URBAN BEST MANAGEMENT PRACTICES TECHNICAL MEMORANDUM

Subtask 2.2
Patapsco Tidal and Bodkin Creek Watershed Study

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Introduction

Under Subtask 2.2 of the Patapsco Tidal and Bodkin Creek watershed study, LimnoTech worked with the Anne Arundel County Department of Public Works to develop a complete geospatial dataset of urban stormwater best management practices (BMPs) within the Patapsco Tidal and Bodkin Creek watersheds. In summary, the effort to develop the dataset entailed four primary steps:

- Step 1 - compiling existing data from multiple County and other agency sources;
- Step 2 - identifying BMPs inside the study area;
- Step 3 - performing research to fill any data gaps; and
- Step 4 - delineating BMPs drainage areas.

This Technical Memorandum documents the steps and procedures LimnoTech and the County performed to complete this task. These steps and procedures were performed in accordance with discussions with County personnel, and the County's Technical Memorandum dated June 7, 2007, entitled "*Anne Arundel County Comprehensive Watershed Studies, Subtask 2.2 – SWM facility maps.*"

Step 1 - Compiling Existing Data

The first step in the process was to compile all of the existing BMP records associated with the Patapsco Tidal and Bodkin Creek watersheds. Several sources were utilized in this process. A unique ID was employed in the compiled dataset to identify the original BMP record and source. The following is a list and brief description of the data sources:

- **Urban BMP Database:** This dataset exists as a point shapefile that was derived from the Anne Arundel County Inspections and Permit urban stormwater management database. The dataset contains Anne Arundel County permitted public and private urban BMPs. Facilities permitted directly by other entities are not included in this dataset. This dataset was current through March 2010 and contained 10,680 BMP records.
- **Dry Pond BMP Dataset:** This point shapefile represented an incomplete record of dry pond BMPs from the Urban BMP Database that had been previously researched and snapped to a flow accumulation grid to facilitate drainage area delineations. A total of 64 dry ponds were in this dataset.
- **Field Verified BMP Dataset:** During the summer of 2010, LimnoTech and Versar collected limited information on BMPs encountered during stream assessment activities in the study area. The collected information included BMP type, a GPS recorded location, condition notes, and a photo. A total of 265 BMPs were included in this dataset.
- **Countywide BMP Polygon Dataset:** The Countywide BMP polygon shapefile represented an incomplete dataset of BMP polygons digitized from operating maps and As-built maps.

The spatial accuracy of these BMPs was considered to be correct. However, the dataset included only a subset of BMPs and lacked important attribute information. Many of these records were duplicates of BMPs contained in the Urban BMP Database. This dataset contained 703 BMP records.

- **Capital Improvement Program Restoration Project Dataset:** This dataset represents the location and drainage area of all of the County's Capital Improvement Program stream restoration and other watershed restoration projects.

- **Disconnected Non-rooftop Dataset:** Although not traditional BMPs, this dataset accounts for credits for disconnected impervious drainage areas, primarily roads, with no or limited curbing. The dataset was generated by identifying road segments and other impervious areas with less than 50% curbing.

- **Maryland State Highway Administration BMP Database:** LimnoTech contacted the Maryland State Highway Administration (SHA) to obtain a list of SHA owned BMPs in the study area. The dataset contained spatial and attribute data for 78 BMP records in the study area.

- **Maryland Aviation Administration BMP Database:** The County obtained a dataset of BMPs located at BWI Airport that are owned by the Maryland Aviation Administration (MAA). Of these BMPs, 111 are located within the study area.

Step 2 - Identifying BMPs Inside the Study Area

With a draft dataset of BMP records compiled from the sources listed above, LimnoTech worked to identify BMPs known or thought to be inside the study area and remove those BMP records known to be outside of the watershed. This also involved updating spatial locations for BMPs with inaccurate or incomplete spatial attributes. LimnoTech followed the protocols for this step as outlined in the County's June 2007 Technical Memo and in conversations with County personnel. As each BMP data source had different degrees of inherent spatial accuracy, the steps for confirming spatial locations varied among the sources. The procedures for each data source are provided below.

- **Urban BMP Database:** The data contained in this dataset is under review by the Department of Public Works' Infrastructure Management Division and the spatial locations for many BMP records are inaccurate or unknown. The following steps were taken to identify BMP locations in reference to the study area boundaries and update as appropriate:
    - The *XY_Source* field describes the source of the location data and was used to determine whether a BMP location was considered spatially accurate. This field was the primary level of screening for BMPs in the Urban BMP Database. Table 1 below provides the values in the database for the *XY_Source* field and indicates whether a particular value is considered spatially accurate. BMPs with spatially accurate sources were determined to be inside or outside of the study area. All BMPs identified inside the study area and BMPs with *XY_Source* values deemed to have questionable spatial accuracy were retained for further research and verification.

- The Parcel and the Structure Address GIS layers were used in tandem with tax account numbers and addresses to determine whether the retained BMPs with questionable spatial data were located inside or outside of the study area. All BMP records with spatial locations and matching tax accounts or addresses outside of the study area were removed from the draft dataset. BMP points located outside the study area, but with a tax account or address associated with a parcel inside the study area, were moved to the study area parcel/address only if other identifying information confirmed it. Unmatched BMPs and matched BMPs inside the study area were retained.

Table 1. Urban BMP Database XY_Sources

XY_Source	Considered Spatially Accurate (Y/N)
2007_To_MDE	No
CleanedbyHand	Yes
County Centroid	No
Hand Moved _2010	Yes
Hand Moved to Address	Yes
Hand placed on address	Yes
Hand placed on street	Yes
HandMovedfromCentroid	Yes
HandPlacedMay09	Yes
IP	No
IP_New09	No
IP_New09IP_New09	No
KCI 2008 GPS	Yes
Magothy Study	Yes
New09	No
PNTStudy	Yes
SevernStudy	Yes
SouthStudy	Yes
UpperPax Study	Yes
converted IP 27 to 83	No
corrected KCI	Yes

- For the records that still remained at this point, additional checks were performed to locate the remaining subset of BMP records. Looking at each BMP record individually, LimnoTech used various County tools to first positively identify a BMP record from the draft dataset and second to confirm or update its location. Specifically, LimnoTech used the Parcel GIS layer, Structure Address GIS layer, As-built records on CountyView, scanned grading and building permits, other archived electronic records, orthophotography, and GoogleMaps to assist in this process. A record was considered positively identified if two pieces of identifying information matched fields in the BMP dataset.

- **Dry Pond BMP Dataset:** Points in this dataset were previously snapped to the flow accumulation grid by the County and were accepted as spatially correct. All of the BMPs were found to be duplicates of BMPs in the Urban BMP Database. The duplicate records from the Urban BMP Database were identified for removal from the final dataset.

- **Field Verified BMP Dataset**: BMPs in the Field Verified dataset included a subset of BMPs from the Urban BMP Database as well as additional BMPs found during field activities. Any Field Verified BMP that matched a BMP from the Urban BMP Database was used to verify the spatial location of the Urban BMP then flagged for removal due its limited attribute data. All other Field Verified BMPs were retained and considered spatially accurate.

- **Countywide BMP Polygon Dataset:** BMP polygons from the Countywide BMP polygon shapefile were spatially accurate digitizations of BMPs. Although spatially accurate, the attribute data associated with these records was very limited. All of the BMPs were found to be duplicates of BMPs in the Urban BMP Database. The duplicate records from the Urban BMP Database were identified for removal from the final dataset.

- **Capital Improvement Program Restoration Project Dataset:** This dataset was considered spatially accurate. Project drainage areas that fell within the study area boundaries were retained.

- **Disconnected Non-rooftop Dataset:** The datasets representing roads and other impervious surfaces were considered spatially accurate. Portions of these impervious surfaces that fell within the study area boundaries were retained.

Resolving Duplicate Records

Given that data was compiled from multiple datasets, it is inevitable that there were duplicate records. Note that the degree of identifying information available made it very difficult to identify duplicates within an individual data source. As such, an effort to identify and remove duplicates was only rigorously performed between data sources. LimnoTech identified duplicate records by examining attributes and spatial locations. Best professional judgment was used to identify and remove duplicate records only when points were co-located with matching identifying attributes and structure types were they considered to be redundant.

- **Maryland State Highway Administration BMP Database:** SHA-owned BMPs were considered spatially accurate. The BMPs were intersected with the study area boundaries to identify those inside the study area.

- **Maryland Aviation Administration BMP Database:** Like the SHA dataset, BMPs owned by MAA were considered spatially accurate. The BMPs were intersected with the study area boundaries to identify those inside the study area.

Step 3 - Performing Research to Fill Data Gaps

LimnoTech researched data gaps concurrently with the step to confirm and update spatial locations at the County offices (see previous section). Looking at each BMP record individually, LimnoTech used County tools including As-builts on CountyView, scanned grading and building permits, and other archived electronic records to fill in data gaps. The following data were researched:

- **Drainage Area:** The design drainage area for the majority of records was found in the existing compiled datasets. For records with null or zero values, the scanned grading and building permits, archived records, and As-builts on CountyView were researched for the information. This data was captured in the final dataset in the field, *DA*.

- **Structure Type:** The structure type was documented using structure codes in accordance with the County BMP master list. For records with missing structure type information, the

scanned grading and building permits, archived records, and As-builts on CountyView were researched for that information. This data was captured in the final dataset in the field, *WMTStruc_type*.

- **Built Date:** The BMP built date was only compiled if it existed in the original dataset or if it was revealed during the record research to identify spatial locations, drainage areas, or structure types. This data was captured in the final dataset in the field, *Built_Date*.

- **Ownership:** The BMP owner was only compiled if it existed in the original dataset or if it was revealed during the record research to identify spatial locations, drainage areas, or structure types. This data was captured in the final dataset in the field, *Ownership*.

Step 4 - Delineating BMP Drainage Areas

To properly account for load reductions associated with BMPs in the County's modeling efforts, LimnoTech and the County worked to delineate drainage areas for all BMPs. Drainage area delineations were handled differently depending on the BMP structure type, the original data source, and the accuracy of the BMP's spatial location. The *Delineate* field in the final dataset was created and populated to categorize the method used to determine the BMP drainage area. The *WMT_DA* field was used to capture the drainage area acreage in the final dataset.

- Drainage area polygons for BMPs associated with the **Urban BMP Database; Dry Pond BMP Dataset; Field Verified BMP Dataset;** and **Countywide BMP Polygon Dataset** were delineated as follows:
    - The points for BMPs with typically large drainage areas (*e.g.*, wet ponds, dry ponds, infiltration basins, wetlands) and with accurate spatial locations were snapped to the nearest flow accumulation grid cell that captured the approximate design drainage area. Occasionally, it was necessary to snap two points representing the same BMP. This was only done when the flow accumulation path was split and one point would not allow for appropriate drainage delineations. The drainage area was then delineated using the flow accumulation grid and the ArcHydro Batch Watershed Delineation tool. The *Delineate* field for all of these BMPs was marked as "Snapped."
    - The points for BMPs associated with rooftop drainage (*e.g.*, dry wells and dry well infiltration trenches) were placed on the building polygon centroid. The building polygon was then used to represent the BMP drainage area. For the few newer BMPs for which a building polygon did not yet exist in the County GIS layer, a building size was recorded or estimated from available information and an equivalent-sized polygon was created to represent the drainage area. The *Delineate* field for all of these BMPs was marked as "Building Footprint."
    - The points for the few BMPs that were designed for parcel or lot level stormwater management (*e.g.*, permeable pavement) and that were not delineated using the flow accumulation grid, were placed on the parcel or lot centroid. The associated parcel polygon was used to represent the BMP drainage area. The *Delineate* field for these BMPs was marked as "Lot Footprint."
    - For the few BMPs where the design drainage area was known, but only the general location of the BMP was known, an artificial circular drainage area polygon was

created. This was accomplished by calculating the radius of a circle with an area equivalent to the known drainage area. This radius was then used to draw a buffer around the general location of the BMP. The polygon created from this buffering step was used as the BMP drainage area. The *Delineate* field for these BMPs was marked as "Buffer."
    - For BMPs with no measurable water quality benefit (*e.g.*, pre-treatment BMPs), drainage areas were not created. The *Delineate* field for these BMPs was marked as "No WQ – No DA."
    - A small subset of BMPs with limited attributes and/or questionable spatial locations were categorized as "Missing Records" in the *Delineate* field. These BMPs will be researched further under another task as additional data becomes available.

- Drainage area polygons for the credits associated with the **Disconnected Non-rooftop Dataset** were generated by using the road segment length and the known road width.

- Drainage area polygons for BMPs associated with the **Capital Improvement Program Restoration Project Dataset; Maryland SHA BMP Database;** and **MAA BMP Database** were previously developed as part of the original dataset development. These drainage area polygons were used as-is with no modifications.

Once the drainage areas were created or compiled for each BMP in the final dataset, the County set up a topology to identify overlapping drainage areas. In those areas with overlapping drainage areas, best professional judgment was used to determine which BMP was predominantly managing a particular intersected drainage area. Overlapping DA segments were assigned to the closest BMP with the assumption that the closer a segment was to a particular BMP it was more likely to be treated by the closest facility. The drainage area polygon was then assigned to the predominant BMP. This was performed to ensure that only a single BMP managed a particular area and that the appropriate BMP was receiving the management credit.

Final Data Deliverables

In addition to this Technical Memo, the data deliverables for this subtask also included:

- a point shapefile representing all BMP locations with compiled, verified, and researched attributes; and
- a polygon shapefile representing the BMP drainage areas.

Summary of Findings

During the research efforts above, a total of 1,578[1] BMPs were confirmed to be in the Patapsco Tidal and Bodkin Creek Watersheds. These BMPs will be used for additional analyses in the watershed study, including the evaluation of water quality under various current and future development scenarios. An additional 504 BMPs were researched and are either missing information or are non-credit BMP types. These BMPs did not have drainage areas delineated (Table 2).

[1] Two BMPs were split into multiple pour points for delineation purposes. Therefore, a total of 1580 features exist in the BMP database.

Table 2. BMPs without Delineated Drainage Areas

BMP			Ownership				
			Private	Public (DPW)	Public (Non-DPW)	Unknown	Total
Missing Records	Filtration	Bioretention	32	2	2	3	39
		Attenuation Swale	4	-	-	-	4
		Sand Filter	6	5	3	1	15
	Infiltration	Dry Well	33	1	-	-	34
		Infiltration Trench	21	-	1	8	30
		Infiltration Trench with Complete Exfiltration	28	2	2	-	32
		Infiltration Trench with Partial Exfiltration	6	4	-	-	10
		Infiltration Basin	3	1	-	-	4
		Porous Pavement	3	-	-	-	3
	Other/Not BMPs	Credits	13	2	-	6	21
		Other	8	-	1	-	9
		Planting	3	-	-	-	3
	Detention Dry	Detention Structure (Dry Pond)	23	5	-	-	28
		Oil Grit Separator	6	4	-	-	10
		Underground Storage	2	-	-	-	2
		BaySaver	1	-	-	-	1
		Stormceptor	1	-	-	-	1
	Wet Ponds	Retention Structure (Wet Pond)	-	1	1	-	2
		Wet Structure	3	4	-	8	15
		Extended Detention Wet Structure	2	1	-	-	3
	Extended Detention Dry	Extended Detention Structure Dry	7	1	-	-	8
	Wetlands	Shallow Marsh	2	1	-	-	3
Missing Records Subtotal			**207**	**34**	**10**	**26**	**277**
No WQ - No DA	Filtration	Bioretention	1	-	-	-	1
	Other/Not BMPs	Credits	75	6	-	4	85
		Exempt	2	-	-	1	3
		Other	11	-	-	1	12
		Planting	113	2	1	10	126
No WQ - No DA Subtotal			**202**	**8**	**1**	**16**	**227**
GRAND TOTAL			***409***	***42***	***11***	***42***	***504***

The 1,578 BMPs have a total drainage area of 6,096 acres. This is 17% of the total Patapsco Tidal and Bodkin Creek watershed area (35,884 acres). BMP drainage areas range in size from 0.001 to 386.25 acres. As seen by the median drainage area size (0.09 acres), the majority of the BMPs manage

relatively small areas. This is reinforced by the fact that only 5% of the delineated drainage areas are larger than 20 acres.

As seen in Table 3, private entities own 78% of the BMPs in the study area. These 1,232 BMPs account for 37.6% of the total drainage area. The DPW owns only 258 BMPs (16%), but the 2,359 acres (38.7%) of associated drainage area is the largest of the ownership types.

Table 3. BMPs by Ownership Type

Ownership	Quantity	Percent by Quantity	Drainage Area (acres)	Percent by Drainage Area	Mean Drainage Area (acres)	Standard Deviation (acres)	Minimum Drainage Area (acres)	Maximum Drainage Area (acres)	Median Drainage Area (acres)
Private	1232	78%	2292.8	38%	1.9	15.6	0.001	386.3	0.05
Public (DPW)	258	16%	2369.7	39%	9.2	14.6	0.004	141.8	3.09
Public (non-DPW)	22	1%	578.7	9%	26.3	37.2	0.084	140.1	7.10
Unknown	66	4%	868.6	14%	13.2	39.3	0.002	272.5	1.52
Total	1578	100%	6109.8	100%	3.9	18.0	0.001	386.3	0.09

The six BMP categories researched include: detention dry, extended detention dry, filtration, infiltration, wet ponds, and wetlands. By far, the greatest numbers of BMPs in the study area are classified as infiltration (73%). Infiltration BMPs drain a total area of 837 acres (14%). Wet Ponds account for only 7% of the BMPs by count, but manage 36% of the total managed drainage area (2,168 acres). Additional analysis of the BMPs by category is included in Table 4.

Table 4. BMPs by Category

Category	Quantity	Percent by Quantity	Drainage Area (acres)	Percent by Drainage Area	Mean Drainage Area (acres)	Standard Deviation (acres)	Minimum Drainage Area (acres)	Maximum Drainage Area (acres)	Median Drainage Area (acres)
Detention Dry	105	7%	1684.8	28%	16.0	39.7	0.042	386.3	5.66
Extended Detention Dry	98	6%	839.2	14%	8.6	18.0	0.019	166.9	3.37
Filtration	94	6%	505.1	8%	5.4	35.3	0.005	340.9	0.37
Infiltration	1153	73%	837.0	14%	0.7	3.0	0.001	39.1	0.05
Wet Ponds	116	7%	2167.9	35%	18.7	34.3	0.023	272.5	7.48
Wetlands	12	1%	75.8	1%	6.3	10.7	0.101	31.7	0.56
Total	1578	100%	6109.8	100%	3.9	18.0	0.001	386.3	0.09

The majority of BMPs owned and maintained by the DPW are categorized as infiltration. These infiltration BMPs account for 40% of the DPW BMPs and drain 334 acres. In terms of BMP count, dry detention and wet ponds are the second and third most numerous BMPs owned by the DPW. BMPs categorized as dry detention have a total drainage area of 910 acres (38%) and wet ponds drain 682 acres (29%). Additional analysis of DPW owned BMPs is found in Table 5.

Table 5. Public (DPW) Owned BMPs

Category	Quantity	Percent by Quantity	Drainage Area (acres)	Percent by Drainage Area	Mean Drainage Area (acres)	Standard Deviation (acres)	Minimum Drainage Area (acres)	Maximum Drainage Area (acres)	Median Drainage Area (acres)
Detention Dry	62	24%	910.5	38%	14.7	14.4	0.050	61.4	10.79
Extended Detention Dry	27	10%	302.9	13%	11.2	9.7	0.078	39.6	9.44
Filtration	18	7%	96.4	4%	5.4	10.1	0.072	40.5	1.16
Infiltration	103	40%	334.3	14%	3.2	6.7	0.004	39.1	0.75
Wet Ponds	41	16%	682.4	29%	16.6	24.8	0.023	141.8	9.61
Wetlands	7	3%	43.2	2%	6.2	8.8	0.101	24.8	2.73
Total	258	100%	2369.7	100%	9.2	14.6	0.004	141.8	3.09

The smallest number of BMPs in the study area is owned by non-DPW public entities. These 22 BMPs account for 1.3% of the total number of BMPs identified in the study. An in-depth analysis of these BMPs is seen in Table 6.

Table 6. Public (Non-DPW) Owned BMPs

Category	Quantity	Percent by Quantity	Drainage Area (acres)	Percent by Drainage Area	Mean Drainage Area (acres)	Standard Deviation (acres)	Minimum Drainage Area (acres)	Maximum Drainage Area (acres)	Median Drainage Area (acres)
Detention Dry	-	-	-	-	-	-	-	-	-
Extended Detention Dry	8	36%	58.4	10%	7.3	8.4	0.169	24.5	4.62
Filtration	3	14%	7.4	1%	2.5	2.5	0.084	5.0	2.28
Infiltration	3	14%	5.7	1%	1.9	0.7	1.391	2.7	1.64
Wet Ponds	8	36%	507.2	88%	63.4	40.0	26.949	140.1	53.37
Wetlands	-	-	-	-	-	-	-	-	-
Total	22	100%	578.7	100%	26.3	37.2	0.084	140.1	7.10

Privately owned BMPs account for 78% of the BMPs identified in this study. A total of 1,022 of these BMPs can be classified as infiltration. These infiltration BMPs have a total drainage area of 400 acres. The dry detention category only makes up 3% of the private BMPs by number. However, dry detention accounts for 32% of the delineated drainage area (738 acres). Extended dry detention has the third greatest delineated drainage area (256 acres) and accounts for only 4% of the private BMPs. Additional analysis of the privately owned BMPs is included in

Table 7.

Table 7. Privately Owned BMPs

Category	Quantity	Percent by Quantity	Drainage Area (acres)	Percent by Drainage Area	Mean Drainage Area (acres)	Standard Deviation (acres)	Minimum Drainage Area (acres)	Maximum Drainage Area (acres)	Median Drainage Area (acres)
Detention Dry	40	3%	738.3	32%	18.5	62.1	0.042	386.3	1.71
Extended Detention Dry	53	4%	256.0	11%	4.8	5.9	0.019	25.2	2.47
Filtration	70	6%	399.6	17%	5.7	40.7	0.005	340.9	0.30
Infiltration	1022	83%	458.2	20%	0.4	2.0	0.001	31.7	0.04
Wet Ponds	44	4%	439.9	19%	10.0	16.7	0.043	73.2	3.69
Wetlands	3	0%	0.8	0%	0.3	0.2	0.125	0.5	0.20
Total	1232	100%	2292.8	100%	1.9	15.6	0.001	386.3	0.05

As seen in Table 8, a total of 66 BMPs did not have clear ownership. BMPs classified as infiltration are greatest in number (25) but account for only 39 acres of drainage. There are 23 wet ponds with a total drainage area of 538 acres. Table 8 discusses the BMPs with unknown ownership in greater detail.

Table 8. BMPs with Unknown Ownership

Category	Quantity	Percent by Quantity	Drainage Area (acres)	Percent by Drainage Area	Mean Drainage Area (acres)	Standard Deviation (acres)	Minimum Drainage Area (acres)	Maximum Drainage Area (acres)	Median Drainage Area (acres)
Detention Dry	3	5%	36.0	4%	12.0	10.7	0.963	22.3	12.75
Extended Detention Dry	10	15%	221.9	26%	22.2	51.4	0.126	166.9	3.00
Filtration	3	5%	1.7	0%	0.6	0.9	0.037	1.7	0.04
Infiltration	25	38%	38.8	4%	1.6	6.5	0.002	32.8	0.03
Wet Ponds	23	35%	538.4	62%	23.4	55.5	0.128	272.5	12.17
Wetlands	2	3%	31.8	4%	15.9	22.3	0.132	31.7	15.90
Total	66	100%	868.6	100%	13.2	39.3	0.002	272.5	1.52

Table 9 is a detailed analysis of all 1,578 BMPs identified and located in this study. The 2,082 researched BMPs are also represented in Figure 1. The BMPs are shown by structure type and ownership.

Table 9. Detailed Statistics on the Urban BMPs in the Patapsco Tidal and Bodkin Creek Watersheds

BMP Type		Quantity	Drainage Area (acres)	Mean Drainage Area (acres)	Standard Deviation (acres)	Minimum Drainage Area (acres)	Maximum Drainage Area (acres)	Median Drainage Area (acres)	Private Ownership	Public (DPW) Ownership	Public (non-DPW) Ownership	Unknown Ownership
Detention Dry	Detention Structure (Dry Pond)	87	1650.14	18.97	43.01	0.042	386.25	9.72	31	53	0	3
	Oil Grit Separator	12	28.77	2.40	2.26	0.167	5.74	1.53	4	8	0	0
	Underground Storage	6	5.87	0.98	1.56	0.078	4.14	0.43	5	1	0	0
Detention Dry Total		**105**	**1684.78**	**16.05**	**39.65**	**0.042**	**386.25**	**5.66**	**40**	**62**	**0**	**3**
Extended Detention Dry	Extended Detention Structure Dry	98	839.22	8.56	17.96	0.019	166.94	3.37	53	27	8	10
Extended Detention Dry Total		**98**	**839.22**	**8.56**	**17.96**	**0.019**	**166.94**	**3.37**	**53**	**27**	**8**	**10**
Filtration	Attenuation Swale	6	2.46	0.41	0.38	0.072	1.12	0.33	4	2	0	0
	Bioretention	65	404.86	6.23	42.20	0.005	340.90	0.31	54	9	0	2
	Pocket Sand Filter	1	0.68	0.68	-	0.679	0.68	0.68	1	0	0	0
	Sand Filter	19	38.68	2.04	3.70	0.076	15.53	0.73	11	4	3	1
	Step Pool Storm Conveyance	3	58.42	19.47	20.02	0.609	40.48	17.33	0	3	0	0
Filtration Total		**94**	**505.10**	**5.37**	**35.33**	**0.005**	**340.90**	**0.37**	**70**	**18**	**3**	**3**
Infiltration	Dry Well	315	25.99	0.08	0.35	0.003	5.48	0.04	314	1	0	0
	Dry Well - Infiltration Trench	1	0.03	0.03	-	0.026	0.03	0.03	1	0	0	0
	Dry Well - Infiltration Trench with Complete Exfiltration	21	0.83	0.04	0.01	0.026	0.06	0.04	21	0	0	0
	Dry Well - Infiltration Trench with Partial Exfiltration	2	0.07	0.03	0.01	0.029	0.04	0.03	2	0	0	0
	Infiltration Basin	39	332.54	8.53	10.46	0.001	39.05	4.25	19	19	0	1
	Infiltration Trench	274	132.40	0.48	2.11	0.001	31.66	0.06	234	28	0	12
	Infiltration Trench with Complete Exfiltration	376	252.73	0.67	2.24	0.004	23.41	0.05	333	29	2	12
	Infiltration Trench with Partial Exfiltration	122	88.47	0.73	2.10	0.004	19.55	0.09	95	26	1	0
	Porous Pavement	3	3.97	1.32	0.41	0.929	1.75	1.30	3	0	0	0
Infiltration Total		**1153**	**837.02**	**0.73**	**3.00**	**0.001**	**39.05**	**0.05**	**1022**	**103**	**3**	**25**
Wet Ponds	Extended Detention Wet Structure	38	418.15	11.00	14.45	0.082	63.06	5.62	22	14	0	2
	Micro Pool	3	32.88	10.96	9.05	0.849	18.31	13.72	1	2	0	0
	Retention Structure (Wet Pond)	60	1628.26	27.14	44.33	0.031	272.47	13.03	10	21	8	21
	Wet Structure	15	88.63	5.91	13.32	0.023	49.78	0.39	11	4	0	0
Wet Ponds Total		*116*	*2167.92*	*18.69*	*34.32*	*0.023*	*272.47*	*7.48*	44	41	8	23
Wetlands	Shallow Marsh	12	75.81	6.32	10.67	0.101	31.66	0.56	3	7	0	2
Wetlands Total		**12**	**75.81**	**6.32**	**10.67**	**0.101**	**31.66**	**0.56**	**3**	**7**	**0**	**2**
Total - All BMPs		***1578***	***6109.84***	***3.87***	***18.03***	***0.001***	***386.25***	***0.09***	***1232***	***258***	***22***	***66***

Figure 1. BMPs in the Patapsco Tidal and Bodkin Creek Watersheds