Litter Assessment along the Delaware River:

Citizen Science Progress Report

732-872-0111
CleanOceanAction.org
info@CleanOceanAction.org
49 Avenel Boulevard
Long Branch, NJ 07740

Clean Ocean Action is a 501(c)(3) tax exempt nonprofit organization.

Made possible with funding from Environmental Endowment for New Jersey.

Reduce Litter in the Delaware River: Issue Background

Plastics and other manufactured debris pollute waterways, embankments, and beaches, and can be found even in the most remote locations and deepest trenches in the ocean. Indeed, the entire world seems awash in trash. The waste finds its way into our waterways from many sources and is harmful to animals that mistake it for food and/or become entangled. It can also pose a risk to navigation from gear entanglement among other mechanical problems.

Marine debris most often starts on land as litter, transportation spillage, or wrongful management, and is either windblown or carried by stormwater into waterways. As nearly all waterways ultimately flow into the sea, most marine debris is picked up by currents and accumulates in massive regions of the ocean called gyres. However, before it gets there, some trash also washes up on along riverbanks, shorelines and beaches. While this creates unsightly beaches and threats to wildlife it also provides a small window of time for citizens to remove this harmful pollution from the marine ecosystem before it goes out to sea. It also allows data to be collected to help track down and eliminate sources as well as providing evidence for stronger policies.

In New Jersey, the shoreline of the Delaware River is no exception. Indeed, concentrations of marine debris found in "hotspot areas" along the tidal portion of the river are even higher than along the ocean shoreline. In 2015, Clean Ocean Action (COA) launched the **Reduce Litter in the Delaware River** project to determine why, and to reduce sources. This report summarizes the results of the initial phases of the project which identified hot spot areas and assessed accumulation.

The goal of **Reduce Litter in the Delaware River** project is to monitor litter and reduce the land-based sources of trash that continue to contribute to pollution along and in the river, and that ultimately flow into the ocean. In partnership with Raritan Valley Community College (RVCC), COA's earliest work in 2015 revealed marine debris litter "hotspots" of highly concentrated trash accumulation along the tidally impacted regions of the Delaware River from Mercer County to Gloucester County. A preliminary research survey in 2015 conducted by Dr. Jay Kelly (RVCC) in collaboration with COA, estimated that there are about 2.8 million pieces of debris along 75km of the tidal portion of the main stem of the Delaware River. This research also indicated that plastics and foam pieces were the most abundant litter (approx. 90%) in the areas studied. These seemingly forgotten regions of the river have amassed all types of debris, especially plastic, for decades. With grant-funded support from the Environmental Endowment of New Jersey (EENJ), COA embarked on this important initiative with RVCC to assess debris accumulation, remove the litter and reduce the litter footprint in waterways. Subsequent efforts are focused on tracking down and eliminating the sources of trash to this region of the Delaware River to improve the quality of the river and ultimately the ocean. Achieving this goal is no easy task due to challenging access to the river, lack of community awareness, and limited funding. The multi-faceted initiative requires a multi-year, multi-pronged effort through active collaboration and community participation.

Reduce Litter in the Delaware River: Background

Clean Ocean Action's name is our mission—to clean up the ocean with action. Reducing sources of harmful marine debris has been a top priority for Clean Ocean Action (COA) for 35 years. In 1985, COA embarked on one of the east coast's first citizen science debris clean up and data collection program along oceanfront beaches, now called the Beach Sweeps. The goal of the Beach Sweeps is to engage people to protect marine life by removing harmful debris, collecting data to create scientific evidence that can be used to enact policies to reduce sources, and educating participants to become self-aware and help solve problems of a wasteful society. Modeled after COA's statewide Beach Sweeps, the Reduce Litter in the Delaware River project focuses on data collection during cleanups at hot-spot areas of litter accumulation along the Delaware River shoreline. During cleanups, citizen science volunteers record the type and quantity of debris using COA's comprehensive data card, which separates debris into nearly 100 categories. COA uses this detailed data to study trends in debris and ultimately, to identify and eliminate sources.

After a preliminary assessment of twenty locations along the Delaware River shoreline, COA focused on four major hot spot areas that met criteria for access and safety (Figure 1):

- Lamberton Road, Trenton
- Taylor Wildlife Preserve, Cinnaminson
- Palmyra Cove Nature Park, Palmyra
- Rivergate Boat Ramp and Red Bank Battlefield Park, West Deptford*

**Data collected from these sites were combined due to their close proximity (< 1 mile apart) and are collectively referred to as "West Deptford" throughout this report.*

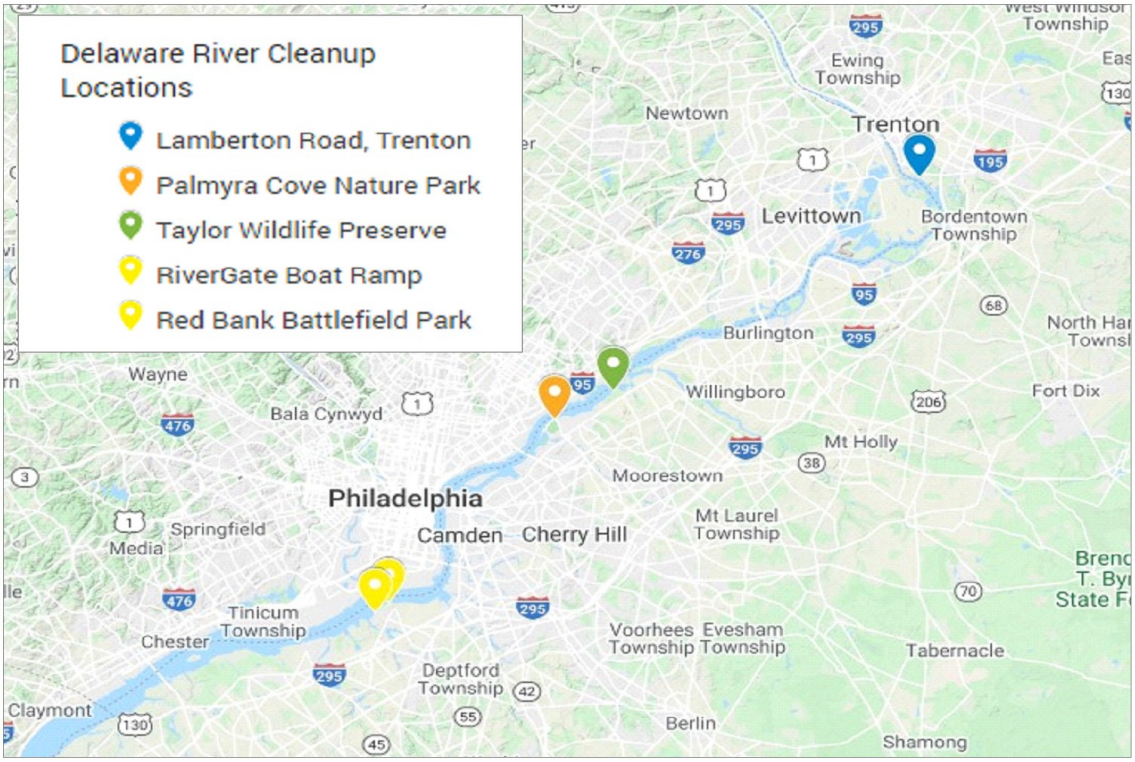


Figure 1. Map of the four major hot-spot areas which were the focus of cleanup efforts as part of the Reduce Litter in the Delaware River project

Reduce Litter in the Delaware River: Trends

Since 2016, 675 COA citizen science volunteers participated in 25 cleanups at these four Delaware River hot-spot locations and removed a total of 73,138 pieces of debris. Throughout this initiative, some significant and alarming trends emerged about the debris accumulating on the shoreline of the Delaware River, in comparison to the robust database of oceanside marine debris which has been COA's focus for three decades. It was astonishing that this remarkable waterfront had so little attention given the magnitude and extent of trash accumulation along the New Jersey side of the river.

- Of the total debris collected at these hot-spot locations along the Delaware River shoreline, 89.7% was plastic debris (Figure 2). This is notably higher by 6.5%, when compared to the seaside Beach Sweep average of 83.19% .
- Foam plastic debris accounts for **over a quarter** (26.0%) of total debris collected along the Delaware River; the seaside Beach Sweep result is about 8% of total debris (Figures 2 and 3).
- The top two most commonly found items along the Delaware River shoreline are **1) plastic beverage/ soda bottles** and **2) foam pieces** (Table 3). This is a stark contrast to the seaside Beach Sweeps where fragmented plastic pieces are now the most commonly found type of debris, while plastic beverage/soda bottles rank #8 and foam pieces rank #6.
- Combined, these two items (plastic beverage/soda bottles and foam pieces) account for **43%** of the debris collected along the Delaware River shoreline since 2016 and make up **60%** of the Dirty Dozen (Table 3, Figure 4).
- Across the four locations, the average total percentage of plastics including foam is **91.15%** (pg. 7). Interestingly, the ratio of plastic to foam plastic varies from one location to the next. For example, Lamberton Road is the only site where the majority of the debris collected was foam plastic (Figure 5).
- The top six most commonly found items along the Delaware River are all plastic, and primarily, single-use plastic (Table 3). Across the four locations, these six items account for **65% - 82%** of total debris.

These highlights are not only surprising and interesting, they offer clues for COA's next stage of the project which is to focus on source trackdown, while at the same time, continue cleanup efforts in these areas to further enhance the dataset established over 4 years, and to assess future trends. Simultaneously, COA is using the data in combination with GIS mapping technology to identify potential land-based sources from where this debris might originate. To investigate these potential sources further, COA has developed a citizen science protocol, called the "Plastic Source Investigation" (PSI) model. Using the PSI model, citizen scientists will attempt to track, verify, and evaluate debris inputs from stormwater conveyance systems, land use, and waste management facilities, with a specific focus on plastic debris. Additional funding will be needed to implement the PSI models and focus on meaningful source reduction efforts. This would be achieved successfully if there is (i) engagement with local residents, universities, schools, organizations, and municipalities, (ii) creation of a platform to educate the public about the detrimental impacts of litter and link various means to reduce them with personal behavioral shifts, and (iii) advocate for improved local and statewide laws and policies that aim to reduce debris at the source.

Comparing the Sweeps by Numbers

The Delaware Sweeps were modeled after COA's statewide biannual Beach Sweeps. The Beach Sweeps take place every April and October at 60-70 locations, primarily along the Atlantic Ocean coast. During the Sweeps, thousands of volunteers collect, categorize, and count debris found on beaches, resulting in a robust database of marine debris spanning over two decades. Similarly, through the Delaware Sweeps, COA is gathering data about debris found on the Delaware River shoreline in order to identify and eliminate sources of debris.

Delaware Sweeps

Table 1. Breakdown of total debris collected at 4 locations along the Delaware River from 2016-2019 by material.

Breakdown by Category/Debris Type		
	Pieces of Debris	% of Total
Plastic	46,571	63.68%
Foam Plastic	19,021	26.01%
Glass	3,570	4.88%
Rubber	784	1.07%
Metal	2,034	2.78%
Paper	489	0.67%
Wood	160	0.22%
Cloth	509	0.70%
Total Debris	**73,138**	
Volunteers	**675**	

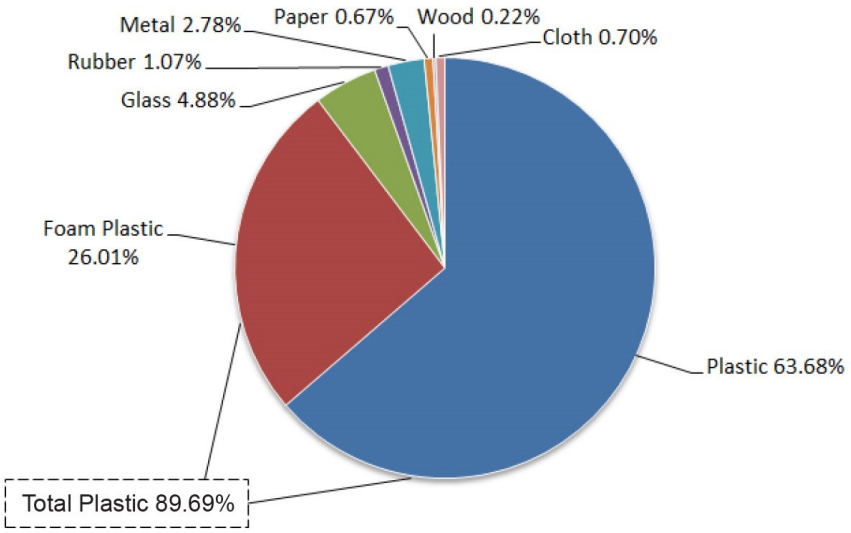


Figure 2. Breakdown of total debris collected at four locations along the Delaware River from 2016-2019 by material. Nearly 90% of collected debris is plastic, and foam plastic comprises over a quarter of total debris.

Beach Sweeps

Table 2. Breakdown of total debris collected at 62 locations, primarily along the Jersey Shore, during the 2019 Beach Sweeps by material.

Breakdown by Category/Debris Type		
2019 Totals	Total	% of Total
Plastic	374,006	75.36%
Foam Plastic	38,884	7.83%
Glass	24,074	4.85%
Rubber	7,795	1.57%
Metal	17,766	3.58%
Paper	16,615	3.35%
Wood	12,356	2.49%
Cloth	4,795	0.97%
Total Debris	**496,291**	
Volunteers	**10,724**	

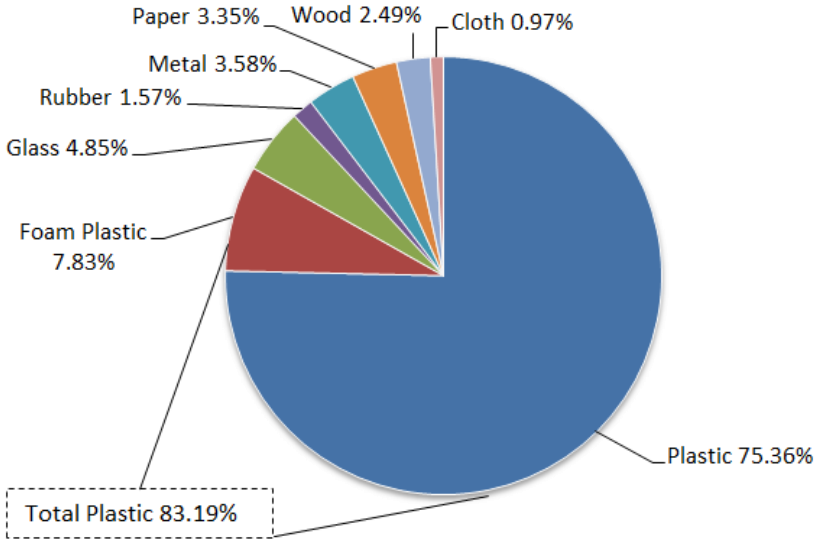


Figure 3. Breakdown of total debris collected at 62 locations, primarily along the Jersey Shore, during the 2019 Beach Sweeps by material. While the vast majority of the debris is plastic, foam plastic is less prevalent along the Jersey Shore as compared to the Delaware River.

The Delaware Dirty Dozen

The Dirty Dozen lists the top twelve most commonly collected items at 4 locations along the Delaware River from 2016-2019. Plastic dominates the list — 92.46% of the Dirty Dozen is plastic.

Along the Delaware River, plastic beverage/soda bottles and foam pieces far outnumber other types of debris. Combined, these two items account for **43.02%** of the debris collected during cleanups along the Delaware River. In contrast, plastic beverage/soda bottles and foam pieces represent only **7.97%** of total debris collected during the 2019 Beach Sweeps. (Visit COA's website for the 2019 Beach Sweeps Report.)

Notably, the top six items on the list are items that are frequently littered and carried to waterways by stormwater runoff or wind. By collecting data about these items, COA seeks to gain a better understanding of how they enter waterways in order to more effectively eliminate the sources.

Table 3. The top twelve most commonly collected items, known as the "Dirty Dozen," based on data from 4 locations along the Delaware River from 2016-2019.

Rank	Debris Item	Pieces of Debris
1	Plastic Beverage/Soda Bottles	17,888
2	Foam Pieces	13,578
3	Plastic Caps/Lids	4,434
4	Food/Candy Wrappers	3,338
5	Plastic Pieces	2,585
6	Plastic Straws/Stirrers	2,585
7	Glass Beverage Bottles	1,682
8	Other Plastic Bottles	1,410
9	Glass Pieces	1,281
10	Other Foam Plastic	1,072
11	Foam Cups	947
12	Metal Beverage Cans	934
	Total Dirty Dozen	**51,734**
	Percent of Total Debris	**71%**
	Number of Volunteers	**675**

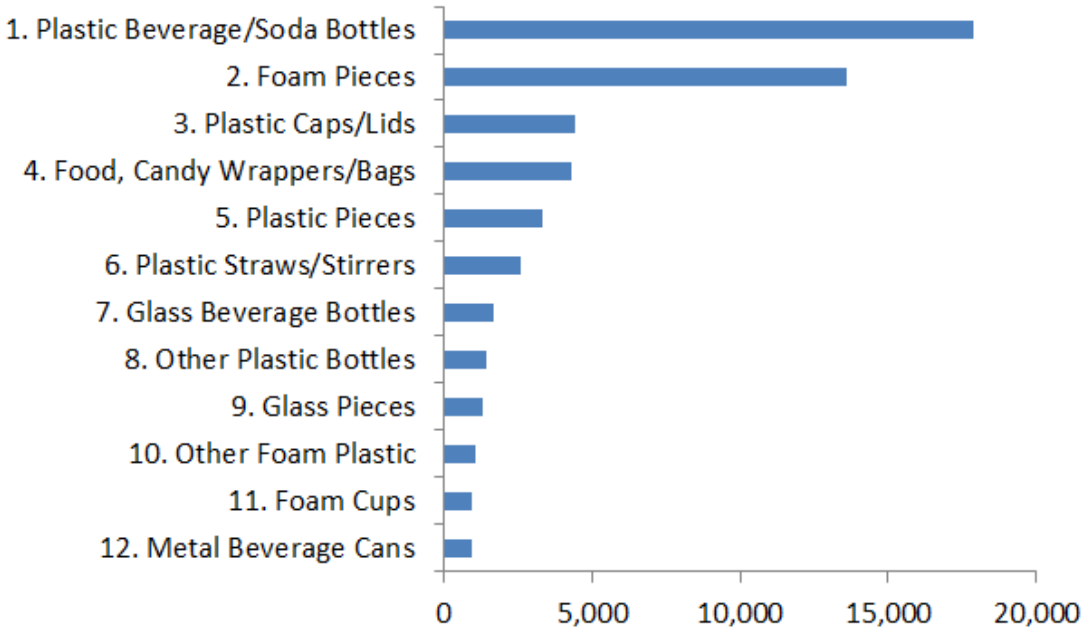
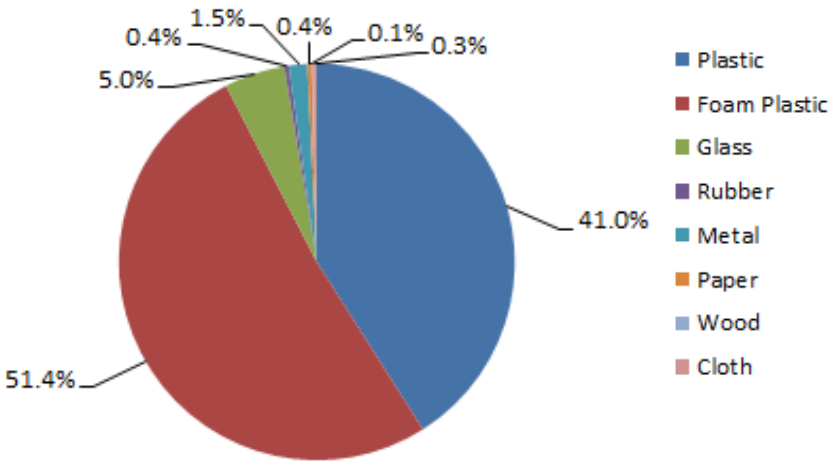


Figure 4. The top 12 most commonly collected items, known as the "Dirty Dozen," at 4 locations along the Delaware River from 2016-2019. By quantity, plastic beverage/soda bottles and foam pieces combined account for 61% of the total Dirty Dozen.

Site Analysis: Debris Breakdown by Material

Of the debris collected at the four cleanup locations, the total percentage of plastic (plastic + foam plastic) is similar across the sites, accounting for an average of 91.15% of all debris. However, the proportion of plastic and foam plastic varies among sites. For example, at Lamberton Road, foam plastic accounts for 51.4% of all debris, as shown below. Meanwhile, a much smaller proportion (16.3%) of the debris collected at Taylor Wildlife Preserve is comprised of foam plastic.

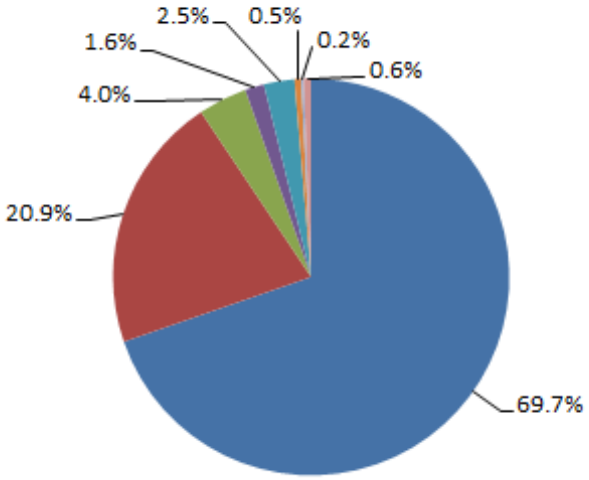
Lamberton Road



Total Plastic: 92.4%

Figure 5. Breakdown by material of debris collected at the Lamberton Road (Trenton) site during 5 cleanups from 2016-2019.

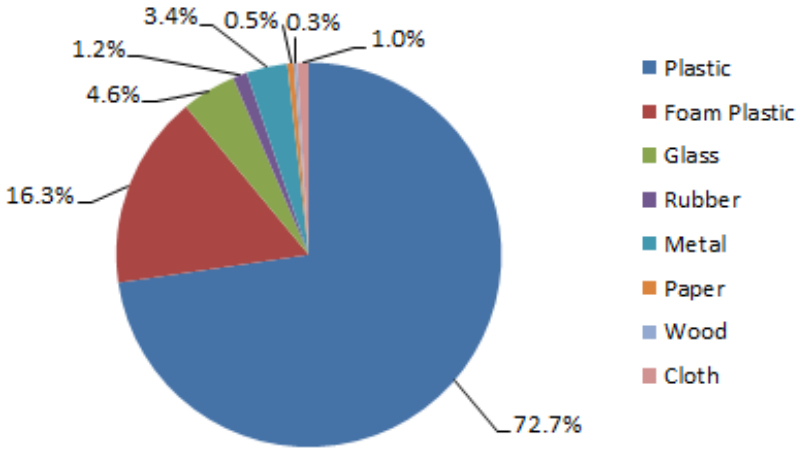
Palmyra Cove Nature Park



Total Plastic: 90.6%

Figure 6. Breakdown by material of debris collected at the Palmyra Cove Nature Park (Palmyra) site during 6 cleanups from 2016-2019.

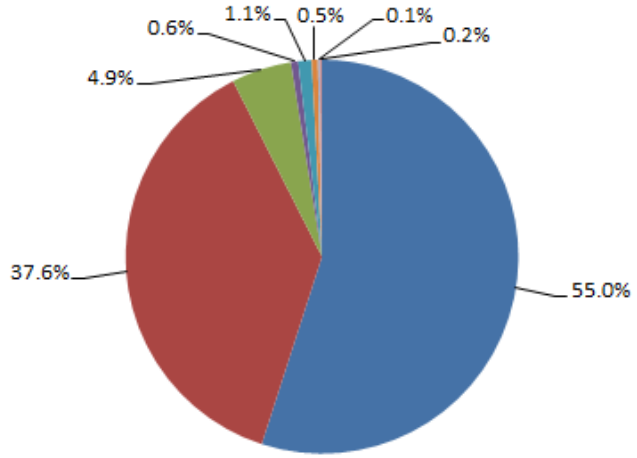
Taylor Wildlife Preserve



Total Plastic:

Figure 7. Breakdown by material of debris collected at the Taylor Wildlife Preserve (Cinnaminson) site during 7 cleanups from 2016-2019.

West Deptford



Total Plastic: 92.6%

Figure 8. Breakdown by material of debris collected at the West Deptford sites during 5 cleanups from 2016-2019.

Site Analysis: The Top Six Items

From the data compiled across the four Delaware Sweeps locations, the top six most commonly found items are: 1) plastic beverage/soda bottles, 2) foam pieces, 3) plastic caps/lids, 4) food/candy wrappers, 5) plastic pieces, and 6) plastic straws/stirrers (Table 3). The six items are ubiquitous at all four cleanup locations; they account for 65% - 85% of all debris collected at each site. Though these items are abundant at all sites, their ranking varies at each site. For example, the number one item at Lamberton Road and West Deptford is foam pieces, while plastic beverage/soda bottles rank number one at Palmyra Cove Nature Park and Taylor Wildlife Preserve.

Table 4. The top six most commonly collected debris items at the Lamberton Road (Trenton) site, based on data from 5 cleanups.

Lamberton Road		
Rank	**Debris Items**	**Pieces of Debris**
1	Foam Pieces	7,375
2	Plastic Beverage/Soda Bottles	2,639
3	Plastic Caps/Lids	914
4	Food/Candy Wrappers	900
5	Plastic Pieces	530
6	Plastic Straws/Stirrers	189
	Total Top 6	**12,547**
	Total Debris Collected	**15,306**
	Top 6 Percent of Total Debris	**82%**
	Number of Volunteers	**39**

Table 5. The top six most commonly collected debris items at the Palmyra Cove Nature Park (Palmyra) site, based on data from 6 cleanups.

Palmyra Cove Nature Park		
Rank	**Debris Items**	**Pieces of Debris**
1	Plastic Beverage/Soda Bottles	3,518
2	Foam Pieces	2,039
3	Food/Candy Wrappers	1,407
4	Plastic Caps/Lids	1,240
5	Plastic Pieces	1,204
6	Plastic Straws/Stirrers	1,156
	Total Top 6	**10,564**
	Total Debris Collected	**16,298**
	Top 6 Percent of Total Debris	**65%**
	Number of Volunteers	**252**

Table 6. The top six most commonly collected debris items at the Taylor Wildlife Preserve (Cinnaminson) site, based on data from 7 cleanups.

Taylor Wildlife Preserve		
Rank	**Debris Items**	**Pieces of Debris**
1	Plastic Beverage/Soda Bottles	10,602
2	Foam Pieces	3,357
3	Plastic Caps/Lids	1,675
4	Food/Candy Wrappers	1,483
5	Plastic Pieces	1,264
6	Plastic Straws/Stirrers	1,121
	Total Top 6	**19,502**
	Total Debris Collected	**27,857**
	Top 6 Percent of Total Debris	**70%**
	Number of Volunteers	**202**

Table 7. The top six most commonly collected debris items at the West Deptford (Rivergate Boat Ramp and Red Bank Battlefield Park) sites, based on data from 5 cleanups.

West Deptford		
Rank	**Debris Items**	**Pieces of Debris**
1	Foam Pieces	1,984
2	Plastic Beverage/Soda Bottles	813
3	Plastic Caps/Lids	620
4	Plastic Pieces	446
5	Food/Candy Wrappers	402
6	Plastic Straws/Stirrers	176
	Total Top 6	**4,441**
	Total Debris Collected	**6,018**
	Top 6 Percent of Total Debris	**74%**
	Number of Volunteers	**59**

Delaware Sweeps Compiled Data 2016-2019

Table 8. Compiled data collected at four Delaware Sweeps locations: Lamberton Road, Palmyra Nature Cove Park, Taylor Wildlife Preserve, and West Deptford. Data was collected by 675 volunteers during 23 cleanups from 2016-2019.

	Items	Total
PLASTIC	Food, Candy Wrappers/Bags	5,040
	Store/Shopping Bags	813
	Trash Bags	364
	Other Bags	410
	Beverages/Soda Bottles	18,723
	Bleach/Cleaner Bottles	439
	Other Bottles	1,538
	Buckets/Crates/Bins	704
	Cap/Lids	5,137
	Cap/Rings	917
	Cigarette Filters	307
	Lighters	418
	Cigarette Packaging	347
	Cigar Tips	638
	Bait Bags/Containers	42
	Fishing Line	65
	Lures, Floats	96
	Fishing Nets - Small	5
	Fishing Nets - Large	2
	Cups	833
	Diapers	13
	Forks, Knives, Spoons	302
	Light Sticks	25
	Plastic Pieces	4,279
	Pens	179
	Ribbon/Tape (no balloons)	58
	Rope	40
	6-Pack Holders	15
	Sheeting Tarps	45
	Shotgun Shells	26
	Strapping Bands	37
	Straws/Stirrers	3,167
	Syringes	151
	Tampon Applicators	166
	Toys	511
	Vegetable Sacks	27
	Other Plastics	692

	Items	Total
FOAM PLASTIC	Building Materials	442
	Buoys/Floats	69
	Fast Food Containers	213
	Foam Cups	1,109
	Packaging Materials	412
	Foam Pieces	15,409
	Foam Plates	280
	Other Foam Plastic	1,087
GLASS	Beverage Bottles	1,819
	Other Bottles/Jars	184
	Lights: Bulbs	54
	Lights: Fluorescent Tubes	3
	Pieces	1,438
	Other Glass	72
RUBBER	Balloons - Mylar	28
	Mylar With String/Ribbon	10
	Balloons - Rubber	45
	Rubber With String/Ribbon	10
	Condoms	86
	Rubber Bands	17
	Gloves	89
	Tires: Part	40
	Tires: Whole	128
	Other Rubber	331
METAL	Appliances	5
	Batteries: Car	2
	Batteries: Other	17
	Bottles Caps	215
	Aerosol Cans	262
	Beverages Cans	1,048
	Other Cans	73
	Car Parts	43
	Crab/Fish Traps	-
	55 Gallon Drums: Old	21
	55 Gallon Drums: New	2
	Fishing: Hooks	17
	Fishing: Sinkers	3

	Items	Total
METAL	Foil	68
	Nails	39
	Pieces	62
	Pull/Pop Tabs	5
	Wire	24
	Other Metal	128
PAPER	Bags	76
	Cardboard	33
	Cartons/Boxes	32
	Cups	64
	Newspaper/Magazines	27
	Paper Pieces	206
	Plates	16
	Other Paper	35
WOOD	Crab/Lobster Traps	-
	Crates/Baskets	4
	Ice Cream Spoon/Sticks	14
	Lumber Pieces	108
	Pallets	12
	Other Wood	22
CLOTH	Blankets/Sheets/Towels	20
	Clothing: Specify	38
	Shoes/Sandals	353
	String (No Balloon)	24
	Other Cloth	74
Total Items Collected		**73,138**
Number of Volunteers		**675**

Roster of the Ridiculous

West Deptford

Knee pad, beaker, plastic doll head, flea and tick medicine, inhaler refill, marker, computer bag, floor mat, plastic fence, lighter fluid bottle, dryer sheet, toe spreader, insulation, inhaler, toothbrush, contact case, doll blanket, Nerf dart, binky, googly eyes, mascara, firework, toy car mirror, giant blue roll of plastic, trash bin from Carbon PA, toy goat, clothes hanger, motor oil container, bubble wrap, Barbie leg, gallon ice cream lid, phone book





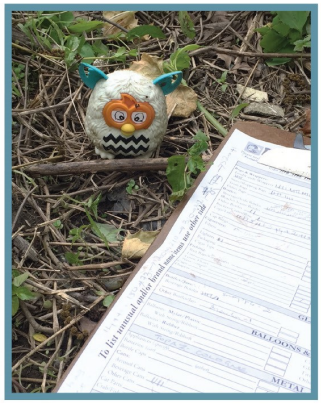


Taylor Wildlife Preserve

Large Styrofoam flotation, CD in case, fridge, boat motor, fishing rod handle, baby doll arm, wiffle bat, urine sample collection cup, bean bag chair, plastic chair, buoy, yellow foam packaging, child's Croc shoe, wooden chair, Nerf darts, lightbulb, inner tube, Mr Turtle pool from 1977


Palmyra Cove Nature Park

Beer barrel, plastic rake, toucan pool float, EZ pass, mattress, baseball helmet, duck decoy



Lamberton Rd

Car floor mat, basketball, Furby, 1960s Avon topaze cologne bottle, Christmas ornament, rubber ball, cigar wrappers, gas tank, lawn mower battery, bike pedal, cable box, toy golf club, plastic ball, dry erase boards, mattress, foam turtle mask, wicker chair, earplugs, Dell computer part

Special Thanks

For several cleanups, COA partnered with TerraCycle, an innovative recycling company located in Trenton, NJ, that has become a global leader in recycling waste that is traditionally difficult to recycle. Most of the plastic debris found along the Delaware River would not have been accepted through municipal recycling due to the type and condition of the plastic. During the cleanups, these dirty and/or degraded rigid plastics were separated and picked up by TerraCycle as part of their Beach Plastic Cleanup Program. This plastic was removed from the environment, diverted from a landfill, and ultimately upcycled into bottles suitable for consumer goods.

Five super sacks (large white bags shown above) were filled with rigid plastics by volunteers from Raritan Valley Community College at a cleanup at Taylor Wildlife Preserve. These plastics were upcycled by TerraCycle into new bottles.

Thanks to our Delaware Sweeps Partners

Taylor Family and Friends of Taylor Wildlife Preserve, Municipalities of West Deptford and Hamilton Township, Gloucester County Clean Communities, Gloucester County Parks

49 Avenel Blvd
Long Branch, NJ 07740
Phone: 732-872-0111
E-mail: info@CleanOceanAction.org

For More Information On Ocean Issues!

@CleanOceanAction