Brier Ditch Subwatershed
Action Plan

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Section 1
Vision and Existing Conditions

The Brier Ditch Subwatershed Action Plan (SWAP) is intended to be an integrated summary document for the Brier Ditch Subwatershed Environmental Baseline Conditions Report and the Brier Ditch Subwatershed Provisional Restoration Projects Inventory. Based on planning level analysis and evaluations, various activities or actions have been identified as part of a 10-year comprehensive restoration plan for the Anacostia River watershed. In addition, the layout of the report is intended to follow as closely as possible the EPA nine key elements to develop a watershed plan to improve water quality impairments, and are the minimal requirements to be eligible to receive incremental Clean Water Act Section 319 funding (EPA, 2008).

Need and Purpose

The Anacostia River watershed is primarily confined to an urban landscape, characterized by an alteration of the natural landscape features to accommodate the population growth and urban sprawl that has occurred over the decades. The increase in impervious areas disrupted the natural hydrologic cycle and ultimately affected the environmental health of the Anacostia River and its tributaries. Urbanization throughout the years caused excessive runoff and a reduction in groundwater recharge, a reduction in water quality through the transport of pollutants, a loss of riparian areas, and ultimately a degradation of the watershed's ecological habitat. It is imperative that actions be taken to protect it from further deterioration and restore the ecosystem to the greatest extent possible.

While urbanization and impervious surfaces are the primary stressors for the overall Anacostia River watershed, there is regional variation throughout the watershed and as such, the extent and source of the environmental stressors as well as potential restoration actions will be evaluated on a subwatershed basis. As part of the Anacostia Restoration Plan (ARP) study, each of the 14 primary subwatersheds and the Tidal Anacostia River reach were evaluated in order to determine problems and opportunities at the subwatershed scale for environmental or ecological restoration, and present this information in such a way that would be beneficial to several different audiences. In addition, for each of the 14 primary subwatersheds and the Tidal Anacostia River reach, a SWAP, an environmental baseline conditions report, and a subwatershed provisional restoration project inventory was generated.

The purpose of the Brier Ditch SWAP is to provide a vision statement and targets for restoration within the subwatershed by the year 2020, identify and describe specific problems within the subwatershed, discuss methodologies used to evaluate potential restoration opportunities, and present a prioritized list of restoration opportunities for implementation.

The identification of restoration opportunities and potential projects were based on the following selected strategies:

1. Stormwater Management Retrofits
2. Stream Restoration
3. Wetland Creation and Restoration
4. Fish Blockage Removal/Modification
5. Riparian Reforestation, Meadow Creation, Street Tree, and Invasive Species Management
6. Trash Reduction
7. Toxic Remediation
8. Parkland Acquisition

Building upon the preceding eight restoration strategies, the following 2020 restoration objectives align with and expand upon the existing Anacostia River watershed restoration goals and requirements established by the Anacostia Watershed Restoration Partnership (AWRP):

1. **Stormwater Management:** Implement stormwater retrofits or Best Management Practices (BMPs) to reduce pollutant loading and increase flow regime stability. Increase use of homeowner BMPs throughout the subwatershed.
2. **Wetland Creation and Restoration:** Increase wetland habitat throughout the subwatershed.
3. **Riparian Corridors:** Increase the health of riparian corridors so as to both improve wildlife habitat connectivity and reduce the number of invasive plant problem sites. Also, increase overall tree canopy coverage throughout the subwatershed.
4. **Aquatic Community**: Increase the health of the aquatic community; specifically increase the number of resident fish species and provide for a healthier macroinvertebrate community food base. Restore migratory fish usage of Brier Ditch.
5. **Trash Reduction**: Dramatically reduce trash loads in Brier Ditch.
6. **Outreach:** Increase participation of residents, businesses, and school-age children in activities that are beneficial to the watershed.
7. **Parkland Acquisition:** Increase parkland and habitat connectivity

10-Year Vision

The Brier Ditch subwatershed vision is to create, by the year 2020, a more environmentally healthy and sustainable watershed by dramatically reducing stormwater runoff volumes, stream channel erosion problems, trash levels and pollutant loadings; protecting and restoring aquatic and terrestrial habitats and associated biological communities; enhancing watershed recreational opportunities; and fully engaging both public and private sectors through expanded environmental education and incentive-based initiatives. The preceding objectives are a continuation of and expansion on the AWRP’s existing Anacostia River watershed goals, leading to the achievement of realistic and attainable restoration targets within the next decade.

Brier Ditch 2020 Restoration Targets

The Brier Ditch 2020 Restoration Targets were determined based on the potential implementation of restoration opportunities identified within the Brier Ditch subwatershed as part of the ARP, along with realistic expectations of what could be accomplished in ten years to meet the 2020 restoration objectives. These targets are established to ensure that restoration of the subwatershed is proceeding in the right direction and at a continuous, reasonable pace. The analysis presented in this SWAP will help to establish specific target levels of restoration for the subwatershed. Quantitative targets established such as stormwater management, aquatic community, trash reduction, wetland creation/restoration, riparian corridor restoration, and land acquisition, will be based on the potential restoration project inventory and recommend acreages or mileages to be restored, whereas the qualitative targets including environmental programs and public outreach will recommend programmatic actions that will serve to increase public awareness and interest in the restoring the Anacostia watershed. The 2020 Restoration Targets are presented in Section 4 of this SWAP.

Existing Conditions in the Brier Ditch Subwatershed

Brier Ditch is a free flowing (nontidal) tributary of the Northeast Branch of the Anacostia River; the stream joins the Northeast Branch at the confluence with Still Creek in Riverdale Park Maryland (Figures 1-2 and 1-3). Major Brier Ditch tributaries include Westbrook tributary, Frenchmans Creek and the Glenridge tributary.

The Brier Ditch subwatershed is approximately 2,653 (4.1 square miles) in size. Elevations in the Brier Ditch subwatershed range from 212 feet at the Patuxent River watershed divide to 28 feet at the confluence with the Northeast Branch. Brier Ditch has an average gradient of 0.5-percent over 3.4 miles of its main stem length. Average base flow for the lower Brier ditch main stem is estimated to be approximately 3 to 4 cubic feet per second. Brier Ditch is located entirely within the Coastal Plain physiographic province and is underlain by sands, gravels, silts and clays.

The ecological condition of macroinvertebrate populations in both the Brier Ditch main stem and tributary network is poor. Surprisingly, the Brier Ditch downstream of Auburn Avenue supports a modest fish community (i.e., approximately 20 species). However, in general, the overall health of the macroinvertebrate and fish communities in Brier Ditch can be generally characterized as poor. Nine acres of wetlands are currently located in the subwatershed an in spite of its proximity to Washington, D.C., Brier Ditch is approximately 29-percent forested.

The entire Brier Ditch middle main stem section, as well as a portion of the upper main stem (i.e., immediately downstream of the Capital Beltway), the Westbrook tributary and the lower section (900 feet) of the Glenridge Tributary have been channelized within a concrete-lined system to reduce potential flooding problems. In addition, the upper main stem channel (from approximately 500 feet below the Capitol Beltway downstream to the Westbrook tributary confluence) has been channelized within a grass lined system.

The entire subwatershed is located within Price George's County, Maryland. The subwatershed has nearly 27,000 residents and a population density of 6,448 people per square mile. The largest land uses by area in the Brier Ditch subwatershed are (1) medium density, single family residential (2) institutional, open space and parkland and (3) high density residential apartments. There are currently approximately 4,551 single family homes in the watershed. Brier Ditch flows through predominantly single family residential land use areas. Impervious surfaces cover 29-percent of the subwatershed and only approximately 7 acres of those impervious surfaces are currently controlled by Best Management Practices (BMPs).

Figure 1-1 and Table 1-1 presents a summary of the impervious surfaces and level of stormwater control within the subwatershed.

Figure 1-1: Impervious Surfaces in Brier Ditch Subwatershed

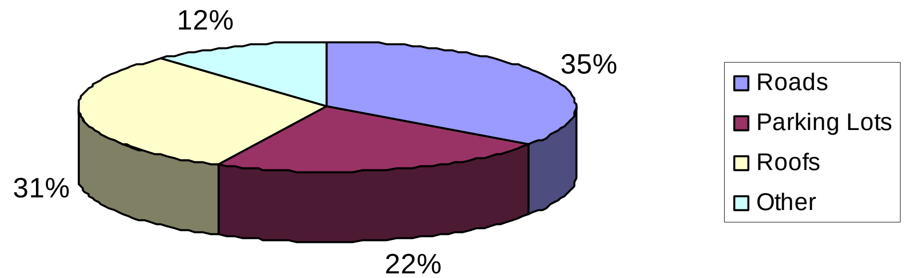


Table 1-1: Impervious Surfaces in the Brier Ditch Subwatershed and Existing Level of Stormwater Control		
	Miles	**Acres**
Roads	**56.9**	**265.2**
State/Federal	6.4	51.1
Local	50.5	214.2
Parking Lots		**166.8**
Public/Institutional		23.4
Private		143.4
Roofs		**236.0**
Public/Institutional		18.8
Private		67.7
Single Family		149.5
Other		**88.2**
Sidewalks		24.5
Single Family Driveways		63.7
Total Impervious Acres		756.2
Total Subwatershed Acres		2,653
Avg. % Imperviousness		29%
Current Impervious Acreage Controlled		7.2
Current-percent Impervious Acreage Controlled by Stormwater Management		0.9%
Number of existing Best Management Practices (BMPs)		8

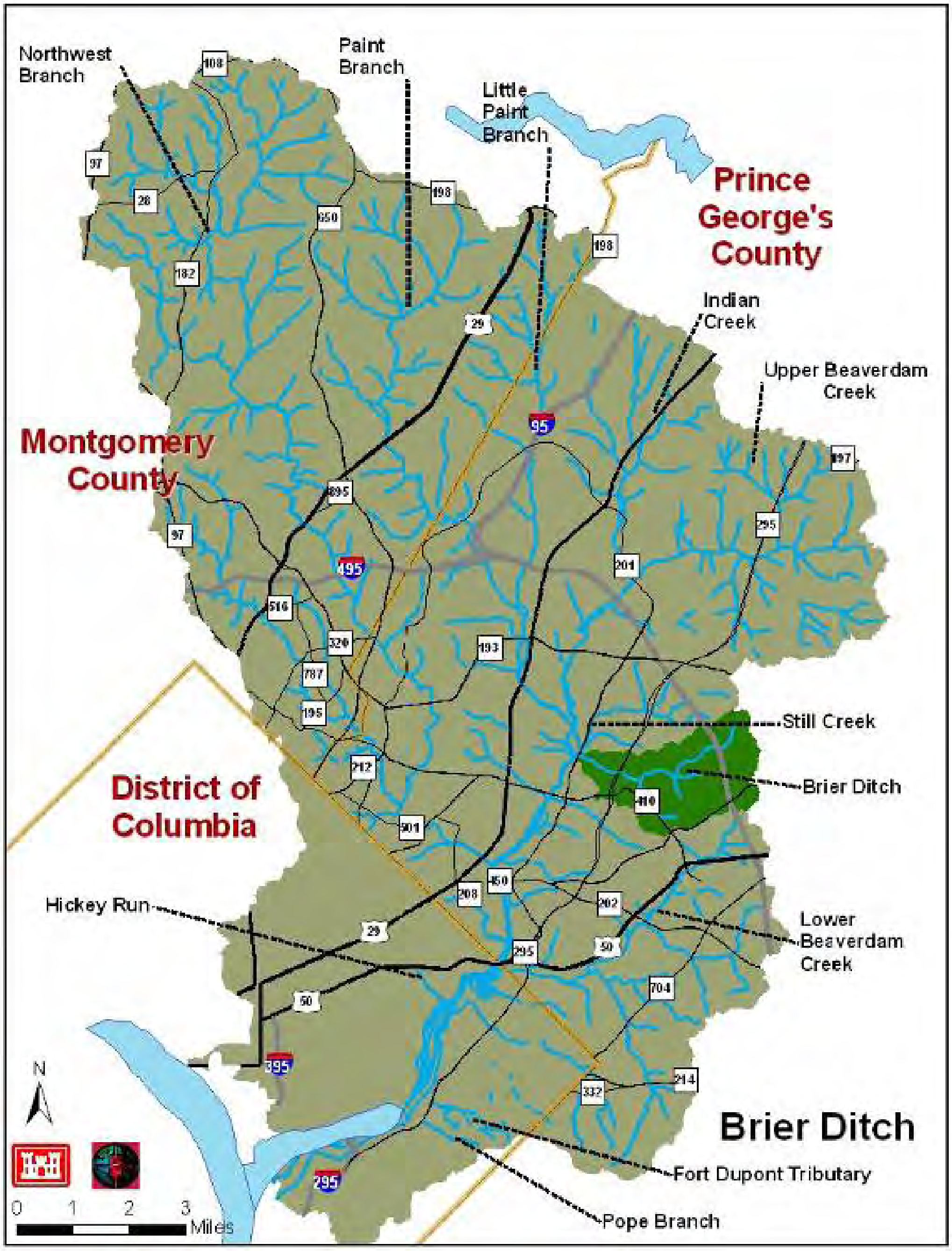


Figure 1-2: Brier Ditch Subwatershed

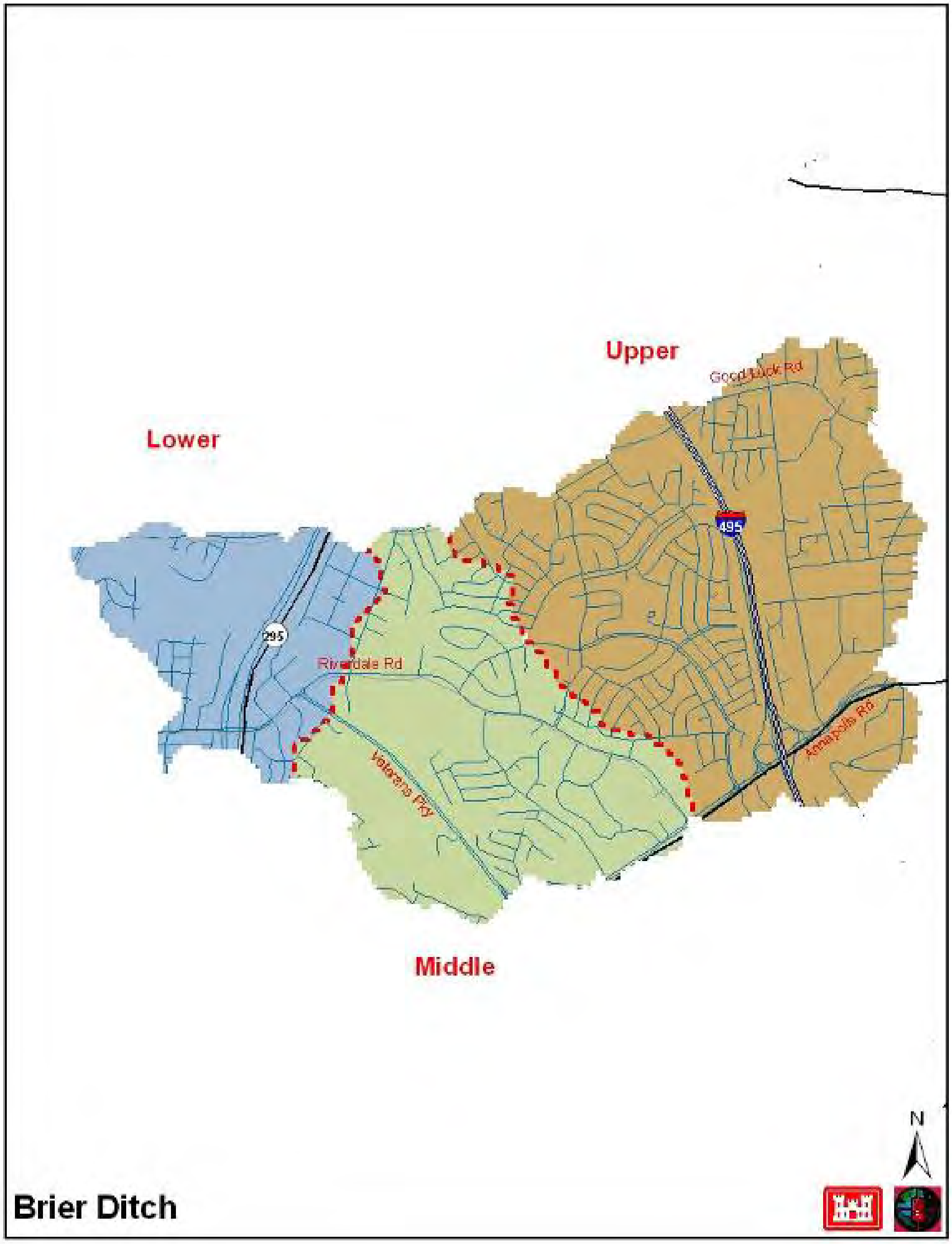


Figure 1-3: Brier Ditch Subwatershed Planning Units

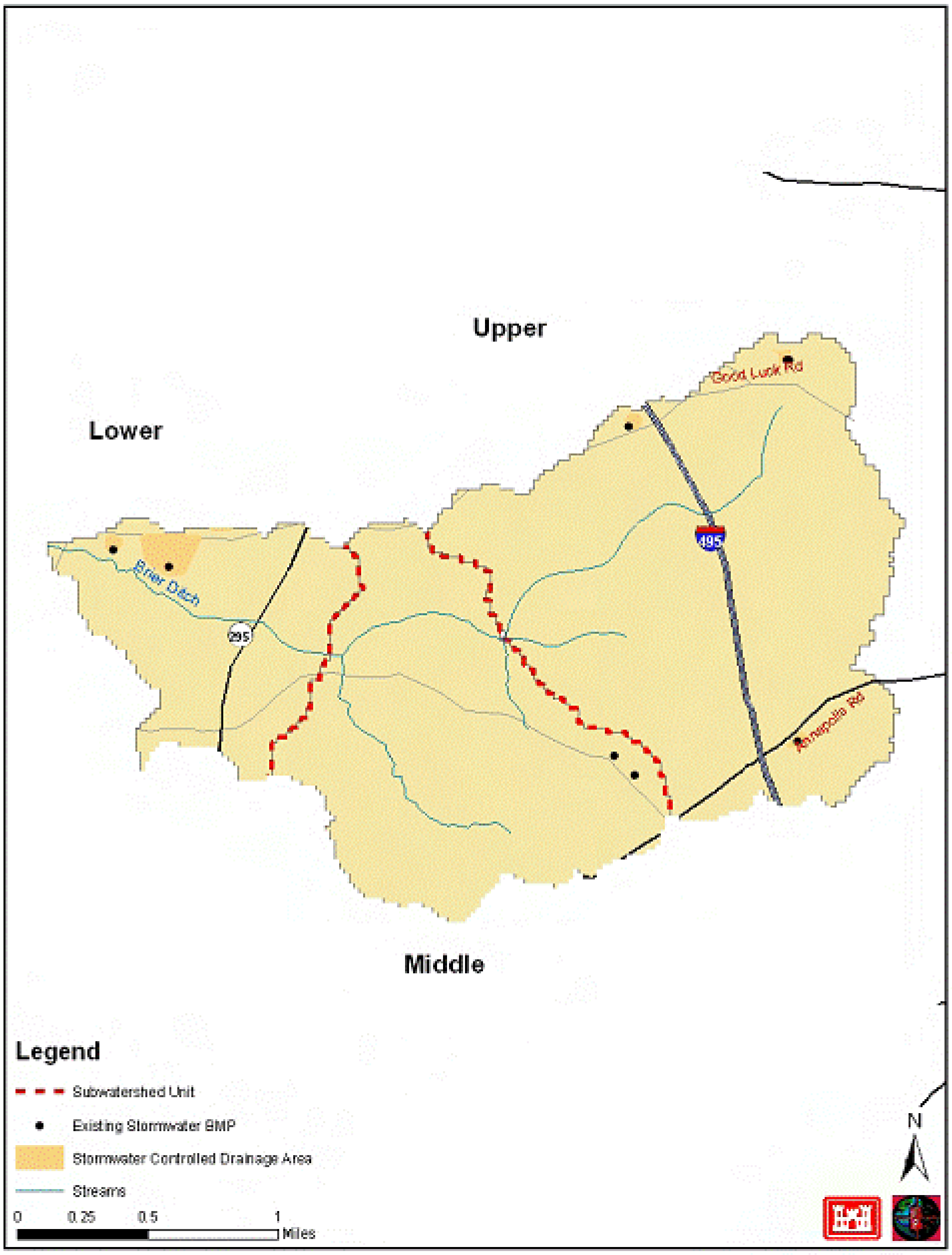


Figure 1-4: Brier Ditch Subwatershed BMP Locations

Problems Facing the Brier Ditch Subwatershed

Changes to Hydrology

The development of the Brier Ditch subwatershed has altered the hydrology and flow regime, and is a major cause of other problems facing the subwatershed. The change in land cover from forest or agriculture to impervious surfaces (such as roofs, roads, and parking lots) has set up a dynamic in which stormwater runoff increases and infiltration of precipitation into soils decreases. An increase in stormwater runoff increases peak discharge that provides energy necessary to erode stream banks as well as discharging pollutants from overland sources into receiving streams. Moderate to severe stream channel erosion was documented in the lower section of the subwatershed along the Brier Ditch.

Poor Aquatic Habitats

Brier Ditch has one of the fewest number of stormwater management controls, is one of the most densely populated, and is the most severely channelized subwatershed within the Maryland portion of the Anacostia River watershed. Despite these facts, the main stem downstream of Auburn Avenue does support a modest fish community of approximately 20 species. That being said, 3 out of the 5 Index of Biotic Integrity (IBI) sampling stations were rating as having non-supporting physical aquatic habitat conditions present. The health of the macroinvertebrate populations in both the main stem and tributaries is also rated as poor. Only about 13-percent of the stream miles within the subwatershed have an adequate riparian forest buffer (i.e., 300-foot total width). Several physical barriers to both resident and anadromous fish movement and migration are present (e.g., concrete channelized stream sections, perched road culverts, piped stream sections, etc). There are 10 field verified fish passage blockages present in the subwatershed currently.

Water Quality

Water quality also plays a major role in the problems facing the Brier Ditch subwatershed. This area was developed prior to the era of mandatory stormwater controls; as such the 8 BMPs present only control roughly 7 acres total (Figure 1-4). The high level of imperviousness, inadequate numbers of stormwater management controls, as well as general moderate to severe stream channel erosion have all contributed to the Brier Ditch subwatershed total suspended solids (TSS) load being approximately 99 tons/square mile/year. The nutrient loading rates associated with this are presented in Table 1-2. The sediment TMDL analysis for the Anacostia River estimates that approximately 70-percent of the sediment loaded into the tidal estuary originates from the stream banks and channels.

Toxics, which include trace metals, polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), pesticides, herbicides, enter the surface waters of the subwatershed via runoff (non-point source) and industrial/municipal discharge. There is currently minimal subwatershed-wide toxics related monitoring data for Brier Ditch. There are currently two corbicula clam bioassay monitoring stations located in the lower main stem that are being used to help determine the extent of this potential problem. On a related note, there are a total of 119 National Pollutant Discharge Elimination (NPDES) related discharges in the Anacostia watershed and 2 of them are located within the Brier Ditch subwatershed. Figure 1-5 shows the location of NPDES sites in the Anacostia watershed. Additionally there are two Resource Conservation and Recovery Act (RCRA) sites located on the boundary between the Brier Ditch and Northeast subwatersheds. The locations of these sites can be found on Figure 1-6. There are no Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites located within this subwatershed.

Figure 1-5: NPDES Sites in the Anacostia River Watershed

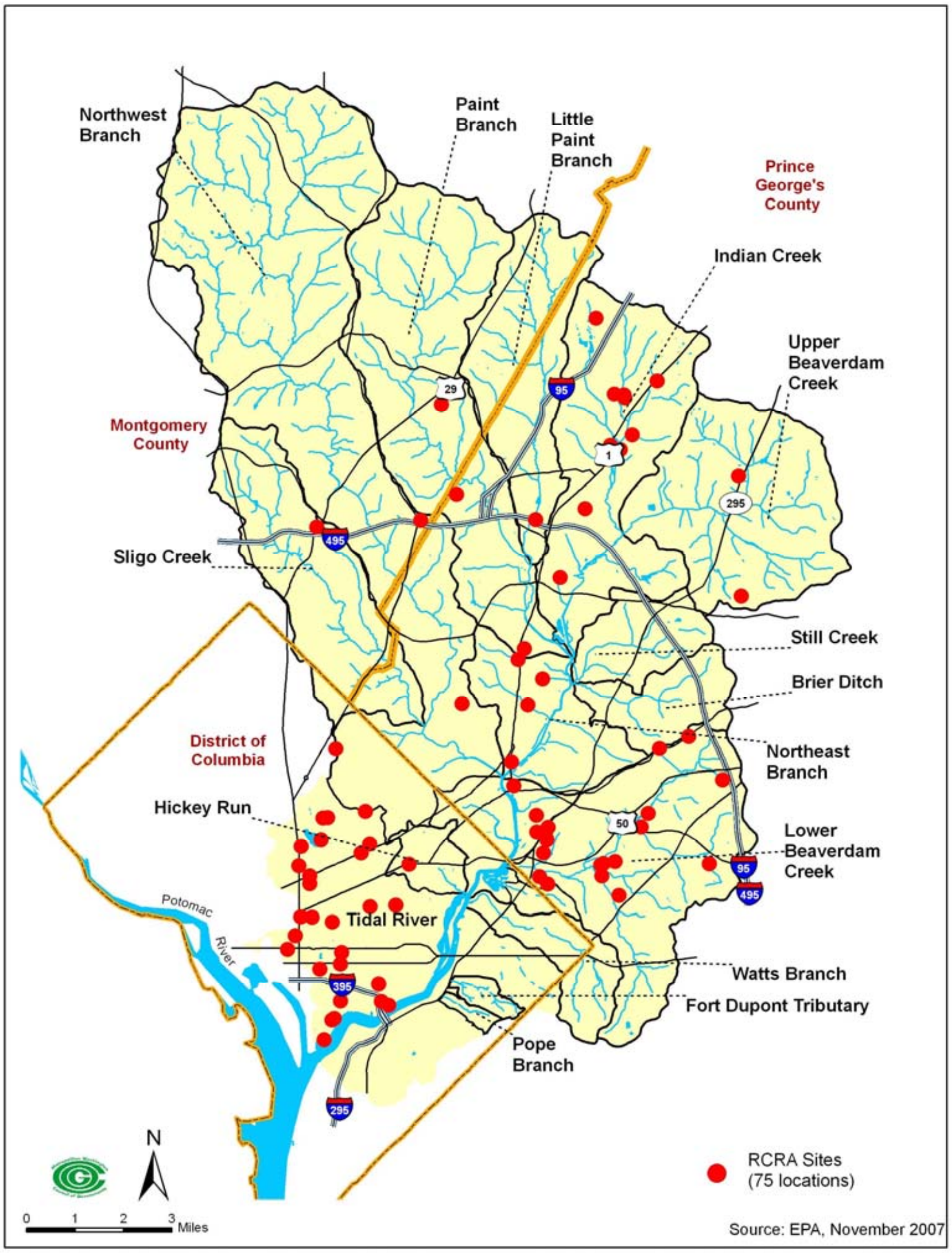


Figure 1-6: RCRA Sites in the Anacostia River Watershed

The available fecal coliform sampling for Anacostia River watershed suggests that streams in the watershed do not meet established bacterial water quality standards. While this data is not specifically available for Brier Ditch, studies done in other subwatersheds of the Anacostia River have shown that bacterial contamination is contributed to the subwatershed by the following sources; Human (9-55-percent), domestic animals (24-28-percent), livestock (6-28-percent), wildlife (12-38-percent). As a result of the requirement for Washington Sanitary Sewer Commission (WSSC) to rehabilitate its sewer line system in Maryland and develop a water quality management plan, there will be 17 bacterial monitoring sites set up in the Maryland portion of the Anacostia watershed; however, none will be located on Brier Ditch.

Trash

Trash is another non-point source contaminant entering the system. Trash surveys have indicated that the lower main stem downstream of Auburn Avenue contains very high trash levels. This can be attributed to in part to high numbers of storm drain outfalls, high number of commercial areas and road corridors, high population density, and to some degree the littering from local recreation facilities.

Flooding

Flooding has been a long-standing problem throughout the Anacostia River watershed, particularly in Prince George's County, though areas of Montgomery County and the District of Columbia experience episodic flooding as well. Prince George's County is prone to flooding because the county is located within the Coastal Plain physiographic province, which is generally wider and flatter, and due to development of floodplains prior to the development of stormwater management regulations and controls. Periodic flooding within Brier Ditch occurs primarily within the lower portions of the subwatershed along the Brier Ditch main stem.

Further data and discussion regarding the current conditions of the Brier Ditch subwatershed can be found in the Anacostia Watershed Environmental Baseline Conditions and Restoration Report prepared by Metropolitan Washington Council of Governments (MWCOG).

Existing Pollutant Loads

Existing pollutant loadings for sediment, nitrogen (N), and phosphorous (P) was calculated for the Anacostia River watershed TMDL by the Maryland Department of the Environment (MDE). As part of the ARP, the sediment, N, and P loadings were calculated for the Brier Ditch subwatershed using the same loading rates per land use for the TMDL in order to estimate the Brier Ditch subwatershed's contribution of pollutant load to the overall Anacostia River load (Kim et al, 2007; Mandel et al, 2008). The Anacostia River watershed TMDL identifies a reduction goal for sediment, N, and P as 85-, 79-, and 80-percent, respectively. By knowing the percent reduction necessary for the entire Anacostia River watershed and applying the percent reduction to the Brier Ditch subwatershed pollutant loading estimate, the subwatershed loading reduction for Brier Ditch necessary to achieve the overall Anacostia River watershed TMDL can be estimated. Additional information is available on the existing pollutant loading calculations is available in the Plan Formulation appendix to the Anacostia Watershed Restoration Plan and Report.

Identifying the existing magnitude of loadings on a subwatershed basis allows for the ability to geographically target and evaluate the scale of restoration needed to reduce N, P, and sediment inputs within each subwatershed to attain goals. A summary table of Brier Ditch subwatershed current loadings and how they compare to the rest of the Anacostia River watershed is found in Table 1-2. The efforts to attain TMDLs are being led by the U. S. Environmental Protection Agency (EPA) and MDE, and as such neither this SWAP nor the ARP are intended to serve as TMDL implementation plans, although data presented here may contribute to that effort. The Plan Formulation appendix of the Anacostia Watershed Restoration Plan and Report provides more details regarding the methodology used to obtain the current loading estimates and presents the results of those analyses. It must be noted that the analyses conducted for the ARP in regards to pollutant reduction only considered overland flow, and does not account for pollutant contribution from the stream channel itself, namely sediment from erosion. Additional detailed modeling would be required to determine sediment transport change associated with reduced runoff volumes from implementation of the stormwater management retrofit projects identified in the ARP.

Table 1-2: Nutrient Loading Estimates for Brier Ditch Subwatershed and Comparison Values			
	Nitrogen lbs/sq mi/year	**Phosphorus lbs/sq mi/year**	**TSS tons/sq mi/year**
Brier Ditch	5,738	595	99
Average Anacostia Subwatershed	5,255	500	99
Completely Forested Watershed	42	8	Value not calculated

Table 1-3: TMDL Reduction Goals			
	Nitrogen lbs/sq mi/year	**Phosphorus lbs/sq mi/year**	**TSS tons/sq mi/year**
Anacostia River Watershed TMDL Reduction Goals	79%	80%	85%
Estimated Brier Ditch TMDL Loadings	5,738	595	99
Estimated Brier Ditch Reduction Goal as Pro-Rated Share of Anacostia TMDL	4,533	476	84

Section 2
Inventory of the Provisional Restoration Candidates

Inventory of the Provisional Restoration Candidates

As part of the ARP study, a systematic process was developed to identify, catalog, and evaluate each restoration opportunity. In addition, the evaluation of restoration projects was completed by using a detailed system to score the various projects and ultimately determine a ranking of projects. The opportunities presented were identified through the compilation of existing data, input from local jurisdictions, GIS analyses, and field observations. The existing data provided by the local municipalities included land use data, public/private ownership information, impervious surfaces data, planning department classifications, digital elevation models, stormwater management data, and aerial photographs. A detailed explanation of the methodology utilized to identify the opportunities can be found in the Plan Formulation appendix to the Anacostia Watershed Restoration Plan and Report.

In addition to the restoration strategies discussed in Section 1, the potential projects identified as part of this analysis are intended to achieve one or more of the following 2020 restoration objectives:

1. Stormwater Management
2. Wetland Creation and Restoration
3. Riparian Corridors
4. Aquatic Community
5. Trash Reduction
6. Outreach
7. Parkland Acquisition

Table 2-1 identifies potential project types per objective, gives a brief description, and states the metric that will be used.

Table 2-1: 2020 Brier Ditch Restoration Objectives		
Objectives	**Description of Objective**	**Metric**
Stormwater Management		
Retrofits, Environmental Site Design (ESD), and Low Impact Development (LID).	Retrofit current stormwater controls, utilize bioretention, filters, bioswales, wet ponds, wetlands to add controlled acreage to the subwatershed	Acres Controlled and Pounds of Nitrogen (N), Phosphorus (P), TSS loading reduced
Homeowner BMPs	Include use of green roofs, disconnects, rain barrels, permeable pavement, and rain gardens	Acres Controlled and Pounds of N, P, TSS loading reduced
Trash		
Implement reduction projects	Reduce trash through use of netting, catching, and grates	Number of Projects Implemented / MWCOG Trash Index Rating
Street Sweeping	Increase street sweeping programs	Acres Swept and Pounds of N, P, TSS loading reduced
Aquatic Community		
IBI Rating for Fish	Restore fish habitat through improved water quality and flow management	Index of Biotic Integrity Rating
IBI Rating for Macroinvertebrate	Restore macroinvertebrate habitat through improved water quality and flow management	Index of Biotic Integrity Rating
Fish Passage	Remove barriers to fish migration	Miles of Stream
Wetland Creation and Restoration		
Create and Restore Acreage	Create new wetlands and vernal pools and restore/expand existing ones	Acreage created or restored
Riparian Corridors		
Invasive Species Management	Removal of invasive species from the corridor	Acres managed
Reforestation	Replanting of the riparian corridor	Acres reforested
Increase Tree Canopy	Tree planting in both urban and non-urban areas	Acres / % increase
Outreach / Public Involvement		
Increase participation of residents and businesses	Educate the public about BMPs and encourage their use of them	Qualitative
Establish Friends of Brier Ditch Organization	Establish a subwatershed group to facilitate public involvement	Yes or No
Incentive Programs	Expand current programs and encourage businesses to offer incentives. Assist private owners with measures such as rain barrels.	Expanded or Maintained

A total of 128 potential restoration candidate projects within the Brier Ditch subwatershed have been identified as part of the ARP investigation. The complete inventory and description of the 128 proposed projects are included in Brier Ditch Subwatershed Provisional Restoration Projects Inventory. The potential restoration projects address five of six restoration strategies identified for the Brier Ditch 2020 restoration objectives (does not include projects for increasing participation). The presence of toxic contaminants has been identified in Brier Ditch; however, detailed studies have not been completed to identify the exact sources and extent of the problem, and thus there are no provisional restoration candidate projects that address toxics in the report. It is recommended that further studies regarding the source and extent of toxic contamination should be undertaken by the appropriate authorities. In addition to illicit discharges, historic dump sites may be sources of toxic contaminants in the system. A diagram of these sites and current NPDES sites can be found in the Anacostia River Watershed Environmental Baseline Conditions and Restoration Report.

Tables 2-2, 2-3, and 2-4 provide a summary of the proposed restoration project types, quantity, and the estimated cost of implementation. It should be noted that the development of the NPDES Municipal Separate Storm Sewer System (MS4) permit by the three local jurisdictions may or may not include provisional restoration projects presented in the SWAP or Brier Ditch Subwatershed Provisional Restoration Projects Inventory.

Table 2-2: Inventory of Restoration Projects in the Brier Ditch Subwatershed

Candidate Project Type	Number of Projects	Estimated Cost ($)	Impervious Acreage Newly Controlled (ac)	Length (mi)	Acreage (Ac)
Stormwater Retrofit	69	39,389,000	341.1	-	-
Stream Restoration	9	4,057,300	-	1.9	-
Wetland Creation / Restoration	4	385,000	-	-	7.7
Fish Blockage Removal / Modification	5	720,000	-	1.6	-
Riparian Reforestation	3	18,000	-	-	2.0
Trash Reduction	7	18,200	-	-	-
Sediment Remediation	0	0	-	-	-
Parkland Acquisition	31	12,660,000			126.6
Total	**128**	**57,247,500**	**341.1**	**3.4**	**136.3**

Table 2-3: Proposed Restoration by Type in the Upper Beaverdam Creek					
Project Type	**Watershed Area**				
	Upper	**Middle**	**Lower**	**Total**	**Total New**
Wetland and Wet Pond Stormwater (acres)*	3.0	0.0	0.0	3.0	3.0
Bioretention (acres)*	106.4	134.6	46.6	287.6	272.0
Bioswales (acres)*	13.0	11.5	0.6	25.1	25.1
Permeable Pavement (acres)*	0.0	3.4	1.6	5.0	5.0
Filter (acres)*	6.9	7.7	0.0	14.6	7.7
Green Roof (acres)*	0.0	4.9	4.1	9.0	9.0
Downspout Disconnects (acres)*	0.0	3.4	1.6	5.0	5.0
Rain Barrels (acres)*	0.0	3.4	1.6	5.0	5.0
Rain Garden (acres)*	3.4	4.4	1.6	9.4	9.4
Dry Pond (acres)*	0.0	0.0	0.4	0.4	0
Invasive Species Management (acres)	0.0	0.0	0.0	0.0	NA
Meadow Planting(acres)	0.2	1.0	6.5	7.7	NA
Wetland Restoration (acres)	0.2	1.0	6.5	7.7	NA
Vernal Pools Restoration/Creation (acres)	0.0	0	0	0.0	NA
Reforestation/Riparian Buffer (acres)	0.0	1.4	0.6	2.0	NA
Land Acquisition (acres)	54.1	72.5	0.0	126.6	NA
Stream Restoration (miles)	0.7	0.7	0.4	1.8	NA
Fish Passage (miles)	0.0	0.7	0.9	1.6	NA
Trash Reduction (number of projects)	0.0	2.0	5.0	7.0	NA
*Note: Acreage shown represents the total acreage controlled by the project. A portion of these are retrofits and upgrades, therefore the acreage is not representative of ‘new’ acreage controlled but represents new and current acreage controlled by the proposed project. The newly controlled acreage is in the last column.					

Table 2-4: Provisional Restoration Project Estimated Unit Costs		
No.	**Practice**	**Approximate Unit Cost ($)**
	Stormwater Retrofit	
1	Existing Stormwater Management Pond/Wetland Retrofitting	$1,000-$3,000/acre of drainage
2	New Stormwater Management Pond/Wetland Construction	$3,000-$5,000/acre of drainage
3	LID-Bioretention with Under Drain System	$100,000/impervious acre
4	LID-Curbside/Street Planter	$100,000/impervious acre
5	LID tree box filter	$54,450-$65,340/impervious acre
6	LID-Green Roof	$42/square foot
7	LID-Single Family Home Rain Garden	$5,000 per individual garden
8	LID-Single Family Home Rain Barrel	$200/barrel (typically two per house)
9	Sand Filter	$20,000 to $25,000 per impervious acre
10	Underground Pipe Storage	$15,000/impervious acre
11	Permeable Pavement	$4.0/square foot
	Stream Restoration/Fish Passage Blockage Removal or Modification	
12	Stream Restoration	$300/linear foot
13	Concrete Stream Channel Removal	$1,000/linear foot
14	Stream Day Lighting	$2,000/linear foot
15	Fish Passage/Riffle Grade Control Structure	$150,000/one foot barrier height
16	Wetland Creation	$50,000/acre
	Trash Reduction/Water Quality	
17	Fresh Creek Trash Netting System	$1,000/acre of drainage
18	End-of-Pipe Trash Catching System	$4,000/acre of drainage
19	Street Sweeping	$50/curb mile
20	Storm Drain Trash Grate	$500/inlet

Results of the Evaluation and Scoring of Restoration Actions in Brier Ditch Subwatershed

To recommend restoration action and to determine the sequence for implementation, the quantitative scoring scheme was used to evaluate the 128 provisional restoration candidate projects. This common scoring system allowed for comparison of candidates across as well as within the restoration strategies. The scores for all 128 projects ranged from 82 to 52 points out of a possible 100. To prioritize among projects based on benefits, the scores were divided into three tiers based on the distribution of the scores, with Tier I projects being those anticipated to provide the greatest potential benefits. Tier I includes projects that scored an 80 or above, Tier II includes projects that scored anywhere from 79 to 65, and Tier III includes those that scored 64 or below. Further discussion on the scoring system for the proposed projects can be found in the Plan Formulation appendix to the Anacostia Watershed Restoration Plan and Report.

The scoring scheme for the provisional stormwater management candidate projects was subsequently further adjusted. The tier system was retained, but the tier boundaries were refined based on distribution of the adjusted score as described in the stormwater management subsection below.

The following tables present the scores and overall rank of the provisional restoration actions for the Brier Ditch subwatershed separated by restoration strategy.

Stormwater Management

To provide for better differentiation for potential benefits that would be produced by the 69 potential stormwater management candidate projects and aid the local communities in prioritization for implementation, the scoring system used for project candidates in this restoration strategy were adjusted from the common scoring system. Variables representing two additional factors unique to stormwater management were incorporated into the scoring system: unit imperviousness and existing stormwater control. Data for these variables was obtained from MWCOG and is presented in the Brier Ditch Environmental Baseline Conditions and Restoration Report. In the adjusted scoring system for the stormwater projects, Tier I includes projects above 100, Tier II includes projects that are between 89 and 99, Tier III are those scored 88 and below, and Tier IV are those projects that did not meet the minimum requirements to be included in the adjusted scoring system but could still be considered as restoration opportunities in the future. Further explanation of the basis for the adjusted scoring can be found in the Plan Formulation appendix to the Anacostia Watershed Restoration Plan and Report. The top 20 stormwater retrofit candidate projects are listed in Table 2-5. Additional information and project descriptions can be in the Brier Ditch Subwatershed Provisional Restoration Projects Inventory.

Table 2-5: Top 20 Potential Stormwater Retrofit Projects within the Brier Ditch Subwatershed

Project ID	Jurisdiction*	Project Name	Adjusted Score	Overall Rank based on Original Scoring	Estimated Cost ($)
BD-M-01-S-21	PG	Patterson Street/Finns Lane Community, New Carrollton, MD	106.4	8	1,910,000
BD-M-01-S-22	PG	76th Avenue/Annapolis Road and Fury Lane/Finns Lane Communities, New Carrollton, MD	106.4	8	2,500,000
BD-L-01-S-4	PG	Parkdale High School, 6001 Good Luck Road, Riverdale, MD	105.4	11	3,950,000
BD-U-01-S-10	PG	Shopping center on the 8300 and 8400 blocks of Annapolis Road, New Carrollton, MD	104.4	13	530,000
BD-U-01-S-25	PG	Charles Carroll Middle School, 6130 Lamont Drive, Hyattsville, MD	103.0	6	430,000
BD-L-01-S-7	PG	63rd Avenue between Roanoke Avenue and Tuckerman Street, Riverdale, MD	102.0	7	162,000
BD-M-01-S-18	PG	6800 block of Auburn Avenue, Riverdale, MD	101.6	15	473,000
BD-L-01-S- 16	PG	6200 and 6300 67th Court, Riverdale, MD	101.0	8	438,000
BD-M-01-S-9	PG	Northwest corner of Annapolis Road and East-West Highway, Lanham, MD	100.4	30	598,000
BD-M-01-S-19	PG	Corinthian Baptist Church, 6703 Good Luck Road, New Carrollton, MD	100.0	11	220,000
BD-U-01-S-24	PG	Robert Frost Elementary School, 6419 85th Avenue, New Carrollton, MD	99.0	13	260,000
BD-U-01-S-7	PG	Whitfield Towne Apartments, 5634 Whitfield Chapel Road, Lanham, MD	98.7	23	760,000
BD-U-01-S-9	PG	Lanham Crossing Shopping Center, 8800 block of Annapolis Road, Lanham, MD	98.7	23	630,000
BD-L-01-S-2	PG	6811 Sarvis Avenue and 6801 Sarvis Avenue, Riverdale, MD	98.7	23	670,000
BD-U-01-S-22	PG	New Carrollton Municipal Center, 6016 Princess Garden Parkway, New Carrollton, MD	98.0	15	260,000
BD-M-01-S-14	PG	Chestnut Ridge Apartment Homes, 6872 Riverdale Road, Lanham, MD	98.0	15	150,000
BD-M-01-S-3	PG	Heritage Square Apartments, 7773 Riverdale Road, New Carrollton, MD	97.5	48	1,460,000
BD-M-01-S-10	PG	Glenridge Elementary School, 7200 Gallatin Street, Landover Hills, MD	97.0	20	360,000
BD-U-01-S-12	PG	Best Western Hotel Capital Beltway and Lanham 30 Office Building, 5910 Princess Garden Parkway, Lanham, MD	96.7	36	550,000
BD-M-01-S-24	PG	7710 Annapolis Road, northwest corner of Finns Lane and Annapolis Road, Lanham, MD	96.6	48	908,000
TOTAL					**17,219,000**

*PG=Prince George's County, Maryland
Scoring Tier = **Tier I**, **Tier II**, **Tier III**

In order to allow for more regional prioritization, the top five stormwater projects for each of the planning units in the subwatershed (Upper, Middle, Lower) are in Tables 2-6, 2-7, and 2-8.

Table 2-6: Top 5 Potential Stormwater Retrofit Projects within the Upper Brier Ditch Subwatershed

Project ID	Jurisdiction*	Project Name	Adjusted Score	Overall Rank based on Original Scoring	Estimated Cost ($)
BD-U-01-S-10	PG	Shopping center on the 8300 and 8400 blocks of Annapolis Road, New Carrollton, MD	104.4	13	530,000
BD-U-01-S-25	PG	Charles Carroll Middle School, 6130 Lamont Drive, Hyattsville, MD	103.0	6	430,000
BD-U-01-S-24	PG	Robert Frost Elementary School, 6419 85th Avenue, New Carrollton, MD	99.0	13	260,000
BD-U-01-S-7	PG	Whitfield Towne Apartments, 5634 Whitfield Chapel Road, Lanham, MD	98.7	23	760,000
BD-U-01-S-9	PG	Lanham Crossing Shopping Center, 8800 block of Annapolis Road, Lanham, MD	98.7	23	630,000
TOTAL					**2,610,000**

*PG=Prince George's County, Maryland
DC=Washington, D.C.
Scoring Tier = **Tier I**, **Tier II**, **Tier III**

Table 2-7: Top 5 Potential Stormwater Retrofit Projects within the Middle Brier Ditch Subwatershed

Project ID	Jurisdiction*	Project Name	Adjusted Score	Overall Rank based on Original Scoring	Estimated Cost ($)
BD-M-01-S-21	PG	Patterson Street/Finns Lane Community, New Carrollton, MD	106.4	8	1,910,000
BD-M-01-S-22	PG	76th Avenue/Annapolis Road and Fury Lane/Finns Lane Communities, New Carrollton, MD	106.4	8	2,500,000
BD-M-01-S-18	PG	6800 block of Auburn Avenue, Riverdale, MD	101.6	15	473,000
BD-M-01-S-9	PG	Northwest corner of Annapolis Road and East-West Highway, Lanham, MD	100.4	30	598,000
BD-M-01-S-19	PG	Corinthian Baptist Church, 6703 Good Luck Road, New Carrollton, MD	100.0	11	220,000
TOTAL					**5,701,000**

*PG=Prince George's County, Maryland
DC=Washington, D.C.
Scoring Tier = **Tier I**, **Tier II**, **Tier III**

Table 2-8: Top 5 Potential Stormwater Retrofit Projects within the Lower Brier Ditch Subwatershed					
Project ID	**Jurisdiction***	**Project Name**	**Adjusted Score**	**Overall Rank based on Original Scoring**	**Estimated Cost ($)**
BD-L-01-S-4	PG	Parkdale High School, 6001 Good Luck Road, Riverdale, MD	105.4	11	3,950,000
BD-L-01-S-7	PG	63rd Avenue between Roanoke Avenue and Tuckerman Street, Riverdale, MD	102.0	7	162,000
BD-L-01-S- 16	PG	6200 and 6300 67th Court, Riverdale, MD	101.0	8	438,000
BD-L-01-S-2	PG	6811 Sarvis Avenue and 6801 Sarvis Avenue, Riverdale, MD	98.7	23	670,000
BD-L-01-S-15	PG	Maryland-National Capital Park Police Headquarters, 6700 Riverdale Road, Riverdale, MD	95.1	23	400,000
TOTAL					**5,260,000**

*PG=Prince George's County, Maryland
DC=Washington, D.C.
Scoring Tier = **Tier I**, **Tier II**, **Tier III**

Stream Restoration

The potential stream restoration candidate projects are presented in Table 2-9. These projects include bank stabilization, in-stream habitat restoration, channel morphology restoration, and regenerative stormwater conveyance. Project lengths range from 75 feet to 3,000 feet. Additional project description information can be found in the Brier Ditch Subwatershed Provisional Restoration Projects Inventory.

Table 2-9: Potential Stream Restoration Projects within the Brier Ditch Subwatershed

Project ID	Jurisdiction*	Project Name	Score	Overall Rank	Estimated Cost ($)
BD-L-02-SR-2	PG	Northeast of the back field of the school on Tuckerman Street (north of the intersection with 63rd Avenue), East Riverdale, MD	72	15	28,000
BD-U-02-SR-2	PG	Intersection of Lamont Drive and Carrollton Parkway, Hyattsville, MD	70	23	639,300
BD-M-02-SR-1	PG	Approximately 1,300 feet northwest of the intersection of Sunrise Drive and Patterson Street, New Carrollton, MD	69	30	30,000
BD-U-02-SR-1	PG	West of the Washington Bible College in adjacent woods, approximately 1,100 feet southwest of the intersection of Good Luck Road and Mallery Drive, Goddard, MD	68	36	390,000
BD-U-02-SR-3	PG	Intersection of Carrollton Parkway and Carrollton Court, Hyattsville, MD	68	36	150,000
BD-L-02-SR-3	PG	Northwest of intersection of Auburn Avenue and Riverdale Road, beyond the northwest corner of parking lot approximately 250 feet downstream of the channelized portion, New Carrollton, MD	59	117	240,000
BD-M-02-SR-2	PG	Approximately 300 feet northeast of the intersection of Riverdale Road and Auburn Avenue, New Carrollton, MD	58	118	1,950,000
BD-M-02-SR-3	PG	Adjacent to 6841 Arbor Manor, Riverdale Road, New Carrollton, MD	57	121	180,000
BD-L-02-SR-1	PG	Approximately 300 feet northeast of parking lot adjacent to 6811 Sarvis Avenue, East Riverdale, MD	55	123	450,000
TOTAL					**4,057,300**

*PG=Prince George's County, Maryland
DC=Washington, D.C.
Scoring Tier = **Tier I**, **Tier II**, **Tier III**

Wetland Creation or Restoration

All of the potential wetland creation or restoration candidate projects (sizes from 0.2 to 5 acres) are presented in Table 2-10. Additional project description information can be found in the Brier Ditch Subwatershed Provisional Restoration Projects Inventory.

Table 2-10: Potential Wetland Creation or Restoration Projects within the Brier Ditch Subwatershed

Project ID	Jurisdiction	Project Name	Score	Overall Rank	Estimated Cost ($)
BD-L-03-W-1	PG	Northwest of Fernwood Terrace on the south side of the stream bordering Interstate 295, New Carrollton, MD	68	36	75,000
BD-M-03-W-1	PG	Northwest of the intersection of Sunrise Drive and Patterson Street, approximately 1,100 feet upstream of PG# 807113, New Carrollton, MD	65	80	50,000
BD-U-03-W-1	PG	Approximately 600 feet northwest of the intersection of Princess Garden Parkway and Woodburn Court, New Carrollton, MD	62	96	10,000
BD-L-03-W-2	PG	Northeast of Fernwood Terrace on the north side of the stream approximately 500 feet east of Interstate 295, New Carrollton, MD	56	122	250,000
TOTAL					**385,000**

*PG=Prince George's County, Maryland
DC=Washington, D.C.
Scoring Tier = **Tier I**, **Tier II**, **Tier III**

Fish Blockage Removal or Modification

T the potential fish blockage removal or modification candidate projects are presented in Table 2-11. They range in size from 800 feet to 3,500 feet. Additional information regarding the project descriptions is available in the Brier Ditch Subwatershed Provisional Restoration Projects Inventory.

Table 2-11: Potential Fish Blockage Removal or Modification Projects within Brier Ditch Subwatershed

Project ID	Jurisdiction	Project Name	Score	Overall Rank	Estimated Cost ($)
BD-M-04-F-1	PG	Intersection of Martins Lane and Martins Terrace, New Carrollton, MD	69	30	45,000
BD-L-04-F-1	PG	Approximately 50 feet northwest of 6801 Berkshire Building, Sarvis Avenue, East Riverdale, MD	54	124	150,000
BD-L-04-F-4	PG	Approximately 200 feet southwest of Silk Tree Drive (PG#795208), Riverdale, MD	54	124	225,000
BD-L-04-F-2	PG	Upstream of the intersection of Auburn Avenue and Riverdale Road at the northwest corner of parking lot, New Carrollton, MD	52	126	150,000
BD-L-04-F-3	PG	Interstate 295 culvert (PG#796104), East Riverdale, MD	52	126	150,000
TOTAL					**720,000**

*PG=Prince George's County, Maryland
DC=Washington, D.C.
Scoring Tier = **Tier I**, **Tier II**, **Tier III**

Riparian Reforestation
The three potential riparian buffer reforestation species management candidate projects are presented in Table 2-12. These buffer reforestation projects range from 0.1 acre to 1.4 acre. Additional information regarding the project descriptions is available in the Brier Ditch Subwatershed Provisional Restoration Projects Inventory.

Table 2-12 Potential Riparian Reforestation Candidate Projects within the Brier Ditch Subwatershed

Project ID	Jurisdiction	Project Name	Score	Overall Rank	Estimated Cost ($)
BD-M-05-R-1	PG	Intersection of Riverdale Road and Auburn Avenue, New Carrollton, MD	69	30	12,600
BD-L-05-R-1	PG	6811 Sarvis Avenue downstream of the northeast corner of the parking lot, East Riverdale, MD	66	56	4,500
BD-L-05-R-2	PG	Approximately 50 feet upstream of the northeast corner of parking lot adjacent to 6811 Sarvis Avenue, East Riverdale, MD	65	80	900
TOTAL					**18,000**

*PG=Prince George's County, Maryland
DC=Washington, D.C.
Scoring Tier = **Tier I**, **Tier II**, **Tier III**

Trash Reduction

The provisional trash reduction candidate projects are presented in Table 2-13. These projects include both trash removal efforts as well as street sweeping. Additional information regarding the project descriptions can be found in the Brier Ditch Subwatershed Provisional Restoration Projects Inventory.

Table 2-13: Potential Trash Reduction Projects within the Brier Ditch Subwatershed

Project ID	Jurisdiction	Project Name	Score	Overall Rank	Estimated Cost ($)
BD-L-06-T-2	PG	Approximately 200 feet east of the parking lot adjacent to 6811 Sarvis Avenue (PG #795212), East Riverdale, MD	82	1	3,400
BD-L-06-T-4	PG	Northwest of the intersection of Auburn Avenue and Riverdale Road, downstream of the northwest corner of parking lot, approximately 200 feet downstream of channelization, New Carrollton, MD	82	1	3,400
BD-L-06-T-3	PG	Approximately 100 feet upstream of Fernwood Terrace to the northeast, New Carrollton, MD	80	3	3,400
BD-L-06-T-5	PG	Approximately 100 feet northwest of dead end on 64th Avenue (PG#795204), East Riverdale, MD	79	4	3,400
BD-L-06-T-1	PG	Approximately 200 feet southwest of Silk Tree Drive (PG #795208), Riverdale, MD	78	5	2,700
BD-M-06-T-1	PG	Riverdale Road between Interstate 295 and Annapolis Road, Riverdale Park, MD	68	36	1,600
BD-M-06-T-2	PG	Auburn Avenue between Riverdale Road and Good Luck Road, Riverdale Park, MD	66	56	300
TOTAL					**18,200**

*PG=Prince George's County, Maryland
DC=Washington, D.C.
Scoring Tier = Tier I, Tier II, Tier III

Parkland Acquisition

The top 20 out of 31 provisional parkland acquisition candidate projects are presented in Table 2-14. The acreage associated with the proposed land acquisitions range from 0.5 acres to 15 acres. Additional information regarding the project descriptions can be found in the Project Inventory section of this appendix.

Table 2-14: Top 20 Potential Parkland Acquisition Projects within the Brier Ditch Subwatershed

Project ID	Jurisdiction	Project Name	Score	Overall Rank	Estimated Cost ($)
BD-M-08-L-12	PG	0000 Sunrise Drive, Lanham	72	15	90,000
BD-U -08-L-3	PG	6511 Princess Garden Parkway, Lanham	66	56	550,000
BD-U -08-L-4	PG	6511 Princess Garden Parkway, Lanham	66	56	310,000
BD-U -08-L-5	PG	6511 Princess Garden Parkway, Lanham	66	56	330,000
BD-U -08-L-6	PG	6511 Princess Garden Parkway, Lanham	66	56	420,000
BD-U -08-L-13	PG	6511 Princess Garden Parkway, Lanham	66	56	370,000
BD-U -08-L-14	PG	0000 Princess Garden Parkway, Lanham	66	56	610,000
BD-U -08-L-15	PG	6410 Princess Garden Parkway, Lanham	66	56	400,000
BD-M-08-L-1	PG	Auburn Avenue and Riverdale Road, Riverdale Park	66	56	480,000
BD-M-08-L-2	PG	Auburn Avenue and Riverdale Road, Riverdale Park	66	56	800,000
BD-M-08-L-3	PG	7021 Riverdale Road, Landham	66	56	960,000
BD-M-08-L-5	PG	7111 Riverdale Road, Lanham	66	56	370,000
BD-M-08-L-11	PG	0000 Veterans Parkway, Riverdale	66	56	370,000
BD-M-08-L-13	PG	7230 Sunrise Drive, Lanham	66	56	630,000
BD-M-08-L-4	PG	6913 Riverdale Road, Lanham	63	90	1,150,000
BD-M-08-L-9	PG	7121 Riverdale Road, Lanham	63	90	1,480,000
BD-M-08-L-6	PG	0000 Riverdale Road, Lanham	62	96	50,000
BD-U-08-L-1	PG	6511 Princess Garden Parkway, Greenbelt	61	101	280,000
BD-U -08-L-2	PG	6511 Princess Garden Parkway, Lanham	61	101	260,000
BD-U -08-L-7	PG	6511 Princess Garden Parkway, Lanham	61	101	290,000
TOTAL					**10,200,00**

*PG=Prince George’s County, Maryland
DC=Washington, D.C.
Scoring Tier = **Tier I**, **Tier II**, **Tier III**

Summary of Recommended Restoration Actions

The Recommended Restoration Actions are those that could potentially be implemented and a roll-up of these projects is presented in Table 2-11. Additional information on the descriptions and details of the potential actions can be found in the Brier Ditch Subwatershed Provisional Restoration Projects Inventory.

Table 2-15 Summary of Recommended Potential Restoration Actions

Candidate Project Type	Number of Projects	Estimated Cost ($)
Stormwater Retrofits		
Tier I*	10	11,211,000
Tier II*	37	22,503,000
Tier III*	5	1,860,000
Tier IV	17	3,815,000
Stream Restoration		
Tier I	0	0
Tier II	5	1,237,300
Tier III	4	2,820,000
Wetland Creation / Restoration		
Tier I	0	0
Tier II	2	125,000
Tier III	2	260,000
Fish Blockage Removal / Modification		
Tier I	0	0
Tier II	1	45,000
Tier III	4	675,000
Riparian Reforestation		
Tier I	0	0
Tier II	3	18,000
Tier III	0	0
Trash Reduction		
Tier I	3	10,200
Tier II	4	8,000
Tier III	0	0
Land Acquisition		
Tier I	0	0
Tier II	14	6,690,000
Tier III	17	5,970,000
TOTAL	**128**	**57,247,500**
***Tiers for the Stormwater Projects Reflect the Adjusted Scoring System**		

Implementation Type of Potential Restoration Actions

Restoration opportunities identified as part of the ARP require additional study, design, or policy change prior to implementation. Table 2-16 provides a summary of the number of projects that fall under each of the four implementation types. Design/build projects are likely those projects ready to be implemented, whereas feasibility projects would require additional detailed studies prior to the design phase. The design/build projects can be implemented by local jurisdictions, agencies, non-profit organizations, or through one of the several USACE design/build programs. It should be noted that USACE has been provided authority under various Water Resource Development Acts to complete Design/Build projects in the Anacostia watershed. The projects requiring feasibility studies like stream restoration or wetland creation likely would be projects USACE could implement following the appropriate Civil Works authority, budgeting cycle, and protocol. Projects classified as requiring a programmatic element prior to implementation may require governmental policy changes or authority to purchase land. Finally, stewardship projects are likely those potential projects to be completed by volunteers from local churches, schools, or community watershed groups such as trash pick up park maintenance.

Additional information regarding what specific projects are classified under each category can be found in the Plan Formulation appendix to the Anacostia Watershed Restoration Plan and Report.

Table 2-16: Summary of Potential Restoration Actions Implementation Types

Implementation Type	Number of Projects	Estimated Cost ($)
Design/Build	69	39,389,000
Feasibility	21	5,180,300
Stewardship	0	0
Programmatic	38	12,678,200
TOTAL	**128**	**57,247,500**

Section 3
Evaluation of the Restoration Strategies

Evaluation of the Restoration Strategies

The proposed restoration projects were evaluated using the approach described in the main report of the ARP. The first step in the evaluation consisted of assessing the potential of the restoration actions to control pollutant loads. As described in the Anacostia Watershed Environmental Baseline Conditions and Restoration Report, the TMDL modeling efforts of Interstate Commission on the Potomac River Basin (ICPRB) and MDE were used to provide the existing pollutant loads, and the Watershed Treatment Model (WTM) was used to estimate the potential pollution reduction achieved by the proposed restoration strategies. The Plan Formulation appendix to the Anacostia Watershed Restoration Plan and Report lists the efficiencies of the various BMPs included in the WTM. It should be noted that the list of stormwater management practices listed in the WTM was expanded to include LID practices. The LID practices included green roofs, rooftop disconnection, rain barrels and cisterns, soil amendments, sheet flow to open space, bioretention, and rain gardens.

The potential restoration strategies were individually evaluated using the WTM to estimate the pollutant reduction benefit the project could provide. The full WTM user guide is available online from the Center for Watershed Protection (CWP) at www.cwp.org.

Potential to Reduce Stormwater Pollutant Loads

The proposed restoration projects would provide additional stormwater controls to 341 impervious acres in the Brier Ditch subwatershed. This represents a 45-percent increase in the acres of impervious surfaces controlled by stormwater management, bringing the total acres controlled by stormwater management up to approximately 348 or 46-percent of the total impervious acres. Table 3-1 summarizes the improvements in stormwater controls after implementation of the proposed projects.

Table 3-1: Level of Stormwater Control in Brier Ditch Subwatershed After Implementation of All Proposed Stormwater Projects

Total Impervious Acres	Existing Stormwater Controls		Potential Future Stormwater Controls		Increase in Impervious Acreage Controlled by Stormwater Projects
	Acres	% of Impervious Total	Acres	% of Impervious Total	
756	7.2	0.9%	348	46.0%	45.1%

Table 3-2: Evaluation of Stormwater Control Levels and Potential in Pollutants Load Reduction					
Impervious Acreage Controlled	**Pollutants Load Reduction Potential**				**Increase in Impervious Acreage Controlled by Stormwater Projects**
	N	**P**	**TSS**	**Bacteria**	
	(lbs/yr)	(lbs/yr)	(tons/yr)	(lbs/yr)	
46% (proposed projects)	3,072	594	124	77,432	45.1%

* Current Stormwater Control Levels are at 0.9%

Using the distribution of projects included in the provisional inventory, several future control levels were evaluated using the WTM to estimate potential pollution reduction. Table 3-2 identifies the maximum control level evaluated (as percent impervious acres controlled) as well as the associated pollution reduction potential. The Plan Formulation appendix of the Anacostia Restoration Plan and Report provides the characteristics of each BMP type included in the provisional inventory.

To fully evaluate the benefits of providing different levels of stormwater control, the existing pollutant load and the pollution reduction potential in the watershed must be considered in terms of the existing Anacostia River TMDLs for nutrients and TSS (Kim et al., 2007; Mandel et al., 2008). The TSS TMDL calls for an 85-percent reduction in existing TSS loading to the Anacostia River watershed. The nutrient TMDL established a necessary reduction of 79-percent for nitrogen and 80-percent for phosphorus. Table 3-3 summarizes the overall Anacostia River TMDL reduction goals, the Brier Ditch existing pollutant loadings, and the ability of the various stormwater control levels to address the pollution reduction in the Brier Ditch subwatershed to help meet the Anacostia River TMDLs. The implementation of all of the proposed stormwater projects reduces the pollutant load between 14 and 34-percent. Given that the TMDL goals for the Anacostia River are between 79 and 85-percent reduction, stormwater controls alone will not be able to address the contribution from Brier Ditch.

Table 3-3: Ability of Stormwater Control Levels to Address TMDL Goals in Brier Ditch Subwatershed			
Impervious Control Level	Pollutant Reduction Achieved		
	N	P	TSS
TMDL Reduction Goal for Brier Ditch as Pro-Rated Share of Anacostia TMDL	16,912 lbs/yr (79%)	1,777 lbs/yr (80%)	315 tons/yr (85%)
Estimate of Existing Pollutant Loads in Brier Ditch	21,408 lbs/yr	2,221 lbs/yr	370 tons/yr
Maximum Reduction Potential from Proposed Projects	3,072 lbs/yr (14%)	594 lbs/yr (27%)	124 tons/yr (34%)

It should be noted that the load reduction estimates of Table 3-3 do not account for reductions in stream channel erosion, which is another benefit of stormwater management. The following section addresses the potential reduction in stream channel erosion following the implementation of the proposed restoration actions.

Potential to Reduce Peak Flow Discharge

The TSS TMDL for the Anacostia River estimates that about 70 to 75-percent of the sediment delivered from the watershed to the tidal estuary comes from stream bank and channel erosion. Estimating the reduction of stream channel sediment loads that would result from controlling urban stormwater runoff is very challenging. A peak flow reduction analysis is used as a surrogate measure to give insight into the potential for reducing in-stream channel erosion loads. In fact, erosion of the stream channel is directly related to the increase in stream energy associated with the peak flow. Reducing the peak flow at the outlet of the watershed will lead to the reduction in erosive shear stress on the stream banks. Therefore, it is logical to assume potential reduction in stream bank erosion by quantifying the reduction in peak flows associated with the levels of stormwater control. Table 3-4 contains the results of that quantification. The Center for Watershed Protection (CWP) has an Impervious Cover Model (ICM) which classifies the ability of a watershed to support wildlife based on its level of impervious. The ICM describes watersheds having an impervious surface cover between 0 to 10-percent as ‘sensitive’, 10 to 25-percent as being ‘impaired’, those having 25 to 60-percent impervious cover as ‘non-supporting’, and those with 60 to 100-percent impervious cover as ‘urban drainage’. Brier Ditch is currently approximately 29-percent impervious, which would be considered in the ‘non-supporting’ range according to the ICM. The Peak Flow Analysis in Table 3-4 would indicate that if approximately 50-percent of all impervious acres in the subwatershed were controlled this would be effectively equivalent to reducing the impervious cover of the watershed enough to place it in the lower end of the ‘impaired’ category under ICM. This analysis however, is not meant to imply that a controlled acre of impervious surface is environmentally equivalent to say forest cover, but does help to evaluate to what level stormwater controls can contribute to reducing runoff and thereby improving the overall environmental health of a stream system.

The peak discharges are estimated using regression equations developed by the Maryland Hydrology Panel in support of the Maryland State Highway Administration (MSHA). The equations are used in the estimate of flood discharges for the design of culverts and bridges (Molgen, 2007). Details on the peak flow reduction potential analysis are given in the Plan Formulation appendix of the Anacostia Watershed Restoration Plan and Report.

Table 3-4 Peak Flow Analysis Results for Brier Ditch Subwatershed

	No Treatment	**Current Treatment**	**Impervious Area Treated with Storm Water Controls**					
	0% Treated	0.9% Treatment	25% Treated	30% Treated	40% Treated	50% Treated	70% Treated	100% Treated
Effective Percent Impervious	32.3*	32.0	25.8	24.5	22.0	19.4	14.2	6.5
Peak Flow (cfs)	287	286	262	257	246	234	207	153
Peak Flow per square mile (cfs)	69	69	63	62	59	56	50	37
Peak Flow in gpd per square mile	44,595,865	44,595,865	40,717,964	40,071,647	38,132,696	36,193,745	32,315,844	23,913,725

(cfs) = cubic feet per second (gpd) = gallons per day Conversion: 1 cfs = 646,316.883 gpd

*The method used to calculate the current level of imperviousness in this table differs slightly from the method used in the cumulative reductions analysis of this SWAP

The Brier Ditch subwatershed is located entirely within the coastal plain geographic province, the peak discharges were estimated using the following regression equation:

(Equation 1 – Coastal) $$Q1.25 = 18.62*DA^{0.611} * (IA+1)^{0.419} * (SD+1)^{0.165}$$

The Q1.25 indicates that the peak discharges are associated with a rainfall event that has the likelihood of occurring once every 1.25 years. In addition, DA represents drainage area in square miles, IA represents-percentage of impervious area, and SD represents-percentage of group D soils, which are soils with a high runoff potential and slow infiltration rate. Although these regression equations have limitations, which are discussed in the Plan Formulation appendix of the Anacostia Watershed Restoration Plan and Report, they provide a reasonable initial measure of the potential for reducing peak discharges as a function of different amounts of stormwater management.

Among the limitations of this analysis, one is of particular importance. The peak discharge analysis should be interpreted with caution. Although the peak flow at the outlet of a watershed is used as a simple yardstick, reducing the peak flow is not a guarantee of reduced stream channel erosion throughout the watershed. The selection of stormwater controls should consider the MDE design manual guidance for redevelopment. Detailed hydrologic and hydraulic analyses are necessary to determine hydrograph timing to avoid inadvertently increasing channel erosion.

Potential to Reduce Pollutant Loads Using Street Sweeping

Street sweeping is included in the provisional project inventory as a trash control, but street sweeping can also serve as an effective pollutant removal technique if the right equipment and the right techniques are employed (Montgomery County 2002). Particles that accumulate on road surfaces such as road grit, sand, and dirt; heavy metals including copper, lead, and zinc; and nitrogen and phosphorus can all be removed to some extent by street sweeping. The highest concentration of pollutants is associated with the smallest particles of road grit (EPA, 1983). Of the three technologies available for street sweeping, regenerative air sweepers and vacuum assisted sweepers provide the greatest pollutant removal. Mechanical broom sweepers do the least to remove the small particles associated with most pollutants.

Decisions such as frequency of sweeping, type of road swept (residential or mixed use, etc.), whether cars are permitted to be parked in the roadway, and training of personnel performing the street sweeping affects the efficiency of the practice. Ideally, street sweeping is most effective when pollutants are permitted to accumulate and then the area is swept prior to a rain event. However, this situation is logistically difficult. The WTM is capable of estimating removal of N, P, and TSS by street sweeping. Evaluations with the WTM identify that weekly sweeping can remove 67-percent more N, P, and TSS than monthly sweeping.

The benefit of street sweeping was evaluated for the roads within the Brier Ditch subwatershed. (Table 3-5). Information regarding the methodology and assumptions made in the analysis can be found in the Plan Formulation appendix to the Anacostia Watershed Restoration Plan and Report.

Table 3-5: Pollutant Reduction Estimate of Weekly Street Sweeping (Streets Only)							
Other Roads		**Annual Pollutant Reduction**			**Percent Reduction**		
Percent of Roadway Treated	**Miles**	**N (lbs/yr)**	**P (lbs/yr)**	**TSS (tons/yr)**	**N**	**P**	**TSS**
5	0.7	61	6	1	0.3%	0.3%	0.2%
10	1.5	122	11	2	0.6%	0.5%	0.5%
15	2.2	182	17	3	0.9%	0.8%	0.7%
20	3.0	243	22	4	1.1%	1.0%	1.0%
25	3.7	304	28	5	1.4%	1.3%	1.2%
50	7.5	608	56	9	2.8%	2.5%	2.5%
75	11.2	912	84	14	4.3%	3.8%	3.7%
100	14.9	1215	112	18	5.7%	5.1%	5.0%
Residential Roads		**Annual Pollutant Reduction**			**Percent Reduction**		
Percent of Roadway Treated	**Miles**	**N (lbs/yr)**	**P (lbs/yr)**	**TSS (tons/yr)**	**N**	**P**	**TSS**
5	2.1	136	17	2	0.6%	0.8%	0.6%
10	4.2	272	34	5	1.3%	1.6%	1.3%
15	6.3	408	52	7	1.9%	2.3%	1.9%
20	8.4	544	69	10	2.5%	3.1%	2.6%
25	10.5	680	86	12	3.2%	3.9%	3.2%
50	21.0	1,360	172	24	6.4%	7.8%	6.5%
75	31.5	2,039	259	36	9.5%	11.6%	9.7%
100	42.0	2,719	345	48	12.7%	15.5%	13.0%

The benefits of street sweeping on pollutant removal can also be considered for parking lots. Parking lots accumulate trash and pollutants that eventually wash into the stormwater system during rain events. The results of the parking lot analysis are displayed in the Table 3-6. The benefit of sweeping parking lots does not appear to be great, but once accumulated over the entire watershed this practice has the potential to not only contribute to reaching trash reduction goals, but also pollutant removal goals if implemented on a large scale.

Table 3-6: Pollutant Reduction Estimate of Weekly Sweeping of Parking Lots							
Parking Lots		**Annual Pollutant Reduction**			**Percent Reduction**		
Percent of Parking Lots Swept	**Acres**	**N (lbs/yr)**	**P (lbs/yr)**	**TSS (tons/yr)**	**N**	**P**	**TSS**
5	8.3	13	1	0	0.1%	0.0%*	0.1%
10	16.7	26	2	0	0.1%	0.1%	0.1%
15	25.0	39	3	1	0.2%	0.1%	0.2%
20	33.4	51	4	1	0.2%	0.2%	0.2%
25	41.7	64	5	1	0.3%	0.2%	0.3%
50	83.4	128	9	2	0.6%	0.4%	0.6%
75	125.1	193	14	3	0.9%	0.6%	0.8%
100	166.8	257	18	4	1.2%	0.8%	1.1%
* Value is less than 0.05							

The full benefit of an enlarged street sweeping program would reflect the pollution reduction gained from sweeping residential and 'other' roads, as well as parking lots. Table 3-7 contains the total pollutant reductions for various levels of road and parking lot sweeping. The data indicates that fairly substantial reductions can be realized once the percentage of roads swept weekly get above 50-percent.

Table 3-7: Total Pollutant Reduction Estimate of Weekly Sweeping of All Streets and Parking Lots							
Streets and Parking Lots		**Total Annual Pollutant Reduction**			**Total-percent Reduction**		
Percent Swept	**Acres**	**N (lbs/yr)**	**P (lbs/yr)**	**TSS (tons/yr)**	**N**	**P**	**TSS**
5	21.6	210	24	4	1.0%	1.1%	1.0%
10	43.2	419	48	7	2.0%	2.1%	1.9%
15	64.8	629	71	11	2.9%	3.2%	2.9%
20	86.4	838	95	14	3.9%	4.3%	3.8%
25	108.0	1,048	119	18	4.9%	5.4%	4.8%
50	216.0	2,096	238	35	9.8%	10.7%	9.6%
75	324.0	3,144	357	53	14.7%	16.1%	14.3%
100	432.0	4,192	475	71	19.6%	21.4%	19.1%
Brier Ditch Goals as Pro-Rated Share of Anacostia TMDL		16,912	1,777	315	79%	80%	85%

As discussed previously, sweeping may be logistically difficult. Stormwater retrofits to the road network within the Brier Ditch subwatershed, including Green Streets, bioswales, or pervious pavement, in conjunction with street sweeping would increase the amount of pollutants removed from the system. These Green Streets initiatives would require programmatic or policy changes to local ordinances. These road network stormwater retrofits are further described in the Anacostia Watershed Restoration Plan and Report and associated Plan Formulation appendix.

Pollutant Reduction of Homeowner Stormwater Management

Provisional stormwater restoration projects implemented by governmental agencies alone are only one piece of the strategy needed to control stormwater and the pollutants carried into the Anacostia River watershed. Implementing every stormwater project outlined in this inventory will account for an approximate 45-percent increase in the impervious acres controlled by stormwater management within the Brier Ditch subwatershed. However, with approximately 4,550 residential homes in the subwatershed, there is also the need to involve private homeowners in the stormwater control effort. Homeowner efforts would target stormwater from the roofs, driveways, and sidewalks. A number of stormwater control treatments, or homeowner BMPs, are available for application: green roofs, rain gardens, rain barrels, permeable pavement, and downspout disconnects. Additional information on homeowner BMPs can be found in the Plan Formulation appendix to the Anacostia Watershed Restoration Plan and Report.

Table 3-8 summarizes the number of residential homes throughout Brier Ditch subwatershed and the related impervious acreage. The impervious acreage that is occupied by single family homes, on-single family homes, single family driveways, and sidewalks equals approximately 305 acres of the 756 total impervious acres (or 40-percent) within the subwatershed. Stormwater management controls ion this acreage could contribute significantly to reducing pollutant and stormwater inputs throughout the watershed.

Table 3-8 : Brier Ditch Subwatershed Impervious Acres Analysis of Residential Homes

		Impervious acres			
Brier Ditch Subwatershed Area	**Number of Residential Homes**	**Single Family Homes**	**Private (non-single family)**	**Single Family Driveway**	**Sidewalks**
Upper	2,924	96.4	22.9	40.9	14.5
Middle	1,178	39.7	29.9	16.5	6.8
Lower	449	13.4	14.9	6.3	3.2
TOTAL	4,551	149.5	67.7	63.7	24.5

An evaluation was performed, using the WTM, to investigate the potential of the homeowner BMPs to control the stormwater inputs produced by residential homes within the subwatershed. Four of the practices are focused on rooftop runoff: green roofs, rain barrels, rain gardens, and downspout disconnects. The fifth practice directly applies to sidewalks and driveways. Six scenarios of various combinations of the five BMPs were evaluated.

1. Control 1-percent of the impervious acreage with green roofs, 1-percent with downspout disconnections, 1-percent with rain barrels and 1-percent with rain gardens. Control 1-percent of the sidewalk and drive way impervious acreage with permeable pavement.

2. Control 5-percent of the impervious acreage with green roofs, 5-percent with downspout disconnections, 5-percent with rain barrels, and 5-percent with rain gardens. Control 5-percent of the sidewalk and drive way impervious acreage with permeable pavement.

3. Control 10-percent of the impervious acreage with green roofs, 10-percent with downspout disconnections, 10-percent with rain barrels, and 10-percent with rain gardens. Control 10-percent of the sidewalk and driveway impervious acreage with permeable pavement.

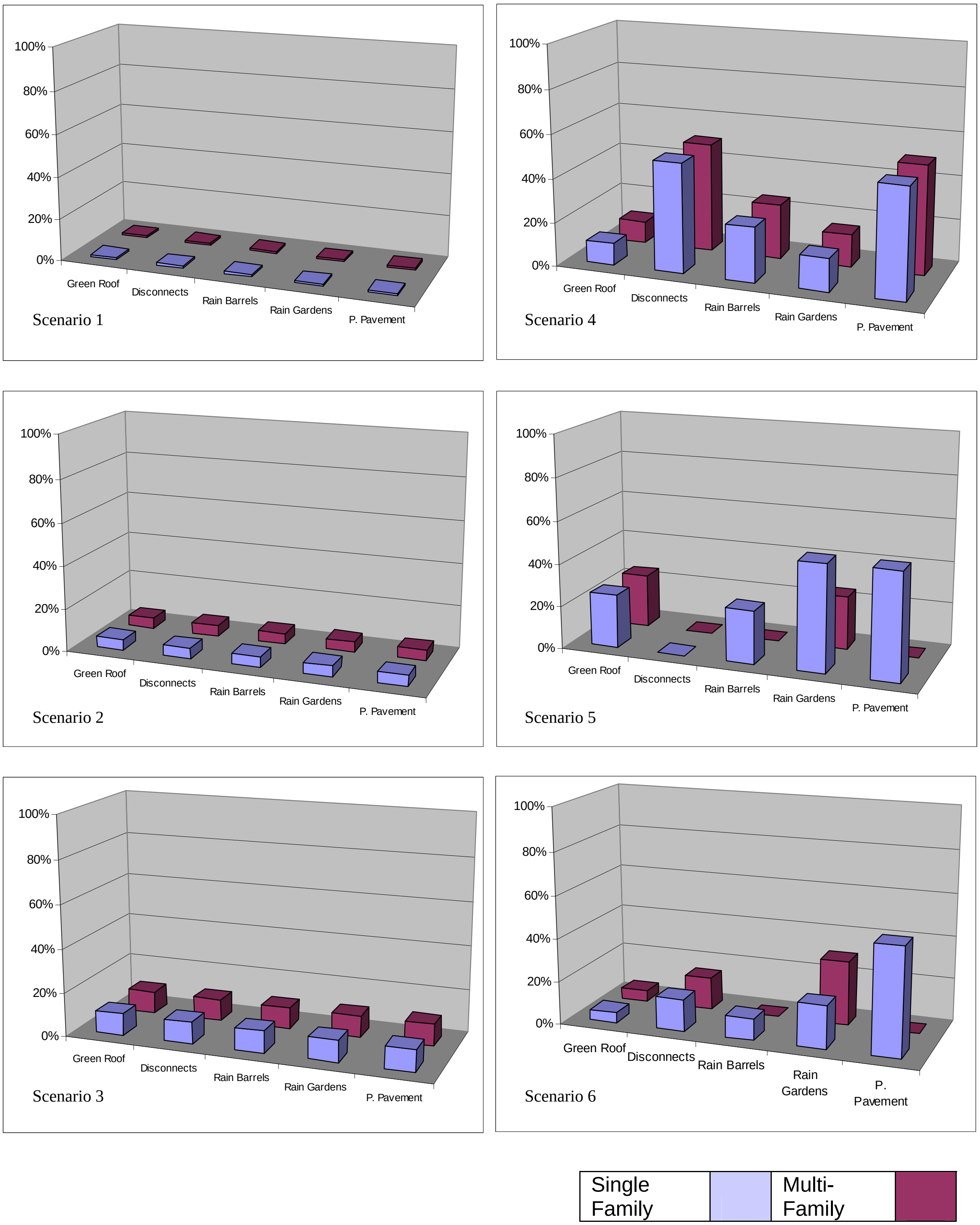
4. Control 10-percent of the impervious acres with green roofs, 50-percent with downspout disconnections, 25-percent with rain barrels, and 15-percent with rain gardens. Control 50-percent of the sidewalk and driveway impervious acreage with permeable pavement.

5. Control half of the acreage of private, multi-family residences by treating 25-percent of the impervious acreage with rain gardens and 25-percent with green roofs. Control half of the single-family driveways and sidewalks with permeable pavement, and control all of the single-family home impervious roof acreage by treating 25-percent with rain barrels, 25-percent with green roofs, and 50-percent with rain gardens.

6. Control half of the acreage of private, multi-family residences by treating 30-percent of the impervious acreage with rain gardens, 15-percent with downspout disconnections, and 5-percent with green roofs. Control half of the single-family driveways and sidewalks with permeable pavement, and control all of the single-family home impervious roof acreage by treating 10-percent with rain barrels, 5-percent with green roofs, 15-percent with downspout disconnections and 20-percent with rain gardens.

Figure 3-1 illustrates the 6 scenarios of homeowner BMPs were analyzed.

Figure 3-1: Homeowner BMP Scenarios



The efficiencies used by the WTM for pollutant reduction estimates when evaluating the first four scenarios of homeowner BMPs are presented in Table 3-9 and Figure 3-2

Figure 3-2: Removal Efficiencies of Homeowner BMPs in WTM

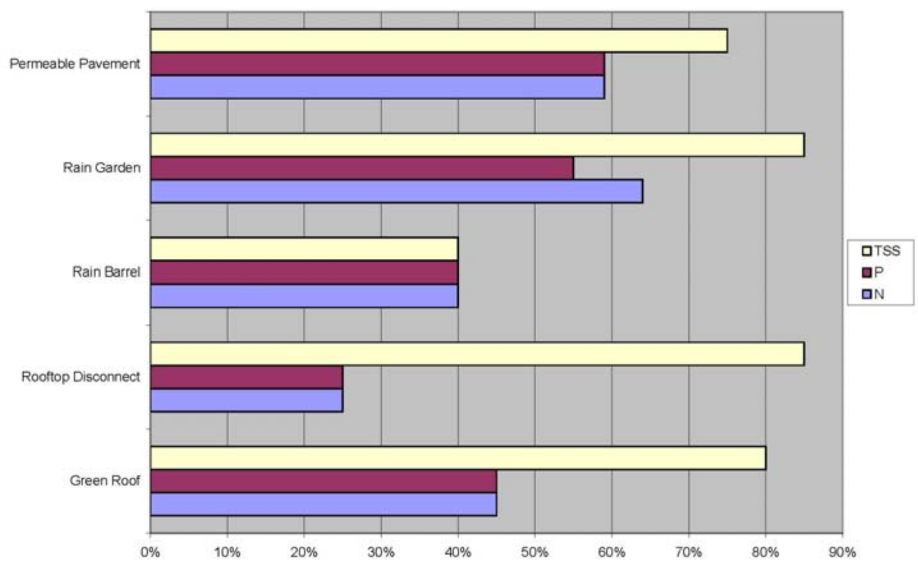


Table 3-9: Removal Efficiencies of Homeowner BMPs in WTM				
	Pollutant Removal Efficiencies of WTM			
	N	P	TSS	Bacteria
Green Roof	45%	45%	80%	0%
Rooftop Disconnect	25%	25%	85%	0%
Rain Barrel	40%	40%	40%	0%
Rain Garden	64%	55%	85%	90%
Permeable Pavement	59%	59%	75%	0%

Based on the removal efficiencies, rain gardens provide the greatest pollutant removal capability for treating rooftop run-off; however, implementation of this may be problematic in areas where there are large numbers of apartments or townhouses rather than single homes. For treating sidewalks and driveways, permeable pavement provides similar capabilities to rain gardens, except there is no reduction for bacteria. Plans that incorporate these two practices on residential properties would make the greatest pollutant removal contributions.

These scenarios evaluate potential plans that could be set as targets for homeowner participation in stormwater control programs. Tables 3-10 and 3-11 provide an estimate of the potential for each of these scenarios to reduce the current pollutant loadings to Brier Ditch.

Table 3-10: Pollutant Reduction of Homeowner Stormwater Control Scenarios (Estimates made using WTM)				
Scenario	**N (lbs/yr)**	**P (lbs/yr)**	**TSS (tons/yr)**	**Bacteria (billions cfu/yr)**
1	120	13	3	1,471
2	604	64	16	7,353
3	1,204	127	32	14,706
4	2,956	319	89	22,058
5	3,476	360	78	62,069
6	2,162	226	55	33,995

Table 3-11: Percent Reduction of Pollutants Estimated for Homeowner Scenarios and Acreage Controlled					
Scenario	**N**	**P**	**TSS**	**Impervious Acreage Controlled**	**Percent of Residential Impervious Acreage Controlled**
1	1%	1%	1%	19.4	6.4%
2	3%	3%	4%	47.8	15.7%
3	6%	6%	9%	95.7	31.3%
4	14%	14%	24%	261.3	85.6%
5	16%	16%	21%	227.4	74.5%
6	10%	10%	15%	152.7	50.0%

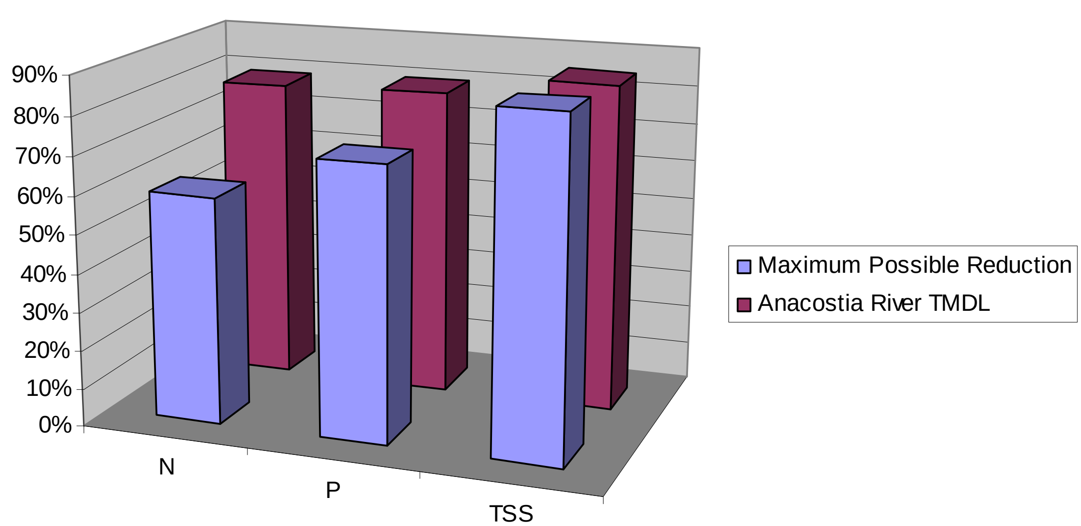
A significant fraction of pollutants could be controlled if homeowner stormwater controls were implemented over a large portion of the subwatershed. In order to achieve this, an effort needs to be put forth to increase public awareness and participation, so that all the citizens of the subwatershed are working together toward the common goal. Local governments can encourage this through significant outreach, coordination, technical assistance, and funding to extensively apply a homeowner’s stormwater management control program. If implemented, such programs have the potential to greatly reduce the pollutant loads to the subwatershed, particularly when implemented alongside provisional stormwater management projects implemented by local governments.

Table 3-12 and Figure 3-3 presents a summary of the potential pollutant load reductions that could be achievable by implementing the aforementioned projects, and compares them to the TMDL reductions goals that were established for the Anacostia River. The numbers presented here, however, do not necessarily account for the interactions of the projects with one another and are clearly subject to some double-counting of reductions. Therefore the numbers in Table 3-12 should not be considered in any further calculations, but rather taken in more relative terms of what is achievable. This double counting of reductions is likely attributed to double coverage of residential acreage through homeowner BMPs, Green Streets in residential areas, and sweeping of residential streets, because all three of these potential project types were considered independently when in reality they would affect the same physical acreage on a map. Likewise, the combining of stormwater retrofit projects with other practices would lead to same reductions being accounted for in multiple projects. The Plan Formulation appendix of the main document addresses this occurrence in more detail.

Therefore, when considering the results of this analysis, it should be viewed not from the standpoint of whether or not a certain level of reductions can be achieved in 10 years, but rather what significant contributions can be made toward creating a healthier Anacostia River watershed. The data presented in this report is an encouraging indicator that it is not too late to take the steps necessary to improve the environmental conditions in the Anacostia River. The projects recommended in this report are a great start down that path, but they need to be supplemented with increased community involvement, a strong education effort, and more environmentally friendly policies. The goal should be to look back in 10 years and see the progress that has been made in restoring the Anacostia River and its subwatersheds.

Table 3-12: Maximum Potential Pollutant Reduction for Stormwater Controls, Homeowner BMPs, and Street Sweeping			
	N (lbs/yr)	**P (lbs/yr)**	**TSS (tons/yr)**
Current Brier Ditch Loading	21,408	2,221	370
Brier Ditch Reduction Goals as Pro-Rated Share of Anacostia TMDL	**16,912 (79%)**	**1,777 (80%)**	**315 (85%)**
Maximum Possible Reduction			
Stormwater Controls (45% of Acreage Controlled)	3,072	594	124
LID Green streets	2,794	266	61
Homeowner BMPs (Scenario 5)	3,476	360	78
Street Sweeping (75% of residential roads and 50% lots)	3,394	366	58
Total Maximum Possible Reduction	12,736	1,586	321
% Total Reduction in Brier Ditch Loading	**59%**	**71%**	**87%**

Figure 3-3: Maximum Possible Reduction versus Anacostia River TMDL



Section 4
10-Year Targets and Milestones

Brier Ditch 10-Year Targets and Milestones

The Brier Ditch 2020 Restoration Targets were determined based on the potential implementation of restoration opportunities identified within the Brier Ditch subwatershed as part of the ARP, along with realistic expectations of what could be accomplished in ten years to meet the 2020 restoration objectives, and as such the target numbers do not necessarily represent the implementation of every project in the potential inventory. These targets are established to ensure that restoration of the subwatershed is proceeding in the right direction and at a continuous, reasonable pace.

Stormwater Management

Using LID methods, ESD principles, and other stormwater management techniques, stormwater retrofit projects should be implemented to increase control to a total of approximately 341 acres of existing impervious surfaces. This represents a 45-percent increase of controlled impervious surfaces.

Operate and maintain existing stormwater management facilities, stormwater drainage systems, and water and wastewater systems.

Aquatic Community

Increase the general Index of Biotic Integrity (IBI) scores to "Fair Range" for both fish and macroinvertebrate communities.

Remove or modify fish passage barriers to open approximately 1.6 miles of Brier Ditch and its tributaries for the movement of both residents and migratory fish.

Trash Reduction

Using the MWCOG Trash Index for reference, reduce trash levels one tier from High to Moderate in the lower Brier Ditch corridor.

Increase existing street sweeping programs to sweep approximately 5 to 10 additional curb miles weekly of residential and other roads. Additionally, increase sweeping of parking lots to approximately 80 to 85 acres.

Wetland Creation and Restoration

Restore approximately 7.7 acres of permanent wetlands.

Riparian Corridors

Reforest approximately 2 acres of riparian buffer along the Brier Ditch.

Based on the Anacostia Watershed Forest Management and Protection Strategy and the Center for Watershed Protection recommended tree canopy cover as a-percentage of land area, increase the overall tree canopy over 40-percent.

Environmental Restoration Programs
Consider the implementation or expansion of programs designed to assist private property owners in controlling impervious surfaces with measures such as rain barrels and rain gardens.

Outreach and Public Participation
Increase both the outreach and education programs for schools and private businesses on the restoration and protection of Brier Ditch subwatershed.

Establish a Friends of Brier Ditch organization, and launch a membership drive.

Promote homeowners and private business restoration incentives, such as reusable grocery bags, rain gardens, rain barrels, and tree planting.

Expand existing programs to provide homeowners with access to BMPs such as rain barrels.

Promote passive use of existing parkland and employ more eco-friendly techniques in areas designated for high usage such as non-paved walking paths and increase height of grass mowing.