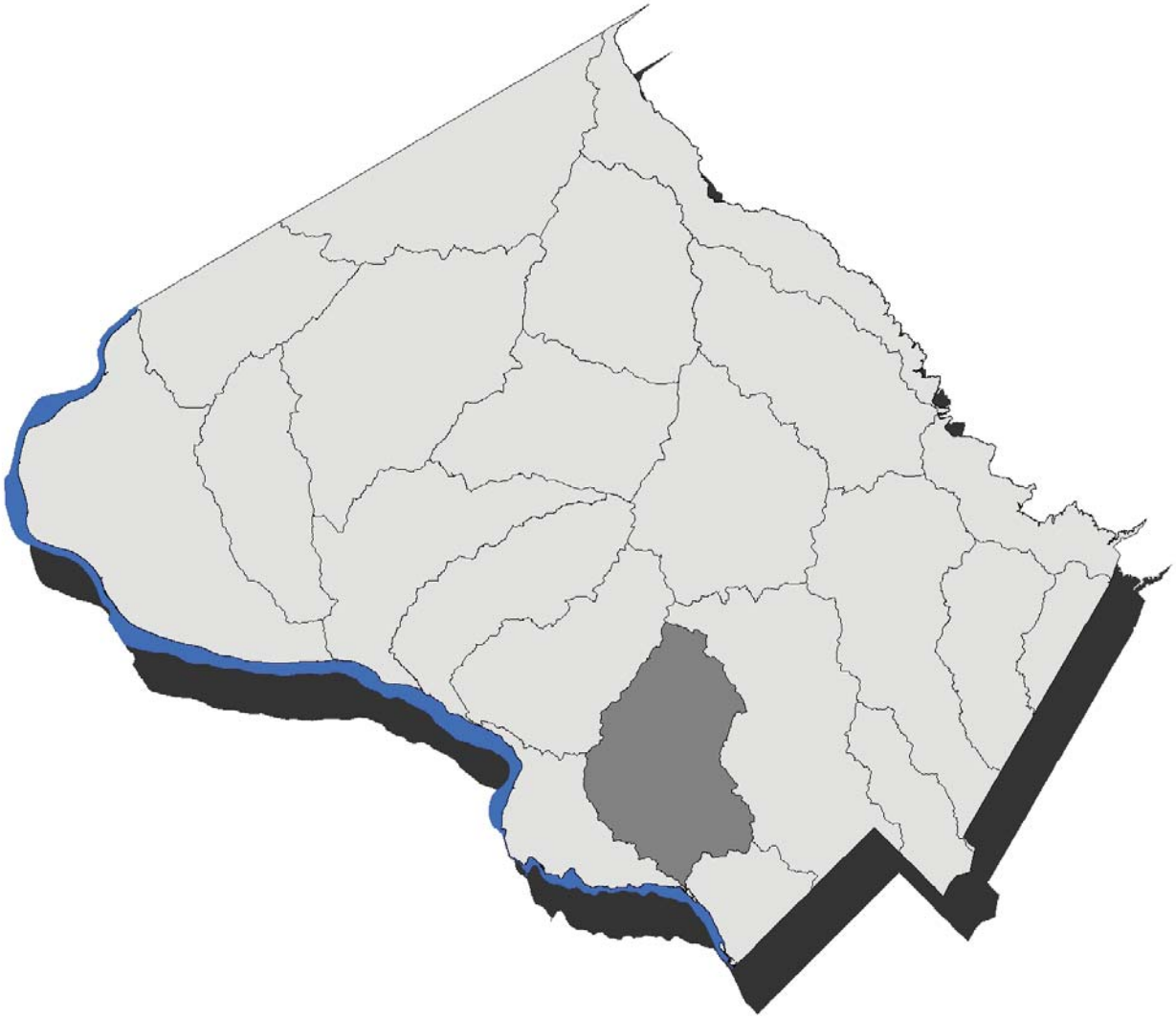
CABIN JOHN CREEK IMPLEMENTATION PLAN

PREPARED FOR:

MONTGOMERY COUNTY

DEPARTMENT OF ENVIRONMENTAL PROTECTION

255 Rockville Pike, Suite 120



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Cabin John Creek Implementation Plan

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Prepared for:

Montgomery County Department of Environmental Protection
255 Rockville Pike, Suite 120
Rockville, MD 20850

Prepared by:

Versar
9200 Rumsey Rd
Columbia, MD 21045-1934

In collaboration with:

Biohabitats, Inc.
2081 Clipper Park Road
Baltimore, MD 21211

Chesapeake Stormwater Network
117 Ingleside Avenue
Baltimore, MD 21228

Horsley Witten Group
90 Route 6A
Sandwich, MA 02563

RESOLVE
1255 23rd Street, NW, Suite 875
Washington, DC, 20037

Capuco Consulting Services
914 Bay Ridge Road, Suite 206
Annapolis, MD 21403

Cabin John Creek Implementation Plan

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Notes to Reader:

1. Throughout this Plan there are text boxes such as this that focus on public outreach and stewardship elements to consider for the Plan. In addition, there are references to Practice Sheets which have been developed that are general strategies that apply countywide but will require some customization on a watershed basis to reflect certain stakeholder demographics and priorities. These practice sheets are included as an appendix to the Countywide Coordinated Implementation Strategy.
2. Environmental Site Design (ESD) is defined within the 2010 Maryland Stormwater Design Manual as the use of small-scale stormwater management practices, nonstructural techniques, and better site planning to mimic natural hydrologic cycling of rainwater and minimize the impact of land development on water resources. The application of the term is focused on new and redevelopment projects, and does not explicitly address or consider retrofit applications where site constraints such as drainage area, utilities, and urban soil quality are significant factors. This watershed implementation plan uses the term ESD in a more flexible manner to include structural practices such as bioretention, vegetated filters, and infiltration that provide distributed runoff management using filtering, infiltration, and vegetative uptake processes to treat the water quality volume to the maximum extent practicable. These practices are also thought of as Low Impact Development (LID) practices.

Acronym list

BMPs – best management practices

DA – drainage area

DEP – Department of Environmental Protection

DF – discount factor

EPA – Environmental Protection Agency

ESD – environmental site design

GIS – geographic information systems

HOA – homeowners association

IA – impervious area

IC – impervious cover

LDR – low density residential

LID – low impact development

MDE – Maryland Department of the Environment

MEP – maximum extent practicable

MDP – Maryland Department of Planning

MNCPPC – Maryland National Capital Parks and Planning Commission

MPR – maximum practicable reductions

MS4 – municipal separate storm sewer system

NPDES – National Pollutant Discharge Elimination System
RR – runoff reduction

SPA – Special Protection Area

TFPI – Trash Free Potomac Watershed Initiative

TMDLs – total maximum daily loads

TN – total nitrogen

TP – total phosphorus

TSS – total suspended solids

USACE – U.S. Army Corps of Engineers

WLAs – waste load allocations

WQPC – water quality protection charge

WRAP – watershed restoration action plan

WTM – watershed treatment model

1 Goals and Existing Conditions

1.1 Introduction to the Implementation Plan and Watershed Goals

This Implementation Plan ("the Plan") for Cabin John Creek was developed in order to quantitatively demonstrate compliance with the County's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer (MS4) Permit. The Plan must meet the requirements of three permit sections:

- Assigned wasteload allocations (WLAs) for EPA-approved **Total Maximum Daily Loads (TMDLs)**
- Watershed restoration **via runoff management and impervious cover treatment**
- **Trash and litter management** to meet the commitments of the Potomac River Watershed Trash Treaty

Outreach and Stewardship Strategy The primary messages for delivery in this watershed will pertain to activities the County is undertaking to manage runoff and reduce bacteria, trash, and litter.

This Plan outlines a comprehensive roadmap for watershed restoration that targets runoff management, bacteria reduction, and trash and litter management - including information pertinent to effectively include stakeholders in watershed restoration. The County MS4 Permit area comprises 74% of the total watershed area. The Plan focuses the restoration effort within the MS4 Permit area which includes approximately 20% impervious cover.

The Maryland Department of the Environment (MDE) established a total maximum daily load (TMDL) for fecal bacteria in 2006 which was approved by EPA in 2007. MDE is currently developing regulatory loading limits for sediment. This Plan addresses and documents fecal bacteria loading to Cabin John Creek from the County's MS4 Permit area. It also tracks potential reduction of fecal bacteria loads through application of various watershed restoration practices. This Plan focuses on achieving the maximum practicable reductions (MPR) as recommended by MDE in the TMDL document. MDE indicated that the required reduction should be implemented in an iterative process that first addresses those sources with the largest impacts to water quality and risks to human health, with consideration given to ease of implementation.

Runoff Management and Impervious Cover Treatment
The MS4 Permit requires that the County restore an additional 20% of untreated impervious cover to the maximum extent practicable (MEP) on a countywide basis during the five-year permit cycle. Therefore, this Plan tracks impervious cover treated to the MEP within the Cabin John Creek watershed from the baseline year of 2009. Full implementation of projects identified through this Plan can provide control of an additional 1,018 acres of currently untreated impervious.

Trash and Litter Reduction
The third major permit element is that of trash and litter management to meet the commitments in the Potomac River Watershed Trash Treaty. The County must identify trash

and litter reduction measures that are being implemented towards the goal of a Trash Free Potomac by the year 2013. This Plan also documents trash loading from the watershed and proposed reduction practices. An estimated 33.5% reduction compared to baseline conditions is projected based on full implementation of BMPs identified in this Plan.

Sediment and Nutrient Reduction
In 2010, MDE submitted a sediment TMDL to EPA for approval. During 2011, the MDE will be developing nutrient WLAs as part of the Bay-wide TMDL. There are no WLAs yet approved by EPA , but the full suite of BMPs proposed in this Plan are estimated to provide 41.9% load reductions for total nitrogen (TN), 41.7% for total phosphorus (TP), and 29.5% for total suspended solids (TSS).

1.2 Existing Conditions in the Cabin John Creek Watershed

Introduction to the watershed conditions
The Cabin John Creek watershed has a drainage area of approximately 26 square miles. Its headwaters begin in the heart of Rockville, near the intersection of Route 355 and Route 28 as a piped stream. The Cabin John Creek mainstem flows south for 11 miles into the Potomac River. The major tributaries of the Creek are Bogley Branch, Booze Creek, Buck Branch, Congressional Branch, Ken Branch, Old Farm Branch, Snakeden Branch and Thomas Branch. The watershed has been strongly affected by development that took place since the 1950's. Centered around the I-270/I-495 transportation corridors, this development took place before environmental regulations for stream buffers, sediment and erosion control and stormwater management were put in effect. As a result, there are few on-site stormwater runoff BMPs in the Cabin John Creek Watershed. A basic profile of the watershed is provided in Table 1, a map depicting existing conditions is presented in Figure 1, and a map depicting resource conditions is presented in Figure 2.

Outreach and Stewardship Strategy Potential Partners:
This watershed has potential for numerous institutional partnerships due to the large number of commercial facilities, schools and places of worship that are located near the major transportation route of I-270. Examples include Rock Spring Centre, Cabin John Shopping Center, Geneva Day School, Montrose Office Center, Tower Oaks Business Center, Bethesda Country Club, Beth Shalom Congregation, St. James Episcopal, Charles Smith Jewish Day, B'nai Israel Congregation, Green Acres School, The Woods Academy, and many others. It is recommended that DEP reach out to these potential partners to achieve the best pollution reduction results. Special emphasis should be placed on partnering with institutions whose property borders or includes streams. Key messages should focus on establishing streamside buffers and stormwater retrofits on the property where possible.

The Cabin John Creek mainstem and a portion of the western tributaries do receive some protection in the form of vegetated buffers established as part of the County's stream valley park system; however, this is not enough to protect the habitat quality and stream conditions within the park from the detrimental impacts that have resulted from unmitigated flows from highly impervious areas located upstream. Several regional stormwater ponds were put in place to control drainage from Montgomery Mall, the office parks at Democracy Blvd, and I-270. This treats only a fraction of the total impervious area in this watershed. Impacts within this watershed include accelerated stream channel down-cutting and widening, as evidenced by toppled trees and exposure of sewer lines originally buried 10-20 feet below the bottom of

stream channels. In the 1998 countywide Stream Protection Strategy, there were only three tributaries identified in the Cabin John Creek watershed that maintained a good resource condition capable of supporting a diverse fish community.

Table 1. Cabin John Creek Watershed Profile

Metric	***Acres***	***Percent of Watershed***
Watershed Drainage Area	16,022	100%
Impervious Cover	3,402	21%
Watershed Area Subject to County MS4 Permit[1]	11,880	74%
Impervious Cover Subject to County MS4 Permit[1]	2,422	20%
Pervious Cover (e.g., forest, turf, meadow, farm fields)[1]	9,458	80%

[1] Excluded areas include Rockville, rural zoning, all MNCPPC lands, Federal and State property, and Federal and State roads.

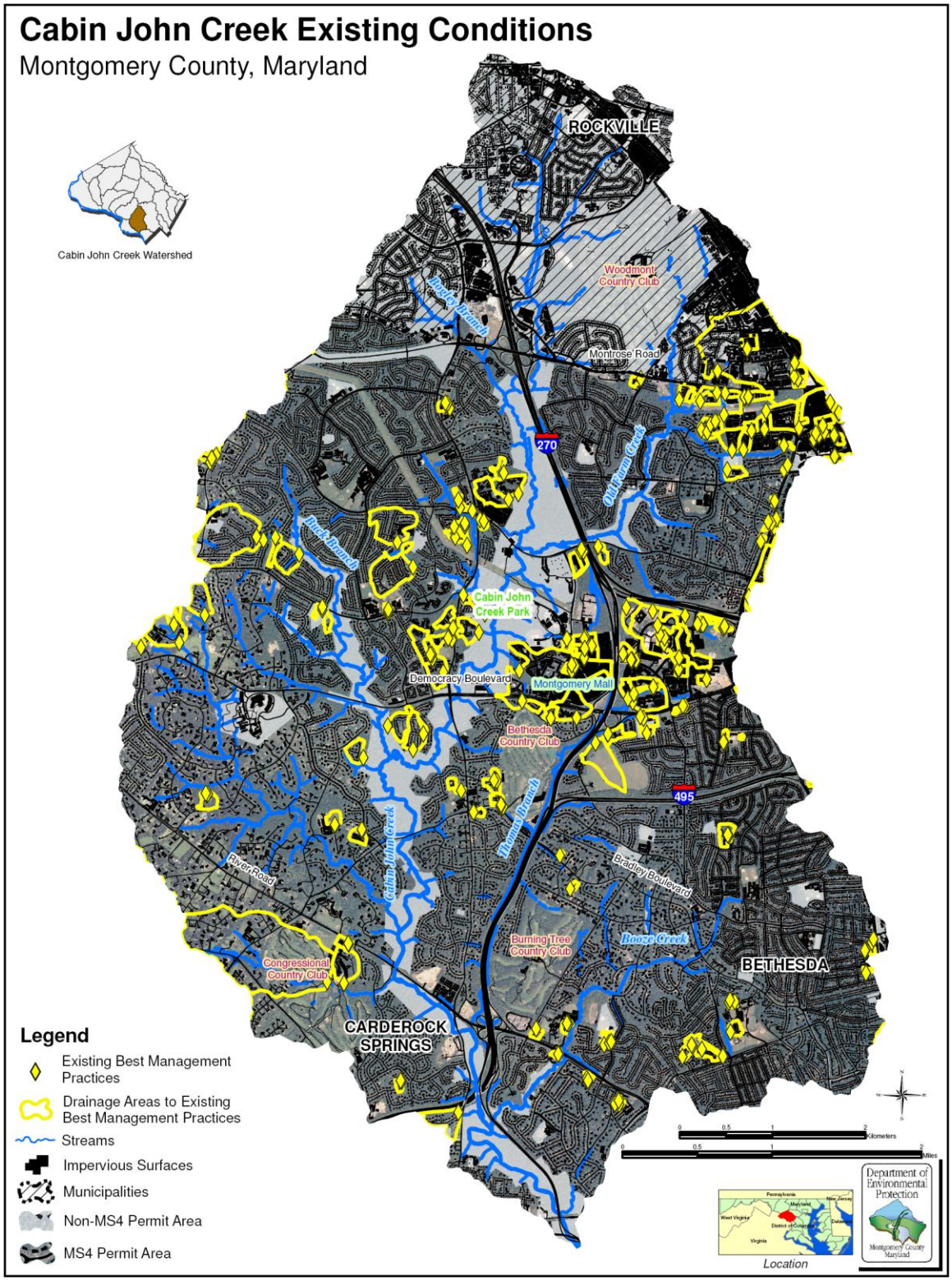

Figure 1. Cabin John Creek watershed existing conditions

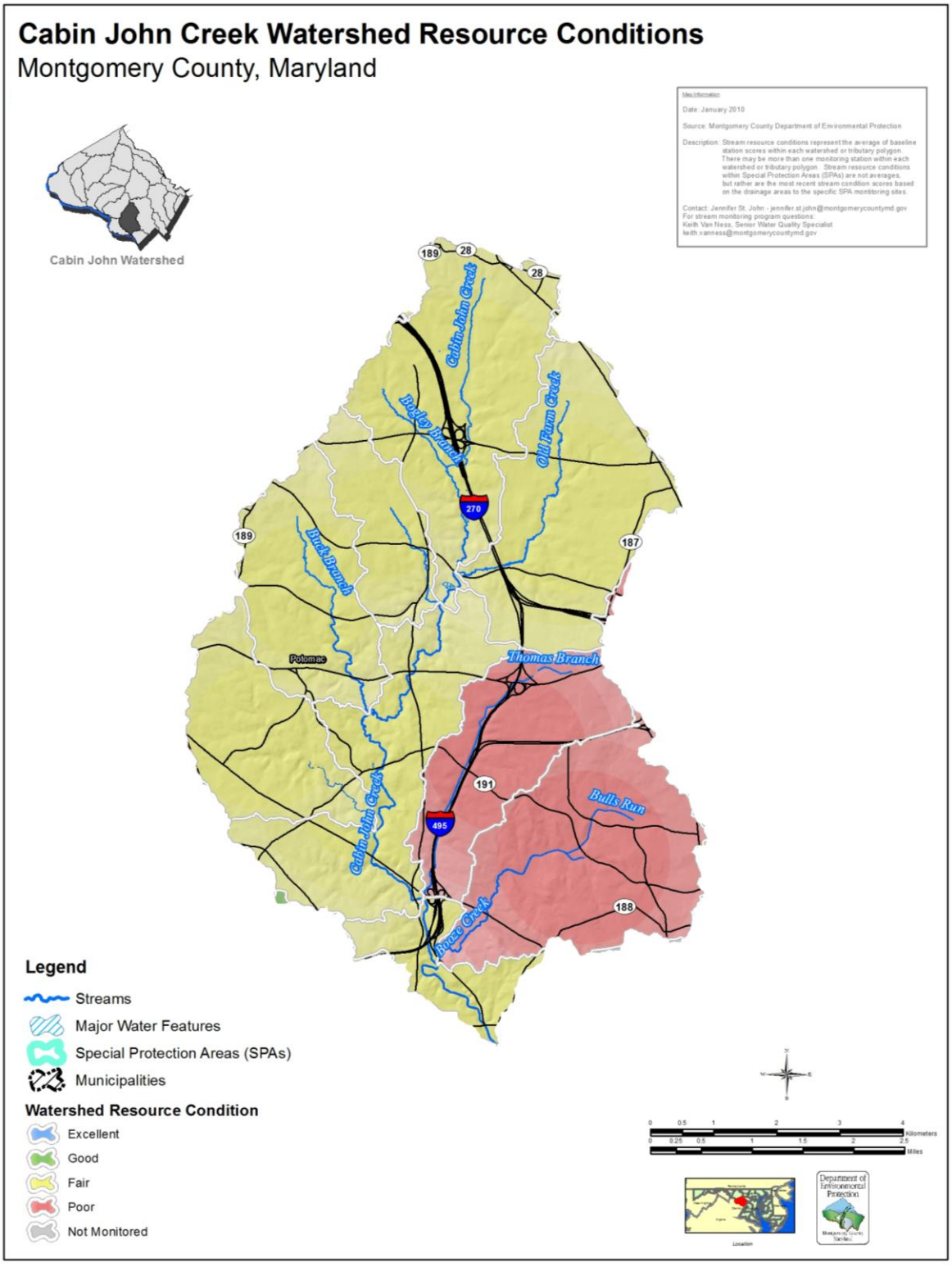

Figure 2. Stream Resource Conditions for the Cabin John Creek Watershed

Watershed Land Use

MS4 Permit area land use in the watershed is displayed in Table 2. Residential land use is the dominant land use, covering about 70% of the watershed. This is followed by municipal/institutional at 13% and roadway at over 7%. The watershed is largely built-out, with just over 5% identified as forest, open water, or bare ground.

Outreach and Stewardship Strategy Demographic Snapshot:
This watershed has relatively few minority stakeholders. Consequently it is not essential to present education and outreach materials in multiple languages to reach a majority of the watershed stakeholders. The watershed's high number of residential areas necessitates that home owner associations (HOA) become a key outreach and stewardship partner for information dissemination. County offices such as DEP Solid Waste, Housing & Community Affairs, Consumer Protection, Commission on Common Ownership of Communities (CCOC) and business groups such as real estate agencies will also be good partners as they have residential customer bases.

Table 2. County MS4 Permit Area Land Uses

Maryland Department of Planning 2002 Land Cover/Land Use	*Watershed Acres*	*Percent of Total (%)*
Low Density Residential (<1 du/acre)	2,544	21%
Medium Density Residential (1-4 du/acre)	5,404	46%
High Density Residential (>4 du/acre)	180	2%
Commercial	259	2%
Industrial	360	3%
Municipal/Institutional- Intensive[1]	672	6%
Municipal/Institutional- Extensive[2]	862	7%
Roadway[3]	827	7%
Rural[4]	98	1%
Forest[5]	647	5%
Open Water	16	0.1%
Bare Ground	12	0.1%
Total Watershed	**11,880**	**100%**

[1] Institutional land use (churches, schools, municipal buildings)
[2] Open Urban Land and Bare Rock land use (parks, cemeteries, and golf courses)
[3] Combined County and private roads (excludes Federal and State roads)
[4] Orchards, Vineyards, Horticulture, Feeding Operations, Cropland, Pasture, and Agricultural Buildings land use
[5] 2002 Land Use Data.

Existing Stormwater Best Management Practices (BMPs)

There are 196 structural stormwater BMPs within the Cabin John Creek MS4 Permit area, each capturing drainage areas that vary from over 250 acres for regional pond BMPs to less than 0.01 acres for small, on-site BMPs. The current inventory of BMPs was categorized according to design era and historic performance criteria. Performance metrics were used to group the BMPs into the five categories as shown in Table 3. The BMPs are classified according to their performance code as established in Appendix B of the Guidance Document.

Table 3. Existing Stormwater Management for Cabin John Creek Watershed

BMP Performance Code[1]	*Count*	*Acres of Impervious Cover (IC) Treatment*	
		Drainage Area Treated	*Total IC in Drainage Area*
(4) Environmental Site Design (ESD) BMPs	34	49	23
(3) Effective BMPs	32	585	165
(2) Under-performing BMPs	10	39	14
(1) Non-performing BMPs	67	603	222
(0) Pretreatment & Unknown[2]	53	97	57
Total	196	1,372	481

[1]For drainage areas with more than one BMP, the maximum performance code was taken after deleting pretreatment BMPs (Code 0).
[2]Drainage area not associated with a specific BMP type

In addition to the structural stormwater management BMPs listed above, there is one completed stream restoration site within the MS4 Permit area. The completed project has restored a total length of stream equal to 4,656 linear feet.

1.3 Problems Facing the Cabin John Creek Watershed

Biological and Habitat Conditions

The third round of the Countywide, five-year monitoring cycle was completed in 2010. There were nine stations in the Cabin John Creek watershed sampled in 2008 for benthic macroinvertebrates, fish species, and habitat metrics in order to assess the stream resource conditions. Results of the survey are in Table 4, summarized by both stream miles and drainage area. The survey data can be used to classify both instream conditions and overall water quality from the watershed. Therefore, the stream miles summary can be interpreted as an indicator of the current instream resource conditions. The drainage area summary can be used to indicate the condition of water quality draining from the watershed.

Currently, the majority of the stream resource conditions in Cabin John Creek were assessed as 'Fair', with the remaining 17.5% assessed as 'Poor'. Zero stream miles were assessed as 'Excellent' or 'Good'.

Table 4. Cabin John Creek Stream Resource Condition Survey Results by Stream Miles and Drainage Area

Resource Condition	*Length (miles)*	*%*	*Area (Acres)*[1]	*%*
Excellent	0.0	0.0%	0.0	0.0%
Good	0.0	0.0%	0.0	0.0%
Fair	58.8	82.5%	12,083.2	74.1%
Poor	12.4	17.5%	4,219.2	25.9%
Not Accessed	0.0	0.0%	0.0	0.0%
Total	71.3	100%	16,302.4	100%

[1] Polygons based on MC_BaselineStreamCond shapefile

Water Quality and Trash Issues

As part of its environmental enforcement program, the County tracks citizen complaints regarding water quality and illegal solid waste dumping. Table 5 summarizes the number and type of citizen complaints about water quality issues recorded for Cabin John Creek during the five-year cycle from 2004 to 2009. The overwhelming majority of the complaints received were related to stormwater pollutant discharge. Table 6 includes the same complaints summarized by location and general zoning type. The majority of complaints recorded were in residential zoning. These locations were given 'hotspot' identification in the pollutant loading model, discussed further in Section 3.

Table 5. Recorded Water Quality Complaints[1] in Cabin John Creek Watershed

Number by Water Quality Complaint Type				
Total # of cases	*Stormwater-Pollutant Discharge*	*Surface Water-Chemical Discoloration/ Unknown*	*Surface Water-Sewage*	*Surface Water-Petroleum Product in Water*
35	30	3	1	1

[1] From WQCases2004_2009_Locations.shp

Table 6. Water Quality Complaint by Zoning[1] in Cabin John Creek Watershed

General Zoning Type[2]	*Acres*	*Total # of Properties*
Apartments	11.1	1
Residential	34	30
Commercial	19.9	3
Industrial	0	0
Non-Conforming	0	0
Unzoned	0	0

[1] From SWCases2004_2009_locations.shp
[2] From County PROPERTIES.shp

Solid waste trash dumping sites were also logged by the County to identify trash hotspots. Table 7 includes a summary of the complaint database by complaint type. The majority of complaints were recorded as residential dumping, followed by dumping on public land and some dumpster management complaints. Table 8 identifies the general zoning type at the site of the complaint. The majority of complaints were in residential areas.

Outreach and Stewardship Strategy Public Education Project:
To reduce trash hot spots, stakeholder outreach is recommended in partnership with HOAs, county recycling offices, Montgomery Parks, and commercial properties (e.g. Cabin John Shopping Center). Educating watershed residents on the importance of proper trash can maintenance, keeping playing fields clean, and dumpster maintenance is recommended for success. Implementation details are in the Practice Sheet entitled Anti-littering Outreach and Stewardship Campaign.

Table 7. Solid Waste Trash Dumping Sites[1] in Cabin John Creek Watershed

Number per Solid Waste Type				
Total # of cases	***Farm Land***	***Residential***	***Public Land***	***Dumpster***
83	0	58	17	8

[1] From SWCases2004_2009_locations.shp

Table 8. Solid Waste Trash Dumping Sites by Zoning[1] in Cabin John Creek Watershed

General Zoning Type[2]	***Acres***	***Total # of Properties***
Apartments	3.3	1
Residential	57.4	68
Commercial	5.6	3
Industrial	3.5	1
Unzoned	3.3	1

[1] From SWCases2004_2009_locations.shp
[2] From County PROPERTIES.shp

1.4 Existing Pollutant Loads and Impervious Surfaces

TMDLs and Existing Bacteria Loads

MDE prepared the "Total Maximum Daily Loads of Fecal Bacteria for the Non-Tidal Segments of Cabin John Creek Basin in Montgomery County, Maryland" Final Report on October 13, 2006. EPA approved the TMDL on March 14th, 2007. This document establishes a TMDL for the non-tidal Cabin John Creek basin which is entirely within Montgomery County. The baseline load and WLA for the MS4 Permit area are displayed in Table 9.

Table 9. Bacteria Baseline Loading Estimates for Cabin John Creek Watershed and Comparison Values from MDE

Parameter	***Year***	***Baseline Montgomery County MS4 load***	***Montgomery County WLA Reduction***	***Target Montgomery County MS4 load***
Bacteria (*E. coli*)	2006	44,257 billion MPN/year	30.7%	30,670 billion MPN/year

Impervious Surfaces

Impervious cover in the County MS4 Permit area of Cabin John Creek watershed, as derived from County GIS, is summarized in Table 10. The roofs of single family homes account for the largest percentage of impervious cover in the watershed at 34.9%. This is followed by County and private roads at over 23%.

Outreach and Stewardship Strategy Public Education Project:
To reduce stormwater pollution on private property, stakeholder outreach is recommended to explain the need for watershed stakeholders to capture some of the precipitation that falls on their roofs and allow for groundwater recharge, hence slowing the flow of surface waters and potential erosion impacts. It is recommended that this can be accomplished by expanding existing County programs such as RainScapes, as described in the Practice Sheet entitled Roof Runoff Reduction Outreach and Stewardship Campaign.

Table 10. MS4 Permit Area Impervious Cover in Cabin John Creek Watershed

Impervious Cover Type	*Impervious Acres*	*Watershed (%)*
1. Roads		
a. Low Density Residential[1]	273.6	11.5%
b. Other[2]	553.2	23.3%
2. Parking Lot		
a. County Small Lots (<1 acre) [3]	21.0	0.9%
b. County Large Lots (>=1 acre) [3]	31.3	1.3%
c. Private	324.7	13.7%
3. Roofs		
a. County[4]	20.4	0.9%
b. Single Family Homes[5]	827.1	34.9%
c. Other	233.7	9.9%
4. Sidewalks[6]	56.3	2.4%
5. Other		
a. Schools[7]	28.2	1.2%
b. Recreational[8]	0.0	0.0%
Total Impervious Acres from GIS[9]	2,369.6	**100.0%**

[1]All roads in RE2 or R200 property zoning.
[2]Includes County and private roads.
[3]Parking lots located in County-owned parcels, derived using County_pnts from the County's PROPERTY geodatabase.
[4]Buildings located in County-owned parcels, derived using County_pnts from the County's PROPERTY geodatabase.
[5]Buildings located on single family home parcels, derived using MDP_pnts from the County's PROPERTY geodatabase and selecting only single-family dwelling types.
[6]Sidewalks in jurisdiction. Does not include all residential sidewalks or driveways.
[7]Impervious cover located in public school parcels, derived using pubsch points from the County's LOCATIONS geodatabase. Some overlap with other impervious.
[8] Impervious cover identified as Recreational in geodatabase. Some overlap with other impervious.
[9] Sum of all GIS impervious (as of 2009 data). Excludes overlaps in schools and recreational.

Existing Trash Loads

The Potomac River Watershed Trash Treaty outlines the agreement between local and state elected officials to commit to a Trash Free Potomac by 2013. The agreement includes three major commitments:

- Support and implement regional strategies aimed at reducing trash and increasing recycling;
- Increase education and awareness of the trash issue throughout the Potomac Watershed; and
- Reconvene annually to discuss and evaluate measures and actions addressing trash reduction.

In general, trash reduction strategies fall into four categories: (1) Structural; (2) Educational; (3) Municipal; and (4) Enforcement. Structural stormwater BMPs will be assigned 95% removal credit for trash from the contributing drainage area. BMPs, while not specifically designed to

capture trash, are also not very good at passing trash, and debris is prone to build up in forebays, around plants and interior elements, and around the outlet structures. This Plan estimates the percent reduction in trash from Cabin John Creek through structural BMPs.

In addition to trash removal by structural stormwater BMPs, programmatic practices from the other three categories (i.e., educational, municipal, and enforcement) provide trash prevention and control. These programmatic practices are specially aimed at reducing trash inputs to roads and streams, including educationally focused programs such as reduce, reuse and recycle campaigns; dumpster management and storm drain marking; and programs tied to operations such as littering and illegal dumping enforcement; stream cleanups; and street sweeping. These programmatic practices are further explored in the countywide strategy.

Existing Other Pollutant Loads

In addition to bacteria and trash, there is a need for the County to track and understand other pollutants of interest such as nutrients and sediment. During 2010, the MDE submitted to EPA a TMDL for sediment in the Cabin John Creek Watershed. During 2011, it is expected that MDE will provide WLAs for nutrients to meet the Bay-wide nutrient TMDL. This Plan establishes some initial estimates for load reductions from baseline conditions for sediment and nutrients.

2 Inventory of Provisional Restoration Candidates

2.1 Types of Restoration Practices

Table 11 summarizes the 11 groups of watershed restoration practices evaluated for the Cabin John Creek watershed. The first four groups of restoration practices involve various forms of Environmental Site Design (ESD). All restoration practices differ in the mode and manner by which they will be delivered in the watershed (capital budgets, water quality protection charge, regulation, etc.). Multiple delivery mechanisms are needed to implement enough watershed restoration practices to meet the stringent watershed treatment and pollutant reduction targets set forth in the County's MS4 Permit, the TMDL, and the Potomac River Watershed Trash Treaty.

Table 11. Restoration Practices to be Evaluated in Watershed Implementation Plans

Description of Practice	***Application in the Cabin John Creek Watershed***
ESD Practices	
New ESD Retrofit Practices - These include small scale ESD practices applied to County- owned or privately owned buildings, streets and parking lots and rights of way. Examples include rainwater harvesting, green roofs, upland reforestation, soil compost amendments, rooftop disconnection "green street" retrofits and converting swales to dry swales.	Public ESD Retrofits
ESD Upgrades - This category includes retrofit ESD practices within existing publicly-owned or privately-owned stormwater infrastructure, so that their hydrologic and pollutant reduction performance is upgraded.	Code 1 and 2 BMP Upgrades (see WTM 3.0)
Impervious Cover Reduction - This category involves cases where un-needed impervious cover is removed, soils amended and vegetation restored primarily on County schools, streets and parking lots.	Not applicable
Voluntary LID Implementation - ESD practices that are installed as a result of County education and incentive programs.	Private ESD retrofits
Programmatic and Operational Practices	
MS4 Programmatic Practices – This category deals with reduced pollutants that can be attributed and quantified through MS4 stormwater education (e.g., lawn care), pollution prevention improvements at municipal hotspots, and better housekeeping on County land and facilities. Also includes any pollutant reductions due to product substitution, such as imposing restrictions on N or P content in fertilizer, increased pet waste enforcement, trash prevention and control.	Pet Waste Education
Hotspot Pollution Prevention – This category credits enhanced structural and non-structural practices employed at non-publicly owned stormwater hotspots that are identified through land use analysis.	Not applicable
Enhanced County Street Sweeping - This category includes any pollutant reduction that can be attributed to more intensive and targeted street sweeping in the watershed conducted by the County.	Not applicable

Description of Practice	*Application in the Cabin John Creek Watershed*
Trash Prevention and Control - This category includes a wide range of programs and practices specially aimed at reducing trash inputs to stream, including reduce, reuse and recycle campaigns, littering and illegal dumping enforcement, dumpster management, storm drain marking, storm drain inlet devices, stream cleanups, instream controls to trap and remove trash, etc. These measures are in addition to any trash trapped and removed by other restoration practices which are computed separately.	Not applicable
Structural Practices	
Traditional Retrofits - This is the traditional retrofit scale where large-scale, non-ESD retrofits are constructed on larger parcels of public or private land as discovered through analysis of MCDEP BMP inventory.	New Ponds
BMP Maintenance Upgrades - Credit for improvement in current permit cycle for major maintenance upgrades of failed stormwater practices that result in significant improvement in hydraulic function and increased treatment capacity using existing County maintenance budget. Credit can only be taken for increased load reduction due to upgrades that significantly rehabilitate BMP function from its installation baseline. (e.g., increase capacity, lengthen flow path, reduce short-circuiting, eliminate design failures).	Code 1 and 2 BMP Upgrades (see WTM 3.0)
Habitat Restoration - This category includes any pollutant reduction or volume reduction that can be attributed to specific stream restoration or riparian reforestation projects planned for construction in the watershed for the permit cycle.	Riparian Reforestation

2.2 Inventory of Previously Identified Projects

Potential restoration strategies for the watershed set forth in this Plan were drawn from the Watershed Feasibility Study and feedback received from watershed stakeholders. Previously identified restoration projects identified are presented in Figure 3.

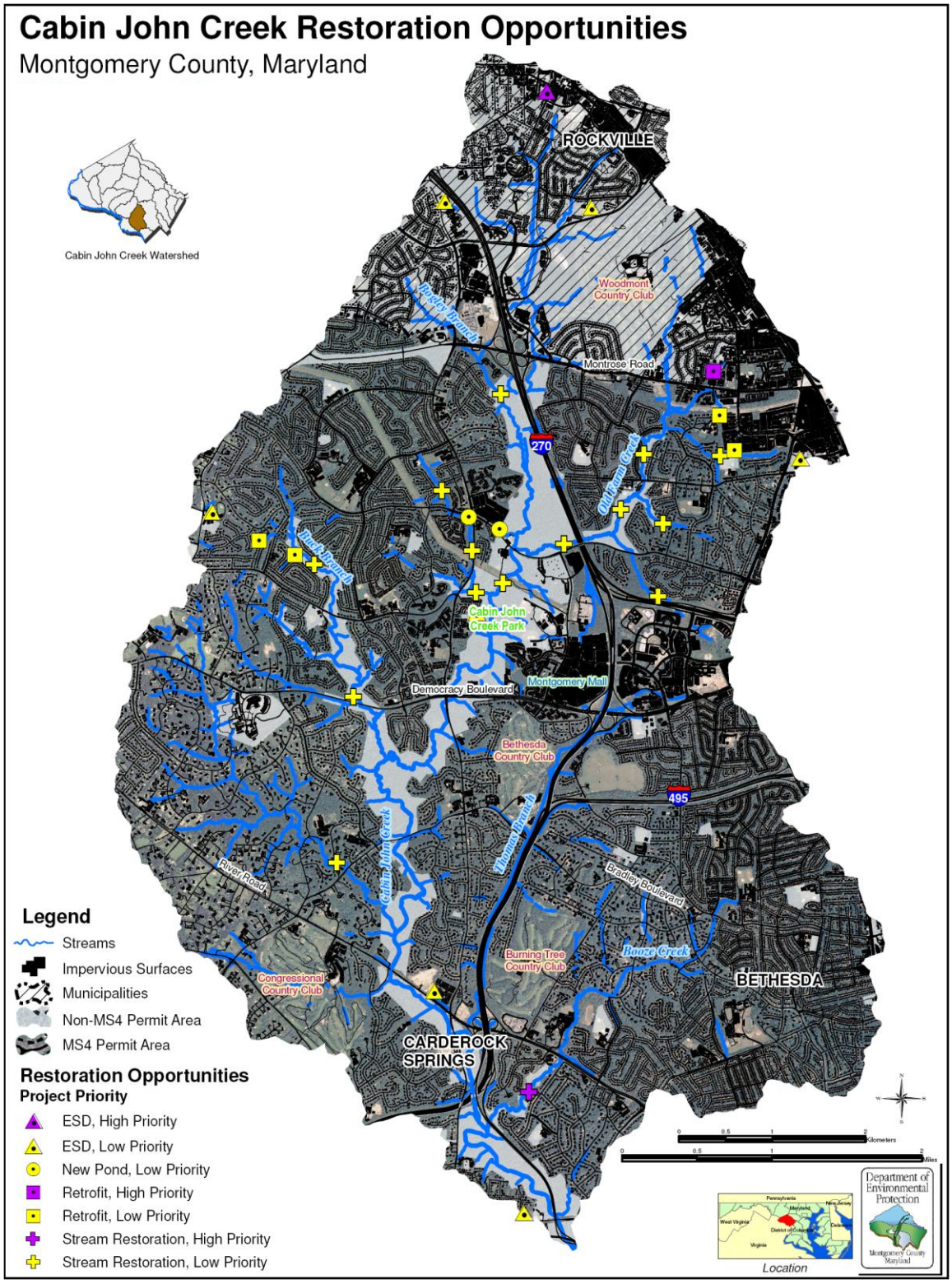

Figure 3. Cabin John Creek watershed restoration opportunities

3 Evaluation of the Restoration Strategies to Meet MS4 Permit and TMDL Requirement

3.1 Pollutant Load Tracking

MDE established the TMDL for bacteria in Cabin John Creek using water quality samples taken from one monitoring station during both wet and dry periods from October 2002 through October 2003. The MS4 Permit area WLA was determined using both bacterial source tracking and distributed land use. MDE used the Maryland Department of Planning (MDP) 2000 land use/land cover information. A similar land use-based model was used in this Plan to develop a primary source load of bacteria, sediment, nutrients, and trash to Cabin John Creek using 2002 MDP land use data for consistency with the countywide Implementation Plan. Further information on land use loading rates can be found in the Implementation Plan Guidance Document, Section 2 and Appendix B.

3.2 Desktop Review of BMP Coverage

A desktop review of BMP coverage was used to analyze the existing BMP coverage and proposed County restoration sites inventory from the Watershed Feasibility Study in Cabin John Creek watershed. The BMPs were classified according to their performance code as shown in Table 12. The relative performance of each practice type was based on national comparative reviews of pollutant reduction and runoff reduction performances of practices (CWP, 2007; and CWP and CSN, 2008) or performance studies on individual practices (Schueler, 1998). The composite efficiencies were also compared to recent research values and assumptions used in local models (USACE 2008; Chesapeake Bay Program, 2008; and MDE, 2008) to further justify the performance coding. A summary of the BMP modeling assumptions are in Table 12.

Table 12. Composite Runoff Reduction, Effectiveness Factor, and Pollutant Reduction by BMP Performance Code

Performance Code	*Description*	*TSS[1] (%)*	*TN[2] (%)*	*TP[3] (%)*	*FC[4] (%)*	*DF[5] (%)*
1	**Non-performing BMPs**	5	0	0	0	0.05
2	**Underperforming BMPs**	20	5	5	10	0.15
3	**Effective BMPs**	80	40	50	65	0.75
4	**ESD Practices**	90	65	65	75	1.0

[1] TSS: Sediment Removal rate
[2] TN: Total Nitrogen Removal Rate (Mass)
[3] TP: Total Phosphorus Removal Rate (Mass)
[4] FC: Fecal coliform reduction, see rationale in Guidance Document, Section 5.5 for why entercocci could not be used.
[5] DF: Discount Factor: Fraction of contributing impervious acres effectively treated to the Water Quality Volume, used to rate BMP treatability

The Watershed Treatment Model (WTM) was used to estimate pollutant sources and treatment options for Cabin John Creek. The spreadsheet used was an updated version of the publically available v3.1, which included an expanded runoff volume reduction component (personal

correspondence, Deb Caraco, 2009). The WTM was used to track a progression of restoration strategies across the watershed to illustrate the effectiveness of each strategy in reducing pollutant loads and ultimately meeting the TMDL load reduction targets. Targeted strategies range from specific capital improvement projects identified by the County to less well defined nonstructural strategies tied to stakeholder participation and involvement. The specific layers of analysis are presented below, following the nomenclature of WTM 1.0 – WTM 5.0.

3.3 Summary of Watershed Treatment Model Scenarios

A summary of the model scenarios evaluated using the WTM are provided in Table 13 below and described in more detail in the following sections.

Table 13. Summary of WTM Scenarios

Implementation Phase	*Description*
WTM Baseline Conditions	The WTM was run under existing conditions approach with the MDP year 2002 land use/land cover data and existing BMPs. A rough calibration to the MDE TMDL baseline load was conducted.
WTM 2.0 Completed as of FY09; High Priority Projects; Low Priority and Other Potential Projects	The WTM was run with a series of future management practices, which were proposed projects from the County inventory of restoration sites. These practices cover new ponds, retrofits of existing facilities, and ESD practices from the proposed projects list determined in the Watershed Action Plan and Feasibility Study.
WTM 3.0 ESD Strategies and Other Structural BMPs	The remaining inventory of BMPs, which have reduced treatment efficiency, were reviewed for retrofit opportunities and potential increased pollutant reduction efficiencies. In addition, the County's inventory for other project types that include public properties (e.g., libraries and parking lots), public schools, and open section roads available for ESD retrofits was reviewed as were areas for private property ESD retrofits.
WTM 4.0 Habitat Restoration	Other projects on public lands and other practices that are identified in Appendix B of the Guidance Document were explored. For Cabin John Creek this focused on habitat restoration related to riparian buffer reforestation.
WTM 5.0 MS4 Programmatic Practices	Other MS4 programmatic practices that are identified in Appendix B of the Guidance Document were examined. For Cabin John Creek, this was limited to pet waste education, since the TMDL pollutant is bacteria

WTM 1.0 – Baseline Conditions

The WTM was run under existing conditions approach with the MDP year 2002 land use/land cover data (Table 2) and existing BMPs coded under "Existing Management Practices" (Table 14). The baseline pollutant load was calculated and compared to the MDE-determined baseline MS4 load for *E. coli* (bacteria). Since the data used to establish the TMDL were collected by MDE

from October 2002 through October 2003 (MDE, 2006a), any BMPs with "approved" dates after 2003 (Table 15) were not included in this baseline calculation. However, BMPs approved after 2003 can be counted towards meeting the TMDL reduction target.

Table 14. Existing BMP Inventory

BMP Performance Category	*Count*	*Total DA (Acres)*	*Total IA (Acres)*
ESD Practices (Code 4)	34	49.2	22.7
Effective BMPS (Code 3)	32	585.2	165.4
Underperforming BMPs (Code 2)	10	38.5	13.5
Non-performing BMPs (Code 1)	67	603.0	222.4
Pretreatment facilities (Code 0)	53	96.5	57.2

DA: Drainage Area
IA: Impervious Area

Table 15. Existing BMPs approved after 2003, subtracted from existing BMP inventory (Table 14) prior to calculating baseline loading for TMDL tracking

BMP Performance Category	*Count*	*Total DA (Acres)*	*Total IA (Acres)*
ESD Practices (Code 4)	2	22.4	1.4
Effective BMPS (Code 3)	2	13.7	0.1
Underperforming BMPs (Code 2)	1	5.9	0.6
Non-performing BMPs (Code 1)	3	117.8	5.2
Pretreatment facilities (Code 0)	1	15.2	0.2

DA: Drainage Area
IA: Impervious Area

WTM 2.0 – Completed as of 2009, High Priority Projects, Low Priority and Other Potential Retrofit Projects

The WTM was run with a series of future management practices, which were proposed projects from the County inventory of restoration sites. These practices cover new ponds, retrofits of existing facilities, and ESD projects from the proposed projects list determined in the Watershed Feasibility Study, as summarized in Table 17. The database also includes stream restoration projects, which were not accounted for during TMDL tracking. Drainage area (DA), impervious area (IA), total length, and total cost were all determined from engineering designs or estimated based on the running average per practice values from the County database (DEP, 2010). In general, the County used the information included in Table 16 below to estimate proposed impervious area and costs, where engineering costs were unavailable:

Table 16. Impervious Cover and Cost Estimates used in the Future Management Scenarios

• **38% imperviousness per drainage acre**
• **New Ponds, $6,000 per drainage acre**
• **Retrofit Pond, $4,000 per drainage acre**
• **ESD project, $200,000 per impervious acre**
• **Wetland, $50,000 per drainage acre**

Retrofits of existing BMPs were reconciled with the existing BMP database and given an incremental increase in pollutant reduction efficiency based on an assumed Code 4 BMP efficiency. The actual drainage area and impervious area from the existing practice were used to calculate pollutant reduction and runoff reduction.

The cumulative pollutant load reduction was computed and compared to the TMDL annual target for bacteria. The applicable target reduction in bacteria from the calculated MDE stormwater WLA is 30.7%. Thus, this step determined how far and at what cost the existing list of projects goes toward meeting the TMDL, impervious cover, trash and other pollutant reduction goals. New Ponds were given effective BMP pollutant reduction efficiency, and ESD practices were given full ESD pollutant reduction efficiency.

Retrofits of existing BMPs were reconciled with the existing urban BMP database and given an incremental increase in pollutant reduction efficiency based on an assumed Code 4 BMP efficiency. The actual drainage area and impervious area from the existing practice was used to calculate pollutant and runoff reduction.

Table 17. Two levels of treatment: High Priority Projects; Low Priority and Other Potential Projects

Restoration Type	*Count*	*Total Cost*	*Total Length (miles)*	*Total DA (acres)*	*Total IA (acres)*
High Priority Projects					
ESD	1	$302,000	0.0	2.2	1.5
Retrofit of Non-performing BMPs	5	$1,309,266	0.0	232.6	86.0
Stream Restoration	1	$1,200,000	0.8	0.0	0.0
Low Priority and Other Potential Projects					
ESD	7	$1,600,000	0.0	9.6	8.1
New Pond	2	$120,000	0.0	20.0	7.6
Stream Restoration	14	$15,046,750	10.3	0.0	0.0

WTM 3.0 –ESD Strategies and Other Structural BMPs

The remaining inventory of Code 1 and 2 BMPs, which have reduced treatment efficiency, was reviewed for retrofit opportunities and potential increased pollutant reduction efficiencies. In addition, the County's inventory for other project types that include public properties (e.g., libraries), public schools, and open section roads available for ESD retrofits was reviewed. Then the Guidance Document was followed for determining total potential reduction from assumed treatment areas from these four target areas.

a. Code 1 and 2 BMP ESD Retrofits- The remaining Code 1 and Code 2 BMP treatment area was calculated by subtracting the previously targeted retrofits from (WTM 2.0) from the total BMP area (summarized in Table 18). It was then assumed these areas were suitable for retrofits and incrementally increased the performance efficiency of Code 1 and 2 BMPs to the MEP within Future Management Practices. The cost per impervious acre estimate was based on typical County retrofits for large pond BMPs.

Table18. Underperforming (Code 2) and Non-performing (Code 1) BMPs targeted for retrofit

Target	Count	Total DA (acres)	Total IA (acres)	Cost per IA	Total Cost
Total Code 2 BMPs	10	38.5	13.5		
-Previously Targeted for Retrofit	0	0.0	0.0		
Remaining Code 2 for Retrofit	**10**	**38.5**	**13.5**	**$12,000**	**$162,000**
Total Code 1 BMPs	67	603.0	222.4		
-Previously Targeted for Retrofit	-5	232.6	81.7		
Remaining Code 1 for Retrofit	**62**	**370.4**	**140.7**	**$12,000**	**$1,688,514**
				Total	**$1,850,514**

Table 19 shows the following:

b. Public properties – Forty percent of the impervious cover from the aggregate area and associated imperviousness from untreated County-owned Large Parking Lots and Rooftops was assigned to future management practices as code 4 (see Table B.4 of Guidance Document, and summary in Table 19 below). The forty percent target for restoration was based on a judgment of the maximum extent practicable considering physical constraints to ESD/LID. The unit cost estimate was based on an equal mix of new ESD retrofits for larger parking lots and rooftops.

c. Public schools – Forty percent of the impervious cover from the aggregate area and associated imperviousness and from untreated Public Schools Parcels was assigned to future management practices as code 4 (see Table B.4 of Guidance Document, and summary in Table 19 below). The restoration target was set similarly to part (b) above.

d. Low Density Residential (LDR) and Other County Roads - Seventy-five percent of the impervious cover from the aggregate area and associated imperviousness from RE2 and R200 roadways was assigned to future management practices as code 4 (see Table B.4 of Guidance Document, and summary in Table 19 below). The restoration target was set similarly to part (b) above. The unit cost estimation was based on an open-section road retrofit. Other County Roads were assigned a forty percent aggregate impervious cover restoration target, and the unit cost was based on a curbed road retrofit.

e. Private Property ESD implementation - In order to identify additional Priority Residential Neighborhoods for private property ESD implementation, a desktop assessment was performed. The criteria used for evaluation included lot size, home ownership, presence or absence of homeowners association (HOA), and presence or absence of existing stormwater management BMPs. Neighborhood areas are then broken into tiers of high, medium, and low based on the points assigned to the various criteria:

Outreach and Stewardship Strategy
Expanded marketing of the RainScapes program should occur in the identified high and medium priority neighborhoods through partnership with the HOAs as well as through institutional properties listed above.

- SWM Score:
  - Yes = 0; No = 2
- Lot Size Score:
  - > 1.0 acre = 0
  - <= 0.25 BUT <= 1.0 = 3 (High)
  - <= 0.1 BUT <0.25 = 2 (Medium)
  - < 0.1 acre = 1 (Low)
- Home Ownership Score:
  - > 70% = 3 (High)
  - <= 30 BUT <=70 = 2 (Medium)
  - < 30% = 1 (Low)
- HOA Score:
  - Yes = 2 ; No = 0
- Total Priority Score:
  - >=9 = High
  - >=6 BUT <=8 = Medium
  - <= 5 = Low

Thirty percent implementation of site-scale ESD projects in the targeted neighborhoods that meet criteria associated high and median priority was assumed, which equates to 222.5 acres of impervious area treatment, and a cost of $66.85 Million assuming $298k per impervious acre. Figure 4 shows the priority neighborhoods in Cabin John Creek. Table B.7 of the Guidance Document describes the basic approach used to make pollutant reduction and cost decisions.

f. Non-residential Property without Adequate Treatment ESD implementation - These are comprised of commercial properties that are not currently paying into Water Quality Protection Charge. It was assumed that 40% of the impervious cover within these properties will apply ESD practices on site. This equates to 131.6 acres of impervious cover. This area was assumed to be treated to the maximum extent practicable within the WTM.

Table 19. Summary of restoration potential within County owned facilities, schools, and ESD roads

Land Cover	***Total IA***	***Restoration Potential****	***Restored IA***	***Unit Cost*****	***Restoration Cost****
Type	Acres	%	Acres	$/Acre IA	$
County Large Parking Lots[1]	31.3	40%	12.5	$317,500	$3,977,640
County Roofs[2]	20.4	40%	8.2	$508,500	$4,149,360
Schools[3]	28.2	40%	11.3	$484,000	$5,459,520
Low Density Residential Roads[4]	273.6	75%	205.2	$137,000	$28,117,435
Other County Roads	553.2	40%	221.3	$200,000	$44,252,960
Priority Neighborhoods[5]	741.5	30%	222.5	$298,000	$63,846,351
Non-residential Property without adequate treatment	329.1	40%	131.6	$298,000	$39,223,952
Totals	1977.3		812.6		$189,027,218

*Restoration target was based on a judgment of the maximum extent practicable considering physical constraints to ESD/LID

**Unit Cost was derived from an equal mix of green roofs, cisterns, permeable paving, and bioretention BMPs according to the Guidance Document.

[1] Parking lots located in County-owned parcels, derived using County_pnts from the County's PROPERTY geodatabase.

[2] Buildings located in County-owned parcels, derived using County_pnts from the County's PROPERTY geodatabase.

[3] Impervious cover located in public school parcels, derived using pubsch points from the County's LOCATIONS geodatabase. Some overlap with other impervious.

[4] All roads in RE2 or R200 property zoning.

[5] Rooftop area in High and Medium Priority Neighborhoods

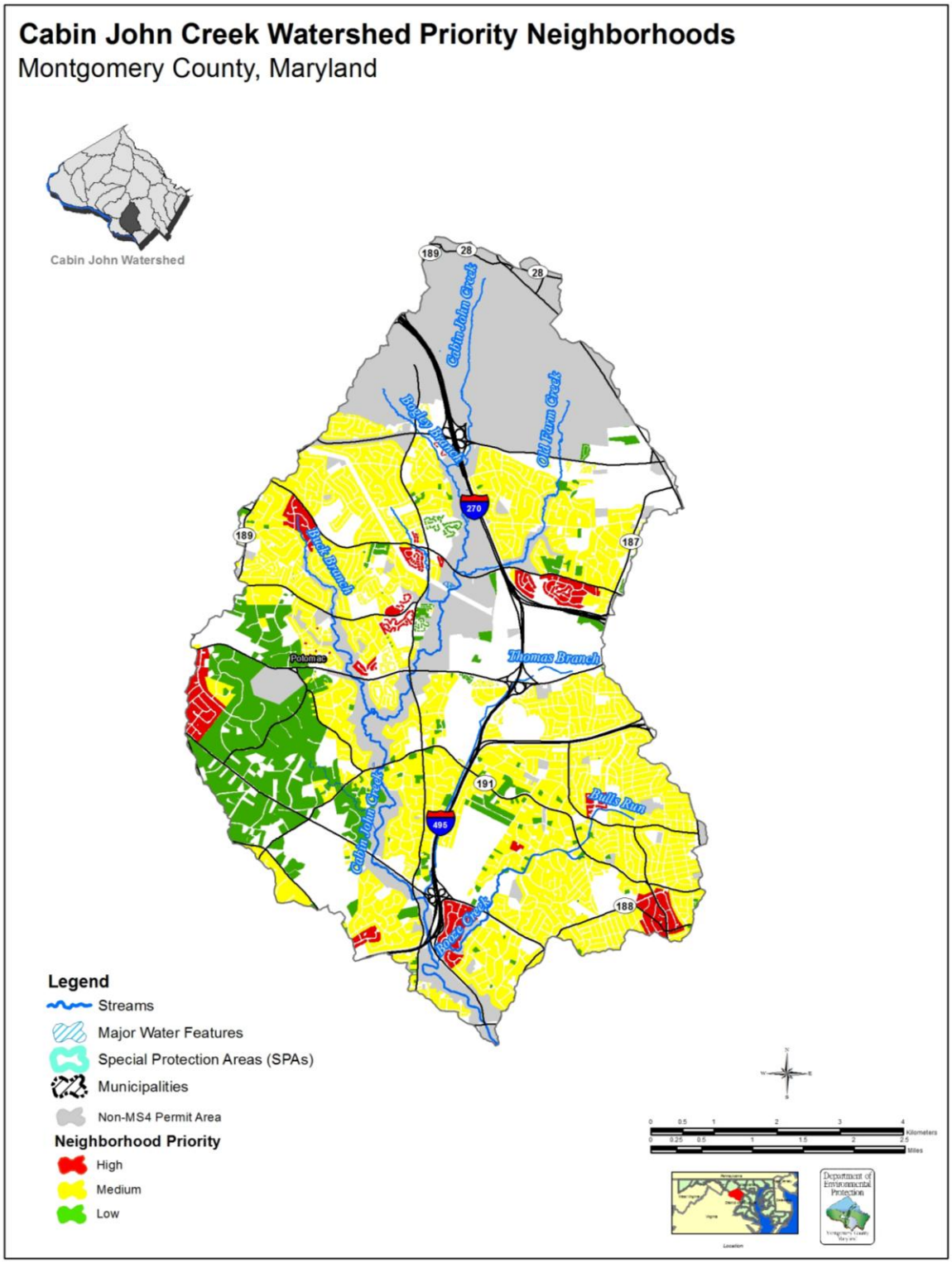

Figure 4 Priority Neighborhoods for the Cabin John Creek Watershed

WTM 4.0 - Habitat Restoration

Other projects on public lands and other practices that are identified in Appendix B of the Guidance Document were explored. The specific order of consideration was dependant on the parameter of focus, which for Cabin John Creek is the bacterial load.

a. Habitat restoration (riparian reforestation) – computed the total amount of unforested 100-ft buffer along streams and then converted land use area to forest area in Future Management Practices (see Table B.13 of the Guidance Document, and summary of areas in Table 20 below). One-hundred percent implementation of riparian reforestation across the total area was assumed.

Table 20. Summary of land use categories within the 100-ft buffer area of County streams in Cabin John Creek Watershed

MDP 2002 Land Cover/Land Use	*Watershed*	*Total Buffer Area*[3]	
	Acres	*Unforested Area (acres)*	*Forested Area (acres)*
Low Density Residential	2,544	166	129
Medium Density Residential	5,404	121	85
High Density Residential	180	11	4
Commercial	259	4	1
Industrial	360	16	11
Municipal/Institutional	672	71	65
Total Watershed	**11,880**[1]	**389**	**295**
Total Cost[2]		**$7,780,000**	

[1] Includes areas not targeted for riparian reforestation [roadways, rural land use, forest, open water and bare ground]
[2] Assumes $20k per acre reforestation
[3] Forested areas are based on Forest08.shp

WTM 5.0 – Programmatic Practices

Other MS4 programmatic practices that are identified in Appendix B of the Guidance Document were examined. For Cabin John Creek, this was limited to pet waste education, since the TMDL pollutant is bacteria.

a. MS4 programmatic practices - Table B.8 of the Guidance Document describes the basic approach.

i. Pet Waste Education- The potential reduction in load was calculated using the WTM Pet Waste Education/Future Management Practice, which requires the total number of dwelling units in the watershed (31,001). Default WTM discounts, which are based on residential surveys include an assumed 40% of households with dogs, 50% of owners who walk their dogs, 60% of owners who currently clean up after their pets, and 90% of owners willing to change their behavior. The percent willing to change is highly dependent on the establishment of ordinance and enforcement (see Caraco, 2001). An 80% dog owner targeting strategy was assumed, which is dependent on the media outlet chosen for education, which for Cabin John Creek was every household within the watershed at a cost of $15 per household. (Schueler 2005, USRM #2, Table 47) The potential load from pet waste is shown in Table 21.

Outreach and Stewardship Strategy Public Education Project: Stakeholder outreach on the importance of pet waste pick up anywhere a pet may go is recommended. Partnerships for implementation should be fostered between homeowner associations and pet product retailers and service industry. Implementation details are in the Practice Sheet entitled Pet Waste Pickup Outreach and Stewardship Campaign.

Table 21. MS4 Programmatic Practices

Strategy	*# households*	*Potential E. Coli Bacteria Source (billion MPN/yr)*	*Unit Cost*	*Total Cost*
Pet Waste	31,001	4,388	$15 per house	$465,010

3.4 Preliminary Results of the Bacteria Load Reduction Analysis

The WTM was run iteratively using a series of spreadsheets for each step outlined above. Initially, the WTM was coded with the existing land use and BMP database to calculate the baseline load. The baseline WTM load was adjusted to match the MDE baseline load. Since the targeted WLA was a 30.7% reduction from the baseline, the reduction was applied to our WTM computed baseline to establish the 30,670 billion MPN/yr target for restoration efforts. From there, the iterative approach was used to track progress as shown in Table 22.

Table 22. Preliminary Results of WTM Modeling

Implementation Phase	E. coli Loading % reduction from baseline	Comments	Cumulative Cost Million $
WTM Baseline Load*	0%	Normalized to MDE Baseline Load	$ -
WTM 2.0	3.2%	High Priority Projects; Low Priority and Other Potential Projects	3.3
WTM 3.0	13.5%	ESD Strategies and Other Structural BMPs	194.2
WTM 4.0	29.9%	Habitat Restoration	202.0
WTM 5.0	39.8%	MS4 Programmatic Practices	202.4
TMDL WLA	30.7%		

* Excludes existing BMPs approved after the TMDL was established in 2003.

The restoration strategy is further illustrated in Figure 5, where the implementation phases are shown in order with their resulting bacteria load in comparison to the WLA. The cost for each implementation phase is also shown. The greatest reduction is attributed to pet waste education and County property ESD retrofits, while pet waste education was the most cost-efficient strategy, shown in Table 23.

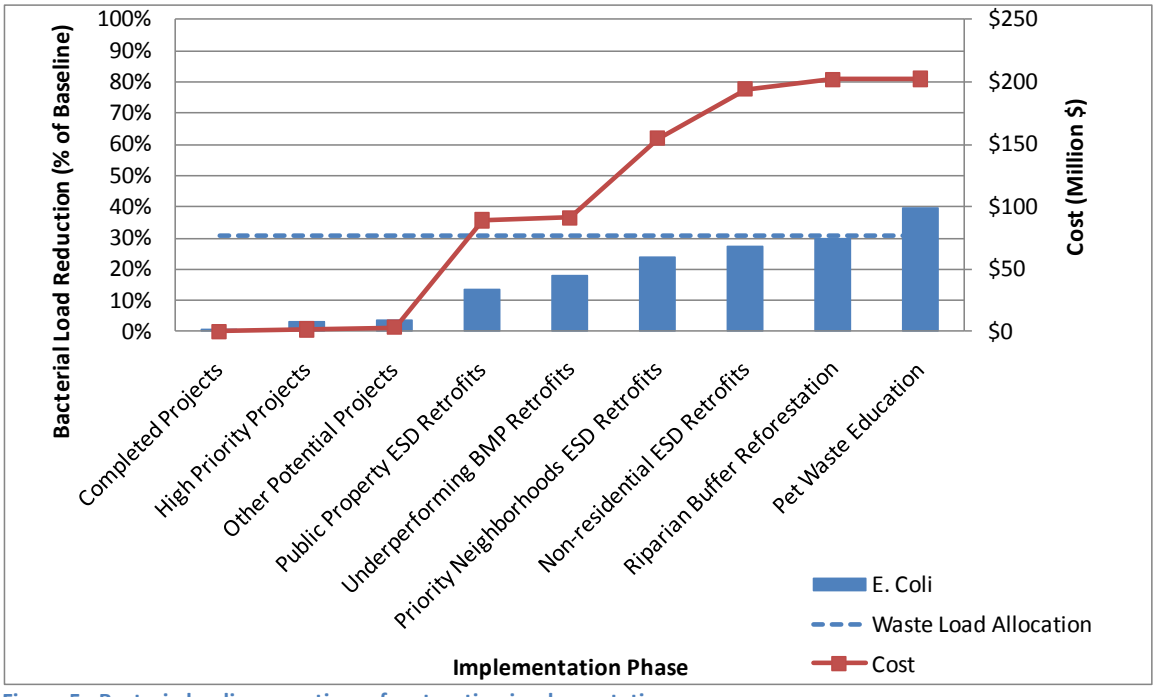

Figure 5. Bacteria loading over time of restoration implementation

Table 23. Individual restoration strategy cost effectiveness for bacterial load reduction

Rank	***Restoration Strategy***	***E. coli reduction***	***Incremental Cost***	***Unit Cost***
		Billion MPN/yr	Million $	Billion MPN /Million $
1	Pet Waste Education	4,388	$0.5	**9,436**
2	Underperforming BMP Retrofits	1,892	$1.9	**1,022**
3	High Priority Projects	1,289	$1.6	**800**
4	Riparian Reforestation	1,133	$7.8	**145**
5	Low Priority and Other Potential Projects	148	$1.7	**86**
6	County Property ESD Retrofits	4,400	$86.0	**51**
7	Private Non-residential ESD Retrofits	1,618	$39.2	**41**
8	Private Residential ESD Retrofits	2,633	$63.8	**41**
9	Completed Projects	112	$0.0	**0**

4 Evaluation of the Restoration Strategies to Meet MS4 Permit Trash Reduction Tracking

Table 24 presents recommended baseline loading rates for urban land uses in Montgomery County based on the MDE (2010b) study. These rates will be used as default values in a land use-based loading calculation model similar to the WTM. The model could be applied to individual Watershed Implementation Plans, or for a countywide calculation of trash loading.

Table 24. Montgomery County Point Source Baseline Loading Rates for Trash

Land Use	***Loading Rate[1] (lbs/ac/yr)***
Low-density residential	1.19
Medium-density residential	19.26
High-density residential	7.88
Commercial	2.22
Industrial	2.22
Institutional	2.22
Extractive	2.22
Parkland	0.32
Roadway[2]	2.22
Agricultural	0.32
Forest	0.32
Water	0
Bare Ground	2.22

[1] Montgomery County Trash Loading Rates from *Draft Total Maximum Daily Loads of Trash for the Anacostia River Watershed, Montgomery and Prince George's Counties, Maryland and The District of Columbia, 2010*
[2] Prince George's County Trash Loading Rates from *Draft Total Maximum Daily Loads of Trash for the Anacostia River Watershed, Montgomery and Prince George's Counties, Maryland and The District of Columbia, 2010*

In general, trash reduction strategies fall into four categories: (1) Structural; (2) Educational; (3) Municipal; and (4) Enforcement. For the purposes of the restoration strategies, structural stormwater BMPs were assigned 95% reduction credit for trash from the contributing drainage area. BMPs, while not specifically designed to capture trash, are also not very good at passing trash, and debris is prone to build up in forebays, around plants and interior elements, and around the outlet structures. Instream controls from trash nets or traps are also assumed to have 90% capture efficiency if maintained periodically.

In addition to trash reduction by structural stormwater BMPs, land use conversions, such as riparian reforestation, have an incremental reduction in trash by changing the loading rate according to Table 24.

Overall, the trash load in Cabin John Creek was reduced by 33.5% using the same restoration strategies outlined for the bacteria load reduction and impervious cover reduction procedures. Specific programmatic practices targeting trash load reduction were not modeled as part of this draft restoration strategy development. However, these practices can have a range of reduction effectiveness between 5-30%, depending on the intensity of implementation and frequency of

follow-up. Examples include anti-litter education campaigns, plastic bag bans, recycling programs, adopt-a-road and adopt-a-stream, street sweeping, and enforcement. Table 25 and Figure 7 illustrate the reduction in trash load over time and implementation of the strategies.

Table 25. Preliminary Trash Results of WTM Modeling

Implementation Phase	*Trash Loading*	*Comments*	*Cost*
	% reduction from Baseline Load		***Million $***
WTM Baseline Load	**0.0%**	**Normalized load using Anacostia loading rates**	$ -
WTM 2.0	1.1%	**Completed Projects**	$0.0
WTM 2.0	2.5%	**High Priority Projects**	$1.6
WTM 2.0	2.9%	**Low Priority and Other Potential Projects**	$3.3
WTM 3.0	30.8%	**ESD Strategies**	$194.2
WTM 4.0	33.5%	**Habitat Restoration**	$202.0
WTM 5.0	33.5%	**MS4 Programmatic Practices**	$202.4

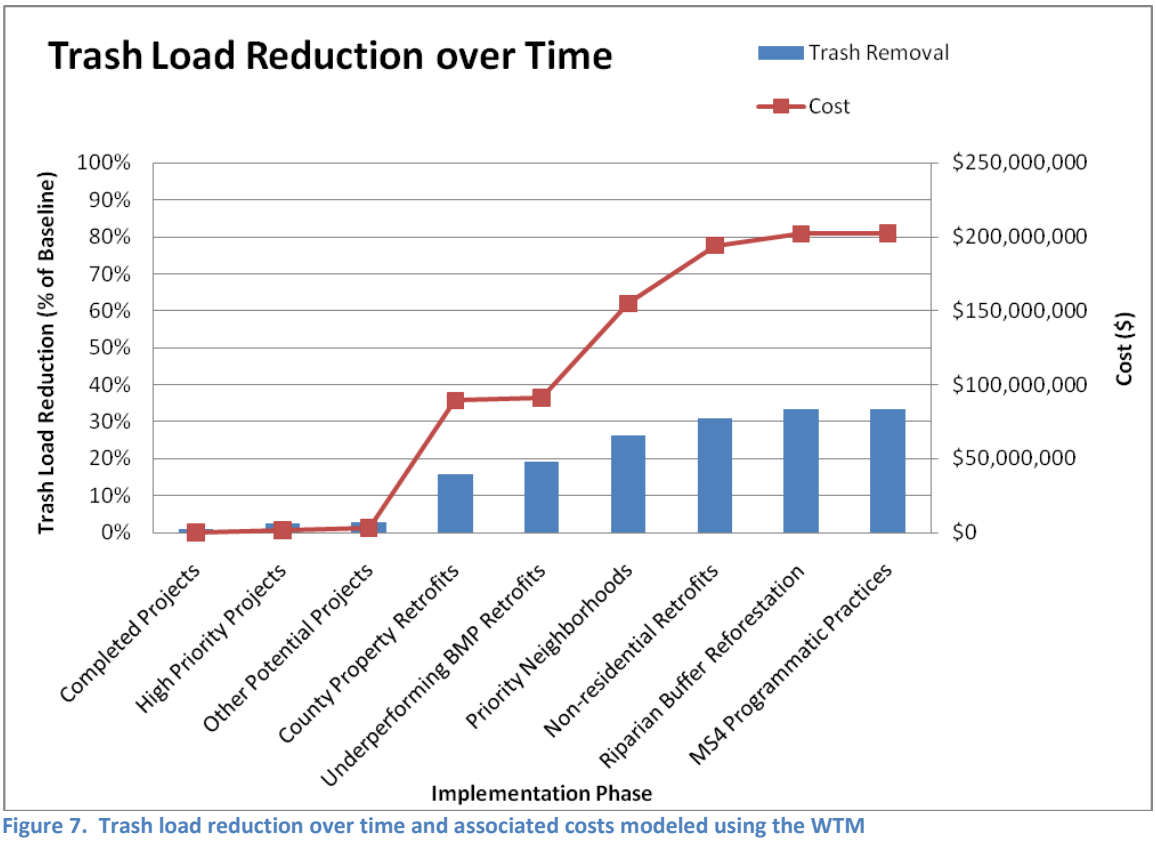

Figure 7. Trash load reduction over time and associated costs modeled using the WTM

5 Nutrient and Sediment Reduction Tracking

While no approved TMDLs are in place for Cabin John Creek related to nutrients or sediment, there are impairments present for total suspended solids (TSS) and Total Phosphorus (TP) parameters. In general, nutrient (Total Nitrogen –TN, and TP and TSS) reduction strategies follow the strategies proposed for bacteria and trash, only with different efficiencies. The respective efficiencies for the various strategies and assumptions about target areas follow the Guidance Document and assumptions presented in this Plan (e.g., Table 12).

Reductions in nutrient and sediment loads from a baseline condition are provided in Table 25.

Overall, the TN, TP, and TSS loads in Cabin John Creek were reduced by 41.9%, 41.7% and 29.5%, respectively, Table 26. Since the same core restoration strategies outlined for the bacteria load reduction and impervious cover reduction procedures are being followed, the cost for implementation also remains generally the same.

Table 26. Preliminary Sediment and Nutrient Results of WTM Modeling

Implementation Phase	*TN Loading*	*TP Loading*	*TSS Loading*	*Comments*
	% reduction from Baseline Load	*% reduction from Baseline Load*	*% reduction from Baseline Load*	
WTM Baseline Load	**0%**	**0%**	**0%**	**Uncalibrated load using default loading rates**
WTM 2.0	0.2%	0.2%	0.3%	**Completed Projects**
WTM 2.0	2.9%	3.0%	3.3%	**High Priority Projects**
WTM 2.0	3.2%	3.3%	3.6%	**Low Priority and Other Potential Projects**
WTM 3.0	25.5%	25.8%	28.4%	**ESD Strategies**
WTM 4.0	26.6%	27.3%	29.5%	**Habitat Restoration**
WTM 5.0	41.9%	41.7%	29.5%	**MS4 Programmatic Practices**

6 Action Inventory Implementation Schedule

6.1 Cabin John Creek Watershed Action Inventory Implementation Schedule

The implementation schedule summarized in Table 27 is an action inventory matrix that identifies priorities and timeframes for implementation of the above identified watershed restoration strategies as a function of project synergies and expected funding levels.

Outreach and Stewardship Strategy Methods of Obtaining Information: Given that overall Montgomery County has a well educated population and given that there are a great number of residences in this watershed, it is assumed that most of the stakeholders in this watershed have access to a personal computer and thus can be reached through electronic messaging and social media. Further, given that resident surveys have indicated that the majority of Montgomery County residents prefer newspapers as their primary source of information, a vigorous press campaign is recommended in this watershed for effective stakeholder outreach and education.

Similar to the other two more urban watersheds in the County (Anacostia and Rock Creek Watersheds), during the first permit cycle (through 2015), a priority was placed on full implementation of complete, high and low priority projects. A list of the high and low priority projects is provided in Appendix A. Fewer opportunities exist overall compared to the Anacostia and Rock Creek Watersheds. Next, 25% implementation of other potential projects was targeted. ESD was emphasized on both public (10%) and private property (10%). Finally, outreach (100%) was targeted for pollutant load reduction but not credited towards impervious cover credit. No riparian reforestation or stream restoration was targeted due to limited or no opportunities. In future permit cycles, the remainder of the other potential projects are targeted along with ESD and some riparian reforestation for impervious cover and pollutant load reduction.

The bacteria load reduction meets the MS4 permit WLA by 2025. Table 28 includes a summary of implementation goals for the 2015, 2017, 2020, 2025, and out years in order to illustrate the expected timeframe for MS4 Permit WLA compliance within Cabin John Creek watershed.

Table 27: Summary of Implementation Plan Schedule for the 2015 Fiscal Period, with expected level of ESD and pollutant load reductions

Strategies	*% Complete in Permit Cycle*	*IC Treated (acres)*	*ESD (% IC)*	*Cost (Million $)*	*ESD (% Cost)*	*% Reduction from baseline*				
						TN	*TP*	*TSS*	*Bacteria*	*Trash*
Completed and High Priority Projects	100.0%	88	2%	$1.6	19%	2.9%	3.0%	3.3%	3.2%	2.5%
Low Priority Projects	100.0%	10	78%	$1.6	98%	0.2%	0.2%	0.2%	0.2%	0.3%
Other Potential Projects	25.0%	1	0%	$0	0%	0.0%	0.0%	0.0%	0.0%	0.0%
Public ESD Retrofits	10.0%	40	100%	$8.8	100%	1.0%	1.0%	1.1%	1.1%	1.3%
Private ESD Retrofits	10.0%	47	100%	$10.3	100%	1.2%	1.2%	1.3%	1.3%	1.5%
Riparian Reforestation	0.0%	-	0%	$0	0%	0.0%	0.0%	0.0%	0.0%	0.0%
Stream Restoration	0.0%	-	0%	$0	0%	0.0%	0.0%	0.0%	0.0%	0.0%
Programmatic Practices	100.0%	-	0%	$0.5	0%	15.3%	14.4%	0.0%	9.9%	0.0%
Subtotal	***18.4%***	***187***	***52.0%***	***$23***	***92.0%***	***20.7%***	***19.9%***	***6.0%***	***15.7%***	***5.6%***

IC: Impervious Cover
ESD: Environmental Site Design
TN: Total Nitrogen
TP: Total Phosphorus
TSS: Total suspended solids

Table 28: Summary of Implementation Plan schedule for the Cabin John Creek Watershed with expected MS4 permit area WLA compliance endpoints

Fiscal Year		2015	2017	2020	2025	2030	TMDL WLAs
Impervious Treated (acres)		187	380	570	1,018	1,018	
ESD (% Impervious)		52%	72%	78%	87%	87%	
Cost (Million $)		23	65	114	215	219	
ESD (% Cost)		92%	91%	86%	90%	88%	
% Reduction from baseline	TN	21%	27%	39%	55%	58%	
	TP	20%	26%	35%	49%	51%	
	TSS	6%	17%	60%	91%	100%	
	Bacteria	16%	22%	27%	40%	40%	31%
	Trash	6%	12%	19%	34%	34%	

TN: Total Nitrogen
TP: Total Phosphorus
TSS: Total suspended solids
WLA: Waste Load Allocation

7 References

Army Corps of Engineers (USACE). 2008. Sligo Creek Study. Baltimore District. Baltimore, MD.

Caraco, D. 2009. *New WTM – No Projections.xls*, Personal Email Communication, October 14, 2009.

Caraco, D. 2001. The Watershed Treatment Model: Version 3.0. U.S. Environmental Protection Agency, Region V. Center for Watershed Protection. Ellicott City, MD

Center for Watershed Protection (CWP) and Chesapeake Stormwater Network (CSN). 2008. Technical Memorandum: The Runoff Reduction Method. Ellicott City, MD.

Center for Watershed Protection (CWP). 2007. National Pollutant Removal Performance Database Version 3.0. Center for Watershed Protection, Ellicott City, MD.

Chesapeake Bay Program (CBP) Nutrient Subcommittee. 2008. Infiltration and Filtration Practices: Definition and Nutrient and Sediment Reduction Effectiveness Estimates. Center for Watershed Protection, Ellicott City, MD.

Chesapeake Stormwater Network (CSN) and Biohabitats. 2011. *Implementation Plan Guidance Document*. Prepared for Montgomery County Department of Environmental Protection, Rockville, MD. http://www.montgomerycountymd.gov/dectmpl.asp?url=/Content/dep/water/esdStrategy.asp

MDE (Maryland Department of Environment). 2006a. Maryland's 2006 TMDL Implementation Guidance for Local Governments. Appendix C: Maryland's Tier II Antidegradation Implementation Procedures. http://www.mde.state.md.us/assets/document/AppendixC.pdf

MDE (Maryland Department of Environment). 2006b. Total Maximum Daily Loads of Fecal Bacteria for the Non-tidal Cabin John Creek Basin in Montgomery County, Maryland, Final. Baltimore, MD.

MDE (Maryland Department of the Environment). 2008. Final 2008 Integrated Report of Surface Water Quality in Maryland. Baltimore, MD: Maryland Department of the Environment.

MDE (Maryland Department of the Environment). 2009. Watershed Report for Biological Impairment of the Cabin John Creek Basin in Montgomery County, Maryland, Biological Stressor Identification Analysis, Results and Interpretation. Baltimore, MD: Maryland Department of the Environment.

MDE (Maryland Department of the Environment). 2010a. Memorandum: 2010 Status of Approved Stormwater Wasteload Allocations for NPDES Regulated Stormwater Entities in Montgomery County. Baltimore, MD: Maryland Department of the Environment.

MDE (Maryland Department of the Environment). 2010b. Total Maximum Daily Loads of Trash for the Anacostia River Watershed, Montgomery and Prince George's Counties, Maryland and the District of Columbia, Final. Baltimore, MD.

Schueler, T. 1998. The performance of oil grit separators in removing pollutants at small sites. Technical Note 119. *Watershed Protection Techniques*. 2(4): 539-542. See also Technical Note 120.

Schueler, T. and A. Kitchell. 2005. Methods to Develop Restoration Plans for Small Urban Watersheds, *Urban Subwatershed Restoration Manual No. 2*, Center for Watershed Protection, Ellicott City, Maryland. Table 47

Appendix A – List of High and Low Priority Projects

High and Low Priorities Project List - Cabin John Watershed

Project Type	**Project Name**
New Stormwater Pond	Cabin John Shopping Center Tuckerman I
Stormwater Pond Retrofit	Executive Blvd Fox Hills of Potomac Pine Knolls Washington Science Center