Indian Creek Subwatershed Action Plan

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Section 1
Vision and Existing Conditions

The Indian Creek Subwatershed Action Plan (SWAP) is intended to be an integrated summary document for the Indian Creek Subwatershed Environmental Baseline Conditions Report and the Indian Creek Subwatershed Provisional Restoration Projects Inventory. Based on a 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 the watershed 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 Indian Creek 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 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 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 providing for a healthier macroinvertebrate community food base. Restore migratory fish usage of Indian Creek.
5. **Trash Reduction**: Dramatically reduce trash loads in Indian Creek.
6. **Outreach:** Increase participation on the part of residents, businesses, and school-age children.
7. **Parkland Acquisition:** Increase parkland and parkland connectivity

10-Year Vision

The Indian Creek 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; to protect and restore aquatic and terrestrial habitats and associated biological communities; to enhance watershed recreational opportunities; and fully engage 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.

Indian Creek 2020 Restoration Targets

The Indian Creek 2020 Restoration Targets were determined based on the potential implementation of restoration opportunities identified within the Indian Creek 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 park Parkland 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 Indian Creek Subwatershed

The Indian Creek subwatershed, which has a drainage area of 15.1 square miles (or approximately 9,694 acres), is located in the northeastern vicinity of the Anacostia River watershed (Figures 1-2 and 1-3). The entirety of the Indian Creek subwatershed is within Prince George's County, Maryland. Select reaches of Indian Creek have been channelized for flood risk management purposes. Approximately 70-percent of the total subwatershed is developed. Overall, the Indian Creek subwatershed is not one of the most heavily populated within the Anacostia Watershed; having a population density of 2,290 persons per square mile, but it is one of the more heavily industrialized subwatersheds within the Anacostia River watershed. The three major land uses in the subwatershed are (1) medium density, single family residential, (2) industrial, and (3) agricultural. The U.S. Department of Agriculture, Beltsville Agricultural Research Center (BARC) makes up the majority of the agricultural land use. Only one private working farm remains in use. Impervious surfaces make up about 21.5-percent (2,085 acres) of the subwatershed, with approximately 31-percent of the subwatershed being forested. Figure 1-1 and Table 1-1 present a summary of the impervious surfaces and level of stormwater control within the Indian Creek subwatershed. Currently, approximately 37-percent (3,583 acres) of the Indian Creek subwatershed impervious acreage has stormwater controls (Figure 1-4). The locations of the current BMPs present in the subwatershed are also shown in Figure 1-4.

The Inter-county Connector (ICC) is large scale ongoing highway construction project that will have the potential to add additional pollutants and stressors to the Indian Creek watershed. The ICC will link existing and proposed development areas between the I-270/I-370 and I-95/US 1 corridors within central and eastern Montgomery County and northwestern Prince George's County with a multi-modal east-west highway. In addition to the new highway, there is a 2,200 acre, 3 billion dollar multi-use development being constructed (Konterra Town Center East) on a former sand and gravel pit on the fringe of the city of Laurel, MD west of I-95. Both projects are currently under construction with the ICC slated for completion in 2011, and the town center taking up to 20 years to complete.

Figure 1-1: Impervious Acres in Indian Creek Subwatershed

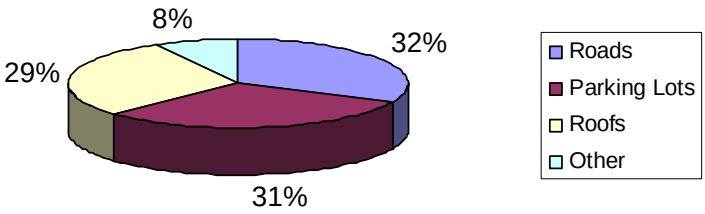


Table 1-1: Impervious Surfaces in the Indian Creek Subwatershed and Existing Level of Stormwater Control		
	Miles	**Acres**
Roads	172.4	663.6
State/Federal	22.1	166.8
Local	150.3	496.8
Parking Lots	…	651.9
Public/Institutional	…	42.8
Private	…	609.1
Roofs	…	599.0
Public/Institutional	…	16.4
Private	…	388.7
Single Family	…	193.8
Other	…	170.6
Sidewalks	…	83.6
Single Family Driveways	…	87.0
Total Impervious Acres		2,085.1
Total Subwatershed Acres		9,694.0
Avg. % Imperviousness		21.5%
Current Impervious Acreage Controlled		771
Current-percent Impervious Acreage Controlled by Stormwater Management		37%
Number of existing Best Management Practices (BMPs)		43

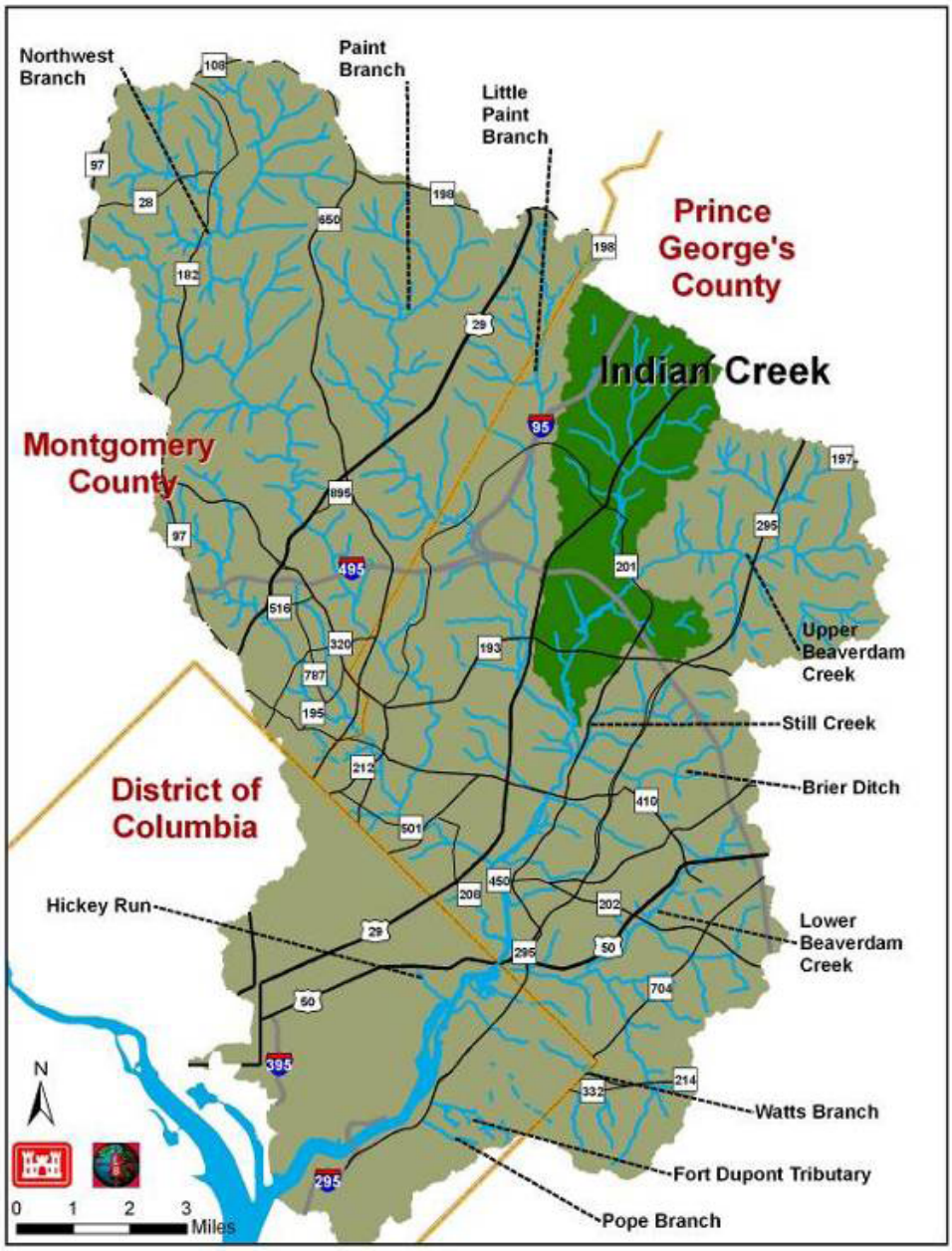


Figure 1-2: Indian Creek Subwatershed

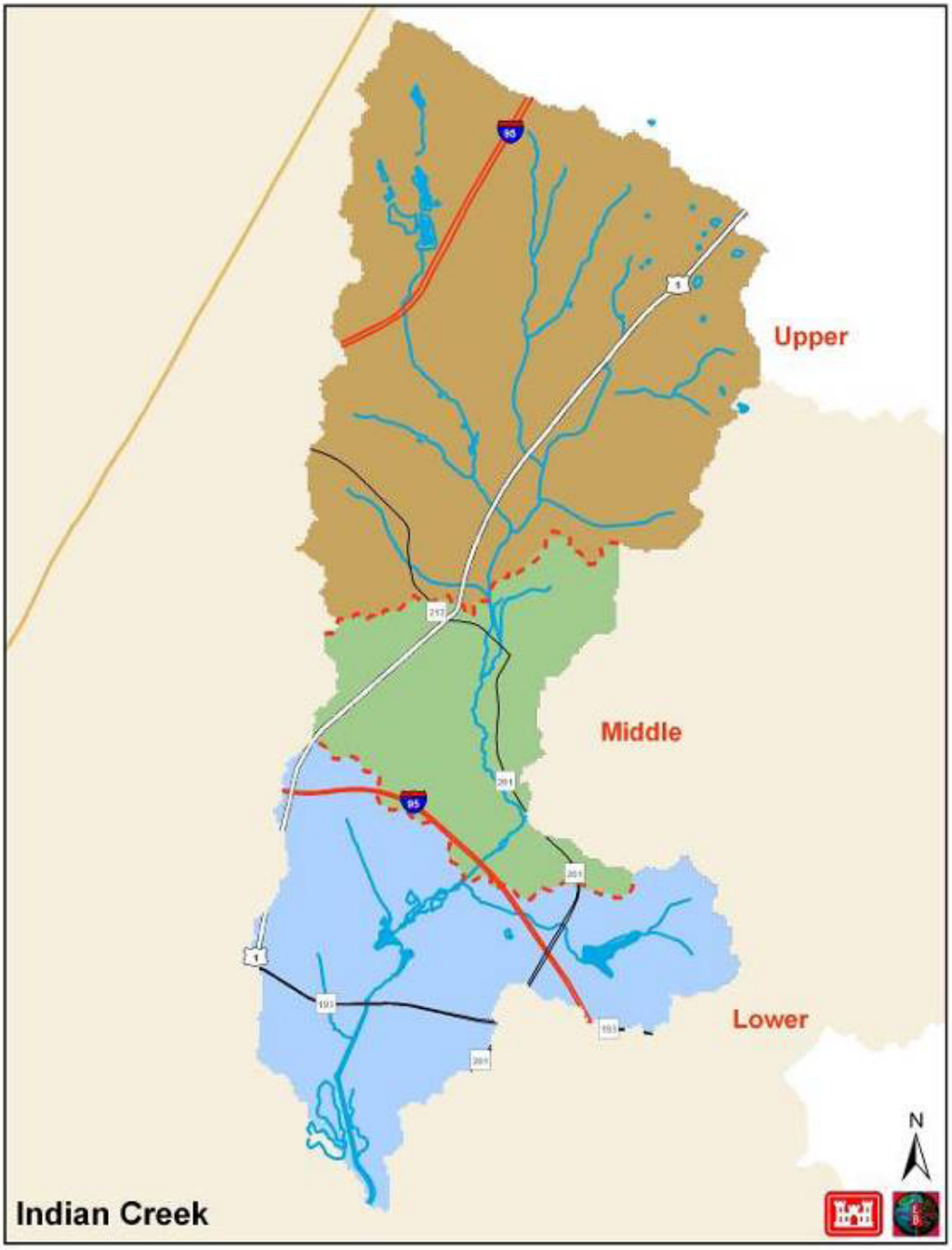


Figure 1-3: Indian Creek Subwatershed Planning Units

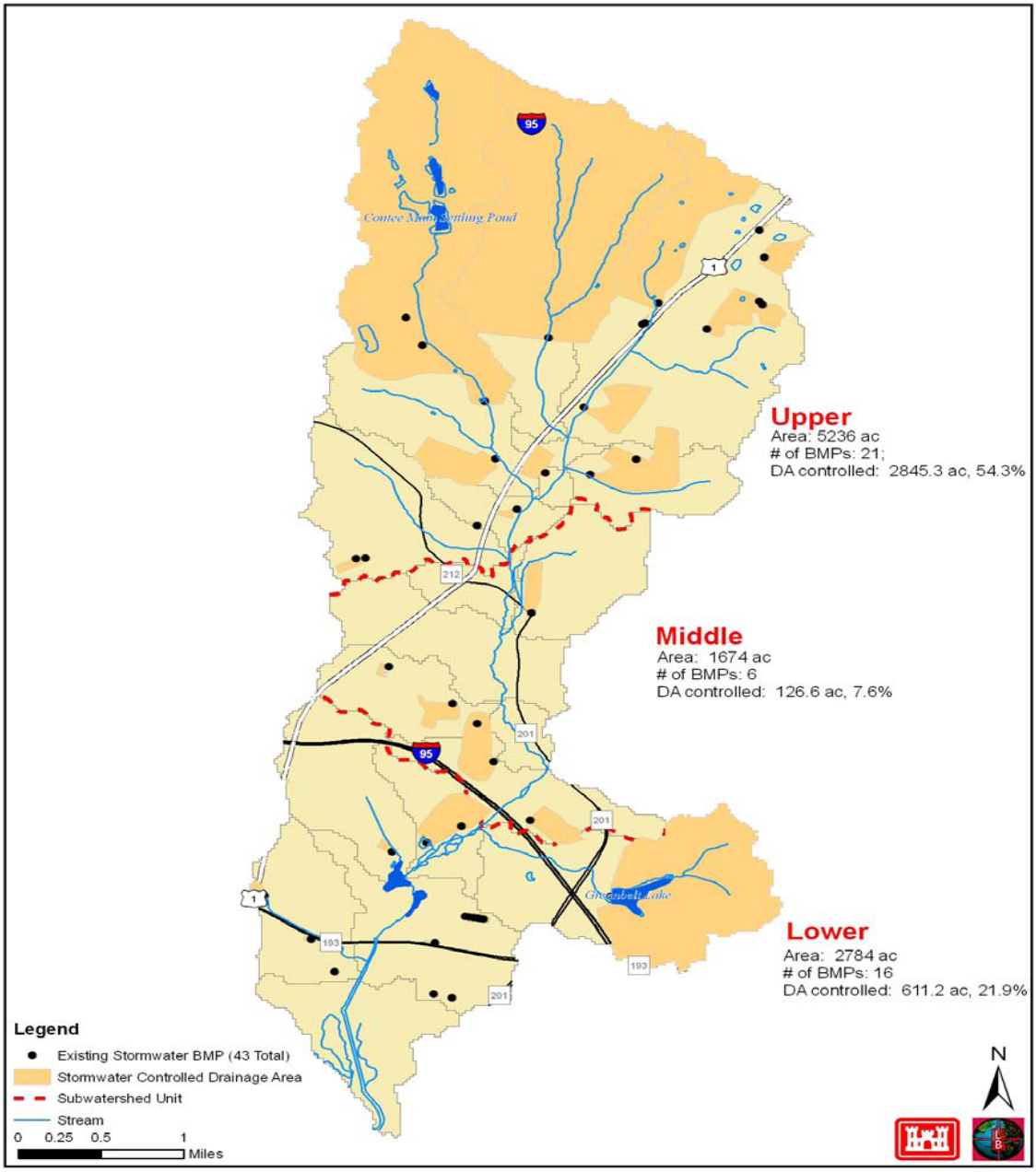


Figure 1-4: Indian Creek Subwatershed BMP Locations

Problems Facing the Indian Creek Subwatershed

Changes to Hydrology

Development of the Indian Creek subwatershed has altered the hydrology and flow regime, and is a cause for other problems facing the subwatershed. With the change in land cover from forest or agriculture to impervious surfaces, such as roofs, roads, and parking lots, stormwater runoff increases where 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 middle portion of the Indian Creek subwatershed, upstream of the Capitol Beltway.

Poor Aquatic Habitats

As with many developed watersheds, the biological characteristics of the streams in this subwatershed are far less than ideal for the support of healthy ecosystems. Only about 30-percent of the stream miles have adequate riparian buffers (at least 300 feet of total width). Two-thirds of the IBI sampling stations were rated as either non-supporting or partially supporting physical aquatic habitat. Only the lower main stem has conditions rated as generally good. There are multiple physical barriers to fish movement in the subwatershed as well. A total of 28 fish barriers have been identified through field visits. Many of these blockages are a result of road culverts and utilities exposed by stream erosion. The Indian Creek Baseline Conditions and Restoration Report, contains additional information on the locations of the fish barriers and IBI data for the subwatershed.

Poor Water Quality

Water quality also plays a major role in the problems facing the Indian Creek subwatershed. The high level of imperviousness, inadequate number of stormwater management controls, both abandoned and active sand and gravel operations, as well as moderate stream channel erosion have all contributed to the Indian Creek subwatershed total suspended solids (TSS) load being the highest among all the Anacostia River subwatersheds. The TSS load is estimated to be approximately 144 tons/square mile/year. The nutrient loading rates associated with this are presented in Table 1-2. The sediment Total Maximum Daily Load (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.

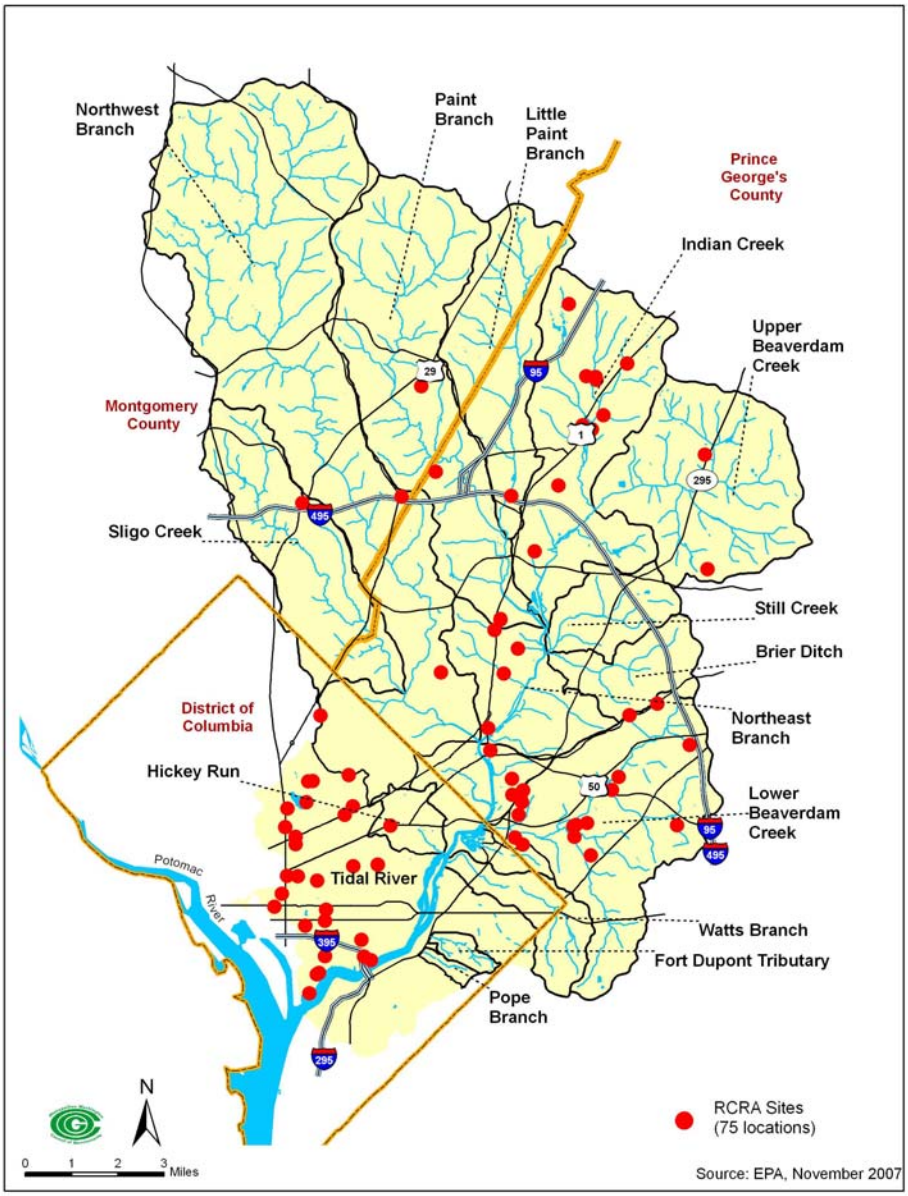


Figure 1-5: RCRA Sites in Anacostia Watershed

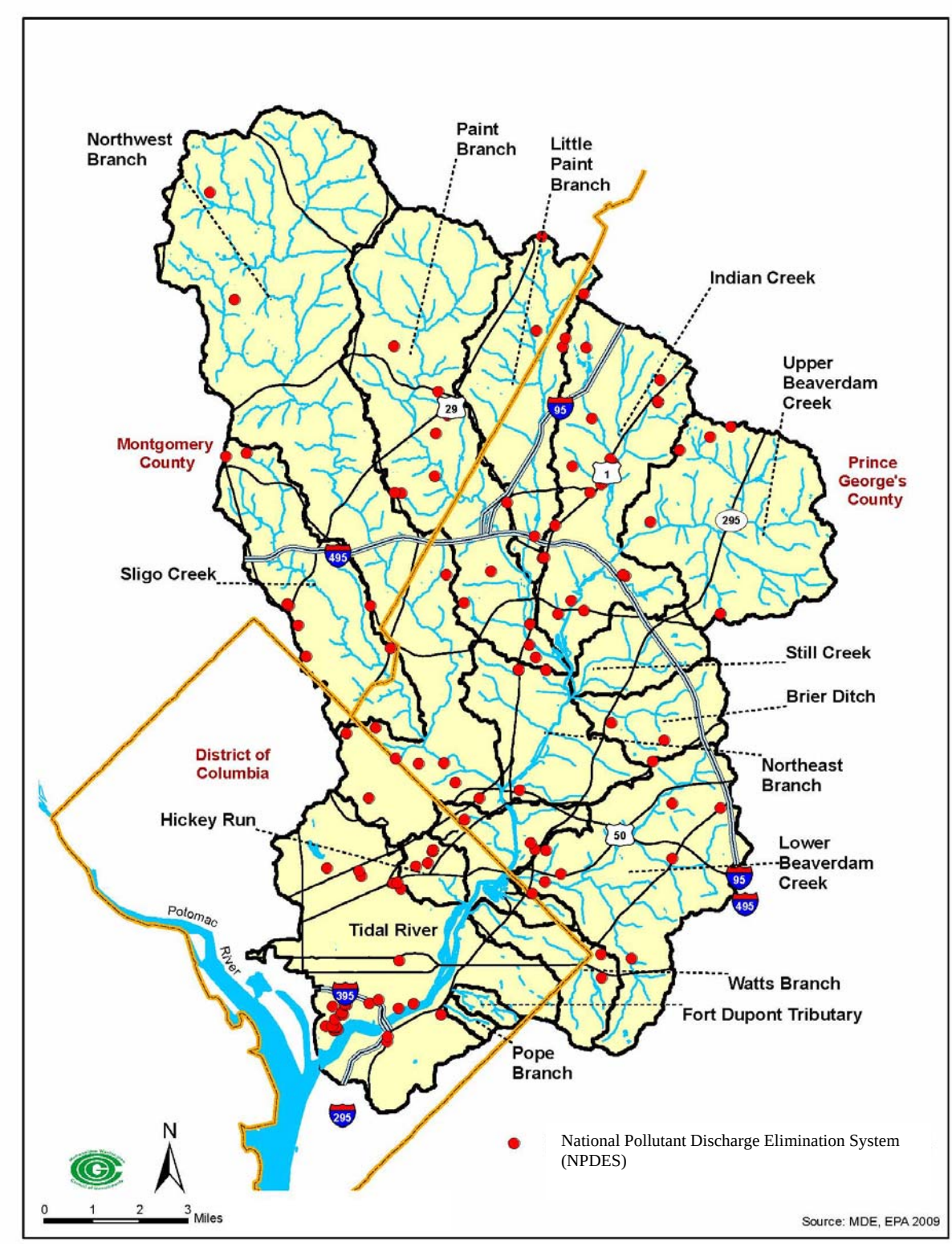


Figure 1-6: NPDES Sites in Anacostia Watershed

Toxics, which include trace metals, polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), pesticides, and herbicides, enter the surface waters of the subwatershed via runoff (non-point source) and industrial/municipal discharge. There are a total of 119 National Pollutant Discharge Elimination System (NPDES) related discharges in the Anacostia River and 18 of them are located within the Indian Creek subwatershed. In addition there are also Resource Conservation and Recovery Act (RCRA) sites found in the Indian Creek subwatershed, indicating historic dump sites and likely source of contaminants and heavy metals. Figures 1-5 and 1-6 indicate the NPDES and RCRA sites that are present in the Anacostia River subwatershed. There has been minimal data collected to determine the extent and source of the toxics that are present in the Indian Creek subwatershed. One study used active bio-monitoring to attempt to locate sources of PCB, PAH, and chlordane, which identified the presence of elevated levels of PAH downstream from the Beltsville Industrial Park and Muirkirk Industrial Park (Phelps, 2007).

The available fecal coliform sampling for the 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 Indian Creek, 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 to 5-percent), domestic animals (24 to 28-percent), livestock (6 to 28-percent), and wildlife (12 to 38-percent). In the future there will be monitoring stations set up at two Indian Creek locations by the Washington Sanitary Sewer Commission (WSSC) so that levels of bacterial contamination can be monitored.

Trash

Trash is another non-point source contaminant entering the system. Surveys have indicated that chronic trash hot spots are found in the subwatershed along the U.S. Route 1 corridor. This is largely due to the heavily commercialization/industrialization of the vicinity and the lack of trash controls. Plastic bags, plastic bottles, and styrofoam have been identified as the most frequent forms of trash in the Indian Creek subwatershed.

Further data and discussion regarding the current conditions of the Indian Creek subwatershed can be found in the Indian Creek Environmental Baseline Conditions and Restoration Report. Information regarding existing conditions and health of the Anacostia River watershed as a whole can be found in the Anacostia Watershed Environmental Baseline Conditions and Restoration Report.

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 experienced development of floodplains prior to the development of stormwater management regulations and controls. Periodic flooding within Indian Creek occurs primarily within the middle and lower portions of the subwatershed just upstream of the Capital Beltway down to the confluence with Paint Branch, and along the Route 1 corridor in the upper portion of the subwatershed.

Existing Pollutant Loads

Existing pollutant loadings for sediment, nitrogen (N), and phosphorous (P) was calculated for the Anacostia River watershed TMDL by MDE. As part of the ARP, the sediment, N, and P loadings were calculated for the Indian Creek subwatershed using the same loading rates per land use for the TMDL in order to estimate the Indian Creek 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 Indian Creek subwatershed pollutant loading estimate, the subwatershed loading reduction for Indian Creek 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.

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 Indian Creek 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 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 Indian Creek Subwatershed and Comparison Values			
	Nitrogen lbs/sq mi/year	**Phosphorus lbs/sq mi/year**	**TSS tons/sq mi/year**
Indian Creek	6,101	466	144
Average Anacostia River Subwatershed	5,255	500	99
Completely Forested Watershed	42	8	N/A

Table 1-3: TMDL Reduction Goals			
	Anacostia River Watershed TMDL Reduction Goals	**Estimated Indian Creek Loadings**	**Estimated Indian Creek Reduction Goals as Pro-Rated Share of Anacostia TMDLs**
TSS tons/sq mi/year	85%	144	122 (85%)
Nitrogen lbs/sq mi/year	79%	6,101	4,820 (79%)
Phosphorus lbs/sq mi/year	80%	466	373 (80%)

Section 2
Inventory of the Provisional Restoration Candidates

Inventory of the Potential Restoration Projects

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 of 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 the potential project types per objective, gives a brief description, and states the metric that will be used to account for the extent of the project's implementation.

Table 2-1: 2020 Indian Creek Restoration Objectives		
Objectives	**Description of Objective**	**Metric**
Stormwater Management		
Retrofits, ESD, 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), Total Suspended Solids (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
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
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
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
Parkland Acquisition		
Increase parkland	Acquire tracts of land to increase current parkland and provide more habitat connectivity	Acres Acquired
Outreach / Public Involvement		
Increase participation of residents and businesses	Educate the public about BMPs and encourage their use of them	Qualitative
Establish Friends of Indian Creek 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 212 potential restoration candidate projects within the Indian Creek subwatershed have been identified as part of the ARP investigation. The complete inventory and description of the 212 proposed projects are included in the Indian Creek Subwatershed Provisional Restoration Projects Inventory. The potential restoration projects address five of six restoration strategies identified for the Indian Creek 2020 restoration objectives (does not include projects for increasing participation, as this will be left to the communities, local authorities, and watershed groups). The presence of toxic contaminants has been identified in Indian Creek; 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 Section 1 of this SWAP on Figures 1-5 and 1-6.

Tables 2-2, 2-3, and 2-4 provide a summary of the proposed restoration project types, quantity, and the typical 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 Indian Creek Subwatershed Provisional Restoration Projects Inventory.

Table 2-2: Inventory of Restoration Projects in the Indian Creek Subwatershed

Candidate Project Type	Number of Projects	Estimated Cost ($)	Additional Impervious Acreage Controlled (ac)	Length Restored or Managed (mi)	Acreage Restored or Created (ac)
Stormwater Retrofit	115	90,788,100	859.0	-	-
Stream Restoration	16	29,246,500	-	3.1	
Wetland Creation / Restoration	14	885,850	-	-	15.7
Fish Blockage Removal / Modification	5	495,000		1.2	
Riparian Reforestation/Invasive Management	21	60,750	-	-	16.2
Trash Reduction	16	51,500	-	4.8	-
Sediment(Toxic) Remediation	-	-	-	-	-
Parkland Acquisition	25	15,640,000	-	-	156.4
Total	212	137,167,700	859.0	9.1	185.5

Table 2-3 Proposed Restoration by Type in the Indian Creek Subwatershed					
Project Type	**Watershed Area**				
	Upper	**Middle**	**Lower**	**Total**	**Total New for Retrofit Projects**
Wetland and Wet Pond Stormwater (acres)*	31.1	73.9	92.1	197.1	184.6
Bioretention (acres)*	214.0	133.0	135.9	482.9	478.0
Bioswales (acres)	3.8	0.0	2.4	6.2	6.2
Permeable Pavement (acres)	1.8	0.0	11.1	12.9	12.8
Sand Filter (acres)*	36.8	92.7	9.6	139.1	138.1
Green Roof (acres)	4.9	0.0	11.4	16.3	16.3
Rain Barrels (acres)	0.3	0.0	10.4	10.7	10.7
Rain Garden (acres)	1.3	0.0	10.7	12.0	12.0
Wet Pond/Pipe/Weir Modification (acres)	455.4	3.0	170.9	629.3	0.0
Street Sweeping (acres)	2.7	0.0	1.3	4.0	N/A
Invasive Species Management (acres)	1.6	0.7	0.1	2.4	N/A
Meadow Planting(acres)	0.0	0.0	0.0	0.0	N/A
Wetland Restoration (acres)	3.8	11.5	0.0	15.3	N/A
Vernal Pools Restoration/Creation (acres)	0.0	0.0	0.0**	0.0	N/A
Reforestation (acres)	4.2	0.9	2.5	7.6	N/A
Parkland Acquisition (acres)	152.7	3.7	0.0	156.4	N/A
Stream Restoration (miles)	2.1	0.3	0.7	3.1	N/A
Fish Passage (miles)	0.0	0.0	1.2	1.2	N/A
Trash Reduction (number of projects)	12	3	1	16.0	N/A

*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.

**Acreage is less than 0.05

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 Indian Creek Subwatershed

To recommend restoration action and to determine the sequence for implementation, the quantitative scoring scheme was used to evaluate the 212 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 212 projects ranged from 83 to 59 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.

The scoring scheme for the provisional stormwater management candidate projects was subsequently further adjusted. The three tier system was retained, but the tier boundaries were adjusted based on distribution of the refined 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 Indian Creek subwatershed separated by restoration strategy.

Stormwater Management

To provide for better differentiation for potential benefits that would be produced by the 115 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 Metropolitan Washington Council of Governments (MWCOG) and is presented in the Indian Creek 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 of 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 Indian Creek Subwatershed Provisional Restoration Projects Inventory.

Table 2-5: Top 20 Potential Stormwater Retrofit Projects within the Indian Creek Subwatershed

Project ID	Jurisdiction*	Project Name	Adjusted Score	Overall Rank (based on original scoring)	Estimated Cost ($)
IC-L-01-S-12	PG	Narragansett Parkway above 52nd Avenue College Park MD.	107.6	8	1,409,000
IC-M-01-S-5	PG	Prince George's County Site 160306, stormwater outfall between Southard Dr and Hanna St, adjacent to northeast corner of Beltsville Industrial Park close to railroad tracks, Beltsville, MD	107.4	19	9,089,000
IC-M-01-S-19	PG	Commercial area (Costco Wholesale) 10925 Baltimore Avenue, Beltsville, MD	106.5	19	1,250,000
IC-M-01-S-29	PG	USDA 5601 Sunnyside Avenue, Beltsville, MD	105.8	10	38,000
IC-L-01-S-11	PG	Narragansett Parkway College Park MD: grassy depression-swale with 2 outfalls, East of the REI Shopping Center	105.6	14	1,726,000
IC-L-01-S-23	PG	Residential area and streets bounded by Pontiac Street and Berwyn Road College Park, MD	105.6	14	2,160,000
IC-L-01-S-15	PG	Greenbelt Lake, Buddy Attick Lake Park, Greenbelt MD	104.6	19	7,620,000
IC-M-01-S-20	PG	Commercial area (District Photo ID) 10501 Rhode Island Avenue, Beltsville, MD	104.4	71	837,000
IC-L-01-S-29	PG	Parking lot and apartment complex on 6000 Cherrywood Lane, Greenbelt, MD	103.6	32	1,842,000
IC-L-01-S-7	PG	Sir Walter Raleigh Inn 6323 Greenbelt Rd, Berwyn Heights, MD 20740	102.9	14	650,000
IC-M-01-S-18	PG	Industrial Complex on 5019 Herzel Place, Beltsville, MD	102.4	92	884,000
IC-M-01-S-24	PG	South end of Tucker Street, Beltsville, MD	102.4	92	876,000
IC-U-01-S-9	PG	Martin Luther King Middle School, 4545 Ammendale Rd, Beltsville, MD	102.4	3	2,977,000
IC-M-01-S-16	PG	End of Somerset Avenue, Beltsville, MD	101.8	48	590,000
IC-L-01-S-32	PG	Stormwater outfall between the east end of Lackawanna St, College Park, MD 20740 and the Greenbelt Metro station	101.6	71	1,621,800
IC-M-01-S-23	PG	Industrial area 10406 Tucker Street	101.5	92	1,260,000
IC-L-01-S-28	PG	School bus park on 6300 Greenbelt Rd # 1, Greenbelt, MD	100.8	48	990,000
IC-M-01-S-14	PG	Beltsville commerce Center Commercial area between route 1 and Southard Drive	99.9	71	460,000
IC-U-01-S-13	PG	Beltsville Elementary School on Howard Rd, Beltsville, MD	99.7	3	950,000
IC-L-01-S-27	PG	Parking lot south of the Target on 6100 Greenbelt Route 1, Greenbelt, MD	99.6	92	3,982,000
TOTAL					**41,211,800**

*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 Indian Creek Branch Subwatershed

Project ID	Jurisdiction*	Project Name	Adjusted Score	Overall Rank based on Original Scoring	Estimated Cost ($)
IC-U-01-S-9	PG	Martin Luther King Middle School, 4545 Ammendale Rd, Beltsville, MD	102.4	3	2,977,000
IC-U-01-S-13	PG	Beltsville Elementary School on Howard Rd, Beltsville, MD	99.7	3	950,000
IC-U-01-S-1	PG	Industrial Park at the Intersection of Virginia Manor Road and Ritz Way, Beltsville, MD	99.2	32	50,000
IC-U-01-S-30	PG	Cedar Lane from Emmanuel United Methodist Church, 11416 Cedar Lane, to Montgomery Rd, Beltsville, MD	98.3	32	1,130,000
IC-U-01-S-49	PG	Stormwater detention pond at dead end of Highview Ave, Beltsville, MD	97.2	71	42,000
TOTAL					**5,149,000**

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

Table 2-7: Top 5 Potential Stormwater Retrofit Projects within the Middle Indian Creek Subwatershed

Project ID	Jurisdiction*	Project Name	Adjusted Score	Overall Rank based on Original Scoring	Estimated Cost ($)
IC-M-01-S-5	PG	Prince George's County Site 160306, stormwater outfall between Southard Dr and Hanna St, adjacent to northeast corner of Beltsville Industrial Park close to railroad tracks, Beltsville, MD	107.4	19	9,089,000
IC-M-01-S-19	PG	Commercial area (Costco Wholesale) 10925 Baltimore Avenue, Beltsville, MD	106.5	19	1,250,000
IC-M-01-S-29	PG	USDA 5601 Sunnyside Avenue, Beltsville, MD	105.8	10	38,000
IC-M-01-S-20	PG	Commercial area (District Photo ID) 10501 Rhode Island Avenue, Beltsville, MD	104.4	71	837,000
IC-M-01-S-18	PG	Industrial Complex on 5019 Herzel Place, Beltsville, MD	102.4	92	884,000
Total					**12,098,000**

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

Table 2-8: Top 5 Potential Stormwater Retrofit Projects within the Lower Indian Creek Subwatershed					
Project ID	**Jurisdiction***	**Project Name**	**Adjusted Score**	**Overall Rank based on Original Scoring**	**Estimated Cost ($)**
IC-L-01-S-12	PG	Narragansett Parkway above 52nd Avenue College Park MD.	107.6	8	1,409,000
IC-L-01-S-11	PG	Narragansett Parkway College Park MD: grassy depression-swale with 2 outfalls, East of the REI Shopping Center	105.6	14	1,726,000
IC-L-01-S-23	PG	Residential area and streets bounded by Pontiac Street and Berwyn Road College Park, MD	105.6	14	2,160,000
IC-L-01-S-15	PG	Greenbelt Lake, Buddy Attick Lake Park, Greenbelt MD	104.6	19	7,620,000
IC-L-01-S-29	PG	Parking lot and apartment complex on 6000 Cherrywood Lane, Greenbelt, MD	103.6	32	1,842,000
Total					**14,757,000**
*PG=Prince George's County, Maryland Scoring Tier = **Tier I**, **Tier II**, **Tier III**					

Stream Restoration

The top 5 out of 16 potential stream restoration candidate projects are presented in Table 2-9. Lengths of the stream restoration projects range from 0.02 miles to 0.5 miles. Additional project description information can be found in the Indian Creek Subwatershed Provisional Restoration Projects Inventory.

Table 2-9: Top 5 Potential Stream Restoration Projects within the Indian Creek Subwatershed

Project ID	Jurisdiction*	Project Name	Score	Overall Rank	Estimated Cost ($)
IC-U-02-SR-3	PG	Unnamed tributary to Indian Creek, crossing at Muirkirk Rd near Virginia Manor Rd (at location of Prince George's County Site 129201), Beltsville MD	78	10	15,000
IC-L-02-SR-1	PG	Downstream of the culvert under the Metro line, south of Narragansett Pkwy, College Park, MD	76	19	24,000
IC-L-02-SR-2	PG	225 ft east of Fayette, between Prince George's County Site 182105 and bridge for trail under Hillside Rd, Greenbelt, MD 20770	76	19	45,000
IC-L-02-SR-3	PG	Greenhill-Hillside Park Greenbelt MD - Site is bridge for trail towards tunnel leading under Hillside RD, Residential	76	19	9,000
IC-L-02-SR-4	PG	Near the tunnel under Hillside Road (Greenhill-Hillside Park), Residential and road – Greenbelt MD	76	19	27,000
Total					**120,000**

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

Wetland Creation or Restoration

All of the potential wetland restoration candidate projects are presented in Table 2-10. These projects include wetland restoration and vernal pool creation. Additional project description information can be found in the Indian Creek Subwatershed Provisional Restoration Projects Inventory.

Table 2-10: Potential Wetland Creation or Restoration within the Indian Creek Subwatershed

Project ID	Jurisdiction	Project Name	Score	Overall Rank	Estimated Cost ($)
IC-L-03-W-3	PG	200 ft downslope from southeast parking lot of Greenbelt Metro (5717 Greenbelt Metro Drive Greenbelt, MD 20770)	78	10	500
IC-U-03-W-1	PG	430 ft north of Van Dusen Rd, approximately 2500 ft west of I-95, Laurel, MD	77	14	1,250
IC-U-03-W-6	PG	800 ft downstream of Regional Stormwater Control IC2, Beltsville MD	76	19	10,000
IC-U-03-W-7	PG	300 ft downstream of Regional Stormwater Control IC2, Beltsville MD	76	19	20,000
IC-L-03-W-2	PG	Narragansett Tributary - 500 feet Downstream and to the west of railroad culvert passing under the Metro line	75	32	70,000
IC-U-03-W-2	PG	Approximately 700 feet north of Van Dusen Rd, 0.60 miles west of I-95, Laurel, MD	75	32	600
IC-U-03-W-3	PG	Approximately 1500 feet north of Van Dusen Rd, 0.65 miles west of I-95, Laurel, MD	75	32	500
IC-U-03-W-5	PG	Approximately 1500 ft north of Van Dusen Rd, 0.50 miles west of I-95, Laurel, MD	72	83	500
IC-M-05-W-1	PG	End of Somerset Ave, Beltsville, MD	71	92	40,000
IC-U-03-W-9	PG	Close to Prince George's County site #140101, 290 ft east of parking lot at end of Trolley Lane, west of Stormwater Regional facility IC2 Beltsville, MD	71	92	170,000
IC-U-03-W-8	PG	Approximately 0.1 mile southwest of the Stormwater Regional Facility IC2	69	138	12,500
IC-M-05-W-2	PG	Prince George's County Site 174103, Greenbelt, MD	67	172	535,000
IC-U-03-W-4	PG	Approximately 2500 ft north of Van Dusen Rd, 0.75 miles west of I-95, Laurel, MD	64	199	5,000
IC-L-03-W-1	PG	Narragansett Tributary Immediately downstream of railroad culvert passing under the Metro line	62	209	20,000
TOTAL					**885,850**

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

Fish Blockage Removal or Modification

All of the potential fish blockage removal or modification candidate projects are presented in Table 2-11. The length of the potential projects identified range from 0.03 miles to 0.6 miles. Additional information regarding the project descriptions is available in the Indian Creek Subwatershed Provisional Restoration Projects Inventory.

Table 2-11: Potential Fish Blockage Removal or Modification Projects within the Indian Creek Subwatershed

Project ID	Jurisdiction	Project Name	Score	Overall Rank	Estimated Cost ($)
IC-L-04-F-3	PG	Greenbelt tributary, Prince George's County Site 180202, south of the Marriott hotel on Ivy Lane and north of the Route 201/I-95 interchange, Greenbelt	76	19	120,000
IC-L-04-F-2	PG	Greenbelt tributary, Rte 201 culvert east of the Marriott hotel,360 ft southwest of Crescent Lane, (close to Prince George's County Site 180201) Greenbelt	71	92	75,000
IC-L-04-F-4	PG	Greenbelt tributary crossing I-95, west of the Marriott hotel on Ivy Lane, Greenbelt	69	138	75,000
IC-L-04-F-5	PG	Greenbelt tributary, 200 ft upstream of the Edmonston Rd crossing, Greenbelt	69	138	75,000
IC-L-04-F-1	PG	At Prince George's County Site 178205, Indian Creek at intersection of Narragansett Parkway and 52nd Avenue	59	212	150,000
TOTAL					**495,000**

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

Riparian Reforestation and Invasive Species Management

All of the potential riparian reforestation and invasive species management candidate projects are presented in Table 2-12. Project sizes ranged from 0.04 acres to 3.4 acres. Additional information regarding the project descriptions is available in the Indian Creek Subwatershed Provisional Restoration Projects Inventory.

Table 2-12: Potential Riparian Reforestation and Invasive Species Management Candidate Projects within the Indian Creek Subwatershed

Project ID	Jurisdiction	Project Name	Score	Overall Rank	Estimated Cost ($)
IC-U-05-R-11	PG	Existing BMP site #0596, 730 ft northeast of the intersection of Muirkirk Rd and Cinder Rd, Beltsville, MD	82	2	1,500
IC-M-05-R-4	PG	At Prince George's County Site 161106 and 157101: Inlet of left fork of box culvert (Site 161101) at NE corner of Powder Mill Rd and Edmontston Rd	80	3	6,300
IC-U-05-R-10	PG	MARC Train Muirkirk Station, east of intersection of Muirkirk Rd and Rte 1, north side of parking lot, Beltsville, MD 20705	80	3	3,000
IC-U-05-R-9	PG	Between a small parking lot and a football field at Vansville Elementary School on 6813 Ammendale Rd Beltsville, MD	78	10	2,000
IC-M-05-R-2	PG	Greenbelt Metro Drive, Greenbelt MD 20770	75	32	1,250
IC-U-05-R-2	PG	Prince George's County Site 129201, stream crossing over Muirkirk Rd, 725 ft from intersection with Virginia Manor Rd, Beltsville, MD	75	32	1,000
IC-L-05-R-3	PG	Prince George's County Site 172201 downstream of Powder Mill Rd, Beltsville, MD 20705	74	48	10,800
IC-U-05-R-5	PG	At Prince George's County Site 130201, 250 ft northwest of end of Cinder Rd, Laurel, MD	73	71	500
IC-U-05-R-7	PG	Behnke Nurseries Co. 11300 Baltimore Ave, Beltsville, MD 20705, near Prince George's County Site 155105	73	71	15,300
IC-L-05-R-4	PG	Prince George's County Site 180206; Unnamed tributary to Indian Creek – Edmonston Road, Greenbelt, MD 20770	71	92	1,800
IC-U-05-R-1	PG	Prince George's County Site 156107: Mainstem of Indian Creek northeast of Old Baltimore Pike / Herzel Road intersection, Beltsville, MD	71	92	1,000
IC-L-05-R-1	PG	51st Street & Lackawanna, College Park, MD 20740	70	118	800
IC-U-05-R-3	PG	Next to Indian Creek, behind building on 6405 Ammendale Rd, Beltsville, MD	70	118	1,500
IC-U-05-R-4	PG	6403 Ammendale Rd, Beltsville, MD 20705 - behind building, 700 ft from Ammendale Rd, southeast corner of parking lot	68	153	500
IC-L-05-R-2	PG	Prince George's County Site 182103, Greenbelt, MD 20770 - 130 ft southeast of Fayette into park	67	172	100
IC-L-05-R-6	PG	Prince George's County Site 190201, 300 ft north of Berwyn Rd, College Park, MD	67	172	6,400
IC-U-05-R-6	PG	Prince George's County Site 146202, south off Ammendale Way, Beltsville MD 20705; 100 ft behind tennis court	66	181	1,000
IC-U-05-R-8	PG	Northwest of building on 12240 Indian Creek Ct, Beltsville, MD	66	181	500
IC-M-05-R-3	PG	Indian Creek mainstem at Herzel Place, Beltsville, MD 20705	65	191	500
IC-L-05-R-5	PG	Prince George's County Site 200302, residential park between Indian Creek and the dead end of Osage Street east of Indian Creek.	63	204	2,700
IC-M-05-R-1	PG	Prince George's County Sites 156101, 156102, 156103: Indian Creek Mainstem 35 ft upstream of Powder Mill Rd culvert, Beltsville, MD 20705	63	204	2,300
Total					**60,750**

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

Trash Reduction

The potential trash reduction candidate projects are presented in Table 2-13. These projects include inlet grates, street sweeping, and trash cleanup. Additional information regarding the project descriptions can be found in the Indian Creek Subwatershed Provisional Restoration Projects Inventory.

Table 2-13: Potential Trash Reduction Projects within the Indian Creek Subwatershed

Project ID	Jurisdiction	Project Name	Score	Overall Rank	Estimated Cost ($)
IC-M-06-T-1	PG	Prince George's County Sites 156101, 156102, 156103: Indian Creek Mainstem upstream of Powder Mill Rd culvert, Beltsville MD 20705	83	1	2,400
IC-M-06-T-2	PG	Small tributary leading to Indian Creek just downstream of Powder Mill Rd culvert, Beltsville, MD 20705	80	3	2,500
IC-M-06-T-3	PG	Prince George's County Site 161104, 1500 ft downstream of Powder Mill Rd between Southard Dr and Edmonston Rd, Beltsville, MD	77	14	2,500
IC-U-06-T-9	PG	6600 Ammendale Rd, Beltsville, MD	75	32	2,500
IC-U-06-T-10	PG	Technology Park on 11800 Ammendale Rd, Beltsville, MD	75	32	5,000
IC-L-06-T-1	PG	Stormwater outfall on Indian Creek close to residential park between Indian Creek and the dead end of Osage Street	74	48	23,000
IC-U-06-T-4	PG	Downstream at Prince George's County Sites 142301 and 142309 - End of Industrial Drive, behind buildings at pond. Beltsville, MD	73	71	1,500
IC-U-06-T-5	PG	Approximately 40 yards off Edmonston Rd/Old Baltimore Pike intersection, close to Prince George's County Site 146201, Beltsville MD 20705	72	83	3,000
IC-U-06-T-8	PG	Existing wet detention pond and wetland located behind Marinucci Ct on Marinucci Rd, Beltsville, MD	72	83	2,000
IC-U-06-T-1	PG	Indian Creek Mainstem trash area, at intersection of Linden Rd and Spruce Ave, Beltsville, MD	70	118	700
IC-U-06-T-2	PG	Stormwater detention pond at dead end of Highview Ave, Beltsville MD	70	118	500
IC-U-06-T-6	PG	Riparian area of Indian Creek tributary, upstream of an existing wet detention pond, 380 ft southwest of intersection of Ammendale Way and Golden Arrow Ct, Beltsville, MD	70	118	500
IC-U-06-T-7	PG	On Old Baltimore Pike, Beltsville, MD 20705; across from building (Electrical Wholesales) on 12200 Old Baltimore Pike	70	118	3,500
IC-U-06-T-11	PG	635 ft north of intersection of Highview Ave and Quimby Ave,, west of the FedEx facility on Rte 1,Beltsville, MD	70	118	700
IC-U-06-T-3	PG	Approx 300 ft northeast of end of Aitcheson Road,100 ft from Prince George's County site # 122101, Beltsville, MD	68	153	500
IC-U-06-T-12	PG	Close to Prince George's County site #140101, 250 ft east of parking lot at end of Trolley Ln, Beltsville, MD	68	153	700
Total					**51,500**

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

Parkland Acquisition

There are a total of 25 Parkland Acquisition projects identified in the Indian Creek subwatershed. The top 10 are presented in Table 2-14. All 25 projects were classified as Tier II. These projects include acquisitions between 0.9 acres to 8 acres. Additional information regarding the project descriptions can be found in the Indian Creek Subwatershed Provisional Restoration Projects Inventory.

Table 2-14: Potential Parkland Acquisition Projects within the Indian Creek Subwatershed

Project ID	Jurisdiction	Project Name	Score	Overall Rank	Estimated Cost ($)
IC-U-08-L-2	PG	11731 Old Gunpowder	79	8	650,000
IC-U-08-L-11	PG	4344 Aitchenson Road	75	32	90,000
IC-U-08-L-19	PG	11603 Cedar Lane	75	32	90,000
IC-M-08-L-1	PG	10901 Montgomery Road	74	48	370,000
IC-U-08-L-3	PG	11717 Pine Street	74	48	400,000
IC-U-08-L-4	PG	4241 Ammendale Road	74	48	380,000
IC-U-08-L-5	PG	4321 Ammendale Road	74	48	390,000
IC-U-08-L-6	PG	4357 Aitchenson Road	74	48	480,000
IC-U-08-L-7	PG	4347 Aitchenson Road	74	48	510,000
IC-U-08-L-9	PG	4362 Aitchenson Road	74	48	510,000
Total					**3,870,000**

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

Summary of Recommended Restoration Actions

The Recommended Restoration Actions are those that could potentially be implemented by 2020 and are presented in Table 2-15. Additional information on the descriptions and details of the potential actions can be found in Indian Creek 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*	17	35,819,800
Tier II*	53	44,220,500
Tier III*	10	4,591,000
Tier IV	35	6,156,800
Stream Restoration		
Tier I	0	0
Tier II	15	27,276,500
Tier III	1	1,970,000
Wetland Creation / Restoration		
Tier I	0	0
Tier II	12	860,850
Tier III	2	25,000
Fish Blockage Removal / Modification		
Tier I	0	0
Tier II	4	345,000
Tier III	1	150,000
Riparian Reforestation, and Invasive Management		
Tier I	3	10,800
Tier II	16	44,950
Tier III	2	5,000
Trash Reduction		
Tier I	2	4,900
Tier II	14	46,600
Tier III	0	0
Toxic Remediation	N/A	N/A
Parkland Acquisition		
Tier I	0	0
Tier II	25	15,640,000
Tier III	0	0
TOTAL	**212**	**137,167,700**

***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 2-13 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 2-13: Summary of Potential Restoration Actions

Implementation Type	Number of Projects	Estimated Cost ($)
Design/Build	116	90,793,100
Feasibility Study	29	30,549,500
Stewardship	36	148,900
Programmatic	31	15,676,200
TOTAL	**212**	**137,167,700**

Section 3
Evaluation and Discussion of the Restoration Strategies

Evaluation of the Proposed Restoration Projects

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 Plan Formulation appendix of the Anacostia Watershed Restoration Plan and 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 of 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 908 impervious acres in the Indian Creek subwatershed. This represents a 44-percent increase in the acres of impervious surfaces controlled by stormwater management, bringing the total acres controlled by stormwater management up to 1,679 or 81-percent of the total impervious acres. Table 3-1 summarizes the improvements in stormwater controls anticipated after implementation of the proposed projects.

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

Total Impervious Acres	Existing Stormwater Controls		Total Potential Future Stormwater Controls		Increase in Impervious Acreage Controlled by Stormwater Projects
	Acres	% of Impervious Total	Acres	% of Impervious Total	
2,085	771	37%	1,679	81%	44%

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)	(billion cfu/yr)	
81% (proposed projects)	8,815	1,439	416	237,405	44%

*** Current Stormwater Control Levels are at 37%**

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 Indian Creek existing pollutant loadings, and the ability of the various stormwater control levels to address the pollution reduction in the Indian Creek subwatershed to help meet the Anacostia River TMDLs. The implementation of all of the proposed stormwater projects reduces the pollutant load between 13 and 28-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 Indian Creek.

Table 3-3: Ability of Stormwater Control Levels to Address TMDL Goals in Indian Creek Subwatershed			
Impervious Control Level	**Pollutant Reduction Achieved**		
	N	**P**	**TSS**
Reduction Goal for Indian Creek as Pro-Rated Share of Anacostia TMDLs	67,423 lbs/yr (79%)	5,219 lbs/yr (80%)	1,714 tons/yr (85%)
Estimate of Existing Pollutant Loads in Indian Creek	85,345 lbs/yr	6,524 lbs/yr	2,017 tons/yr
Maximum Reduction Potential from Proposed Projects	8,815 lbs/yr (13%)	1,439 lbs/yr (28%)	416 tons/yr (24%)

It should be noted that the load reduction estimates contained in 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'. Indian Creek is currently approximately 21.5-percent impervious, which would be considered in the high end of the 'impaired' 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 'sensitive' 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 Indian Creek Subwatershed

	No Treatment	**Current Treatment**	**Impervious Area Treated with Stormwater Controls**					
	0% Treated	20.5% Treated	25% Treated	30% Treated	40% Treated	50% Treated	70% Treated	100% Treated
Effective-percent Impervious	16.0	13.4	12.8	12.1	10.9	9.6	7.0	3.2
Peak Flow (cfs)	775	722	710	696	667	636	566	431
Peak Flow per square mile (cfs)	27	25	25	24	23	22	20	15
Peak Flow per square mile (gallons per day)	17,310,674	16,134,353	15,862,403	15,549,944	14,897,416	14,202,632	12,649,584	9,637,109

Indian Creek subwatershed is located entirely within the coastal plan geographic provinces, 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. 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 Maryland Department of the Environment's (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 nitrogen, phosphorus, 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 Indian Creek subwatershed (Table 3-5). Information regarding the methodology and assumptions made in the analysis can be found the Plan Formulation appendix of the Anacostia Watershed Restoration Plan and Report.

Table 3-5: Pollutant Reduction Estimate of Weekly Street Sweeping (Streets Only)

Non-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	4.7	210	20	5	0.2%	0.3%	0.2%
10	9.3	420	40	10	0.5%	0.6%	0.5%
15	14.0	631	59	15	0.7%	0.9%	0.7%
20	18.7	841	79	20	1.0%	1.2%	1.0%
25	23.4	1,051	99	24	1.2%	1.5%	1.2%
50	46.7	2,102	198	49	2.5%	3.0%	2.4%
75	70.1	3,153	297	73	3.7%	4.6%	3.6%
100	93.4	4,204	396	98	4.9%	6.1%	4.8%

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	4.0	268	34	5	0.3%	0.5%	0.2%
10	7.9	537	68	9	0.6%	1.0%	0.4%
15	11.9	805	101	14	0.9%	1.6%	0.7%
20	15.8	1,073	135	18	1.3%	2.1%	0.9%
25	19.8	1,341	169	23	1.6%	2.6%	1.1%
50	39.5	2,683	338	45	3.1%	5.2%	2.2%
75	59.3	4,024	507	68	4.7%	7.8%	3.4%
100	79.0	5,366	676	90	6.3%	10.4%	4.5%

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	32.6	42	4	1	0.05%	0.05%	0.05%
10	65.2	84	7	2	0.1%	0.1%	0.1%
15	97.8	126	11	3	0.1%	0.2%	0.2%
20	130.4	168	14	4	0.2%	0.2%	0.2%
25	163.0	209	18	5	0.2%	0.3%	0.3%
50	326.0	419	35	11	0.5%	0.5%	0.5%
75	489.0	628	53	16	0.7%	0.8%	0.8%
100	651.9	838	71	22	1.0%	1.1%	1.1%

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 totals for implementing sweeping in all roads and parking lots. The data indicates that very large-percentages of the roads and parking lots would have to be swept on a weekly basis to get a reasonable amount of pollutant load reduction.

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	65.8	520	57	10	0.6%	0.9%	0.5%
10	131.6	1,041	114	21	1.2%	1.8%	1.0%
15	197.3	1,561	171	31	1.8%	2.6%	1.6%
20	263.1	2,081	229	42	2.4%	3.5%	2.1%
25	328.9	2,602	286	52	3.0%	4.4%	2.6%
50	657.8	5,204	572	105	6.1%	8.8%	5.2%
75	986.6	7,805	857	157	9.1%	13.1%	7.8%
100	1,315.5	10,407	1,143	210	12.2%	17.5%	10.4%
Indian Creek Reduction Goals as Pro-Rated Share of Anacostia TMDLs		67,423	5,219	1,714	79%	80%	85%

As discussed previously, sweeping may be logistically difficult. Stormwater retrofits to the road network within the Indian Creek 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 street 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 approximately 44-percent increase in the impervious acres controlled by stormwater management within the Indian Creek subwatershed. However, with approximately 6,200 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 rooftop disconnects.

Table 3-8 summarizes the number of residential homes throughout Indian Creek subwatershed and the related impervious acreage. The impervious acreage that is occupied by single family homes, multi-family homes, single family driveways, and sidewalks equals approximately 753 acres of the 2,085 total impervious acres, or 36-percent within the subwatershed. Stormwater management controls on this acreage could contribute significantly to reducing pollutant and stormwater inputs throughout the watershed.

Table 3-8 : Indian Creek Subwatershed Impervious Acres Analysis of Residential Homes

		Impervious acres			
Watershed Area	**Number of Residential Homes**	**Single Family Homes**	**Private (multi-family)**	**Single Family Driveway**	**Sidewalks**
Upper Indian	2,135	75.8	161.4	29.9	25.6
Middle Indian	502	16.3	98.6	7.0	25.9
Lower Indian	3,581	101.7	128.7	50.1	32.1
TOTAL	6,218	193.8	388.7	87.0	83.6

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 rooftop 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.

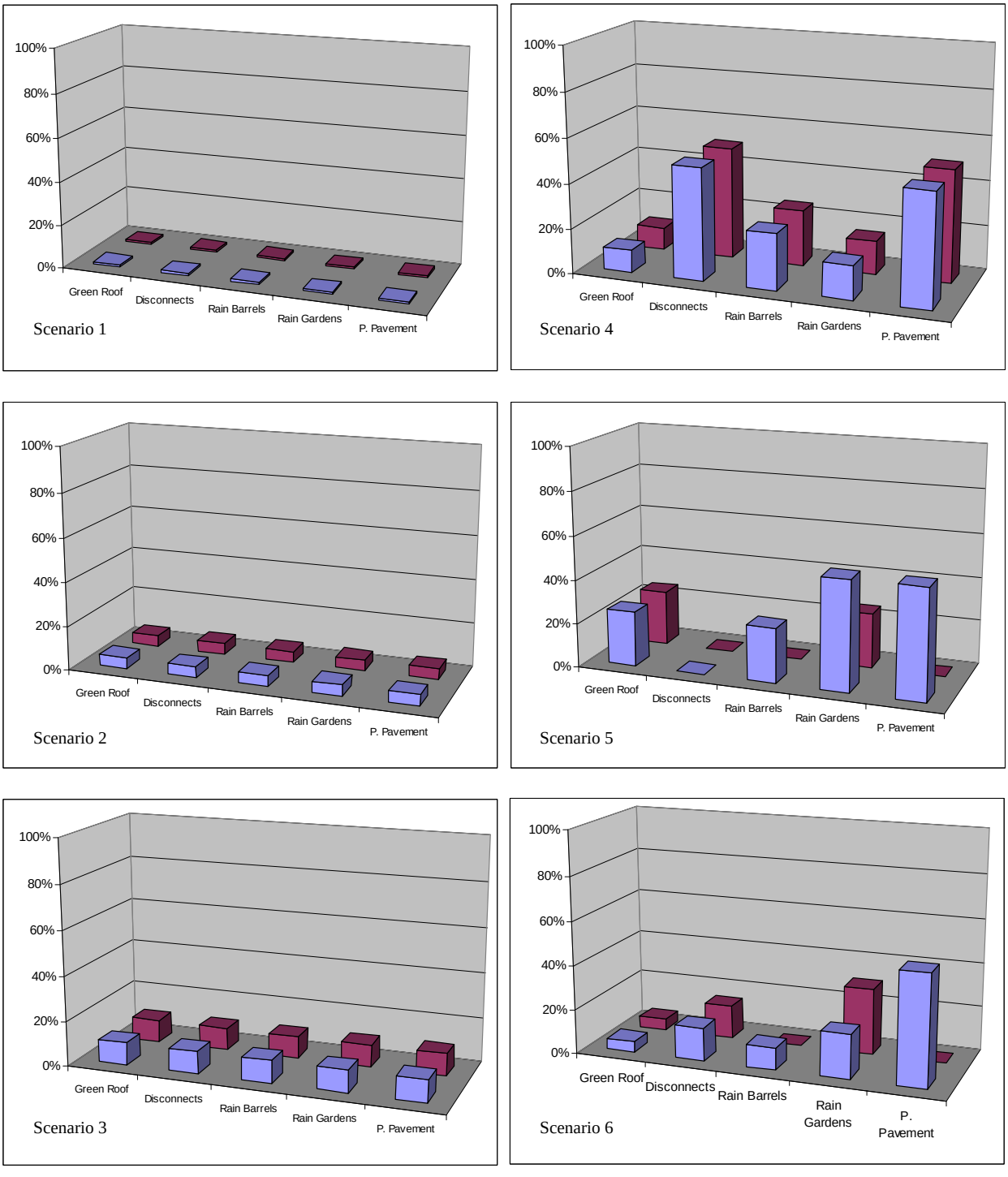
4. Control 10-percent of the impervious acres with green roofs, 50-percent with downspout disconnections, 25-percent with rain barrels, and 15-percent with rain gardens. Control 50-percent of the sidewalk and driveway impervious acreage with permeable pavement.

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

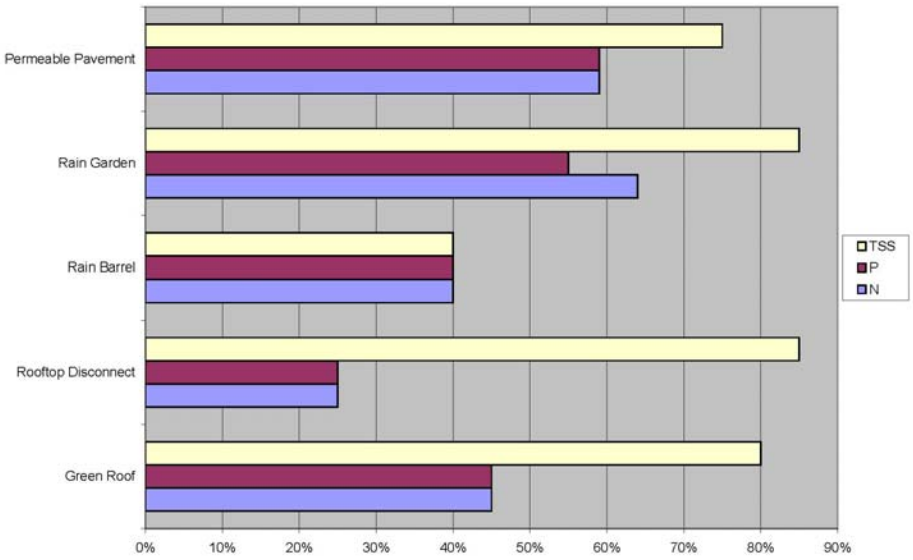


Table 3-9: Removal Efficiencies of Homeowner BMPs in WTM

	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 runoff. 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 Indian Creek.

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	308	30	11	3,946
2	1,538	152	54	19,731
3	3,075	304	107	39,462
4	7,273	732	289	59,193
5	7,161	693	215	131,477
6	5,312	511	177	105,256

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	0%	0%	1%	40.1	5.3%
2	2%	2%	3%	125.0	16.6%
3	4%	5%	5%	250.1	33.2%
4	9%	11%	14%	667.8	88.7%
5	8%	11%	11%	473.5	62.9%
6	6%	8%	9%	376.6	50.0%

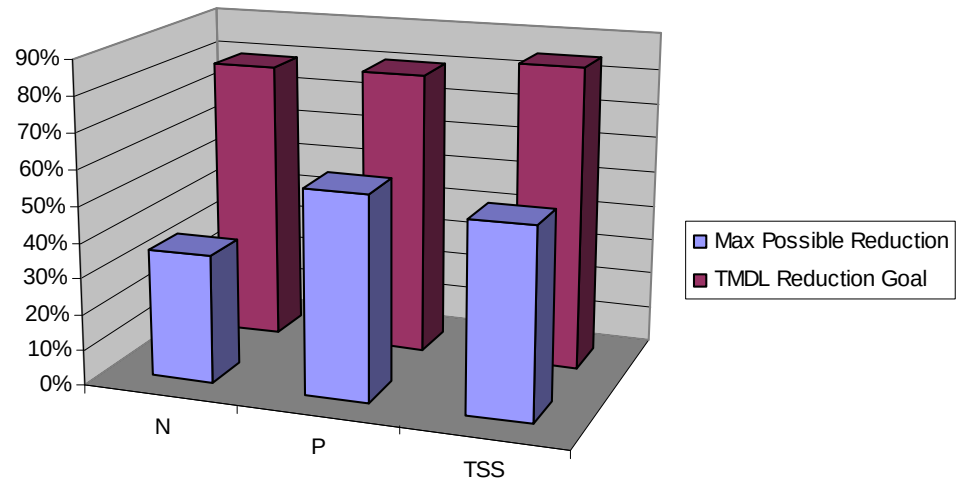
While Indian Creek subwatershed is not a heavily residential subwatershed (most impervious acres are industrial), the percentage reductions shown in the above tables illustrate that the impervious surfaces associated with those residencies do have an impact on the subwatershed. In order to achieve this, 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 great 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 Indian Creek Loading	85,345	6,524	2,017
Indian Creek Reduction Goals	67,423 (79%)	5,219 (80%)	1,714 (85%)
Maximum Possible Reduction			
Stormwater Controls (81% of Impervious Acreage Controlled)	8,815	1,439	416
LID Green Streets	8185	729	232
Homeowner BMPs (Scenario 5)	7,161	693	215
Street Sweeping (75% residential and 50% parking lots)	8,186	875	172
Total Maximum Possible Reduction	**32,347**	**3,736**	**1,035**
% Total Reduction in Indian Creek Loading	**38%**	**57%**	**51%**

Figure 3-3: Maximum Reduction Possible with Proposed Projects



***Note: The TMDL Reduction Goals are for the Anacostia River,**

Section 4
10-Year Targets and Milestones

Indian Creek 10-Year Restoration Targets and Milestones

The Indian Creek 2020 Restoration Targets were determined based on the potential implementation of restoration opportunities identified within the Indian Creek 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 Low Impact Development (LID) methods, Environmental Site Design (ESD) principles, and other stormwater management techniques, stormwater retrofit projects should be implemented to control approximately 900 to 910 acres of existing impervious surfaces. This represents a 44-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 1.2 miles of Indian Creek and tributaries for the movement of both resident and migratory fish.

Trash Reduction
Using the MWCOG Trash Index for reference, reduce trash levels one tier from High to Medium or from Medium to Light.

Increase existing street sweeping programs to sweep approximately 30 to 40 additional curb miles weekly of residential and other roads. Additionally, increase sweeping of parking lots so that a total of 140-160 acres is swept.

Wetland Creation and Restoration
Create or restore approximately 15.7 acres of wetlands, and approximately 0.01 acres of vernal pools.

Riparian Corridors
Create, restore, or treat approximately 7.6 acres of riparian and upland forest, and manage invasive species on approximately 2.5 acres.

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.

Parkland Acquisition
Acquire approximately 75 acres of land or easement to improve connectivity of parkland, riparian cover, and wildlife corridors.

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

Promote homeowner 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 Best Management Practices (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.

Expand web presence of citizen based subwatershed action groups.