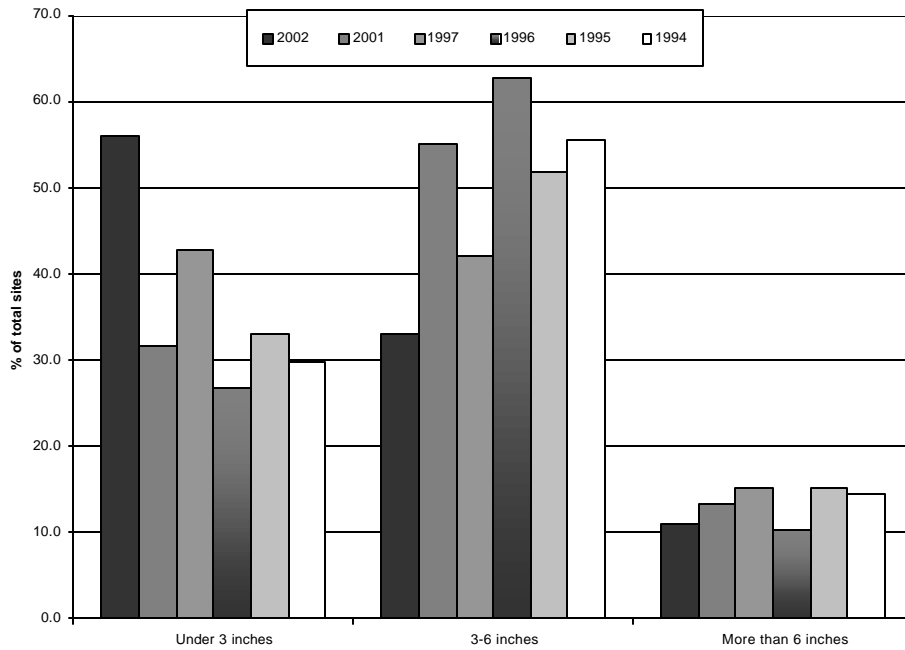


Table 3.23 Distribution of Sites by Grass Height

GRASS HEIGHT	2002 Number of Sites	2002 % of Total Sites	2001 % of Total Sites	1997 % of Total Sites	1996 % of Total Sites	1995 % of Total Sites	1994 % of Total Sites
Under 3 inches	375	56.0	31.6	42.7	26.9	33.0	29.9
3-6 inches	221	33.0	55.1	42.1	62.7	51.9	55.6
More than 6 inches	74	11.0	13.3	15.2	10.4	15.1	14.5

### 3.6.9 Catch Points

The five data classifications for catch points are fence, hedge, mow line, other, and none. Catch points usually apply to variable sites since it is a catch point, private property line, or 40-foot width that defines the outer boundary of such a site. Variable sites account for 50% of the sites in this survey, and just fewer than 50% of the sites this year had some type of catch point.

The other 50% of survey sites are fixed sites that extend to an 18-foot width and normally would not contain a catch point. However, fixed sites could have a recorded catch point if:

1. The fixed site width ends exactly at a catch point, such as a ditch or a mow line, as it often does. The surveyor may then record the designated catch point.
2. There is a ditch located in the site and the surveyor was able to go beyond the ditch with the 18-foot measure. The surveyor may score such a site as "other."

Just over 50% of the 2002 sites had no catch point.

"Other" refers to any catch point not identifiable as a fence, hedge, or mow line: for example, a steep ditch or one containing deep water, a retaining or other type of wall, a planter, a steep bank, the base of a large sign, or even parking stoppers at the edge of a parking lot.

"None" may refer either to variable sites of 40-foot width with no catch points or to fixed sites with no catch points.

There were less than half as many sites having fences as catch points in 2002 compared to 2001, as shown in Figure 3.24 and Table 3.24.

Figure 3.24 Distribution of Sites by Catch Point

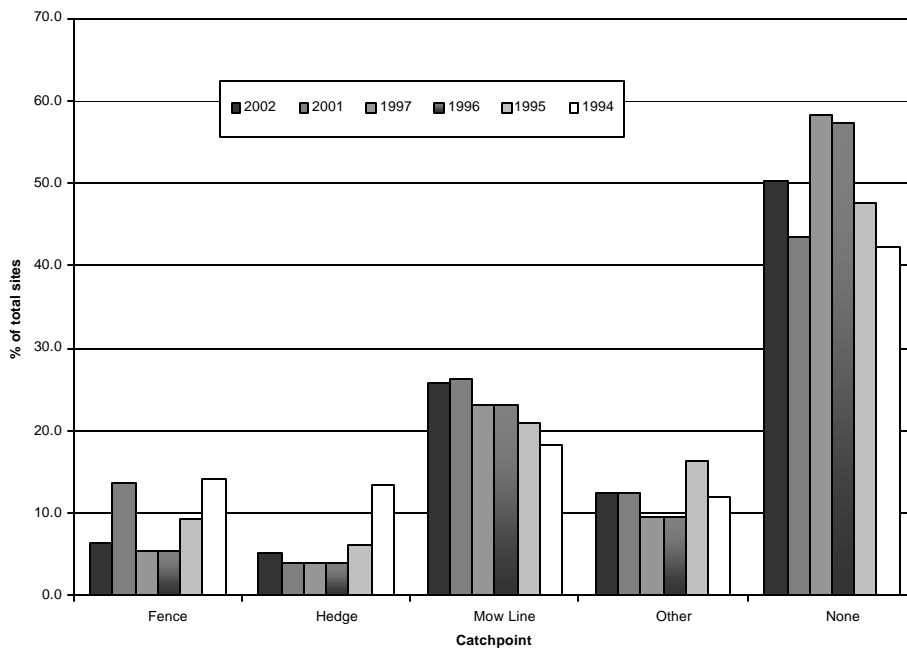


Table 3.24 Distribution of Sites by Catch Point

CATCHPOINT	2002 Number of Sites	2002 % of Total Sites	2001 % of Total Sites	1997 % of Total Sites	1996 % of Total Sites	1995 % of Total Sites	1994 % of Total Sites
Fence	42	6.3	13.6	5.4	5.4	9.3	14.2
Hedge	34	5.1	3.9	3.9	3.9	6.1	13.4
Mow Line	173	25.8	26.4	23.0	23.0	20.9	18.3
Other	83	12.4	12.5	9.5	9.6	16.3	11.9
None	338	50.4	43.6	58.2	57.4	47.5	42.2

### 3.7 VISUAL RATING

Before conducting the count, each site was first rated subjectively by its visual appearance from the vehicle, prior to walking the survey site. The sites were rated from 1 (little or no litter) to 4 (extremely littered/illegal dump). The 2002 survey was the second to include a visual rating of each site.

Figure 3.25 Distribution of Sites by Visual Rating

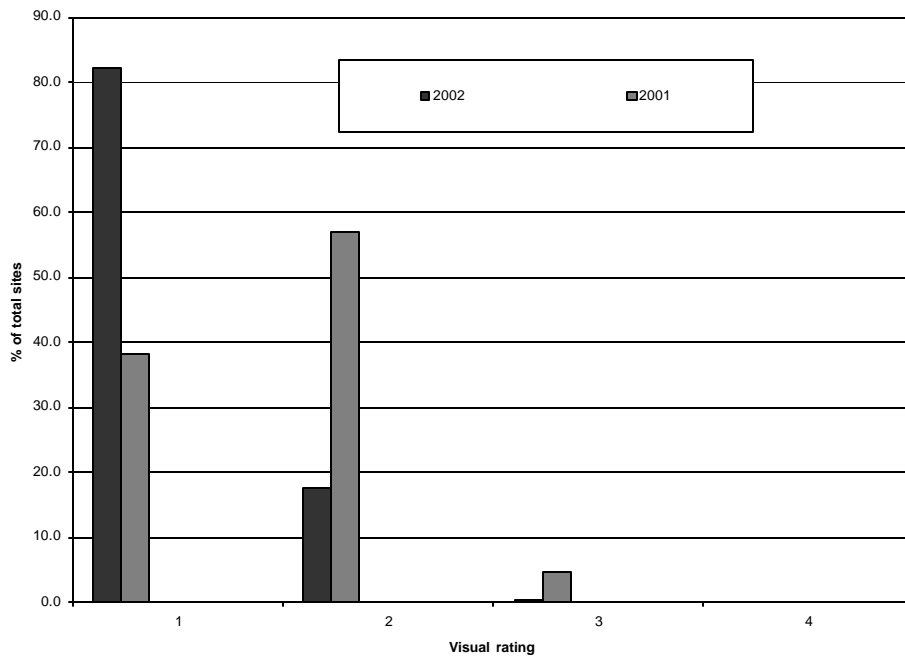


Table 3.25 Distribution of Sites by Visual Rating

VISUAL RATING	2002 Number of Sites	2002 % of Total Sites	2001 % of Total Sites	1997 % of Total Sites	1996 % of Total Sites	1995 % of Total Sites	1994 % of Total Sites
1	550	82.1	38.2				
2	118	17.6	57.0				
3	2	0.3	4.8				
4	0	0.0	0.0				

Over four-fifths of the sites were rated as a 1. This was over twice as many as in 2001. However, there were less than a third as many sites rated "2" as last year and only two were rated "3." None of the sites showed extreme litter or contained illegal dumpsites based upon the visual ratings.



Figure 3.26  
2002 Roadside Litter Survey Site Locations  
(not to scale)

## 4. DATA ANALYSIS

The objectives of the Florida Litter Study are to measure roadside litter levels over time and to identify what types of items and materials become litter. Info Tech, Inc. has analyzed the roadside litter survey data each year to determine the statistical significance of the collected data.

This chapter presents the results of the statistical analysis of the 2002 data, including comparisons of the 2002 data with that of previous years. As in the 1995, 1996, 1997, and 2001 surveys, the Center surveyed 10 sites per county in 2002, providing a total of 670 sites.

The data are analyzed in two ways:

The litter density analysis is equivalent to analyzing the data on a square foot basis. The total area surveyed varies from year to year depending on the widths of the variable-width sites.

The total number of items analysis is equivalent to analyzing the data on a linear foot basis because all the sites are equal in length (200 feet).

To accurately determine any changes and to determine whether the changes were statistically significant, Info Tech, Inc. received the completed database from the Center and imported the collected data into a statistical analysis software program. This enables statisticians to adjust the data to enable comparisons. It can then be determined if the differences seen were due to a difference in the characteristics of the sample sites or to the presence of more or less litter. Adjustments are made for differences in a number of site characteristics, including site type, grass height, adopted roads, proximity to a visible traffic signal, proximity to a fast-food or convenience store, number of lanes, divided highway, and catch point. (For a description of the site characteristics, see Chapter 3). Several other characteristics also were evaluated, including area of the site, whether the site had a fixed or variable width and differences among counties. The differences among counties are significant in all statistical models. These differences attempt to control for features that are not site characteristics, but are more region specific, such as population density.

### 4.1 LARGE LITTER RESULTS

#### 4.1.1 2002 Data Compared to Previous Years

The analysis showed that for large litter items, there was **significantly less total large litter in 2002 than in 1997, but significantly more than in 1995 and 2001, and no significant difference between 1996 and 2002 litter rates.** It should be noted that the two statistical approaches - litter density and total number of items - yielded almost identical results.

All differences are expressed in percentages, since the statistical models are multiplicative (using logarithmic transforms). This transformation is used so that the assumptions necessary to ensure the validity of the statistical analyses are satisfied. The result is that percentage changes in geometric means (rather than absolute differences in arithmetic means) are compared by the statistical models. The comparison of the modeled geometric means

takes into account that a different number of sites were sampled within each level of a site characteristic across years, which is true of a comparison of arithmetic means. That is, arithmetic means estimate a weighted average whose weights are a function of the sample size within each site characteristic and year category. The means from the model estimate unweighted averages, which are not affected by the unbalanced nature of the design. Therefore, the percent difference from previous years will vary with the addition of another year's survey data, and with changes in the model from year-to-year. The following differences are determined after adjusting for all statistically significant site characteristics or effects. Even though the effects are not necessarily the same from survey to survey, as discussed below, there are consistent indicators.

Litter Density: There was an estimated 12% increase from 1995 to 2002, a (non-significant) 7% increase from 1996 to 2002, a 15% decrease from 1997 to 2002, and a 25% increase from 2001 to 2002. A 95% confidence level provides a range within which the "true change" in litter density may fall. The ranges for the 2002 data were:

- |               |   |
|---------------|---|
| 1995 to 2002: | True change ranged from a 4% to 20% increase, for an estimated 12% increase.  |
| 1996 to 2002: | True change ranged from a 2% decrease to 15% increase, for an estimated 7% increase. Although it may be tempting to conclude that an increase is more likely than a reduction because most of the 95% confidence interval indicates an increase, this inference is statistically incorrect. A statistically valid inference requires that the entire interval support that inference (that is, the interval cannot contain zero). |
| 1997 to 2002: | True change ranged from a 5% to 26% decrease, for an estimated 15% decrease.  |
| 2001 to 2002: | True change ranged from an 18% to 31% increase, for an estimated 25% increase.  |

Total Number of Items: There was an estimated 11% increase from 1995 to 2002, a (non-significant) 7% increase from 1996 to 2002, a 14% decrease from 1997 to 2002, and a 24% increase from 2001 to 2002. A 95% confidence level provides a range within which the "true change" in total number of items may fall. The ranges for the 2002 data were:

- |               |   |
|---------------|---|
| 1995 to 2002: | True change ranged from a 4% to 18% increase, for an estimated 11% increase.  |
| 1996 to 2002: | True change ranged from a 2% decrease to a 14% increase, for an estimated 7% increase. This increase was not statistically significant. |
| 1997 to 2002: | True change ranged from a 5% to 24% decrease, for an estimated 14% decrease.  |

2001 to 2002: True change ranged from a 17% to 30% increase, for an estimated 24% increase.

In 1995, the survey recorded a total of 28,526 large litter items, in 1996 the items increased to 32,633, in 1997 they increased even more to 34,794, and in 2001 the total dropped to 27,183 large litter items. In the 2002 survey, a total of 30,317 large litter items were counted, for an increase of 3,134 items from last year's survey.

While there was a decrease in vehicle and tire debris items from 17.43% in 2001 to 14.04% in 2002, it still increased from the 9.89% seen in 1996. If vehicle and tire debris – which when combined form the largest category of litter - are removed from all years, then the percent change for all other items is:

1995 vs. 2002:	Litter density-	9% increase (-1% to 17%).
	Litter count-	9% increase (-0.5% to 16%).
1996 vs. 2002:	Litter density-	3% increase (-11 to 7%)
	Litter count-	2% increase (-10% to 7%)
1997 vs. 2002:	Litter density-	20% decrease (10% to 31%)
	Litter count-	19% decrease (9% to 30%)
2001 vs. 2002:	Litter density-	26% increase (19% to 33%).
	Litter count-	25% increase (18% to 31%).

(The numbers in parenthesis are 95% confidence intervals; this convention will be followed throughout this chapter.)

The change from 1995 to 2002 is no longer statistically significant, with an increase of 9% when vehicle and tire debris items are removed from the calculations, compared to 11%-12% when all items are included.

#### 4.1.2 Significant Effects for Large Litter Items

The effects of various site characteristics were evaluated to determine their relationship to the amount of large litter on survey sites. Analyses were performed for both litter density and total number of items. In 2002, the significant site characteristics indicated by the data were site area, county, site type, grass height, and number of lanes:

- **Site Type:** The mean litter amount for rural sites was significantly greater than for urban or residential sites. The rural sites had 55% (23% to 96%) more litter per site than urban sites and 56% (22% to 101%) more litter density; rural sites also had 29% (9% to 53%) more litter per site than residential sites and 29% (7% to 54%) more litter density. The majority of the sites were rural at 67%, 12% were urban, 20% were residential, and only 1% was industrial.
- **Grass Height:** The mean litter amount increased as grass height increased. The sites with a grass height less than three inches had an estimated 39% (27% to 49%) less litter per

site than sites with a grass height between three and six inches, and 39% (26% to 50%) less litter density. The sites with a grass height less than three inches also had an estimated 41% (22% to 55%) less litter per site than sites with a grass height greater than six inches, and 42% (22% to 57%) less litter density. Over half the sites, had a grass height of less than 3 inches at 56%, 33% had a grass height between 3 inches and 6 inches, and 11% had a grass height of over 6 inches.

- Number of Lanes: This year, the number of lanes showed a significant relationship to the amount of large litter instead of the divided highway effect being significant. The number of lanes effect was also significant in the 1994-1996 surveys. This is expected, since the two effects are highly correlated, i.e., the greater the number of lanes then the greater the chance that the highway will be divided. The mean amount of litter increased as the number of lanes increased. This year, there were no eight-lane roads sampled, so the comparisons are limited to two-, four-, and six-lane roads. The majority of the sites were two-lane roads (81%), followed by four-lane roads (16%), and then six-lane roads (3%). The sites on two-lane roads had an estimated 42% (12% to 62%) less litter per site than sites on six-lane roads, and 45% (14% to 65%) less litter density.

Other characteristics worth discussing are adopted sites, site location with regard to fast-food/convenience store or traffic signal, and site area (square footage). While sites on adopted roads had less large litter, the difference was not statistically significant. This is because the number of adopted sites (8%) is too small to show a significant effect.

Two site characteristics, proximity to a fast-food or convenience store and proximity to a visible traffic signal, were not significant effects for large litter in any of the previous survey years, and they also were not significant for 2002. Also in 2002, the mean density of litter decreased as the area of the site increased, but the total number of litter pieces per site increased as the area increased.

Further survey of site characteristics across years revealed the same significant effects as in the prior year's analysis. For example, it is still true that the sites surveyed in 2001 with a grass height of less than 3 inches had significantly less litter amounts than almost all other height classifications in other years. Likewise, the residential sites also had significantly less litter in year 2001 than other site type classifications and significantly less than almost all other site type classifications in other years.

Table 4.1 summarizes the statistically significant effects for large litter 1994–2002.



Table 4.1 Significant Effects for Large Litter, 1994 - 2002

Effects	2002	2001	1997	1996	1995	1994
County	X	X	X	X	X	X
Area	X	X	X	X	X	X
Number of Lanes	X			*	X	X
Grass Height	X	X	X	X	X	X
Adopted Roads				X	X	
Catch Point		X		*	X	
Site Type	X	X	X			
Divided Highway		X	X			
Traffic Signal						
Fast-Food/Convenience						

X = Statistically significant.

\* = Borderline statistical significance.

#### 4.1.3 2002 Large Litter Count Compared to Visual Rating

In addition to the litter survey, a visual appearance rating also was scored for the 2002 survey. On a four point scale, with a one (1) being a clean site and a four (4) being the most littered site possible, 82% were scored a one, 18% were scored a two, and only 0.3% were scored a three (two sites). No sites were scored a category four. This year there was over double the number of sites that scored a one compared to the 2001 survey, even though the amount of large litter increased from last year. The trend of increasing litter amounts with an increase in the visual rating score was statistically significant, as it was in 2001. The sites with a score of one had 50% (40% to 58%) less litter per site than sites with a score of two and 49% (39% to 58%) less litter density.

## 4.2 SMALL LITTER RESULTS

### 4.2.1 2002 Data Compared to Previous Years

The analysis showed that for small litter items, there was **significantly less litter in 2002 than in the last three survey years, 1996, 1997, and 2001, and a non-significant change from the 1995 survey year.** As with large litter, the two statistical approaches - litter density and total number of items - yielded almost identical results.

Litter Density: There was an estimated significant 19% decrease from 1996 to 2002, 56% decrease from 1997 to 2002, and 37% decrease from 2001 to 2002. There was a non-significant increase of 5% from 1995 to 2002. A 95% confidence interval provides the following ranges of "true change":

1995 to 2002: True change ranged from a 4% decrease to 14% increase, with an estimated increase of 5%. This change was not statistically significant.

1996 to 2002:	True change ranged from an 8% to 31% decrease, with an estimated decrease of 19%.
1997 to 2002:	True change ranged from a 41% to 72% decrease, with an estimated decrease of 56%.
2001 to 2002:	True change ranged from a 24% to 51% decrease, with an estimated decrease of 37%.

Total Number of Items: There was an estimated 20% decrease from 1996 to 2002, a 51% decrease from 1997 to 2002, and a 33% decrease from 2001 to 2002. There was a non-significant increase from 1995 to 2002 of 5%.

1995 to 2002:	True change ranged from a 4% decrease to 13% increase, for an estimated increase of 5%. The change was not statistically significant.
1996 to 2002:	True change ranged from a 10% to 31% decrease, for an estimated decrease of 20%.
1997 to 2002:	True change ranged from a 38% to 65% decrease, for an estimated decrease of 51%.
2001 to 2002:	True change ranged from a 22% to 46% decrease, for an estimated decrease of 33%.

#### **4.2.2 Significant Effects for Small Litter Items**

The effects of various site characteristics were evaluated to determine their relationship with the amount of small litter on the site. Analyses were performed for both litter density and total number of items.

In 2002, the characteristics for which significant differences were found were county, number of lanes, site type, and presence of traffic signal.

Number of Lanes: The mean litter amount increased as the number of lanes increased. The mean litter amount for sites on two-lane roads was significantly less than sites on four- or six-lane roads. The sites on two-lane roads had an estimated 56% (32% to 72%) less litter per site than sites on six-lane roads, and 58% (31% to 74%) less litter density. The sites on two-lanes roads also had an estimated 23% (5% to 38%) less litter per site than on four-lane roads, and 26% (7% to 42%) less litter density.

Site Type: The mean litter amount for rural sites was less than for urban sites. The rural sites had 32% (11% to 47%) less litter per site than urban sites, and 43% (25% to 57%) less litter density.

Traffic Signal: The mean litter amount within the visibility of a traffic signal was greater than that outside the visibility of a traffic signal. The presence of a traffic signal

increases the mean items per site by an estimated 32% (14% to 47%) and the mean litter density by an estimated 29% (8% to 46%). Only 14% of the sites were within visibility of a traffic signal.

The catch point, divided highway, and adopted road effects were not significant effects in any of the survey years.

Table 4.2 summarizes the statistically significant effects for small litter for 1994 – 2002.

Table 4.2 Significant Effects for Small Litter, 1994 - 2002

Effects	2002	2001	1997	1996	1995	1994
County	X	X	X	X	X	X
Number of Lanes	X	X	X	X	X	X
Grass Height			X		X	
Traffic Signal	X		X	X	X	X
Fast-Food/Convenience		X	*		X	X
Site Type	X	X	X	X		
Catch Point						
Divided Highway						
Adopted Road						

X = Statistically significant.

\* = Borderline statistical significance.

### 4.3 VARIABILITY

In 1994, the statistical analysis revealed a data variability of  $\pm 15\%$ . Project statisticians advised the Center that an increase in the number of sites surveyed would likely reduce the variability. The Center increased the number of survey sites from 268 (four per county) in 1994 to 670 (10 per county) in 1995.

As predicted, the variability decreased to approximately 11%. Increasing the number of sites beyond 670 may have resulted in an even lower variability; however, the Center determined that doing so would not be cost effective, and  $\pm 11\%$  was considered an acceptable level of variability.

In 1996, 1997, 2001, and 2002 the Center continued to survey 670 sites each year. The variability remained in the range of 9-10% in 1996 and 1997 but improved slightly in 2001 and 2002 to the 8.5-9% range.

## 5. DISCUSSION

One measure of the success of a society in properly disposing of solid waste is the nature and amount of solid waste that escapes or avoids the structured mechanisms of public services designed to dispose of it properly. This solid waste can then be found collected, dumped, and strewn across the countryside. In small amounts it is called litter and in larger amounts it is called dumping. The effects of improper waste handling and disposal range from unsightly landscapes to health and environmental dangers to trashy and neglected real estate that permits the incubation of crime, social disorder, and urban decay. Florida has been at the forefront in developing and maintaining complex and costly systems for collecting, sorting, processing, and disposing of solid waste. Public roadways criss-cross the state in a web that provides avenues of transport for people and products. These roadways quite literally pass by the front porch of nearly every home, factory, and shop in the state. Sampling the amount and types of litter on roadside right-of-ways is a reasonable and practical method of discovering how much and what types of waste have fallen by the wayside.

Litter has been defined as misplaced solid waste. It is composed of numerous items in the solid waste stream that are the products of human production and consumption activities. This study has categorized litter into large and small litter. Large litter has been subdivided into 73 categories of usage and material type. For analysis and discussion, those 73 categories have been grouped into seven categories by material type and eight categories by usage. Two categories, vehicle debris and tire pieces, are counted separately but are discussed here as a single unit. Small litter has been subdivided into 14 subcategories. Materials associated with the roadway such as pavement pieces, lane markers, sign pieces, erosion control netting, and so forth, are not counted in this study. Also not counted are natural, organic materials that have not been shaped into useful products. Some examples of these are tree limbs, landscape clippings, animal carcasses, agricultural products, food products, etc.

This chapter presents a discussion of the results of the 2002 data by examining trends in the data in the context of other qualitative and anecdotal information gathered by the researchers in the course of conducting this study, participating in state and national forums and partnerships, discussions with solid waste experts, reviewing literature, and observing litter as an environmental issue.

### 5.1 LITTER TRENDS: 2002

In surveys conducted in 1995 and 1996, the amount of large litter on Florida's roadsides remained fairly stable. The 1997 survey showed a statistically significant increase in the amount of large litter. From 1997 to 2001 there was a 15% decrease and a 25% increase from 2001 to 2002. (See Figure 3.1, p. 19.)

As was noted in the report on the 2001 Litter Survey, these increases and decreases have not been adjusted for other factors such as population growth, tourism rates, or traffic counts. Any of those could reasonably be expected to affect the amount of litter on roadsides. Table 5.1 shows population growth estimates for 1995 to 2001. Estimates for 2002 were not available at the time of this report.

Table 5.1 Population Growth Estimates: 1995-2001

	<b>2001</b>	<b>1997</b>	<b>1996</b>	<b>1995</b>
<b>Population</b>	<b>16,331,739</b>	<b>14,938,576</b>	<b>14,623,650</b>	<b>14,336,174</b>

The table below offers a comparison of the raw numbers of large and small litter pieces counted in each study year-to-date. Again, these numbers are the raw data prior to analyses and no statistical significance should be attributed to the increases or decreases shown.

Table 5.2 Totals of Large and Small Litter: 1995 – 2002

	<b>2002</b>	<b>2001</b>	<b>1997</b>	<b>1996</b>	<b>1995</b>
Large Litter Counts	30,317	27,183	34,794	32,633	28,526
Small Litter Counts	7,783	9,814	11,241	9,414	6,913
<b>Total Counts</b>	<b>38,100</b>	<b>36,997</b>	<b>46,035</b>	<b>42,047</b>	<b>35,439</b>

In 2002, the large litter count was up to 30,317 from 27,183 in 2001. Small litter was down from 9,814 pieces in 2001 to 7,783 pieces in 2002.

### **5.1.1 Large Litter Rankings: The Top Ten**

The vehicle and tire debris category has been the highest ranked every year but 1994. Perhaps this is because, as litter items, these are most closely connected to use on the roadway and therefore the most likely items to fail to make it into proper disposal channels. For that reason, in 2001 and again this year researchers on this study asked statisticians to remove this category and separately analyze the change in all of the rest of the litter.

Construction debris and miscellaneous plastic moved up to the highest level in all years. One hypothesis is that the building industry has grown with the population and with increased economic activity. Therefore, the transport of construction and demolition materials has increased, along with some associated loss of those materials during transport.

Miscellaneous paper, snack packages, beer cans, miscellaneous plastic film, and towels/napkins are down from levels found in most previous years. Cigarette/cigar packages and home items have remained fairly constant.

### **5.1.2 Large Litter by Materials**

Glass, paper, and steel-product litter is at some of the lowest levels ever while plastic and mixed material litter is at the highest level ever. Overall, it appears that there is more large litter made of plastic, aluminum, and paper.

### **5.1.3 Large Litter by Usage**

The eight major categories of usage are listed in Chapter 3, Section 3.4. One of these, debris, includes construction, vehicle, tire, and home-item debris. Over one-fourth of all large litter is in this usage category. Vehicle and tire debris has always been found in large amounts. Since those items are ones whose use is associated with roadways, that is not surprising. As discussed below in Section 5.3, Sources and Causes of Litter, there is some evidence that both construction debris and home items are spilled frequently during transport in uncovered trucks. Miscellaneous litter, that which could not be identified according to any of the other use categories, was at its highest level since the first year of the studies. The non-beverage container category, while low as an overall percentage of large litter, was at its highest level ever.

Take-out food, beverage containers, and outer packaging litter were at their lowest levels of all study years. In the outer packaging category, plastic other bags and plastic retail bags were down from all other years. This was surprising because anecdotal observations suggest that plastic retail bags are seen frequently blowing around city streets and commercial areas. One possible explanation for this year's low count of these items may be that there were quite a few windy survey days and the bags may have blown off the roadside and to catch points beyond the survey sites. Surveyors would often observe plastic retail bags in tree branches or weeds past the survey area.

In the printed paper category, lottery tickets were at the lowest level since the first year of the study. This may seem surprising as the Florida Lottery indicates that ticket sales are at the highest level ever. However, in the last few years lottery retailers have been able to print up to five tickets on one slip of paper. That practice may have reduced the total number of pieces littered.

### **5.1.4 Small Litter**

In the Center's pilot studies, cigarette butts were the most numerous single small litter item. This ranking has remained constant through all six surveys.

Most of the "small" litter items identified in the survey are broken or mulched pieces of "large" litter. For example, eight of the study's 14 small litter categories (pieces of glass, paper, hard plastic, aluminum and other metal, rubber, polystyrene foam, and plastic film) together accounted for between 60% and 70% of all small litter items in every previous survey and remained constant this year at 67.60%. Cigarette butts accounted for 24%-33% of small litter items in each previous survey and this year were at the low end of that range at 25.92%. The other "whole" small litter items - bottle caps, candy wrappers, polystyrene foam peanuts, and straws - together accounted for 3.03% of small litter items.

### 5.1.5 Site Characteristics

There were over two-and-a-half times as many residential area sites in this year's study when compared to last year and most previous years. This could be due to population growth. Researchers generally find lower litter counts in residential areas, and this held true with rural sites showing 29% more litter per site than residential sites. Therefore, with a large increase in residential sites, it is surprising that the large litter count increased rather than decreased this year.

Adopted-road programs are active in every part of the state and are considered a key element of litter reduction. These volunteer-based programs are administered through partnerships between local KFB organizations and the city, county, or state authority responsible for the highway. Besides assisting with roadside cleanup, the signs and advertising for these programs help to raise public awareness of anti-litter efforts. Adopted road segments showed a third less litter per site in 1995 and a fifth less litter in 1996, but no significant difference in 1997, 2001, and again this year. This is likely due to the small percentage of adopted sites in the study sample. Just under 8% of the sites in this year's study were adopted, less than the average 10% in most previous years but considerably more than last year. These sites had less large litter but the difference was not statistically significant. Though there were more adopted sites in this year's sample than last year's, a lower percentage of them were currently adopted. This year only 71% of designated adopted road sites were currently adopted as compared to 84% last year.

The hypothesis that there would be more litter near fast-food/convenience stores and traffic signals has not held true in any of the survey years, including 2002, concerning large litter. However, both of those site characteristics have sometimes been significant factors for small litter. There were more sites this year near both traffic signals and fast-food/convenience stores and there was significantly more small litter on those sites near traffic signals but not fast-food/convenience stores. In every year but 2001, there has been more small litter on sites near traffic signals. Since the most abundant small litter item is cigarette butts, the study gives scientific validity to the frequent observation that cigarette butts collect more readily around and near intersections with traffic lights.

It would appear that either growing conditions or mowing patterns were different in 2002. Over one-half of the sites had less than three inches of grass, a number more similar to the 3-6 inch category in all previous years. Even though both grass height and small litter amounts were down from previous years, the two factors are apparently unrelated. The amount of small litter was unrelated to grass height in 2002 and all but two of the previous years. However, the amount of large litter found on a site has always increased as grass height increased and that trend continued this year.

By definition, fixed sites are almost predetermined to have no catch point. Because half of the sites are fixed sites, the data have shown that, in past surveys, between 42% and 58% do not have catch points. This year there were 50.4% with none. Sites with a mow-line catch point were in the 18% to 26% range and this year made up 25.8% of the sites. There were only half as many sites as normal with a fence catch point this year. This is perhaps understandable when considered in tandem with this year's site-type findings. There were fewer rural, urban/business,

and industrial sites this year, and each of those land uses is more likely to utilize fencing than residential areas.

The surveyors rejected some possible random sites in the field when they discovered that certain site characteristics did not meet survey methodology criteria. For example, sites within one mile of a landfill entrance were rejected as not representative of roadside litter conditions. Prior investigation has shown that roads leading to landfills are more heavily littered than others because trucks hauling solid waste tend to spill some as they approach and leave the landfill. Approximately five or ten sites were rejected during this survey for that reason.

## **5.2 ALTERNATIVE LITTER ASSESSMENT: VISUAL RATING**

The Center included a visual rating as part of this roadside survey in order to determine if a significant relationship occurred between the number of pieces of litter on the site and the visual rating number assigned. The visual rating system, though less precise, has certain advantages over the roadside litter survey method and other measurement techniques. The primary advantages are the ease of conducting and scoring the measurement and the associated reduced cost. Also, since a similar visual scoring system is being used by KAB both in Florida and throughout the nation, it is helpful for validation purposes to compare the ratings given to a site to the actual litter count on the site.

The visual rating is a system of describing the amount of perceptible litter without, or in this case before, actually counting the litter. It does not classify or categorize the litter and by nature only takes into consideration litter large enough to be seen from a distance. A score of one to four is assigned based upon the amount of litter seen. A score of 1 is very clean and 4 is very littered. Center researchers studied and reported on this type of system in the 1999-2000 research year as part of work done in an advisory role for the KAB organization. KAB developed a visual rating system for use by its local organizations to track community progress in litter cleanup.

The 2002 results indicate that the amount of litter statistically increased as the visual scores increased from a 1 rating to a 2 rating. There was about 50% more litter on sites rated a 2 than on sites rated a 1. A large majority (82%) of the sites were rated a 1, only two sites rated a 3, and none rated a 4. Therefore, it was not possible to evaluate statistical significance beyond the ratings of 1 and 2 for this survey. In short, this survey sample shows a positive correlation between the visual rating of a site by a trained observer and the actual counted pieces of large litter on the site, but only for the sites with small amounts of litter.

Researchers have no data to explain the seemingly contradictory results that indicate more than twice as many sites in 2002 were rated a 1 as in 2001 while the overall large litter count increased this year. Perhaps the sites that appeared clean had higher counts this year than last or the ones that appeared more littered had much more litter than the sites given the same rating last year.



### **5.3 SOURCES AND CAUSES OF LITTER**

Prior research suggests that litter can be attributed to many sources and can be either intentional or accidental. Accidental litter can occur through thoughtlessness, carelessness, or inattention.

Motorists and pedestrians are believed to account for less than half of all litter. The rest is generated mostly from points where materials are unpacked, assembled, disassembled, transferred from containers, or transported, and also where solid waste is stored or collected.

Examples are:

- residential trash setouts and pickup practices
- commercial refuse storage areas (dumpsters)
- commercial shipping and receiving points (loading docks)
- construction and demolition sites
- trucks with uncovered loads

Additional sources of litter include special events that draw crowds to a particular area for a limited amount of time.

Center researchers have considered alternate methods of conducting further research on sources of litter. In 2000, researchers explored ways to gather data on litter generated by residential trash setouts and pickup practices, uncovered trucks, and at a special event through a perception/opinion survey. Further development of research methods and pilot studies would be needed before researchers could test the theories below.

#### **5.3.1 Residential Trash Setouts and Pickup Practices**

In 1999, a Center researcher conducted a pilot study of neighborhood litter to determine how much and what type of litter was generated by recycling and automated solid waste collection. The neighborhood selected had 102 single-family residences and one main entrance/exit (no through traffic). Three surveys were conducted on the weekly collection day for 15 weeks. All litter on the right-of-way was picked up before the first collection (solid waste), after that collection, and again after the recycling pickup. In this way, the litter generated after each pickup could be analyzed for composition. Litter from each solid waste collection survey ranged from 2 pieces to 16 pieces with a mean of 7.2. Counts for the recycling survey ranged from 7 pieces to 42 pieces with a mean of 18.87. The most numerous items were paper (40%), packaging (11%), other (11%), beverage (9%), bags (9%), and cups (8%). An undetermined amount of litter could have been dropped by residents or others traveling through the study area between pickups. Otherwise, it appeared that the collection procedure itself generated some litter.

Using the experience gained from the 1999 pilot study of spillage-generated residential litter, researchers in 2001 experimented with alternative methods of examining spilled litter. The thesis was that observation of trucks doing pickups in different types of neighborhood settings would show the frequency of litter spillage. By directly observing the collection process, the amount of spillage could be accurately recorded because there would be no intervening variable, such as litter from other sources.

The methodology used was to follow an automated solid waste truck through residential neighborhoods and observe and record whether spillage occurred. Additional circumstances of the spillage were also recorded: weather, container overfilled (lid not completely closed or waste on top of container), bag spilled, loose litter spilled, and whether the driver picked up spillage. Fifty residential pickups using several different types of trucks were observed in each of five different neighborhoods during five field data collection trips. The primary truck in use during these observations had a pincer-type mechanical arm that dumped one can at a time in the top of the truck. A second, older type of truck was used as a backup to out-of-service trucks. This type used a mechanical arm to dump each can into a hopper, roughly the size of a small dumpster, at the front of the truck. The hopper was then periodically raised over the cab and inverted so that the contents fell into an opening in the top of the truck body. This operation was necessary roughly once in every city block. Collection managers pointed out that the volume and height of this step causes more spillage, especially on windy days or when the load is composed of mostly light, loose material.

The goal of these experiments was to discover how to study the problem, so the observations that were made are informational and anecdotal. Mechanical pickup using the newer type of trucks appears to generate some litter but this is minimal when residents and collection drivers follow proper procedures. Most spillage appeared to occur when cans were overfilled. Residents who follow the proper setout procedures can reduce or eliminate most litter associated with pickup. That is, overfilled containers, unbagged waste, and waste outside of the containers likely contribute to neighborhood litter more than the pickup process itself. Collection procedures require drivers to pick up spillage and in these observations drivers almost always picked up spills. However, this may have been influenced by the fact that drivers were aware they were being observed by researchers and it can be assumed this increased their diligence. (Interviews with one or two residents indicated that drivers don't usually pick up spillage.) Local solid waste managers who were interviewed believed that overfilled containers and unbagged contents are the main contributors to spillage with truck design and operator skill as secondary factors.

### **5.3.2 Trucks With Uncovered Loads**

Another source of litter, particularly along roadways, is from uncovered loads. Center researchers reasoned that observations of trucks hauling loads to or from collection points at highway speeds would produce data on the extent to which open loads contribute to highway litter. The trial design was to observe a section of highway within one mile of a household waste collection center or a solid waste transfer facility for a period of one hour or until the passage of fifty trucks was recorded. The observation point selected was to be such that it would provide a clear view of the entrance/exit and still allowed the observer to see approaching trucks while they were still at highway speed. The following information was recorded:

- a. Date, time beginning and ending, day, speed limit, weather, location
- b. Observation number and time
- c. Vehicle type (pickup, trailer, dump, waste, van, recycle, semi)
- d. Closed or covered
- e. Overfilled

- f. In or out of facility
- g. Litter spilled
- h. Comments and surveyor

Two observations were first conducted at the solid waste transfer station, followed by two observations at two different collection centers where the operators also were interviewed. About 50 trucks came and went from the transfer station in an observation hour. Most were commercial waste haulers coming from town or tractor-trailer transfer trucks going to and from the landfill. Almost all trucks were covered and only two pieces of spilled litter were seen in 92 observations. It was difficult to see if top-loading waste trucks were closed or covered. Trucks leaving the transfer station with the beds open were responsible for the two pieces spilled. This is consistent with the finding that the roadside leading to the transfer station from town appeared much less littered than the other side of the divided highway leading away and into town. Commercial haulers seem to be covering their loads or using trucks designed not to spill waste. Small, light pieces of litter came from open designs, but infrequently. The transfer station manager believed that most commercial haulers cover their loads while “mom and pop” haulers and individuals are less likely to do so. It would appear that laws requiring commercial haulers to cover their loads are effective.

Only a few trucks passed the observers at the two household waste collection centers visited and none were overfilled or spilling litter. The site operators said that most residents stop there in the morning on their way to work or on Sunday afternoon. Both sides of the two lane, rural roadway near one collection station had a fairly significant amount of “normal” litter (not predominantly large bags or pieces). However, the station located on a four-lane, divided highway had approaches that looked very clean overall. Household waste drop-off sites may receive more overfilled and uncovered trucks susceptible to spillage than transfer stations visited primarily by commercial haulers, but not enough data was collected to test this theory. However, when considering private, uncovered vehicle loads, it is reasonable that most spillage occurs when the vehicle first reaches highway speed, after leaving the point of origin and before the load approaches the drop-off point.

### **5.3.3 Perception/Opinion Survey and Special Events**

An interesting aspect of the sources of litter is the behavioral component of littering, especially of intentional littering. Center researchers reviewed numerous psychological and sociological studies of littering behavior as part of the 1997-1998 and 1998-1999 Florida Litter Study. Studies have shown that the attitudes and behaviors involved in littering are complex but are amenable to change. Some proposals to effect changes in littering behavior are outlined in the following section of this report.

Perception and opinion surveys can be used to discover the attitudes and behaviors involved in littering, but are limited somewhat by the extent to which interviewees are candid in their responses. Rob Curnow, an Australian psychologist who has conducted numerous studies on littering behavior and litter programs, paired interviews with observations to test litterers' responses to questions about littering against their observed littering behavior.

Another aspect of the sources of litter and of littering behavior is the extent to which people litter in crowds at special events. People seem more likely to litter when they are at a special event like a parade, concert, or sports event. This is especially true when the crowd is large. This is possibly one of the reasons Curnow also studied littering behavior at the 2000 Olympics in Sydney, Australia.

In order to gain a first hand look at this phenomenon and to learn how organizers manage the litter and waste at such an event, Center researchers visited the Sunfest in West Palm Beach in 1999. There they conferred with the organizers, including solid waste department representatives who participated in organizing and running the multi-day event. Sunfest is an outdoor event centered around a series of concerts in a downtown area. Cooperation between the solid waste authority and all others concerned with this event has produced a number of sound practices that contribute substantially to the recycling and disposal of waste generated by the event. Nonetheless, food and drink containers and other litter covered the areas in front of concert stages following the concerts.

In 2000, Center researchers considered the use of a perception/opinion survey to gather data on public perceptions regarding litter and ran a trial of a test survey at a local special event that annually draws a large crowd - the University of Florida homecoming parade. The study thesis was that useful information can be obtained by a survey of the public concerning their perceptions of the who, what, when, where, and why of littering. Also, responses to such a survey could give some insight into littering behavior in Florida. This information would be of interest to policy makers engaged in deciding how to allocate limited public funds and to groups like KAB and its affiliates when they decide where to target their public information and education efforts.

The University of Florida homecoming parade is a special event that presented an opportunity to conduct in-person, sidewalk interviews for a crowd survey. It was postulated that people watching a parade would be more relaxed than when shopping or on errands, which are the usual activities when sidewalk interviews are conducted. Therefore, they may be more receptive to participating in a survey. Also, the event and the surrounding activities typically produce high litter levels due to the crowd, food and drink vending on the streets, etc.

A short questionnaire was constructed to record information concerning the date, day, and location of the survey and the sex, race, age, and education of the respondent. Ten questions were asked about who litters and why, where they have seen litter, from where they think it comes, is litter an important environmental issue, have they ever littered, and what did they litter. Potential respondents of different ages, sexes, and races were approached with the survey as they stood along the parade route. Each survey took about five to ten minutes. Eleven surveys were completed in about two hours. Many refused to participate, making it difficult to get a large number of responses. A random method of selecting interviewees was needed. Respondents seemed most likely to participate in the survey when they identified most with the interviewer. A survey by phone would be more efficient in time spent and would eliminate some of both interviewer and interviewee bias by making the interview more anonymous.

Respondents were split between thinking that young males litter the most to “anyone.” Most indicated that they were bothered by fast-food packaging and cigarette butts on streets and sidewalks. All thought that littering is deliberate rather than accidental and that it is an important environmental issue. Almost all had littered “when they were young.” The limited results of this trial survey are interesting but such a survey requires careful piloting of the questions, random selection of respondents, and all of the other conventions of a valid survey. Future surveys could produce interesting information on littering in crowds and at special events.

## **5.4 SOLUTIONS: WHAT HAS WORKED?**

Previous Center reports discussed factors that may affect the quantity and composition of litter along Florida's roadsides. Much is already known about what is effective in reducing litter. Programs that have proven effective in the past are educational programs, adopted road programs and other organized volunteer cleanups, publicly funded maintenance activities, recycling, and enforcement activities.

### **5.4.1 Education**

Beginning in 1994, KFB received grants from FDEP to fund statewide public education and awareness programs in Florida. The first such program provided public education concerning litter prevention, the second, in 1995, encouraged recycling, and the third, in 1997, promoted environmental awareness. Much of that funding was directed to activities such as development of local KFB educational programs rather than the more costly mass media blitzes. During that same period, the Florida litter surveys indicated that litter counts, unadjusted for population growth, either stayed the same or increased. Following the 1997 roadside survey, policy makers in the FDEP requested more research on effective anti-litter programs elsewhere and on the behavioral aspects of littering.

In the 1997-1998 research year, the Center surveyed other states to review their litter laws and to identify effective litter management programs and their costs. The Center also examined research concerning the reasons for littering behavior and effective methods of changing such behavior. Research indicated that the most effective programs had promoted education by utilizing public information spots in the mass media, programs in schools, and well-publicized volunteer cleanups. Public education and awareness campaigns have been effective at reducing littering in Texas, Oklahoma, Indiana, Ohio, Idaho, and Pennsylvania in particular. The public appeared to respond to mass media promotions using catchy anti-litter slogans and memorable visual images or cartoon-like characters that deliver anti-littering messages.

In studies performed elsewhere with subjects of various ages, young people littered more than older people, but they also are amenable to peer pressure and behavioral change. Programs in elementary schools can be effective particularly at forming or changing behavior patterns. For example, Alachua County contracted with an educational puppet production program that traveled to classrooms with a reduce-reuse-recycle message for the students. Educators believe that children apply that information at home to influence disposal and recycling patterns in their families. Characters included Litter Pal and Compost Kid. Litter Man also visits classrooms to

educate tomorrow's citizens about littering. Another school classroom program, Trash Troopers, teaches children to spot and report litterers.

Science fair projects and displays are another means of teaching children about solid waste issues and proper disposal behaviors. As part of its public service function, the Center has served as a resource for a number of students who have written school papers or completed science fair projects concerning littering and other solid waste issues. In 2000, one middle school student studied litter at a local public park and constructed a display for a science fair project. In another science fair attended by students from all over the county, the Center produced a display to demonstrate where trash goes and how a bioreactor landfill works. A climbing wall was included to gain the children's attention and involvement and to demonstrate how outdoor recreational equipment could be constructed out of non-CCA lumber.

#### **5.4.2 Cleanup Activities**

State and local government agencies in Florida spend millions of dollars each year cleaning up roadside litter. Even volunteer cleanups require substantial public funding, coordination, and support. In 1997-1998, the Center conducted a survey of all Florida counties to ascertain the types and costs of litter management programs. Responses to that survey included listings of programs funded in part by state litter grants to counties and local KAB affiliates, participation in the FDOT sponsored Adopt-A-Highway program, the Adopt-A-Shore Program, and the amounts spent to clean up litter on public lands such as parks and thoroughfares.

In 1998-1999, the Center surveyed private sector businesses, city solid waste departments, and local KFB affiliates to further determine the economic impacts of litter removal and reduction activities. Random surveys of businesses in Florida's ten largest cities indicated an average annual expenditure of \$2,435 per business in direct litter-related activities, not including costs for routine solid waste or landscaping services.

These two surveys demonstrated that litter cleanup requires a wide array of programs and services in the public sector, the private sector, and in public/private partnerships. Examples of such programs are:

- Adopted road programs, most of which utilize the KFB organization and volunteers partnered with the FDOT, counties, or cities to do cleanups;
- KFB beautification programs and awards;
- Judicial system work programs using offenders in cleanups as part of community work service, jail, or prison sentences;
- Maintenance activities by the FDOT, counties, or cities.

Roadside litter cleanups utilizing either individuals sentenced to community work service or crews of incarcerated offenders combines education, enforcement, and litter removal activities. There are even combination programs that employ contract crews composed of youth who have been court-ordered into drug, alcohol, or delinquency treatment programs. Those programs contract with a highway department and the youth are paid to pick up litter.

Sections 3.6.4 and 5.1.5 reported on and briefly described adopted road programs. Those programs are coordinated by more than 40 local affiliates of the KFB program with signage, tools, and disposal of the collected waste provided by the public works or solid waste department. The Florida Department of Transportation (FDOT) alone has about 1,500 state highway road segments of two miles each in the Adopt-A-Highway program. Though this survey found no significant difference in the litter counts between adopted sites and non-adopted sites, volunteer-based adopted road programs have been considered an important tool in reducing and controlling roadside litter in many states, including Florida. Several factors could account for the lack of any real difference between adopted sites and non-adopted sites. Only 7.8% of the survey sites were adopted and only 5.5% were currently assigned to a cleanup group, according to the signs present in the area of the site. This survey eliminates sites that are being cleaned at the time of the survey or have just been cleaned, as evidenced by bags of trash awaiting disposal. The decision to eliminate those sites was made during pilot studies and was related to the methodology of conducting a valid survey. Thus, adopted sites that were included in the survey may not have been cleaned for several months.

Many highway segments are unsuitable for adoption programs due to safety or other considerations. For example, segments on interstate highways with 70-mile-per-hour speed limits are deemed unsafe for volunteers. FDOT, county public works, and city streets departments all clean roadways as part of their maintenance functions. In addition, they also contract with private companies for regular litter pickups along specific roadways. During litter research activities in 1999-2000, Center researchers interviewed such a crew in Brevard County. The crew consisted of two drivers who collected roadside trash using four-wheeled all terrain vehicles, a flat-bed truck to transport those vehicles, and a driver and truck to haul the collected trash. In 2000, researchers interviewed a contract crew in Alachua county that consisted of four youths walking the roadside picking up litter using bags and extension grabbers. Those workers were residents of a residential drug treatment program and were paid \$60 for a ten-hour workday. The facility contracted with the county to conduct the cleanups.

### **5.4.3 Solid Waste Management Practices**

Other factors that contribute to the amount of roadside litter are the structuring of state, county, and city solid waste disposal programs and the enforcement mechanisms in place to deter improper disposal. Disposal systems include household and commercial pickup procedures and costs, availability and ease of recycling, and availability and costs of landfill or transfer facilities. Enforcement mechanisms include litter and illegal dumping laws, covered-load laws and other regulations covering waste haulers, enforcement agencies and officers, and programs such as telephone hotlines and trash troopers. It is generally believed that the majority of people will “do the right thing” with regard to solid waste disposal if they know how to do it, it is convenient within their usual sphere of activities, and it is inexpensive compared to the alternatives.

An earlier section of this chapter discussed litter generation by trash pickup procedures and by transportation practices. Other aspects of pickup are the items accepted and the costs involved. In 1999-2000, Center researchers conducted a field and phone survey of large, rural landholders in every part of the state, land managers from each of the five water management districts, and park patrol officers and rangers on state and federal park lands to assess the extent

of illegal dumping and the costs associated with cleanups. In areas where household-generated items such as tires, furniture, hazardous chemicals, or yard waste were not accepted for curbside pickup or involved a special fee, they were much more likely to collect in neighborhoods or be dumped illegally somewhere. Where landfill tipping fees were lower than in neighboring counties, haulers would drive the extra distance to save money on the disposal. Undoubtedly, some loads are dumped in out-of-the-way places instead of being delivered to transfer or landfill destinations. Illegal dumping is usually hidden back off of main roads, but our studies found tires dumped along canal roads and landscaping debris dumped in front of rural gates where a driveway provided a place to pull off.

Litter is also affected by changes in recycling practices. Fluctuating markets for recovered items and changes in collection costs may periodically change the availability of curbside or drop-off recycling for a particular material, such as glass or plastic, and may contribute to increased littering of items made from those materials. On the other hand, if there is an economic incentive of a payment for particular materials or items, they are more likely to be collected and turned in.

Enforcement of litter laws and regulations can substantially reduce litter. In our prior surveys, landfill and solid waste operators stated that uncovered trucks were charged additional fees as fines and that practice had greatly increased compliance with the law requiring loads to be covered. Researchers also sat in on a meeting of a State Attorney's Task Force on hazardous waste and illegal dumping. Officers from state and local agencies, FDEP, codes, and others all shared information on current cases as they monitored waste transportation and disposal. Examples included someone who had drained oil into a ditch behind an abandoned shopping center and an entrepreneur who was paid to haul off old tires and then dumped them on his mother's farm.

Enforcement activities are more effective when citizens assist code and law enforcement officers by reporting littering and illegal dumping. Programs such as telephone hotlines and trash troopers help to extend public resources for curtailing harmful disposal practices. Trash troopers are school children who record the license numbers of litterers in vehicles and call them in to the local KFB. Law enforcement identifies the owners and KFB sends an informational letter to the offender informing them of litter fines and penalties.

Effective litter reduction requires the use of a number of different tools. Not only does society have to convey knowledge of appropriate behaviors but policies and practices must be shaped to reward proper disposal. Litter composition changes not only with product consumption trends but with changes in packaging, recycling, and disposal practices and costs.



# APPENDIX

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## **BACKGROUND INFORMATION**

Prior to conducting the first Florida Litter Study, Center researchers reviewed earlier litter surveys and consulted with other experienced litter researchers. When applicable, previously successful litter survey strategies were incorporated into the pilot survey and the initial methodology for these surveys. However, procedural descriptions from other surveys were often sketchy due to a lack of available documentation. To fill this need for a detailed guide to survey procedures, this manual has been continuously updated to reflect the latest refinements in forms and procedures. Each annual survey in this series of litter surveys has deliberately and carefully followed the protocols of the original methodology so that the results of successive surveys can be compared based upon use of the same measurement techniques.

A manual such as this is integral to quality research and this is especially true in longitudinal surveys such as this one. The experience gained in each repetition of the survey has been incorporated into the manual as refinements of the many details involved in conducting it. The utility of such a manual was demonstrated in 2001 when, after a three-year hiatus, Center researchers set about to duplicate the 1994–1997 surveys. As the principal investigator and the original developer of the survey, the current director of the Center provided the institutional memory and expertise for recreating the research. New researchers, other than the original development staff, were charged with conducting the research and relied heavily upon the previous reports, procedures manual, training manual and notes, and other written documentation to supply the operational descriptions necessary to coordinate the project. This procedures manual, when used as a supplement to the Annual Report of the Florida Litter Study, provides a detailed description of the methodology used by the Florida Center for Solid and Hazardous Waste Management to conduct the Florida Litter Study.

## **SITE SELECTION PROCEDURES**

This section details the procedures used to locate random sites on roadways in each of Florida's 67 counties.

## **MATERIALS**

1. Three complete sets of the most current official General Highway County Maps, obtained from the Florida Department of Transportation (FDOT)
2. A table or listing of computer-generated random numbers used to obtain coordinates for potential survey sites
3. 1 Scale Master Plus Digital Plan Measure (electronic measuring instrument)
4. 3 stainless steel rulers: 2-18" and 1-36"
5. Plastic Template (for circles)
6. Highlighter markers: yellow, orange, green, etc.
7. A copy machine
8. Business-size envelopes (#10)
9. Large storage envelopes
10. Fine-point black and red pens
11. Masking tape and scotch tape

12. Scissors
13. Site direction sheets

## **RANDOM NUMBER SITE COORDINATES**

InfoTech, Inc. of Gainesville, Florida, used a SAS<sup>®</sup> computer procedure for selection of the coordinates and directionals used in the site mapping procedure. The map coordinates were generated to fit the standard State of Florida Department of Transportation map size of 17 ½ by 28 inches in ¼ inch increments. The method used to generate random coordinates allowed for spatially (or geographically) random points. Each point on the map had the same potential for being chosen.

The lists of random number coordinates consist of three columns containing vertical numbers, horizontal numbers, and compass directions (north, south, east, and west). A sample of the sheet is shown in Figure 1 below.

**FIGURE 1. RANDOM MAP COORDINATES (QUARTER-INCH)**

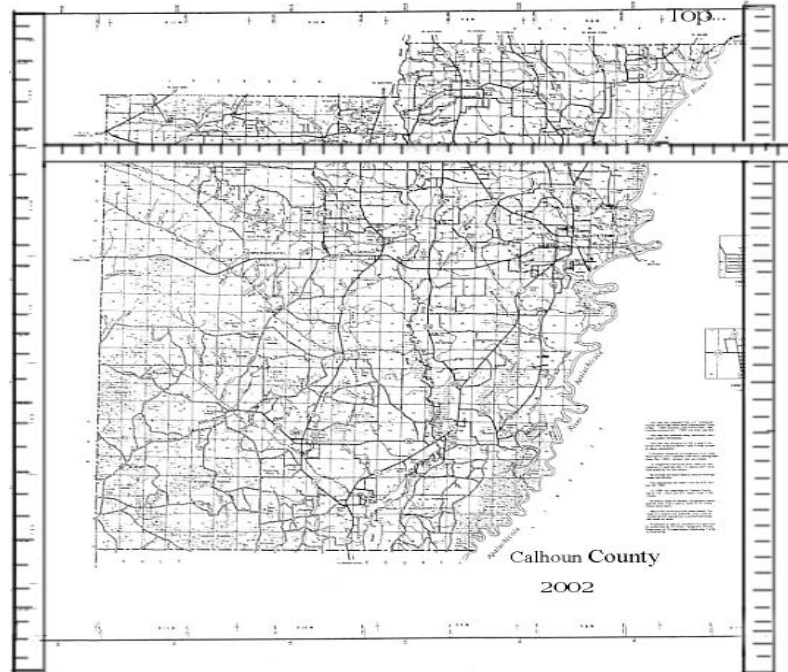
VERTICAL	HORIZONTAL	DIRECTIONAL
12 ¼	17 ¼	West
7 ¼	5 ¾	West
15 ½	10 ½	West
2 ½	27 ½	South
7 ¾	1 ¾	West
15 ½	25 ¾	East
7 ½	16 ¼	North

## **PLOTTING SITES**

1. The names of those doing the plotting, the date, and the county name are printed on the random coordinate sheets in the left margin next to the first available set of unused coordinates.
2. An FDOT general highway county map is taped to a worktable with masking tape. The widest side of the map paper is placed in the horizontal direction regardless of the orientation of the county on the map. The top of each map is then labeled as such on the upper right corner of the map and the survey year is placed in the lower right corner.
3. Two metal rulers are taped to the vertical edges of the map. The “0” point of the measuring stick is placed at the top outside edge of the map grid. The map diagram is shown in Figure 2 below.
4. The first available set of random numbers is used to locate the first point on the map. The vertical axis is located on two vertical rulers. The horizontal ruler is then placed across the two vertical points.

5. The vertical point determines the horizontal axis and the horizontal point determines the vertical axis. A dot is placed on the map at the intersection of the vertical and horizontal axes and is referred to as the “random point.” When this point lands directly on a named or numbered paved roadway, the directional indicator is disregarded, and the random point is the roadway site.

**FIGURE 2. PLOTTING MAP DIAGRAM**



6. Only roadways with the map key designation of county road, state highway, U.S. numbered highway, interstate highway, hard surfaced named or numbered road, divided highway, and highway with full control of access are used as site locations (See Figure 3 for a sample map section and key). In most cases the random point location is not directly on a highway that meets the survey criteria. Plotters then refer to the third column on the random coordinate sheet for the directional indicator (N, S, E, and W).

**FIGURE 3. GENERAL LEGEND**



The map figure indicating map grid North (N, or a “compass rose”) is used as the direction guide. The compass direction is followed from the random point until that line intersects a named or numbered paved roadway. If the direction indicated is north, then the plotter proceeds in map direction north by using a fourth ruler oriented in that direction or by following the map grid lines that run parallel to the indicated direction. Since the plotting orientation of the map does not always place North at the top of the map, plotters adopted the practice of using a separate card with compass directions on it as an aid and a reminder. They would orient that card in the proper map direction in front of them as they plotted and described sites on each map

7. A point, written in red ink, is placed on the map where a valid site is located. The dot is circled in red ink and colored in with a yellow marker. The next consecutive site number is written in black ink next to the yellow circle.
8. When a county map is printed on two sheets of paper, the first site is plotted using the random coordinates list and procedures described above on sheet one, as labeled on the map inset. Map sheet two is then used to plot site two, site three is plotted on sheet one, and so on, alternating map sheets for each successive site until at least 18 sites are plotted, nine on each map.
9. Once a site has been plotted on the map, the site number also is printed to the left of the set of coordinates on the random numbers sheet. After 18 or more sites have been plotted on a county map or maps, a line is drawn across the random coordinate sheet below the last row of coordinates used.
10. If no roads of the designated road type are encountered, the set of coordinates is rejected as unusable and an “R” for rejection is printed on the random coordinate sheet to the left of the set of rejected coordinates. Valid sites cannot be located on any of the following map features:

- a. map insets
- b. blank spaces (off the gridded portion of the map)
- c. county borders
- d. bodies of water
- e. unpaved or private roads
- f. bridges
- g. roadways not labeled with a number or name
- h. points located on an interstate highway within one mile of an interstate interchange
- i. on regions where access cannot be made to the road because of a lack of adjoining roads
- j. where no roads of the designated types are encountered

The above set of procedures is carried out for sites 1 through 18 in each county. In a few counties where prior surveys have shown that many sites will likely be rejected, additional alternate sites are plotted. For example, in highly urbanized areas such as Pinellas county, sites are frequently too narrow to accommodate the 18 feet required for a fixed site and must be rejected. In Martin county, roads running along the St. Lucie and other canals have miles of guard rails along the roadway that do not allow enough space for safe pull off and survey. In those counties, as many as 24 sites are plotted. When unforeseen circumstances cause a high number of site rejections, it may be necessary for the office support or project management staff to plot additional sites while the surveyor is in the field and relay the site directions by telephone.

The first map plotted is the official master map that remains in the office for project management purposes. A copy of this map is reproduced for field use by the project coordinators for Quality Control (QC) purposes. The first ten sites are then placed on a third map for use by the survey technician in completing the field survey.

## **DESCRIBING SITE LOCATIONS**

After all sites have been plotted, an intersection of two major roadways is located on the map near each site. This is the “beginning point” for defining the location of the site. The beginning point intersection must be a point at which the two roads physically intersect. An overpass or an underpass where two roads cross without an intersection or interchange is not a usable intersection because the survey technicians may have difficulty ascertaining the starting point if the overpass/underpass is unmarked, not visible, or otherwise obscured by traffic conditions.

1. An electronic measuring wheel is calibrated to the scale of the map. This device is used to trace the roadway from the beginning point intersection to the point of the site. The measurement obtained is the distance from the beginning point to the site in tenths of a mile.
2. The survey site plotter(s) write directions from the beginning point to the site for each site plotted.

The survey order of the first ten sites is determined by the site plotter(s) as they list the sites on the site directions sheet (Form 1). Since the first ten sites will always be visited,

the survey order can be predetermined. Whenever possible, survey order for the first ten sites is based upon the following criteria:

- The surveyor will travel from Gainesville to the county by the quickest and most direct route, using major highways.
  - After the first site, travel is minimized by ordering sites in a travel pattern, often roughly circular in the county, that minimizes the distance traveled between sites while using paved roads and main travel arteries.
  - The surveyor reaches each site without having previously passed by it on the way to another site. This procedure is meant to eliminate the opportunity for the surveyor to preview and perhaps prejudge sites and to preserve the random nature of each site.
3. The site direction sheet for alternate sites 11 – 18 is copied and cut into pieces, each with directions to one site. Map inserts are made for sites 11–18 by photocopying the area of the master map in which the site is located and then cutting out a piece of the map copy that encompasses the site.
  4. The map township and range coordinates of sites 11 – 18, taken from the map border, are written on the back of each alternate site map piece to assist the surveyor later in placing the map piece onto the field map.
  5. The map pieces containing the site location and the corresponding site directions for sites 11 – 18 are placed in individually numbered, sealed envelopes. After sites 1 – 10 have been visited and surveyed or rejected, envelopes for sites numbered 11 and higher are opened sequentially one-at-a-time and visited for survey until ten surveys have been completed. On occasion, while the county survey is proceeding, the project manager may authorize a specific site envelope to be opened and surveyed out of order to save excessive survey travel. This would only apply when prior rejections have determined that the site will definitely be visited as a survey site, all fixed sites have been completed, and the alternate site is on or near a route the surveyor will be using to reach other sites. This procedure allows for practical field considerations while maintaining random site selection.
  6. The field map, containing sites 1 – 10, the corresponding site directions sheet and the envelopes containing directions to sites 11 – 18 are then placed in a large storage envelope and labeled with the county name. This is the survey technician's packet for the county survey.
  7. The master map and site direction sheets as well as the QC map (copy) and site directions sheets are placed in separate storage envelopes and labeled with the county name and the year. The master map and the QC map each show all 18 (or more) possible sites plotted. The master map packet stays in the office for project management and the QC packet is given to the QCs for field use.



**Form 1. Site Directions Sheet**

**Site Directions Sheet**

COUNTY: \_\_\_\_\_

SITE # \_\_\_\_\_

DIRECTIONS: From the intersection of

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SITE # \_\_\_\_\_

DIRECTIONS: From the intersection of

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SITE # \_\_\_\_\_

DIRECTIONS: From the intersection of

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SITE # \_\_\_\_\_

DIRECTIONS: From the intersection of

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## **FIELD SURVEY METHOD**

This section supplements Chapter 2, Roadside Litter Survey Methodology, by supplying further details concerning the methods and procedures used to conduct the litter survey.

### **SURVEY SCHEDULE**

Chapter 2, Section 2.5, Survey Schedule, describes the rationale behind the order of the counties surveyed. Since there are a number of variables involved in choosing the counties to survey in any given week, it is important to stress that the schedule must be flexible and will vary somewhat from one survey to the next. In 2002, there were only a couple of weeks that necessitated moving the survey to counties other than the original plan. These changes were due mostly to personnel availability and scheduling requests. The final order of survey in 2002 was as follows:

- Week 1 – Dixie, Levy, Gilchrist, LaFayette, Suwannee, Columbia, Union, Bradford
- Week 2 – Liberty, Franklin, Wakulla, Taylor, Jefferson, Madison, Hamilton
- Week 3 – Citrus, Hernando, Sumter, Pasco, Flagler, Volusia, Seminole, Lake
- Week 4 – Escambia, Santa Rosa, Okaloosa, Walton, Holmes, Washington, Bay, Gulf
- Week 5 – Highlands, Glades, DeSoto, Hardee, Pinellas, Hillsborough, Manatee, Sarasota
- Week 6 – Polk, Orange, Indian River, Brevard, Osceola, St. Lucie, Okeechobee, Martin
- Week 7 – Monroe, Dade, Palm Beach, Broward, Hendry, Collier, Lee, Charlotte
- Week 8 – Baker, Clay, Nassau, Duval, St. Johns, Alachua, Marion, Putnam
- Week 9 – Leon, Jackson, Gadsden, Calhoun

### **SURVEYOR/COUNTY MATCHING PROCEDURES**

The survey plan is to survey all 67 counties of the state in nine weeks using eight survey technicians and two or three project coordinators (QCs). Each surveyor completes one county per week. Each QC will have a group of two to four counties to cover weekly and these are grouped according to easy access from one to another. County groupings for each week will rely on the number of available surveyors and QCs in any given week. If there is a full staff throughout the fieldwork, each surveyor will survey a total of eight or nine counties. During training each surveyor is given a list of all of the counties and asked to list assignment preferences. It is beneficial to both the survey and the surveyor if the surveyor knows roads and landmarks in the county or has friends or relatives there that he or she can stay with overnight. The project manager makes every effort to assign counties according to the preference list.

Some counties present unique challenges to the survey and may be assigned according to surveyor performance or familiarity with the characteristics of the county. For example, highly urban or isolated rural counties may be a better fit to the individual skills of one surveyor over another. Some surveyors work more quickly than others and are better able to travel to counties requiring more travel time. The project management staff monitors surveyor performance closely and uses the knowledge of how surveyors perform in the early weeks to make county assignments as the survey progresses. Counties with heavy traffic, large populations, high litter

levels, and far distances from the survey office are surveyed after the surveyors have gained some experience and demonstrated their level of performance.

## CONDUCTING THE SURVEY

### Supplies and Equipment

The checklist below outlines the supplies and equipment used in the survey. When the equipment is issued to the survey technicians, most of the small items are organized in a box or plastic storage container to facilitate transfer to and from rental vehicles. Surveyors normally keep some items with them in the passenger compartment for easy access and use. These items would include the manual, forms, maps, camera, tape recorder, GPS, phone, safety glasses, clipboard, markers, pencils, and other paperwork supplies. The rest of the equipment is carried in the trunk of the survey vehicle. Rubber boots are issued upon request.

#### **Form 2. Items to be Taken on a Survey - Checklist:**

- Binder containing procedure manual and survey forms.....
- Maps – County survey site maps, state of Florida map, local driving map.....
- Site directions sheet (from office).....
- Field tech site directions sheet (to be filled out by surveyor).....
- Mileage log.....
- Time card sheet.....
- Data transcription sheets for small and large litter survey.....
- Camera and bag.....
- Tape recorder.....
- Print film (24 exposure).....
- Spare batteries.....
- Spare tape cassettes.....
- Gps.....
- Cell phone.....
- Note cards for designating site # in photographs (4x6 index cards).....
- Safety glasses.....
- Clip board.....
- Pens & pencils.....
- Scissors.....
- Scotch tape.....
- Magic marker – black.....
- Flasher for top of car.....
- Box for holding supplies.....
- String – 210 feet.....
- 2 flags.....
- 3 templates for 4 square inch measurement.....
- Hard hat.....
- Pepper spray.....
- Spray paint (2 cans – red).....
- Safety vest.....

- Protective gloves.....
- Anti-microbial towelettes .....
- First aid kit.....
- Rain poncho.....
- Safety cones (4).....
- Steel (fence post) stakes (5).....
- Measuring wheel.....
- Pvc frame (1' x 5').....

Safety and specialty survey items are purchased from catalogs, when possible. Staff chose tape recorders, GPS units, and cameras that would all use AA batteries interchangeably to simplify the inventory. Below are listed some additional considerations when choosing equipment for this survey:

1. Cell phones- Though a significant survey cost, portable phones increase surveyor safety and assist in the coordination of the fieldwork. Many situations can be addressed and solved quickly when the surveyors have ready communication with the QC team and project management.
2. Safety vests- All surveyors were provided with reflective vests that meet current ANSI, and therefore FDOT, standards for visibility. In bad weather, vehicle speeds of 25 mph or more, complex work backgrounds, and tasks that divert attention from approaching traffic, reflective strips are required.
3. Safety glasses- Federal regulations (29CFR1910.133) require protective eyewear where there is a reasonable probability of injury that could be prevented by such equipment. Such hazards include flying objects and glare. Surveyors were issued glasses or over-prescription glasses that met ANSI standard Z87.1 and provided ultraviolet protection. Some used their own eyewear if it was shatterproof and fit their prescription. Surveyors found that the glasses tinted for anti-glare were too dark for other than bright sunlight conditions.
4. Spray can handles- These allow better control and less likelihood of spray on hands, clothes, and other equipment. The handle also protects the can nozzle from accidental discharge when bumped during driving and moving the equipment.
5. Equipment boxes- The paper file boxes used previously were not durable, especially in rain and wet conditions. This year, inexpensive plastic storage totes helped to keep gear together and in working order.
6. Safety cones- As an aid to judging grass height, one cone per surveyor was marked with measures of 3 inches and 6 inches to enable accurate classification in the field.
7. Stakes- Metal fence stakes were sprayed with florescent paint to increase their visibility. This helped visibility of the markers both on the site as well as in photos. In 2001, a mowing tractor ran over metal stakes while the technician was on the site.
8. Small litter frames- Some surveyors noted that the five-foot-long frames are too long to fit easily in some smaller vehicles and can be cumbersome to transport. This year the staff fitted the frames with couplings in the long pieces so they could be broken into two pieces for transport and reassembled on site. This adaptation caused many surveyors problems with the assembly and rigidity of the frame.
9. Ponchos- In 2001, the one-time emergency use ponchos, the cheapest available, were so flimsy they were useless. A slight upgrade from under a dollar to fewer than three dollars

each provided bright, visible ponchos of a heavier plastic. These were provided for emergency use and few surveyors had to use them.

The inventory list below shows the quantities of the above items normally needed to conduct the statewide data collection. When possible, items for the last two surveys have been purchased in packaging units and types that will meet survey needs with the least expense. For example, 36-exposure rolls of film would best meet the need for weekly photos of ten sites per county, but film packs in multiple rolls of 24 exposures each were often considerably less expensive. The 2001 and 2002 surveys used 100-speed film (bright sun, outdoors) for the same reason. However, cloudy, rainy and other reduced light conditions occurred with sufficient frequency to warrant the use of 200- or 400-speed film if the budget permits the additional expense of higher speed film. Also in 2002, the use of the least expensive spray paint for marking sites proved to be a waste of time and materials because the paint spray was too thin to easily and quickly place the marks. As a result, the survey required additional cans of paint and a number of site markings were difficult for QCs to locate.

**Form 3. Inventory List**

ITEMS	Needed Per Surveyor	# On Hand	Need To Purchase	Price Each	Total Cost	Comments
AC Adapters for Tape Recorders	1					
Anti-microbial Wipes	2 doz.					
Batteries, AA	2-8 pks.					
Binders for Training Manual	1					
Camera Bags	1					
Cameras	1					
Cameras, disposable	1					
Clipboards	1					
Equipment Boxes	1					
Film - 24 Exposure	14 rolls					
First Aid Kits	1					
Stake Wire Flags	2					
Flashing Lights	1					
PVC Frames(1'x5')	1					
Gloves	1-pr.					
GPS	1					
Headphones	1					
Index Cards (4x6)	1-pk.(100)					
String Reels or Spools	1					
Maps, State	1					
Measuring Wheels	1					
Pencils	2					
Pens	2					

Pepper Spray	1					
Permanent Markers, Black	2					
Cell Phones	1					
Ponchos	1					
Safety Cones	4					
Safety Glasses	1					
Hard Hats	1					
Safety Vests	1					
Scissors	1					
Scotch Tape	1					
Marking Paint - Red	5					
Spray Can Handles	1					
Steel (Fence Post) Stakes	5					
Tape Recorders	1					
Tapes - Cassette (90 Minute)	24					
Templates - 4 Sq.Inch Each	1-set					

### Locating and Evaluating Sites

1. Ten sites are surveyed per county. The surveys are completed in the order designated on the Site

Directions Sheet (not necessarily in numerical order). If any of the first 10 sites are eliminated (see Conditions for Site Rejections), the surveyor should refer to envelope 11 after the visit to the tenth site to find the location of the next site. If site 11 is eliminated, the same procedure is repeated with envelopes 12, 13, etc., until a valid site is found. Documentation is made of all rejected sites and the reason for the rejection is recorded into the tape recorder.

The surveyor proceeds from site-to-site by following the order on the site directions sheet. If practical, site order is arranged so that the surveyor does not pass the site enroute to another site. The intention is to limit the opportunities for the surveyor to preview and possibly prejudge the site.

2. The surveyor uses the site directions written by the map plotter to locate the reference point at which to begin recording mileage. The reference point will be an intersection of two roads. When approaching the designated reference point, the surveyor should slow down or stop the vehicle (if possible) and begin recording mileage at a clear and permanent landmark. A note should be made concerning that permanent landmark on the tape recorder (later transcribe to the site directions sheet) so the site can be found easily for a follow-up survey of that same site. If starting from an interstate interchange or other area where stopping would be hazardous, a record is made of the mileage. The reference point is recorded with as much detail as possible.

3. When two miles away from the site in rural areas and one mile away in urban areas, the surveyor begins to look for and record the occurrence of adopted road signs. If the adopted road designation sign also shows the name of an adopting individual or group, a record of “currently adopted” is entered. When one mile away from the site, the surveyor begins to look for and record the occurrence of fast-food or convenience stores. This data is recorded on cassette tape. When approaching the actual site location, the surveyor records the occurrence of a traffic signal, if any, slows down the vehicle, and turns on the flashers one-tenth of a mile before the site. If there is a curb or other roadside hazard (washout, soft sand, steep grade, etc.) that prevents a safe pull off, the surveyor should continue to drive in the same direction and look for a place to pull off anywhere within the next mile. It is permissible to turn right into a parking lot, driveway, or side street in order to park off the roadway. (The red X would then be placed where the turn was made, see below). If it is not possible to pull off within one mile of the original starting point, the site is rejected and the surveyor proceeds to the next site after noting the reason for the site rejection on the site directions sheet. The vehicle should be pulled off the road gradually so that it comes to a stop at the correct mileage reading. Next, the surveyor will determine the GPS reading and record the coordinates into the tape recorder and onto the field tech site directions sheet.

#### **Determination of Fixed and Variable Sites**

4. The first five sites surveyed will have a **FIXED** width of 18 feet. If the width of right-of-way available for survey is less than 18 feet, the site is rejected and the next site is located until five sites are surveyed with a width of 18 feet.

The second five sites surveyed will have a **VARIABLE** width with a maximum width of 40 feet. The boundary for the site will either be a catch point (such as a fence, hedge, mow line, etc.), 40 feet from the edge of the paved roadway or a private property boundary. There is a minimum width for these sites of one foot. As long as there is some amount of grass, dirt, or other unpaved area, the site is included in the survey. The site must be set up in front of the vehicle, in the direction of travel.

The site should be visually observed from the car to determine the safety of the area. The site should also be checked for other factors that would cause the site to be rejected.

#### **Conditions for Site Rejection**

Once at the site, any of the following factors can cause the site to be **REJECTED** or moved to an alternate location:

1. Construction is occurring on the site; or, nearby construction may interfere with the survey or the quality control survey.
2. Surveyor security and safety concerns: the surveyor determines the site is unsafe for survey due to dangers posed by traffic or other factors.

3. Site is located on a bridge or there is a guardrail too close to the traffic lane(s) to allow for safe pull off and parking. In this case, the site is moved exactly one mile from the original location, traveling in the same direction.
4. Highway cleanup or mowing crews are at the site or within one mile of the site.
5. There are bags of collected litter on or within one mile of the site, indicating a cleanup has just occurred.
6. A majority of the site is submerged in water.
7. The site is located on an interstate highway within one mile of an interchange.
8. The designated right-of-way is completely paved, leaving no grassy or unpaved area for survey.
9. County solid waste collection containers (typically, dumpsters or other designated collection points) are within one-tenth mile of the site.
10. The site is within one mile of the entrance to a county or regional landfill.
11. There is a curb, soft or steep shoulder, washout, or other shoulder condition making pull off and parking impossible or unsafe. In this instance, the site location is moved forward to where access can be gained, but no more than one mile from the original site description. The new distance is calculated using the odometer and is recorded. If the site cannot be entered within the one-mile distance, the site is rejected.
12. Site cannot be found.
13. The site is too narrow for a fixed site.

For any sites requiring a location change due to the reasons stated in #3 or #11, the exact location of the new site is documented.

If the site is rejected, the reasons for rejection are documented on the tape recorder and on the site directions sheet.

### **Preparing for the Survey**

1. If the site is suitable for survey, record on the site directions sheet the actual mileage from the starting or reference point as indicated by the odometer reading and any new directions necessary for locating the site in the future. Also note any landmarks which may help to identify the starting point and the survey location.
2. Car flashers and the rooftop flasher should be in operation at this time. The survey is then performed.
3. Before beginning each survey, **THE SURVEYOR SHOULD BE CERTAIN THE TAPE RECORDER IS WORKING.** The surveyor should record the county name, site number, GPS coordinates, date, time, and surveyor name as well as **ALL** of the following information:



County:

Site #:

GPS Coordinates: Lat. \_\_\_ N/Long. \_\_\_ W

Date of Survey:

Time Started/Time Finished:

Surveyor Name:

Whether the site is variable or fixed:

Site widths: For fixed sites, all widths are 18 feet.

For variable sites: Width 1 is the beginning point

Width 2 is the midpoint

Width 3 is the endpoint

Site length: Always 200 feet.

Road type: A. County Road ("CR") B. State Road ("SR") C. Interstate

Number of lanes: 2, 4, 6 or 8

Is the road divided? Yes or No

Site type: A. Rural B. Urban/Business C. Residential D. Industrial

Grass Height: A. Under 3" B. 3 – 6" C. Over 6"

Part of Adopt A Highway: Yes or No

Currently Adopted: Yes or No

Fast food or convenience store within 1 mile? Yes or No

Traffic signal within view? Yes or No

Litter catch point in site: A. Fence B. Hedge C. Mow line D. Other E. None

Visual Rating: 1, 2, 3, or 4

Comments:

(Note: Only one answer can be entered in the database. If there is more than one catch point on the site, record the most prominent one.)

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**Comments: Include a word or two to describe any condition that may have affected the survey.**

**For example: "windy," "rainy," "located in a state park," etc.**

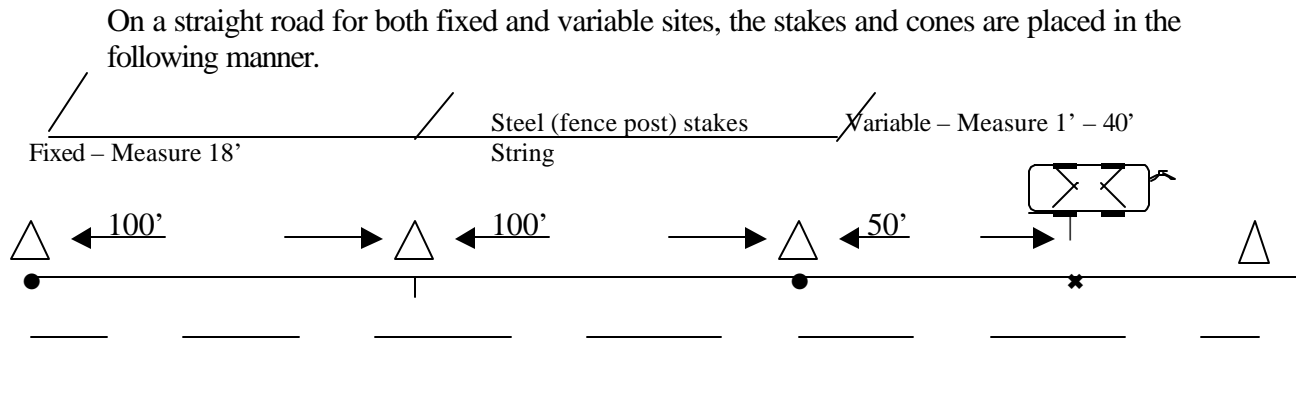
### **Setting up the Site**

1. The beginning point of the site is established by painting an X on the edge of the roadway opposite the front driver-side tire of the surveyor's vehicle and measuring 50 feet from the X using a wheeled measuring device. The beginning of the site is marked with a cone and a 4-inch round paint dot at a point 50 feet in front of the front tire of the vehicle.
2. Using the measuring wheel, the site is measured to 100 feet and the midpoint marked with a painted line perpendicular to the roadway and a second cone. Measuring continues for another 100 feet to make the site 200 feet in length overall. The end of the site is marked with a round paint dot and a cone, identical to the markings at the beginning point.
3. The width of the site is either fixed or variable. On both types of sites, the right-of-way and sampling zone begin where the pavement and the grass or soil meet.

**FIXED SITES** - A width of 18 feet is measured from the roadside. A steel (fence post) stake is placed at each end and at the midpoint of the site to mark the 18-foot line. If the roadside is curved, two additional stakes are placed at 50-foot intervals to make a total of five stakes. Once the stakes are in place, a string is attached to all of the stakes and pulled taut to delineate the 18-foot boundary line.

**VARIABLE SITES** – The site width is measured from the roadside to the catch point (up to 40 feet). A stake is placed at each end and at the midpoint to mark the boundary. The catch point is used as the boundary of the site unless there is an obvious private property line before the catch point. The edge of a sidewalk is **not** a catch point. If necessary, a string is attached to all of the stakes and pulled taut to delineate the boundary.

**Figure 4. Site Setup – Stake and Cone Placement**



The width of the variable site is measured and recorded at both ends and the center.

### Conducting the Large Litter Survey

1. **Before recording any data, a test recording is performed to ensure that the tape is working properly.** The tape recorder is left running throughout the entire survey. Documentation into the tape recorder is made of any landmarks that might aid in the future location of the site. **Only one county is recorded per tape.** If the tape runs out while conducting a survey, the tape is labeled and the recording is continued on another labeled tape.
2. All litter four inches square in area and larger, including all litter touching the boundary string, is documented into the tape recorder. A 4-square-inch template is used to check the size of the litter if there is any doubt. All litter should be entered into the tape recorder as specifically as possible without using brand names to aid in transcribing. Example: beer bottle, gum wrapper, fast-food foil wrapper.
3. Each site should be surveyed twice, making two separate passes. One pass is made while walking away from the vehicle and the second pass is made on the way back to the vehicle.

Care is taken to document on the tape recorder the start, midpoint, and end of each separate trip. When conducting the survey, a serpentine walk is used. It is important to maintain focus and pay close attention in order to observe and record all litter.

4. Litter is not to be manipulated (touched, turned over, kicked) unless necessary for identification purposes. If litter is partially buried or covered by grass or leaves, only the visible portion is measured and recorded.
5. If litter is found in a bag such as home garbage, it is to be counted as one piece of litter and a description of the bag documented on tape.
6. When the survey is completed, the time is recorded.

### **Conducting the Small Litter Survey**

Three cross-sections are to be surveyed at each site: one on both ends of the site and one in the middle

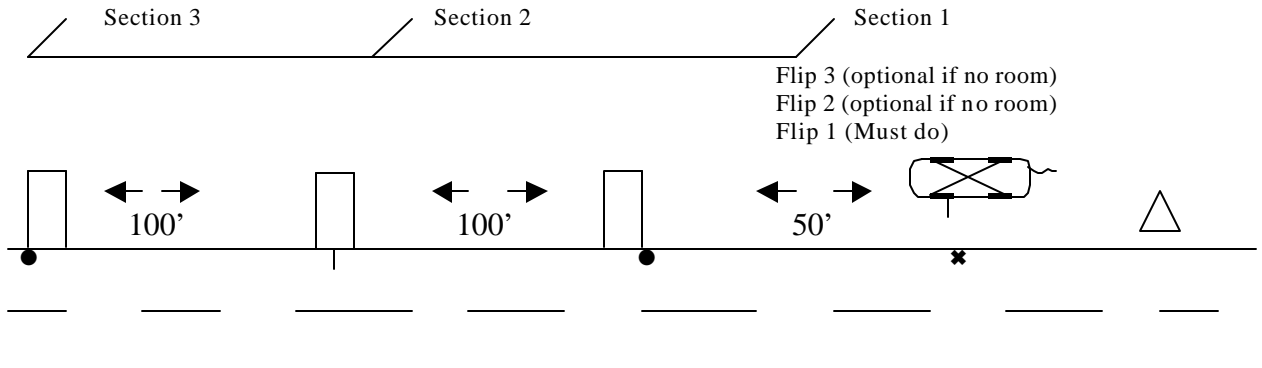
(100-foot mark) of the site.

1. For the near end of the survey (section #1), the one foot by five foot frame is placed at the beginning of the site with the one-foot side bordering the pavement. To keep the frame from slipping, two flags are inserted into the ground at the end of the frame, opposite the pavement edge.
2. The surveyor stands at the long side of the frame, facing the traffic. All litter less than four square inches is documented into the tape recorder. Any litter touching the **top** and **left** side of the frame **is included** in the survey. Any litter touching the bottom and right side of the frame is **not included** in the survey.
3. **Before recording any data into the tape recorder, a test recording should be made to ensure that the tape recorder is operating correctly.** The litter should be entered into the tape recorder as specifically as possible.
4. The frame is flipped two more times away from the road. Litter is counted in the same manner each time. This will result in a cross-section measuring 1 foot wide by 15 feet long in which all small items of litter are counted.
5. The same procedure is repeated for the middle (section #2) and the far end (section #3) of the site. In the middle section (#2), the frame is placed with the one-foot side at the edge of the pavement, and the centerline in the middle of the one-foot width of the frame. For section #3, the frame is placed in the far corner of the site, again with the one-foot side at the edge of the pavement.
6. When counting litter, care should be taken to note which section and which flip are being counted, for example, "I am now starting the small litter survey for site

#4 in Marion County. I am now starting the first flip of section #1, . . . This is flip #2 of section #1, . . . etc.”

7. If a site is less than 15 feet wide, or obstructions do not allow for placement of the frame, one or more flips are eliminated to accommodate the site width. No small litter is counted if the site is less than 5 feet wide. Any such anomalies are noted on the tape recorder.

**Figure 5. Small Litter Frame Placement**



### **Taking Site Photographs**

For uniformity, three site photos are taken at these specified locations:

1. From the beginning point of the site facing the ending point, showing the site and the horizon.
2. From the beginning point, perpendicular to the road, facing away from the road, showing the width of the site.
3. From the ending point of the site facing the beginning point, showing the site and the vehicle.

An index card is held in one hand so it can be seen and read through the viewfinder of the camera. In large, neat printing, the card will show the county, site number, date, surveyor’s name or initials, and F or V for either a Fixed or Variable site. The placement of the card in the viewfinder should be such that the best view of the site and site characteristics is obtained.

### **TRANSCRIBING PROCEDURES**

All recorded data is transcribed as soon as possible. The verbal data recorded on the tape is transferred to written data sheets (Forms 2 and 3) that list all the categories of litter included in the survey. Tick marks arranged in groups of five (++++) are placed after each category. The tape is paused to insure all verbal information is transferred to the data sheets. Most surveyors transcribe each day’s data at the motel during the evening hours. Each is supplied with an AC

adapter to use for this purpose in order to save on battery use. When the surveyors return to the office, they transcribe any remaining data in a quiet work area designated for this purpose. All data must be transcribed before the end of the workweek. The surveyor does not get a new county assignment until the paperwork for each county is completed.

When the datasheets are complete, the number of tick marks for each category is totaled and recorded on the data sheet in the far right hand column. The total number of pieces for pass 1 is written and circled at the bottom of the right hand column for Pass 1. Pass 2 is totaled in the same manner.

The totals for the three flips of each section of the small litter count are entered in a total column for that section. These totals are again added in a column to the far right showing item totals for all three sections. The total for all small litter pieces counted (a maximum of 9 flips) is entered at the bottom of the far right column in the space labeled "Grand Total."

## **OFFICE PROCEDURES FOR FIELD COORDINATION**

The master map and master site directions sheets for each county remain in the office each week so that the project manager and staff have them as a reference to the sites while the survey technicians and the QCs are in the field. Frequently, questions about the site directions come up or the project manager must refer to the map to assess the progress of the surveys. On occasion, additional sites must be plotted and described while the survey is in progress. In 2002, Wakulla County had a number of sites plotted along a road that was found to be closed during the survey. Eight sites were rejected and three more were plotted in the office and called out to the field surveyor.

Each day surveyors contact the QCs by phone when they have completed two sites, or by 1:00 PM, and again at 4:00 PM and when they check in to their lodging. This allows the QCs to receive updated site location descriptions, to plan for which sites they can re-survey, to answer questions, and to monitor the safety and progress of the survey. The QCs call the office with any questions, concerns, or progress reports as needed and by 4:00 PM, when they have the daily report of sites completed. Surveyors also call the office when they are unable to reach their assigned QC.

The office staff maintains a phone log of all calls during the field survey as a record and a reference for anyone who needs to know the status of the fieldwork. From the phone log reports, the project manager also keeps a running chart of sites completed and rejected each day, by surveyor and county. The log also shows which sites have been QC'd and when. Since the master map and the QC map show all plotted sites, this allows the project management staff to make decisions that may expedite the field survey. For example, once five fixed sites have been surveyed and one or more other sites have been rejected, it is possible to route alternate survey sites out of numerical order if they must be visited and surveyed or rejected anyway. Alternate sites are sometimes very near other remaining sites and this procedure can save the technician from driving back and forth across the county several times. The QC or the project manager makes this determination as the situation warrants.

Sometimes it is necessary for a surveyor to receive assistance in completing a county. Weather conditions, illness, and other adverse survey conditions have been reasons for a QC or another surveyor to complete one or more sites in a county. The project manager makes this decision based upon considerations such as available personnel, the survey schedule, and costs involved. In 2002, a QC completed two sites in two different counties because a high number of rejected sites caused the surveyors to be behind schedule.

**FORM 4. LARGE ITEM COUNT SHEET, PASS 1**

**FLORIDA LITTER SURVEY LARGE ITEM COUNT SHEET**

County: \_\_\_\_\_ Site # \_\_\_\_\_  
 GPS Coordinates: Lat. \_\_\_\_\_ N  
 Long. \_\_\_\_\_ W  
 Date of Survey: \_\_\_\_\_  
 Time of Survey: Starting \_\_\_\_\_ Ending \_\_\_\_\_  
 Surveyor: \_\_\_\_\_  
 Site Length 200 ft  
 Width: Variable \_\_\_\_\_ ft, \_\_\_\_\_ ft, \_\_\_\_\_ ft,  
 Or Fixed 18 ft  
 Road Type: CR SR US  
 Number of Lanes: 2 4 6 or more Divided: Y N  
 Comments: \_\_\_\_\_

CIRCLE ONLY ONE  
 Site type A B C D  
 Grass Height A B C  
 Part of Adopt A Highway Y N  
 Currently Adopted Y N  
 Name of Organization: \_\_\_\_\_  
 W/in 1 mi of FF/convenience Y N  
 Visible traffic signal Y N  
 Catch point for litter A B C D E  
 Visual Rating 1 2 3 4

<b>BEVERAGE</b>	<b>Pass 1</b>	<b>T</b>
Beer cans		
Beer bottles		
Soda cans		
Soda glass bottles		
Soda plastic bottles		
Sports/other cans		
Sports/other glass bottles		
Sports/other plastic bottles		
Wine/liquor glass bottles		
Wine/liquor plastic bottles		
Milk jugs/water/juice (HDPE)		
Gable top containers		
Foil pouch		
Aseptic box		
Broken glass containers		
Six pack plastic rings		

**CUPS**

Plastic disposable		
Plastic reusable		
Polystyrene foam		
Paper		
Plastic cup lids		

**BAGS**

Plastic retail		
Paper retail		
Paper small		
Feed		
Ice		
Zipper/sandwich		
Plastic other		
Paper other		

**CONTAINERS**

Corrugated cardboard boxes		
Paperboard boxes		

Paper beverage casing		
Polystyrene foam clam shell		
Plastic clam shell		
Plastic jars/bottles/boxes		
Glass jars/bottles		
Cans – steel		
Cans – aluminum		
Container lids		
Aerosol cans		

**FOOD WRAPS**

Paper		
Paper/foil composite		

**TRAYS**

Polystyrene foam		
Paper		

**TAKE OUT FOOD EXTRAS**

Condiment packages		
Utensils		

**PLATES**

Paper		
Polystyrene foam		
Plastic		

**PACKAGING**

Snacks		
Plastic		
Paper		
Plastic/paper combo		
Polystyrene foam		
Foil		

**PAPER**

Towel/napkin		
Lottery		
Newspaper/books/mags/adver		
Stationary/school/business		

**TOBACCO**

Cigarette/cigar		
Dip/chew/snuff		

**OTHER**

Foil/pie tins		
Misc. Paper		
Misc. Paperboard		
Misc. Cardboard		
Misc. Plastic		
Misc. Plastic Film		
Misc. Polystyrene Foam		
Misc. Glass		
Construction debris		
Vehicle debris		
Tire pieces		
Home items		



**FORM 5. LARGE ITEM COUNT SHEET, PASS 2**

**FLORIDA LITTER SURVEY LARGE ITEM COUNT SHEET**

County \_\_\_\_\_ Site # \_\_\_\_\_  
 Date of Survey \_\_\_\_\_  
 Time of Survey: Starting \_\_\_\_\_ Ending \_\_\_\_\_  
 Surveyor \_\_\_\_\_

**BEVERAGE**

Pass 2

T

Beer cans		
Beer bottles		
Soda cans		
Soda glass bottles		
Soda plastic bottles		
Sports/other cans		
Sports/other glass bottles		
Sports/other plastic bottles		
Wine/liquor glass bottles		
Wine/liquor plastic bottles		
Milk jugs/water/juice (HDPE)		
Gable top containers		
Foil pouch		
Aseptic box		
Broken glass containers		
Six pack plastic rings		

**CUPS**

Plastic disposable		
Plastic reusable		
Polystyrene foam		
Paper		
Plastic cup lids		

**BAGS**

Plastic retail		
Paper retail		
Paper small		
Feed		
Ice		
Zipper/sandwich		
Plastic other		
Paper other		

**CONTAINERS**

Corrugated cardboard boxes		
Paperboard boxes		

Paper beverage casing		
Polystyrene foam clam shell		
Plastic clam shell		
Plastic jars/bottles/boxes		
Glass jars/bottles		
Cans – steel		
Cans – aluminum		
Container lids		
Aerosol cans		

**FOOD WRAPS**

Paper		
Paper/foil composite		

**TRAYS**

Polystyrene foam		
Paper		

**TAKE OUT FOOD EXTRAS**

Condiment packages		
Utensils		

**PLATES**

Paper		
Polystyrene foam		
Plastic		

**PACKAGING**

Snacks		
Plastic		
Paper		
Plastic/paper combo		
Polystyrene foam		
Foil		

**PAPER**

Towel/napkin		
Lottery		
Newspaper/books/mags/adver		
Stationary/school/business		

**TOBACCO**

Cigarette/cigar		
Dip/chew/snuff		

**OTHER**

Foil/pie tins		
Misc. Paper		
Misc. Paperboard		
Misc. Cardboard		
Misc. Plastic		
Misc. Plastic Film		
Misc. Polystyrene Foam		
Misc. Glass		
Construction debris		
Vehicle debris		
Tire pieces		
Home items		

**FORM6. SMALL ITEM COUNT SHEET**

**FLORIDA LITTER SURVEY SMALL ITEM COUNT SHEET  
(Less than Four Square Inches)**

County \_\_\_\_\_ Site # \_\_\_\_\_

Date of Survey \_\_\_\_\_

Time of Survey: Starting \_\_\_\_\_ Ending \_\_\_\_\_

Surveyor \_\_\_\_\_

\*\* The following is a count of pieces of litter, not necessarily whole items. \*\*

	Section #1 (closest to your vehicle)				Section #2 (the midpoint of the site)				Section #3 (the end of the site)						
SMALL ITEM	Flip 1 (Road)	Flip 2	Flip 3	T	Flip 1 (Road)	Flip 2	Flip 3	T	Flip 1 (Road)	Flip 2	Flip 3	T	Sections 1,2,3 Totals		
Cigarette butts															
Bottle caps															
Straws															
Candy wrappers															
Poly foam peanuts															
Poly foam pieces															
Glass															
Paper															
Plastic film															
Hard plastic															
Aluminum															
Rubber															
Metal (not aluminum)															
Other material															
	<b>Section 1 Total</b>					<b>Section 2 Total</b>					<b>Section 3 Total</b>				
													<b>Grand Total</b>		

## **QUALITY CONTROL METHODS AND PROCEDURES**

Quality control procedures are incorporated into every aspect of the survey. Procedures that have been developed to assure the integrity of the data and of the resulting survey are listed below:

### **SURVEY SITE PLOTTING**

Quality control measures employed during mapping and plotting of sites include:

- Researchers secure the most up-to-date county general highway maps from the FDOT prior to plotting the survey sites. The map inventory is compared to a table or listing of the latest revisions to assure that the most recent maps have been received.
- Random number lists are marked as they are used and used only once.
- Whenever possible, two research assistants plot the sites together, thereby providing a check on the separate tasks involved. For example, one person gives the beginning point descriptive highway names or numbers and measures the distance to the random point. Another person writes this description on the site direction sheet. When plotting the same points on the second map of the same county, they reverse the process by reading the site directions and plotting the site using the directions, thus locating the site in the same way the survey technicians will be required to do so. They then compare the maps to assure both agree on the site locations.

### **TECHNICIAN TRAINING, EQUIPMENT, AND SUPPLIES**

Survey technicians receive uniform training, equipment, and data collection forms. Quality control during the preparation and training phase includes the following:

- Securing reliable equipment and adequate supplies
- Calibration of the site measuring wheels to assure accurate site measurement
- Checking the small litter measurement frames and the small litter templates for accuracy
- Updating training manuals and materials that are issued to all surveyors for training and reference use
- Providing uniform and mandatory survey technician training covering all aspects of the survey methodology and procedures
- Training the project coordinators in quality control procedures and an in-depth understanding of the survey methodology and procedures and preparing them to assist with the survey technician training.

### **QUALITY CONTROL SURVEYS**

In each county, two of the ten sites surveyed are resurveyed for quality control. The survey plan is to survey all 67 counties of the state in nine weeks using eight survey technicians and two or three project coordinators. This number of project coordinators has been found to permit completion of the survey on schedule while allowing for some absences or loss of

surveyors during the course of the fieldwork. The normal attrition rate in most of the previous years was one or two survey technicians from the time of hiring until completion of the fieldwork. In this survey, nine survey technicians were hired initially and one dropped out at the beginning of training. Hiring three project coordinators provides enough coverage to conduct all quality control surveys in a timely manner as required, provide field support within an hour or less driving time from all survey technicians, and provide adequate coverage to continue the field work if a QC is absent unexpectedly. It also provides temporary coverage for survey technicians. Coordinators have been able to conduct the field surveys when survey technicians experienced difficulties that would otherwise disrupt the survey schedule. For example, coordinators have filled in when technicians have become ill, had an equipment failure, or encountered delays due to poor weather conditions or numerous site rejections. It is also beneficial to have experienced QC surveyors to assist with training and provide closer field monitoring during the crucial early weeks of the survey when surveyors are learning the procedures and forming habits in the survey routine.

As an additional check on surveyor performance, QC and surveyor county pairings are purposely rotated from week-to-week. This allows for count comparisons between a number of different individuals over the course of the fieldwork. Any error built in to any one combination of QC and surveyor will be reduced. This practice also allows each of the project coordinators to assess the performance of each of the surveyors in a variety of situations. Any potential problem areas are thus more likely to be spotted and addressed before they materially affect the survey.

Project coordinators, who have been trained in quality control procedures, usually conduct the QC resurveys. However, since the QC survey itself is a recount and resurvey of an original field survey, an experienced survey technician, other than the original surveyor, could perform the QC survey, if necessary. In 2002, the project coordinators performed all QC recounts of sites.

QC surveys are to be completed only after the technician survey is completed and without the prior knowledge of the surveyor. A complete QC resurvey includes a complete recount of litter on the site following almost all of the same procedures used by the survey technicians. Two differences in procedure are that QCs do not put the data on tape for a QC survey and they do not photograph the site. Because they are thoroughly familiar with the datasheet and litter classifications, project coordinators use a clipboard and datasheet on the site to record the recounts. This saves time and labor by eliminating the data transcription step. Since the site has already been surveyed, it is unnecessary to create another tape as primary documentation of the survey. Some reasons for tape recording the original survey data are:

- The tapes provide primary documentation of the survey. Sounds of wind, traffic, and other road noise authenticate the field data collection.
- The recorder facilitates more speedy coverage of the site. This increases surveyor safety by reducing the amount of time spent walking on the roadside and increasing the amount of free attention available for awareness of oncoming traffic.

Since in most cases a second set of site photos is unnecessary, the QCs do not photograph the sites unless the original surveyor was unable to do so.

Sites are chosen for QC resurvey in a somewhat random fashion based upon several practical considerations, as follows:

- Project coordinators are required to QC two sites per county. Every effort is made to QC one fixed and one variable site in each county due to differences in the application of the methodology with each of these site types. This practice was followed in every county in the 2002 survey.
- Another consideration is the availability of completed sites at times when the project coordinator can reach the site soon after the survey. In order to minimize the effects of intervening variables and yield accurate count comparisons, resurvey counts are conducted as soon as possible after the survey. Most are performed within hours of the survey and a few are completed the following morning, if the QC could not get to the site at the end of the previous day. All QC surveys are performed within 24 hours of the initial survey. After 24 hours, the site would only be checked to verify if it was in the correct location and if the dimensions of the site were correct.

Other QC field tasks include:

- Checking rejected sites and additional sites randomly as resources permit. Often the project coordinators pass by or near other sites on their route of travel and will check the site without doing a complete recount. This is especially important in the first two weeks when surveyors are new to the job and developing their routine. During that time, it is recommended that QCs check every rejected and every variable site, if possible. In 2002, the project manager and project coordinators checked from four to eight sites per surveyor during the first week of the survey. It is most important to check the application of the rejection criteria and the accuracy of the site location and set-up dimensions early in the fieldwork.
- Providing a field resource to surveyors in case they have questions, equipment failure, or an emergency. The project coordinators carry spare equipment to resupply surveyors and may also assist when vehicles are disabled or other unforeseen circumstances arise.

## **REVIEW OF FIELD PROCEDURE AND DOCUMENTATION**

Each week when the survey team returns to the office, the project coordinators and other research staff conduct a number of procedures designed to assure complete and accurate documentation of the survey and the quality of the survey data. Once all field documentation has been completed and the data transcribed, the project coordinators meet with the survey technicians individually to review all data and supporting documentation, compare it to the QC data, and discuss any differences and deficiencies. Items reviewed include:

- Data sheets- Checking to assure that all fields are complete and pass 1, pass 2, and small litter data have been totaled.
- Site directions- Checking for directions to the actual location as found and surveyed, or, reasons for rejections.

- Mileage and time logs and time sheet- Checking for a complete time and travel record that documents the order in which sites were surveyed.
- Site photos- Reviewing for technique and quality as well as whether the photo demonstrates adherence to the methodology, such as whether the site was properly set up as a fixed or variable site.
- Identifying instances of differences between the survey data and the QC data and discussing and ascertaining the reasons for the differences, if possible. Recording the possible reasons for large differences, e.g., rainy, windy, could not stretch a string, a long interval between the survey and the QC survey, etc.
- Computing difference totals using the formula:  $\text{QC count minus survey technician count divided by the QC count times 100 equals the percent difference}$ . Most surveys should be in the plus or minus 5 – 15% range. Differences exceeding 15% are more closely reviewed. Such count differences may indicate the need for additional technician training or may need to be resolved through resurvey.
- Data transcription- Retranscribing the taped data of a site and comparing it with the surveyor's data sheet for accuracy of transcription, litter categorization and methodology. In the first several weeks, it is important to listen to the data taping procedure and retranscribe the recorded data from at least one site per surveyor weekly, more if resources permit. Once it is apparent that surveyors have mastered taping and transcription, tapes are periodically spot-checked, as indicated by general surveyor performance.

## **DATA ENTRY QUALITY CONTROL**

The data is entered into a database each week as it comes in to the office. Quality control measures in the data entry process are as follows:

- As they are entered into the database, each data sheet is numbered consecutively and initialed in red in the upper right corner by the person entering the data. Any data sheets containing omissions are pulled out, reviewed, and filled in completely prior to entry. Project staff resolve data omissions through site documentation review, technician interview, or by revisiting the field site if necessary.
- Each week, following the data entry for that week, the database manager or data entry research assistant generates a printout of the data set for each site. The printouts of data entered into the database are then compared manually to the original data sheets by a person other than the one who initially entered the data. Any errors are marked in red and the entries in the database are corrected.
- For any corrected entries, a second printout is generated and the data entry for that site is rechecked for accuracy.