Total Maximum Daily Loads of Trash and Debris for the Middle Branch and Northwest Branch Portions of the Patapsco River Mesohaline Tidal Chesapeake Bay Segment, Baltimore City and County, Maryland

FINAL

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Submitted to:

U.S. Environmental Protection Agency, Region 3
Water Protection Division
1650 Arch Street
Philadelphia, PA 19103-2029

December 2014

EPA Submittal Date: September 2, 2014
EPA Approval Date: January 5, 2015

Document version: December 3, 2014

Acknowledgements

The Maryland Department of the Environment gratefully acknowledges the input and advice on this TMDL from the following organizations:

- Baltimore City Department of Public Works
- Baltimore County Department of Environmental Protection and Sustainability
- Blue Water Baltimore
- National Aquarium
- Baltimore Waterfront Partnership
- Baltimore Development Corporation
- Baltimore Harbor Watershed Association
- All other concerned groups and citizens!

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LIST OF ABBREVIATIONS

ac	Acre
ACT!	(National) Aquarium Conservation Team
BCDEPS	Baltimore County Department of Environmental Protection and Sustainability
BCDPW	Baltimore City Department of Public Works
BMP	best management practice
BWB	Blue Water Baltimore
CFR	Code of Federal Regulations
COMAR	Code of Maryland Regulations
CRWQCB	California Regional Water Quality Control Board
CWA	Clean Water Act
DNR	Maryland Department of Natural Resources
DOC	U.S. Department of Commerce
EPA	U.S. Environmental Protection Agency
GIS	Geographic Information System
in	Inches
LA	Load Allocation
lbs	Pounds
lbs/ac/day	Pounds per Acre per Day
lbs/ac/in	Pounds per Acre per Inch
lbs/ac/yr	Pounds per Acre per Year
lbs/day	Pounds per Day
MD	Maryland
MDP	Maryland Department of Planning
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer System
MTAC	Mid Atlantic Tributary Assessment Coalition
NCDC	National Climatic Data Center
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
PATMH	Patapsco River Mesohaline
PCBs	Polychlorinated Biphenyls
STATSGO	State Soil Geographic Database
SWAP	Small Watershed Action Plan
SWM	Stormwater Management
SWMF	Stormwater Management Facility
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
WLA	Wasteload Allocation
WQLS	Water Quality Limited Segment
WQMIS	Water Quality Monitoring and Inspections Section
yr	Year

EXECUTIVE SUMMARY

Section 303(d) of the federal Clean Water Act (CWA) and the EPA's implementing regulations direct each state to identify and list waters, known as water quality-limited segments (WQLSs), in which current required controls of a specified substance are inadequate to achieve water quality standards. For each WQLS, the State is required to either establish a TMDL of the specified substance that the waterbody can receive without violating water quality standards, or demonstrate that water quality standards are being met (CFR 2010a, b). This document, upon approval by the U.S. Environmental Protection Agency (EPA), establishes a Total Maximum Daily Load (TMDL) for trash and debris in portions of the Middle Branch and Northwest Branch of the Patapsco River Mesohaline Tidal Chesapeake Bay Segment (PATMH) (2012 *Integrated Report of Surface Water Quality in Maryland* Assessment Unit ID: MD-PATMH-MiddleBranch_NorthwestHarbor). Specifically, the listing is limited to the shoreline of the *"Middle Branch from the mouth (Ferry Bar Park to Harbor Hospital Center) extending westward and the Northwest Branch from the Hull Street Pier to Canton Waterfront Park."*

The Maryland Department of the Environment (MDE) has identified the PATMH Tidal Chesapeake Bay Segment (Integrated Report Assessment Unit ID: PATMH) on the State's 2012 Integrated Report (IR) as impaired by multiple pollutants. The IR includes listings for the entire PATMH, as well as specific estuaries within the PATMH. See Table 1 for all IR listings associated with this segment.

Table ES-1. 2012 Integrated Report Impairment Listings for the mesohaline areas of the Patapsco River (PATMH)

Assessment Unit	Designated Use	Year listed	Identified Pollutant	Listing Category*	Status
MD-PATMH	Seasonal Migratory fish spawning and nursery Subcategory	1996	TN	4a	TMDL 2008
		1996	TP	4a	TMDL 2008
	Aquatic Life and Wildlife	1996	Mercury, Copper, Nickel, & Cyanide	4b	Individual Control Strategy for related facility
	Aquatic Life and Wildlife	1996	Chromium, Zinc, & Lead in Sediments	5	
	Open Water Fish and Shellfish	1996	TN	4a	TMDL 2008
	Open Water Fish and Shellfish Seasonal Shallow Water Submerged Aquatic Vegetation	1996	TP	4a	TMDL 2008
		1996	TSS	4a	TMDL 2010
	Aquatic Life and Wildlife	2004	Impacts to Estuarine Biological Communities	5	

Assessment Unit	Designated Use	Year listed	Identified Pollutant	Listing Category*	Status
MD-PATMH	Seasonal Deep-Channel Refuge Use	1996	TP	4a	TMDL 2010
		1996	TN	4a	TMDL 2010
	Seasonal Deep-Water and Shellfish Subcategory	1996	TP	4a	TMDL 2008
		1996	TN	4a	TMDL 2008
	Aquatic Life and Wildlife	2008	Debris/Trash	5	
MD-PATMH-02130903	Aquatic Life and Wildlife	1998	Chlordane - sediments	4a	TMDL 2002
	Fishing	1998	PCBs	5	TMDL 2011
MD-PATMH-Bear_Creek	Aquatic Life and Wildlife	1998	Zinc (in sediments)	5	
			Chromium (in sediments)	5	
			PCBs (Sediments & Fish Tissue)	5	TMDL 2011
MD-PATMH-Bodkin_Creek	Open-Water Fish and Shellfish Subcategory	1996	TN	4a	TMDL 2010
			TP	4a	TMDL 2010
	Aquatic Life and Wildlife	1996	Copper	5	
			Lead	2	WQA 2009
			Zinc	2	WQA 2009
MD-PATMH-Curtis_Bay_Creek	Aquatic Life and Wildlife	1998	Zinc (in sediments)	5	
			PCBs (Sediments & Fish Tissue)	5	TMDL 2011
MD-PATMH-Furnace_Creek	Water Contact Sports	1998	Enterococcus	4a	TMDL 2010
MD-PATMH-Marley_Creek	Water Contact Sports	1998	Enterococcus	4a	TMDL 2010
MD-PATMH-MiddleBranch – NorthwestHarbor	Water Contact Sports	2010	Enterococcus	5	
MD-PATMH-Middle_ Harbor	Aquatic Life and Wildlife	1998	Zinc (in Sediments)	5	
MD-PATMH-Pine_Grove_Village_Beach	Water Contact Sports	N/A	Enterococcus	2	
MD-PATMH-Rock_Creek	Water Contact Sports	N/A	Fecal Coliform	2	

*Listing Category definitions – 2: attaining some standards but insufficient data to assess completely; 4a: impaired, TMDL completed; 4b: impaired, non-TMDL pollution controls required; 5: impaired TMDL required.

As stated above, this TMDL will address the trash impairment to the shoreline of the "*Middle Branch from the mouth (Ferry Bar Park to Harbor Hospital Center) extending westward and the Northwest Branch from the Hull Street Pier to Canton Waterfront Park.*" For the purpose of this TMDL, it is assumed that the source of the trash causing the impairment is primarily generated in the upland watershed draining to the tidal shoreline of the Middle Branch and Northwest Branch. Therefore, the spatial extent of this TMDL will include all areas directly draining to the impaired shoreline. This includes the portion of the Baltimore Harbor watershed directly draining to the impaired shoreline, as well as the upstream watersheds of the Jones Falls and

Gwynns Falls. (For simplicity, further reference in this document to Baltimore Harbor Watershed will refer only to those acres with direct drainage to the impairment.) It was also determined by MDE that due to tidal and current conditions, trash loads downstream of the impairment will not likely contribute to the impairment.

Maryland's current water quality standards have a narrative standard (COMAR 2012c) applicable to trash, but do not include relevant numeric criteria. Therefore, the TMDL target is set equal to 100 percent removal or capture of the baseline trash load to establish quantitative implementation for the narrative standard. A similar approach was developed by EPA Region IX for trash TMDLs in California (CRWQCB 2007) and also used in the Anacostia River Trash TMDL (MDE 2010a). The baseline load is defined as the annual trash load calculated from monitoring data obtained through storm drain monitoring and in-stream sampling. The baseline load, and therefore the TMDL removal load, is calculated as an average (because of high seasonal and annual variability) of the measured or estimated removal rate from point and nonpoint sources. The TMDL target is calculated as the amount removed relative to the baseline load to satisfy the narrative water quality standards for trash. Trash may be removed from anywhere within the spatial extent of the TMDL to achieve compliance with the TMDL. Stormwater outfall and in-stream monitoring for trash were used to establish the nonpoint source and point source baseline loads. At the time of sampling for the baseline load, many trash removal processes were already in place (e.g. street sweeping, trash nets, and community clean-ups), therefore the TMDL value to be removed must be in addition to trash already being removed when the baseline sampling was conducted. The exception to this is that due to their sampling methodology, Baltimore County will be given credit for structural trash removal BMPs.

EPA's regulations require TMDLs to take into account seasonality and critical conditions for stream flow, loading, and water quality parameters (CFR 2010a, b). The intent of this requirement is to ensure that the water quality of the waterbody is protected during times when it is most vulnerable. In the Middle Branch/Northwest Branch, the critical conditions for trash are high-flow events because these events represent conditions during which trash is most easily transported to and through streams and the storm drain system. These critical conditions are considered in this TMDL because data were collected over four seasons and included monitoring after rain events that led to high-flow conditions.

All TMDLs need to be presented as a sum of wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources generated within the assessment unit, accounting for natural background, tributary, and adjacent segment loads. Furthermore, all TMDLs must include a margin of safety (MOS) to account for any lack of knowledge and uncertainty concerning the relationship between loads and water quality (CFR 2010a,b). This TMDL employs both an explicit and implicit MOS. An explicit MOS of 5 percent was incorporated into the TMDL. Conservative assumptions incorporated into the allocations are considered to be implicit MOS. It is also assumed that there is no natural background for trash. The wasteload allocation was characterized as any trash that could reasonably enter the MS4 through a street-level storm drain system. The load allocation was all other trash, generally discharged by direct dumping and including for example, car bodies and parts, carpets, construction debris, and tires.

Tables ES-2 through ES-7 summarize the annual and daily baseline trash loads in the Middle Branch/Northwest Branch. Compliance with these TMDLs will require the removal of 100 percent of the baseline trash loads. These TMDLs were developed to meet the narrative water quality standards in the Middle Branch/Northwest Branch.

Table ES-2. Annual trash TMDLs for Baltimore Harbor watershed

WLA (lbs/yr removed)		LA (lbs/yr removed)	MOS (5%)	TMDL (lbs/yr removed)
Baltimore City Phase I MS4	42,869.4	2,912.6	2,378.4	49,946.6
Baltimore City Other Point Sources	1,786.2			
Total WLA	**44,655.6**			

Note: lbs = pounds; MS4 = municipal separate storm sewer system

Table ES-3. Daily trash TMDLs for Baltimore Harbor watershed

WLA (lbs/day removed)		LA (lbs/day removed)	MOS (5%)	TMDL (lbs/day removed)
Baltimore City Phase I MS4	117.4	8.0	6.5	136.8
Baltimore City Other Point Sources	4.9			
Total WLA	**122.3**			

Table ES-4. Annual trash TMDLs for Gwynns Falls watershed

WLA (lbs/yr removed)		LA (lbs/yr removed)	MOS (5%)	TMDL (lbs/yr removed)
Baltimore City: Phase I MS4	93,519.3	21,271.1	9,717.4	204,065.0
Baltimore City: Other Point Sources	2,892.3			
Baltimore County: Phase I MS4	72,831.6			
Baltimore County: Other Point Sources	1,533.3			
State Highway Administration	2,300.0			
Total WLA	**173,076.5**			

Table ES-5. Daily trash TMDLs for Gwynns Falls watershed

WLA (lbs/day removed)		LA (lbs/day removed)	MOS (5%)	TMDL (lbs/day removed)
Baltimore City: Phase I MS4	256.2	58.3	26.6	559.0
Baltimore City: Other Point Sources	7.9			
Baltimore County: Phase I MS4	199.5			
Baltimore County: Other Point Sources	4.2			
State Highway Administration	6.3			
Total WLA	**474.1**			

Table ES-6. Annual trash TMDLs for Jones Falls watershed

WLA (lbs/yr removed)		LA (lbs/yr removed)	MOS (5%)	TMDL (lbs/yr removed)
Baltimore City: Phase I MS4	81,107.0	19,013.8	7,453.4	156,520.4
Baltimore City: Other Point Sources	1,655.2			
Baltimore County: Phase I MS4	45,399.4			
Baltimore County: Other Point Sources	472.9			
State Highway Administration	1,418.7			
Total WLA	**130,053.2**			

Table ES-7. Daily trash TMDLs for Jones Falls watershed

WLA (lbs/day removed)		LA (lbs/day removed)	MOS (5%)	TMDL (lbs/day removed)
Baltimore City: Phase I MS4	222.2	52.1	20.4	428.8
Baltimore City: Other Point Sources	4.5			
Baltimore County: Phase I MS4	124.4			
Baltimore County: Other Point Sources	1.3			
State Highway Administration	3.9			
Total WLA	**356.3**			

It is important to note that, unlike most TMDLs, which are expressed in terms of the loads of a pollutant that may be added to a waterbody, these trash TMDLs are expressed in the negative, i.e., in terms of quantities of trash that must be removed or prevented from entering the waterbody in addition to current removal rates.

The Clean Water Act and EPA regulations require reasonable assurance that TMDL WLAs and LAs will be implemented. WLAs are assigned to municipal separate storm sewer systems (MS4s) and other regulated land areas. The WLAs address trash items that can typically enter the storm sewer systems through street-level storm drains, while the LA is assigned to larger trash and debris that are attributed to activities such as dumping. The reduction goals established by these TMDLs will be reached through National Pollutant Discharge Elimination System permits (mainly MS4s) to achieve WLAs, and other source controls to achieve LAs.

In the case of the Middle Branch/Northwest Branch Trash TMDLs, there is reasonable assurance that the goals of these TMDLs can be met with proper watershed planning, implementing pollution-reduction best management practices (BMPs), as well as political and financial mechanisms and enforcement of the MS4 permit requirements. The TMDLs can be achieved through a comprehensive, adaptive approach that addresses the following:

- Enforcement of illicit dumping laws
- Regulatory and voluntary approaches to trash removal and prevention
- Appropriate storm drain capture technologies

Since the TMDL methodology is directly linked to monitoring data, MDE will make it a priority to revisit the TMDL allocation values to ensure the allocations are based on accurate, representative and up-to-date data. Because the implementation of the TMDL is strongly linked to the MS4 permit requirements, the TMDL will be reevaluated in coordination with the MS4 renewal process.

Criteria to be considered for reevaluating the TMDL allocations will include:

- Evaluation of all new data presented by Baltimore City, Baltimore County, and other third parties over the five-year permit cycle;
- Public participation in the reevaluation process.

1.0 INTRODUCTION AND BACKGROUND

Section 303(d) of the federal Clean Water Act (CWA) and the EPA's implementing regulations direct each state to identify and list waters, known as water quality-limited segments (WQLSs), in which current required controls of a specified substance are inadequate to achieve water quality standards. For each WQLS, the State is required to either establish a TMDL of the specified substance that the waterbody can receive without violating water quality standards, or demonstrate that water quality standards are being met (CFR 2010a, b). This document, upon approval by the U.S. Environmental Protection Agency (EPA), establishes a Total Maximum Daily Load (TMDL) for trash and debris in the Northwest Branch and Middle Branch portions of the Patapsco River Mesohaline (PATMH) Tidal Chesapeake Bay Segment (Middle Branch/Northwest Branch) (2012 *Integrated Report of Surface Water Quality in Maryland* Assessment Unit ID: MD-PATMH-MiddleBranch_NorthwestBranch). More specifically, the listing is limited to the shoreline of the *"Middle Branch from the mouth (Ferry Bar Park to Harbor Hospital Center) extending westward and the Northwest Branch from the Hull Street Pier to Canton Waterfront Park."*

TMDLs are established to determine the pollutant load reductions needed to achieve and maintain water quality standards. A water quality standard is the combination of a designated use for a particular body of water and the water quality criteria designed to protect that use. Designated uses include activities such as swimming, drinking water supply, protection of aquatic life, and shellfish propagation and harvest. Water quality criteria consist of narrative statements and numeric values designed to protect the designated uses. Criteria may differ among waters with different designated uses.

The Maryland Department of the Environment (MDE) has identified the PATMH Tidal Chesapeake Bay Segment (Integrated Report Assessment Unit ID: PATMH) on the State's 2012 Integrated Report (IR) as impaired by multiple pollutants. The IR includes listings for the entire PATMH, as well as specific embayments within the PATMH. See Table 1 for all IR listings associated with this tidal segment.

Table 1. 2012 Integrated Report Listings for PATMH

Assessment Unit	Designated Use	Year listed	Identified Pollutant	Listing Category*	Status
MD-PATMH	Seasonal Migratory fish spawning and nursery Subcategory	1996	TN	4a	TMDL 2008
		1996	TP	4a	TMDL 2008
	Aquatic Life and Wildlife	1996	Mercury, Copper, Nickel, & Cyanide	4b	Individual Control Strategy for related facility
	Aquatic Life and Wildlife	1996	Chromium, Zinc, & Lead in Sediments	5	
	Open Water Fish and Shellfish	1996	TN	4a	TMDL 2008
	Open Water Fish and Shellfish Seasonal Shallow Water Submerged Aquatic Vegetation	1996	TP	4a	TMDL 2008
		1996	TSS	5	TMDL 2010
	Aquatic Life and Wildlife	2004	Impacts to Estuarine Biological Communities	5	
MD-PATMH	Seasonal Deep-Channel Refuge Use	1996	TP	4a	TMDL 2010
		1996	TN	4a	TMDL 2010
	Seasonal Deep-Water and Shellfish Subcategory	1996	TP	4a	TMDL 2008
		1996	TN	4a	TMDL 2008
	Aquatic Life and Wildlife	2008	Debris/Trash	5	
MD-PATMH-02130903	Aquatic Life and Wildlife	1998	Chlordane - sediments	4a	TMDL 2002
	Fishing	1998	PCBs	5	TMDL 2011
MD-PATMH-Bear_Creek	Aquatic Life and Wildlife	1998	Zinc (in sediments)	5	
			Chromium (in sediments)	5	
			PCBs (Sediments & Fish Tissue)	5	TMDL 2011
MD-PATMH-Bodkin_Creek	Open-Water Fish and Shellfish Subcategory	1996	TN	4a	TMDL 2010
			TP	4a	TMDL 2010
	Aquatic Life and Wildlife	1996	Copper	5	
			Lead	2	WQA 2009
			Zinc	2	WQA 2009
MD-PATMH-Curtis_Bay_Creek	Aquatic Life and Wildlife	1998	Zinc (in sediments)	5	

Assessment Unit	Designated Use	Year listed	Identified Pollutant	Listing Category*	Status
			PCBs (Sediments & Fish Tissue)	5	TMDL 2011
MD-PATMH-Furnace_Creek	Water Contact Sports	1998	Enterococcus	4a	TMDL 2010
MD-PATMH-Marley_Creek	Water Contact Sports	1998	Enterococcus	4a	TMDL 2010
MD-PATMH-MiddleBranch – NorthwestHarbor	Water Contact Sports	2010	Enterococcus	5	
MD-PATMH-Middle_ Harbor	Aquatic Life and Wildlife	1998	Zinc (in Sediments)	5	
MD-PATMH-Pine_Grove_Village_Beach	Water Contact Sports	N/A	Enterococcus	2	
MD-PATMH-Rock_Creek	Water Contact Sports	N/A	Fecal Coliform	2	

*Listing Category definitions – 2: attaining some standards but insufficient data to assess completely; 4a: impaired, TMDL completed; 4b: impaired, non-TMDL pollution controls required; 5: impaired TMDL required.

1.1 Watershed Description

The PATMH Chesapeake Bay Segment (PATMH) is a tidal estuary, or embayment, located on the western shore of the Chesapeake Bay. The total watershed draining to PATMH covers 1,514 square kilometers (km^2) (374,040 acres) and spans Baltimore City, Carroll, Howard, Anne Arundel, and Baltimore Counties. Only two specific segments within the PATMH are listed as impaired for trash – the Middle Branch and the Northwest Branch. More specifically, the *"Middle Branch from the mouth (Ferry Bar Park to Harbor Hospital Center) extending westward and the Northwest Branch from the Hull Street Pier to Canton Waterfront Park."* This impaired shoreline receives drainage from three distinct Maryland 8-digit watersheds: Baltimore Harbor, Gwynns Falls, and Jones Falls, all within Baltimore City and Baltimore County. Approximately 5,700 acres of the MD 8-digit Baltimore Harbor watershed drain to the impaired shoreline. (For simplicity, further mention in this document to Baltimore Harbor Watershed will refer only to those acres with direct drainage to the impairment.) The entire Gwynns Falls watershed (approx 42,000 acres) drains to the Middle Branch impairment and the entire Jones Falls watershed (approx 37,000 acres) drains to the Northwest Branch impairment. All three contributing watersheds are highly urbanized, with mainly residential and commercial areas, especially within Baltimore City. The northern portions of both the Gwynns Falls and Jones Falls in Baltimore County include more forest land use as well as small amounts of crop land. The combined population of the three watersheds is approximately 725,000 (MDP 2012).

Middle Branch

The Middle Branch of the PATMH drains a small amount of the Baltimore Harbor Watershed, including the industrial areas of Westport and Spring Garden, and both of Baltimore's major sports stadiums. The majority of the drainage to the Middle Branch is from the Gwynns Falls watershed. The total drainage area of the Middle Branch is approximately 45,000 acres, in Baltimore City and Baltimore County.

Northwest Branch

The Northwest Branch of the PATMH is the location of Baltimore City's celebrated Inner Harbor, and also receives drainage from the historical Baltimore City neighborhoods of Canton, Federal Hill, Fells Point, and Patterson Park, extending north to include Clifton Park. Additionally, the Jones Falls Watershed discharges into the Northwest Branch. The total drainage area of this segment is approximately 42,000 acres.

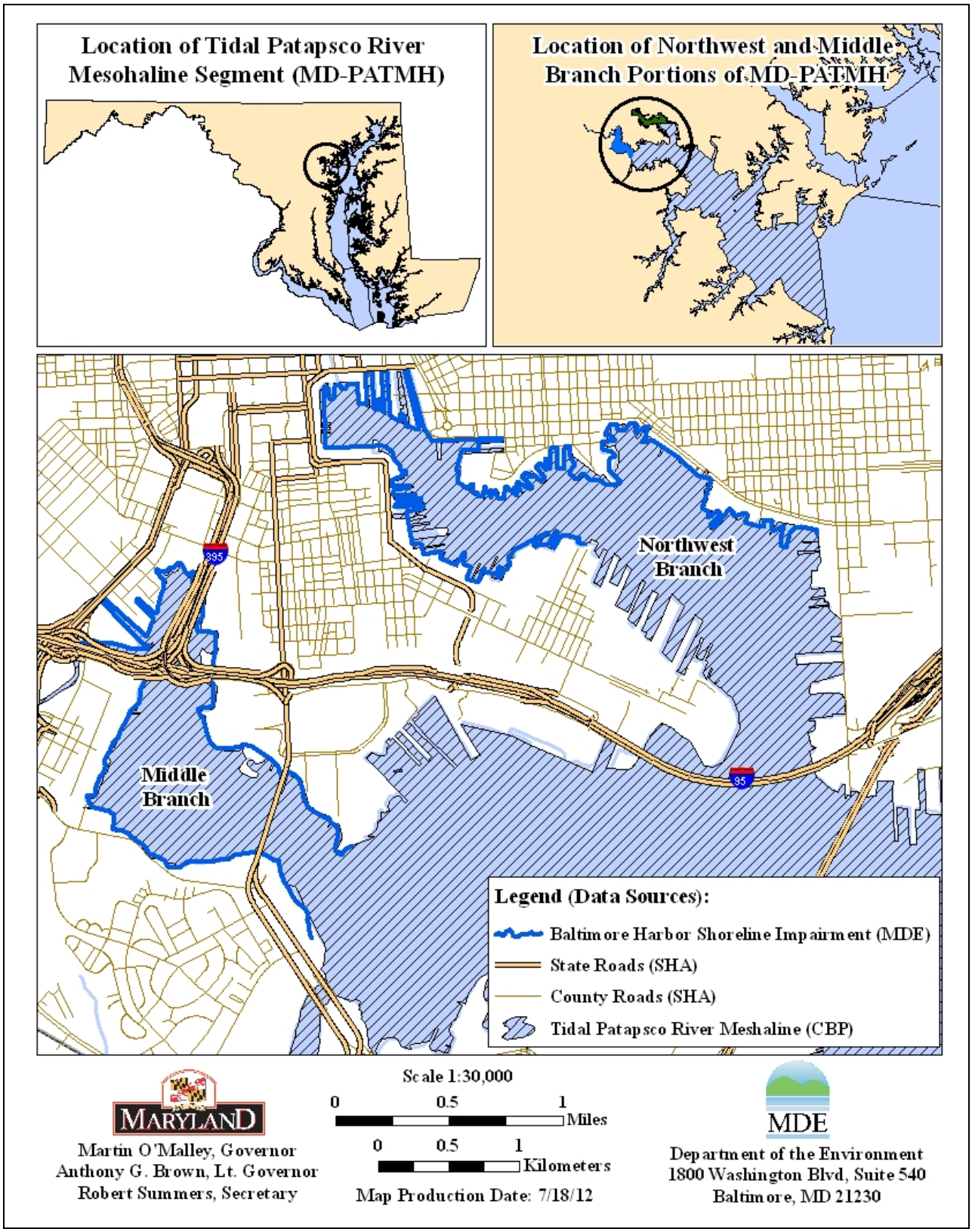

Figure 1. Geographical Location of Middle Branch/Northwest Branch Trash Impairment

Document version: December 3, 2014

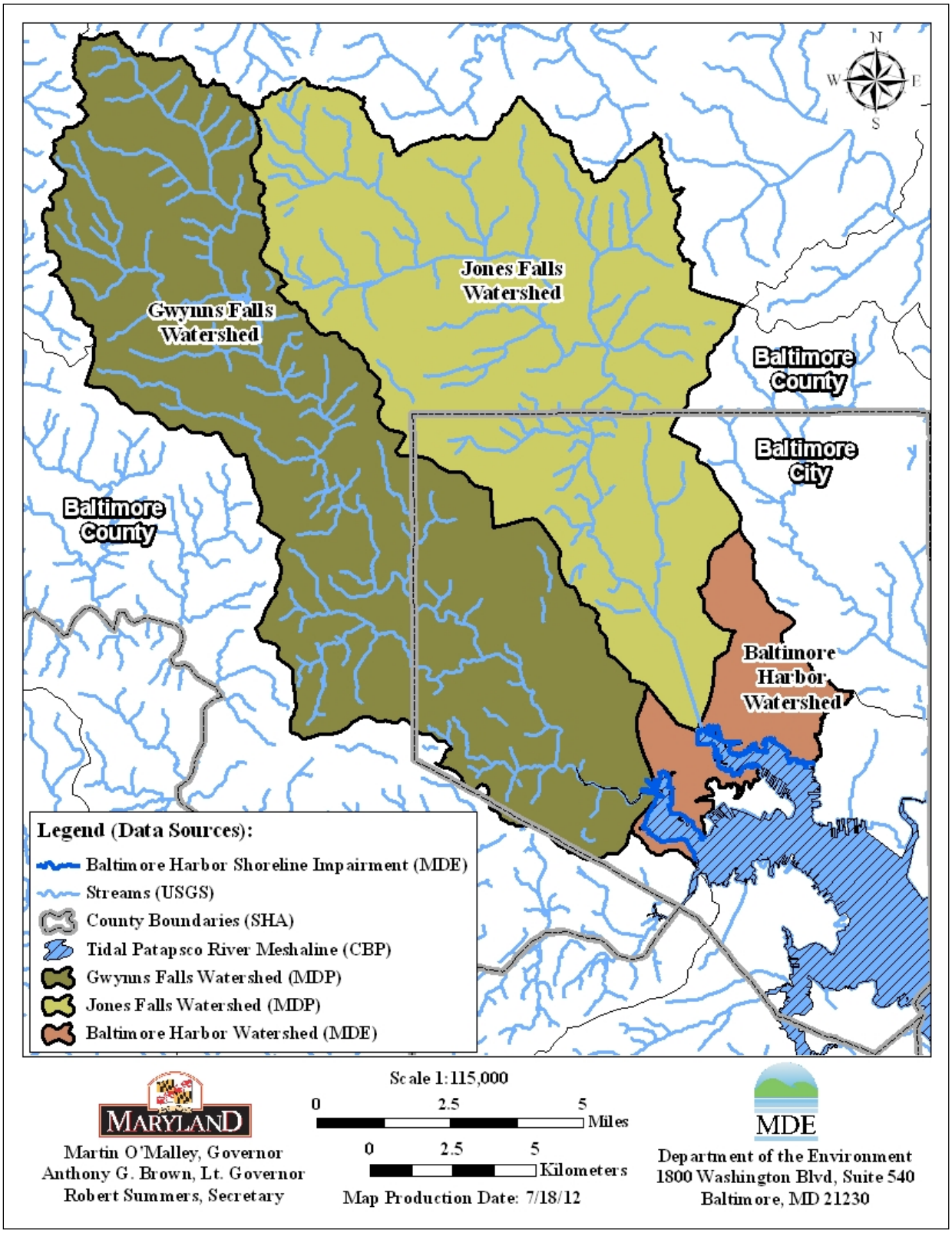

Figure 2. Spatial Extent of Middle Branch/Northwest Branch TMDL

1.2 Land Use

The land use dataset used for this TMDL is the Maryland Department of Planning 2010. See Tables 2 – 4 for detailed land use of areas covered in this TMDL. [Note: Values in tables have been rounded.]

Table 2. Baltimore Harbor Watershed Land Use

General Land Use	Detailed Land Use	Area (Acres)	Percent (%)	Grouped Percent (%)
	Medium Density Residential	51.4	0.9	
	High Density Residential	2,742.7	48.0	
	Commercial	677.0	11.9	
	Industrial	835.6	14.6	
	Institutional	816.6	14.3	
	Open Urban Land	404.7	7.1	
Urban	Transportation	117.3	2.0	98.8
	Deciduous Forest	16.8	0.3	
	Water	44.4	0.8	
Other	Bare Ground	4.8	0.1	1.2
	Total	**5,711.3**	**100.0**	**100.0**

Table 3. Gwynns Falls Watershed Land Use

		Baltimore City			Baltimore County		
General Land Use	Detailed Land Use	Area (Acres)	Percent (%)	Grouped Percent (%)	Area (Acres)	Percent (%)	Grouped Percent (%)
	Low Density Residential	23.7	0.2		1,916.6	6.9	
	Medium Density Residential	2,430.4	17.6		8,807.8	31.6	
	High Density Residential	4,424.4	32.0		4,003.1	14.4	
	Commercial	1,022.1	7.4		2,238.7	8.0	
	Industrial	1,328.4	9.6		1,211.8	4.3	
	Institutional	1,297.4	9.4		1,685.0	6.0	
	Open Urban Land	1,151.9	8.3		1,005.8	3.6	
Urban	Transportation	552.9	4.0	88.5	690.8	2.5	77.3
	Deciduous Forest	1,453.5	10.5		4,157.1	14.9	
	Evergreen Forest	0.0	0.0		504.8	1.8	
	Mixed Forest	0.0	0.0		68.5	0.2	
	Brush	49.1	0.4		252.2	0.9	
Forest	Large Lot Forest	0.0	0.0	10.9	192.2	0.7	18.6
	Cropland	0.0	0.0		642.0	2.3	
	Pasture	0.0	0.0		303.0	1.1	
	Large Lot Agricultural	0.0	0.0		56.1	0.2	
Agriculture	Agricultural Buildings	0.0	0.0	0.0	5.0	0.0	3.6
	Extractive	0.0	0.0		77.4	0.3	
Extractive	Bare Ground	0.0	0.0	0.0	25.1	0.1	0.4
	Water	82.6	0.6		16.7	0.1	
Water	Wetlands	0.0	0.0	0.6	32.3	0.1	0.2
	Total	13,816.3	100.0	100.0	27,891.9	100.0	100.0

Table 4. Jones Falls Watershed Land Use

		Baltimore City			Baltimore County		
General Land Use	Detailed Land Use	Area (Acres)	Percent (%)	Grouped Percent (%)	Area (Acres)	Percent (%)	Grouped Percent (%)
Urban	Low Density Residential	575.2	5.0	90.5	8,061.6	31.3	68.2
	Medium Density Residential	2,738.7	23.6		3,534.5	13.7	
	High Density Residential	3,319.9	28.7		1,363.2	5.3	
	Commercial	1,159.5	10.0		1,042.1	4.1	
	Industrial	258.0	2.2		224.6	0.9	
	Institutional	1,497.6	12.9		1,240.0	4.8	
	Open Urban Land	582.7	5.0		1,771.5	6.9	
	Transportation	346.4	3.0		301.8	1.2	
Forest	Deciduous Forest	893.5	7.7	8.6	3,778.2	14.7	19.7
	Evergreen Forest	0.0	0.0		111.8	0.4	
	Mixed Forest	106.7	0.9		11.8	0.0	
	Brush	0.0	0.0		22.9	0.1	
	Large Lot Forest	0.0	0.0		1,146.4	4.5	
Agriculture	Cropland	0.0	0.0	0.0	1,786.3	6.9	10.9
	Pasture	0.0	0.0		352.3	1.4	
	Orchards	0.0	0.0		28.0	0.1	
	Large Lot Agricultural	0.0	0.0		635.1	2.5	
	Agricultural Buildings	0.0	0.0		14.4	0.1	
Extractive	Extractive	0.0	0.0	0.4	173.4	0.7	0.8
	Bare Ground	48.4	0.4		26.2	0.1	
Water	Water	54.3	0.5	0.5	59.8	0.2	0.4
	Wetlands	0.0	0.0		41.1	0.2	
	Total	11,580.9	100.0	100.0	25,726.9	100.0	100.0

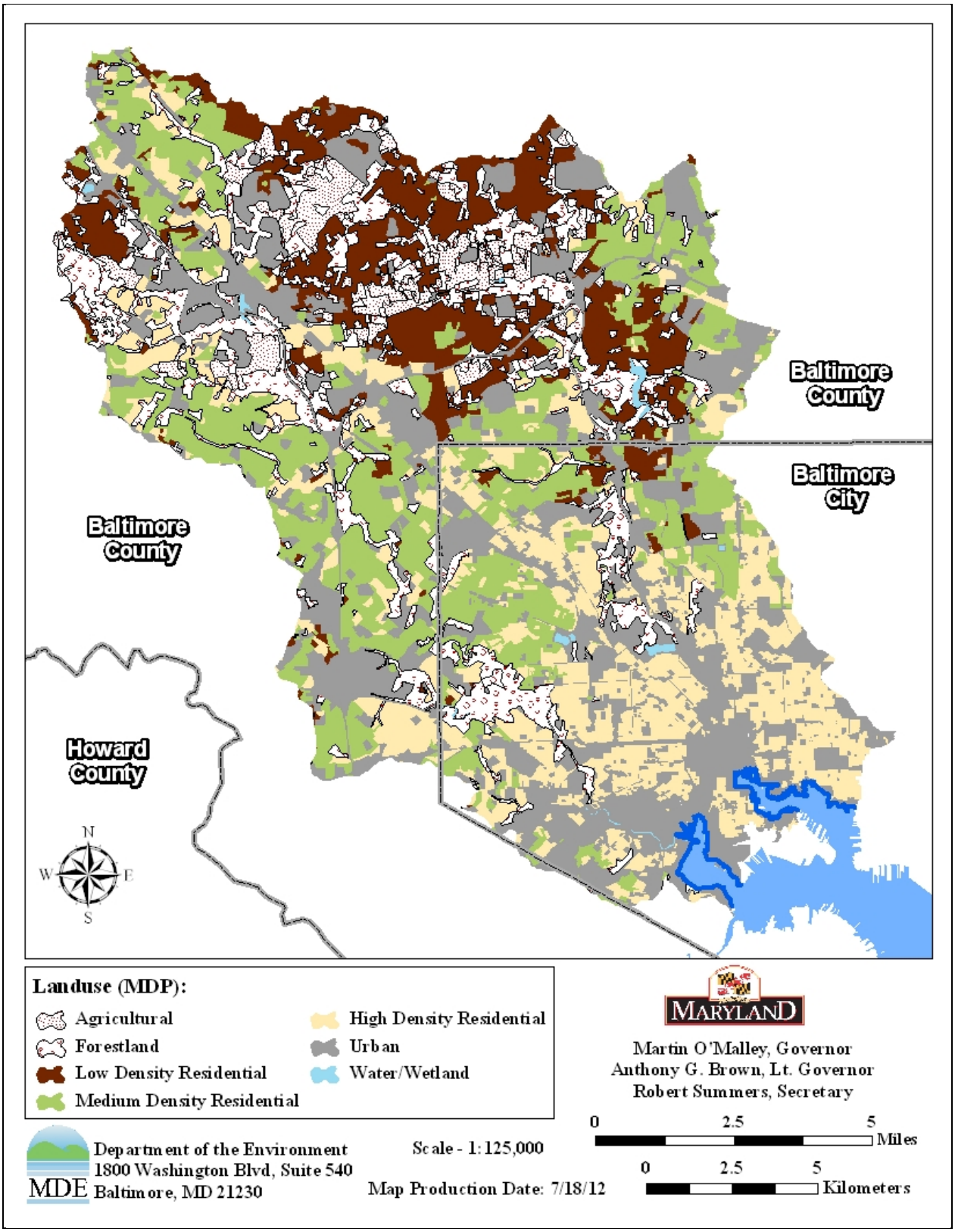

Figure 3. Land Use of the Middle Branch/Northwest Branch trash impairment

1.3 Previous and Existing Studies

This section includes several studies regarding trash in the Baltimore Harbor area. It is not intended to be all-inclusive and other studies may exist. The summaries are meant to provide brief synopsis of the reports. The full reports should be reviewed by interested parties wishing more information.

Baltimore Harbor Trash Report (Moffatt and Nichol 2006)
In 2006, a Baltimore Harbor Trash Study was performed to review and assess strategies for addressing the floating trash and debris in the Baltimore Harbor. The geographical scope of the study was the Northwest Branch from Federal Hill around to Fells Point, including the Inner Harbor. The study presented short term (1 – 3 years) and medium term (3 – 5 years) recommendations.

The study evaluated the types and sources of trash and the negative impacts of trash to public health and aquatic life in the Harbor. It cited the methodologies currently in use to reduce trash in the Harbor, including boats and floating booms, trash netting facilities, street sweeping, and community trash clean-ups. It investigated successful trash reduction programs in other geographical regions, from trash netting facilities to recycling programs and bottle bills.

The conclusion of the study was that a comprehensive approach would be required to solve the problem of trash in the Harbor. It was recommended that Baltimore City hire a staff person to manage and coordinate the efforts to reduce trash in the Harbor. It also recommended a number of short term and medium term trash reduction efforts, including increasing the efficiency of current programs, conducting a regional Trash Summit, instituting an educational/outreach program, and considering trash reduction legislation.

Middle Branch Patapsco Trash Management Plan (Coastal Estuarine Hydrology & Hydraulics Engineers 2007)

Trash pollution is a significant aesthetic, environmental and human health concern in the Middle Branch of the Patapsco River. The *Middle Branch Patapsco Trash Management Plan* study provided an initial assessment of conditions in the Middle Branch and its upland drainage area.

The first section of the study presented an explanation of the trash problem, including a definition of trash and the types and sources of trash. It also presented extensive information regarding the negative impacts of trash to human and wildlife health and aquatic life.

The second section of the study presented the results of a qualitative baseline trash assessment for the Middle Branch shoreline from the confluence with the main branch of the Patapsco River, clockwise around to Ferry Bar. Trash levels were rated from 1 to 5, based on percent coverage of trash. Trash hotspots (rating of 5) were found between the Baltimore Rowing Club and Middle Branch Marina, and at Smith Cove to the southern end of the Westport property.

The third section of the study provided information on structural and non structural trash management strategies currently being used in Baltimore City. These included trash netting

facilities, street sweeping, community trash clean-ups, and an extensive list of possible funding sources for implementation of the trash management plan was provided. These included local, state and federal sources, as well as private foundations and organizations.
The conclusion of the study was that in order to restore a trash free Middle Branch, cooperation and participation would be required by citizens, government, and businesses. Structural and non-structural methodologies would need to be utilized. The study recommended 15 overall strategies, including: aggressive educational and public relations campaigns, bottle bill legislation, city funding incentives, enforcement of litter laws, increased coordination of trash clean-ups, hydrodynamic modeling of the study area, and watershed plans for target areas.

Harris Creek Small Watershed Action Plan (CWP 2010)

The *Harris Creek Small Watershed Action Plan* (*the Plan*) was developed to improve watershed management by identifying greening efforts and opportunities, summarize work that is being done in the watershed and build stakeholder and citizen involvement. *The Plan* outlines a series of recommendations, implementation strategies, and priority projects for completion. It was completed as an EPA "A – I criteria" plan. *The Plan* is the culmination of several efforts including community stakeholder meetings, desktop and field assessments, and a background review conducted by Center for Watershed Protection (CWP) and Baltimore Harbor Waterkeeper Association.

The Plan provides a detailed watershed overview and background, including information on neighborhoods and demographics. Harris Creek is an underground stream located on the east side of Baltimore that drains approximately two square miles and discharges into the Baltimore Harbor in Canton. The Harris Creek Watershed is a dynamic, urban landscape that encompasses seventeen neighborhoods and two City parks. The watershed is negatively impacted by water quality pollutants, soil contaminants, and trash. Several efforts towards improvement have occurred in the watershed, including a Trash Survey, a Stakeholder and Community Survey, and Community Gardens.

Section 2.4 of the Plan report presents the Watershed Efforts and Programs, including results of the Harris Creek Watershed Trash Survey. A trash survey was conducted by CWP in the Harris Creek Watershed to identify potential trash source areas and other pollution sources in the watershed. One of the key findings of the survey was that there was a need for basic education with increased efforts and City management action in trash "hot spot" neighborhoods. Seven recommendations were presented, including conducting a trash education program, increasing littering violation citations, and increased street sweeping in neighborhoods with high trash ratings.

Section 3 of the Plan presents the six Watershed Goals and Objectives, one of which is to reduce trash. Nine recommendations were given on structural and non-structural ways to reduce trash. Trash reduction is also included in the recommendations and implementation strategies (Section 5.1) and estimates of quantifiable trash reduction rates of the various recommendations are presented in Section 6.1.

State of Baltimore Harbor's Ecological and Human Health (Wicks 2011)

EcoCheck (NOAA – UMCES Partnership) conducted a baseline condition assessment of the current ecosystem health of the Baltimore Harbor and its watershed, including the upstream watersheds of Gwynns Falls and Jones Falls. The study was prepared for the Waterfront Partnership of Baltimore, Inc. The assessment is based on methodologies validated through peer-reviewed scientific articles, health indicators developed by the EPA Chesapeake Bay program, and a standardized sampling and data analysis method through the Mid-Atlantic Tributary Assessment Coalition (MTAC).

The assessment evaluated eight ecological health indicators and two human health/aesthetic indicators: dissolved oxygen, chlorophyll *a*, water clarity, total nitrogen, total phosphorus, benthic community, aquatic grass, toxics in sediment, bacteria, and trash. The indicators were assessed based on the following methodology: establishing thresholds for each indicator based on literature values, scoring the data with multiple thresholds or pass/fail method where necessary, and rating the performance of the indicator on a "very poor to good scale".

Due to the limited trash data available and varying methodologies used to collect the trash data, the methodology used to evaluate the other indicators described above could not be completed for trash. However, the assessment indicates that trash is still considered a major problem in the Baltimore Harbor and its associated watersheds.

The assessment recommends the establishment of a uniform trash monitoring program in order to be able to compare inter-annual trash data. This would include monitoring directly within the Baltimore Harbor and also in the upstream watersheds of Gwynns Falls and Jones Falls. (Wicks 2011)

A Healthy Harbor Plan for Baltimore, MD (Waterfront Partnership of Baltimore, Inc. 2011)

In 2010, the Waterfront Partnership of Baltimore, Inc. unveiled its Healthy Harbor initiative with a goal of making the Harbor swimmable and fishable by 2020. Included in the initiative were pilot projects to help improve water quality and help educate the public about the Harbor's health. To reach the swimmable and fishable goals, the Waterfront Partnership initiated the development of a very specific plan of action for restoration. This plan was developed by the Center for Watershed Protection, Inc. and Biohabitats, Inc., with input form Baltimore City and County and Blue Water Baltimore. The Healthy Harbor Plan focuses on the Northwest and Middle Branches of the Harbor and addresses three key issues: eliminating sewage, removing trash, and managing stormwater.

Chapter 4 of the Healthy Harbor Plan addresses the issue of trash. The chapter offers six strategies to reduce the trash by 75% by 2020 and 100% by 2030. They are:

1. Develop a public outreach program and increase enforcement of existing litter and disposal regulations
2. Support new legislation to eliminate plastic bags and bottles
3. Conduct a trash survey to identify high trash generation areas for targeted action and outreach

4. Install green infrastructure and other methods of stormwater management volume control to capture trash from stormwater
5. Increase practices that prevent trash from entering storm drain inlets
6. Increase practices the capture trash at storm drain outlets

The chapter also presents a detailed schedule for implementation strategies and a cost estimate for implementation.

Upper Gwynns Falls Small Watershed Action Plan (Morton Thomas Associates, Inc. 2011)

The Baltimore County Department of Environmental Protection and Sustainability (BCDEPS) completed a Small Watershed Action Plan (SWAP) for the Upper Gwynns Falls watershed in 2011. A SWAP identifies strategies to bring a small watershed into compliance with water quality standards. Strategies go beyond traditional government capital projects and include actions in partnership with local watershed associations, citizen awareness campaigns and volunteer activities. It presents actions for watershed restoration and preservation and identifies priority projects for implementation. The SWAP also satisfies various environmental program requirements, including NPDES and TMDL.

The Upper Gwynns Falls SWAP established eight goals and objectives. Goal 7 was to reduce trash and promote recycling. The objectives of this goal are to:

1. Develop a baseline trash load through 1-year monitoring period.
2. Implement an effective monitoring program to identify hotspots and document long term conditions and assess trends.
3. Reduce trash through cleanups and educational activities on proper trash handling.
4. Increase stewardship by students, religious institutions, boy/girl scouts and other community groups through activities such as clean-ups, storm drain marking and recycling awareness.
5. Increase the quantity of material recycled and compost.
6. Utilize code enforcement policies and implement actions for improper handling of trash and improper vehicle storage and maintenance.
7. Increase trash removal maintenance in SWM facilities.

2.0 WATER QUALITY CRITERIA

Water quality standards designate the *uses* to be protected (e.g., water supply, recreation, aquatic life) and the *criteria* for their protection (e.g., how much of a pollutant can be present in a waterbody without impairing its designated uses). TMDLs are developed to meet applicable water quality standards, which may be expressed as numeric water quality criteria or narrative criteria for the support of designated uses.

The TMDL target identifies the numeric goals or endpoints for the TMDL that are designed to achieve applicable water quality standards. The TMDL target may be equivalent to a numeric water quality standard where one exists, or it may be calculated to achieve compliance with a narrative standard. This section reviews the applicable water quality standards and identifies an appropriate TMDL target for calculation of the trash TMDL for the Middle Branch/Northwest Branch.

Maryland's water quality standards are established by COMAR Title 26 Subtitle 08, Chapter 2. All surface waters in Maryland are protected for water contact recreation, fishing and protection of aquatic life and wildlife (Use I). Additional segment specific designated uses, for all watersheds in the spatial extent of this TMDL are included in Table 5 (COMAR 2012a, d).

Table 5. Segment-specific designated uses in the Middle Branch/Northwest Branch

Water	Designated use	Description
PATMH	Use II	Migratory Spawning and Nursery Use; Shallow Submerged Aquatic Vegetation Use; Open Water Fish and Shellfish Use
Baltimore Harbor Watershed	Use I	Water Contact Recreation and Protection of Aquatic Life
Gwynns Falls	Use I/III/IV	Water Contact Recreation and Protection of Aquatic Life, Natural and Recreational Trout Waters
Jones Falls	Use I/III/IV	Water Contact Recreation and Protection of Aquatic Life, Natural and Recreational Trout Waters

The Maryland narrative criteria for surface waters states:

> The waters of this State may not be polluted by:
> (1) Substances attributable to sewage, industrial waste, or other waste that will settle to form sludge deposits that:
> (a) Are unsightly, putrescent, or odorous, and create a nuisance, or
> (b) Interfere directly or indirectly with designated uses;
> (2) Any material, including floating debris, oil, grease, scum, sludge, and other floating materials attributable to sewage, industrial waste, or other waste in amounts sufficient to:
> (a) Be unsightly;
> (b) Produce taste or odor;
> (c) Change the existing color to produce objectionable color for aesthetic purposes;
> (d) Create a nuisance; or
> (e) Interfere directly or indirectly with designated uses. (COMAR 2012c)

Maryland's water quality standards also include an antidegradation policy, which requires that waters of the State be protected and maintained for existing uses and the basic uses of water contact recreation, fishing, protection of aquatic life and wildlife, and agricultural and industrial water supply as identified in Use I (COMAR 2012a). Certain waters of this State possess an existing quality that is better than the water quality standards established for them. The quality of these waters will be maintained unless the state finds that a change in quality is justifiable as a result of necessary economic or social development; and the change will not diminish uses made of, or presently existing, in these waters. There are no "high quality," or Tier II, stream segments (Benthic Index of Biotic Integrity (BIBI) and Fish Index of Biotic Integrity (FIBI) aquatic life assessment scores > 4 (scale 1-5)) located within the watershed draining to the impaired segments requiring the implementation of Maryland's anti-degradation policy (COMAR 2012b; MDE 2011).

3.0 DATA INVENTORY

TMDL development requires a complete review of existing data to establish existing conditions in the study area. This section describes the data from numerous sources that were used to characterize the watersheds and water quality conditions, identify pollutant sources, and support the calculation of trash TMDLs for the Middle Branch/Northwest Branch.

3.1 Baltimore City Stormwater Outfall Monitoring

Baltimore City Department of Public Works (BCDPW) Water Quality Monitoring and Inspections Section (WQMIS) conducted a trash monitoring study to provide data for this TMDL. The study occurred between January and September 2011. The study consisted of sampling at five stormwater outfalls, two within the Jones Falls Watershed and three within the Gwynns Falls watershed. No stations were sampled in the Baltimore Harbor Watershed due to several factors, including: lack of accessibility (under water), very high wet weather flow rates that damaged equipment, and the limitation of significant sub-watershed sizes. Sampling sites were selected based on a number of different contributing factors including accessibility, land use, and socioeconomics, in order to capture a robust sample of the Baltimore City trash load. The most important factor was accessibility. As mentioned above, many of the stormwater outfalls are under water and not accessible. The size and discharge amount of the outfall are also factors because of the sample device's ability to withstand excessive force of the water. See Table 6 for detailed information on the sites and Figure 4 for a location map of the sites. (BCDPW WQMIS 2012)

Table 6. Baltimore City Stormwater Outfall site information

Site Name	Watershed	Location	Associated Stream	Outfall Size	Drainage Acres	Land use
DeSoto	Gwynns Falls	Benson Ave	Maiden Choice Creek	48”	20.48	High Density Residential
Leon Day	Gwynns Falls	Ellicott Driveway	Gwynns Falls	30”	19.38	High Density Residential
Liberty	Gwynns Falls	Parkview Ave	Powder Mill Run	48”	43.07	High Density Residential
Western Run	Jones Falls	Strathmore	Western Run	36”	40.67	High Density Residential
North Ave	Jones Falls	Falls Rd between Howard St. and North Ave. bridges	Jones Falls	36”	23.39	Commercial

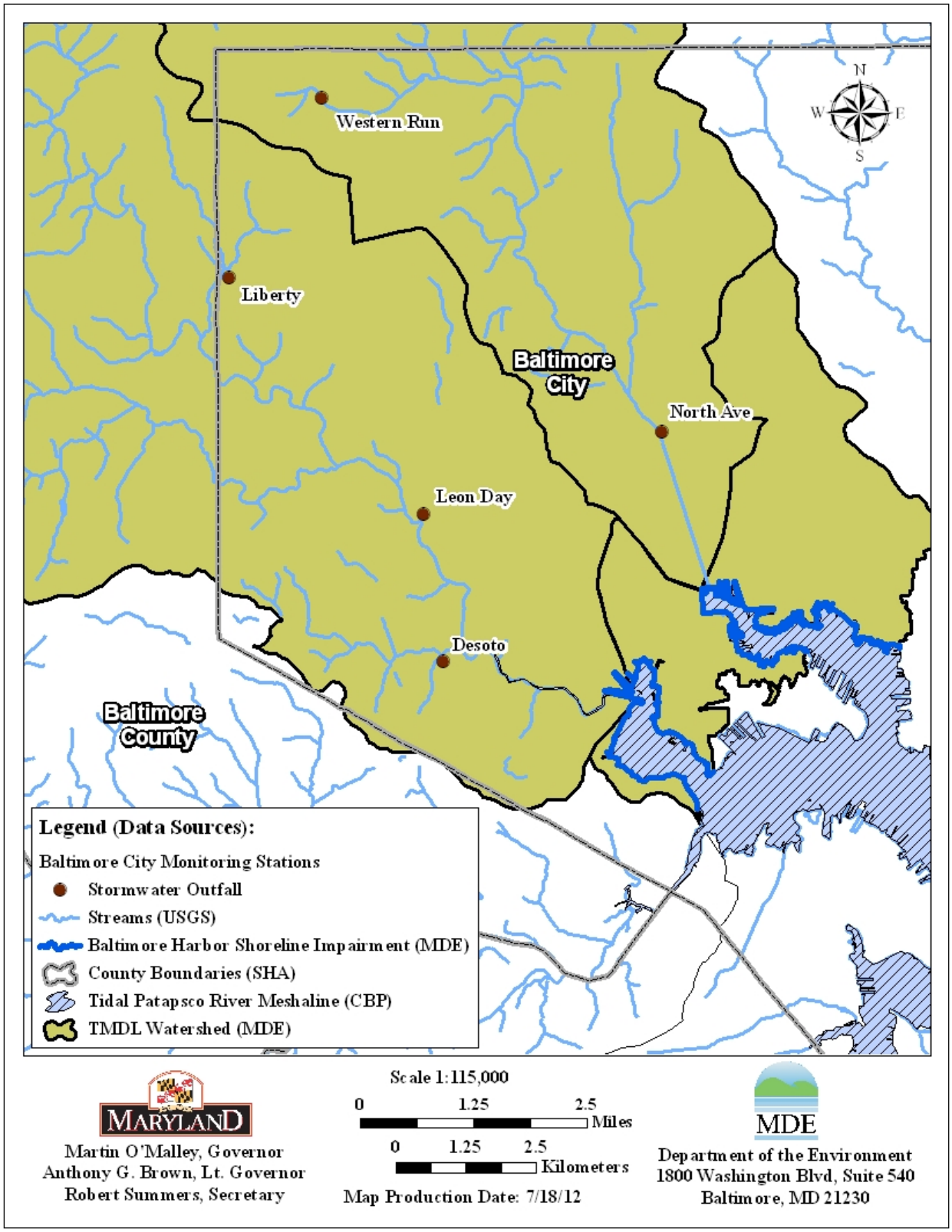

Figure 4. Baltimore City WQIMS Trash Monitoring Sites and impaired area.

Once the sample devices were installed, sampling occurred approximately every 2 – 4 weeks and was based on the amount of trash and other debris in the collection device. The collection devices in the three Gwynns Falls locations were installed on 1/1/2011, while the two in Jones Falls locations were installed on 3/9/2011. The samples were manually collected by WQIMS staff, using extensive safety precautions. The organic debris was removed from the sample and the remaining trash was collected in a large industrial garbage bag. Every effort was made to minimize the amount of liquid in the sample. All containers that held liquid were emptied before weighing the sample. The dry weight of the trash was measured and recorded. For more information regarding this monitoring study, contact Baltimore City Department of Public Works WQMIS. See Table 7 for the dry weight of trash collected at each sampling event. (BCDPW-WQMIS 2012)

Table 7. Baltimore City Trash Monitoring Data

DeSoto (Gwynns)		Leon Day (Gwynns)		Liberty (Gwynns)		Western Run (Jones)		North Ave (Jones)	
Date	Weight (lbs)	Date	Weight (lbs)	Date	Weight (lbs)	Date	Weight (lbs)	Date	Weight (lbs)
3/8/2011	8	3/8/2011	44	3/8/2011	7	3/15/2011	1	3/15/2011	6
3/15/2011	2	3/15/2011	24	3/25/2011	3	3/25/2011	0.5	3/25/2011	18
3/29/2011	20	3/29/2011	38	5/19/2011	5	4/15/2011	2	4/15/2011	16
5/18/2011	2	5/18/2011	31	6/15/2011	1	5/20/2011	1.5	5/19/2011	40
6/15/2011	6	7/26/2011	22	7/28/2011	3	6/14/2011	0	6/15/2011	18
7/20/2011	6	8/11/2011	9	8/16/2011	1	7/20/2011	2	7/20/2011	18
8/16/11	4	8/16/2011	41	8/26/2011	1	8/11/2011	2	7/26/2011	5
8/26/11	1	8/26/2011	4	8/31/2011	0	8/16/2011	1	8/11/2011	12
8/31/11	0	8/31/2011	0	9/13/2011	1	8/26/2011	1	8/16/2011	9
9/13/11	3	9/13/2011	4	10/4/11	3.5	8/31/2011	0	8/26/2011	9
10/4/11	2	10/4/11	3	10/28/11	2	9/13/2011	0.5		
10/28/11	1	10/28/11	1						

Note: Data provided by BCDPW-WQMIS 2012

3.2 Baltimore County Stormwater Outfall and Stream Monitoring

Baltimore County Department of Environmental Protection and Sustainability (BCDEPS) also conducted a trash monitoring study to provide data for this TMDL. The study occurred between October 2010 and October 2011. Twenty in-stream sites and seventeen stormwater management facilities (SWMF) were randomly selected in the Jones Falls and Gwynns Falls watersheds. The stream sites were selected based on a stratified selection criteria with at least one site in each subwatershed in the Baltimore County portion of Gwynns Falls and Jones Falls using a geographic information system (GIS) subroutine for the site selection. An excess of points were selected and randomly ranked for field site visits to investigate for access and safety. Ten sites were selected in Gwynns Falls and ten sites in Jones Falls. Within the stream, a 500 ft. reach was measured and marked for the survey. All trash was collected within the bankfull of the reach. SWMF were selected based on a number of criteria, including: facility type, ownership, drainage area, and land use. Field assessment of the SWMF was conducted to determine if the facility conditions were conducive to trash monitoring. Facilities that were excessively wet or provided access or safety problems were not selected. Facilities within a predominate land use category were investigated until sufficient facilities had been identified to provide a representative sample for that land use. At the SWMF sites, trash was collected within the fenced boundary of the facility. See Tables 8 and 9 for detailed information on the selected sites and Figure 5 for a location map of the sites**.** (BCDEPS 2011)

Table 8: Baltimore County Trash Monitoring – SWMF Site Characterization

SWMF Number	Watershed	Drainage Area (acres)	Land Use Designation
270	Gwynns Falls	7.3	High Density Residential
564	Gwynns Falls	17.61	Low Density Residential
1112	Gwynns Falls	17.44	Medium Density Residential
1580	Gwynns Falls	9.5	Medium Density Residential
1656	Gwynns Falls	12.78	High Density Residential
1709	Gwynns Falls	13.84	Commercial
1731	Gwynns Falls	3.75	Roadway
3264	Gwynns Falls	12.34	Roadway
3641	Gwynns Falls	13.64	Institutional
4171	Gwynns Falls	5.03	Low Density Residential
1340	Jones Falls	23.75	High Density Residential
2207	Jones Falls	3.92	Institutional
2949	Jones Falls	7.74	Open Urban
3307	Jones Falls	11.45	Medium Density Residential
3552	Jones Falls	18.25	Medium Density Residential
3953	Jones Falls	3.74	Low Density Residential
4172	Jones Falls	8.99	Low Density Residential

Table 9: Baltimore County Trash Monitoring – Stream Site Characterization

Streams Site	Stream Name	Watershed	Drainage Area (acres)	Major Land Use Designation
G-DR-1	Dead Run	Gwynns Falls	238.41	High Density Residential
G-DR-3	Dead Run	Gwynns Falls	408.97	Medium Density Residential
G-GF-1	Gwynns Falls	Gwynns Falls	83.74	Low Density Residential
G-GF-2	Gwynns Falls	Gwynns Falls	150.26	Medium Density Residential
G-HH-1	Horsehead Branch	Gwynns Falls	508.47	Medium Density Residential
G-MC-1	Maiden's Choice	Gwynns Falls	414.4	Medium Density Residential
G-PM-1	Powder Mill	Gwynns Falls	2,435.80	Medium Density Residential
G-RR-2	Red Run	Gwynns Falls	112.82	Forest
G-RR-4	Red Run	Gwynns Falls	522.83	Forest
G-SL-1	Scotts Level	Gwynns Falls	738.66	Medium Density Residential
J-DR-1	Deep Run	Jones Falls	1,149.03	Low Density Residential
J-LJF-1	Lower Jones Falls	Jones Falls	48.77	High Density Residential
J-LRR-1	Lake Roland Reservoir	Jones Falls	180.29	Institutional
J-MB-1	Moore's Branch	Jones Falls	1,315.70	Low Density Residential
J-NB-1	Jones Falls North Branch	Jones Falls	642.02	Low Density Residential
J-RR-1	Roland Run	Jones Falls	221.48	Open Urban
J-RR-2	Roland Run	Jones Falls	3009.8	Medium Density Residential
J-SHB-1	Slaughterhouse Branch	Jones Falls	265.8	Low Density Residential
J-TR-1	Towson Run	Jones Falls	320.41	High Density Residential
J-WR-1	Western Run	Jones Falls	583.8	Open Urban
4172		Jones Falls	8.99	Low Density Residential

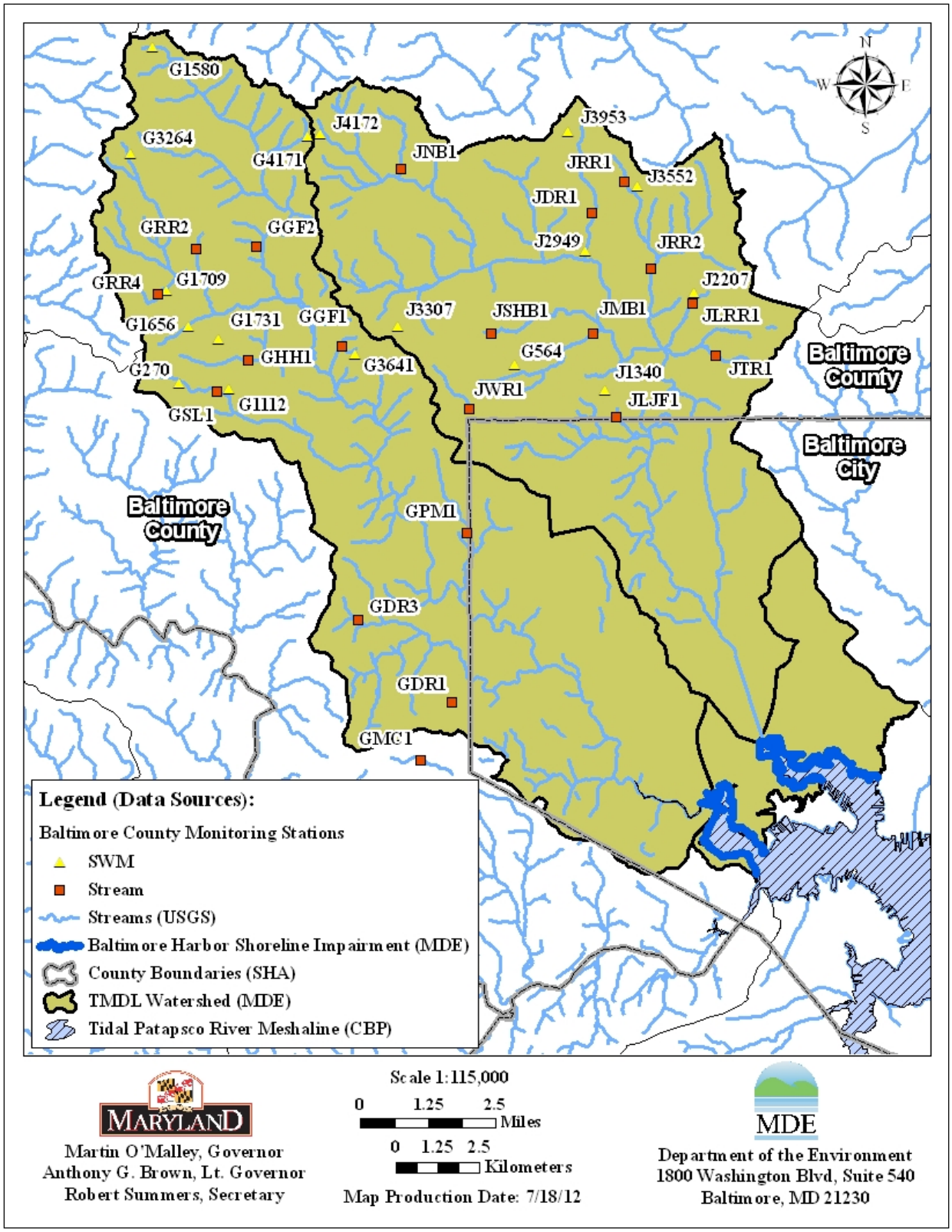

Figure 5. BCDEPS Trash Monitoring Sites

In order to determine the amount of trash accumulated during the year long study, trash was removed at each site prior to the initial seasonal sampling. Baseline data was collected in October 2010 at each site. The project timeline was as follows:

- Baseline sampling in October 2010-November 2010
- Winter Sampling in December 2010-February 2011
- Spring Sampling in April 2011-May 2011
- Summer Sampling in July 2011-August 2011
- Fall Sampling in October 2011-November 2011

Collected trash was brought back to the laboratory and spread out on tarps to dewater. Items were emptied of contents (liquids, sediment, etc.) that would affect the normal weight of the object collected. Trash was sorted into 5 categories: plastic bottles; glass bottles, aluminum cans; other; and dumping. Once sorted, the categories were weighed individually. Additionally, the bottles and cans were counted per item in each category. The individual seasonal samples accumulated for a time period between 50 and 125 days. For more information regarding this monitoring study, contact BCDEPS. See Tables 10 and 11 for the weight of trash collected at each sampling event. (BCDEPS 2011)

Table 10: Baltimore County Trash Monitoring – SWMF Site Data

SWM Facility Number	Baseline (lbs)	Winter (lbs)	Spring (lbs)	Summer (lbs)	Fall (lbs)
270	331.9	31.1	56.4	20.9	33.0
564	40.9	8.9	15.8	8.4	5.2
1112	69.0	14.6	34.5	24.5	16.9
1580	28.4	8.4	2.8	2.6	3.9
1656	18.4	4.0	22.5	10.2	1.8
1709	185.4	23.0	19.5	16.2	20.7
1731	15.0	1.8	9.0	1.6	2.7
3264	4.0	1.1	1.1	0.7	1.9
3641	19.8	13.6	16.3	4.5	4.8
4171	2.6	0.6	0.8	0.5	0.6
1340	134.7	45.0	46.9	22.4	21.3
2207	4.7	0.5	1.5	1.0	0.6
2949	7.0	8.5	3.7	2.6	1.5
3307	11.4	4.5	9.8	1.0	1.5
3552	11.9	9.2	6.0	1.7	2.5
3953	10.5	0.5	0.6	<0.1	<0.1
4172	4.3	1.0	1.0	0.9	0.5

Table 11: Baltimore County Trash Monitoring – Stream Site Data

Streams Site	Baseline (lbs)	Winter (lbs)	Spring (lbs)	Summer (lbs)	Fall (lbs)
G-DR-1	300.2	16.8	98.7	129.9	61.1
G-DR-3	413.1	11.1	79.9	83.4	65.8
G-GF-1	26.9	2.3	4.3	2.3	1.3
G-GF-2	90.4	13.8	51.6	19.1	45.8
G-HH-1	2.6	0.3	0.1	<0.1	9.0
G-MC-1	83.1	15.9	22.8	20.4	35.4
G-PM-1	406.5	18.8	94.1	138.2	61.4
G-RR-2	5.4	0.1	3.1	0.7	0.1
G-RR-4	14.4	3.4	2.3	0.5	2.0
G-SL-1	96.5	11.4	20.3	10.6	8.6
J-DR-1	19.4	6.5	12.0	6.7	12.0
J-LJF-1	113.4	14.0	25.5	10.6	17.2
J-LRR-1	7.1	0.6	1.8	0.9	3.0
J-MB-1	11.4	0.3	2.9	6.2	0.1
J-NB-1	25.6	<0.1	0.3	<0.1	<0.1
J-RR-1	3.9	0.1	0.3	2.0	1.1
J-RR-2	35.2	3.4	14.1	4.1	9.8
J-SHB-1	11.2	1.1	4.2	6.5	3.9
J-TR-1	43.6	3.4	4.3	3.0	4.2
J-WR-1	35.5	5.8	8.4	3.0	1.8

3.3 Historical Trash Data

In 2006, Baltimore installed its first trash capture system located near the mouth of Gwynns Run within Carroll Park. Various devices were then installed at several locations throughout Baltimore City including Harris Creek, Jones Falls, Briarclift, and Warner/Alluvion St. Limited descriptions of these capture systems were available, but it is known that some are simple boom systems while some are more complicated interceptors with nets. A waterwheel was used at Jones Falls and Harris Creek. Baltimore City also has an extensive skimmer/skiff program in the Northwest Branch. Data for these devices was provided to MDE by BCDPW and spans the years of 2006 – 2011, varying based on location of capture device. The data provided is simply a total weight of debris removed from the trash capture device. It includes any organic debris mixed in with the trash and the material is very wet, as all of the devices are in-stream processes. Additionally, many of the datasets were incomplete (e.g. non-sequential sample dates, zero values) and could not be accounted for by Baltimore City DPW. Therefore, it was determined that the data were incompatible with the Baltimore City and County sampling studies designed for use in this TMDL. (BCDPW 2011)

MDE was also provided extensive data from the National Aquarium in Baltimore, detailing their biannual clean-ups of Fort McHenry wetlands. The data submitted were solely in terms of number of items collected and were therefore incompatible for use with the TMDL methodology. (NAIB 2008)

3.4 Precipitation

In order to calculate point source loading rates, described in Sections 5.1.1 and 5.1.2, the trash sampling data was normalized by inches of precipitation that occurred during each sample period. This normalization was selected because precipitation is the primary mode of transport for trash to enter storm drains and streams. Precipitation data used was from NOAA's National Climatic Data Center (NCDC) Climate Data Online website: http://www.ncdc.noaa.gov/cdo-web/

Three NCDC stations were used to normalize the trash sample data. They are:

- MD00001567812396 – for all Baltimore City sampling sites, located at Maryland Science Center in Baltimore
- MD00001567812396 – for Baltimore County Gwynns Falls sampling, located at the northwestern tip of Gwynns Falls watershed
- MD00001567812396 – for Baltimore County Jones Falls sampling sites, located on the eastern border of Jones Falls Watershed

Additionally, 30-year climate normals from Baltimore Washington International (BWI) airport were used. Climate normals are calculated by National Oceanic and Atmospheric Administration (NOAA)/National Climatic Data Center (NCDC) for thousands of stations across the United States every decade, and are updated using the most recent 30-year period of data (currently 1981 – 2010). Normals are more than just a 30-year averaging of meteorological parameters as they incorporate other factors than just the raw data into the computation. These factors account for missing and questionable data, and location and instrument changes of a station. The climate normals also include numerous statistical computations (e.g., probabilities, frequencies, percentiles). Some widely-used normals include temperature (max, min and average), precipitation, snow (snowfall and snow depth) on time-scales ranging from hourly (for select sites) to annually. [http://www.erh.noaa.gov/er/lwx/climate/LWX_1981-2010_Normals_Website_pdf_version.pdf]

4.0 SOURCE ASSESSMENT

Sources of trash in the Middle Branch/Northwest Branch include point and nonpoint sources. For the purposes of this TMDL, items considered to have come from point sources include materials that are small enough to enter into the storm sewer system through a street level storm drain, such as glass bottles, aluminum cans, and plastic bags. Trash and debris stemming from nonpoint sources are items that are too large to travel through the street level storm drain, such as construction materials, appliances, and carpet.

4.1 Point Sources

A point source, according to 40 CFR 122.3, is any discernible, confined, and discrete conveyance, including any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, and vessel or other floating craft from which pollutants are or could be discharged. The National Pollutant Discharge Elimination System (NPDES) program, established under Clean Water Act sections 318, 402, and 405, requires permits for the discharge of pollutants from point sources. (CFR 2012c)

Stormwater discharges are generated by runoff from urban land and impervious areas such as paved streets, parking lots, and rooftops during precipitation events. These discharges often contain high concentrations of pollutants that can eventually enter nearby waterbodies. Most stormwater discharges are considered point sources and require coverage by an NPDES permit.

Municipal Separate Storm Sewer System (MS4)

Under the NPDES stormwater program, operators of large, medium, and regulated small MS4s must obtain authorization to discharge pollutants. The Stormwater Phase I Rule, 55 *Federal Register* 47990 (November 16, 1990) requires all operators of medium and large MS4s to obtain an NPDES permit coverage and to develop and implement a stormwater management program. Pursuant to 40 CFR 122.26, medium and large MS4s are defined by the size of the population within the MS4 area, not including the population served by combined sewer systems (CSSs). Medium MS4s are systems in an incorporated place with a population between 100,000 and 249,999; large MS4s are systems in an incorporated place with a population of 250,000 or more (CFR 2012d) Phase II of the rule extends coverage of the NPDES stormwater program to certain small MS4s (64 *Fed. Reg.* 68722 (December 8, 1999)). Small MS4s are defined as, *inter alia*, any MS4 that is not a medium or large MS4 covered by Phase I of the NPDES stormwater program (CFR 2012d). Only a select subset of small MS4s, referred to as regulated small MS4s, require an NPDES stormwater permit. Regulated small MS4s are defined as all small MS4s in *urbanized areas* as defined by the Bureau of the Census, and those small MS4s outside an urbanized area that are designated by NPDES permitting authorities (CFR 2012d, e). MS4s are characteristic of urban areas and, through stormwater, can contribute trash to the water. Permitted MS4s within the Middle Branch/Northwest Branch are listed in Table 12.

Other Permitted Facilities

Other facilities with NPDES permitted stormwater outfalls that drain to the impaired shoreline are addressed in aggregate. These facilities can include state and federally owned facilities and general industrial stormwater permitees.

Table 12. NPDES permits in the Middle Branch/Northwest Branch

Jurisdiction	Permit number
Baltimore City Phase I	MD0068292
Baltimore County Phase I	MD0068314
Maryland State Highway Administration	MD0068276
Other permitted facilities	Aggregated

4.2 Nonpoint Sources

Nonpoint sources of pollutants are diffuse, non-permitted sources. For the purposes of this TMDL, nonpoint sources of trash are defined by trash size. Trash that is reasonably considered too large to enter the MS4 system through a street-level storm drain is considered to have come from a nonpoint source, even though a particular discharge fitting this description might constitute a discharge from a point source under the Clean Water Act. Accidental or intentional dumping of materials, such as construction materials, vehicles, appliances and bricks, constitute nonpoint sources of trash.

Additionally, but to a lesser extent, direct disposal or windblown dispersal of smaller trash items along the river and tributaries are part of the point source load because such items could not be distinguished from items traveling through the storm sewer system and are also presumed to be either a small part of the total trash load, or would eventually have been washed down a storm drain.

5.0 TOTAL MAXIMUM DAILY LOADS AND LOAD ALLOCATIONS

5.1 Development of Loading Rates and Baseline Loads

Monitoring data described in Sections 3.1 and 3.2 were used to establish the baseline point source and nonpoint source loads. To differentiate between the point source and nonpoint source loads, items that are generally considered too large to move through the storm drain system are considered part of the baseline nonpoint source load, and items that would generally be able to move through the storm drain system are considered part of the baseline point source load. The baseline loads do not include natural debris, such as sticks and leaves.

5.1.1 Baltimore City Point Source Loading Rate

Point source baseline loading rates in Baltimore City were established using the data collected at sampling sites listed in Section 2.1. As stated in Section 3.4, the trash sampling data was normalized by inches of precipitation, based on the strong correlation between trash and rainfall. More specifically, precipitation is the primary mode of transport for trash to enter storm drains and streams.

To calculate the baseline loading rate for each sampling event, the drainage acreage, start and end dates, and total weight for each sample event were taken from the BCDPW data. The precipitation for each sample period was determined using the NCDC data at the Maryland Science Center station (MD00001567812396). The total weight (lbs) was then divided by total acreage (ac) and the total precipitation (in) to get a normalized unit loading rate, expressed in units of lbs/ac/in. This value was then annualized by multiplying by the 30-year normal rainfall, also from NCDC data. The mean annual rainfall at BWI from 1981 to 2010 is 41.88 inches/year.

$$Annualized\ Trash\ Loading\ Rate = \frac{W_s}{A * R} * R_A \qquad \text{(Eq 5.1)}$$

where:

s = sample event
W = trash weight, in lbs
A = drainage area of sample site, in acres
R = rainfall during sample period, in inches
R_N = 30 yr normal annual rainfall, in inches

The average of the individual samples was then taken, to determine a site unit loading rate. Results for the Desoto sampling site are provided in Table 13, as a sample of the calculations used at the Baltimore City sites.

Table 13. Sample baseline loading rate calculation for Desoto sample site

Site	Drainage Area (Acres)	Start Date	End Date	Sample Duration (Days)	Weight (LBS)	Rain (in)	Normalized Unit Loading Rate (lbs/ac/in)	Annualized Unit Loading Rate (lbs/ac/yr)
Desoto	20.48	1/1/2011	3/8/2011	66	8	5.67	0.0689	2.89
Desoto	20.48	3/8/2011	3/15/2011	7	2	2.95	0.0331	1.39
Desoto	20.48	3/15/2011	3/29/2011	14	20	1.14	0.8583	35.95
Desoto	20.48	3/29/2011	5/18/2011	50	2	6.18	0.0158	0.66
Desoto	20.48	5/18/2011	6/15/2011	28	6	0.75	0.3896	16.32
Desoto	20.48	6/15/2011	7/20/2011	35	6	4.16	0.0705	2.95
Desoto	20.48	7/20/2011	8/16/11	27	4	5.74	0.0340	1.42
Desoto	20.48	8/16/2011	8/26/11	10	1	2.98	0.0164	0.69
Desoto	20.48	8/31/2011	9/13/11	13	3	7.37	0.0199	0.83
Desoto	20.48	9/13/2011	10/4/11	21	2	3.51	0.0278	1.16
Desoto	20.48	10/4/2011	10/28/11	24	1	1.62	0.0301	1.26
							Average	**5.96**

Based on the limited number of stations (5) and the overwhelmingly dominant type of land use (urban), it was decided by MDE to combine data from all sites to produce a single urban land use loading rate for Baltimore City. Use of the data in such a manner will produce a more robust average loading rate and will equalize the effect of possible trash "hot spots." The urban land use loading rate will be used for all acreage in Baltimore City, excluding the areas of Gwynns Falls and Jones Falls that are forested. These acres will use the Baltimore County forest land use loading rate.

Additionally, due to the methodology used for sampling, any upstream practices that are already in place (e.g. street sweeping, volunteer clean-ups, trash nets, etc.) are inherently captured in this baseline rate. Therefore, the TMDL value to be removed must be in addition to trash already being removed when the baseline sampling was conducted.

The calculation of the Baltimore City urban land use loading rate, 7.88 lb/ac/yr, appears in Table 14. See Appendix B for full Baltimore City data set and analysis.

Table 14. Calculation of Baltimore City Urban Land Use Loading Rate

Site	Acre	Total (lbs)	Total Rain	Annualized Unit Loading Rate (lbs/ac/yr)
Desoto	20.48	55	42.07	5.96
Leon Day	19.38	221	42.07	15.39
Liberty	43.07	27.5	42.07	0.76
North Ave	23.39	151	23.9	16.83
Western Run	40.67	11.5	34.9	0.46
			Average	**7.88**

5.1.2 Baltimore County Point Source Loading Rate

Point source baseline loading rates in Baltimore County were established using the data collected at sampling sites listed in Section 3.2. The methodology used to calculate baseline loads is similar to that which was used in Baltimore City (Section 5.1.1). The data used included only the SWMF sites. SWMF site #270 was eliminated from the data for being an outlier, due to excessively high trash loads compared to other outfalls with major land use of High Density Residential. Data from stream sites were not used because it was determined that the methodology used for the collecting the samples at the stream sites was not comparable to the methodology used for SWMF sites. The main reason for this is that the stream site samples are collected on an instantaneous basis, whereas the SWMF samples are collected of the entire sample period. This is evidenced by the low trash loading rates calculated at the stream sites. The differential in rates is also due in part to the trapping efficiencies of the SWMF present in the drainage areas upstream of the stream sampling sites and also by flow-by of trash.

As detailed in Section 3.2, Baltimore County conducted sampling on a seasonal basis. Therefore, the baseline loading rate was first calculated at each sampling event, by season. To calculate the baseline loading rate for each sampling event, the drainage acreage, start and end dates, and total weight for each sample event were taken from the BCDEPS data. The precipitation for each

sample period was determined using the NCDC data. The Reisterstown NCDC station (MD00001567812396) was used for the Gwynns Falls samples, while the Towson NCDC station (MD00001567812396) was used for the Jones Falls sites. As per the calculations for Baltimore City data, using Eq 5.1, the total weight (lbs) was then divided by total acreage (ac) and the total precipitation (in) to get a normalized unit loading rate, expressed in units of lbs/ac/in. This value was then annualized by multiplying by the 30-year mean annual rainfall. [Since the Maryland Science Center is the only station within the watershed with long term annual the annual value of 41.88 inches/year was used in the calculations for Baltimore County.] A sample of the seasonal calculations appears in Table 15.

Table 15. Sample Baseline Loading Rate Calculation for Winter Sampling Period

Site	Drainage Area (Acres)	Watershed	Land Use	Start Date	End Date	# Days	Weight (lbs)	Rain (in)	Normalized Unit Loading Rate (lb/ac/in)	Annualized Unit Loading Rate (lb/ac/yr)
564	17.6	Gwynns Falls	LDR	11/1/2010	1/10/2011	70	8.9	5.07	0.1000	4.19
1112	17.4	Gwynns Falls	MDR	10/22/2010	1/4/2011	74	14.6	5.48	0.1531	6.41
1580	9.5	Gwynns Falls	MDR	10/25/2010	12/28/2010	64	8.4	5.43	0.1636	6.85
1656	12.8	Gwynns Falls	HDR	11/8/2010	1/25/2011	78	4.0	4.63	0.0669	2.80
1709	13.8	Gwynns Falls	Commercial	11/9/2010	1/4/2011	56	23.0	3.62	0.4590	19.22
1731	3.9	Gwynns Falls	Roadway	11/9/2010	12/28/2010	49	1.8	3.57	0.1319	5.52
3264	12.3	Gwynns Falls	Roadway	10/25/2010	12/28/2010	64	1.1	5.43	0.0167	0.70
3641	13.6	Gwynns Falls	Institutional	11/1/2010	12/22/2010	51	10.9	4.69	0.2127	8.91
4171	5.0	Gwynns Falls	LDR	10/25/2010	12/28/2010	64	0.6	5.43	0.0225	0.94
1340	23.8	Jones Falls	HDR	10/29/2010	2/17/2011	111	45.0	8.74	0.2169	1.89
2207	3.9	Jones Falls	Institutional	11/3/2010	12/22/2010	49	0.5	4.89	0.0259	0.23
2949	7.7	Jones Falls	Open Urban	11/3/2010	2/17/2011	106	8.5	8.74	0.1254	1.09
3307	11.5	Jones Falls	MDR	11/3/2010	12/22/2010	49	4.5	4.89	0.0811	0.71
3552	18.3	Jones Falls	MDR	10/21/2010	2/17/2011	119	9.2	9.44	0.0533	0.46
3953	3.7	Jones Falls	LDR	10/21/2010	2/17/2011	119	0.5	9.44	0.0143	0.12
4172	9.0	Jones Falls	LDR	10/21/2010	12/28/2010	68	1.0	5.63	0.0193	0.17

The four seasonal values were then averaged to determine the loading rate for each sampling site. Results are shown in Table 16.

Table 16. Average Baseline Loading Rate Calculation per Site

Site	Drainage Area (Acres)	Watershed	Land Use	Winter (lb/ac/yr)	Spring (lb/ac/yr)	Summer (lb/ac/yr)	Fall (lb/ac/yr)	Average (lb/ac/yr)
564	17.61	Gwynns Falls	LDR	4.19	2.35	2.33	0.52	**2.34**
1112	17.44	Gwynns Falls	MDR	6.41	4.85	7.79	1.77	**5.20**
1580	9.5	Gwynns Falls	MDR	6.85	0.95	1.18	0.70	**2.42**
1656	12.78	Gwynns Falls	HDR	2.80	5.47	3.28	0.26	**2.95**
1709	13.84	Gwynns Falls	Commercial	19.22	3.45	6.17	2.77	**7.91**
1731	3.75	Gwynns Falls	Roadway	5.52	5.84	2.30	1.31	**3.74**
3264	12.34	Gwynns Falls	Roadway	0.70	0.29	0.24	0.26	**0.37**
3641	13.635	Gwynns Falls	Institutional	8.91	3.11	1.60	0.67	**3.57**
4171	5.028	Gwynns Falls	LDR	0.94	0.55	0.42	0.21	**0.53**
1340	23.75	Jones Falls	HDR	1.89	6.10	3.41	1.70	**3.27**
2207	3.92	Jones Falls	Institutional	0.23	0.94	1.09	0.26	**0.63**
2949	7.74	Jones Falls	Open Urban	1.09	1.80	1.16	0.37	**1.11**
3307	11.45	Jones Falls	MDR	0.71	2.13	0.30	0.27	**0.85**
3552	18.25	Jones Falls	MDR	0.46	1.24	0.30	0.28	**0.57**
3953	3.736	Jones Falls	LDR	0.12	0.64	0.03	0.02	**0.20**
4172	8.992	Jones Falls	LDR	0.17	0.35	0.37	0.10	**0.25**

Finally, the sites were grouped according to predominate land use type and the average for each land use was calculated. Average land use loading rates for the eight land uses that were fully represented and calculated based on sample data appear in Table 17.

Additionally, due to the methodology used for sampling (i.e. within the SWMF), only practices that are upstream of the SWMF (e.g. street sweeping, volunteer clean-ups, etc.) are inherently captured in this baseline rate. Because the samples were collected within the SWMF, the baseline rates do not account for the fact that this trash is removed from the SWMF and therefore, does not enter the watershed. Therefore, the TMDL value to be removed must be in addition to any non-structural trash removal practices in place when the baseline sampling was conducted. Structural practices in place when the baseline sampling was conducted will be given credit towards achievement of the TMDL value.

Table 17. Baltimore County land use baseline loading rates

Land Use	Annualized Unit Loading Rate (lb/ac/yr)	Number of sites
Low Density Residential	0.90	4
Medium Density Residential	2.45	4
High Density Residential	4.01	2
Commercial	7.91	1
Institutional	1.99	2
Open Urban	2.15	1
Roadway	2.06	2
Forest	0.02	2

Other land use types in Baltimore County, which were not represented by the sampling sites, were assigned baseline loading rates as follows:

Agriculture
All Agricultural land use acres will be assigned the Open Urban land use loading rate.

Industrial, Extractive and Bare Ground
Industrial, extractive and bare ground land use will be assigned the Commercial land use loading rate.

Water and Wetlands
Water and wetlands were assumed to have a loading rate of zero.

5.1.3 Nonpoint Source Loading Rates

In establishing the nonpoint source baseline loading rate, only items that are considered too large to enter the stormwater system through street-level storm drains were counted. It is generally assumed that these larger items have been intentionally and illegally dumped into the watershed. While it is easily understood how small items enter the storm sewer via street level storm drains and are transferred to the impaired shoreline, it may not be as clear as to how larger dumped items are transported. While dumping is generally considered a land based problem, these items all have the potential to be transferred into the stream system by rainfall or other means. Therefore, for the purpose of this TMDL, all dumped or nonpoint source loads are considered to have the potential to impact the impaired shoreline

Baltimore County collected nonpoint source trash data, when it was found, at all of its thirty-seven sampling sites detailed in Section 3.2. Nonpoint source trash was found at eight individual sampling sites, with a total of eleven nonpoint source data events. Baltimore City did not collect any nonpoint source trash data, and will therefore be assigned the same loading rate as Baltimore County.

To calculate the baseline loading rate for each sampling event, the drainage acreage, start and end dates, and total weight for each sample event were taken from the BCDEPS data. The total weight (lbs) was then divided by total acreage (ac) and the total number of days (day) to get a normalized unit loading rate, expressed in units of lbs/ac/day. The nonpoint source loading rate was normalized to days, as opposed to inches of rain used in the point source calculation, because it is not assumed that dumping activities are associated with rainfall.
Once a normalized loading rate was calculated for each sample event, the average of the 11 values was taken to represent the nonpoint source loading rate. This rate will be applied to 100% of the affected acres in Baltimore City and Baltimore County, as a conservative assumption for this TMDL.
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$$Annualized\ Trash\ Loading\ Rate = \frac{W_s}{A * D} * 365 \frac{days}{yr} \qquad \text{(Eq 5.2)}$$

where:

s = sample event
W = trash weight, in lbs
A = drainage area of sample site, in acres
D = number of days in sample period

Table 18. Baltimore County nonpoint source data and loading rate

Site	Drainage Area (Ac)	Watershed	Land Use	Start Date	End Date	# Days	Dump (lbs)	lbs/ac/d	lbs/ac/yr
3641	13.635	Gwynns Falls	Institutional	11/1/2010	12/22/2010	51	2.67	0.0038	1.40
G-DR-1	238.41	Gwynns Falls	HDR	1/25/2011	4/2/2011	67	25.00	0.0016	0.57
G-DR-3	408.97	Gwynns Falls	MDR	1/25/2011	4/2/2011	67	15.00	0.0005	0.20
G-GF-2	150.26	Gwynns Falls	MDR	1/4/2011	4/2/2011	88	4.00	0.0003	0.11
G-PM-1	2435.8	Gwynns Falls	MDR	1/25/2011	4/4/2011	69	20.20	0.0001	0.04
G-SL-1	738.66	Gwynns Falls	MDR	1/4/2011	4/26/2011	112	9.20	0.0001	0.04
3307	11.45	Jones Falls	MDR	12/22/2010	4/21/2011	120	6.74	0.0049	1.79
J-LJF-1	48.77	Jones Falls	HDR	2/9/2011	4/26/2011	76	10.00	0.0027	0.98
G-DR-3	408.97	Gwynns Falls	MDR	4/2/2011	7/15/2011	104	13.23	0.0003	0.11
G-DR-3	408.97	Gwynns Falls	MDR	7/15/2011	11/4/2011	112	15.00	0.0003	0.12
G-GF-2	150.26	Gwynns Falls	MDR	7/15/2011	11/2/2011	110	10.00	0.0006	0.22
								Average	**0.51**

5.2 TMDL Allocations

A TMDL is the total amount of pollutant that can be assimilated by the receiving waterbody while still achieving water quality standards or goals. It is composed of the sum of individual WLAs for point sources and LAs for nonpoint sources and natural background levels. In addition, the TMDL must include an MOS, implicitly or explicitly, to account for any uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this definition is represented by the following equation:

$$\text{TMDL} = \Sigma WLAs + \Sigma LAs + MOS$$

In TMDL development, allowable loadings from each pollutant source are summed to a cumulative TMDL threshold, thus providing a quantitative basis for establishing water quality-based controls. TMDLs can be expressed as a mass loading over time (e.g., grams of pollutant per day) or as a concentration in accordance with 40 CFR 130.2(l). The State of Maryland reserves the right to revise these allocations if the revised allocations are consistent with the achievement of water quality standards.

TMDL endpoints represent the water quality targets used to quantify TMDLs and their individual components. In this TMDL, the endpoint is equal to 100 percent removal of the baseline load, calculated as an average (because of high seasonal and annual variability) of the measured or estimated removal rate. At the time of sampling for the baseline load, many trash removal processes were already in place (e.g. street sweeping, trash nets, and community clean-ups), therefore the TMDL value to be removed must be in addition to trash already being removed when the baseline sampling was conducted. However, due to their sampling methodology, Baltimore County will be given credit for structural trash removal BMPs.

The baseline load is defined as the annual trash load calculated from monitoring data obtained through storm drain and in-stream sampling. The baseline load represents a typical annual load. The numeric target is derived from the narrative water quality criteria and includes both an explicit and an implicit MOS.

As presented in Section 1.4, the narrative water quality criteria in both jurisdictions describe the level of trash in subjective terms such as *objectionable*, *nuisance*, and *unsightly*. EPA's *Quality Criteria for Water 1986 (*known as the Gold Book) (USEPA 1986) states with respect to aesthetic uses that such "concepts may vary within the minds of individuals encountering the waterway," i.e., a narrative was constructed because an objective, quantifiable threshold cannot be developed. Accordingly, the TMDL is expressed as the quantity of trash that must be captured or removed for the waterbody to achieve the narrative criteria, rather than as the amount of trash that can be added to the waterbody without being objectionable, unsightly or constituting a nuisance. Trash may be removed from anywhere within the spatial extent of the TMDL to achieve compliance with the TMDL. A TMDL target equal to 100 percent removal of the baseline load is not the same as zero (0) trash in the waterway, but it should result in compliance with the narrative standard, as determined by the agencies responsible for interpreting the standard. This target provides an objective and measurable basis for compliance, consistent with stormwater and other discharge permits. No water quality standards exist that are zero, even for extremely toxic substances. While there might be a quantity of trash that could be discharged to the Middle Branch/Northwest Branch before being deemed by the general public as

objectionable, and the like, it is not necessary to calculate that quantity for purposes of this TMDL. Whatever that level might be, it has been concluded that removal of 100 percent of the baseline load would achieve the applicable narrative water quality criteria. Removal of 100 percent of the baseline load also would be sufficient to avoid interference with designated uses.

5.2.1 Load Allocations

The LA is the portion of the TMDL that is allocated to nonpoint sources and background levels. The target LA for trash in the Middle Branch/Northwest Branch is 100 percent removal of the baseline load calculated as an average. As described in Section 5.2, MDE interprets that endpoint as sufficient to achieve applicable narrative water quality criteria. The TMDL is expressed in terms of quantity removed, rather than quantity added to the waterbody. The load to be removed is summarized in Table 19.

Table 19. Summary of Nonpoint Source Annual and Daily Load allocations

Jurisdiction	Annual Baseline Nonpoint Source Load (lbs/yr)	MOS (5%)	Annual LA to be removed (lbs/yr)	Daily LA to be removed (lbs/day)
Baltimore Harbor	2,912.6	145.6	3,058.2	8.4
Gwynns Falls	21,271.1	1,063.6	22,334.7	61.2
Jones Falls	19,013.8	950.7	19,964.5	54.7

5.2.2 Wasteload Allocations

Federal regulations (CFR 2012a, b) require TMDLs to include individual WLAs for each point source. WLAs were developed for the Baltimore City MS4, Baltimore County MS4, the Maryland State Highway Administration, and other smaller point sources. A complete list of NPDES permitted facilities in the Middle Branch/Northwest Branch appears in Appendix A.

Municipal Separate Storm Sewer System (MS4)

EPA's stormwater permitting regulations require municipalities to obtain permit coverage for all stormwater discharges from urban MS4s. A November 22, 2002, EPA memorandum from Robert Wayland and James Hanlon, Water Division Directors, clarifies existing regulatory requirements for MS4s connected with TMDLs (USEPA 2002). The key points are as follows:

- NPDES-regulated MS4 discharges must be included in the WLA component of the TMDL and may not be addressed by the LA component of TMDL.
- The stormwater allotment can be a gross allotment and does not need to be apportioned to specific outfalls. Available data and information are frequently not detailed enough to determine WLAs for NPDES-regulated stormwater discharges on an outfall-specific basis. In such a situation, WLAs can be expressed in the TMDL as a single number for all NPDES-regulated stormwater discharges.
- Industrial stormwater permits need to reflect technology-based and water quality-based requirements.

On the basis of that memorandum, MS4s are treated as point sources for the TMDL, and the trash loading generated within the boundary of a MS4 area was assigned a WLA.

Other Point Sources

Other point sources include areas of Baltimore City and Baltimore County that are not covered under the City, County or State Highway MS4 NPDES permits. These include industrial permitted facilities and other private properties. The other point source baseline loads were established using the land-use-based trash loading rates stormwater outfall monitoring and the land use distribution within each drainage area. The point source baseline wasteloads to be removed are summarized in Table 20.

Table 20. Summary of Point Source Annual and Daily Waste Load Allocations

Jurisdiction	Annual Baseline Point Source Load (lbs/yr)	MOS (5%)	Annual WLA to be removed (lbs/yr)	Daily WLA to be removed (lbs/day)
Baltimore Harbor	44,655.6	2,232.8	46,888.4	128.4
Gwynns Falls	173,076.5	8,653.8	181,730.3	497.8
Jones Falls	130,053.2	6,502.7	136,555.9	374.1

5.3 Critical Conditions and Seasonal Variations

According to EPA's regulation 40 CFR 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that water quality is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards (USEPA 1999). Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

In the Middle Branch/Northwest Branch, the critical conditions for trash are high flow events because these events represent conditions during which trash is most easily transported to and through streams and the storm sewer system. These critical conditions are accounted for in this TMDL because data were collected over four seasons and included monitoring after rain events that led to high flow conditions. The annual rainfall for 2010 and 2011 were well above the long-term average annual rainfall of 41.88 inches (National Weather Service 2010). Data collection over the four seasons also accounted for possible localized seasonal variation in trash loading

due to the large number of sites at which data were collected. The 30-year average annual rainfall was used to account for long-term conditions in the watershed.

5.4 Margin of Safety

Clean Water Act section 303(d) requires that a TMDL incorporate a margin of safety (MOS) to account for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality. The MOS can be implicit (e.g., incorporated into the TMDL analysis through conservative assumptions) or explicit (e.g., expressed in the TMDL as a portion of the loadings) or a combination of both. The Middle Branch/Northwest Branch Trash TMDL employs both an explicit and implicit MOS. An explicit MOS of 5 percent was incorporated into the TMDL due to the variability present in all trash collection data. Since the TMDL requires 100 percent removal of the baseline load, the MOS was incorporated as an additional 5 percent of the total baseline load that must be removed. Additionally, conservative assumptions were incorporated into the determination of the baseline loading rates (LA and WLA) and represent an implicit MOS. The WLAs are conservative estimates of actual loads because they were calculated under the assumption that all land in the watershed (including non-point source lands not regulated under NPDES stormwater permits) contributes to the point source trash load. The WLAs are also conservative because they were based on average and not median values, which in this instance lead to higher loading rates. The LAs are conservative estimates of actual loads because although dumping of large items into the watershed occurs on a site specific basis, the nonpoint source loading rate was applied to all acres in the watershed.

5.5 TMDL Summary

Tables 21 through 26 describe the TMDLs for each segment of the watershed. The TMDLs are expressed in terms of the quantity of trash that must be removed, rather than the quantity that may be added to the waterbody. Trash may be removed from anywhere within the spatial extent of the TMDL to achieve compliance with the TMDL. TMDLs must be expressed in terms of a daily load. For this TMDL the calculated annual quantity of trash that must be remove was divided by 365 days to obtain the daily load. Compliance with these TMDLs will require the removal of 100 percent of the daily baseline trash load calculated as an average.

Table 21. Annual trash TMDLs for Baltimore Harbor watershed

WLA (lbs/yr removed)		**LA (lbs/yr removed)**	**MOS (5%)**	**TMDL (lbs/yr removed)**
Baltimore City Phase I MS4	42,869.4	2,912.6	2,378.4	49,946.6
Baltimore City Other Point Sources	1,786.2			
Total WLA	**44,655.6**			

Note: lbs = pounds; MS4 = municipal separate storm sewer system

Table 22. Daily trash TMDLs for Baltimore Harbor watershed

WLA (lbs/day removed)		LA (lbs/day removed)	MOS (5%)	TMDL (lbs/day removed)
Baltimore City Phase I MS4	117.4	8.0	6.5	136.8
Baltimore City Other Point Sources	4.9			
Total WLA	**122.3**			

Table 23. Annual trash TMDLs for Gwynns Falls watershed

WLA (lbs/yr removed)		LA (lbs/yr removed)	MOS (5%)	TMDL (lbs/yr removed)
Baltimore City: Phase I MS4	93,519.3	21,271.1	9,717.4	204,065.0
Baltimore City: Other Point Sources	2,892.3			
Baltimore County: Phase I MS4	72,831.6			
Baltimore County: Other Point Sources	1,533.3			
State Highway Administration	2,300.0			
Total WLA	**173,076.5**			

Table 24. Daily trash TMDLs for Gwynns Falls watershed

WLA (lbs/day removed)		LA (lbs/day removed)	MOS (5%)	TMDL (lbs/day removed)
Baltimore City: Phase I MS4	256.2	58.3	26.6	559.0
Baltimore City: Other Point Sources	7.9			
Baltimore County: Phase I MS4	199.5			
Baltimore County: Other Point Sources	4.2			
State Highway Administration	6.3			
Total WLA	**474.1**			

Table 25. Annual trash TMDLs for Jones Falls watershed

WLA (lbs/yr removed)		LA (lbs/yr removed)	MOS (5%)	TMDL (lbs/yr removed)
Baltimore City: Phase I MS4	81,107.0	19,013.8	7,453.4	156,520.4
Baltimore City: Other Point Sources	1,655.2			
Baltimore County: Phase I MS4	45,399.4			
Baltimore County: Other Point Sources	472.9			
State Highway Administration	1,418.7			
Total WLA	**130,053.2**			

Table 26. Daily trash TMDLs for Jones Falls watershed

WLA (lbs/day removed)		LA (lbs/day removed)	MOS (5%)	TMDL (lbs/day removed)
Baltimore City: Phase I MS4	222.2	52.1	20.4	428.8
Baltimore City: Other Point Sources	4.5			
Baltimore County: Phase I MS4	124.4			
Baltimore County: Other Point Sources	1.3			
State Highway Administration	3.9			
Total WLA	**356.3**			

6.0 ASSURANCE OF IMPLEMENTATION

This section provides the basis for reasonable assurances that this trash TMDL will be achieved and maintained. Section 303(d) of the Clean Water Act and current EPA regulations require reasonable assurance that the TMDL load and WLAs can and will be implemented (CFR 2010a, b).

In the case of the Middle Branch/Northwest Branch Trash TMDL, there is reasonable assurance that the goals of these TMDLs can be met with proper watershed planning, implementing pollution-reduction BMPs, and using strong political and financial mechanisms and permit enforcement. The TMDLs can be achieved through a comprehensive, adaptive approach that addresses the following:

- Appropriate storm drain capture technologies
- Enforcement of illicit dumping laws
- Regulatory and voluntary approaches to trash removal and prevention

Since the TMDL methodology is directly linked to monitoring data, MDE will make it a priority to revisit the TMDL allocation values to ensure the allocations are based on accurate, representative and up-to-date data. Because the implementation of the TMDL is strongly linked to the MS4 permit requirements, the TMDL will be reevaluated in coordination with the MS4 renewal process.

Criteria to be considered for reevaluating the TMDL allocations will include:

- Evaluation of all new data presented by Baltimore City, Baltimore County, and other third parties over the five-year permit cycle;
- Public participation in the reevaluation process.

The following sections provide additional detail related to programs, policies and regulatory mechanisms available to ensure implementation of this TMDL.

6.1 Trash Reduction Efforts in Baltimore City (BCDPW 2010)

The Baltimore City Department of Public Works (BCDPW) conducts several activities that are designed to reduce the amount of trash going into streams. The following is presented on their website. (BCDPW 2010)

Street Sweeping
Baltimore City's street sweeping program, under the Bureau of Solid Waste, helps to keep debris out of the storm drains and the Chesapeake Bay. In 2010, 64,948 lane-miles of roadway were swept and 6,972 tons of debris were removed. A street sweeping study conducted in Hamilton (northeast Baltimore), showed that such activity reduces not only trash, but also bacteria and other pollutants from entering the Harbor. The amount of debris removed by street sweeping and

inlet cleaning during 2009 was 10,010 tons of debris, which equates to the equivalent of treating 1,100 acres of impervious surface (4.7% of the City's total impervious surface area).

Storm Drain Cleaning

In 2010, Bureau of Water and Wastewater Maintenance Division personnel cleaned 2,891 inlets in response to complaints that street-level storm drains were clogged, and cleaned another 2,154 inlets as part of the routine, pro-active maintenance plan. The cleaning of those 5,045 inlets in 2010 resulted in a total of 1,027 tons of debris removed. Volunteer crews also have conducted cleanups along Back River in 2010. Some of that material originated in Baltimore, along the Herring Run and its tributaries.

Litter Control and Recycling

The BCDPW Office of Media and Communications has provided outreach on litter, trash, recycling, the One-Plus-One Campaign (going to once-a-week pick-up of trash and recyclables from twice a week). Because of this, recycling has increased dramatically. The components of the campaign include: the cost of litter, what the City is doing, and what citizens can do.
The City held over 100 community meetings to educate citizens about service changes and effects of trash on streams and streets. It is BCDPW's responsibility to educate citizens to help in keeping streets and storm drains clean and to talk about the consequences if they are not. Here is a brief list of the accomplishments related to trash and water quality:

- Increased mechanical sweeping operations to serve more than 1,500 miles of streets each week
- Provided customer service training to Solid Waste crews
- Moved Sanitation Code Enforcement to Housing to increase efficiency of management and service delivery
- Moved Baltimore Housing cleaning and boarding operation to Solid Waste, augmenting and complimenting existing cleaning operations.
- Scrubbed Solid Waste yards
- Extended citizen drop-off summer hours at all Solid Waste district service centers
- Focused resources and energy on placing and maintaining more public trashcans along gateways and at bus stops across the City with dedicated collection crews to maintain the cans in the most heavily traveled corridors
- Established cleaning of neighborhood parks assigned to Solid Waste as a 7-day operation during the summer months
- Reduced response time for cleaning complaints (dirty alleys, backyards, lots) from 21 to 14 days.

Harbor Cleaning

Baltimore employs a fleet of trash skimmers to collect about 200 tons of debris from the Harbor each year -- especially significant considering much of it is styrofoam and light plastic. The trash flows in from streams such as the Jones Falls and Harris Creek after it is washed into storm drains during heavy rains. The City also uses a series of booms and nets to corral the trash, but that can create an unsightly pileup of debris close to shore. The best way to reduce trash going into the Harbor is to persuade residents not to throw it onto streets and sidewalks in the first place.

Baltimore has tried several ideas in past years to limit the amount of trash that winds up in the Harbor. The City began installing a series of nets (interceptors) across trash-prone storm drain discharges**.** Trash interceptor locations have included:

1. Alluvion Street Debris Collector - Middle Branch
2. Briarclift - Briarclift Debris Collector - Dead Run
3. Gwynns Run Gwynns Run Pollution Control Facility (In redesign)
4. Bush Street Debris Collector – Middle Branch

Watershed 246 Management Plan
Baltimore City through a $24,900 grant to the Watershed Alliance and the Center for Watershed Protection is developing a watershed plan aimed at reducing trash, increasing green space, creating more natural hydrology, and improving the livability of the community. There is significant public outreach for watershed neighborhoods including citizen bus tours, group site visits, and trash enforcement meetings with top-level Public Works, Baltimore Housing Development and Code Enforcement officials.

6.2 Trash Reduction Efforts in Baltimore County (BCDEPS 2012)

Baltimore County currently has numerous programs to reduce the amount of trash entering the environment and waterways. These programs include municipal operations, solid waste management, enforcement, watershed management, as well as volunteer based clean-up and awareness efforts.

Municipal Operations
Street sweeping and inlet cleaning are municipal operations intended to intercept litter before it reaches waterways. These activities are managed and conducted by the Baltimore County Department of Public Works. They also handle solid waste management such as residential trash collection and weekly single-stream recycling pick ups. Special collections for household hazardous waste are held in the spring and fall every year. In addition, materials are accepted every day at the Eastern Sanitary Landfill. Collection of household hazardous waste is managed by BCDEPS.

Enforcement
Enforcement of trash regulations is conducted by the Department of Permits, Approvals, and Inspections. The Environmental Health section of the Department of Health is responsible for inspections of a number of types of facilities to ensure cleanliness and proper trash management.

Watershed Management
The Department of Environmental Protection and Sustainability (BCDEPS) is responsible for watershed management. Small Watershed Action Plans (SWAPs) have been completed for the Lower Jones Falls and the Upper Gwynns Falls. SWAPs for the remaining Baltimore County areas in the Baltimore Harbor watershed are now in progress, or slated for completion by 2014. Upland assessments for the SWAPs identify areas in need of improved trash management, providing the data needed to target citizen awareness efforts and additional street sweeping.

A baseline trash study of stormwater management facilities and stream sites was conducted by BCDEPS as a precursor to the trash TMDL. It has developed into an on-going monitoring program. Trash from both fixed and random sampling sites will be collected on an annual basis to document trends and identify problem areas. Results of this study will help to target improvement efforts.

Additionally, BCDEPS monitors trash reduction through its Illicit Connections program. Citizen and staff reported trash complaints are investigated, and are given to the appropriate agency for enforcement. Through this program, trash investigations are tracked until resolved.

Volunteer awareness efforts

- In a unique partnership with the Back River Restoration Committee (BRRC), a trash boom is in operation near the mouth of the Back River, beneath the Interstate 695 bridge. This trash boom has been successful in removing a massive amount of trash and debris from Back River before it can enter the Chesapeake Bay.

- The Baltimore Watershed Agreement, initially signed in 2002, and renewed in 2006, details the collaboration of Baltimore County and Baltimore City to address environmental issues within shared watersheds. The Phase I Action Plan outlines five main topic areas, including Trash, and is organized by Implementation, Policy & Regulation, Planning & Collaboration, Education, and Outreach & Awareness. The public is kept informed of progress at the State of Our Watersheds Conference, which is alternately hosted by the County and the City every two years.

- In April 2012, County Executive Kevin Kamenetz, kicked off Clean Green County, a program to encourage citizens to voluntarily pick up litter in their neighborhoods. The results of this program will be submitted to BCDEPS so that they may be documented as pollutant reduction. Another region-wide volunteer program to reduce trash is Project Clean Stream, organized by the Alliance for the Chesapeake Bay. This annual effort to clean up streams and watersheds is supported by BCDEPS.

- BCDEPS works closely with the Maryland Green Schools program, run by the Maryland Association of Environmental and Outdoor Educators, to help schools in the county achieve Green School status or to be re-certified. As a part of this program, schools emphasize reducing the amount of trash generated.

6.3 Permit Compliance

The MS4 NPDES permits for Baltimore City and Baltimore County require compliance with applicable TMDLs.

6.3.1 Baltimore City MS4 NPDES Permit (MDE 2012)

The Baltimore City NPDES MS4 Discharge Permit (Permit MD0068292) expired on January 3, 2010, and as of the date of this TMDL had been administratively extended pending reissuance. A

draft renewal permit has been prepared by MDE and was open for public comment from June 13, 2012 through July 19, 2012. The draft permit requires the following, which are beneficial to trash reduction:

Part III.D.4, 5b, and 6

4. Trash and Litter

Baltimore City drains to at least two major water bodies (the Middle Branch and Northwest Branch of the Patapsco River) determined to be impaired by trash. The trash and litter section of this permit is to assist in efforts to address water quality improvements. Increases in trash discharges to receiving waters have become a growing concern both nationally and within Maryland. This section requires Baltimore City to evaluate current trash and litter control efforts; develop strategies to reduce trash, floatables, and debris within those areas draining to the Middle Branch and Northwest Branch of the Patapsco River; and bolster public education.

a. Within one year of permit issuance, the City shall inventory and evaluate all current trash and recyclable pick-up operations, litter control programs, and public outreach efforts. The analysis shall identify opportunities for improving overall efficiency, especially in the Middle Branch and Northwest Branch of the Patapsco River.

b. Within one year of permit issuance, develop and implement a public education and outreach campaign with specific performance goals, and corresponding deadlines to initiate or increase residential and commercial recycling rates, improve trash management, and reduce littering. The strategy shall include:

i. Educating the public on the importance of reducing, reusing, and recycling;
ii. Disseminating information by using signs, articles, and other media outlets;
iii. Promoting educational programs in schools, businesses, community associations, etc.; and
iv. Providing the strategy to interested parties upon request.

c. Evaluating annually the effectiveness of the education program.

d. Within one year of the Environmental Protection Agency's (EPA) approval of a trash total maximum daily load (TMDL) for the Middle Branch and Northwest Branch of the Patapsco River, implement those program improvements identified in Part III.D.4.a above and any additional programs needed to address the TMDL.

e. Submit annually, a report which details progress toward implementing the trash reduction strategies. The report shall describe the status of trash

elimination efforts including resources (e.g., personnel and financial) expended and the effectiveness of all program components.

5. Property Management and Maintenance

b. The City shall implement a program to reduce pollutants associated with maintenance activities at City-owned facilities including parks, roadways, and parking lots. The maintenance program shall include these or MDE-approved alternate activities:

i. Street sweeping;
ii. Inlet inspection and cleaning;
iii. Reducing the use of pesticides, herbicides, fertilizers, and other pollutants associated with vegetation management through the increased use of integrated pest management;
iv. Reducing to the MEP the use of winter weather deicing materials through research, continual testing and improvement of materials, equipment calibration, employee training, and effective decision making.

The City shall report annually on the changes in any maintenance practices and the overall pollutant reductions resulting from the maintenance program. Within one year of permit issuance, an alternative maintenance program may be submitted for MDE approval indicating the activities to be undertaken and associated pollutant reductions.

6. Public Education

Baltimore City shall continue to implement a public education and outreach program to reduce stormwater pollutants. Outreach efforts may be integrated with other aspects of the City's activities. These efforts are to be documented and summarized in each annual report. The City shall within one year of permit issuance, develop a work plan to implement a public outreach and education campaign with specific performance goals and deadlines to:

a. Establish and publicize a compliance hotline or similar mechanism for the public reporting of water quality complaints, including suspected illicit discharges, illegal dumping, and spills.

b. Provide information to inform the general public about the benefits of:

i. Increasing water conservation;
ii. Residential and community stormwater management implementation and facility maintenance;
iii. Proper erosion and sediment control practices;

iv. Increasing proper disposal of household hazardous waste;
v. Improving lawn care and landscape management (e.g., the proper use of herbicides, pesticides, and fertilizers, ice control and snow removal, cash for clippers, etc.);
vi. Residential car care and washing; and
vii. Proper pet waste management.

c. Provide information regarding the following water quality issues to the regulated community when requested:

i. NPDES permitting requirements;
ii. Pollution prevention plan development;
iii. Proper housekeeping; and
iv. Spill prevention and response.

6.3.2 Baltimore County MS4 NPDES Permit (MDE 2005)

The Baltimore County NPDES MS4 Discharge Permit (Permit MD0068292) expired on June 15, 2010, and as of the date of this TMDL had been administratively extended pending reissuance. The current permit requires the following, which are beneficial to trash reduction:

Part III.E

6. Road Maintenance

A plan to reduce pollutants associated with road maintenance activities shall be developed and implemented. At a minimum, an annual progress report shall be submitted that documents the following activities:

a. Street sweeping;

b. Inlet cleaning;

c. Reducing the use of pesticides, herbicides, fertilizers, and other pollutants associated with roadside vegetation management through the use of integrated pest management (IPM); and

d. Controlling the overuse of winter weather deicing materials through continual testing and improvement of materials, equipment calibration, employee training, and effective decision-making.

7. Public Education

A public education and outreach program shall be implemented to reduce stormwater pollutants. As part of this program, Baltimore County shall develop material and make it available for distribution to the public by watershed

associations and at community events. These efforts are to be documented and summarized in each annual report. At a minimum, the County shall:

a. Establish and publicize a compliance hotline for the public reporting of suspected illicit discharges, illegal dumping, and spills.

b. Provide information regarding the following water quality issues to the general public:

i. Water conservation;
ii. Stormwater management facility maintenance;
iii. Erosion and sediment control;
iv. Household hazardous waste;
v. Lawn care and landscape management (e.g., the proper use of herbicides, pesticides, and fertilizers, ice control and snow removal, cash for clippers, etc.);
vi. Litter control, recycling, and composting;
vii. Car care, mass transit, and alternative transportation;
viii. Pet waste management.

c. Provide information regarding the following water quality issues to the regulated community when requested:

i. NPDES permitting requirements;
ii. Pollution prevention plan development;
iii. Proper housekeeping; and
iv. Spill prevention and response.

6.4 Blue Water Baltimore (BWB 2012)

In September 2010, five watershed groups in the Baltimore Area - Jones Falls Watershed Association, Herring Run Watershed Association, Gwynns Falls Watershed Association, Baltimore Harbor Watershed Association, and Baltimore Harbor WATERKEEPER legally merged to become Blue Water Baltimore (BWB). Blue Water Baltimore's mission is to use community based restoration, education, and advocacy to achieve clean water in Baltimore's rivers, streams, and harbor, so that citizens of the Baltimore region will enjoy a vibrant natural environment, livable neighborhoods, and a healthy, thriving Inner Harbor and Chesapeake Bay.

Blue Water Baltimore has several programs which have the potential to reduce trash in the Middle Branch/Northwest Branch.

- **Adopt-a-Stream:** Volunteers receive stream monitoring training and then select a 1/4-mile section of a stream near their neighborhood that they would like to monitor on a regular basis for pollution and trash. Volunteers are required to conduct 3 trash cleanups of their stream on a yearly basis.
- **Project Clean Stream:** An annual stream and shoreline cleanup, sponsored by the Alliance for the Chesapeake Bay. BWB coordinates the Baltimore area sites for this program. Project Clean Stream focuses on a larger message of the entire Chesapeake Bay watershed. As BWB seeks more volunteers and sites in all stretches of the watershed, BWB is promoting and reinforcing the direct relationship that cleaner, litter-free streams and woodlands result in a healthier, more beautiful Chesapeake Bay.

- **Educational Outreach:** Blue Water Baltimore works hard to develop and offer applied environmental education opportunities that meet state curriculum standards, engage students by combining in-class and outdoor education with hands-on restoration work, inspire students to continue to explore nature and give them the skills to actively protect and speak out for a healthy, vibrant environment

6.5 National Aquarium in Baltimore (NAIB 2012)

Every spring and fall, the National Aquarium Conservation Team (ACT!) recruits volunteers to restore habitat for wildlife, remove debris, and maintain trails at Fort McHenry National Monument and Historic Shrine in Baltimore. Since the National Aquarium took over stewardship of this marsh in 1999, volunteers have helped collect nearly 600,000 pieces of debris.

Fort McHenry Field Days are more than just debris cleanups, however; work can include trail maintenance, light construction, or planting native flowers in NAIB's or ACT!'s rain and butterfly gardens. This work all adds up to creating a valuable green space in the heart of Baltimore City that is utilized by hundreds of species of birds, reptiles like box turtles and diamondback terrapins, and aquatic critters like juvenile blue crabs and small fish.

ACT! partners with the National Park Service, Maryland Port Administration, and Steinweg Baltimore to make this event possible. Charitable funding is generously provided by Constellation Energy.

6.6 General Summary of Potential BMPs that Could be Used to Achieve the TMDL

Nonstructural BMPs

- Enforce existing regulations and ordinances that prohibit trash, litter, and debris
- Post signage indicating the penalties for littering and dumping violations
- Implement new regulations banning, controlling, or taxing certain materials known to significantly affect trash loading
- Implement return deposit fee for glass and plastic containers
- Increase prevalence of trash receptacles and increase trash collection frequency to keep receptacles from overflowing
- Increased and targeted street sweeping
- Establish more partnerships with business districts to improve litter removal efforts
- Recycling Programs
- Implement a reporting system for persons who observe illegal dumping or disposal of trash
- Stencil catch basins, indicating that storm drains lead to the Middle Branch/Northwest Branch
- Perform surveillance in known illegal dumping areas
- Implement trash-related community service as an alternative to environmental crime-related fines
- Conduct public education and outreach

Structural BMPs

- Catch basin inserts
- End of pipe nets
- Floating trash traps/trash booms
- Vortex separation systems

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APPENDIX A – NPDES PERMITS

Table A-1. NPDES permits

MDE PERMIT #	NPDES #	FACILITY_NAME	WATERSHED	COUNTY
01DP0307	MD0000264	CSX TRANSPORTATION, INC. - RIVERSIDE YARD	BALTIMORE HARBOR	Baltimore City
01DP0376	MD0001341	AMERICAN SUGAR REFINING, INC.	BALTIMORE HARBOR	Baltimore City
06DP0309	MD0002763	LOCKE INSULATORS, INC.	BALTIMORE HARBOR	Baltimore City
99DP2312	MD0061930	TRIGEN BALTIMORE ENERGY- SPRING GARDENS PLANT	BALTIMORE HARBOR	Baltimore City
06DP3066	MD0066877	TRIGEN BALTIMORE ENERGY - SARATOGA STREET STEAM PLANT	BALTIMORE HARBOR	Baltimore City
08DP3449	MD0069141	PATTERSON PARK BOAT LAKE	BALTIMORE HARBOR	Baltimore City
06DP3560	MD0069922	UMMS AMBULATORY CARE CENTER	BALTIMORE HARBOR	Baltimore City
08DP3635	MD0070092	ROWEN CONCRETE, INC.	BALTIMORE HARBOR	Baltimore City
09DP3652	MD0070467	UNIVERSITY OF MARYLAND SCHOOL OF PHARMACY	BALTIMORE HARBOR	Baltimore City
09DP3656	MD0070505	FREDERICK DOUGLAS-ISSAC MYERS MARITIME PARK	BALTIMORE HARBOR	Baltimore City
02SW1018		BALTIMORE CITY DPW - CENTRAL GARAGE	BALTIMORE HARBOR	Baltimore City
02SW0432		PQ CORPORATION	BALTIMORE HARBOR	Baltimore City
02SW1593		THE FURST BROTHERS COMPANY	BALTIMORE HARBOR	Baltimore City
02SW1622		VAC PAC MANUFACTURING COMPANY, INC.	BALTIMORE HARBOR	Baltimore City
02SW1784		UNIVERSITY OF MARYLAND MEDICAL CENTER	BALTIMORE HARBOR	Baltimore City
02SW0704		BALTIMORE CITY DPW - MIDDLETOWN FUELING STATION	BALTIMORE HARBOR	Baltimore City
02SW0707		BALTIMORE CITY DPW - FALLSWAY SUBSTATION	BALTIMORE HARBOR	Baltimore City
02SW0832		H & S BAKERY	BALTIMORE HARBOR	Baltimore City
02SW1885		MID ATLANTIC BAKING COMPANY	BALTIMORE HARBOR	Baltimore City
02SW0989		COCA-COLA BOTTLING CO. - BALTIMORE	BALTIMORE HARBOR	Baltimore City
02SW1658		AMERICAN LIMOUSINES, INC.	BALTIMORE HARBOR	Baltimore City
02SW1676		MTA - KIRK AVENUE BUS DIVISION	BALTIMORE HARBOR	Baltimore City
05SF5501		MARYLAND STADIUM AUTHORITY	BALTIMORE HARBOR	Baltimore City
01DP0015	MD0001295	THE SHERWIN WILLIAMS COMPANY	GWYNNS FALLS	Baltimore City
01DP0138	MD0001911	KAYDON RING & SEAL, INC.	GWYNNS FALLS	Baltimore City
01DP2119	MD0060640	WHEELABRATOR BALTIMORE, LP	GWYNNS FALLS	Baltimore City
01DP2613	MD0063771	GEMS, INC.	GWYNNS FALLS	Baltimore City
93DP0314	MD0066532	J.V. WELLS INC	GWYNNS FALLS	Baltimore City
93DP3202	MD0067792	WESTVIEW MALL	GWYNNS FALLS	Baltimore County
09DP3680	MD0070726	FORMER CARR-LOWREY GLASS COMPANY PROPERTY	GWYNNS FALLS	Baltimore City
02SW0930		ESTES EXPRESS LINES - BALTIMORE	GWYNNS FALLS	Baltimore City
02SW0787		HOUFF TRANSFER, INC.	GWYNNS FALLS	Baltimore City
02SW0712		NEW ENGLAND MOTOR FREIGHT	GWYNNS FALLS	Baltimore County
02SW0848		UNITED PARCEL SERVICE - VERO ROAD	GWYNNS FALLS	Baltimore County
02SW1656		JOE CORBI'S WHOLESALE PIZZA	GWYNNS FALLS	Baltimore City
02SW1375		MR. MARTIN L. REESE	GWYNNS FALLS	Baltimore City
02SW1492		CRUSADER CHEMICAL COMPANY, INC.	GWYNNS FALLS	Baltimore City
02SW1778		TRIAD INCORPORATED	GWYNNS FALLS	Baltimore City
02SW0864		P. FLANIGAN & SONS INC. - MONROE STREET	GWYNNS FALLS	Baltimore City

MDE PERMIT #	NPDES #	FACILITY_NAME	WATERSHED	COUNTY
02SW1912		DECKER'S SALVAGE COMPANY, INC	GWYNNS FALLS	Baltimore City
02SW1297		WINCHESTER HOMES, INC.	GWYNNS FALLS	Baltimore City
02SW1402		THE BERG BROTHERS RECYCLING COMPANY	GWYNNS FALLS	Baltimore City
02SW1487		DEPSCO SERVICES, INC.	GWYNNS FALLS	Baltimore City
02SW0681		CLEAN HARBORS OF BALTIMORE	GWYNNS FALLS	Baltimore City
02SW1014		P. FLANIGAN & SONS, INC.	GWYNNS FALLS	Baltimore City
02SW1206		TRIFINITY MANUFACTURING BALTIMORE, LLC	GWYNNS FALLS	Baltimore City
02SW1836		PATUXENT MATERIALS, INC. - BALTIMORE	GWYNNS FALLS	Baltimore City
02SW0739		RUBBER MILLERS, INC.	GWYNNS FALLS	Baltimore City
02SW1785		MTA - WASHINGTON BLVD. BUS DIVISION	GWYNNS FALLS	Baltimore City
02SW1589		DOVCO INDUSTRIAL FABRICATORS, INC.	GWYNNS FALLS	Baltimore City
02SW1138		ALL SUPPLIES & PARTS, INC. - ASAP COMPRESSORS	GWYNNS FALLS	Baltimore City
02SW2140		MASONVILLE DREDGED MATERIAL CONTAINMENT FACILITY	GWYNNS FALLS	Baltimore City
02SW0650		SOUTHERN GALVANIZING	GWYNNS FALLS	Baltimore City
02SW1495		CARROLL AWNING COMPANY, INC.	GWYNNS FALLS	Baltimore City
02SW0779		SAFETY-KLEEN SYSTEMS, INC. - BALTIMORE	GWYNNS FALLS	Baltimore City
02SW1216		UNITED IRON AND METAL, LLC	GWYNNS FALLS	Baltimore City
02SW1248		POTTS & CALLAHAN, INC. - GWYNNS FALLS	GWYNNS FALLS	Baltimore City
02SW1884		CRISPY BAGEL COMPANY	GWYNNS FALLS	Baltimore City
02SW0703		BALTIMORE CITY DPW - WESTERN SUBSTATION	GWYNNS FALLS	Baltimore City
02SW0777		EMANUEL TIRE COMPANY-MORELAND	GWYNNS FALLS	Baltimore City
02SW1016		CAPITOL CAKE COMPANY	GWYNNS FALLS	Baltimore City
02SW1992		BEVERAGE CAPITAL CORPORATION PLANT #1	GWYNNS FALLS	Baltimore County
02SW0155		NURAD TECHNOLOGIES, INC.	GWYNNS FALLS	Baltimore City
02SW1657		ACTAVIS - BALTIMORE	GWYNNS FALLS	Baltimore County
02SW1053		LIGON AND LIGON, INC.	GWYNNS FALLS	Baltimore City
02SW0868		BALTIMORE CONCRETE PRODUCTS, INC.	GWYNNS FALLS	Baltimore City
02SW1978		P & J CONTRACTING COMPANY, INC.	GWYNNS FALLS	Baltimore City
02SW1964		BALTIMORE COUNTY BUREAU OF HIGHWAYS - SHOP 2	GWYNNS FALLS	Baltimore County
02SW0705		BALTIMORE CITY DPW - NORTHWESTERN SUBSTATION	GWYNNS FALLS	Baltimore City
02SW1307		NORTHWEST TRANSFER STATION	GWYNNS FALLS	Baltimore City
02SW1677		MTA - NORTHWEST BUS DIVISION	GWYNNS FALLS	Baltimore City
02SW1673		MTA - METRO WABASH MAINTENANCE FACILITY	GWYNNS FALLS	Baltimore City
02SW1027		NATIONAL INSTRUMENT COMPANY, INC.	GWYNNS FALLS	Baltimore City
02SW1996		MTA - OLD COURT METRO MAINTENANCE FACILITY	GWYNNS FALLS	Baltimore County
02SW0034		FOUNDRY SERVICE 7 SUPPLY CO., INC	GWYNNS FALLS	Baltimore County
02SW0025		SWEETHEART CUP CORPORATION	GWYNNS FALLS	Baltimore County
02SW0306		QUEST INTERNATIONAL	GWYNNS FALLS	Baltimore County
02SW2009		SHA - OWINGS MILLS SHOP	GWYNNS FALLS	Baltimore County
02SW1716		SHIRE U.S. MANUFACTURING, INC.	GWYNNS FALLS	Baltimore County
02SW1398		DANIEL G. SCHUSTER, LLC. - OWINGS MILLS	GWYNNS FALLS	Baltimore County
06DP0075	MD0002101	FLEISCHMANN'S VINEGAR COMPANY, INC.	JONES FALLS	Baltimore City
06DP2002	MD0059676	NATIONAL AQUARIUM IN BALTIMORE	JONES FALLS	Baltimore City

MDE PERMIT #	NPDES #	FACILITY_NAME	WATERSHED	COUNTY
06DP2910	MD0065901	TELEDYNE ENERGY SYSTEMS	JONES FALLS	Baltimore County
07DP3397	MD0068888	BALTIMORE COUNTRY CLUB AT FIVE FARMS	JONES FALLS	Baltimore County
10DP3715	MD0071013	UNIVERSITY OF BALTIMORE	JONES FALLS	Baltimore City
02SW0659		PITT OHIO EXPRESS, INC. - BALTIMORE	JONES FALLS	Baltimore City
02SW0805		GEORGE G. RUPPERSBERGER & SONS, INC.	JONES FALLS	Baltimore City
02SW0747		U.S. POSTAL SERVICE - OLIVER STREET VMF	JONES FALLS	Baltimore City
02SW1675		MTA - NORTH AVENUE LIGHTRAIL FACILITY	JONES FALLS	Baltimore City
02SW1156		NORFOLK RAILWAY CORPORATION - FLEXI-FLO TERMINAL	JONES FALLS	Baltimore City
02SW1056		VEOLIA TRANSPORTATION - BALTIMORE	JONES FALLS	Baltimore City
02SW1810		POTTS & CALLAHAN, INC. - REPAIR SHOP	JONES FALLS	Baltimore City
02SW2071		BEVERAGE CAPITAL CORPORATION PLANT #2	JONES FALLS	Baltimore City
02SW0599		PEPSI BOTTLING GROUP, LLC	JONES FALLS	Baltimore City
02SW0255		WOODBERRY QUARRY LANDFILL	JONES FALLS	Baltimore City
02SW0105		HEDWIN CORPORATION - ROLAND HEIGHTS	JONES FALLS	Baltimore City
02SW1211		COLD SPRING LANDFILL	JONES FALLS	Baltimore City
02SW0702		BALTIMORE CITY DPW - NORTHEASTERN SUBSTATION	JONES FALLS	Baltimore City
02SW2135		MID-STATES OIL REFINING, LLC	JONES FALLS	Baltimore City
02SW0861		HOLLINS ORGANIC PRODUCTS, INC.	JONES FALLS	Baltimore County
02SW1296		COCKEY'S ENTERPRISES, INC.	JONES FALLS	Baltimore County
02SW1751		SHA - BROOKLANDVILLE SHOP	JONES FALLS	Baltimore County
02SW3028		PALL FILTRATION & SEPARATIONS GROUP - TIMONIUM	JONES FALLS	Baltimore County
02SW3030		PALL FILTRATION & SEPARATIONS - GREENSPRING #2	JONES FALLS	Baltimore County
08DP3599		MERCY MEDICAL CENTER CONSTRUCTION DEWATERING PROJECT	JONES FALLS	Baltimore City

APPENDIX B – BALTIMORE CITY DATA AND ANALYSIS

All data in this appendix was provided by BCDPW-WQMIS 2011.

Table B-1. Desoto Site Trash Data and Analysis

Site	Drainage Area (acres)	Start Date	End Date	Sample Duration (Days)	Weight (LBS)	Days of Total Accumulation	Total Accumulated Weight (Lbs)	Notes	Rain (in)	LB/AC/IN	LB/AC/YR
Desoto	20.48	1/1/2011	3/8/2011	66	8	66	8		5.67	0.0689	2.89
Desoto	20.48	3/8/2011	3/15/2011	7	2	73	10	a lot of leaves removed	2.95	0.0331	1.39
Desoto	20.48	3/15/2011	3/29/2011	14	20	87	30	a lot of leaves removed	1.14	0.8583	35.95
Desoto	20.48	3/29/2011	5/18/2011	50	2	137	32		6.18	0.0158	0.66
Desoto	20.48	5/18/2011	6/15/2011	28	6	165	38		0.75	0.3896	16.32
Desoto	20.48	6/15/2011	7/20/2011	35	6	200	44		4.16	0.0705	2.95
Desoto	20.48	7/20/2011	8/16/11	27	4	227	48		5.74	0.0340	1.42
Desoto	20.48	8/16/2011	8/26/11	10	1	237	49	removed for Irene	2.98	0.0164	0.69
Desoto	20.48	8/26/2011	8/31/11	0	0	237	49	reinstalled			
Desoto	20.48	8/31/2011	9/13/11	13	3	250	52		7.37	0.0199	0.83
Desoto	20.48	9/13/2011	10/4/11	21	2	271	54		3.51	0.0278	1.16
Desoto	20.48	10/4/2011	10/28/11	24	1	295	55	Removed due to high leaf loading	1.62	0.0301	1.26
									Average		**5.96**

Table B-2. Leon Day Site Trash Data and Analysis

Site	Drainage Area (acres)	Start Date	End Date	Sample Duration (Days)	Weight (LBS)	Days of Total Accumulation	Total Accumulated Weight (Lbs)	Notes	Rain (in)	LB/AC/IN	LB/AC/YR
Leon Day	19.38	1/1/2011	3/8/2011	66	44	66	44	a lot of leaves removed	5.67	0.400748	16.78
Leon Day	19.38	1/1/2011	3/15/2011	7	24	73	68	a lot of leaves removed	2.95	0.419961	17.59
Leon Day	19.38	1/1/2011	3/29/2011	14	38	87	106	fewer leaves to remove	1.14	1.723319	72.17
Leon Day	19.38	1/1/2011	5/18/2011	50	31	137	137		6.18	0.258787	10.84
Leon Day	19.38	1/1/2011	7/26/2011	69	22	206	159		5.29	0.214538	8.98
Leon Day	19.38	1/1/2011	8/11/2011	16	9	222	168		1.69	0.274957	11.52
Leon Day	19.38	1/1/2011	8/16/2011	5	41	227	209	major damage	3.67	0.576564	24.15
Leon Day	19.38	1/1/2011	8/26/2011	10	4	237	213	removed for Irene	2.98	0.069163	2.90
Leon Day	19.38	1/1/2011	8/31/2011	0	0	237	213	reinstalled			
Leon Day	19.38	1/1/2011	9/13/2011	13	4	250	217		7.37	0.028005	1.17
Leon Day	19.38	1/1/2011	10/4/11	21	3	271	220		3.51	0.044079	1.85
Leon Day	19.38	1/1/2011	10/28/11	24	1	295	221	Removed due to high leaf loading	1.62	0.031811	1.33
									Average		**15.39**

Table B-3. Liberty Site Trash Data and Analysis

Site	Drainage Area (acres)	Start Date	End Date	Sample Duration (Days)	Weight (LBS)	Days of Total Accumulation	Total Accumulated Weight (Lbs)	Notes	Rain (in)	LB/AC/IN	LB/AC/YR
Liberty	43.07	1/1/2011	3/8/2011	66	7	66	7		5.67	0.028688	1.20
Liberty	43.07	1/1/2011	3/25/2011	17	3	83	10		4.09	0.017044	0.71
Liberty	43.07	1/1/2011	5/19/2011	55	5	138	15		6.28	0.018487	0.77
Liberty	43.07	1/1/2011	6/15/2011	27	1	165	16	damaged/repairs made	0.65	0.035526	1.49
Liberty	43.07	1/1/2011	7/28/2011	43	3	208	19		4.54	0.015344	0.64
Liberty	43.07	1/1/2011	8/16/2011	19	1	227	20		5.36	0.004333	0.18
Liberty	43.07	1/1/2011	8/26/2011	10	1	237	21	removed for Irene	2.98	0.00778	0.33
Liberty	43.07	1/1/2011	8/31/2011	0	0	237	21	reinstalled			
Liberty	43.07	1/1/2011	9/13/2011	13	1	250	22		7.37	0.00315	0.13
Liberty	43.07	1/1/2011	10/4/11	21	3.5	271	25.5		3.51	0.02314	0.97
Liberty	43.07	1/1/2011	10/28/11	24	2	295	27.5	Removed due to high leaf loading	1.62	0.028628	1.20
									Average		**0.76**

Table B-4. North Avenue Site Trash Data and Analysis

Site	Drainage Area (acres)	Start Date	End Date	Sample Duration (Days)	Weight (LBS)	Days of Total Accumulation	Total Accumulated Weight (Lbs)	Notes	Rain (in)	LB/AC/IN	LB/AC/YR
North Ave	23.39	3/9/2011	3/15/2011	6	6	6	6	Very dry	2.95	0.0869907	3.64
North Ave	23.39	3/9/2011	3/25/2011	10	18	16	24		1.14	0.6763604	28.33
North Ave	23.39	3/9/2011	4/15/2011	21	16	37	40		1.58	0.4322126	18.10
North Ave	23.39	3/9/2011	5/19/2011	34	40	71	80	damaged posts	4.70	0.364102	15.25
North Ave	23.39	3/9/2011	6/15/2011	27	18	98	98		0.65	1.177519	49.31
North Ave	23.39	3/9/2011	7/20/2011	35	18	133	116	serious damage	4.16	0.1851024	7.75
North Ave	23.39	3/9/2011	7/26/2011	6	5	139	121	damage repaired	0.38	0.5597599	23.44
North Ave	23.39	3/9/2011	8/11/2011	16	12	155	133		1.69	0.3037578	12.72
North Ave	23.39	3/9/2011	8/16/2011	5	9	160	142	slight damage	3.67	0.1048649	4.39
North Ave	23.39	3/9/2011	8/26/2011	10	9	170	151	Removed Device (damage beyond repair)	2.98	0.1289368	5.40
									Average		**16.83**

Table B-5. Western Run Site Trash Data and Analysis

Site	Drainage Area (acres)	Start Date	End Date	Sample Duration (Days)	Weight (LBS)	Days of Total Accumulation	Total Accumulated Weight (Lbs)	Notes	Rain (in)	LB/AC/IN	LB/AC/YR
Western Run	40.67	3/9/2011	3/15/2011	6	1	6	1	a lot of leaves removed	2.95	0.0083383	0.35
Western Run	40.67	3/9/2011	3/25/2011	10	0.5	16	1.5	fewer leaves to remove	1.26	0.009789	0.41
Western Run	40.67	3/9/2011	4/15/2011	21	2	37	3.5	a lot of leaves removed/road resurface	1.58	0.0310716	1.30
Western Run	40.67	3/9/2011	5/20/2011	35	1.5	72	5	huge amount of organic matter, bag broken.	4.70	0.0078525	0.33
Western Run	40.67	3/9/2011	6/14/2011	25	0	97	5	Bag repaired	0.65	0	0.00
Western Run	40.67	3/9/2011	7/20/2011	36	2	133	7		4.16	0.0118284	0.50
Western Run	40.67	3/9/2011	8/11/2011	22	2	155	9		2.07	0.0237467	0.99
Western Run	40.67	3/9/2011	8/16/2011	5	1	160	10		3.67	0.0067011	0.28
Western Run	40.67	3/9/2011	8/26/2011	10	1	170	11	removed for Irene	2.98	0.0082393	0.35
Western Run	40.67	3/9/2011	8/31/2011	0	0	170	11	reinstalled			
Western Run	40.67	3/9/2011	9/13/2011	13	0.5	183	11.5		7.37	0.0016681	0.07
Western Run	40.67	3/9/2011	10/4/11					Removed due to sewage problem present.			
									Average		**0.46**

APPENDIX C – BALTIMORE COUNTY DATA AND ANALYSIS

All data in this appendix was provided by BCDEPS, via personal communication from December, 2011

Table C-1. Winter Trash Data and Analysis

Site	Drainage Area (Acres)	Watershed	Land Use	Start Date	End Date	# Days	Weight (lbs)	Rain (in)	Normalized Unit Loading Rate (lb/ac/in)	Annualized Unit Loading Rate (lb/ac/yr)
564	17.61	Gwynns Falls	LDR	11/1/2010	1/10/2011	70	8.92	5.07	0.1000	4.19
1112	17.44	Gwynns Falls	MDR	10/22/2010	1/4/2011	74	14.64	5.48	0.1531	6.41
1580	9.5	Gwynns Falls	MDR	10/25/2010	12/28/2010	64	8.44	5.43	0.1636	6.85
1656	12.78	Gwynns Falls	HDR	11/8/2010	1/25/2011	78	3.95	4.63	0.0669	2.80
1709	13.84	Gwynns Falls	Commercial	11/9/2010	1/4/2011	56	23.01	3.62	0.4590	19.22
1731	3.75	Gwynns Falls	Roadway	11/9/2010	12/28/2010	49	1.77	3.57	0.1319	5.52
3264	12.34	Gwynns Falls	Roadway	10/25/2010	12/28/2010	64	1.12	5.43	0.0167	0.70
3641	13.635	Gwynns Falls	Institutional	11/1/2010	12/22/2010	51	10.93	4.69	0.2127	8.91
4171	5.028	Gwynns Falls	LDR	10/25/2010	12/28/2010	64	0.62	5.43	0.0225	0.94
1340	23.75	Jones Falls	HDR	10/29/2010	2/17/2011	111	44.99	8.74	0.2169	1.89
2207	3.92	Jones Falls	Institutional	11/3/2010	12/22/2010	49	0.50	4.89	0.0259	0.23
2949	7.74	Jones Falls	Open Urban	11/3/2010	2/17/2011	106	8.48	8.74	0.1254	1.09
3307	11.45	Jones Falls	MDR	11/3/2010	12/22/2010	49	4.53	4.89	0.0811	0.71
3552	18.25	Jones Falls	MDR	10/21/2010	2/17/2011	119	9.18	9.44	0.0533	0.46
3953	3.736	Jones Falls	LDR	10/21/2010	2/17/2011	119	0.50	9.44	0.0143	0.12
4172	8.992	Jones Falls	LDR	10/21/2010	12/28/2010	68	0.98	5.63	0.0193	0.17

Table C-2. Spring Trash Data and Analysis

Site	Drainage Area (Acres)	Watershed	Land Use	Start Date	End Date	# Days	Weight (lbs)	Rain (in)	Normalized Unit Loading Rate (lb/ac/in)	Annualized Unit Loading Rate (lb/ac/yr)
564	17.61	Gwynns Falls	LDR	1/10/2011	4/21/2011	101	15.80	16.00	0.0561	2.3486
1112	17.44	Gwynns Falls	MDR	1/4/2011	5/3/2011	119	34.45	17.06	0.1158	4.8488
1580	9.5	Gwynns Falls	MDR	12/28/2010	4/6/2011	99	2.75	12.74	0.0227	0.9510
1656	12.78	Gwynns Falls	HDR	1/25/2011	4/14/2011	79	22.49	13.46	0.1307	5.4749
1709	13.84	Gwynns Falls	Commercial	1/4/2011	5/3/2011	119	19.47	17.06	0.0825	3.4543
1731	3.75	Gwynns Falls	Roadway	12/28/2010	5/3/2011	126	8.95	17.11	0.1395	5.8433
3264	12.34	Gwynns Falls	Roadway	12/28/2010	4/6/2011	99	1.11	12.74	0.0070	0.2947
3641	13.635	Gwynns Falls	Institutional	12/22/2010	4/21/2011	120	16.32	16.12	0.0742	3.1090
4171	5.028	Gwynns Falls	LDR	12/28/2010	4/6/2011	99	0.84	12.74	0.0131	0.5493
1340	23.75	Jones Falls	HDR	2/17/2011	4/26/2011	68	46.85	13.55	0.1456	6.0958
2207	3.92	Jones Falls	Institutional	12/22/2010	4/21/2011	120	1.49	16.85	0.0225	0.9435
2949	7.74	Jones Falls	Open Urban	2/17/2011	4/14/2011	56	3.72	11.21	0.0429	1.7965
3307	11.45	Jones Falls	MDR	12/22/2010	4/21/2011	120	3.06	16.85	0.0508	2.1267
3552	18.25	Jones Falls	MDR	2/17/2011	4/14/2011	56	6.04	11.21	0.0295	1.2367
3953	3.736	Jones Falls	LDR	2/17/2011	4/6/2011	48	0.57	9.99	0.0152	0.6359
4172	8.992	Jones Falls	LDR	12/28/2010	4/6/2011	99	1.04	13.80	0.0084	0.3512

Table C-3. Summer Trash Data and Analysis

Site	Drainage Area (Acres)	Watershed	Land Use	Start Date	End Date	# Days	Weight (lbs)	Rain (in)	Normalized Unit Loading Rate (lb/ac/in)	Annualized Unit Loading Rate (lb/ac/yr)
564	17.61	Gwynns Falls	LDR	4/21/2011	7/26/2011	96	8.39	8.57	0.0556	2.3288
1112	17.44	Gwynns Falls	MDR	5/3/2011	7/26/2011	84	24.52	7.56	0.1860	7.7911
1580	9.5	Gwynns Falls	MDR	4/6/2011	7/20/2011	105	2.63	9.86	0.0281	1.1776
1656	12.78	Gwynns Falls	HDR	4/14/2011	7/26/2011	103	10.16	10.15	0.0783	3.2800
1709	13.84	Gwynns Falls	Commercial	5/3/2011	8/5/2011	94	16.15	7.92	0.1473	6.1707
1731	3.75	Gwynns Falls	Roadway	5/3/2011	7/28/2011	86	1.56	7.57	0.0548	2.2960
3264	12.34	Gwynns Falls	Roadway	4/6/2011	7/20/2011	105	0.70	9.86	0.0058	0.2420
3641	13.635	Gwynns Falls	Institutional	4/21/2011	7/26/2011	96	4.45	8.57	0.0381	1.5962
4171	5.028	Gwynns Falls	LDR	4/6/2011	7/20/2011	105	0.50	9.86	0.0100	0.4189
1340	23.75	Jones Falls	HDR	4/26/2011	8/9/2011	105	22.44	11.60	0.0814	3.4103
2207	3.92	Jones Falls	Institutional	4/21/2011	7/28/2011	98	1.04	10.22	0.0259	1.0852
2949	7.74	Jones Falls	Open Urban	4/14/2011	7/28/2011	105	2.59	12.01	0.0278	1.1647
3307	11.45	Jones Falls	MDR	4/21/2011	8/8/2011	109	1.00	12.16	0.0072	0.3009
3552	18.25	Jones Falls	MDR	4/14/2011	8/5/2011	113	1.70	12.92	0.0072	0.3028
3953	3.736	Jones Falls	LDR	4/6/2011	7/28/2011	113	0.03	13.23	0.0007	0.0280
4172	8.992	Jones Falls	LDR	4/6/2011	7/20/2011	105	0.92	11.60	0.0088	0.3681

Table C-4. Fall Trash Data and Analysis

Site	Drainage Area (Acres)	Watershed	Land Use	Start Date	End Date	# Days	Weight (lbs)	Rain (in)	Normalized Unit Loading Rate (lb/ac/in)	Annualized Unit Loading Rate (lb/ac/yr)
564	17.61	Gwynns Falls	LDR	7/26/2011	11/2/2011	99	32.96	22.98	0.1965	8.2276
1112	17.44	Gwynns Falls	MDR	7/26/2011	10/28/2011	94	5.22	24.10	0.0123	0.5153
1580	9.5	Gwynns Falls	MDR	7/20/2011	10/20/2011	92	16.93	22.98	0.0422	1.7692
1656	12.78	Gwynns Falls	HDR	7/26/2011	10/28/2011	94	3.92	24.81	0.0166	0.6966
1709	13.84	Gwynns Falls	Commercial	8/5/2011	10/28/2011	84	1.84	22.98	0.0062	0.2617
1731	3.75	Gwynns Falls	Roadway	7/28/2011	10/28/2011	92	20.73	22.62	0.0662	2.7738
3264	12.34	Gwynns Falls	Roadway	7/20/2011	10/20/2011	92	2.70	22.97	0.0313	1.3123
3641	13.635	Gwynns Falls	Institutional	7/26/2011	10/17/2011	83	1.88	24.81	0.0061	0.2573
4171	5.028	Gwynns Falls	LDR	7/20/2011	10/20/2011	92	4.76	21.83	0.0160	0.6698
1340	23.75	Jones Falls	HDR	8/9/2011	11/2/2011	85	8.56	25.32	0.0005	0.0192
2207	3.92	Jones Falls	Institutional	7/28/2011	10/24/2011	88	21.28	22.10	0.0405	1.6975
2949	7.74	Jones Falls	Open Urban	7/28/2011	10/17/2011	81	0.55	22.74	0.0062	0.2589
3307	11.45	Jones Falls	MDR	8/8/2011	10/17/2011	70	1.50	21.76	0.0089	0.3738
3552	18.25	Jones Falls	MDR	8/5/2011	10/17/2011	73	1.48	19.83	0.0065	0.2729
3953	3.736	Jones Falls	LDR	7/28/2011	10/14/2011	78	2.52	20.86	0.0066	0.2775
4172	8.992	Jones Falls	LDR	7/20/2011	10/20/2011	92	0.03	21.58	0.0004	0.0153

APPENDIX D – CONSIDERATIONS FOR DEVELOPING IMPLEMENTATION PLANS FOR TRASH TMDLS

Background

During the development of the Baltimore Harbor Trash TMDL, stakeholders expressed the desire that specific, implementation-related elements be included in the TMDL documentation. While it is beyond the scope of the TMDL development process and the TMDL report to include specific recommendations for implementation, MDE appreciates the stakeholders' concerns, especially given the differences between trash TMDLs and those addressing more conventional or 'typical' pollutants. To that end, MDE is including this Appendix, which focuses on several issues that stakeholders have indicated to be of interest. The purpose of this appendix is to outline some issues that MDE recommends be taken into consideration during the development of a trash implementation plan; this appendix is not intended to serve as strict guidance.

While it is commonly recognized that trash is a serious water quality concern, the specific level at which trash impacts water quality has not yet been determined. TMDLs are more often developed for pollutants that have well-established thresholds of impairments. Unlike other pollutants that have long studied scientific and literature values and can be modeled to determine TMDL endpoints, trash is an unconventional pollutant and is considered newly emerging as related to TMDLs. This is the second of only two trash TMDLs in Maryland, and the only other state to have written trash TMDLs is California.

It is for the combination of these reasons that MDE has chosen to include this appendix in addition to the TMDL. This appendix focuses on several issues that stakeholders have indicated to be of interest.

Monitoring

Trash monitoring is a difficult and labor intensive task. Unlike other pollutants trash cannot be measured by simply collecting with a water column sample and performing a laboratory analysis, with established techniques. Trash monitoring involves creation of sampling devices, extensive manual collection of samples, separation of organics from the sample, and counting or weighing of the actual trash. The diversity of types of trash alone can present a challenge for monitoring.

MDE strongly recommends inclusion of a sampling program within a trash TMDL implementation program. Continued trash monitoring can and should be used to improve the TMDL analysis and corresponding TMDL allocations. It is also important to show a reduction in trash levels due to non-structural BMPs (e.g. educational programs), if used.

Specific elements to consider when developing a trash monitoring plan include:

- Diversity of locations and land uses sampled
- Identification of trash sources
- Establishing consistent sampling procedures
- Identification of trash hot spots (i.e. an area with excessively high trash load)
- Sampling in-stream versus storm drain outfalls
- Appropriate frequency of sampling, including sampling in conjunction with large storm events

Many examples of trash sampling techniques, as related to TMDLs, can be found in documentation from California, the District of Columbia (DC), and Maryland.

California has tied monitoring to implementation within its TMDL based on its definition of compliance. Compliance is measured based on installation of full capture structural BMPs. However, if full-capture BMPs are not feasible, partial-capture BMPs can be installed with the additional requirement that monitoring be completed to prove required reductions are being met (CWQRB 2007).

Monitoring is also being done by non-governmental organizations in California. Clean Water Action California completed a trash monitoring study in 2010 – 2011, and the Los Angeles (LA) River Waterkeeper is currently seeking volunteers for a trash survey (CWAC 2011 and LAW 2013).

In DC, the District Department of the Environment (DDOE) has committed to "continue to collect empirical data on all end-of-pipe BMPs and adjust efficiencies for future TMDL planning purposes" within its draft implementation plan. DC also performs quarterly, qualitative monitoring through its Office of the Clean City – Citywide Cleanliness Assessment (DDOE 2013a and DCOCC 2013).

In Montgomery County and Prince George's County, monitoring has continued using the protocols and sampling locations that were developed for the Anacostia Trash TMDL. These include in-stream and land based monitoring. Storm drain inlet sampling has recently been added in Montgomery County (MWCOG 2013).

Additionally, there is specific language in the Municipal Separate Storm Sewer System (MS4) permit that requires monitoring. For example:

"Assessment of controls is critical for determining the effectiveness of the NPDES stormwater management program and progress toward improving water quality. The County shall use chemical, biological, and physical monitoring to assess watershed restoration efforts, document BMP effectiveness, or calibrate water quality models for showing progress toward meeting any applicable WLAs developed under EPA approved TMDLs identified above." (MDE 2010)

Best Management Practices for Reducing Trash

BMPs for trash are generally divided into two main categories, structural and non-structural. An extensive list of BMPs is given in Section 6.6 of the TMDL. MDE strongly recommends that a combination of structural and non-structural BMPs be used for implementation of the TMDL. MDE recognizes the importance and productiveness of educational and outreach programs, but does not believe the TMDL can be achieved with only non-structural BMPs.

Specific considerations when choosing BMPs include the following:

- Effectiveness in reducing trash
- Cost of implementation
- Feasibility of installation/maintenance
- Provision of benefits in addition to reducing trash
- Demonstrated success by other TMDLs

In California, six main types of BMPs are being used: river and beach clean-up; street sweeping; installation of stormwater capture devices; stormwater drain cleaning and maintenance; manual cleanup of litter; and public education. Achievement of the LA trash TMDL is strongly tied to installation of structural BMPs, as compliance is measure based on installation of full capture trash systems (CWQRB 2007). In Ballona Creek, implementation is focused on four BMPs: street sweeping, hand litter pick-up, streetside trash containers, and catch basin debris excluders (LADPW 2007).

DDOE lists the following seven BMPs in its draft implementation plan (DDOE 2013):

1. In-stream and end-of-pipe best management practices (e.g., trash traps)
2. Skimmer boat activities
3. Stream and river cleanup activities
4. Roadway and block cleanup activities
5. Street sweeping of environmental hotspots
6. Education and outreach
7. Regulatory approaches (e.g., Bag Law)

Montgomery County based its implementation on four categories of BMPs: structural, educational, municipal, and enforcement. Montgomery County states that it expects 68% of its trash reduction to come from structural practices and the remainder from the other three categories (MCDEP 2012a).

Source reduction

Source reduction is also an important aspect of the implementation process for trash TMDLs. As with most TMDLs, the bulk of the pollutant derives from the watershed. Trash is unique, in that unlike other pollutants, it can be removed from the water to meet the TMDL, but the true intent of the TMDL is to prevent trash from ever reaching the water.

Source reduction can generally be accomplished in two ways. The first way is through development of educational and outreach programs that reduce littering, and therefore the trash load. Ideally, this would be the ultimate solution to the trash problem. One area of concern expressed by stakeholders is if the jurisdictions are doing all they can, yet cannot collect the required TMDL allocation of trash because through education they have reduced the trash load. If a jurisdiction is unable to collect the amount of trash specified in their WLA and they can show through monitoring that trash is not impairing designated use, the TMDL allocations can be revised.

Reducing litter from the land before it enters the water can also be considered upland source reduction. Practices useful for this are storm drain screens, street sweeping, and manual collection of street litter.

The main method of implementation of the trash TMDLs in California is installation of full capture devices, designed to prevent trash from entering the LA River. California did extensive research before defining a full capture system as "any single device or series of devices that traps all particles retained by a 5 mm mesh screen and has a design treatment capacity of not less than the peak flow rate Q resulting from a one-year, one-hour, storm in the subdrainage area." California also has extensive bag bans in 90 cities and counties, and currently has proposed legislation for a statewide bag ban/fee system (LA Times 2014).

One of DC's first actions to reduce trash occurred even before the approval of the trash TMDL. The District's bag law, which took effect on January 1, 2010, was the first of its kind in the US. The law charges a five-cent fee for bags, with most of the fee going towards the Anacostia River Clean Up and Protection fund. (DDOE 2013b). As mentioned in the previous section, the District plans to use a wide array of BMPs for implementation of the trash TMDL, several of which reduce upland sources. These include roadway cleanups, street sweeping, and educational programs.

Montgomery County has used several source trash reduction strategies in its implementation plan. It states:

> *"The County's trash strategy recognizes the importance of eliminating trash at its source. To do so requires enhanced and stepped up approaches for programmatic practices such as education, improved enforcement, targeted media campaigns, and commitments from commercial business districts."* (MCDEP 2012b)

Two of the main strategies used so far were an educational outreach program and the passing of a bag law. The educational outreach program was coordinated by the Alice Ferguson Foundation

for Montgomery and Prince George's County, as well as DC. The campaign consisted of conducting research as to why people litter and then producing media messages against littering. (AFF 2013) Montgomery County passed legislation (effective January 1, 2012), that places fee on each paper or plastic carryout bag. The revenues from this charge will be used for litter clean up costs (Montgomery County Government 2012). Montgomery County also plans to use littering and illegal dumping enforcement to reduce upland sources.

Relationship of the TMDL and MS4 permit

One of the main mechanisms for implementation of any TMDL Stormwater-WLA is the MS4 permit. Per Part 4.E of the permit (MDE 2013):

> *By regulation at 40 CFR §122.44, BMPs and programs implemented pursuant to this permit must be consistent with applicable WLAs developed under EPA approved TMDLs*

Each MS4 jurisdiction is required to annually provide watershed assessments, restoration plans, opportunities for public participation, and TMDL compliance status to MDE. There are also requirements for assessment of controls, or monitoring.

In regards to the trash TMDL, the MS4 permit is especially significant for implementation. The MS4s For Baltimore City and Baltimore County offer five specific elements for trash and litter. They are summarized here; the individual county permit should be reviewed for specific language.

- Within one year of permit issuance, inventory all trash related operations and identify areas for improvement
- Develop and implement a public education and outreach program with specific performance goals
- Annual evaluation of the education program
- Within one year of TMDL approval, implement improvements identified for trash related operations
- Submit annual reports regarding progress towards implementing trash reduction strategies

Additional Resources

Additional information regarding TMDL implementation can be found on the MDE website.

- TMDL Implementation
  http://www.mde.state.md.us/programs/Water/TMDL/TMDLImplementation/Pages/Programs/WaterPrograms/TMDL/implementation.aspx

- Maryland TMDL Data Center
  http://www.mde.state.md.us/PROGRAMS/WATER/TMDL/DATACENTER/Pages/index.aspx

- Maryland's NPDES Municipal Separate Storm Sewer System (MS4) Permits
  http://www.mde.state.md.us/programs/Water/StormwaterManagementProgram/Pages/Programs/WaterPrograms/sedimentandstormwater/storm_gen_permit.aspx

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