MATTAWOMAN CREEK

WATERSHED ASSESSMENT

JUNE | 2016

PREPARED FOR

Charles County

Department of Planning and

Growth Management

Watershed Protection and Restoration Program

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PREPARED BY

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ACKNOWLEDGEMENTS

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BayFAST	Bay Facility Assessment Scenario Tool
BMP	Best Management Practices
CBP	Chesapeake Bay Program
CIP	Capital Improvement Plan
EOS	Edge of Stream
EPA	U.S. Environmental Protection Agency
ESD	Environmental Site Design
FA	Future Allocation
MAST	Maryland Assessment Scenario Tool
MDE	Maryland Department of the Environment
MDP	Maryland Department of Planning
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
NTP	Notice to Proceed
SPSC	Step Pool Storm Conveyance
SW-WLA	Stormwater Wasteload Allocation
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
WIP	Watershed Implementation Plan
WLA	Wasteload Allocation
WRR	Maryland Water Resources Registry

1 INTRODUCTION

1.1 BACKGROUND

Charles County Department of Planning and Growth Management (PGM) has initiated a series of watershed assessments in response to requirements set forth by the Maryland Department of the Environment (MDE) in the County's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit (11-DP-3322 MD0068365), issued on December 26, 2014. The watershed assessments support the County's goals for healthy watersheds and natural resources, and also support progress towards satisfying several regulatory and permit requirements.

Mattawoman Creek Watershed and Lower Patuxent River Watershed (Figure 1) were selected for the 2015 watershed assessments and follow the methodologies and formats set forth in the County's Port Tobacco River Watershed plan, which was completed in September 2015 and served as a pilot assessment for the County's current assessment methods. The Lower Patuxent River Watershed assessment is reported separately (KCI, 2016) from this Mattawoman Creek assessment report. The assessments build from the planning strategies included in the County's Phase II Watershed Implementation Plan (WIP) Strategy (February 2013). The WIP describes in broad terms the County's various non-agricultural source sectors (wastewater, urban stormwater, septic), their associated TMDL load reduction targets, reduction strategies, costs of plan implementation and potential funding sources. The watershed assessments provide the next step in the planning process specifically for the urban stormwater sector regulated by the County's NPDES permit. The watershed assessments, through desktop and field assessment, identify watershed and water quality conditions and identify and prioritize specific restoration solutions to meet the County's watershed restoration goals.

1.2 WATERSHED DESCRIPTION

Mattawoman Creek is located in northwestern Charles County, Maryland, and drains directly into the Potomac River, which ultimately drains to the Chesapeake Bay (Figure 2). Mattawoman Creek divides Charles County to the south and Prince George's County to the north in the upper portion of the creek. The Town of Waldorf is located along the eastern portion of the Mattawoman Creek Watershed, with US Highway 301 (Crain Highway) running from the northern extent of the watershed through to the southeastern extent along the eastern boundary. The Town of Indian Head is located in the western portion of the watershed. Mattawoman Creek is approximately 34 miles long from the headwaters to confluence with the Potomac River with approximately 70 square miles of its watershed contained within Charles County. Land use in the Charles County portion of the watershed is predominately forested (53%), with the remaining area devoted to developed land (39%) and agriculture (7%; MDP, 2010).

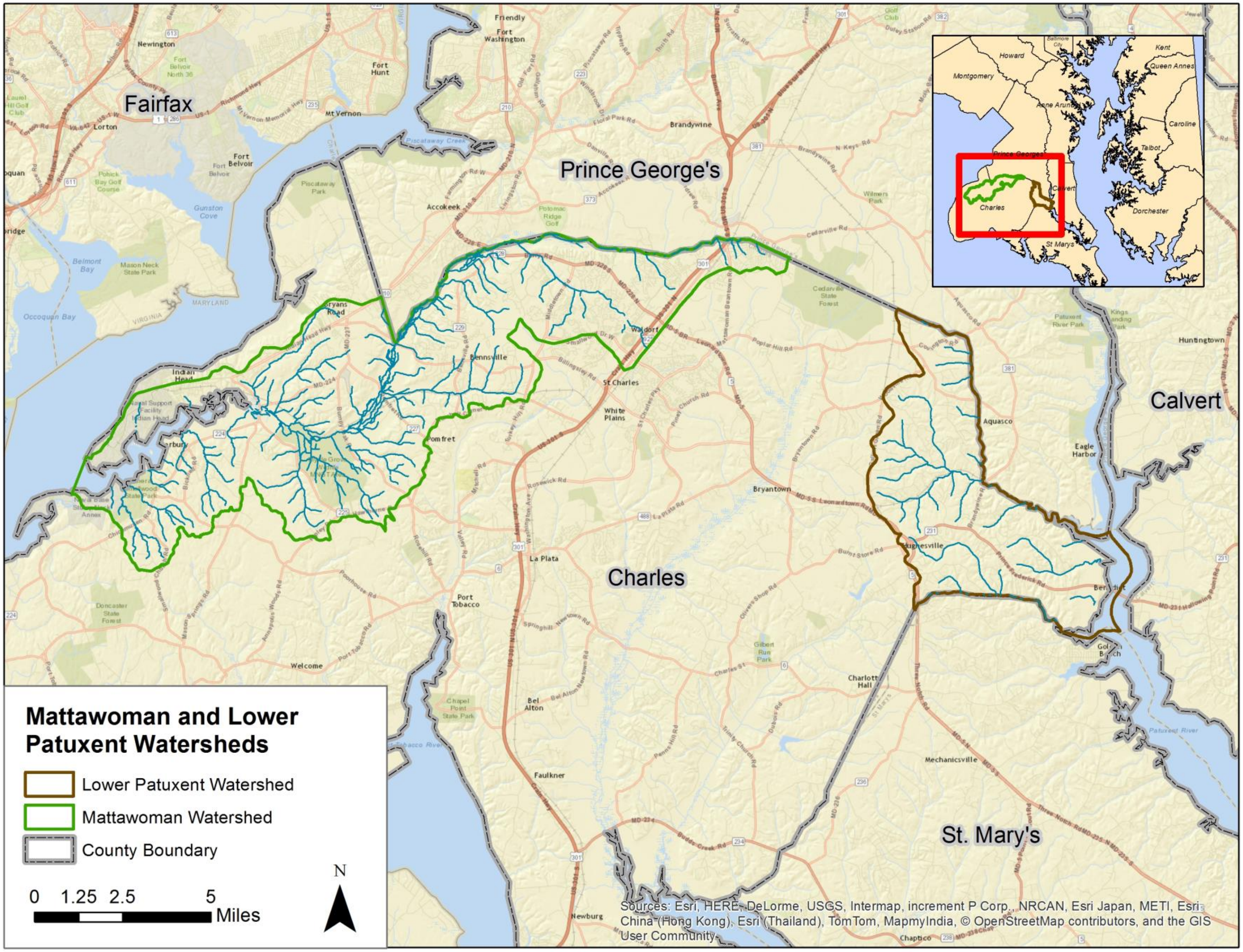


FIGURE 1: STUDY AREA LOCATION MAP

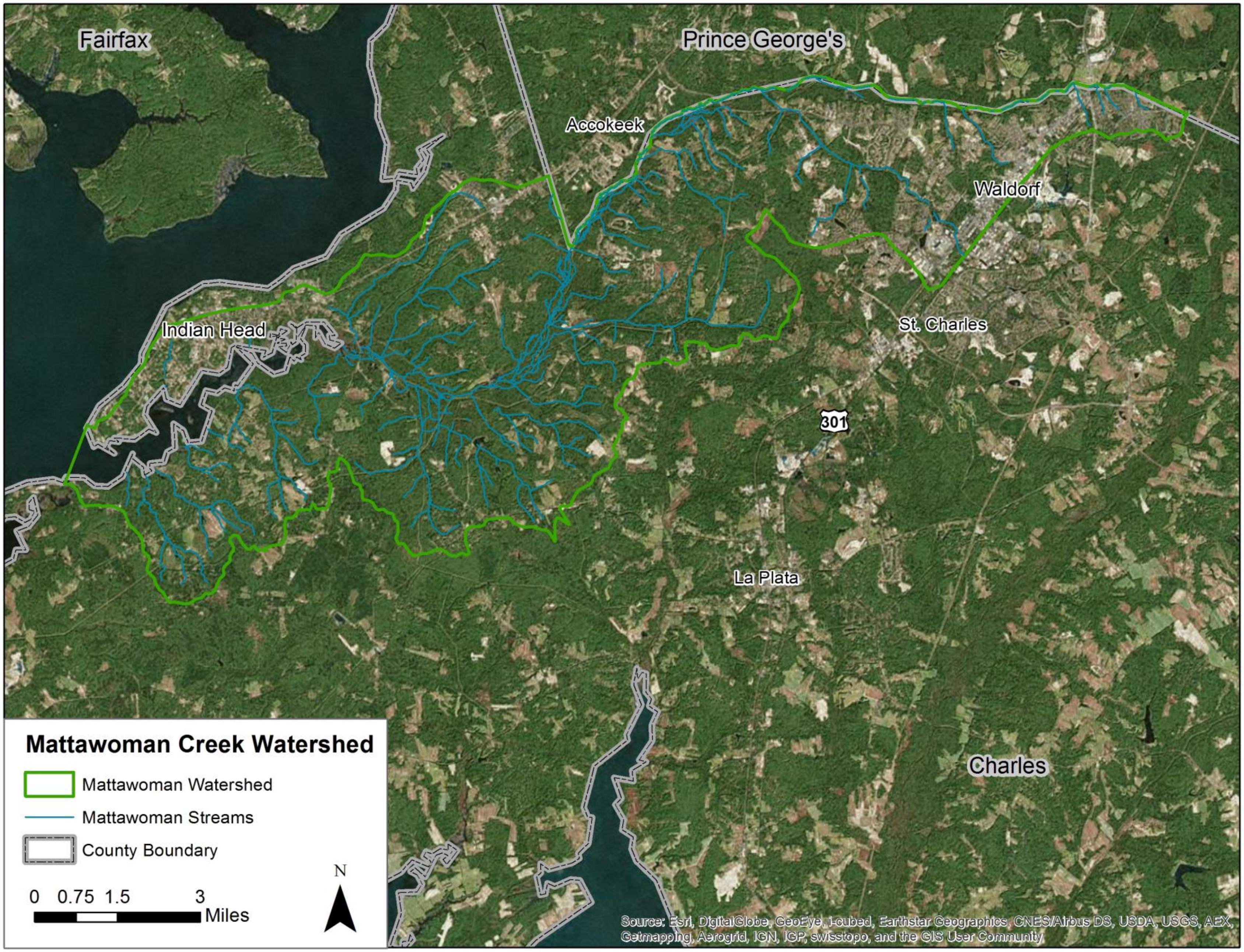


FIGURE 2: MATTAWOMAN CREEK WATERSHED LOCATION

1.3 PREVIOUS WATERSHED STUDIES AND ASSESSMENTS

Several other watershed studies and plans have been developed for the Mattawoman Creek Watershed. Most recently, Vista Designs, Inc. was contracted by Charles County to identify pond retrofits, stream restoration, new water quality facilities, or alternative best management practices (BMPs) to assist the County in compliance with their MS4 permit, which requires 20% treatment of the currently untreated impervious surfaces. The *Mattawoman Creek Watershed NPDES: MS4 Retrofit Study* summarizes the study (Vista, 2015b). The projects proposed in the study were made available to KCI prior to this current assessment to avoid redundancy.

The *Mattawoman Creek Watershed Management Plan: Charles County Maryland* (2003) was developed by the US Army Corp of Engineers Planning Division and Charles County Planning Division, the Charles County Planning Division, and the Charles County Mattawoman Creek Watershed Citizen's Advisory Committee. The goals of the management plan were to document natural resources, current and projected urbanization and growth, the impact of this growth on natural resources and water quality, and finally to develop a planning guide and recommendations for future development.

Integrating Priorities and Achieving a Sustainable Watershed Using the Watershed Resources Registry in the Mattawoman Creek Watershed (2011) was developed by the Interstate Commission on the Potomac River Basin for MDE and U.S. Environmental Protection Agency (EPA), and uses the Maryland Water Resources Registry (WRR) to identify environmental restoration and preservation sites, such as riparian wetland, upland, and stormwater restoration, and preservation projects, throughout the Mattawoman Creek watershed.

The Interagency Mattawoman Ecosystem Management Task Force developed *The Case for Protection of the Watershed Resources of Mattawoman Creek: Recommendations and Management Initiatives to Protect the Mattawoman Ecosystem* (2012). The task force includes representatives from Maryland Department of Natural Resources, Office for a Sustainable Future, Department of Planning, Department of the Environment, State Highway Administration, and others and provides guidance for the County in updating the Charles County Comprehensive Plan as it concerns protecting and conserving resources in the Mattawoman Creek Watershed. Elements included in the report are:

1. Land Use and Growth Management
2. Fisheries Resources
3. Non-tidal Streams
4. Wetlands, Coastal Resources, and Coastal Climate Change
5. Forest Resources
6. Wildlife and Rare Species Habitats
7. Water Resources Management for a Future Climate
8. Stormwater Management

KCI has previously developed watershed restoration plans (KCI, 2004, KCI, 2007, and KCI 2011) for subwatersheds within the Charles County Development District for the NPDES 2002-2007 permit term. County watersheds were ranked and prioritized by condition, and impervious area within the Development District was calculated so that restoration study areas selected would equal 10% of untreated impervious area within the Development District to coincide with the previous NPDES permit terms and 10% restoration goal. Baseline monitoring to identify stressors included stream corridor assessments, geomorphic assessments, physical and chemical water quality analysis, biomonitoring, and physical habitat assessments. These assessments led to the identification of restoration techniques, including source controls, land conservation, BMP retrofits, new BMPs, and stream restoration. Concept plans for improvement projects were developed and included opportunities and benefits, constraints and feasibility, and a preliminary capital cost estimate for each project.

1.4 Goals

1.4.1 Watershed Assessments

The County's current round of watershed assessments will satisfy section IV.E.1 of the NPDES permit to develop detailed watershed assessments for the entire County by the end of the permit term (2019) with a focus on urban stormwater sources and restoration. The following schedule of assessments is being implemented:

- Port Tobacco – completed 2015;
- Mattawoman Creek and Lower Patuxent River – completed 2016;
- Zekiah Swamp, Gilbert Run, and Wicomico River – to be complete 2016; and
- Potomac River (upper,middle, lower) and Nanjemoy Creek – to be complete 2017.

The assessments identify management strategies that support several planning goals, including:

- Implementation of restoration efforts for twenty percent of the County's impervious area;
- Meeting Chesapeake Bay Total Maximum Daily Load (TMDL) stormwater load reduction targets; and
- Meeting TMDL targets for local waterway impairments, specifically stormwater waste-load allocations (SW-WLAs).

To accomplish these goals the assessments are structured to meet the following objectives:

- Characterize current water quality conditions;
- Characterize current stream and watershed conditions;
- Identify and rank water quality problems;
- Identify and prioritize water quality improvement projects;

- Estimate pollutant load reductions achievable with implementation of the plan and develop reduction milestones towards meeting SW-WLAs.

Because the primary goal of this current study is related to the urban stormwater sector and meeting the restoration goals of the NPDES permit, watershed elements such as rare, threatened and endangered species, coastal waterways, climate impacts, etc. while extremely important are outside of the scope of this current effort. These elements are addressed in other State and County planning efforts and the results of this study can be combined with those efforts to address a wider range of watershed features.

1.4.2 Impervious Restoration

As a requirement of the NPDES MS4 Discharge Permit issued by MDE to Charles County, the County must treat 20% of remaining Countywide baseline untreated impervious acres by the end of the current permit term in December, 2019. Impervious accounting methodology is included in Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated (MDE, 2014a). Untreated impervious includes those areas where stormwater practices provide less than the current Maryland standard water quality volume for runoff from 1” of rainfall. Section 6.3 of this report describes the impervious credit achieved, with specificity for the Mattawoman Creek watershed.

1.4.3 TMDLs

The total allowable load to a waterbody consists of two categories of sources: point sources (Wasteload Allocation or WLA) and non-point sources (Load Allocation or LA). Stormwater regulated by NPDES permits is regulated as a point source. In Maryland, MDE designates this allowable load as the SW-WLA. They may also include to other components, a Margin of Safety (MOS) which has generally been included implicitly in the analysis, and a Future Allocation (FA) which is used to account for growth in wastewater point sources and is not frequently included.

There are local TMDLs with SW-WLAs assigned to Charles County for nitrogen and phosphorus for the Mattawoman Creek.

Mattawoman Creek was first identified in 1996 as being impaired by nutrients and a TMDL for nitrogen and phosphorus was put in place in 2004 (MDE, 2004) using a baseline year of 2000. The low flow TMDL for nitrogen is 1,544 lbs/month. Nonpoint source load allocation is 164 lbs/month of total nitrogen and the waste load allocation for point sources including wastewater treatment plants and urban stormwater are allocated 1,366 lbs/month of total nitrogen. The low flow TMDL for phosphorus is 411 lbs/month. Nonpoint sources are allocated 5 lbs/month of phosphorus and point sources are allocated 404 lbs/month of phosphorus. The water quality goals associated with the TMDLs of nitrogen and phosphorus are:

1. Minimum DO level of 5.0mg/L
2. Peak chlorophyll *a* levels below 50 µg/L

As a result of the low flow TMDLs, average daily loads will be approximately 51 lbs/day of nitrogen and 14 lbs/day of phosphorus. These loading limits represent a maximum amount of a pollutant that the water body can receive and still meet water quality standards. Pollutant loads from point and nonpoint sources must be reduced by implementing a variety of control measures. Responsibility for TMDL reductions is divided among various contributing jurisdictions within the area draining to the water body.

The TMDL loading targets, or allocations, are also divided among the pollution source categories, which in this case includes non-point sources (termed load allocation or LA) and point sources (termed waste load allocation or WLA). The WLA consists of loads attributable to regulated process water or wastewater treatment and to regulated stormwater. Table 1 presents the Mattawoman Creek local TMDL baseline and WLA. Total nitrogen (TN) and total phosphorus (TP) loads are measured in edge of stream (EOS) loads, which is the amount of a pollutant load transported from a source to the nearest stream.

TABLE 1: MATTAWOMAN CREEK LOCAL TMDL BASELINE AND TARGET LOADS

	Mattawoman Creek	
	TN-EOS lbs	**TP-EOS lbs**
Baseline and Target		
TMDL Baseline Year	2000	2000
Baseline Load	56,526	4,958
Target Percent Reduction	54.0%	47.0%
Load Reduction	30,524	2,330
WLA	26,002	2,628

Chesapeake Bay TMDL

In December, 2010, the U.S. EPA published the Chesapeake Bay TMDL. The Bay TMDL sets limits on loading of three pollutants (nitrogen, phosphorus and sediment) delivered to the Bay from contributing segments, such as the Mattawoman Creek.

The County's MS4 permit is requiring compliance with the Chesapeake Bay TMDL for the urban stormwater sector through the use of the 20% impervious surface treatment strategy. Therefore it is expected that the 20% goal and associated credit accounting will take precedence over the Bay TMDL loading goals and crediting. While not a requirement in the County's MS4 permit, the strategies provided in this plan to meet local TMDL reduction targets have been modeled in order to calculate expected progress toward meeting the Bay TMDL nutrient and sediment reduction goals.

Charles County's Bay TMDL goal is defined at the County scale and is provided here in Table 2 with the reduction described in terms of both the loading reduction and the percent reduction. Section 6 of this report describes the reductions achieved, with more specificity for the Mattawoman Creek watershed.

TABLE 2: CHARLES COUNTY BAY TMDL STORMWATER GOALS

	TN-EOS (lbs/yr)	**TP-EOS (lbs/yr)**	**TSS-EOS (lbs/yr)***
Bay TMDL Goal %	18.2%	37.7%	-
Bay TMDL Target Stormwater Reduction	42,759	7,554	-

*No target reduction for sediment. It is anticipated that by achieving the phosphorus goal, enough sediment will be removed to improve water quality.

2 WATERSHED ASSESSMENT METHODS

The following assessments were conducted throughout the Mattawoman Creek watershed:

- Upland Assessment
- Nutrient Synoptic Survey
- Stream Corridor Assessment

Property access permission letters were sent to all landowners within the target watershed with streams on their property. Passive permission was assumed through the letters, although landowners were given the opportunity to deny access to their properties. All properties targeted for assessments were able to be accessed as part of this effort as no site permissions were denied.

2.1 UPLAND ASSESSMENT

KCI assessed upland pollution sources and restoration opportunities using the methodology detailed in the Center for Watershed Protection's Unified Subwatershed and Site Reconnaissance Manual (CWP, 2004). These assessments included both the Neighborhood Source Assessment (NSA) and Hotspot Site Investigations (HSI). General procedures for each type of assessment are provided in the following sections.

2.1.1 NEIGHBORHOOD SOURCE ASSESSMENT

A Neighborhood Source Assessment (NSA) reconnaissance was conducted in residential neighborhood areas to evaluate the pollution-producing behaviors. The NSA rates the potential severity and type of non-point source pollution from residential behaviors. It also provides an assessment of the influence of imperviousness for each site by providing an estimate of whether roof drainage is directed to cisterns, storm drains, impervious areas or pervious areas and the percent of driveways in the neighborhood that are impervious.

A desktop analysis was performed in which all neighborhoods in the Mattawoman Creek watershed were identified and delineated. These neighborhoods were then categorized by similar characteristics, including house type (single family, townhouse, etc.), lot size, year built, and stormwater management era. Individual neighborhoods that characterized each category were selected for field visits so the assessment was conducted in a variety of residential areas that represent the different housing types found throughout each watershed. Neighborhoods were then rated on the Pollution Severity Index as either severe, high, moderate, or none based on their potential to generate pollutants. Neighborhoods were also rated on the Restoration Opportunity Index as either high, moderate, or low based on their potential for restoration opportunities.

2.1.2 Hotspot Site Investigations

A Hotspot Site Investigation (HSI) was conducted to identify potential stormwater hotspots. Hot Spots for this plan are defined as commercial, industrial, institutional, municipal or transportation-related operations that typically produce high levels of stormwater runoff and pollutants, while presenting potential risk for spills, leaks or illicit discharges. These include gas stations, commercial car washes, vehicle and equipment maintenance facilities, and sites where pesticides, fertilizers, or industrial chemicals may be stored or used.

The HSI assessment was conducted at locations identified in the office from aerial photography and mapping layers in GIS, and was targeted towards business, commercial, and industrial sites in the urban areas of the watershed. Additionally, using available GIS layers, potential hot spot locations that received no or only partial stormwater management were prioritized. Field crews rated each hotspot on the likelihood that current activities at the site are causing stormwater runoff contamination. Appropriate follow-up actions for each hotspot, including education, retrofits, and referral for immediate enforcement were also noted.

2.2 Nutrient Synoptic Survey

2.2.1 Water Quality Sampling

Synoptic water quality sampling was performed across the Mattawoman Creek watershed. The sampling locations were selected by locating sites which represented the watershed and also had ease of access. Sites located on a stream that crossed under a road or other infrastructure were sampled upstream of the road so the structure was not directly impacting the flow and water quality. In some locations, a site was selected upstream and downstream of a confluence to show changes in the flow and water quality at the confluence. Sample collection did not occur within 24 hours after a rainfall event totaling more than 0.25 inches of precipitation. A sub-meter Trimble® GPS unit was used to navigate to each sample point. If a grab sample could not be collected at the original sampling point, the location was shifted upstream or downstream accordingly, and an additional GPS point was collected if the point was moved significantly. Sampling locations remained within the original sampling reach and were not moved downstream of a confluence that would include flow from any additional reaches. Site conditions (e.g. clarity, odor, condition of site) were recorded at each sampling site. Grab samples were collected from each site for laboratory analysis of water quality parameters. Samples were preserved on ice for transport immediately after they were collected. Three duplicate samples and one lab blank were collected for quality assurance purposes.

Environmental Testing Lab Inc.[1] completed all laboratory analysis according to standard, approved methods. A complete list of analytical parameters and methods, including detection limits, is presented in Table 3.

[1] 3430 Rockefeller Ct, Waldorf, MD 20602

TABLE 3: WATER CHEMISTRY ANALYTICAL METHODS

Parameter	Method	Detection Limit	Units
Enterococcus (E. coli)	Colilert	1	MPN/100 ml
Ortho-phosphate Phosphorus	EPA 365.1	0.01	mg/L
TKN	EPA 351.2	0.5	mg/L
Nitrate + Nitrite	EPA 353.2	0.5	mg/L
Total Nitrogen	EPA 351.2 + 353.2	1	mg/L
Total Phosphorus	EPA 365.1	0.01	mg/L

Additional water quality measurements were collected *in situ* from each sampling site. Temperature, pH, specific conductivity, and dissolved oxygen were measured with a YSI ProPlus® multiprobe, and turbidity was measured with a Hach 2100 Turbidimeter. Optical brightener (fluorescent whitening agents) samples were collected in sample bottles wrapped in aluminum foil, and analyzed in the field using a Turner Designs AquaFluor® Handheld Flurometer configured with an Optical Brightener channel, following the California EPA Surface Water Ambient Monitoring Program's SOP (Burres, 2011). The Flurometer unit has a minimum detection limit of 0.5ppm and a range of 0-30,000ppm.

2.2.2 Stream Discharge Measurement

Stream discharge measurements were performed at each sampling site in conjunction with water quality sampling in order to calculate instantaneous baseflow pollutant loads. A suitable transect, one that approximates a "U" shaped channel, was located at each site for measuring stream discharge. Transects were selected to be free of irregularities that may create backflows and cross flows. A SonTek FlowTracker® Handheld Acoustic Doppler Velocimeter was used to collect a series of approximately 10 velocity measurements at regular intervals across the wetted width of the stream to determine instantaneous discharge. The measurements collected at regular intervals included depth (to the nearest 0.5cm) and velocity (to the nearest 0.00 m/sec). Velocity was measured at 0.6 of the distance from the water surface to the bottom of the stream. Due to the difficulty of obtaining accurate discharge measurements below approximately 0.05 cfs with the flowmeter, discharge at low flow sites was obtained by measuring cross sectional area and using a float to measure velocity.

2.3 Stream Corridor Assessment

Prior to performing stream corridor assessments, approximately 8.5 miles of stream reaches were prioritized using select GIS data elements as shown in the table below. Table 8 presents the selection and exclusion factors for selecting SCA reaches. KCI used the following general criteria for prioritizing stream reaches:

Criteria for selection:

- Topography – narrow, steep stream valleys and tortuous meander
- Vicinity to high density of stormwater infrastructure (outfalls, BMPs)

- Drainage area consists of untreated or undertreated impervious surfaces

Criteria for exclusion:

- Land use- adequate forest cover, wide riparian buffers
- Low density development and agriculture

TABLE 4: SCA REACH SELECTION AND EXCLUSION FACTORS

Data Element	Factors for selection	Factors for exclusion
Topography	Narrow, steep valleys and side slopes, tortuous meanders	Flat, wide floodplains
Stormwater infrastructure (outfalls, BMPs, BMP treated areas, Stormwater by Era)	Reaches downstream of untreated or undertreated areas	Reaches downstream of treated areas
Forest Cover	Lack of riparian buffer and forest	Adequate forest cover, wide riparian buffers
Development	Higher density development	Low density development and agriculture

Field crews conducted stream field investigations using standard SCA protocols as outlined in Stream Corridor Assessment Survey: SCA Survey Protocols (Yetman, 2001). Using the same methodology as other SCA surveys will allow for the results to be incorporated into, and directly compared against, other County and State assessment datasets. Property access permission letters were sent to all landowners within the target watershed with streams on their property. All of the properties targeted for assessments were able to be accessed as part of this effort.

The field investigation consisted of a two-person team walking the stream channel and conducting a visual assessment to locate problem areas and assess their severity and correctability. The field team collected information on channel alteration, erosion, exposed utility pipes, drainage pipe outfalls, fish barriers, inadequate buffers, construction in or near the stream, trash dumping, and recorded any unusual conditions. Representative sites were selected at locations representative of each stream segment. The general physical habitat condition was assessed at the representative sites using a modified version of the EPA's Rapid Bioassessment Protocols (Barbour et al., 1999). The assessment includes qualitative ratings for ten habitat parameters as well as information on wetted width, pool, run, and riffle depths, and channel substrate.

During the field assessment points were given unique alphanumeric identifiers according to the stream reach and point type. This allowed each point to have a unique ID, for example, 001_IB001. A complete list of point types and corresponding alphanumeric identifiers used during the field assessments is included below:

- Erosion (ES)
- Exposed pipe (EP)
- Pipe outfall (PO)
- Inadequate buffer (IB)
- Fish barrier (FB)
- Trash dumping (TD)
- Channel alteration (CA)
- Unusual condition (UC)

A GPS location was recorded and a photograph was taken for each assessment point. Linear features (eroding banks, buffer impacts, and channel alteration) were documented with a GPS location at each end of the impact and a line feature was developed to better represent the full extent of the problem area. The assessment rated each feature on a 1 to 5 scale according to its severity, correctability, and accessibility; where a score of 1 is the most severe, but also the most correctible and the most accessible. The results were then compiled into a database which will be used to identify and prioritize areas for restoration actions.

In addition to the basic SCA set of impacts and assessments, KCI added an inventory of Potential BMP Locations, in which the field crew could identify up to five potential BMP types that could be implemented at any particular location. This reduced the need for additional field visits and property owner coordination. The potential BMP types included the following:

- Bioretention/raingarden
- Invasive plant control
- Livestock exclusion fencing
- Outfall stabilization
- Riparian buffer enhancement or replacement
- Stabilized crossing
- Stormwater management pond
- Streambank stabilization
- Streamside grass buffer
- Wetland creation
- Wetland restoration
- Water trough

3 WATERSHED ASSESSMENT RESULTS

3.1 UPLAND ASSESSMENT

Upland assessments including both the NSA and HSI were completed on March 19th and 20th, 2015. Field crews assessed a total of 10 neighborhoods and 21 hotspots in the Mattawoman Creek watershed.

3.1.1 NEIGHBORHOOD SOURCE ASSESSMENT

A total of 10 neighborhoods were assessed in the Mattawoman Creek watershed (Figure 3). General characteristics of each neighborhood are presented in Table 5. A complete record of NSA data is included in Appendix A.

TABLE 5: GENERAL CHARACTERISTICS OF NEIGHBORHOODS ASSESSED

Site ID	Neighborhood / Subdivision	LU Type	Lot Size (acres)	Age (Decade)	Curb & Gutter	% Imperv -ious	% Lawn	% Canopy
MW-1	Lancaster	Single Fam Detached	<1/4	1980	Yes	50	40	10
MW-2	Indian Head	Single Fam Detached	>1	1930-1950	Yes	50	40	0
MW-3	Riverside Run	Single Fam Attached	<1/4	1990	Yes	70	18	5
MW-4	Potomac Heights	Single Fam Detached	1/4	1940	No	80	15	10
MW-5	Livingston Rd / Ford Drive	Single Fam Detached	>1	1950-1970	No	40	50	5
MW-6	Somerset	Single Fam Attached	<1/4	1990	Yes	80	10	5
MW-7	Fox Chase Apartments	Multifamily	<1/4	1980	Yes	50	30	4
MW-8	Indian Head Hwy and Warehouse Landing Road/ Jenkins Lane	Single Fam Detached	1/2	1950-1970	No	30	60	30
MW-9	Somerset	Single Fam Detached	<1/4	1990-2010	Yes	60	25	5
MW-10	Livingston Rd/ Billingsley Rd	Mobile Home	<1/4	Unknown	No	75	15	40

Of the 10 neighborhoods assessed, only two (Indian Head and Somerset) received a 'high' pollution severity rating due to the potential for nutrient, bacteria, sediment, and oil and grease pollution (Table 6). All other neighborhoods received a "moderate" pollution severity rating.

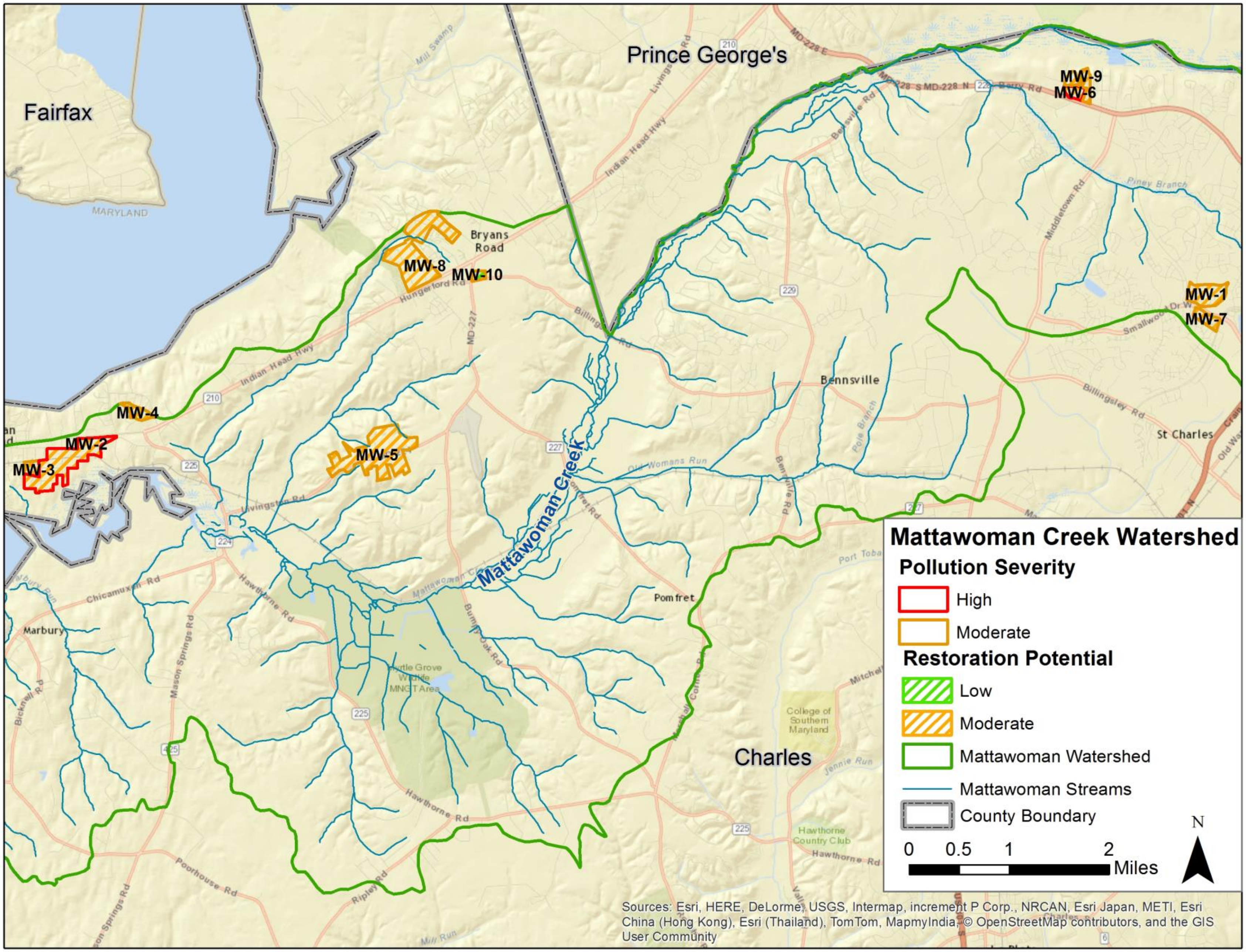


FIGURE 3: NEIGHBORHOOD SOURCE ASSESSMENT RESULTS

The restoration potential was rated as 'moderate' for all but one neighborhood, which received a "low" rating (Table 6). The restoration potential is based off of an index that ranks specific neighborhood features using benchmark values (e.g., less than 10% of storm drains stenciled). Depending on the feature type, if more than five features fall above or below the benchmark value, the neighborhood is considered to have a 'high' restoration potential; three to five benchmarks will have a 'moderate' restoration potential; and, a neighborhood with a 'low' restoration potential will have two or fewer benchmarks. Rain barrels, rain gardens, and conservation landscaping were the most common restoration actions recommended. Other recommended restoration measures include street sweeping, tree planting, and stormwater management retrofits.

TABLE 6: NEIGHBORHOOD POLLUTION SEVERITY AND RESTORATION POTENTIAL

NSA Site ID	Neighborhood / Subdivision	Pollution Severity	Pollution Sources	Restoration Potential	Potential Action
MW-1	Lancaster	Moderate	Nutrients, Bacteria, Sediment	Moderate	rain barrels, conservation landscaping, street sweeping
MW-2	Indian Head	High	Nutrients, Sediment, Oil and Grease	Moderate	rain barrels, conservation landscaping, street sweeping
MW-3	Riverside Run	Moderate	Nutrients, Bacteria, Sediment	Moderate	rain barrels, conservation landscaping, street sweeping
MW-4	Potomac Heights	Moderate	Nutrients, Sediment, Bacteria	Moderate	rain barrels, conservation landscaping
MW-5	Livingston Rd / Ford Drive	Moderate	Sediment, Nutrients, Oil and Grease	Moderate	rain barrels, conservation landscaping, rain gardens, swale retrofits
MW-6	Somerset	High	Nutrients, Bacteria, Sediment	Moderate	rain barrel, conservation landscaping, street sweeping, tree planting in common area
MW-7	Fox Chase Apartments	Moderate	Nutrients	Moderate	retrofit ditch for stormwater management, conservation landscaping
MW-8	Indian Head Hwy and Warehouse Landing Road/ Jenkins Lane	Moderate	Nutrients	Moderate	rain barrels, rain gardens, conservation landscaping, tree planting
MW-9	Somerset	Moderate	Nutrients	Moderate	rain barrel, conservation landscaping, street sweeping, tree planting in common area
MW-10	Livingston Rd/ Billingsley Rd	Moderate	Sediment, Oil and Grease	Low	retrofit perimeter swales, tree planting at common area

3.1.2 Hotspot Site Investigations

A total of 21 sites were investigated in the Mattawoman Creek watershed (Figure 4). The location, general description, and common operations (i.e., vehicle operations, outdoor materials, waste management, physical plant, turf/landscaping) of each site investigated are presented in Table 7. A complete record of HSI data is included in Appendix B.

Of the 21 sites investigated, only one (MW-8) was designated 'confirmed' as having high potential for discharging pollutants into stormwater runoff (Table 7). A total of 17 locations were designated as 'potential' hotspots, while the remaining three sites were considered 'low' potential. It was recommended that a review of the storm water pollution prevention plan is scheduled at 12 sites (55%). Specific recommendations for each site can be found in Table 7.

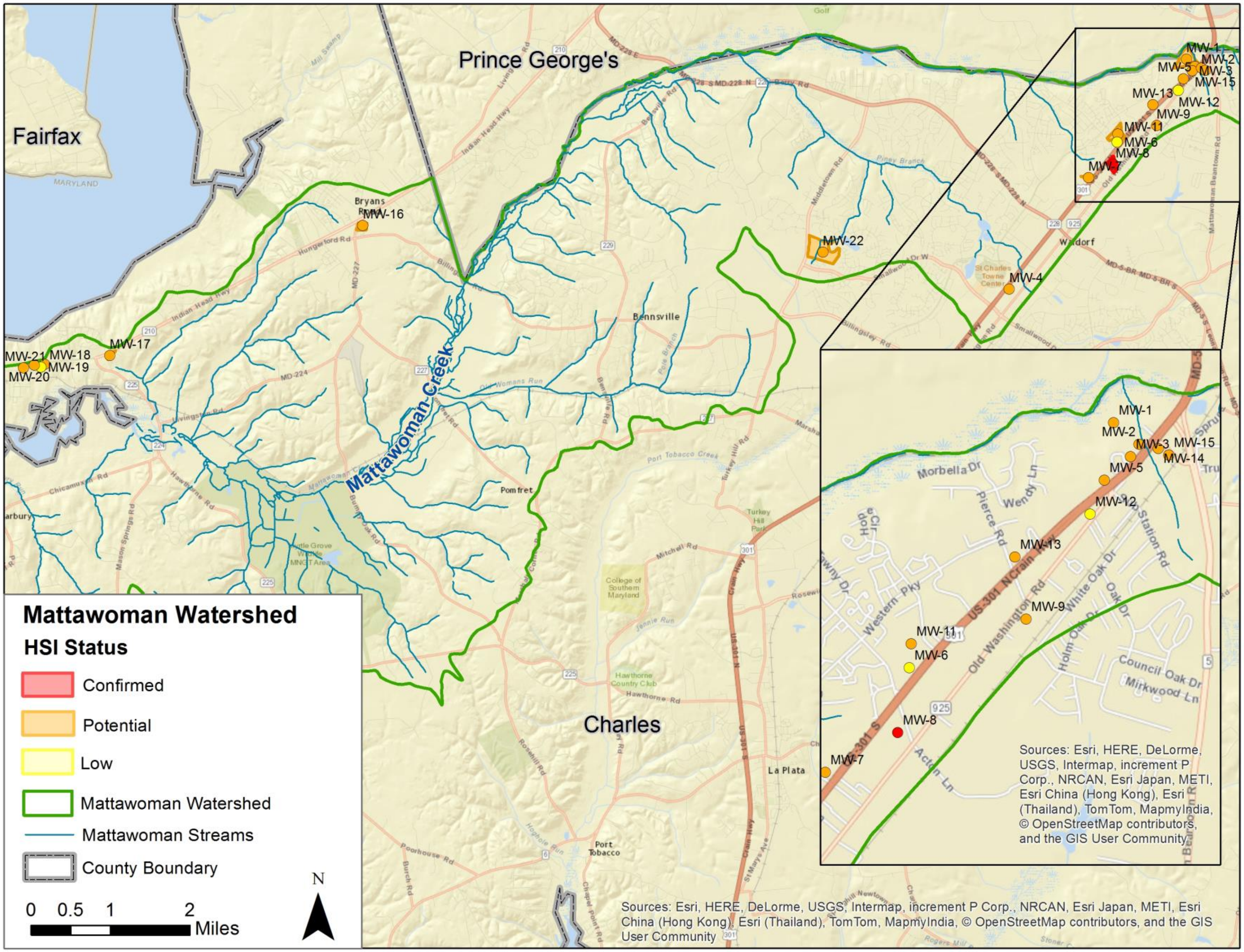


FIGURE 4: HOT SPOT INVESTIGATION RESULTS

TABLE 7: HOT SPOT INVESTIGATION LOCATIONS AND OPERATIONS

HSI Site ID	Location	Description	Vehicle Ops	Outdoor Materials	Waste Mgmt.	Physical Plant	Landscaping	HSI Status	Potential Action	Notes
MW-1	J&JLogistics	junkyard	Yes	Yes	Yes	Yes	Yes	Potential	Schedule a review of storm water pollution prevention plan, clean up storage	Unable to fully assess area due to fence
MW-2	McDonald's	restaurant	No	No	Yes	Yes	Yes	Potential	Schedule a review of storm water pollution prevention plan	
MW-3	Premier Auto Imports	car sales	Yes	No	No	Yes	Yes	Potential	Schedule a review of storm water pollution prevention plan	
MW-4	Super 8 Motel	motel	No	No	Yes	Yes	Yes	Potential	Schedule a review of storm water pollution prevention plan, clean up dumpster, put lid on	
MW-5	Xtra Fuels	gas station	No	No	Yes	Yes	Yes	Potential	Inlet cleaning, cleaning paved areas around fueling station, lot repair, sweeping gravel/sediment	
MW-6	Goodyear closed- Admiral Tire	N/A	N/A	N/A	N/A	N/A	N/A	Not a Hotspot	N/A	Not currently open- did not assess- no current

HSI Site ID	Location	Description	Vehicle Ops	Outdoor Materials	Waste Mgmt.	Physical Plant	Landscaping	HSI Status	Potential Action	Notes
	opening soon- did not assess									issues
MW-7	Gardiner Outdoor Products Corporation	tractor sales/retail	Yes	Yes	Yes	Yes	No	Potential	Schedule a review of storm water pollution prevention plan	Could not access due to fence- check outdoor storage/ fueling area
MW-8	Toyota Dealership	Toyota car dealership and Collision Center	Yes	Yes	Yes	Yes	Yes	Confirmed	Cleaner car practices to prevent staining; clean up dumpsters, get lids	
MW-9	Atlantic refinishing	refinishing, unclear	No	Yes	Yes	Yes	No	Potential	Storage cleanup, very messy	
MW-11	Lowes	Lowe's store	No	Yes	Yes	Yes	Yes	Potential	Cleaning inlets, litter in parking lot drains, seeding bare spots in grass, street sweeping	
MW-12	IHOP	restaurant	No	No	Yes	Yes	Yes	Not a Hotspot	Schedule a review of storm water pollution prevention plan	No stormwater management
MW-13	Enterprise Car Rental	car rentals	Yes	No	Yes	Yes	Yes	Potential	Schedule a review of storm water pollution prevention plan, repair car cleaning area drains so it doesn’t drain over	

HSI Site ID	Location	Description	Vehicle Ops	Outdoor Materials	Waste Mgmt.	Physical Plant	Landscaping	HSI Status	Potential Action	Notes
									parking lot	
MW-14	US Fuel	gas station	No	No	Yes	Yes	Yes	Potential	Schedule a review of storm water pollution prevention plan	No stormwater management
MW-15	Foods In	convenience store	No	No	Yes	Yes	Yes	Potential	Schedule a review of storm water pollution prevention plan	No stormwater management, need to clean trash, sediment, and organics from parking and inlets, dumpster lids
MW-16	Bryans Road Building and Supply Co., Inc.	building supply store	Yes	Yes	Yes	Yes	Yes	Potential	Schedule a review of storm water pollution prevention plan, install stormwater management in medium	
MW-17	Dash In	gas station, convenience store	No	No	Yes	Yes	Yes	Potential	Clean pavement around fueling area	Staining of pavement
MW-18	Grinder's Seafood	restaurant	No	Yes	Yes	Yes	No	Potential	Schedule a review of storm water pollution prevention plan	Install stormwater management, property all pervious
MW-19	Dale's Smokehouse	restaurant	No	No	Yes	Yes	Yes	Not a Hotspot	Schedule a review of storm water pollution	Install stormwater management, property all

HSI Site ID	Location	Description	Vehicle Ops	Outdoor Materials	Waste Mgmt.	Physical Plant	Landscaping	HSI Status	Potential Action	Notes
									prevention plan	pervious
MW-20	Indian Head Service Center	car service	Yes	Yes	No	Yes	No	Potential	Pavement removal, add stormwater management, check outdoor storage area	
MW-21	Clean Puppy Car Wash	car wash	Yes	No	Yes	Yes	Yes	Potential	Clean up source from black stains coming from back of building, retrofit swale	
MW-22	West Lake High School	high school	No	No	Yes	Yes	Yes	Potential	Install rain gardens, conservation landscaping, tree plantings	

3.2 Synoptic Water Quality Survey

Synoptic water quality sampling was performed across the Mattawoman Creek watershed from April 22-29, 2015. A total of 51 sites were visited (Figure 5) for water quality and discharge measurements; however, one site was dry and no samples could be collected for water quality analysis. Synoptic sampling occurred at least 24 hours after rainfall events totaling more than 0.25 inches. The only rain event totaling more than 0.25 inches that occurred during the range of sampling dates was 0.35 inches on April 25, 2014. All sampling dates were at least 24 hours after these events (Wunderground weather station KMDHUGHE3, KMDWALDO8).

3.2.1 Stream Discharge

Discharge measurements were collected at each site in conjunction with the collection of grab samples. Results of flow measurements are shown in Table 10. One site had no flow present during site visits due to dry (i.e., intermittent flow) conditions. Overall, discharge values ranged from 0.02 to 18.8 cubic feet per second (cfs) for sites where samples were collected.

3.2.1 Water Quality

In situ water quality measurement results are presented in Table 10. Results of nutrients and bacteria baseflow concentrations and instantaneous load results, calculated using stream flow measurements, from water quality grab samples are presented in Figure 6 through Figure 10 and Table 11, which use color-coded nutrient ranges and ratings derived from Frink (1991; Table 8) and Southerland, et al. (2005; Table 9).

TABLE 8: NUTRIENT RANGES AND RATINGS FROM FRINK (1991)

Parameter	Baseline	Moderate	High	Excessive
Nitrate-Nitrite Concentration mg/L	<1	1 – 3	3 – 5	>5
Nitrate-Nitrite Yield kg/ha/day	<0.01	0.01 – 0.02	0.02 – 0.03	>0.03
Orthophosphate Concentration mg/L	<0.005	0.005 – 0.01	0.01 – 0.015	>0.015
Orthophosphate Yield kg/ha/day	<0.0005	0.0005 – 0.001	0.001 – 0.002	>0.002

TABLE 9: TOTAL NUTRIENT RANGES AND RATINGS FROM SOUTHERLAND ET AL.,(2005)

Parameter	Low	Moderate	High
Total Nitrogen mg/L	< 1.5	1.5 – 7.0	>7.0
Total Phosphorus mg/L	< 0.025	0.025 – 0.070	> 0.070

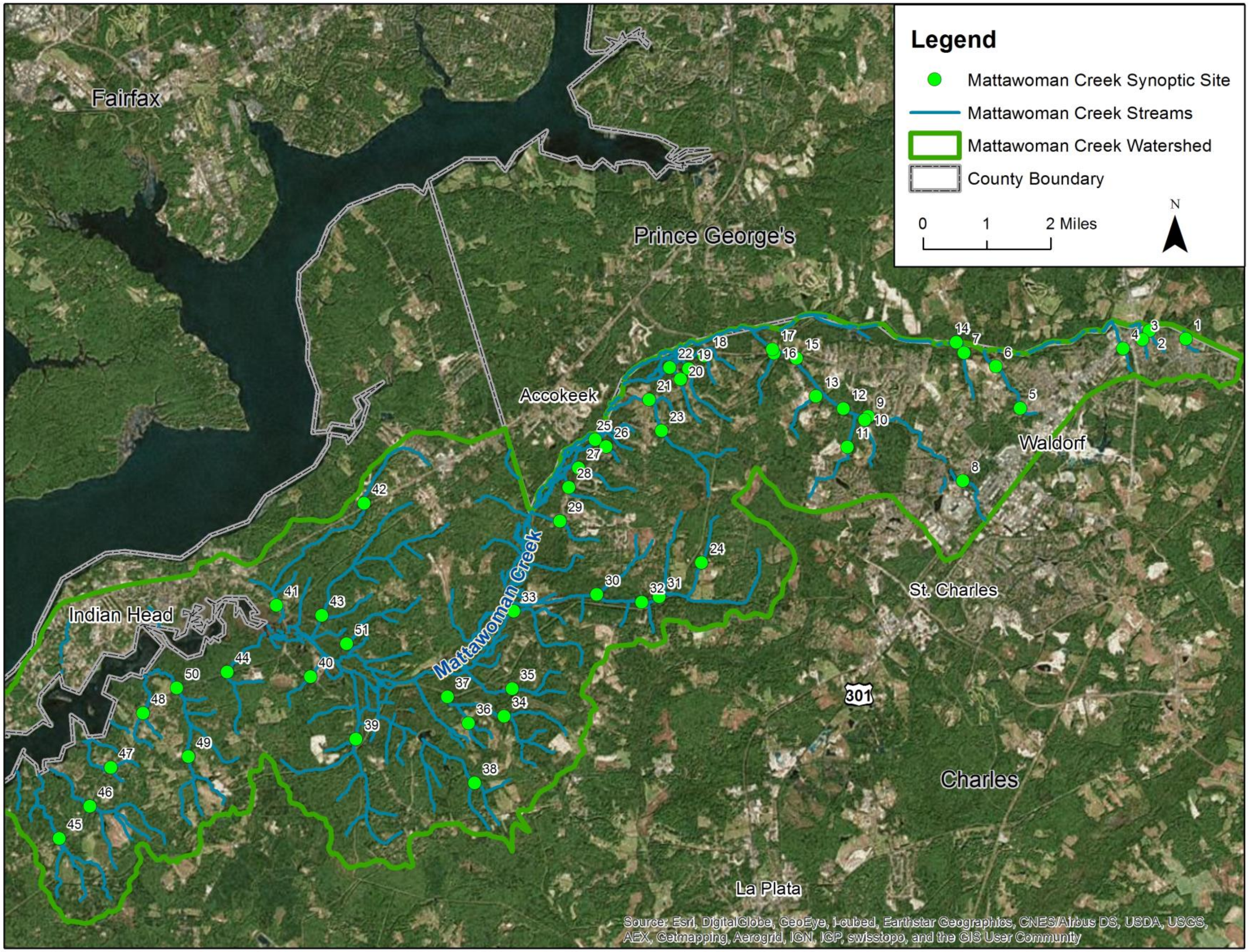


FIGURE 5: SYNOPTIC WATER QUALITY SURVEY SAMPLING LOCATIONS

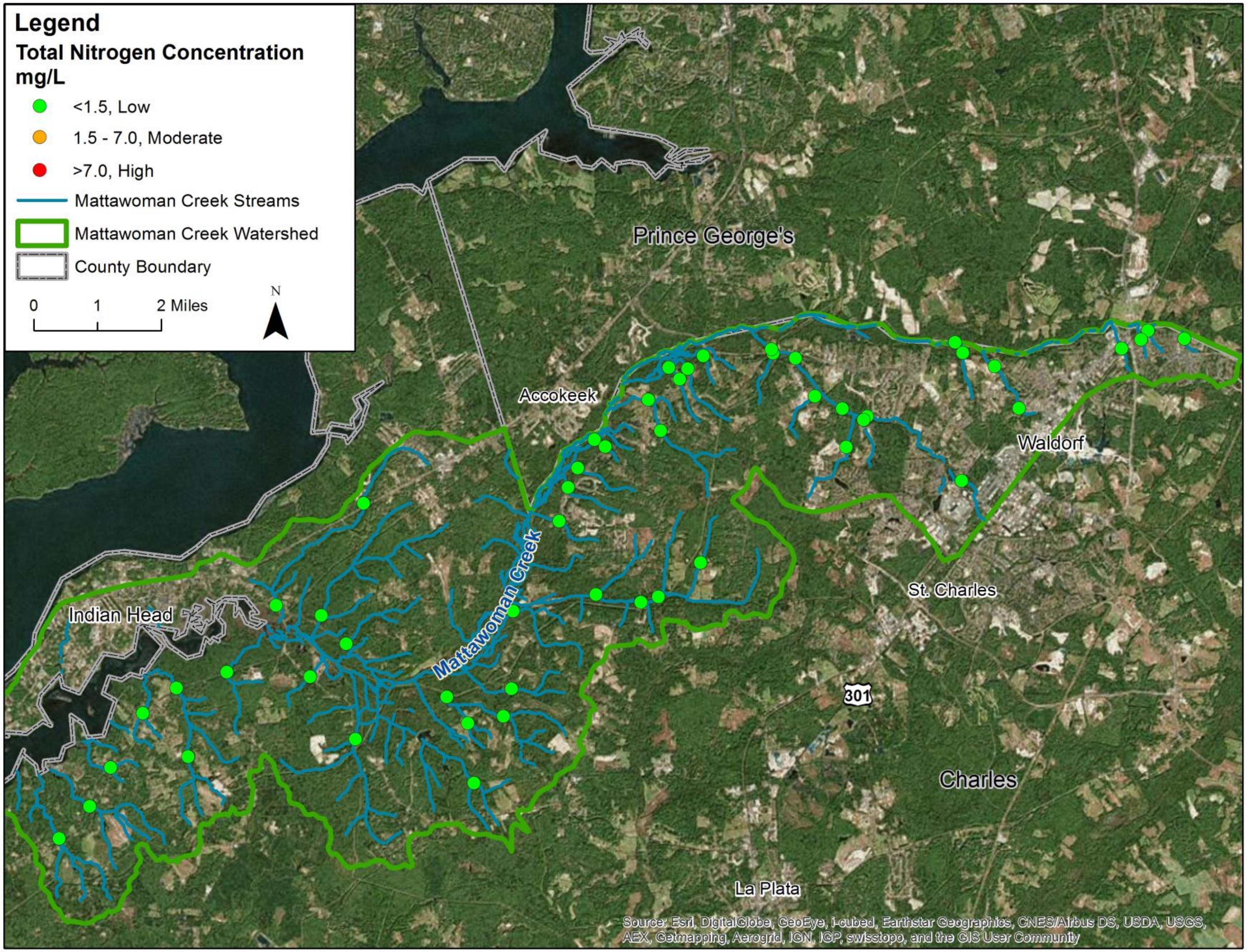


FIGURE 6: SYNOPTIC WATER QUALITY SURVEY SAMPLING RESULTS: TOTAL NITROGEN CONCENTRATION

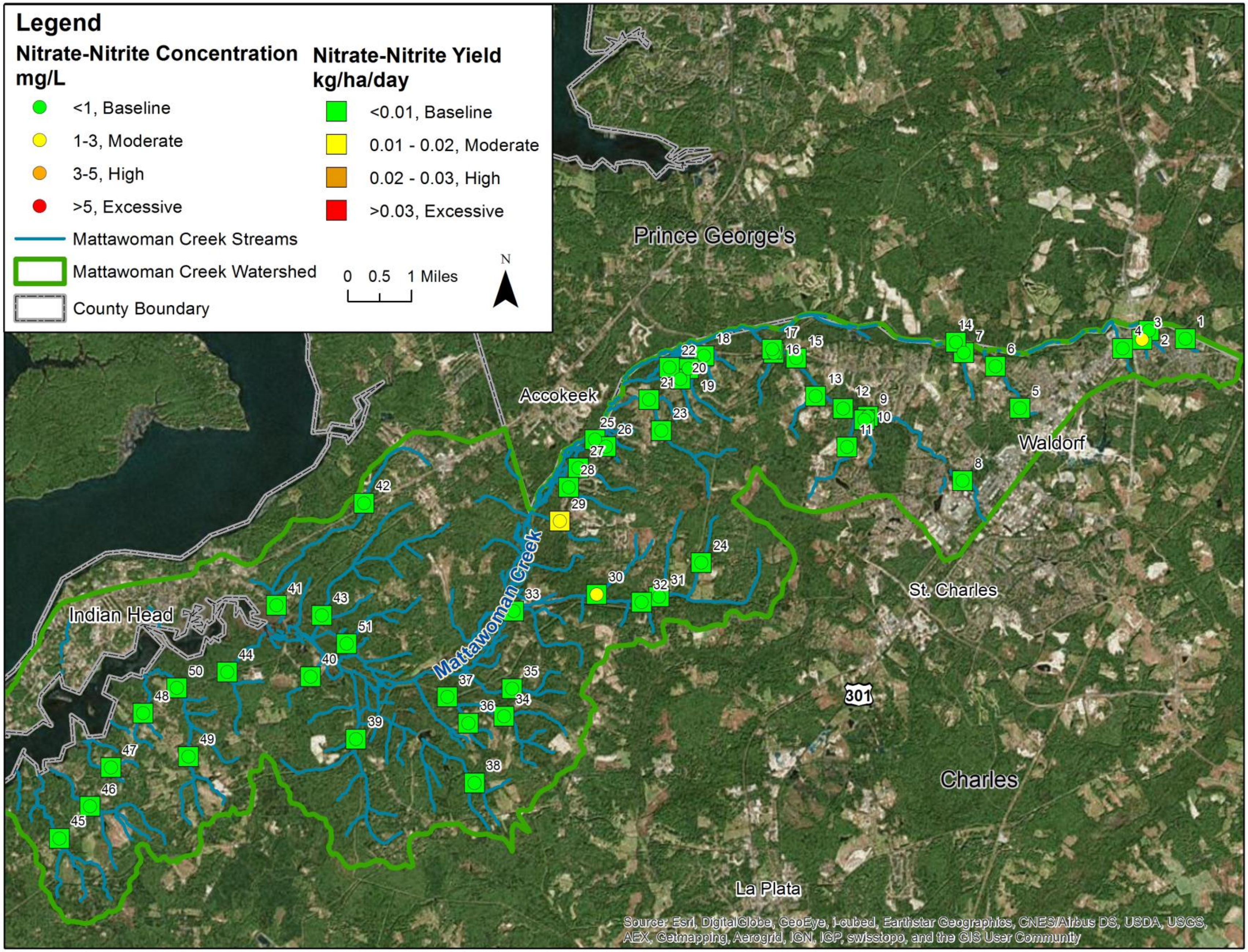


FIGURE 7: SYNOPTIC WATER QUALITY SURVEY SAMPLING RESULTS: NITRATE-NITRITE CONCENTRATION AND YIELD

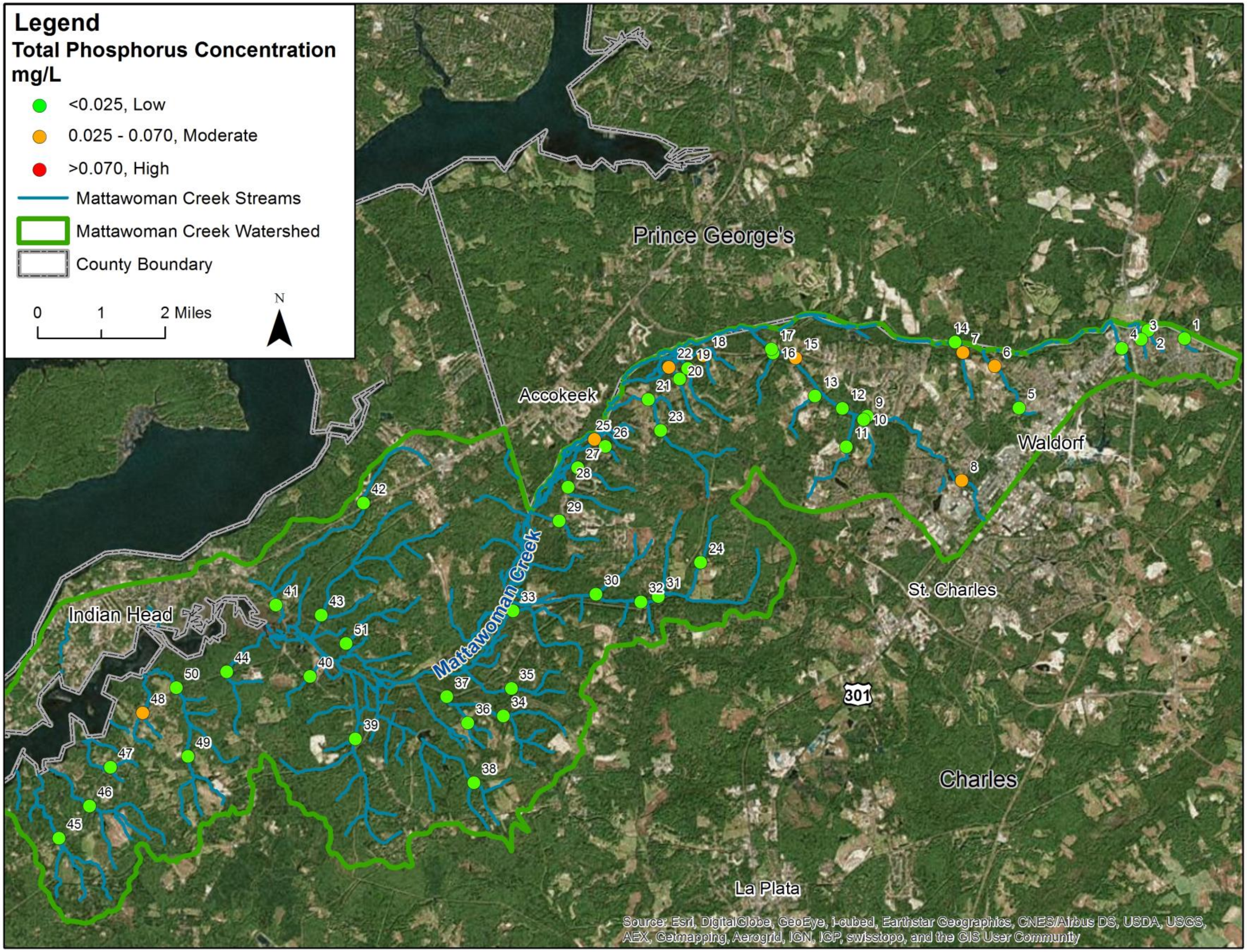


FIGURE 8: SYNOPTIC WATER QUALITY SURVEY SAMPLING RESULTS: TOTAL PHOSPHORUS CONCENTRATION

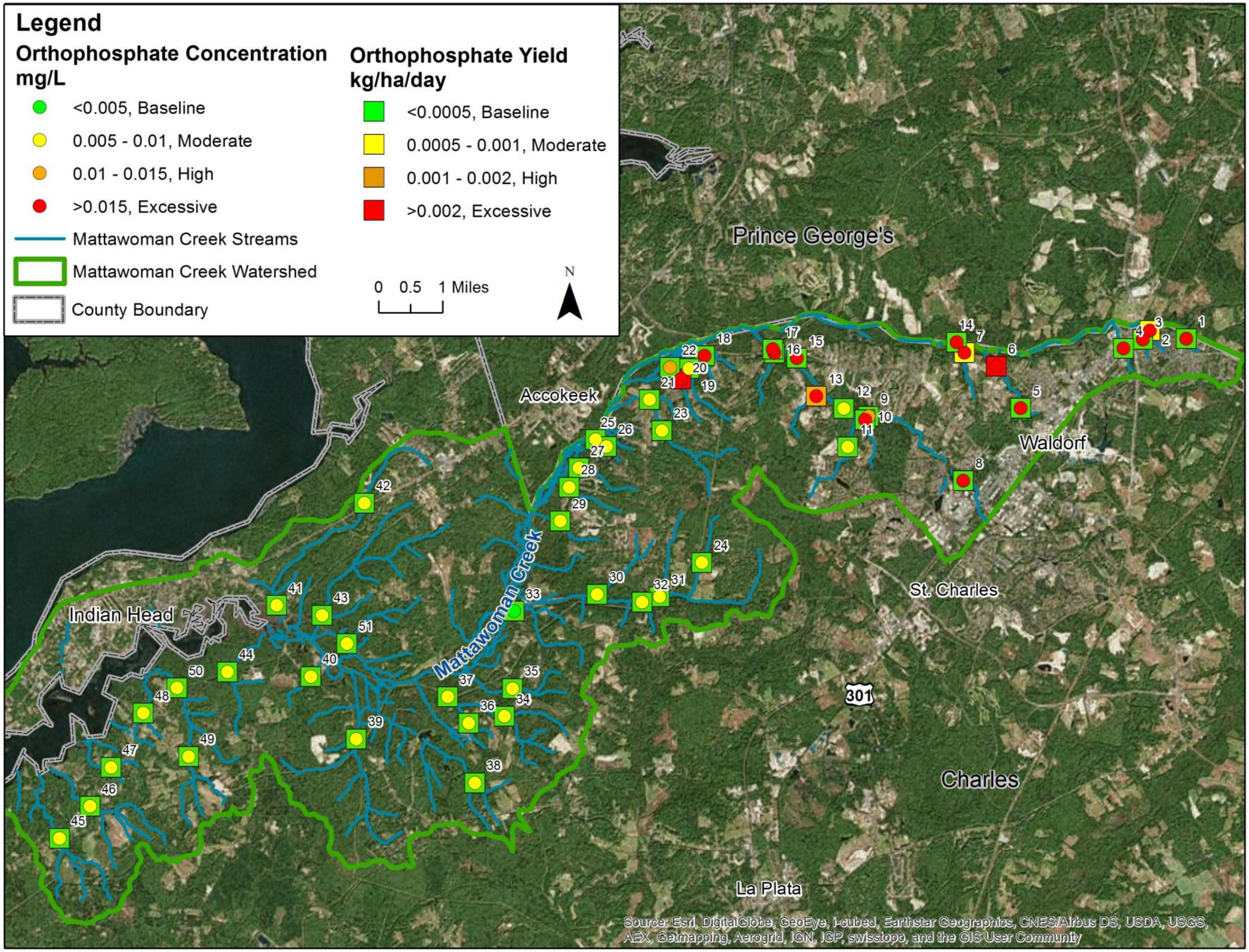


FIGURE 9: SYNOPTIC WATER QUALITY SURVEY SAMPLING RESULTS: ORTHOPHOSPHATE CONCENTRATION AND YIELD

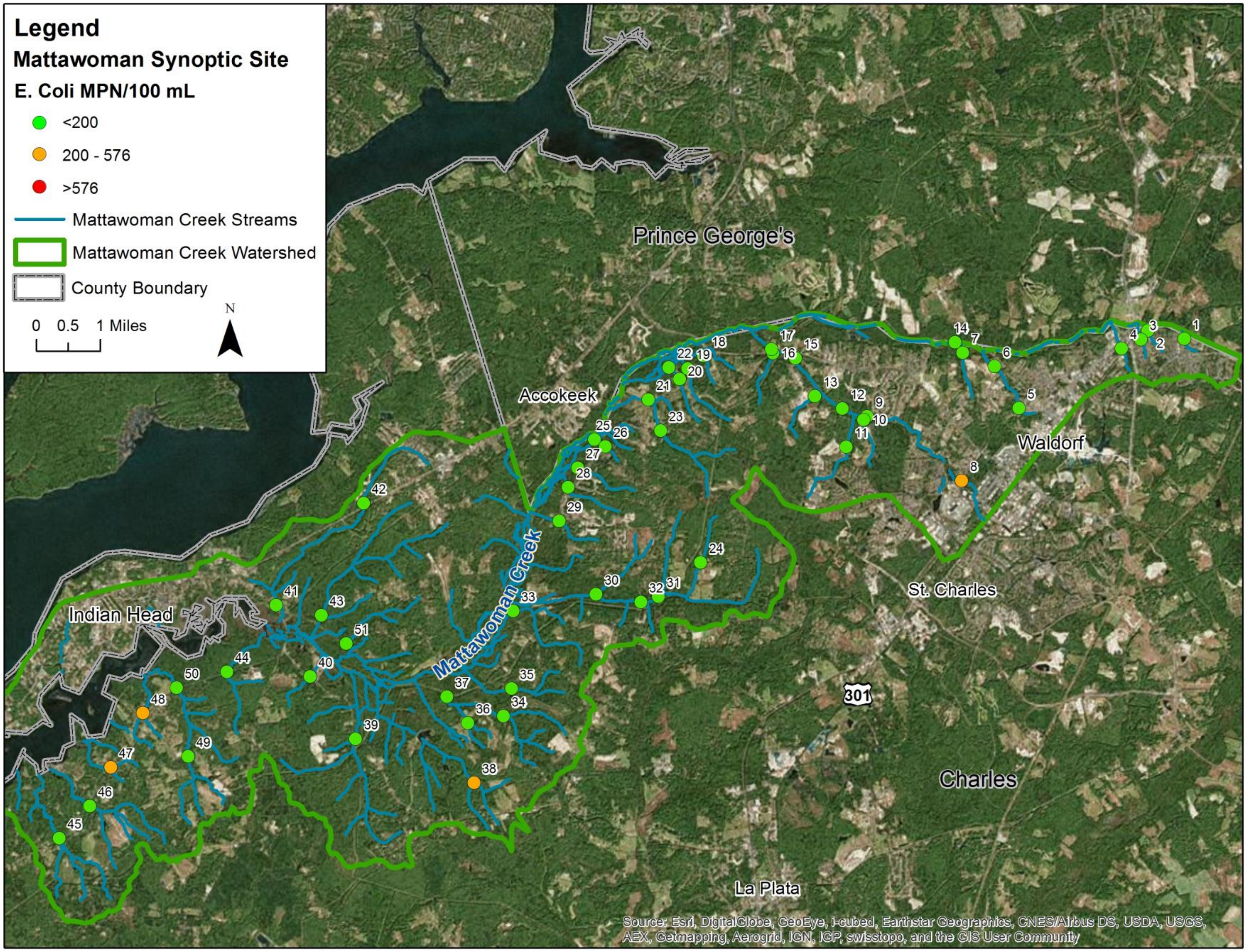


FIGURE 10: SYNOPTIC WATER QUALITY SURVEY SAMPLING RESULTS: BACTERIA

TABLE 10: STREAM DISCHARGE MEASUREMENT AND IN SITU WATER QUALITY MEASUREMENT RESULTS

Station	Date	Area (Hectares)	Area (Acres)	Discharge (cfs)	Discharge (Ls)	Temperature (°C)	pH	Dissolved Oxygen (mg/L)	Specific Conductance (µS/cm)	Turbidity (NTU)	Optical Brightener (ppm)
MW-1	4/24/2015	137	338.5	0.74	20.9	10.9	6.58	10.11	168.8	6.04	2.45
MW-2	4/24/2015	21	51.9	0.04	1.1	10.4	6.75	10.15	195.0	2.79	1.69
MW-3	4/24/2015	91	224.9	0.12	3.4	10.6	**6.36**	7.66	**256.1**	4.26	3.08
MW-4	4/24/2015	26	64.2	0.02	0.5	9.2	**5.72**	**3.69**	111.0	4.83	3.67
MW-5	4/24/2015	122	301.5	0.49	13.8	10.1	6.84	9.27	**324.2**	10.70	3.18
MW-6	4/24/2015	352	869.8	1.22	34.5	9.8	6.81	9.60	**281.8**	7.01	3.58
MW-7	4/24/2015	194	479.4	1.02	28.7	9.4	6.69	9.92	143.3	8.17	3.54
MW-8	4/23/2015	225	556.0	0.65	18.3	15.5	6.82	7.58	**315.1**	15.20	3.17
MW-9	4/27/2015	953	2,354.9	3.63	102.8	14.2	6.94	8.91	**294.2**	6.41	2.57
MW-10	4/27/2015	137	338.5	0.44	12.4	13.3	6.61	8.03	136.0	10.10	2.82
MW-11	4/27/2015	295	729.0	0.91	25.6	14.3	6.65	8.55	212.4	6.65	1.77
MW-12	4/29/2015	1,430	3,533.6	5.13	145.4	16.1	6.72	9.17	207.9	5.92	1.42
MW-13	4/27/2015	272	672.1	1.11	31.5	12.1	6.64	9.93	152.6	8.22	2.34
MW-14	4/24/2015	5,180	12,800.0	18.83	533.2	10.7	7.13	9.33	149.2	14.20	3.89
MW-15	4/24/2015	1,917	4,737.0	7.05	199.6	13.9	7.09	10.22	235.9	8.96	1.92
MW-16	4/24/2015	127	313.8	1.09	30.7	13.5	6.88	9.92	119.2	3.42	0.82
MW-17	4/24/2015	2,100	5,189.2	10.23	289.6	13.1	7.17	10.44	233.4	7.38	1.83
MW-18	4/27/2015	47	116.1	0.12	3.5	12.8	**6.05**	6.75	70.9	8.23	1.37
MW-19	4/27/2015	119	294.1	0.78	22.0	11.3	6.72	10.38	98.4	2.57	0.79
MW-20	4/27/2015	60	148.3	0.41	11.7	9.8	6.62	10.12	111.7	3.39	0.85
MW-21	4/27/2015	510	1,260.2	2.19	62.0	11.0	6.54	10.50	88.9	4.58	1.38
MW-22	4/27/2015	202	499.2	0.32	9.0	10.7	**6.45**	10.28	117.5	46.60	0.75
MW-23	4/27/2015	510	1,260.8	2.27	64.2	11.0	**6.27**	9.99	72.9	4.27	1.60
MW-24	4/29/2015	168	416.0	0.64	18.0	16.9	**6.13**	9.48	96.1	4.92	1.13
MW-25	4/29/2015	114	281.6	0.90	25.6	19.8	**6.22**	7.84	99.3	14.40	1.61
MW-26	4/29/2015	18	45.2	0.08	2.2	12.8	**5.36**	6.08	158.4	0.90	0.32
MW-27	4/29/2015	129	320.0	0.66	18.7	16.7	**6.42**	8.87	150.8	4.45	1.14
MW-28	4/29/2015	109	268.8	0.64	18.2	16.6	6.83	8.76	120.5	5.05	0.89
MW-29	4/29/2015	122	300.8	0.84	23.6	15.6	6.50	9.48	239.1	1.33	0.66
MW-30	4/29/2015	186	460.8	0.43	12.2	14.1	6.53	9.56	166.0	2.75	4.36
MW-31	4/29/2015	886	2,188.8	4.15	117.6	14.9	**6.36**	10.19	119.2	3.34	0.75
MW-32	4/29/2015	969	2,393.6	4.12	116.6	14.9	**6.43**	9.95	128.1	3.21	0.80
MW-33	4/29/2015	215	531.2	0.00	0.0	-	-	-	-	-	-
MW-34	4/29/2015	321	793.6	1.26	35.8	12.1	**6.40**	10.31	80.0	2.94	0.59
MW-35	4/29/2015	174	428.8	0.68	19.3	11.4	**6.08**	9.66	63.0	3.48	1.06
MW-36	4/29/2015	78	192.0	0.17	4.8	11.5	**6.33**	9.86	58.9	4.52	0.60

Station	Date	Area (Hectares)	Area (Acres)	Discharge (cfs)	Discharge (Ls)	Temperature (°C)	pH	Dissolved Oxygen (mg/L)	Specific Conductance (µS/cm)	Turbidity (NTU)	Optical Brightener (ppm)
MW-37	4/29/2015	474	1,171.2	1.59	44.9	12.5	6.72	10.28	89.4	3.93	0.76
MW-38	4/29/2015	280	691.2	0.84	23.9	12.0	6.64	10.47	104.7	2.52	0.93
MW-39	4/29/2015	800	1,977.6	2.42	68.4	12.6	6.57	10.65	59.4	2.83	0.99
MW-40	4/28/2015	122	300.8	0.65	18.3	14.7	6.81	9.75	81.2	5.95	0.85
MW-41	4/28/2015	686	1,696.0	2.07	58.7	13.7	7.11	10.45	196.7	6.16	1.50
MW-42	4/28/2015	319	787.2	0.89	25.1	13.4	6.79	10.09	199.8	4.55	1.91
MW-43	4/28/2015	717	1,772.8	2.64	74.8	13.3	6.79	10.28	91.7	3.78	0.97
MW-44	4/28/2015	249	614.4	0.84	23.7	11.4	6.82	10.94	91.8	3.24	1.19
MW-45	4/28/2015	365	902.4	1.16	32.8	11.1	7.06	11.01	98.2	6.55	1.49
MW-46	4/28/2015	337	832.0	0.89	25.1	11.1	7.00	10.25	82.4	4.57	1.51
MW-47	4/28/2015	60	147.2	0.17	4.7	10.7	7.09	11.09	107.3	4.32	1.79
MW-48	4/28/2015	106	262.4	0.16	4.6	11.3	6.68	10.27	176.1	13.20	2.29
MW-49	4/28/2015	383	947.2	2.21	62.7	13.0	6.85	10.54	94.1	5.86	1.40
MW-50	4/28/2015	660	1,632.0	2.71	76.7	11.9	6.86	10.71	99.8	4.90	1.54
MW-51	4/28/2015	186	460.8	0.86	24.3	13.9	6.64	9.57	79.5	3.86	0.85

Note: bold values indicate exceedances of COMAR standards or water quality thresholds.

MDE has established acceptable water quality standards for each designated Stream Use Classification, which are listed in the *Code of Maryland Regulations (COMAR) 26.08.02.03-.03 - Water Quality*. The non-tidal streams located in the Mattawoman Creek watershed are covered in *COMAR* in Sub-Basin 02-14-01: Lower Potomac River Area are designated Use I waters. Specific designated uses for Use I streams include water contact sports, fishing, the growth and propagation of fish, agricultural water supply, and industrial water supply. The acceptable criteria for Use I waters are as follows:

- pH - 6.5 to 8.5
- DO - may not be less than 5 mg/l at any time
- Turbidity - maximum of 150 Nephelometric Turbidity Units (NTU's) and maximum monthly average of 50 NTU
- Temperature - maximum of 90°F (32°C) or ambient temperature of the surface water, whichever is greater
- E. coli – 576 MPN/100ml for *Infrequent Full Body Contact Recreation*.

For the majority of sites, *in situ* water quality parameters fell within COMAR limits for Use I streams. Only one site in the Mattawoman Creek watershed had DO levels below the COMAR standard of 5.0 mg/L. Fourteen sites in the Mattawoman Creek watershed had pH values below the minimum threshold of 6.5 SU, although pH values below 6.5 are common for streams that drain wetlands, which have naturally low pH levels. All sites were within acceptable ranges for temperature and turbidity. Although MDE does not have a water quality standard for specific conductivity, Morgan et al. (2007) have reported biological impairment thresholds in Maryland of 247 µS/cm for benthic macroinvertebrates. A total of five sites in the Mattawoman Creek watershed had specific conductivity values exceeding the threshold for benthic macroinvertebrates, with values ranging from 58.9 to 324.2 µS/cm.

Optical brighteners are whitening agents found in cleaning products such as laundry soaps and detergents, and can be found in toilet paper. Presence of optical brighteners in stream water can indicate illicit discharge of sewer systems and leaking septic tanks. The optical brightener results in the Mattawoman Creek watershed were generally inconclusive. The field fluorometer was calibrated with a 50ppm laundry detergent solution, following the California EPA Surface Water Ambient Monitoring Program's SOP (Burres, 2011). According to this method, sample measurements below 5ppm are considered negative for optical brightener. Field results ranged from 0.3 to 4.4 ppm, therefore it was concluded that none of the samples contained optical brighteners.

TABLE 11: WATER QUALITY GRAB SAMPLING RESULTS- NUTRIENT AND BACTERIA CONCENTRATIONS AND INSTANTANEOUS LOADS.

Station	Discharge (L/sec)	Ortho-P (mg/L)	TKN (mg/L)	Nitrate-Nitrite (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	E. Coli (MPN/100 ml)	Ortho-P (kg/H/day)	TKN (kg/H/day)	Nitrate-Nitrite (kg/H/day)	Total Nitrogen (kg/H/day)	Total Phosphorus (kg/H/day)
MW-1	20.9	0.030	0.25	0.6	0.5	0.01	96	0.00039	0.00329	0.00790	0.00658	0.00013
MW-2	1.1	0.200	0.25	0.8	0.5	0.005	129.6	0.00093	0.00117	0.00373	0.00233	0.00002
MW-3	3.4	0.040	0.25	1	1	0.02	143.9	0.00013	0.00080	0.00320	0.00320	0.00006
MW-4	0.5	0.200	0.25	0.25	0.5	0.005	28.8	0.00032	0.00040	0.00040	0.00080	0.00001
MW-5	13.8	0.030	0.25	0.25	0.5	0.02	83.6	0.00029	0.00244	0.00244	0.00488	0.00020
MW-6	34.5	0.400	0.25	0.25	0.5	0.03	88.4	0.00338	0.00211	0.00211	0.00423	0.00025
MW-7	28.7	0.050	0.25	0.25	0.5	0.03	127.4	0.00064	0.00320	0.00320	0.00640	0.00038
MW-8	18.3	0.050	0.25	0.25	0.5	0.04	248.1	0.00035	0.00176	0.00176	0.00352	0.00028
MW-9	102.8	0.010	0.5	0.25	0.5	0.005	34.5	0.00009	0.00466	0.00233	0.00466	0.00005
MW-10	12.4	0.020	0.5	0.25	0.5	0.01	36.9	0.00016	0.00392	0.00196	0.00392	0.00008
MW-11	25.6	0.005	0.25	0.25	0.5	0.01	155.3	0.00004	0.00188	0.00188	0.00375	0.00008
MW-12	145.4	0.005	0.25	0.25	0.5	0.02	21.3	0.00004	0.00220	0.00220	0.00439	0.00018
MW-13	31.5	0.100	0.25	0.25	0.5	0.005	64.4	0.00100	0.00250	0.00250	0.00501	0.00005
MW-14	533.2	0.050	0.25	0.25	0.5	0.02	69.1	0.00044	0.00222	0.00222	0.00445	0.00018
MW-15	199.6	0.040	0.25	0.25	0.5	0.03	47.3	0.00036	0.00225	0.00225	0.00450	0.00027
MW-16	30.7	0.020	0.25	0.25	0.5	0.005	48.7	0.00042	0.00523	0.00523	0.01045	0.00010
MW-17	289.6	0.030	0.25	0.25	0.5	0.02	33.1	0.00036	0.00298	0.00298	0.00596	0.00024
MW-18	3.5	0.020	0.8	0.25	0.5	0.06	49.5	0.00013	0.00508	0.00159	0.00318	0.00038
MW-19	22.0	0.005	0.25	0.25	0.5	0.005	59.4	0.00008	0.00399	0.00399	0.00798	0.00008
MW-20	11.7	0.200	0.25	0.25	0.5	0.005	139.6	0.00337	0.00421	0.00421	0.00842	0.00008
MW-21	62.0	0.005	0.25	0.25	0.5	0.005	102.2	0.00005	0.00262	0.00262	0.00525	0.00005
MW-22	9.0	0.010	0.25	0.25	0.5	0.04	172.5	0.00004	0.00096	0.00096	0.00192	0.00015
MW-23	64.2	0.005	0.25	0.25	0.5	0.005	58.3	0.00005	0.00272	0.00272	0.00544	0.00005
MW-24	18.0	0.005	0.25	0.25	0.5	0.005	14.5	0.00005	0.00231	0.00231	0.00462	0.00005
MW-25	25.6	0.005	0.25	0.25	0.5	0.05	18.3	0.00010	0.00485	0.00485	0.00969	0.00097
MW-26	2.2	0.005	0.25	0.25	0.5	0.005	24.1	0.00005	0.00263	0.00263	0.00526	0.00005
MW-27	18.7	0.005	0.25	0.25	0.5	0.005	72.7	0.00006	0.00313	0.00313	0.00625	0.00006
MW-28	18.2	0.005	0.25	0.25	0.5	0.005	63.1	0.00007	0.00362	0.00362	0.00723	0.00007
MW-29	23.6	0.005	0.25	1.1	1.1	0.005	12.1	0.00008	0.00420	0.01846	0.01846	0.00008
MW-30	12.2	0.005	0.25	1.2	1.2	0.005	43.7	0.00003	0.00141	0.00679	0.00679	0.00003
MW-31	117.6	0.005	0.25	0.5	0.5	0.005	20.3	0.00006	0.00287	0.00574	0.00574	0.00006
MW-32	116.6	0.005	0.25	0.25	0.5	0.005	18.7	0.00005	0.00260	0.00260	0.00520	0.00005
MW-33	-	-	-	-	-	-	-	-	-	-	-	-
MW-34	35.8	0.005	0.25	0.25	0.5	0.005	44.3	0.00005	0.00241	0.00241	0.00481	0.00005
MW-35	19.3	0.005	0.25	0.25	0.5	0.005	148.3	0.00005	0.00241	0.00241	0.00481	0.00005
MW-36	4.8	0.005	0.25	0.25	0.5	0.005	28.8	0.00003	0.00133	0.00133	0.00266	0.00003

Station	Discharge (L/sec)	Ortho-P (mg/L)	TKN (mg/L)	Nitrate-Nitrite (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	E. Coli (MPN/100 ml)	Ortho-P (kg/H/day)	TKN (kg/H/day)	Nitrate-Nitrite (kg/H/day)	Total Nitrogen (kg/H/day)	Total Phosphorus (kg/H/day)
MW-37	44.9	0.005	0.25	0.25	0.5	0.005	36.9	0.00004	0.00205	0.00205	0.00410	0.00004
MW-38	23.9	0.005	0.25	0.7	0.5	0.005	328.2	0.00004	0.00185	0.00517	0.00369	0.00004
MW-39	68.4	0.005	0.25	0.25	0.5	0.005	9.8	0.00004	0.00185	0.00185	0.00369	0.00004
MW-40	18.3	0.005	0.25	0.25	0.5	0.005	93.2	0.00006	0.00324	0.00324	0.00648	0.00006
MW-41	58.7	0.005	0.25	0.25	0.5	0.005	53.8	0.00004	0.00185	0.00185	0.00369	0.00004
MW-42	25.1	0.005	0.25	0.25	0.5	0.02	36.4	0.00003	0.00170	0.00170	0.00340	0.00014
MW-43	74.8	0.005	0.25	0.25	0.5	0.005	14.6	0.00005	0.00225	0.00225	0.00450	0.00005
MW-44	23.7	0.005	0.25	0.25	0.5	0.005	60.9	0.00004	0.00206	0.00206	0.00412	0.00004
MW-45	32.8	0.005	0.25	0.25	0.5	0.005	116.2	0.00004	0.00194	0.00194	0.00389	0.00004
MW-46	25.1	0.005	0.25	0.25	0.5	0.005	36.8	0.00003	0.00161	0.00161	0.00322	0.00003
MW-47	4.7	0.005	0.25	0.8	0.5	0.005	387.3	0.00003	0.00170	0.00545	0.00341	0.00003
MW-48	4.6	0.005	0.6	0.25	0.5	0.03	396.8	0.00002	0.00223	0.00093	0.00185	0.00011
MW-49	62.7	0.005	0.25	0.7	0.5	0.005	185	0.00007	0.00353	0.00989	0.00707	0.00007
MW-50	76.7	0.005	0.25	0.5	0.5	0.005	95.9	0.00005	0.00251	0.00502	0.00502	0.00005
MW-51	24.3	0.005	0.25	0.25	0.5	0.005	22.6	0.00006	0.00281	0.00281	0.00563	0.00006

At this time, Maryland does not have specific numeric water quality criteria for nitrogen and phosphorus. To remain consistent with the Watershed Restoration Action Strategy report for Port Tobacco River Watershed (MDE, 2006b), nutrient ranges and ratings for nitrate-nitrite and orthophosphate were derived from Frink (1991) and used for comparison of water quality results (Table 8). Total nitrogen and total phosphorus concentrations were compared to those provided by the Maryland Biological Stream Survey (Southerland, et al. 2005; Table 9).

Total nitrogen concentrations were low in all subwatersheds (Figure 6 and Table 11). Nitrate/nitrite concentrations were moderate in three subwatersheds (Figure 12 and Table 11). Baseline concentrations were found in the remaining subwatersheds (Figure 7 and Table 11). Instantaneous nitrate/nitrite yields were moderate in only one subwatershed and baseline in the remaining subwatersheds (Figure 7 and Table 11). Total phosphorus concentrations were moderate in eight subwatersheds, and low in the remaining subwatersheds (Figure 8 and Table 11). Excessive concentrations of orthophosphate were found in 16 subwatersheds, which had values ranging from 0.005 mg/L to 0.400 mg/L (Figure 9 and Table 11). Moderate concentrations were found in 34 subwatersheds, however half the detection limit for orthophosphate (0.005) falls between the baseline and moderate ratings, therefore the 32 subwatersheds that were below the detection limit should be considered to have baseline levels.

Orthophosphates, also termed phosphates, are the reactive phosphates that are most readily used by biota. Measures of orthophosphates provide a good estimation of the amount of phosphorus available for algae and plant growth. Orthophosphates are found naturally but elevated values may indicate human sources which include fertilizers for both agricultural and residential use, cleaners, and wastewater sewage. Phosphorus bound to sediments is also released through erosional processes. The measured elevated levels were clustered in the north eastern portions of the watershed which coincides with the most developed areas in the watershed. These areas were the focus of the Stream Corridor Assessment described below and the stormwater BMP restoration site searches described in section 4. Solutions to the elevated orthophosphate include the suite of restoration practices being implemented by the County and include stream restoration, BMP retrofit, and education on proper chemical disposal and fertilizer application. Many of the identified projects in the watershed are located in the areas identified with high orthophosphate levels.

Elevated bacteria levels (*E. coli* > 576 mpn/100 ml; mpn = most probable number) were not found at any sites, however four subwatersheds had levels exceeding the standard for water contact recreation of 200mpn/100 ml (Figure 10 and Table 11).

3.3 Stream Corridor Assessment

Field crews walked approximately 6.3 miles of mapped stream channels between April 21 and 24, 2015. Figure 11 shows the stream reaches walked by field crews and the location of the representative sites for each walked reach. Erosion sites, pipe outfalls, and buffer breaks were the most widespread and frequent problems identified. The total number of points identified and ranked by severity in each watershed can be found in Table 12. The majority of points were categorized as moderate to minor severity. Only one point received a rating of “very severe,” while 12 received a rating of “severe”. A more detailed discussion of each data point type follows. A complete dataset is included as Appendix C.

TABLE 12: WATERSHED DATA POINTS BY SEVERITY

Potential Problems	Total	Very Severe	Severe	Moderate	Low	Minor
Erosion (1.4 miles)	20	0	1	7	9	3
Buffer (4.2 miles)	23	1	8	9	5	0
Pipe Outfall	27	0	1	2	12	12
Fish Barrier	1	0	0	1	0	0
Trash	7	0	1	3	3	0
Channel Alteration	18	0	0	4	5	9
Construction	1	0	1	0	0	0
Exposed Pipe	0	0	0	0	0	0
Unusual Conditions	13	0	0	2	7	4
Total	***110***	1	12	28	41	28
Representative Sites	**8**					
Potential BMP Sites	**7**					

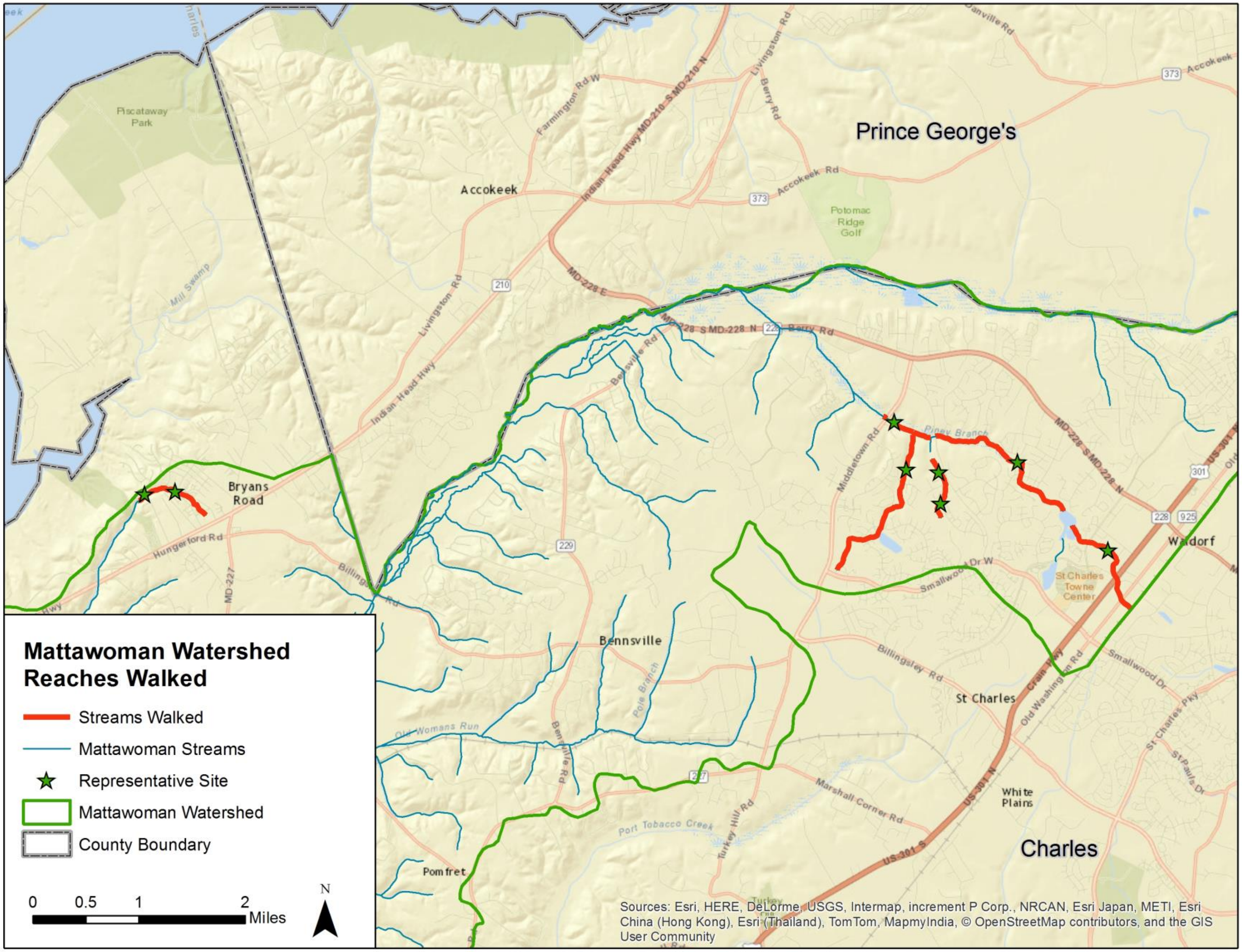


FIGURE 11: MATTAWOMAN CREEK WATERSHED STREAM CORRIDOR ASSESSMENT REACHES WALKED AND REPRESENTATIVE SITES

Erosion Sites

Twenty erosion sites totaling 1.4 miles were identified. The stream erosion process was identified as widening for 90% of sites, headcutting for 5%, downcutting for 5%. While collecting stream erosion data, field crews also attempted to determine the leading possible cause of erosion at each site. These potential causes included: an upstream road crossing, bends and slopes in the stream channel, upstream land use changes, and pipe outfalls. The most commonly described possible causes for erosion was landuse change upstream (75%), followed by bend at steep slope (10%). No sites presented an immediate threat to infrastructure. Locations of erosion sites can be found in Figure 13 and Figure 14.

Inadequate Buffers

Inadequate buffers, defined as buffers less than 50 feet wide from the edge of the stream, were identified at 23 sites, totaling 4.2 miles of inadequate buffers for both right and left bank combined. Approximately 65% of the inadequate buffer length identified was affecting both sides of the stream channel. Crop fields, lawn, and sewer easement were the most commonly identified types of land use where the stream buffer was found to be deficient. The location of reaches with inadequate buffers is displayed in Figure 13 and Figure 14.

Pipe Outfalls

Twenty-seven pipe outfall points were located and assessed. Approximately 88 percent of the outfalls received severity ratings of either “low” or “minor,” indicating that they typically do not have dry weather discharges nor appear to be causing localized erosion. A total of two outfalls were rated as “moderate”, one was rated “severe” and no outfalls were rated “very severe” due to localized erosion impacts. All of the pipe outfalls were associated with stormwater conveyance, and any observed discharge was clear and odorless, with the exception of two sites with medium brown discharge and one site with an orange color. Locations and severity of these points is shown in Figure 13 and Figure 14. Pipe outfalls with severity scores less than moderate are displayed, but not labeled.

Fish Barriers

Only one fish barrier was observed during the survey and was identified as a beaver dam. The barrier received a severity rating of “moderate” and the beaver dam was causing a 36 inch drop in elevation. The location and severity of the fish barrier is displayed in Figure 13.

Channel Alteration

Channel alteration impacts were found at 18 sites, totaling approximately 1,907 feet in length. All channel alteration locations had a severity rating of “low” to “moderate” and were primarily associated with rip rap stabilization efforts. Six of the sites were located at a road crossing. Locations of channel alteration sites can be found in Figure 15 and Figure 16.

Unusual Conditions and Trash

There were 13 unusual condition/comment points identified in the study area. Eight of these sites noted beaver ponds or dams. Other unusual conditions include large debris jams, an old silt fence falling into the stream, an exposed section of old storm drain pipe, and a blown-out former road crossing with an exposed culvert in the channel.

A total of seven trash dumping sites were also identified. One site was rated “severe”, three sites were rated as “moderate”, and 3 sites were rated as “low” severity. Only two of the sites could not be cleaned up by volunteers due to the presence of large metal pieces of trash. Point locations and severity scoring of unusual conditions and trash sites can be seen in Figure 15 and Figure 16.

In-Stream Construction

One site with active of in-stream construction was identified. A bridge over Piney Branch was being constructed at McDaniel Road. It was rated “severe” due to the impact on the stream, however adequate sediment control practices were in place. The location of the in stream construction can be seen in Figure 15.

Representative and Other Points

Representative points were taken at 8 locations (Figure 11). Figure 12, below, presents the proportion of reaches in each assessment category for each habitat parameter, giving insight into the types of stream impacts creating the most degradation. In general, the modified qualitative RBP assessment at these sites revealed stream channels dominated by sand and gravel substrates. None of the stream reaches assessed were rated “poor” for riparian and bank vegetation, but ratings ranged from “marginal” to “optimal”. Stream reaches with channel alteration were generally in good condition and no reaches receiving a “poor” or “marginal” rating. There was moderate sediment deposition throughout the study area, with only one site rated “poor”. Channel flow status was good throughout the study area. Both velocity/depth diversity and shelter for fish were found to be “suboptimal” at all of the reaches assessed. Benthic substrate was generally rated “suboptimal” throughout majority of the reaches.

Stream channel erosion is a major factor leading to impaired habitat conditions. The majority of the identified erosion sites (90%) were described as channel widening processes. As the stream channels widen, the ability to effectively transport sediments (eroded bank material and from runoff over land) is reduced, leading to reduced scores for several habitat parameters including flow, velocity, embeddedness and macroinvertebrate habitat.

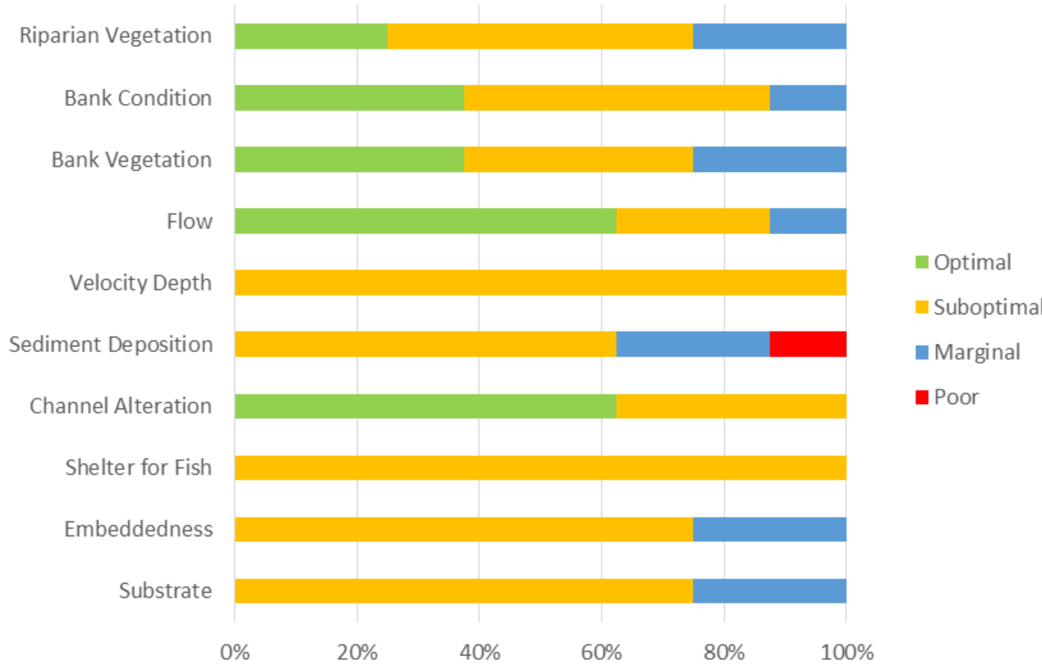


FIGURE 12: PROPORTION OF REACHES PER ASSESSMENT CATEGORY

Exposed Pipes

No exposed pipes were identified in the assessment.

Potential Improvements (BMP Locations)

Seven initial potential improvement sites were identified during the SCA fieldwork. Multiple improvements were recommended for one site. Recommended BMP types include outfall stabilization (3 sites), riparian buffer enhancement and wetland restoration (1 site), stream restoration (2 sites), and bioretention/raingarden (1 site). The locations of these preliminary sites as well as the primary BMP type are displayed in Figure 17 and Figure 18. These projects were further expanded and are presented in the following section.

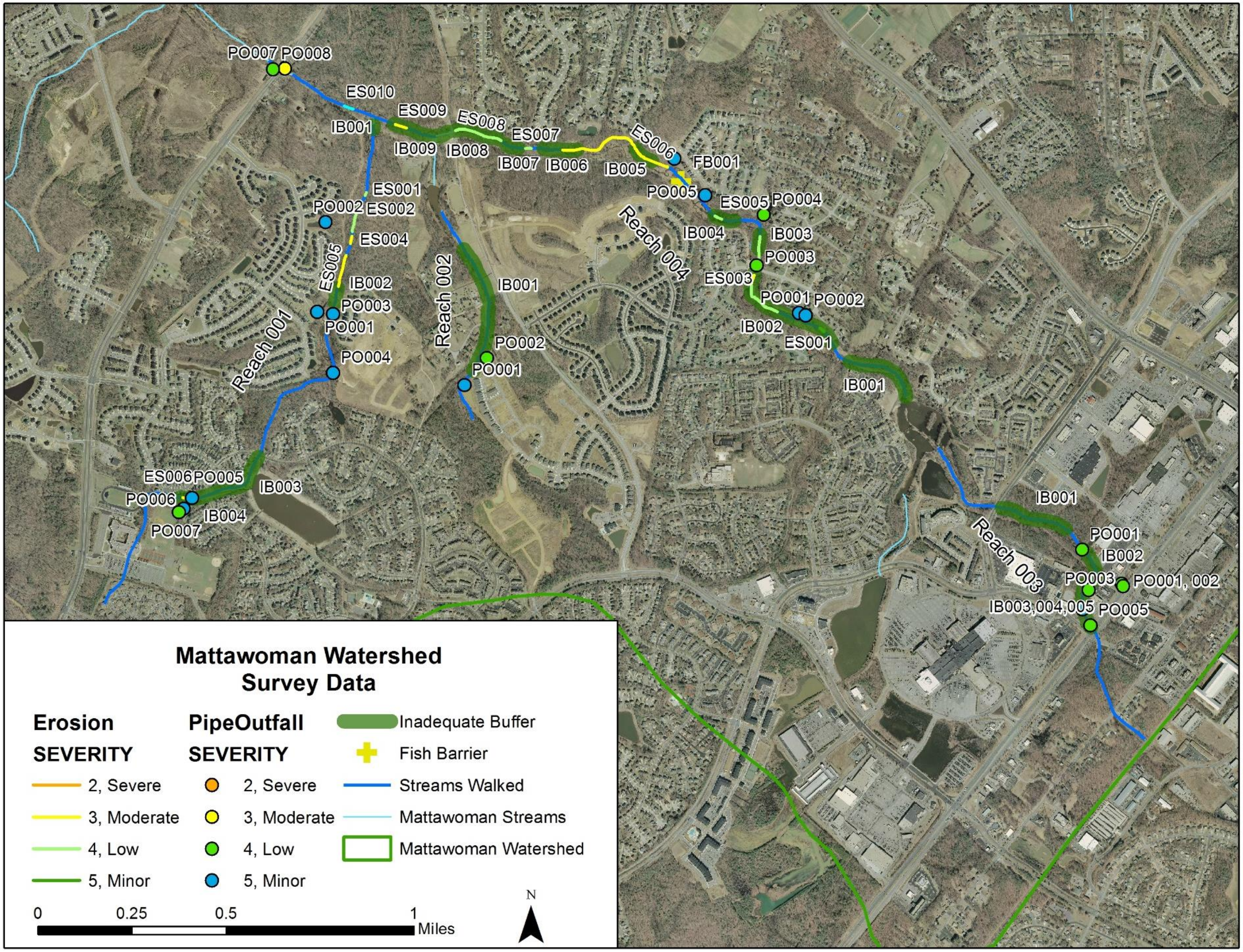


FIGURE 13: SURVEY DATA MAP SHOWING PIPE OUTFALL, EROSION, FISH BARRIER, AND INADEQUATE BUFFER SITES, EASTERN REACHES

FIGURE 14: SURVEY DATA MAP SHOWING PIPE OUTFALL, EROSION, FISH BARRIER, AND INADEQUATE BUFFER SITES, WESTERN REACHES

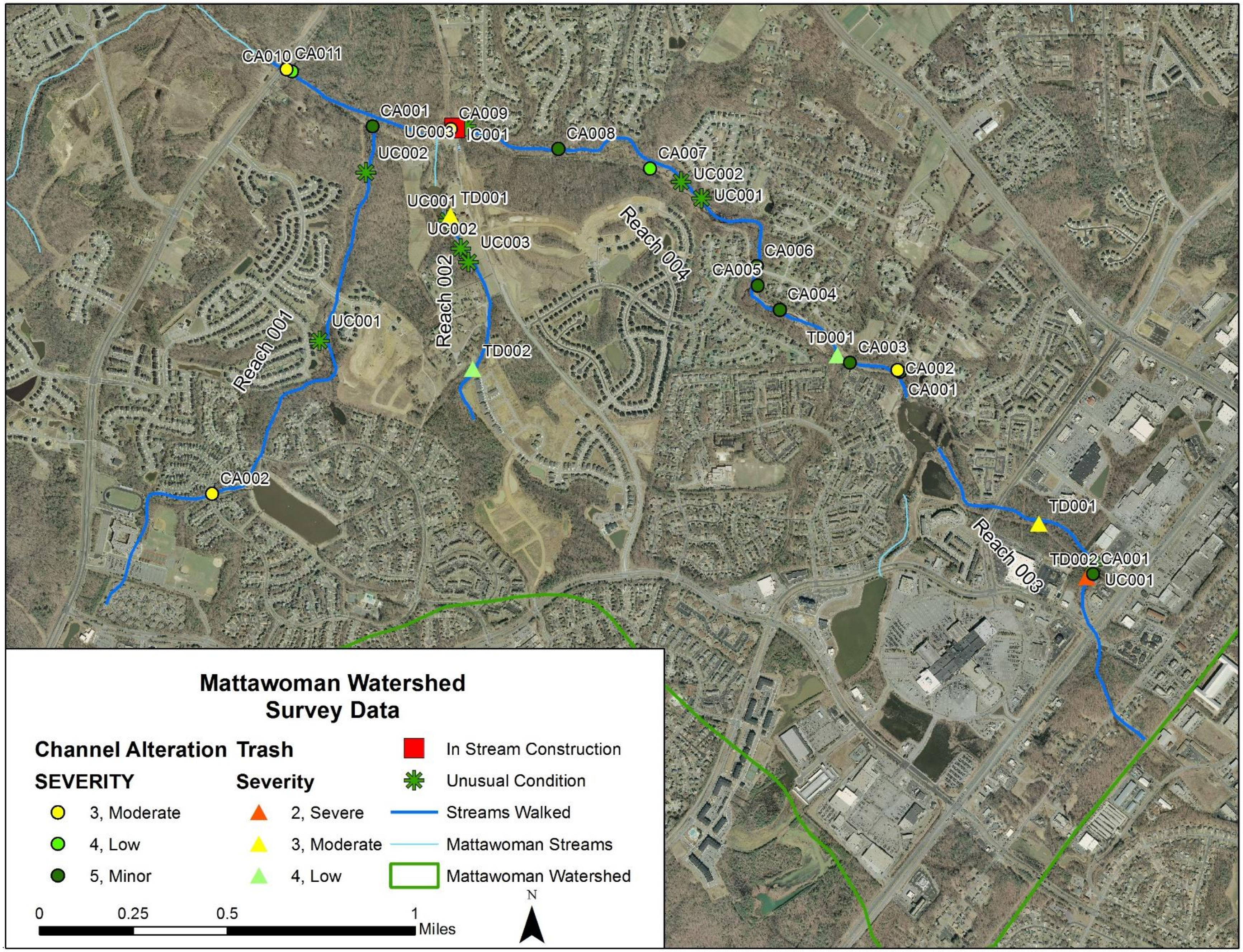


FIGURE 15: SURVEY DATA MAP SHOWING CHANNEL ALTERATION, TRASH DUMPING, IN STREAM CONSTRUCTION, AND UNUSUAL CONDITION SITES, EASTERN REACHES

FIGURE 16: SURVEY DATA MAP SHOWING CHANNEL ALTERATION, TRASH DUMPING, IN STREAM CONSTRUCTION, AND UNUSUAL CONDITION SITES, WESTERN REACHES

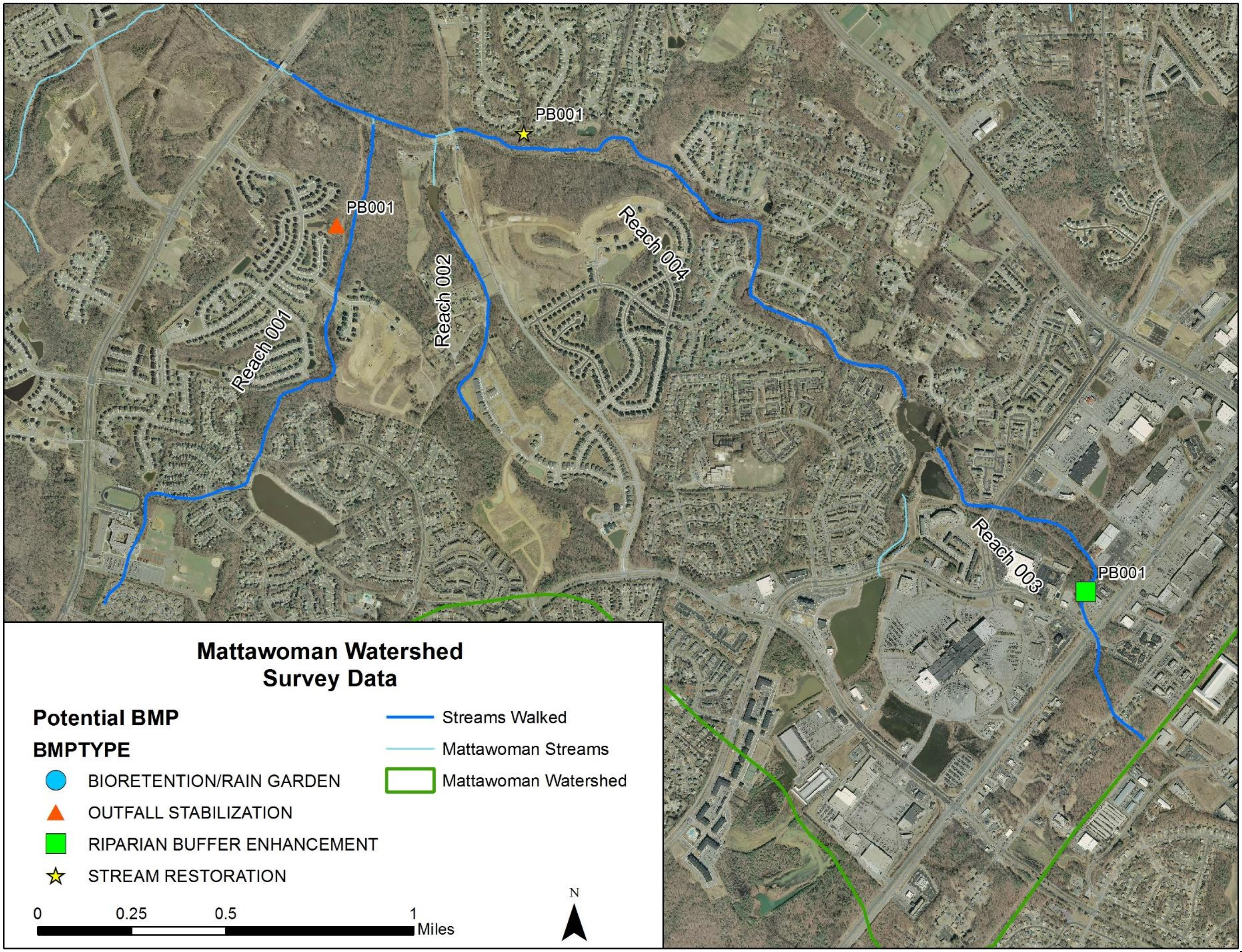


FIGURE 17: SURVEY DATA MAP SHOWING POTENTIAL BMP LOCATIONS, EASTERN REACHES

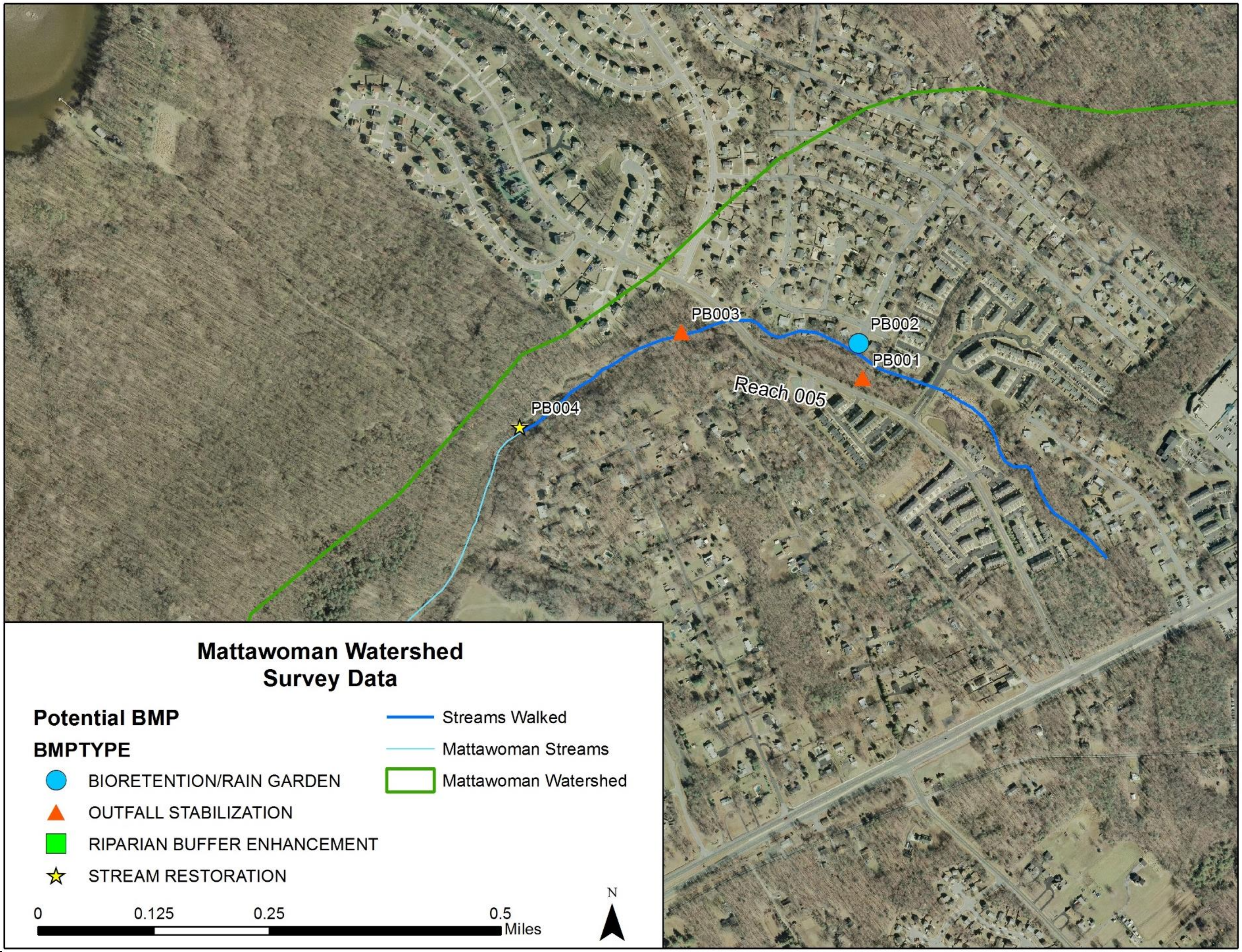


FIGURE 18: SURVEY DATA MAP SHOWING POTENTIAL BMP LOCATIONS, WESTERN REACHES

4 Potential Water Quality Improvement Projects

Results of the desktop and field watershed assessments were compiled and the results were analyzed to determine those specific areas of impairment most in need of restoration. Restoration measures were then developed according to the type and source of impact. The following section presents the methods and results for each restoration measure type which include both structural and non-structural practices and programs:

- Stream restoration;
- Shoreline erosion control;
- Stormwater BMPs (step pool stormwater conveyance (SPSC), bioretention, wet pond);
- Reforestation;
- Environmental site design;
- Street sweeping;
- Inlet cleaning;
- Trash clean-up;
- Homeowner practices (rain barrels, rain gardens, downspout disconnect).

Mapping of the site specific structural practices are included in Figure 19. Tables presenting cost, load reduction, and impervious credit associated with each of the proposed projects are included in each section below.

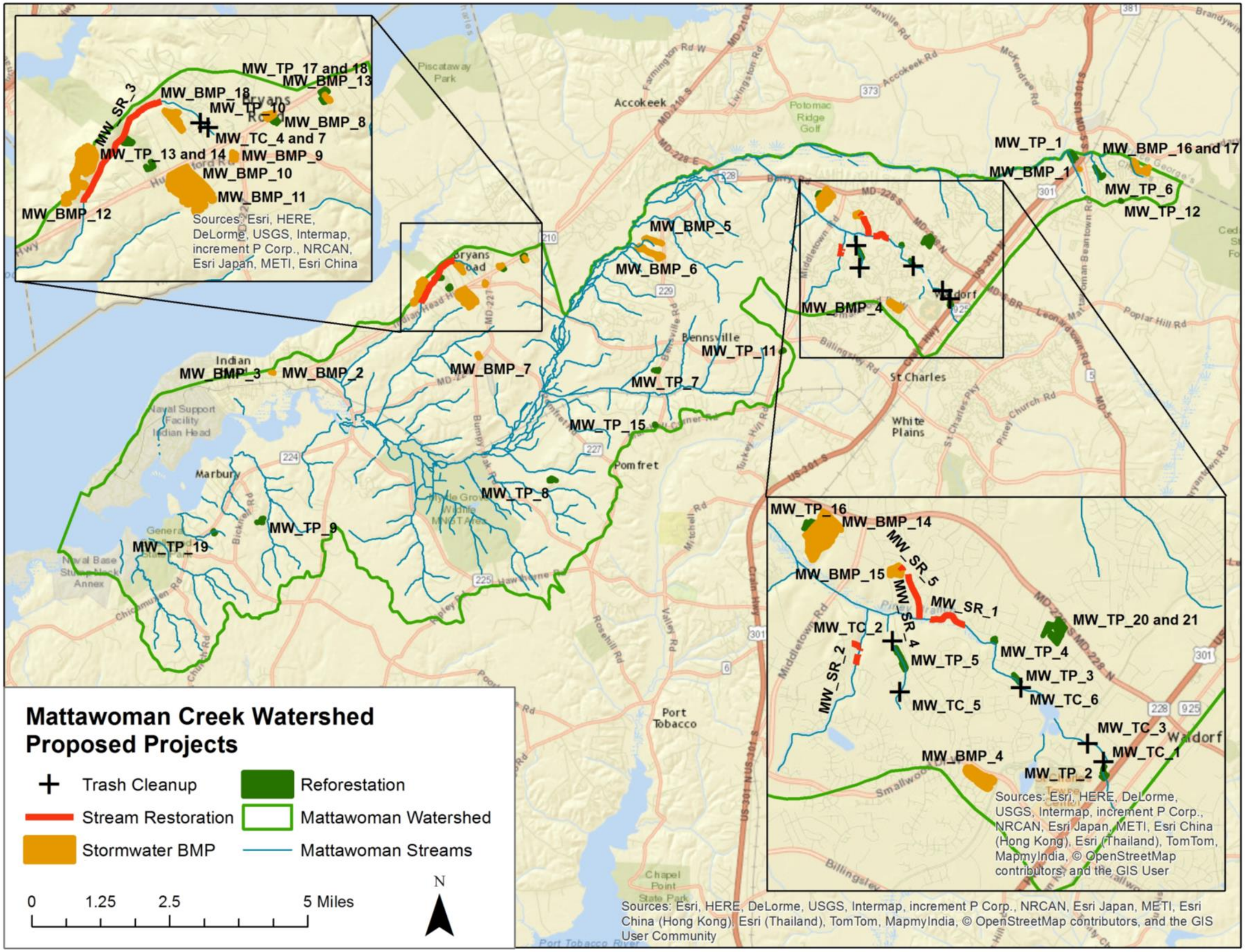


FIGURE 19: LOCATION OF MATTAWOMAN CREEK WATERSHED POTENTIAL WATER QUALITY IMPROVEMENT PROJECTS

4.1 Stream Restoration

Stream restoration opportunities were field identified during the SCA assessment. The SCA stream segments were selected based on the surrounding land use within their drainage areas; streams receiving a high percent of impervious area were selected to better identify stream reaches in need of restoration. The current condition of streams was assessed and locations of stream erosion were identified and mapped using GPS. The assessment rated each segment of stream erosion on a 1 to 5 scale according to its severity, correctability, and accessibility; where a score of 1 is the most severe, but also the most correctible and the most accessible. Priority areas in need of stream restoration were determined using these three scores. The site ranking criteria can be found in Table 13.

TABLE 13: STREAM RESTORATION AND PIPE OUTFALL SITE RANKING CRITERIA

Priority Ranking	Scores
High	Severity = 1 or 2 AND Correctability/Access = 1 - 4
Medium	Severity = 1 or 2 AND Correctability or Access = 5, OR Severity = 3 AND Correctability/Access = 1 - 4
Low	Severity = 1 or 2 AND Correctability AND Access = 5; OR Severity = 3 AND Correctability/Access = 5; OR Severity = 4 - 5
Very Low	Severity = 4 or 5 AND Correctability/Access = 5; OR Severity = 3 AND Correctability AND Access = 5

Next, high and medium priority erosion sites were identified and combined into stream restoration projects based on proximity to other erosion sites. Pipe outfall data collected during the SCA assessment was ranked according to the same methods used for stream restoration sites (Table 13). Pipe outfalls with high and medium priority rankings would have been selected and incorporated into nearby stream restoration projects, however no medium or high priority outfalls were located in the vicinity of the stream restoration sites.

A total of five stream restoration projects were identified with a total length of approximately 10,434 linear feet (Table 14). Impacts to those streams include stream headcutting, widening, and downcutting.

Vista Design, Inc. identified one stream restoration site in the Mattawoman Creek Watershed (Vista, 2015b). This site was also recommended for restoration during the SCA assessment (MW_SR_4), however since the Vista assessment was limited to a subwatershed boundary, the SCA assessment identified a much longer reach in need of restoration. As a result, the Vista project will not be included in the accounting in this report in an effort to avoid duplication.

A unit cost estimate of $645/ft was used to estimate the initial cost of the stream restoration projects and a cost factor per impervious acre treated was used to derive the total cost over 20 years (King and Hagan, 2011). It should be noted that economy of scale is not built in to this cost estimate. Larger stream restoration projects are likely estimated to be much costlier than actual project costs may be.

Load reductions were calculated for total nitrogen, total phosphorus, and total suspended sediment for each restoration site with estimated removal efficiencies from *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* (MDE, 2014a) which are shown in Table 15 and Table 16.

TABLE 14: STREAM RESTORATION PROJECT DESCRIPTIONS

Restoration Site ID	SCA Reach	Length (ft)	Current Condition	Proposed Actions
MW_SR_1	004	1,732	Stream located downstream from St. Charles Town Center, receives flow from Waldorf and residential neighborhoods. Channel incised with localized areas of severe bank erosion.	Stream bank and bed stabilization to repair bank erosion.
MW_SR_2	001	946	Stream receives runoff from many very large residential developments. Channel incised with a considerable amount of bank erosion.	Stream bank and bed stabilization to repair bank erosion. Project includes stabilization of outfall channel from adjacent pond.
MW_SR_3	005	5,564	Stream receives runoff from adjacent residential properties. Channel incised with localized areas of severe bank erosion.	Stream bank and bed stabilization to repair bank erosion and improve habitat. Project includes stabilization of outfall channel from adjacent pond.
MW_SR_4*	N/A	1,984	Stream receives runoff from adjacent residential properties. Channel deeply incised.	Stream bank and bed stabilization to repair bank erosion.
MW_SR_5	N/A	208	Stream originates at a pond outfall. Channel incised with a considerable amount of bank erosion.	Stream bank and bed stabilization to repair bank erosion.

*A portion of this stream restoration site was also identified in Vista, 2015b

TABLE 15: STREAM RESTORATION REMOVAL EFFICIENCY AND IMPERVIOUS ACRE EQUIVALENT

Pounds Reduced per Linear Foot			Impervious Acre Equivalent per Linear Foot
TN	TP	TSS	
0.075	0.068	15	0.01

TABLE 16: STREAM RESTORATION COST, IMPERVIOUS CREDIT, AND LOAD REDUCTION

Site ID	SCA Reach	Erosion length (ft)	Total Initial Cost	Total Cost Over 20 Years	Imperv-ious credit	Load Reduction (lbs/yr)		
						TN	TP	TSS
MW_SR_1	004	1,732	$1,116,892	$1,425,466	17.32	129.9	117.7	25,974.2
MW_SR_2	001	946	$610,381	$779,017	9.46	71.0	64.3	14,190.0
MW_SR_3	005	5,564	$3,588,903	$4,580,442	55.64	417.3	378.4	83,462.9
MW_SR_4	N/A	1,984	$1,279,806	$1,633,389	19.84	148.8	134.9	29,762.9
MW_SR_5	N/A	208	$134,160	$171,226	2.08	15.6	14.1	3,120.0
	Total	10,037	$6,474,077	$8,262,729	83.05	622.9	564.8	124,585.7

4.2 Shoreline Erosion Control

Areas with significant shoreline erosion were identified using the Maryland DNR Maryland Coastal Atlas (DNR, 2015). Historic shoreline data and shoreline rate of change transects were used to search for shoreline with moderate (4 to 8 feet of erosion per year) and high (greater than 8 feet of erosion per year) erosion along the Mattawoman Creek. Shoreline without adequate erosion transect data was also analyzed using the historic shoreline data to identify additional areas with significant erosion issues. Areas with artificial stabilization or bulkhead were excluded from this search.

No potential shoreline restoration projects were identified during this investigation.

4.3 Stormwater BMPs

Sites to develop new or retrofit stormwater BMPs were identified as part of the watershed assessment and planning process. Additional sites identified in previous assessments are described in section 4.3.2. All assessments, including the resulting proposed stormwater BMPs and projected treatment, are included in the sections below.

The potential to provide stormwater management through BMP facilities throughout the Mattawoman Creek watershed is relatively high. One of the most widely used retrofits to obtain water quality treatment involves modifying existing ponds. Considering this, a review of existing BMPs was conducted, and any ponds exhibiting potential for retrofit were field visited. A large portion of the ponds are not providing any water quality treatment, and converting these dry ponds will provide large amounts of water quality volume and impervious area treatment. Constructing a series of small BMP facilities such as bioretention adjacent to commercial parking lot and driveways is also an effective way to provide stormwater management and treat high amounts of imperviousness in this watershed.

4.3.1 Watershed Assessment Stormwater BMP Analysis

A desktop analysis was performed to compile a list of potential sites for stormwater management. Results from the investigation conducted prior to the stormwater (BMP) assessment, including the neighborhood source assessment, hot spot investigation, and stream corridor assessment, were reviewed for potential concurrent stormwater management opportunities. Several of these sites were selected for additional review to assess feasibility for stormwater management through structural or ESD practices. The sites selected included neighborhoods with little to no existing stormwater management, as well as pipe outfalls requiring stabilization. A database containing geospatial information for existing Charles County stormwater facilities was also used to identify potential BMP retrofit sites.

A field visit was then conducted for each site. Sites with limited opportunity for stormwater management were noted, but not evaluated further. Sites that displayed potential for stormwater management retrofit or improvement were documented through photographs, field map annotation, and field reconnaissance forms. Existing site conditions, including ownership, existing stormwater management, site drainage, and conveyance, were recorded. Details that may not be readily available in GIS format, such as adjacent land use, access constraints, potential permitting considerations, and potential utility conflicts were also noted. Finally, a preliminary stormwater BMP proposed treatment option, purpose, and location was established for each site.

Following the field visit, the potential stormwater BMP sites were inventoried, and field information was corroborated and/or expanded upon using a variety of additional resources such as County as-built records and County spatial data. With additional supporting information, the potential sites were again queried for conditions that might eliminate the project from consideration completely.

Planning-level drainage areas were then delineated to the remaining selected potential stormwater BMP sites in ArcGIS using stormdrain shapefiles, two-foot contour data, and orthophotography, as well as field-observed drainage patterns. An impervious area layer was created by merging building, roadway, and driveway shapefiles and then clipped to each drainage area to establish the acres of impervious area draining to each site.

To determine the water quality volume (WQv) required at each retrofit site, procedures from MDE 2000 Maryland Stormwater Design Manual were used including the following equation:

$$WQv = \frac{(0.05+0.009*I)(A)}{12}$$

where:

I = Percent impervious cover
A = Drainage area (in acres)
I = Percent impervious cover

Once the MDE required water quality volume was established for each potential site, the proposed BMP type was finalized, and an estimate of the WQv provided was completed for each retrofit.

The BMP facility types that were identified include created wetland, infiltration basin, step pool storm conveyance systems, bioretention, and wet ponds. Table 17 below includes a brief discussion of the existing site conditions and the proposed site improvements. Table 18 contains a summary of the impervious area treated by the proposed BMP types. BMP drainage areas are displayed in Figure 19.

TABLE 17: PROPOSED SWM BMP PROJECTS

Site ID	Existing Conditions	Proposed Improvements
MW_BMP_1	Existing grass area adjacent to the US Fuel driveway, receives flow from the building and parking lot through a curb cut. No existing SWM on site. Overhead wires present near the grass area.	Bioretention
MW_BMP_2	Existing grass area along the adjacent gravel area, and receives sheet flow from this area. No existing SWM on site.	Bioretention
MW_BMP_3	Existing grass area adjacent to the restaurant driveway, receives sheet flow from a portion of the driveway. No existing SWM on site. An existing inlet in good condition is located in the grass area. Utility poles are observed; limited surface area.	Bioretention
MW_BMP_4	Existing wooded area between the roadway and apartment community. Almost half of this community flows into this area though existing stormdrains. Trees need to be removed for proposed facility. Check the existing stormdrain inverts to connect	Bioretention

Site ID	Existing Conditions	Proposed Improvements
	the proposed facility.	
MW_BMP_5	Existing dry pond built in 1998 with gravel channel outfall. It seems the pond is not receiving flow from the adjacent community, need to check the design.	Wet pond
MW_BMP_6	Existing dry pond built in 2000 with concrete weir control structure. The weir structure is blocked and ponding water. This pond is receiving drainage from the adjacent residential area.	Created wetland
MW_BMP_7	Existing dry pond installed in 2000 with a gravel channel outfall. It receives flow from the adjacent driveway and storage buildings.	Bioretention
MW_BMP_8	Existing dry pond installed in 2000 with a concrete riser, in good condition. It receives water from adjacent building and driveway, also small portion of the Indian Head highway.	Wet pond
MW_BMP_9	Existing dry pond installed in 1992 with PVC riser, located adjacent to the parking lot of fire company. Very small surface area. It connects to an existing depression area with ponded water.	Wet pond
MW_BMP_10	Existing dry pond installed in 1999 with concrete weir control structure. It receives water from the adjacent residential area. The outfall channel is eroded, needs outfall stabilization.	Created wetland
MW_BMP_11	Existing dry pond installed in 1998 with concrete weir control structure. It receives water from the adjacent residential area, large surface area.	Created wetland
MW_BMP_12	Existing dry pond installed in 2006 with concrete riser control structure, in good condition. It receives water from the adjacent residential area. Minor erosion around the two inflow areas.	Wet pond
MW_BMP_13	Existing pond built in 2010. It looks like a wetland, but is a dry pond in county’s database. Only a small parking lot drains into this pond through stormdrain. The majority of the pond drains bypass the pond into the wooded area through stormdrain.	Created wetland
MW_BMP_14	Existing pond built in 1996. It receives flow from almost the whole school property. There is another small dry pond without WQ treatment drains to this big pond. Large surface area. Check the infiltration rate.	Infiltration basin
MW_BMP_15	Existing dry pond with concrete weir control structure. The structure is in good condition. Check the infiltration rate.	Infiltration basin
MW_BMP_16	Existing dry pond with gravel outfall channel. It receives water from the adjacent residential area. Limited surface area.	Wet pond
MW_BMP_17	Existing pond built in 1994 with concrete riser in good condition. It receives flow from the adjacent residential area. Large surface area.	Infiltration basin
MW_BMP_18	The outfall channel is about 50’ long, has a 2.5’ headcut. The average channel 2.5’ in width and 1.5’ in depth.	SPSC

TABLE 18: AREA TREATED BY SWM BMP PROJECTS PER TYPE

Treatment Type	Restoration Site IDs	Total Drainage Area (ac)	Impervious Area Treated (ac)
Created Wetland	MW_BMP_6	17.09	5.53
	MW_BMP_10	32.96	5.47
	MW_BMP_11	10.58	4.46
	MW_BMP_13	0.21	0.22
SPSC	MW_BMP_18	5.91	1.52
Bioretention	MW_BMP_1	0.14	0.14
	MW_BMP_2	0.26	0.20
	MW_BMP_3	0.05	0.04
	MW_BMP_4	6.71	3.41
	MW_BMP_7	1.99	1.79
Wet ponds	MW_BMP_5	5.92	2.09
	MW_BMP_8	1.83	1.41
	MW_BMP_9	1.43	1.15
	MW_BMP_12	24.83	7.79
	MW_BMP_16	2.51	1.33
Infiltration Basin	MW_BMP_14	36.94	11.07
	MW_BMP_15	3.92	1.90
	MW_BMP_17	13.19	4.86
	Mattawoman Total	**166.47**	**54.38**

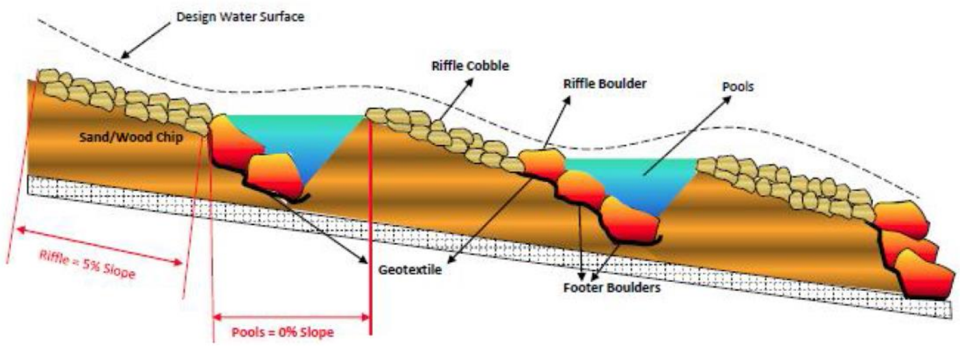
The following provides a general description of each of the stormwater BMP treatment types.

SPSC

Step pool storm conveyance systems or SPSC are open-channel conveyance structures that convert surface storm flow to shallow groundwater flow, and safely convey, attenuate, and treat the quality of storm flow. They utilize a series of constructed shallow aquatic pools, riffle grade control, native vegetation, and an underlying sand/woodchip mix filter bed media.

An SPSC system consists of alternating pools and riffle channels. The length of the pools is typically twice the length of the riffles and a minimum of 18 inches deep. The maximum length of the riffle structures is typically eight feet so as not to build excessive energy. Also, an SPSC segment used for water quality should not exceed 5% in longitudinal slope. If the overall slope exceeds five percent, boulder cascades may be utilized to traverse the grade. All unarmored sides of the pool are laid at no steeper than 3H:1V. In the event the connecting stream is incised, boulders are used to construct an in-stream weir.

One site was identified as a potential step pool stormwater conveyance (SPSC) opportunity: MW_BMP_18. The site is located on a private property owned by South Hampton Homeowners Assn Inc. and is an outfall of an existing stormwater management pond. The outfall structure is in good condition, but the outfall channel has moderate erosion issues. Limitations to the potential SPSC installation include property ownership, unavoidable tree impacts, and utility impacts. The project might need a forest permit.

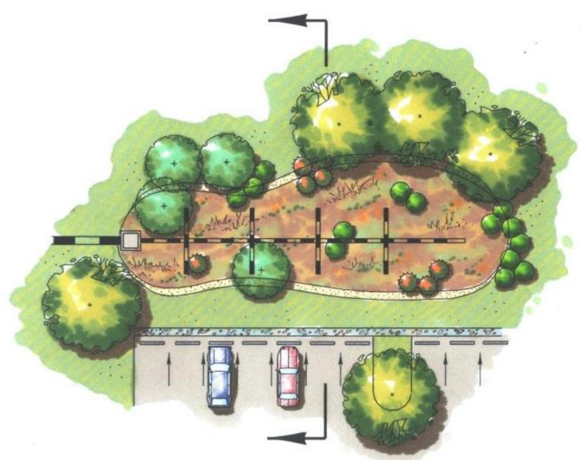


Profile for Regenerative Stormwater Conveyance System (source: Anne Arundel County, 2011)

Bioretention

A bioretention area combines open space with SWM through the use of landscaping and permeable soils to treat runoff from parking lots and urban areas. The permeable soils filter suspended sediments and some pollutants from the runoff while the landscaping promotes evapotranspiration of the runoff and uptake of nutrients.

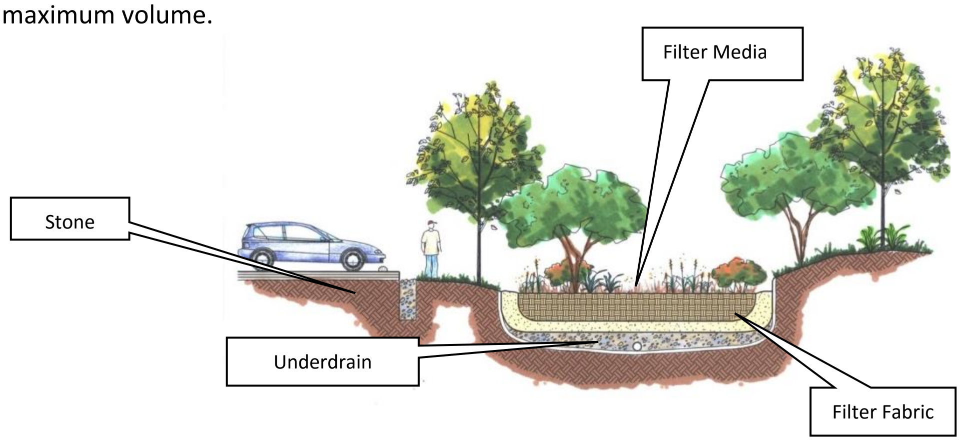
Bioretention areas generally consist of a stone diaphragm, filter fabric, filter media, landscaping, and an underdrain system. The stone diaphragm reduces the velocity of the runoff from the impervious surface that is entering the facility and also removes suspended material that may clog the filter media. The underdrain system is a perforated pipe system that collects the water that has filtered through the permeable media and transports it to a downstream open channel or connects into a nearby storm drain.



Plan view of bioretention area

The landscaping in a bioretention area is also very important. The plants chosen are native plant species that are tolerant of standing water. A wide variety of trees, shrubs, and herbaceous plants are selected for varying levels of vegetative uptake, for encouragement of various wildlife species, and for improved aesthetics. The permeable soil in the bioretention area is approximately 2.5 feet to 4 feet deep with 3 inches of mulch above it.

The ponding within the bioretention area is typically 6 inches to 12 inches. There is generally a catch basin or weir provided within the ponding area that is used for overflow when the ponding area reaches its maximum volume.



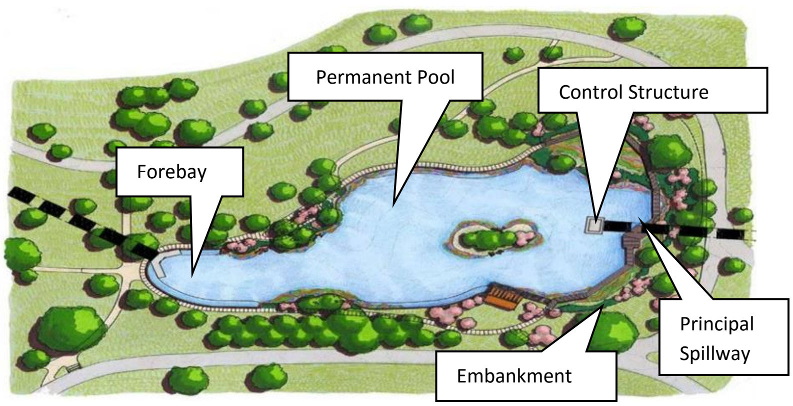
There were five opportunities for bioretention identified within the Mattawoman Creek watershed and One of the five is an existing dry pond (MW_BMP_7). Existing pond retrofits are ideal since land costs are minimal, and construction costs are less than the cost of constructing a new pond. However, the existing pond with no riser structure has limited surface area. Bioretention is more cost effective and could provide water quality treatment.

The remaining five areas with the potential for bioretention include MW_BMP_1, MW_BMP_2, MW_BMP_3, MW_BMP_4, and MW_BMP_17. All of these sites were identified in the field and have a relatively small amount of drainage reaching them. All of these sites are located on commercial and residential properties, adjacent to parking lot or driveway. The drainage areas to these sites are small, but the potential bioretention areas would provide treatment for small drainage areas with high amounts of imperviousness. Obvious limitations include obtaining permission from property owners and confirming potential for utilities impacts.

Wet Pond

A wet pond is designed to provide water quality treatment with a permanent pool of water. This is accomplished by detaining water and releasing it at a controlled rate, which allows time for suspended sediment and some nutrients to settle out of the water before it leaves the pond.

A wet pond typically consists of a forebay, embankment, control structure, principal spillway, and a permanent pool. The forebay is small pool located at the inflow of a pond and is designed to allow coarse sediment to settle out of the water column before it flows into the main body of the pond. The embankment, which is typically designed to confine the 100-year storm, contains a clay core to minimize seepage from the upstream side to the downstream side. The principal spillway runs through the embankment and is the primary means for flow to leave the pond. The control structure regulates the level of water within the facility. It has openings set at specific elevations, the lowest of which controls the depth of water in the pond. The permanent pool is the elevation of water that remains in the facility, maintained by the control structure.



Plan view of wet pond

Typically a safety bench is installed just above the permanent pool elevation around the perimeter of the pond. Approximately 18 inches below the water surface is typically an aquatic bench that is required to be put in for wetland planting to improve aesthetics and vegetative uptake of nutrients. The aquatic bench should extend to a depth of 18 inches below the permanent pool elevation. The combined minimum width of these two benches is 15 feet.

There were five sites identified as having potential for wet pond retrofit. All of these sites are dry ponds without water quality volume provided. As previously stated, existing pond retrofits are ideal since land costs are minimal, and construction costs are less than the cost of constructing a new pond. All of these sites are located on private properties, residential or commercial. The drainage areas to these sites are large, and converting dry pond to wet pond could provide large amounts of water quality volume storage, and treat high amounts of imperviousness. Obvious limitations include obtaining permission from property owners and confirming potential for utilities impacts.

Created Wetland

There were four sites identified as having potential for created wetland retrofit. All of these sites are currently dry ponds without water quality volume provided. As previously stated, existing pond retrofits are ideal since land costs are minimal, and construction costs are less than the cost of constructing a new pond. All of these sites are located on private properties, residential or commercial. The surface areas of these sites are relatively large, and can be graded to wetland. The drainage areas to these sites are large, and converting dry pond to created wetland could provide a large amount of water quality volume storage, and treat high amounts of imperviousness. Further water balance analysis and groundwater table investigations will be needed to decide if wetland is feasible on these sites. Obvious limitations include obtaining permission from property owners and confirming potential for utilities impact. MW_BMP_6 might need wetland, instream and forest permit.

Infiltration Basin

There were three sites identified as having potential for infiltration retrofit. All of these sites are dry ponds without water quality volume provided. As previously stated, existing pond retrofits are ideal since land costs are minimal, and construction costs are less than the cost of constructing a new pond. MW_BMP_14 is located on school property, and the other two are on residential properties. Further investigations of infiltration rates on site will be needed to determine if infiltration practices are feasible on these sites. The drainage areas to these sites are large, and converting dry pond to infiltration basin could provide a large amount of water quality volume storage, and treat high amounts of imperviousness. Obvious limitations include obtaining permission from property owners and confirming potential for utilities impacts.

4.3.2 Additional Assessments

Additional assessments have been conducted in the Mattawoman Creek watershed by Vista Design, Inc., George, Miles & Buhr, LLC (GMB), NG&O Engineering, and The Wilson T. Ballard Company (WT Ballard). Individual assessments are described below and impervious treatment, load reductions, and project costs are included in the cost and treatment summary in section 4.3.3.

Vista Design, Inc. was contracted by Charles County to identify potential sites for implementing pond retrofits, stream restoration, new water quality facilities, or alternative BMPs to assist with the County's impervious surface treatment requirement as specified in the MS4 permit in the Mattawoman Creek Watershed. Refer to the document *Mattawoman Creek Watershed NPDES: MS4 Retrofit Study* (Vista, 2015b) for project background, methodology, and concept designs.

GMB conducted four stormwater management assessments in the Mattawoman Creek Watershed that are included in this assessment: Henry E. Lackey High School (GMB, 2014a), Mattawoman Middle School/Berry Elementary School (GMB, 2015a), J.C. Parks Elementary School/Matthew A. Henson Middle School (GMB, 2015b), and General Smallwood Middle School (GMB, 2014b).

NG&O Engineering, Inc. developed the Stavors Road Stormwater Management Design Plan Report in which they proposed a submerged gravel wetland facility (NG&O Engineering, Inc., 2012). This project (NGO-1) is described below.

4.3.3 Stormwater BMP Cost and Treatment Summary

Results from the four stormwater BMP assessments are compiled below. Impervious acres treated, runoff depth treated, load reduction, initial costs, and total costs over 20 years are shown Table 19. Restoration site IDs that include "MW_SWM" are from the watershed assessment. Codes for other assessments are as follows:

- “VIS-” Vista Design, Inc.
- “GMB-” George, Miles & Buhr, LLC
- “NGO-“ NG&O Engineering
- “WTB-“ The Wilson T. Ballard Company

TABLE 19: STORMWATER BMP RUNOFF DEPTH TREATED, IMPERVIOUS TREATED, LOAD REDUCTION, AND COST

KCI Projects								
Site ID	**BMP Type**	**Impervious Acres Treated**	**Runoff Depth**	**Load Reduction (lbs/yr)**			**Total Initial Costs***	**Total Costs Over 20 Years****
				TN	**TP**	**TSS**		
MW_BMP_1	Bioretention	0.14	1.55	0.7	0.2	52.0	$25,477	$29,655
MW_BMP_2	Bioretention	0.20	1.12	1.2	0.2	81.9	$37,741	$43,929
MW_BMP_3	Bioretention	0.04	0.94	0.2	0.1	16.7	$7,526	$8,760
MW_BMP_4	Bioretention	3.41	1.18	27.7	4.1	1,519.1	$636,143	$740,446
MW_BMP_5	Wet Pond	2.09	0.82	12.7	2.4	1,034.8	$137,842	$170,263
MW_BMP_6	Created Wetland	5.53	1.16	39.1	6.3	2,643.1	$364,846	$450,660
MW_BMP_7	Bioretention	1.79	1.00	8.8	1.8	704.3	$334,362	$145,957
MW_BMP_8	Wet Pond	1.41	1.64	4.9	1.1	520.4	$93,329	$115,280
MW_BMP_9	Wet Pond	1.15	1.05	3.7	0.9	432.5	$76,145	$94,054
MW_BMP_10	Created Wetland	5.47	0.81	65.7	9.0	3,590.5	$360,949	$445,846
MW_BMP_11	Created Wetland	4.46	1.35	25.5	4.6	1,954.5	$294,680	$363,990
MW_BMP_12	Wet Pond	7.79	1.24	57.4	9.1	3,772.8	$514,090	$635,006
MW_BMP_13	Created Wetland	0.22	2.60	0.6	0.1	66.8	$14,322	$17,690
MW_BMP_14	Infiltration Basin	11.07	0.77	130.8	17.4	6,298.2	$733,352	$933,930
MW_BMP_15	Infiltration Basin	1.90	2.60	17.1	2.1	767.6	$126,140	$160,640
MW_BMP_16	Wet Pond	1.33	2.20	6.4	1.2	502.0	$87,454	$108,023
MW_BMP_17	Infiltration Basin	4.86	1.51	54.4	6.7	2,368.8	$321,844	$409,872
MW_BMP_18	SPSC	1.52	0.31	7.2	1.2	487.0	$73,429	$118,935
Subtotal		54.38	NA	464.1	68.5	26,813.0	$4,239,671	$4,992,936

Level 2- Projects in Construction								
Site ID	**BMP Type**	**Impervious Acres Treated**	**Runoff Depth**	**Load Reduction (lbs/yr)**			**Total Initial Costs***	**Total Costs Over 20 Years****
				TN	**TP**	**TSS**		
VIS-P-8	SPSC	28.30	1.00	229.9	43.7	17,727.1	$1,810,340	$2,172,408
WTB-1	Submerged Gravel Wetlands	15.20	1.00	90.1	15.9	6,811.1	$1,006,225	$1,207,470
VIS-P-7	SPSC	11.97	1.00	120.6	21.7	8,699.2	$915,000	$1,098,000
	Level 2 Subtotal	55.47	NA	440.6	81.3	33,237.4	$3,731,565	$4,477,878
Level 3- Projects in Full Design								
Site ID	**BMP Type**	**Impervious Acres Treated**	**Runoff Depth**	**Load Reduction (lbs/yr)**			**Total Initial Costs***	**Total Costs Over 20 Years****
				TN	**TP**	**TSS**		
VIS-P-1	Submerged Gravel Wetland/Created Wetland	13.70	0.57	1,394.2	213.2	77,645.1	$720,139	$864,167
VIS-P-1A	Created Wetland	21.20	0.57	807.2	168.0	73,208.2	$720,139	$864,167
VIS-P-2	Pond Retrofit	1.70	1.00	6.8	1.7	796.3	$442,000	$530,400
VIS-P-3	Filterra/SPSC Facility	0.83	1.00	4.6	1.2	565.1	$111,300	$133,560
VIS-P-4	Bioretention	0.61	1.00	4.9	1.1	444.6	$231,000	$277,200
VIS-P-5	Organic Filter	0.34	1.00	2.3	0.5	225.8	$21,500	$25,800
VIS-P-5A	Organic Filter	0.35	1.00	2.5	0.6	244.5	$21,500	$25,800
VIS-P-6	Submerged Gravel Wetland	18.64	1.00	56.0	14.8	6,899.1	$1,185,000	$1,422,000
VIS-C-9	SPSC/Stream Restoration	6.39	1.00	79.1	10.5	4,060.6	$562,000	$674,400
VIS-C-22	Wet Pond	12.22	1.00	192.3	23.0	8,676.3	$715,400	$858,480
NGO-1	Submerged Gravel Wetland	3.96	1.25	27.1	4.6	1,934.9	$400,000	$480,000

Level 3- Projects in Full Design continued								
Site ID	**BMP Type**	**Impervious Acres Treated**	**Runoff Depth**	**Load Reduction (lbs/yr)**			**Total Initial Costs***	**Total Costs Over 20 Years****
				TN	**TP**	**TSS**		
VIS-13-0013	Storm Drain Cleaning	N/A	N/A	822.5	329.0	98,700.0	N/A	N/A
GMB-Lackey-SWM-01	Grass Swale	0.56	1.00	0.9	0.1	22.5	$22,500	$27,000
GMB-Lackey-SWM-02	Grass Swale	0.59	1.00	0.9	0.1	21.5	$22,500	$27,000
GMB-Lackey-SWM-03	Bioswale	0.88	1.00	4.6	0.6	183.0	$32,688	$39,226
GMB-Lackey-SWM-04	Submerged Gravel Wetland	3.96	1.00	24.8	3.0	976.5	$138,400	$166,080
GMB-Lackey-SWM-05	Bioswale	0.46	1.00	1.8	0.2	71.2	$32,688	$39,226
GMB-Lackey-SWM-06	Existing Pond	7.09	1.52	22.9	2.8	901.9	$184,056	$220,867
GMB-Lackey-SWM-07	Submerged Gravel Wetland	0.82	1.00	2.2	0.3	85.9	$50,119	$60,143
GMB-Lackey-SWM-08	Submerged Gravel Wetland	1.05	1.00	3.2	0.4	125.6	$54,650	$65,580
GMB-Henson-SWM-01	Constructed Wetland	9.81	1.00	27.9	3.4	1,098.8	$428,194	$513,833
GMB-Mattawoman /Berry WS 1A	Dry Pond Conversion to Constructed Wetland	6.75	1.00	48.1	7.7	3,239.6	$241,887	$290,264
GMB-Mattawoman /Berry WS 1B	Wet Swale/Bioswale	0.26	1.00	7.1	0.8	263.3	$114,506	$137,407
GMB-Mattawoman /Berry WS 2	Dry Pond Conversion to Bioretention	5.45	1.00	36.6	6.1	2,306.0	$243,964	$292,757
	Level 3 Subtotal	117.62	NA	3,580.4	793.6	282,696.3	$6,696,130	$8,035,356

Level 5- Existing SWM Facility Inspection/Upgrades								
Site ID	**BMP Type**	**Impervious Acres Treated**	**Runoff Depth**	**Load Reduction (lbs/yr)**			**Total Initial Costs***	**Total Costs Over 20 Years****
				TN	**TP**	**TSS**		
VIS-A	Pond Retrofit	1.92	1.00	21.5	2.9	1,130.4	$126,716	$126,717
VIS-B	Pond Retrofit	1.34	1.00	12.8	1.8	729.6	$88,437	$88,439
	Level 5 Subtotal	3.26	NA	34.3	4.7	1,860.0	$215,153	$215,156

Level 6- Feasibility and Concept Design Projects (Charles County NTP Issued)								
Site ID	**BMP Type**	**Impervious Acres Treated**	**Runoff Depth**	**Load Reduction (lbs/yr)**			**Total Initial Costs***	**Total Costs Over 20 Years****
				TN	**TP**	**TSS**		
VIS-C-22	Sheetflow to Conservation	2.26	1.00	23.1	3.0	950.2	$71,000	$85,200
VIS-C-5	Submerged Gravel Wetland	2.77	1.00	8.2	2.2	951.8	$128,500	$154,200
VIS-C-6	Wet Pond/Impervious Removal	27.53	1.00	154.8	31.8	12,881.3	$298,000	$357,600
VIS-C-8	Submerged Gravel Wetland	2.09	0.99	7.1	1.7	735.3	$165,500	$198,600
VIS-C-16	Sheetflow to Conservation	11.67	1.00	79.7	13.3	5,194.9	$77,000	$92,400
VIS-C-29	Created Wetland/SPSC/SGW/SR	20.51	0.51	150.9	80.5	20,256.4	$2,408,000	$2,889,600
GMB-Smallwood-SWM-01	Submerged Gravel Wetland	0.97	1.00	3.5	0.4	138.6	$49,681	$59,617
GMB-Smallwood-SWM-02	Bioswale	0.96	1.00	3.8	0.5	147.7	$32,688	$39,226
GMB-Smallwood-SWM-03	Bioretention	0.40	1.00	2.2	0.3	88.2	$57,500	$69,000
GMB-Smallwood-SWM-04	Submerged Gravel Wetland	1.23	1.00	4.8	0.6	191.0	$61,106	$73,327
GMB-Smallwood-SWM-05	Submerged Gravel Wetland	1.84	1.00	9.5	1.2	375.5	$75,844	$91,013

Level 6- Feasibility and Concept Design Projects (Charles County NTP Issued) continued								
Site ID	BMP Type	Impervious Acres Treated	Runoff Depth	Load Reduction (lbs/yr)			Total Initial Costs*	Total Costs Over 20 Years**
				TN	TP	TSS		
GMB-Smallwood-SWM-06	Existing Grass Swale	0.12	1.00	0.1	0.0	3.5	$17,500	$21,000
	Level 6 Subtotal	72.35	NA	447.8	135.4	41,914.4	$3,442,319	$4,130,783

Level 7- Feasibility and Concept Design Projects (Medium Priority)								
Site ID	BMP Type	Impervious Acres Treated	Runoff Depth	Load Reduction (lbs/yr)			Total Initial Costs*	Total Costs Over 20 Years**
				TN	TP	TSS		
VIS-C-7	Dry Swale/Bioretention Islands	5.17	1.00	31.0	7.8	3,379.8	$298,000	$357,600
VIS-C-23	Submerged Gravel Wetland	5.01	1.00	16.7	4.2	1,823.6	$286,500	$343,800
VIS-C-24	Bioretention Islands	1.99	1.00	10.4	3.0	1,305.3	$92,000	$110,400
VIS-C-25	Submerged Gravel Wetland	3.09	1.00	16.7	4.5	1,976.6	$124,500	$149,400
	Level 7 Subtotal	15.26	NA	74.8	19.5	8,485.3	$801,000	$961,200

Level 8- Alternate Feasibility and Concept Design Projects								
Site ID	BMP Type	Impervious Acres Treated	Runoff Depth	Load Reduction (lbs/yr)			Total Initial Costs*	Total Costs Over 20 Years**
				TN	TP	TSS		
VIS-C-1	Sheetflow to Conservation	1.05	1.00	7.5	1.2	386.5	$61,500	$73,800
VIS-C-4	SPSC/Stream Restoration	4.37	1.00	29.4	4.6	1,831.9	$310,000	$372,000
VIS-C-10	StormFilter	1.15	1.00	5.1	1.0	403.5	$80,500	$96,600
VIS-C-11	SPSC/Stream Restoration	12.65	1.00	502.3	52.7	16,038.8	$2,146,000	$2,575,200
VIS-C-12	SPSC	11.25	1.00	122.8	16.7	6,096.6	$870,000	$1,044,000

VIS-C-13	StormFilter	2.39	1.00	11.1	2.1	829.5	$97,500	$117,000
VIS-C-14	Submerged Gravel Wetland	2.40	1.00	25.9	2.8	913.3	$124,000	$148,800
VIS-C-15	Submerged Gravel Wetland	0.57	1.00	3.5	0.9	390.1	$102,000	$122,400
VIS-C-17	Submerged Gravel Wetland	2.71	1.00	8.8	2.2	935.7	$124,500	$149,400
VIS-C-18	StormFilter	2.89	1.00	12.4	2.6	1,005.4	$141,500	$169,800
VIS-C-19	Submerged Gravel Wetland	4.39	1.00	36.2	4.4	1,472.2	$242,500	$291,000
VIS-C-20	SPSC/Stream Restoration	48.26	1.00	294.3	58.3	23,781.1	$2,178,000	$2,613,600
VIS-C-21	Submerged Gravel Wetland	25.20	1.00	146.4	27.2	10,398.7	$537,000	$644,400
VIS-C-26	Dry Swale	1.81	1.00	18.4	2.5	938.5	$88,000	$105,600
VIS-C-27	SPSC	3.48	1.00	25.9	4.1	1,560.2	$316,000	$379,200
VIS-C-28	SPSC	11.26	1.00	185.7	21.3	7,217.9	$714,000	$856,800
Level 8 Subtotal		135.83	NA	1,435.7	204.6	74,199.9	$8,133,000	$9,759,600
Mattawoman Total		454.17	NA	6,477.74	1,307.59	469,206.36	$27,258,839	$32,572,909

For Vista retrofit sites, impervious acres represent the additional impervious surface treatment that may result from completion of the project and does not include current facility treatment.

For watershed assessment sites GMB-Mattawoman/Berry WS 1A, WS 1B, and WS2, VIS-P-6, VIS-C-9, VIS-C-22, VIS-A, VIS-B, and NGO-1, load reductions are calculated using updated removal rates from Schueler and Lane, 2015. The remaining load reductions for Vista retrofit sites were provided in Vista, 2015b and load reductions from GMB sites (except Mattawoman/Berry sites because load reductions were not provided) are from GMB, 2014a; GMB, 2014b; and GMB, 2015b.

*Bioretention, wet pond, created wetland, and infiltration basin cost estimates from King and Hagan, 2011. SPSC cost estimates from KCI projects.
**Watershed assessment sites (projects termed: ‘MW_SWM’), bioretention, wet pond, created wetland, and infiltration basin 20 year cost estimates from King and Hagan, 2011. Total cost over 20 years was not provided for projects proposed by Vista, GMB, NG&O Engineering, and WT Ballard, therefore a 20% factor was applied to estimate to calculate the additional cost needed over time.

4.4 Reforestation

Several potential reforestation sites were field identified during the SCA assessment performed in April 2015, however these sites were limited to the stream segments walked during the SCA assessment. A GIS desktop assessment was performed to supplement the SCA identified reforestation projects. The desktop assessment focused first on the opportunity to plant riparian buffers. Using the most recent available aerial photography, stream reaches without adequate 50 foot buffer on both banks were identified. Streams within land use areas categorized as agriculture were excluded from this search. Next, tree planting opportunities larger than 0.25 (as required by MDE in *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* Guidance, 2014) acres outside of riparian areas were identified. Targeted property types include property owned by the Charles County Board of Education, parks, other Charles County owned sites, and church parcels. Due to the limitations associated with a desktop assessment, these sites should be visited and confirmed as appropriate planting sites. Some sites may have constraints not identified during the desktop assessment.

Cost estimates for the proposed plantings were calculated based on estimates from King and Hagan. A total initial cost estimate of $11,000/acre and a total cost over 20 years of $19,069 was used to estimate the cost of reforestation projects (King and Hagan, 2011). It should be noted that economy of scale is not built in to this cost estimate. While there are very few large reforestation projects identified, larger projects will likely cost less than estimated here due to economy of scale. Load reductions were calculated for total nitrogen, total phosphorus, and total suspended sediment for the site with estimated removal efficiencies from *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* (Table 20; MDE, 2014a). These efficiencies assume a survival rate of 100 trees/acre or greater with at least 50% of trees having a two inch diameter or greater (4.5 feet above ground; MDE, 2014a). Twenty potential reforestation sites were identified, totaling 31 acres (Table 21).

TABLE 20: REFORESTATION BMPS EFFICIENCY AND IMPERVIOUS ACRE EQUIVALENT

BMP	Efficiency Per Acre			Impervious Acre Equivalent
	TN	TP	TSS	
Reforestation on Pervious Urban	66%	77%	57%	0.38
Impervious Urban to Forest	71%	94%	93%	1.00

TABLE 21: REFORESTATION SITE COST, IMPERVIOUS CREDIT, AND LOAD REDUCTION

Site ID	SCA Reach ID	Property type	Area (acres)	Total Initial Cost	Total Cost Over 20 Years	Impervious Credit	Load Reduction (lbs/year)		
							TN	TP	TSS
MW_TP_1	N/A	park	1.87	$20,596	$35,705	0.7	7.1	0.5	81.4
MW_TP_2	003 IB002	Commercial	0.86	$9,510	$16,487	0.3	3.2	0.2	37.6
MW_TP_3	004 IB002	Residential open space	0.70	$7,745	$13,426	0.3	2.6	0.2	30.6
MW_TP_4	N/A	residential open space	0.28	$3,102	$5,378	0.1	1.1	0.1	12.3

Site ID	SCA Reach ID	Property type	Area (acres)	Total Initial Cost	Total Cost Over 20 Years	Impervious Credit	Load Reduction (lbs/year)		
							TN	TP	TSS
MW_TP_5	002 IB001	open field	1.76	$19,320	$33,492	0.7	6.6	0.4	76.3
MW_TP_6	N/A	County owned property	3.05	$33,549	$58,159	1.2	11.5	0.7	132.6
MW_TP_7	N/A	park	1.55	$17,016	$29,498	0.6	5.8	0.4	67.3
MW_TP_8	N/A	school	1.41	$15,563	$26,979	0.5	5.3	0.3	61.5
MW_TP_9	N/A	school	2.16	$23,805	$41,268	0.8	8.2	0.5	94.1
MW_TP_10	N/A	County owned property	0.93	$10,191	$17,667	0.4	3.5	0.2	40.3
MW_TP_11	N/A	County owned property	0.55	$6,070	$10,522	0.2	2.1	0.2	24.0
MW_TP_12	N/A	County owned property	0.25	$2,798	$4,850	0.1	1.0	0.1	11.1
MW_TP_13	N/A	park	1.94	$21,288	$36,904	0.7	7.3	0.5	84.1
MW_TP_14	N/A	library	0.23	$2,505	$4,342	0.1	0.9	0.1	9.9
MW_TP_15	N/A	church	0.43	$4,749	$8,232	0.2	1.7	0.1	18.8
MW_TP_16	N/A	church	3.28	$36,058	$62,508	1.2	12.3	0.8	142.5
MW_TP_17	N/A	church	0.40	$4,414	$7,652	0.2	1.5	0.1	17.4
MW_TP_18	N/A	church	0.66	$7,269	$12,600	0.3	2.5	0.2	28.7
MW_TP_19	N/A	church	0.76	$8,398	$14,558	0.3	2.8	0.2	33.1
MW_TP_20	N/A	school	1.39	$15,344	$26,600	0.5	5.3	0.3	60.6
MW_TP_21	N/A	church	6.46	$71,020	$123,116	2.5	24.4	1.5	280.6
Mattawoman Total			30.94	$340,310	$589,942	11.8	116.7	7.6	1,344.8

5 Programmatic Practices

Currently, the County performs several programmatic practices throughout the Mattawoman watershed including the following: mechanical street sweeping and inlet cleaning, which are conducted continually throughout each fiscal year; trash clean-ups, which are organized on an as-needed basis and vary in location; and, homeowner practices, including rainwater harvesting, rain gardens, and downspout disconnection, which are generally reliant on homeowner participation.

Nutrient and sediment removal for both street sweeping and inlet cleaning under the existing program were calculated using fiscal year 2015 County data. The potential to increase sweeping route miles and number of inlets cleaned and the resultant increased pollutant removal were investigated in Sections 5.1 and 5.2 below. The potential to expand the County's trash clean-up program with the inclusion of sites identified during the SCA assessment is also discussed in Section 5.3. Nutrient removals from planned homeowner practices if implemented throughout the Mattawoman watershed are included in Section 5.4.

5.1 Mechanical Street Sweeping

Nutrient and sediment removal from mechanical street sweeping was calculated using fiscal year 2015 County data. Nutrient and sediment load reductions were primarily calculated using the MDE guidance (MDE, 2014a; Table 22), however updated methods have been recommended and are reported in *Recommendations of the Expert Panel to Define Removal Rates for Street and Storm Drain Cleaning Practices* (Schueler et al., 2015). Load reductions have been calculated using both the MDE guidance and the mass loading approach in Schueler et al., 2015 and are shown in Table 22. Reductions using the MDE guidance are used in the Treatment Summary in Section 6.

Street sweeping practices are expected to continue in the Mattawoman watershed annually. Street sweeping data was recorded by date collected, location and total miles swept. Amount of material removed in dry tons was not provided in the fiscal year 2015 County data, however average material removed per mile swept in each watershed was calculated from fiscal year 2014 data provided by the County. The average material removed per mile was applied towards the fiscal year 2015 miles swept data.

Table 23 shows the amount of material collected in the Mattawoman as well as the amount of pollutants removed. The cost of countywide mechanical street sweeping for FY15 was $53,400 to sweep approximately 200 miles. Approximately 100 street miles were swept in the Mattawoman Creek watershed, resulting in a total cost of $27,837 for the fiscal year 2015 (Table 23).

TABLE 22: MECHANICAL STREET SWEEPING REMOVAL EFFICIENCY AND IMPERVIOUS ACRE EQUIVALENT

Method	Pounds Reduced per Dry Ton			Impervious Acre Equivalent per Ton
	TN	TP	TSS	
MDE Guidance (MDE, 2014a)	3.5	1.4	420	0.4
Expert Panel Recommendations (Schueler et al., 2015)	5	2	600	N/A

TABLE 23: POLLUTANT REMOVAL FROM FY 2015 MECHANICAL STREET SWEEPING

Watershed	Miles Swept	Material Removed Weight (Ton)	Cost	Total Cost Over 20 Years*	Lbs Reduced / yr**			Impervious Credit (Ac)
					TN	TP	TSS	
Mattawoman Creek	100.7	366.0	$27,837	$556,749	**1,281.0** (1,830.0)	**512.4** (732.0)	**153,720.0** (219,600.0)	146.4

* Annual practice cost over 20 years calculated by multiplying initial costs by 20 years.

Reduction calculations from MDE, 2014a in **bold and calculations from Schueler et al., 2015 in parenthesis.

The new *Recommendations of the Expert Panel* report (Schueler et al., 2015) determined removal rates for eleven different street sweeping practices using Advanced Sweeping Technology (AST) and Mechanical Broom Technology (MBS) at different frequencies. AST is defined as sweepers classified as either Regenerative-Air Sweepers (RAS) or Vacuum Assisted Sweepers (VAS).

The report indicates that some credit can be obtained for sweeping at a quarterly frequency of one pass every 12 weeks with AST; however, the credits are very low at 2% for TSS, 1% for TP, and 0% for TN. AST performed twice a week (100 times per year) removal rates are much higher with 21% for TSS, 4% for TN, and 10% for TP. The Expert Panel reported that sweeping with MBT is ineffective for pollutant removal. At a frequency of twice per week, removal was only 1% for TSS and 0% for TN and TP. Charles County's street sweeping program will need to be reviewed in light of these potential changes to determine the most efficient and cost effective sweeping methods to institute.

5.2 Inlet Cleaning

Similar to mechanical street sweeping, nutrient and sediment removal from inlet cleaning was calculated using fiscal year 2015 County data following load reductions as noted in the MDE guidance (MDE, 2014a) as well as the new *Recommendations of the Expert Panel* report (Schueler et al., 2015; Table 24). Inlet cleaning data was recorded by date collected, location, number of inlets or catch basins cleaned and total weight of material removed in dry tons. In order to extrapolate these data to the amount of material collected, the average amount of material removed per pipe (0.15 ton) was applied to the total pipes cleaned per watershed. Inlet cleaning is expected to continue in the Mattawoman watershed annually.

Table 25 shows the amount of material collected in the Mattawoman watershed as well as the amount of pollutants removed. The cost of countywide inlet cleaning for FY15 was $93,400 to clean 247 pipes, resulting in an average cost of $378/pipe. Approximately 183 pipes were cleaned in the Mattawoman Creek watershed, resulting in a total cost of $69,199 for the fiscal year 2015 (

Table 25).

A significant amount of sediment is expected to be removed from the storm drain system in the Pinefield subdivision through the Pinefield Drainage Improvements (Vista, 2013). It is estimated that approximately 235 tons of material will be removed, resulting in an impervious credit of 94 acres. This credit will be a one-time credit, rather than the annual credit of the other inlet cleaning practices.

TABLE 24: INLET CLEANING REMOVAL EFFICIENCY AND IMPERVIOUS ACRE EQUIVALENT

Method	Pounds Reduced per Dry Ton			Impervious Acre Equivalent per Ton
	TN	TP	TSS	
MDE Guidance (MDE, 2014a)	3.5	1.4	420	0.4
Expert Panel Recommendations (Schueler et al., 2015)	5.4	1.2	600	N/A

TABLE 25: POLLUTANT REMOVAL FROM FY 2015 INLET CLEANING

Watershed / Area	# of Inlets Cleaned	Material Removed Weight (Ton)	Cost	Total Cost Over 20 Years*	Lbs Reduced / yr			Impervious Credit (Ac)
					TN	TP	TSS	
Mattawoman Creek	183	26.7	$69,199	$1,383,984	**93.5** (144.3)	**37.4** (32.1)	**11,224** (16,034.4)	10.7

Pinefield Drainage Improvements	N/A	235	N/A	N/A	822.5	329.0	98,700.0	94

* Annual practice cost over 20 years calculated by multiplying initial costs by 20 years.

Reduction calculations from MDE, 2014a in **bold and calculations from Schueler et al., 2015 in parenthesis.

5.3 Trash Clean-Ups

Areas in need of trash cleanup were field identified during the SCA assessment. Data collected at each site included the type of trash, an estimate of truckloads of trash, and if the site is a good opportunity for a volunteer clean-up. During the assessment the sites were given scores for severity, correctability, and access. Using these scores, the sites were prioritized in the same way as stream restoration and pipe outfall sites. All sites found during the SCA assessment were recommended for trash clean-up due to the limited number of sites identified.

Charles County's NPDES MS4 permit includes a requirement for Litter and Floatables (Section IV.D.4). The County currently operates an aggressive litter control program which utilizes three full-time crews who remove debris from County maintained right-of-way throughout the workweek. In addition, volunteers perform litter pickup on the weekends through community cleanups, the Adopt-A-Road Program, and annual Watershed Cleanup Events. Watershed cleanup events and volunteer opportunities are posted through the County's website (http://www.charlescountymd.gov/pw/ litter/litter-control).

A total of seven sites were identified as suitable trash clean-up sites (Table 26). The cost of trash removal is dependent on the removal approach. Of the seven sites identified, five were determined to be suitable for a volunteer clean-up opportunity and two were not. Using volunteers would obviously be less expensive than a paid crew. The cost of trash removal is estimated to be $1,000/site, for a total of $7,000 in the Mattawoman Creek Watershed.

TABLE 26: TRASH CLEAN-UP SITES

Restoration Site ID	Type	Truck Loads	Volunteer Opportunity	Cost
MW_TC_1	Scrap wood and pallets	10	Yes	$1,000
MW_TC_2	Rusty metal	6	No	$1,000
MW_TC_3	Assorted trash	2	Yes	$1,000
MW_TC_4	Assorted trash	1	Yes	$1,000
MW_TC_5	Rusty metal	2	Yes	$1,000
MW_TC_6	Plastic bottles, assorted trash	1	Yes	$1,000
MW_TC_7	Old metal pieces, assorted trash	3	No	$1,000
			Mattawoman Total	$7,000

5.4 Homeowner Practices

The implementation of homeowner practices is not only a cost effective strategy to supplement County restoration BMPs (e.g., stormwater BMPs, stream restoration, shoreline erosion control, etc.), but they also encourage the community to actively participate in cleaning up and taking ownership of the health of their watershed.

Nutrient removal from planned homeowner practices, including rainwater harvesting (i.e., rain barrels), rain gardens, and downspout disconnection, was calculated for each neighborhood assessed during the NSA reconnaissance and then projected to the watershed scale. The removal rates for 1 inch of rainfall treatment for this suite of homeowner BMPs are included in Table 27 (Goulet and Schueler, 2014). However, rainfall treatment varies based on site constraints, homeowner participation, and feasibility. Therefore, removal rates were calculated individually, by neighborhood, for each practice type based on specific site and design parameters in order to estimate total rain treatment and nutrient removal as shown in Tables 37, 38 and 39.

Impervious acre equivalencies for homeowner practices are also included in Table 27. An impervious acre equivalent assumption was applied to each homeowner practice based on the associated modeling BMP type (rain barrel: impervious surface reduction, rain garden: bioretention/rain gardens, disconnection of rooftop runoff: impervious surface reduction).

TABLE 27: REMOVAL EFFICIENCIES FOR HOMEOWNER PRACTICES

Practice	Efficiency Per Acre*		Impervious Acre Equivalent
	TN	TP	
Rain Barrel	28%	33%	0.75
Rain Garden	60%	70%	1.00
Downspout Disconnection	45%	52%	0.75

* based on treating the full 1 inch runoff

A series of assumptions were incorporated into the calculation of nutrient removal from homeowner practices, including the following:

<u>General Assumptions</u>

- Household participation per neighborhood:
  - Rain barrels = 30% of homes
  - Rain gardens = 10% of homes
  - Downspout Disconnections = 10% of homes
- Apartment or condominiums are not included in homeowner practices
- These practices will treat rooftop impervious area only
- Townhomes generally have 2 downspouts; Single-family homes generally have 4 downspouts – based on data collection during the NSA reconnaissance
- Total nitrogen and total phosphorus removed by each NSA neighborhood are standard removals that can be applied to additional neighborhoods identified as having similar housing densities, lot size, and forest cover in order to calculate total removal at the watershed scale.

<u>Rain Barrel Assumptions</u>

- Townhomes would use 1 rain barrel; Single-family homes would use 2 rain barrels
- Rain barrel capacity = 55 gal
- 50% of roof area will be treated

<u>Rain Garden Assumptions</u>

- Townhomes are not participating in the rain gardens strategy due to site limitations
- 50% of roof area will be treated
- Average rain garden depth = 8 in. as per Chesapeake Stormwater Network guidance (2013a)
- Engineering factor of 0.12 used to calculate Surface Area of rain garden as per Chesapeake Stormwater Network guidance (2013a)

<u>Downspout Disconnection Assumptions</u>

- Townhomes are not participating in the downspout disconnection strategy due to site limitations
- 1 downspout will be disconnected per single-family home
- Available pervious land measured in GIS between driveway and property line for a subset of households within each NSA neighborhood. As per Chesapeake Stormwater Network guidance, available pervious land area should be >10 feet in width with a length no less than 40 feet (2013b).
- An 'Average' infiltration ranking with an infiltration factor of 0.5 was applied to all NSA neighborhoods.

Nutrient removal and impervious credit for rain barrel, rain garden, and downspout disconnection practices for each NSA neighborhood, projection by neighborhood type, and watershed total are shown in Tables 35, 36 and 37.

Estimated costs for each homeowner practice are also included in the following tables. While some costs may be the responsibility of individual homeowners, the County is currently working with partners to subsidize costs and is in the process of securing additional funding for further support.

For the rain barrel practice, a cost of $60/barrel plus $25/fixtures and attachments was used to calculate an estimated cost of $354,629 for implementation in the Mattawoman watershed. The County currently covers 50% of costs for home owners who participate in the rain barrel practice. According to the University of Connecticut Cooperative Extension System, rain garden costs may vary from a minimum cost of $5/sq ft of rain garden size - $45/sq ft of rain garden size dependent on soil removal costs, soil amendments, need for a contractor, and planting size (http://nemo.uconn.edu/raingardens/calculator.htm). An initial cost estimate of $25/sq ft of rain garden size and a total cost of $1,315,240 is projected for implementing the rain garden practice in the Mattawoman watershed. An estimated cost of $10/downspout extension was used to calculate the cost of implementing the downspout disconnection practice which resulted in a total cost of $5,806 in the Mattawoman watershed. A grant program with Chesapeake Bay Trust and the County was initiated in FY 2016 for non-profit organizations to help alleviate practice costs in which the County provides 50% credit to the annual stormwater remediation fee for these practices.

TABLE 28: PROJECTED NUTRIENT REMOVAL AND IMPERVIOUS CREDIT FROM PLANNED RAIN BARRELS

NSA ID	Neighbor-hood Type	Average Roof Area to Treat (sq ft) for 50% of Total Area	Rainfall Depth Treated (in)	% Removal Based on Total Rain Treatment		Lbs Reduced per NSA Neighborhood		# of Similar Neighbor-hoods in Matta-Woman	Total # of Homes	Projected Lbs Reduced per Neighborhood Type		Treated Imperv-ious Acres	# of Rain Barrels Needed	Cost
				TN	TP	TN lbs/yr	TP lbs/yr			TN lbs/yr	TP lbs/yr			
MW-01	Single Family	643	0.14	30%	35%	2.2	0.5	12	839	28.4	6.1	9.3	1,677	$142,545
MW-02	Single Family	712	0.12	28%	32%	2.0	0.4	1	113	3.9	0.8	1.4	226	$19,176
MW-03	Townhomes	345	0.26	28%	33%	0.7	0.2	2	131	2.2	0.5	0.8	131	$11,093
MW-04	Single Family	796	0.11	25%	30%	0.8	0.2	1	47	1.7	0.4	0.6	94	$7,956
MW-05	Single Family	863	0.10	24%	28%	0.3	0.1	2	25	0.9	0.2	0.4	50	$4,284
MW-06	Townhomes	351	0.25	28%	33%	0.6	0.1	14	558	9.6	2.1	3.4	558	$47,430
MW-07	Apartments	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0	$0
MW-08	Single Family	904	0.10	23%	27%	1.2	0.3	9	339	12.2	2.6	5.3	678	$57,630
MW-09	Single Family	731	0.12	27%	32%	1.2	0.3	10	380	13.2	2.8	4.8	759	$64,515
MW-10	Mobile Park	-	-	-	-	-	-	-	0	0.0	0.0	0.0	0	$0
								Total	**2,432**	**72.1**	**15.5**	**26.0**	**4,173**	**$354,629**

TABLE 29: PROJECTED NUTRIENT REMOVAL AND IMPERVIOUS CREDIT FROM PLANNED RAIN GARDENS

NSA ID	Neighbor-hood Type	Average Roof Area to Treat (sq ft) for 50% of Total Area	Rainfall Depth Treated (in)	% Removal Based on Total Rain Treatment		Lbs Reduced per NSA Neighborhood		# of Similar Neighbor-hoods in a l·űűl·π ǿoYl·ƴ	Total # of Homes	Projected Lbs Reduced per Neighborhood Type		Treated Imperv-ious Acres	Cost
				TN	TP	TN lbs/yr	TP lbs/yr			TN lbs/yr	TP lbs/yr		
MW-01	Single Family	643	1.0	60%	70%	1.4	0.3	12	280	18.8	4.0	4.1	$561,856
MW-02	Single Family	712	1.0	60%	70%	1.4	0.3	1	38	2.8	0.6	0.6	$83,717
MW-03	Townhomes	-	-	-	-	-	-	-	-	-	-	-	$-
MW-04	Single Family	796	1.0	60%	70%	0.6	0.1	1	16	1.3	0.3	0.3	$38,796
MW-05	Single Family	863	1.0	60%	70%	0.3	0.1	2	8	0.8	0.2	0.2	$22,665
MW-06	Townhomes	-	-	-	-	-	-	-	-	-	-	-	$-
MW-07	Apartments	-	-	-	-	-	-	-	-	-	-	-	$-
MW-08	Single Family	904	1.0	60%	70%	1.1	0.2	9	113	10.7	2.3	2.3	$319,213
MW-09	Single Family	731	1.0	60%	70%	0.9	0.2	10	127	9.7	2.1	2.1	$288,993
MW-10	Mobile Park	-	-	-	-	-	-	-	-	-	-	-	$-
								Total	**582**	**44.1**	**9.5**	**9.6**	**$1,315,240**

TABLE 30: PROJECTED NUTRIENT REMOVAL AND IMPERVIOUS CREDIT FROM PLANNED DOWNSPOUT DISCONNECTION

NSA ID	Neighbor-hood Type	Average Roof Area to Treat (sq ft) with one Downspout Disconnect	Rainfall Depth Treated (in)	% Removal Based on Total Rain Treatment		Lbs Reduced per NSA Neighborhood		# of Similar Neighbor-hoods in a l·ǘǘl·π ǿoYl·ƴ	Total # of Homes	Projected Lbs Reduced per Neighborhood Type		Treated Imperv-ious Acres	# of Downspout Extensions Needed	Cost
				TN	TP	TN lbs/yr	TP lbs/yr			TN lbs/yr	TP lbs/yr			
MW-01	Single Family	322	0.0	-1%	-1%	0.0	0.0	12	280	0.0	0.0	1.5	280	$2,795
MW-02	Single Family	356	0.6	48%	56%	0.6	0.1	1	38	1.1	0.2	0.2	38	$376
MW-03	Townhomes	0	0.0	-1%	-1%	0.0	0.0	2	0	0.0	0.0	0.0	0	$0
MW-04	Single Family	398	0.0	-1%	-1%	0.0	0.0	1	16	0.0	0.0	0.1	16	$156
MW-05	Single Family	432	0.5	43%	50%	0.1	0.0	2	8	0.3	0.1	0.1	8	$84
MW-06	Townhomes	0	0.0	-1%	-1%	0.0	0.0	14	0	0.0	0.0	0.0	0	$0
MW-07	Apartments	0	0.0	-1%	-1%	0.0	0.0	2	0	0.0	0.0	0.0	0	$0
MW-08	Single Family	452	2.2	67%	78%	0.6	0.1	9	113	6.0	1.3	0.9	113	$1,130
MW-09	Single Family	366	0.0	-1%	-1%	0.0	0.0	10	127	0.0	0.0	0.8	127	$1,265
MW-10	Mobile Park	0	0.0	-1%	-1%	0.0	0.0	0	0	0.0	0.0	0.0	0	$0
								Total	**582**	**7.4**	**1.6**	**3.6**	**582**	**$5,806**

5.5 SEPTIC PRACTICES

Although septic strategies including connections, pump outs, and upgrades do not receive nutrient and sediment load reduction credits towards SW-WLAs for the urban stormwater sector, they do count towards impervious credit and were included in the County's impervious accounting (Section 6.3). According to MDE guidance (MDE, 2014a) each septic connection achieves an impervious equivalent of 0.39 ac, each pump-out achieves an impervious acre equivalent of 0.03 ac and each septic upgrade achieves an impervious acre equivalent of 0.26 ac (Table 31).

Table 32 shows impervious credit for septic connections, pump outs, and upgrades. As of Fall 2015, there were 19 septic connections in the Mattawoman since 2010; 163 septic pump outs since 2007; and, 17 upgrades since 2014. Estimated costs of septic connections, pump outs and upgrades are $42,330/connection (LimnoTech, 2013), $117/pump out (Charles County data), and $13,000/upgrade (MDE, 2011). Total costs for septic practices in the Mattawoman watershed were $222,279 (Table 32). This cost does not include the cost of the 19 septic connections within the watershed because these connections were voluntary and costs were incurred by the homeowners. Total cost over 20 years for annual septic practices are also included in Table 32 and were calculated by multiplying initial costs by 20 years. The County currently administers a Bay Restoration Fund (BRF) Septic System Grant Program through the Health Department that provides financial assistance to homeowners for septic system upgrades or connections to the public sewer system (https://www.charlescountymd.gov/pgm/planning/septic-system-upgrade-assistance). The County also has a septic pump-out reimbursement program to encourage residents to use this practice (http://www.charlescountymd.gov/pgm/planning/septic-system-pump-out-reimbursement-program).

TABLE 31: SEPTIC EFFICIENCIES AND IMPERVIOUS AREA EQUIVALENCIES

Practice	Efficiency Per Practice*		Impervious Acre Equivalent
	TN	TP	
Septic Pumping	0%	0%	0.03
Septic Denitrification	0%	0%	0.26
Septic Connections	0%	0%	0.39

* No credit given to septic practices for Urban MS4 source sector

TABLE 32: POLLUTANT REMOVAL AND IMPERVIOUS CREDIT FROM SEPTIC PRACTICES

Practice	Number	Cost	Total Cost over 20 Years	Lbs Reduced / yr***			Impervious Credit (Ac)
				TN	TP	TSS	
Connection	19	$0**	N/A	0.0	0.0	0.0	7.4
Pumping*	163	$18,516	$370,325	0.0	0.0	0.0	4.9
Denitrification	17	$203,763	N/A	0.0	0.0	0.0	4.4

* Annual practice cost over 20 years calculated by multiplying initial costs by 20 years.

** Cost not included because connections were voluntary and costs were incurred by homeowners.

*** No credit given to septic practices for Urban MS4 source sector

6 TREATMENT SUMMARY

6.1 EXISTING BMPS – ACTUAL IMPLEMENTATION

Charles County maintains a database of stormwater urban restoration BMP facilities and water quality and capital improvement projects (WQIP and CIP) in addition to tracking ESD and operational practices. Current BMP implementation through 2015 in the Mattawoman Creek watershed are shown in Table 33. BMP implementation for the Port Tobacco watershed and Lower Patuxent watershed can be found in the Port Tobacco Watershed Assessment (KCI, 2015) and Lower Patuxent River Watershed Assessment (KCI, 2016).

TABLE 33: CURRENT RESTORATION BMP IMPLEMENTATION THROUGH 2015 IN THE MATTAWOMAN CREEK WATERSHED

BMP	Unit	Mattawoman Creek 2015 Current Implementation*
Inlet Cleaning	# of pipes	183
Street Sweeping	miles swept	101
Wet Pond	acres	51
Underground Storage Chamber	acres	9
Dry Swale	acres	2
Filterra	acres	1
SPSC	acres	23
Rain Garden	Acres	0
Septic Connections	connection	19
Septic Pump outs	pump out	163
Septic Upgrades	upgrade	17

*Includes all of the County's ESD restoration BMPs through 2015.

6.2 Planned Implementation

Table 34 presents the planned implementation of BMPs described in sections 4, 5, and 6 of this report.

TABLE 34: BMP IMPLEMENTATION - PLANNED LEVELS

BMP	Unit	Mattawoman
Bioretention	acre	25
Created wetland	acre	1,286
Downspout Disconnection - Homeowner Practice	# of homes participating	581
Rain Barrels - Homeowner Practice	# of homes participating	2,430
Rain Gardens - Homeowner Practice	# of homes participating	581
Dry Swale	acre	22
Filtering Practices	acre	59
Infiltration basin	acre	54
Inlet Cleaning	# of pipes	183
Organic Filter	acre	2
Pond Retrofit	acre	145
Reforestation	acres	31
Sheetflow to Conservation	acre	58
Shoreline Erosion Control	linear feet	0
Step Pool Stormwater Conveyance Systems	acre	831
Stream Restoration	linear feet	10,434
Street Sweeping	miles swept	101
Submerged Gravel Wetland	acre	520
Wet Pond	acre	92

6.3 Impervious Credit

As a requirement of the NPDES MS4 Discharge Permit issued by MDE to Charles County on December 26, 2014, the County must treat 20% of remaining baseline untreated impervious acres by 2019. Impervious acres treated within the Mattawoman Creek watershed will count towards this goal.

Table 35 shows impervious treatment achieved by planned strategies described in this report for the Mattawoman Creek watershed.

TABLE 35: MATTAWOMAN CREEK IMPERVIOUS ACCOUNTING

Impervious Accounting	Mattawoman Creek
Baseline Impervious Treatment	
Impervious Estimate*	3,326.4 acres
Impervious Treated	1,157.3 acres
Impervious Treated Percent	35%
Impervious Untreated	2,169.1 acres
Impervious Untreated Percent	65%
Potential Impervious Treatment	
Operational Practices	157.1 acres
Septic Connections	7.4 acres
Septic Pump Outs	4.9 acres
Septic Upgrades	4.4 acres
Homeowner Practices	39.2 acres
Structural Practices	135.0 acres
Vista Retrofit Practices	456.4 acres
GMB Structural Practices	56.5 acres
Total Potential Impervious Treatment	**860.9 acres**
Summary of Projected Progress	
Impervious Untreated	2,169.1 acres
Total Potential Impervious Treatment	**860.9 acres**
Percent of Untreated Impervious Treated	**40%**

*Impervious acres include County and private lands outside the Town of LaPlata and is based on 2011 aerial photos (Vista, Draft 2015a).

6.4 Local TMDL and Bay TMDL Baseline and Target Loads

6.4.1 Local TMDLs

Mattawoman Creek local TMDL baseline and calibrated target loads are presented in Table 36.

According to the MDE guidance document *Guidance for Using the Maryland Assessment Scenario Tool to Develop Stormwater Wasteload Allocation Implementation Plans for Local Nitrogen, Phosphorus, and Sediment TMDLs* (MDE, 2014b), Section I, baseline loads and WLAs must be calibrated to the model used to calculate load reductions:

Because all of Maryland's approved local nutrient and sediment TMDLs were developed using watershed models other than MAST [Maryland Assessment Scenario Tool], the baseline and target loads from these TMDLs need to be translated into MAST loadings. This adjustment is required to account for potential differences between models. This is a two-step process that involves 1) creating a MAST scenario that replicates the baseline year of the TMDL, and 2) applying the load reduction percentage from the TMDL to the MAST loading for the baseline year.

Local TMDL baseline loads for nutrients and sediments were calibrated in BayFAST (Bay Facility Assessment Scenario Tool) by modeling County BMPs installed prior to the TMDL baseline year on top of baseline land use background loads. BayFAST was chosen as the model for calibrating baseline loads because it allows users to delineate facility boundaries (e.g., watershed, parcel, drainage area) and alter land use information within the delineated boundary depending on the model year. The general calibration procedure is as follows:

1. For each local TMDL, a facility boundary for the 8-digit TMDL watershed within Charles County borders was delineated within BayFAST.

2. All default land use acreages were deleted and regulated pervious and impervious acres were replaced with MAST Local Base County Phase I MS4 urban pervious and impervious acres using the Compare Scenario tool in MAST for the respective baseline year for each local TMDL. This approach inherently disaggregates County MS4 loads from the rest of the NPDES regulated area within the watershed.

3. County BMPs installed prior to the TMDL baseline year were then added to the model.

4. The reduction percentage published in the TMDL document was then applied to the calibrated baseline loads modeled in BayFAST to calculate a calibrated reduction in EOS-lbs/yr.

5. A calibrated WLA was calculated by subtracting the calibrated reduction from the BayFAST baseline load.

Calibrated load reductions calculated based on TMDL percent reductions and baseline loads modeled in BayFAST using Charles County Phase I MS4 baseline pervious and impervious land use and baseline treatment are the target reductions.

- **Calibrated 2000 Baseline Loads**: Baseline levels (i.e., land use loads with baseline BMPs) from baseline year conditions in the Charles County MS4 source sector for each SW-WLA calibrated to BayFAST CBP v.5.3.2.
- **Target Percent Reductions**: Percent reductions assigned to Charles County Phase I MS4 stormwater sector (http://wlat.mde.state.md.us/ByMS4.aspx).
- **Calibrated Target Reductions:** Target reduction calibrated to BayFAST CBP v.5.3.2 by multiplying the reduction percent published by the calibrated baseline load.
- **Calibrated TMDL WLA**: Allocated loads are calculated from the baseline levels, calibrated to CBP P5.3.2 as noted above, using the following calculation: Baseline – (Baseline x Target Percent Reduction); or, Baseline x (1 – Target Percent Reduction).

TABLE 36: LOCAL TMDL BASELINE AND TARGET LOADS

	Mattawoman Creek	
	TN- EOS lbs	TP- EOS lbs
Baseline and Target		
TMDL Baseline Year	2000	2000
Baseline Load	56,526	4,958
Target Percent Reduction	54.0%	47.0%
Calibrated Target Reduction	30,524	2,330
Calibrated TMDL WLA	26,002	2,628

6.4.2 Chesapeake Bay TMDL

The County's MS4 permit is requiring compliance with the Chesapeake Bay TMDL for the urban stormwater sector through the use of the 20% impervious surface treatment strategy. Therefore it is expected that the 20% goal and associated credit accounting will take precedence over the Bay TMDL loading goals and crediting. While not a requirement in the County's MS4 permit, the strategies provided in this plan to meet local TMDL reduction targets have been modeled in order to calculate potential progress toward meeting the Bay TMDL nutrient and sediment reduction goals.

Bay TMDL baseline and calibrated target loads are presented in Table 44. Modeling terminology is defined below.

- **Calibrated 2000 Baseline Loads**: Baseline levels (i.e., land use loads with baseline BMPs) from baseline year conditions in the Charles County MS4 source sector for each SW-WLA calibrated to MAST CBP v.5.3.2.
- **Target Percent Reductions**: Percent reductions assigned to Charles County Phase I MS4 stormwater sector (http://wlat.mde.state.md.us/ByMS4.aspx).
- **Calibrated Target Reductions:** Target reduction calibrated MAST CBP v.5.3.2 by multiplying the reduction percent published by the calibrated baseline load.
- **Calibrated TMDL WLA**: Allocated loads are calculated from the baseline levels, calibrated to CBP P5.3.2 as noted above, using the following calculation: Baseline – (Baseline x Target Percent Reduction); or, Baseline x (1 – Target Percent Reduction).

TABLE 37: BAY TMDL BASELINE AND TARGET LOADS

	TN- EOS (lbs/yr)	TP- EOS (lbs/yr)	TSS- EOS (lbs/yr)
Bay TMDL Baseline and Targets			
2010 Baseline Loads	235,070	20,037	5,739,174
Target Percent Reduction	18.2%	37.7%	-
Calibrated Target Reduction	42,759	7,554	-
Calibrated Bay TMDL WLA	192,311	12,483	-

6.5 Local TMDL and Bay TMDL Expected Load Reductions

This section provides a summary of pollutant load treatment from current and planned BMP implementation throughout the Mattawoman Creek watershed towards the County's local TMDL and Bay TMDL goals, including the restoration BMPs implemented through 2015 (presented in Section 6.1) and planned implementation (Section 6.2). Table 38 presents local TMDL progress and planned reductions and Table 39 presents Bay TMDL progress and planned reductions.

As described in Section 1, the goal of this watershed assessment is to ensure that there is enough treatment throughout the watershed, the second and third of a series of watershed assessments, so that the Charles County Bay TMDL goals are achieved. Progress and planned reductions from the County's other watershed assessments, Port Tobacco River Watershed Assessment (KCI, 2015) and Lower Patuxent River Watershed Assessment (KCI, 2016) are also included. Descriptions of the reductions are described below. It is important to note that loads for the Town of LaPlata are not included in baseline, progress, or planning loads for Countywide results as LaPlata is not considered part of the County's MS4 permit. Since LaPlata is located in the Port Tobacco and Zekiah Swamp watersheds, loads were disaggregated from both watersheds based on land area proportion for Countywide results. Planned accounting and modeling terminology is described below.

- **Restoration Reduction**: Load reductions from restoration BMPs with a built date after the baseline to 2015.
- **Restoration Reduction Percent**: The percent difference of the baseline load and the restoration reduction.
- **Reduction Remaining for Treatment**: The difference between the calibrated TMDL target reduction and restoration reduction.
- **Reduction Percent Remaining**: The difference between the Target Percent Reduction and Restoration Reduction Percent. This is the percent reduction left to be treated.
- **Planned Reductions**: The sum of loads treated by planned projects.
- **Reduction (Progress + Planned)**: The sum of loads treated from restoration BMPs with a built date after the baseline to 2015 (i.e., 2015 Progress Reductions) and Planned Reductions.
- **Reduction Percent (Progress + Planned)**: The percent difference of the baseline load and the Reduction (Progress + Planned).
- **Reduction Remaining for Treatment**: The difference between the calibrated target reduction and the Reduction (Progress + Planned).

TABLE 38: LOCAL TMDL PROGRESS AND PLANNED REDUCTIONS

	Mattawoman Creek	
	TN- EOS lbs/yr	**TP- EOS lbs/yr**
Baseline and Target		
TMDL Baseline Year	2000	2000
Baseline Load	56,526	4,958
Target Percent Reduction	54.0%	47.0%
Calibrated Target Reduction	30,524	2,330
Calibrated TMDL WLA	26,002	2,628
2015 Progress Reductions		
Restoration Reduction (from baseline to 2015)	1,665	600
Restoration Reduction Percent	3%	12%
Reduction Remaining for Treatment	28,858	1,730
Planned Reduction		
Planned Reductions	7,549	2,061
Totals		
Reduction (Progress + Planned)	9,214	2,661
Reduction Percent (Progress + Planned)	30.2%	114.2%
Reduction Remaining for Treatment	21,309	(331)

TABLE 39: BAY TMDL PROGRESS AND PLANNED REDUCTIONS

	TN- EOS (lbs/yr)	TP- EOS (lbs/yr)	TSS*- EOS (lbs/yr)
Bay TMDL Baseline and Targets			
2010 Baseline Loads	235,070	20,037	5,739,174
Target Percent Reduction	18.2%	37.7%	-
Calibrated Target Reduction	42,759	7,554	-
Calibrated Bay TMDL WLA	192,311	12,483	-
2015 Progress Reductions			
Restoration Reductions (from 2010 to 2015)	1,768	637	178,707
Port Tobacco	*103*	*37*	*11,151*
Mattawoman	*1,665*	*600*	*167,556*
Lower Patuxent	-	-	-
Planned Reductions			
Planned Reductions	16,535	4,925	1,915,136
Port Tobacco	*8,435*	*2,391*	*855,663*
Mattawoman	*7,549*	*2,061*	*532,736*
Lower Patuxent	*552*	*473*	*526,737*

	TN- EOS (lbs/yr)	TP- EOS (lbs/yr)	TSS*- EOS (lbs/yr)
Totals			
Reduction (Progress + Planned)	18,616	5,630	2,124,939
Reduction Percent (Progress + Planned)	7.9%	28.1%	-
Reduction Remaining for Treatment	24,144	1,924	-

Loads outside of the Town of LaPlata.

*No target reduction for sediment. It is anticipated that by achieving the phosphorus goal, enough sediment will be removed to improve water quality.

6.6 Cost Summary

A summary of project costs by project category is provided in (Table 40). Costs for restoration projects include the planning, design, surveying, environmental permitting, agency review, and construction costs and were estimated using a variety of sources.

King and Hagan (2011) cost estimates were used for many restoration project types, including stream restoration and all stormwater management projects, except SPSC which was calculated using actual costs from previous KCI projects. Street sweeping and inlet cleaning costs were calculated using costs from County data. Trash clean-up costs were assumed to be $1,000 per clean-up site. Cost per rain barrel was assumed to be $85. Rain gardens were assumed to be $25/ sq ft of rain garden and an estimated cost of $10/ downspout extension was used to calculate costs for downspout disconnection. While some costs of these homeowner practices may be the responsibility of individual homeowners, the County is currently working with partners to subsidize costs and is in the process of securing additional funding for further support.

Costs for Vista retrofit sites are included in the Stormwater Management project type section of the table below using the ID 'VIS'. Details on concept cost estimates for these sites may be found in Vista, 2015b. GMB costs were provided in GMB, 2014a, GMB, 2014b, GMB, 2015a, and GMB, 2015b.

TABLE 40: SUMMARY RESTORATION PROJECT COSTS

	Total Initial Cost	Cost Over 20 Years
Mattawoman		
Stream Restoration	$6,730,142	$8,589,540
Stormwater Management	$4,239,670	$4,992,937
Stormwater Management (Level 2)	$3,731,565	$4,477,878
Stormwater Management (Level 3)	$6,696,130	$8,035,356
Stormwater Management (Level 5-8)	$12,591,472	$15,066,739
Reforestation	$340,310	$589,942
Trash Cleanups	$7,000	
Street Sweeping	$27,837	$556,749
Inlet Cleaning	$69,199	$1,383,984
Homeowner Practices	$1,675,674	
Septic Practices	$222,279	$370,325
Total	$36,331,278	$44,063,450

- Additional costs to calculate total cost over 20 years not provided for Vista, and GMB sites (stormwater BMPs coded 'VIS', 'BAY', and 'GMB'). A 20% factor was applied to estimate the additional cost needed over time.
- Annual practices cost over 20 years calculated by multiplying initial costs by 20 years. Annual practices include street sweeping, inlet cleaning, and septic pump outs. Cost over 20 years for annual practices does not account for inflation.

7 PRIORITIZATION

A complete description of the prioritization methods is included in Appendix D. This section provides a brief summary of the method and presents the results. The prioritization involved a matrix made up of a series of parameters, or metrics, which evaluated each project and allowed for discrimination between the facilities. There are three categories of metrics, project benefits, project constraints, and project costs. Metrics were selected using a pairwise comparison by the project team by comparing pairs of metrics to evaluate which has greater importance. From this analysis, the weight of each chosen metric was calculated. Next, the projects were scored for each metric. Quantitative metrics were scored based on results of the preliminary design and cost estimates (e.g. impervious area treated, pollutant removal). Other metrics were scored more qualitatively based on professional judgment and assessment of each project site (e.g. access constraints, public visibility/education/outreach). Each project was ranked based on the total score and the final prioritization was determined. The final prioritized list of projects is presented in Table 41 and Table 42. Vista, and GMB sites were not included in the prioritization.

TABLE 41: MATTAWOMAN CREEK WATERSHED PRIORITIZATION RANKING BY PROJECT TYPE

Project ID	Project Type	Benefits Rank	Constraints Rank	Cost Rank	Total Score	Final Rank
MW_SR_1	Stream Restoration	4	50	40.5	95	40

Project ID	Project Type	Benefits Rank	Constraints Rank	Cost Rank	Total Score	Final Rank
MW_SR_2	Stream Restoration	5	42	47	94	38.5
MW_SR_3	Stream Restoration	3	51	42	96	41
MW_SR_4	Stream Restoration	1	47	40.5	89	33
MW_SR_5	Stream Restoration	2	46	43	91	36
MW_TP_1	Reforestation	18	22.5	14	55	9.5
MW_TP_2	Reforestation	6	41	18	65	17.5
MW_TP_3	Reforestation	11	16	13	40	3
MW_TP_4	Reforestation	36	34	24	94	38.5
MW_TP_5	Reforestation	19	25.5	27	72	22.5
MW_TP_6	Reforestation	15	14	25.5	55	9.5
MW_TP_7	Reforestation	33	18	15	66	19
MW_TP_8	Reforestation	39	7	25.5	72	22.5
MW_TP_9	Reforestation	30	7	19	56	12.5
MW_TP_10	Reforestation	25	7	17	49	5
MW_TP_11	Reforestation	50	7	8	65	17.5
MW_TP_12	Reforestation	43	7	10	60	15
MW_TP_13	Reforestation	12	17	21	50	6
MW_TP_14	Reforestation	35	7	11	53	7
MW_TP_15	Reforestation	40	7	9	56	12.5
MW_TP_16	Reforestation	10	7	22	39	2
MW_TP_17	Reforestation	32	7	16	55	11
MW_TP_18	Reforestation	27	7	12	46	4
MW_TP_19	Reforestation	24	15	28	67	20
MW_TP_20	Reforestation	21	22.5	20	64	16
MW_TP_21	Reforestation	8	7	23	38	1
MW_TC_1	Trash Cleanups	45	20	4	69	21
MW_TC_2	Trash Cleanups	51	20	4	75	25
MW_TC_3	Trash Cleanups	49	1	4	54	8
MW_TC_4	Trash Cleanups	42	13	4	59	14
MW_TC_5	Trash Cleanups	48	20	4	72	24
MW_TC_6	Trash Cleanups	47	28.5	4	79	27.5
MW_TC_7	Trash Cleanups	47	28.5	4	79	27.5
MW_BMP_1	Bioretention	41	45	49	135	50
MW_BMP_2	Bioretention	37	30.5	50	118	49

Project ID	Project Type	Benefits Rank	Constraints Rank	Cost Rank	Total Score	Final Rank
MW_BMP_3	Bioretention	44	48	48	140	51
MW_BMP_4	Bioretention	16	38	51	105	45.5
MW_BMP_5	Wet Pond	29	25.5	31	86	31
MW_BMP_6	Created Wetland	14	43	33	90	34
MW_BMP_7	Bioretention	34	30.5	34	99	43
MW_BMP_8	Wet Pond	26	36	39	101	44
MW_BMP_9	Wet Pond	38	38	38	114	48
MW_BMP_10	Created Wetland	13	33	30	76	26
MW_BMP_11	Created Wetland	9	44	35	88	32
MW_BMP_12	Wet Pond	20	32	32	84	29
MW_BMP_13	Created Wetland	31	38	36	105	45.5
MW_BMP_14	Infiltration Basin	23	40	45	108	47
MW_BMP_15	Infiltration Basin	17	35	46	98	42
MW_BMP_16	Wet Pond	28	25.5	37	91	35
MW_BMP_17	Infiltration Basin	22	25.5	44	92	37
MW_BMP_18	SPSC	7	49	29	85	30

TABLE 42: MATTAWOMAN CREEK WATERSHED PRIORITIZATION FINAL RANKING

Project ID	Project Type	Final Rank
MW_TP_21	Reforestation	1
MW_TP_16	Reforestation	2
MW_TP_3	Reforestation	3
MW_TP_18	Reforestation	4
MW_TP_10	Reforestation	5
MW_TP_13	Reforestation	6
MW_TP_14	Reforestation	7
MW_TC_3	Trash Cleanups	8
MW_TP_1	Reforestation	9.5
MW_TP_6	Reforestation	9.5
MW_TP_17	Reforestation	11
MW_TP_9	Reforestation	12.5
MW_TP_15	Reforestation	12.5
MW_TC_4	Trash Cleanups	14

Project ID	Project Type	Final Rank
MW_TP_12	Reforestation	15
MW_TP_20	Reforestation	16
MW_TP_2	Reforestation	17.5
MW_TP_11	Reforestation	17.5
MW_TP_7	Reforestation	19
MW_TP_19	Reforestation	20
MW_TC_1	Trash Cleanups	21
MW_TP_5	Reforestation	22.5
MW_TP_8	Reforestation	22.5
MW_TC_5	Trash Cleanups	24
MW_TC_2	Trash Cleanups	25
MW_BMP_10	Created Wetland	26
MW_TC_6	Trash Cleanups	27.5
MW_TC_7	Trash Cleanups	27.5
MW_BMP_12	Wet Pond	29
MW_BMP_18	SPSC	30
MW_BMP_5	Wet Pond	31
MW_BMP_11	Created Wetland	32
MW_SR_4	Stream Restoration	33
MW_BMP_6	Created Wetland	34
MW_BMP_16	Wet Pond	35
MW_SR_5	Stream Restoration	36
MW_BMP_17	Infiltration Basin	37
MW_SR_2	Stream Restoration	38.5
MW_TP_4	Reforestation	38.5
MW_SR_1	Stream Restoration	40
MW_SR_3	Stream Restoration	41
MW_BMP_15	Infiltration Basin	42
MW_BMP_7	Bioretention	43
MW_BMP_8	Wet Pond	44
MW_BMP_4	Bioretention	45.5
MW_BMP_13	Created Wetland	45.5
MW_BMP_14	Infiltration Basin	47
MW_BMP_9	Wet Pond	48

Project ID	Project Type	Final Rank
MW_BMP_2	Bioretention	49
MW_BMP_1	Bioretention	50
MW_BMP_3	Bioretention	51

The project prioritization results provide a starting point for the County's planning process of project implementation. Table 42 presents the potential projects listed by final ranking. The highest ranked projects (lower final rank numbers) in general provide the greatest benefits with the least constraints and project costs, relative to all other potential projects. These projects should be first priority to achieve the greatest load reductions to meet Bay restoration goals. In general, reforestation and trash cleanup projects ranked very high due to their relatively low cost and low constraints. Beyond these projects, there is a diversity of high priority projects including wet pond retrofits, SPSC, and stream restorations.

As noted in Section 6, the planned projects summarized above will have an implementation target of 2025 to align with Bay restoration goals. Feasibility studies of the planned strategies may reveal that some existing structures identified for retrofitting or enhancement or that new restoration strategies may not be feasible candidates for future projects and may be eliminated from consideration. The County will take an adaptive management approach and will reevaluate treatment needs as feasibility studies progress. The County will continue to track the overall effectiveness of the various BMP strategies and will adapt the suite of solutions based on the results. In addition, new technologies are continuously evaluated to determine if the new technologies allow more efficient or effective pollution control.

Support, cooperation, and participation from the citizens of Charles County are very important for the successful implementation of restoration projects, especially homeowner practices. Treatment in the Mattawoman Creek watershed is imperative for Bay restoration by providing the load reductions presented in Section 6.4.3.

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APPENDIX A – NEIGHBORHOOD SOURCE ASSESSMENT DATA

Site ID	Watershed	Date	Assessed by	Neighborhood / Subdivision / Streets	Area (acres)	HOA	LU Type	Lot Size (acres)	Age (Decade)	% with Garages	% with Basement	Sewer Service
MW-1	Mattawoman	3/19/2015	SB/LW	Lancaster	47.0	Unknown	Single Fam Detached	<1/4	1980	20	0	Yes
MW-2	Mattawoman	3/20/2015	SB/LW	Indian Head	122.0	Unknown	Single Fam Detached	>1	1930-1950	0	0	Yes
MW-3	Mattawoman	3/20/2015	SB/LW	Riverside Run	14.0	Yes	Single Fam Attached	<1/4	1990	0	0	Yes
MW-4	Mattawoman	3/20/2015	SB/LW	Potomac Heights	16.0	Yes	Single Fam Detached	1/4	1940	0	0	Yes
MW-5	Mattawoman	3/20/2015	SB/LW	Livingston Rd / Ford Drive	160.0	Unknown	Single Fam Detached	>1	1950-1970	5	40	No
MW-6	Mattawoman	3/19/2015	SB/LW	Somerset	14.0	Yes	Single Fam Attached	<1/4	1990	0	100	Yes
MW-7	Mattawoman	3/19/2015	SB/LW	Fox Chase Apartments	19.0	Unknown	Multifamily	<1/4	1980	0	0	Yes
MW-8	Mattawoman	3/19/2015	SB/LW	Indian Head Hwy and Warehouse Landing Road/ Jenkins Lane	152.0	No	Single Fam Detached	1/2	1950-1970	40	100	Yes
MW-9	Mattawoman	3/19/2015	SB/LW	Somerset	25.0	Yes	Single Fam Detached	<1/4	1990-2010	100	100	Yes
MW-10	Mattawoman	3/19/2015	SB/LW	Livingston Rd/ Billingsley Rd	8.0	No	Mobile Home	<1/4	Unknown	0	0	Unknown

Site ID	Infill Index	% Impervious Cover	% Lawn	% Landscaped	% Bare Soil	% Forest Canopy	Land Cover Comments	% Non-target Irrigation	% High Lawn Mgmt	% Medium Lawn Mgmt	% Low Lawn Mgmt
MW-1	No Evidence	50	40	10	0	10		0		50	50
MW-2	No Evidence	50	40	10	0	0		0		20	80
MW-3	No Evidence	70	18	10	2	5		0		10	90
MW-4	No Evidence	80	15	5	0	10	very dense housing	0		20	80
MW-5	No Evidence	40	50	5	5	5	some lots with forested back yards	0		50	50
MW-6	No Evidence	80	10	10		5	some lots with tree in front yard	0	100		
MW-7	No Evidence	50	30	19	1	4		0		100	
MW-8	5-10%	30	60	10	0	30		0		30	70
MW-9	No Evidence	60	25	10	5	5	some lots with forested back yards	0	30	70	
MW-10	No Evidence	75	15	0	10	40		0			100

Site ID	Lawn Maintenance Comments	% Lots w/ Outdoor Pools	No. of Outdoor Pools	% Yards with Trash	% Impervious driveways, parking	Driveway Condition	% Clean Driveways	Sidewalks	Sidewalk Condition	% Clean Sidewalks	Distance, sidewalk to street	Pet Waste	Curb / Gutter
MW-1		0	0	0	100	Clean	100	Yes - 2	Clean	80	1	No	Yes
MW-2		0	0	30	100	Breaking up	50	Yes - 1	Clean	70	0	No	Yes
MW-3		0	0	20	N/A			Yes - 2	Clean	80	0	No	Yes
MW-4		0	0	20	100	Breaking up	70	No				No	No
MW-5		0	0	10	100	Breaking up	70	No				No	No
MW-6	very small lawn- townhouse	0	0	5	N/A			Yes - 2	Clean	100	1	No	Yes
MW-7		0	0	0	100	Clean	100	Yes - 2	Clean	100	0	No	Yes
MW-8		2	2	10	100	Clean	100	No				No	No
MW-9		0	0	0	100	Clean	90	Yes - 2	Clean	100	2	No	Yes
MW-10		0	0	60	N/A			No				No	No

Site ID	Curb / Gutter Condition	% Gutters not clean	% Down-spouts to SD / SS	% Down-spouts to IA	% Down-spouts to Pervious	% Down-spouts to Rain Barrels	Lawn Area D/S of Leader	Downspout Comments	SD Inlets
MW-1	Sediment/Organic Matter/ Overhead Tree Canopy	40	0	20	80	0	Yes		Yes
MW-2	Sediment/Organic Matter	50	0	30	70	0	No	areas not large enough for rain gardens	Yes
MW-3	Sediment/Organic Matter	20	0		100	0	Yes	some space for small rain gardens, mostly draining to front yard	Yes
MW-4			0	80	20	0	No	areas not large enough for rain gardens	No
MW-5			0	20	80	0	Yes	some drain to driveway	No
MW-6	Sediment/Organic Matter	30	0	100	0	0	No		Yes
MW-7	Clean	10	0	10	90	0	Yes	40% downspouts could be directed to rain garden space	Yes
MW-8			0	0	100	0	Yes	downspouts to lawn	No
MW-9	Sediment	10	0	5	95	0	No	some downspouts draining to driveway	Yes
MW-10							No	mobile homes - no downspouts	No

Site ID	% Inlets Marked	Inlet Condition	Catch Basin Inspected	Basin ID	SW Pond	Pond Over-grown	Pond Surf Area	Common Open Space	Pet Waste	Dumping	Buffers Present	Buffer Encroach-ment	Pollution Severity	Pollution Severity Score	Restoration Index
MW-1	100	Dirty	No		No			No					Moderate	3	Moderate
MW-2	0	Dirty	No		No			No					High	5	Moderate
MW-3	0	Dirty	No		No			No					Moderate	3	Moderate
MW-4			No		No			No					Moderate	2	Moderate
MW-5			No		No			No					Moderate	2	Moderate
MW-6	0	Dirty	No		No			Yes	No	No	No		High	5	Moderate
MW-7	0	Clean	No		No			Yes	No	No	No		Moderate	1	Moderate
MW-8			No		No			No					Moderate	2	Moderate
MW-9	0	Clean	No		No			Yes	No	No	No		Moderate	4	Moderate
MW-10			No		No			Yes	No	No	No		Moderate	2	Low

Site ID	Pollution Sources	Potential Action	Notes
MW-1	Nutrients, Bacteria, Sediment	rain barrels, conservation landscaping, street sweeping	
MW-2	Nutrients, Sediment, Oil and Grease	rain barrels, conservation landscaping, street sweeping	
MW-3	Nutrients, Bacteria, Sediment	rain barrels, conservation landscaping, street sweeping	no driveways but parking lot in fair condition with potholes and breaking up
MW-4	Nutrients, Sediment, Bacteria	rain barrels, conservation landscaping	very little room for treatment
MW-5	Sediment, Nutrients, Oil and Grease	rain barrels, conservation landscaping, rain gardens, swale retrofits	
MW-6	Nutrients, Bacteria, Sediment	rain barrel, conservation landscaping, street sweeping, tree planting in common area	
MW-7	Nutrients	retrofit ditch for stormwater management, conservation landscaping	
MW-8	Nutrients	rain barrels, rain gardens, conservation landscaping, tree planting	
MW-9	Nutrients	rain barrel, conservation landscaping, street sweeping, tree planting in common area	
MW-10	Sediment, Oil and Grease	retrofit perimeter swales, tree planting at common area	

APPENDIX B – HOT SPOT INVESTIGATION DATA

Site ID	Watershed	Date	Assessed by	Site Name	Category	NPDES Status	Operation Description	Vehicle Operations	Vehicle Types	No. of Vehicles	Vehicle Activities	Vehicle Storage	Vehicle Runoff Div Method	Spills / Leakage	Notes	Uncovered Fueling	Connected Fueling
MW-1	Mattawoman	3/19/2015	SB/LW	J&J Logistics	industrial	unregulated	junkyard	Yes	Junk	100	Junk	Yes	Yes	Yes	junk yard with old car storage	Unknown	Unknown
MW-2	Mattawoman	3/19/2015	SB/LW	McDonald's	commercial	unregulated	restaurant	No									
MW-3	Mattawoman	3/19/2015	SB/LW	Premier Auto Imports	commercial	unregulated	car sales	Yes	Car Sales	30	Store	Yes	Yes	No	used car sales	No	No
MW-4	Mattawoman	3/20/2015	SB/LW	Super 8 Motel	commercial	unregulated	motel	No									
MW-5	Mattawoman	3/19/2015	SB/LW	Xtra Fuels	commercial	unregulated	gas station	No									
MW-6	Mattawoman	3/19/2015	SB/LW	Goodyear closed- Admiral Tire opening soon- did not assess													
MW-7	Mattawoman	3/19/2015	SB/LW	Gardiner Outdoor Products Corporation	commercial	unregulated	tractor sales/retail	Yes	Fleet	10	Store	Yes	Yes	No	few fleet vehicles	Yes	No
MW-8	Mattawoman	3/19/2015	SB/LW	Toyota Dealership	commercial	unregulated	Toyota car dealership and Collision Center	Yes	Dealership	100	Maint/Rep/ Junk/Fuel/ Wash/ Store	Yes	Yes	No	some evidence of old stains	No	Unknown
MW-9	Mattawoman	3/19/2015	SB/LW	Atlantic refinishing	commercial	unregulated	refinishing, unclear	No									
MW-11	Mattawoman	3/19/2015	SB/LW	Lowes	commercial	unregulated	Lowe's store	No									
MW-12	Mattawoman	3/19/2015	SB/LW	IHOP	commercial	unregulated	restaurant	No									
MW-13	Mattawoman	3/19/2015	SB/LW	Enterprise Car Rental	commercial	unregulated	car rentals	Yes	Rental	10	Wash/Store	Yes	Yes	No	car rental and washing	No	No
MW-14	Mattawoman	3/19/2015	SB/LW	US Fuel	commercial	unregulated	gas station	No									
MW-15	Mattawoman	3/19/2015	SB/LW	Foods In	commercial	unregulated	convenience store	No									
MW-16	Mattawoman	3/19/2015	SB/LW	Bryans Road Building and Supply Co., Inc.	commercial	unregulated	building supply store	Yes	Fleet	5	Maint/Rep/Fuel/ Wash/ Store	Yes	No	No	few fleet vehicles	Unknown	Unknown
MW-17	Mattawoman	3/20/2015	SB/LW	Dash In	commercial	unregulated	gas station, convenience store	No									
MW-18	Mattawoman	3/20/2015	SB/LW	Grinder's Seafood	commercial	unregulated	restaurant	No									
MW-19	Mattawoman	3/20/2015	SB/LW	Dale's Smokehouse	commercial	unregulated	restaurant	No									
MW-20	Mattawoman	3/20/2015	SB/LW	Indian Head Service Center	commercial	unregulated	car service	Yes	Repair	4	Maint/Repair/Store	Yes	Yes	No	clean	No	No
MW-21	Mattawoman	3/20/2015	SB/LW	Clean Puppy Car Wash	commercial	unregulated	car wash	Yes	none	0	Wash	No		No		No	No
MW-22	Mattawoman	3/19/2015	SB/LW	West Lake High School	institutional	unregulated	high school	No									

Site ID	Notes	Outdoor Washing	Wash Discharge to Storm Drain	Notes	Outdoor Materials	Loading	Stored Outside	Material Description	Storage Area	Connected Storage	Staining	No Cover	Liquid Storage Contain-ment	Labels Missing	Waste Mgmt	Type	Dumpster	Dumpster	Connected	Div Methods Lacking
MW-1	unable to access inside fence	Unknown	Unknown	unable to access inside fence	Yes	Yes	Yes	construction materials, lumber, vehicles	Impervious	Unknown	Unknown	Yes	Unknown	Unknown	Yes	Garbage		garbage, construction, can not access beyond fence to see dumpster	Unknown	
MW-2					No										Yes	Garbage		good condition	Yes	Yes
MW-3		Unknown	Yes	did not observe signs of washing	No										No					
MW-4					No										Yes	Garbage	No cover/Open Lid	open lid, overflowing, lots of trash	No	
MW-5					No										Yes	Garbage		good condition	Yes	Yes
MW-6																				
MW-7		Yes	No	observed potential wash water draining across parking lot to woods at north side of property	Yes	Can't Tell	Yes	wood chips	Impervious	No	No	Yes	Unknown	Unknown	Yes	Garbage	No cover/Open Lid	open lid	No	
MW-8	no apparent fueling areas outdoors	No	Unknown		Yes	Yes	No			No	Yes	Yes	No	No	Yes	Garbage	Overflowing	multiple dumpsters overflowing and no cover	Yes	Yes
MW-9					Yes	Yes	Yes	unclear, liquids, barrels, etc	grass/dirt	No	No	Yes	Yes	Yes	Yes	Construction				
MW-11					Yes	Yes	Yes	lumber, soil, bagged mulch, potted plants	Impervious	No	No	Yes	Unk	No	Yes	Garbage			Unknown	Unknown
MW-12					No										Yes	Garbage		good condition	No	
MW-13	very few cars in lot	Yes	Yes	small drain present at washing area, however it was not working, water running down parking lot, draining to stormwater BMP behind EZ Storage	No										Yes	Garbage	No cover/Open Lid	good condition but open lid	Yes	Yes
MW-14					No										Yes	Garbage		good condition	No	
MW-15					No										Yes	Garbage	No cover/Open Lid	no lids	No	
MW-16	fenced back area	Unknown	Unknown	potential washing in back	Yes	Yes	Yes	lumber, mulch, brick, building materials	Impervious	No	Unknown	Yes	Unknown	Unknown	Yes	Garbage		can not access back		
MW-17					No										Yes	Garbage	No cover/Open Lid	open lid	No	
MW-18					Yes	Yes	Yes	crab baskets, wooden baskets	Impervious	No	No	Yes	No	No	Yes	Garbage		good condition	Yes	Yes
MW-19					No			small wood pile							Yes	Garbage		good condition	No	
MW-20		No	No		Yes	No	Yes	rock, soil, tires, wheels, car parts	Impervious	No	No	Yes	No	No	No			no observed dumpster		
MW-21		No	Yes	drains within covered car wash stations, black stains from automatic carwash portion	No										Yes	Garbage		good condition	Yes	Yes
MW-22					No										Yes	Garbage		good condition	Yes	No

Site ID	Notes	Physical Plant	Building Age	Building Condition	Discharge to MS4	Parking Lot Age	Parking Lot Condition	Parking Lot Condition	Parking Lot Material	Down-spouts to IA	Down-spouts to MS4	Notes	Stains to MS4	Turf/Land-scaping	% Forest Canopy	% Lawn	% Land-scaped	% Bare Soil	Turf Mgmt	% Non-target Irrigation	Drain to MS4	Organics on IA	Notes
MW-1		Yes	1950s	Clean	Unknown	1980s	Dirty	breaking up, gravel	Paved/Concrete	Yes	Unknown	draining to impervious	Unknown	Yes	20	20	0	0	Low	0	Unknown	No	
MW-2	dumpsters uphill from inlets	Yes	1970s	Clean	Yes	2000s	Clean	good conditions	Paved/Concrete	No	Yes		No	Yes	0	0	5	0	Medium	0	Yes	Yes	landscaped parking lot
MW-3	no dumpster observed, barrels observed in back- appeared to be empty/dry	Yes	1970s	Clean	Yes	1970s	Clean	gravel and sediment	Paved/Concrete	Yes	No		No	Yes	0	5	5	0	Low	0	Yes	Yes	landscaped front at 301
MW-4	dumpster immediately adjacent to wetland	Yes	1980s	Clean	Yes	1980s	Clean	good condition	Paved/Concrete	Yes	Yes	downspouts to parking lot, sheet flow to potential SWM	No	Yes	10	5	5	0	Low	0	Yes	Yes	trees in front of motel
MW-5	dumpsters uphill from inlets	Yes	1970s	Clean	Yes	1970s	Breaking up	stained, gravel, sediment, breaking up	Paved/Concrete	Yes	No	Draining to impervious parking lot	Yes	Yes	0	0	5	0	Low	0	Yes	No	landscaped front at 301
MW-6			2000s			2000s																	
MW-7		Yes	1970s	Clean	No	1970s	Clean	clean	Paved/Concrete	Yes	No		No	No									
MW-8		Yes	2000s	Clean	Yes	2000s	Clean	clean, some cracks, staining in isolated locations	Paved/Concrete	Yes	Yes	Draining to impervious parking lot	Yes	Yes	0	2	2	0	Medium	0	Yes	Yes	
MW-9	No dumpster observed	Yes	1970s	Clean	No	1970s	Clean	clean	Paved/Concrete	Yes	No		No	No									
MW-11	Gated back storage and dumpster area	Yes	2000s	Clean	Yes	2000s	Clean	clean, some cracks	Paved/Concrete	None Visible	Unknown		No	Yes	10	5	5	0	Medium	0	Yes	Yes	median parking lots landscaped
MW-12		Yes	1970s	Clean	No	1970s	Clean	clean	Paved/Concrete	Yes	No		No	Yes	0	1	5	0	Low	0	No	Yes	
MW-13	sheet flow from dumpster and parking lot to BMP behind EZ Storage	Yes	1970s	Clean	Yes	1970s	Clean	clean	Paved/Concrete	No	Yes		No	Yes	0	5	10	0	Low	0	Yes	Yes	parking lot landscaping
MW-14		Yes	1990s	Clean	Yes	1990s	Clean	some straining	Paved/Concrete	Yes	Yes	draining to impervious	No	Yes	0	5	5	0	Low	0	Yes	Yes	parking lot landscaping
MW-15		Yes	1970s	Clean	Yes	1970s	Breaking up	trash, cracks, breaking, sediment	Paved/Concrete	Yes	No		No	Yes	0	0	10	0	Low	0	Yes	Yes	parking lot landscaping
MW-16	can not access fenced back	Yes	2000s	Clean	NO	2000s	Clean	clean	Paved/Concrete	Yes	No	downspouts drain to impervious parking	No	Yes	0	10	0	10	Low	0	No	No	some turf at road, bare soil at storage area in back
MW-17		Yes	1970s	Clean	Yes	1970s	Stained	some stains around fueling area	Paved/Concrete	Yes			Yes	Yes	0	5	5	0	Low	0	Yes	Yes	minimal landscaping
MW-18	dumpster immediately uphill from drainage swale	Yes	1970s	Clean	Yes	1970s	Clean		Paved/Concrete	Yes	No	downspouts to parking lot	No	No									
MW-19		Yes	1970s	Clean	Yes	1970s	Clean	pot holes	Paved/Concrete	Yes	No	half of downspouts to parking lot, half to pervious	No	Yes	5	50	0	0	Low	0	No	No	minimal landscaping
MW-20		Yes	1970s	Clean	Yes	1970s	Clean	good condition	Paved/Concrete	Yes	No	downspouts to parking lot	No	No									
MW-21	dumpster uphill from SWM wetland	Yes	2000s	Clean	Yes	2000s	Clean	good condition	Paved/Concrete	Yes	No	downspouts to parking lot	Yes	Yes	0	5	10	0	Low	0	Yes	Yes	minimal landscaping
MW-22	inlet at dumpsters	Yes	1980s	Clean	No	1980s	Clean	clean	Paved/Concrete	No	Yes	no downspouts apparent	No	Yes	10	40	5	5	High	0	Yes	Yes	fields- high turf management

Site ID	MS4	SWM Practices	SWM Practices	Private SD	Gutter Sediment	Gutter Organics	Gutter Litter	Catch Basin Inspected	Basin ID	Inlet Condition	Hotspot Status	Potential Action	Notes
MW-1	No	Unknown	Unknown	Unknown							Potential	Schedule a review of storm water pollution prevention plan, clean up storage	unable to fully assess area due to fence
MW-2	Yes	Yes	underground storage	Yes	2	4	1	No			Potential	Schedule a review of storm water pollution prevention plan	
MW-3	Yes	No		Yes	2	2	0	No			Potential	Schedule a review of storm water pollution prevention plan	
MW-4	Yes	Yes	2 infiltration basins receiving sheet flow from parking lot- front and back	No				No			Potential	Schedule a review of storm water pollution prevention plan, clean up dumpster, put lid on	
MW-5	Yes	No		Yes	4	1	5	No			Potential	Inlet cleaning, cleaning paved areas around fueling station, lot repair, sweeping gravel/sediment	
MW-6											Not a Hotspot		not currently open- did not assess- no current issues
MW-7	No										Potential	Schedule a review of storm water pollution prevention plan	Could not access due to fence- check outdoor storage/ fueling area
MW-8	Yes	Yes	Two infiltration practices capturing back parking lot; front parking lot possibly crosses street to pond	Yes	3	3	2	No			Confirmed	Cleaner car practices to prevent staining; clean up dumpsters, get lids	
MW-9	No										Potential	Storage cleanup, very messy	
MW-11	Yes	Yes	wetland/wet pond treating front half of parking lot, wet pond treating remaining	Yes	3	3	4	No			Potential	Cleaning inlets, litter in parking lot drains, seeding bare spots in grass, street sweeping	
MW-12	No										Not a	Schedule a review of storm water pollution prevention plan	no stormwater management plan
MW-13	Yes	Yes	parking lot unintentionally drains to BMP behind EZ Storage	No	4	1	1	No			Potential	Schedule a review of storm water pollution prevention plan, repair car cleaning area drains so it doesn't drain over parking lot	
MW-14	Yes	No		Yes	2	2	0	No			Potential	Schedule a review of storm water pollution prevention plan	no stormwater management plan
MW-15	Yes	No		Yes	3	3	3	No			Potential	Schedule a review of storm water pollution prevention plan	no stormwater management plan, clean trash and sediment, and organics from parking and inlets, dumpster lids
MW-16	No	No		No							Potential	Schedule a review of storm water pollution prevention plan, install stormwater managemant in medium	
MW-17	Yes	Yes	infiltration with vegetation treating most of the parking lot	Yes	1	1	1	No			Potential	Staining of pavement	
MW-18	Yes	No		Yes	2	5	2	No			Potential	Schedule a review of storm water pollution prevention plan	install stormwater management, property all pervious
MW-19	Yes	No	no inlets, drains to road downhill to inlet at Grinder's	No				No			Not a Hotspot	Schedule a review of storm water pollution prevention plan	install stormwater management, property all pervious
MW-20	No	No		No							Potential	pavement removal, add stormwater management, check outdoor storage area	
MW-21	Yes	Yes	wetland, sheet flow from parking lot	No				No			Potential	clean up source from black stains coming from back of building, retrofit swale	
MW-22	Yes	Yes	property draining to large wet pond	Yes	3	2	2	No			Potential	rain gardens, conservation landscaping, tree plantings	

APPENDIX C – STREAM CORRIDOR ASSESSMENT DATA

Inadequate Buffer

SUBWATERSHED	SITE ID	FIELD DATE	PHOTO	BANK	UNSHADED	WIDTH LEFT	WIDTH RIGHT	LENGTH LEFT	LENGTH RIGHT	LAND USE LEFT	LAND USE RIGHT	RECENTLY ESTABLISHED	LIVESTOCK	SEVERITY	CORRECTABILITY	ACCESS	WETLAND
Mattawoman	001_IB001	4/21/2015	MW_R001_IB001.jpg	Both	Both	0	0	51	51	OTHER	OTHER	NO	NO	5	5	4	2
Mattawoman	001_IB002	4/21/2015	MW_R001_IB002.jpg	Both	Both	0	0	64	191	LAWN	LAWN	NO	NO	4	2	2	3
Mattawoman	001_IB003	4/21/2015	MW_R001_IB003.jpg	Both	Both	0	0	925	925	LAWN	LAWN	NO	NO	3	2	2	5
Mattawoman	001_IB004	4/21/2015	MW_R001_IB004.jpg	Both	Neither	25	10	373	373	LAWN	LAWN	NO	NO	4	2	2	5
Mattawoman	002_IB001	4/21/2015	MW_R002_IB001.jpg	Right	Neither	>50	20	0	486	FOREST	CROP FIELD	NO	NO	4	2	2	3
Mattawoman	002_IB002	4/21/2015	MW_R002_IB002.jpg, MW_R002_IB002_2.jpg	Both	Both	5	5	314	314	LAWN	CROP FIELD	NO	NO	3	2	2	3
Mattawoman	002_IB003	4/21/2015	MW_R002_IB003.jpg, MW_R002_IB003_2.jpg	Both	Neither	25	20	920	920	LAWN	OTHER	NO	NO	4	2	2	2
Mattawoman	003_IB001	4/21/2015	MW_R003_IB001.jpg, MW_R003_IB001_2.jpg	Left	Neither	40	>50	672	0	OTHER	FOREST	NO	NO	4	3	2	4
Mattawoman	003_IB002	4/21/2015	MW_R003_IB002.jpg, MW_R003_IB002_2.jpg	Both	Neither	10	10	272	272	LAWN	PAVED	NO	NO	2	4	1	5
Mattawoman	003_IB003	4/21/2015	MW_R003_IB003.jpg	Both	Both	5	15	65	65	OTHER	LAWN	YES	NO	4	2	2	2
Mattawoman	003_IB004	4/21/2015	MW_R003_IB004.jpg, MW_R003_IB004_2.jpg	Both	Neither	15	15	602	602	PAVED	LAWN	NO	NO	3	3	1	2
Mattawoman	003_IB005	4/21/2015	MW_R003_IB005.jpg	Both	Both	0	0	137	137	LAWN	LAWN	NO	NO	3	3	1	4
Mattawoman	004_IB001	4/23/2015	MW_R004_IB001.jpg	Left	No	10	100	952	0	SEWER EASEMENT	FOREST	NO	NO	3	4	3	1
Mattawoman	004_IB002	4/23/2015	MW_R004_IB002.jpg	Both	Yes	45	10	1723	1723	RESIDENTIAL	SEWER EASEMENT	NO	NO	2	4	3	1
Mattawoman	004_IB003	4/23/2015	MW_R004_IB003.jpg	Left	No	10	50	199	0	RESIDENTIAL	FOREST	NO	NO	4	5	2	4
Mattawoman	004_IB004	4/23/2015	MW_R004_IB004.jpg	Left	No	20	50	302	0	SEWER EASEMENT	FOREST	NO	NO	3	5	4	2
Mattawoman	004_IB005	4/23/2015	MW_R004_IB005.jpg	Left	No	20	50	302	0	SEWER EASEMENT, SOME RECENT TREE PLANTING	FOREST	YES	NO	4	5	3	4
Mattawoman	004_IB006	4/23/2015	MW_R004_IB006.jpg	Left	Neither	20	50	477	0	SEWER EASEMENT	FOREST	NO	NO	4	5	3	5
Mattawoman	004_IB007	4/23/2015	MW_R004_IB007.jpg	Left	Neither	10	50	185	0	FOREST	SEWER	NO	NO	4	5	3	3
Mattawoman	004_IB008	4/23/2015	MW_R004_IB008_1.jpg, MW_R004_IB00_2.jpg	Both	Neither	30	30	630	630	SEWER/ FOREST	RESIDENTIAL	NO	NO	4	3	3	4
Mattawoman	004_IB009	4/23/2015	MW_R004_IB009.jpg	Both	Neither	10	45	731	203	SEWER	FOREST	NO	NO	3	4	4	3
Mattawoman	005_IB001	4/24/2015	MW_R005_IB001_1.jpg, MW_R005_IB001_2.jpg	Both	Neither	30	25	2549	2549	RESIDENTIAL	RESIDENTIAL	NO	NO	3	4	2	3
Mattawoman	005_IB002	4/24/2015	MW_R005_IB002.jpg	Both	Neither	50	5	96	128	FOREST	CONSTRUCTION/ RESIDENTIAL	NO	NO	3	2	2	4

SCA Scoring: Severity (1 = Most Severe, 5 = Minor); Correctability (1 = Minor/Easy, 5 = Major/Difficult); Accessibility (1 = Easily Accessible, 5 = Difficult to Access)

Channel Alteration

SUBWATERSHED	SITE ID	FIELD DATE	PHOTO	TYPE	BOTTOM WIDTH	LENGTH (FT)	PERENNIAL	SEDIMENTATION	VEG IN CHANNEL	ROAD CROSSING	LENGTH (FT)	SEVERITY	CORRECTABILITY	ACCESS
Mattawoman	001_CA002	4/21/2015	MW_R001_CA002.jpg	RIP RAP	72	450	YES	NO	NO	ABOVE	561	3	4	2
Mattawoman	004_CA002	4/23/2015	MW_R004_CA002.jpg	CONCRETE	10	15	YES	NO	NO	YES	30	3	2	1
Mattawoman	004_CA009	4/23/2015	MW_R004_CA009.jpg	ROAD CROSSING	10	40	YES	NO	NO	YES	71	3	5	2
Mattawoman	004_CA011	4/23/2015	MW_R004_CA011.jpg	ROAD CROSSING	100	60	YES	NO	NO	YES	101	3	5	1
Mattawoman	004_CA007	4/23/2015	MW_R004_CA007.jpg	RIP RAP	6	12	YES	NO	NO	NO	19	4	5	3
Mattawoman	004_CA010	4/23/2015	MW_R004_CA010.jpg	RIP RAP	10	30	YES	NO	NO	NO	62	4	4	2
Mattawoman	005_CA001	4/24/2015	MW_R005_CA001.jpg	RIP RAP	7	15	YES	NO	NO	NO	29	4	5	2
Mattawoman	005_CA002	4/24/2015	MW_R005_CA002_1.jpg, MW_R005_CA002_2.jpg	ROAD CROSSING/ RIP RAP	6	200	YES	NO	NO	YES	188	4	5	2
Mattawoman	005_CA004	4/24/2015	MW-R005_CA004.jpg	ROAD CROSSING	40	200	YES	YES	NO	YES	168	4	5	2
Mattawoman	001_CA001	4/21/2015	MW_R001_CA001.jpg	RIP RAP	36	25	YES	YES	YES	NO	27	5	4	4
Mattawoman	003_CA001	4/21/2015	MW_R003_CA001.jpg	RIP RAP	48	40	YES	NO	YES	NO	46	5	2	2
Mattawoman	004_CA001	4/23/2015	MW_R004_CA001.jpg	RIP RAP	10	20	YES	NO	NO	NO	31	5	5	3
Mattawoman	004_CA003	4/23/2015	MW_R004_CA003.jpg	RIP RAP	10	50	YES	NO	NO	NO	80	5	5	3
Mattawoman	004_CA004	4/23/2015	MW_R004_CA004_1.jpg, MW_R004_CA004_2.jpg	RIP RAP	5	200	YES	NO	NO	NO	263	5	5	3
Mattawoman	004_CA005	4/23/2015	MW_R004_CA005.jpg	RIP RAP	8	50	YES	NO	NO	NO	30	5	5	2
Mattawoman	004_CA006	4/23/2015	MW_R004_CA006.jpg	ROAD CROSSING	40	100	YES	YES	NO	YES	100	5	5	1
Mattawoman	004_CA008	4/23/2015	MW_R004_CA008.jpg	RIP RAP	20	15	YES	NO	YES	NO	33	5	5	3
Mattawoman	005_CA003	4/24/2015	MW_R005_CA003.jpg	RIP RAP	4	60	YES	NO	NO	NO	68	5	4	3

SCA Scoring: Severity (1 = Most Severe, 5 = Minor); Correctability (1 = Minor/Easy, 5 = Major/Difficult); Accessibility (1 = Easily Accessible, 5 = Difficult to Access)

In Stream Construction

SUBWATERSHED	SITE ID	FIELD DATE	PHOTO	TYPE OF ACTIVITY	SEDIMENT CONTROL	STREAM LENGTH AFFECTED(FT)	COMPANY	LOCATION	SEVERITY
Mattawoman	004_IC001	4/23/2015	MW_R004_IC001.jpg	ROAD CROSSING	ADEQUATE	100	BRAWNY CONSTRUCTION	MCDANIEL RD	2

SCA Scoring: Severity (1 = Most Severe, 5 = Minor); Correctability (1 = Minor/Easy, 5 = Major/Difficult); Accessibility (1 = Easily Accessible, 5 = Difficult to Access)

Erosion Site

SUBWATERSHED	SITE ID	FIELD DATE	PHOTO	TYPE	POSSIBLE CAUSE	LENGTH LEFT (FT)	LENGTH RIGHT (FT)	HEIGHT (FT)	LAND USE LEFT	LAND USE RIGHT	INFRASTRUCE THREATENED?	SEVERITY	CORRECTABILITY	ACCESS	STREAM	TYPEDESC	CAUSEDES
Mattawoman	001_ES001	4/21/2015	MW_R001_ES001.jpg	WIDENING	BEND AT STEEP SLOPE	0	45	4	FOREST	FOREST	NO	4	4	4			
Mattawoman	001_ES002	4/21/2015	MW_R001_ES002.jpg	WIDENING	PIPE OUTFALL	7	7	4	FOREST	FOREST	NO	5	4	5			
Mattawoman	001_ES003	4/21/2015	MW_R001_ES003.jpg, MW_R001_ES003_2.jpg	WIDENING	LAND USE CHANGE UPSTREAM	204	51	3	FOREST	FOREST	NO	4	3	5			
Mattawoman	001_ES004	4/21/2015	MW_R001_ES004.jpg	WIDENING	BEND AT STEEP SLOPE	41	41	5	FOREST	FOREST	NO	3	4	4			
Mattawoman	001_ES005	4/21/2015	MW_R001_ES005.jpg, MW_R001_ES005_2.jpg	WIDENING	BELOW ROAD CROSSING	447	0	4	FOREST	FOREST	NO	3	4	3			
Mattawoman	001_ES006	4/21/2015	MW_R001_ES006.jpg	HEADCUTTING	LAND USE CHANGE UPSTREAM	12	12	3	FOREST	FOREST	NO	3	3	3			
Mattawoman	004_ES001	4/23/2015	MW_R004_ES001.jpg	WIDENING	LAND USE CHANGE UPSTREAM	84	0	2	RESIDENTIAL	FORESTED WETLAND	NO	5	3	4			
Mattawoman	004_ES002	4/23/2015	MW_R004_ES002_1.jpg, MW_R004_ES002_2.jpg	WIDENING	LAND USE CHANGE UPSTREAM	241	241	1	RESIDENTIAL	FOREST/ SEWER EASEMENT	NO	4	4	4			
Mattawoman	004_ES003	4/23/2015	MW_R004_ES003.jpg	WIDENING	LAND USE CHANGE UPSTREAM	89	0	8	SEWER EASEMENT/ FOREST	RESIDENTIAL	NO	3	4	2			
Mattawoman	004_ES004	4/23/2015	MW_R004_ES004.jpg	WIDENING	LAND USE CHANGE UPSTREAM	0	128	2	RESIDENTIAL	FOREST	NO	4	4	4			
Mattawoman	004_ES005	4/23/2015	MW_R004_ES005.jpg	WIDENING	LAND USE CHANGE UPSTREAM	74	74	2	WETLAND	WETLAND	NO	4	4	4			
Mattawoman	004_ES006	4/23/2015	MW_R004_ES006.jpg	WIDENING	LAND USE CHANGE UPSTREAM	693	693	2	SEWER EASEMENT/FOREST	FOREST	NO	3	3	3			
Mattawoman	004_ES007	4/23/2015	MW_R004_ES007.jpg	WIDENING	LAND USE CHANGE UPSTREAM	81	81	3	FOREST	FOREST	NO	4	4	4			
Mattawoman	004_ES008	4/23/2015	MW_R004_ES008_1.jpg, MW_R004_ES008_2.jpg	WIDENING	LAND USE CHANGE UPSTREAM	475	475	2	FOREST/SEWER EASEMENT	RESIDENTIAL	NO	4	4	4			
Mattawoman	004_ES009	4/23/2015	MW_R004_ES009.jpg	WIDENING	LAND USE CHANGE UPSTREAM	48	65	3	SEWER EASEMENT	FOREST	NO	3	3	2			
Mattawoman	004_ES010	4/23/2015	MW_R004_ES010.jpg	WIDENING	LAND USE CHANGE UPSTREAM	40	40	4	FOREST	FOREST	NO	4	4	5			
Mattawoman	005_ES001	4/24/2015	MW_R005_ES001.jpg	WIDENING	LAND USE CHANGE UPSTREAM	41	41	1	RESIDENTIAL	RESIDENTIAL	NO	5	5	3			
Mattawoman	005_ES002	4/24/2015	MW_R005_ES002_1.jpg, MW_R005_ES002_2.jpg	WIDENING	LAND USE CHANGE UPSTREAM	255	255	1	RESIDENTIAL	RESIDENTIAL	NO	4	4	3			
Mattawoman	005_ES003	4/24/2015	MW_R005_ES003_1.jpg, MW_R005_ES003_2.jpg	WIDENING	LAND USE CHANGE UPSTREAM	1084	1084	4	FOREST	FOREST	NO	2	3	3			
Mattawoman	005_ES004	4/24/2015	MW_R005_ES004.jpg	DOWNCUTTING	BMP POND DISCHARGE	0	76	2	FOREST	FOREST	NO	3	2	3			

SCA Scoring: Severity (1 = Most Severe, 5 = Minor); Correctability (1 = Minor/Easy, 5 = Major/Difficult); Accessibility (1 = Easily Accessible, 5 = Difficult to Access)

Fish Barrier

SUBWATERSHED	SITE ID	FIELD DATE	PHOTO	BLOCKAGE	TYPE	REASON	WATER DROP (IN)	WATER DEPTH (IN)	SEVERITY	CORRECTABILITY	ACCESS
Mattawoman	004_FB001	4/23/2015	MW_R004_FB001.jpg	TOTAL	BEAVER DAM	TOO HIGH	36	0	3	2	3

SCA Scoring: Severity (1 = Most Severe, 5 = Minor); Correctability (1 = Minor/Easy, 5 = Major/Difficult); Accessibility (1 = Easily Accessible, 5 = Difficult to Access)

Pipe Outfall

SUBWATERSHED	REACH	SITE	SITE ID	FIELD DATE	PHOTO	OUTFALL TYPE	PIPE TYPE	LOCATION OF PIPE	DIAMETER (IN)	CHANNEL WIDTH (FT)	DISCHARGE	COLOR	ODOR	SEVERITY	CORRECTABILITY	ACCESS
Mattawoman	005	PO003	005_PO003	4/24/2015	MW_R005_PO003.jpg	STORMWATER	Corrugated Metal	Right Bank	24	0	YES	Clear	None	2	3	1
Mattawoman	004	PO007	004_PO007	4/23/2015	MW_R004_PO007_1.jpg, MW_R004_PO007_2.jpg	BRIDGE DECK DRAINS	Plastic	Both	8	0	NO			3	5	1
Mattawoman	005	PO002	005_PO002	4/24/2015	MW_R005_PO002.jpg	STORMWATER	Concrete Pipe	Left Bank	18	5	YES	Orange Iron	None	3	2	2
Mattawoman	001	PO007	001_PO007	4/21/2015	MW_R001_PO007.jpg	STORMWATER	Concrete Pipe	Head of Stream	30	0	Yes	Medium brown	None	4	4	2
Mattawoman	002	PO002	002_PO002	4/21/2015	MW_R002_PO002.jpg	STORMWATER	Other	Right Bank	12	0	Yes	Medium brown	None	4	5	3
Mattawoman	003	PO001	003_PO001	4/21/2015	MW_R003_PO001.jpg	STORMWATER	Corrugated Metal	Right Bank	24	0	Yes	Clear	None	4	4	2
Mattawoman	003	PO002	003_PO002	4/21/2015	MW_R003_PO002.jpg	STORMWATER	Concrete Pipe	Head of Stream	24	0	Yes	Clear	None	4	4	2
Mattawoman	003	PO003	003_PO003	4/21/2015	MW_R003_PO003.jpg	STORMWATER	Concrete Pipe	Head of Stream	24	0	Yes	Clear	None	4	5	2
Mattawoman	003	PO005	003_PO005	4/21/2015	MW_R003_PO005.jpg	STORMWATER	Concrete Pipe	Left Bank	30	0	Yes	Clear	None	4	5	1
Mattawoman	003	PO006	003_PO006	4/21/2015	MW_R003_PO006.jpg	STORMWATER	Concrete Pipe	Right Bank	18	0	Yes	Clear	None	4	4	2
Mattawoman	004	PO003	004_PO003	4/23/2015	MW_R004_PO003.jpg	STORMWATER	Corrugated Metal	Right Bank	18	0	YES	Clear	None	4	5	2
Mattawoman	004	PO004	004_PO004	4/23/2015	MW_R004_PO004.jpg	STORMWATER MANAGEMENT POND	Corrugated Metal	Right Bank	36	5	YES	Clear	None	4	5	3
Mattawoman	004	PO008	004_PO008	4/23/2015	MW_R004_PO008.jpg	STORMWATER	Concrete Pipe	Left Bank	30	6	NO			4	5	2
Mattawoman	005	PO001	005_PO001	4/24/2015	MW_R005_PO001.jpg	STORMWATER	Concrete Pipe	Left Bank	18	6	YES	Clear	None	4	4	2
Mattawoman	005	PO004	005_PO004	4/24/2015	MW_R005_PO004.jpg	TRIB	Corrugated Metal	Right Bank	48	2	YES	Clear	None	4	4	2
Mattawoman	001	PO001	001_PO001	4/21/2015	MW_R001_PO001.jpg	STORMWATER	Plastic	Left Bank	6	0	Yes	Clear	None	5	5	2
Mattawoman	001	PO002	001_PO002	4/21/2015	MW_R001_PO002.jpg	STORMWATER	Other	Left Bank	0	0	Yes	Clear	None	5	5	5
Mattawoman	001	PO003	001_PO003	4/21/2015	MW_R001_PO003.jpg	STORMWATER	Corrugated Metal	Right Bank	12	0	No			5	5	5
Mattawoman	001	PO004	001_PO004	4/21/2015	MW_R001_PO004.jpg	STORMWATER	Corrugated Metal	Right Bank	15	0	Yes	Clear	None	5	5	4
Mattawoman	001	PO005	001_PO005	4/21/2015	MW_R001_PO005.jpg	STORMWATER	Concrete Pipe	Left Bank	21	0	Yes	Clear	None	5	5	4
Mattawoman	001	PO006	001_PO006	4/21/2015	MW_R001_PO006.jpg	STORMWATER	Concrete Pipe	Right Bank	18	0	Yes	Clear	None	5	4	2
Mattawoman	002	PO001	002_PO001	4/21/2015	MW_R002_PO001.jpg	STORMWATER	Other	Left Bank	12	0	Yes	Clear	None	5	5	3
Mattawoman	003	PO004	003_PO004	4/21/2015	MW_R003_PO004.jpg	STORMWATER	Concrete Pipe	Left Bank	24	0	No			5	5	2
Mattawoman	004	PO001	004_PO001	4/23/2015	MW_R004_PO001.jpg	STORMWATER	Concrete Pipe	Right Bank	15	5	YES	Clear	None	5	5	2
Mattawoman	004	PO002	004_PO002	4/23/2015	MW_R004_PO002.jpg	STORMWATER	Concrete Pipe	Right Bank	18	4	YES	Clear	None	5	5	3
Mattawoman	004	PO005	004_PO005	4/23/2015	MW_R004_PO005.jpg	WEIR/UNDERDRAIN	Plastic	Right Bank	6	10	NO			5	5	3
Mattawoman	004	PO006	004_PO006	4/23/2015	MW_R004_PO006.jpg	WEIR/ UNDERDRAIN	Plastic	Right Bank	6	10	NO			5	5	3

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Potential BMP

SUBWATERSHED	SITE ID	FIELD DATE	PHOTO	BMP TYPE 1	BMP TYPE 2	COMMENTS
Mattawoman	001_PB001	4/21/2015	MW_R001_PB001.jpg, MW_R001_PB001_2.jpg	OUTFALL STABILIZATION		HEADCUTS FORMING FROM PIPE OUTFALL
Mattawoman	003_PB001	4/21/2015	MW_R003_PB001.jpg	RIPARIAN BUFFER ENHANCEMENT	WETLAND RESTORATION	WETLAND ENHANCEMENT
Mattawoman	004_PB001	4/23/2015	MW_R004_PB001.jpg	STREAM RESTORATION		STREAM RESTORATION ON UNMAPPED TRIB TO PINEY BRANCH, DOWNCUTTING AND WIDENING, 4 FT DOWNCUT, MAJOR EROSION
Mattawoman	004_PB002	4/24/2015	MW_R005_PB002.jpg	BIORETENTION/RAIN GARDEN		WILL RESOLVE EROSION PROBLEMS FROM PIPE AND RUNOFF, PAVEMENT REMOVAL REQUIRED, BUT SPACE EXISTS FOR BMP
Mattawoman	005_PB001	4/24/2015	MW_R005_PB001.jpg	OUTFALL STABILIZATION	SPSC	HEADCUT/ EROSION ON OUTFALL CHANNEL, CHANNEL ABOUT 60 FEET FROM OUTDALL TO MAIN CHANNEL, CROSSES SEWER LINE
Mattawoman	005_PB003	4/24/2015	MW_R005_PB003.jpg	OUTFALL STABILIZATION	POND RETROFIT	
Mattawoman	005_PB004	4/24/2015	MW_R005_PB004.jpg	STREAM RESTORATION		

Representative Site

SUBWATERSHED	SITE ID	FIELD DATE	PHOTO	SUBSTRATE	EMBEDDEDNESS	SHELTER FOR FISH	CHANNEL ALTERATION	SEDIMENT DEPOSITION	VELOCITY DEPTH	FLOW	VEGETATION	BANK CONDITION	RIPARIAN VEGETATION	RIFFLE WIDTH (IN)	RUN WIDTH (IN)	POOL WIDTH (IN)	RIFFLE DEPTH (IN)	RUN DEPTH (IN)	POOL DEPTH (IN)	BOTTOM TYPE
Mattawoman	001_RE001	4/21/2015	MW_R001_RE001.jpg	Suboptimal	Suboptimal	Suboptimal	Optimal	Marginal	Suboptimal	Optimal	Optimal	Suboptimal	Optimal	60	60	60	2	6	18	GRAVEL
Mattawoman	002_RE001	4/21/2015	MW_R002_RE001.jpg	Marginal	Marginal	Suboptimal	Optimal	Suboptimal	Suboptimal	Optimal	Marginal	Optimal	Suboptimal	36	36	36	2	6	15	GRAVEL
Mattawoman	002_RE002	4/21/2015	MW_R002_RE002.jpg	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal	Marginal	36	36	36	6	12	18	GRAVEL
Mattawoman	003_RE001	4/21/2015	MW_R003_RE001.jpg	Marginal	Marginal	Suboptimal	Optimal	Marginal	Suboptimal	Optimal	Suboptimal	Optimal	Suboptimal	48	48	48	4	6	15	SAND
Mattawoman	004_RE001	4/23/2015	MW_R004_RE001.jpg	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	96	96	120	3	5	24	GRAVEL
Mattawoman	004_RE002	4/23/2015	MW-R004_RE002.jpg	Suboptimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Optimal	84	84	120	4	6	36	GRAVEL
Mattawoman	005_RE001	4/24/2015	MW_R005_RE001_US.jpg, MW_R005_RE001_DS.jpg	Suboptimal	Suboptimal	Suboptimal	Optimal	Poor	Suboptimal	Marginal	Marginal	Marginal	Suboptimal	48	48	96	2	4	12	GRAVEL
Mattawoman	005_RE002	4/24/2015	MW_R005_RE002_US.jpg, MW_R005_RE002_DS.jpg	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Suboptimal	Marginal	60	72	120	1	3	12	GRAVEL

Habitat Assessment Rankings (in order from worst to best condition) - Poor, Marginal, Suboptimal, Optimal

Trash Dumping

SUBWATERSHED	SITE ID	FIELD DATE	PHOTO	TYPE	TYPE DESCRIPTION	TRUCKLOADS	EXTENT	VOLUNTEER PROJECT?	OWNER TYPE	SEVERITY	CORRECTABILITY	ACCESS
Mattawoman	003_TD002	4/21/2015	MW_R003_TD002.jpg	COMMERCIAL	SCRAP WOOD AND PALLETS	10	SINGLE SITE	Yes	PRIVATE	2	3	3
Mattawoman	002_TD001	4/21/2015	MW_R002_TD001.jpg	RESIDENTIAL	RUSTY METAL	6	SINGLE SITE	No	PRIVATE	3	3	1
Mattawoman	003_TD001	4/21/2015	MW_R003_TD001.jpg	RESIDENTIAL		2	SINGLE SITE	Yes	COUNTY	3	2	2
Mattawoman	005_TD002	4/24/2015	MW_R005_TD002.jpg	RANDOM TRASH		1	SMALL LOCALIZED	YES	HOA	3	2	1
Mattawoman	002_TD002	4/21/2015	MW_R002_TD002.jpg	RESIDENTIAL	RUSTY METAL	2	SINGLE SITE	Yes	PRIVATE	4	2	3
Mattawoman	004_TD001	4/23/2015	MW_R004_TD001.jpg	BOTTLES	BOTTLES WASHED UP ON FLOODPLAIN	1	SMALL LOCALIZED	YES	HOA	4	1	3
Mattawoman	005_TD001	4/24/2015	MW_R005_TD001.jpg	METAL	OLD METAL PIECES, ASSORTED TRASH	3	ISOLATED PILES	NO	HOA	4	1	2

SCA Scoring: Severity (1 = Most Severe, 5 = Minor); Correctability (1 = Minor/Easy, 5 = Major/Difficult); Accessibility (1 = Easily Accessible, 5 = Difficult to Access)

Unusual Condition

SUBWATERSHED	SITE ID	PHOTO	FIELD DATE	COMMENT	SEVERITY	CORRECTABILITY	ACCESS
Mattawoman	001_UC001	MW_R001_UC001.jpg, MW_R001_UC001_2.jpg	4/21/2015	BEAVER POND	5	5	3
Mattawoman	005_UC003	MW_R005_UC003.jpg	4/24/2015	LARGE BEAVER DAM RESULTING IN LARGE POND US OF ROAD	3	4	2
Mattawoman	005_UC004	MW_R005_UC004.jpg	4/24/2015	LARGE DEBRIC JAM, CAUSING SOME BANK EROSION	3	2	4
Mattawoman	001_UC002	MW_R001_UC002.jpg	4/21/2015	OLD SILT FENCE FALLING INTO STREAM	4	2	2
Mattawoman	002_UC003	MW_R002_UC003.jpg	4/21/2015	BEAVER DAM	4	2	3
Mattawoman	003_UC001	MW_R003_UC001.jpg	4/21/2015	BEAVER DAM	4	2	2
Mattawoman	004_UC002	MW_R004_UC002.jpg	4/23/2015	BEAVER DAM	4	3	3
Mattawoman	004_UC003	MW_R004_UC003.jpg	4/23/2015	DEBRIS BLOCKAGE, CAUSING BANK EROSION	4	4	2
Mattawoman	005_UC001	MW_R005_UC001_1.jpg, MW_R005_UC001_2.jpg	4/24/2015	LARGE EXPOSED SECTION OF STORM DRAIN PIPE- REMOVE PIPE	4	3	2
Mattawoman	005_UC002	MW_R005_UC002.jpg	4/24/2015	BEAVER DAM	4	5	3
Mattawoman	002_UC001	MW_R002_UC001.jpg	4/21/2015	LARGE BEAVER POND	5	5	3
Mattawoman	002_UC002	MW_R002_UC002.jpg	4/21/2015	WASHED OUT OLD ROAD CROSSING, CULVERT REMAINING	5	3	4
Mattawoman	004_UC001	MW_R004_UC001.jpg	4/23/2015	BEAVER DAM	5	5	3

SCA Scoring: Severity (1 = Most Severe, 5 = Minor); Correctability (1 = Minor/Easy, 5 = Major/Difficult); Accessibility (1 = Easily Accessible, 5 = Difficult to Access)

APPENDIX D – PRIORITIZATION METHODS

Project Prioritization Methods

To support County environmental manager's resource allocation decision making process, a prioritization was developed for the Mattawoman Creek subwatershed projects identified in this report. The results indicate which projects are the most beneficial and cost effective relative to the set of projects identified.

The prioritization involved a matrix made up of a series of parameters, or metrics, which evaluated each proposed project and allowed for discrimination between the projects. Each metric was scored for each project, either qualitatively or quantitatively as appropriate. Weighting factors were applied to metrics that were deemed the most critical, and the sum of the weighted scores determined the highest priority projects to implement.

The approach included scoring and ranking of the project benefits, constraints and costs. Including factors of feasibility and cost is necessary because the potential exists for the most beneficial project to also be relatively less feasible. It might be the most expensive project, have limited access, utility conflicts, or require disturbance to natural resources.

The following describes the methods used.

Metric Evaluation

The prioritization uses a series of metrics, or indicators, that describe various attributes of a project. A series of candidate metrics was developed for each of the three categories: Benefits, Constraints, and Cost. Metrics evaluated by the project team are listed in Table 1 with a brief description of each.

Table 1: Candidate Prioritization Metrics

Metric	Description
Project Benefits	
Quantity Control	Level of quantity control (cfs/ac)
Water Quality Treatment	Rainfall Depth Treated (in)
Pollutant Removal	TN, TP, and TSS removed (lb) based on modeling
Groundwater Recharge	Amount of recharge based on level of expected infiltration
Channel Protection	Based on proposed level of quantity control and downstream stability
Channel Stabilization	Level of channel stabilization provided will be dependent on channel condition and type of project
Water/Stream Temperature	Does project reduce receiving water temperature?
Instream Habitat Improvement	Does project provide or improve instream habitat?
Riparian Habitat Improvement	Does project provide or improve riparian habitat?
Wetland Habitat Improvement	Does project provide or improve wetland habitat?
Fish Passage	Does project reduce or eliminate barriers to fish passage?
Public Visibility/Education/Outreach	Is project in close proximity to public places?
Community Aesthetic Improvement	Does the project improve community appearance?
Public Safety Improvement	Is there a public safety issue that is addressed by the project?
Combined Benefit	Are there multiple projects in close proximity that together provide a larger cumulative benefit?
Impervious Area Treated	Area of impervious surface treated (acres)
Proximity to MS4	Does the project receive MS4 drainage?
Project Constraints	

Metric	Description
Access	Are there constraints to access – mature trees, infrastructure, steep slopes?
Permitting	Are there significant permitting issues – wetland/forest disturbance?
Maintenance Requirements	What is the level of maintenance involved – frequency, expense, equipment?
Ownership	Is ownership of the parcels involved held publicly or privately? Are private owners cooperative?
Adjacent Land Use	Are adjacent properties compatible with the type of potential project?
Design/Construction	Do the site layout, topography, elevations allow for a design that maximizes benefit and is constructible?
Public Safety	Does the project create a public safety hazard?
Existing Utility Conflicts	Are there existing underground or overhear utilities conflicting with the design? Are the private or public?
Fish Passage	Does the project introduce or make worse a barrier to fish passage?
Project Cost	
Total Life Cycle Cost	Total life cycle cost of the project
Cost per Impervious Area Treated	Total cost of the project divided by the impervious area treated, dollars per acre
Cost per Pollutant Removed	Total cost of the project divided by the amount of pollutant removed, dollars per lb of TP, TN, TSS

Candidate metrics were evaluated for inclusion based on the following attributes:

Duplication. Selected metrics are not duplicative of one another. Results of the prioritization can be skewed if two or more metrics are evaluating very similar project factors.

Project Goals and Objectives. Selected metrics are linked to the overall project goal and objectives. The primary goals of the current projects are to maximize impervious surface treatment and pollutant removal, therefore metrics linked to those goals would be important to include. Secondary goals include items such as habitat improvement and stream channel protection. The linkage to project goals is also accounted for in the metric weighting which is described below.

Relative Management Importance. The suite of candidate metrics was evaluated by County resource managers to determine the factors that were most important to them. To evaluate the suite, a pairwise comparison was used. Results of the comparison were also used to derive the metric weights.

Each metric was analyzed by the project team by comparing pairs of metrics to evaluate which has greater importance. The project team included representatives from Charles County Department of Planning and Growth Management. Each metric is evaluated individually against all of the other metrics and the evaluator selects one by one, which metric has greater importance. The results are tabulated for each metric category (benefits, constraints, costs). Metrics with the greatest number of selections represent those that were felt overall to be the most important. Results are presented in Figures 1-3.

Figure 1: Project Benefits Metric

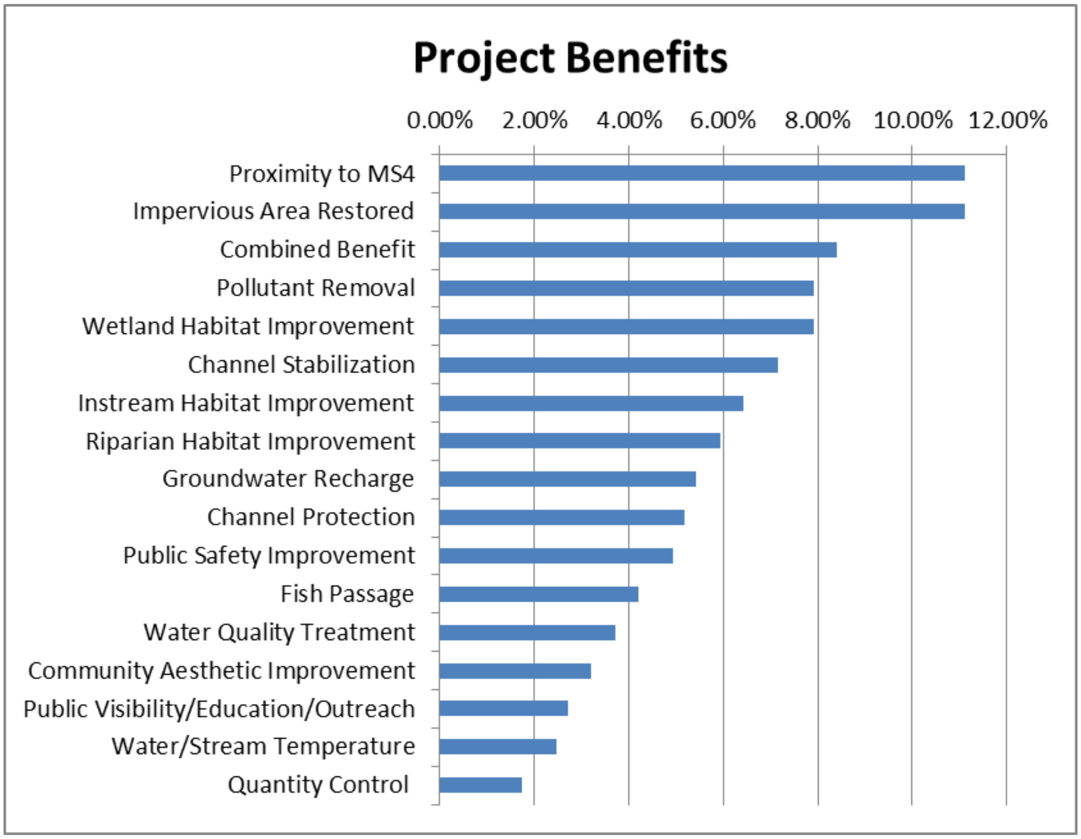


Figure 2: Project Constraints Metric Weights

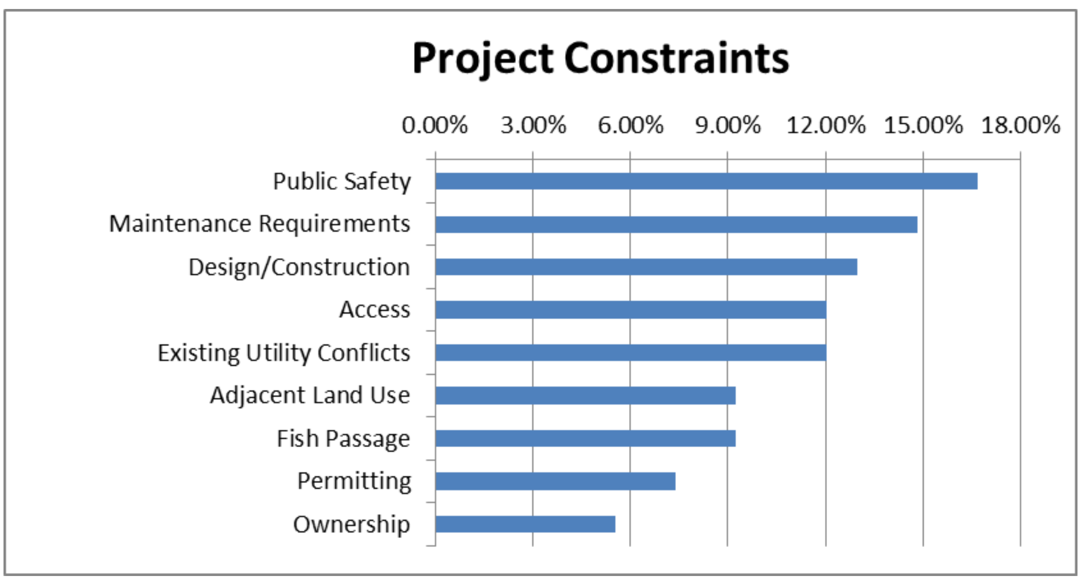
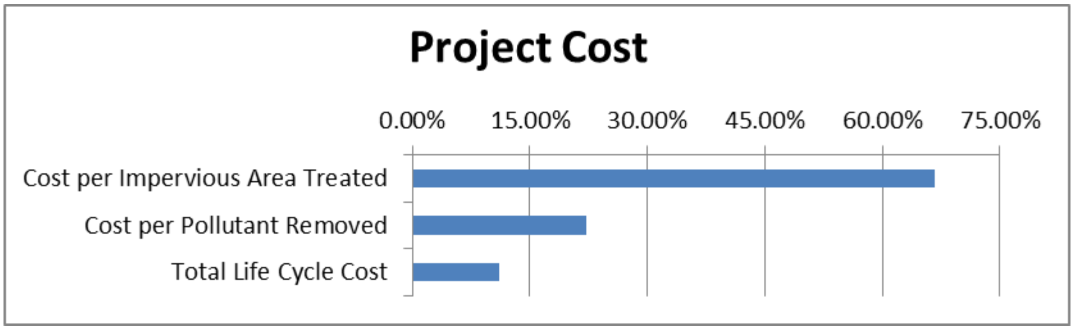


Figure 3: Project Cost Metric Weights



Metric Selection Results

Based on the evaluation described above, a final list of selected metrics was derived. Selected metrics are listed below in order of importance by category. Two constraint metrics (fish passage and public safety) and two benefits metrics (quantity control and public safety improvement) were not used due to their lack of discrimination potential between projects.

Project benefit:

- proximity to MS4
- impervious area treated
- combined benefit
- pollutant removal
- wetland habitat improvement
- channel stabilization
- instream habitat improvement
- riparian habitat improvement
- groundwater recharge
- channel protection
- fish passage
- water quality treatment
- community aesthetics improvement
- public visibility/education/outreach
- water/stream temperature

Project constraint:

- maintenance requirements
- design/construction
- access
- existing utility conflicts
- adjacent land use
- permitting
- ownership

Project cost:

- cost per impervious acre treated
- cost per pollutant removed
- total life cycle cost

Metric Weighting Factors

Weighting factors were developed and applied to allow resource managers to impart the relative importance of the selected metrics into the prioritization. For example, if pollutant load reduction is far more critical in selection versus impervious surface treatment, then it would be more highly weighted. Weights were developed within each of the three categories (benefit, constraints, and cost). Results of the pairwise comparison were totaled and the proportion of the result for each metric of the total was used as the final weight (Table 2).

Table 2: Weighting Factor Results

Metric	Final Weight
Proximity to MS4	11.17%
Impervious Area Restored	11.17%
Combined Benefit	8.44%
Pollutant Removal	7.94%
Wetland Habitat Improvement	7.94%
Channel Stabilization	7.20%
Instream Habitat Improvement	6.45%
Riparian Habitat Improvement	5.96%
Groundwater Recharge	5.46%
Channel Protection	5.21%
Public Safety Improvement	4.96%
Fish Passage	4.22%
Water Quality Treatment	3.72%
Community Aesthetic Improvement	3.23%
Public Visibility/Education/Outreach	2.73%
Water/Stream Temperature	2.48%
Quantity Control	1.74%
Total	100%
Public Safety	16.67%
Maintenance Requirements	14.81%
Design/Construction	12.96%
Access	12.04%

Metric	Final Weight
Existing Utility Conflicts	12.04%
Adjacent Land Use	9.26%
Fish Passage	9.26%
Permitting	7.41%
Ownership	5.56%
Total	100%
Cost per Impervious Area Treated	66.67%
Cost per Pollutant Removed	22.22%
Total Life Cycle Cost	11.11%
Total	100%

Scoring

Quantitative metrics were scored based on results of the preliminary design and cost estimates (e.g. impervious area treated, pollutant removal). Other metrics were scored more qualitatively based on professional judgment and assessment of each project site (e.g. access constraints, public visibility/education/outreach).

Each project was assigned a score between 1 and 5 for each metric. Projects evaluated to have the most benefit received a score of 5, and those with the least benefit were given a score of 1. Constraints were evaluated in a similar fashion such that projects with more constraints were scored a 1, and those with the least were given a score of 5.

Project Benefits

Proximity to MS4 and impervious acres restored were both given the highest weight. Proximity to MS4 scores were determined based on the proximity of the site to MS4 drainage. Areas receiving MS4 drainage received the highest scores and projects in agricultural land use received lower scores. Impervious acres restored scores were calculated by ranking the projects by impervious acres restored and then calculating the corresponding score.

Combined benefit scores were calculated based on the number of projects within close proximity. Clustered projects received higher scores than isolated projects.

Pollutant removal scores were calculated by using the modeled total nitrogen, phosphorus, and sediment load reduction to rank each project. The ranking was then used to calculate a score for each project.

Wetland, riparian, and in-stream habitat scores were calculated based on the habitat benefit from each project. Generally, stream restoration projects received higher scores in these categories. Projects near or within wetlands got a higher wetland habitat score. Stream restoration and SPSC projects that would have tree planting associated with the project received higher scores for riparian habitat. All stream restoration projects received the highest score of 5 for in-stream habitat.

Channel stabilization was scored based on the type of project and level of increased channel stabilization anticipated. Stream restoration and SPSC projects were given scores of 5 and 4, respectively, however all other projects have no potential increased channel stability and were given scores of 1.

Groundwater recharge was calculated for the stormwater management projects and scores were calculated based on these values. No other project type would provide groundwater recharge.

The one SPSC project (MW_SWM_18) is the only project that would provide an increase in channel protection, therefore this project was given the highest score of 5, and all other projects received scores of 1.

Each project was scored according to the potential improvement to public safety that the project would achieve. No projects were found to have any associated public safety improvement aspects and all projects received a score of 1.

Projects that would address fish passage issues received higher scores for the fish passage metric. While no stream restoration site specifically had a fish passage issue identified, stream restoration projects should generally improve fish passage, therefore stream restoration projects were all given scores of 2, while all other projects received scores of 1.

Water quality treatment scores were calculated by ranking the projects by rainfall depth treated and then calculating the corresponding score.

Community aesthetic improvement scores were calculated based on the anticipated improvement of community appearance. Projects such as trash cleanups, stream restoration, and reforestation in highly visible areas received higher scores. Stormwater management projects were scored based on the project type and anticipated appearance of the facility and associated plantings.

Public visibility/education/outreach scores were calculated based on the project's proximity to public areas that could provide educational opportunities for the community.

Water/stream temperature was scored based on project type. Stream restoration projects received higher scores if tree planting would be associated with the project. All reforestation projects received the highest score of 5. Stormwater management projects generally received moderate scores with the exception of the wet ponds (MW_SWM_5, 8, 9, 12, and 16), which would provide no benefit to water temperature.

Projects were scored according to their potential for quantity control (cfs/acre). No projects were found to have associated quantity control benefits and all projects received a score of 1.

Project Constraints

Design and construction constraints, such as site layout, topography, and elevations, were analyzed for each project. Projects that were identified as having steep slopes, nearby infrastructure, or other design and construction constraints received lower scores.

The degree of maintenance required for each project was estimated. Biorentention and infiltration basin projects generally require more maintenance and received lower scores, while trash cleanups, reforestation, and stream restoration projects generally require less maintenance and received higher scores.

Existing utility conflicts were assessed and scored. Majority of the projects did not have utility conflicts, however some sites were found to have underground and overhead electric, cable or telephone lines and subsequently received lower scores in this metric.

Ease of access was analyzed for each site. The presence of paved access roads or trails, or proximity to existing roads or parking lots was considered and scored accordingly.

Permitting requirements was evaluated for each project. Stream restoration projects generally require extra permitting and received lower scores than the projects such as reforestation and trash cleanups.

Site ownership was identified and scored. Projects on private property received lower scores than those on public property.

Lastly, adjacent land use was determined and scored. Adjacent properties with land use not compatible with the project type received lower scores.

Project Costs

Project costs were calculated and ranked for each project in three categories: life cycle cost, cost per pollutant reduced, and cost per impervious area. Scores were calculated for each category and then averaged for the final project cost score.

Results

Weighting factors were applied to the scores for each metric. Total scores were then summed for each project for both the benefit and constraint categories and the projects ranked within each category. Projects were also ranked according to the cost metrics, including total project cost, cost per pollutant removed, and cost per impervious acre treated. A ranking for each metric category was assigned based on the results. The final ranking incorporates the results of the category rankings. The final prioritized lists of projects for Mattawoman Creek are presented in Table 3. Projects listed by final rank are presented in Table 4.

Table 3: Mattawoman Creek Prioritization Ranking by Project Type

Project ID	Project Type	Benefits Rank	Constraints Rank	Cost Rank	Total Score	Final Rank
MW_SR_1	Stream Restoration	4	50	40.5	95	40
MW_SR_2	Stream Restoration	5	42	47	94	38.5
MW_SR_3	Stream Restoration	3	51	42	96	41
MW_SR_4	Stream Restoration	1	47	40.5	89	33
MW_SR_5	Stream Restoration	2	46	43	91	36
MW_TP_1	Reforestation	18	22.5	14	55	9.5
MW_TP_2	Reforestation	6	41	18	65	17.5
MW_TP_3	Reforestation	11	16	13	40	3
MW_TP_4	Reforestation	36	34	24	94	38.5
MW_TP_5	Reforestation	19	25.5	27	72	22.5
MW_TP_6	Reforestation	15	14	25.5	55	9.5
MW_TP_7	Reforestation	33	18	15	66	19
MW_TP_8	Reforestation	39	7	25.5	72	22.5
MW_TP_9	Reforestation	30	7	19	56	12.5
MW_TP_10	Reforestation	25	7	17	49	5
MW_TP_11	Reforestation	50	7	8	65	17.5
MW_TP_12	Reforestation	43	7	10	60	15
MW_TP_13	Reforestation	12	17	21	50	6
MW_TP_14	Reforestation	35	7	11	53	7
MW_TP_15	Reforestation	40	7	9	56	12.5
MW_TP_16	Reforestation	10	7	22	39	2
MW_TP_17	Reforestation	32	7	16	55	11
MW_TP_18	Reforestation	27	7	12	46	4
MW_TP_19	Reforestation	24	15	28	67	20
MW_TP_20	Reforestation	21	22.5	20	64	16
MW_TP_21	Reforestation	8	7	23	38	1
MW_TC_1	Trash Cleanups	45	20	4	69	21
MW_TC_2	Trash Cleanups	51	20	4	75	25
MW_TC_3	Trash Cleanups	49	1	4	54	8
MW_TC_4	Trash Cleanups	42	13	4	59	14
MW_TC_5	Trash Cleanups	48	20	4	72	24
MW_TC_6	Trash Cleanups	47	28.5	4	79	27.5
MW_TC_7	Trash Cleanups	47	28.5	4	79	27.5
MW_BMP_1	Bioretention	41	45	49	135	50
MW_BMP_2	Bioretention	37	30.5	50	118	49
MW_BMP_3	Bioretention	44	48	48	140	51

Project ID	Project Type	Benefits Rank	Constraints Rank	Cost Rank	Total Score	Final Rank
MW_BMP_4	Bioretention	16	38	51	105	45.5
MW_BMP_5	Wet Pond	29	25.5	31	86	31
MW_BMP_6	Created Wetland	14	43	33	90	34
MW_BMP_7	Bioretention	34	30.5	34	99	43
MW_BMP_8	Wet Pond	26	36	39	101	44
MW_BMP_9	Wet Pond	38	38	38	114	48
MW_BMP_10	Created Wetland	13	33	30	76	26
MW_BMP_11	Created Wetland	9	44	35	88	32
MW_BMP_12	Wet Pond	20	32	32	84	29
MW_BMP_13	Created Wetland	31	38	36	105	45.5
MW_BMP_14	Infiltration Basin	23	40	45	108	47
MW_BMP_15	Infiltration Basin	17	35	46	98	42
MW_BMP_16	Wet Pond	28	25.5	37	91	35
MW_BMP_17	Infiltration Basin	22	25.5	44	92	37
MW_BMP_18	SPSC	7	49	29	85	30

Table 4: Mattawoman Creek Prioritization Final Ranking

Project ID	Project Type	Final Rank
MW_TP_21	Reforestation	1
MW_TP_16	Reforestation	2
MW_TP_3	Reforestation	3
MW_TP_18	Reforestation	4
MW_TP_10	Reforestation	5
MW_TP_13	Reforestation	6
MW_TP_14	Reforestation	7
MW_TC_3	Trash Cleanups	8
MW_TP_1	Reforestation	9.5
MW_TP_6	Reforestation	9.5
MW_TP_17	Reforestation	11
MW_TP_9	Reforestation	12.5
MW_TP_15	Reforestation	12.5
MW_TC_4	Trash Cleanups	14
MW_TP_12	Reforestation	15
MW_TP_20	Reforestation	16
MW_TP_2	Reforestation	17.5

Project ID	Project Type	Final Rank
MW_TP_11	Reforestation	17.5
MW_TP_7	Reforestation	19
MW_TP_19	Reforestation	20
MW_TC_1	Trash Cleanups	21
MW_TP_5	Reforestation	22.5
MW_TP_8	Reforestation	22.5
MW_TC_5	Trash Cleanups	24
MW_TC_2	Trash Cleanups	25
MW_BMP_10	Created Wetland	26
MW_TC_6	Trash Cleanups	27.5
MW_TC_7	Trash Cleanups	27.5
MW_BMP_12	Wet Pond	29
MW_BMP_18	SPSC	30
MW_BMP_5	Wet Pond	31
MW_BMP_11	Created Wetland	32
MW_SR_4	Stream Restoration	33
MW_BMP_6	Created Wetland	34
MW_BMP_16	Wet Pond	35
MW_SR_5	Stream Restoration	36
MW_BMP_17	Infiltration Basin	37
MW_SR_2	Stream Restoration	38.5
MW_TP_4	Reforestation	38.5
MW_SR_1	Stream Restoration	40
MW_SR_3	Stream Restoration	41
MW_BMP_15	Infiltration Basin	42
MW_BMP_7	Bioretention	43
MW_BMP_8	Wet Pond	44
MW_BMP_4	Bioretention	45.5
MW_BMP_13	Created Wetland	45.5
MW_BMP_14	Infiltration Basin	47
MW_BMP_9	Wet Pond	48
MW_BMP_2	Bioretention	49
MW_BMP_1	Bioretention	50
MW_BMP_3	Bioretention	51

Note: Lowest numerical value for each rank category is the highest ranked project

APPENDIX E – PUBLIC COMMENTS

Charles County solicited public review and comment of the draft Watershed Assessments (Port Tobacco, Mattawoman, and Lower Patuxent watersheds) through a public meeting and review period. A public meeting was held at the Charles County government location in La Plata Maryland on May 9, 2016. The meeting included presentations of the County's completed watershed assessments and a presentation on the draft Restoration Plan. Questions and answer sessions followed each of the presentations. A 30-day public review period followed the meeting with questions and comments due to the County on June 9, 2016. The documents for review were available on the County's website.

A summary of the questions and comments received regarding the Watershed Assessments, and the County's response to the comment, are included in this appendix. Comments on the Restoration Plan are included as an Appendix to Restoration Plan report.

<u>Public Meeting Comment Summary: Watershed Assessments 5/9/2016</u>

Questions related to the presentation on the County's Watershed assessments:

1) Q: What sites were rated severe during the Stream Corridor Assessment for the Mattawoman Watershed?
   A: The following numbers of sites were rated 'severe'
   a. 1 erosion
   b. 8 buffer
   c. 1 pipe outfall
   d. 1 trash
   e. 1 construction

2) Q: Where were the Stream Corridor Assessments conducted?
   A: The following were completed:
   a. Field crews assessed 8 miles in Port Tobacco and identified 5 miles of erosion
   b. Field crews assessed 8 miles in Mattawoman Creek and identified 1.4 miles of erosion
   c. Field crews assessed 3.5 miles in Lower Patuxent and identified 0.8 miles of erosion

3) Q: Does Port Tobacco have a stormwater component?
   A: Port Tobacco does not have a stormwater waste load allocation, therefore there is no MS4 urban stormwater treatment required to meet a TMDL.

4) Q: Stormwater that goes into the wastewater treatment plant, how is that allocated?
   A: Charles County does not have combined sewer, so stormwater is not directed to the treatment plant. The wastewater sector has separate goals from the urban sector for TMDL compliance.

5) Q: Can you explain downspout disconnection?
   A: Downspouts are normally directed to an impervious surface such that runoff from rooftops will flow into and through stormwater systems. We want to direct the flow to a lawn, breaking up the path, and keeping the flow and related pollutants out of the stormwater system.

6) Q: In the Mattawoman will the high levels of orthophosphate be taken care of in the restoration plan and can the results be explained more?
   A: The County has added more detail related to the orthophosphate levels in the watershed assessment.

7) Q: Will there be more presentations on sources of pollutants other than stormwater? How do we deal with other sources of pollutants in Mattawoman Creek, which are moving targets?
A: As the TMDLs have been coming out, the other sectors area also having informational meetings to find solutions. TMDLs have a load from the baseline year that we need to reduce, and the State is developing Accounting for Growth policies and stormwater management regulations to address loads from new growth since the baseline year. There is some residual pollutant after stormwater controls are implemented, so the Accounting for Growth policies are to address the residual.

8) Q: Regarding step pool conveyance systems which can take down quite a bit of forest, do any of the proposed retrofits take down forest for this type of stormwater management? Charles County should design into the plan, not to take down forest for restoration projects.
A: KCI always avoids taking out excessive trees and if absolutely necessary it would be limited to edge trees, not forests. During site feasibility evaluations the size of the project, slopes, utilities, and tree removal are evaluated. Impacts to trees are part of a project selection and prioritization process and are avoided whenever possible.

9) Q: Forest is the best way to manage stormwater. As a part of the counterbalance to this plan, forest retention should be encouraged as a first priority for decision makers, because then stormwater doesn't have to be paid for by the taxpayers. Counties could recommend forest retention be in the plan, so that MDE might credit this practice. Is there any way to encourage forest retention?
A: Forest retention is a good strategy to limit future impacts and additional pollutant loads; however MDE does not currently give restoration credit for forest retention for impervious treatment or for TMDL compliance therefore forest retention is not included as a strategy.

10) Q: Are upstream areas fixed in storm restoration? It may not make sense to complete a stream restoration project without also treating the upstream areas.
A: The County looks to combine upstream stormwater treatment with stream restoration whenever possible. During site selections the County's consultants look into combined projects but it is not always feasible. Ownership and cost become a factor, the County typically has more access to stream valley corridors than multiple, private upstream properties. The goal with adding upstream management is to reduce the stormwater flow to lower the shear stress (erosion potential) in the stream so that a softer approach with more focus on the biological components can be used in the restoration. Update sizing of channel to its current flow regime can help bring habitat functions back.

Public Comment Period Summary: Watershed Assessments 5/9/2016-6/6/2016

Mattawoman Watershed Society Letter dated June 9, 2016

1) Recommended clarifications to the Mattawoman Assessment:

   Comment: A table of abbreviations in the [plan] would be extremely helpful. For example EOS and NTP are never formally defined.

   Response: Added a table of abbreviations and defined EOS.

   Comment: Section 1.3 listing previous work misses the Watershed Resources Registry: http://www.potomacriver.org/wp-content/uploads/2014/12/ICPRB11-031.pdf

   Response: Added description of this report.

   Comment: If a reference has an online link, providing it would be helpful.

   Response: Added online links where available.

   Comment: On p. 37, the units for 247 S/cm are incorrectly given as g/l.[1] The county or consultant might be interested in MWS monthly data on conductance. For example, on April 3, 2016, 7 of 20 sites exhibited conductance greater than 247 S/cm.

   Explain the meaning and significance Optical Brightners, and the concentrations given in Table 10.

   Response: Fixed units. Added explanation of optical brightener significance and results.

   Comment: Explain the likely outcomes of stream restoration when the upstream catchment is not retrofitted with measures to address the cause of the stream degradation. Provide the scientific backing for this practice.

   Response: As noted above in response to a similar public meeting question, the County looks to combine upstream stormwater treatment with stream restoration whenever possible. During site selections the County's consultants look into combined projects but it is not always feasible. Ownership and cost become a factor, the County typically has more access to stream valley corridors than multiple, private upstream properties. The goal with adding upstream management is to reduce the stormwater flow to lower the shear stress (erosion potential) in the stream so that a softer approach with more focus on the biological components can be used in the restoration. Update sizing of channel to its current flow regime can help bring habitat functions back. A project can still be successful when the upstream catchment is not retrofitted. Many Counties in Maryland have used this approach with good success, particularly with outcomes related to channel stability, infrastructure protection and public safety, and pollutant loading reduction. Biological outcomes are tougher to meet with this approach, however the restored channel is typically in a very degraded biological state at the outset.

MDE has accepted stream restoration as an important tool for meeting MS4 impervious surface goals and TMDL requirements. The Chesapeake Bay Program's Urban Stormwater Workgroup published the Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects. The document details the types of approved projects and protocols for crediting impervious treatment and pollutant removal. The document also includes an extensive list of References Cited, which includes much of the current scientific literature on the subject.
http://www.chesapeakebay.net/documents/Stream_Panel_Report_Final_08282014_Appendices_A_G.pdf

The Bay Program has also published a fact sheet with useful stream restoration information.
http://www.chesapeakebay.net/documents/U4._Urban_Stream_Restoration_Fact_Sheet_in_Chesapeake_Bay_Watershed.pdf