Demonstration of Trash Reduction Technologies in the Anacostia Watershed

(Nash Run Trash Trap Project)

Final Technical Report

Prepared for:
The District Department of Environment

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October 2010

Grant Award Number: 08G-08-IWQAR-WPD03

Grant Award Period: September 15, 2008 through September 30, 2010

Table of Contents

ACKNOWLEDGEMENTS

The author wishes to thank all who have aided in one way or another in the writing of this report, especially my former co-worker and mentor Mr. Steve McKindley-Ward, whose professional critical thinking was very helpful in the design and construction of a successful and sturdy trash trap. I also had the pleasure of working with Mr. John Wasiutynski of the District Department of the Environment (DDOE) and Mr. Stephen Syphax of the National Park Service (NPS) – both of whom provided critical support to the project and demonstrated their commitment to protecting the environment. Because of the technical and financial assistance provided by DDOE and NPS, the Anacostia Watershed Society was able to install the trash trap at Nash Run. While this project was a rewarding success, it required a lot of strenuous work and meticulous sorting and would not have been possible without the tremendous help of volunteers and interns. It is impossible to list the names of all the volunteers who contributed to this project, but I would like to specifically thank the interns that provided their tireless help to maintain the trap over the past year. Lastly, I'd like to say thank you to my co-workers for allowing me to pile up trash bags at the Anacostia Watershed Society's headquarters despite their sometimes unpleasant odor.

2009-2010 interns: Thank you for your help on the trash trap!
Leena A. Chapagain
Grace Babcock
David A. Omidy
Meghan A. Jackson
Peter Hudak
Miguel Sevener
Michael Ellis
Tyler Moulton
Paul M. Dorsey
Andrew S. Sailo
Lindsay A. Johnson
My Ngoc Nguyen
Heyfa Khenissi
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Joey Hager
Hilary Anja-Tanke
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Masaya Maeda
October 2010

EXECUTIVE SUMMARY

Purpose of the Project

The purpose of the project is to install a trash-trap in order to prevent trash from entering the Anacostia River via Nash Run. This will also serve as a model of a relatively inexpensive, highly cost-effective approach for small waterways in D.C. to satisfy the standards established by the Trash Treaty for a Trash Free Potomac by 2013, and it will help the District meet the impending trash total maximum daily load (TMDL) requirements and fulfill the U.S. EPA's Strategic Plan objective 2.2 – "improving water quality on a watershed basis."

Anacostia Watershed and Nash Run

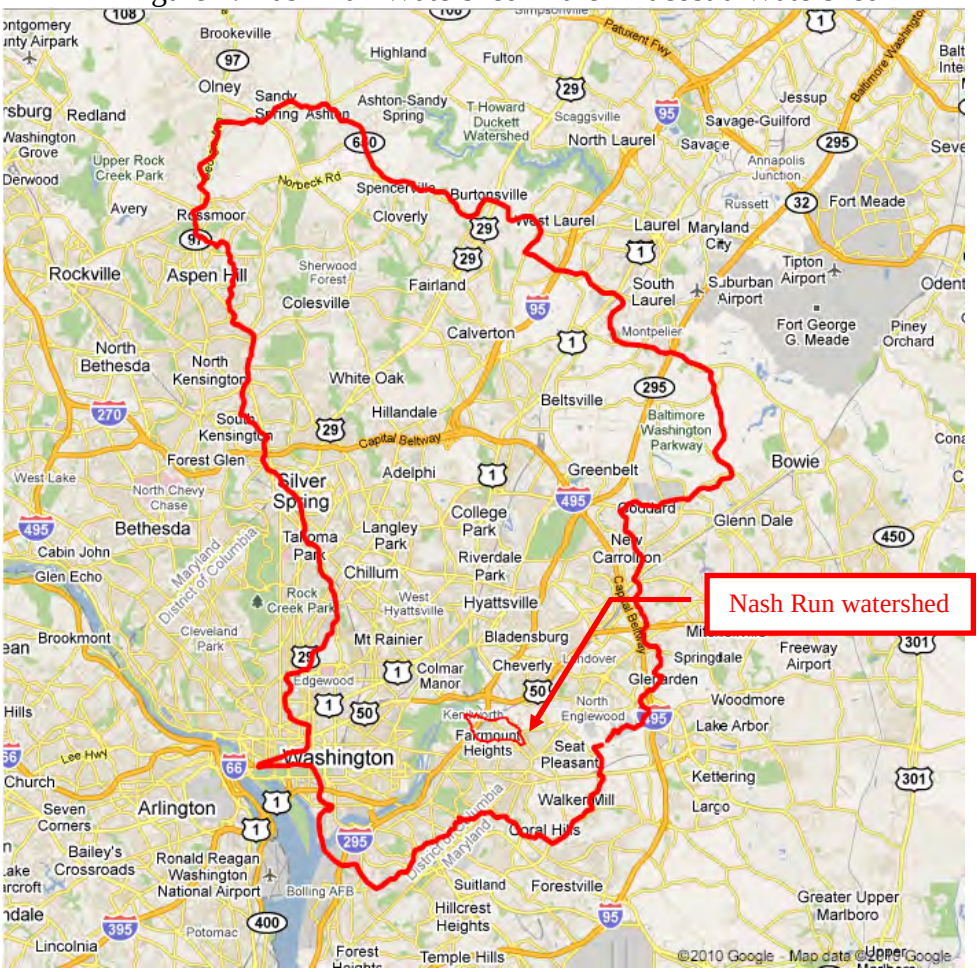
The Anacostia Watershed is approximately 117,353 acres (176 square miles) and encompasses a diverse section of land, with 49% of its drainage area in Prince George's County, 34% in Montgomery County, and 17% in the District of Columbia. Land use is mostly residential or forest land. Nearly a third of the watershed is park and forest lands, which are evenly dispersed throughout the watershed, such as the National Park Service's Anacostia Park and Greenbelt Park, and the U.S. Department of Agriculture's National Arboretum and Beltsville Agricultural Research Center. The industrial and manufacturing land use is largely confined to the tidal area of the basin, such as Hickey Run, Lower Beaverdam Creek, and Indian Creek. These creek sub-watersheds contain impervious land uses as high as 80%.

In the District, the Anacostia Watershed is heavily urbanized. Its municipal separate storm sewer system (MS4) consists of 9,460 acres with 168 outfalls. These drains deposit the region's rainwater into the streams and rivers of the watershed. The remaining area of DC is served by combined sewers that may overflow during rainstorms, discharging sanitary sewage, storm water, and trash to the river.

The Nash Run sub-watershed measures approximately 0.7 square miles (460 acres), with almost two-thirds of the area lying within the District of Columbia. Nash Run exits a storm sewer pipe west of Kenilworth Avenue NE. The 17.5 by 8 ft outfall is located between Douglas and Polk Streets NE. Prior to the outfall, Nash Run is fed by a network of storm sewer pipes – some originating in Maryland. The remainder of the watershed is in Deanwood Park in Prince George's County, Maryland. All but 5% of the watershed is urban residential and commercial property drained by storm drains.[1] The relative location of Nash Run watershed to the Anacostia watershed can be seen in Figure 1. Nash Run flows into Kenilworth Marsh, which is a part of the Kenilworth Aquatic Gardens.

[1] *DISTRICT OF COLUMBIA Final Total Maximum Daily Loads for organics and Metals in the Anacostia River, Fort Chaplin Tributary, Fort Davis Tributary, Fort Dupont Creek, Fort Station Tributary, Hickey Run Nash Run, Popes Branch, Texas Avenue Tributary, and Watts Branch*, by Department of Health Environmental Health Administration Bureau of Environmental Quality Water Quality Division Water Quality Control Branch, August 2003

Figure 1: Nash Run Watershed in the Anacostia Watershed



Trash Trap Location

The Nash Run Trash Trap site is approximately 280 ft west of Anacostia Avenue NE. The closest intersection is Anacostia Avenue and Douglas Street NE. At this location, the stream spreads out into a fan shape. The left fork facing downstream has a perennial flow, and the right fork is an ephemeral stream. The middle section only flows when the water level becomes high. This site was selected because the stream flow force dissipates as the stream fans out at high flow events. Figure 2 shows the location of the Nash Run Trash Trap.

Figure 2: Nash Run Trash Trap Location

Data Collection Protocol

Regardless of size, each trash piece captured in the Nash Run trash trap was collected. Almost every bottle was emptied at the collection. The trash was bagged and brought to the AWS Headquarters. All trash bags were weighed and recorded after collection (Weight-C). The trash was sorted out into 47 categories. AWS followed the trash categorization method, which was created by the Alice Ferguson Foundation and adapted through AWS's 2008 study, *ANACOSTIA WATERSHED TRASH REDUCTION PLAN*[2]. While the modeled study did not include pieces of trash smaller than 1 square inch, we counted and weighed each piece of trash regardless of size. We recorded the number and weight of trash after sorting (Weight-S) for each category. Although the trash was slightly drier after sorting, it was in a similar to condition to when it was collected from the trap because it was kept in plastic trash bags. All bottles were emptied completely at sorting. The average weight loss after sorting compared to Weight-C was about 20%. A producer/vendor identification survey was conducted for some trash categories for trash collected between July 2009 and December 2009. Trash volume characterization was conducted for trash collected between March 2010 and September 2010. Bottles and cans were recycled, and all other non-recyclables were properly disposed.

Re-bar Screen Performance

Initially, AWS used 1" mesh plastic net in the trash trap design in order to capture as many trash pieces as possible. However, some portions of the plastic nets were replaced with a re-bar screen to increase the amount of stream water flowing through the trap and reduce the frequency of flooding. Unfortunately, small trash pieces could not be captured completely with the re-bar screens.

[2] Minor changes were made to the trash category definitions.

In order to understand what trash pieces are captured and not captured by the re-bar screens compared to 1" mesh plastic net, re-bar screen performance was tested. The result is shown in Table 1.

Table 1: Trash Removal Ratio by Re-bar Screen for Each Trash Category

	Trash Category Number	Trash Category	# of trash pieces on re-bar screen	# of trash pieces on plastic net under rebar screen	Trash Removal Ratio by Re-bar Screen (%)
Bottles	1	Liquor	1	0	100
	3	Soft Drink	2	0	100
	4	Water, Plastic	3	0	100
	12	Plates	3	0	100
	13	Foam Packaging	3	1	75
	14	Chunks	14	5	74
	15	Styrofoam Cups	6	0	100
Wrap	18	Food Wrapper	34	18	65
	11	Take Out Food Packaging	1	0	100
Plastic Bags	19	Plastic Bags	3	0	100
Others	20	Cigarette Packs, Matches, Cigars, Tobacco	26	3	90
	24	Drugs	4	1	80
	26	Toys, Balls	2	1	67
	40	Misc. Plastic **Trash**	57	60	49
	41	Lids, straws, tops	12	7	63
	42	Misc. Paper Pieces	9	4	69
	44	Juice Packs	1	0	100

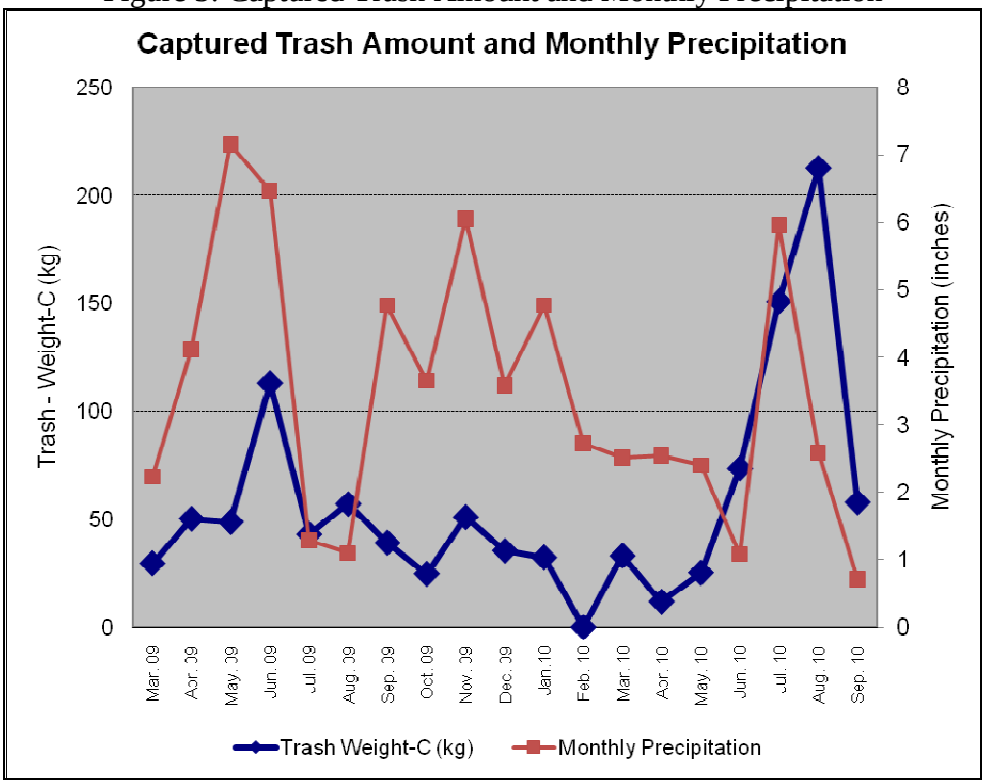
All large trash pieces were captured during manageable rainfall events. A certain percentage of small trash pieces escaped from the re-bar screens. About 51% of Misc. Plastic Trash flowed through the screens. The Misc. Plastic Trash category includes cellophane films. Overall, the trash removal performance of re-bar screen was good.

At this point, there is no known trash trap that is both structurally strong and able to capture all trash pieces regardless of size. A boom type trash trap cannot capture all neutrally buoyant trash pieces. A net type trash trap cannot withstand the fierce stream flow on high flow events. Although every type of trash trap helps to reduce trash in waterways, none of them pose an ultimate solution to trash pollution. The key to achieving such a solution is education, enforceable regulation of pollution, and Low Impact Development (LID) implementation. Unfortunately, LID implementation, which could eliminate stormwater runoff that carries trash to waterways, may take 100 years to be thoroughly introduced throughout a watershed. If LID was comprehensively implemented within a watershed, the majority of trash and debris discarded by individuals would remain on land instead of being carried into the river by stormwater runoff. Furthermore, picking up trash on land is much easier and cost effective than straining trash out of a stream flow.

Precipitation and Trash Load

Figure 3 shows the relationship between the amount of captured trash and monthly precipitation. Generally, there is a tendency to have more trash when there is higher monthly precipitation. However, in September 2009 through January 2010, the trash amount was relatively small compared to monthly precipitation.

Figure 3: Captured Trash Amount and Monthly Precipitation



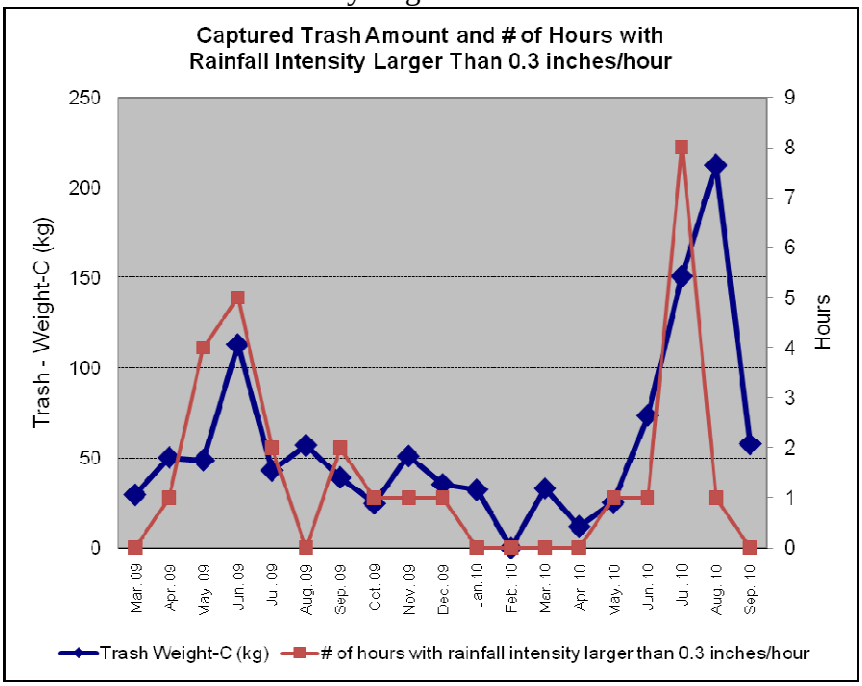
Then the rainfall intensity data was analyzed to understand the relationship between the trash amount and the rainfall intensity. Table 2 shows the number of hours at various rainfall intensity (inches/hour) levels. For example, in April 2009, there were 12 hours of precipitation with intensity more than 0.1 inches/hour. Among the 12 hours, there were 4 hours of precipitation more intense than 0.2 inches/hour. Among those 4 hours, there was 1 hour of precipitation more intense than 0.3 inches/hour.

Table 2: Number of Hours at Various Rainfall Intensity Levels

	Year	2009											2010								
	Month	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9
# of hours with intensity more than (inches)	>0.5	0	0	0	2	2	1	0	1	1	0	0	0	0	0	0	0	0	5	1	0
	>0.4	0	0	0	3	4	1	0	1	1	1	0	0	0	0	0	0	0	5	1	0
	>0.3	0	0	1	4	5	2	0	2	1	1	1	0	0	0	0	1	1	8	1	0
	>0.2	0	0	4	6	9	2	2	9	2	5	2	1	0	1	2	3	2	11	3	1
	>0.1	0	2	12	20	16	3	5	12	5	13	12	9	0	6	5	6	3	12	5	3

At various rainfall intensity levels, the relationship between rainfall intensity and captured trash amount was examined (See Chapter 5). It seemed that rainfall intensity level of larger than 0.3 inches/hour had a relatively strong correlation to the amount of trash collected (See Figure 5-3-4). The only time this correlation seemed weaker was in August 2010 when there were fewer hours of intense rainfall despite the large amount of trash collected. However, this discrepancy might be due to the scattered nature of the precipitation during specific rainfall events in August. Despite the relatively short amount of time in August when the recorded rate of rainfall was equal to or greater than 0.3 inches/hour, staff members and volunteers from AWS observed two major flooding events at Nash Run during this time. Since the precipitation data is collected at National Airport, which is approximately 6.5 miles from the trash trap, it is not necessarily representative of the amount of precipitation for Nash Run.

Figure 4: Captured Trash Amount and Number of Hours with Rainfall Intensity larger than 0.3 inches/ hour



Trash Characteristics by Number of Trash Pieces

Table 3 shows the breakdown of trash by category. The pie chart in Figure 6 shows the make-up of the total pollution captured in the trash trap. From the table and figure, AWS determined that the top ten trash categories comprise 81.9% of the total number of trash pieces.

Interestingly, Food Wrappers and Misc. Plastic Trash (which includes cellophane pieces such as candy and snack wrappers) were the most frequently captured trash items. Neither of these pollutant categories is presently addressed by regulation. Figure 5 shows photos of Food Wrappers and Misc. Plastic Trash.

Figure 5: Food Wrappers and Misc. Plastic Trash

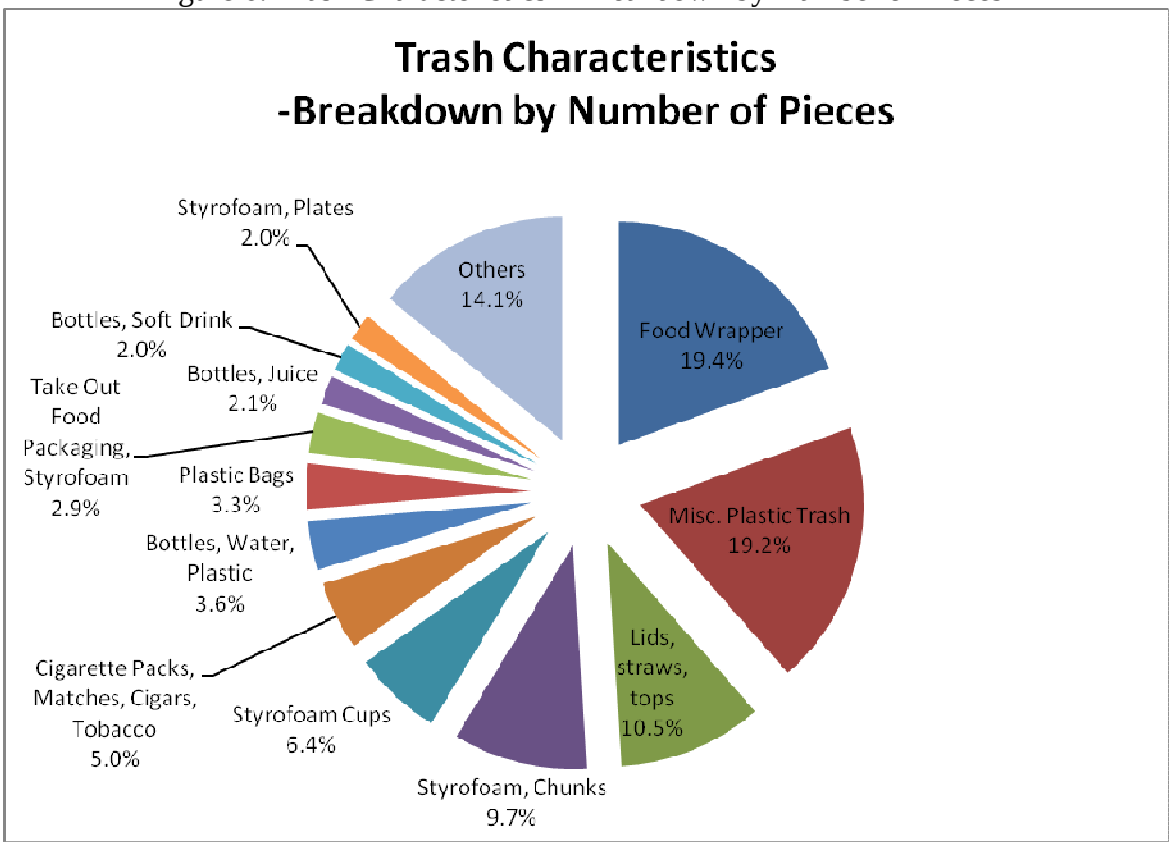
It should be noted that these categories (Misc. Plastic Trash and Food Wrappers) cannot be captured completely by re-bar screen. The removal rate by 1" spaced re-bar screen is 65% and 49% respectively. As a result of the installation of 1.5" spaced re-bar screen, the total number of trash pieces (both removed and free-flowing) in these categories may be close to or more than double.

The Plastic Bags category was the eighth most abundant pollutant found in the trap and comprised 3.3% of the total number of trash pieces. In a report titled ANACOSTIA WATERSHED TRASH REDUCTION PLAN (the Plan) published in 2008 by the Anacostia Watershed Society for the District Department of the Environment, it reported that about 50% of trash in free-flowing streams was plastic bags. This discrepancy can be explained as follows: In the Plan, a surveyor walked along a stream counting visible trash pieces in the stream channel. As a result, the survey demonstrates trash characteristics for the "most unsightly trash in streams," or the trash pieces most visible to the naked eye. Since plastic bags are easily snagged by twigs, branches, and roots, they tend to be more concentrated in streams than other trash items. Because the Nash Run Trash Trap strains the stream flow in order to capture trash, it collects pieces that otherwise would not be caught by overhanging branches, roots, or twigs. This accounts for the seemingly lower ratio of plastic bags.

Table 3: Trash Characteristics – Breakdown by Number of Pieces

Trash Category	%
Food Wrapper	19.4
Misc. Plastic Trash	19.2
Lids, straws, tops	10.5
Styrofoam, Chunks	9.7
Styrofoam Cups	6.4
Cigarette Packs, Matches, Cigars, Tobacco	5.0
Bottles, Water, Plastic	3.6
Plastic Bags	3.3
Take Out Food Packaging, Styrofoam	2.9
Bottles, Juice	2.1
Bottles, Soft Drink	2.0
Styrofoam, Plates	2.0
Drugs	1.8
Cups, Plastic	1.4
Styrofoam, Foam Packaging	1.1
Juice Packs	1.0
Other Metal, Foil Packets	1.0
Cups, Paper	0.7
Broken Glass pieces	0.7
Cans, Beer	0.6
Misc. Paper Pieces	0.6
Toys, Balls	0.6
Bottles, Sports Drink, Plastic	0.6
Construction Material	0.6
Bottles, Liquor	0.6
Home Food Packagin	0.5
Cans, Soft Drink	0.5
Toiletries	0.3
Toys, Misc. Other	0.3
Take Out Food Packaging, Paper and Plastic	0.3
Other Misc. Cartons	0.2
Clothing	0.1
Misc. Plastic Debris	0.1
Cans, Juice	0.1
Beverage Carriers, Rings, Cartons	0.1
Auto Products Containers	0.1
Other Fabric	0.1
Bottles, Beer	0.1
Napkins, Paper Towels, Tissues	0.1

Figure 6: Trash Characteristics – Breakdown by Number of Pieces



Trash Characteristics by Wet Weight

Table 4 shows the breakdown of trash by Weight-S. Figure 7 shows a pie chart of the breakdown by Weight-S. Bottles Juice was the heaviest trash among all categories. This is because juice bottles are often made of glass. Surprisingly, Food Wrappers was the third heaviest trash category, and Misc. Plastic Trash, which includes cellophane pieces, was the 8th heaviest trash category even though each individual food wrapper and plastic trash piece is very light. Additionally, Plastic Bags were 7th heaviest. The top ten trash categories consist of 60.7% of the total trash Weight-S.

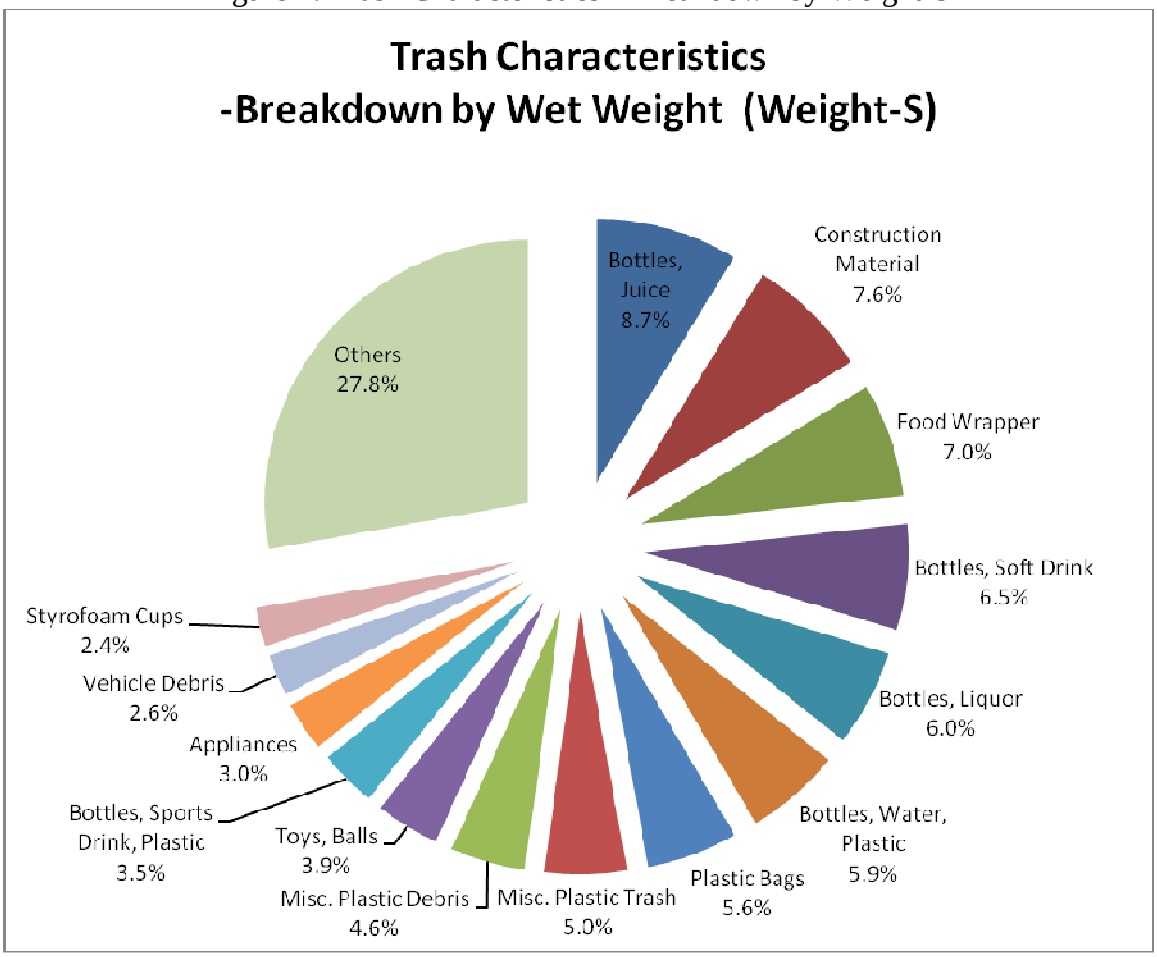
Although Construction Debris was the 2nd heaviest trash category, the number of pieces of construction debris was not significant. This is due to the fact that some Construction Debris pieces, such as wet lumber, were very heavy.

As mentioned in Section **Trash Characteristics by Number of Trash Pieces**, Food Wrappers and Misc Plastic Trash were the most abundant pollutants by number of trash pieces. Both of these trash categories were also among the top trash categories also by weight.

Table 4: Trash Characteristics – Breakdown by Weight-S

Trash Category	%
Bottles, Juice	8.7
Construction Material	7.6
Food Wrapper	7.0
Bottles, Soft Drink	6.5
Bottles, Liquor	6.0
Bottles, Water, Plastic	5.9
Plastic Bags	5.6
Misc. Plastic Trash	5.0
Misc. Plastic Debris	4.6
Toys, Balls	3.9
Bottles, Sports Drink, Plastic	3.5
Appliances	3.0
Vehicle Debris	2.6
Styrofoam Cups	2.4
Lids, straws, tops	2.1
Styrofoam, Chunks	1.7
Cans, Beer	1.6
Bottles, Beer	1.6
Clothing	1.5
Cups, Plastic	1.5
Cups, Paper	1.4
Take Out Food Packaging, Styrofoam	1.3
Napkins, Paper Towels, Tissues	1.3
Juice Packs	1.2
Auto Products Containers	1.1
Cigarette Packs, Matches, Cigars, Tobacco	1.0
Drugs	1.0
Other Misc. Cartons	1.0
Cans, Soft Drink	1.0
Broken Glass pieces	0.8
Styrofoam, Plates	0.8
Toys, Misc. Other	0.8
Misc Large Debris	0.8
Other Metal, Foil Packets	0.7
Toiletries	0.7
Home Food Packagin	0.6
Misc. Paper Pieces	0.5
Newspapers, Magazine, Books	0.3
Other Fabric	0.3
Cans, Juice	0.2
Carpet	0.2
Take Out Food Packaging, Paper and Plastic	0.2
Foam Packaging	0.2
Games, Cassettes, CDs	0.1
Advertising, Signs, Cards,	0.1
Beverage Carriers, Rings, Cartons	0.1

Figure 7: Trash Characteristics – Breakdown by Weight-S

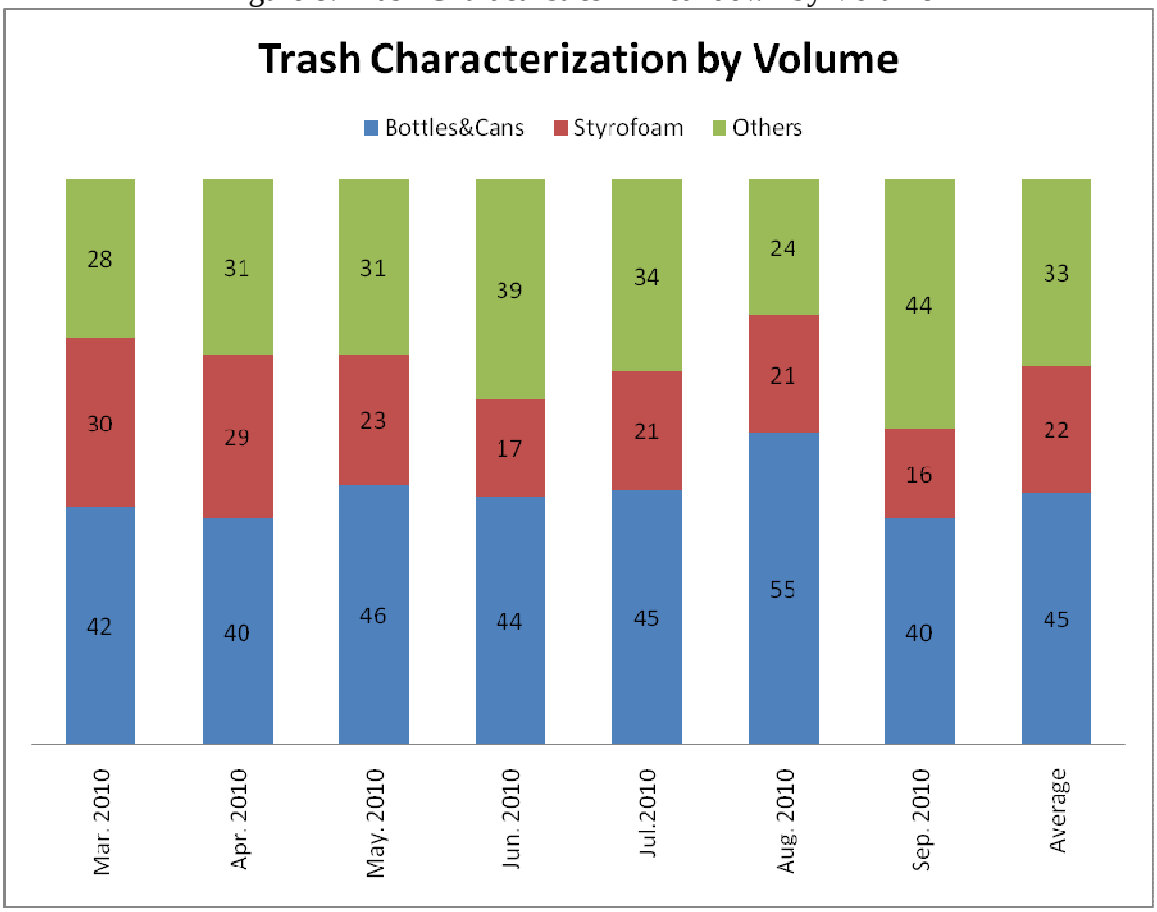


Trash Characterization by Trash Volume

In addition to weighing and sorting, AWS conducted trash volume analysis. Sorted trash pieces were bagged into three major categories for trash collected between March and September of 2010. Then the breakdown of the major categories by volume was measured.

Figure 8 shows the trash characteristics by volume over months. On average, 45% of the trash was Bottles & Cans. About 22% of the average trash volume was Styrofoam. If there were effective measures in place to reduce pollutants, such as a bottle deposit bill and a ban on Styrofoam, about 67% of trash by volume would disappear from all streams.

Figure 8: Trash Charactristics – Breakdown by Volume



Producer/Vendor Identification Survey

In order to understand which vendors are contributing the most to trash pollution, AWS conducted a Producer/Vender Identification survey on some trash categories for trash collected between July and December of 2009.

Table 5 shows the summary of the top ten producers/vendors' contributions to trash pollution. All trash categories were dominated by only a handful companies. Because of this monopoly of pollution, the majority of public resources (tax dollars, private funders' financial resources, volunteers' time, etc) used to conduct trash cleanup efforts benefit only a handful of companies.

Table 5: Summary of Percentage of Top 10 Producers'/Vendors' Contribution to Trash Pollution for Each Trash Category

Trash Category	Percentage by Count for top 10 producers /vendors	Top 10 companies
Bottles Liquor	71.2	Paul Masson, The Smirnoff Co, Spirits Marque one, Sutter Home Winery, William Grant & Sons, Bacardi Bottleing Corporation, CLS Remy Cointreau, Grosscurth Distillers Company, 808 Spirit Co. , Arbor Mist Winery
Bottles Soft Drink	95.9	Pepsi Co, The Coca Cola Company, Canada Dry, Lipton / Pepsi, Dr Pepper/Seven Up INC, TX, Ferolito Vultaggio & Sons, Beverage Marketing USA Inc., American Beverage, Corporation, Lipton, Sunkist Growers Inc
Bottles Water Plastic	91.0	Deer Park Spring Water Company Division of Nestle Waters North America, Inc., The Coca Cola Company, Nestle, Advanced H2O LLC, Bottling Group LLC, Vintage Water Company, CG Roxane, Safeway, Save a lot, Poland Spring Water Company
Bottles Sports Drink Plastic	100.0*	The Gatorade company, Glaceau, South Beach Beverage Co Inc, Sundance Beverage Company, The Coca Cola company, ALDI Inc.
Bottles Juice	95.9	American Beverage Company, Tropicana, Sunny Delight Beverage Company, Sundance Beverage Co., The Coca Cola Company, Welch's, Campbell Soup Company, Dole, Dr. Pepper / Seven Up Inc, King Juice Company Inc.
Cans Beer	92.9	Anheuser-Busch, The Plank Road Brewery, Miller Brewing Co, United Brands Co., The Stroh Brewery, Coors Brewing Co, Olde English 800 Brewing Co., Steel Brewing Company, Budwiser, Drink Four Brewing Company
Cans Soft Drink	88.2	Ferolito Vultaggio & Sons Lake Success, PepsiCo, Dr Pepper / Seven Up Inc. TX, Shasta Beverage Inc., Rerolito Vultaggio & Sons, Safeway, The Coca Cola Company, Arizona Beverage Co., Beverage Marketing USA, Canada Dry Potomac Corporation Landover MD
Styrofoam Cups	93.7	McDonald, Chick Fil-A, 7-Eleven, Dunkin Dnuts, Pop eyes, The Cup Café, Denny's, KFC, Forgers, Sam's Club
Cups Plastic	84.4	McDonald's, 7-Eleven, Taco Bell, Pop Eyes, Starbucks, Chuck E. Cheese's, Carvel Ice Cream, Del Monte Foods, Fudd Ruckers, KFC
Cups Paper	92.9	McDonald's, Wendy's, 7-Eleven, Checkers, Pop eyes, Burger King, The Coca-Cola Company, KFC, ARBY's, Chick Fill A
Food Wrapper	87.6	Frito-Lay Inc, UTZ, Just Born Inc, ConAgra Foods Inc, Mars Snackfood US Inc., The Hershey Company, Wise Foods Inc., Herr's Food Inc., Bickel's Snack Foods Inc., Sunshine Biscuits LLC
Juice Packs	98.6	Wild, KRAFT Foods Global Inc., The Coca-Cola Company, Nestle USA Inc., ALDI Inc, Ardmore, Clover and Dairy, Johanna Foods Inc, Apple & Eve L.L.C, Orchard Gold

*Only 6 producers/vendors are identified for this category.

Summary

- Since it was impractical to remove all types/sizes of trash pieces with a trash trap, it was thought that trash traps – although very important in producing a reduction of trash in waterways – should be considered transitional measures. An ultimate and comprehensive solution to trash pollution would be education, enforceable regulation of pollution, and Low Impact Development (LID) implementation. LID will reduce/eliminate the amount of stormwater runoff that carries trash to waterways. Unfortunately, it would take a significant amount of time for LID to be thoroughly implemented throughout a watershed.

- Both the number of and the weight of Food Wrappers and Misc. Plastic Trash were the highest of all trash categories. Unlike Bottles & Cans and Styrofoam products, these trash categories are rarely addressed/mentioned as major contributors to pollution in the environmental community. An effective measure/effort to reduce these trash items should to be implemented.
- If effective trash reduction measures, such as a bottle deposit bill and a ban on Styrofoam, were implemented, about 67% of trash by volume could disappear from all streams in the watershed.
- All trash categories were dominated by only a handful companies. Because of this monopoly of pollution, the majority of public resources (tax dollars, private funders' financial resources, volunteers' time, etc) used to conduct trash cleanup efforts benefit only a handful of companies.

CHAPTER 1
BACKGROUND

1-1 Anacostia Watershed and Nash Run

The Anacostia Watershed is approximately 117,353 acres (176 square miles) and encompasses a diverse section of land, with 49% of its drainage area in Prince George's County, 34% in Montgomery County, and 17% in the District of Columbia. Land use is mostly residential or forest land. Nearly a third of the watershed is park and forest lands, which are evenly dispersed throughout the watershed, such as the National Park Service's Anacostia Park and Greenbelt Park, and the U.S. Department of Agriculture's National Arboretum and Beltsville Agricultural Research Center. The industrial and manufacturing land use is largely confined to the tidal area of the basin, such as Hickey Run, Lower Beaverdam Creek, and Indian Creek. These creek sub-watersheds contain impervious land uses as high as 80%.

In the District, the Anacostia Watershed is heavily urbanized. Its municipal separate storm sewer system (MS4) consists of 9,460 acres with 168 outfalls. These drains deposit the region's rainwater into the streams and rivers of the watershed. The remaining area of DC is served by combined sewers that may overflow during rainstorms, discharging sanitary sewage, storm water, and trash to the river.

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Though Nash Run is a small watershed, it empties a large amount of trash into the Anacostia River via Kenilworth Marsh. In a study[2] conducted by the Anacostia Watershed Society (AWS) for the District Department of the Environment (DDOE), Nash Run had the highest number of trash items per 100 linear ft of any of the streams

[1] *DISTRICT OF COLUMBIA Final Total Maximum Daily Loads for organics and Metals in the Anacostia River, Fort Chaplin Tributary, Fort Davis Tributary, Fort Dupont Creek, Fort Station Tributary, Hickey Run Nash Run, Popes Branch, Texas Avenue Tributary, and Watts Branch*, by Department of Health Environmental Health Administration Bureau of Environmental Quality Water Quality Division Water Quality Control Branch, August 2003

[2] *ANACOSTIA WATERSHED TRASH REDUCTION PLAN*, prepared for District of Columbia Department of the Environment, Prepared by the Anacostia Watershed Society in December 2008.

monitored in the study. A graph of annual average trash for various streams in D.C. is excerpted from the report in Figure 1-1-3.

Figure 1-1-1: Nash Run Watershed in the Anacostia Watershed

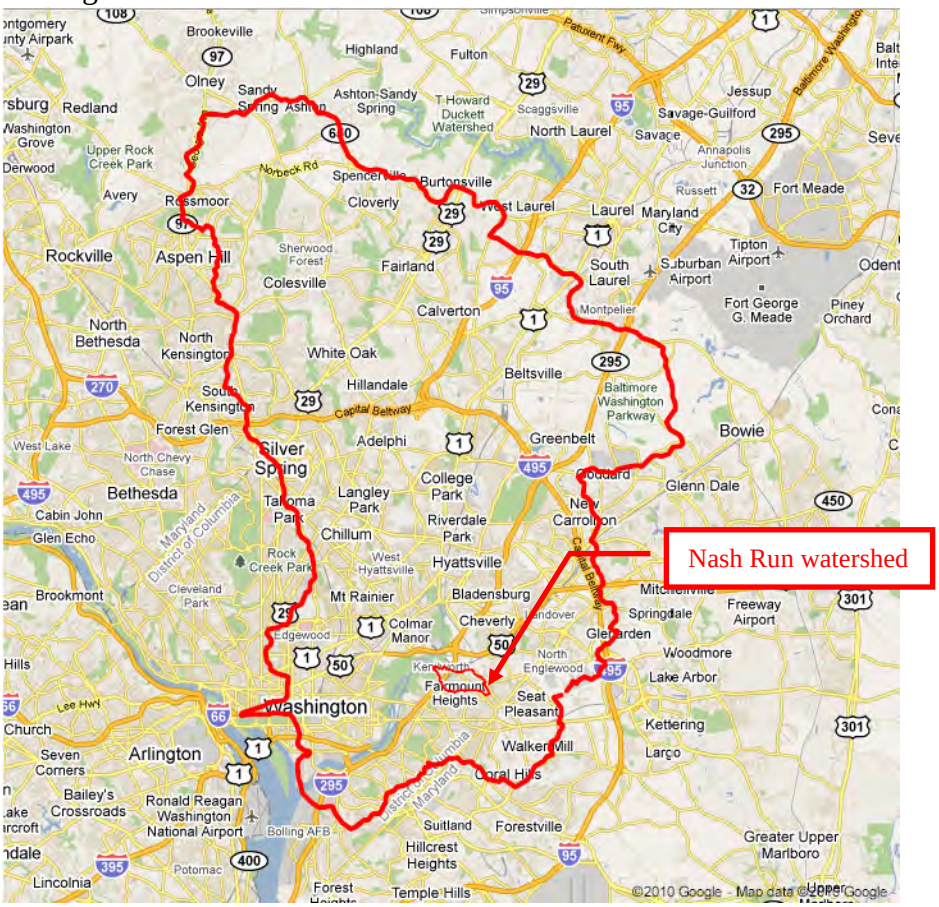


Figure 1-1-2: Nash Run Sub-Watershed Boundary

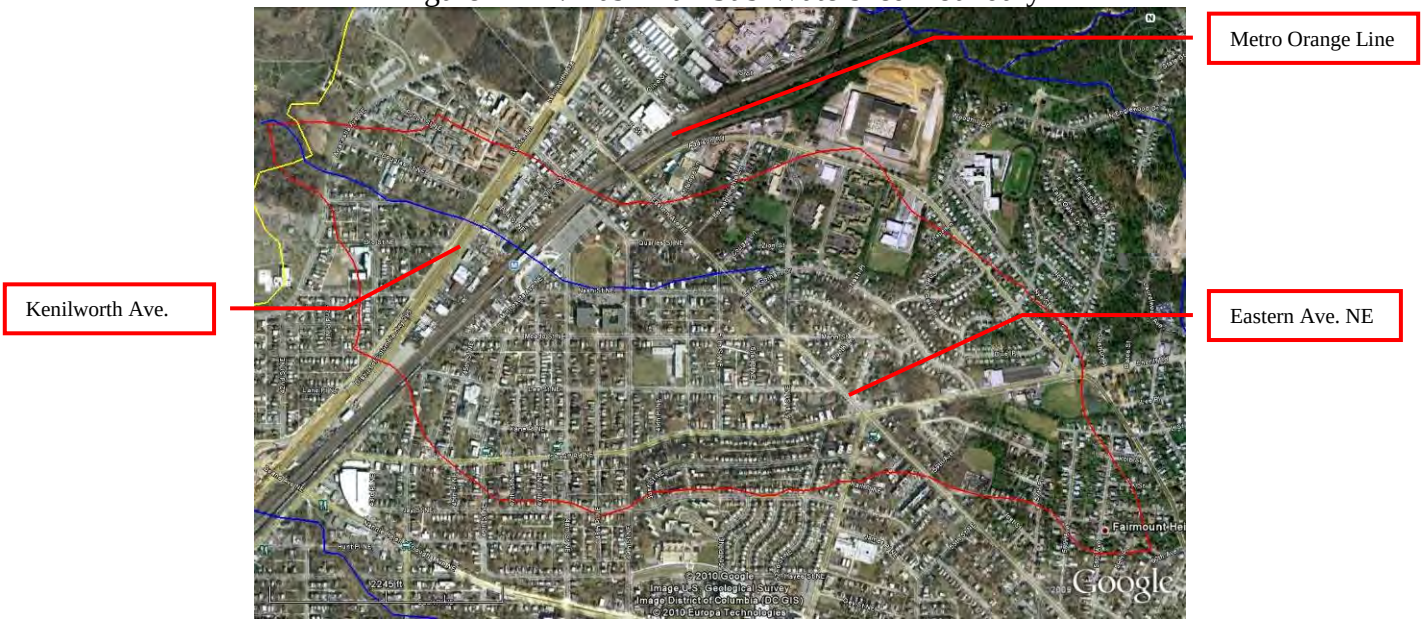
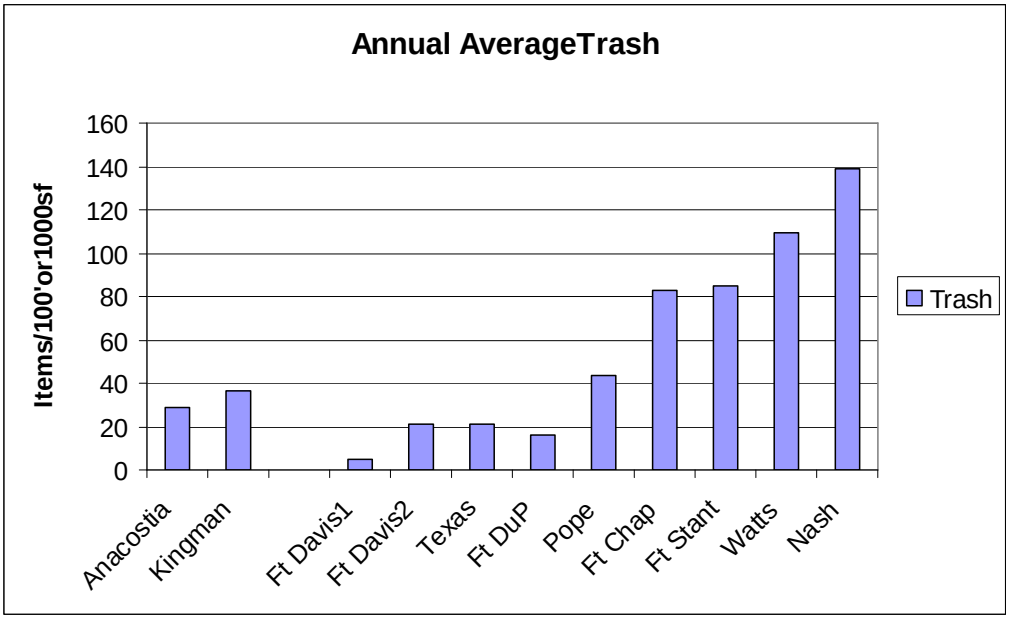


Figure 1-1-3: Annual Average Trash



1-2 Purpose of the Project

The purpose of the project is to install a trash-trap in order to prevent trash from entering the Anacostia River via Nash Run. This will also serve as a model of a relatively inexpensive, highly cost-effective approach for small waterways in D.C. to satisfy the

standards established by the Trash Treaty for a Trash Free Potomac by 2013, and it will help the District meet the impending trash total maximum daily load (TMDL) requirements and fulfill the U.S. EPA's Strategic Plan objective 2.2 – "improving water quality on a watershed basis."

CHAPTER 2
Trash Trap Construction

2-1 Site Determination

The Nash Run Trash Trap site is approximately 280 ft west of Anacostia Avenue NE. The closest intersection is Anacostia Avenue and Douglas Street NE. At this location, the stream spreads out into a fan shape. The left fork facing downstream has a perennial flow, and the right fork is an ephemeral stream. The middle section only flows when the water level becomes high. This site was selected because the stream flow force dissipates as the stream fans out at high flow events. This is critically important because many types of trash traps are broken due to strong stream force. Additionally, the site lies in a floodplain. During extreme weather, the stream overflows the floodplain, preventing the trash trap from acting as a dam and causing flooding in the upstream residential area.

2-2 Trash Trap Design

The design of the Nash Run Trash Trap is shown in Figure 2-2-1. Because this is a pilot project, AWS decided to take an adaptive approach and make modifications and adjustments to the trap as needed so that the trap would withstand the stream flow force and capture as much trash as possible. The design shown in Figure 2-2-1 is the original design. The changes made to this design are described later in the chapter.

The trap is designed to allow stream water to dissipate from both ends of the trap at extreme events as shown in Figure 2-2-1. This is necessary to avoid flooding in an upstream residential area. It was also designed so that stream flow could overflow the trap during severe weather events, such as the one on 8/12/2010 when three inches of rain fell in approximately one hour. Although this rapid increase in stream flow caused by rainfall and stormwater runoff allowed trash to escape from the trap, the majority of debris remained captured.

In order to prevent the trap from becoming a fish barrier and allow fish to migrate up/downstream, the bottom of the trap in the water did not have a mesh screen covering the bottom.

A sturdy one-inch mesh plastic net was used to trap trash. While this net was strong enough to hold large amounts of trash, it would break apart during severe weather events, which acted as another safeguard for preventing flooding upstream of the trap.

Figure 2-2-1: Nash Run Trash Trap Design

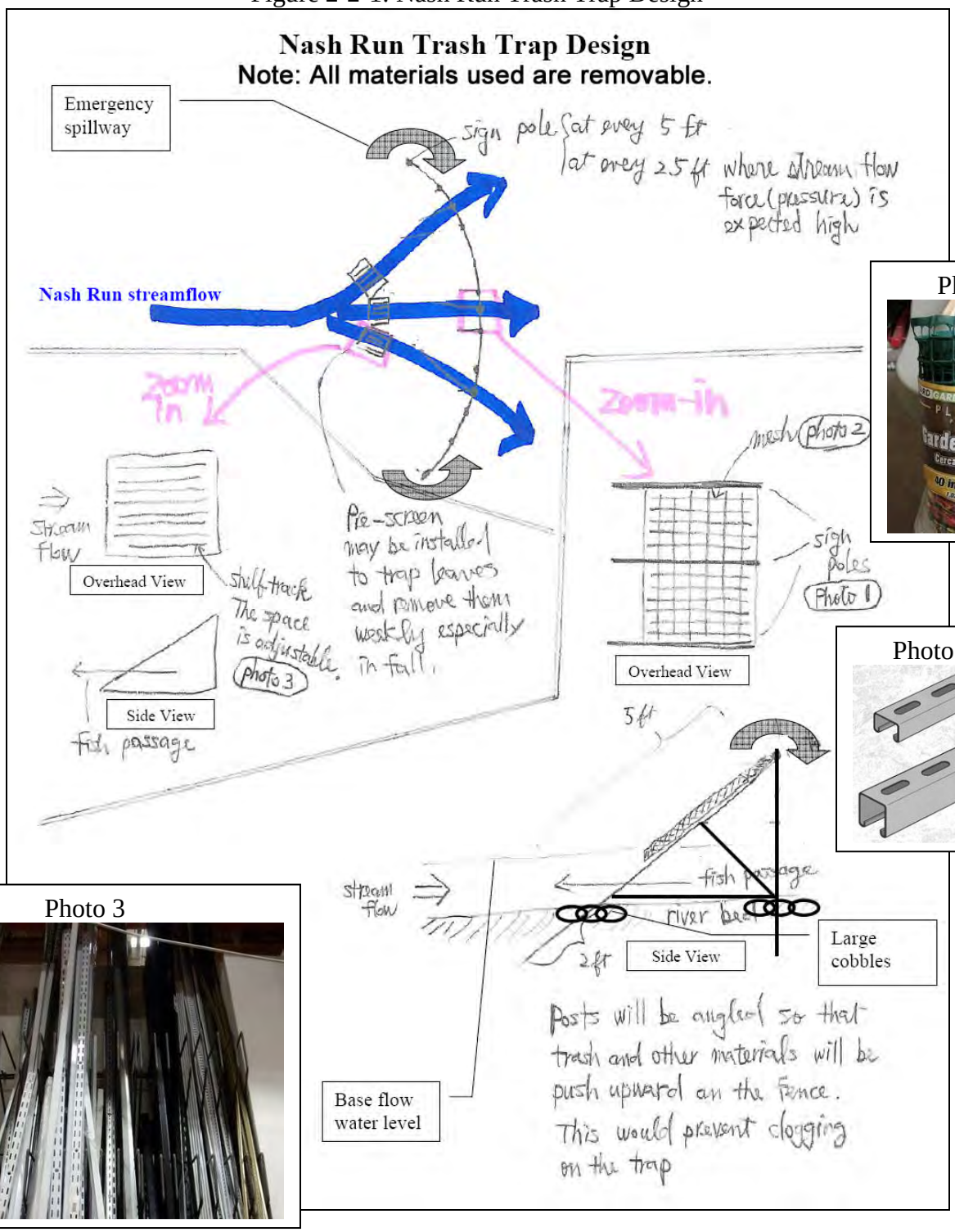


Photo 2

Photo 1

Photo 3

The face of the trash trap was tilted approximately 45 degrees downstream to dissipate force of the stream flow. Many trash traps installed elsewhere are erected at a right angle. However, a right-angle construction would concentrate the stream force onto a metal pole at the riverbed causing the rupture of the pole. To avoid this issue, the AWS trap was specifically erected at a more acute angle.

The distance between the poles was 5 ft where the stream force was weaker and 2.5 ft where the stream force was stronger at high flow events. A pre-screen was designed but never installed due to a concern that it would create additional scouring in the stream.

This trash trap was structurally successful. It withstood extreme events during the project's duration. However, there was no hurricane during this time period, which would have tested the structural strength under the most severe weather conditions.

2-3 Trash Trap Installation

On December 5th 2008, the detailed trash trap installation location was decided as shown in Figure 2-3-1. The red line in the photo shows the imaginary line of a trash trap.

Two AWS staff members started installing the trash trap in February 2009. Initially, AWS planned to involve volunteers in the installation; however, we realized that the procedure was going to be a complex trial and error process. Since we ourselves would have to contemplate how to install the trap and could not give any clear direction to other people, we opted to install the trap without the help of volunteers.

Though we had to take a trial and error approach to install the trap, the installation itself was completed within 2 weeks. Prior to the installation, AWS staff had a long and extensive discussion on how to install the trap and what tools and materials we would use. The total cost of these supplies was approximately $2,000. Additional materials and supplies needed for repairs, modifications, and maintenance cost approximately $2,700.

The construction started on February 2, 2009. A 12-gage metal stake (UniStrut®) was used to construct the trash trap frame because it was locally available, easy to handle, affordable, structurally strong, and is compatible with many other products and accessories. The diagonal and vertical UniStrut stakes were struck into the ground by at least two feet. The triangle frame unit made of UniStrut was structurally strong.

A black net and a green plastic net were both installed to discern which net performs better. The black net was a little difficult to see, so pink tape was tied to it in order to prevent birds from diving into the net and being killed accidentally (See Figure 2-3-4).

Figure 2-3-1: Imaginary Trash Trap in Red Line (photo taken on 12/5/2008)

Figure 2-3-2: Trash Trap Frame Installation

Figure 2-3-3: Trash Trap Frame Installation

Figure 2-3-4: Installation Completion

2-4 Trash Trap Modification and Adjustment

For the first month following its installation, the trash trap worked well. It seemed to be capturing trash very effectively. Figure 2-4-1 shows a photo of the trash captured by the trap after a rainfall event. However, there was a sign of scouring in front of the trap on the right fork. It is seen in Figure 2-4-1 in the bottom right quarter.

Figure 2-4-1: Trash Captured by the Trash Trap (Photo taken on 3/31/2009)

On April 3, 2009, the plastic net was torn apart. Prior to this date, the total precipitation at National Airport was 0.77 inches. The plastic net was ruptured several times in April. The frequency was more than we expected, then we placed a metal fence underneath the plastic net for some "panels" of the trash trap where stronger stream flow force worked.

As we observed the trap longer, we found that the trap may be creating flood events in the flood plain more frequently than used to be though there was no flooding in the upstream residential area thanks to the pressure release design (See **2-2 Trash Trap Design** for the detail). See Figure 2-4-4 for an evidence of a flood event. In the figure, the high-water mark can be seen higher than the flood plain.

Figure 2-4-2: Ruptured Plastic Net

Figure 2-4-3: Metal Fence

Metal Fence was placed just underneath of the 1"inch mesh plastic net. This photo was taken before the plastic net installation.

Figure 2-4-4: Evidence of a Flood Event

The high-water mark can be seen above the flood plain

As soon as mowing season started, the trap started receiving a significant amount of grass clippings. Grass clippings formed a layer on the plastic net to become a filter. The grass clipping filter accumulated small particles of sediment and eventually plastered the trash trap as shown in Figure 2-4-5.

Figure 2-4-5: Plastered Trash Trap and Sampled Grass Clipping

After a series of tests, AWS decided to replace some panels of plastic net with re-bar screen in order to reduce the number of flood events. The prototype re-bar screen is shown in Figure 2-4-6.

Figure 2-4-6: Prototype Re-bar Screen

A prototype re-bar screen was placed on top of the plastic net to see what kinds of trash could be captured and what kinds escape. Other types of screens (bamboo and fishing wire) were also tested but proven ineffective.

On June 23rd, a second phase re-bar screen was installed on the left fork (Figure 2-4-7). While the re-bar screen allowed stream flow to pass through the trap smoothly, it also allowed a portion of small trash pieces to flow through it.

Figure 2-4-7: Second Phase Re-bar Screen

By November 18, 2009, a total of 10 panels of plastic net were replaced with re-bar screen (Figure 2-4-8). Not only did the installation of re-bar screen allow for better stream flow passage, it also allowed the captured organic and trash materials, which collected after moderate-to-severe rainfall events and sometimes plastered the screen, could manually be moved higher up on the rebar screen so that the trap could receive and capture more trash during future rainfall events. This maintenance could be relatively easily done in about 2-3 hours by one person. Prior to the re-bar screen installation, AWS had to clean up the trap every time there was a moderate-to-severe rainfall. Such cleanup events were totally weather-dependent, and therefore, could not be planned far enough in advance to generate volunteers from the general public. The re-bar screen allowed AWS to plan monthly volunteer cleanups, which we have routinely offered to the public since March 2010.

Figure 2-4-8: Re-bar Screen Installation Completion

After several tests to determine the most effective re-bar width, we eventually fixed it at 1.5 inches. One-inch wide re-bar screens got clogged too often and two-inch spaced re-bar screens were not structurally strong enough and released large pieces of trash during even manageable rainfall events.

CHAPTER 3
DATA COLLECTION PROTOCOL

3-1 Overall Trash Data Collection Workflow

The overall workflow is shown below:

Trash collection
Almost all bottles were emptied.
↓
Weighing (Wet weight after collection: **Weight-C**)
↓
Detailed sorting into 47 categories. Trash pieces were counted and weighed for each category. All bottles were emptied completely (Wet weight after sorting: **Weight-S**)
↓
Producer/vendor identification survey was conducted for some trash categories for all trash collected from July 2009 to December 2009.
↓
Trash volume characterization was conducted. Sorted trash pieces were bagged into 3-4 major categories for all trash collected from March 2010 to September 2010.
↓
Bottles and cans were recycled
↓
All other non-recyclables were properly disposed.

Initially, we wanted to calculate the dry weight / wet weight ratio in order to convert wet-weight data into dry-weight data; however, we learned that the wet-weight varies depending upon the season and the duration of time between when the trash was collected and when it was sorted. Since all trash studies conducted for Total Maximum Daily Load (TMDL) development uses wet-weight data, we decided that it would be appropriate to use the wet-weight data for our study as well.

Regardless of size, each trash piece captured in the Nash Run trash trap was collected. The trash was bagged and brought to the AWS Headquarters. All trash bags were weighed and recorded after collection (Weight-C). The trash was sorted out into 47 categories. AWS followed the trash categorization method, which was created by the Alice Ferguson Foundation and adapted through AWS's 2008 study, ***ANACOSTIA WATERSHED TRASH REDUCTION PLAN***[1]. While the modeled study did not include pieces of trash smaller than 1 square inch, we counted each piece of trash and weighed regardless of size. We recorded the number and weight of trash for each category. A producer/vendor identification survey was conducted for some trash categories for trash collected between July 2009 and December 2009. Trash volume characterization was

[1] Minor changes were made to the trash category definitions.

conducted for trash collected between March 2010 and September 2010. Bottles and cans were recycled, and all other non-recyclables were properly disposed.

3-2 Trash Category Definition

Shown below is the Trash Category Definitions used for this study. Each category was given a category number to make the sorting task easier. A tally sheet for the detailed sorting is shown in Figure 3-2-1.

1 Liquor Bottles- Bottles that originally held an alcoholic beverage other than beer, such as wine, vodka, whiskey, rum, or bottled mixed drinks. Includes all sizes and types of bottles from plastic single-shot, mini bottles to large multiple-serving glass bottles. Broken bottles are only included if they are roughly 90% intact.
2 Beer Bottles- Glass bottles that originally held beer or a similar malt beverage. In the absence of a distinguishing label, bottle shape and color were used to determine the original contents. Broken bottles are only included if roughly 90% intact.
3 Soft Drink Bottles- Bottles of any size, usually plastic and rarely glass, which originally contained a non-alcoholic, carbonated beverage. Though not carbonated, tea bottles also fall into this category. In the absence of a distinguishing label or bottle cap, any bottle shaped like a standard soft drink bottle falls into this category even though a small number of these bottles may have contained water or juice. All bottles, whether crushed or torn, are included if they can be identified.
4 Water, Plastic- Plastic bottles originally sold containing drinking water. This category does not include gallon jugs or any larger bottles intended for use with a dispenser. This category also does not include lost re-usable water bottles.
5 Sports Drinks, Plastic- Plastic bottles that originally held a non-alcoholic, non-carbonated beverage commonly marketed for improved hydration during sports (i.e. Gatorade, Powerade). This category also includes "enhanced water," water that has been heavily augmented with flavor, color, or sugars (i.e. Vitamin Water, Propel Fitness Water). These beverages come in a fairly unique style of bottle that makes them easy to distinguish. Rarely, similarly-shaped juice bottles may be attributed to this category if unlabeled.
6 Juice Bottles- Glass or plastic bottles that originally contained a non-alcoholic, non-carbonated beverage marketed as a juice drink, regardless of whether or not the actual beverage contained any real fruit juice. Juice bottles come in many shapes and sizes and are most easily identified by their label.
7 Beer Cans- Metal cans of various sizes, whether flattened or not, that appear to originally have contained beer or a similar malt beverage. This also includes beverages that are beer based, but have additives such as caffeine and may be marketed as a form of alcoholic energy drink. In the absence of a clearly distinguishable label, a best guess of original contents is made based on size, shape, and any remaining label color and patterns; unlabeled cans may be confused with soft drink or juice cans.
8 Soft Drink Cans- Metal cans, whether flattened or not, that originally contained a non-alcoholic, carbonated beverage. This category also includes similarly marketed and

distributed non-carbonated tea (i.e. Arizona Tea). In the absence of a clearly distinguishable label, a best guess of original contents is made based on size, shape, and any remaining label color and patterns; unlabeled cans may be confused with beer or juice cans.

9 Juice Cans- Metal cans that originally contained a non-alcoholic, non-carbonated beverage marketed as a juice drink, whether or not the actual beverage contained any real fruit juice. In the absence of a clearly distinguishable label, a best guess of original contents is made based on size, shape, and any remaining label color and patterns; unlabeled cans may be confused with soft drink or beer cans.

10 Home Food Packaging- Packaging from food traditionally eaten in the home or that would require a special tool to open or prepare. This category includes cans that require a can opener, packets of powdered mashed potato, cake mix boxes, and milk jugs.

11-1 Take Out Food Packaging, Paper and Plastic- Anything used in the packaging of prepared foods, including plastic or cardboard hinged lid containers, disposable lidded containers, and french fry cups.

11-2 Take Out Food Packaging Styrofoam[2]

12 Styrofoam plates- Expanded polystyrene foam plates or parts of plates. In the case of multiple pieces of plate that clearly came from the same plate, the pieces were counted as a singe plate.

13 Styrofoam, foam packaging- Foam packing material such as foam packing peanuts or foam wrapping sheets.

14 Styrofoam Chunks- Miscellaneous and unidentifiable pieces of foam.

15 Styrofoam Cups- Foam beverage cups. Pieces can be identified by the distinctive rim and curved shape. Includes all types of foam beverage cups, from small 8-oz generic white coffee cups to extra-large size cups commonly used with lids and straws to sell fountain soda and iced beverages. If several pieces of the same cup appear in one area, they are counted as a single cup.

16 Plastic Cups- Disposable cups made of plastic or large pieces of those cups. If several pieces of the same cup appear in one area, they are counted as a single cup.

17 Paper Cup- Disposable cups made of paper (most often heavily treated or coated). If several pieces of the same cup appear in one area, they are counted as a single cup.

18 Food Wrappers- This includes many kinds of wrappers and bags that serve as food packaging such as potato chip bags, candy wrappers, packaging from individually-wrapped pastries or sandwiches, etc. This category also includes discarded packets of flavored rolling paper intended for use with loose tobacco. These packages look so much like candy wrappers with their large colorful cartoon pictures of whatever fruit they are flavored to resemble that they were always included in the food wrapper count.

19 Plastic Bags- Plastic grocery bags, shopping bags, garbage bags, newspaper sleeves, and the shreds or parts of torn bags.

20 Cigarette Packs, Matches, Cigars, Tobacco- Smoking-related products and their packaging.

[2] Styrofoam is a word that is used for objects that are more correctly made from expanded polystyrene foam (EPF).

21 Napkins, Paper Towels, Tissues- Disposable paper-based products intended for cleaning or drying.
22 Beverage Carriers, Rings, Cartons- Plastic ring-type beverage carriers, cardboard carriers or boxes.
23 Toiletries- External personal care products and their packaging, including soap, shampoo, lotions, antiperspirant, cosmetics, and fragrances.
24 Drugs- Prescription and over-the-counter therapeutic drug packaging (usually plastic bottles) as well as illegal drug packaging and paraphernalia, including tiny baggies and hypodermic syringes. Condoms are included in this category as a preventive care product.
25 Games, Cassettes, CDs- Includes audio or computer CDs, audio or video cassettes and their tape, and vinyl records.
26 Toys, Balls- Includes all types and sizes of recreational balls made from any material and any toy or part of a toy. A piece of plastic may carry a brand name, picture, or pattern that makes it clear it came from a toy, or the shape and color of the piece may be identifiable as a toy part. Some toy parts are not recognizable and may have been categorized as miscellaneous plastic.
27 Toys, Misc. Other- Includes things that are not strictly toys, but fit in no other categories, such as backpacks, school supplies, wallets, credit and identification cards, portable CD players, calculators, cell phones, batteries, etc.
28 Newspapers, Magazine, Books- Any paper publication. In the case of a book torn in half, the two parts are counted as a single item. In the case of a newspaper blown apart, each sheet is counted individually. In the rare case that a newspaper is still all folded together, it is counted as a single item.
29 Advertising, Signs, Cards- Includes corrugated plastic advertising signs, election posters, paper flyers, postcard advertisements, and lost street signs.
30 Other Misc. Cartons- Bottle, cartons, and containers that do not fit in any other category. Includes large juice and water jugs.
31 Other Metal, Foil Packets- Metal food or drink containers not covered by other categories and aluminum foil.
32 Other Fabric- Fabric that cannot be identified or did not come from clothes or as part of a car or appliance. Includes blankets, towels, and cloth used to wrap items for transport.
33 Clothing- In addition to the usual clothes such as shirts, pants, and socks, this category also includes hats, shoes, purses, and umbrellas.
34 Auto Products Containers- Bottles, cans, tubes, and other containers that held products used in the care and maintenance of an automobile. Includes oil and other engine fluid bottles, washer fluid bottles, and car wax or polish containers.
35 Vehicle Debris- Anything that was once part of an automobile. Includes various metal auto parts, pieces of the car body, seats, hubcaps, mirrors, hood ornaments, and license plates.
36 Construction Material- Items that were used in the construction or deconstruction of something. Includes building material such as lumber, vinyl tile, siding, or roofing material. Also includes tools such as hammers, shovels, and hoses.
37 Appliances- Includes bicycles, shopping carts, strollers, scooters, lawnmowers, furniture, and appliances such as washing machines, refrigerators, radiators, etc.
38 Carpet- Includes carpet and carpet pad.

39 Miscellaneous Large Debris- Large debris that does not fit in any other category or is not identifiable. Includes garbage cans and recycling bins.
40 Miscellaneous Plastic Trash- Usually pieces of plastic with dimensions of a few inches and are not readily identifiable as to their purpose. Broken cell phones and small plastic cases might fall into this category. One should be careful not to put small car parts and pieces into this category since these items would be categorized as small auto parts.
41 Lids, Straws, Tops- All caps and tops that came off bottles. When these are with bottles and cups, it should be counted in the bottle or cup category as one. Straws that are not with cups also are included in this category.
42 Misc. Paper Pieces- Misc paper pieces are usually pieces of paper with dimensions of a few inches and are not readily identifiable.
43 Paper Bags
44 Juice Packs- Plastic and paper juice packs (such as CapriSun) are counted in this category.
45 Broken Glass Pieces- All broken glass pieces that are not identifiable and do not fit any other category are counted in this category.
46 Miscellaneous Plastic Debris- Debris is mainly those things that are too large to come through a storm sewer (although some of it does). Miscellaneous plastic debris would be a plastic lawn chair, a bucket, a commercial bakery tray, or other large items that do not fall under another category.

Figure 3-2-1: Tally Sheet for Detailed Sorting

Trash Collection Date:					W(kg)
Bottles	1	Liquor			
	2	Beer			
	3	Soft Drink			
	4	Water, Plastic			
	5	Sports Drink, Plastic			
	6	Juice			
Cans	7	Beer			
	8	Soft Drink			
	9	Juice			
Home Food Packaging	10	Home Food Packaging			
Styrofoam	11-1	Take Out Food Packaging, paper and plastic			
	11-2	Take Out Food Packaging, **Styrofoam**			
	12	Plates			
	13	Foam Packaging			
	14	Chunks			
	15	Cups			
			same		
Cup	15	Styro			
	16	Plastic			
	17	Paper			
Wrap	18	Food Wrapper			
			same		
			same		
Plastic Bags	19	Plastic Bags			
Others	11-1	Take Out Food Packaging, **paper and plastic**			
	11-2	Take Out Food Packaging, **Styrofoam**			
	20	Cigarette Packs, Matches, Cigars, Tobacco			
	21	Napkins, Paper Towels, Tissues			
	22	Beverage Carriers, Rings, Cartons			
	23	Toiletries			
	24	Drugs			
	25	Games, Cassettes, CDs			
	26	Toys, Balls			
	27	Toys, Misc. Other			
	28	Newspapers, Magazine, Books			
	29	Advertising, Signs, Cards,			
	30	Other Misc. Cartons			
	31	Other Metal, Foil Packets			
	32	Other Fabric			
	33	Clothing			
	34	Auto Products Containers			
	35	Vehicle Debris			
	36	Construction Material			
	37	Appliances			
	38	Carpet			
	39	Misc Large Debris			
	40	Misc. Plastic **Trash**			
	41	Lids, straws, tops			
	42	Misc. Paper Pieces			
	43	Paper Bags			
	44	Juice Packs		Capri Sun should be here not in Food Wrapper	
	45	Broken Glass Pieces			
	46	Misc. Plastic Debris			

Inventory Date and person*hour

Note: Colored in pink will be further sorted out for producer or vender

3-3 Producer/Vendor Identification Survey

In order to understand which producers/vendors are contributing to trash pollution in the Anacostia River, AWS conducted a Producer/Vendor Identification analysis for trash collected from July 2009 to December 2009. Fifteen categories were selected for this in-depth analysis. The categories are shaded in pink in Figure 3-2-1. Since there were so many small, candy wrappers in the "Food Wrapper category," it was not practicable to identify a producer/vendor for each piece. In this instance, only large pieces such as potato chips bags were selected to identify producers/vendors. When a producer and a vendor were different such as a private brand product, a vendor was recorded because a vendor is more responsible for the trash piece. An example is a CVS private brand water bottle. Although the water bottle is produced by a factory operator, CVS is considered responsible for its manufacture and distribution. While responsibility for pollution ultimately lies with the consumer who discards the product, manufacturers and vendors play a key role in the cycle by producing and distributing the plastic and Styrofoam that ends up in the river.

3-4 Trash Volume Characterization

The numbers of bottles and cans, the amount of Styrofoam, and/or the weights of the categories seemed insignificant when we conducted this study; however, their total volume was quite large. AWS decided to take on the extra task of characterizing the trash by volume. After sorting each piece of trash collected from March 2010 to September 2010 into one of the 47 defined categories, the trash pieces were combined and bagged according to 3-4 major categories. We then measured the breakdown of these bags' volume.

CHAPTER 4
Local Community Group and Volunteer Involvement

4-1 Youth Training under Service #4[1] in the Grant Agreement

Trainings provided to young adults are summarized in Table 4-1-1.

Table 4-1-1: Summary of Youth Training

Number of individuals trained	Types of training	Trainer	Outcome
12 people on 4/4/2009	Trash cleanup, downstream of the trash trap. Explanation on the trash challenges of the Anacostia.	Steve McKindley-Ward	Understanding of the challenges on trash pollution.
11 Cesar Chavez students and 2 teachers on 4/22/2009	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Steve McKindley-Ward	Understanding of the challenges on trash pollution.
28 UMD students on 5/9/2009	Trash trap cleanup and trash cleanup downstream of the trash trap. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Steve McKindley-Ward	Understanding of the challenges on trash pollution.
2 AWS interns on 5/28/2009	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Steve MW, Masaya Maeda	Understanding of the challenges on trash pollution.
2 AWS interns on 6/4/2009	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Steve MW, Masaya Maeda	Understanding of the challenges on trash pollution.
1 AWS intern on 6/9/2009	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Steve MW, Masaya Maeda	Understanding of the challenges on trash pollution.
2 AWS interns on 6/11/2009	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Steve MW, Masaya Maeda	Understanding of the challenges on trash pollution.

[1] Service #4 in the Grant Agreement: Train at-risk and-or underemployed young adults from the District in the use and application of trash reduction technologies as part of the District's green color jobs initiative.

3 AWS interns on 6/19,25/2009	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Steve MW, Masaya Maeda	Understanding of the challenges on trash pollution.
3 AWS interns on 7/1/2009	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Steve MW	Understanding of the challenges on trash pollution.
1 AWS intern on 8/3/2009	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Masaya Maeda	Understanding of the challenges on trash pollution.
1 AWS intern on 8/20/2009	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Masaya Maeda	Understanding of the challenges on trash pollution.
2 AWS interns on 9/28/2009	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Steve MW	Understanding of the challenges on trash pollution.
2 AWS interns on 10/26/2009	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Steve MW, Steve Kinzer, Masaya Maeda	Understanding of the challenges on trash pollution.
1 AWS intern on 11/23/2009	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Steve MW, Masaya Maeda	Understanding of the challenges on trash pollution.
2 AWS interns on 11/24/2009	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Steve MW, Masaya Maeda	Understanding of the challenges on trash pollution.
1 volunteer on 12/18/2009	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Steve MW, Steve Kinzer, Masaya Maeda	Understanding of the challenges on trash pollution.
6 Cesar Chavez students and 1 environmentalist on 3/29/2010	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Masaya Maeda	Understanding of the challenges on trash pollution.

50 volunteers on 4/10/2010*	Trash cleanup, downstream of the trash trap. Explanation on the trash challenges of the Anacostia.	Eric Sibley, Masaya Maeda	Understanding of the challenges on trash pollution.
2 volunteers on 5/2/2010	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Steve MW	Understanding of the challenges on trash pollution.
1 volunteer on 5/28/2010	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Steve Kinzer, Masaya Maeda	Understanding of the challenges on trash pollution.
8 volunteers from Friends of Kenilworth Aquatic Gardens (KEAQ) on 6/26/2010	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Masaya Maeda	Understanding of the challenges on trash pollution.
2 interns on 6/29/2010	After rain trap maintenance. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Masaya Maeda	Understanding of the challenges on trash pollution.
3 volunteers on 7/31/2010	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Masaya Maeda	Understanding of the challenges on trash pollution.
1 intern on 8/4/2010	After rain trap maintenance. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Masaya Maeda	Understanding of the challenges on trash pollution.
1 intern on 8/13/2010	After rain trap maintenance. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Masaya Maeda	Understanding of the challenges on trash pollution.
2 interns on 8/17/2010	After rain trap maintenance. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Masaya Maeda	Understanding of the challenges on trash pollution.
4 interns on 8/18/2010	After rain trap maintenance. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Masaya Maeda	Understanding of the challenges on trash pollution.
2 interns on 8/24/2010	After rain trap maintenance. Explanation on the trash challenges of the Anacostia.	Masaya Maeda	Understanding of the challenges on trash pollution.

	Explanation on the function of the trash trap, etc.		
6 volunteers on 8/28/2010	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Masaya Maeda	Understanding of the challenges on trash pollution.
12 volunteers from KEAQ on 9/25/2010	Trash trap cleanup. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Masaya Maeda	Understanding of the challenges on trash pollution.
1 intern on 10/1/2010	After rain trap maintenance. Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Masaya Maeda	Understanding of the challenges on trash pollution.
In total, 19 interns and 143 volunteers (this number has been adjusted to exclude duplicate counting) were trained for trash trap cleanup, stream cleanup, and trap maintenance and committed approximately 659 hours to the project.			
5 interns in June 2009	Nash Run trash characterization (trash sorting into 47 categories). Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Steve MW, Masaya Maeda	Understanding of the challenges of trash pollution and trash characteristics – what types of trash need to be addressed and how.
4 interns in July 2009	Nash Run trash characterization (trash sorting into 47 categories). Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Steve MW, Masaya Maeda	Understanding of the challenges of trash pollution and trash characteristics – what types of trash need to be addressed and how.
2 interns on 11/2/2009	Nash Run trash characterization (trash sorting into 47 categories). Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Steve MW, Masaya Maeda	Understanding of the challenges of trash pollution and trash characteristics – what types of trash need to be addressed and how.
2 interns on 6/16/2010	Nash Run trash characterization (trash sorting into 47 categories). Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Masaya Maeda	Understanding of the challenges of trash pollution and trash characteristics – what types of trash need to be addressed and how.
4 interns on 7/14/2010	Nash Run trash characterization (trash sorting into 47 categories). Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Masaya Maeda	Understanding of the challenges of trash pollution and trash characteristics – what types of trash need to be addressed and how.
2 interns on 7/21/2010	Nash Run trash characterization (trash sorting into 47 categories). Explanation on the trash challenges of the	Masaya Maeda	Understanding of the challenges of trash pollution and trash

	Anacostia. Explanation on the function of the trash trap, etc.		characteristics – what types of trash need to be addressed and how.
4 interns on 7/28/2010	Nash Run trash characterization (trash sorting into 47 categories). Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Masaya Maeda	Understanding of the challenges of trash pollution and trash characteristics – what types of trash need to be addressed and how.
3 interns on 8/4/2010	Nash Run trash characterization (trash sorting into 47 categories). Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Masaya Maeda	Understanding of the challenges of trash pollution and trash characteristics – what types of trash need to be addressed and how.
3 interns on 9/1/2010	Nash Run trash characterization (trash sorting into 47 categories). Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Masaya Maeda	Understanding of the challenges of trash pollution and trash characteristics – what types of trash need to be addressed and how.
2 interns on 9/29/2010	Nash Run trash characterization (trash sorting into 47 categories). Explanation on the trash challenges of the Anacostia. Explanation on the function of the trash trap, etc.	Masaya Maeda	Understanding of the challenges of trash pollution and trash characteristics – what types of trash need to be addressed and how.
In total, 17 interns were trained for trash characterization. (This number has been adjusted to exclude duplicate counting).			
Approximately 100 Green Jobs Training Program youth on 7/21/2010	Presentation on Trash Pollution including Nash Run trash trap activities	Masaya Maeda	Understanding of the challenges on trash pollution. Understanding of trash characteristics…what types of trash need to be addressed and how. Understanding of effectiveness of trash traps depending on the types of a trap.

*Volunteers included elderly individuals in this particular event.

4-2 Community Groups/Individuals Involvement under Service #3[2] in the Grant Agreement[3]

On 4/22/2009, 11 students and 2 teachers from Cesar Chavez High School, located in the Nash Run watershed, helped clean up the trash trap. AWS Horticulturist Steve

[2] Service #3 in the Grant Agreement: Engage local community groups in the maintenance and monitoring of the Nash Run Trash Trap.
[3] Some information described in this section duplicates the information in Table 4-1-1.

McKindley-Ward led the group and gave oral presentation on the trash trap and the background of trash pollution of the river.

On 3/29/2010, 6 students from Cesar Chavez High School and 1 environmentalist from Clean Water Action helped clean up the trash trap. AWS Water Quality Specialist Masaya Maeda led the group and gave oral presentation on the trash trap and the background of trash pollution of the river.

AWS has been in contact with a community group called Friends of Kenilworth Aquatic Gardens. Nash Run empties into Kenilworth Marsh, which is a part of the Gardens. The Nash Run trash trap captures trash before it reaches a marsh in the Gardens. Initially, the group said that they were not supposed to work outside of the Gardens, but after seeing the success of the trap's trash reduction in Kenilworth Marsh, they became interested in helping our Nash Run Trash Trap project. In fact, the Friends of Kenilworth Aquatic Gardens helped clean up the trash trap on June 26, 2010. After the event, the group offered to help AWS clean up the trap again in September and October 2010, incorporating the cleanup tasks into their existing work plan. We are very encouraged to see the change in the Friends of Kenilworth Aquatic Gardens' participation and are excited to have them as partners in restoring the watershed.

4-3 Other Outreach Effort

Throughout the project, AWS has reached out to the community in the Nash Run watershed through attempts to connect with and educate members of the local Advisory Neighborhood Commission, congregations, and past volunteers living near the trash trap site. However, no responses have been received.

CHAPTER 5
Trash Data and Analysis

5-1 Trash Data

Raw trash weight data is shown in *Attachment 1*. Since the wet weight after collection (Weight-C) on April 22, 2009, was accidentally not measured, it was estimated using the Weight-C/Weight-S ratio from March 30, 2009. There was a significant amount of trash in June and July 2010. The number of bags for each month was 20 and 29 respectively. The bag weights were consolidated for these months in the table in *Attachment 1*.

Trash characterization data by number of trash pieces is shown in *Attachment 2*. From April to September 2009, the trash trap was cleaned up several times in each month. Only the largest amount of trash in each of these months was sorted out into the 47 pre-defined categories. Then the characterization data was adjusted for those months. For example, in May 2009, the trash trap was cleaned up on May 9th (26.27 kg of trash) and on May 28th (22.45 kg of trash). Only the trash collected on May 9th was sorted. Then, in order to estimate the total number for each category for May 2009, the number of trash pieces was multiplied by an Adjustment Coefficient of 1.85 ((26.27+22.45)/26.27).

Trash characterization data by trash weight is shown in *Attachment 3*. The same adjustment was made for trash weight for each category for trash collected between April and September 2009 as described in the above paragraph.

Trash pieces in some categories were washed and dried to measure dry weight. The Dry Weight /Wet Weight Ratio was calculated for those categories. The results are shown in Table 5-1-1. The weight of bottles and cans remained relatively constant throughout the process. The weight of Styrofoam pieces was reduced by approximately half after drying. Paper cups were reduced to 31.9% of their wet weight. Surprisingly, Food Wrappers and Plastic Bags were reduced to 25.4% and 12.4% of their wet weights respectively. This reduction is most likely attributed to the adsorbent nature of the thin materials, which carry water and pick up sediment and dirt. From this finding, we learned that data on the number of pieces of trash, instead of the weight of those pieces, should be used to conduct trend analysis for Food Wrappers and Plastic Bags because the weight for these categories varies depending upon temperature and other factors.

Table 5-1-1: Dry/Wet Weight Ratio

Trash Collection Date: 5/9/2009			Wet Weight (kg)	Dry Weight (kg, Dried at room temperature)	Dry/Wet Weight Ratio (%)
Bottles	1	Liquor	2.240	2.130	95.1
	3	Soft Drink	0.600	0.535	89.2
	4	Water, Plastic	0.900	0.900	100.0
	5	Sports Drink, Plastic	0.260	0.235	90.4
	6	Juice	1.930	1.825	94.6
Cans	7	Beer	0.660	0.675	102.3
	8	Soft Drink	0.390	0.300	76.9
	9	Juice	0.090	0.090	100.0
Styrofoam	12	Plates	0.270	0.120	44.4
	14	Chunks	0.240	0.130	54.2
	15	Styrofoam Cups	0.670	0.350	52.2
Cup	16	Plastic	0.260	0.175	67.3
	17	Paper	0.360	0.115	31.9
Wrap	18	Food Wrapper	1.890	0.480	25.4
	11-2	Take Out Food Packaging, **Styrofoam**	0.250	0.130	52.0
Plastic Bags	19	Plastic Bags	1.010	0.125	12.4
Others	20	Cigarette Packs, Matches, Cigars, Tobacco	0.130	0.105	80.8
	24	Drugs	0.375	0.325	86.7
	26	Toys, Balls	0.740	0.620	83.8
	36	Construction Material	1.150	0.715	62.2
	40	Misc. Plastic **Trash**	1.180	0.505	42.8
	41	Lids, straws, tops	0.390	0.365	93.6
	44	Juice Packs	0.090	0.055	61.1
		total	16.426	11.005	67.0

5-2 Re-bar Screen Performance

In order to understand what trash pieces were captured and not captured by the re-bar screens compared to a one-inch mesh plastic net, re-bar screen performance was tested. At first, a prototype re-bar screen was made and placed over the one-inch mesh plastic net as shown in Figure 5-2-1. After a few storms, trash on the re-bar screen and trash on the plastic net under the rebar screen were collected separately. Each collection of trash was sorted out in accordance with AWS's sorting protocol. The trash removal ratio for each trash category is summarized in Table 5-2-1. Example photos of trash pieces on the re-bar screen and the plastic net are shown in Figure 5-2-2.

Figure 5-2-1: Prototype Re-bar Screen

Table 5-2-1: Trash Removal Ratio by Re-bar Screen for Each Trash Category

	Trash Category Number	Trash Category	# of trash pieces on re-bar screen	# of trash pieces on plastic net under rebar screen	Removal Ratio by Re-bar Screen (%)
Bottles	1	Liquor	1	0	100
	3	Soft Drink	2	0	100
	4	Water, Plastic	3	0	100
	12	Plates	3	0	100
	13	Foam Packaging	3	1	75
	14	Styrofoam Chunks	14	5	74
	15	Styrofoam Cups	6	0	100
Wrap	18	Food Wrapper	34	18	65
	11	Take Out Food Packaging	1	0	100
Plastic Bags	19	Plastic Bags	3	0	100
Others	20	Cigarette Packs, Matches, Cigars, Tobacco	26	3	90
	24	Drugs	4	1	80
	26	Toys, Balls	2	1	67
	40	Misc. Plastic **Trash**	57	60	49
	41	Lids, straws, tops	12	7	63
	42	Misc. Paper Pieces	9	4	69
	44	Juice Packs	1	0	100

Figure 5-2-2: Trash Pieces on the Re-bar Screen and the Plastic Net

All large trash pieces were captured for manageable rainfall events. A certain percentage of small trash pieces escaped from re-bar screen. About 51% of "Misc. Plastic Trash" flow through the screen. The category includes cellophane films as seen in Figure 5-2-2 (bottom photo). Overall, the trash removal performance of re-bar screen was good. However, this test was conducted for 1" spacing re-bar screen. Later the screen spacing was increased to 1.5" so that stream water could pass more smoothly through the trash

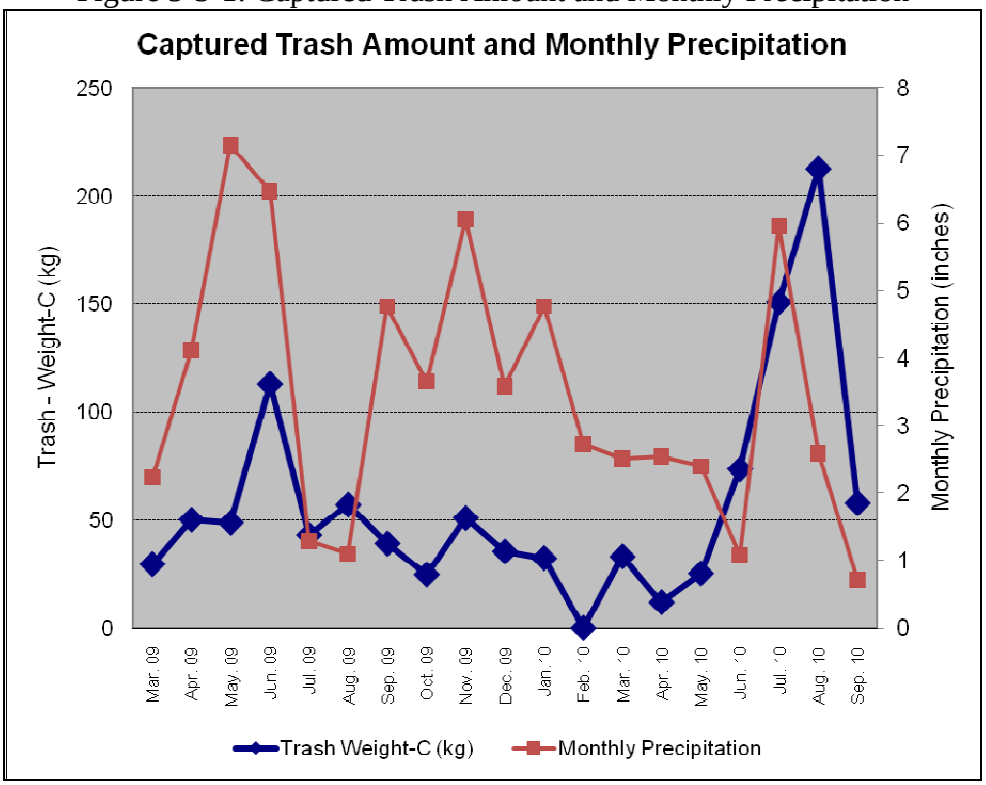
trap. This increase in re-bar screen width was necessary to reduce the number of overflow events. The 1.5" spacing re-bar screen's removal ratio must be lower than that in the table. However, many small pieces captured by 1" spacing rebar screen was tangled with organic matter, and the 1.5" spacing re-bar screen has still been capturing those small pieces.

Initially, AWS used 1" mesh plastic net because AWS wanted to capture almost all trash pieces including even very small ones. The use of re-bar screen was a trade-off after facing the reality in the field. Unfortunately, small trash pieces could not be captured completely. At this point, there is no known trash trap that is both structurally strong and able to capture all trash pieces regardless of size. A boom type trash trap cannot capture all neutrally buoyant trash pieces. A net type trash trap cannot withstand the fierce stream flow on high flow events. Although every type of trash trap helps to reduce trash in waterways, none of them pose an ultimate solution to trash pollution. The key to achieving such a solution is education, law enforcement, and Low Impact Development (LID) implementation. Unfortunately, LID implementation, which could eliminate stormwater runoff, which carries trash to waterways, may take 100 years to be thoroughly introduced throughout a watershed.

5-3 Precipitation and Trash Load

Figure 5-3-1 shows the relationship between the amount of captured trash and monthly precipitation. Since trash trap cleanup events did not always correspond with the beginning and end of each month, monthly precipitation totals were adjusted to demonstrate how much rain fell in between monthly cleanup events. For example, if trap cleanup events were conducted on May 25th and June 22nd, the total of monthly precipitation for June was calculated by adding the daily precipitation totals between May 26th and June 22nd. Generally, there is a tendency to have more trash when there is higher monthly precipitation. However, from September 2009 to January 2010, the trash amount was relatively small compared to the total amount of monthly precipitation.

Figure 5-3-1: Captured Trash Amount and Monthly Precipitation



Then the rainfall intensity data was analyzed to understand the relationship between the trash amount and the rainfall intensity. Hourly precipitation data was obtained from the Friends of Sligo Creek website (http://www.fosc.org/admin/NOAA.htm), which reports NOAA's accumulation of precipitation at National Airport. Table 5-3-1 shows the number of hours above various rainfall intensity levels (inches/hour) for each month. The values for each month were adjusted based on the dates trash trap cleanups were conducted. For example, if trap cleanup events were conducted on May 25th and June 22nd, the values for June were calculated using hourly precipitation rates from May 26th through June 22nd.

Here is an example to explain how to read the table. In April 2009, there were 12 hours of precipitation with intensity more than 0.1 inches/hour. Among the 12 hours, there were 4 hours of precipitation more intense than 0.2 inches/hour. Among the 4 hours, there was 1 hour of precipitation more intense than 0.3 inches/hour.

Table 5-3-1: Number of Hours at Various Rainfall Intensity Levels

	Year	2009											2010								
	Month	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9
# of hours with intensity more than (inches)	>0.5	0	0	0	2	2	1	0	1	1	0	0	0	0	0	0	0	0	5	1	0
	>0.4	0	0	0	3	4	1	0	1	1	1	0	0	0	0	0	0	0	5	1	0
	>0.3	0	0	1	4	5	2	0	2	1	1	1	0	0	0	0	1	1	8	1	0
	>0.2	0	0	4	6	9	2	2	9	2	5	2	1	0	1	2	3	2	11	3	1
	>0.1	0	2	12	20	16	3	5	12	5	13	12	9	0	6	5	6	3	12	5	3

At various rainfall intensity levels, the relationship between rainfall intensity and captured trash amount was examined as shown in Figure 5-3-2 through 5-3-6. It seems that rainfall intensity level of larger than 0.3 inches/hour had a relatively strong correlation to the amount of trash collected (See Figure 5-3-4). The only time this correlation seemed weaker was in August 2010 when there were fewer hours of intense rainfall despite the large amount of trash collected. However, this discrepancy might be due to the scattered nature of the precipitation during specific rainfall events in August. Despite the relatively short amount of time in August when the recorded rate of rainfall was equal to or greater than .3 inches/hour, staff members and volunteers from AWS observed two major flooding events at Nash Run during this time. Since the precipitation data is collected at National Airport, which is approximately 6.5 miles from the trash trap, it is not necessarily representative of the amount of precipitation for Nash Run. From these graphs, it is observed that the rainfall intensity larger than 0.3 inches/hour may be a tipping point to carry trash pieces into a nearby stream.

Figure 5-3-2: Captured Trash Amount and Number of Hours with Rainfall Intensity larger than 0.1 inches/ hour

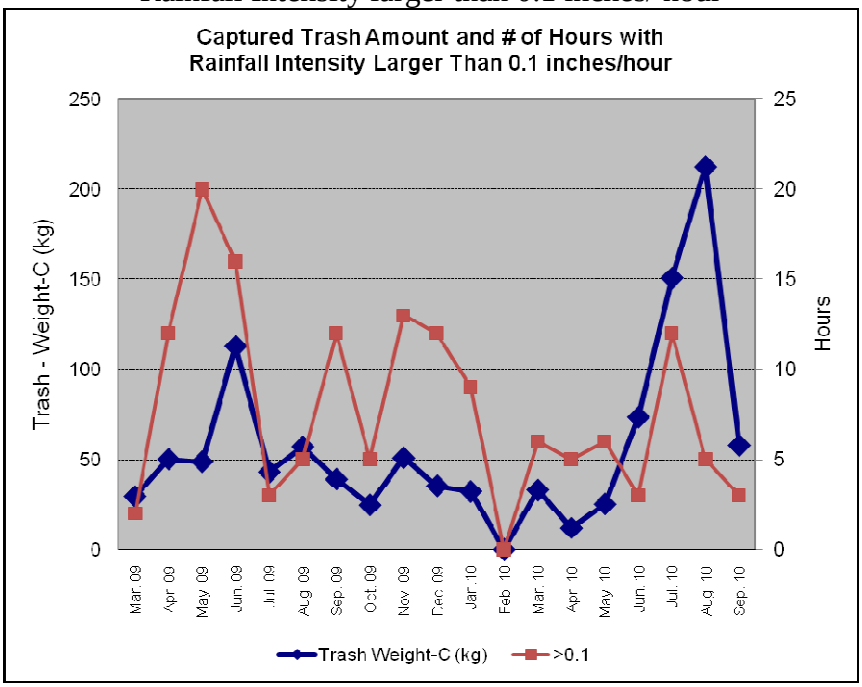


Figure 5-3-3: Captured Trash Amount and Number of Hours with Rainfall Intensity larger than 0.2 inches/ hour

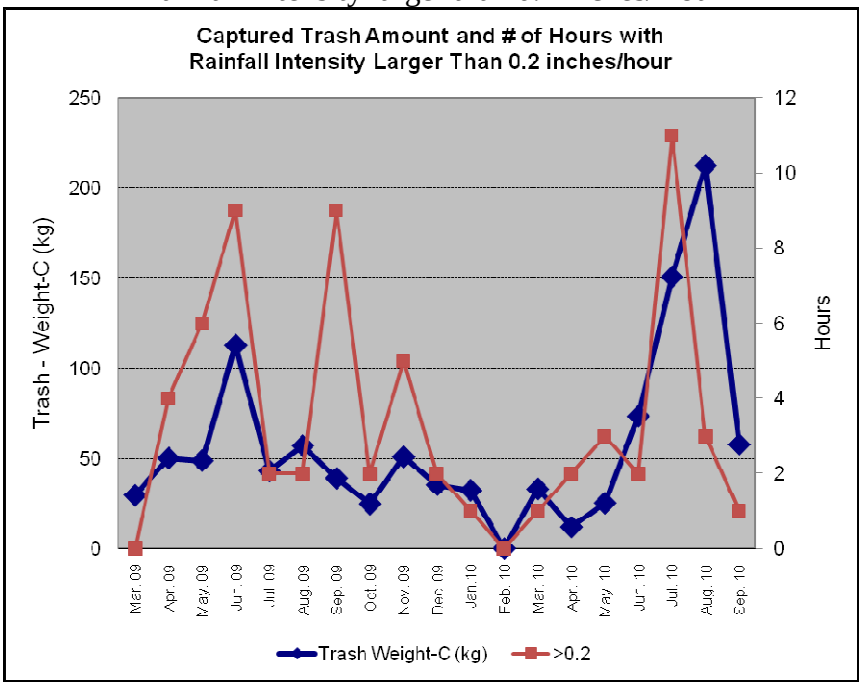


Figure 5-3-4: Captured Trash Amount and Number of Hours with Rainfall Intensity larger than 0.3 inches/ hour

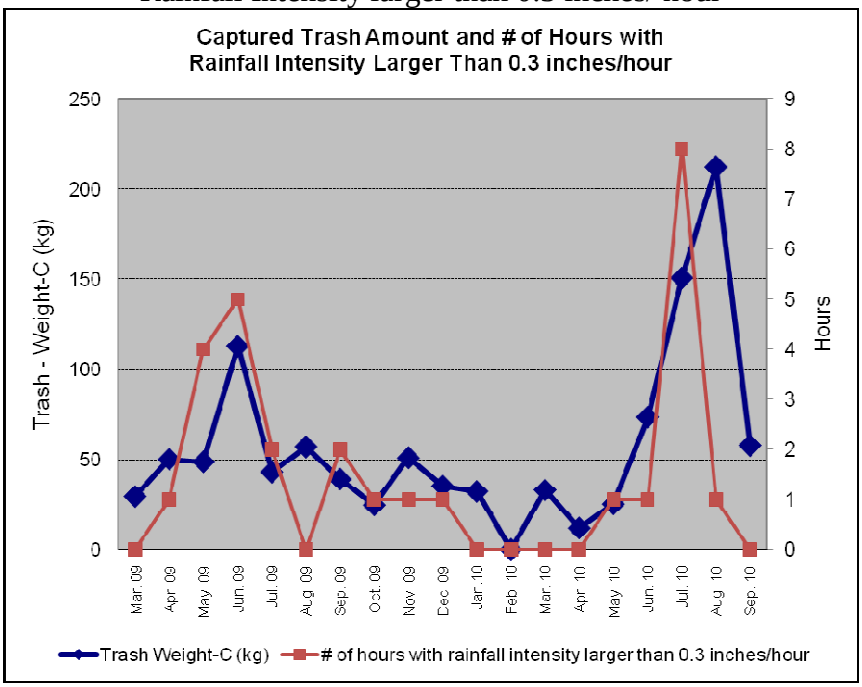


Figure 5-3-5: Captured Trash Amount and Number of Hours with Rainfall Intensity larger than 0.4 inches/ hour

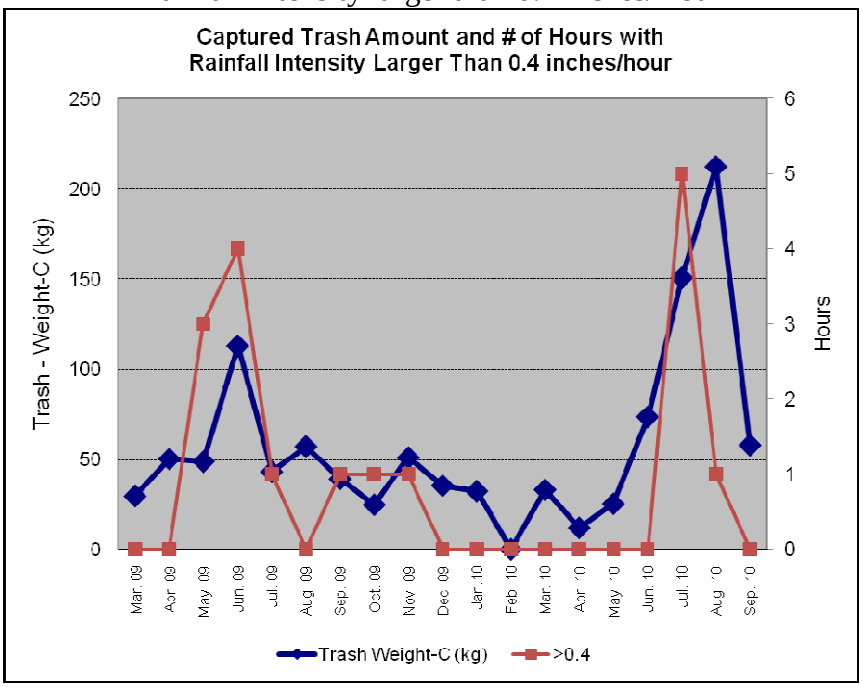
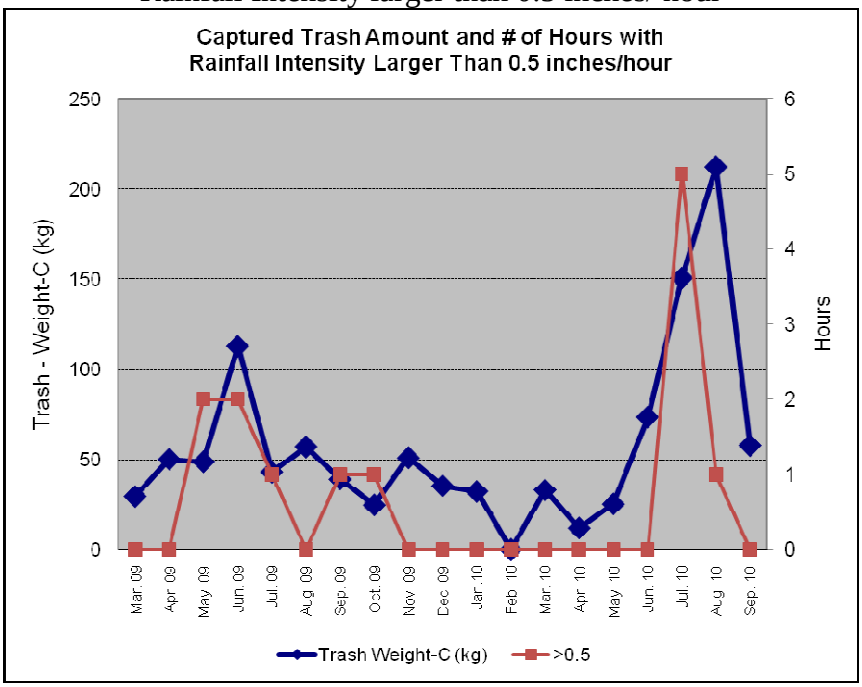


Figure 5-3-6: Captured Trash Amount and Number of Hours with Rainfall Intensity larger than 0.5 inches/ hour



5-4 Trash Characteristics by Number of Trash Pieces

Number of trash pieces over months is shown in Figure 5-4-1. Items that exceeded 150 counts in at least one month were plotted in the graph. The numbers of pieces for most trash categories were relatively stable. Some trash categories such as Food Wrappers, Misc. Plastic Trash, Lids Straws Tops, and Styrofoam Chunks seem to be carried by large number during intense rainfall events. This can be said because the items had peaks in Figure 5-4-1 in June 2009, July 2010, and August 2010 when the rates of rainfall were heaviest. Since the total number of trash pieces for other trash categories remained relatively constant during the period, it can be inferred that these items are relatively easily transported by smaller rainfall events.

Food Wrappers, Misc. Plastic Trash, Lids Straws Tops, and Styrofoam Chunks may be more resistant from being washed away or may be tangled with leaves and twigs. A food wrapper may be flattened and attached to impervious surfaces such as asphalt and it may be washed away only when there is enough stormwater runoff that will carry thin, flow-resistant trash. Styrofoam chunks may be tangled or captured by leaves and twigs. When leaves and twigs are carried downstream by relatively intense rainfall, the Styrofoam chunks may be flushed with those organic materials.

The Plastic Bags category was the eighth most abundant pollutant found in the trap and comprised 3.3% of the total number of trash pieces. In a report titled *ANACOSTIA WATERSHED TRASH REDUCTION PLAN* (the Plan) published in 2008 by the

Anacostia Watershed Society for the District Department of the Environment, it reported that about 50% of trash in free-flowing streams was plastic bags. This discrepancy can be explained as follows: In the Plan, a surveyor walked along a stream counting visible trash pieces in the stream channel. As a result, the survey demonstrates trash characteristics for the "most unsightly trash in streams," or the trash pieces most visible to the naked eye. Since plastic bags are easily snagged by twigs, branches, and roots, they tend to be more concentrated in streams than other trash items. Because the Nash Run Trash Trap strains the stream flow in order to capture trash, it collects pieces that otherwise would not be caught by overhanging branches, roots, or twigs. This accounts for the seemingly lower ratio of plastic bags.

Table 5-4-1 shows the breakdown of trash pieces. Figure 5-4-2 shows a pie chart of the breakdown of trash pieces. From the table and figure, it was found that the top 10 trash categories consist of 81.9% of total trash pieces. Interestingly Food Wrappers and Misc. Plastic Trash, which includes cellophane pieces, were the top contributors of pollution.

It should be noted that these categories (Food Wrappers and Misc. Plastic Trash) cannot be captured completely by re-bar screen as mentioned in Section 5-2 (See Table 5-2-1). The removal rate by 1" spaced re-bar screen is 65% and 49% respectively. As a result of the installation of 1.5" spaced re-bar screen, the total number of trash pieces (both removed and free-flowing) in these categories may be close to or more than double.

Figure 5-4-1: Number of Trash Pieces over Months

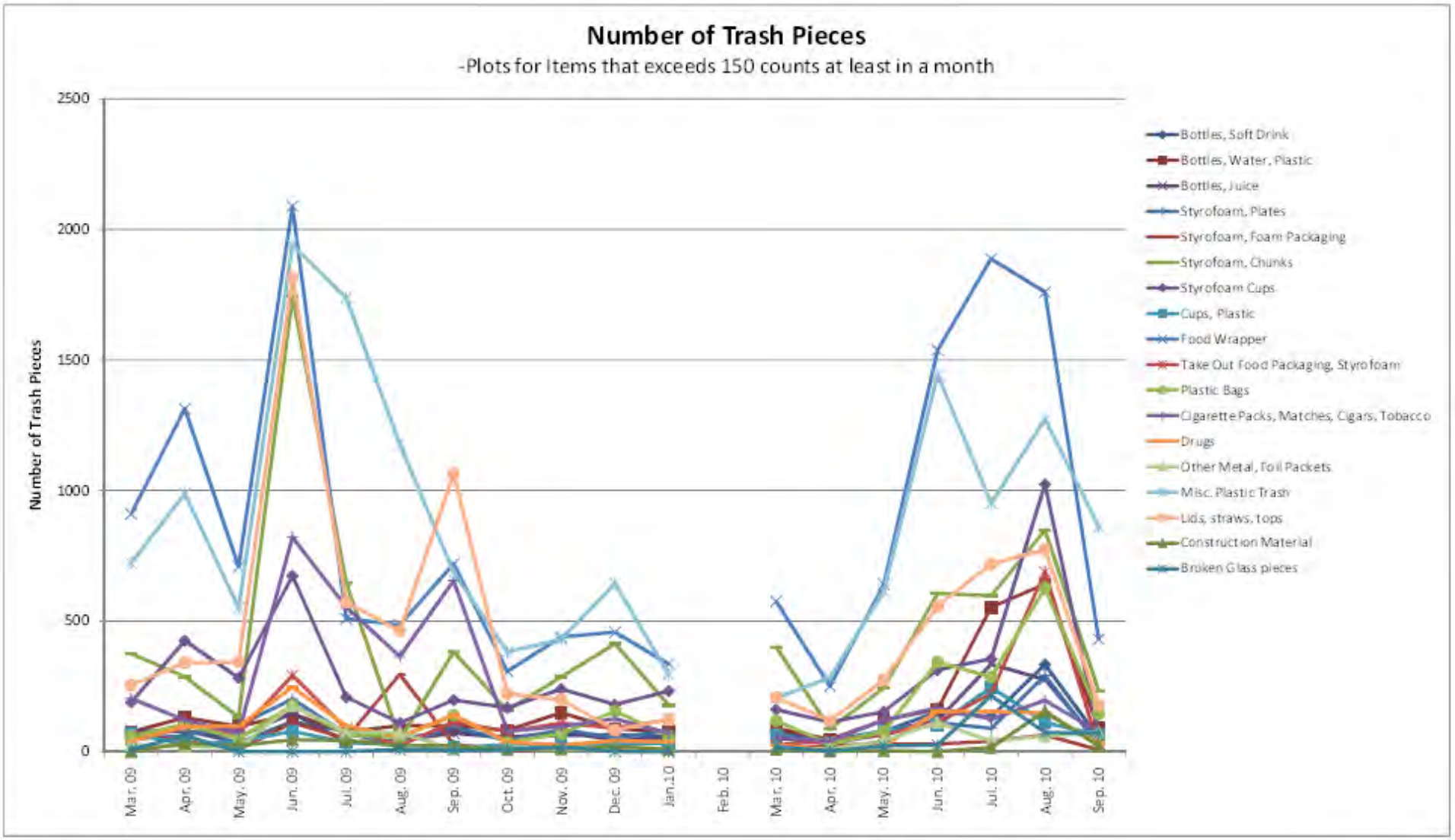
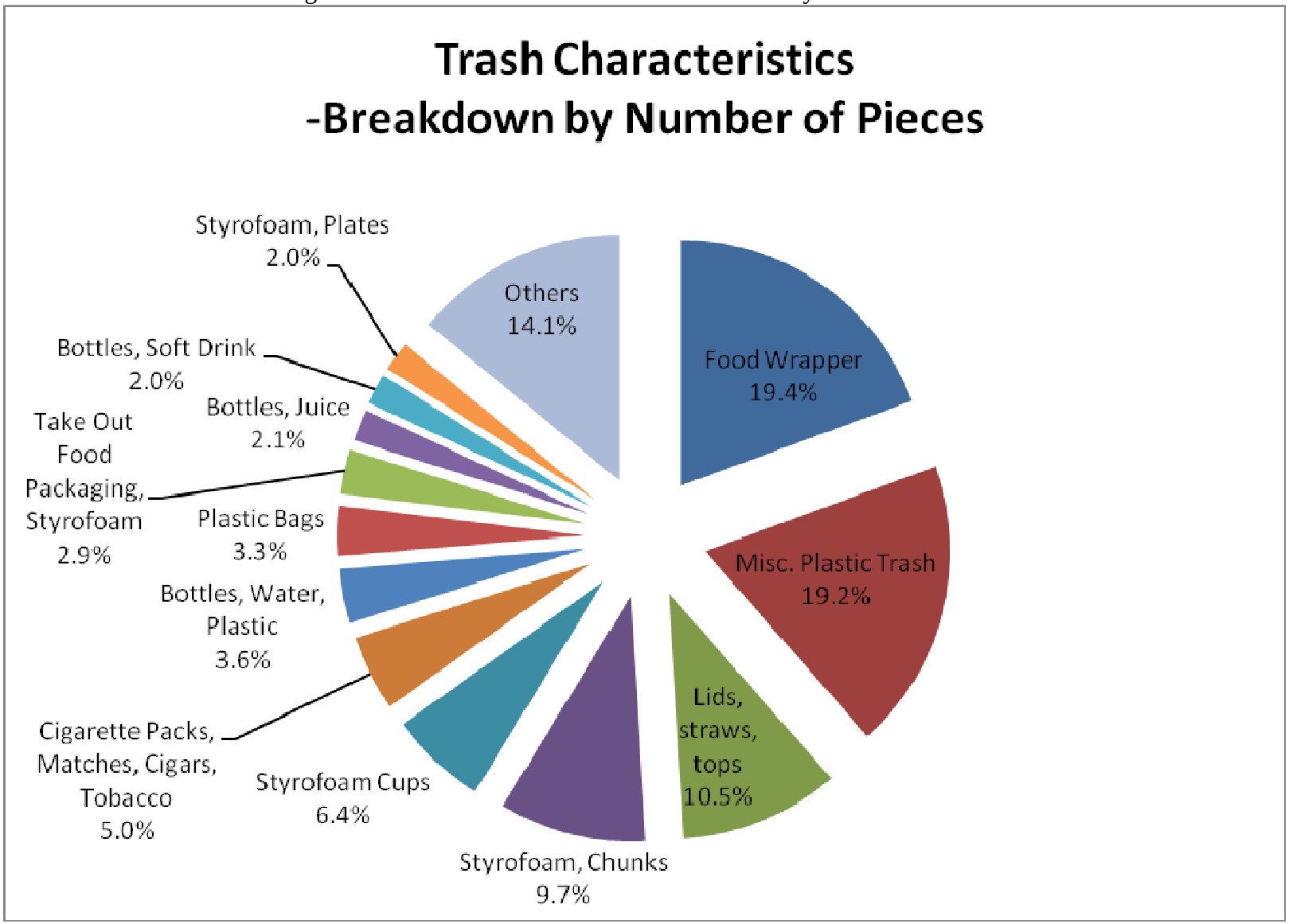


Table 5-4-1: Trash Characteristics – Breakdown by Number of Pieces

Trash Category	%
Food Wrapper	19.4
Misc. Plastic Trash	19.2
Lids, straws, tops	10.5
Styrofoam, Chunks	9.7
Styrofoam Cups	6.4
Cigarette Packs, Matches, Cigars, Tobacco	5.0
Bottles, Water, Plastic	3.6
Plastic Bags	3.3
Take Out Food Packaging, Styrofoam	2.9
Bottles, Juice	2.1
Bottles, Soft Drink	2.0
Styrofoam, Plates	2.0
Drugs	1.8
Cups, Plastic	1.4
Styrofoam, Foam Packaging	1.1
Juice Packs	1.0
Other Metal, Foil Packets	1.0
Cups, Paper	0.7
Broken Glass pieces	0.7
Cans, Beer	0.6
Misc. Paper Pieces	0.6
Toys, Balls	0.6
Bottles, Sports Drink, Plastic	0.6
Construction Material	0.6
Bottles, Liquor	0.6
Home Food Packagin	0.5
Cans, Soft Drink	0.5
Toiletries	0.3
Toys, Misc. Other	0.3
Take Out Food Packaging, Paper and Plastic	0.3
Other Misc. Cartons	0.2
Clothing	0.1
Misc. Plastic Debris	0.1
Cans, Juice	0.1
Beverage Carriers, Rings, Cartons	0.1
Auto Products Containers	0.1
Other Fabric	0.1
Bottles, Beer	0.1
Napkins, Paper Towels, Tissues	0.1

Figure 5-4-2: Trash Characteristics – Breakdown by Number of Pieces



5-5 Trash Characteristics by Wet Weight

Data on trash wet weight over months for each trash category after sorting (Weight-S) is shown in Figure 5-5-1. Items that exceeded 5kg at least in a month were plotted in the graph. Figure 5-5-1 shows no meaningful trend.

Table 5-5-1 shows the breakdown of trash by Weight-S. Figure 5-5-2 shows a pie chart of the breakdown by Weight-S. Bottles Juice was the heaviest trash among all categories. This is because Juice bottles are often made of glass. Surprisingly, Food Wrappers was the third heaviest trash category, and Misc. Plastic Trash, which includes cellophane pieces, was the 8th heaviest trash category even though each individual food wrapper and plastic trash piece is very light. Additionally, Plastic Bags were 7th heaviest. The top ten trash categories consist of 60.7% of the total trash Weight-S.

Although Construction Debris was the 2nd heaviest trash category, the number of pieces of construction debris was not significant. This is due to the fact that some Construction Debris pieces, such as wet lumber, were very heavy.

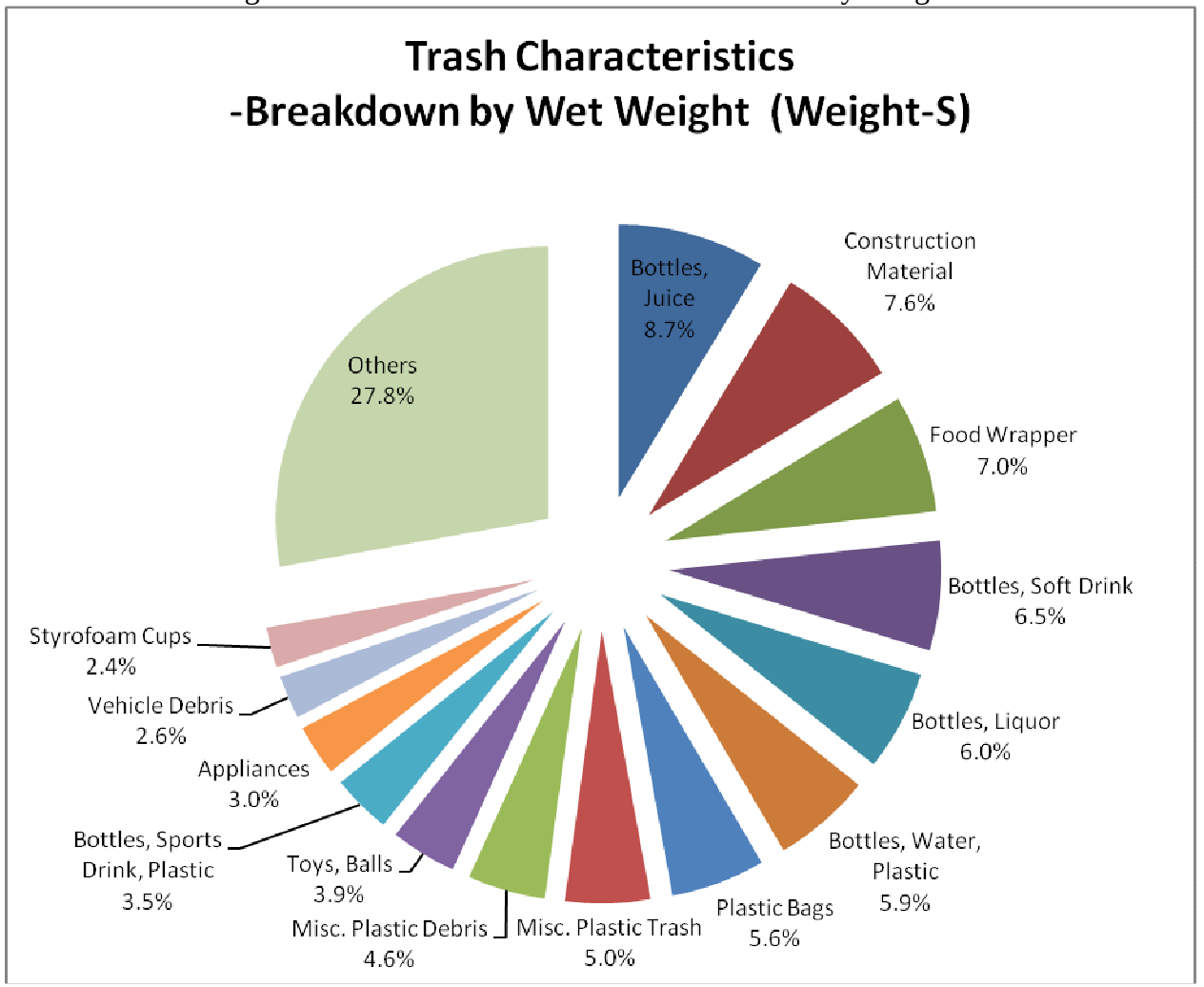
As mentioned in Section 5-4, Misc Plastic Trash and Food Wrappers were the most abundant trash category by number of pieces. Both of these trash categories were also among the top trash categories by weight.

Figure 5-5-1: Wet Weight after Sorting (Weight-S) over Months

Table 5-5-1: Trash Characteristics – Breakdown by Weight-S

Trash Category	%
Bottles, Juice	8.7
Construction Material	7.6
Food Wrapper	7.0
Bottles, Soft Drink	6.5
Bottles, Liquor	6.0
Bottles, Water, Plastic	5.9
Plastic Bags	5.6
Misc. Plastic Trash	5.0
Misc. Plastic Debris	4.6
Toys, Balls	3.9
Bottles, Sports Drink, Plastic	3.5
Appliances	3.0
Vehicle Debris	2.6
Styrofoam Cups	2.4
Lids, straws, tops	2.1
Styrofoam, Chunks	1.7
Cans, Beer	1.6
Bottles, Beer	1.6
Clothing	1.5
Cups, Plastic	1.5
Cups, Paper	1.4
Take Out Food Packaging, Styrofoam	1.3
Napkins, Paper Towels, Tissues	1.3
Juice Packs	1.2
Auto Products Containers	1.1
Cigarette Packs, Matches, Cigars, Tobacco	1.0
Drugs	1.0
Other Misc. Cartons	1.0
Cans, Soft Drink	1.0
Broken Glass pieces	0.8
Styrofoam, Plates	0.8
Toys, Misc. Other	0.8
Misc Large Debris	0.8
Other Metal, Foil Packets	0.7
Toiletries	0.7
Home Food Packagin	0.6
Misc. Paper Pieces	0.5
Newspapers, Magazine, Books	0.3
Other Fabric	0.3
Cans, Juice	0.2
Carpet	0.2
Take Out Food Packaging, Paper and Plastic	0.2
Foam Packaging	0.2
Games, Cassettes, CDs	0.1
Advertising, Signs, Cards,	0.1
Beverage Carriers, Rings, Cartons	0.1

Figure 5-5-2: Trash Characteristics – Breakdown by Weight-S



5-6 Trash Characterization by Trash Volume

While conducting trash sorting, counting, and weighing, it was thought that the volume of Bottles and Cans and Styrofoam were significant. When trash is seen in rivers, generally people see it in terms of volume and number of pieces rather than by its collective weight. Figure 5-6-1 shows an example of a method AWS used to measure the volume breakdown of pollutants. One square box on the left in the figure represents 10 percent of the total trash volume. From the figure, the breakdown by volume could be read; 42% Bottles and Cans, 30% Styrofoam, 28% Others (21% Others and 7% Plastic Cups).

Figure 5-6-1: Trash Characteristics – Breakdown by Volume for March 2010 Trash

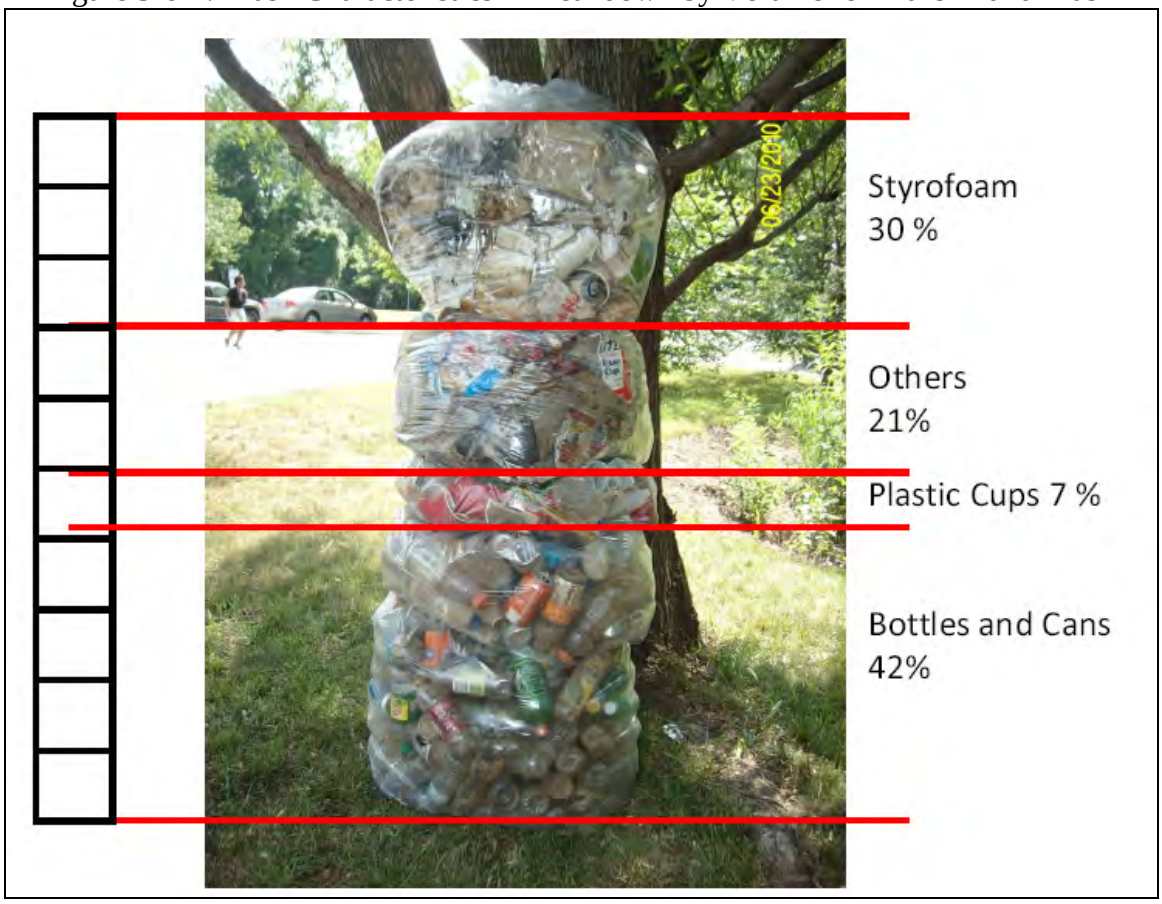
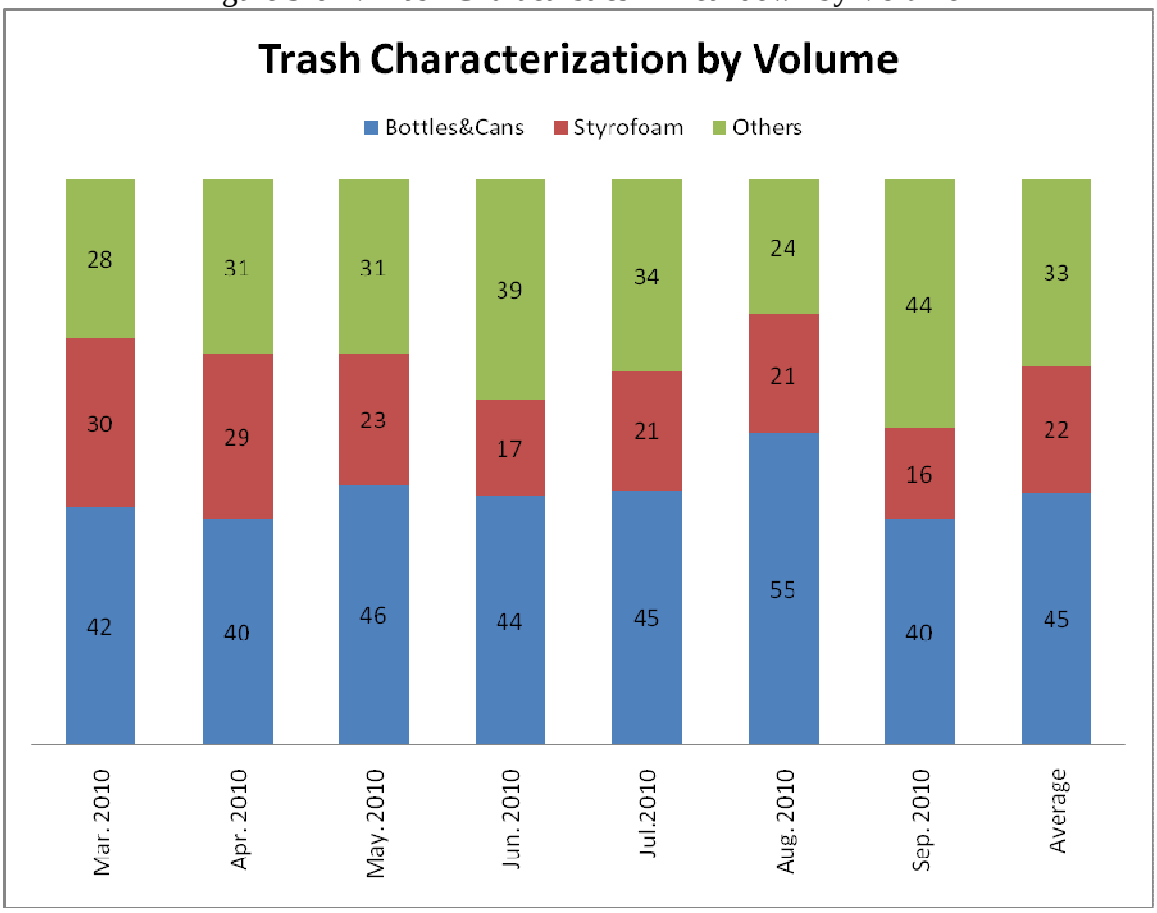


Figure 5-6-2 shows the trash characteristics by volume over months. On average, 45% of the trash was Bottles & Cans. About 22% of the average trash volume was Styrofoam. If there were effective measures in place to reduce pollutants, such as a bottle deposit bill and a ban on Styrofoam, about 67% of trash by volume would disappear from all streams.

Figure 5-6-2: Trash Charactristics – Breakdown by Volume



5-7 Producer/Vendor Identification Survey

In order to understand which vendors are contributing the most to trash pollution, AWS conducted a Producer/Vender Identification survey on some trash categories for trash collected between July and December of 2009. The trash categories analyzed were: Bottles Liquor, Bottles Soft Drink, Bottles Water Plastic, Bottles Sports Drink Plastic, Bottles Juice, Cans Beer, Cans Soft Drink, Styrofoam Cups, Cups Plastic, Cups Paper, Food Wrapper, and Juice Packs.

Because Food Wrappers includes a significant number of small wrappers such as candy wrappers, only larger wrappers were identified for producers/vendors. Survey results are shown in Table 5-7-1 through Table 5-7-12.

Table 5-7-1: Producer/Vendor ID Survey for Bottles Liquor

Producer/Vendor	# of items	Percentage
Paul Masson	10	19.2
The Smirnoff Co	7	13.5
Spirits Marque one	5	9.6
Sutter Home Winery	4	7.7
William Grant & Sons	3	5.8
Bacardi Bottleing Corporation	2	3.8
CLS Remy Cointreau	2	3.8
Grosscurth Distillers Company	2	3.8
808 Spirit Co.	1	1.9
Arbor Mist Winery	1	1.9
Beringer Vineyards	1	1.9
Diago North America	1	1.9
E&J Distillers	1	1.9
Majestic Distilling Co.	1	1.9
Mickey Brewing Co.	1	1.9
Miller Inc.	1	1.9
Philips Products Co.	1	1.9
Schmitt Sohne GMBH	1	1.9
Skyy Spirits	1	1.9
The 20/20 Wine Co	1	1.9
The Jeremiah Weed Distilling Company	1	1.9
The SHR Robert Burnett Co.	1	1.9
white Rock Distillers, Inc	1	1.9
woodbridge winery	1	1.9
Seagram	1	1.9
unknown	14	-
Percentage for top 10 producers/vendors		71.2

Table 5-7-2: Producer/Vendor ID Survey for Bottles Soft Drink

Producer/Vendor	# of items	Percentage
Pepsi Co	77	28.4
The Coca Cola Company	35	12.9
Canada Dry	32	11.8
Lipton / Pepsi	29	10.7
Dr Pepper/Seven Up INC, TX	24	8.9
Ferolito Vultaggio & Sons	21	7.7
Beverage Marketing USA, Inc.	18	6.6
American Beverage Corporation	11	4.1
Lipton	8	3.0
Sunkist Growers, Inc	5	1.8
Welch Foods Inc.	2	0.7
Welch Fruit, Inc.	2	0.7
3rd Generation and Beverage Source 1	1	0.4
King Juice Company Inc. Milwaukee WL	1	0.4
LDI (Cayman) Ltd	1	0.4
Rio Grande Food Products	1	0.4
Tropicana	1	0.4
Turkey Hill Dairy	1	0.4
USA ALMAR Import & Export	1	0.4
Unknown	33	-
Percentage for top 10 producers/vendors		95.9

Table 5-7-3: Producer/Vendor ID Survey for Bottles Water Plastic

Producer/Vendor	# of items	Percentage
Deer Park Spring Water Company, Division of Nestle Waters North America, Inc.	126	56.5
The Coca Cola Company	18	8.1
Nestle	11	4.9
Advanced H2O LLC	10	4.5
Bottling Group LLC	9	4.0
Vintage Water Company	8	3.6
CG Roxane	7	3.1
Safeway	5	2.2
Save a lot	5	2.2
Poland Spring Water Company	4	1.8
7-Eleven, Inc	3	1.3
PepsiCo Inc.	3	1.3
CVS	2	0.9
Glacéau	2	0.9
Super Value Inc.	2	0.9
Walmart	2	0.9
ALDI, Inc.	1	0.4
CCDA Waters, L.L.C.	1	0.4
DS Waters of America, Inc.	1	0.4
Evian	1	0.4
Kirkland	1	0.4
Premium Waters, Inc.	1	0.4
Unknown	262	-
Percentage for top 10 producers/vendors		91.0

Table 5-7-4: Producer/Vendor ID Survey for Bottles Sports Drink Plastic

Producer/Vendor	# of items	Percentage
The Gatorade company	40	72.7
Glaceau	7	12.7
South Beach Beverage Co, Inc	3	5.5
Sundance Beverage Company	2	3.6
The Coca Cola company	2	3.6
ALDI, Inc.	1	1.8
unknown	18	-
Percentage for top 6 producers/vendors		100.0

Table 5-7-5: Producer/Vendor ID Survey for Bottles Juice

Producer/Vendor	# of items	Percentage
American Beverage Company	137	62.0
Tropicana	19	8.6
Sunny Delight Beverage Company	17	7.7
Sundance Beverage Co.	12	5.4
The Coca Cola Company	12	5.4
Welch's	5	2.3
Campbell Soup Company	4	1.8
Dole	2	0.9
Dr. Pepper / Seven Up, Inc	2	0.9
King Juice Company, Inc.	2	0.9
Alliance Food, Inc	1	0.5
Bug Juice Brands, Inc.	1	0.5
Harrisburg Dairies	1	0.5
Mott's LLP	1	0.5
Ocean Spray Cranberries, Inc.	1	0.5
PepsiCo, Inc	1	0.5
Simply Orange Juice Company	1	0.5
Swiss	1	0.5
Turkey Hill Dairy	1	0.5
Unknown	34	-
Percentage for top 10 producers/vendors		95.9

Table 5-7-6: Producer/Vendor ID Survey for Cans Beer

Producer/Vendor	# of items	Percentage
Anheuser-Busch	14	25
The Plank Road Brewery	9	16.1
Miller Brewing Co	8	14.3
United Brands Co.	6	10.7
The Stroh Brewery	5	8.9
Coors Brewing Co	3	5.4
Olde English 800 Brewing Co.	3	5.4
Steel Brewing Company	2	3.6
Budwiser	1	1.8
Drink Four Brewing Company	1	1.8
G. NELLMAN Brewing Co.	1	1.8
Plank Road Brewery	1	1.8
St. IDES Brewing Co.LTD	1	1.8
The Steel Brewing Company	1	1.8
Percentage for top 10 producers/vendors		92.9

Table 5-7-7: Producer/Vendor ID Survey for Cans Soft Drink

Producer/Vendor	# of items	Percentage
Ferolito Vultaggio & Sons Lake Success	9	17.6
PepsiCo	8	15.7
Dr Pepper / Seven Up Inc. TX	7	13.7
Shasta Beverage, Inc.	6	11.8
Rerolito Vultaggio & Sons	4	7.8
Safeway	3	5.9
The Coca Cola Company	3	5.9
Arizona Beverage Co.	2	3.9
Beverage Marketing USA	2	3.9
Canada Dry Potomac Corporation Landover, MD	1	2.0
Cintron Beverage Group, LLC	1	2.0
Food Lion, LLC	1	2.0
glacéau	1	2.0
Red Bull N.A., Inc	1	2.0
Sunkist Growers Inc. and Dr. Pepper/Seven up, Inc.	1	2.0
Wal-Mart Stores, Inc	1	2.0
Unknown	1	-
Percentage for top 10 producers/vendors		88.2

Table 5-7-8: Producer/Vendor ID Survey for Styrofoam Cups

Producer/Vendor	# of items	Percentage
McDonald	151	73.7
Chick Fil-A	14	6.8
7-Eleven	5	2.4
Dunkin Dnuts	4	2.0
Pop eyes	4	2.0
The Cup Café	4	2.0
Denny's	3	1.5
KFC	3	1.5
Forgers	2	1.0
Sam's Club	2	1.0
Bengal Traders	1	0.5
Bowl Noodle Soup	1	0.5
Burger Delight	1	0.5
Burger King Joe	1	0.5
Fair Field Inn	1	0.5
Hampton	1	0.5
IHOP	1	0.5
Japa classics	1	0.5
Low Coffee	1	0.5
Savory Supreme Roast	1	0.5
Smith field's	1	0.5
Sonic	1	0.5
Wendy's	1	0.5
Unknown	693	-
Percentage for top 10 producers/vendors		93.7

Table 5-7-9: Producer/Vendor ID Survey for Cups Plastic

Producer/Vendor	# of items	Percentage
McDonald's	6	18.8
7-Eleven	5	15.6
Taco Bell	4	12.5
Pop Eyes	3	9.4
Starbucks	3	9.4
Chuck E. Cheese's	2	6.3
Carvel Ice Cream	1	3.1
Del Monte Foods	1	3.1
Fudd Ruckers	1	3.1
KFC	1	3.1
Panera	1	3.1
S.R. Rosati Inc	1	3.1
T.G.I Fridays	1	3.1
The Coca-Cola Company	1	3.1
Wendy's	1	3.1
Unknown	108	-
Percentage for top 10 producers/vendors		84.4

Table 5-7-10: Producer/Vendor ID Survey for Cups Paper

Producer/Vendor	# of items	Percentage
McDonald's	34	40.5
Wendy's	15	17.9
7-Eleven	14	16.7
Checkers	4	4.8
Pop eyes	3	3.6
Burger King	2	2.4
The Coca-Cola Company	2	2.4
KFC	2	2.4
ARBY's	1	1.2
Chick Fill A	1	1.2
ICEE	1	1.2
Panda Express	1	1.2
Pepsi	1	1.2
Starbucks	1	1.2
Subway	1	1.2
Target	1	1.2
Unknown	10	-
Percentage for top 10 producers/vendors		92.9

Table 5-7-11: Producer/Vendor ID Survey for Food Wrapper

Producer/Vendor	# of items	Percentage
Frito-Lay, Inc	161	34.5
UTZ	78	16.7
Just Born, Inc	33	7.1
ConAgra Foods, Inc	30	6.4
Mars Snackfood US, Inc.	26	5.6
The Hershey Company	25	5.4
Wise Foods, Inc.	19	4.1
Herr's Food, Inc.	18	3.9
Bickel's Snack Foods, Inc.	10	2.1
Sunshine Biscuits, LLC	9	1.9
Nestle	8	1.7
Martine's Potato Chips Inc	7	1.5
Kisko Products	6	1.3
Rich Ice Cream Co.	5	1.1
Nissin	4	0.9
Reese Candy Co under License from Nestle	4	0.9
Wm. Wrigley Jr. Company	3	0.6
Carolina Food Inc	2	0.4
Keystone Food Products, Inc	2	0.4
Kraft Foods	2	0.4
Masterfoods USA	2	0.4
Stork USA	2	0.4
Troyer Potato Products, Inc	2	0.4
Unilever	2	0.4
Barcelona Nut Co	1	0.2
Greenbrier International, Inc.	1	0.2
Hershey Food Corporation	1	0.2
Kellogg Sales	1	0.2
Poppee's Popcorn, Inc.	1	0.2
Topps Company Inc	1	0.2
Wye River Wholesale, Inc.	1	0.2
Unknown + others	1468	-
Percentage for top 10 producers/vendors		87.6

Table 5-7-12: Producer/Vendor ID Survey for Juice Packs

Producer/Vendor	# of items	Percentage
Wild	75	53.6
KRAFT Foods Global, Inc.	27	19.3
The Coca-Cola Company	23	16.4
Nestle USA, Inc.	3	2.1
ALDI, Inc	2	1.4
Ardmore	2	1.4
Clover and Dairy	2	1.4
Johanna Foods, Inc	2	1.4
Apple & Eve L.L.C	1	0.7
Orchard Gold	1	0.7
Toropicana Products, Inc	1	0.7
WAWA	1	0.7
Unknown	10	-
Percentage for top 10 producers/vendors		98.6

Tables 5-7-1 through Table 5-7-12 demonstrate that only a handful of producers/vendors for each category contribute trash pollution by a large percentage. Table 5-7-13 shows the summary of the top 10 producers/vendors' contribution to trash pollution. Since there are numerous manufacturers, producers, and vendors not listed in Table 5-7-1 through Table 5-7-12, the majority of public resources (tax dollars, private funders' financial resources, volunteers' time) used to conduct trash cleanup efforts benefit only a handful of companies.

Table 5-7-13: Summary of Percentage of Top 10 Producers'/Vendors' Contribution to Trash Pollution for Each Trash Category

Trash Category	Percentage by Count For top 10 producers /vendors	Top 10 companies
Bottles Liquor	71.2	Paul Masson, The Smirnoff Co, Spirits Marque one, Sutter Home Winery, William Grant & Sons, Bacardi Bottleing Corporation, CLS Remy Cointreau, Grosscurth Distillers Company, 808 Spirit Co. , Arbor Mist Winery
Bottles Soft Drink	95.9	Pepsi Co, The Coca Cola Company, Canada Dry, Lipton / Pepsi, Dr Pepper/Seven Up INC, TX, Ferolito Vultaggio & Sons, Beverage Marketing USA Inc., American Beverage, Corporation, Lipton, Sunkist Growers Inc
Bottles Water Plastic	91.0	Deer Park Spring Water Company Division of Nestle Waters North America, Inc., The Coca Cola Company, Nestle, Advanced H2O LLC, Bottling Group LLC, Vintage Water Company, CG Roxane, Safeway, Save a lot, Poland Spring Water Company
Bottles Sports Drink Plastic	100.0*	The Gatorade company, Glaceau, South Beach Beverage Co Inc, Sundance Beverage Company, The Coca Cola company, ALDI Inc.
Bottles Juice	95.9	American Beverage Company, Tropicana, Sunny Delight Beverage Company, Sundance Beverage Co., The Coca Cola Company, Welch's, Campbell Soup Company, Dole, Dr. Pepper / Seven Up Inc, King Juice Company Inc.
Cans Beer	92.9	Anheuser-Busch, The Plank Road Brewery, Miller Brewing Co, United Brands Co., The Stroh Brewery, Coors Brewing Co, Olde English 800 Brewing Co., Steel Brewing Company, Budwiser, Drink Four Brewing Company
Cans Soft Drink	88.2	Ferolito Vultaggio & Sons Lake Success, PepsiCo, Dr Pepper / Seven Up Inc. TX, Shasta Beverage Inc., Rerolito Vultaggio & Sons, Safeway, The Coca Cola Company, Arizona Beverage Co., Beverage Marketing USA, Canada Dry Potomac Corporation Landover MD
Styrofoam Cups	93.7	McDonald, Chick Fil-A, 7-Eleven, Dunkin Dnuts, Pop eyes, The Cup Café, Denny's, KFC, Forgers, Sam's Club
Cups Plastic	84.4	McDonald's, 7-Eleven, Taco Bell, Pop Eyes, Starbucks, Chuck E. Cheese's, Carvel Ice Cream, Del Monte Foods, Fudd Ruckers, KFC
Cups Paper	92.9	McDonald's, Wendy's, 7-Eleven, Checkers, Pop eyes, Burger King, The Coca-Cola Company, KFC, ARBY's, Chick Fill A
Food Wrapper	87.6	Frito-Lay Inc, UTZ, Just Born Inc, ConAgra Foods Inc, Mars Snackfood US Inc., The Hershey Company, Wise Foods Inc., Herr's Food Inc., Bickel's Snack Foods Inc., Sunshine Biscuits LLC
Juice Packs	98.6	Wild, KRAFT Foods Global Inc., The Coca-Cola Company, Nestle USA Inc., ALDI Inc, Ardmore, Clover and Dairy, Johanna Foods Inc, Apple & Eve L.L.C, Orchard Gold

*Only 6 producers/vendors are identified for this category.

5-8 Other Observation and Suggestion

About a month after growing season began in early March, the trap started receiving a large amount of grass clippings. By May 28, 2009, a significant amount of grass clippings which had been trapped by the net were documented. Grass clippings

accumulated in a layer on the trash trap and worked as a sieve, filtering fine sediment particles and clogging the net almost completely (See Figure 5-8-1 and 5-8-2). The amount of grass clippings was not measured because we did not have the resources to spend a significant amount of time to measure it. However, in a natural setting, there would be no grass clippings in the stream water. Any additional organic matter in the river resulting from human activities could degrade the water quality. When an excessive amount of organic matter gets into a stream, it will consume oxygen dissolved in the water exacerbating water quality. A large amount of fallen leaves, twigs, branches and logs were also captured. These may be attributed to impervious surfaces that will not allow leaves and twigs to remain on the land and create stormwater runoff that causes erosion on stream banks undermining large trees. In order to improve water quality and reduce pollution, LID implementation should be stressed as a high priority throughout the watershed to remedy these problems.

Figure 5-8-1: Grass Clippings Trapped on the Net

Figure 5-8-2: Plastered Trash Trap

The trash trap was tilted back in order to strengthen its structure. We also believed this tilting would allow trash and organic matter to be pushed higher up on the re-bar screen by the stream force. The idea was that it would keep the lower portion of the screen free from trash and organic matter allowing the stream to flow smoothly. Our re-bar screen was gradually tilted back more and more, and we believe the screen should be tilted more than 30 degrees for this kind of project in the future. Additionally, re-bars have wavy surfaces, which increase the friction coefficient. Metal bars with smooth surfaces are suggested for future use (although these materials are more expensive).

This trap was successful especially in terms of structural strength. The metal frame was strong enough to bear the burden of stream force for about two years. However, it is suggested that this type of technology should only be used in smaller streams. The Nash Run stream force was thought to be very strong for the AWS Nash Run Trash Trap. Though the trap was successful, it did not experience a hurricane (as of this writing).

Although it was difficult to engage local community people close to the trash trap. AWS was asked to install trash traps at several sites. An individual who lives in University Park demonstrated an interest in getting involved, and she said there was a group ready to maintain an additional trash trap. The group actually installed a trash trap in Wells Run

without AWS's involvement. A sub-watershed group called Citizens to Conserve and Restore the Indian Creek (CCRIC) contacted AWS and said that they wanted to install and maintain several trash traps. An individual and a very active volunteer in Cheverly asked AWS if we were interested in installing a trash trap in Quincy Manor Run. Because maintaining the trash trap requires consistent and collaborative efforts, it is recommended that a trap only be installed in a community where there is an existing organization who could maintain the trap and who has an interest in doing so.

The number of plastic bags was counted and the trend was checked. However, the data showed a contradiction between the number of plastic bags and their weight. It was thought that we should accumulate more data on the bags to observe the trend as accurately as possible.

Attachment 1: Raw Trash Weight Data

After Collection / Before Sorting

Total trash weight (lb)	2399.40										
Trash weight (Weight-C (lbs))	65.07	56.44	54.22	57.91	49.50	60.65	58.59	51.36	34.79	43.50	28.84
Trash collection date	2009.3.30	2009.04.04	2009.04.22	2009.05.09	2009.05.28	2009.06.04	2009.06.09	2009.06.11	2009.06.15	2009.06.19 and 25	2009.07.01
Total Weight for each trash collection (Weight-C (kg))	**29.52**	**25.60**	**24.59**	**26.27**	**22.45**	**27.51**	**26.58**	**23.30**	**15.78**	**19.73**	**13.08**
bag 1	5.22	6.33	missed to measure bags' weight	9.36	0.90	4.60	4.71	4.98	1.12	0.80	4.72
2	6.79	9.87		4.48	1.00	12.66	4.84	1.73	5.85	3.53	7.13
3	1.89	9.40		2.57	1.31	2.31	1.46	1.78	5.17	2.43	1.23
4	5.72			0.86	9.15	6.54	3.93	10.06	3.64	0.70	
5	3.94			0.73	1.66	1.40	1.01	4.75		6.52	
6	5.95			8.26	5.69		1.93			4.42	
7					2.75		7.52			1.34	
8							1.18				
9											
Note			* Weight is an estimate								

After Sorting

Sorting date	4/30, 5/1, 5/5	No sorting	5/28,6/25	14, 16 including trash washing to generate dry-weight/# of item	No sorting	7/30	No sorting	No sorting	No sorting	No sorting	No sorting
Inventory person hours	16		16	88		18					
Total wet weight (Weight-S (kg))	24.518		20.43	16.43		19.86					
Total wet weight (Weight-S (lb)) (Total wet weight (kg)*2.20462262)	54.053		45.040	36.213		43.784					
Weight loss after sorting (kg)	4.997		**4.164**	9.842		7.650					
wet-W after collection/wet-W after sorting ratio	1.204		Wet-W after collection is an estimate	1.599		1.385					
wet weight loss (%) between colleciton and sorting	16.9		16.9	37.5		27.8					
Note				Inventory person hours include trash washing							

Attachment 1: Raw Trash Weight Data

After Collection / Before Sorting

↓trash weight without a toy car (kg)

Total trash weight (lb)			19.3				15.67 ←trash weight without construction debris (large piece of lumber)				
Trash weight (Weight-C (lbs))	65.98	35.05	90.61	45.97	40.12	54.52	112.22	78.00	71.17		72.82
Trash collection date	2009.07.24-28	2009.08.03	2009.08.20	2009.09.10	2009.09.28	2009.10.26	2009.11.23-24	12/18/2009	02/01/2010 (January trash)	no February trash	3/26/2010
Total Weight for each trash collection (Weight-C (kg))	**29.93**	**15.90**	**41.10**	**20.85**	**18.20**	**24.73**	**50.9**	**35.38**	**32.28**		**33.03**
bag 1	1.26	2.53	3.33	2.95	7.12	1.9	8.09	6.76	3.63		9.41
2	3.21	5.03	1.25	4.71	3.61	7.88	0.41	7.98	10.89		4.79
3	3.43	1.55	3.95	0.87	5.59	2.25	4.83	1.79	4.04		6.97
4	1.88	2.22	4.42	4.73	1.22	3.99	1.7	6.39	3.4		2.7
5	7.78	3.52	1.24	2.41	0.66	8.71	6.97	4.75	2.46		3.5
6	7.01	1.05	1.5	5.18			2.48	7.71	7.86		3.06
7	5.36		3.61				7.08				2.6
8			21.8				3.26				
9							10.78				
							3.53				
							1.77				
Note											

After Sorting

Sorting date	No record	No sorting	No record	No sorting	11/2	2/1/2010	Feb-10	3/3/2010	Mar-10		6/16/2010
Inventory person hours	9		5		10	10	8.5	10	11		15
Total wet weight (Weight-S (kg))	27.15		37		14.231	18.25	28.99	29.45	25.849		24.518
Total wet weight (Weight-S (lb)) (Total wet weight (kg)*2.20462262)	59.856		81.571		31.374	40.234	63.912	64.926	56.987		54.053
Weight loss after sorting (kg)	2.780		4.100		3.969	6.480	21.910	5.930	6.431		8.512
wet-W after collection/wet-W after sorting ratio	1.102		1.111		1.279	1.355	1.756	1.201	1.249		1.347
wet weight loss (%) between colleciton and sorting	9.3		10.0		21.8	26.2	43.0	16.8	19.9		25.8
Note											

Attachment 1: Raw Trash Weight Data

After Collection / Before Sorting

Total trash weight (lb)						
Trash weight (Weight-C (lbs))	26.17	55.62	162.07	332.41	468.50	127.29
Trash collection date	05/02/2010 (April trash)	05/28/2010 (May trash)	6/26/2010 (June trash)	7/31/2010 (July Trash	8/28/2010 (August Trash)	9/25/2010 (September Trash)
Total Weight for each trash collection (Weight-C (kg))	**11.87**	**25.23**	**73.515**	**150.78**	**212.51**	**57.74**
bag 1	1.02	11.3	3.81	97.46	212.51	9.65
2	5.09	13.36	1.995	53.32		9.22
3	3.03	0.57	40.655			38.87
4	2.73		25.57			
5			1.485			
6						
7						
8						
9						
Note		total 14 bags (8 full bags equivalent)	totall 22 bags (20 bags equivalent)	total 31 bags (29 bags equivalent)	total 45 bags	total 11 bags and 2 tires

After Sorting

Sorting date	7/14/2010	7/21/2010	7/28/2010	8/4/2010	9/1/2010	9/29/2010
Inventory person hours	12.5	12	25.5	20	23	12.5
Total wet weight (Weight-S (kg))	11.275	20.155	64.349	117.043	164.96	48.495
Total wet weight (Weight-S (lb)) (Total wet weight (kg)*2.20462262)	24.857	44.434	141.865	258.035	363.675	106.913
Weight loss after sorting (kg)	0.595	5.075	9.166	33.7374	47.5496	9.245
wet-W after collection/wet-W after sorting ratio	1.053	1.252	1.142	1.28825	1.28825	1.19064
wet weight loss (%) between colleciton and sorting	5.0	20.1	12.5	22.4	22.4	16.0
Note						

Attachment 2: Trash Characterization by Number of Trash Pieces

Before Adjustment

		Month and Year	Mar. 09	Apr. 09	May. 09	Jun. 09	Jul. 09	Aug. 09	Sep. 09	Oct. 09	Nov. 09	Dec. 09	Jan.10	Feb. 10
		Adjustment Coefficient*	1.00	2.04	1.85	4.10	1.44	1.39	2.15	1.00	1.00	1.00	1.00	1.00
		Trash Collection Date	2009.03.30	2009.04.22	2009.05.09	2009.06.04	2009.07.24-28	2009.08.20	2009.09.28	2009.10.26	2009.11.23-24	2009.12.18	2010.02.01	
Bottles	1	Liquor	6	10	12	21	12	3	6	8	22	18	20	
	2	Beer	2	2	0	0	0	0	2	0	0	0	1	
	3	Soft Drink	61	40	18	28	54	38	36	55	61	65	57	
	4	Water, Plastic	75	64	52	35	52	72	46	81	149	88	75	
	5	Sports Drink, Plastic	17	8	8	10	8	7	6	9	22	19	10	
	6	Juice	79	38	30	36	24	30	33	53	76	44	49	
Cans	7	Beer	26	9	26	4	8	7	4	9	16	11	6	
	8	Soft Drink	11	6	18	3	13	3	4	4	18	7	1	
	9	Juice	1	1	4	0	0	0	0	4	2	0	0	
Food	10	Home Food Packagin	0	0	0	2	6	16	1	5	8	17	11	
Packaging														
Styrofoam														
	12	Plates	48	30	54	49	47	22	45	41	84	54	80	
	13	Foam Packaging	72	20	4	27	35	213	13	3	12	4	13	
	14	Chunks	375	140	71	425	449	33	178	158	286	413	178	
	15	Styrofoam Cups	189	208	152	164	145	79	92	168	240	180	232	
Cup														
	16	Plastic	70	13	21	19	24	19	7	27	26	31	31	
	17	Paper	16	14	15	15	13	12	8	20	19	22	14	
Wrap	18	Food Wrapper	910	643	382	509	354	350	335	307	439	457	335	
	11-1	Take Out Food Packaging, **Paper and Plastic**	***item	***item	0	0	26	10	15	8	11	11	14	
	11-2	Take Out Food Packaging, **Styrofoam**	60	48	38	71	60	17	53	77	109	90	121	
Plastic Bag	19	Plastic Bags	57	51	27	43	45	39	65	36	69	155	58	
Others														
	20	Cigarette Packs, Matches, Cigars, Tobacco	203	59	39	200	385	263	305	78	96	126	70	
	21	Napkins, Paper Towels, Tissues	1	0	0	0	0	0	0	0	2	2	0	
	22	Beverage Carriers, Rings, Cartons	0	0	0	0	0	0	1	1	3	4	1	
	23	Toiletries	6	6	2	20	10	8	9	10	10	5	6	
	24	Drugs	39	47	53	60	69	41	65	37	25	42	37	
	25	Games, Cassettes, CDs	0	0	0	0	0	0	0	0	0	3	1	
	26	Toys, Balls	13	11	7	19	14	20	14	12	6	13	6	
	27	Toys, Misc. Other	1	17	3	12	17	13	12	10	10	6	4	
	28	Newspapers, Magazine, Books	0	0	0	0	0	0	0	0	0	1	0	
	29	Advertising, Signs, Cards,	0	0	0	0	0	0	0	0	0	0	0	
	30	Other Misc. Cartons	28	3	0	0	0	2	2	0	5	2	2	
	31	Other Metal, Foil Packets	26	10	8	43	52	52	4	14	7	19	10	
	32	Other Fabric	0	2	0	0	0	0	0	0	0	0	0	
	33	Clothing	2	1	2	3	5	6	0	3	4	4	0	
	34	Auto Products Containers	4	2	0	0	0	0	3	1	4	1	7	
	35	Vehicle Debris	1	0	0	0	0	0	0	0	0	0	0	
	36	Construction Material	0	15	12	11	30	16	11	7	11	20	9	
	37	Appliances	0	1	0	0	1	0	0	0	1	0	0	
	38	Carpet	0	0	0	0	0	0	0	0	0	0	0	
	39	Misc Large Debris	0	0	0	1	0	0	0	0	0	1	0	
	40	Misc. Plastic **Trash**	722	484	297	473	1209	849	320	382	430	644	296	
	41	Lids, straws, tops	254	167	185	442	398	333	496	222	199	82	124	
	42	Misc. Paper Pieces	20	0	0	0	0	55	5	0	18	33	2	
	43	Paper Bags	0	0	0	0	0	0	0	0	0	0	4	
	44	Juice Packs	0	35	7	22	27	27	19	17	32	25	24	
	45	Broken Glass pieces	8	30	0	0	0	6	2	9	18	0	0	
	46	Misc. Plastic **Debris**	0	3	0	0	1	1	1	0	0	2	0	
		total	3403	2238	1547	2767	3593	2662	2218	1876	2550	2721	1909	

*Only selected collection event of trash bags in a month was sorted out during the first several months. For those months the number of trash pieces was adjusted based on th

Attachment 2: Trash Characterization by Number of Trash Pieces

Before Adjustment

Month and Year			Mar. 10	Apr. 10	May. 10	Jun. 10	Jul. 10	Aug. 10	Sep. 10
Adjustment Coefficient*			1.00	1.00	1.00	1.00	1.00	1.00	1.00
Trash Collection Date			2010.03.26	2010.05.02	2010.05.28	2010.06.26	2010.07.31	2010.08.28	2010.09.25
Bottles	1	Liquor	12	7	9	22	60	69	21
	2	Beer	5	0	0	0	28	5	0
	3	Soft Drink	77	46	77	152	133	334	52
	4	Water, Plastic	89	46	120	163	552	642	90
	5	Sports Drink, Plastic	14	9	16	34	89	90	17
	6	Juice	52	32	76	119	335	276	32
Cans	7	Beer	11	5	30	28	64	106	35
	8	Soft Drink	7	10	18	25	44	101	23
	9	Juice	1	10	7	13	16	0	9
Food Packaging	10	Home Food Packagin	15	3	34	128	85	53	5
Styrofoam									
	12	Plates	69	30	67	111	89	292	24
	13	Foam Packaging	6	25	28	29	40	64	7
	14	Chunks	400	88	244	606	597	848	232
	15	Styrofoam Cups	161	113	152	313	355	1023	69
Cup									
	16	Plastic	62	33	82	102	246	111	64
	17	Paper	12	19	13	47	109	95	27
Wrap	18	Food Wrapper	575	250	640	1537	1887	1760	430
	11-1	Take Out Food Packaging, **Paper and Plastic**	17	7	6	8	81	0	17
	11-2	Take Out Food Packaging, **Styrofoam**	25	42	65	112	222	689	18
Plastic Bag	19	Plastic Bags	118	29	77	342	286	626	145
Others									
	20	Cigarette Packs, Matches, Cigars, Tobacco	57	40	120	168	125	196	76
	21	Napkins, Paper Towels, Tissues	0	2	6	8	8	16	4
	22	Beverage Carriers, Rings, Cartons	4	1	6	12	12	21	4
	23	Toiletries	9	1	10	8	8	42	6
	24	Drugs	25	8	22	153	153	148	33
	25	Games, Cassettes, CDs	2	0	1	8	4	0	11
	26	Toys, Balls	9	11	17	34	85	48	11
	27	Toys, Misc. Other	5	0	3	16	16	32	3
	28	Newspapers, Magazine, Books	0	0	0	0	12	0	1
	29	Advertising, Signs, Cards,	0	0	0	0	0	5	0
	30	Other Misc. Cartons	1	0	7	24	20	21	3
	31	Other Metal, Foil Packets	11	10	41	112	40	58	73
	32	Other Fabric	3	0	0	8	36	0	0
	33	Clothing	1	5	4	4	12	5	18
	34	Auto Products Containers	4	1	1	4	12	16	2
	35	Vehicle Debris	0	1	0	4	4	12	13
	36	Construction Material	8	1	4	0	16	154	22
	37	Appliances	0	0	0	0	5	11	0
	38	Carpet	0	0	0	0	0	1	0
	39	Misc Large Debris	0	0	0	0	0	0	0
	40	Misc. Plastic **Trash**	204	283	614	1444	951	1272	861
	41	Lids, straws, tops	208	118	274	557	718	774	178
	42	Misc. Paper Pieces	0	28	2	12	101	106	50
	43	Paper Bags	0	0	0	0	0	0	0
	44	Juice Packs	26	8	33	60	141	111	21
	45	Broken Glass pieces	19	2	22	25	214	74	69
	46	Misc. Plastic **Debris**	0	74	0	4	0	3	0
		total	2324	1398	2948	6556	8011	10310	2776

*Only selected collection event of trash bags in a month was sorted out ıe month's wet weight.

Attachment 2: Trash Characterization by Number of Trash Pieces

After Adjustment

Month and Year			Mar. 09	Apr. 09	May. 09	Jun. 09	Jul. 09	Aug. 09	Sep. 09	Oct. 09	Nov. 09	Dec. 09	Jan.10	Feb. 10
Trash Collection Date			2009.03.30	2009.04.22	2009.05.09	2009.06.04	2009.07.24-28	2009.08.20	2009.09.28	2009.10.26	2009.11.23-24	2009.12.18	2010.02.01	
Bottles	1	Bottles, Liquor	6	20	22	86	17	4	13	8	22	18	20	
	2	Bottles, Beer	2	4	0	0	0	0	4	0	0	0	1	
	3	Bottles, Soft Drink	61	82	33	115	78	53	77	55	61	65	57	
	4	Bottles, Water, Plastic	75	131	96	144	75	100	99	81	149	88	75	
	5	Bottles, Sports Drink, Plastic	17	16	15	41	11	10	13	9	22	19	10	
	6	Bottles, Juice	79	78	56	148	34	42	71	53	76	44	49	
Cans	7	Cans, Beer	26	18	48	16	11	10	9	9	16	11	6	
	8	Cans, Soft Drink	11	12	33	12	19	4	9	4	18	7	1	
	9	Cans, Juice	1	2	7	0	0	0	0	4	2	0	0	
Food Packaging	10	Home Food Packaging	0	0	0	8	9	22	2	5	8	17	11	
Styrofoam														
	12	Styrofoam, Plates	48	61	100	201	68	31	97	41	84	54	80	
	13	Styrofoam, Foam Packaging	72	41	7	111	50	295	28	3	12	4	13	
	14	Styrofoam, Chunks	375	286	132	1744	645	46	382	158	286	413	178	
	15	Styrofoam Cups	189	425	282	673	208	110	197	168	240	180	232	
Cup														
	16	Cups, Plastic	70	27	39	78	34	26	15	27	26	31	31	
	17	Cups, Paper	16	29	28	62	19	17	17	20	19	22	14	
Wrap	18	Food Wrapper	910	1312	709	2089	509	485	719	307	439	457	335	
	11-1	Take Out Food Packaging, **Paper and Plastic**	***item	***item	0	0	37	14	32	8	11	11	14	
	11-2	Take Out Food Packaging, **Styrofoam**	60	98	70	291	86	24	114	77	109	90	121	
Plastic Bag	19	Plastic Bags	57	104	50	176	65	54	139	36	69	155	58	
Others														
	20	Cigarette Packs, Matches, Cigars, Tobacco	203	120	72	821	553	365	654	78	96	126	70	
	21	Napkins, Paper Towels, Tissues	1	0	0	0	0	0	0	0	2	2	0	
	22	Beverage Carriers, Rings, Cartons	0	0	0	0	0	0	2	1	3	4	1	
	23	Toiletries	6	12	4	82	14	11	19	10	10	5	6	
	24	Drugs	39	96	98	246	99	57	139	37	25	42	37	
	25	Games, Cassettes, CDs	0	0	0	0	0	0	0	0	0	3	1	
	26	Toys, Balls	13	22	13	78	20	28	30	12	6	13	6	
	27	Toys, Misc. Other	1	35	6	49	24	18	26	10	10	6	4	
	28	Newspapers, Magazine, Books	0	0	0	0	0	0	0	0	0	1	0	
	29	Advertising, Signs, Cards,	0	0	0	0	0	0	0	0	0	0	0	
	30	Other Misc. Cartons	28	6	0	0	0	3	4	0	5	2	2	
	31	Other Metal, Foil Packets	26	20	15	176	75	72	9	14	7	19	10	
	32	Other Fabric	0	4	0	0	0	0	0	0	0	0	0	
	33	Clothing	2	2	4	12	7	8	0	3	4	4	0	
	34	Auto Products Containers	4	4	0	0	0	0	6	1	4	1	7	
	35	Vehicle Debris	1	0	0	0	0	0	0	0	0	0	0	
	36	Construction Material	0	31	22	45	43	22	24	7	11	20	9	
	37	Appliances	0	2	0	0	1	0	0	0	1	0	0	
	38	Carpet	0	0	0	0	0	0	0	0	0	0	0	
	39	Misc Large Debris	0	0	0	4	0	0	0	0	0	1	0	
	40	Misc. Plastic **Trash**	722	988	551	1941	1737	1177	687	382	430	644	296	
	41	Lids, straws, tops	254	341	343	1814	572	462	1064	222	199	82	124	
	42	Misc. Paper Pieces	20	0	0	0	0	76	11	0	18	33	2	
	43	Paper Bags	0	0	0	0	0	0	0	0	0	0	4	
	44	Juice Packs	0	71	13	90	39	37	41	17	32	25	24	
	45	Broken Glass pieces	8	61	0	0	0	8	4	9	18	0	0	
	46	Misc. Plastic **Debris**	0	6	0	0	1	1	2	0	0	2	0	
		total	3403	4568	2869	11355	5163	3692	4759	1876	2550	2721	1909	0

Attachment 2: Trash Characterization by Number of Trash Pieces

After Adjustment

Month and Year			Mar. 10	Apr. 10	May. 10	Jun. 10	Jul. 10	Aug. 10	Sep. 10			
Trash Collection Date			2010.03.26	2010.05.02	2010.05.28	2010.06.26	2010.07.31	2010.08.28	2010.09.25	sub-total	Percentage in all trash	Percentage in a large category
Bottles	1	Bottles, Liquor	12	7	9	22	60	69	21	437	0.6	6.2
	2	Bottles, Beer	5	0	0	0	28	5	0	49	0.1	0.7
	3	Bottles, Soft Drink	77	46	77	152	133	334	52	1607	2.0	22.9
	4	Bottles, Water, Plastic	89	46	120	163	552	642	90	2814	3.6	40.1
	5	Bottles, Sports Drink, Plastic	14	9	16	34	89	90	17	452	0.6	6.5
	6	Bottles, Juice	52	32	76	119	335	276	32	1651	2.1	23.5
Cans	7	Cans, Beer	11	5	30	28	64	106	35	460	0.6	51.6
	8	Cans, Soft Drink	7	10	18	25	44	101	23	358	0.5	40.2
	9	Cans, Juice	1	10	7	13	16	0	9	72	0.1	8.1
Food Packaging	10	Home Food Packaging	15	3	34	128	85	53	5	405	0.5	
										0	0.0	
Styrofoam										0	0.0	
										0	0.0	
	12	Styrofoam, Plates	69	30	67	111	89	292	24	1546	2.0	
	13	Styrofoam, Foam Packaging	6	25	28	29	40	64	7	836	1.1	
	14	Styrofoam, Chunks	400	88	244	606	597	848	232	7659	9.7	
										0	0.0	
	15	Styrofoam Cups	161	113	152	313	355	1023	69	5090	6.4	
Cup										0	0.0	
	16	Cups, Plastic	62	33	82	102	246	111	64	1104	1.4	
	17	Cups, Paper	12	19	13	47	109	95	27	583	0.7	
										0	0.0	
Wrap	18	Food Wrapper	575	250	640	1537	1887	1760	430	15350	19.4	
	11-1	Take Out Food Packaging, **Paper and Plastic**	17	7	6	8	81	0	17	263	0.3	
	11-2	Take Out Food Packaging, **Styrofoam**	25	42	65	112	222	689	18	2313	2.9	
Plastic Bag	19	Plastic Bags	118	29	77	342	286	626	145	2587	3.3	
										0	0.0	
Others										0	0.0	
										0	0.0	
	20	Cigarette Packs, Matches, Cigars, Tobacco	57	40	120	168	125	196	76	3941	5.0	
	21	Napkins, Paper Towels, Tissues	0	2	6	8	8	16	4	49	0.1	
	22	Beverage Carriers, Rings, Cartons	4	1	6	12	12	21	4	71	0.1	
	23	Toiletries	9	1	10	8	8	42	6	264	0.3	
	24	Drugs	25	8	22	153	153	148	33	1458	1.8	
	25	Games, Cassettes, CDs	2	0	1	8	4	0	11	30	0.0	
	26	Toys, Balls	9	11	17	34	85	48	11	456	0.6	
	27	Toys, Misc. Other	5	0	3	16	16	32	3	264	0.3	
	28	Newspapers, Magazine, Books	0	0	0	0	12	0	1	14	0.0	
	29	Advertising, Signs, Cards,	0	0	0	0	0	5	0	5	0.0	
	30	Other Misc. Cartons	1	0	7	24	20	21	3	126	0.2	
	31	Other Metal, Foil Packets	11	10	41	112	40	58	73	788	1.0	
	32	Other Fabric	3	0	0	8	36	0	0	51	0.1	
	33	Clothing	1	5	4	4	12	5	18	96	0.1	
	34	Auto Products Containers	4	1	1	4	12	16	2	68	0.1	
	35	Vehicle Debris	0	1	0	4	4	12	13	35	0.0	
	36	Construction Material	8	1	4	0	16	154	22	439	0.6	
	37	Appliances	0	0	0	0	5	11	0	20	0.0	
	38	Carpet	0	0	0	0	0	1	0	1	0.0	
	39	Misc Large Debris	0	0	0	0	0	0	0	5	0.0	
	40	Misc. Plastic **Trash**	204	283	614	1444	951	1272	861	15184	19.2	
	41	Lids, straws, tops	208	118	274	557	718	774	178	8304	10.5	
	42	Misc. Paper Pieces	0	28	2	12	101	106	50	459	0.6	
	43	Paper Bags	0	0	0	0	0	0	0	4	0.0	
	44	Juice Packs	26	8	33	60	141	111	21	790	1.0	
	45	Broken Glass pieces	19	2	22	25	214	74	69	534	0.7	
	46	Misc. Plastic **Debris**	0	74	0	4	0	3	0	94	0.1	
		total	2324	1398	2948	6556	8011	10310	2776	79188		

Attachment 3: Trash Characterization by Trash Weight

Before Adjustment

		Month and Year	Mar. 09	Apr. 09	May. 09	Jun. 09	Jul. 09	Aug. 09	Sep. 09	Oct. 09	Nov. 09	Dec. 09	Jan.10	Feb. 10
		Adjustment Coefficient*	1.00	2.04	1.85	4.10	1.44	1.39	2.15	1.00	1.00	1.00	1.00	1.00
		Trash Collection Date	2009.03.30	2009.04.22	2009.05.09	2009.06.04	2009.07.24-28	2009.08.20	2009.09.28	2009.10.26	2009.11.23-24	2009.12.18	2010.02.01	
Bottles	1	Liquor	1.42	1.315	2.24	2.46	0.77	0.13	0.63	0.94	3.35	2.1	4.215	
	2	Beer	0.43	0.73	0	0	0	0	0.735	0	0	0	0.285	
	3	Soft Drink	2.113	1.335	0.6	1.56	2.065	1.68	1.185	1.82	2.3	2.37	1.875	
	4	Water, Plastic	1.465	1.035	0.9	0.65	0.98	1.29	0.815	1.61	3.17	1.69	1.355	
	5	Sports Drink, Plastic	0.64	0.3	0.26	0.26	0.42	0.31	0.385	0.45	1.03	0.92	0.54	
	6	Juice	3.095	2.395	1.93	1.86	1.425	1.095	1.53	2.13	3.79	1.6	3.205	
									0	0	0	0	0	
Cans	7	Beer	0.675	0.28	0.66	0.125	0.215	0.24	0.105	0.23	0.41	0.32	0.13	
	8	Soft Drink	0.245	0.135	0.39	0.09	0.33	0.065	0.105	0.11	0.49	0.14	0.015	
	9	Juice	0.035	0.035	0.09	0	0	0	0	0.12	0.05	0	0	
Food Packaging	10	Home Food Packagin	0	0	0	0.07	0.12	0.18	0.07	0.06	0.13	0.17	0.285	
Styrofoam														
	12	Plates	0.335	0.255	0.27	0.26	0.17	0.115	0.015	0.19	0.27	0.2	0.195	
	13	Foam Packaging	0.045	0.02	0	0.05	0.03	0.26	0.025	0.09	0.04	0.05	0.055	
	14	Chunks	0.64	0.27	0.24	0.65	0.195	0.055	0.165	0.25	0.37	0.52	0.3	
	15	Styrofoam Cups	0.765	0.855	0.67	0.81	0.44	0.39	0.33	0.68	0.79	0.6	0.635	
Cup														
	16	Plastic	0.635	0.185	0.26	0.23	0.25	0.245	0.065	0.37	0.29	0.34	0.27	
	17	Paper	0.385	0.025	0.36	0.44	0.17	0.19	0.19	0.65	0.53	0.63	0.275	
Wrap	18	Food Wrapper	2.825	2.95	1.89	1.94	1.77	1.305	0.755	1.47	1.36	1.38	0.99	
	11-1	Take Out Food Packaging, **Paper and Plastic**	***item	***item	0	0	0.24	0.06	0.095	0.04	0.12	0.18	0.1	
	11-2	Take Out Food Packaging, **Styrofoam**	0.52	0.435	0.25	0.56	0.19	0.105	0.21	0.41	0.5	0.37	0.34	
Plastic Bag	19	Plastic Bags	2.015	1.23	1.01	1.3	1.655	1.035	0.636	1.77	1.33	2.55	0.79	
Others														
	20	Cigarette Packs, Matches, Cigars, Tobacco	0.34	0.185	0.13	0.47	0.53	0.335	0.39	0.19	0.17	0.23	0.175	
	21	Napkins, Paper Towels, Tissues	0.37	0	0	0	0	0	0	0	1.12	0.08	0	
	22	Beverage Carriers, Rings, Cartons	0	0	0	0	0	0	0.015	0.04	0.14	0.03	0	
	23	Toiletries	0.147	0.045	0.03	0.265	0.205	0.12	0.135	0.79	0.11	0.14	0.08	
	24	Drugs	0.067	0.32	0.375	0.165	0.195	0.375	0.46	0.22	0.22	0.78	0.445	
	25	Games, Cassettes, CDs	0	0	0	0	0	0	0	0	0	0.08	0.035	
	26	Toys, Balls	0.345	0.66	0.74	0.71	0.295	1.065	0.955	0.21	0.44	1.42	1.685	
	27	Toys, Misc. Other	0.005	0.06	0.0108	0.09	2	0.07	0.175	0.06	0.27	0.14	0.525	
	28	Newspapers, Magazine, Books	0	0	0	0	0	0	0	0	0	0.04	0	
	29	Advertising, Signs, Cards,	0	0	0	0	0	0	0	0	0	0	0	
	30	Other Misc. Cartons	0.485	0.215	0	0	0	0.17	0.115	0	0.2	0.09	0.085	
	31	Other Metal, Foil Packets	0.255	0.1	0.09	0.17	0.135	0.1	0.015	0.18	0.36	0.07	0.03	
	32	Other Fabric	0	0.205	0	0	0	0	0	0	0	0	0	
	33	Clothing	0.5	0.06	0.22	0.26	2	0.67	0	0.36	0.23	0.34	0	
	34	Auto Products Containers	0.265	0.68	0	0	0	0	0.215	0.1	0.19	0.04	0.565	
	35	Vehicle Debris	0.04	0	0	0	0	0	0	0	0	0	0	
	36	Construction Material	0	1.26	1.15	0.31	1.225	0.94	1.495	0.3	1.75	4.29	0.69	
	37	Appliances	0	0.1	0	0	5.29	0	0	0	0.07	0	0	
	38	Carpet	0	0	0	0	0	0	0	0	0	0	0	
	39	Misc Large Debris	0	0	0	1.515	0	0	0	0	0	0.51	0	
	40	Misc. Plastic **Trash**	2.125	1.47	1.18	1.36	2.255	1.29	0.745	1.42	2.03	1.71	0.715	
	41	Lids, straws, tops	0.621	0.405	0.39	0.99	0.875	0.575	0.855	0.41	0.34	0.3	0.215	
	42	Misc. Paper Pieces	0.275	0	0	0	0	0.26	0.045	0	0.18	0.15	0	
	43	Paper Bags	0	0	0	0	0	0	0	0	0	0	0.01	
	44	Juice Packs	0	0.33	0.09	0.24	0.305	0.42	0.285	0.24	0.39	0.3	0.305	
	45	Broken Glass pieces	0.395	0.515	0	0	0	0.06	0.075	0.34	0.46	0	0	
	46	Misc. Plastic **Debris**	0	0.035	0	0	0.405	21.8	0.21	0	0	2.58	0	
		total	24.518	20.43	16.426	19.86	27.15	37	14.231	18.25	28.99	29.45	21.415	

*Only selected trash in a month was sorted out for the first several months. For those months the weight of trash pieces was adjusted based on the month's wet weight.

Attachment 3: Trash Characterization by Trash Weight

Before Adjustment

Month and Year			Mar. 10	Apr. 10	May. 10	Jun. 10	Jul. 10	Aug. 10	Sep. 10
Adjustment Coefficient*			1.00	1.00	1.00	1.00	1.00	1.00	1.00
Trash Collection Date			2010.03.26	2010.05.02	2010.05.28	2010.06.26	2010.07.31	2010.08.28	2010.9.25
Bottles	1	Liquor	1.01	0.546	1.145	3.265	6.6313	5.3547	1.5
	2	Beer	0.635	0	0	0	5.2003	3.6846	0
	3	Soft Drink	2.63	1.925	1.36	2.995	4.6157	11.133	2.435
	4	Water, Plastic	1.51	0.735	1.905	2.865	9.3121	11.452	1.73
	5	Sports Drink, Plastic	0.794	0.415	0.75	1.408	3.1645	15.242	0.795
	6	Juice	2.205	1.09	2.845	4.975	15.52	10.206	1.025
			0	0	0	0			
Cans	7	Beer	0.35	0.145	0.615	0.735	2.4994	3.3931	1.125
	8	Soft Drink	0.145	0.02	0.545	0.435	1.1086	2.3592	0.595
	9	Juice	0.035	0.175	0.195	0.33	0.5039	0	0.445
Food Packaging	10	Home Food Packagin	0.25	0.179	0.31	1.1	1.0078	0.6362	0.115
Styrofoam									
	12	Plates	0.285	0.11	0.22	0.49	0.7458	1.2989	0.115
	13	Foam Packaging	0.02	0.02	0.025	0.025	0.1008	0.3181	0.04
	14	Chunks	0.575	0.36	0.195	0.57	1.0481	5.2486	0.26
	15	Styrofoam Cups	0.715	0.395	0.61	2.38	2.0962	2.3062	0.345
Cup									
	16	Plastic	0.565	0.345	0.835	1.125	3.4265	1.0338	0.735
	17	Paper	0.16	0.235	0.23	0.895	2.1769	2.2532	0.48
Wrap	18	Food Wrapper	1.995	0.93	1.62	5.2	10.755	6.1234	1.805
	11-1	Take Out Food Packaging, **Paper and Plastic**	0.07	0.065	0.035	0	0.5845	0	0.075
	11-2	Take Out Food Packaging, **Styrofoam**	0.365	0.16	0.225	0.575	1.2094	1.8026	0.145
Plastic Bag	19	Plastic Bags	2.175	0.23	0.775	3.3	6.1073	7.926	3.95
Others									
	20	Cigarette Packs, Matches, Cigars, Tobacco	0.11	0.065	0.125	0.28	0.2217	2.3062	0.175
	21	Napkins, Paper Towels, Tissues	0	0.09	0.535	0.72	4.4142	2.4388	1.02
	22	Beverage Carriers, Rings, Cartons	0.045	0	0.035	0.16	0	0	0.025
	23	Toiletries	0.17	0.03	0.075	0.24	0.1814	1.67	0.105
	24	Drugs	0.505	0.05	0.06	0.94	0.7861	0.8483	0.17
	25	Games, Cassettes, CDs	0.155	0	0.045	0.06	0.1008	0	0.195
	26	Toys, Balls	1.195	0.45	1.09	9.146	1.814	5.9379	0.345
	27	Toys, Misc. Other	0.055	0	0.03	1.1	0.3225	0.5302	0.055
	28	Newspapers, Magazine, Books	0	0	0	0	1.9551	0	0.95
	29	Advertising, Signs, Cards,	0	0	0	0	0	0.6362	0
	30	Other Misc. Cartons	0.055	0	0.32	2.26	1.2497	2.6773	0.105
	31	Other Metal, Foil Packets	0.12	0.035	0.085	0.64	0.2419	2.4653	0.45
	32	Other Fabric	0.315	0	0	0.5	1.0683	0	0
	33	Clothing	0.045	0.33	0.24	4.16	0.4636	0.2121	0.775
	34	Auto Products Containers	0.25	0.075	0.085	4.06	0.9876	1.1133	0.105
	35	Vehicle Debris	0	0.06	0	0.28	0.3023	0.9977	20.26
	36	Construction Material	4.005	0.175	0.44	0	2.8622	35.68	2.44
	37	Appliances	0	0	0	0	17.137	0.9278	0
	38	Carpet	0	0	0	0	0	2.07	0
	39	Misc Large Debris	0	0	0	0	0	0	0
	40	Misc. Plastic **Trash**	1.05	0.175	1.3	3.4	5.7646	3.8702	2.21
	41	Lids, straws, tops	0.57	0.97	0.465	1.125	1.4311	1.67	0.435
	42	Misc. Paper Pieces	0	0.4	0.035	0	2.2172	0.4506	0.245
	43	Paper Bags	0	0	0	0	0	0	0
	44	Juice Packs	0.23	0.1	0.445	0.5	1.9551	1.8026	0.19
	45	Broken Glass pieces	0.485	0.065	0.305	0.91	1.814	0.6892	0.525
	46	Misc. Plastic **Debris**	0	0.125	0	1.2	0	4.195	0
		total	25.849	11.275	20.155	64.349	125.11	164.96	48.495

*Only selected trash in a month was sorted out for the first several months. For those months th

Attachment 3: Trash Characterization by Trash Weight

After Adjustment

		Month and Year	Mar. 09	Apr. 09	May. 09	Jun. 09	Jul. 09	Aug. 09	Sep. 09	Oct. 09	Nov. 09	Dec. 09	Jan.10	Feb. 10
		Trash Collection Date	2009.03.30	2009.04.22	2009.05.09	2009.06.04	2009.07.24-28	2009.08.20	2009.09.28	2009.10.26	2009.11.23-24	2009.12.18	2010.02.01	
Bottles	1	Bottles, Liquor	1.42	2.68	4.15	10.10	1.11	0.18	1.35	0.94	3.35	2.10	4.22	
	2	Bottles, Beer	0.43	1.49	0.00	0.00	0.00	0.00	1.58	0.00	0.00	0.00	0.29	
	3	Bottles, Soft Drink	2.11	2.72	1.11	6.40	2.97	2.33	2.54	1.82	2.30	2.37	1.88	
	4	Bottles, Water, Plastic	1.47	2.11	1.67	2.67	1.41	1.79	1.75	1.61	3.17	1.69	1.36	
	5	Bottles, Sports Drink, Plastic	0.64	0.61	0.48	1.07	0.60	0.43	0.83	0.45	1.03	0.92	0.54	
	6	Bottles, Juice	3.10	4.89	3.58	7.63	2.05	1.52	3.28	2.13	3.79	1.60	3.21	
Cans	7	Cans, Beer	0.68	0.57	1.22	0.51	0.31	0.33	0.23	0.23	0.41	0.32	0.13	
	8	Cans, Soft Drink	0.25	0.28	0.72	0.37	0.47	0.09	0.23	0.11	0.49	0.14	0.02	
	9	Cans, Juice	0.04	0.07	0.17	0.00	0.00	0.00	0.00	0.12	0.05	0.00	0.00	
Food Packaging	10	Home Food Packagin	0.00	0.00	0.00	0.29	0.17	0.25	0.15	0.06	0.13	0.17	0.29	
Styrofoam														
	12	Styrofoam, Plates	0.34	0.52	0.50	1.07	0.24	0.16	0.03	0.19	0.27	0.20	0.20	
	13	Foam Packaging	0.05	0.04	0.00	0.21	0.04	0.36	0.05	0.09	0.04	0.05	0.06	
	14	Styrofoam, Chunks	0.64	0.55	0.45	2.67	0.28	0.08	0.35	0.25	0.37	0.52	0.30	
	15	Styrofoam Cups	0.77	1.74	1.24	3.32	0.63	0.54	0.71	0.68	0.79	0.60	0.64	
Cup														
	16	Cups, Plastic	0.64	0.38	0.48	0.94	0.36	0.34	0.14	0.37	0.29	0.34	0.27	
	17	Cups, Paper	0.39	0.05	0.67	1.81	0.24	0.26	0.41	0.65	0.53	0.63	0.28	
Wrap	18	Food Wrapper	2.83	6.02	3.51	7.96	2.54	1.81	1.62	1.47	1.36	1.38	0.99	
	11-1	Take Out Food Packaging, **Paper and Plastic**	***item	***item	0.00	0.00	0.34	0.08	0.20	0.04	0.12	0.18	0.10	
	11-2	Take Out Food Packaging, **Styrofoam**	0.52	0.89	0.46	2.30	0.27	0.15	0.45	0.41	0.50	0.37	0.34	
Plastic Bag	19	Plastic Bags	2.02	2.51	1.87	5.33	2.38	1.44	1.36	1.77	1.33	2.55	0.79	
Others														
	20	Cigarette Packs, Matches, Cigars, Tobacco	0.34	0.38	0.24	1.93	0.76	0.46	0.84	0.19	0.17	0.23	0.18	
	21	Napkins, Paper Towels, Tissues	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.12	0.08	0.00	
	22	Beverage Carriers, Rings, Cartons	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.04	0.14	0.03	0.00	
	23	Toiletries	0.15	0.09	0.06	1.09	0.29	0.17	0.29	0.79	0.11	0.14	0.08	
	24	Drugs	0.07	0.65	0.70	0.68	0.28	0.52	0.99	0.22	0.22	0.78	0.45	
	25	Games, Cassettes, CDs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.04	
	26	Toys, Balls	0.35	1.35	1.37	2.91	0.42	1.48	2.05	0.21	0.44	1.42	1.69	
	27	Toys, Misc. Other	0.01	0.12	0.02	0.37	2.87	0.10	0.38	0.06	0.27	0.14	0.53	
	28	Newspapers, Magazine, Books	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	
	29	Advertising, Signs, Cards,	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	30	Other Misc. Cartons	0.49	0.44	0.00	0.00	0.00	0.24	0.25	0.00	0.20	0.09	0.09	
	31	Other Metal, Foil Packets	0.26	0.20	0.17	0.70	0.19	0.14	0.03	0.18	0.36	0.07	0.03	
	32	Other Fabric	0.00	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	33	Clothing	0.50	0.12	0.41	1.07	2.87	0.93	0.00	0.36	0.23	0.34	0.00	
	34	Auto Products Containers	0.27	1.39	0.00	0.00	0.00	0.00	0.46	0.10	0.19	0.04	0.57	
	35	Vehicle Debris	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	36	Construction Material	0.00	2.57	2.13	1.27	1.76	1.30	3.21	0.30	1.75	4.29	0.69	
	37	Appliances	0.00	0.20	0.00	0.00	7.60	0.00	0.00	0.00	0.07	0.00	0.00	
	38	Carpet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	39	Misc Large Debris	0.00	0.00	0.00	6.22	0.00	0.00	0.00	0.00	0.00	0.51	0.00	
	40	Misc. Plastic **Trash**	2.13	3.00	2.19	5.58	3.24	1.79	1.60	1.42	2.03	1.71	0.72	
	41	Lids, straws, tops	0.62	0.83	0.72	4.06	1.26	0.80	1.83	0.41	0.34	0.30	0.22	
	42	Misc. Paper Pieces	0.28	0.00	0.00	0.00	0.00	0.36	0.10	0.00	0.18	0.15	0.00	
	43	Paper Bags	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
	44	Juice Packs	0.00	0.67	0.17	0.98	0.44	0.58	0.61	0.24	0.39	0.30	0.31	
	45	Broken Glass pieces	0.40	1.05	0.00	0.00	0.00	0.08	0.16	0.34	0.46	0.00	0.00	
	46	Misc. Plastic **Debris**	0.00	0.07	0.00	0.00	0.58	30.23	0.45	0.00	0.00	2.58	0.00	
		total	24.52	41.70	30.47	81.50	39.02	51.31	30.53	18.25	28.99	29.45	21.42	0.00

Attachment 3: Trash Characterization by Trash Weight

After Adjustment

Month and Year			Mar. 10	Apr. 10	May. 10	Jun. 10	Jul. 10	Aug. 10	Sep. 10			
Trash Collection Date			2010.03.26	2010.05.02	2010.05.28	2010.06.26	2010.07.31	2010.08.28	2010.9.25	sub-total	Percentage in all trash	Percentage in a large category
Bottles	1	Bottles, Liquor	1.01	0.55	1.15	3.27	6.63	5.35	1.50	51.05	6.0	18.6
	2	Bottles, Beer	0.64	0.00	0.00	0.00	5.20	3.68	0.00	13.30	1.6	4.8
	3	Bottles, Soft Drink	2.63	1.93	1.36	3.00	4.62	11.13	2.44	55.65	6.5	20.2
	4	Bottles, Water, Plastic	1.51	0.74	1.91	2.87	9.31	11.45	1.73	50.19	5.9	18.3
	5	Bottles, Sports Drink, Plastic	0.79	0.42	0.75	1.41	3.16	15.24	0.80	30.17	3.5	11.0
	6	Bottles, Juice	2.21	1.09	2.85	4.98	15.52	10.21	1.03	74.64	8.7	27.1
										0.00		
Cans	7	Cans, Beer	0.35	0.15	0.62	0.74	2.50	3.39	1.13	13.80	1.6	56.8
	8	Cans, Soft Drink	0.15	0.02	0.55	0.44	1.11	2.36	0.60	8.37	1.0	34.4
	9	Cans, Juice	0.04	0.18	0.20	0.33	0.50	0.00	0.45	2.13	0.2	8.8
Food Packaging	10	Home Food Packagin	0.25	0.18	0.31	1.10	1.01	0.64	0.12	5.10	0.6	
										0.00	0.0	
Styrofoam										0.00	0.0	
										0.00	0.0	
	12	Styrofoam, Plates	0.29	0.11	0.22	0.49	0.75	1.30	0.12	6.98	0.8	
	13	Foam Packaging	0.02	0.02	0.03	0.03	0.10	0.32	0.04	1.53	0.2	
	14	Styrofoam, Chunks	0.58	0.36	0.20	0.57	1.05	5.25	0.26	14.71	1.7	
										0.00	0.0	
	15	Styrofoam Cups	0.72	0.40	0.61	2.38	2.10	2.31	0.35	20.51	2.4	
Cup										0.00	0.0	
	16	Cups, Plastic	0.57	0.35	0.84	1.13	3.43	1.03	0.74	12.61	1.5	
	17	Cups, Paper	0.16	0.24	0.23	0.90	2.18	2.25	0.48	12.34	1.4	
										0.00	0.0	
Wrap	18	Food Wrapper	2.00	0.93	1.62	5.20	10.76	6.12	1.81	59.91	7.0	
	11-1	Take Out Food Packaging, **Paper and Plastic**	0.07	0.07	0.04	0.00	0.58	0.00	0.08	1.90	0.2	
	11-2	Take Out Food Packaging, **Styrofoam**	0.37	0.16	0.23	0.58	1.21	1.80	0.15	11.14	1.3	
Plastic Bag	19	Plastic Bags	2.18	0.23	0.78	3.30	6.11	7.93	3.95	47.82	5.6	
										0.00	0.0	
Others										0.00	0.0	
										0.00	0.0	
	20	Cigarette Packs, Matches, Cigars, Tobacco	0.11	0.07	0.13	0.28	0.22	2.31	0.18	9.00	1.0	
	21	Napkins, Paper Towels, Tissues	0.00	0.09	0.54	0.72	4.41	2.44	1.02	10.79	1.3	
	22	Beverage Carriers, Rings, Cartons	0.05	0.00	0.04	0.16	0.00	0.00	0.03	0.51	0.1	
	23	Toiletries	0.17	0.03	0.08	0.24	0.18	1.67	0.11	5.72	0.7	
	24	Drugs	0.51	0.05	0.06	0.94	0.79	0.85	0.17	8.90	1.0	
	25	Games, Cassettes, CDs	0.16	0.00	0.05	0.06	0.10	0.00	0.20	0.67	0.1	
	26	Toys, Balls	1.20	0.45	1.09	9.15	1.81	5.94	0.35	33.66	3.9	
	27	Toys, Misc. Other	0.06	0.00	0.03	1.10	0.32	0.53	0.06	6.95	0.8	
	28	Newspapers, Magazine, Books	0.00	0.00	0.00	0.00	1.96	0.00	0.95	2.95	0.3	
	29	Advertising, Signs, Cards,	0.00	0.00	0.00	0.00	0.00	0.64	0.00	0.64	0.1	
	30	Other Misc. Cartons	0.06	0.00	0.32	2.26	1.25	2.68	0.11	8.45	1.0	
	31	Other Metal, Foil Packets	0.12	0.04	0.09	0.64	0.24	2.47	0.45	6.37	0.7	
	32	Other Fabric	0.32	0.00	0.00	0.50	1.07	0.00	0.00	2.30	0.3	
	33	Clothing	0.05	0.33	0.24	4.16	0.46	0.21	0.78	13.06	1.5	
	34	Auto Products Containers	0.25	0.08	0.09	4.06	0.99	1.11	0.11	9.69	1.1	
	35	Vehicle Debris	0.00	0.06	0.00	0.28	0.30	1.00	20.26	21.94	2.6	
	36	Construction Material	4.01	0.18	0.44	0.00	2.86	35.68	2.44	64.88	7.6	
	37	Appliances	0.00	0.00	0.00	0.00	17.14	0.93	0.00	25.94	3.0	
	38	Carpet	0.00	0.00	0.00	0.00	0.00	2.07	0.00	2.07	0.2	
	39	Misc Large Debris	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.73	0.8	
	40	Misc. Plastic **Trash**	1.05	0.18	1.30	3.40	5.76	3.87	2.21	43.17	5.0	
	41	Lids, straws, tops	0.57	0.97	0.47	1.13	1.43	1.67	0.44	18.05	2.1	
	42	Misc. Paper Pieces	0.00	0.40	0.04	0.00	2.22	0.45	0.25	4.41	0.5	
	43	Paper Bags	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.0	
	44	Juice Packs	0.23	0.10	0.45	0.50	1.96	1.80	0.19	9.92	1.2	
	45	Broken Glass pieces	0.49	0.07	0.31	0.91	1.81	0.69	0.53	7.28	0.8	
	46	Misc. Plastic **Debris**	0.00	0.13	0.00	1.20	0.00	4.20	0.00	39.44	4.6	
		total	25.85	11.28	20.16	64.35	125.11	164.96	48.50	857.34		