

**Assessment of Roadside Litter  
Island County, Washington  
2005**

W.O. # 1212  
Tasks 2 and 3  
Final Report

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## **EXECUTIVE SUMMARY**

We conducted a baseline assessment of roadside litter in Island County in June-October 2005. The primary goal was to determine major sources of litter to assist the Environmental Health Action Team in targeting and evaluating litter reduction efforts. Follow-up surveys at the same sites are planned for subsequent years.

Litter was collected and tallied at 22 survey sites, 5 on north Whidbey, 6 central Whidbey, 7 south Whidbey, and 4 on Camano Island. Of these, 13 sites were within one mile of a fast food restaurant or convenience store, 5 were in sight of a school, 6 were located along a state highway, 2 on major arterials, 5 on less busy arterial roads, and 4 along minor rural roads. Mowing, which mulches litter items into many pieces, affected 19 sites.

Each survey site was approximately 100 meters long with the length adjusted to visible landmarks to facilitate repeat surveys of the same location. Site width was determined by landscape features that trapped litter. Overall amount of litter at each site was quantified by counting each item. All items counted were collected. Each item was counted only once, i.e., under only one category. Objects greater than 1-inch in diameter were defined as "large" litter in this study and were classified into one of 80 categories. A "Small Item Survey" was conducted on approximately 10% of each survey site. This area was scanned minutely and all visible litter was collected, with items less than 1-inch in diameter defined as "small" and classified into one of 14 separate categories. While collecting larger litter from the rest of each site, workers also collected "small" litter optionally; these items were recorded separately.

In all, 6,494 pieces of litter were collected and catalogued. Of these, 3,695 (57%) were in the large litter categories. Fast food items (snacks, takeout, and fast food; 1169 items) made up 32%, or one third, of large litter. Another 25% of large litter objects were miscellaneous items of paper, cardboard, plastic, and glass whose original purpose could not be identified. Product packaging accounted for 13%, beverage containers for 9%, and debris items (debris from vehicles, road and building construction, and a wide assortment of items from home or garden) for 9% of large litter. The remaining 12% included printed paper, retail bags and boxes, and non-beverage containers. Overall, the most abundant single litter category was packaging for snack food (828 items: bags and wrappers for

chips, cookies, candy bars, gum, cereal bars, toaster pastries, muffins, etc.). This trend was consistent across sites; among large litter from 21 of the 22 surveys, snack packaging ranked either first or second in quantity. Other items numbering first or second at a site were beer cans and bottles (3 sites), paper food wrap (1 site), condiment packages (1 site), paper towels/napkins/tissue (1 site), printed paper (4 sites), cigarette packages (1 site), miscellaneous plastic film (6 sites), and home or garden items (2 sites).

Certain "large litter" categories were found commonly across the 22 sites surveyed. Home/garden items were recorded at all sites, snack packaging at 21 sites, and cigarette/cigar packages at 20 sites. Other items common to a majority of sites were beer and soda cans, all categories of paper, miscellaneous plastic film, plastic packaging, plastic retail bags, plastic sandwich bags, plastic water and soda bottles, plastic cup lids and plastic container lids, and paper cups.

In the designated "Small Item" surveys, 1,447 objects (22% of all litter) were collected. Most numerous overall were cigarettes (631). More than a third of these were from a single site, but cigarettes were still the most abundant small litter item in 10 of the "Small Item" surveys. Other small litter items found in the highest quantity were candy wrappers (223), paper pieces (127), and plastic film (101). An additional 1,352 "small" objects (21% of all litter items) were collected on the 90% of each site outside the "Small Item" survey area. Among these, cigarette butts (874) and polystyrene peanuts (297) were found in highest quantity. Looking at all 2,799 small items to see what litter types were found commonly across different areas, cigarette butts (1,505) were collected at 21 sites, polystyrene peanuts (358) on 18 sites, straws (70) on 16 surveys and bottle caps (62) at 17 sites.

Survey locations with the highest quantity of litter were Highway 20 north of Oak Harbor (south of the intersection with Regatta Drive) and the four sites on north, central and south Whidbey next to secondary schools. On the basis of these 22 surveys, packaging from snacks, fast food and takeout food appears to be the major source of larger roadside litter in Island County. It is abundant and widespread. Cigarette filters are the most common and most numerous small litter item overall.

## **I. Introduction**

The goal of this study was to conduct a baseline assessment of roadside litter in Island County in order to assist the Environmental Health Action Team in targeting and evaluating litter reduction efforts. We determined there would be a minimum of 16 survey sites, 4 each on north, central and south Whidbey Island and 4 on Camano Island. A survey protocol was needed to quantify and qualify the amount and categories of litter and to ensure consistency among sites surveyed.

I studied methods used in litter surveys in Washington State (one conducted by Washington Department of Transportation, the other by Washington Department of Ecology), Ohio, Florida, and Prince Edward Island (copies are on CD, Task 2.A. Background Research). These used a variety of techniques. After reviewing them and conducting five preliminary surveys (on CD, Task 2.B. Pilot Surveys) plus one litter pickup with WSU Waste Wise volunteers of their 2-mile stretch of Hwy 525 in Clinton, we developed the methods used (on CD, Task 2.C. Survey Protocol).

Primary goals of this assessment were:

1. Quantify overall amount of roadside litter at a survey site.
2. Classify the litter in order to target reduction efforts toward the probable source.
3. Select sites and develop a protocol to allow for multiple repeat surveys of the same sites over several years.
4. Conduct surveys with the assistance of community volunteers.

Methods were needed that would achieve our goals within the budget limitations of the project and the degree of effort reasonable to ask of volunteers.

## **II. Methods**

Due to the small sample size this project entails, we knew it was not possible to apply rigorous scientific method involving randomization of sites. Instead we targeted sites to represent a variety of road types and locales as well as the geographic range required.

In each of the four geographic areas we looked for sites to meet the following criteria:

- a) near a school
- b) along a highway or major arterial
- c) near a shopping center or other area of heavy use
- d) in a quiet, rural residential area

During pilot surveys we realized that sites also needed to meet these requirements:

- e) a survey should preferably take about an hour to complete
- f) because we will be conducting repeat surveys at the same site, we wanted to clean a site as thoroughly as possible each time
- g) each site needed to be reasonably accessible and to have a catchment point to keep litter on-site. (For example, preliminary site CW-B was along the top of a steep embankment. Most litter rolled or blew down the slope and was not accessible, so this was not a good site.)
- h) safety concerns required a sufficiently wide road shoulder and adequate view of approaching traffic

### **PROTOCOL**

Instructions for conducting the litter survey are in Attachment 1. Field data was recorded using Attachment 2a: Litter Survey Form, Attachment 2b: Site Documentation Form, and Attachment 2c: Site Map. We determined that each survey site would be approximately 100 meters (300 feet) long, with the length adjusted to visible landmarks to help subsequent surveyors find the same area on repeat visits. Site width was determined by landscape features that trapped litter (fence, forest edge, dense shrubbery, etc.) Each item of litter larger than 1" diameter would be collected and counted on the survey form under one of 80 "large litter" categories.

It is standard for litter surveys to sample some portion of the whole site for small litter. We determined that a "Small Item Survey" would be conducted along 10% of the route, beginning at either end. This area would be completely cleaned of all visible litter, with items smaller than 1" diameter tallied under 14 categories in a separate section of the survey form. Over the remainder of each survey site, items less than 1" would be collected and recorded optionally, but would be tallied separately so as to be

distinguishable from items found in the designated "Small Item Survey". Table 1 contains a description of items that belong under each litter category. All items counted were collected. Each item was counted only once (i.e., under only one category).

To be able to return to the sites to conduct follow-up surveys, each site was mapped, characterized and photographed and GPS coordinates recorded (see Task 3 files on CD). A hand-drawn map of each site was created to show landmarks and record other features needed to facilitate replication. Measurements and compass bearings recorded on field forms are not exact but are estimates intended for general information. These maps are on the disc as jpg files under Task 3. Site Maps.

### **III. Results**

The contract required 15 litter assessment surveys divided among the four geographic areas. In the end we conducted 22 site surveys, 5 on north Whidbey, 6 central Whidbey, 7 south Whidbey, and 4 on Camano (Table 2).

Different reasons led to the addition of more sites in some regions. NW5 had so little litter it was not useful for analyzing litter composition. After observing a large quantity of litter immediately on the other side of the fence boundary for CW1, we decided to survey that site as well but not to consider it as representative of one of the 4 primary central Whidbey sites. Also on central Whidbey, we wanted a sample near the Transfer Station and conducted 2 surveys in this area, CW3 and CW5. On South Whidbey two contiguous survey lengths were done along Highway 525 just south of Ken's Korner, SW4 and SW5, to be able to compare two nearly-identical sites. The Campbell Road site, SW6, was chosen to represent the rural residential area, but it had almost no litter directly beside the road and a huge number of alcoholic beverage containers in the woods a short way off the road. Because SW6 seemed an anomaly that might skew some of the analysis, we asked a trained volunteer to conduct an additional survey on French Road (SW7).

#### **SITE CHARACTERISTICS**

Characteristics of each site location can be found on the CD in the Excel file "Survey Site Descriptions" under Task 3/Site Data. Some of the variation among sites is captured in Table 3. Thirteen sites were within 1 mile of a fast food restaurant or

convenience store. On Camano the school site (CW2) was by an elementary school because older students are bussed to off-island schools. On Whidbey, sites NW1 and SW2 were in proximity to high schools and CW1 and CW2 were across the street from Coupeville middle and high schools.

The remaining sites were situated along a variety of road types: six along a state highway (CW3, CW5, NW4, SW1, SW4, SW5), two along major arterials (CA1, NW3), five on roads with significant arterial traffic (CA3, CW4, NW2, SW3, SW7) and four along minor rural roads (CA4, CW6, NW5, SW6).

Mowing of the grass road verge affected 19 sites. Mowing mulches litter items into many pieces.

#### **LITTER CHARACTERISTICS**

In all, 6,494 pieces of litter were collected and catalogued. Of these, 3,695 (57%) were "large" litter items (>1" diameter), 1,447 (22%) were items <1" diameter collected in the designated "Small Item" survey areas, and 1,352 (21%) were small items picked up in the other 90% of each survey site. The difference between the two categories of small items is that at all 22 sites, the "Small Item Survey" area was searched attentively for every visible piece of litter however small; in the remaining area of each survey site, small items were collected with varying rigor depending on the time, interest and stamina of the worker picking up that site. At least some cigarette butts, though not necessarily all present, were collected outside the "Small Item" area on 15 of the 22 sites. Other small objects commonly picked up on the rest of a site were polystyrene peanuts, straws and bottle caps. Because the collection of small items outside the "Small Item Survey" was optional and variable, these items have been omitted from some of the analysis.

The data can be analyzed and interpreted in a multitude of ways. What follows is a sampling of information that can be gleaned from it. The complete database is available on the CD for further analysis.

Each site was examined for which litter items were found in highest quantity on that site (red and green squares on Attachment 4: Annotated Data spreadsheet; on CD under Task 3/ Site Data/ Data\_Analysis file). Out of the 22 sites, packaging for snack food (828 items: bags and wrappers for chips, cookies, candy bars, gum, cereal bars, toaster pastries, muffins, etc.) ranked either first or second at 21 sites. Other items numbering

first or second at a site were beer cans and bottles (3 sites), paper food wrap (1 site), condiment packages (1 site), paper towels/napkins/tissue (1 site), printed paper (4 sites), cigarette packages (1 site), miscellaneous plastic film (6 sites), and home or garden items (2 sites).

Looking at large litter categories that were found commonly across the 22 sites surveyed (Table 4): "home/garden items" were found at all sites, "snacks/candy/cookie/gum packaging" at 21 sites, "cigarette/cigar packages" at 20 sites. Other items common to a majority of sites were beer and soda cans, all categories of paper, miscellaneous plastic film, plastic packaging--food, plastic packaging--other, plastic retail bags, plastic zipper/sandwich bags, plastic water and soda bottles, plastic cup lids and plastic container lids, and paper cups.

A wide range of objects was recorded under the "home and garden items" category, including plant pots, shoes, pens and pencils, cigarette lighters, and artificial flowers. For descriptions of more of these see Attachment 3: Individual Survey Notes; on CD under Task 3/Site Data. We did not find any large items on the order of furniture or appliances. The only objects in all the surveys that did not fit into garbage bags were a few signs on stakes, a 6-foot length of pipe, a plastic gas can, and a piece of vinyl flooring. The rest of the trash collected filled an estimated 27 county Adopt-a-Road litter bags.

There was a fairly even split between alcoholic and non-alcoholic beverage containers (Table 5). When all sites are included in the analysis, 52% of beverage containers were from alcoholic drinks. If the Campbell Road site, an anomaly among sites surveyed, is removed from analysis, 59% of beverage containers found represented non-alcoholic drinks and only 41% alcoholic drinks. For more on Campbell Road, see SW6 under Attachment 3: Survey Notes.

### **LITTER TRENDS**

To examine litter trends, all litter categories on the survey form were classified into eight "major categories" organized according to material usage (Table 6). For each category its percentage of total litter was calculated. The data was examined two ways: 1) all litter items collected (Fig. 1, n=6494), and 2) "large litter" only, excluding litter recorded as "Small Items" (Fig. 2, n=3695). The "large litter" analysis excluded

cigarettes, which comprised almost one quarter of all litter items collected during the surveys.

Because a clear distinction was not made during field surveys between candy and gum wrappers tallied on the survey sheet under 13.4 ("candy wrappers") and under 9.1 ("snacks/candy/cookies/gum packaging"), for analysis all candy and gum wrappers collected outside the "Small Item" survey area were included under 9.1 For more information see Attachment 4: Annotated Data worksheet.

### **Litter Items by Material Usage (Figs. 1a, 1b, 2a, 2b)**

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 constituted 5% of all litter items identified, 9% of large litter.

Non-Beverage Containers include jars, bottles, boxes, cans and lids which are not related to any type of beverage. Non-beverage containers constituted 1% of all litter items and 1% of large litter.

Fast 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. In general these items are disposable and are made of plastic, paper or polystyrene. This category also includes paper food/fast food bags, plastic zipper/sandwich bags, and plastic/polystyrene "clam shell" containers. Fast food items made up 23% of all litter collected, 32% of large litter.

Product Packaging includes all types of packaging associated with a product when it is removed from the shelf at a retail store. Product packaging constituted 8% of all litter items, 13% of large litter.

Outer Packaging includes bags or boxes into which items from stores or restaurants are placed. Examples are: corrugated cardboard box, paper retail bag, paper bag other, plastic retail bag and plastic bag other. Outer packaging constituted 2% of all litter items, 3% of large litter.

Printed Paper Items include newspapers, books, magazines, advertisements, school or business papers, letters, receipts, public notices, business cards and lottery tickets. Printed paper items constituted 5% of all litter items, 8% of large litter.

Debris Items include roofing, tarpaper, insulation, lumber, construction debris, road debris, vehicle debris, tire pieces, textiles and home items. Debris items constituted 5% of all litter items, 9% of large litter.

Miscellaneous Items include all items made of paper, paperboard, cardboard, plastic, plastic film, polystyrene foam and glass that cannot be specifically identified. Miscellaneous items constituted 28% of all litter items, 25% of large litter.

Cigarette butts comprise a significant proportion of overall number of litter items found, so it seemed worthwhile to consider them. (Tobacco product packaging is included under the product packaging category.) Cigarettes constituted 23% of total litter items counted. However, this number under-represents the quantity of cigarette filters on the survey sites since they were sometimes collected only in the "Small Item" 10% portion of the survey area. (Cigarettes were not included in large litter analysis.)

### **Litter Items by Material Type (Figs. 3a and 3b)**

Another way of looking at litter trends is to examine the material that litter items are made of. For this the litter categories were classified into seven "major categories" organized according to material type: aluminum, composite, glass, paper, plastic, steel and mixed (Table 7).

Aluminum items accounted for 2% of litter counted.

Beverage containers in three categories are made of composite materials: aseptic boxes, foil pouches, and gable top paper containers. These constituted less than 1% of the litter items.

Glass items accounted for 3% of the litter.

Paper includes all kinds of paper and cardboard. Paper items constituted 16% of litter collected.

Plastic includes a wide variety of plastics, from those used in condiment packaging and plastic cups to polystyrene foam, plastic utensils, plastic bottles, and plastic bags. Plastic items accounted for 27% of the litter.

Only two litter categories fall under steel: aerosol cans and steel cans. No aerosol cans were found, and steel cans constituted less than 1% of litter found.

Mixed items may be made from an assortment of materials and include such categories as container lids, snack, candy and gum packages, cigarette packs, and most debris items. Litter falling into the mixed category constituted 52% of all items recorded.

In the designated "Small Item" surveys, 1,447 objects (22% of all litter) were collected (Figs. 4a & 4b). Most numerous categories were cigarettes (n=631), candy wrappers (n=223), paper pieces (n=127), and plastic film (n=101). An additional 1,352 "small" objects (21% of all litter items) were collected on the 90% of each site outside the "Small Item" survey area (Attachment 4). The number of these additional small items collected at a single site ranged from 3 to 551. Cigarettes (n=874) and polystyrene

peanuts (n=297) were found in highest quantity. Looking at all 2,799 small items to see what litter types were found commonly across different areas, cigarette butts (1,505) were collected at 21 sites, polystyrene peanuts (358) on 18 sites, straws (70) on 16 surveys and bottle caps (62) at 17 sites. Cigarettes were found in especially high quantity at CW 1 and CW 2 (Terry Road), NW3 (Ault Field Road) and NW4 (Highway 20 north of Frontier Industries). Although cigarettes were the item found in highest numbers overall, it should be noted that over 1/3 of all cigarettes were collected at one site (NW3) and about 1/5 at another site (CW1), so these sites weight the figures disproportionately. However, cigarettes were still the most abundant small litter item in 10 of the "Small Item" surveys.

Survey sites were ranked by the overall number of litter items collected at each site (Table 8). Survey locations with the highest quantity of litter were Highway 20 north of Frontier Industries (NW4), the two Terry Road sites across from Coupeville Middle and High schools (CW1 and CW2), Second Avenue next to Oak Harbor High School (NW1) and Maxwellton Road across from South Whidbey High School (SW2).

#### **IV. Discussion**

In consultation with the Health Department during development of this project, we determined that the primary goal of these surveys would be to examine the "quality", i.e., composition, of roadside litter in Island County. We would also quantify litter collected, although the scope of this survey did not allow a randomized design that would enable scientific comparisons of overall amount of litter across the county. However, over time we may be able to see trends in litter quantity at a given site after multiple repeat surveys, and the proportions of different categories of litter can be compared among sites. Litter can be quantified by weight, volume, or a count of items in each category. Because the counting method gives the most information about the source of the litter, as each item tallied points to an intentional or accidental act that led to a piece of roadside litter, a count of items was most appropriate to the purpose of this study.

When interpreting litter data, one should keep in mind various complicating factors when conducting a field study like this. Some litter on a site might have been missed because it was hidden by obscuring vegetation or fallen leaves, or was in unreachable

places. Many objects are cut into numerous small, and often unidentifiable, pieces by mowers. Wind can also blow litter away from the site where it was originally deposited.

People walking the roadway may have picked up some litter. With the ten sites that were part of Adopt-a-Road or Adopt-a-Highway programs, we could ensure an adequate time after these official pickups for fresh litter to collect. But we cannot control for others who remove litter while walking. Accuracy of our assessment of litter composition might be affected by what items tend to be collected by citizens cleaning up the roadsides. More visible items like cans, bottles and cups may be taken away but such small items as cigarettes, broken pieces of debris, and candy wrappers may be left behind.

Another factor that makes it difficult to interpret quantitative litter data over time is the effect of population trends among residents or tourists. If the number of people traveling the roads continually grows, litter quantities per capita could decrease even as the amount of roadside litter increases. Seeing changes over time in the proportion of different litter categories may be more informative about changing behavior patterns than actual numbers.

Survey locations with the highest quantity of litter were Highway 20 north of Oak Harbor and the four sites on north, central and south Whidbey next to secondary schools. Because of the variation in length and width of sites, such comparisons among sites should be considered cautiously, but are nevertheless interesting.

On the basis of these 22 surveys, packaging from snacks, fast food and takeout food appears to be the major source of larger roadside litter in Island County. It is abundant and widespread. Cigarette butts are the most common and most numerous small litter item. They are an environmental health concern because of the toxins they concentrate and their sometimes-fatal effect if consumed by fish. Cigarette filters are the largest litter category in many nationwide studies. Excellent information on the problem can be found at <http://www.longwood.edu/cleanva/cigarettelitterhome.html>).

## **Acknowledgments**

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## **Additional Attachments (in files on disc)**

- Adopt-a-Highway information acquired for Task 1
- Adopt-a-Road information acquired for Task 1
- Scanned map of each site including written documentation of how the route was done
- Photos of each site showing start, finish, and "Small Item" area.
- Spreadsheets containing Site Descriptions, Survey Data, and Data Analysis