Loch Raven North
Small Watershed Action Plan

Volume I

Prepared for:

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March 2015

Prepared by:

PARSONS BRINCKERHOFF

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List of Acronyms and Abbreviations

BCLTA	Baltimore County Land Trust Alliance
BIBI	Benthic Index of Biotic Integrity
BMC	Baltimore Metropolitan Council
BMP	Best Management Practice
BWB	Blue Water Baltimore
CBP	Chesapeake Bay Program
CWA	Clean Water Act
CWP	Center for Watershed Protection
DA	Drainage Area
DNR	Department of Natural Resources
DPW	Department of Public Works
EPS	Environmental Protection and Sustainability
ESD	Environmental Site Design
GIS	Geographic Information System
GVC	Gunpowder Valley Conservancy
HSI	Hotspot Site Investigation
ISI	Institutional Site Investigation
LU/LC	Land Use/ Land Cover
MBSS	Maryland Biological Stream Survey
MDA	Maryland Department of Agriculture
MDE	Maryland Department of the Environment
MDP	Maryland Department of Planning
MS4	Municipal Separate Storm Sewer System
NCR	Northern Central Railway
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NSA	Neighborhood Source Assessment
PAA	Pervious Area Assessment
PSI	Pollution Severity Index
ROI	Restoration Opportunity Index
RWPC	Reservoir Watershed Protection Committee
SCA	Stream Corridor Assessment
SCD	Soil Conservation District
SCWQP	Soil Conservation and Water Quality Plan
SHA	State Highway Administration
SWAP	Small Watershed Action Plan
SWM	Stormwater Management
SWPPP	Stormwater Pollution Prevention Plan
TMDL	Total Maximum Daily Loads
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids

UMBC	University of Maryland, Baltimore County
URDL	Urban/Rural Demarcation Line
USEPA	United States Environmental Protection Agency
WIP	Watershed Implementation Plan
WQA	Water Quality Assessments
WQMP	Water Quality Management Plan

ACKNOWLEDGEMENTS

LOCH RAVEN NORTH STEERING COMMITTEE

Organization	*Representative*
Albright Farms Inc	Tom Albright
Baltimore City, Reservoir Natural Resources	Clark Howells, Ryan Mazeska, William Felter
Baltimore County Farm Bureau	Jo-Ann Chason, Frank Dudek
Department of Natural Resources – Fisheries	Mark Staley
Department of Natural Resources – Parks	Sarah Witcher, Todd Easton
Baltimore County – Environmental Protection and Sustainability (EPS)	Steve Stewart, Erin Wisnieski, Dennis Genito, Karen Ogle, Don Outen
Franklin and Marshall College	Mike Rahnis
Gunpowder RIVERKEEPER	Theaux Le Gardeur
Gunpowder Valley Conservancy	Charlie Conklin, Nancy Pentz
National Park Service	Wink Hastings
North County Preservation	Mike Pierce
Baltimore County Office of Planning	Wally Lippincott, Carmela Iacovelli
Baltimore County Soil Conservation District	Jim Ensor
Sparks Glencoe Community Planning Council	Theaux Le Gardeur, Robert Stanhope
Tributary Team	John Hobner
Trout Unlimited	Brian Bernstein, Jim Gracie
University of Maryland, Baltimore County	Andy Miller, Mitchell Donovan
Parsons Brinckerhoff	Kate Klavon, Lori Gies, Kristine Bronnenkant

TECHNICAL ASSISTANCE/REPORTS

Technical Report	*Representative*
Upland Surveys (Neighborhood Source Assessments, Hotspot Assessments, and Institutional Site Assessments) , Stream Corridor Assessments, and Mill Dam Assessments	Erin Wisnieski, Steve Stewart – EPS Parsons Brinckerhoff, Inc. in association with NMP Engineering Consultants, Inc. and Coastal Resources, Inc.
Watershed Characterization	Parsons Brinckerhoff, Inc.

CHAPTER 1: INTRODUCTION

1.1 Purpose

This Small Watershed Action Plan (SWAP) is a strategy for the restoration of the Loch Raven North watershed. This report presents recommendations for watershed restoration, describes management strategies for each of the 17 subwatersheds comprising Loch Raven North, and identifies priority projects for implementation. A schedule for implementation through 2025 is presented in addition to planning level cost estimates, where feasible. Financial and technical partners for plan implementation are suggested for the various recommendations. This SWAP is intended to assist the Baltimore County Department of Environmental Protection and Sustainability (EPS) and other partners to continue restoration efforts in the Loch Raven North watershed. Figure 1-1 provides a graphic representation of the Loch Raven North watershed covered in this SWAP.

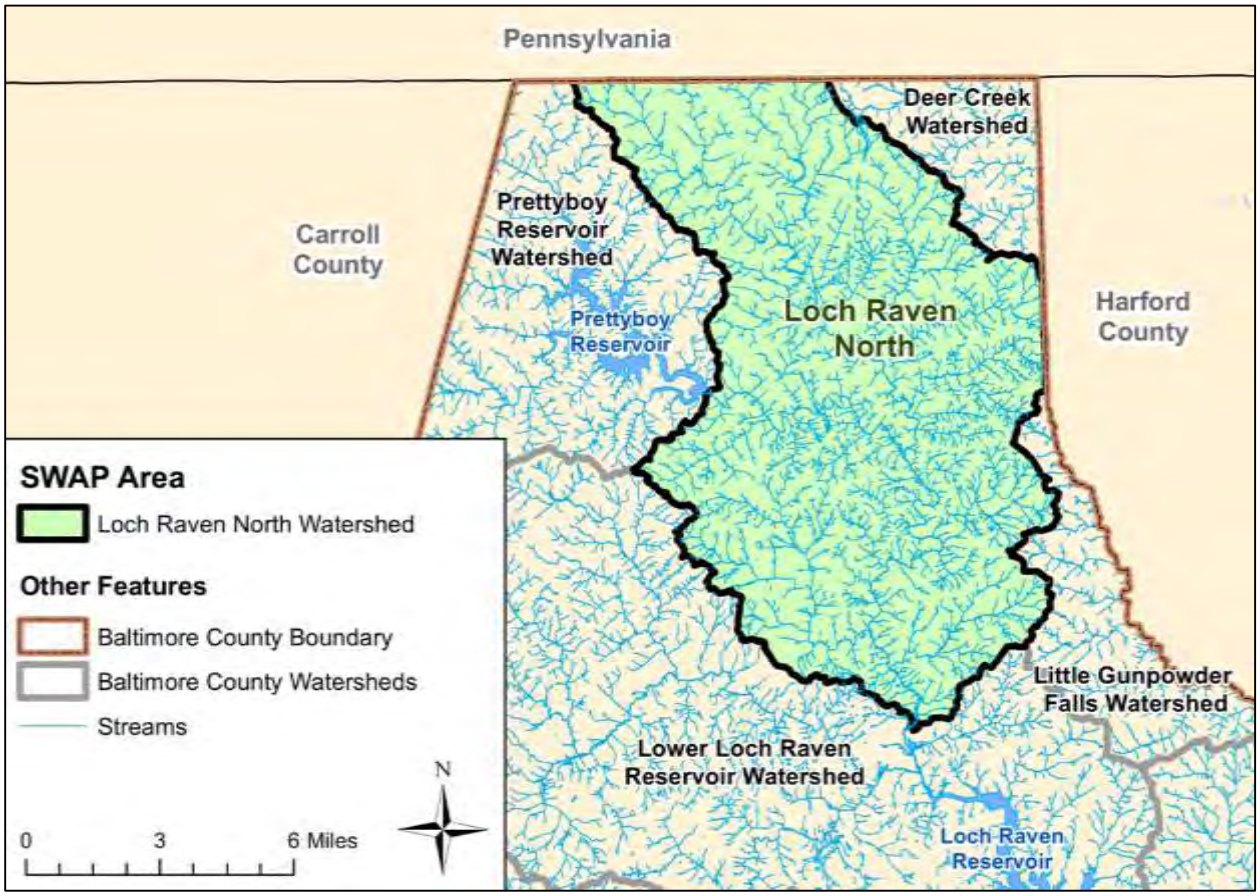

Figure 1-1: Location of Loch Raven North Watershed

1.2 Background

A SWAP identifies strategies for bringing a small watershed into compliance with water quality criteria. Strategies include a combination of government capital projects, actions in partnership with local watershed associations, citizen awareness campaigns, and volunteer activities. Effective implementation

of watershed restoration strategies requires the coordination of all watershed partners and the participation of many stakeholders.

Over the past year, Loch Raven North watershed partners have worked together, conducting assessments, identifying restoration opportunities, and engaging the community, in order to build a successful plan. A Steering Committee, consisting of key watershed partners, was formed to develop the Loch Raven North SWAP. This includes Baltimore County personnel and leaders from the local community. The Steering

Committee met regularly throughout SWAP development. Loch Raven North Steering Committee members are listed below:

Albright Farms Inc.	……	Tom Albright
Baltimore City – Reservoir Natural Resources	……	Clark Howells, Ryan Mazeska, William Felter
Baltimore County Farm Bureau	……	Jo-Ann Chason, Frank Dudek
Department of Natural Resources - Fisheries	……	Mark Staley
Department of Natural Resources - Parks	……	Sarah Witcher, Todd Easton
Baltimore County – Environmental Protection and Sustainability (EPS)	……	Erin Wisnieski, Steve Stewart, Dennis Genito, Karen Ogle, Don Outen
Franklin and Marshall College	……	Mike Rahnis
Gunpowder RIVERKEEPER	……	Theaux Le Gardeur
Gunpowder Valley Conservancy	……	Charlie Conklin, Nancy Pentz
National Park Service	……	Wink Hastings
North County Preservation	……	Mike Pierce
Baltimore County Office of Planning	……	Wally Lippincott, Carmela Iacovelli
Baltimore County – Soil Conservation District	……	Jim Ensor
Sparks Glencoe Community Planning Council	……	Theaux Le Gardeur, Robert Stanhope
Tributary Team	……	John Hobner
Trout Unlimited	……	Brian Bernstein, Jim Gracie
University of Maryland, Baltimore County	……	Andy Miller, Mitchell Donovan
Parsons Brinckerhoff	……	Kate Klavon, Lori Gies, Kristine Bronnenkant

In addition, since the participation of many stakeholders is an essential component for effective watershed restoration, two stakeholder meetings were held during SWAP development. Stakeholder meetings are intended to raise citizen awareness and solicit feedback from neighborhood residents, local community leaders, institutions, and business associations regarding watershed restoration strategies. A description of each stakeholder meeting including date, approximate number of attendees and topics covered, is provided below:

- ***Stakeholder Meeting #1*** (September 29, 2014; 36 attendees): This meeting included an introduction of the SWAP process and the Loch Raven North SWAP Steering Committee

members. A description of the watershed, the county's restoration goals, environmental requirements (see Section 1.3), and a SWAP framework were presented. The current condition of the Loch Raven North watershed was also presented based on desktop analyses and field assessments. Dr. Dorothy Merritts, a professor and researcher from Franklin and Marshall College, presented an overview on the impacts of historic mill dams on stream conditions. A Vision & Goals Questionnaire was conducted during the meeting where attendees were asked to rate the importance of a list of six watershed goals. Attendees were also given an opportunity to fill out a "blue card" to report the type and location of environmental problems (e.g. dumping, erosion, illicit discharges, etc.) in the watershed. An "actions survey" was conducted to gage citizens' interest in potential restoration activities. The results of the surveys were used later to identify rates of participation for certain restoration actions that are recommended for the watershed.

- ***Stakeholder Meeting #2*** (Scheduled for March 11th, 2015):

1.3 Environmental Requirements

The SWAP was developed to satisfy environmental program requirements while also meeting citizen needs for a healthy environment, clean water, and an aesthetically pleasing community. The following environmental program requirements were considered during the development of this SWAP and are briefly described in the subsequent sections:

- National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit assessment and planning requirements
- 303(d) listings and Local TMDL reductions for the Loch Raven watershed including fecal bacteria and reductions for the Loch Raven Reservoir including total phosphorus and sediment
- TMDLs for the Chesapeake Bay for nutrient and sediment reductions to meet water quality standards

1.3.1 NPDES MS4 Permits

Many requirements of Baltimore County's NPDES permit (11-DP-3317, MD0068314) will be addressed by this plan. One of these requirements is the systematic assessment of water quality and development of restoration plans for all watersheds within the County. This assessment must include the following:

- Source identification information based on geographic information system (GIS) data
- Determination of current water quality conditions
- Identification and ranking of water quality problems
- Results of visual watershed inspections
- Identification of structural and non-structural water quality improvement opportunities
- Specification of overall watershed restoration goals

The County's NPDES permit (effective December 2013) also requires the County to address 20% of the untreated impervious cover during each 5-year permit term (MDE, 2013). It is anticipated that future permits will have the same requirement. To date, restoration projects have addressed 17.6% of the impervious cover county-wide and 10.5% of the impervious cover in the entire Loch Raven Reservoir watershed with the majority of restoration being done outside of the Loch Raven North watershed and

within the Urban Rural Demarcation Line (URDL) (EPS, 2014). As of 2013, restoration actions and stormwater management have reduced county urban stormwater loads of phosphorus by 17.8% and nitrogen by 6.4% (accurate reductions for sediment are not available) (EPS, 2013).

This SWAP meets the systematic assessment and planning requirements of the NPDES permit and provides strategies for how Baltimore County will meet goals for addressing impervious cover.

1.3.2 303(d) Listing and Local Total Maximum Daily Loads (TMDLs)

The 303(d) list is comprised of waters that are impaired or threatened by a pollutant and are in need of a TMDL. According to the United States Environmental Protection Agency (USEPA), a TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet state water quality standards. TMDLs can be developed for a single pollutant or group of pollutants of concern which generally include sediment, metals, bacteria, nutrients, and pesticides.

The Loch Raven North watershed (Area X) contains approximately 32% of the total Loch Raven Reservoir drainage area, which includes portions of Pennsylvania, Carroll County, and Harford County. The Loch Raven Reservoir impoundment is listed as impaired for numerous pollutants of concern including: methylmercury (2002 listing), sedimentation and siltation (1996 listing), and total phosphorus (1996 listing). The Loch Raven Reservoir tributaries, including those in the Loch Raven North watershed, are listed as impaired for fecal bacteria (2008) and a 303(d) listing for impacts to benthic/fish communities (2002 listing) (MDE, 2012). The main source of mercury in the reservoir was found to be from atmospheric deposition and the TMDL is expected to be met over time through air quality regulatory controls such as The Maryland Healthy Air Act of 2006 (MDE, 2002), which has been in full effect since 2007 (MDE, 2007). The current impairment listings for Loch Raven North are shown in Table 1-1.

Table 1-1: Loch Raven North Water Quality Impairment Listing and Status

Impairment (Year Listed)	*Applicable Segment*	*Listing Category*	*Status*	*Approval Date*
Sediment (1996)	MD-02130805 (Impoundment)	4a	TMDL	03/27/2007
Phosphorus (1996)	MD-02130805 (Impoundment)	4a	TMDL	03/27/2007
Mercury (2002)	MD-02130805 (Impoundment)	4a	TMDL	08/16/2004
Fecal Bacteria (2008)	MD-02130805 (Tributaries)	4a	TMDL	12/3/2009
Biological Impairment (2002)	MD-02130805 (Tributaries)	5	Impaired	N/A

Note that in 2003, a Water Quality Assessments (WQA) was submitted for the Loch Raven Reservoir impoundment in response to impairment listings for phosphorus. The WQA justified the classification of heavy metals, including arsenic, cadmium, chromium, copper, nickel, lead, and selenium under category 2 of the Integrated Report listings meaning the Loch Raven Reservoir was meeting water quality standards for those heavy metals (MDE, 2003).

Nutrient and sediment, particularly addressing the Loch Raven Reservoir TMDL for phosphorus and sediment load reduction requirements, are the main focus of this SWAP document. The Loch Raven Reservoir TMDL is broken up by land use and jurisdiction. The agricultural source sector reductions are developed and tracked by the Maryland Department of Agriculture with input from the local Soil Conservation Districts. Baltimore County is responsible for producing a strategy addressing the urban stormwater load reductions. According to the TMDL, urban stormwater is accountable for 15% of the total phosphorus reduction and 0% of the sediment reduction (MDE, 2006). However, since the TMDL has been established, the sediment load to the reservoir has increased from the baseline analysis. In order to return to the baseline load, approximately 358.3 tons/year of urban sediment load need to be addressed in the Loch Raven Reservoir watershed (EPS, 2014a). Loch Raven North is responsible for 102 tons/year of these reductions. These reduction goals also yield partial credit toward the Chesapeake Bay restoration and is discussed further in Section 1.3.3.

1.3.3 TMDLs for Chesapeake Bay Nutrient and Sediment Impairment

The Chesapeake Bay Program (CBP) has developed the Phase 5 Watershed Model. This model, in conjunction with the Estuary Model, is used to determine the sources and reductions of nitrogen, phosphorus, and sediment needed to meet Chesapeake Bay tidal water quality standards. The Phase 5 model was used to develop a Chesapeake Bay-wide TMDL and to assign nutrient and sediment load reductions to individual states and ultimately local jurisdictions based on the segment loads. In Maryland, nutrient load reductions were assigned on a County-by-County basis for achievement by a 2025 timeframe. Specific sediment reductions for sediment have not been assigned, but it is assumed that meeting nutrient load reductions will address needed sediment load reductions. Table 1-2 lists the nutrient load reduction requirements for Baltimore County for urban stormwater sources under the Chesapeake Bay TMDL (EPS, 2012).

Table 1-2: Baltimore County Urban Source Sector Pollutant Load Reductions

TMDL Pollutant	% Pollutant Load Reduction Requirements for Baltimore County by 2025
Nitrogen	32.2
Phosphorus	47.0

In developing the pollutant reduction strategy in Baltimore County's *Phase II Watershed Implementation Plan* (WIP), consideration was given to the relative delivery ratios for Baltimore County's fourteen 8-digit watersheds and the land use loading rates for urban impervious and urban pervious (EPS, 2012). The Loch Raven North watershed has varying delivery to the bay for pollutants due to treatment factors in the reservoir and drinking water withdrawals. The delivery ratios to the Bay from the Loch Raven watershed for nitrogen, phosphorus, and sediment are 25.9%, 36.0%, and 22.5%, respectively. Therefore, any pollutant reduction actions that take place within the Loch Raven North watershed receive partial credit toward Bay restoration.

1.4 USEPA Watershed Planning A-I Criteria

The Clean Water Act (CWA) was amended in 1987 to establish Section 319 Nonpoint Source Management Program, after recognizing the need for federal assistance to focus state and local nonpoint source efforts. Under this section, states, tribes, and territories can receive grant money for the development and implementation of programs aimed at reducing nonpoint source (NPS) pollution. NPS pollution comes from many different sources and is a result of human activities on the land. It is caused by pollutants from human activities and atmospheric deposition that are deposited on the ground and eventually carried to receiving waters by stormwater runoff. Common NPS pollutants and sources include:

- Excess fertilizers, herbicides, and insecticides from agricultural lands and residential areas
- Oil, grease, and toxic chemicals from urban runoff and energy production
- Sediment from improperly managed construction sites, crop and forest lands, and eroding stream banks
- Salt from irrigation practices and winter road clearing activities and acid drainage from abandoned mines
- Bacteria and nutrients from livestock, pet wastes, and failing septic systems

CWA Section 319 grant funds can be requested to support various activities such as technical assistance, financial assistance, education, training, technology transfer, restoration projects, and monitoring to assess the success of specific nonpoint source implementation projects. Watershed-based plans to restore impaired water bodies and address NPS pollution using incremental Section 319 funds must meet the USEPA A through I criteria for watershed planning (USEPA, 2012):

A. An identification of the causes and sources or groups of sources that will need to be controlled to achieve the load reductions estimated in the watershed plan

B. Estimates of pollutant load reductions expected through implementation of proposed NPS management measures

C. A description of the NPS management measures that will need to be implemented

D. An estimate of the amounts of technical and financial assistance to implement the plan

E. An information/education component that will be used to enhance public understanding and encourage participation

F. A schedule for implementing the NPS management measures

G. A description of interim, measurable milestones for the NPS management measures

H. A set of criteria to determine load reductions and track substantial progress towards attaining water quality standards

I. A monitoring component to evaluate effectiveness of the implementation records over time

Table 1-3 summarizes the location(s) within this document where each criterion is addressed.

Table 1-3: Where to Locate Information for USEPA's A-I Criteria

Report Section	USEPA Criteria								
	A	B	C	D	E	F	G	H	I
Chapter 1					✓				
Chapter 2									
Chapter 3	✓	✓	✓		✓	✓		✓	
Chapter 4			✓		✓				
Chapter 5				✓			✓	✓	✓
Appendix A			✓	✓	✓	✓			✓
Appendix B				✓	✓				
Appendix C		✓						✓	
Appendix D									
Appendix E	✓		✓						
Appendix F									
Appendix G									
Appendix H									
Appendix I									
Appendix J									
Appendix K									
Appendix L									

1.5 Regional Reservoir Agreement and County Master Plan

The Reservoir Watershed Management Agreement and the Baltimore County Master Plan are two formal documents that address water quality and land use in the Loch Raven North watershed. The Reservoir Watershed Agreement was signed in 2005 by multiple government agencies including Baltimore County, Baltimore City, Carroll County, Maryland Department of the Environment, Maryland Department of Agriculture, Baltimore and Carroll Counties Soil Conversation District, Reservoir Watershed Protection Committee (RWPC) and Baltimore Metropolitan Council (BMC). As a participating partner, Baltimore County has agreed to make voluntary commitments to implement actions to reach established water quality goals in the reservoir watersheds. Actions include monitoring the reservoirs and major tributaries, watershed modeling, issuing discharge permits (NPDES), promoting agricultural Best Management

Practices (BMP), continuing the implementation of stormwater management regulations, administering sewer and septic regulations and inspections, aiding urban nutrient reductions, and overall land management through conservation and strategic development (BRWMP, 2005). Supporting the Reservoir Agreement and implementing proposed water quality action strategies will also help the county meet local and regional TMDL goals.

The Baltimore County Master Plan is a guiding document for future development within Baltimore County with the goal of protecting the environment, preserving agriculture, and ensuring a safe and attractive place to live and work (DP, 2010). The plan aims to concentrate development and redevelopment within the URDL. The report also emphasizes the importance of resource conservation with a preservation goal of at least 80,000 acres of land to protect agriculture and natural resources (DP, 2010). Supporting the Baltimore County Master Plan to limit development outside the URDL and promote land preservation will help maintain the rural nature of the watershed and prevent further deterioration in water quality.

1.6 Partner Capabilities

In order to achieve effective watershed restoration, the capabilities of many organizations must be brought together and coordinated. Within the Baltimore region, the cooperation and coordination has been advancing in recent years as common goals in water quality improvement in local streams and tidal waters are sought.

1.6.1 Baltimore County

Baltimore County has a waterway restoration program to implement restoration projects, including stream restoration, stormwater conversions and retrofits, and reforestation projects. Baltimore County has an extensive monitoring program that assesses the current ambient water quality, efficiency of various restoration projects in relation to pollutant removal and biological community improvement, and tracks trends over time. The County also has an illicit discharge and elimination program that monitors and rates storm drain outfalls, tracks pollutant sources, and coordinates remediation.

1.6.2 Baltimore City Reservoir Natural Resources Section

Baltimore City's Reservoir Natural Resources Section is responsible for the management and protection of the Loch Raven, Prettyboy, and Liberty Reservoirs and their surrounding City-owned buffer lands. The Loch Raven North watershed drains to the Loch Raven Reservoir. The Reservoir Natural Resources Section is committed to the protection of the reservoirs and contiguous watershed lands from outside influences that would adversely impact the drinking water resource and interfere with providing the highest quality public water supply to approximately 1.8 million consumers within the Baltimore metropolitan area.

1.6.3 Gunpowder Valley Conservancy

The Gunpowder Valley Conservancy (GVC) is a non-profit organization that emphasizes and organizes land preservation, restoration, stream cleanups, and education to protect and sustain natural resources in the Gunpowder Watershed. The organization acts as a channel connecting citizens with programs and information aimed to help them become better stewards of the natural and historical resources within the watershed. The GVC also works with citizens to implement stormwater management practices on their own property such as rain barrels, rain gardens, and bayscaping.

1.6.4 Trout Unlimited

Trout Unlimited is a national conservation organization with 400 chapters, including a Maryland chapter that covers the majority of Baltimore County, with the goal to conserve, protect, and restore North America's coldwater fisheries and their watersheds. In the Chesapeake Bay region, Trout Unlimited has developed the Coldwater Land Conservancy Fund to help land trusts and agencies acquire lands for public use or to place perpetual conservation easements on them, securing prime habitat for trout.

1.6.5 Local Businesses and Civic Organizations

A variety of community businesses and civic organizations in the Loch Raven North watershed have a vested interest in improving water quality in the watershed. Each of these organizations will have an important role in achieving the goals and objectives of the SWAP.

Community representatives involved with the planning process include representatives from the Gunpowder RIVERKEEPER, the Tributary Team, the Sparks-Glencoe Community Planning Council, the North County Preservation, and Albright Farms Inc.

1.6.6 University of Maryland, Baltimore County

As a research institution conducting environmental and ecological studies within the Baltimore Region, the research conducted at the University of Maryland, Baltimore County (UMBC) is beneficial for potential restoration methods. UMBC has also conducted and published research in regards to the quantification of legacy sediment release in stream reaches located within the Loch Raven North watershed boundary.

1.6.7 Franklin and Marshall College

Franklin and Marshall College is a leader in research regarding the impact of mill dams and legacy sediment. Some of their research involves historic mill dams located in northern Maryland. The school continues to conduct research determining the overall sediment load due to historic dams and methods to restore the mill ponds to their natural state.

1.6.8 Baltimore County Soil Conservation District

The Soil Conservation District (SCD) of Maryland works with local, State, and Federal authorities as well as the private sector to address each County's soil and water conservation needs. Local landowners and residents have access to technical services through the soil conservation district that help them install soil conservation practices on their lands that reduce erosion and improve water quality. Specifically, the SCD aims to work with farmers to install conservation practices on agricultural land.

1.6.9 Maryland Department of Agriculture

The Maryland Department of Agriculture (MDA) works closely with Maryland farmers to promote and preserve agricultural activities in the State while balancing the need to protect natural resources. MDA has many offices focusing on conservation and preservation to protect the Chesapeake Bay, its tributaries, and the wildlife it accommodates.

1.6.10 Maryland Department of Natural Resources

The Maryland Department of Natural Resources (DNR) seeks to preserve, protect, restore, and enhance the State's natural resources. In the Loch Raven North watershed, the Maryland DNR manages the Torrey C. Brown Rail Trail (formerly the Northern Central Railway (NCR) Trail) and the Gunpowder Falls State Park – Hereford Area. The State Park is a recreational destination for hiking, fishing, and river recreation. DNR also initiates and supports legislation consistent with the Department's stewardship role and mission to preserve and enhance the State's natural resources. The DNR works to preserve and protect Maryland's land and trees, manage Maryland's wildlife and fisheries, and protect Maryland's waterways.

1.6.11 Maryland State Highway Administration

Maryland's State Highway Administration (SHA) operates and maintains several major roadways in the watershed including I-83. As a public entity possessing its own NPDES permit for stormwater discharges, SHA is also subject to the pollution reduction requirements of the Chesapeake Bay TMDL. In addition, as sodium and chlorides from road salts are a major pollutant of concern in the watershed, coordination of water quality improvements between Baltimore County and SHA is important in achieving restoration of surface and ground waters in the area.

1.7 Loch Raven North Watershed Overview

The total study area of the Loch Raven North SWAP is comprised of 17 subwatersheds that drain to the Loch Raven Reservoir. The total watershed is approximately 61,436 acres (96 square miles) as shown in Table 1-4.

Table 1-4: Loch Raven North Subwatershed Areas

Subwatershed	Area (Acres)	Area (Sq Miles)
Little Falls	11,135	17.40
Beetree Run	5,149	8.05
Fourth Mine Branch	1,633	2.55
Third Mine Branch	4,416	6.90
Owl Branch	2,384	3.72
Second Mine Branch	3,337	5.21
First Mine Branch	2,931	4.58
Gunpowder Falls (Below Prettyboy)	4,648	7.26
Bush Cabin Run	2,264	3.54
Mingo Branch	507	0.79
Panther Branch	741	1.16
Charles Run	2,820	4.41
Piney Creek	5,976	9.34
Gunpowder Falls	7,712	12.05
Buffalo Creek	1,888	2.95
Carroll Branch	2,567	4.01
My Lady's Manor Branch	1,329	2.08
Total	***61,436***	***95.99***

The Loch Raven North watershed was subdivided for planning and management purposes into the 17 subwatersheds shown in Figure 1-2. The smaller drainage areas of the subwatersheds are intended to focus restoration, preservation, and monitoring efforts. The *Loch Raven North Watershed Characterization Report* includes detailed analyses and descriptions of the current watershed conditions and potential water quality issues and is included as Appendix E of this report. A summary of the key watershed characteristics for Loch Raven North based on the characterization report is provided in Table 1-5.

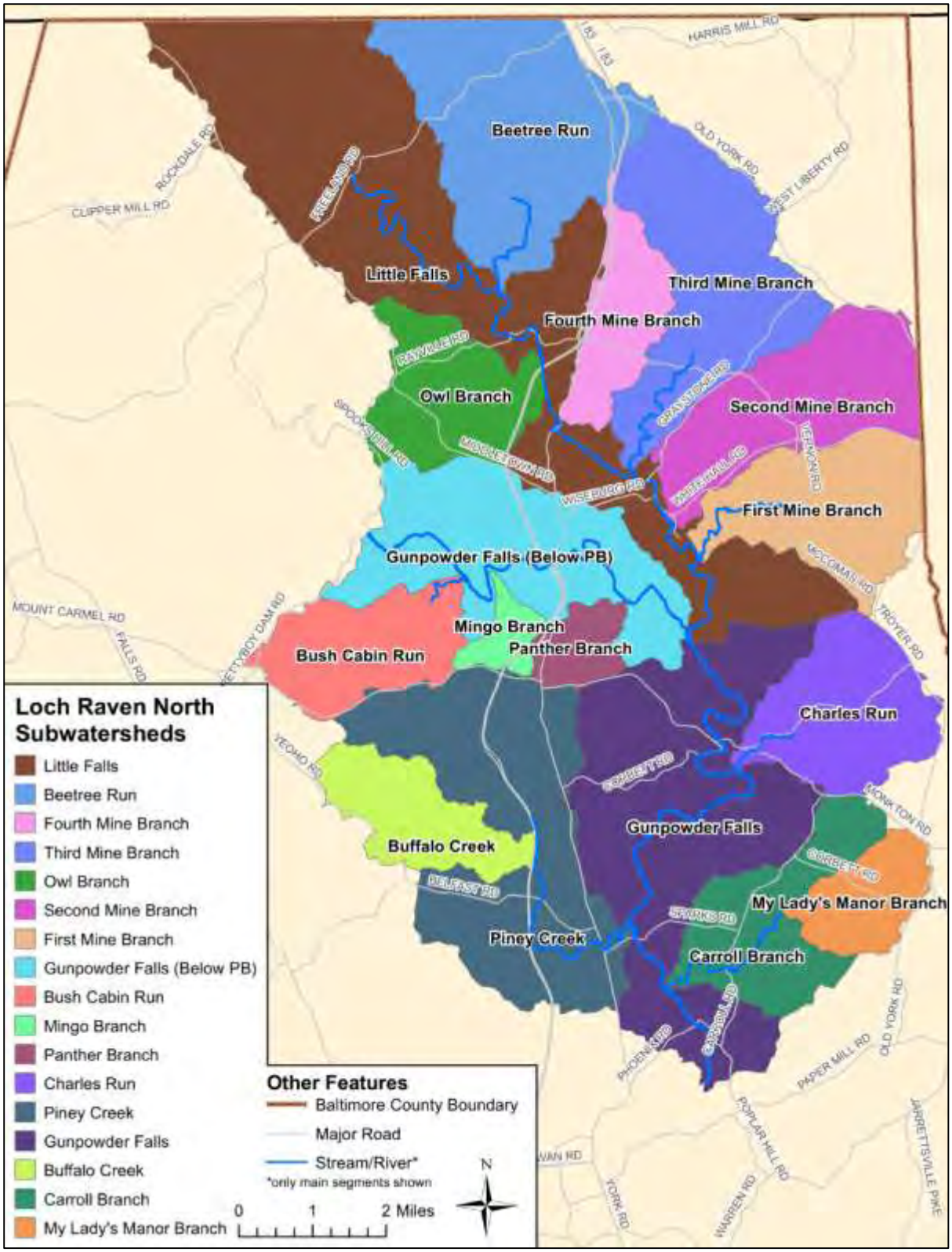

Figure 1-2: Loch Raven North SWAP Watershed and Subwatersheds

Table 1-5: Loch Raven North Key Watershed Characteristics

Drainage Area	61,436	Acres	
	95.99	sq. mi.	
Stream Length	668.3	Miles	
Population	32,633	(2010 Census)	
	0.53	persons/acre	
Land Use/Land Cover	Very Low Density Residential:		12.2%
	Low Density Residential:		13.0%
	Medium/High Density Residential:		0.2%
	Commercial:		0.3%
	Industrial:		0.1%
	Institutional:		0.4%
	Open Urban:		0.5%
	Agriculture:		35.7%
	Forest:		36.8%
	Transportation:		0.5%
	Other:		0.4%
Land in Easement	29,730	Acres	48.4%
Impervious Cover	2,068	Acres	3.4%
Soils	A Soils (low runoff potential):		0.0%
	B Soils:		70.4%
	C Soils:		11.7%
	D Soils (high runoff potential):		17.6%
	Water:		0.3%

1.8 Report Organization

This report is organized into the following five major chapters:

Chapter 1 explains the purpose of this report including underlying environmental requirements and key watershed characteristics.

Chapter 2 presents the watershed vision, goals, and objectives for restoring the Loch Raven North watershed.

Chapter 3 describes the types of watershed restoration practices recommended for the Loch Raven North and estimated pollutant load reductions.

Chapter 4 discusses prioritization of the 17 subwatersheds that make up the Loch Raven North watershed and summarizes subwatershed-specific restoration strategies.

Chapter 5 presents the implementation plan restoration evaluation criteria and monitoring framework.

This volume (Volume I) also includes the following appendices with additional, detailed information used to develop and support this SWAP:

- Appendix A: Loch Raven North Action Strategies
- Appendix B: Cost Analysis and Potential Funding Sources
- Appendix C: Pollutant Load Reduction Efficiencies
- Appendix D: Loch Raven North SWAP Uplands Assessment Map

A second volume (Volume II) includes the following appendices with supporting documentation related to the current conditions of the Loch Raven North watershed:

- Appendix E: Loch Raven North Watershed Characterization Report
- Appendix F: Chesapeake Bay TMDL Executive Summary
- Appendix G: Total Maximum Daily Loads of Fecal Bacteria for the Loch Raven Reservoir Basin in Baltimore, Carroll, and Harford Counties, Maryland
- Appendix H: Total Maximum Daily Loads of Phosphorus and Sediments for Loch Raven Reservoir and Total Maximum Daily Loads of Phosphorus for Prettyboy Reservoir, Baltimore, Carroll, and Harford Counties, Maryland
- Appendix I: Total Maximum Daily Load of Mercury for Loch Raven Reservoir in Baltimore County, Maryland
- Appendix J: Water Quality Management Plan for Loch Raven Watershed: Executive Summary and Stream Stability Assessment and Analysis
- Appendix K: Water Quality Analysis of Heavy Metals for the Loch Raven Reservoir Impoundment in Baltimore County, Maryland
- Appendix L: Watershed Report for Biological Impairment of the Loch Raven Reservoir in Baltimore, Carroll, and Harford Counties, Maryland and York County, PA Biological Stressor Identification Analysis Results and Interpretation

CHAPTER 2: VISION, GOALS AND OBJECTIVES

2.1 Vision Statement

The Loch Raven North Steering Committee adopted the following vision statement that served as a guide in the development of the Small Watershed Action Plan (SWAP):

> *Our vision is for the people who live, work, and visit in the watershed to enhance and preserve the land and water in a way that supports functional terrestrial and aquatic ecosystems in order to provide clean drinking water, healthy streams and forest, sustainable agriculture, and recreational opportunities.*

2.2 Loch Raven North SWAP Goals & Objectives

A total of six goals were identified for restoring the Loch Raven North watershed based on the vision statement and input from both Steering Committee and Stakeholder meetings. The goals were developed through discussions with the Loch Raven North SWAP Steering Committee and refined based on feedback from watershed residents at the Stakeholder meetings. Stakeholders were given the opportunity to rank the importance of goals, raise additional issues important to the community, and indicate restoration activities of interest to achieve watershed goals. Stakeholder participation is important to ensure the implementation and success of the plan.

The following sections present a discussion of each of the six goals for restoring and preserving the Loch Raven North watershed. For each goal, a series of objectives was developed to ensure that the plan will meet each goal. Action strategies describe the method that will be used to achieve the objective and ultimately, the water quality goal. An example of an action strategy for phosphorus reduction could be "implement stormwater retrofits to treat runoff" in a given subwatershed. The action strategies developed to achieve these objectives and goals are summarized in Appendix A and discussed further in Chapter 3.

When possible, action strategies are expressed as quantifiable measures (e.g., linear feet of forested buffer planted). However, the numerical values assigned to these actions are intended to serve as a guide rather than an absolute measure in achieving watershed goals and objectives. Many actions address multiple watershed goals and objectives. In Appendix A, Table A-1 lists the action strategies proposed for Loch Raven North and their applicable goals and objectives.

The general types of restoration strategies proposed for the Loch Raven North watershed are discussed further in Chapter 3.

Goal 1: Restore and maintain healthy streams for natural aquatic ecosystems and cold water fisheries

Although the Loch Raven North watershed is rural, development and land clearing have occurred throughout the watershed. The change from predevelopment conditions has led to an increase in stream flows and higher water temperatures resulting in detrimental consequences to the streams themselves and the aquatic species they accommodate. By enacting measures that mimic the predevelopment

hydrology and buffer land use of the watershed, erosive flows, channelization, and the resultant sediment transport within the watershed can be greatly mitigated. This will also produce healthier, higher quality aquatic habitats.

Objectives:

1. Encourage riparian buffer preservation and plantings to improve water quality and habitat on public and private lands
2. Reduce physical and chemical impacts from impervious areas
3. Reduce expansion of invasive aquatic species in the watershed
4. Implement bank stabilization/stream restoration techniques where appropriate to promote system-wide improvements in stream function
5. Maintain water quality to sustain a native trout population

Goal 2: Restore and maintain forests and other terrestrial habitat to healthy sustainable conditions

Healthy, vibrant forests create a significant ecological impact on a watershed through influences on air quality, water quality, and wildlife habitat. From absorbing pollutants in the air to pollutants in rainfall and runoff, trees are a vital part of decreasing nutrient loads in the watershed. Healthy forest systems also provide food and habitat for native wildlife.

Objectives:

1. Improve forest and wetland coverage
2. Manage deer to reach healthy herd populations that reduce their impact on forest habitat and public health
3. Reduce expansion of invasive terrestrial species in the watershed
4. Preserve habitat and encourage preservation of land that supports rare, threatened, and endangered species

Goal 3: Improve drinking water quality and quantity

The Loch Raven North watershed drains to the Loch Raven Reservoir, a Use III-P designated water body and a drinking water source for citizens within Baltimore County and Baltimore City. Stormwater runoff carries pollutants from upland areas through the Loch Raven North tributaries to the reservoir. Citizens within the Loch Raven North watershed rely on wells and groundwater for their drinking water source, which can become contaminated through infiltrated stormwater runoff. Reducing sources of non-point source pollutants and stewardship actions will reduce pollution in groundwater, streams, and the reservoir.

Objectives:

1. Reduce annual average Total Phosphorus urban loads by 15% to meet reservoir Total Maximum Daily Load (TMDL) goals

2. Reduce annual average Sediment loads by 4% to meet reservoir TMDL goals
3. Reduce sodium in drinking water sources
4. Protect and promote groundwater recharge

Goal 4: Improve and maintain sustainable agricultural practices

Over a third of the Loch Raven North watershed is agricultural land (i.e. cropland, pasture, etc.) and is a defining feature of the watershed. By promoting the use of established, as well as new or innovative, conservation practices, a large area of land can be treated to reduce pollutant runoff. Agricultural best management practices (BMPs) help reduce soil loss, trap nutrients, and minimize the use of nutrients and pesticides on land.

Objectives:

1. Increase agricultural land held in preservation
2. Promote use of BMPS on agricultural land

Goal 5: Support environmentally-friendly recreation opportunities of natural and historic resources

The Loch Raven Reservoir and its tributaries provide opportunities for the public to appreciate and experience wildlife, habitat, and water resources in Baltimore County. Many of the streams in the Loch Raven North watershed are used recreationally throughout the year for fishing, kayaking, and other water activities. A TMDL for fecal coliform was developed for the tributaries that drain to the Loch Raven North reservoir for water contact recreation. Fecal bacteria are microscopic single-celled organisms found in the wastes of warm-blooded animals. Excessive amounts of fecal bacteria in surface water used for recreation increases the risk of pathogen-induced illness to humans.

Objectives:

1. Reduce presence of Bacteria in waterways from urban sources to meet TMDL goals
2. Increase awareness of safe and eco-friendly use of recreation opportunities

Goal 6: Promote land preservation

Currently, 48% of the Loch Raven North Watershed is held under some type of conservation easement. Conservation easements are voluntary agreements to protect conservation features of property such as farmland and natural resources. These easements prohibit more intensive land uses such as commercial, industrial, and high-density residential, protecting the rural or scenic character of the land from further development. Land preservation programs are available through the state, county, and local organizations.

Objectives:

1. Preserve natural lands and agricultural lands to advance the County's 80,000 acre goal and the State's land preservation initiatives

CHAPTER 3: RESTORATION STRATEGIES

3.1 Introduction

This chapter presents an overview of the key restoration strategies and associated pollutant load reductions proposed for restoring and preserving the Loch Raven North watershed. A complete list of actions proposed for the watersheds including goals and objectives targeted, timelines, performance measures, cost estimates, and responsible parties is included in Appendix A. Although only key, quantifiable restoration strategies are the focus of this chapter, it is important to remember that a combination and variety of restoration practices, from capital stream restoration projects to public education and outreach, are needed to engage citizens and meet watershed-based goals and objectives.

The restoration of the Loch Raven North watershed will occur as a partnership between the local government, watershed groups, businesses, and citizens. The actions of each partner are critical to the success of the overall watershed restoration strategy. Local governments are able to implement large capital projects such as stream restoration, large-scale stormwater retrofits, changes in municipal operations, and large-scale public awareness. Watershed groups and citizens are able to implement locally-based programs such as tree plantings, storm drain marking, and downspout disconnection. Therefore, key restoration strategies are divided into two broad categories: municipal strategies (Section 3.2) and citizen-based strategies (Section 3.3). It is important that restoration occurs at all levels to ensure that a wide range and variety of projects is implemented. This will encourage citizen participation and awareness, which is also critical to the success of restoration efforts.

The watershed pollutant loading analysis performed to estimate current nutrient loads generated by the various non-point and septic sources within the Loch Raven North watershed is discussed in Section 3.5.1. Section 3.5.2 discusses the pollutant removal calculations for proposed practices (i.e., key restoration strategies discussed in Sections 3.2, 3.3, and 3.4) to ensure that regulatory requirements are met in Loch Raven North.

3.2 Municipal Strategies

Baltimore County works to restore local streams and improve water quality through capital improvement projects and municipal management activities (e.g. development review, street sweeping, illicit connection programs, etc.). This plays an important role in the Small Watershed Action Plan (SWAP) implementation process. Key municipal strategies proposed for restoring Loch Raven North are discussed in the following sections.

3.2.1 Stormwater Management

Increased importance of water quality and water resource protection has led to the development of the Maryland Stormwater Design Manual, which provided Best Management Practice (BMP) design standards and environmental incentives (MDE, 2009). Since that time there has been a general shift towards adopting low-impact practices that mimic natural hydrologic processes and achieve pre-development conditions. The Maryland Stormwater Act of 2007 takes those principles one step further and requires that environmental site design (ESD) be implemented to the maximum extent practicable via nonstructural BMPs and/or other better site design techniques. The intent of ESD BMPs is to distribute

flow throughout a development site and reduce stormwater runoff leaving the site. This will also reduce pollutant loads and prevent stream channel erosion.

3.2.1.1 Existing Stormwater Management

A total of 112 existing stormwater management (SWM) facilities are located within the Loch Raven North watershed including dry and wet ponds, underground detention, wetlands, infiltration practices, filtration practices, extended detention, and grass swales and channels. Existing SWM facilities treat a total drainage area of approximately 730 acres of land or approximately 1% of the watershed.

3.2.1.2 Stormwater Retrofits

Stormwater retrofits involve implementing BMPs in existing developed areas where SWM practices do not currently exist to help improve water quality. Stormwater retrofits improve water quality by capturing and treating runoff before it reaches receiving water bodies. Based on initial field and desktop evaluations, several sites with sufficient open space for stormwater retrofits to treat runoff from impervious parking lots or roadways were identified. These sites were located in all four upland components surveyed: neighborhoods, publicly owned hotspots, institutions, and pervious areas.

3.2.1.3 Impervious Cover Removal

Impervious surfaces include roadways, parking lots, roofs, and other paved surfaces that prevent precipitation from naturally seeping into the ground. As a result, impervious surface runoff can result in erosion, flooding, habitat destruction, and increased pollutant loads to receiving water bodies. Subwatersheds with higher amounts of impervious cover are more likely to have degraded stream systems and contribute significantly to water quality problems in a watershed. Removing impervious cover and converting to pervious or forested land promotes infiltration of runoff and reduces pollutant loads. Unused or unmaintained impervious surfaces with the potential for removal were identified at several institutions, mostly on school properties. The areas of these impervious surfaces were used to estimate potential pollutant load reductions as a result of impervious cover removal activities.

3.2.1.4 Stormwater Education and Outreach

While not included in pollutant reduction calculations, education and outreach tools can be used to inform residents of the water quality impacts associated with large impervious parking lots, driveways, or patios and options available for conversion to or incorporating more permeable surfaces.

3.2.2 Stream Restoration

Stream restoration practices are used to enhance the aquatic function, appearance, and stability of stream corridors. Stream restoration practices range from routine, simple stream repairs such as vegetative bank stabilization and localized grade control to comprehensive repairs such as full channel redesign and realignment. Stream corridor assessments (SCAs) performed in the Loch Raven North watershed identified restoration opportunities for stream repair and buffer reforestation. Stream segments identified during the SCAs with significant erosion and channel alteration were used to estimate pollutant load reductions which would result from stream repair efforts. Stabilizing the stream channel improves

water quality by preventing soil and the pollutants contained in it, from eroding into the stream and receiving waters. Lengths of eroded and altered channel segments were recorded during the SCAs.

3.2.3 Reforestation

Trees provide air and water quality benefits, as well as aesthetic value. They provide habitat for terrestrial and aquatic wildlife and shade that helps keep water temperatures low. Trees also help slow runoff and absorb nutrients through their root systems. Tree planting incentive programs can help increase the success of planting efforts. Converting open pervious areas into forested areas through tree planting can reduce pollutant loads to nearby water bodies and also reduce erosion. All of the pervious area assessments (PAAs) in the Loch Raven North watershed had potential for tree planting. 14 of the 15 PAAs within the Loch Raven North watershed are publicly owned and should be targeted for initial restoration efforts. This would provide a maximum of approximately 99 acres of publicly owned acres available for planting.

3.2.4 Street Sweeping

Street sweeping removes trash, sediment, and organic matter such as leaves and twigs from the curb and gutter system, preventing them from entering storm drains and nearby streams. This helps reduce sedimentation and pollutants, such as nutrients, oils, and metals, in the stream. Excessive organic matter clogs streams and storm drains resulting in costly maintenance. In addition, decay of a disproportionate amount of organic matter in the stream takes away oxygen needed for supporting aquatic life.

Neighborhoods with significant build-up along curbs and inlets were recommended for street sweeping during the neighborhood source assessments (NSAs). These areas will be referred to Baltimore County Department of Public Works (DPW) staff to determine whether street sweeping is conducted there and at what frequency. The majority of the build-up observed along curbs and inlets was organic material. Seasonal street sweeping may be an appropriate course of action for the watershed to address annual events such as tree leaf litter. This could address build-up of excessive curb and gutter material. Given the rural, potentially seasonal aspect of the recommended street sweeping, a conservative zero participation rate was given in the pollutant removal analysis pending the recommendations of the DPW.

3.2.5 Illicit Connection Detection/Disconnection

An Illicit Discharge Detection and Elimination program has been developed by Baltimore County to find and remediate discharges into streams that are harmful to aquatic life and water quality or that are causing erosion/sedimentation problems. The County will continue their Illicit Discharge Detection and Elimination program, seeking to improve techniques and methodologies for more effective reductions of these discharges. Pollutant reductions associated with this program are not included in pollutant removal

analysis due to the uncertainty in the contributions of illicit connection to overall pollutant loading rates. However, this program will provide a margin of safety in the overall nutrient reduction strategy.

3.3 Citizen-Based Strategies

The participation of citizens in watershed restoration is an essential part of the SWAP process. When large numbers of individuals become involved in citizen-based water quality improvement initiatives, changes can be made to the aesthetic and chemical aspects of waterways within a watershed that would not be possible otherwise. Citizen participation and stewardship is critical to the implementation and long-term maintenance of restoration activities. Key citizen-based strategies proposed for Loch Raven North are discussed in the following sections.

3.3.1 Reforestation

Trees improve water quality by capturing and removing pollutants in runoff including excess nutrients through their roots before the pollutants enter groundwater and streams. Tree leaves and stems also intercept precipitation, reducing the energy of raindrops and preventing excess erosion from their impact on the ground. In addition to water quality improvement, trees provide air quality, aesthetic, and economic benefits. For example, trees strategically planted around a house can form windbreaks to reduce heating costs in the winter and can provide shade, reducing cooling costs in the summer. Incentive programs, such as the Department of Natural Resources (DNR) Tree-Mendous Maryland program for planting on public or common spaces and Baltimore County's "Big Trees Sale" for planting on private property, can help increase the success of planting efforts. Additionally, for planting on larger properties, especially for reforestation greater than one acre, citizens can contact EPS about opportunities for reforestation "turf-to-trees" projects funded through the stormwater remediation fees. These projects cover site preparation, planting, deer shelters, and monitoring and maintenance for three years.

Riparian Buffer

Stream riparian buffers are critical to maintaining healthy streams and rivers. Forested buffer areas along streams improve water quality and prevent flooding by filtering pollutants, reducing surface runoff, stabilizing stream banks, trapping sediment, and providing habitat for various types of terrestrial and aquatic life. Buffer encroachment as a result of development and agriculture was noted during uplands and stream surveys conducted throughout the watershed. Areas on privately owned land (e.g. residential properties) can be targeted for buffer awareness initiatives to encourage landowners to plant and/or create a no-mow area adjacent to streams. Approximately 53,000 linear feet of inadequate buffer was identified during the SCAs and approximately 3,970 acres of stream buffer were categorized as open pervious area during desktop analysis. These are good candidates for tree planting and are targeted for initial buffer reforestation efforts.

Upland Pervious Areas

Converting private open areas in the upland portion of the watershed to forested areas through tree plantings can also reduce nutrient inputs to nearby streams and reduce erosion. Unutilized, large open areas on private land should be investigated for tree planting potential. One of the 15 PAAs within the

Loch Raven North watershed is privately owned and a portion of the property within the 100-foot buffer should be investigated for restoration efforts.

Shade Tree Plantings

Several opportunities for neighborhood tree plantings were identified during the NSAs. Opportunities for open space, shade tree plantings were also identified at several institutional sites. Open space trees provide aesthetic value in addition to air and water quality benefits. They provide shade and absorb nutrients through their root systems while also providing habitat for wildlife. Canvassing residents and/or contacting homeowner associations can be effective techniques for implementing an open space tree planting program within a neighborhood. Tree planting incentive programs mentioned previously can also help increase the success of planting efforts.

3.3.2 Downspout Disconnection

Disconnected downspouts that direct rooftop runoff to pervious surfaces can help reduce runoff and pollutants introduced to local streams. This can be achieved through downspout redirection (from impervious to pervious areas, i.e. driveways to lawns), rain barrels, and/or rain gardens. A combination of outreach and awareness techniques and financial incentives can be used to implement a downspout disconnection program in neighborhoods identified as potential candidates during NSAs. Pilot disconnection programs have been conducted in Upper Back River by Blue Water Baltimore (BWB) and the Center for Watershed Protection (CWP). Results from these programs can be used to inform successful techniques and strategies for Loch Raven North.

Rain Gardens

Although not all the neighborhoods were recommended for downspout disconnection, over 75% of the total neighborhoods had ample space for rain garden implementation. Rain gardens have many water quality benefits such as filtration of pollutants from runoff, recharging groundwater supply, and reducing total runoff and flooding potential. They also provide beautification of yards, attract and provide habitat for pollinators and birds, and do not require mowing. The Gunpowder Valley Conservancy (GVC) provides various workshops throughout the year in and near the watershed, including rain garden workshops where residents can learn how to create one on their own property.

3.3.3 Residential Nutrient Management

Raising awareness among citizens about some of the common activities around their homes and how those activities can negatively affect water quality is a vital, citizen-based strategy. Yards and lawns represent a significant portion of the pervious cover in a subwatershed and act as a major source of polluted runoff. Maintenance behaviors tend to be similar within individual neighborhoods and certain activities can impact subwatershed quality such as fertilization, pesticide use, watering, landscaping, and trash/yard waste disposal. Residential nutrient management efforts related to lawn maintenance and bayscaping can help reduce polluted runoff to nearby streams.

Lawn Maintenance Education

A well-maintained lawn can be beneficial to the watershed. However, lawn maintenance activities often involve over-fertilization, poor pest-management, and over watering resulting in polluted stormwater runoff to local streams. Lawns with a dense, uniform grass cover or signs designating poisonous lawn care indicate high lawn maintenance activities. With the passage of Maryland's Fertilizer Use Act in 2011, the amount of phosphorus and nitrogen contained in fertilizers sold in Maryland is regulated, limiting the amounts of nutrients that can be applied to lawns (MDA, 2011). Neighborhoods identified as having high lawn maintenance practices should still be targeted for awareness programs emphasizing responsible fertilizing techniques such as proper application amount, proper time of year for fertilization, soil testing for nutrient requirements, and keeping fertilizers away from impervious surfaces. Lawn maintenance education can be achieved through door-to-door canvassing, informational brochures/mailings, excerpts in community newsletters, or demonstrations at community meetings. Information on organic alternatives to chemical lawn treatments should also be included in these outreach efforts. Due to the enactment of the 2011 Fertilizer Use Act, specific pollution reductions for lawn maintenance education are not computed for Loch Raven North.

Bayscaping

Reducing the amount of mowed lawn and increasing landscaping features provides water quality benefits through interception and filtration of stormwater runoff. Bayscaping refers to the use of plants native to the Chesapeake Bay watershed for landscaping. Because they are native to the region, these plants require less irrigation, fertilizers, and pesticides to maintain as compared to non-native or exotic plants. This means less stormwater pollution and lawn maintenance requirements. Bayscaping is also beneficial to wildlife. Similar to lawn maintenance education, bayscaping awareness can be raised through informational brochures/mailings, excerpts in community newsletters, or demonstrations at community meetings. The GVC also provides workshops on bayscaping throughout the year. A combination of outreach/awareness techniques and financial incentives can be used to implement a bayscaping program in neighborhoods identified as potential candidates during the NSAs. Specific pollution reductions for bayscaping were not computed for Loch Raven North.

3.4 Agricultural Best Management Practices

Agriculture makes up approximately 36% of the total land use in Loch Raven North covering approximately 21,800 total acres. There are many agricultural BMPs used by farmers aimed to reduce soil loss, trap nutrients, and minimize nutrient and pesticide use on land. Chapter 2 of the *Loch Raven North Watershed Characterization Report* (Appendix E) lists the current agricultural BMPs being used on farmland throughout the watershed. The Maryland Department of Agriculture in conjunction with the Baltimore County Soil Conservation District works with farms to implement BMPs in an effort to meet water quality standards. While the county does not receive pollution reduction credit for implemented agricultural BMPs, it will continue to work with the agricultural community to help achieve overall pollution reduction goals for the watershed. A few of the major agricultural BMPs being applied in the watershed are explained below.

3.4.1 Farm Conservation Plans

Farm conservation plans are agronomic, management, and engineered practices that protect and improve soil and water quality and prevent deterioration of natural resources on or adjacent to farms. Plans include BMPs to manage the farm's resources, control soil erosion, and protect water quality. The

Maryland Department of Agriculture refers to these plans as Soil Conservation and Water Quality Plans (SCWQP). These plans are required on farmland enrolled in the Maryland Agricultural Land Preservation Foundation Program and by the Federal Food Security Act on all highly erodible lands. Some of the BMPs that can be included in a farm conservation plan that apply to the Loch Raven North watershed are discussed below.

Agricultural Riparian Forest/Grass Buffers

Riparian buffers are wooded or grassy areas along streams that help filter nutrients, sediments, and other pollutants from upland areas and help remove nutrients from groundwater. Forest buffers also help control flooding and reduce erosion while creating habitat for wildlife. Mature forest buffers can help remove nutrients in stormwater runoff. Grass buffers have these same advantages but forested buffers are preferable. Agricultural open pervious areas identified within the 100-foot stream buffer during SCAs and through Geographic Information System (GIS) analysis are good candidates for tree planting and should be targeted for initial buffer restoration efforts.

Cover Crops

Implementation of cover crops improves water quality by recycling unused plant nutrients and protecting fields against wind and water erosion. The crops retain excess nitrogen and phosphorus that would likely runoff with stormwater during rain events. This practice can also increase the productivity of farmland and improve the soil for the next year's crops. Maryland nutrient management regulations require farmers to plant cover crops when organic nutrient sources are applied to the field in the fall.

Stream Protection with Fencing

Stream protection with fencing restricts livestock access to waterways. Limited access protects stream buffers from livestock and reduces the effects large animals can have on bank erosion and bacterial contamination from animal waste.

3.4.2 Nutrient Management Plans

As a requirement of the Maryland Water Quality Improvement Act of 1998, all Maryland farmers grossing $2,500 or more annually or raising 8,000 pounds or more of live animal weight are required to produce and operate using a nutrient management plan that addresses nitrogen and phosphorus inputs. The nutrient management plans aim to specify the amount of nutrient sources (i.e. fertilizer, manure, etc.) that can safely be applied to farmland in order to achieve yields and prevent excess nutrients from entering waterways.

3.5 Pollutant Loading & Removal Analyses

This section presents results of the watershed pollutant loading analysis performed to estimate current nutrient and sediment loads generated by the various non-point and septic sources within the Loch Raven North watershed. Also discussed are the pollutant removal calculations for proposed BMPs to ensure that Total Maximum Daily Load (TMDL) requirements are met in the Loch Raven North watershed.

3.5.1 Pollutant Loading Analysis

A pollutant loading analysis was performed to estimate total nitrogen, total phosphorus, and total sediment loads currently generated by all non-point and septic sources present within the Loch Raven North watershed.

3.5.1.1 Land-Use Pollutant Loading

Land-use pollutant loading estimates were based on Maryland Department of Planning's (MDP) 2010 Land Use/Land Cover (LU/LC) GIS layer and pollutant loading rates derived by Baltimore County from the Chesapeake Bay Program October 2011 Watershed Model. The pollutant loading analysis is described in detail in Chapter 3.3 of the *Watershed Characterization Report* (Appendix E). Table 3-1 summarizes the results from the watershed pollutant loading analysis including areas, pollutant loading rates, and annual pollutant load for each nonpoint source/land use type.

Table 3-1: Annual Loch Raven North Land-Use Nitrogen, Phosphorus, and Total Suspended Solids Loads

		NITROGEN		PHOSPHORUS		SEDIMENT	
WRE Land Use	Area (acres)	Loading Rate (lbs/ac)	Load (lbs)	Loading Rate (lbs/ac)	Load (lbs)	Loading Rate (lbs/ac)	Load (lbs)
Impervious Urban	2,068	17.36	35,909	1.51	3,123	1,601.51	3,312,700
Pervious Urban	8,088	11.55	93,414	0.30	2,426	220.64	1,784,482
Cropland	17,479	23.08	403,405	1.32	23,072	1,111.18	19,421,808
Pasture	6,646	7.76	51,577	0.72	4,785	277.62	1,845,197
Livestock (AFO/CAFO)	50	162.74	8,206	23.92	1,206	4,099.94	206,732
Forest and Wetlands	27,036	2.77	74,890	0.04	1,081	64.36	1,740,032
Water*	15	-	-	-	-	-	-
Extractive	46	16.30	750	2.59	119	2966.60	136,499
Total	***61,428***		***668,149***		***35,814***		***28,447,451***

* Nutrient loadings from water were not included in the analysis

3.5.1.2 Septic System Pollutant Loading

Homes, businesses, and institutions, which manage wastewater from their site through the utilization of septic systems, contribute nitrogen loading in the watershed via groundwater deposition. Over 6,500 septic systems are used in the Loch Raven North watershed. Septic systems are classified by their location in the watershed as either within 1,000 feet of a stream, within the Critical Area Buffer, or greater than 1,000 feet of a stream. Unique loading rates were developed for each category to determine the nitrogen loading from individual septic systems, described in detail in Section 3.3.2 of the *Watershed Characterization Report* (Appendix E). Table 3-2 summarizes the estimated nitrogen pollutant loading from septic systems in Loch Raven North developed by the Maryland Department of the Environment (MDE), Chesapeake Bay Program (CBP), and EPS.

Table 3-2: Loch Raven North Pollutant Loads from Septic Systems

Pollution Source	Total # of Septic Systems	Total Nitrogen Load (lb/year)	Total Phosphorus Load (lb/year)	Total Sediment Load (lb/year)
Septic Systems	6,554	66,878	-	-

3.5.2 Pollutant Removal Analysis

As discussed in Chapter 1, as part of the Loch Raven Reservoir TMDLs, a reduction in total phosphorus and sediment loads from urban stormwater discharges is necessary to meet water quality standards. The load reductions needed for Loch Raven North to achieve this are summarized in Table 3-3. Full implementation is required for the Loch Raven Reservoir TMDL by 2025.

Table 3-3: Loch Raven North Pollutant Load Reductions Based on Loch Raven Reservoir TMDL

Source	Area (acres)	Total Nitrogen (lbs/yr)	Total Phosphorus (lbs/yr)	Total Sediment (lbs/yr)
Urban Load	10,156	129,322	5,550	5,097,183
2025 Reduction Goal:		-	832	204,111

Reductions towards the Loch Raven Reservoir TMDL also have partial reduction credit to the Chesapeake Bay TMDL based on the delivery ratio of each pollutant as shown in Table 3-4. The reduction goals to meet the Chesapeake Bay TMDL are shown in Table 3-5. The Chesapeake Bay TMDL reduction goals are calculated based on the Maryland Assessment Scenario Tool (MAST) target loads; for nitrogen: 32.2% reduction and for phosphorus: 47.0% reduction (EPS, 2012). Given the partial delivery ratio to the Chesapeake Bay, the primary objective of this SWAP is to meet local TMDL reduction requirements.

Table 3-4: Pollutant Delivery Ratios from the Loch Raven Reservoir to the Chesapeake Bay

	Total Nitrogen Delivery Ratio	Total Phosphorus Delivery Ratio	Total Sediment Delivery Ratio
Loch Raven North	25.9%	36.0%	22.5%

Table 3-5: Loch Raven North Watershed Pollutant Load Reductions Based on Chesapeake Bay TMDL

Source	Area (acres)	Total Nitrogen (lbs/yr)	Total Phosphorus (lbs/yr)	Total Sediment (lbs/yr)
Urban Load	10,156	129,322	5,550	5,097,183
2025 Reduction Goal:		41,642	2,608	-

The following sections present a quantitative analysis of pollutant removal capabilities of proposed BMPs to ensure that the required reductions in nutrient loads from urban runoff in the Loch Raven North watershed are achieved. Note that many of the removal efficiencies used to estimate pollutant reductions are based on the peer-reviewed and CBP-approved nonpoint source BMP tables developed for the Phase 5.0 CBP Watershed Model. Additional pollutant reductions from the 2011 MDE *Draft Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated,* the 2014 MDE *Accounting for Stormwater Wasteload Allocations and Impervious Acres*, and the 2013 *Recommendations of the Expert Panel to Define Removal Rates for Urban Nutrient Management* were used if values were not available in the BMP tables. These documents are included in Appendix C. Also note that the calculations and estimates presented in the following subsections represent maximum potential pollutant removal capabilities.

A summary of overall pollutant load reduction estimates is presented at the end of this section for two

scenarios: a maximum implementation scenario and the projected implementation schedule to meet the 2025 milestone.

3.5.2.1 Existing Urban Restoration Practices

Stormwater Management (SWM)

As described in Section 2.3.7.2 of the *Watershed Characterization Report* (Appendix E), there are 112 existing SWM facilities in Loch Raven North including dry and wet ponds, underground detention, wetlands, infiltration and filtration practices, extended detention, grass swales and channels, and other types of SWM facilities (i.e. environmentally sensitive design). The pollutant removal capability of existing SWM facilities in the watershed is not accounted for in the pollutant loading analysis. Therefore, it is included in the pollutant removal analysis.

Pollutant reductions for existing SWM are calculated based on the approximate pollutant load received from the drainage area (DA) and removal efficiencies recommended by CBP for the various types of SWM facilities. The equation used to estimate total nitrogen (TN) load reductions for a particular type of SWM facility is expressed as:

[12.73 (*lbs/ac/yr*) x *DA (acres)*] x *efficiency (%)*

The equation used to estimate total phosphorus (TP) load reductions for a particular type of SWM facility is expressed as:

[0.55 (*lbs/ac/yr*) x *DA (acres)]* x *efficiency (%)*

The equation used to estimate total suspended solids (TSS) load reductions for a particular type of SWM facility is expressed as:

[502 (*lbs/ac/yr*) x *DA (acres)*] x *efficiency (%)*

The pollutant load received from the drainage area contributing to the SWM facility is denoted by the first expression in brackets in each of the above equations. The pollutant loading rates shown, 12.73 lbs TN/ac/yr, 0.55 lbs TP/ac/yr, and 502 lbs TSS/ac/yr, represent weighted averages of impervious and pervious urban rates used in the pollutant loading analysis (Table 3-1) since this represents the likely sources of runoff being treated. Note that impervious and pervious urban loading rates are based on CBP's Phase 5.3 Watershed Model run from October of 2011. The percent pollutant removal efficiency depends on the type of facility and is based on the values shown in Appendix C under CBP's BMP Table for *Urban BMPs*. The total pollutant load reduction expected from existing SWM is a sum of the removal capacities of the individual facilities. A summary of existing SWM load reduction calculations and results are shown in Table 3-6.

Table 3-6: Existing SWM Load Reductions

SWM Facility Type	No. (#)	DA (acres)	TN Load From DA (lbs/ac/yr)*	TN Removal Efficiency (%)	Max Potential TN Load Reduction (lbs/yr)	TP Load from DA (lbs/ac/yr)*	TP Removal Efficiency (%)	Max Potential TP Load Reduction (lbs/yr)	TSS Load from DA (lbs/ac/yr)*	TSS Removal Efficiency (%)	Max Potential TSS Load Reduction (lbs/yr)
Dry Pond	12	129.1	12.73	5%	82	0.55	10%	7.1	502	10%	6,479
Underground Detention	2	9.0	12.73	5%	6	0.55	10%	0.5	502	10%	452
Wetland	3	26.7	12.73	20%	69	0.55	45%	6.7	502	60%	8,040
Infiltration	15	66.2	12.73	80%	675	0.55	85%	30.8	502	95%	31,578
Filtration	36	229.2	12.73	40%	1,167	0.55	60%	75.1	502	80%	92,024
Extended Detention	27	242.1	12.73	20%	617	0.55	20%	26.6	502	60%	72,902
Grass Swales & Channels	6	4.8	12.73	10%	6	0.55	10%	0.3	502	50%	1,214
Other	11	22.4	12.73	50%	142	0.55	60%	7.3	502	90%	10,097
Totals:	***112***	***729.5***			***2,763***			***154.1***			***222,787***

*Based on weighted average of impervious and pervious urban loading rates

County Restoration Programs

Baltimore County tracks the annual sale of rain barrels and estimates the rate of installation and corresponding pollutant reductions attributed to each sale. It is estimated that each barrel drains 250 square feet of rooftop for pollutant reductions purposes. Since 2011, 139 barrels have been sold in the Loch Raven North watershed. Pollutant reduction for rain barrels were calculated using the BMP removal efficiencies reported by MDE (MDE, 2011) as shown in Appendix C. The equation used to estimate total nitrogen (TN) load reductions due to rain barrels is expressed as:

[17.36 *(lbs/ac/yr)* x *DA (acres)*] x 50%

The equation used to estimate total phosphorus (TP) load reductions due to rain barrels is expressed as:

[1.51 *(lbs/ac/yr)* x *DA (acres)*] x 60%

The equation used to estimate TSS load reductions due to rain barrels is expressed as:

[1,602 *(lbs/ac/yr)* x *DA (acres)*] x 90%

The pollutant load received from the rooftop drainage area contributing to the rain barrels is denoted by the first expression in brackets in each of the above equations, which is the impervious urban loading rate.

Local watershed associations organize volunteers to plant trees throughout the watershed. Baltimore

County EPS keeps track of the number of trees being planted, the acres being planted, and whether the plantings are in a stream buffer area or in an upland area. In 2014, 1.0 acre of stream buffer was planted and 0.51 acres of upland area was planted. Nutrient reductions for reforestation were estimated based on acre of land use change from pervious urban to forest. The equation used to estimate TN load reductions for reforestation is expressed as:

[11.55 *(lbs/ac/yr)* – 2.77 *(lbs/ac/yr)*] x *Open Pervious Area (acres)*

The equation used to estimate TP load reductions for the land use conversion portion of stream buffer reforestation is expressed as:

[0.30 *(lbs/ac/yr)* – 0.04 *(lbs/ac/yr)*] x *Open Pervious Area (acres)*

The equation used to estimate TSS load reductions for the land use conversion portion of stream buffer reforestation is expressed as:

[221 *(lbs/ac/yr)* – 64 *(lbs/ac/yr)*] x *Open Pervious Area (acres)*

The loading rate is reduced by a factor equal to the difference between pervious urban and forest loading rates used in the watershed pollutant loading analysis, as shown in the first expression in brackets in the equations above. The approximate reduction in pollutant load is then the reduced loading rate multiplied by the estimated area planted (i.e. the expression in the second brackets in the equations above).

For reforestation of stream buffers, an additional pollutant removal factor is added to the land use conversion to determine the total removal capacity of buffer reforestation. Per the BMP performance guidance from CBP under CBP's BMP Table for *Urban BMPs* in Appendix C, 1 acre of buffer treats approximately 1 acre of upland area for nitrogen, phosphorus, and sediment with varying efficiencies for urban and mixed open buffers. The weighted loading rate for the entire watershed is used to represent this upland area and is the final number in brackets in the equations below. The TN total reductions for the removal efficiency portion of buffer reforestation can be expressed as:

$$\left[Open\ Pervious\ Area\ (acres) \times \frac{1\ (upland\ acres)}{1\ (buffer\ acre)} \times 12.73\ (lbs/ac/yr) \right] \times 25\%$$

The TP load reductions for the removal efficiency portion of buffer reforestation can be expressed as:

$$\left[Open\ Pervious\ Area\ (acres) \times \frac{1\ (upland\ acres)}{1\ (buffer\ acre)} \times 0.54\ (lbs/ac/yr) \right] \times 50\%$$

The TSS load reductions for the removal efficiency portion of buffer reforestation can be expressed as:

$$\left[Open\ Pervious\ Area\ (acres) \times \frac{1\ (upland\ acres)}{1\ (buffer\ acre)} \times 502\ (lbs/ac/yr) \right] \times 50\%$$

The land use conversion and additional removal efficiency are added to yield a total pollutant load reduction for buffer reforestation. A summary of load reductions for existing rain barrel sales and local watershed associations' reforestation efforts are shown in Table 3-7.

Table 3-7: Existing Pollutant Load Reductions from Rain Barrel Sales and Big Tree Sales

Pollutant	Rain Barrels Sold (#)	Load Reduction from Rain Barrels (lbs/yr)	Upland Reforestation (acres)	Load Reduction from Upland Reforestation (lbs/yr)	Buffer Reforestation (acres)	Load Reduction from Buffer Reforestation (lbs/yr)	*Total Load Reduction (lbs/yr)*
TN	139	7	0.5	4	1.0	12	***23***
TP	139	1	0.5	0	1.0	1	***1***
TSS	139	1,150	0.5	80	1.0	407	***1,637***

3.5.2.2 Agricultural Best Management Practices

The Loch Raven North watershed is approximately 36% agricultural land use. As of August 2014, there were approximately 750 documented agricultural BMPs in the Loch Raven North watershed as reported in Chapter 2 of the *Loch Raven North Watershed Characterization Report* (Appendix E). The Maryland Department of Agriculture and the Baltimore County Soil Conservation district will continue to work with farmers throughout the County to track and encourage BMP implementation on farmland in an effort to achieve agricultural TMDL pollutant reductions. Baltimore County will work with the agricultural community to help achieve the Loch Raven Reservoir and Chesapeake Bay TMDLs.

3.5.2.3 Proposed Urban Restoration Practices

Stormwater Retrofits

Proposed stormwater retrofits for the purposes of this SWAP refer to implementing BMPs to capture and treat runoff from impervious surfaces (i.e. parking lots, roadways), which are currently untreated. This includes sites identified for retrofit potential during the uplands surveys for neighborhoods, institutions, and publicly owned stormwater hotspots. Pollutant reductions for stormwater retrofits are calculated based on the approximate pollutant load received from the impervious drainage area (DA) and removal efficiency for BMP practices. The equation used to estimate TN load reductions for stormwater retrofits is expressed as:

$$[17.36\ (lbs/ac/yr) \times DA\ (acres)] \times 50\%$$

The equation used to estimate TP load reductions for stormwater retrofits is expressed as:

$$[1.51\ (lbs/ac/yr) \times DA\ (acres)] \times 60\%$$

The equation used to estimate TSS load reductions for stormwater retrofits is expressed as:

$$[1{,}602\ (lbs/ac/yr) \times DA\ (acres)] \times 90\%$$

The pollutant load received from the drainage area contributing to the SWM facility is denoted by the first expression in brackets in the equations above. The pollutant loading rates shown, 17.36 lbs TN/ac/yr, 1.51 lbs TP/ac/yr, and 1,602 lbs TSS/ac/yr, are the impervious urban rates used in the pollutant loading analysis (Table 3-1) since this represents the source of runoff being treated. Pollutant removal efficiencies are those cited by MDE for BMP practices as shown in Appendix C (MDE, 2011). A summary of stormwater

retrofit load reduction calculations and results for the Loch Raven North SWAP area are shown in Table 3-8.

Table 3-8: Stormwater Retrofit (Bioretention Practices) Load Reductions

Pollutant	Impervious Urban Loading Rate (lbs/ac/yr)	Impervious Area for SW Retrofit (acres)	Load from DA (lbs/yr)	Removal Efficiency (%)	Max Potential Load Reduction (lbs/yr)
TN	17.36	8.2	142	50%	71
TP	1.51	8.2	12	60%	7
TSS	1,602	8.2	13,086	90%	11,777

Impervious Cover Removal

Potential sites for impervious cover removal were identified at multiple institutions. Pollutant reductions for impervious cover removal are calculated based on a land use conversion from impervious to pervious urban. The equation used to estimate TN load reductions for impervious cover removal is expressed as:

[17.36 *(lbs/ac/yr)* – 11.55 *(lbs/ac/yr)*] x *Impervious Area (acres)*

The equation used to estimate TP load reductions for impervious cover removal is expressed as:

[1.51 *(lbs/ac/yr)* – 0.30 *(lbs/ac/yr)]* x *Impervious Area (acres)*

The equation used to estimate TSS load reductions for impervious cover removal is expressed as:

[1,602 *(lbs/ac/yr)* – 221 *(lbs/ac/yr)*] x *Impervious Area (acres)*

Impervious cover removal involves converting impervious surfaces to pervious surfaces such as turf or permeable paving. Therefore, the loading rate would be reduced by a factor equal to the difference between impervious and pervious urban loading rates used in the watershed pollutant loading analysis (Table 3-1) as shown in the first expression in brackets in the equations above. The approximate reduction in pollutant load is then the reduced loading rate multiplied by the area proposed for impervious cover removal. All of the impervious cover removal recommended and included in the removal calculation is located on publicly owned lands. A summary of impervious cover removal calculations and results are shown in Table 3-9.

Table 3-9: Impervious Cover Removal Load Reductions

Pollutant	Impervious Urban Loading Rate (lbs/ac/yr)	Pervious Urban Loading Rate (lbs/ac/yr)	Reduction in Loading Rate (lbs/ac/yr)	Impervious Area Removed (acres)	Max. Potential Load Reduction (lbs/yr)
TN	17.36	11.55	5.81	0.25	1.45
TP	1.51	0.30	1.21	0.25	0.30
TSS	1,602	221	1,381	0.25	344

Downspout Disconnection

A total of 23 neighborhoods (out of 67 surveyed) have potential for downspout disconnection. A neighborhood is recommended for disconnection if at least 25 percent of the downspouts are directly and/or indirectly connected to the storm drain system and the average lot has at least 15 feet of pervious area available down gradient from the downspout. During the uplands assessments, the percentage of homes with connected downspouts was noted. This percentage was used to determine the rooftop area that could be addressed by disconnection in recommended neighborhoods. This is explained in further detail in Chapter 4 of the *Watershed Characterization Report* (Appendix E).

Pollution reductions for downspout disconnection are calculated based on the pollutant load received from the total rooftop DA recommended for disconnection and the pollutant removal efficiency cited by MDE for "Disconnection of Rooftop Runoff" as shown in Appendix C (MDE, 2011). The equation used to estimate TN load reductions for downspout disconnection is expressed as:

[17.36 *(lbs/ac/yr)* x *DA (acres)*] x 50%

The equation to estimate TP load reductions for downspout disconnection is expressed as:

[1.51 *(lbs/ac/yr)* x *DA (acres)*] x 60%

The equation used for TSS load reductions for downspout disconnection is expressed as:

[1,602 *(lbs/ac/yr)* x *DA (acres)*] x 90%

The pollutant load received from the impervious rooftop drainage area recommended for disconnection is denoted by the first expression in brackets in the equation above. The pollutant loading rates show, 17.36 lbs TN/ac/yr, 1.51 lbs TP/ac/yr, and 1,602 lbs TSS/ac/yr, are the impervious urban rates used in the pollutant loading analysis. A summary of downspout disconnection load reduction calculations and results are shown in Table 3-10.

Table 3-10: Downspout Disconnection Load Reductions

Pollutant	Impervious Urban Loading Rate (lbs/ac/yr)	DA (Rooftop area recommended for disconnection) (acres)	Removal Efficiency (%)	Max. Potential Load Reduction (lbs/yr)
TN	17.36	14.9	50%	130
TP	1.51	14.9	60%	14
TSS	1,602	14.9	90%	21,516

Stream Buffer Reforestation

The current vegetative condition of the stream riparian buffer (100 feet on either side of a stream system) was analyzed in Section 2.2.7.2 of the *Watershed Characterization Report* (Appendix E). Buffer conditions were either classified as impervious, open pervious, or forested areas. Open pervious areas are the best areas to initially target for restoration. Approximately 3,972 acres of open pervious area were identified within the stream buffer zone.

Pollutant reductions for stream buffer reforestation are calculated based on a land use conversion from pervious urban to forest plus an additional reduction efficiency per BMP performance guidance from CBP. The equation used to estimate TN load reductions for the land use conversion portion of stream buffer reforestation is expressed as:

[11.55 *(lbs/ac/yr)* – 2.77 *(lbs/ac/yr)*] x *Open Pervious Area (acres)*

The equation used to estimate TP load reductions for the land use conversion portion of stream buffer reforestation is expressed as:

[0.30 *(lbs/ac/yr)* – 0.04 *(lbs/ac/yr)*] x *Open Pervious Area (acres)*

The equation used to estimate TSS load reductions for the land use conversion portion of stream buffer reforestation is expressed as:

[221 *(lbs/ac/yr)* – 64 *(lbs/ac/yr)*] x *Open Pervious Area (acres)*

The first expression in brackets in the equations above represents the difference between pervious urban and forest loading rates used in the watershed pollutant loading analysis (Table 3-1). This reduction in loading rate is then multiplied by the available open pervious area for reforestation to determine the load reductions from land use conversion.

An additional pollutant removal factor is added to the land use conversion to determine the total removal capacity of buffer reforestation. Per the performance guidance in CBP's BMP Table for *Urban BMPs* shown in Appendix C, 1 acre of buffer treats approximately 1 acre of upland area for nitrogen, phosphorus, and sediment with varying efficiencies for urban and mixed open buffers. The weighted loading rate for the entire watershed is used to represent this upland area and is the final number in brackets in the equations below. The TN total reductions for the removal efficiency portion of buffer reforestation can be expressed as:

$$\left[Open\ Pervious\ Area\ (acres) \times \frac{1\ (upland\ acres)}{1\ (buffer\ acre)} \times 12.73\ (lbs/ac/yr) \right] \times 25\%$$

The TP load reductions for the removal efficiency portion of buffer reforestation can be expressed as:

$$\left[Open\ Pervious\ Area\ (acres) \times \frac{1\ (upland\ acres)}{1\ (buffer\ acre)} \times 0.54\ (lbs/ac/yr) \right] \times 50\%$$

The TSS load reductions for the removal efficiency portion of buffer reforestation can be expressed as:

$$\left[Open\ Pervious\ Area\ (acres) \times \frac{1\ (upland\ acres)}{1\ (buffer\ acre)} \times 502\ (lbs/ac/yr) \right] \times 50\%$$

The loading rates shown in the equations above represent the overall urban loading rates. This is estimated as the weighted average of urban impervious and urban pervious land use within the watershed. These are used to calculate the pollutant load from the upland area that would be treated by buffer reforestation of urban pervious land. There are 3,972 areas of open pervious area identified, of which 2,504 acres are agricultural land; leaving 1,468 acres of urban pervious land available for stream buffer reforestation. As mentioned, the land use conversion and additional removal efficiency are added to yield a total pollutant load reduction. A summary of stream buffer reforestation calculations and results are shown in Table 3-11.

Table 3-11: Stream Buffer Reforestation Load Reductions

		LU CONVERSION			BUFFER BMP REMOVAL			
Pollutant	Open Urban Pervious Area (acres)	Pervious Urban Loading Rate (lbs/ac/yr)	Forest Loading Rate (lbs/ac/yr)	Land Use Conversion Reduction (lbs/yr)	Reduction Efficiency (%)	Overall Urban Loading Rate (lbs/ac/yr)	Efficiency Load Reduction (lbs/yr)	Max. Potential Load Reduction (lbs/yr)
TN	1,468	11.55	2.77	12,883	25%	12.73	4,671	17,554
TP	1,468	0.30	0.04	381	50%	0.54	401	782
TSS	1,468	221	64	229,309	50%	502	368,201	597,510

Tree Plantings

Several opportunities for planting open space trees were identified in neighborhoods and institutions during the uplands assessments. Tree planting opportunities were also identified for pervious areas through a desktop analysis. For neighborhood, institution, and pervious area tree planting opportunities, the number of trees was estimated based on a density of 100 trees per acre. Pollutant reductions for pervious area reforestation are calculated based on a land use conversion from pervious urban to forest. An approximation of 100 trees per acre is used to calculate the area available for conversion. The equation used to estimate TN load reductions for tree plantings is expressed as:

[11.55 *(lbs/ac/yr)* – 2.77 *(lbs/ac/yr)*] x [# Trees x (1 acre)/100 Trees]

The equation to estimate TP load reductions for tree plantings is expressed as:

[0.30 *(lbs/ac/yr)* – 0.04 *(lbs/ac/yr)*] x [# Trees x (1 acre)/100 Trees]

The equation used for TSS load reductions for tree plantings is expressed as:

[221 *(lbs/ac/yr)* – 64 *(lbs/ac/yr)*] x [# Trees x (1 acre)/100 Trees]

Tree plantings involve converting open pervious area to forest. Therefore, the loading rate would be reduced by a factor equal to the difference between pervious urban and forest loading rates used in the watershed pollutant loading analysis, as shown in the first expression in brackets in the equations above. The approximate reduction in pollutant load is then the reduced loading rate multiplied by the open pervious area available for reforestation (i.e. the expression in the second brackets in the equations above). Any tree planting in the 100 foot stream buffer was excluded from the reductions to avoid double counting. A summary of tree planting load reduction calculations and results are shown in Table 3-12, Table 3-13, and Table 3-14.

Table 3-12: Neighborhood Open Space and Tree Canopy Planting Load Reductions

Pollutant	Pervious Urban Loading Rate (lbs/ac/yr)	Forest Loading Rate (lbs/ac/yr)	Reduced Loading Rate (lbs/ac/yr)	Estimated # Trees for NSAs (#)	New Forest Area (acres)	Max. Potential Load Reduction (lbs/yr)
TN	11.55	2.77	8.78	106,059	1,061	9,312
TP	0.30	0.04	0.26	106,059	1,061	276
TSS	221	64	156	106,059	1,061	165,749

Table 3-13: Institution Tree Planting Load Reductions

Pollutant	Pervious Urban Loading Rate (lbs/ac/yr)	Forest Loading Rate (lbs/ac/yr)	Reduced Loading Rate (lbs/ac/yr)	Estimated # Trees for ISIs (#)	New Forest Area (acres)	Max. Potential Load Reduction (lbs/yr)
TN	11.55	2.77	8.78	3,724	37	327
TP	0.30	0.04	0.26	3,724	37	10
TSS	221	64	156	3,724	37	5,820

Table 3-14: Pervious Area Tree Planting Load Reductions

Pollutant	Pervious Urban Loading Rate (lbs/ac/yr)	Forest Loading Rate (lbs/ac/yr)	Reduced Loading Rate (lbs/ac/yr)	Estimated # Trees for PAAs (#)	New Forest Area (acres)	Max Potential Load Reduction (lbs/yr)
TN	11.55	2.77	8.78	7,283	73	639
TP	0.30	0.04	0.26	7,283	73	19
TSS	221	64	156	7,283	73	11,382

Street Sweeping

Three neighborhoods were recommended for street sweeping in the Loch Raven North watershed and

contain a total of approximately 2.5 miles of road. A review of the aerial mapping of the SWAP area and specifically the neighborhoods recommended for street sweeping was conducted and an average street width of 26 feet was assumed to determine the total area of street sweeping.

Pollutant reductions for street sweeping are calculated based on the pollutant load received from the total street DA recommended for sweeping and removal efficiency. Pollution reduction efficiencies were obtained from the 2014 *Accounting for Stormwater Wasteload Allocations and Impervious Areas Treated* guidance from MDE shown in Appendix C. The equation used to estimate TN load reductions for street sweeping is expressed as:

[17.36 *(lbs/ac/yr)* x *DA (acres)*] x 5%

The equation used to estimate TP load reductions for street sweeping is expressed as:

[1.51 *(lbs/ac/yr)* x *DA (acres)*] x 6%

The equation used to estimate TSS load reductions for street sweeping is expressed as:

[1,602 *(lbs/ac/yr)* x *DA (acres)*] x 25%

The pollutant load received from the roadway areas recommended for street sweeping is represented by the first term in the brackets above, which is the impervious urban pollutant loading rate. Removal efficiencies are those reported for regenerative/vacuum street sweeping. A summary of street sweeping reduction calculations and results are shown in Table 3-15.

Table 3-15: Street Sweeping Load Reductions

Pollutant	Impervious Urban Loading Rate (lbs/ac/yr)	Proposed Miles of Street Sweeping (miles)	Proposed Area of Street Sweeping* (acres)	Removal Efficiency (%)	Max Potential Load Reduction (lbs/yr)
TN	17.36	2.5	8.0	5%	7
TP	1.51	2.5	8.0	6%	1
TSS	1,602	2.5	8.0	25%	3,203

*Estimated based on 26 foot road width

Stream Corridor Restoration

Stream corridor restoration practices are used to enhance the appearance, stability, and aquatic function of stream corridors. These practices include stream stabilization (i.e. grading and vegetative stabilization) and stream restoration (i.e. redesign and realignment). Several potential stream restoration sites were identified during the SCAs to improve water quality and address potential environmental problem sites, such as significant erosion and channel alterations. The SCAs are explained in Section 3.6 of the *Watershed Characterization Report* (Appendix E). Stream corridor assessments were conducted in four subwatersheds: Fourth Mine Branch, Piney Creek, Mingo Branch, and Panther Branch. Stream restoration sites identified in the 1997 Water Quality Management Plan for Loch Raven Watershed were also utilized for potential pollutant reduction calculations. This included impaired stream reaches identified in the Beetree Run subwatershed and the Carroll Branch subwatershed. Pollutant reduction for stream corridor

restoration are calculated based on EPA approved interim load reduction factors reported in the 2014 MDE report, *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* shown in Appendix C and are multiplied by the linear feet of identified significant erosion and channel alteration sites. The equation used to estimate TN load reductions for stream restoration is expressed as:

0.075 *(lbs/ft)* x *Restoration Length (ft)*

The equation used to estimate TP load reductions for stream restoration is expressed as:

0.068 *(lbs/ft)* x *Restoration Length (ft)*

The equation used to estimate TSS load reductions for stream restoration is expressed as:

44.900 *(lbs/ft)* x *Restoration Length (ft)*

Very Severe or Severe erosion lengths or channel alteration lengths were documented for approximately 0.42% of the total surveyed stream length (2,171 feet) during the Loch Raven North SCA. Additionally, as part of the 1997 Water Quality Management Plan for Loch Raven Watershed, approximately 12,400 feet of stream were rated as impaired. A summary of stream corridor restoration reduction calculations and results are shown in Table 3-16.

Table 3-16: Stream Restoration Load Reductions for Stream Reaches in Loch Raven North

		Loch Raven North SCAs		1997 Loch Raven Water Quality Management Plan		
Pollutant	Reduction in Loading Rate (lbs/ft/yr)	Length of Very Severe and Severe Sites (ft)	Max. Potential Load Reduction (lbs/yr)	Length of Slightly Poor to Very Poor Sites (ft)	Max. Potential Load Reduction (lbs/yr)	Combined Max Potential Load Reduction (lbs/yr)
TN	0.075	2,171	163	12,400	930	1,093
TP	0.068	2,171	148	12,400	843	991
TSS	44.900	2,171	97,475	12,400	556,760	654,235

Fertilizer Act of 2011

On May 19, 2011, Governor Martin O'Malley signed the Fertilizer Use Act of 2011, an environmental law designed to reduce the amount of nutrients washing into the Chesapeake Bay from lawns, golf courses, parks, recreation areas, and other non-agricultural sources. The law limits the amount of phosphorus contained in lawn fertilizer products sold to the public, establishes a training, verification, and licensing program for people who are hired to apply fertilizer to non-agricultural landscapes, limits fertilizer amounts applied to turf, and requires the implementation of a homeowner education program about best management practices to be followed when using fertilizers (MDA, 2011). The Fertilizer Act was fully implemented in October of 2013 and contains new content requirements and labeling instructions including restricting phosphorus and decreasing nitrogen amounts in fertilizer sold in Maryland.

Pollutant reductions from the Fertilizer Act of 2011 are calculated based on the 2013 CBP approved study entitled *Recommendations of the Expert panel to Define Removal Rates for Urban Nutrient Management* (Schueler & Lane, 2013) shown in Appendix C. For states with fertilizer legislation, a 25% reduction in phosphorus was recommended from urban pervious land uses. For nitrogen, a 9% reduction was estimated for commercial areas and a 4.5% reduction was recommended for "do-it-yourself" land uses. To reach a blended nitrogen reduction weight, a weighted average (4.56%) was calculated based on the ratio of commercial and residential land use within the study area. The equation used to estimate TN load reductions from the Fertilizer Act of 2011 is expressed as:

[11.55 *(lbs/ac/yr)* x *Urban Pervious Area (acres)*] x 4.56%

The equation used to estimate TP load reductions from the Fertilizer Act of 2011 is expressed as:

[0.30 *(lbs/ac/yr)* x *Urban Pervious Area (acres)*] x 25%

It is assumed that no reduction in TSS will occur because of the new law. Calculations and results of the nutrient reductions derived from the Fertilizer Act of 201 are summarized in Table 3-17.

Table 3-17: Load Reductions from the Fertilizer Act of 2011

Pollutant	Pervious Urban Loading Rate (lbs/ac/yr)	Pervious Urban Area (acres)	Removal Efficiency (%)	Max Potential Load Reduction (lbs/yr)
TN	11.55	8,088	4.56%	4,256
TP	0.30	8,088	25.00%	607
TSS	221	8,088	0.00%	-

MS4 Retrofits and State Owned Properties Restoration

Baltimore County, as part of its NPDES permit, is currently assessing the condition of each of the county's outfalls to determine if there is retrofit potential at the outfall and restoration potential in the downstream drainage way. As part of the Phase II Watershed Implementation Plan (WIP), Baltimore County estimated that 16% of the county's outfalls will need to be retrofitted in order to meet pollution reduction and impervious area treatment requirements (EPS, 2012). Since potential outfall retrofits are located within the urban land area in the Liberty Reservoir watershed, pollutant reductions were estimated from the urban land use in the watershed (Table 3-18). The acres of land available for retrofit includes all urban land in the planning area (10,156 acres) minus the area already being treated by existing stormwater facilities (730 acres).

Although the Liberty Reservoir planning area lies entirely within Baltimore County, there is approximately 4,700 acres (295 acres of which is impervious) in the study area owned and operated by the State of Maryland. The State of Maryland and its departments owning property within Loch Raven North watershed include the State Highway Administration and the Department of Natural Resources. Because the State of Maryland has responsibility for the pollution reduction requirements on its own property, specific projects and restoration opportunities were not identified in these areas. The state owned land property is included within the urban area in Table 3-18.

Pollutant reductions for outfall retrofits and state owned property are calculated based on the approximate pollutant load received from publicly owned urban area within the watershed and removal efficiency of urban BMP retrofits from the June 2011 draft document, *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* shown in Appendix C (MDE, 2011). The equation used to estimate TN load reductions for outfall retrofits and state owned property is expressed as:

[12.73 *(lbs/ac/yr)* x *Urban Area (acres)*] x 25%

The equation used to estimate TP load reductions for stormwater retrofits is expressed as:

[0.55 *(lbs/ac/yr)* x *Urban Area (acres)*] x 35%

The equation used to estimate TSS load reductions for stormwater retrofits is expressed as:

[502 *(lbs/ac/yr)* x *Urban Area (acres)*] x 65%

The pollutant load received from the urban land use is denoted by the first expression in brackets in the equations above. The pollutant loading rates shown, 12.73 lbs TN/ac/yr, 0.55 lbs TP/ac/yr, and 502 lbs TSS/ac/yr are the weighted average of impervious and pervious urban rates used in the pollutant loading analysis (Table 3-1) since this represents the source of runoff being treated. A summary of stormwater retrofit and state owned property load reduction calculations and results are shown in Table 3-18.

Table 3-18: MS4 Outfall Retrofit and State Owned Properties Load Reductions

Pollutant	Urban Loading Rate (lbs/ac/yr)	Urban Area (acres)	Load from Retrofit Urban Area (lbs/yr)	Removal Efficiency (%)	Max Potential Load Reduction (lbs/yr)
TN	12.73	9,427	120,033	25%	30,008
TP	0.55	9,427	5,151	35%	1,803
TSS	502	9,427	4,731,052	65%	3,075,184

3.5.2.4 Overall Pollutant Load Reductions

The sum of maximum potential pollutant load reductions calculated for individual BMPs represents the overall pollutant removal capacity for a maximum implementation scenario (i.e., 100% of the projects implemented). A practicable pollutant load reduction was estimated for each BMP as the maximum potential load reduction multiplied by a projected participation factor. An overall projected pollutant removal capacity is the sum of practicable pollutant load reductions for individual BMPs. Projected participation factor assumptions are described in Table 3-19. Participation rates for existing measures that have already been implemented are 100%.

Table 3-19: Projected Participation Factors

BMP	Projected Participation	Basis of Assumption
Completed Measures		
Existing SWM	100%	Existing – BMPs already implemented
Existing County Restoration Programs	100%	Existing - Rain Barrels and Tree Planting reductions
Proposed Urban Measures		
SW Retrofits (NSA)	50%	General estimate to achieve reduction goal
SW Retrofits (HSI)	50%	General estimate to achieve reduction goal
SW Retrofits (ISI)	50%	General estimate to achieve reduction goal
ISI Impervious Cover Removal	50%	General estimate to achieve reduction goal
NSA Downspout Disconnection	9%	36% willingness factor* 25% participation
Reforest Urban Stream Buffers	0.5%	General estimate to achieve reduction goal
NSA Tree Plantings (Open Space)	18%	36% willingness factor * 50% participation
NSA Tree Plantings (Lot Canopy)	2%	36% willingness factor * 5% participation
ISI Tree Plantings	25%	General estimate to achieve reduction goal (97% public land)
PAA Tree Plantings	25%	General estimate to achieve reduction goal (99% public land)
Street Sweeping	0%	Participation dependent on results of DWP Investigation
Stream Restoration (SCA)	50%	General estimate to achieve reduction goal
Stream Restoration (WQMP)	15%	General estimate to achieve reduction goal
Credits for Fertilizer Act of 2011	100%	participation as part of Maryland law
MS4 Retrofits and State Owned Property Restoration	0%	General estimate to achieve reduction goal

Table 3-20 presents a summary of estimated pollutant load reductions for two scenarios – maximum implementation and projected practicable implementation by 2025 – including how reductions were credited, pollutant removal efficiencies, maximum potential load reductions, units available for restoration, projected participation, and projected load reductions. Currently, the project implementation plan shown in Table 3-20 meets the 2025 Loch Raven Reservoir TMDL reduction goals for both phosphorus and sediment. The Chesapeake Bay TMDL reduction goals are not met for 2025 in part due to the low delivery ratios from Loch Raven Reservoir to the Chesapeake Bay. Reductions towards the Loch Raven Reservoir TMDL also have a partial reduction credit to the Chesapeake Bay TMDL based on the delivery ratio of each pollutant as shown in Table 3-4. The reduction goals to meet the Chesapeake Bay TMDL are shown in Table 3-5. The Chesapeake Bay TMDL reduction goals, calculated based on the Maryland Assessment Scenario Tool (MAST) target loads, are a 32.2% reduction of nitrogen and a 47.0% reduction of phosphorus by 2025 (EPS, 2012).

To meet the Chesapeake Bay TMDL goals, it may be more beneficial to add additional restoration efforts downstream of the reservoir where delivery ratios are much higher. Greater reductions are possible in the Loch Raven North watershed if restoration BMPs are implemented to a greater extent than those assumed by projected participation factors. Greater reductions may also be achieved through restoration actions not included in this analysis such as public education/outreach efforts (e.g., tour of completed projects, education of hotspots, etc.). These types of actions are not included in the pollutant removal analysis because reduction efficiencies are not well known and difficult to accurately estimate.

Table 3-20: Summary of Pollutant Load Reduction Estimates

BMP	How Credited	TN Efficiency	TP Efficiency	TSS Efficiency	Total Units Available		Projected Participation	Units Proposed		Max Potential TN Load Reduction (lbs/yr)	Max Potential TP Load Reduction (lbs/yr)	Max Potential TSS Load Reduction (lbs/yr)	Projected 2025 TN Load Reduction (lbs/yr)	Projected 2025 TP Load Reduction (lbs/yr)	Projected 2025 TSS Load Reduction (lbs/yr)
Completed Measures															
Existing SWM	Efficiency	varies	varies	varies	730	acres	100%			2,763	154	222,787	2,763	154	222,787
Existing County Restoration Programs	Efficiency	varies	varies	varies	varies		100%			23	1	1,637	23	1	1,637
Proposed Urban Measures															
SW Retrofits (NSA)	Efficiency	50%	60%	90%	0.74	acres	50%	0.37	acres	6	1	1,067	3	0	534
SW Retrofits (HSI)	Efficiency	50%	60%	90%	2.49	acres	50%	1.24	acres	22	2	3,582	11	1	1,791
SW Retrofits (ISI)	Efficiency	50%	60%	90%	4.95	acres	50%	2.47	acres	43	4	7,128	21	2	3,564
ISI Impervious Cover Removal	LU Conversion	N/A	N/A	N/A	0.25	acre	50%	0.12	acres	1.45	0.30	344	1	0.15	172
NSA Downspout Disconnection	Efficiency	50%	60%	90%	15	acres	9%	1	acres	130	14	21,516	12	1	1,936
Reforest Urban Stream Buffers	LU Conversion + Efficiency	25%	50%	50%	1,467	acres	0.5%	7	acres	17,554	782	597,510	88	4	2,988
NSA Tree Plantings (Open Space)	LU Conversion	N/A	N/A	N/A	13	acres	18%	2	acres	115	3	2,046	21	1	368
NSA Tree Plantings (Lot Canopy)	LU Conversion	N/A	N/A	N/A	1,047	acres	2%	19	acres	9,197	272	163,703	166	5	2,947
ISI Tree Plantings	LU Conversion	N/A	N/A	N/A	37	acres	25%	9	acres	327	10	5,820	82	2	1,455
PAA Tree Planting	LU Conversion	N/A	N/A	N/A	73	acres	25%	18	acres	639	19	11,382	160	5	2,845
Street Sweeping	Efficiency	5%	6%	25%	2.5	miles	0%	-	miles	7	1	3,203	0	0	0
Stream Restoration (SCA)	Lbs per Ln Ft	0.075	0.068	44.900	2,171	ft	50%	1,085	ft	163	148	97,475	81	74	48,738
Stream Restoration (WQMP)	Lbs per Ln Ft	0.075	0.068	44.900	12,400	ft	15%	1,860	ft	930	843	556,760	140	126	83,514
Credits for Fertilizer Act of 2011	Efficiency	4.56%	25%	0%	8,088	acres	100%	8,088	acres	4,256	607	0	4,256	607	0
MS4 Retrofits and State Owned Property Restoration	Efficiency	25%	35%	65%	9,427	acres	0%	-	acres	30,008	1,803	3,075,184	0	0	0
Total Load Reduction (lbs/yr):										***66,184***	***4,664***	***4,771,144***	***7,826***	***984***	***375,275***
Total Load Reduction towards Chesapeake Bay TMDL (lbs/yr):										***17,142***	***1,679***	***1,073,507***	***2,027***	***354***	***84,437***
Total Existing Urban Load (lbs/yr)										129,322	5,550	5,097,183	129,322	5,550	5,097,183
Local Reduction Achieved *(Local Reduction Goal)*:										***51%***	***84%***	***94%***	***6%*** *(-)*	***18%*** *(15%)*	***7%*** *(4%)*
Chesapeake Bay Reduction Achieved *(Reduction Goal)*:										***13%***	***30%***	***21%***	***2%*** *(32%)*	***6%*** *(42%)*	***2%*** *(-)*
Local Urban TMDL Reduction Goals (lbs/yr)													*-*	*832*	*204,111*
Chesapeake Bay TMDL Reduction Goals (lbs/yr)													*41,642*	*2,608*	*-*

CHAPTER 4: SUBWATERSHED MANAGEMENT STRATEGIES

4.1 Introduction

This chapter describes the criteria and methodology used to rank the 17 subwatersheds comprising the Loch Raven North watershed (see Figure 1-2). The subwatershed ranking provides a tool for targeting restoration actions by location/water body. This chapter also summarizes management strategies and implementation priorities within each subwatershed. Individual subwatershed summaries include key subwatershed characteristics. More detailed information on a subwatershed basis can be found in the *Loch Raven North Watershed Characterization Report* included as Appendix E.

4.2 Subwatershed Prioritization

A ranking methodology was developed to prioritize subwatersheds within this study in terms of restoration need and potential. Subwatersheds were evaluated based on 17 criteria. Each criterion was scored from 1 to 4 with scores of 0 given if the criterion was not applicable. The sum of the criteria for each subwatershed was used to prioritize subwatersheds within this study in terms of restoration need and potential.

Subwatersheds are represented by an overall prioritization score on a scale of 68, where 0 denotes the least significant impacts to water quality and 68 corresponds to the greatest water quality improvement potential. The total prioritization score for a subwatershed is comprised of the following ranking criteria:

- Nitrogen Loads
- Phosphorus Loads
- Sediment Load
- Impervious Surfaces
- Neighborhood Restoration Opportunity/Pollution Source Indexes
- Neighborhood Downspout Disconnection
- Institutional Site Index
- Forest Coverage
- Illicit Discharge Data
- Stream Buffer Improvement
- Stream Corridor Restoration
- Historic Mill Dam Index
- Conservation Easements
- Hotspot Site Index
- Pervious Area Index
- Septic Systems
- Biological Indicators

Each criterion has a maximum possible score of 4. In general, subwatersheds were divided into quartiles based on supporting criterion data to yield an even distribution of the number of watersheds per possible score (i.e., 1, 2, 3, and 4). In some cases, criterion data did not support dividing the subwatersheds into four equal parts. Examples include a distribution of data that is too clustered or cases where zero values were assigned to subwatersheds with no recommended action for a particular criterion.

Criteria used to calculate overall prioritization scores were selected considering Small Watershed Action Plan (SWAP) goals and information compiled during watershed characterization and field efforts. Criteria and scoring designations are described in the sections below. Subwatershed restoration prioritization scoring and ranking results are summarized at the end of this section.

4.2.1 Nitrogen, Phosphorus, and Sediment Loads

One of the main objectives to improve and maintain water quality and meet pollution reduction requirements in the Loch Raven North watershed is to reduce annual average total nitrogen, phosphorus, and sediment loads. Annual pollutant loads (lbs/year) for total nitrogen, phosphorus, and sediment were calculated for each subwatershed based on loading rates established by the Maryland Department of the Environment (MDE) and Chesapeake Bay Program (CBP) for various land use types and subwatershed land distributions. The pollutant loading analysis for the Loch Raven North watershed is explained in further detail in Section 3.3 and the *Watershed Characterization Report* (Appendix E).

For each subwatershed, annual nitrogen, phosphorus, and sediment loads were divided by the subwatershed's area. This represents pollutant loading rates (lbs/acre/year) and allows a direct comparison between the 17 subwatersheds, regardless of size. Subwatersheds with higher pollutant loading rates are higher priorities for restoration within the Loch Raven North watershed. Therefore, higher pollutant loading rates were assigned higher scores to denote greater water quality impacts and restoration need.

Subwatershed nitrogen loading rates ranged from 6.46 to 14.10 lbs/acre/year. The following point system was used to assign nitrogen load scores to the 17 subwatersheds based on the range and distribution of subwatershed nitrogen loading rates:

- ≥ 13.00 lbs/acre/year = 4 pts
- 12.99 – 11.00 lbs/acre/year = 3 pts
- 9.01 – 10.99 lbs/acre/year = 2 pts
- ≤ 9.00 lb/acre/year = 1 pt

Subwatershed phosphorus loading rates ranged from 0.28 to 0.86 lbs/acre/year. The following point system was used to assign phosphorus load scores to the 17 subwatersheds based on the range and distribution of subwatershed phosphorus loading rates:

- ≥ 0.80 lbs/acre/year = 4 pts
- 0.79 – 0.60 lbs/acre/year = 3 pts
- 0.59 – 0.40 lbs/acre/year = 2 pts
- ≤ 0.39 lbs/acre/year = 1 pt

Subwatershed sediment loading rates ranged from 257 to 635 lbs/acre/year. The following point system was used to assign sediment load scores to the 17 subwatersheds based on the range and distribution of

subwatershed sediment loading rates:

- ≥ 600 lbs/acre/year = 4 pts
- 599 – 500 lbs/acre/year = 3 pts
- 499 – 400 lbs/acre/year = 2 pts
- ≤ 399 lbs/acre/year = 1 pt

Nitrogen, phosphorus, and sediment loading rates and corresponding scores are summarized in Table 4-1 by watershed.

Table 4-1: Nitrogen, Phosphorus, and Sediment Load Scores

SUBWATERSHED	Nitrogen Loading Rate (lbs/acre/yr)	Nitrogen Load Score	Phosphorus Loading Rate (lbs/acre/yr)	Phosphorus Load Score	Sediment Loading Rate (lbs/acre/yr)	Sediment Load Score
Little Falls	10.73	2	0.57	2	454.17	2
Beetree Run	11.59	3	0.59	2	505.99	3
Fourth Mine Branch	11.21	3	0.58	2	487.60	2
Third Mine Branch	12.79	3	0.82	4	548.69	3
Owl Branch	9.71	2	0.42	2	356.30	1
Second Mine Branch	14.10	4	0.86	4	620.73	4
First Mine Branch	10.22	2	0.55	2	439.81	2
Gunpowder Falls (Below PB)	6.46	1	0.28	1	257.65	1
Bush Cabin Run	10.57	2	0.56	2	438.10	2
Mingo Branch	8.09	1	0.38	1	352.89	1
Panther Branch	7.37	1	0.35	1	287.17	1
Charles Run	10.49	2	0.56	2	454.70	2
Piney Creek	13.49	4	0.73	3	602.91	4
Gunpowder Falls	8.33	1	0.39	1	318.88	1
Buffalo Creek	13.75	4	0.76	3	635.79	4
Carroll Branch	12.49	3	0.71	3	547.49	3
My Lady's Manor Branch	13.71	4	0.81	4	623.35	4

4.2.2 Impervious Surfaces

Various studies have shown a correlation between the amount of impervious surface within a watershed and water quality degradation. Impervious surfaces prevent precipitation from naturally infiltrating into the ground, which prohibits the natural filtration of pollutants and conveys concentrated, accelerated stormwater runoff directly to the stream system. Consequently, stormwater runoff from impervious surfaces can cause stream erosion and habitat degradation from the high energy flow and is likely more polluted than runoff generated from pervious areas.

Less developed watersheds, such as Loch Raven North, with small amounts of impervious cover are more likely to have better water quality in local streams than urbanized watersheds with greater amounts of impervious cover. Maryland Department of Natural Resources (DNR) has found that brook trout

populations are eliminated in watersheds with impervious surfaces exceeding 4% (DNR, 2006). Less developed watersheds are susceptible to an increase in stream degradation through development and urbanization.

As described in the *Watershed Characterization Report* (Appendix E), roads and buildings data layers were used to derive impervious surface areas and the percent impervious area for each subwatershed. Similar to the pollutant load criteria, percentages of impervious area for subwatersheds were used to assign scores as it allows a direct comparison between the 17 subwatersheds. Subwatersheds with higher percentages of impervious cover are higher priorities for restoration within Loch Raven North. Therefore, higher percentages of imperviousness are assigned higher scores to denote greater water quality impacts and restoration need.

Impervious cover represents approximately 3.4% of the overall Loch Raven North watershed. Subwatershed percent impervious values range from 1.7 to 6.2%. The following point system was used to assign impervious cover scores to the 17 subwatersheds based on the range and percentage for each subwatershed:

- ≥ 4.0% = 4 pts
- 4.0 – 3.1% = 3 pts
- 3.0 – 2.0% = 2 pts
- < 2.0% = 1 pt

Percent impervious values and corresponding scores are summarized in Table 4-2 by subwatershed.

Table 4-2: Percent Impervious Scores

SUBWATERSHED	% Impervious	% Impervious Score
Little Falls	3.4%	3
Beetree Run	3.6%	3
Fourth Mine Branch	4.0%	3
Third Mine Branch	2.1%	2
Owl Branch	5.1%	4
Second Mine Branch	2.6%	2
First Mine Branch	1.7%	1
Gunpowder Falls (Below PB)	3.3%	3
Bush Cabin Run	3.0%	2
Mingo Branch	3.0%	2
Panther Branch	6.2%	4
Charles Run	3.1%	3
Piney Creek	5.0%	4
Gunpowder Falls	3.8%	3
Buffalo Creek	2.2%	2
Carroll Branch	2.5%	2
My Lady's Manor Branch	2.0%	2

4.2.3 Neighborhood Restoration Opportunity/Pollution Source Indexes

As described in Chapter 4 of the *Watershed Characterization Report* (Appendix E), neighborhood pollution severity and restoration potential were rated during Neighborhood Source Assessments (NSAs). The severity of pollution generated by a neighborhood is denoted by the Pollution Severity Index (PSI) and was rated as severe, high, moderate, or low. A neighborhood's potential for residential restoration projects is denoted by the Restoration Opportunity Index (ROI) and was rated as high, moderate, or low. Out of the 67 neighborhoods assessed, the majority were rated as both moderate for PSI and ROI. 19 were rated as high for both PSI and ROI, 24 were rated as high for PSI with a moderate ROI, and 13 were rated as a moderate PSI and a high ROI. Neighborhoods with high PSI and high ROI ratings represent the best areas to initially target for restoration. Because some of the neighborhoods were encompassed within multiple subwatersheds, those neighborhoods were counted for each subwatershed to portray a more accurate subwatershed ranking.

Neighborhoods were weighted based on potential restoration. The weighting assigned to each PSI/ROI rating is shown in Table 4-3. Three subwatersheds, Piney Creek, Little Falls, and Gunpowder Falls, were given a score of 4. Each contained three neighborhoods with high PSI and ROI ratings and had the highest total number of NSAs within a subwatershed at 13, 16, and 20, respectively. One subwatershed, Fourth Mine Branch, contained no NSAs and was given a score of 0. The NSA PSI and ROI scores are summarized in Table 4-3.

Table 4-3: NSA PSI/ROI Scores

	# of NEIGHBORHOODS FOR PSI/ROI RATINGS										
SUBWATERSHED	High/ High	High/ Mod	High/ Low	Mod/ High	Mod/ Mod	Mod/ Low	Low/ High	Low/ Mod	Low/ Low	Weighted Score	NSA PSI/ROI Score
Weighted assigned to each PSI/ROI Rating	*16*	*8*	*4*	*8*	*2*	*1*	*2*	*1*	*0*	-	-
Little Falls	3	6	0	0	5	1	0	1	0	108	4
Beetree Run	2	0	0	0	3	0	0	0	0	38	2
Fourth Mine Branch	0	0	0	0	0	0	0	0	0	0	0
Third Mine Branch	0	1	0	0	1	0	0	0	0	10	1
Owl Branch	3	1	0	0	1	1	0	1	0	60	3
Second Mine Branch	1	1	0	2	0	0	0	0	0	40	2
First Mine Branch	0	0	0	0	1	0	0	0	0	2	1
Gunpowder Falls (Below PB)	3	3	0	0	4	0	0	0	0	80	3
Bush Cabin Run	1	0	0	1	2	0	0	0	0	28	2
Mingo Branch	0	0	0	1	0	0	0	0	0	8	1
Panther Branch	0	1	0	0	0	0	0	0	0	8	1
Charles Run	0	0	0	1	0	0	0	1	0	9	1
Piney Creek	3	2	0	3	3	1	0	0	1	95	4
Gunpowder Falls	1	5	0	5	6	1	0	1	1	110	4
Buffalo Creek	0	0	0	0	0	1	0	0	0	1	1
Carroll Branch	2	2	0	0	2	0	0	0	0	52	3
My Lady's Manor Branch	0	2	0	0	0	0	0	0	0	16	1

4.2.4 Neighborhood Downspout Disconnection

Connected downspouts discharge rooftop runoff either directly to the storm drain system or to

impervious surfaces. In both cases, there is little to no treatment of stormwater runoff before it reaches the stream system. Disconnected downspouts drain to pervious areas such as yards and lawns, rain barrels, or rain gardens, all of which allow rooftop runoff to infiltrate into the ground and enter streams through the groundwater system in a slower, more natural fashion. Downspout disconnection is desirable because it decreases flow to local streams during storm events and reduces pollutant loads to streams.

Downspout disconnection was recommended for neighborhoods where at least 25 percent of the downspouts are connected to impervious areas or directly connected to the storm drain system and where the average lot has at least 15 feet of pervious area available down gradient from the connected downspout for redirection. This criterion is used for subwatershed prioritization because it has a quantitative pollution reduction efficiency related to nutrient reduction goals.

The acres of rooftop addressed if downspout disconnection were implemented in the recommended neighborhood were calculated in the *Watershed Characterization Report* (Appendix E). The percentage of subwatershed rooftop area addressed was also calculated and was used to compare the restoration potential among the 17 subwatersheds. Subwatersheds with the highest percentages of impervious rooftop acres addressed through downspout disconnection denote the greatest restoration potential and therefore, were scored the highest. Percentages of subwatershed areas addressed through downspout disconnection range from approximately 0.3 – 7.8%. The following point system was used to assign downspout disconnect scores to the 17 subwatersheds based on the distribution and range of percentages of subwatershed rooftop areas addressed:

- ≥ 6.0% = 4 pts
- 5.9 – 4.0% = 3 pts
- 3.9 – 2.0% = 2 pts
- 1.9 – 0.1% = 1 pt
- No NSAs recommended in subwatershed = 0 pts

Percentage of rooftop area addressed by downspout disconnection and corresponding scores are summarized in Table 4-4 by subwatershed.

Table 4-4: NSA Downspout Disconnect Scores

SUBWATERSHED	% Rooftop Area Addressed	NSA Downspout Disconnect Score
Little Falls	0.6%	1
Beetree Run	2.4%	2
Fourth Mine Branch	0.0%	0
Third Mine Branch	0.0%	0
Owl Branch	7.8%	4
Second Mine Branch	2.5%	2
First Mine Branch	0.0%	0
Gunpowder Falls (Below PB)	6.8%	4
Bush Cabin Run	4.4%	3
Mingo Branch	0.6%	1
Panther Branch	0.0%	0
Charles Run	0.0%	0
Piney Creek	3.5%	2
Gunpowder Falls	5.4%	3
Buffalo Creek	0.0%	0
Carroll Branch	4.9%	3
My Lady's Manor Branch	0.3%	0

4.2.5 Institutional Site Index

Institutions offer unique opportunities for watershed restoration. Typically, institutional properties encompass considerable portions of land including various natural resources. In addition, they offer the opportunity to engage a wide range of citizens in restoration activities. This raises citizen awareness while also providing water quality improvement benefits in the watershed. A total of 14 community-based facilities were surveyed during Institutional Site Investigations (ISIs) including faith-based facilities and schools. The focus of ISIs is to identify potential restoration opportunities, educate the community, and provide water quality benefits. Subwatersheds with more institutional sites present more opportunities for implementing restoration actions (i.e. tree planting, stormwater retrofits, community cleanups, etc.) and encouraging citizen participation. Public institutional sites are good candidates for initial restoration efforts because there are opportunities to make use of and build upon existing partnerships and in many cases, incorporate student projects. While private institutions also have restoration potential, they will require a different approach and the development of new partnerships to implement restoration efforts. For all these reasons, subwatershed prioritization for this criterion was based on the number of institutions and considered public versus private ownership.

For purposes of this prioritization, publicly owned ISIs are given a greater score because they have the greatest restoration potential. The number of publicly owned institutions were summed and then multiplied by two to give them a weighted score. The number of privately owned institutions was then added to this number to give a total weighted number. The following point system was used to assign institutional site scores to the 17 subwatersheds based on the distribution and range ISIs addressed:

- > 5 = 4 pts
- 4 = 3 pts

- 3 = 2 pts
- 2 = 1 pt
- No ISIs located in subwatershed = 0 pts

The total number of institutions including public versus Private ISIs and corresponding institutional site index scores are summarized by subwatershed in Table 4-5.

Table 4-5: ISI Scores

SUBWATERSHED	# of Public ISIs	Weighted # of Public ISIs (x2)	# of Private ISIs	Total Weighted # of ISIs	ISI Score
Little Falls	3	6	0	6	4
Beetree Run	1	2	0	2	1
Fourth Mine Branch	1	2	0	2	1
Third Mine Branch	0	0	0	0	0
Owl Branch	0	0	0	0	0
Second Mine Branch	0	0	0	0	0
First Mine Branch	0	0	0	0	0
Gunpowder Falls (Below PB)	1	2	0	2	1
Bush Cabin Run	0	0	0	0	0
Mingo Branch	0	0	0	0	0
Panther Branch	2	4	0	4	3
Charles Run	0	0	0	0	0
Piney Creek	3	6	0	6	4
Gunpowder Falls	1	2	2	4	3
Buffalo Creek	0	0	0	0	0
Carroll Branch	0	0	0	0	0
My Lady's Manor Branch	0	0	0	0	0

4.2.6 Forest Coverage

The forests that once dominated the landscape of the Loch Raven North watershed, while still dense in some areas, have mostly been converted to agriculture or developed areas throughout much of the watershed. Forests have a monumentally positive impact to the hydrology of uplands areas from the stream hydraulics to terrestrial habitat. A major goal identified for the Loch Raven North watershed is to restore and maintain native forest coverage in agreement with Baltimore County's goal of achieving and maintaining a tree canopy of 50% in reservoir watersheds (BCACEQ, 2013). This is a feature identified for subwatershed prioritization based on the percentage of subwatershed forest cover as calculated in the *Watershed Characterization Report* (Appendix E).

For purposes of this prioritization, subwatersheds with smaller percentages of forest cover are given a greater score because there is a higher percentage of area that can be converted to tree cover. Percentages of forest cover area in the 17 Loch Raven North subwatersheds range from approximately 22% to 71%. The following point system was used to assign forest coverage scores to the 17 subwatersheds based on the range of percentages in each subwatershed:

- < 30% = 4 pts
- 30 – 39% = 3 pts
- 40 – 49% = 2 pts
- ≥ 50% = 1 pt

Forest coverage percentages and corresponding scores are summarized in Table 4-6 by subwatershed.

Table 4-6: Forest Coverage Scores

SUBWATERSHED	% of Subwatershed with Forest Cover	Forest Cover Score
Little Falls	33%	3
Beetree Run	38%	3
Fourth Mine Branch	42%	2
Third Mine Branch	38%	3
Owl Branch	28%	4
Second Mine Branch	32%	3
First Mine Branch	46%	2
Gunpowder Falls (Below PB)	66%	1
Bush Cabin Run	33%	3
Mingo Branch	71%	1
Panther Branch	53%	1
Charles Run	35%	3
Piney Creek	23%	4
Gunpowder Falls	40%	2
Buffalo Creek	34%	3
Carroll Branch	24%	4
My Lady's Manor Branch	22%	4

4.2.7 Illicit Discharge Data

Baltimore County tracks illicit discharges through a program of routine outfall screenings. Illicit discharges refer to leaking pipe or incorrectly connected pipes. The County has an outfall prioritization system based on data from the outfall screening. Under this system, major outfalls (greater than 3 feet in diameter) are assigned one of the following priority ratings: critical, high, low, or none. Critical outfalls are those with problems that require immediate correction and/or close monitoring, or outfalls with reoccurring problems. These are sampled the most frequently (4 times a year). On the other end of the rating scheme, outfalls that are not prioritized have insufficient data to determine a priority rating.

There are two major outfalls in the Loch Raven North watershed, both located in the Gunpowder Falls (Below Prettyboy) subwatershed. There are 66 minor outfalls (less than 3 feet in diameter) throughout the watershed that are unrated (Priority 0). The major and minor outfalls were used to prioritize the subwatersheds. The Gunpowder Falls subwatershed was given the highest score because it is the only subwatershed to contain documented major outfalls. The number of minor outfalls (Priority 0) was used

to assign scores for the remaining subwatersheds. The following point system was used to assign illicit discharge scores to the 17 watersheds based on the Priority 0, minor outfalls:

- ≥ 15 = 4 pts
- 10 -14 = 3 pts
- 5 – 9 = 2 pts
- 1 – 4 = 1 pt
- No minor or major outfalls in subwatershed = 0 pts

County outfall ratings and corresponding scores are shown in Table 4-7 by subwatershed.

Table 4-7: Illicit Discharge Data Scores

SUBWATERSHED	COUNTY OUTFALL PRIORITIZATION RATINGS				Illicit Discharge Data Score
	Priority 1 (Critical)	Priority 2 (High)	Priority 3 (Low)	Priority 0* (None)	
Little Falls	0	0	0	8	2
Beetree Run	0	0	0	1	1
Fourth Mine Branch	0	0	0	0	0
Third Mine Branch	0	0	0	1	1
Owl Branch	0	0	0	11	3
Second Mine Branch	0	0	0	2	1
First Mine Branch	0	0	0	0	0
Gunpowder Falls (Below PB)	0	2	0	2	4
Bush Cabin Run	0	0	0	1	1
Mingo Branch	0	0	0	2	1
Panther Branch	0	0	0	1	1
Charles Run	0	0	0	0	0
Piney Creek	0	0	0	14	3
Gunpowder Falls	0	0	0	19	4
Buffalo Creek	0	0	0	0	0
Carroll Branch	0	0	0	4	1
My Lady's Manor Branch	0	0	0	0	0

*All minor outfalls in the Loch Raven North watershed have a Priority 0 rating

4.2.8 Stream Buffer Improvements

Forested buffer areas along streams play a crucial role in improving water quality and flood mitigation since they can reduce surface runoff, stabilize stream banks, trap sediment, and provide habitat for various types of terrestrial and aquatic life. Maintaining healthy streams and forest buffers are important for reducing nutrient and sediment loadings to the Gunpowder Falls subwatershed, its tributaries, and the Loch Raven Reservoir. When stream buffers are converted from forest to agriculture or developed areas, many of these benefits are lost and stream health declines. Riparian buffer zones can be reestablished or preserved as a Best Management Practice (BMP) to reduce land use impacts by intercepting and controlling pollutants entering a water body.

In the *Watershed Characterization Report* (Appendix E), the vegetation condition of stream buffers was analyzed based on a 100-foot buffer on either side of the stream system. Three classifications were used to classify stream buffer conditions: impervious, open pervious, or forested. For each subwatershed, acreages and percentages of stream buffer area were determined for the three classifications. Open pervious (e.g. mowed lawns) represents the greatest potential for stream buffer reforestation. Therefore, the percentages of open pervious buffer area were used to prioritize restoration potential among subwatersheds. Subwatersheds with greater percentages of open pervious buffer areas denote the greatest potential for stream buffer improvement and were scored the highest.

Open pervious buffer area percentages range from approximately 10 to 45%. The following point system was used to assign stream buffer improvement scores to the 17 subwatersheds based on the distribution and range of open pervious buffer area percentages:

- ≥ 35% = 4 pts
- 34 – 30 = 3 pts
- 29 – 20 = 2 pts
- ≤ 19% = 1 pt

Percentages of open pervious stream buffer areas and corresponding scores are summarized in Table 4-8 by subwatershed.

Table 4-8: Stream Buffer Improvement Scores

SUBWATERSHED	% Open Pervious Stream Buffer Area	Stream Buffer Improvement Score
Little Falls	31%	3
Beetree Run	33%	3
Fourth Mine Branch	33%	3
Third Mine Branch	45%	4
Owl Branch	21%	2
Second Mine Branch	34%	3
First Mine Branch	21%	2
Gunpowder Falls (Below PB)	10%	1
Bush Cabin Run	30%	3
Mingo Branch	15%	1
Panther Branch	18%	1
Charles Run	25%	2
Piney Creek	41%	4
Gunpowder Falls	19%	1
Buffalo Creek	38%	4
Carroll Branch	35%	4
My Lady's Manor Branch	29%	2

4.2.9 Stream Corridor Restoration

Stream Corridor Assessments (SCAs) were conducted based on the Maryland Department of Natural Resources (DNR) survey protocols to quickly assess physical stream conditions and identify common environmental problems in the stream corridor (DNR, 2001). This included documentation of erosion sites, inadequate stream buffers, fish migration barriers, exposed or discharging pipes, channelized or altered stream sections, trash dumping sites, in or near stream construction, and unusual conditions. SCAs were focused in four subwatersheds with the greatest length of wadeable streams best suited for the survey method and for identifying stream corridor restoration efforts: Fourth Mine Branch, Mingo Branch, Panther Branch, and Piney Creek. As previously mentioned, maintaining healthy streams is fundamental to improving water quality in the Loch Raven North watershed. This criterion relates to other watershed goals such as improving drinking water quality.

Along the 28.9 miles of stream walked in the Loch Raven North watershed, a total of 1,203 potential environmental problems were observed. The most frequently observed problems were erosion sites, fish barriers, inadequate buffers, pipe outfalls, and channel alterations. Because stream buffer improvement is addressed in a separate criterion, it is not included in the stream corridor restoration ranking criterion. The remaining four frequently observed problems were evaluated/scored separately and then combined to determine an overall stream corridor restoration score. Erosion, fish barriers, pipe outfalls, and channel alterations are good indicators of potential pollution sources and restoration needs. Each problem category and overall stream corridor restoration criterion scoring are described below.

Erosion

Erosion can destabilize stream banks, impact habitat, and cause sediment pollution problems downstream. Significant erosion problems are often a result of land use changes in a watershed. Since erosion is also a natural process, it was not the purpose of the SCA survey to identify every occurrence of erosion. Erosion was documented for unstable stream reaches with significant amounts of erosion along the stream's banks such as vertical stream banks and where vegetative roots along a reach were unable to hold soil onto the banks. Very severe and severe eroded stream length percentages (based on surveyed stream miles) were used to directly compare and rank subwatersheds. A higher percentage of stream length that is significantly eroded represents a greater need and potential for stream corridor restoration.

The percentages of significant erosion within surveyed subwatersheds range from 1.5 to 13.3 percent. The following point system was used to assign erosion scores to the four subwatersheds based on the percentage of erosion.

- ≥ 10.1% = 4 pts
- 3.1 – 10 = 3 pts
- 1 – 3 = 2 pts
- ≤ 0.9% = 1 pt

Percentages of very severe and severe erosion and corresponding sub-criterion scores are summarized in

Table 4-9 by subwatershed.

Table 4-9: SCA Erosion Scores

SUBWATERSHED	% Very Severe and Severe Erosion	Erosion Score
Fourth Mine Branch	3.8	3
Mingo Branch	13.3	4
Panther Branch	1.5	2
Piney Creek	3.3	3

Fish Migration Barriers

Fish migration barriers are obstacles or impediments that interfere with the upstream movement of fish. Many species of fish depend upon the ability to migrate into the upper reaches of streams to spawn. By limiting the length of streams available to these species, fish barriers decrease the population sizes of fish and in turn the health and biodiversity of aquatic habitats. Fish barriers include any manmade or natural structure that prevents fish from swimming over or through. During the SCAs, 139 fish barriers were identified within the four surveyed subwatersheds. The subwatersheds were ranked based on the number of fish barriers found during the SCAs. The following point system was used to assign fish barrier scores to the four subwatersheds based on the number of fish barriers.

- ≥ 41 = 4 pts
- 31 – 40 = 3 pts
- 21 – 30 = 2 pts
- ≤ 20 = 1 pt

Table 4-10 summarizes the number of fish barriers in surveyed stream corridors and the corresponding fish barrier sub-criterion scores by subwatershed.

Table 4-10: SCA Fish Barrier Scores

SUBWATERSHED	# Fish Barriers	Fish Barrier Score
Fourth Mine Branch	26	2
Mingo Branch	30	3
Panther Branch	42	4
Piney Creek	41	4

Pipe Outfalls

Pipe outfalls refer to storm drain outfalls or small manmade channels that discharge stormwater into a stream corridor. Pipe outfalls are considered a potential water quality problem since they can carry untreated runoff and pollutants such as oil, heavy metals, and nutrients to a stream system. During the SCAs, the field team documented the pollution severity of pipe outfalls based on discharge presence, color, odor, amount, and downstream impacts. For example, outfalls with a strong discharge relative to

the normal stream flow, a distinct color and/or odor, and where discharge was causing significant impacts downstream were considered severe problems.

The total number of severe and moderately severe outfalls observed during the SCAs were used to rank subwatersheds for this sub-criterion. Subwatersheds with more occurrences of severe to moderately severe discharging pipes represent a greater need and potential for stream corridor restoration. The following point system was used to assign pipe outfall scores to the four subwatersheds based on the number of severe and moderately severe pipe outfalls in the subwatersheds.

- ≥ 3 or more = 4 pts
- 2 = 3 pts
- 1 severe = 2 pts
- 1 moderately severe = 1 pt

While both Mingo Branch and Panther Branch each have one pipe outfall in their respective subwatersheds, the pipe outfall in Mingo Branch is the only observed severe pipe outfall in the Loch Raven North watershed. Therefore, Mingo Branch subwatershed was assigned a higher score than Panther Branch subwatershed. Table 4-11 summarizes the number of severe and moderately severe pipe outfalls in surveyed stream corridors and the corresponding pipe outfall sub-criterion scores by subwatershed.

Table 4-11: SCA Pipe Outfall Scores

SUBWATERSHED	# Pipe Outfalls	Pipe Outfall Score
Fourth Mine Branch	2	3
Mingo Branch	1	2
Panther Branch	1	1
Piney Creek	4	4

Channel Alteration

Sections of stream where the banks or channel have been significantly modified from their naturally occurring structure or condition can have adverse impacts on stream health. This includes channels that have been dredged, widened, straightened, and/or covered with concrete. While often intended to convey more water and prevent flooding, habitat impairments and downstream instabilities may result. During the SCAs, the field team documented 42 channel alteration lengths. The total length of channel alteration observed and percentage of the total stream length surveyed that is altered were calculated in the *Watershed Characterization Report* (Appendix E). Altered stream length percentages (based on surveyed stream miles) were used to directly compare and rank subwatersheds. A higher percentage of stream length that is significantly altered represents a greater need and potential for stream corridor restoration. There were no channel alterations in the surveyed streams within Mingo Branch subwatershed; therefore, Mingo Branch received zero points. The following point system was used to assign channel alteration scores to the four subwatersheds based on the percentage of altered stream lengths.

- ≥ 2.1% = 4 pts
- 1.1 – 2.0% = 3 pts
- 0.6 – 1.0% = 2 pts
- >0% – 0.5% = 1 pt
- 0% = 0 pts

Table 4-12 summarizes the percentages of altered stream lengths in surveyed stream corridors and the corresponding channel alteration sub-criterion scores by subwatershed.

Table 4-12: SCA Channel Alteration Scores

SUBWATERSHED	% Altered*	Channel Alteration Score
Fourth Mine Branch	1.6	3
Mingo Branch	0.0	0
Panther Branch	0.5	1
Piney Creek	2.8	4

* % altered based on altered length observed in the field divided by total stream length surveyed.

Overall Stream Corridor Restoration Score

Stream corridor restoration may involve addressing all four environmental problem categories. Therefore, to determine the overall score for the stream corridor restoration criterion, subwatersheds were ranked according to the sum of the sub-criterion scores. The subwatershed with the highest total sub-criteria score received the highest ranking (4 points). The subwatershed with the lowest total sub-criteria score received the lowest ranking for this criterion (1 point). The following point system was used to assign overall stream corridor restoration scores to the four subwatersheds based on the total sub-criteria score for each subwatershed.

- ≥ 14 = 4 pts
- 11 – 13 = 3 pts
- 9 – 10 = 2 pts
- ≤ 8 = 1 pt

Table 4-13 summarized sub-criteria totals and overall stream corridor restoration scores by subwatershed.

Table 4-13: SCA Stream Corridor Restoration Scores

SUBWATERSHED	Total of Sub-Criteria Score	Overall Stream Corridor Restoration Score
Fourth Mine Branch	11	3
Mingo Branch	9	2
Panther Branch	8	1
Piney Creek	15	4

4.2.10 Historic Mill Dam Index

The Loch Raven North watershed was home to many mill dams built in the 1700-1800s and, due to the rural nature of the watershed, many of these locations have not been further developed. The mill dams back up streams, creating ponds that trap and store sediment and alter the stream's natural morphology. Throughout the watershed, 33 historic mill dam locations were assessed for potential restoration opportunities such as legacy sediment removal, stream restoration, floodplain reconnection, and buffer planting. These restoration actions can potentially decrease pollutant loading and re-establish healthy, natural stream systems.

Each mill dam site and its recommended actions are analyzed in the *Watershed Characterization Report* (Appendix E). The number of historic mill dam sites with recommended restoration actions was used to prioritize restoration potential for each subwatershed. Subwatersheds with more mill dam locations recommended for restoration were scored higher than those without. The following point system was used to assign mill dam index scores to the 17 subwatersheds based on the number of dams:

- ≥ 5 = 4 pts
- 3 – 4 = 3 pts
- 2 = 2 pts
- 1 = 1 pt
- No mill dams recommended for restoration in subwatershed = 0 pts

The number of recommended mill dams per subwatershed and corresponding scores are summarized in Table 4-14.

Table 4-14: Mill Dam Site Index

SUBWATERSHED	# of Historic Mill Dams Assessed	# of Historic Mill Dam Sites with Recommended Actions	Mill Dam Restoration Score
Little Falls	14	9	4
Beetree Run	2	2	2
Fourth Mine Branch	1	1	1
Third Mine Branch	0	0	0
Owl Branch	0	0	0
Second Mine Branch	0	0	0
First Mine Branch	3	1	1
Gunpowder Falls (Below PB)	1	0	0
Bush Cabin Run	1	1	1
Mingo Branch	0	0	0
Panther Branch	2	0	0
Charles Run	1	0	0
Piney Creek	5	4	3
Gunpowder Falls	2	1	1
Buffalo Creek	1	1	1
Carroll Branch	0	0	0
My Lady's Manor Branch	0	0	0

4.2.11 Conservation Areas

There are many programs working to conserve land in the Loch Raven North watershed. These conservation efforts include county zoning, agricultural land preservation programs, local land trusts, and rural land conservation easements. Approximately 48% of the Loch Raven North watershed is held under some type of conservation easements, and several plots of land are held under multiple easements. One of the primary goals for the Loch Raven North watershed is to promote land conservation, ensuring that the natural resources in the watershed are protected, benefiting both terrestrial and aquatic health and improving overall water quality.

In the *Watershed Characterization Report* (Appendix E), conservation areas throughout the watershed are quantified and the different types of easements are explained in detail. The total acreage of conservation areas in each watershed was calculated, and the overall percentage of land in conservation was used to compare subwatersheds. The percentages of current land in conservation for subwatersheds ranged from 18 to 84%. The lower the total percentage of conservation land in a subwatershed, the more land available to place in conservation, and therefore, a higher conservation score was given. The following point system was used to assign conservation area scores to the 17 subwatersheds based on the distribution and range of percentages currently in conservation:

- ≤ 40% = 4 pts
- 41 – 60% = 3 pts
- 61 – 70% = 2 pts

- > 70% = 1 pt

Percentages of land in conservation areas and corresponding scores are summarized in Table 4-15 by subwatershed.

Table 4-15: Conservation Easement Scores

SUBWATERSHED	% of Land in Conservation	Conservation Easement Score
Little Falls	36%	4
Beetree Run	37%	4
Fourth Mine Branch	31%	4
Third Mine Branch	59%	3
Owl Branch	18%	4
Second Mine Branch	66%	2
First Mine Branch	74%	1
Gunpowder Falls (Below PB)	64%	2
Bush Cabin Run	52%	3
Mingo Branch	71%	1
Panther Branch	41%	3
Charles Run	46%	3
Piney Creek	36%	4
Gunpowder Falls	47%	3
Buffalo Creek	66%	2
Carroll Branch	64%	2
My Lady's Manor Branch	84%	1

4.2.12 Hotspot Site Index

Stormwater hotspots are areas that have potential to generate higher concentrations of stormwater pollutants than typically found in runoff from developed areas and/or have a higher risk of spill, leaks, or illicit discharges due to the nature of the facility (CWP, 2004). Stormwater pollutants generated at hotspots vary depending on the activities at each location, but they can include nutrients, hydrocarbons, metals, chloride, pesticides, bacteria, and trash. Hotspots are categorized by their function and include commercial, municipal, transport-related, and industrial facilities. The purpose of the Hotspot Sight Investigations (HSIs) is to evaluate pollution potential from hotspot operations and identify potential restoration practices that may be necessary.

A total of 25 hotspots were assessed in the Loch Raven North watershed. Common operations observed at these hotspots that had potential for pollutant runoff included vehicle operations, outdoor material storage, waste management, physical plant, turf/landscape management, and stormwater infrastructure. Using these categories, the hotspots were ranked as a severe hotspot, confirmed hotspot, potential hotspot, or not a hotspot. These rankings were used to determine the hotspot index score to prioritize subwatersheds. The following point system was used to assign hotspot site scores based on the total number of potential, confirmed, or severe hotspot sites in each subwatershed:

- ≥ 5 = 4 pts

- 3 – 4 = 3 pts
- 2 = 2 pts
- 1 = 1 pt
- No HSIs in subwatershed = 0 pts

The number of hotspot sites and corresponding rating are shown in Table 4-16 by subwatershed.

Table 4-16: HSI Site Index Scores

SUBWATERSHED	Hotspot Rating				HSI Score
	Not a Hotspot	Potential	Confirmed	Severe	
Little Falls	0	1	0	0	1
Beetree Run	0	2	2	1	4
Fourth Mine Branch	0	0	1	0	1
Third Mine Branch	0	2	0	0	2
Owl Branch	0	4	0	0	3
Second Mine Branch	0	1	0	0	1
First Mine Branch	0	0	1	0	1
Gunpowder Falls (Below PB)	1	0	0	0	0
Bush Cabin Run	0	0	0	0	0
Mingo Branch	0	2	2	0	3
Panther Branch	0	2	0	0	2
Charles Run	0	0	0	0	0
Piney Creek	1	1	1	0	2
Gunpowder Falls	0	0	0	0	0
Buffalo Creek	0	0	0	0	0
Carroll Branch	0	0	0	0	0
My Lady's Manor Branch	0	0	0	0	0

4.2.13 Pervious Area Index

The most likely candidates for successful pervious area restoration efforts are those on public lands with minimal site preparation required. Baltimore County has an aggressive reforestation program using grants and Stormwater Remediation Fee funds. The County collaborates routinely with organizations and citizens to reforest on a variety of sites. For community open space reforestation sites, DNR's "Tree-mendous Maryland" program is a source for trees. Privately owned lands are often planned for future development or expansion of an existing facility. In addition, larger open parcels have greater potential for reforestation and water quality benefits than smaller areas.

Subwatershed prioritization related to pervious area restoration was based on the total acres of land within a subwatershed available for planting. Publicly owned lands were given a higher weighted value than land that is privately owned. The following point system was used to assign pervious area scores to the 17 subwatersheds based on the distribution and range of percentages of subwatershed areas addressed:

- ≥ 2.00% = 4 pts
- 0.89 – 1.99% = 3 pts
- 0.40 – 0.89% = 2 pts
- 0.01 – 0.39% = 1 pt
- No Previous Area Assessments (PAAs) in subwatershed = 0 pts

Pervious area percentages and corresponding scores are summarized in Table 4-17 by subwatershed.

Table 4-17: Pervious Area Restoration Scores

SUBWATERSHED	Acres Planting Public	Weighted Public (x2)	Acres Planting Private	Total Weighted Acres	% weighed acres per subwatershed acres	Pervious Area Score
Little Falls	7	14	0	14	0.13%	1
Beetree Run	3	6	0	6	0.12%	1
Fourth Mine Branch	0	0	0	0	0.00%	0
Third Mine Branch	1	2	0	2	0.05%	1
Owl Branch	0	0	0	0	0.00%	0
Second Mine Branch	0	0	0	0	0.00%	0
First Mine Branch	0	0	0	0	0.00%	0
Gunpowder Falls (Below PB)	19	38	0	38	0.82%	2
Bush Cabin Run	32	64	0	64	2.83%	4
Mingo Branch	0	0	0	0	0.00%	0
Panther Branch	23	46	0	46	6.21%	4
Charles Run	0	0	0	0	0.00%	0
Piney Creek	17	34	1	35	0.59%	2
Gunpowder Falls	0	0	0	0	0.00%	0
Buffalo Creek	0	0	0	0	0.00%	0
Carroll Branch	0	0	0	0	0.00%	0
My Lady's Manor Branch	0	0	0	0	0.00%	0

4.2.14 Septic Systems

The majority of the Loch Raven North watershed relies on septic systems for waste treatment. Septic systems can increase the nitrogen load that enters a stream system, especially if the system is not functioning properly. These systems can also increase the bacterial contamination of nearby streams. According to Baltimore County Environmental Protection and Sustainability (EPS), there are approximately 6,500 septic systems in the Loch Raven North watershed.

Subwatersheds with a greater number of septic systems have the greatest potential to be a nutrient and pathogenic pollutant source and were assigned a higher restoration score. For septic systems that are

within 1,000 feet of the stream, the nitrogen load that enters the stream system is nearly twice as much as septic systems located greater than 1,000 feet from the stream. To account for higher nitrogen loads near streams, septic systems within 1,000 feet of the stream were weighted. The remaining septic systems, greater than 1,000 feet from the stream, were added to the weighted septic systems to reach the total weighted septic system number. The following point system was used to assign septic system scores to the 17 subwatersheds:

- ≥ 2,000 = 4 pts
- 1,999 – 1,000 = 3 pts
- 999 – 400 = 2 pts
- < 400 = 1 pt

Number of septic systems and corresponding scores are summarized in Table 4-18 by subwatershed.

Table 4-18: Septic System Scores

SUBWATERSHED	Total # of Septic Systems	# of Septic Systems < 1000' from stream	Total Weighted Septic Systems	Septic System Restoration Score
Little Falls	1,316	1,282	2,598	4
Beetree Run	598	572	1,170	3
Fourth Mine Branch	102	102	204	1
Third Mine Branch	261	260	521	2
Owl Branch	539	526	1,065	3
Second Mine Branch	258	257	515	2
First Mine Branch	129	128	257	1
Gunpowder Falls (Below PB)	469	453	922	2
Bush Cabin Run	271	256	527	2
Mingo Branch	11	11	22	1
Panther Branch	173	173	346	1
Charles Run	283	283	566	2
Piney Creek	779	770	1,549	3
Gunpowder Falls	1,007	1,004	2,011	4
Buffalo Creek	98	98	196	1
Carroll Branch	199	197	396	1
My Lady's Manor Branch	61	61	122	1

4.2.15 Biological Indicators

Stream biological health is an important indicator of water quality. Loch Raven North is known for its high quality streams that accommodate trout, including the native brook trout. The brook trout require high quality waters with low temperatures and are very sensitive to environmental disturbances. Baltimore County takes macroinvertebrate samples throughout the Loch Raven North watershed to determine Benthic Index of Biotic Integrity (BIBI) scores.

BIBI scores for Loch Raven North fall in the “Fair” and “Good” condition ratings with average scores from

3.17 to 4.33. The higher the BIBI score, the better the overall water quality and aquatic habitat in that stream system. Therefore, high scores were given to subwatersheds with lower BIBI scores. The following point system was used to assign BIBI scores for the 17 subwatersheds based on the distribution and range of values:

- < 3.35 = 4 pts
- 3.35 – 3.64 = 3 pts
- 3.65 – 3.99 = 2 pts
- ≥ 4.00 = 1 pt

Average BIBI values and corresponding scores are summarized in Table 4-19 by subwatershed.

Table 4-19: Benthic Index of Biotic Integrity Scores

SUBWATERSHED	# Samples	Avg. BIBI Value	Rating	BIBI Score
Little Falls	21	4.10	Good	1
Beetree Run	12	4.19	Good	1
Fourth Mine Branch	5	3.73	Fair	2
Third Mine Branch	3	3.56	Fair	3
Owl Branch	1	4.00	Good	1
Second Mine Branch	3	3.78	Fair	2
First Mine Branch	3	3.33	Fair	4
Gunpowder Falls (Below PB)	6	3.89	Fair	2
Bush Cabin Run	4	4.33	Good	1
Mingo Branch	2	4.00	Good	1
Panther Branch	1	4.33	Good	1
Charles Run	6	3.89	Fair	2
Piney Creek	9	3.74	Fair	2
Gunpowder Falls	6	3.50	Fair	3
Buffalo Creek	6	4.00	Good	1
Carroll Branch	3	3.78	Fair	2
My Lady's Manor Branch	2	3.17	Fair	4

4.2.16 Subwatershed Prioritization Summary

The 17 subwatersheds that make up the Loch Raven North watershed are ranked according to their total prioritization score (i.e. the sum of prioritization criterion scores) based on their need and restoration potential. Subwatershed ranking results are summarized in Table 4-20 including criterion scores, total scores, and ranking by subwatershed.

Subwatersheds were placed into one of five priority categories based on ranking results: very high, high, medium, medium-low, and low. Subwatersheds given a very high priority are those with greater pollution and restoration potential, while those with low priority are those with lower pollution and restoration potential. These results are summarized in Table 4-21 and illustrated in Figure 4-1.

Subwatershed prioritization scores range from 18 to 56 points. The following point system was used to assign prioritization categories for the 17 subwatersheds based on the distribution and range of prioritization scores:

- ≥ 41 = Very High
- 36 – 40 = High
- 31 – 35 = Medium
- 26 – 30 = Medium-Low
- ≤ 25 = Low

Table 4-20: Subwatershed Ranking Results

SUBWATERSHED	Nitrogen Load	Phosphorus Load	Sediment Load	% Impervious	NSA PSI/ROI	NSA Downspout Disconnect	ISI Site Index	Forest Cover	Illicit Discharge Data	Stream Buffer Improvement	Stream Corridor Restoration	Historic Mill Dam Restoration	Conservation Areas	Hotspot Site Index	Pervious Area Index	Septic System	BIBI	TOTAL SCORE	SUBWATERSHED RANK
Little Falls	2	2	2	3	4	1	4	3	2	3	0	4	4	1	1	4	1	***41***	***2***
Beetree Run	3	2	3	3	2	2	1	3	1	3	0	2	4	4	1	3	1	***38***	***3***
Fourth Mine Branch	3	2	2	3	0	0	1	2	0	3	3	1	4	1	0	1	2	***28***	***10***
Third Mine Branch	3	4	3	2	1	0	0	3	1	4	0	-	3	2	1	2	3	***32***	***6***
Owl Branch	2	2	1	4	3	4	0	4	3	2	0	-	4	3	0	3	1	***36***	***4***
Second Mine Branch	4	4	4	2	2	2	0	3	1	3	0	-	2	1	0	2	2	***32***	***6***
First Mine Branch	2	2	2	1	1	0	0	2	0	2	0	1	1	1	0	1	4	***20***	***16***
Gunpowder Falls (Below PB)	1	1	1	3	3	4	1	1	4	1	0	0	2	0	2	2	2	***28***	***10***
Bush Cabin Run	2	2	2	2	2	3	0	3	1	3	0	1	3	0	4	2	1	***31***	***8***
Mingo Branch	1	1	1	2	1	1	0	1	1	1	2	-	1	3	0	1	1	***18***	***17***
Panther Branch	1	1	1	4	1	0	3	1	1	1	1	0	3	2	4	1	1	***26***	***13***
Charles Run	2	2	2	3	1	0	0	3	0	2	0	0	3	0	0	2	2	***22***	***15***
Piney Creek	4	3	4	4	4	2	4	4	3	4	4	3	4	2	2	3	2	***56***	***1***
Gunpowder Falls	1	1	1	3	4	3	3	2	4	1	0	1	3	0	0	4	3	***34***	***5***
Buffalo Creek	4	3	4	2	1	0	0	3	0	4	0	1	2	0	0	1	1	***26***	***13***
Carroll Branch	3	3	3	2	3	3	0	4	1	4	0	-	2	0	0	1	2	***31***	***8***
My Lady's Manor Branch	4	4	4	2	1	0	0	4	0	2	0	-	1	0	0	1	4	***27***	***12***

Table 4-21: Subwatershed Prioritization

Rank	Subwatershed	Total Score	Prioritization Category
1	Piney Creek	56	Very High
2	Little Falls	41	Very High
3	Beetree Run	38	High
4	Owl Branch	36	High
5	Gunpowder Falls	34	Medium
6	Second Mine Branch	32	Medium
6	Third Mine Branch	32	Medium
8	Carroll Branch	31	Medium
8	Bush Cabin Run	31	Medium
10	Gunpowder Falls (Below PB)	28	Medium-Low
10	Fourth Mine Branch	28	Medium-Low
12	My Lady's Manor Branch	27	Medium-Low
13	Panther Branch	26	Medium-Low
13	Buffalo Creek	26	Medium-Low
15	Charles Run	22	Low
16	First Mine Branch	20	Low
17	Mingo Branch	18	Low

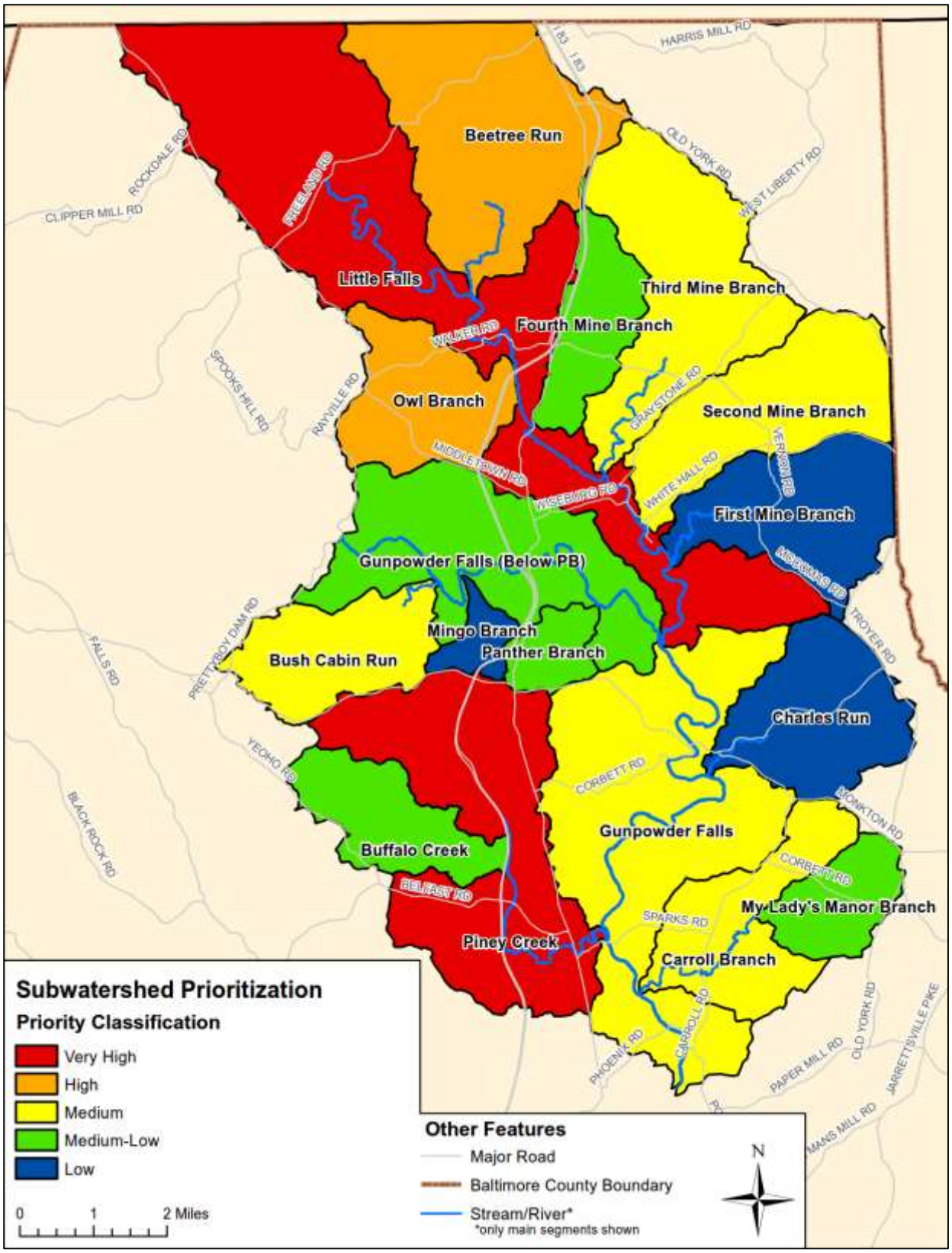

Figure 4-1: Loch Raven North Subwatershed Prioritization

4.3 Subwatershed Restoration Strategies

Restoration strategies for each subwatershed are presented in the following subsections. Subwatersheds are presented in the numerical order based on the unique ID numbers assigned during the field assessments and summarized in Section 4.2.1 of the *Watershed Characterization Report* (Appendix E). A description of key watershed characteristics is presented for each subwatershed including drainage area, stream length, population, land use/land cover, land in conservation easements, impervious cover, and soils. Assessment results for neighborhoods, hotspots, institutions, pervious areas, illicit discharges, historic mill dams, and stream corridors are also summarized for each subwatershed. Finally, a subwatershed management strategy including recommended citizen and municipal actions are presented at the end of each subsection.

Several of the assessment categories that were considered only examined a percentage of opportunities within a given subwatershed. These categories include neighborhoods, hotspots, and institutions. The objective of the assessments is to review a representative sample of the neighborhoods, businesses, and institutions in the watershed to identify the most likely opportunities to limit pollution sources and implement pollution reduction measures.

For example, because there are numerous operations that qualify as stormwater hotspots, not all could be individually evaluated during the uplands survey. The assessments are intended to represent common types of hotspot operations located throughout the watershed and help develop an overall strategy to encompass all hotspot operations.

4.3.1 Little Falls

The Little Falls subwatershed is the largest subwatershed in the Loch Raven North watershed and also contains the most stream miles. Agriculture and forest make up the majority of the land use throughout the subwatershed (36% and 33%, respectively). Being the largest subwatershed, it contains the greatest number of acres held in conservation easements but ranks the 3rd lowest in percent lands in conservation easements (36%). Key characteristics regarding the Little Falls subwatershed are summarized in Table 4-22.

Table 4-22: Key Subwatershed Characteristics – Little Falls

Drainage Area	11,135	acres	
	17.40	sq. mi.	
Stream Length	112.9	miles	
Population	5,907	(2010 Census)	
	0.53	persons/acre	
Land Use/Land Cover	Very Low Density Residential:		15.0%
	Low Density Residential:		14.5%
	Medium/High Density Residential:		0.1%
	Commercial:		0.5%
	Industrial:		0.0%
	Institutional:		0.2%
	Open Urban:		0.0%
	Agriculture:		36.4%
	Forest:		32.7%
	Transportation:		0.2%
	Other:		0.3%
Land in Easement	3,992	acres	35.8%
Impervious Cover	378	acres	3.4%
Soils	A Soils (low runoff potential):		0.0%
	B Soils:		72.1%
	C Soils:		9.9%
	D Soils (high runoff potential):		17.7%
	Water:		0.3%

4.3.1.1 Neighborhoods

A total of 10 distinct neighborhoods were identified and assessed within the Little Falls subwatershed during the uplands assessment of Loch Raven North. Characteristics such as lot size, age, and type were used to delineate neighborhoods rather than subwatershed boundaries. As a result, some neighborhoods overlap multiple subwatersheds. Qualitative descriptions of neighborhoods and recommendations are included within the subwatershed restoration strategy for the subwatershed where the majority of the neighborhood resides. While descriptions are not repeated for neighborhoods overlapping multiple subwatersheds, calculations presented in the *Watershed Characterization Report* were based on the fraction of the NSA area within respective watersheds.

Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, rain gardens, storm drain marking, buffer improvement, tree planting, and public education (i.e., bayscaping, and increasing lot tree canopy). A summary of neighborhood recommended actions is presented in Table 4-23.

Table 4-23: NSA Recommendations – Little Falls

NSA_ID	Lot Size (acres)	Opportunity for	Rain Gardens	Storm Drain Marking	Bayscape	Increase Lot Canopy	Buffer Improvement	# of Shade Trees	Notes
NSA_X_0101	1		X		X	X			-
NSA_X_0102	3-5		X		X	X			Stand alone parcel has stream that needs buffer
NSA_X_0103	1-3		X		X	X			There is no buffer along stream right outside neighborhood line
NSA_X_0104	1-3			X	X	X	X		-
NSA_X_0105	1-3		X		X	X	X	38	-
NSA_X_0106	1-3		X		X	X	X		-
NSA_X_0107	3-5			X	X				-
NSA_X_0108	3-5			X	X		X		-
NSA_X_0109	1-3	X	X	X	X	X	X	54	SWM maintenance needed, defined channel
NSA_X_0110	1-3		X		X		X		-

Two of the neighborhoods assessed in the Little Falls subwatershed had common space available for potential tree planting (Figure 4-2, left). Although only one NSA was recommended for downspout disconnection (NSA_X_0109), due to the large lot sizes and grassed lawns, seven of the NSAs were noted for rain garden implentation. The large lot sizes also contributed to recommendations of bayscaping, increasing lot canopy, and buffer improvement at the majority of the neighborhoods (Figure 4-2, right). Additionally, four NSAs in the Little Falls subwatershed were recommended for storm drain marking as the current inlets are unmarked.

Figure 4-2: Open Space Tree Planting Opportunity at NSA_X_0105 (left) and Large Lots with Potential for Bayscaping and Lot Canopy Improvement at NSA_X_0109 (right)

4.3.1.2 Hotspots

One hotspot investigation was performed within the Little Falls subwatershed. Table 4-24 summarizes the potential pollution sources found at the site.

Table 4-24: HSI Results Summary – Little Falls

HSI_ID	HSI Status	Description		Vehicle Operations	Outdoor Materials	Waste Management	Physical Plant	Turf/Landscape Management	Storm Water	Notes
HSI_X_0101	Potential	Industrial	Construction Facility	X	X	X	X			-

HSI_X_0101 is a construction facility located off of Wiseburg Road in the Little Falls subwatershed. Potential pollution activities include vehicle operations (storage) and management of outdoor materials and waste. Specific observations made at this site include downspouts connected directly to impervious surfaces; however, there was no alternative for disconnection. Recommendations include future education for waste management and schedule a review of the storm water pollution prevention plan as the site is located directly next to Little Falls.

Figure 4-3: Downspout Discharging to Impervious (left) and Stored Equipment (right) at HSI_X_0101

4.3.1.3 Institutions

Two elementary schools and one faith-based institutional site were assessed for retrofit opportunities in the Little Falls subwatershed during the uplands assessment of Loch Raven North. Table 4-25 summarizes recommendations for the institutional sites assessed in the Little Falls subwatershed.

Table 4-25: ISI Recommendations – Little Falls

Site ID	Name	Public/ Private	Nutrient Management	# Trees for Planting	Stormwater Retrofit	Downspout Disconnection	Impervious Cover Removal	Trash Management	Storm Drain Marking	Buffer Improvement	Notes
ISI_X_0101	Parke Memorial United Methodist Church	Private		20							-
ISI_X_0102	Seventh District Elementary	Public		211	X		X	X	X		Nearby residents concerned about stormwater flowing into yard and causing erosion
ISI_X_0103	Prettyboy Elementary	Public		62	X			X	X		A lot of soil and sediment in inlets, dumpster sits on top of storm drain system

All of the institutional sites assessed in the Little Falls subwatershed had opportunities for tree planting. The two schools had opportunities for stormwater retrofits, trash management, and storm drain marking. At ISI_X_0102, there are multiple walkways along building entrances that may be altered to remove impervious areas while still functioning as needed (Figure 4-4, left) as well as significant open space available for tree planting (Figure 4-4, right).

Figure 4-4: Potential Impervious Removal (left) and Open Space Available for Tree Planting (right) at ISI_X_0102

At ISI_X_0102, a public school, the parking lot located at the southwest corner of the school drains to a curb and gutter system and eventually to storm drain inlets, discharging to a grassy area and causing downstream erosion. The adjacent turf area is potentially suitable for the placement of a bioretention facility (Figure 4-5).

Figure 4-5: Parking Lot (left) could Potentially be Treated by SWM Retrofit at Outfall (right) at ISI_X_0102

At ISI_X_0103, multiple rain gardens have been constructed around the property, although some inlets remain susceptible to heavy sediment loads and significant sediment was observed inside them (Figure 4-6). Schools are an excellent location for educational outreach due to the large populations that frequent them and additional rain gardens around unprotected inlets was recommended. Additionally, the school parking lot at ISI_X_0103 currently drains towards a single location in the open area in front of the school. A storm drain system under the open area currently discharges runoff at the edge of the school property along the side of the highway into the Loch Raven North watershed and presents the opportunity for stormwater retrofit to treat the impervious runoff through microbioretention.

Figure 4-6: Existing Rain Garden (left) and Inlet in Need of Protection (right) at ISI_X_0103

Trash management was recommended for both elementary schools in the Little Falls subwatershed. At ISI_X_0103, dumpsters were observed on top of storm drain inlets (Figure 4-7).

Figure 4-7: Dumpsters Stored Near Storm Drains at ISI_X_0102 (left) and Dumpsters Stored on Storm Drains (right) at ISI_X_0103

4.3.1.4 Pervious Areas

Three pervious areas were assessed in the Little Falls subwatershed. The first, PAA_X_0101, is a 3.76 acre lot owned by the Maryland State Highway Administration and Department of Natural Resources near the intersection of Walker Road and Stablers Church Road. The plot of land is within the Little Falls stream buffer and available land for planting is approximately 2 acres of tree planting.

PAA_X_0102 is made up of a cluster of 10 publicly owned parcels at the intersection of Calder Avenue at York Road. The parcels border the Fourth Mine Branch and Little Falls above their confluence, both of which have inadequate stream buffers. The area has the potential for approximately 4 acres of tree planting. There is also a potential for a stormwater retrofit to treat current roadway runoff that drains to a swale.

PAA_X_0103 is publicly owned and located in the Little Falls subwatershed at the intersection of Graystone Road, Wiseburg Road, and the Torrey C. Brown Rail Trail. While there is less than 1 acre available for planting, additional trees in this area would provide a stream buffer for both banks along a 150 foot section of Little Falls.

4.3.1.5 Illicit Discharges

Baltimore County tracks illicit discharges through a program of routine screening at major outfalls. The County uses a prioritization system based on this data where outfalls are assigned one of the following priority ratings: none (priority 0), low (priority 3), high (priority 2), and critical (priority 1). Priority 1 outfalls have major problems that require immediate correction and/or close monitoring, or have recurring problems. These outfalls are sampled four times each year. Priority 2 outfalls have moderate to minor problems and potential to become more severe. These are sampled once a year. Priority 3 outfalls have minor to no problems and are monitored on a 10-year cycle. Priority 0 outfalls lack sufficient data to determine a priority rating. More information on Baltimore County's Illicit Discharge Elimination program can be found in Section 3.4.3 for the *Watershed Characterization Report* (Appendix E).

There are no major outfalls located in the Little Falls subwatershed.

4.3.1.6 Stream Corridors

A stream corridor assessment was not completed for this subwatershed.

4.3.1.7 Historic Mill Dams

A total of 14 historic mill dam sites were investigated in the Little Falls subwatershed to determine potential restoration opportunities. Of the 14 sites, nine had recommended actions including stream stabilization/restoration, wetland creation, floodplain reconnection, and buffer creation. The most prominent restoration action was buffer creation (seven sites) to increase the forest cover along the stream. Table 4-26 summarizes the results of the mill dam assessments and restoration opportunities for the Little Falls subwatershed. Additional information on mill dam assessments and restoration recommendations can be found in Appendix B of the *Watershed Characterization Report* (Appendix E).

Table 4-26: Summary of Historic Mill Dam Sites - Little Falls

			Recommended Action				
Mill Dam ID	No Action	Legacy Sediment Removal	Stream Stabilization/ Restoration	Wetland Creation	Floodplain Reconnection	Fish Passage	Buffer Creation
MD01_006A1	-	-	-	-	-	-	X
MD01_006B2	-	-	X	-	X	-	-
MD01_006C3	-	-	-	X	-	-	X
MD01_011C1	X	-	-	-	-	-	-
MD01_012A1	-	-	X	-	X	-	-
MD01_012A2	-	-	-	-	-	-	X
MD01_012A3	X	-	-	-	-	-	-
MD01_017C2	X	-	-	-	-	-	-
MD01_017C3	-	-	-	-	-	-	X
MD01_022C2	X	-	-	-	-	-	-
MD02_006A1	-	-	-	-	-	-	X
MD02_006B2	-	-	X	X	X	-	X
MD02_006C3	X	-	-	-	-	-	-
MD02_012A2	-	-	-	-	-	-	X
Total	***5***	***0***	***3***	***2***	***3***	***0***	***7***

4.3.1.8 Subwatershed Management Strategy

<u>Engaging Citizens & Watershed Groups</u>

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-23 and educate citizens on the benefits of rain barrels and rain gardens.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-23.
3. Increase tree canopies on private lots by educating citizens on the benefits of trees and raising awareness of programs such as Baltimore County's "Big Trees Sale". Educate those neighborhoods

that were noted for buffer improvements on the benefits of stream buffers.

4. Educate citizens about the benefits and importance of proper lawn care and bayscaping.
5. Inform citizens of the importance of septic system maintenance.

Municipal Actions

1. Investigate planting open space trees in the neighborhoods as indicated in Table 4-23 and at the institutions indicated in Table 4-25.
2. Provide education to hotspots indicated in Table 4-24 and similar facilities on proper methods for vehicle operations, storage of outdoor materials, waste management, physical plant maintenance, turf/landscape maintenance, and storm system maintenance.
3. Investigate potential for installation of stormwater retrofits and conduct programs with institutions to provide education and install retrofits at the facilities in Table 4-25.
4. Investigate potential impervious cover removal at ISI_X_0102.
5. Provide education to institutions indicated in Table 4-25 on proper waste management.
6. Investigate potential for tree planting at PAA_X_0101, PAA_X_0102, and PAA_X_0103.
7. Investigate opportunities for restoration at the historic mill dam sites indicated in Table 4-26.

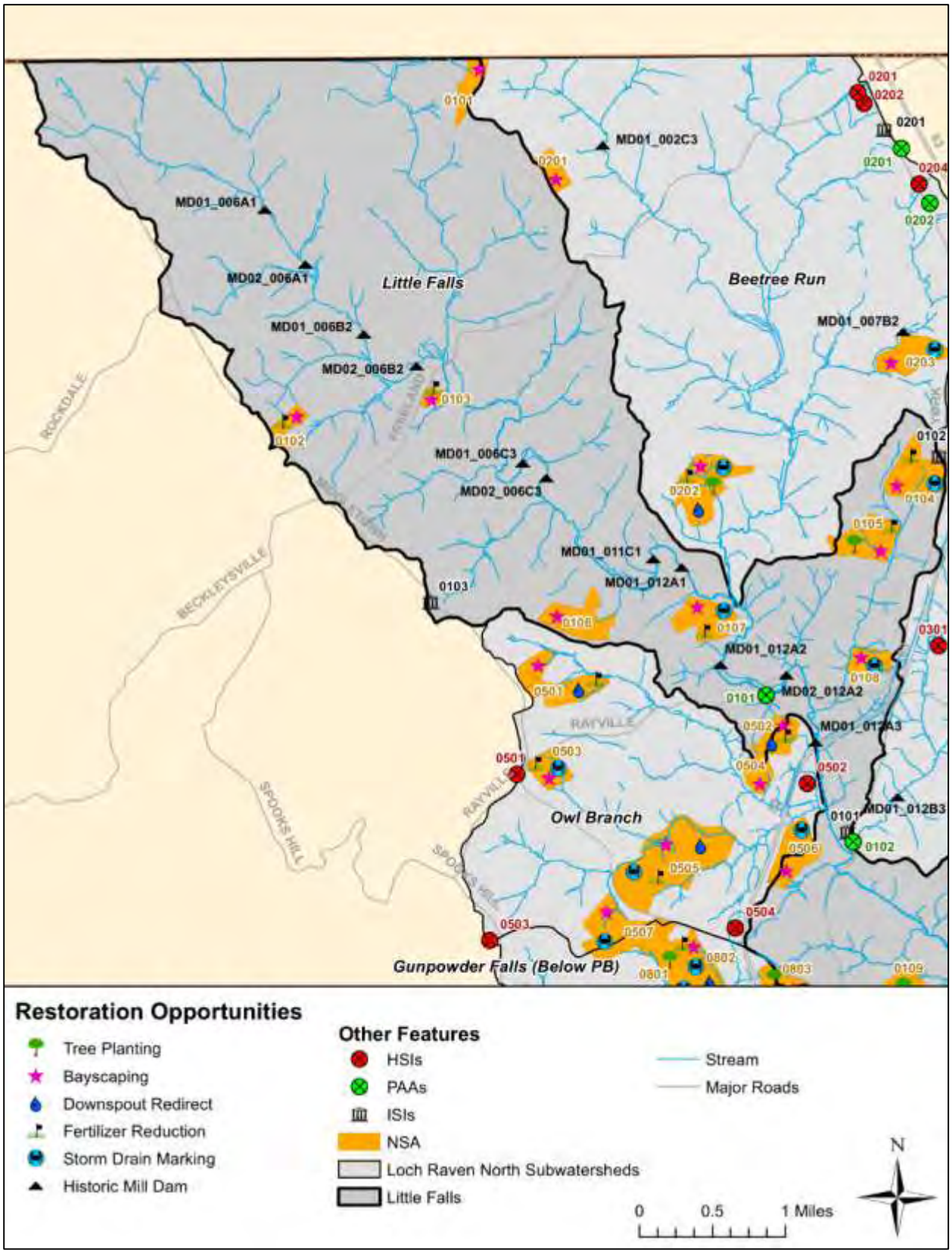

Figure 4-8: Restoration Opportunities in the Little Falls subwatershed (North)

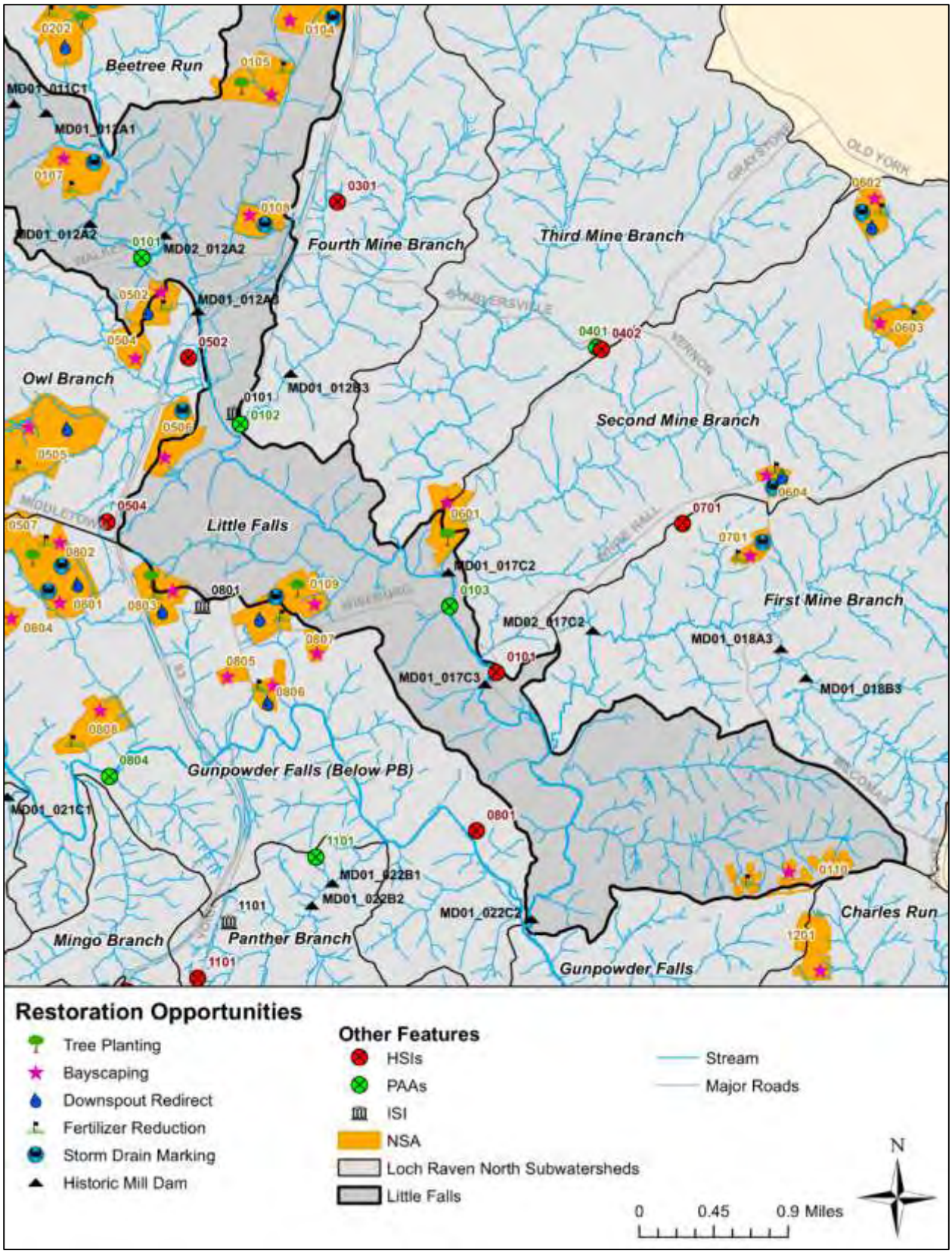

Figure 4-9: Restoration Opportunities in the Little Falls subwatershed (South)

4.3.2 Beetree Run

The Beetree Run subwatershed is the 4th largest subwatershed in the Loch Raven North planning area. Like most of the subwatersheds in Loch Raven North, the majority of the land use in the Beetree Run subwatershed is agricultural (36%) and forest (38%). Table 4-27 summarizes key characteristics of Beetree Run.

Table 4-27: Key Subwatershed Characteristics – Beetree Run

Drainage Area	5,149	acres	
	8.05	sq. mi.	
Stream Length	45.3	miles	
Population	2,665	(2010 Census)	
	0.52	persons/acre	
Land Use/Land Cover	Very Low Density Residential:		11.4%
	Low Density Residential:		13.2%
	Medium/High Density Residential:		0.3%
	Commercial:		0.4%
	Industrial:		0.0%
	Institutional:		0.2%
	Open Urban:		0.6%
	Agriculture:		35.5%
	Forest:		37.9%
	Transportation:		0.6%
	Other:		0.0%
Land in Easement	1,924	acres	37.4%
Impervious Cover	184	acres	3.6%
Soils	A Soils (low runoff potential):		0.0%
	B Soils:		74.7%
	C Soils:		8.1%
	D Soils (high runoff potential):		17.1%
	Water:		0.1%

4.3.2.1 Neighborhoods

A total of three distinct neighborhoods were identified and assessed within the Beetree Run subwatershed during the uplands assessment of Loch Raven North. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, rain gardens, storm drain marking, buffer improvement, tree planting, and public education (i.e. bayscaping and increasing lot tree canopy). A summary of neighborhood recommended actions is presented in Table 4-28.

Table 4-28: NSA Recommendations – Beetree Run

NSA_ID	Lot Size (acres)	Opportunity for	Rain Gardens	Storm Drain Marking	Bayscape	Increase Lot Canopy	Buffer Improvement	# of Shade Trees	Notes
NSA_X_0201	3-5		X		X	X			-
NSA_X_0202	1-3	X	X	X	X	X	X	118	-
NSA_X_0203	1-3			X	X		X		-

Most of the neighborhoods in the Beetree Run subwatershed are recommended for storm drain marking and public education related to bayscaping and increasing lot tree canopy. Two neighborhoods, NSA_X_0202 and NSA_X_0203, are recommended for buffer improvement that may be achieved through public education about the benefits of providing a stream buffer by reducing the amount of mowed lawn through tree and vegetation planting.

Figure 4-10: Space for Buffer Planting at NSA_X_0202 (left) and Unmarked Storm Drain at NSA_X_0203 (right).

4.3.2.2 Hotspots

Five hotspot investigations were performed within the Beetree Run subwatershed. The assessments include a human services center, concrete company, construction storage yard, gas station, and park and ride facility. Table 4-29 summarizes the potential pollution sources found at these sites.

Table 4-29: HSI Results Summary – Beetree Run

HSI ID	HSI Status	Description		Vehicle Operations	Outdoor Materials	Waste Management	Physical Plant	Turf/Landscape Management	Storm Water	Notes
HSI_X_0201	Confirmed Hotspot	Commercial	Human Services	X	X	X	X	X	X	A lot of loose trash behind and around dumpsters, directly connected to storm drain system, possible retrofit of pond
HSI_X_0202	Confirmed Hotspot	Industrial	Concrete Company	X	X	X	X	X		Evidence of dumping off south side of property, evidence of sediment on pavement, possible SWM
HSI_X_0203	Potential Hotspot	Industrial	Construction		X	X	X	X	X	Appeared to be a lot of rubble and waste along facility. Could not access to verify
HSI_X_0204	Potential Hotspot	Commercial	Gas Station	X		X	X		X	Possible impervious removal and onsite retrofit
HSI_X_0205	Severe Hotspot	Transport-Related	Parking lot			X			X	Trash and dumping around parking lot, possible area for retrofit, SWM under construction

HSI_X_0201 is a human services facility near the intersection of Freeland Road and York Road. Potential pollution sources at this hotspot include vehicle operations, outdoor material storage, waste management, physical plant management, landscape management, and stormwater retrofit. Open dumpsters were observed along with asphalt staining nearby (Figure 4-11). This presents an opportunity for educational outreach. Currently, there is a dry pond stormwater facility with potential to convert to a wet pond.

Figure 4-11: Open Dumpster with Nearby Asphalt Staining at HSI_X_0201

HSI_X_0202 is an industrial facility related to concrete production located off of York Road. Potential pollution sources at this hotspot include vehicle operations, outdoor material storage, physical plant management, turf/landscaping management, and management of waste. Uncovered, outdoor material storage was observed throughout the site along with possible dumping (Figure 4-12). Sediment was observed on the private drive leading to York Road. This site was recommended for a follow-up site investigation and scheduled review of storm water pollution prevention plan to address the possible dumping, sediment, and outdoor storage materials. This facility currently holds a National Pollutant Discharge Elimination System (NPDES) permit.

Figure 4-12: Possible Dumping (left) and Outdoor Discarded Materials (right) at HSI_X_0202

HSI_X_0203 is an industrial construction facility located on Old York Road. Potential pollution sources at this hotspot include outdoor materials storage, waste and landscape management, physical plant, and stormwater retrofit. The drive leading to the facility is breaking up (Figure 4-13, left). Additionally, piles of discarded concrete were observed at multiple locations on the property. It was not possible to view the entire property, and a follow-up site inspection is recommended.

Figure 4-13: Concrete Drive is Breaking (left) and Discarded Concrete (right) at HSI_X_0203

HSI_X_0204 is a gas station located off of York Road. Potential pollution sources at this hotspot include vehicle operations, outdoor material storage, waste management, and physical plant management. Uncovered dumpsters and stained asphalt were observed on the property, as well as outdoor storage of materials. Additionally, one of the fueling stations was uncovered. Portions of the parking lot showed signs of deterioration and there appeared to be an excessive amount of unused pavement that could potentially be removed. The majority of the parking lot drains towards the dumpsters and an open pervious area that drains to a headwall (Figure 4-14). There appeared to be room for a stormwater retrofit to treat the parking lot.

Figure 4-14: Excessive Impervious and Open Space for Potential Storm Water Management (SWM) Retrofit at HSI_X_0203

HSI_X_0205 is a park and ride facility off of I-83 in Parkton, Maryland. Observed waste management pollution was observed at the time of the assessment. The parking lot drains to a single inlet. Downstream of this inlet, the outfall is visibly polluted with trash and oily substances (Figure 4-15, right). A stormwater management facility is under construction and located adjacent to the park and ride; however, it is unclear if the facility will treat the parking lot or portions of the road. There is open space near the inlet, which could potentially be retrofitted with a SWM facility, such as microbioretention. Dumping was observed on the edge of the property where there is a stream. The site was recommended for illicit discharge

testing, future education to manage dumping, and potential for a SWM retrofit.

Figure 4-15: Polluted Outfall Discharge and Dumping at HSI_X_0205

4.3.2.3 Institutions

One public institutional site was assessed for retrofit opportunities in the Beetree Run subwatershed during the uplands assessment of Loch Raven North. Table 4-30 summarizes recommendations for the institutional site assessed in Beetree Run.

Table 4-30: ISI Recommendations – Beetree Run

Site ID	Name	Public/ Private	# Trees for Planting	Stormwater Retrofit	Impervious Cover Removal	Trash Management	Storm Drain Marking	Notes
ISI_X_0201	Maryland Line United Methodist Church	Private	11			X		-

ISI_X_0201 is a faith-based facility off of York Road. Recommendations for water quality projects at this institution include education on proper trash management and tree planting. Open turf behind the church presents an opportunity for tree planting (Figure 4-16), while improperly disposed of trash observed on site presents an opportunity for educational outreach.

Figure 4-16: Tree Planting Opportunity (left) and Trash Dumping (right) at ISI_X_0201

4.3.2.4 Pervious Areas

The Beetree Run subwatershed contains two pervious areas that were assessed in the Loch Raven North watershed. The first, PAA_X_0201 is a state owned, 11 acre parcel of land along York Road. There is the potential for non- stream buffer tree planting; however, only 1 acre of the parcel is located within the Loch Raven North watershed and was considered for potential tree planting.

PAA_X_0202 is a cluster of three state owned parcels located along York Road. Although there are no streams or forested areas on the parcel, there is a potential for 2 acres of tree planting. Due to the proximity to York Road, there is also potential for a stormwater retrofit, such as a bioswale, to treat roadway runoff.

4.3.2.5 Illicit Discharges

No major outfalls are located in the Beetree Run subwatershed.

4.3.2.6 Stream Corridors

A stream corridor assessment was not completed for this subwatershed.

4.3.2.7 Historic Mill Dams

Two historic mill dam sites were assessed in the Beetree Run subwatershed. Each site had two recommended restoration activities: stream stabilization/restoration and floodplain reconnection at one site and stream stabilization/restoration and fish passage at the other. The site should be reassessed for fish passage by a specialist to determine if creating a fish passage will be beneficial or harmful to the native species. A summary of the recommended actions for the mill dam sites in the Beetree Run subwatershed are summarized in Table 4-31. Additional information on mill dam assessments and restoration recommendations can be found in *Appendix B* of the *Watershed Characterization Report* (Appendix E).

Table 4-31: Summary of Historic Mill Dam Sites - Beetree Run

Mill Dam ID	No Action	Legacy Sediment Removal	Stream Stabilization/ Restoration	Wetland Creation	Floodplain Reconnection	Fish Passage	Buffer Creation
	Recommended Action						
MD01_002C3	-	-	X	-	X	-	-
MD01_007B2	-	-	X	-	-	X	-
Total	***0***	***0***	***2***	***0***	***1***	***1***	***0***

4.3.2.8 Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhood NSA_X_0202 and educate citizens on the benefits of rain barrels and rain gardens indicated in Table 4-28.

2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-28.

3. Increase tree canopies on private lots by educating citizens on the benefits of trees and creating awareness to programs such as Baltimore County's "Big Trees Sale".

4. Educate citizens about the benefits and importance of bayscaping and proper lawn care.

5. Educated residents of NSA_X_0202 and NSA_X_0203 about the importance of stream buffers and encourage more environmentally friendly stream treatments.

6. Inform citizens of the importance of septic system maintenance.

Municipal Actions

1. Engage residents in NSA _X_0202 for participation in possible open space tree planting events.

2. Provide education to hotspots indicated in Table 4-29 and similar facilities on proper methods for vehicle operations, storage of outdoor materials, waste management, physical plant maintenance, turf/landscape maintenance, and storm system maintenance.

3. Engage institution, ISI_X_0201, in tree planting for a possible 11 additional trees.

4. Educate ISI_X_0201 on proper trash management.

5. Investigate the potential for tree planting at PAA_X_0201 and PAA_X_0202.

6. Investigate the potential for installation of stormwater retrofits at PAA_X_0202 to treat York Road runoff.

7. Investigate the opportunity for historic mill dam restoration projects indicated in Table 4-31.

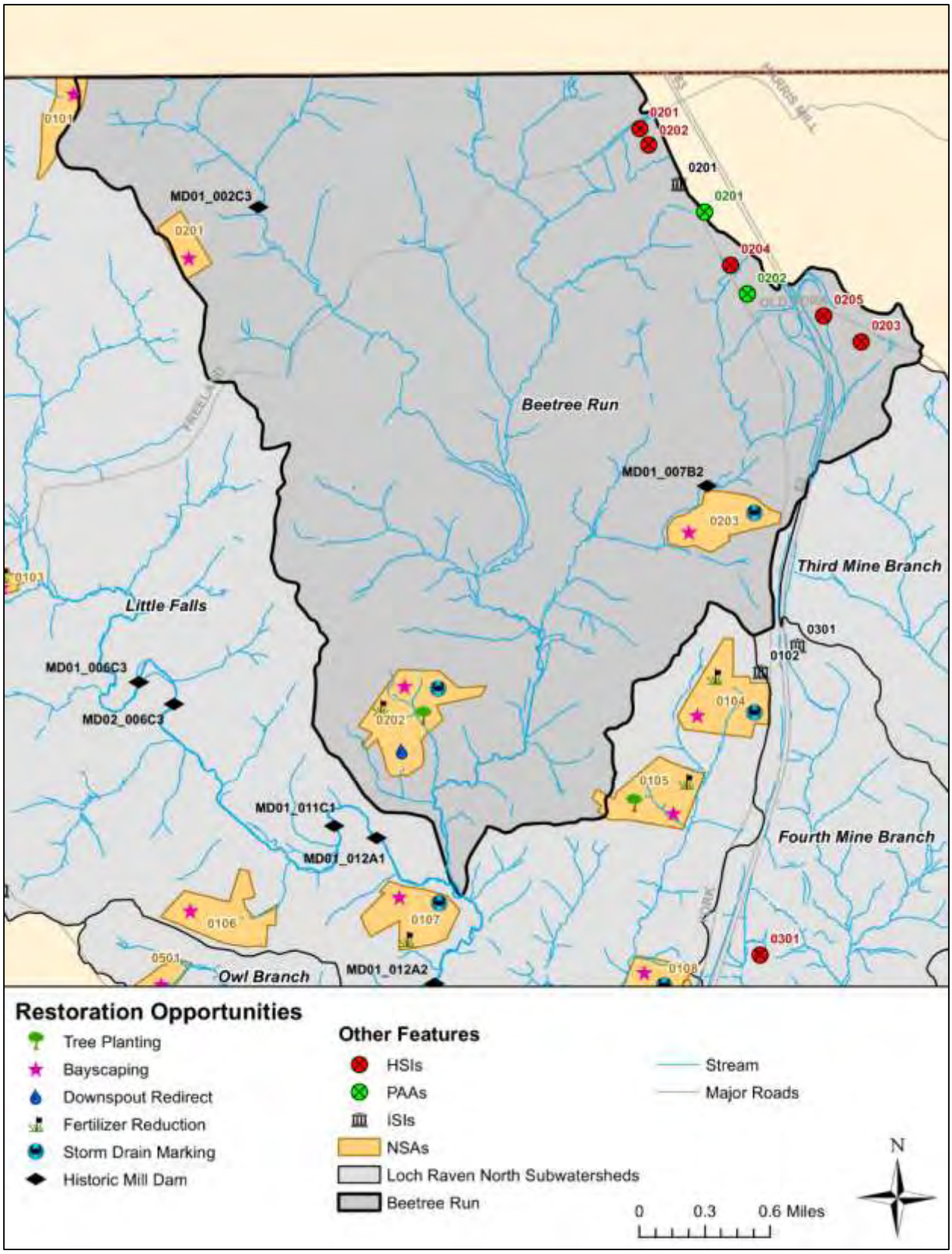

Figure 4-17: Restoration Opportunities in the Beetree Run Subwatershed

4.3.3 Fourth Mine Branch

The Fourth Mine Branch subwatershed is the 4th smallest subwatershed in the Loch Raven North planning area and is comprised of mostly agricultural (37%), forest (42%), and low density residential land (8%) uses. It boasts the 3rd highest population density of any subwatershed, and ranks 4th highest in percent impervious cover (4.0%) and 2nd lowest in conservation easements (31%). This subwatershed also has the largest percentage of "other" land use due to the large publicly owned landfill within the watershed, which accounts for approximately 4.7% land cover in the subwatershed. Table 4-32 summarizes key characteristics of the Fourth Mine Branch subwatershed.

Table 4-32: Key Subwatershed Characteristics – Fourth Mine Branch

Drainage Area	1,633	Acres	
	2.55	sq. mi.	
Stream Length	20.8	Miles	
Population	1,375	(2010 Census)	
	0.84	persons/acre	
Land Use/Land Cover	Very Low Density Residential:		3.9%
	Low Density Residential:		8.4%
	Medium/High Density Residential:		0.0%
	Commercial:		0.2%
	Industrial:		0.0%
	Institutional:		1.0%
	Open Urban:		0.0%
	Agriculture:		36.6%
	Forest:		42.2%
	Transportation:		2.9%
	Other:		4.8%
Land in Easement	508	Acres	31.1%
Impervious Cover	65	Acres	4.0%
Soils	A Soils (low runoff potential):		0.0%
	B Soils:		66.0%
	C Soils:		13.5%
	D Soils (high runoff potential):		20.5%
	Water:		0.0%

4.3.3.1 Neighborhoods

No NSAs were assessed in the Fourth Mine Branch subwatershed.

4.3.3.2 Hotspots

One hotspot investigation was performed within the Fourth Mine Branch subwatershed. Table 4-33 summarizes the potential pollution sources found at this site.

Table 4-33: HSI Results Summary – Fourth Mine Branch

HSI_ID	HSI Status	Description		Vehicle Operations	Outdoor Materials	Waste Management	Physical Plant	Turf/Landscape Management	Storm Water	Notes
HSI_X_0301	Confirmed Hotspot	Transport-Related	Bus Lot	X		X	X	X	X	Staining of concrete by drain next to fueling area. Drains to underground facility (verified by maintenance personnel)

HSI_X_0301 is a bus servicing lot located off Stablers Church Road. The facility is a confirmed hotspot with pollution potential from vehicle operations, waste management, physical plant management, and turf/landscape management. Multiple buses are stored, fueled, and repaired on the property. Staining was observed near the stormdrain inlets; however, maintenance staff verified that the drains led to underground treatment facility (Figure 4-18). Additionally, a dumpster was observed with the lid open. The facility currently holds an NPDES permit. The site was recommended for future education on trash management and a review of the storm water pollution prevention plan.

Figure 4-18: Buses Stored, Maintained, and Fueled (left) and Staining at Storm Drains (right) at HSI_C_304

4.3.3.3 Institutions

One public institutional site was assessed for retrofit opportunities in the Fourth Mine Branch subwatershed during the uplands assessment of Loch Raven North. Table 4-34 summarizes recommendations for the institutional site assessed in the Fourth Mine Branch subwatershed.

Table 4-34: ISI Recommendations – Fourth Mine Branch

Site ID	Name	Public/ Private	# Trees for Planting	Stormwater Retrofit	Downspout Disconnection	Trash Management	Storm Drain Marking	Buffer Improvement	Notes
ISI_X_0301	Redeemer Lutheran Church	Private	73				X		-

ISI_X_0301 is a faith-based institution located next to I-83 off of Downes Road. Restoration opportunities at this location involve tree planting and storm drain marking. Currently, the property drains to an extended detention pond (Figure 4-19) but the inlets in the parking lot are unmarked. Additionally, there is open pervious area surrounding the church that could be used for open space trees.

Figure 4-19: Existing Stormwater Facility (left) and Potential Tree Planting (right) at ISI_X_0301

4.3.3.4 Pervious Areas

No pervious area assessments were located in this subwatershed.

4.3.3.5 Illicit Discharges

No major outfalls are located in the Fourth Mine Branch subwatershed.

4.3.3.6 Stream Corridors

Assessment teams walked approximately 5.9 miles of stream within the Fourth Mine Branch subwatershed to identify water quality problems and restoration opportunities. A total of 367 potential environmental problems were identified in the Fourth Mine Branch subwatershed. The most prominent environmental problems encountered were erosion sites, fish barriers, and inadequate buffers. Table 4-35 summarizes the results of the SCA survey and restoration opportunities for this subwatershed.

Table 4-35: Summary of Stream Conditions - Fourth Mine Branch

OPPORTUNITIES (# of Environmental Problem Sites)								
Inadequate Buffer	Erosion Sites	Trash Dumping	Fish Barriers	Pipe Outfalls	Exposed Pipes	Channel Alteration	Unusual Conditions or Comments	Total
20	286	0	26	10	1	13	11	**367**

Length of Channel Alteration (ft)	Length of Erosion (ft)	Length of Inadequate Buffer (ft)
641	36,508	11,169

4.3.3.7 Historic Mill Dams

One historic mill dam site was assessed in the Fourth Mine Branch subwatershed. At this site, recommendations included stream restoration and buffer creation. The restoration actions identified for the mill dam site are shown in Table 4-36. Additional information on mill dam assessments and restoration recommendations can be found in *Appendix B* of the *Watershed Characterization Report* (Appendix E).

Table 4-36: Summary of Historic Mill Dam Sites - Fourth Mine Branch

	Recommended Action						
Mill Dam ID	No Action	Legacy Sediment Removal	Stream Stabilization/ Restoration	Wetland Creation	Floodplain Reconnection	Fish Passage	Buffer Creation
MD01_012B3	-	-	X	-	-	-	X
Total	***0***	***0***	***1***	***0***	***0***	***0***	***1***

4.3.3.8 Subwatershed Management Strategy

<u>Engaging Citizens & Watershed Groups</u>

1. Inform citizens of the importance of septic system maintenance.

<u>Municipal Actions</u>

1. Provide education to HSI_X_0301 and similar facilities on proper methods for vehicle operations, waste management, physical plant maintenance, turf/landscape maintenance, and storm system maintenance.

2. Engage institutional site ISI_X_0301 in tree plantings.

3. Engage institutional site ISI_X_0301 to participate in storm drain marking.

4. Investigate the potential for stormwater conversion at ISI_X_0301 and conduct programs with institution to provide education and complete conversion at facility.

5. Investigate the potential for stream restoration projects in the Fourth Mine Branch subwatershed.

6. Investigate potential historic mill dam restoration actions indicated in Table 4-36.

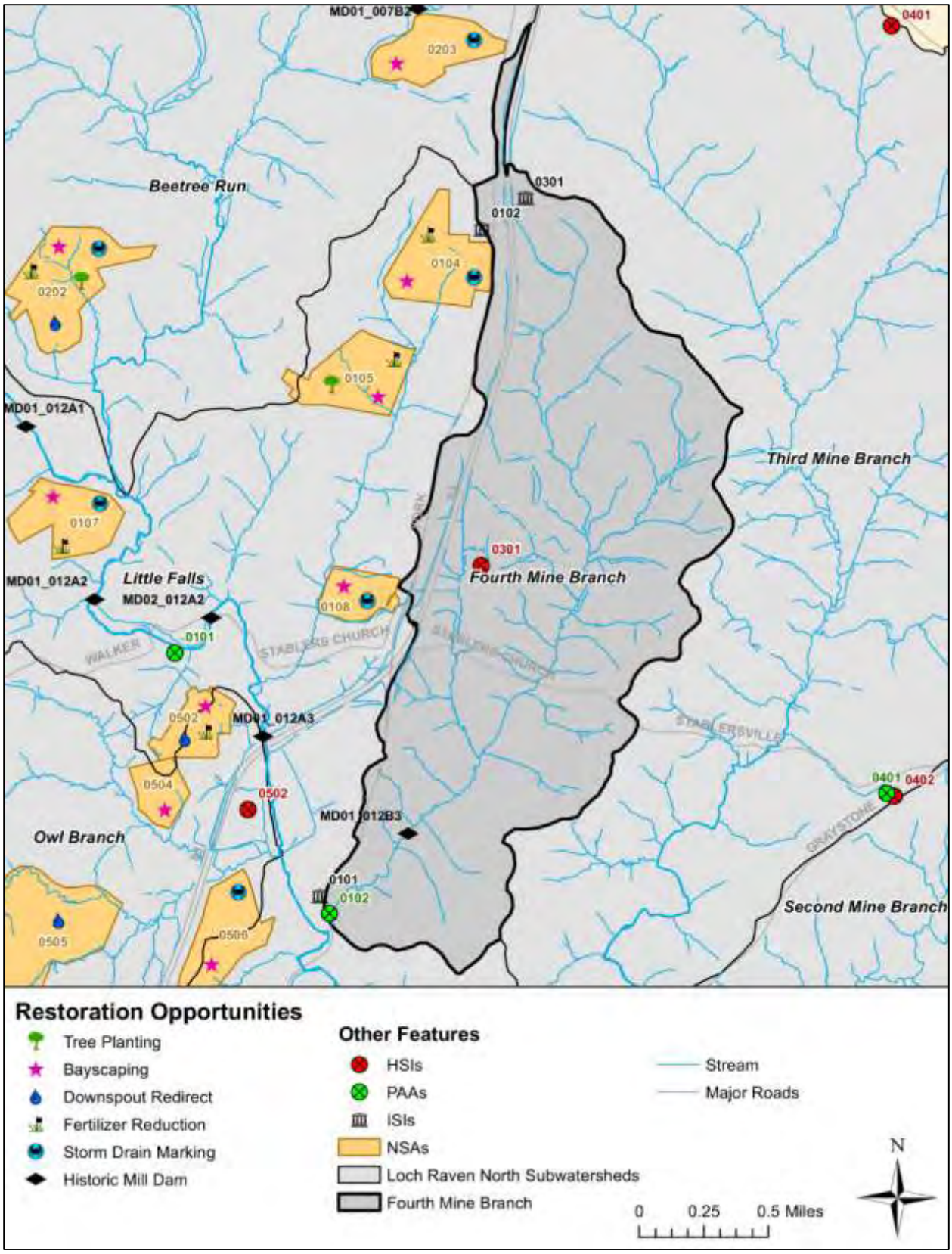

Figure 4-20: Restoration Opportunities in the Fourth Mine Branch Subwatershed

4.3.4 Third Mine Branch

The Third Mine Branch subwatershed has the 2nd lowest population density and 3rd lowest percentage of impervious cover (2.1%) within the Loch Raven North watershed. Like the majority of the Loch Raven North subwatershed, the Third Mine Branch subwatershed is primarily agricultural (49%) and forest (38%) land use and has the 3rd lowest percentage of urban land uses (10%) of any subwatershed. Table 4-37 summarizes key characteristics of the Third Mine Branch subwatershed.

Table 4-37: Key Subwatershed Characteristics – Third Mine Branch

Drainage Area	4,416	acres	
	6.90	sq. mi.	
Stream Length	44.2	miles	
Population	1,193	(2010 Census)	
	0.27	persons/acre	
Land Use/Land Cover	Very Low Density Residential:		9.0%
	Low Density Residential:		4.4%
	Medium/High Density Residential:		0.0%
	Commercial:		0.0%
	Industrial:		0.0%
	Institutional:		0.0%
	Open Urban:		0.0%
	Agriculture:		48.6%
	Forest:		37.6%
	Transportation:		0.4%
	Other:		0.0%
Land in Easement	2,609	acres	59.1%
Impervious Cover	91	acres	2.1%
Soils	A Soils (low runoff potential):		0.0%
	B Soils:		73.2%
	C Soils:		8.9%
	D Soils (high runoff potential):		17.9%
	Water:		0.0%

4.3.4.1 Neighborhoods

One neighborhood was identified and assessed within the Third Mine Branch subwatershed during the uplands assessment of the Loch Raven North planning area. Recommendations for addressing stormwater volume and pollutants within this subwatershed include storm drain marking, buffer improvement, tree planting, and public education (i.e., bayscaping and increasing lot tree canopy). A summary of neighborhood recommended actions is presented in Table 4-38.

Table 4-38: NSA Recommendations – Third Mine Branch

NSA_ID	Lot Size (acres)	Rain Gardens	Storm Drain Marking	Bayscape	Buffer Improvement	Notes
NSA_X_0401	1-3	X	X	X	X	-

The NSA located in the Third Mine Branch subwatershed has large lot sizes (1-3 acres) with large grass yards. This presents an excellent opportunity to encourage bayscaping. Educational outreach will also help encourage residents to plant trees where possible, especially along stream buffers. Additionally, there is potential for storm drain marking as inlets are currently unmarked (Figure 4-21).

Figure 4-21: Unmarked Storm Drains (left) and Large Open Lots with Bayscaping Potential (right) in NSA_X_0401

4.3.4.2 Hotspots

Two hotspot investigations were performed within the Third Mine Branch subwatershed. These included a bus maintenance facility and a truck shop. Table 4-39 summarizes the potential pollution sources found at each of the sites.

Table 4-39: HSI Results Summary - Third Mine Branch

HSI ID	HSI Status	Description		Vehicle Operations	Outdoor Materials	Waste Management	Physical Plant	Turf/Landscape Management	Storm Water	Notes
HSI_X_0401	Potential Hotspot	Transport-Related	Bus Maintenance	X		X	X	X		-
HSI_X_0402	Potential Hotspot	Transport-Related	Truck Shop	X	X	X	X	X		Better trash/construction materials management, better outdoor storage management, rain barrels on site

HSI_X_0401 is a bus maintenance facility located along Old York Road in the Third Mine Branch subwatershed. This hotspot contained a variety of potential pollution activities including vehicle operations, waste management, physical plant management, and turf/landscape management. A large dumpster with no lid was observed at the facility. Impervious runoff is directed to large grassy areas. Bus fleets are stored and maintained onsite.

HSI_X_0402 is a publicly owned truck shop located along Graystone Road. This hotspot contained a variety of potential pollution activities including vehicle operations, outdoor material storage, waste management, physical plant, and landscape management. County fleet vehicles are both stored and fueled at the facility. A pile of uncovered stone/gravel is being stored at the facility (Figure 4-22). Downspouts from the building on site are collected into rain barrels. The facility holds an NPDES permit. The back pervious portion of this property was also evaluated as a PAA (PAA_X_0401).

Figure 4-22: Uncovered Outdoor Storage (left) and Rain Barrels at HSI_X_0402 (right)

4.3.4.3 Institutions

No ISIs were assessed in the Third Mine Branch subwatershed.

4.3.4.4 Pervious Areas

PAA_X_0401 is a publicly owned highway shop that is approximately 50% open, pervious area. The site was also assessed as a hotspot. The open, pervious area provides potential for a stormwater retrofit in order to treat the impervious runoff at the truck shop. There is a total of 1 acre available for tree planting that would provide stream buffer to a small, headwater tributary.

4.3.4.5 Illicit Discharges

There are no major outfalls in the Third Mine Branch subwatershed.

4.3.4.6 Stream Corridors

A stream corridor assessment was not completed for this subwatershed.

4.3.4.7 Historic Mill Dams

No mill dam assessments were completed in the Third Mine Branch subwatershed.

4.3.4.8 Subwatershed Management Strategy

<u>Engaging Citizens & Watershed Groups</u>

1. Engage citizens in a storm drain marking program and conduct marking activities in NSA_X_0401.
2. Educate citizens about the benefits and importance of bayscaping and rain gardens.
3. Educate residents in NSA_X_0401 about the importance of stream buffers and encourage more environmentally friendly stream treatments.
4. Inform citizens of the importance of septic system maintenance.

<u>Municipal Actions</u>

1. Provide education to hotspots indicated in Table 4-39 and similar facilities on proper methods for vehicle operations, storage of outdoor materials, waste management, physical plant maintenance, and turf/landscape maintenance.
2. Investigate potential for tree planting at PAA_X_0401.

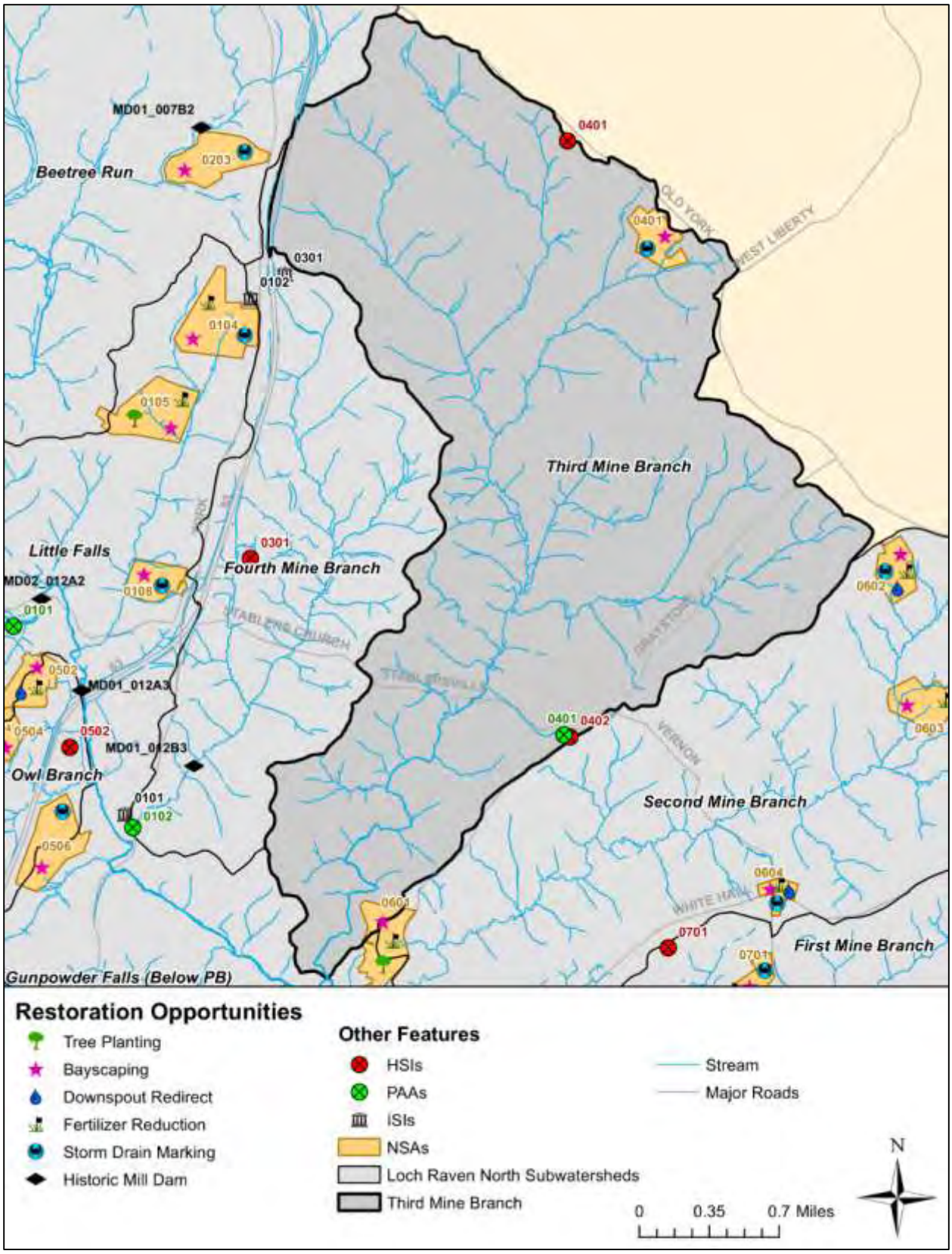

Figure 4-23: Restoration Opportunities in the Third Mine Branch Subwatershed

4.3.5 Owl Branch

The Owl Branch subwatershed, while the 7th smallest subwatershed, is the 2nd most densely populated subwatershed in the Loch Raven North watershed. It also has the 2nd highest impervious cover percentage (5.1%). The Owl Branch subwatershed has the largest percentage of Low Density land use (35%) and the lowest percentage of agricultural land use (15%). This subwatershed also has the lowest percentage of land held under an easement at (18%) and the highest percentage of urban land uses (36%). Table 4-40 summarizes key characteristics of the Owl Branch subwatershed.

Table 4-40: Key Subwatershed Characteristics – Owl Branch

Drainage Area	2,384	acres	
	3.72	sq. mi.	
Stream Length	21.6	miles	
Population	2,388	(2010 Census)	
	1.00	persons/acre	
Land Use/Land Cover	Very Low Density Residential:		18.9%
	Low Density Residential:		35.1%
	Medium/High Density Residential:		0.0%
	Commercial:		0.1%
	Industrial:		0.4%
	Institutional:		0.1%
	Open Urban:		0.8%
	Agriculture:		15.0%
	Forest:		28.3%
	Transportation:		1.4%
	Other:		0.0%
Land in Easement	437	acres	18.3%
Impervious Cover	121	acres	5.1%
Soils	A Soils (low runoff potential):		0.0%
	B Soils:		76.2%
	C Soils:		8.0%
	D Soils (high runoff potential):		15.8%
	Water:		0.1%

4.3.5.1 Neighborhoods

A total of seven distinct neighborhoods were identified and assessed within the Owl Branch subwatershed during the uplands assessment of the Loch Raven North planning area. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, rain gardens, buffer improvement, storm drain marking, and public education (i.e., bayscaping, increasing lot tree canopy, and pet waste management). A summary of neighborhood recommended actions is presented in Table 4-41.

Table 4-41: NSA Recommendations – Owl Branch

NSA_ID	Lot Size (acres)	Opportunity for [illegible]	Rain Gardens	Storm Drain Marking	Bayscape	Increase Lot Canopy	Pet Waste Management	Buffer Improvement	Notes
NSA_X_0501	3-5	X	X		X	X	X	X	Reforestation underway
NSA_X_0502	1-3	X	X		X	X	X		Pet waste in SWM facility
NSA_X_0503	3-5		X	X	X	X		X	-
NSA_X_0504	3-5				X			X	-
NSA_X_0505	1-3	X	X	X	X			X	-
NSA_X_0506	3-5			X	X			X	-
NSA_X_0507	3-5		X	X	X	X		X	-

All of the neighborhoods in the Owl Branch subwatershed were recommended for public education related to bayscaping and all but one of the NSAs were recommended for buffer improvement which can be achieved through public education about the benefits of providing a stream buffer by reducing the amount of mowed lawn through tree and vegetation planting. About 60% of the neighborhoods assessed in the Owl Branch subwatershed were recommended for storm drain marking and an increase in lot canopy. Two of the NSAs were recommended for pet waste education. Specifically, at NSA_X_0502, pet waste was observed inside the fenced area of a stormwater management facility.

4.3.5.2 Hotspots

Four hotspot investigations were performed within the Owl Branch subwatershed. Table 4-42 summarizes the potential pollution sources found in the Owl Branch subwatershed.

Table 4-42: HSI Results Summary – Owl Branch

HSI ID	HSI Status	Description		Vehicle Operations	Outdoor Materials	Waste Management	Physical Plant	Turf/Landscape Management	Storm Water	Notes
HSI_X_0501	Potential Hotspot	Commercial	Gas Station	X	X	X	X	X		Trash Management
HSI_X_0502	Potential Hotspot	Industrial	Construction	X	X	X				-
HSI_X_0503	Potential Hotspot	Municipal	Office	X	X	X	X	X	X	Trash management
HSI_X_0504	Potential Hotspot	Municipal	Fire station	X		X	X	X	X	Clean and well maintained

At all four hotpots in the Owl Branch subwatershed, potential pollution sources included vehicle operations and waste management. HSI_X_0501 and HSI_X_0503 could both benefit from education related to proper waste management. All of the hotspots were determined to be potential hotspots. HSI_X_0501 is a gas station with both covered and uncovered fueling stations. Overflowing dumpsters were observed during the assessment. At HSI_X_0502, construction vehicles and materials (aggregate) were being stored in an open area. HSI_X_0503 is the city reservoir office where it was observed that vehicles are stored and fueled. Salt piles, tires, and garbage were observed on the property and while the salt was covered, the discarded tires and trash were not (Figure 4-24). HSI_X_0504 is a Baltimore County fire station and houses approximately six vehicles. Overall, this site was clean and well maintained.

Figure 4-24: Waste Management Educational Opportunities at HSI_X_0501 (left) and HSI_X_0503 (right)

4.3.5.3 Institutions

No ISIs were assessed in the Owl Branch subwatershed.

4.3.5.4 Pervious Areas

No pervious area assessments were located in the Owl Branch subwatershed.

4.3.5.5 Illicit Discharges

No major outfalls are located within the Owl Branch subwatershed.

4.3.5.6 Stream Corridors

A stream corridor assessment was not completed for this subwatershed.

4.3.5.7 Historic Mill Dams

No historic mill dams were located in the Owl Branch subwatershed.

4.3.5.8 Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-41 and educate citizens on the benefits of rain barrels and rain gardens.

2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-41.

3. Increase tree canopies on private lots by educating citizens on the benefit of trees and raising awareness to programs such as Baltimore County's "Big Trees Sale".

4. Educate residents about the importance of stream buffers and encourage more environmentally friendly stream treatments.

5. Educate citizens about the benefits and importance of proper lawn care, bayscaping, and pet waste management in the neighborhoods indicated in Table 4-41.

6. Inform citizens of the importance of septic system maintenance.

Municipal Actions

1. Provide education to hotspots indicated in Table 4-42 and similar facilities on proper methods for vehicle operations, storage of outdoor materials, waste management, physical plant maintenance, turf/landscape maintenance, and storm system maintenance.

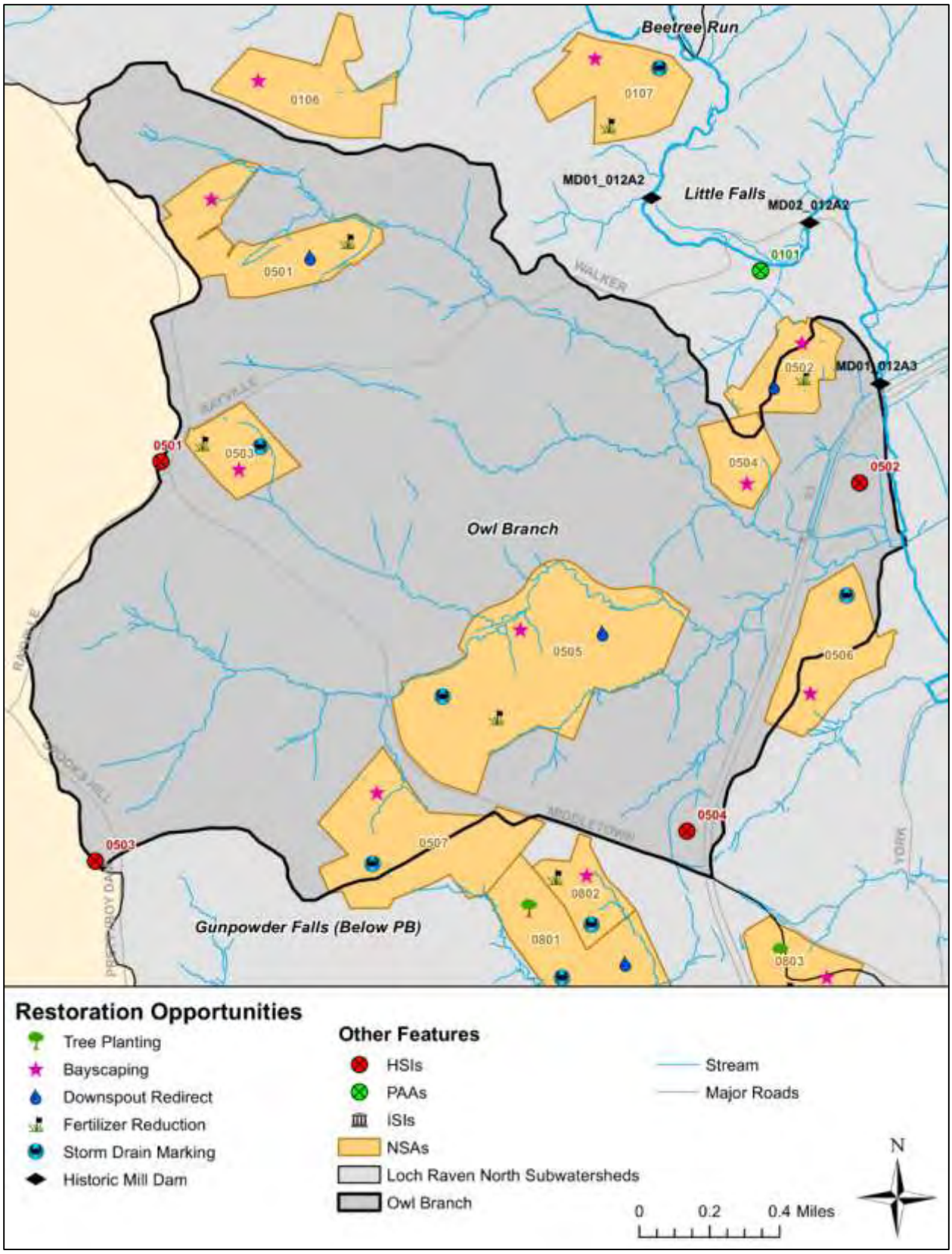

Figure 4-25: Restoration Opportunities in the Owl Branch Subwatershed

4.3.6 Second Mine Branch

The Second Mine Branch subwatershed is the 7th largest subwatershed and has the 5th lowest population density of all subwatersheds in the Loch Raven North watershed. Over half of the land use in the subwatershed is agricultural (52%) followed by forest (32%). Table 4-43 summarizes key characteristics of the Second Mine Branch subwatershed.

Table 4-43: Key Subwatershed Characteristics – Second Mine Branch

Drainage Area	3,337	Acres	
	5.21	sq. mi.	
Stream Length	33.0	Miles	
Population	1,054	(2010 Census)	
	0.32	persons/acre	
Land Use/Land Cover	Very Low Density Residential:		7.4%
	Low Density Residential:		7.1%
	Medium/High Density Residential:		0.0%
	Commercial:		0.2%
	Industrial:		0.0%
	Institutional:		0.0%
	Open Urban:		1.2%
	Agriculture:		52.4%
	Forest:		31.7%
	Transportation:		0.0%
	Other:		0.0%
Land in Easement	2,203	Acres	66.0%
Impervious Cover	86	Acres	2.6%
Soils	A Soils (low runoff potential):		0.0%
	B Soils:		74.8%
	C Soils:		10.2%
	D Soils (high runoff potential):		15.0%
	Water:		0.0%

4.3.6.1 Neighborhoods

Four neighborhoods were identified and assessed within the Second Mine Branch subwatershed during the uplands assessment of Loch Raven North. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, buffer improvement, tree planting, and public education (i.e. bayscaping and increasing lot tree canopy). A summary of neighborhood recommended actions is presented in Table 4-44.

Table 4-44: NSA Recommendations – Second Mine Branch

NSA_ID	Lot Size (acres)	Opportunity for [illegible]	Rain Gardens	Storm Drain Marking	Bayscape	Increase Lot Canopy	Buffer Improvement	# of Shade Trees	Notes
NSA_X_0601	1-3				X	X		108	-
NSA_X_0602	1-3	X	X	X	X	X	X		-
NSA_X_0603	3-5				X		X		-
NSA_X_0604	1-3	X	X	X	X				-

All of the NSAs assessed in the Second Mine Branch subwatershed were recommended for bayscaping due to their large lot size and large lawns. NSA_X_0601 was recommended for open space tree planting due to the large common space that is currently open grass (Figure 4-26); it was assumed the majority of the open space is used for community events and trees were only recommended along the down slope border. NSA_X_0602 and NSA_X_0604 were both recommended for downspout disconnection; due to their large lot sizes, they are excellent candidates for rain garden implementation. These two NSAs also have curb and gutter systems with unmarked storm drains.

Figure 4-26: Open Common Space Available for Tree Planting at NSA_X_0601 (left) and Large Open Lots with Bayscaping Potential (right) in NSA_X_0604

4.3.6.2 Hotspots

One hotspot investigation was performed within the Second Mine Branch subwatershed. Table 4-45 summarizes the potential pollution sources found at the site.

Table 4-45: HSI Results Summary – Second Mine Branch

HSI ID	HSI Status	Description		Vehicle Operations	Outdoor Materials	Waste Management	Physical Plant	Turf/Landscape Management	Storm Water	Notes
HSI_X_0601	Potential Hotspot	Industrial	Salvage Yard	X	X	X	X			-

HSI_X_0601 is a salvage yard located off of Old York Road. The property lies on the border of Loch Raven North and the Deer Creek watershed with the majority of the site located on the Deer Creek side. The property is full of old, discarded cars and other scrap material, and runoff was observed leaving the site (Figure 4-27). There is an opportunity for trash management education as various types of waste were present, and uncovered and overflowing dumpsters were present.

Figure 4-27: Numerous Cars Stored at Salvage Yard (left) and Runoff from Site at HSI_X_0601

4.3.6.3 Institutions

None of the ISIs assessed were located in the Second Mine Branch subwatershed.

4.3.6.4 Pervious Areas

No pervious areas were assessed in the Second Mine Branch subwatershed.

4.3.6.5 Illicit Discharges

There are no major outfalls in the Second Mine Branch subwatershed.

4.3.6.6 Stream Corridors

A stream corridor assessment was not completed for this subwatershed.

4.3.6.7 Historic Mill Dams

No mill dam assessments were completed in this subwatershed

4.3.6.8 Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-44 and educate citizens on the benefits of rain barrels and rain gardens.

2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-44.

3. Increase tree canopies on private lots by educating citizens on the benefits of trees and raising awareness of programs such as Baltimore County's "Big Trees Sale".

4. Educate citizens about the benefits and importance of proper lawn care and bayscaping in the neighborhoods indicated in Table 4-44.

5. Educate residents of NSA_X_0602 and NSA_X_0603 about the importance of stream buffers and encourage more environmentally friendly stream treatments.

6. Inform citizens of the importance of septic system maintenance.

Municipal Actions

1. Engage residents of NSA_X_0601 for participation in possible open space tree planting events.

2. Work with hotspot HSI_X_0601 and similar businesses to instruct proper practices for vehicle operations, waste management, storage of outdoor materials, physical plant maintenance, turf/landscape maintenance, and storm system maintenance.

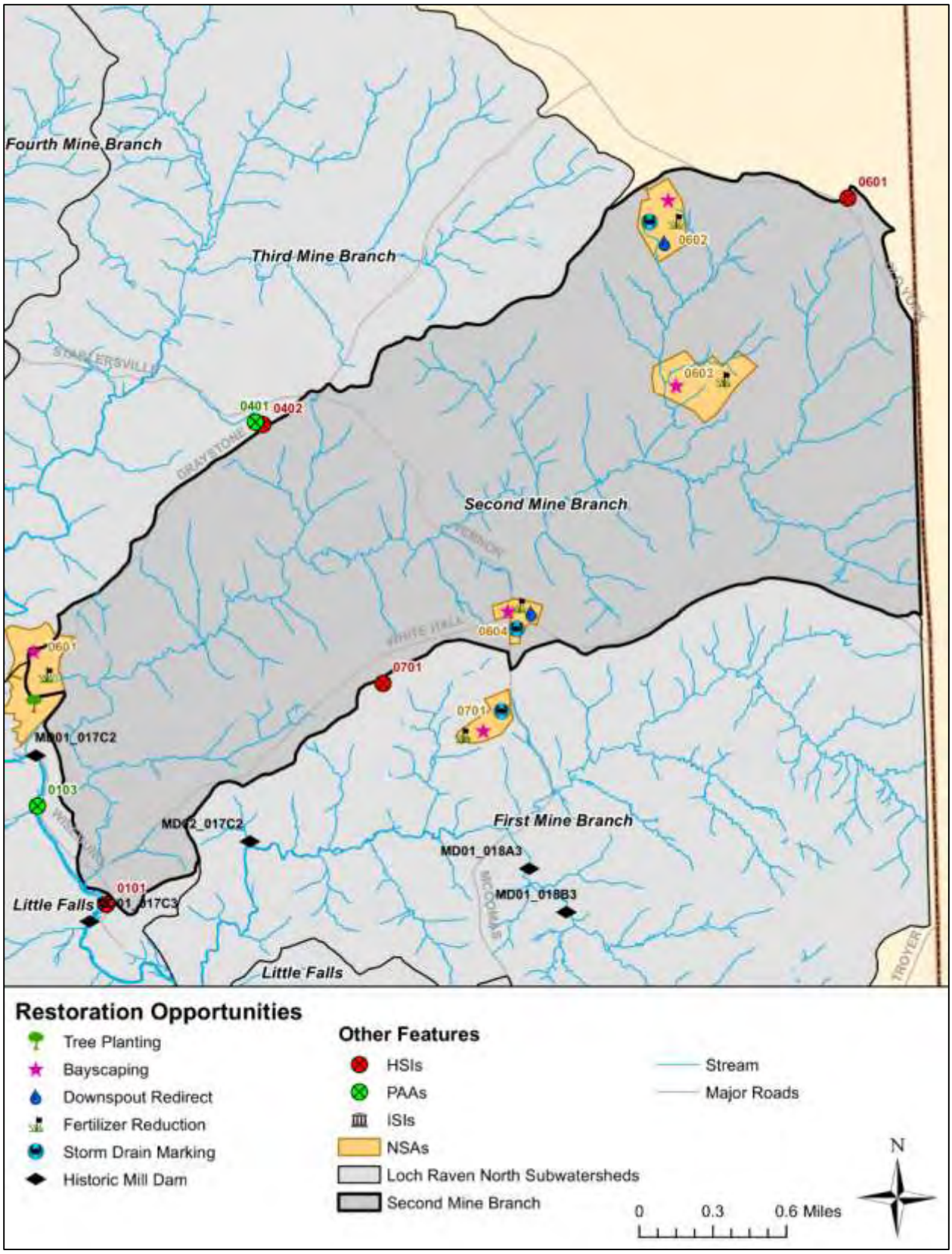

Figure 4-28: Restoration Opportunities in the Second Mine Branch Subwatershed

4.3.7 First Mine Branch

The First Mine Branch subwatershed is the 3rd least densely populated subwatershed in the Loch Raven North planning area. The First Mine Branch subwatershed also has the lowest percentage of impervious cover (1.7%). Like the majority of subwatersheds in the Loch Raven North watershed, the land use in the First Mine Branch subwatershed is primarily forest (47%) and agriculture (40%). The First Mine Branch subwatershed also has the 2nd greatest percentage of lands in conservation easements (74%). Table 4-46 summarizes key characteristics of the First Mine Branch subwatershed.

Table 4-46: Key Subwatershed Characteristics – First Mine Branch

Drainage Area	2,931	Acres	
	4.58	sq. mi.	
Stream Length	40.6	Miles	
Population	852	(2010 Census)	
	0.29	persons/acre	
Land Use/Land Cover	Very Low Density Residential:		7.7%
	Low Density Residential:		1.9%
	Medium/High Density Residential:		0.0%
	Commercial:		0.0%
	Industrial:		0.0%
	Institutional:		0.0%
	Open Urban:		4.2%
	Agriculture:		39.7%
	Forest:		46.5%
	Transportation:		0.0%
	Other:		0.0%
Land in Easement	2,156	Acres	73.5%
Impervious Cover	49	Acres	1.7%
Soils	A Soils (low runoff potential):		0.0%
	B Soils:		73.0%
	C Soils:		13.3%
	D Soils (high runoff potential):		13.7%
	Water:		0.0%

4.3.7.1 Neighborhoods

One distinct neighborhood was identified and assessed within the First Mine Branch subwatershed during the uplands assessment of Loch Raven North. Recommendations for addressing stormwater volume and pollutants within this subwatershed include rain gardens, buffer improvement, storm drain marking, and public education (i.e., bayscaping and increasing lot tree canopy). A summary of neighborhood recommended actions is presented in Table 4-47.

Table 4-47: NSA Recommendations – First Mine Branch

NSA_ID	Lot Size (acres)	Rain Gardens	Storm Drain Marking	Bayscape	Increase Lot Canopy	Notes
NSA_X_0701	1-3	X	X	X	X	-

NSA_X_0701 was recommended for storm drain marking, bayscaping, and increased lot canopy which can be accomplished through educational outreach. The lots within the NSA are large and most homes have large lawns that could accommodate rain gardens and/or bayscaping.

4.3.7.2 Hotspots

One hotspot investigation was performed within the First Mine Branch subwatershed. Table 4-48 summarizes the potential pollution sources found in the First Mine Branch subwatershed.

Table 4-48: HSI Results Summary – First Mine Branch

HSI ID	HSI Status	Description		Vehicle Operations	Outdoor Materials	Waste Management	Physical Plant	Turf/Landscape Management	Storm Water	Notes
HSI_X_0701	Confirmed Hotspot	Municipal	Golf Course	X	X	X	X	X	X	Space for BMP downstream of parking lot, buffer zone can be reforested

The hotspot in the First Mine Branch subwatershed is a publicly owned golf course. It has potential pollution sources due to vehicle operations, outdoor materials storage, waste management, physical plant, and landscape management. Golf carts are stored, maintained, repaired, fueled, and washed onsite. There is also potential for a stormwater retrofit at this site. There is potential to construct a BMP to treat the impervious runoff from the parking lot. A bioretention facility could be established in the current open space area that is separated from the parking lot by a curb and gutter with a blocked inlet (Figure 4-29). The marking lot medians also present an opportunity for some tree planting.

Figure 4-29: Downstream Open Space Available for Potential SWM Retrofit to Treat Parking lot at HSI_X_0701

4.3.7.3 Institutions

No ISIs were assessed in the First Mine Branch subwatershed.

4.3.7.4 Pervious Areas

No pervious areas were assessed in the First Mine Branch subwatershed.

4.3.7.5 Illicit Discharges

No major outfalls are located within the First Mine Branch subwatershed.

4.3.7.6 Stream Corridors

A stream corridor assessment was not completed for this subwatershed.

4.3.7.7 Historic Mill Dams

Three historic mill dam locations were assessed in the First Mine Branch subwatershed. Only one site was recommended for a restoration opportunity and included buffer planting. Table 4-49 summarizes the results of the mill dam assessment and restoration opportunities. Additional information on mill dam assessments and restoration recommendations can be found in *Appendix B* of the *Watershed Characterization Report* (Appendix E).

Table 4-49: Summary of Historic Mill Dam Sites - First Mine Branch

Mill Dam ID	No Action	Legacy Sediment Removal	Stream Stabilization/ Restoration	Recommended Action Wetland Creation	Floodplain Reconnection	Fish Passage	Buffer Creation
MD01_018A3	-	-	-	-	-	-	X
MD01_018B3	X	-	-	-	-	-	-
MD02_017C2	X	-	-	-	-	-	-
Total	***2***	***0***	***0***	***0***	***0***	***0***	***1***

4.3.7.8 Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Engage citizens in a storm drain marking program and conduct marking activities in neighborhood NSA_X_0701.

2. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs such as Baltimore County's "Big Trees Sale".

3. Educate citizens about the benefits and importance of bayscaping and rain gardens.

4. Inform citizens of the importance of septic system maintenance.

Municipal Actions

1. Provide education to HSI_X_0701 and similar facilities on proper methods for vehicle operations, storage of outdoor materials, waste management, physical plant maintenance, turf/landscape maintenance, and storm system maintenance.

2. Investigate potential for installation of stormwater retrofits at HSI_X_0701.

3. Investigate the opportunity for buffer creation at historic mill dam site MD01_018A3.

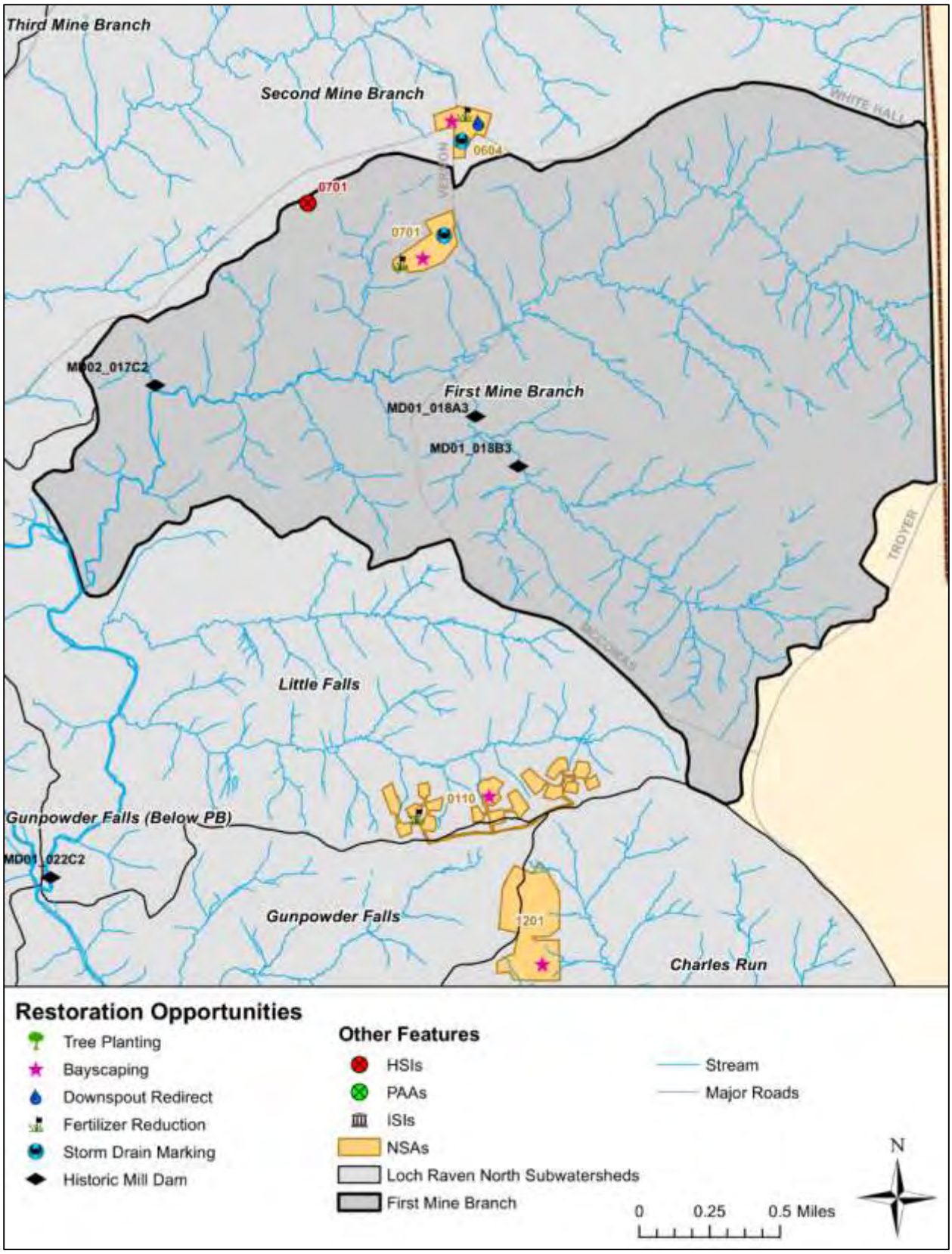

Figure 4-30: Restoration Opportunities in the First Mine Branch Subwatershed

4.3.8 Gunpowder Falls (Below Prettyboy)

The Gunpowder Falls (Below Prettyboy) subwatershed is the 5th largest subwatershed in the Loch Raven North watershed with the 3rd largest amount of stream miles. The Gunpowder Falls (Below Prettyboy) subwatershed has the lowest percentage of agricultural land (11%) in the watershed but the 2nd highest percentage of forested land (66%). The subwatershed's population density, percent impervious area (3.3%), and percent lands in conservation easements (64%) rank near the average for the watershed at 7th, 8th, and 6th greatest, respectively. Table 4-50 summarizes key characteristics of the Gunpowder Falls (Below Prettyboy) subwatershed.

Table 4-50: Key Subwatershed Characteristics – Gunpowder Falls (Below Prettyboy)

Drainage Area	4,648	acres	
	7.26	sq. mi.	
Stream Length	60.1	miles	
Population	2,544	(2010 Census)	
	0.55	persons/acre	
Land Use/Land Cover	Very Low Density Residential:		5.4%
	Low Density Residential:		15.4%
	Medium/High Density Residential:		0.1%
	Commercial:		0.0%
	Industrial:		0.0%
	Institutional:		0.0%
	Open Urban:		0.3%
	Agriculture:		10.7%
	Forest:		65.6%
	Transportation:		1.2%
	Other:		1.3%
Land in Easement	2,996	acres	64.5%
Impervious Cover	153	acres	3.3%
Soils	A Soils (low runoff potential):		0.0%
	B Soils:		69.7%
	C Soils:		7.6%
	D Soils (high runoff potential):		22.3%
	Water:		0.3%

4.3.8.1 Neighborhoods

Eight neighborhoods were identified and assessed within the Gunpowder Falls (Below Prettyboy) subwatershed during the uplands assessment of the Loch Raven North planning area. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, buffer improvement, tree planting, and public education (i.e., bayscaping, pet waste management, and increasing lot tree canopy). A summary of neighborhood recommended actions is presented in Table 4-51.

Table 4-51: NSA Recommendations – Gunpowder Falls (Below Prettyboy)

NSA_ID	Lot Size (acres)	Opportunity for Pollutant Discharge Elimination	Rain Gardens	Storm Drain Marking	Bayscape	Increase Lot Canopy	Pet Waste Management	Buffer Improvement	# of Shade Trees	Notes
NSA_X_0801	1-3	X	X	X	X	X		X	65	Sinkhole in asphalt forming at inlet
NSA_X_0802	1-3		X	X	X			X		Deer/other wildlife waste
NSA_X_0803	1-3	X	X		X	X	X		660	-
NSA_X_0804	1-3		X		X	X				-
NSA_X_0805	1-3				X	X				-
NSA_X_0806	1-3	X	X		X	X	X			-
NSA_X_0807	1-3				X	X				-
NSA_X_0808	5-10		X		X	X		X		-

All of the NSAs assessed in the Gunpowder Falls (Below Prettyboy) subwatershed were recommended for public education in the form of bayscaping. Conveying the importance of planting on private property can also help introduce buffer and lot canopy improvements in neighborhoods, another recommendation for the NSAs in the Gunpowder Falls (Below Prettyboy) subwatershed. NSA_X_0801 and NSA_X_0803 both have common space within the neighborhoods suitable for open space tree planting.

Figure 4-31: Large Open Lots with Potential for Bayscaping at NSA_X_0806 (left) and Open Space with Tree Planting Potential (right) in NSA_X_0803

4.3.8.2 Hotspots

One hotspot investigation was performed within the Gunpowder Falls (Below Prettyboy) subwatershed. This hotspot was an active quarry. Table 4-52 summarizes the potential pollution sources found at each of the sites.

Table 4-52: HSI Results Summary – Gunpowder Falls (Below Prettyboy)

HSI ID	HSI Status	Description		Vehicle Operations	Outdoor Materials	Waste Management	Physical Plant	Turf/Landscape Management	Storm Water	Notes
HSI_X_0801	Not a Hotspot	Industrial	Quarry	X	X		X	X		Whole facility cannot be assessed, potential for tree planting along roadway into the facility

Due to the nature of the facility and limited access, a thorough inspection could not be completed. HSI_X_0801 is a large quarry located off of Big Falls Road. Large trucks were observed hauling materials out of the site. Additionally, an uncovered fueling tank was noted. Along the drive into the facility, a grassy buffer approximately 20 feet wide on each side of the road has the potential for tree planting.

Figure 4-32: Opportunities for Tree Planting along Drive (left) and Vehicle Fueling at HSI_X_0801

4.3.8.3 Institutions

One private institutional site was assessed for retrofit opportunities in the Gunpowder Falls (Below Prettyboy) subwatershed during the uplands assessment of the Loch Raven North planning area Table 4-52 summarizes recommendations for the institutional sites assessed in the Gunpowder Falls (Below Prettyboy) subwatershed.

Table 4-53: ISI Recommendations – Gunpowder Falls (Below Prettyboy)

Site ID	Name	Public/ Private	# Trees for Planting	Stormwater Retrofit	Downspout Disconnection	Trash Management	Storm Drain Marking	Buffer Improvement	Notes
ISI_X_0801	Our Lady of Grace Roman Catholic Church	Private	62		X	X			School attached to church

ISI_X_0801 is a faith-based institution located off of Middletown Road. Restoration opportunities at this location involve downspout disconnection, tree planting, and trash management education. Large open space is available for planting an estimated 62 trees (Figure 4-33, left). Dumpsters are stored above a stormdrain inlet, creating potential pollution concerns. Portions of the parking lot are already being treated by underground storage, grass swales, and a level spreader; additionally, a portion of the property has been reforested (Figure 4-33, right). Additional tree plantings are recommended

Figure 4-33: Potential Tree Planting (left) and Existing Stormwater Management and Reforestation Area (right) at ISI_X_0801

4.3.8.4 Pervious Areas

Four pervious area assessments were conducted in the Gunpowder Falls (Below Prettyboy) subwatershed. Pervious areas PAA_X_0801 and PAA_X_0802 are located in the Gunpowder Falls State Park and offer approximately 4 acres of planting that would close a forest gap.

PAA_X_0803 is located in Gunpowder Falls State Park and surrounds a parcel of private property. Tree planting can be completed on approximately 10 acres of land and would increase stream buffer and close the forest gap.

Also located in Gunpowder Falls State Park, PAA_X_0804 is a 5 acre parcel located along a 1,000 foot stretch of Gunpowder Falls. Approximately five acres of land could be reforested; however, during the upland assessment, it was observed that recent plantings had already been conducted on this property.

4.3.8.5 Illicit Discharges

The Gunpowder Falls (Below Prettyboy) subwatershed contains two Priority 2 major outfalls. Priority 2 indicates moderate to minor problems that have the potential to become severe and are monitored annually. Baltimore County will continue their Illicit Discharge Detection and Elimination program while seeking to improve techniques for more effective reductions of these discharges.

4.3.8.6 Stream Corridors

A stream corridor assessment was not completed for this subwatershed.

4.3.8.7 Historic Mill Dams

One historic mill dam location was assessed in the Gunpowder Falls (Below Prettyboy) subwatershed. The site was located along a densely forested reach of Gunpowder Falls, and there were no recommended restoration actions for this mill dam site. Additional information on mill dam assessments and restoration recommendations can be found in *Appendix B* of the *Watershed Characterization Report* (Appendix E).

4.3.8.8 Subwatershed Management Strategy

<u>Engaging Citizens & Watershed Groups</u>

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-51 and educate citizens on the benefits of rain barrels and rain gardens.

2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-51.

3. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs such as Baltimore County's "Big Trees Sale".

4. Educate citizens about the benefits and importance of proper lawn care, bayscaping, and pet waste management in the neighborhoods indicated in Table 4-51.

5. Educate residents about the importance of stream buffers and encourage more environmentally friendly stream treatments in the neighborhoods specified in Table 4-51.

6. Inform citizens on the importance of septic system maintenance.

<u>Municipal Actions</u>

1. Engage residents in NSA_X_0801 and NSA_X_0803 for participation in possible open space tree planting events.

2. Provide education to hotspot HSI_X_0801 and similar facilities on proper methods for vehicle

operations, storage of outdoor materials, waste management, physical plant maintenance, turf/landscape maintenance, and storm system maintenance.

3. Engage institution ISI_X_0801 for tree planting.

4. Educate institution ISI_X_0801 on proper trash management and potential downspout disconnection.

5. Investigate potential tree planting at PAA_X_0801, PAA_X_0802, and PAA_X_0803.

6. Work with State DNR to identify opportunities to expand stream buffers in Gunpowder State Park – Hereford.

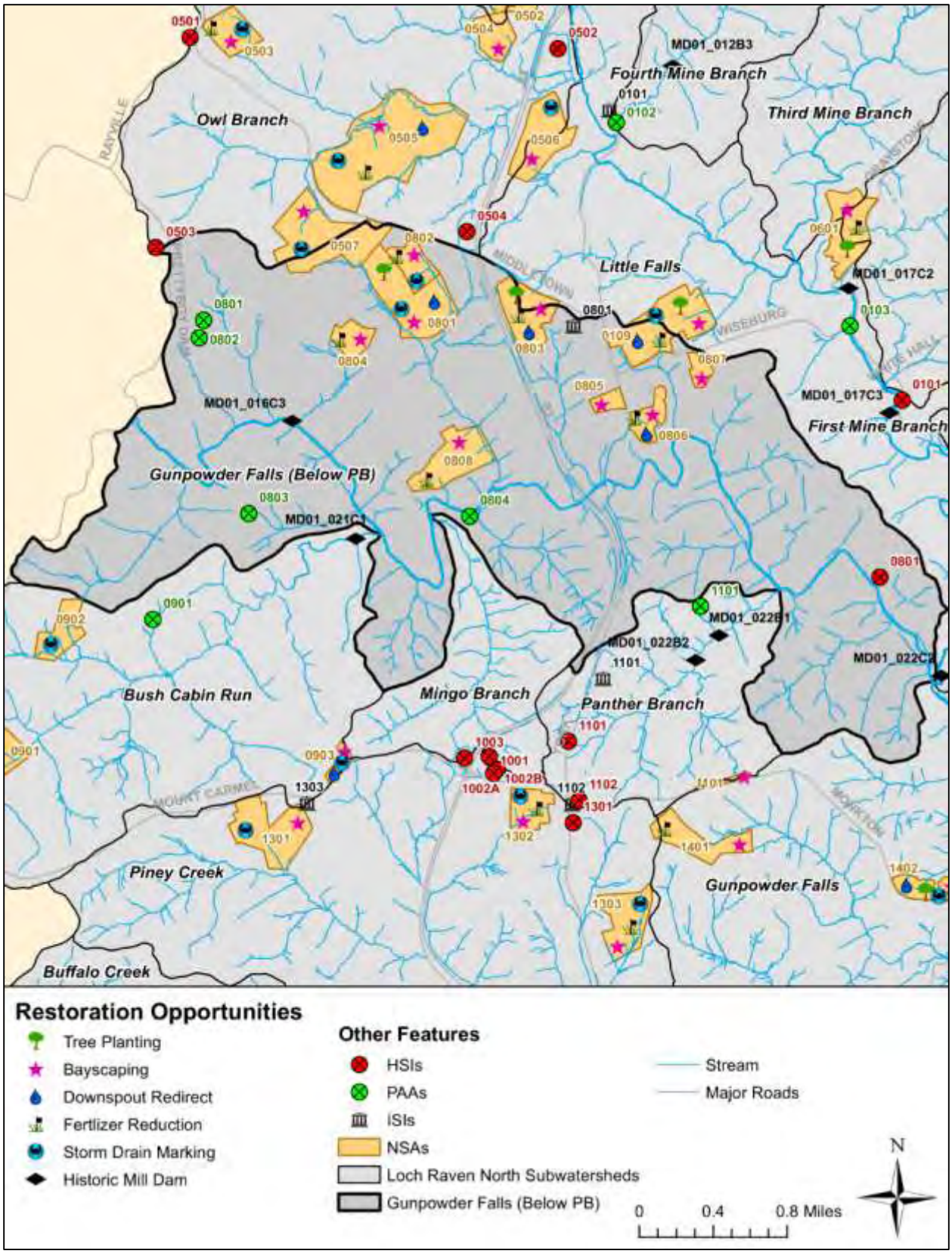

Figure 4-34: Restoration Opportunities in the Gunpowder Falls (Below Prettyboy) Subwatershed

4.3.9 Bush Cabin Run

The Bush Cabin Run subwatershed is the 6th smallest subwatershed with the 4th lowest population density of all the subwatersheds in the Loch Raven North watershed. Similar to the majority of the subwatersheds, the Bush Cabin Run subwatershed is primarily agricultural (37%) and forest (33%) land uses. Table 4-54 summarizes key characteristics of the Bush Cabin Run subwatershed.

Table 4-54: Key Subwatershed Characteristics – Bush Cabin Run

Drainage Area	2,264	acres	
	3.54	sq. mi.	
Stream Length	20.5	miles	
Population	900	(2010 Census)	
	0.40	persons/acre	
Land Use/Land Cover	Very Low Density Residential:		14.0%
	Low Density Residential:		16.0%
	Medium/High Density Residential:		0.0%
	Commercial:		0.0%
	Industrial:		0.0%
	Institutional:		0.1%
	Open Urban:		0.0%
	Agriculture:		36.6%
	Forest:		33.2%
	Transportation:		0.0%
	Other:		0.0%
Land in Easement	1,175	acres	51.9%
Impervious Cover	67	acres	3.0%
Soils	A Soils (low runoff potential):		0.0%
	B Soils:		72.7%
	C Soils:		12.0%
	D Soils (high runoff potential):		15.3%
	Water:		0.0%

4.3.9.1 Neighborhoods

A total of seven distinct neighborhoods were identified and assessed within the Bush Cabin Run subwatershed during the uplands assessment of the Loch Raven North planning area. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, rain gardens, buffer improvement, storm drain marking, and public education (i.e., bayscaping, increasing lot tree canopy, and pet waste management). A summary of neighborhood recommended actions is presented in Table 4-55.

Table 4-55: NSA Recommendations – Bush Cabin Run

NSA_ID	Lot Size (acres)	Opportunity for [illegible]	Rain Gardens	Storm Drain Marking	Bayscape	Increase Lot Canopy	Buffer Improvement	Street Sweeping (mi)	Notes
NSA_X_0901	3-5	X	X	X	X	X	X		-
NSA_X_0902	1-3		X	X			X	0.2	Recommend cleaning along curb/inlets and low spots
NSA_X_0903	1	X	X	X	X	X			-

All of the neighborhoods in the Bush Cabin Run subwatershed were recommended for storm drain marking and had sufficient room for rain garden implementation. Bayscaping, increasing lot canopy, and buffer improvement were all recommendations for NSAs within the subwatershed, and educational outreach to the neighborhoods in the Bush Cabin Run subwatershed could increase the awareness of benefits from planting. NSA_X_0902 was recommended for street sweeping due to organic materials littering the curbs and inlets. Seasonal street sweeping is a possible implementation to reduce organic litter.

4.3.9.2 Hotspots

No hotspots were assessed in the Bush Cabin Run subwatershed.

4.3.9.3 Institutions

No ISIs were assessed in the Bush Cabin Run subwatershed.

4.3.9.4 Pervious Areas

PAA_X_0901 is the largest pervious area assessed in the Loch Raven North watershed and is located on Maryland DNR owned land in the Bush Cabin Run subwatershed. There is approximately 32 acres of pervious area that could be planted with trees to expand the existing forest and provide buffer along multiple tributaries running through the parcel.

4.3.9.5 Illicit Discharges

No major outfalls are located within the Bush Cabin Run subwatershed.

4.3.9.6 Stream Corridors

A stream corridor assessment was not completed for this subwatershed.

4.3.9.7 Historic Mill Dams

One historic mill dam site was assessed in the Bush Cabin Run subwatershed. Portions of the dam were

still visible. Recommended restoration actions for the dam location include legacy sediment removal, stream restoration, floodplain reconnection, fish passage, and buffer creation. Additional information on mill dam assessments and restoration recommendations can be found in *Appendix B* of the *Watershed Characterization Report* (Appendix E).

Table 4-56: Summary of Historic Mill Dam Sites - Bush Cabin Run

	Recommended Action						
Mill Dam ID	**No Action**	**Legacy Sediment Removal**	**Stream Stabilization/ Restoration**	**Wetland Creation**	**Floodplain Reconnection**	**Fish Passage**	**Buffer Creation**
MD01_021C1	-	X	X	-	X	X	X
Total	***0***	***1***	***1***	***0***	***1***	***1***	***1***

4.3.9.8 Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-55 and educate citizens on the benefits of rain barrels and rain gardens.

2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-55.

3. Increase tree canopies on private lots by educating citizens on the benefits of trees and raising awareness to programs such as Baltimore County's "Big Trees Sale".

4. Educate residents of NSA_X_0901 and NSA_X_0902 about the importance of stream buffers and encourage more environmentally friendly stream treatments.

5. Inform citizens of the importance of septic system maintenance.

Municipal Actions

1. Investigate conducting seasonal street sweeping operations at the neighborhood NSA_X_0902.

2. Investigate the potential for tree planting at PAA_X_0901.

3. Investigate possible restoration opportunities at historic mill dam site MD01_021C1.

4. Work with State DNR to identify opportunities to expand stream buffers in Gunpowder State Park – Hereford.

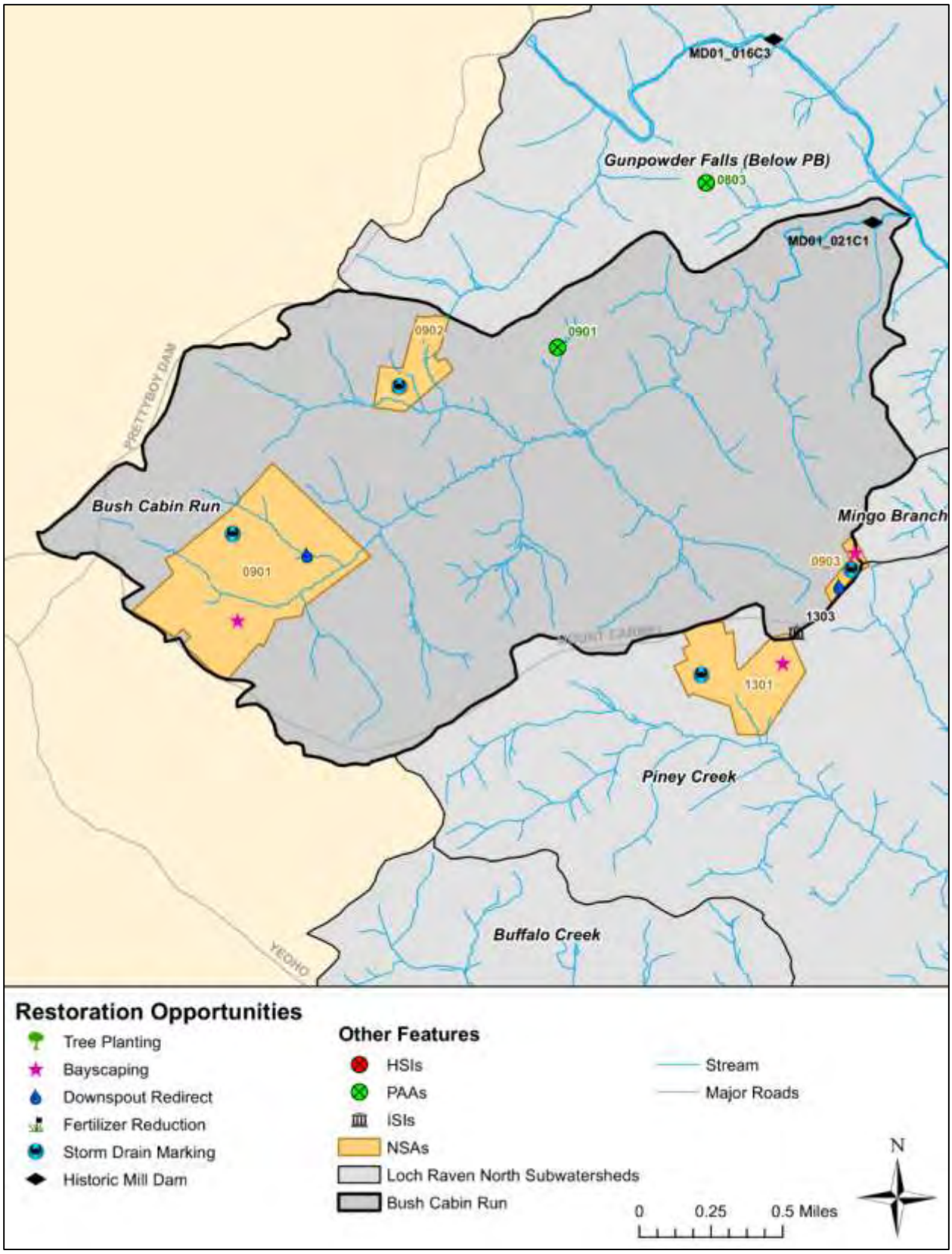

Figure 4-35: Restoration Opportunities in the Bush Cabin Run Subwatershed

4.3.10 Mingo Branch

The Mingo Branch subwatershed is the smallest subwatershed with the lowest number of stream miles in the Loch Raven North watershed. The subwatershed has very little residential land use (0.7%); however, it has the 4th greatest population density of any subwatershed. Forested land use occupies 71% of the entire subwatershed, the greatest percent forest cover of any subwatershed; most of the forest cover is part of the Gunpowder Falls State Park. The Mingo Branch subwatershed, while having the second smallest area of land in conservation easements is the third largest subwatershed in percent land in conservation (71%) all of which is DNR conservation land. Table 4-57 summarizes key characteristics of the Mingo Branch subwatershed.

Table 4-57: Key Subwatershed Characteristics – Mingo Branch

Drainage Area	507	Acres	
	0.79	sq. mi.	
Stream Length	7.4	Miles	
Population	371	(2010 Census)	
	0.73	persons/acre	
Land Use/Land Cover	Very Low Density Residential:		0.0%
	Low Density Residential:		0.4%
	Medium/High Density Residential:		0.3%
	Commercial:		3.1%
	Industrial:		0.0%
	Institutional:		0.0%
	Open Urban:		0.5%
	Agriculture:		22.8%
	Forest:		71.4%
	Transportation:		1.6%
	Other:		0.0%
Land in Easement	361	Acres	71.2%
Impervious Cover	15	Acres	3.0%
Soils	A Soils (low runoff potential):		0.0%
	B Soils:		80.5%
	C Soils:		10.0%
	D Soils (high runoff potential):		9.5%
	Water:		0.0%

4.3.10.1 Neighborhoods

No NSAs were assessed within the Mingo Branch subwatershed.

4.3.10.2 Hotspots

Four hotspot investigations were performed within the Mingo Branch subwatershed. These included a

shopping center, a gas station, a truck shop, and a parking lot. Table 4-58 summarizes the potential pollution sources found at each of the sites.

Table 4-58: HSI Results Summary – Mingo Branch

HSI ID	HSI Status	Description		Vehicle Operations	Outdoor Materials	Waste Management	Physical Plant	Turf/Landscape Management	Storm Water	Notes
HSI_X_1001	Potential Hotspot	Commercial	Shopping Center		X	X	X		X	-
HSI_X_1002	Potential Hotspot	Commercial	Gas Station	X	X	X	X	X	X	Education on keeping the dumpster lid closed
HSI_X_1003	Confirmed Hotspot	Transport-Related	Parking lot					X		Tree planting in islands, potential for BMP to treat impervious parking lot
HSI_X_1004	Confirmed Hotspot	Municipal	SHA Truck Shop	X	X	X	X	X	X	Wet pond collects and sediment trap treat impervious areas. Recent construction near SWM facility. Significant sediment observed on site.

HSI_X_1001 is a commercial shopping center located off Mount Carmel Road in the Mingo Branch subwatershed. The potential pollution sources observed at this location were outdoor materials storage, waste management, physical plant, and stormwater infrastructure. The facility has downspouts draining directly to the impervious parking lot and storm drain inlets. Materials and waste are stored properly on pallets outside the facility and are partially covered by the building.

HSI_X_1002 is a gas station located along Mount Carmel Road in Mingo branch. This hotspot contained a variety of potential pollution activities including vehicle operations, outdoor material storage, waste management, physical plant, and landscape management. The fueling stations at the station are covered. At the time of the assessment, the dumpsters were not properly closed.

HSI_X_1003 is a park and ride facility located at the Mount Carmel Road, Hereford exit (Exit 27) off of I-83. The only potential pollutant source observed at the site was due to landscape management. There is a large grassy area north of the parking facility that could potentially be converted to a SWM retrofit to treat the parking lot (Figure 4-36, left). A stream corridor assessment was conducted downstream of the parking lot and a very severe erosion site was observed; for more information see Section 3.6 in the *Watershed Characterization Report* (Appendix E). It is also recommended to observe the use of the facility to determine if impervious removal is possible. Also, tree plantings were recommended in the medians of the parking lot.

HSI_X_1004 is a Maryland State Highway Administration maintained truck shop located off of Mount Carmel Road. This hotspot contained a variety of potential pollution activities including vehicle operations, outdoor material storage, and waste management, physical plant, and landscape management. The site has many pollution prevention methods in place including an outdoor water storage tank that collects

runoff from the truck shop and washing station, a stormwater pond that collects runoff from half of the facility, and a sedimentation basin (Figure 4-36, left). The facility also has an updated Stormwater Pollution Prevention Plan (SWPPP). Significant sediment was observed on the impervious areas around the site and recent construction activity by another agency was observed without obvious erosion and sediment control measures. A follow up inspection for the construction area was recommended.

Figure 4-36: Space Available for Potential SWM Facility at HSI_X_1003 (left) and Storm Drain with Sedimentation Basin at HSI_X_1004 (right)

4.3.10.3 Institutions

No ISIs were assessed in the Mingo Branch subwatershed.

4.3.10.4 Pervious Areas

No pervious areas were assessed in the Mingo Branch subwatershed.

4.3.10.5 Illicit Discharges

There are no major outfalls in the Mingo Branch subwatershed.

4.3.10.6 Stream Corridors

Field teams assessed approximately 3.7 miles of streams within the Mingo Branch subwatershed to identify water quality problems and restoration opportunities. A total of 126 potential environmental problems were identified in the Mingo Branch subwatershed. The most frequent water quality and environmental issues observed were erosion sites and fish barriers. Table 4-59 summarizes the results of the Mingo Branch subwatershed SCA survey.

Table 4-59: Summary of Stream Conditions - Mingo Branch

Inadequate Buffer	Erosion Sites	Trash Dumping	Fish Barriers	Pipe Outfalls	Exposed Pipes	Channel Alteration	Unusual Conditions or Comments	Total
4	83	1	30	4	0	0	4	**126**

Length of Channel Alteration (ft)	Length of Erosion (ft)	Length of Inadequate Buffer (ft)
0	7,623	1,649

4.3.10.7 Historic Mill Dams

No historic mill dams were assessed in the Mingo Branch subwatershed.

4.3.10.8 Subwatershed Management Strategy

<u>Engaging Citizens & Watershed Groups</u>

1. No actions recommended.

<u>Municipal Actions</u>

1. Work with hotspots in Table 4-58 and similar businesses to implement appropriate practices for vehicle operations, outdoor materials storage, waste management, physical plant maintenance, turf/landscape management, and storm system maintenance.

2. Investigate the potential for installation of stormwater retrofits and potential impervious removal at the park and ride facility, HSI_X_1003.

3. Look into stream restoration potential along SCA reaches and other environmental problems shown in Table 4-59.

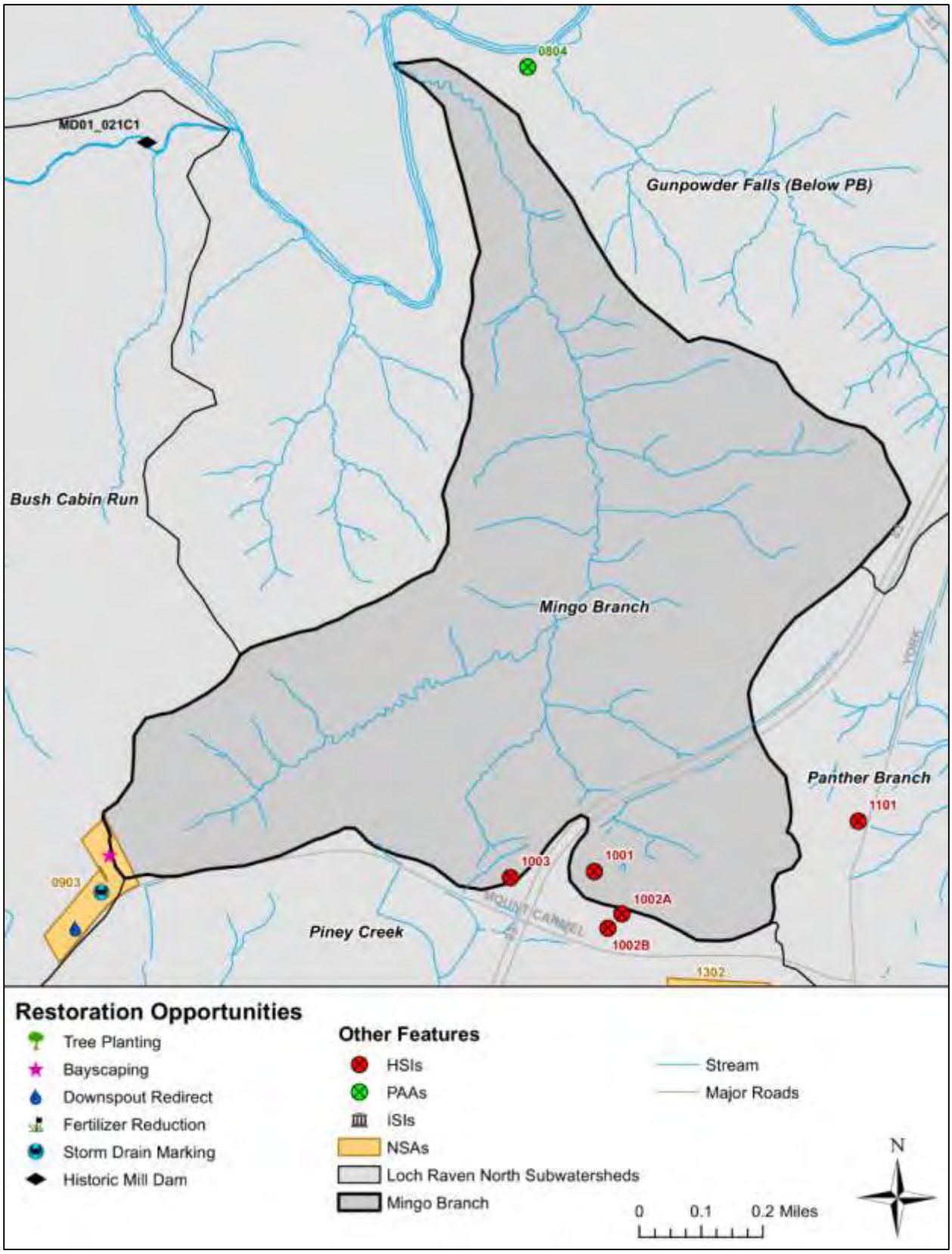

Figure 4-37: Restoration Opportunities in the Mingo Branch Subwatershed

4.3.11 Panther Branch

The Panther Branch subwatershed is the 2nd smallest subwatershed with 2nd fewest miles of stream in the Loch Raven North watershed. It has the highest population density at approximately 1.6 persons per acre and the highest impervious coverage (6.2%). The Panther Branch subwatershed also has the highest percentage of commercial and institutional land use (8%); however, combined they make up less than 10% of the total subwatershed. More than 50% of the Panther Branch subwatershed is forested land use; however, the subwatershed has the least amount of area of land in conservation easements and ranks 5th lowest in percent land in conservation easements (41%). Table 4-60 summarizes key characteristics of the Panther Branch subwatershed.

Table 4-60: Key Subwatershed Characteristics – Panther Branch

Drainage Area	741	Acres	
	1.16	sq. mi.	
Stream Length	10.0	Miles	
Population	1,186	(2010 Census)	
	1.60	persons/acre	
Land Use/Land Cover	Very Low Density Residential:		2.8%
	Low Density Residential:		14.9%
	Medium/High Density Residential:		0.9%
	Commercial:		4.0%
	Industrial:		0.0%
	Institutional:		4.3%
	Open Urban:		0.0%
	Agriculture:		18.9%
	Forest:		53.2%
	Transportation:		0.9%
	Other:		0.0%
Land in Easement	303	Acres	40.9%
Impervious Cover	46	Acres	6.2%
Soils	A Soils (low runoff potential):		0.0%
	B Soils:		73.8%
	C Soils:		16.5%
	D Soils (high runoff potential):		9.7%
	Water:		0.0%

4.3.11.1 Neighborhoods

One neighborhood was identified and assessed within the Panther Branch subwatershed during the uplands assessment of the Loch Raven North planning area. Recommendations for addressing stormwater volume and pollutants within this subwatershed primarily include public education in the form of bayscaping, waste management, and potential rain garden implementation. A summary of the neighborhood recommended actions is presented in Table 4-61.

Table 4-61: NSA Recommendations – Panther Branch

NSA_ID	Lot Size (acres)	Rain Gardens	Bayscape	Trash Management	Notes
NSA_X_1101	1/2	X	X	X	Construction activity causing sediment, overgrown abandoned houses, need better trash management

The neighborhood located in the Panther Branch subwatershed is situated between Monkton Road and Big Falls Road. Compared to other neighborhoods in the Loch Raven North planning area, the Panther Branch neighborhood has small lots sizes. However, there are still opportunities for bayscaping and rain garden implementation. A major observation at this neighborhood was evidence of dumping along properties lines. Construction activities were also observed on one property.

4.3.11.2 Hotspots

Two hotspot investigations were performed within the Panther Branch subwatershed. Table 4-62 summarizes the potential pollution sources found in the Panther Branch subwatershed.

Table 4-62: HSI Results Summary – Panther Branch

HSI ID	HSI Status	Description		Vehicle Operations	Outdoor Materials	Waste Management	Physical Plant	Turf/Landscape Management	Storm Water	Notes
HSI_X_1101	Potential Hotspot	Commercial	Garden Center		X	X	X	X		Parking lot not in good condition; uncovered materials on wood pallets
HSI_X_1102	Potential Hotspot	Municipal	Fire station	X	X	X	X	X	X	Pipe/Endwall at infiltration basin filled with debris, erosion in a few spots, sediment in facility

HSI_X_1101 is a garden center located on York Road in the Panther Branch subwatershed. Potential pollution sources included outdoor material storage, waste management, physical plant, and landscape management. Materials such as bags of mulch and fertilizer are properly on pallets (Figure 4-38, left). A storm drain is located down gradient of the parking lot along York Road. Additionally, open construction dumpsters were located behind the facility.

HSI_X_1102 is a volunteer fire station and community hall located along Monkton Road in the Panther Branch subwatershed. This hotspot contained a variety of potential pollution activities including vehicle operations, outdoor material storage, stormwater infrastructure, waste management, physical plant, and landscape management. An infiltration basin is located down gradient of the parking lot, treating the

impervious runoff from the site (Figure 4-38, right). The infiltration basin discharges to a SWM pond further downstream. The infiltration basin is filled with debris and shows signs of erosion at multiple locations. The hotspot also had an outdoor loading dock, material storage, and dumpsters with staining.

Figure 4-38: Outdoor Materials Stored at HSI_X_1101 (left) and SWM Facility at HSI_X_1102 (right)

4.3.11.3 Institutions

Two institutional sites were assessed for retrofit opportunities in the Panther Branch subwatershed during the uplands assessment of the Loch Raven North planning area. Table 4-63 summarizes recommendations for the institutional sites assessed in the Panther Branch subwatershed.

Table 4-63: ISI Recommendations – Panther Branch

Site ID	Name	Public/ Private	# Trees for Planting	Stormwater Retrofit	Impervious Cover Removal	Trash Management	Storm Drain Marking	Buffer Improvement	Notes
ISI_X_1101	Hereford High School	Public	1,062			X	X	X	Tree Planting areas are drawn on map, trash cans do not have lids, Follow-up on E&S for construction
ISI_X_1102	Hereford United Methodist Church	Private	22				X		-

ISI_X_1101 is a public high school located off of York Road in the Panther Branch subwatershed. There is a considerable opportunity for tree planting at this location due to large, unused pervious areas (Figure 4-39, left). A stream also runs through the site and tree planting would be an opportunity to increase stream buffer. It was noted that storm drains at the school were unmarked. Construction was ongoing during the assessment, it was recommended that a follow-up visit be made to ensure proper erosion and sediment controls are in practice.

ISI_X_1102 is a faith-based facility located at the corner of York Road and Monkton Road in the Panther Branch subwatershed. Restoration opportunties at this site include tree planting (Figure 4-39, left) and downspout disconnection.

Figure 4-39: Space for Tree Planting at ISI_X_1101 (left) and ISI_X_1102 (right)

4.3.11.4 Pervious Areas

The majority of PAA_X_1101 is located in the Panther Branch subwatershed and spills into the Gunpowder Falls (Below Prettyboy) subwatershed. The large parcel of land is publicly owned and situated northeast of Hereford High School. Although the majority of the parcel is already forested, there is potential to plant approximately 23 acres of land including 300 feet of stream buffer.

4.3.11.5 Illicit Discharges

No major outfalls are located within the Panther Branch subwatershed.

4.3.11.6 Stream Corridors

Field teams walked approximately 5.9 miles of stream within the Panther Branch subwatershed to identify potential water quality problems and restoration opportunities. A total of 192 potential environmental problems were identified in this subwatershed. The most predominant water quality issues included erosion sites, fish barriers, and inadequate buffers. The majority of the streams assessed were located on publicly owned land. Table 4-64 summarizes the results of the SCA survey in the Panther Branch subwatershed.

Table 4-64: Summary of Stream Conditions - Panther Branch

Inadequate Buffer	Erosion Sites	Trash Dumping	Fish Barriers	Pipe Outfalls	Exposed Pipes	Channel Alteration	Unusual Conditions or Comments	Total
13	105	9	42	10	1	3	9	**192**

Length of Channel Alteration (ft)	Length of Erosion (ft)	Length of Inadequate Buffer (ft)
149	5,936	3,902

4.3.11.7 Historic Mill Dams

Two historic mill dam locations were assessed in the Panther Branch subwatershed. Both were located on publicly owned, densely forested state park land. Remnants of the dams were observed along with steep, eroded banks; however, the channels appeared to stabilize downstream. Both sites are heavily forested, and because construction access would be very difficult, no recommendations were made for either dam location. Additional information on mill dam assessments and restoration recommendations can be found in *Appendix B* of the *Watershed Characterization Report* (Appendix E).

4.3.11.8 Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Educate citizens about the benefits and importance of proper trash management, bayscaping, and rain garden implementation.

2. Inform citizens of the importance of septic system maintenance.

Municipal Actions

1. Work with hotspots in Table 4-62 and similar businesses to implement appropriate practices for vehicle operations, outdoor materials storage and management of waste, physical plant management, turf/landscape management, and storm system maintenance.

2. Conduct tree planting and storm drain marking at the institutions indicated in Table 4-63.

3. Provide education to institutions indicated in Table 4-63 on proper waste management.

4. Investigate potential tree planting at PAA_X_1101.

5. Investigate the potential for stream restoration along reaches with environmental problems shown in Table 4-64.

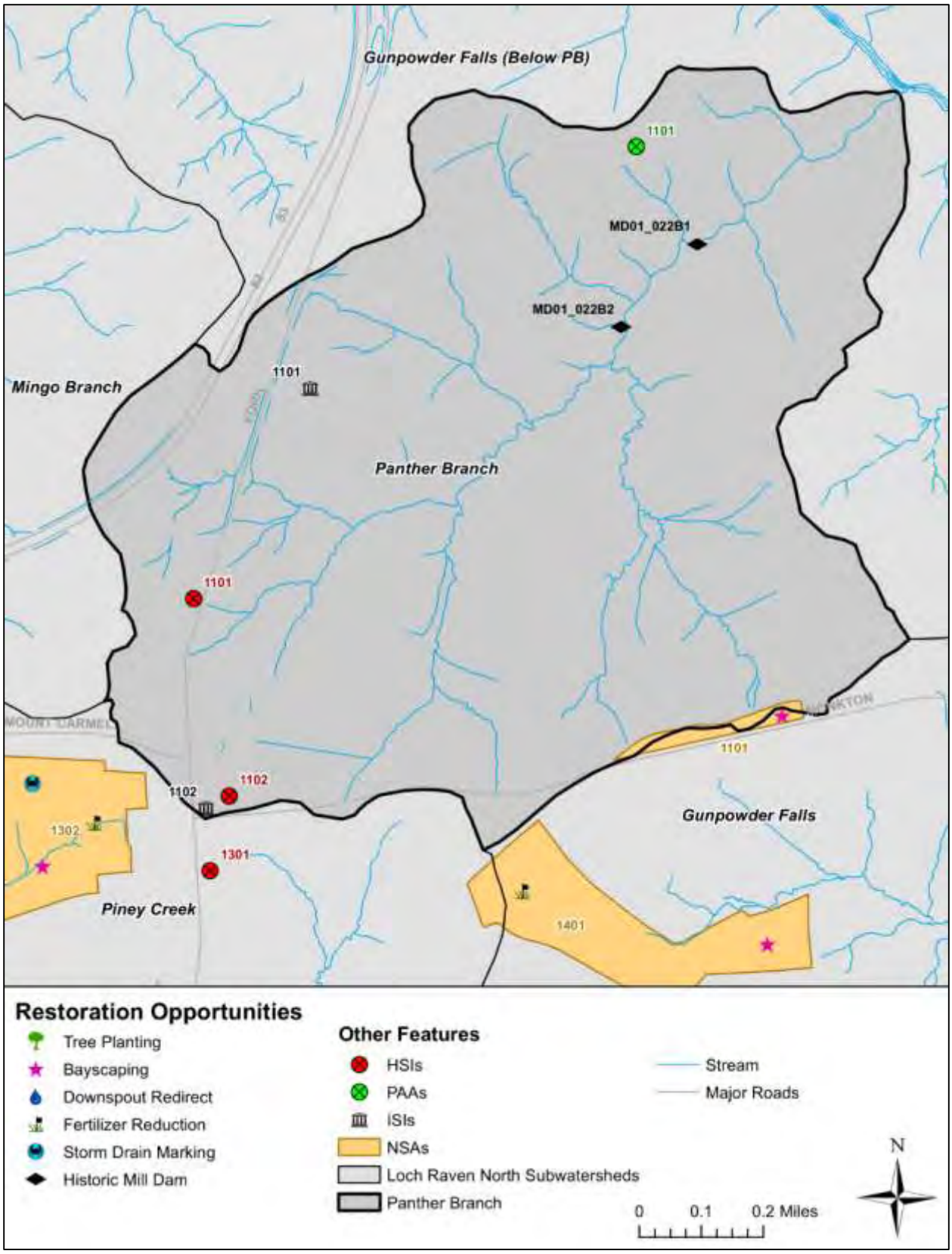

Figure 4-40: Restoration Opportunities in the Panther Branch Subwatershed

4.3.12 Charles Run

The Charles Run subwatershed is located along the eastern edge of the Loch Raven North watershed. Its characteristics are very similar to the average for the watershed as a whole, ranking 9th in overall area and 9th in percent impervious area (3.1%). Also similar to the watershed as a whole, Charles Run has approximately 35% agricultural and 35% forest land uses. Table 4-65 summarizes key characteristics of the Charles Run subwatershed.

Table 4-65: Key Subwatershed Characteristics – Charles Run

Drainage Area	2,820	acres	
	4.41	sq. mi.	
Stream Length	37.2	miles	
Population	1,141	(2010 Census)	
	0.40	persons/acre	
Land Use/Land Cover	Very Low Density Residential:		21.0%
	Low Density Residential:		9.4%
	Medium/High Density Residential:		0.0%
	Commercial:		0.1%
	Industrial:		0.0%
	Institutional:		0.2%
	Open Urban:		0.0%
	Agriculture:		34.7%
	Forest:		34.7%
	Transportation:		0.0%
	Other:		0.1%
Land in Easement	1,292	acres	45.8%
Impervious Cover	89	acres	3.1%
Soils	A Soils (low runoff potential):		0.0%
	B Soils:		65.8%
	C Soils:		15.0%
	D Soils (high runoff potential):		18.9%
	Water:		0.3%

4.3.12.1 Neighborhoods

Two neighborhoods were identified and assessed within the Charles Run subwatershed during the uplands assessment of the Loch Raven North planning area. Recommendations for addressing stormwater volume and pollutants within this subwatershed include storm drain marking, buffer improvement, and public education (i.e., bayscaping and increasing lot tree canopy). A summary of neighborhood recommended actions is presented in Table 4-66.

Table 4-66: NSA Recommendations – Charles Run

NSA_ID	Lot Size (acres)	Rain Gardens	Storm Drain Marking	Bayscape	Increase Lot Canopy	Buffer Improvement	Notes
NSA_X_1201	1-3	X		X		X	-
NSA_X_1202	1-3	X	X	X	X		Unclear how downspouts connect to storm drain/discharge

Both NSAs located in the Charles Run subwatershed have large lot sizes (1-3 acres) with large grass yards. This presents an excellent opportunity to encourage bayscaping. Educational outreach will also help encourage residents to plant trees where possible, especially along stream buffers. Additionally, there is potential for storm drain marking at NSA_X_1202 as the inlet is currently unmarked.

4.3.12.2 Hotspots

No HSIs were assessed in the Charles Run subwatershed.

4.3.12.3 Institutions

No ISIs were assessed in the Charles Run subwatershed.

4.3.12.4 Pervious Areas

No pervious areas were assessed in the Charles Run subwatershed.

4.3.12.5 Illicit Discharges

There are no major outfalls in the Charles Run subwatershed.

4.3.12.6 Stream Corridors

A stream corridor assessment was not completed for this subwatershed.

4.3.12.7 Historic Mill Dams

One historic mill dam location was assessed in the Charles Run subwatershed. Although the mill (now rehabilitated) and race were observed, there were no signs of a dam found at the supposed location. No restoration actions were recommended for this site as the nearby reach is densely forested with no signs of erosion. Additional information on mill dam assessments and restoration recommendations can be found in *Appendix B* of the *Watershed Characterization Report* (Appendix E).

4.3.12.8 Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Engage citizens in a storm drain marking program and conduct marking activities in NSA_X_1202.
2. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs such as Baltimore County's "Big Trees Sale".
3. Educate neighborhoods on the benefits of bayscaping and implementing rain gardens.
4. Educate residents of NSA_X_1201 about the importance of stream buffers and encourage more environmentally friendly stream treatments.
5. Inform citizens of the importance of septic system maintenance.

Municipal Actions

1. No actions recommended.

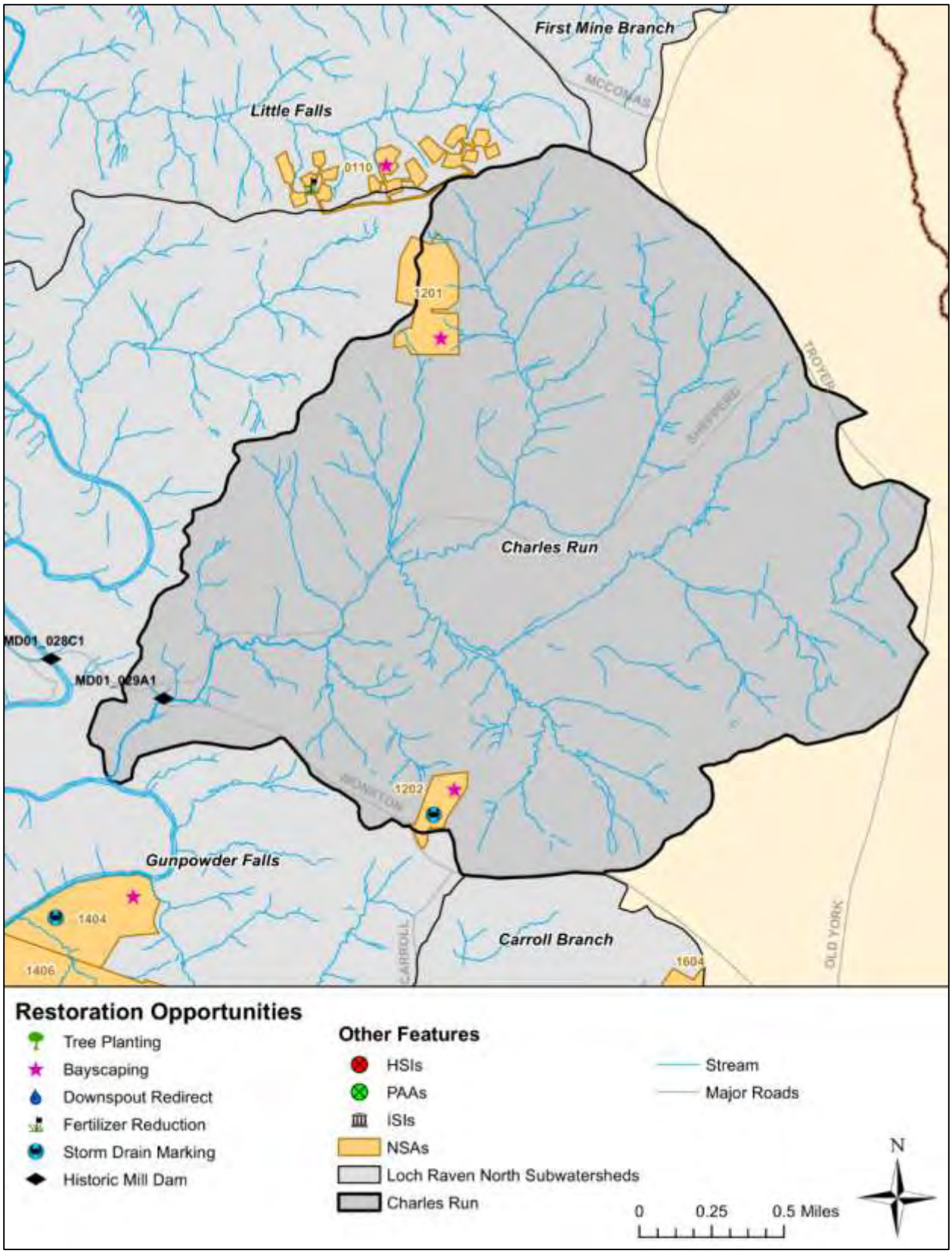

Figure 4-41: Restoration Opportunities in the Charles Run Subwatershed

4.3.13 Piney Creek

The Piney Creek subwatershed is the 3rd largest subwatershed in the Loch Raven North watershed. It is the 6th most populated subwatershed and also has the 3rd highest impervious cover (5.0%). Although forest cover is a significant land use (23%) in the subwatershed, it is the second lowest of the Loch Raven North watershed. It also ranks low in percent lands in conservation easements (36%) at 4th lowest of the subwatersheds. Table 4-67 summarizes key characteristics of the Piney Creek subwatershed.

Table 4-67: Key Subwatershed Characteristics – Piney Creek

Drainage Area	5,976	Acres	
	9.34	sq. mi.	
Stream Length	58.7	Miles	
Population	3,410	(2010 Census)	
	0.57	persons/acre	
Land Use/Land Cover	Very Low Density Residential:		11.1%
	Low Density Residential:		15.5%
	Medium/High Density Residential:		0.1%
	Commercial:		1.0%
	Industrial:		0.5%
	Institutional:		0.7%
	Open Urban:		0.5%
	Agriculture:		46.3%
	Forest:		22.5%
	Transportation:		1.6%
	Other:		0.2%
Land in Easement	2,169	Acres	36.3%
Impervious Cover	301	Acres	5.0%
Soils	A Soils (low runoff potential):		0.0%
	B Soils:		57.8%
	C Soils:		24.6%
	D Soils (high runoff potential):		17.6%
	Water:		0.0%

4.3.13.1 Neighborhoods

A total of 10 distinct neighborhoods were identified and assessed within the Piney Creek subwatershed during the uplands assessment of the Loch Raven North planning area (NSA_X_1304 could not be assessed due to dense forest obstructing homes). Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, buffer improvement, and public education (i.e., bayscaping, increasing lot tree canopy, and pet waste management). A summary of neighborhood recommended actions is presented in Table 4-68.

Table 4-68: NSA Recommendations – Piney Creek

NSA_ID	Lot Size (acres)	Opportunity for [illegible]	Rain Gardens	Storm Drain Marking	Bayscape	Increase Lot Canopy	Pet Waste Management	Buffer Improvement	Notes
NSA_X_1301	3-5		X	X	X			X	Clean algae and remove cattails from SWM facility
NSA_X_1302	1-3			X	X	X	X	X	It was unclear if the SWM Pond was designed to be a wet or dry pond. If it is a dry pond needs to be converted, potentially into a wet pond.
NSA_X_1303	3-5		X	X	X			X	No access to SWM ponds, potential rain garden in each property yard
NSA_X_1304	-								Unable to see houses; steep wooded slopes and dense wooded lots
NSA_X_1305	1-3		X	X	X	X			clean leaves/debris at inflow, stabilize bare soil with seed or mulch
NSA_X_1306	1-3		X		X	X			-
NSA_X_1307	1-3	X	X	X	X			X	broken curb at the end of Delbarton Dr.
NSA_X_1308	1-3		X	X				X	cannot access SWM pond
NSA_X_1309	1-3	X	X	X	X			X	Sediment along roadways, remove concrete ditch and replace with grass or riprap
NSA_X_1310	1-3	X	X	X	X			X	cannot access SWM pond
NSA_X_1311	5-10	X	X	X	X			X	-

All of the neighborhoods in the Piney Creek subwatershed will benefit from public education related to bayscaping, rain gardens, and tree planting/buffer improvement. These recommendations must occur on homeowner private property, thus educational outreach is the best means of implementing these actions. Additionally, downspout disconnection was recommended for roughly half of the neighborhoods and 90% of neighborhoods would benefit from storm drain marking.

Figure 4-42: Common Recommendations for NSAs in the Piney Creek subwatershed Include Bayscaping and Lot Canopy Improvement (NSA_X_1301, left) and Downspout Disconnection and Storm Drain Marking (NSA_X_1307, right)

4.3.13.2 Hotspots

Three hotspot investigations were performed within the Piney Creek subwatershed. These hotspots include a service garage and two commercial office buildings. Table 4-69 summarizes the potential pollution sources found in the Piney Creek subwatershed.

Table 4-69: HSI Results Summary – Piney Creek

HSI ID	HSI Status	Description		Vehicle Operations	Outdoor Materials	Waste Management	Physical Plant	Turf/Landscape Management	Storm Water	Notes
HSI_X_1301	Confirmed Hotspot	Commercial	Garage	X	X	X	X	X		Fuel pump not in operation, may be some oil containers in back but cannot verify
HSI_X_1302	Potential Hotspot	Commercial	Health Services		X	X	X	X	X	-
HSI_X_1303	Not a Hotspot	Commercial	Offices			X	X	X		-

HSI_X_1301 is an auto body shop located on York Road in the Piney Creek subwatershed. Potential pollutant sources at this site included vehicle operations, outdoor material storage, waste management, physical plant, and landscape management. There was evidence of staining on the asphalt outside the shop (Figure 4-43, left). Additionally, downspouts were directly connected to impervious surfaces but no opportunities for disconnection were present.

HSI_X_1302 is a commercial health services property located along Ridgebrook Road in the Piney Creek subwatershed. The facility has multiple stormwater management ponds located on their property,

treating the parking lot runoff. A small section of the parking lot, near a storm drain, was breaking up (Figure 4-43, right). Uncovered loading docks were observed and the entire area drained to the storm drain system. There was a large amount of open, pervious area with the potential for tree planting.

Figure 4-43: Asphalt Staining at HSI_X_1301 (left) and Breaking Up Parking Lot at HSI_X_1303 (right)

HSI_X_1303 is a commercial business center along Ridgebrook Road. The site appeared to be recently developed and was determined to not be a hotspot. There are some spaces for tree planting along parking island. An uncovered dumpster was located behind the building.

4.3.13.3 Institutions

Two public and one private institutional sites were assessed for retrofit opportunities in the Piney Creek subwatershed during the uplands assessment of the Loch Raven North planning area. Table 4-70 summarizes recommendations for the institutional sites assessed in the Piney Creek subwatershed.

Table 4-70: ISI Recommendations – Piney Creek

Site ID	Name	Public/ Private	# Trees for Planting	Stormwater Retrofit	Impervious Cover Removal	Trash Management	Storm Drain Marking	Buffer Improvement	Notes
ISI_X_1301	Sparks Elementary School	Public	2056				X	X	Unable to locate outfall from pond, area around inlet eroded, pond inflows severely eroded
ISI_X_1302	Old Sparks Elementary School	Public	263		X			X	Removal of impervious areas can be used for tree planting, school not in use, sports fields and parking lot are used
ISI_X_1303	Pentecostal Church of Baltimore County	Private	33	X					-

ISI_X_1301 is a public elementary school located off of Belfast Road in the Piney Creek subwatershed. There are currently two stormwater management ponds located on the property. Inlets drain the impervious areas to the ponds. Sediment from a portion of the property is draining to one of these inlets (Figure 4-44, left). There are multiple areas along the border of the property that are unused and suitable for tree planting.

ISI_X_1302 is a public park facility located Sparks Road in the Piney Creek subwatershed. The site used to be an elementary school, but has since been abandoned and is used recreationally. Impervious removal is recommended at this site to take out the abandoned, degraded walkways (Figure 4-44, center). There are also opportunities for buffer planting along the stream that border the property.

ISI_X_1303 is a faith-based institution located on Mount Carmel Road in the Piney Creek subwatershed. There is potential for a stormwater retrofit, such as a biorention facility, to treat the impervious, parking lot runoff (Figure 4-44, right). Additionally, there is potential for tree planting along the border of the property.

Figure 4-44: Disturbed Soil near Storm Drain in ISI_X_1301 (left), Impervious Removal Opportunity at ISI_X_1302 (center), and SWM Opportunity to Treat Parking Lot at ISI_X_1303 (right)

4.3.13.4 Pervious Areas

Three pervious areas were assessed in the Piney Creek subwatershed. PAA_X_1301 and PAA_X_1302 are adjacent parcels located near Sparks Elementary School. PAA_X_1301 is a privately owned parcel that is actively farmed. There is potential for planting along the stream on this parcel to expand the forest buffer. PAA_X_1302 is publicly owned. The reach of the Piney Creek subwatershed through the parcel has no buffer. Planting on this property would provide approximately 13 acres of reforestation and is a high priority location.

PAA_X_1303 is a publicly owned parcel of land located just off of York Road. The majority of the parcel is forested; however, there is approximately 2 additional acres available for planting. This area was also assessed during the stream corridor and mill dam assessments.

4.3.13.5 Illicit Discharges

No major outfalls are located within the Piney Creek subwatershed.

4.3.13.6 Stream Corridors

Field crews walked a total of 11.8 miles of stream in the Piney Creek subwatershed to identify water quality problems and restoration opportunities. A total of 518 potential environmental problems were identified in the Piney Creek subwatershed, the most of all subwatersheds assessed in the Loch Raven North watershed. The most prevalent water quality issues included erosion sites and inadequate buffers. Many of the inadequate buffers were due to agricultural clearing for cropland or pasture. Table 4-71 summarizes the results of the SCA survey and restoration opportunities for the subwatershed.

Table 4-71: Summary of Stream Conditions - Piney Creek

Inadequate Buffer	Erosion Sites	Trash Dumping	Fish Barriers	Pipe Outfalls	Exposed Pipes	Channel Alteration	Unusual Conditions or Comments	Total
57	330	15	41	30	1	26	18	**518**

Length of Channel Alteration (ft)	Length of Erosion (ft)	Length of Inadequate Buffer (ft)
1,749	19,727	38,241

4.3.13.7 Historic Mill Dams

Five historic mill dam locations were assessed in the Piney Creek subwatershed. Four of the sites were recommended for restoration activities including legacy sediment removal, stream restoration, wetland creation, floodplain reconnection, and buffer creation. Buffer creation was recommended for all four sites. A summary of the mill dam assessments for the Piney Creek subwatershed is shown in Table 4-72. Additional information on mill dam assessments and restoration recommendations can be found in *Appendix B* of the *Watershed Characterization Report* (Appendix E).

Table 4-72: Summary of Historic Mill Dam Sites - Piney Creek

	Recommended Action						
Mill Dam ID	No Action	Legacy Sediment Removal	Stream Stabilization/ Restoration	Wetland Creation	Floodplain Reconnection	Fish Passage	Buffer Creation
MD01_028A2	X	-	-	-	-	-	-
MD01_034A1	-	X	X	X	X	-	X
MD01_034B1	-	X	X	X	X	-	X
MD02_034A1	-	X	X	X	X	-	X
MD02_034B1	-	-	-	-	-	-	X
Total	***1***	***3***	***3***	***3***	***3***	***0***	***4***

4.3.13.8 Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-68 and educate citizens on the benefits of rain barrels and rain gardens.

2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-68.

3. Increase tree canopies on private lots by educating citizens on the benefits of trees and about programs such as Baltimore County's "Big Trees Sale".

4. Educate citizens about the benefits and importance of proper lawn care, pet waste management, and bayscaping in the neighborhoods indicated in Table 4-68.

5. Educate the residents of neighborhoods indicated in Table 4-68 about the importance of stream buffers and encourage more environmentally friendly stream treatments.

6. Inform citizens of the importance of septic system maintenance.

Municipal Actions

1. Work with hotspots indicated in Table 4-69 and similar businesses to implement appropriate practices for vehicle operations, waste management, physical plant management, turf/landscape management, and storm system maintenance.

2. Work with teachers and students at ISI_X_1301 to conduct storm drain marking at the school.

3. Investigate potential stormwater retrofit at ISI_X_1303.

4. Conduct tree plantings at institutional sites indicated in Table 4-70. Educate those institutions that were noted for stream buffer improvements on the benefits of forested stream buffers.

5. Remove extraneous impervious cover at ISI_X_1302.

6. Investigate PAA_X_1301, PAA_X_1302, and PAA_X_1303 for potential tree planting opportunities.

7. Investigate potential stream restoration along reaches within the Piney Creek subwatershed noted for environmental problems in Table 4-71.

8. Explore recommended actions regarding historic mill dam locations indicated in Table 4-72 for potential restoration and habitat improvement.

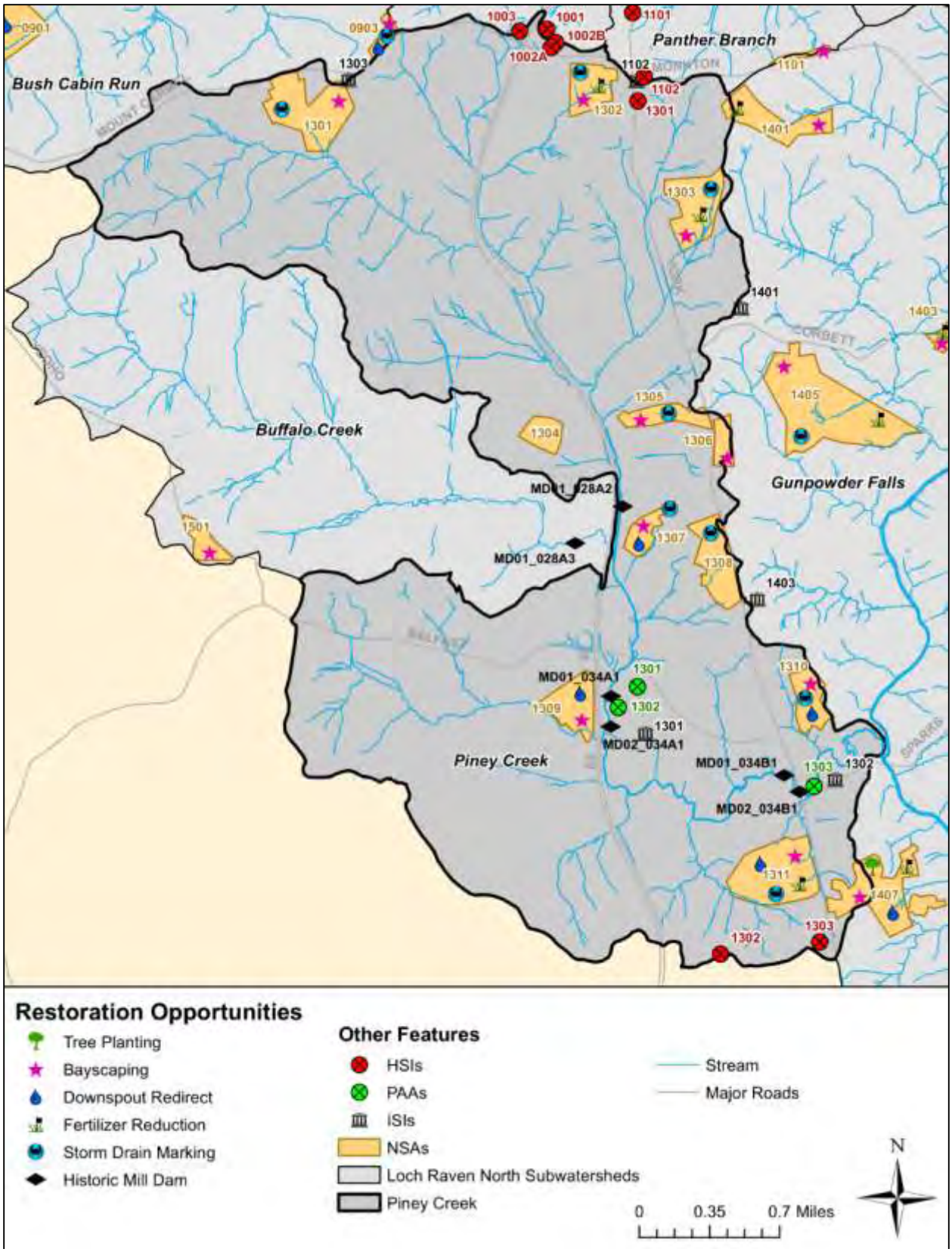

Figure 4-45: Restoration Opportunities in the Piney Creek Subwatershed

4.3.14 Gunpowder Falls

The Gunpowder Falls subwatershed is the 2nd largest subwatershed and the 2nd greatest length of stream miles in the Loch Raven North watershed. The Gunpowder Falls subwatershed has the 3rd lowest agricultural land use (19%) and 2nd highest low density residential land use (18%). The subwatershed has the 2nd greatest area of land in conservation easements but ranks 10th for percent land in easements (47%). Table 4-73 summarizes key characteristics of the Gunpowder Falls subwatershed.

Table 4-73: Key Subwatershed Characteristics – Gunpowder Falls

Drainage Area	7,712	Acres	
	12.05	sq. mi.	
Stream Length	99.0	Miles	
Population	5,434	(2010 Census)	
	0.70	persons/acre	
Land Use/Land Cover	Very Low Density Residential:		19.2%
	Low Density Residential:		18.4%
	Medium/High Density Residential:		1.0%
	Commercial:		0.0%
	Industrial:		0.0%
	Institutional:		1.2%
	Open Urban:		0.4%
	Agriculture:		18.7%
	Forest:		40.4%
	Transportation:		0.0%
	Other:		0.6%
Land in Easement	3,599	Acres	46.7%
Impervious Cover	290	Acres	3.8%
Soils	A Soils (low runoff potential):		0.0%
	B Soils:		70.8%
	C Soils:		12.9%
	D Soils (high runoff potential):		14.8%
	Water:		1.6%

4.3.14.1 Neighborhoods

A total of 11 distinct neighborhoods were identified and assessed within the Gunpowder Falls subwatershed during the uplands assessment of the Loch Raven North planning area. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, tree planting, street sweeping, storm drain marking, buffer improvement, and public education (i.e., bayscaping, increasing lot tree canopy, and pet waste management). A summary of neighborhood recommended actions is presented in Table 4-74.

Table 4-74: NSA Recommendations – Gunpowder Falls

NSA_ID	Lot Size (acres)	Opportunity for Downspout Disconnection	Rain Gardens	Storm Drain Marking	Bayscape	Increase Lot Canopy	Buffer Improvement	# of Shade Trees	Street Sweeping (mi)	Notes
NSA_X_1401	1-3				X		X			-
NSA_X_1402	1-3	X	X	X	X		X	277		Potential for bioretention facility
NSA_X_1403	1-3		X		X	X		151		Invasive species in SWM facility, 2 vacant lots which are potential for tree planting if not planned for development
NSA_X_1404	3-5		X	X	X		X			-
NSA_X_1405	1-3		X	X	X		X			-
NSA_X_1406	3-5		X	X	X		X			-
NSA_X_1407	1-3	X	X		X	X	X	135		-
NSA_X_1408	1-3		X	X	X	X	X			-
NSA_X_1409	< 1/4	X		X	X	X	X	74	1.38	BMP potential at Old Forge Garth
NSA_X_1410	1	X		X		X	X			Need to clean sediment on roadway that drains to inlets
NSA_X_1411	1-3	X	X	X	X	X	X			Tree planting along Stewarts Glen Dr

All of the neighborhoods in the Gunpowder Falls subwatershed will benefit from public education related actions that can be completed on private, homeowner property such as bayscaping, rain gardens, downspout disconnection, and tree planting/buffer improvement. Four of the neighborhoods in the Gunpowder Falls subwatershed had common space areas suitable for shade tree planting, an example is shown in (Figure 4-46, left). Approximately 80% of the neighborhood had unmarked storm drains and two neighborhoods were recommended for street sweeping due to organic matter clogging inlets.

Figure 4-46: Open Space for Tree Planting at NSA_X_1403 (left) and Large Neighborhood Lots with Potential for Bayscaping and Planting (right)

4.3.14.2 Hotspots

No HSIs were assessed in the Gunpowder Falls subwatershed.

4.3.14.3 Institutions

Three institutional sites were assessed for retrofit opportunities in the Gunpowder Falls subwatershed during the uplands assessment of the Loch Raven North planning area. Table 4-75 summarizes recommendations for the institutional sites assessed in the Gunpowder Falls subwatershed.

Table 4-75: ISI Recommendations – Gunpowder Falls

Site ID	Name	Public/ Private	# Trees for Planting	Stormwater Retrofit	Impervious Cover Removal	Trash Management	Storm Drain Marking	Buffer Improvement	Notes
ISI_X_1401	Hereford Middle School	Public	240	X	X	X		X	Minor breaking of parking lot, trash cans overflowing, potential for BMP pending discharge location, some inlets in field are not marked
ISI_X_1402	Oldfields School	Private	155	X				X	Bare soil at horse stable, minor sediment/erosion along roadway, potential for SWM facilities
ISI_X_1403	O'Dwyer Retreat House	Private	28			X	X		Dumpster located on steep slope, relocate to flat area

ISI_X_1401 is a public middle school located off of Corbett Road. Multiple restoration opportunities were

present at this location. Educational outreach related to trash management was recommended as trash cans were observed overflowing. There is potential for stormwater retrofit to treat the parking lot; however, the discharge point of the drainage system could not be verified. There were multiple impervious areas that appear to be discarded, disconnected walkways in the field areas that could be removed (Figure 4-47, left) and numerous areas for tree planting along the sloped embankment to the parking lot and along the property borders.

ISI_X_1402 is a private, girl's school located off of Glencoe Road. The school has multiple horse stables and pastures. The northeastern edge of the property borders a stream and provides an opportunity for buffer improvement. Additionally, there are two areas observed during the assessment with potential for stormwater retrofit. The first would treat the parking lot near the school exit (Figure 4-47, left) and the second would treat the roadway and street at the school entrance.

ISI_X_1403 is a faith-based retreat house located off of York Road. The site has a parking lot, two large buildings, and a swimming pool on the property. Storm drains were observed at the institution and they were unmarked. Additionally, trash management education is recommended as the dumpster was located on an impervious slope that drained down to the stormwater inlet.

Figure 4-47: Impervious Removal Opportunity at ISI_X_1401 (left) and Stormwater Retrofit Location to Treat Parking at ISI_X_1402 (right)

4.3.14.4 Pervious Areas

No pervious areas were assessed in the Gunpowder Falls subwatershed.

4.3.14.5 Illicit Discharges

There are no major outfalls in the Gunpowder Falls subwatershed.

4.3.14.6 Stream Corridors

A stream corridor assessment was not completed for this subwatershed.

4.3.14.7 Historic Mill Dams

Two historic mill dam locations were assessed in the Gunpowder Falls subwatershed for potential restoration opportunities. One of the historic dam locations was recommended for buffer creation while the other site had no recommended actions. The mill dam assessment results are summarized below in Table 4-76. Additional information on mill dam assessments and restoration recommendations can be found in *Appendix B* of the *Watershed Characterization Report* (Appendix E).

Table 4-76: Summary of Historic Mill Dam Sites - Gunpowder Falls

	Recommended Action						
Mill Dam ID	No Action	Legacy Sediment Removal	Stream Stabilization/ Restoration	Wetland Creation	Floodplain Reconnection	Fish Passage	Buffer Creation
MD01_028C1	-	-	-	-	-	-	X
MD01_034C3	X	-	-	-	-	-	-
Total	***1***	***0***	***0***	***0***	***0***	***0***	***1***

4.3.14.8 Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-74 and educate citizens on the benefits of rain barrels and rain gardens.

2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-74.

3. Increase tree canopies on private lots by educating citizens on the benefits of trees and about program such as Baltimore County's "Big Trees Sale" in the neighborhoods indicated in Table 4-74.

4. Educate citizens of the benefits and importance of bayscaping as indicated in Table 4-74.

5. Inform citizens of the importance of septic system maintenance.

Municipal Actions

1. Work with ISI_X_1403 to conduct storm drain marking.

2. Provide education to institutions indicated in Table 4-75 on proper waste management.

3. Investigate potential stormwater retrofits at ISI_X_1401 and ISI_X_1402 and conduct programs with institutions to provide education and install retrofits at the facilities.

4. Conduct tree plantings at all institutional sites as indicated in Table 4-75.

5. Remove extraneous impervious cover at ISI_X_1401.

6. Investigate historic mill dam site MD01_028C1 for potential buffer creation.

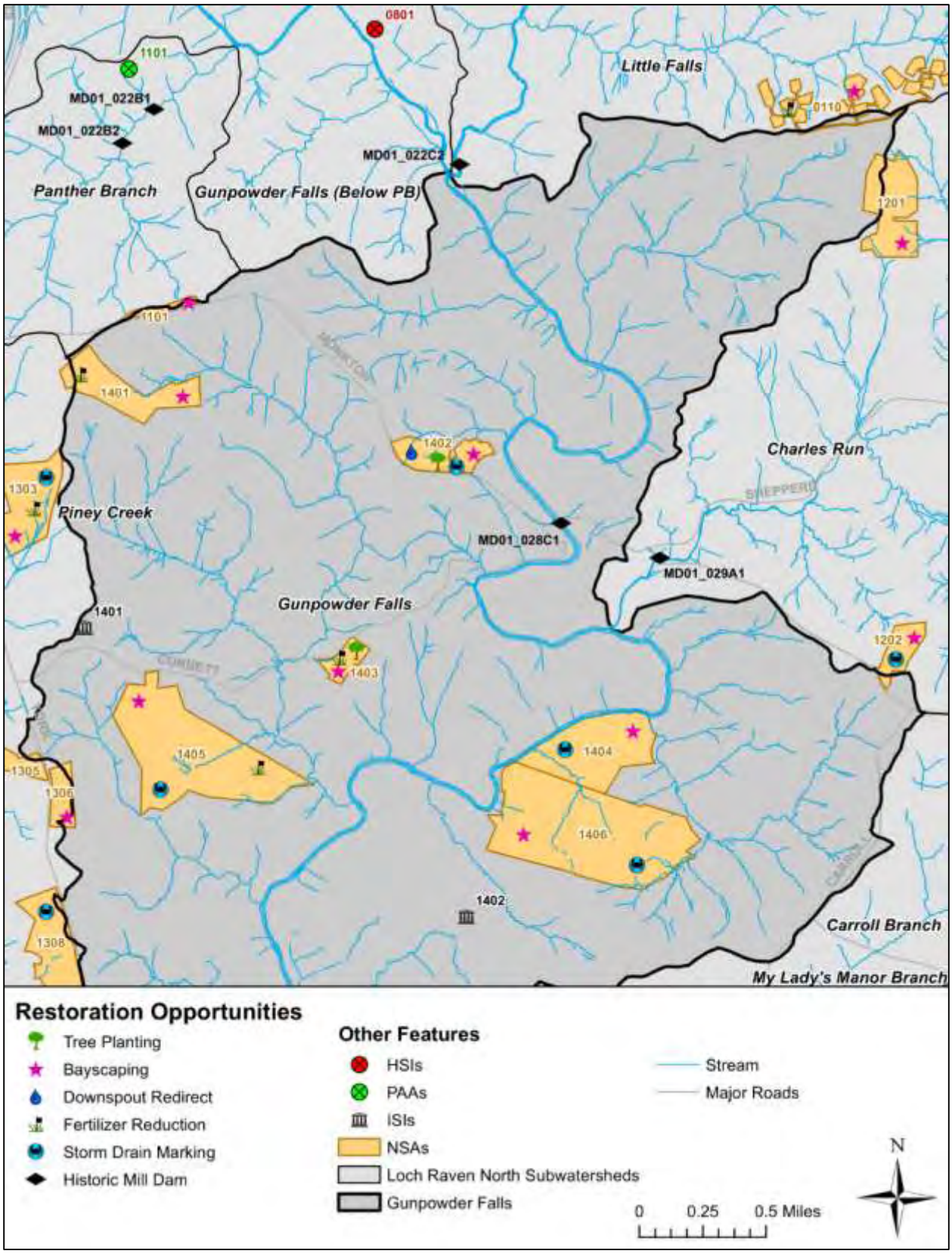

Figure 4-48: Restoration Opportunities in the Gunpowder Falls Subwatershed (North)

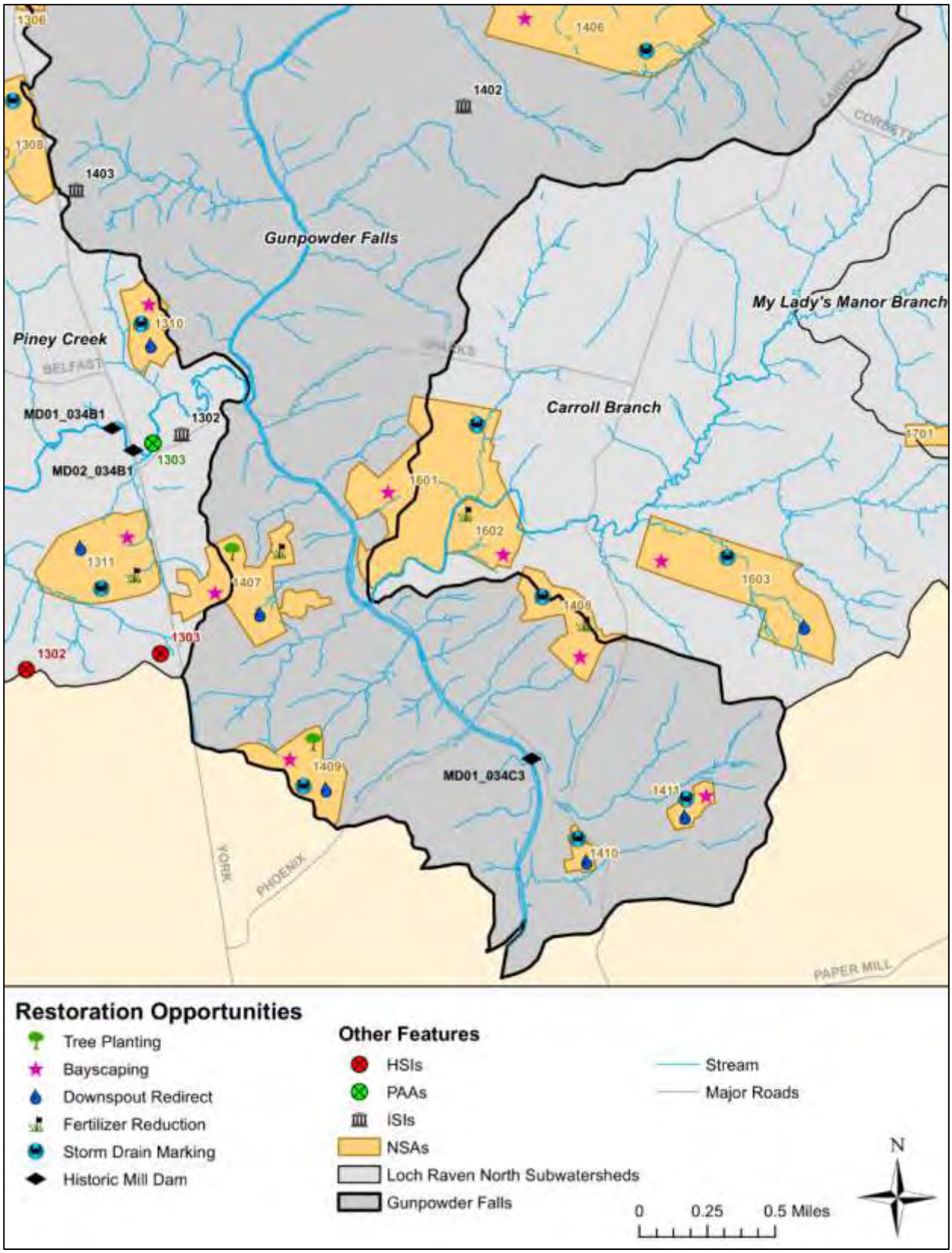

Figure 4-49: Restoration Opportunities in the Gunpowder Falls Subwatershed (South)

4.3.15 Buffalo Creek

The Buffalo Creek subwatershed is 5th smallest subwatershed and is located in the southwest corner of the Loch Raven North watershed. The subwatershed has the 2nd highest total percentage of agricultural land use (55%). Other significant land use includes forest (34%) and residential (11%). The Buffalo Creek subwatershed has the lowest population density and 4th lowest percent impervious (2.2%) of any subwatershed. Table 4-77 summarizes key characteristics of the Buffalo Creek subwatershed.

Table 4-77: Key Subwatershed Characteristics – Buffalo Creek

Drainage Area	1,888	acres	
	2.95	sq. mi.	
Stream Length	16.6	miles	
Population	493	(2010 Census)	
	0.26	persons/acre	
Land Use/Land Cover	Very Low Density Residential:		6.7%
	Low Density Residential:		3.9%
	Medium/High Density Residential:		0.0%
	Commercial:		0.0%
	Industrial:		0.0%
	Institutional:		0.0%
	Open Urban:		0.0%
	Agriculture:		54.9%
	Forest:		34.0%
	Transportation:		0.4%
	Other:		0.0%
Land in Easement	1,247	acres	66.0%
Impervious Cover	42	acres	2.2%
Soils	A Soils (low runoff potential):		0.0%
	B Soils:		66.5%
	C Soils:		7.9%
	D Soils (high runoff potential):		25.5%
	Water:		0.0%

4.3.15.1 Neighborhoods

One neighborhood was identified and assessed within the Buffalo Creek subwatershed during the uplands assessment of Loch Raven North. Recommendations for this neighborhood include addressing public education in the form of bayscaping. A summary of neighborhood recommended actions is presented in Table 4-78.

Table 4-78: NSA Recommendations – Buffalo Creek

NSA_ID	Lot Size (acres)	Bayscape	Notes
NSA_X_1501	3-5	X	Flooded yard and roadway, no storm drain or defined channel

The neighborhood assessed in the Buffalo Creek subwatershed has large lot sizes (3-5 acres) with approximately 70% forest canopy on average. Most homes still had ample lawn space to incorporate bayscaping on their properties. No common space was observed in this neighborhood for tree planting or stormwater management retrofit.

4.3.15.2 Hotspots

No HSIs were assessed in the Buffalo Creek subwatershed.

4.3.15.3 Institutions

No ISIs were assessed in the Buffalo Creek subwatershed.

4.3.15.4 Pervious Areas

No pervious areas were assessed in the Buffalo Creek subwatershed.

4.3.15.5 Illicit Discharges

No major outfalls are located within the Buffalo Creek subwatershed.

4.3.15.6 Stream Corridors

A stream corridor assessment was not completed for this subwatershed.

4.3.15.7 Historic Mill Dams

One historic mill dam location was assessed in the Buffalo Creek subwatershed for potential restoration opportunities. The dam is located on private property and was recommended for stream restoration and floodplain reconnection as shown in Table 4-79. Additional information on mill dam assessments and restoration recommendations can be found in *Appendix B* of the *Watershed Characterization Report* (Appendix E).

Table 4-79: Summary of Historic Mill Dam Sites - Buffalo Creek

	Recommended Action						
Mill Dam ID	No Action	Legacy Sediment Removal	Stream Stabilization/ Restoration	Wetland Creation	Floodplain Reconnection	Fish Passage	Buffer Creation
MD01_028A3	-	-	X	-	X	-	-
Total	***0***	***0***	***1***	***0***	***1***	***0***	***0***

4.3.15.8 Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Educate citizens about the benefits and importance of bayscaping.
2. Inform citizens of the importance of septic system maintenance.

Municipal Actions

1. Investigate potential restoration actions for historic mill dam site MD01_028A3.

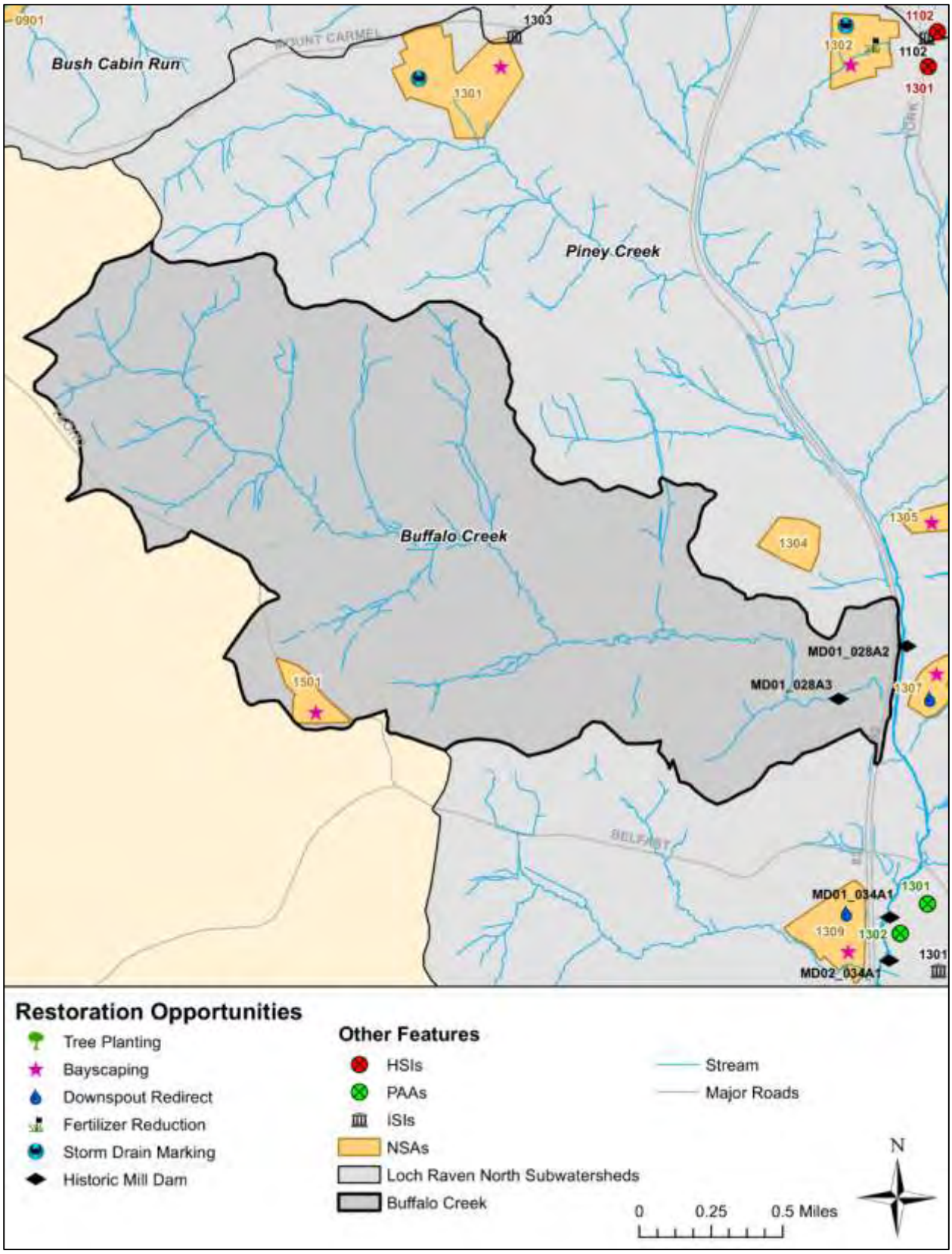

Figure 4-50: Restoration Opportunities in the Buffalo Creek Subwatershed

4.3.16 Carroll Branch

The Carroll Branch subwatershed is the 8th smallest subwatershed and is located in the southern portion of the Loch Raven North watershed. Like the majority of the subwatersheds in Loch Raven North, the Carroll Branch subwatershed is primarily made up of agricultural (54%), forest (24%), and residential land use (22%). It ranks 10th for population density and 13th for percent impervious cover (2.5%). Table 4-80 summarizes key characteristics of the Carroll Branch subwatershed.

Table 4-80: Key Subwatershed Characteristics – Carroll Branch

Drainage Area	2,567	Acres	
	4.01	sq. mi.	
Stream Length	26.6	Miles	
Population	1,325	(2010 Census)	
	0.52	persons/acre	
Land Use/Land Cover	Very Low Density Residential:		11.4%
	Low Density Residential:		10.7%
	Medium/High Density Residential:		0.0%
	Commercial:		0.0%
	Industrial:		0.0%
	Institutional:		0.0%
	Open Urban:		0.0%
	Agriculture:		53.7%
	Forest:		23.8%
	Transportation:		0.0%
	Other:		0.3%
Land in Easement	1,640	Acres	63.9%
Impervious Cover	65	Acres	2.5%
Soils	A Soils (low runoff potential):		0.0%
	B Soils:		72.4%
	C Soils:		6.5%
	D Soils (high runoff potential):		20.9%
	Water:		0.2%

4.3.16.1 Neighborhoods

A total of four distinct neighborhoods were identified and assessed within the Carroll Branch subwatershed during the uplands assessment of the Loch Raven North planning area. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, rain gardens, buffer improvement, storm drain marking, and public education (i.e., bayscaping and increasing lot tree canopy). A summary of neighborhood recommended actions is presented in Table 4-81.

Table 4-81: NSA Recommendations – Carroll Branch

NSA_ID	Lot Size (acres)	Opportunity for [illegible]	Rain Gardens	Storm Drain Marking	Bayscape	Buffer Improvement	Street Sweeping (mi)	Notes
NSA_X_1601	5-10		X	X	X	X		-
NSA_X_1602	3-5		X		X	X		-
NSA_X_1603	5-10	X	X	X	X	X	0.96	Curb/Gutter breaking near low points, Unclear about discharge point and downspout connections
NSA_X_1604	3-5	X	X		X			Clean debris/organic matter at low spot (culvert)

All of the neighborhoods in the Carroll Branch subwatershed were recommended for public education related to bayscaping and all but one of the NSAs were recommended for buffer improvement which can be achieved through public education about the benefits of providing a stream buffer by reducing the amount of mowed lawn through tree and vegetation planting. Due to the large lot sizes in each neighborhood, opportunities for planting on homeowner properties are high. Two of the neighborhoods were recommended for downspout disconnection and all were recommended for rain gardens due to the large open space on each property. Two of the neighborhoods were recommended for storm drain marking as inlets were unmarked. NSA_X_1603 was recommended for street sweeping as inlets were littered with organic debris.

4.3.16.2 Hotspots

No HSIs were assessed in the Carroll Branch subwatershed.

4.3.16.3 Institutions

No ISIs were assessed in the Carroll Branch subwatershed.

4.3.16.4 Pervious Areas

No pervious areas were assessed in the Carroll Branch subwatershed.

4.3.16.5 Illicit Discharges

No major outfalls are located within the Carroll Branch subwatershed.

4.3.16.6 Stream Corridors

A stream corridor assessment was not completed for this subwatershed.

4.3.16.7 Historic Mill Dams

No historic mill dams were assessed in the Carroll Branch subwatershed.

4.3.16.8 Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection measures in neighborhoods according to Table 4-81 and educate citizens on the benefits of rain barrels and rain gardens.

2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-81.

3. Educate citizens about the benefits and importance of bayscaping.

4. Educate residents indicated in Table 4-81 about the importance of stream buffers and encourage more environmentally friendly stream treatments.

5. Inform citizens of the importance of septic system maintenance.

Municipal Actions

1. Conduct seasonal street sweeping at the NSA_X_1603 to clear organic matter littering curbs and inlets.

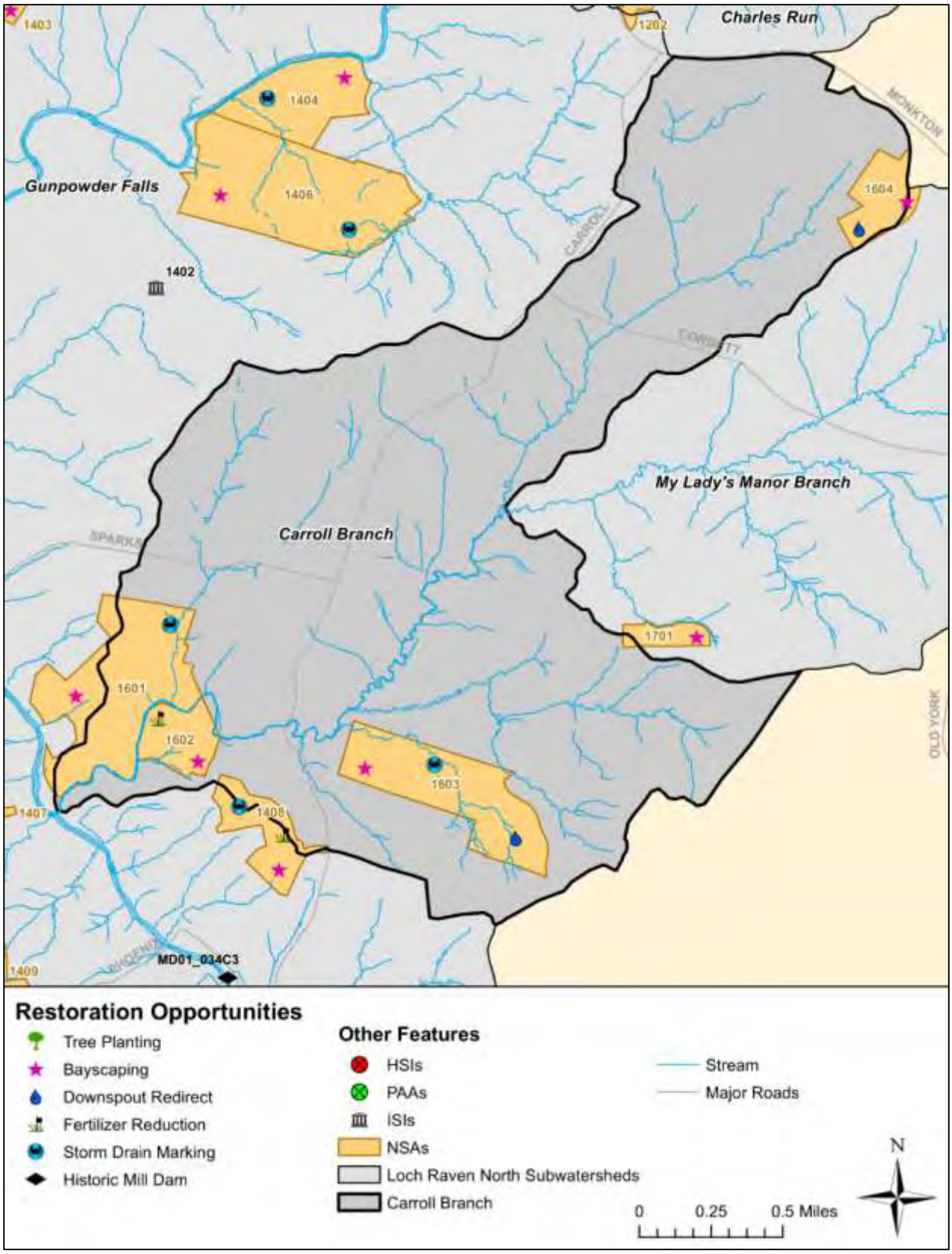

Figure 4-51: Restoration Opportunities in the Carroll Branch Subwatershed

4.3.17 My Lady's Manor Branch

The My Lady's Manor Branch subwatershed is the 3rd smallest subwatershed in the Loch Raven North watershed. The subwatershed has the highest percentage of agricultural land use (64%) and lowest percentage of forested land use (22%). The My Lady's Manor Branch subwatershed also has the highest percentage of land held under an easement (84%) and the 2nd lowest percent of impervious area (2.0%). Table 4-82 summarizes key characteristics of the My Lady's Manor Branch subwatershed.

Table 4-82: Key Subwatershed Characteristics – My Lady's Manor Branch

Drainage Area	1,329	Acres	
	2.08	sq. mi.	
Stream Length	13.8	Miles	
Population	395	(2010 Census)	
	0.30	persons/acre	
Land Use/Land Cover	Very Low Density Residential:		7.2%
	Low Density Residential:		4.6%
	Medium/High Density Residential:		0.0%
	Commercial:		0.0%
	Industrial:		0.0%
	Institutional:		0.0%
	Open Urban:		0.0%
	Agriculture:		64.0%
	Forest:		22.1%
	Transportation:		0.0%
	Other:		2.1%
Land in Easement	1,120	Acres	84.3%
Impervious Cover	27	Acres	2.0%
Soils	A Soils (low runoff potential):		0.0%
	B Soils:		67.6%
	C Soils:		8.9%
	D Soils (high runoff potential):		23.5%
	Water:		0.0%

4.3.17.1 Neighborhoods

One neighborhood was identified and assessed within the My Lady's Manor Branch subwatershed during the uplands assessment of the Loch Raven North planning area. Recommendations for addressing stormwater volume and pollutants within this subwatershed include buffer improvement and public education (i.e., bayscaping and rain gardens). A summary of neighborhood recommended actions is presented in Table 4-83.

Table 4-83: NSA Recommendations – My Lady's Manor Branch

NSA_ID	Lot Size (acres)	Rain Gardens	Bayscape	Buffer Improvement	Notes
NSA_X_1701	1-3	X	X	X	Unclear about how downspouts connect to storm drain/discharge, stream is behind the yard and encroaching

The neighborhood in the My Lady's Manor Branch subwatershed was recommended for public education related to bayscaping and buffer improvement, which can be achieved through public education about the benefits of providing a stream buffer by reducing the amount of mowed lawn through tree and vegetation planting. Due to the large lot size (1-3 acres), the neighborhood was also recommended for rain garden implementation.

4.3.17.2 Hotspots

No HSIs were assessed in the My Lady's Manor Branch subwatershed.

4.3.17.3 Institutions

No ISIs were assessed in the My Lady's Manor Branch subwatershed.

4.3.17.4 Pervious Areas

No pervious areas were assessed in the My Lady's Manor Branch subwatershed.

4.3.17.5 Illicit Discharges

No major outfalls are located within the My Lady's Manor Branch subwatershed.

4.3.17.6 Stream Corridors

A stream corridor assessment was not completed for this subwatershed.

4.3.17.7 Historic Mill Dams

No historic mill dams were assessed in the My Lady's Manor Branch subwatershed.

4.3.17.8 Subwatershed Management Strategy

<u>Engaging Citizens & Watershed Groups</u>

1. Educate citizens about the benefits and importance of bayscaping and rain garden implementation as indicated in Table 4-83.

2. Educate residents of NSA_X_1701 about the importance of stream buffers and encourage more environmentally friendly stream treatments.

Municipal Actions

1. No actions recommended.

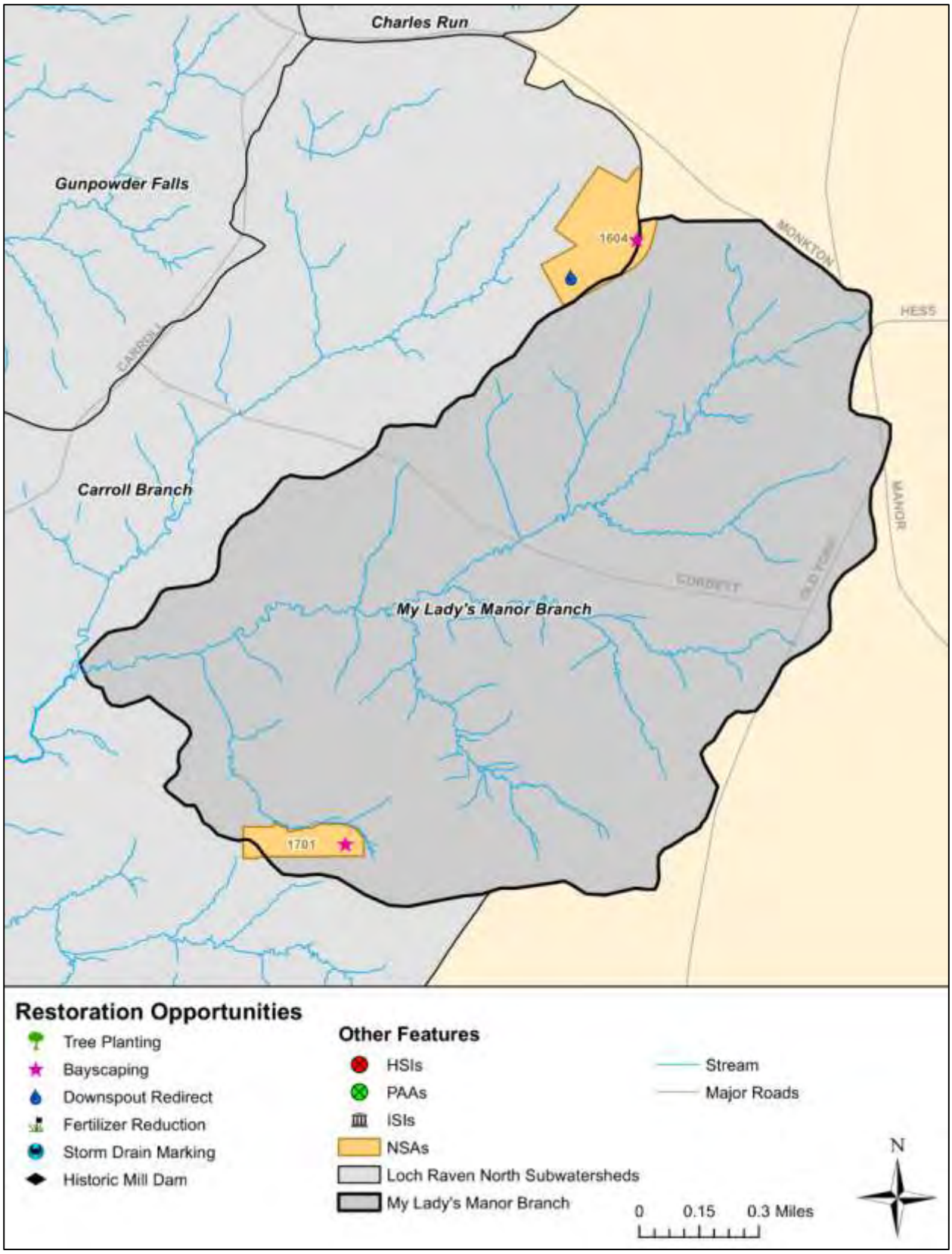

Figure 4-52: Restoration Opportunities in the My Lady's Manor Branch Subwatershed

CHAPTER 5: PLAN EVALUATION

5.1 Introduction

The Loch Raven North Small Watershed Action Plan (SWAP) is based on an implementation schedule with an anticipated endpoint of 2025. This time frame is necessary to implement restoration measures and meet the Chesapeake Bay Total Maximum Daily Loads (TMDL). The ability to implement this plan within the specified timeframe is dependent upon the availability of staff and sufficient funding. The Loch Raven North SWAP Implementation Committee (an outgrowth of the Steering Committee) will meet twice per year to assess progress in meeting watershed goals and objectives to discuss funding options. In addition, any completed projects will be recorded in the county's annual National Pollutant Discharge Elimination System (NPDES) report. An adaptive management approach will be used to meet watershed goals and objectives based on SWAP evaluation data. The Loch Raven North SWAP Implementation Committee will initiate a revision of the plan within six months if additional TMDLs are developed and approved or when a water quality issue arises.

Progress and success of the Loch Raven North SWAP will be evaluated during implementation based on the following: interim measureable milestones, pollutant load reduction criteria, implementation tracking, and monitoring. These evaluation components are described in the following sections.

5.2 Interim Measurable Milestones

Overall performance measures have been developed for each action listed in Appendix A and will be used to gage the progress and success of proposed restoration strategies. The progress and success of actions in Appendix A will be evaluated every year. Actions strategies may be modified and/or new actions may be proposed based on this annual evaluation. New actions proposed will also be evaluated on a semiannual basis and modified as necessary to meet watershed goals and objectives.

2-year milestones will also be developed for the Loch Raven Reservoir TMDL using the same schedule as other local TMDLs and the Chesapeake Bay TMDL. The first 2-year milestone period for the Loch Raven Reservoir TMDL for restoration actions will be fiscal years 2016-2017 (July 1, 2015 – July 30, 2017) and for programmatic actions will be calendar years 2016-2017.

5.3 Pollutant Load Reduction Criteria

Current pollutant load reduction scenarios and calculations for proposed actions are presented in Chapter 3. The removal efficiencies used to estimate pollutant reductions are based on the peer-reviewed and Chesapeake Bay Program (CBP)-approved nonpoint source Best Management Practice (BMP) tables developed for the Phase 5.0 CBP Watershed Model. Additional pollutant reductions from the 2011 Maryland Department of the Environment (MDE) *Draft Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated,* the 2014 MDE *Accounting for Stormwater Wasteload Allocations and Impervious Acres,* the 2013 CBP Approved final report *Recommendations of the Expert Panel to Define Removal Rates for Urban Nutrient Management*, and the 2014 *Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects* were not available in the BMP tables. These references are available in Appendix C.

5.4 Implementation Tracking

Implementation of restoration actions for the Loch Raven North SWAP will be overseen by the Implementation Committee. The committee will assess progress with individual actions related to the amount complete and the ease of implementation. Overall progress with meeting pollutant reductions will also be assessed. Adaptive management will allow the committee to discuss changes to the action schedule depending on the success of individual actions and the overall progress with the plan. If additional water quality issues arise, the Loch Raven North SWAP Implementation Committee will initiate revisions of the plan.

5.5 Monitoring

Baltimore County currently conducts water quality monitoring programs within the Loch Raven North watershed. Additional monitoring is anticipated to assess the effectiveness of restoration projects and progress in meeting TMDL reductions.

5.5.1 Existing Monitoring

Baltimore County conducts chemical, biological, bacterial, and illicit connection monitoring within the Loch Raven North watershed. These are described in detail in Chapter 3.4 of the *Watershed Characterization Report* (Appendix E) and listed below:

- Chemical Baseflow and Trend Monitoring – 40 monitoring sites throughout the county, 12 of which are located within the Loch Raven North watershed, provide information on ambient chemical conditions and assess trends in chemical concentrations and loads (EPS, 2014).

- Biological Monitoring – Conducted since 2003 following the Maryland Biological Stream Survey (MBSS) probabilistic monitoring methods to assess ecological health in local streams, assess the effectiveness of stream restoration projects, and provide data on the best streams in the county to serve as bench marks for other stream assessments (EPS, 2014).

- Bacterial Monitoring – Of the seven bacterial monitoring sites in the Loch Raven Reservoir, four are located within Loch Raven North as part of the Bacteria Trend Monitoring Program in response to the development of bacteria TMDLs.

- Illicit Discharge Detection and Elimination Program – Routine outfalls screening and prioritization system to track and reduce illicit connections and discharges.

5.5.2 SWAP Implementation Monitoring

SWAP implementation monitoring activities will focus on project specific monitoring and targeted subwatershed monitoring. Project specific monitoring will be indentified as restoration progresses. It will not be possible to monitor all restoration projects due to the number of actions proposed. Project specific monitoring will target activities with limited data regarding removal efficiencies such as bayscaping education. Subwatershed monitoring will measure overall improvement in water quality as a result of multiple restoration activities within a subwatershed. This will also be developed as restoration progresses. There is potential to coordinate a citizen-based stream watch program since the watershed is

vast and over 650 miles of stream are present. Monitoring activities will be coordinated among SWAP participants through participation in the Loch Raven North SWAP Implementation Committee.

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APPENDIX A:

Loch Raven North Action Strategies

APPENDIX B:

Cost Analysis and Potential Funding Sources

Cost Analysis and Potential Funding Sources

This appendix presents cost estimates and potential funding sources for the implementation of proposed restoration BMPs in the Loch Raven North SWAP. Each is described below.

Cost Analysis

The cost analysis is based on the actions detailed in Appendix A. Cost estimates are summarized in Tables B-1 and B-2. Table B-1 presents cost estimates based on the maximum implementation scenario described in Chapter 3. Table B-2 presents cost estimates based on the projected participation rates (refer to Chapter 3) in nutrient and sediment loads from urban stormwater runoff. For each scenario, estimates are provided in 2014 dollars and represent total cost estimates for the anticipated implementation timeframe. Unit costs are based on a combination of local information and previous SWAPs completed for other local watersheds. BMP costs are not annualized over the implementation timeframe and do not include costs of existing staff. Costs are also presented in dollars per pound of nitrogen, phosphorus, and sediment removal for those BMPs where pollutant removal calculations were possible (refer to Chapter 3). This provides an additional tool for the assessment and selection of BMPs. The total cost of implementation exclusive of staffing costs is approximately $59,908,962 for maximum implementation and $2,925,727 based on projected participation rates for 2025.

Table B-1: Maximum Estimated Costs for Loch Raven North SWAP Implementation

Action	Unit Cost		Max Quantity		Max Total Cost	Max TN Load Reduction (lbs / yr)	Max TP Load Reduction (lbs / yr)	Max TSS Load Reduction (lbs / yr)	Max Cost / lb of TN Removal per year	Max Cost / lb of TP Removal	Max Cost / lb of TSS Removal
SW Retrofits	$ 75,000	/ retrofit	11	retrofits	$ 825,000	71	7	11,777	$ 11,632	$ 111,445	$ 70
Impervious Cover Removal	$ 25,000	/ acre	0.25	acre	$ 6,221	1.4	0.3	344	$ 4,303	$ 20,661	$ 18
Downspout Disconnection Program	$ 300	/ house	126	houses	$ 37,930	130	14	21,516	$ 293	$ 2,805	$ 2
Reforest Stream Buffer	$ 10,000	/ acre	1,467	acres	$ 14,672,969	17,554	782	597,510	$ 836	$ 18,754	$ 25
NSA Tree Plantings (Open Space)	$ 350	/ tree	1,309	trees	$ 458,150	115	3	2,046	$ 3,986	$ 134,615	$ 224
NSA Tree Plantings (Lot Canopy)	$ 350	/ tree	104,750	trees	$ 36,662,452	9,197	272	163,703	$ 3,986	$ 134,615	$ 224
Institutional Tree Planting	$ 350	/ tree	3,724	trees	$ 1,303,400	327	10	5,820	$ 3,986	$ 134,615	$ 224
PAA Tree Planting	$ 10,000	/ acre	73	acres	$ 728,292	639	19	11,382	$ 1,139	$ 38,462	$ 64
Stream Restoration Projects (SCA)	$ 350	/ ln ft	2,171	ln ft	$ 759,829	163	148	97,475	$ 4,667	$ 5,147	$ 8
Stream Restoration Projects (WQMP)	$ 350	/ ln ft	12,400	ln ft	$ 4,340,000	930	843	556,760	$ 4,667	$ 5,147	$ 8
Outreach Efforts	$ 500	/ effort	143	efforts	$ 71,500	N/A	N/A	N/A	NA	NA	NA
Post Signs	$ 40	/ sign	8	signs	$ 320	N/A	N/A	N/A	NA	NA	NA
Pollution Prevention Workshops	$ 500	/ workshop	3	workshops	$ 1,500	N/A	N/A	N/A	NA	NA	NA
Neighborhood BMP Meetings	$ 500	/ meeting	20	meetings	$ 10,000	N/A	N/A	N/A	NA	NA	NA
ISI Recommendation Meetings	$ 500	/ meeting	6	meetings	$ 3,000	N/A	N/A	N/A	NA	NA	NA
Storm Drain Markers	$ 400	/ site	46	sites	$ 18,400	N/A	N/A	N/A	NA	NA	NA
Waterway Cleanups	$ 1,000	/ cleanup	10	cleanups	$ 10,000	N/A	N/A	N/A	NA	NA	NA
				Total:	***$ 59,908,962***	***29,127***	***2,099***	***1,468,333***			

Note: 'NA" denotes not assessed in the pollutant removal analysis.

Table B-2: 2025 Projected Estimated Costs for Loch Raven North SWAP Implementation

Action	Unit Cost		Proj. 2025 Quantity		Proj. 2025 Total Cost	Proj. 2025 TN Load Reduction (lbs / yr)	Proj. 2025 TP Load Reduction (lbs / yr)	Proj. 2025 TSS Load Reduction (lbs / yr)	Proj. 2025 Cost / lb of TN Removal per year	Proj. 2025 Cost / lb of TP Removal per year	Proj. 2025 Cost / lb of TSS Removal per year
SW Retrofits	$ 75,000	/ retrofit	6	retrofits	$ 450,000	35	4	5,889	$ 12,690	$ 121,576	$ 76
Impervious Cover Removal	$ 25,000	/ acre	0.1	acre	$ 3,000	1	0	172	$ 4,150	$ 19,928	$ 17
Downspout Disconnection Program	$ 300	/ house	11	houses	$ 3,414	12	1	1,936	$ 293	$ 2,805	$ 2
Reforest Stream Buffer	$ 10,000	/ acre	7	acres	$ 73,365	88	4	2,988	$ 836	$ 18,754	$ 25
NSA Tree Plantings (Open Space)	$ 350	/ tree	236	trees	$ 82,467	21	1	368	$ 3,986	$ 134,615	$ 224
NSA Tree Plantings (Lot Canopy)	$ 350	/ tree	1,885	trees	$ 659,924	166	5	2,947	$ 3,986	$ 134,615	$ 224
Institutional Tree Planting	$ 350	/ tree	931	trees	$ 325,850	82	2	1,455	$ 3,986	$ 134,615	$ 224
PAA Tree Planting	$ 10,000	/ acre	18	acres	$ 182,073	160	5	2,845	$ 1,139	$ 38,462	$ 64
Stream Restoration Projects (SCA)	$ 350	/ ln ft	1,085	ln ft	$ 379,914	81	74	48,738	$ 4,667	$ 5,147	$ 8
Stream Restoration Projects (WQMP)	$ 350	/ ln ft	1,860	ln ft	$ 651,000	140	126	83,514	$ 4,667	$ 5,147	$ 8
Outreach Efforts	$ 500	/ effort	143	efforts	$ 71,500	N/A	N/A	N/A	N/A	N/A	N/A
Post Signs	$ 40	/ sign	8	signs	$ 320	N/A	N/A	N/A	N/A	N/A	N/A
Pollution Prevention Workshops	$ 500	/ workshop	3	workshops	$ 1,500	N/A	N/A	N/A	NA	NA	NA
Neighborhood BMP Meetings	$ 500	/ meeting	20	meetings	$ 10,000	N/A	N/A	N/A	NA	NA	NA
ISI Recommendation Meetings	$ 500	/ meeting	6	meetings	$ 3,000	N/A	N/A	N/A	NA	NA	NA
Storm Drain Markers	$ 400	/ site	46	sites	$ 18,400	N/A	N/A	N/A	NA	NA	NA
Waterway Cleanups	$ 1,000	/ cleanup	10	cleanups	$ 10,000	N/A	N/A	N/A	NA	NA	NA
				Total:	***$ 2,925,727***	***784***	***222***	***150,851***			

Note: 'NA" denotes not assessed in the pollutant removal analysis.

Potential Funding Sources

Funding sources for the implementation of the Loch Raven North SWAP includes local government funding for Baltimore County, monetary and time contributions to the Gunpowder Valley Conservancy, and various grants as described below.

Baltimore County uses general funds to support staff, whose responsibility is to monitor and improve water quality through implementation of various programs including capital restoration projects. Baltimore County has a Waterway Improvement Capital Program that is funded by a combination of general funds and bonds. Approximately $6.7 million per year is allocated for various restoration projects throughout the County. Baltimore County provides grants to local watershed organizations through its Watershed Association Citizen Restoration Planning and Implementation Grant Program. These funds provide staffing for restoration project implementation and education and outreach programs.

In order to implement all of the actions listed in Appendix A and to meet the anticipated funding needs summarized in Table B-2, additional funding from grants will be required. Table B-3 presents potential funding sources to support the implementation of the Loch Raven North SWAP including funding source, applicant eligibility, eligible projects, funding amount, cost share requirements, and grant cycle. The anticipated major grant funding sources include the following:

The Chesapeake and Atlantic Coastal Bays Trust Fund: The Trust Fund was established to provide financial assistance to local governments and political subdivisions for the implementation of nonpoint source pollution control projects. These are intended to achieve the state's tributary strategy developed in accordance with the Chesapeake 2000 Agreement and to improve the health of the Atlantic Coastal Bays and their tributaries. The BayStat Program directs the administration of the Trust Fund, with multiple state agencies receiving moneys, including Maryland Department of Environment (MDE), Department of Natural Resources (DNR), Maryland Department of Agriculture (MDA), and Maryland Department of Planning (MDP).

http://www.dnr.maryland.gov/ccs/funding/trust_fund.asp

- ***319 Non-point Pollution Grants:*** Federal money for restoration implementation is available annually through MDE.

  http://www.mde.state.md.us/programs/Water/319NonPointSource/Pages/Programs/WaterPrograms/319nps/factsheet.aspx

- ***Bay Restoration Fund (MDE):*** This is a dedicated fund, financed by wastewater treatment plant users, to upgrade Maryland's wastewater treatment plants with enhanced nutrient removal technology. In addition, a similar fee paid by septic system users is utilized to upgrade onsite systems and to pay for cover crops to reduce nitrogen loading to the Bay. Proposed modifications to the fund will allow the fund to be used for implementation of stormwater restoration projects.

  http://www.mde.state.md.us/programs/Water/BayRestorationFund/Pages/index.aspx

- ***Stormwater Pollution Control Cost Share Program (MDE):*** The Maryland Stormwater Pollution Control Cost-Share Program provides grant funding for stormwater management retrofit and conversion projects in urban areas developed prior to 1984. These projects reduce nutrients, sediments and other pollutant loads entering the state's waterways through the use of infiltration basins, infiltration trenches, vegetated swales, extended detention ponds, bioretention basins, wetlands and other innovative structures.

http://mde.maryland.gov/programs/ResearchCenter/ReportsandPublications/Pages/ResearchCenter/publications/general/emde/vol3no3/capital.aspx

Linked Deposit (MDE): The Linked Deposit mechanism is designed to provide a source of low interest financing to encourage private landowners, and water system owners to implement capital improvements that will reduce the delivery of nutrients to the Chesapeake Bay and its tributaries, and provide safe drinking water.

http://www.mde.state.md.us/programs/Water/QualityFinancing/LinkedDeposit/Pages/Programs/WaterPrograms/Water_Quality_Finance/link_deposit/index.aspx

- ***Innovative Nutrient and Sediment Reduction Program (National Fish and Wildlife Foundation):*** The National Fish and Wildlife Foundation (NFWF), in partnership with U.S. Environmental Protection Agency (USEPA) and the Chesapeake Bay Program, will award grants on a competitive basis to support the demonstration of innovative approaches to expand the collective knowledge about the most cost effective and sustainable approaches to dramatically reduce or eliminate nutrient and sediment pollution to the Chesapeake Bay and its tributaries.

- ***Chesapeake Bay Stewardship Fund:*** The goal of the Chesapeake Bay Stewardship Fund is to accelerate local implementation of the most innovative, sustainable and cost effective strategies to restore and protect water quality and vital habitats within the Chesapeake Bay watershed. The Stewardship Fund offers four grant programs: the Chesapeake Bay Small Watershed Grant Program; the Chesapeake Bay Targeted Watersheds Grant Program; the Chesapeake Bay Conservation Innovation Grant Program; and the Innovative Nutrient and Sediment Reduction Program. Major funding for the Chesapeake Bay Stewardship Fund comes from the USEPA, the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), the U.S. Department of Agriculture Forest Service (USFS), and the National Oceanic and Atmospheric Administration (NOAA).

  http://www.nfwf.org/chesapeake/Pages/home.aspx

- ***MD State Highway Administration (SHA) Transportation Alternatives Program (TAP)*:** This is a reimbursable, federal-aid funding program for transportation-related community projects designed to strengthen the intermodal transportation system. The TAP supports communities in developing projects that improve the quality of life for their citizens and enhance the travel experience for people traveling by all modes. Among the qualifying TAP categories is environmental mitigation to address water pollution due to highway runoff or to reduce vehicle-caused wildlife mortality while maintaining habitat connectivity.

  http://www.sha.maryland.gov/Index.aspx?PageId=144

- ***Chesapeake Bay Trust:*** Provides grants through a variety of grant programs that focus on environmental education, urban greening, fisheries, and remediation of water quality issues. Specifically the Targeted Watershed Grant Program provides funding for on-the ground solutions that address the most pressing nonpoint source pollution challenges facing a small watershed, and that result in measurable improvements in water quality and wildlife habitat. The program also seeks to support cost effective approaches to Chesapeake Bay restoration actions at the small watershed scale and establish a replicable model of restoration that can be transferred and used throughout the region.

  http://www.cbtrust.org/site/c.miJPKXPCJnH/b.5457271/k.C58E/Grants.htm

- ***Natural Resources Conservation Service:*** The US Department of Agriculture Natural Resources Conservation Service (NRCS) provides financial assistance to landowners to protect and conserve natural resources. The programs are voluntary to eligible landowners and agricultural producers. NRCS delivers conservation technical assistance through its voluntary Conservation Technical Assistance Program (CTA). CTA is available to any group or individual interested in conserving our natural resources and sustaining agricultural production in this country.

  http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/

Table B-3: Loch Raven North SWAP Potential Funding Sources

Managing Agency	Funding Source	Application Eligibility	Eligible Projects	Funding Amount	Cost Share/ In - Kind	Project Period
American Forests	Global ReLeaf Program (American Forests)	All Public Lands or Public-Accessible Lands Local Government State Government	Public Lands Restoration Projects for areas with 20 acres or more of plantable land	Varies	Covers tree planting costs In-Kind: Yes	None specified
Chesapeake Bay Trust	Targeted Watershed Initiative Grant Program	Non-profits 501(c) Institutions Soil/Water Conservation Districts Local Government	Involve local organizations; Address non-point source pollution; Projects related to water quality and habitat restoration	$600,000	25% In-Kind: Yes	3 years
Chesapeake Bay Trust	Capacity Building Initiative Grant Program	Non-profits 501(c) with a board on which half the members participate meaningfully and at least one paid staff (or a part-time paid staff and volunteer)	Strengthen an organization through management operations, technology, governance, fundraising, and communications	$15,000 per year	0% In-Kind: No	3 years
Chesapeake Bay Trust	Stewardship Grant Program	Non-profits 501(c) Schools/Universities Soil/Water Conservation Districts Local Government State Government	Improve local waters that contribute to the overall health of the Chesapeake Bay, while building citizen-based resource stewardship; Restore and protect vital habitats; Improve conservation on private lands; Improve urban stormwater management	$20,000 to $200,000	25% In-Kind: ?	1 Year
Maryland Department of Natural Resources	Clean Water Action Plan Nonpoint Source Program 319 Grant	Non-profits 501(c) Universities Soil/Water Conservation Districts Local Government State Government	Located in a Category I and Category III watershed as outlined in the MD unified watershed assessment; Establish cover crops; Address Stream restoration and riparian buffers	$5,000 to $40,000	40%	Annual
Maryland Department of the Environment	Bay Restoration Fund	Local Governments	Fees from wastewater treatment plant users and septic systems users pay fee to fund upgrades to systems and implement cover crops to reduce nitrogen loading to the bay	None specified	50% In-Kind: YES	None specified

Managing Agency	Funding Source	Application Eligibility	Eligible Projects	Funding Amount	Cost Share/ In - Kind	Project Period
National Fish and Wildlife Foundation	Chesapeake Bay Small Watersheds Grant Program	Non-profits 501(c) Local Government	Community-based projects that improve the condition of local watersheds while building stewardship among citizens; watershed restoration, conservation, and planning	$20,000 to $200,000	25%	1-5 years
National Fish and Wildlife Foundation	Chesapeake Bay Targeted Watersheds Grant Program	Non-profits 501(c) Universities Local Government State Government	Innovative demonstration type restoration projects	$400,000 to $1,000,000	25% In-Kind: YES	2-3 years
Natural Resources Conservation Service	Watershed Operations Program	Local Government State Government Tribes	Address watershed protection, flood mitigation, water quality, soil erosion, sediment control, habitat enhancement, and wetland creation and restoration	None specified	Varies	None specified
United States Environmental Protection Agency	Targeted Watersheds Grant Program - Capacity Building Grant Program	Non-profits 501(c) Institutions Local Government State Government	Promote organizational development of local watershed partnerships; Provide training and assistance to local watershed groups	$400,000 to $800,000	25% In-Kind: YES	2 years
United States Environmental Protection Agency	Targeted Watersheds Grant Program - Implementation Grant Program	Non-profits 501(c) Universities Local Government State Government	Watershed Restoration and/or Protection Projects (must include a monitoring component)	$600,000 to $900,000	25% In-Kind: YES	3-5 years

Loch Raven North Action Strategies

This appendix presents the actions related to the goals and objectives presented in Chapter 2 of the Loch Raven North SWAP. A complete list of actions proposed for the watershed including timelines, performance measures, unit cost estimates, responsible parties, and goals and objectives are included in Table A-1. Some of the key columns included in Table A-1 are briefly described below.

Action

Actions developed to achieve watershed goals and objectives are grouped in Table A-1 according to the type of activity. Actions are grouped according to the following categories (and subcategories for restoration actions):

- Restoration Actions
  - Nutrient Reduction
  - Stormwater Management
  - Tree Canopy
  - Trash Management
  - Stream Corridor Restoration
  - Land Preservation
  - Bacteria Reduction
  - Chloride/Sodium Reduction
  - Deer Management
  - Sustainable Agricultural Practices
- Outreach & Awareness
- Monitoring
- Funding
- Reporting

Basis for Performance Measure

This column describes how performance measures were developed for each action. Performance measures were developed using the information in this column in conjunction with the action timeline.

Performance Measure

This column describes how the success/completion of a given action will be measured. In many cases, it is the numeric basis of the performance measure.

Total Number Unit to Reach 2025 Goal

The total number of units represents the actions needed to meet local TMDL reduction goals.

Unit Cost

Unit costs are used to develop overall cost estimates for proposed watershed action strategies (see Appendix B).

Responsible Party

Those responsible for ensuring the success/completion of a given action are denoted by a numeric code in this column. Responsible parties are indicated as follows:

- DNR - Maryland Department of Natural Resources
- DP – Baltimore County Department of Planning
- DPW – Baltimore County Department of Public Works
- EPS - Baltimore County Department of Environmental Protection and Sustainability
- GVC - Gunpowder Valley Conservancy (GVC)
- MDA - Maryland Department of Agriculture
- SCD - Baltimore County Soil Conservation District
- SHA - Maryland State Highway Administration
- SWAP Implementation Committee
- Trout Unlimited

Table A-1: Loch Raven North Action Strategies – Action Detail Matrix

	Action	Basis for Performance Measure	Performance Measure	Total Number Units to reach 2025 Goal	Unit Cost	Respons. Party*	Goal 1					Goal 2				Goal 3				Goal 4		Goal 5		Goal 6
							1	2	3	4	5	1	2	3	4	1	2	3	4	1	2	1	2	1
RESTORATION ACTIONS																								
	Nutrient Reduction																							
1	Introduce bayscapes on large lawns in the 64 neighborhoods identified	Continue outreach efforts to educate residents on bayscaping including e-mail blasts, web-based flyers, mailbox flyers, and outreach events, as appropriate	# of outreach efforts performed	2 efforts	$500 / effort	EPS, GVC					x					x	x		x					
2	Work with community groups to educate about proper fertilizer use in the 5 neighborhoods identified.	Continue outreach efforts to educate residents on bayscaping including e-mail blasts, web-based flyers, mailbox flyers, and outreach events, as appropriate	# of outreach efforts performed	1 effort	$500 / effort	EPS, SWAP, GVC					x					x			x					
3	Continue municipal road maintenance street sweeping activities. Investigate the 3 neighborhoods recommended for street sweeping to implement activities and/or adjust frequency as needed	Investigate the 2.5 miles of road within neighborhoods identified for street sweeping	Investigation completed	3 investigations	Existing Staff	EPS, DPW		x			x					x	x					x		
	Stormwater Management																							
4	Investigate the feasibility of implementing stormwater retrofits and conversions to treat runoff from impervious surfaces (streets) in the 3 neighborhoods identified	3 potential neighborhood sites identified	3 neighborhoods investigated	3 investigations	Existing Staff	EPS		x			x					x	x		x			x		
5	Investigate the feasibility of implementing stormwater retrofits for treating parking lots at the 3 hotspot sites identified (3 public, 0 private)	3 potential hotspot sites identified	3 stormwater hotspots investigated	3 investigations	Existing Staff	EPS		x			x					x	x		x			x		
6	Investigate the feasibility of implementing stormwater retrofits for parking lots and/or roads at the 5 institutional sites identified (3 public, 2 private)	5 potential institution sites identified	5 institutions investigated	5 investigations	Existing Staff	EPS		x			x					x	x		x			x		
7	Design and implement stormwater retrofits at feasible sites identified in Actions 4, 5, and 6	3 neighborhoods + 3 stormwater hotspots + 5 institutions = 11 sites identified x 50% participation rate = 6 stormwater retrofits	50% participation x 11 retrofit sites	6 sites	$75,000 / retrofit	EPS		x			x					x	x		x			x		
8	Investigate in coordination with institutional partners the feasibility of reducing impervious cover at the 3 institutional sites identified (3 public, 0 private)	Maximum potential of 0.25 acres of impervious cover removal identified x 50% participation rate; Work with institutions to remove impervious cover and meet 0.12 acres reduction goal	50% participation x 0.25 acres	0.12 acres	$25,000 / acre	EPS, GVC, SWAP		x			x					x	x		x			x		
9	Develop and implement a downspout disconnection program. Use rain barrels, rain gardens, and/or redirection for downspout disconnection in the 23 recommended neighborhoods	14.93 acres of impervious rooftop identified x 9% participation rate = 1.34 acres	9% participation x 14.93 acres	1.34 acres	$300 / house	EPS, GVC, SWAP		x			x					x	x		x					
	Tree Canopy																							
10	Investigate the feasibility of planting riparian stream buffers on open pervious land (not including agricultural land)	1467 acres of open pervious land identified within the 100-foot stream buffer through GIS analysis	Feasible buffer planting sites identified	1467 acres	Existing Staff	EPS, GVC	x				x	x				x	x	x	x			x		
11	Reforest stream buffers at feasible sites with a minimum width of 35 feet	1467 acres of open pervious stream buffer identified in the GIS analysis x 0.5% participation rate = 7 acres	0.5% participation x 1467 acres	7 acres	$10,000 / acre	EPS, GVC, SWAP	x				x	x				x	x	x	x			x		
12	Encourage shade tree planting in the 10 recommended neighborhoods*	Maximum potential of 1309 trees x (1 acre/100 trees) = 13.09 acres x 18% participation rate = 2.36 acres	18% participation x 13.09 acres	236 trees	$350 / tree	EPS, GVC, SWAP					x	x				x	x		x			x		
13	Encourage homeowners to increase lot canopy on private land in the 36 recommended neighborhoods*	Maximum potential of acres for planting (assuming goal of 40% lot canopy) = 1047 acres x 1.8% participation rate = 189 acres (or 18855 trees)	1.8% participation x 1047 acres	1,885 trees	$350 / tree	EPS, GVC, SWAP					x	x				x	x		x			x		
14	Encourage institutions to plant trees on available open space at the 14 sites identified*	Maximum potential of 3724 trees x (1 acre/100 trees) = 37.24 acres x 25% participation rate = 9.31 acres (or 931 trees)	25% participation x 3724 trees	931 trees	$350 / tree	EPS, GVC, SWAP					x	x				x	x		x			x		
15	Plant trees on the recommended PAA sites on open space*	73 acres of open pervious land identified through GIS analysis	25% participation x 73 acres	18 acres	$10,000 / acre	EPS, GVC					x	x				x	x		x			x		
16	Continue requiring riparian buffers and forest conservation for all new and re-development	On-going, keep track of existing riparian buffer and forest preserved	Acres preserved	On-going	Existing Staff	EPS	x				x	x				x	x	x	x			x		

	Action	Basis for Performance Measure	Performance Measure	Total Number Units to reach 2025 Goal	Unit Cost	Respons. Party*	Goal 1					Goal 2				Goal 3				Goal 4		Goal 5		Goal 6
							1	2	3	4	5	1	2	3	4	1	2	3	4	1	2	1	2	1
17	Investigate opportunities to remove invasive species on public land including forming a volunteer group dedicated to controlling invasive species	Outreach to non-profit organizations operating in the planning area and other public entities to form volunteer groups to remove invasive species on public land	# of outreach efforts performed	20 efforts	$500 / effort	EPS, GVC						x		x										
18	Promote awareness of forest sustainability programs and tree planting opportunities available to landowners	Publicize forest sustainability programs and funding sources available for tree planting and reforestation on private property including via e-mail blasts, web-based flyers, and outreach events, as appropriate	# of outreach efforts performed	20 efforts	$500 / effort	EPS, GVC, SWAP	x				x	x				x	x		x			x		
	*Acreage does not include potential area within riparian stream buffer that is already counted for in Actions 10 and 11																							
	Trash Management																							
19	Post no dumping signs in problem areas identified and enforce no dumping	Signs posted at 3 HSI and 5 SCA sites identified with dumping, if appropriate	Problem areas identified and addressed	8 signs	$40 / sign	EPS					x													
20	Identify areas where additional trash cans, covered receptacles, and/or better maintenance measures are needed	Assess park & rides, community parks, state parks, and nature trails in the watershed	Problem areas identified and addressed	Identification	Existing Staff	EPS					x													
21	Educate for better trash management at the 7 institutional sites identified (6 public, 1 private) and 21 stormwater hotspots identified.	7 potential institution sites and 21 hotspots identified	Perform 5-6 site visits per year	28 sites	Existing Staff	EPS					x													
22	Encourage and support waterway cleanups in streams.	Conduct annual stream cleanups.	1 cleanup per year	10 cleanups	$1,000 / cleanup	EPS, GVC, SWAP					x													
	Stream Corridor Restoration																							
23	Evaluate the restoration potential and feasibility of restoring mill dam sites identified in the mill dam assessments	Identify water quality improvement opportunities	14 Feasible restoration sites identified	Identification	Existing Staff	EPS				x	x					x	x							
24	Complete stream restoration projects at feasible sites based on 0.41 miles of Very Severe and Severe erosion and channel alteration sites identified during the SCAs and 2.35 miles of impaired reaches identified in the 1997 Water Quality Management Plan	Stabilize and restore 0.41 miles (2171 L.F.) of unstable streams in Mingo Branch, Fourth Mine Branch, Panther Branch, and Piney Creek subwatersheds to provide water quality improvement x 50% participation = 1085 L.F. Stabilize and restore 2.35 miles (12400 L.F.) of unstable streams in Beetree Run and Carrolls Branch subwatersheds to provide water quality improvement x 15% participation = 1860 L.F.	(50% participation x 2171 L.F.) + (15% participation x 12400 L.F.) = 2945 L.F	2,945 LF	$350 / linear foot	EPS				x	x					x	x							
25	Conduct a follow up inspection of the outfalls identified as Very Severe - Severe in the stream corridor assessment	1 outfall identified as Severe	1 outfall assessed	1 outfall	Existing Staff	EPS				x	x					x	x							
	Land Preservation																							
26	Work with landowners to place perpetual land preservation easements on forested and agricultural lands, seeking to preserve 80% of the Agricultural Preservation Priority Areas (County Master Plan) in accordance with State goals	Identify and assist privately-owned properties within the watershed to enroll in private and public programs available for preservation of their lands	Actively work with interested landowners to protect private properties based on financial resources and landowner participation	Ongoing	Existing Staff	DP, SCD, GVC	x								x									x
27	Work with state and county programs and local land trusts (BCLTA) to acquire undeveloped parcels for permanent conservation and preservation to obtain the County's land preservation goals	Identify forested parcels within the 100-foot stream buffers and that contain forest interior and facilitate preservation and conservation through agencies	10% of available land parcels conserved	Ongoing	Existing Staff	DP, GVC	x								x									x
28	Work with DNR to protect rare, threatened, and endangered species and their habitats	Work with DNR Natural Heritage Program to identify land near known rare, threatened, and endangered (R,T&E) species for permanent preservation	Acres preserved near known R,T&E habitats	Ongoing	Existing Staff	DP, DNR	x				x				x									x
	Bacteria Reductions																							
29	Identify non-points sources of *E. Coli* through reach scale monitoring and sanitary surveys and investigate remedial actions	Based on subwatershed monitoring results, identify sources of bacteria and investigate reduction actions	Investigation completed and sources identified	Ongoing	Existing Staff	EPS																x		
	Chloride/Sodium Reductions																							
30	Continue monitoring chloride and sodium levels through the trend monitoring program	Continue monthly monitoring of existing monitoring sites located in the watershed	Ongoing	Ongoing	Existing Staff	EPS					x							x						

	Action	Basis for Performance Measure	Performance Measure	Total Number Units to reach 2025 Goal	Unit Cost	Respons. Party*	Goal 1					Goal 2				Goal 3				Goal 4		Goal 5		Goal 6
							1	2	3	4	5	1	2	3	4	1	2	3	4	1	2	1	2	1
31	Investigate how to reduce salt usage on roads to decrease sodium levels	Work with SHA to identify potential alternatives to salting roadways, such as improving equipment, in extreme winter weather to reduce the dependence on salt	Alternative Salting Practices Identified	Ongoing	Existing Staff	EPS, Public Works, SHA					x							x						
	Deer Management																							
32	Coordinate with DNR to expand outreach effort to inform residents of existing DNR regulated deer management programs on public and private property	Promote awareness of DNR regulated programs to hunters, animal control businesses, and producers (farmers, arborists) and distribute educational materials to the public about the current conditions and risks of an overabundance of deer	# of outreach efforts performed	20 efforts	$500 / effort	EPS, GVC, SCD							x										x		
33	Encourage increased deer management in coordination with DNR on public land	Explore opportunities to increase the use of DNR regulated programs to government land managers (federal, state, county, and local) and accessibility to land	Contact DNR regarding existing programs	Ongoing	Existing Staff	EPS, GVC							x									x		
	Sustainable Agricultural Practices																							
34	Increase awareness of Federally and State funded Ag BMP Programs	Continue to work with the Baltimore County Soil Conservation District, Natural Resources Conservation Service, and the Maryland Department of Agriculture to inform farmers of funding available for BMP installation	Practices Installed using available funding	Ongoing	Existing Staff	EPS, SCD, MDA					x					x	x				x	x		
35	Promote the economical and environmental benefits of agricultural BMPs to local farmers	Work with Baltimore County Soil Conservation District to promote BMP use to small farmers who may not quality for funding	Practices Installed	Ongoing	Existing Staff	EPS, SCD, MDA					x					x	x				x	x		
36	Support SCD and their ability to reduce pollution from agricultural lands by seeking mechanisms to increase funding for agricultural BMP implementation and SCD staffing	Increase in number of staff within SCD office	Contact local legislators regarding state budget priorities	Ongoing	Existing Staff	GVC, SWAP					x					x	x				x	x		
37	Seek mechanisms to fund BMP implementation on small equine facilities	Work with SCD in obtaining funding for the implementation of agricultural BMPs on small equine facilities	1 grant proposal per year	Ongoing	Existing Staff	EPS, GVC, SCD					x					x	x				x	x		
38	Seek to preserve high-value agricultural land within the Loch Raven North watershed	Promote land conservation for high-value agricultural land	Acres preserved	Ongoing	Existing Staff	EPS, SCD, GVC														x		x		x
39	Convene an Agricultural - TMDL workgroup	Promote coordination between the county and the agricultural community to reach TMDL goals	Establish a workgroup and meet	Within 1 year, then on-going	Existing Staff	EPS, SCD					x					x	x			x	x	x		x
	OUTREACH & AWARENESS																							
40	Distribute pollution prevention information to facilities falling within hotspot categories identified in the watershed and provide guidance/workshops. Include working with business partners to cut off stream access in areas with dumping issues and encourage them to keep parking lots free of trash and debris.	23 confirmed or potential hotspot sites assessed; Categories identified: transport-related, commercial, industrial, and municipal; Conduct 3 workshops and distribute outreach material	1 workshop every 3 years	3 workshops	$500 / workshop	EPS, GVC, SWAP					x													
41	Form partnerships with community groups and discuss the BMP recommendations from the neighborhood assessments and implementation options	67 neighborhoods assessed - target at least 3 neighborhoods per informational meeting	2 neighborhood meetings per year	20 meetings	$500 / meeting	EPS, GVC, SWAP		x			x					x	x		x			x		
42	Form partnerships with institutions and discuss the BMP recommendations from the institutional assessments and implementation options. Include implementing/enhancing recycling programs on their properties.	6 institutions recommended	1 institution meetings per year	6 meetings	$500 / meeting	EPS, GVC, SWAP		x			x					x	x		x			x		
43	Work with community groups to install storm drain markers in the 39 recommended neighborhoods	Install markers in 39 neighborhoods identified	11-12 neighborhoods per year	39 sites	$400 / event (site)	EPS, GVC, SWAP		x			x					x	x					x		
44	Work with institutional sites to install storm drain markers at the 7 recommended sites (5 public, 2 private)	Install markers at 7 institutions identified	2 institutions per year	7 sites	$400 / event (site)	EPS, GVC, SWAP		x			x					x	x					x		
45	Develop a pet waste outreach program to address proper pet waste management in neighborhoods with waste issues	Develop a pet waste outreach program to reach neighborhoods identified for pet waste management	Develop program	Ongoing	Existing Staff	EPS, GVC																x		

	Action	Basis for Performance Measure	Performance Measure	Total Number Units to reach 2025 Goal	Unit Cost	Respons. Party*	Goal 1					Goal 2				Goal 3				Goal 4		Goal 5		Goal 6
							1	2	3	4	5	1	2	3	4	1	2	3	4	1	2	1	2	1
46	Conduct a tour of a completed water quality project/BMP on public property	Conduct two tours of completed watershed restoration projects (e.g., stormwater retrofit)	1 tour per 5 years	2 tours	Existing Staff	EPS		x			x													
47	Continue educational outreach to inform the public on proper septic system maintenance for the estimated 6,554 septic systems in the planning area	Continue outreach efforts including e-mail blasts, web-based flyers, and outreach events, as appropriate	# of outreach efforts performed	20 efforts	$500 / effort	EPS					x											x		
48	Increase homeowner awareness of the proper buffer, forest, and wetland management including invasive species removal	Distribute educational materials including via e-mail blasts, web-based flyers, mailbox flyers, and outreach events, as appropriate, about proper buffer management and invasive species removal	# of outreach efforts performed	20 efforts	$500 / effort	EPS, GVC, SWAP						x		x										
49	Coordinate with DNR to increase awareness of prevention measures for the spread of didymo (an invasive algae) in the Gunpowder Falls	Continue outreach efforts including e-mail blasts, web-based flyers, and outreach events, as appropriate, to control the spread of didymo targeting fishermen and other water recreational users	# of outreach efforts performed	20 efforts	$500 / effort	EPS, GVC, Trout Unlimited			x														x	
50	Increase citizen awareness of the current road salting practices and the potential public health risk related to increased sodium in the Reservoir as outlined in the *Road Salt Recommendations to the Baltimore County Council* publication	Distribute educational materials including via e-mail blasts, web-based flyers, mailbox flyers, and outreach events, as appropriate, about current road salting practices and their implications	# of outreach efforts performed	20 efforts	$500 / effort	EPS, GVC					x							x						
MONITORING																								
51	Continue to monitor and remove illicit connections through the Illicit Connections Program	Inspect both major outfalls annually and the 66 minor outfalls according to their designated inspection schedule as per the NPDES Permit	68 outfalls assessed	Ongoing	Existing Staff	EPS					x					x	x					x		
52	Expand the Stream Watch program, a citizen-based program to increase the ability to monitor/identify sources of water quality and habitat degradation	Implement a program based on number of stream miles with Very Severe or Severe erosion	3 miles of stream adopted	3 miles adopted	Existing Staff	EPS, GVC, SWAP					x					x	x						x	
53	Continue stormwater facility maintenance and inspection program	Assure continued function of Stormwater Facilities as required as part of the NPDES MS4 permit	Continue routine inspections	Ongoing	Existing Staff	EPS		x			x					x	x		x			x		
54	Continue biological monitoring program	Biological monitoring stations in Area X are assessed in even-numbered and a report generated	Stations monitored and report generated	Ongoing	Existing Staff	EPS					x													
55	Conduct subwatershed prioritization monitoring	Perform bacteria monitoring to identify which subwatersheds exceed water quality standards	Stations monitored and reported in the MS4 report	Ongoing	Existing Staff	EPS																x		
56	Perform synoptic survey within the watershed	Complete synoptic survey with the watershed	completed synoptic survey	1 survey	Existing Staff	EPS					x													
FUNDING																								
57	Coordinate grant funding requests to secure funding and implement restoration projects to meet TMDL nutrient reductions requirements	Seek a minimum of 1 grant per year to meet nutrient reduction goals within 10 years	1 grant proposal per year	10 proposals	Existing Staff	EPS, GVC, SWAP					x					x	x					x		
58	Support an increase in funding requests for environmental education in the watershed	Seek a minimum of 1 grant per year to improve environmental education within 13 years	1 grant proposal per year	10 proposals	Existing Staff	EPS, GVC			x		x		x	x		x	x	x			x	x	x	
59	Support an increase in funding applications for the Maryland Department of Natural Resources Land Conservation Programs including Program Open Space, Rural Legacy, Maryland Environmental Trust, and Baltimore County	Submit a minimum of 1 application per year	1 application per year	10 applications	Existing Staff	EPS, GVC, SWAP	x				x				x				x	x				x
REPORTING																								
60	Loch Raven North Implementation Committee will meet to discuss implementation progress and assess any changes needed to meet the goals	Conduct meetings in a semi-annual basis	2 meetings per year	20 meetings	Existing Staff	SWAP										x	x					x		
61	Develop a unified restoration tracking system to track progress toward meeting TMDL reduction requirements	Tracking system currently being developed for similar SWAPs (e.g., Back River, Jones Falls)	Tracking system developed	On-going	Existing Staff	EPS, SWAP										x	x					x		
62	Update the status of restoration projects and BMPs on an annual basis	Provide progress update in annual NPDES Report	NPDES annual report	Annual Reports	Existing Staff	EPS										x	x					x		

APPENDIX C:

Pollutant Load Reduction Efficiencies

Pollutant reductions for the Loch Raven North watershed were estimated using available literature approved by the Chesapeake Bay Program. The following reports and tables were referenced in the Section 3.5.2 Pollutant Removal Analysis of the Loch Raven North SWAP and relevant portions are presented in this Appendix:

- Chesapeake Bay Program Pollutant Load Reduction Efficiencies currently used in Scenario Builder (MAST)
- Chesapeake Bay Program Approved Recommendations of the Expert Panel to Define Removal Rates for Urban Nutrient Management
- Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated (Final)
- Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated (Draft)

Non-Point Source Best Management Practices and Efficiencies currently used in Scenario Builder

Values in parentheses are in progress of official approval

Agriculture BMPs		*How Credited*	*TN Reduction Efficiency*	*TP Reduction Efficiency*	*SED Reduction Efficiency*
Nutrient Management		Landuse Change	N/A	N/A	N/A
Forest Buffers (varies by region; see Appendix 2)		Efficiency, Landuse Change	19-65%	30-45%	40-60%
Wetland Restoration (varies by region; see Appendix 2)		Efficiency	7-25%	12-50%	4-15%
Land Retirement		Landuse Change	N//A	N/A	N/A
Grass Buffers (varies by region; see Appendix 2)		Efficiency, Landuse Change	13-46%	30-45%	40-60%
Non-Urban Stream Restoration		Mass reduction/length	0.02 lb/ft	0.003 lb/ft	2 lb/ft
Tree Planting		Landuse Change	N/A	N/A	N/A
Carbon Sequestration/Alternative Crops		Landuse Change	N/A	N/A	N/A
Conservation Tillage		Landuse Change	N/A	N/A	N/A
Continuous No-Till (varies by region; see Appendix 2)		Efficiency	(10-15%)	(20-40%)	(70%)
Enhanced Nutrient Management		Efficiency	(7%)	(N/A)	(N/A)
Decision Agriculture		Efficiency	(4%)	(N/A)	(N/A)
Conservation Plans	High-till	Efficiency	8%	15%	25%
	Low-till	Efficiency	3%	5%	8%
	All hay	Efficiency	3%	5%	8%
	Pasture	Efficiency	5%	10%	14%
Cover Crops (see Appendix 1)		Efficiency	Varies	Varies	Varies
Commodity Cover Crops (see Appendix 2)		Efficiency	Varies	Varies	Varies
Stream Access Control with Fencing (see Grass Buffers)		Efficiency, Landuse Change	13-46%	30-45%	40-60%
Alternative Watering Facility		Efficiency	5%	8%	10%
Prescribed Grazing & PIRG(varies by region; see Appendix 2)		Efficiency	9-11%	24%	30%
Horse Pasture Management		Efficiency	N/A	20%	40%
Animal Waste Management Livestock		Application Reduction	75%	75%	N/A
Animal Waste Management Poultry		Application Reduction	75%	75%	N/A
Barnyard Runoff Control		Efficiency	20%	20%	40%
Loafing Lot Management		Efficiency	20%	20%	40%
Mortality Composters		Efficiency	40%	10%	N/A
Water Control Structures		Efficiency	33%	N/A	N/A
Poultry Phytase		Application Reduction	N/A	N/A	N/A
Swine Phytase		Application Reduction	N/A	N/A	N/A

Dairy Precision Feeding and Forage Management	Application Reduction	N/A	N/A	N/A
Poultry Litter Transport	Application Reduction	N/A	N/A	N/A
Ammonia Emissions Reduction (alum, biofilters, lagoon covers)	Application Reduction	15-60%	N/A	N/A
Poultry Litter Injection (interim)	Efficiency	25%	0%	0%
Liquid Manure Injection (interim)	Efficiency	25%	0%	0%
Phosphorus Sorbing Materials in Ditches (interim)	Efficiency	0%	40%	0%
Crop Irrigation management (interim)	Efficiency	4%	0%	0%
Capture Reuse Nurseries (interim)	Efficiency	75%	75%	0%
Resource BMPs	***How Credited***	***TN Reduction Efficiency***	***TP Reduction Efficiency***	***SED Reduction Efficiency***
Forest Harvesting Practices	Efficiency	50%	60%	60%
Dirt & Gravel Road Erosion & Sediment Control – Driving Surface Aggregate + Raising the Roadbed	Mass reduction/length	0	0	2.96lb/ft
Dirt & Gravel Road Erosion & Sediment Control – with outlets	Mass reduction/length	0	0	3.6lb/ft
Dirt & Gravel Road Erosion & Sediment Control – outlets only	Mass reduction/length	0	0	1.76lb/ft
Urban BMPs	***How Credited***	***TN Reduction Efficiency***	***TP Reduction Efficiency***	***SED Reduction Efficiency***
Forest Conservation	Landuse Change	N/A	N/A	N/A
Urban Growth Reduction	Landuse Change	N/A	N/A	N/A
Impervious Urban Surface Reduction	Landuse Change	N/A	N/A	N/A
Forest Buffers	Efficiency, Landuse Change	25%	50%	50%
Tree Planting	Landuse Change	N/A	N/A	N/A
Abandoned Mine Reclamation	Landuse Change	N/A	N/A	N/A
Wet Ponds and Wetlands	Efficiency	20%	45%	60%
Dry Detention Ponds and Hydrodynamic Structures	Efficiency	5%	10%	10%
Dry Extended Detention Ponds	Efficiency	20%	20%	60%
Infiltration Practices w/o Sand, Veg.	Efficiency	80%	85%	95%
Infiltration Practices w/ Sand, Veg.	Efficiency	85%	85%	95%
Filtering Practices	Efficiency	40%	60%	80%
Erosion and Sediment Control	Efficiency	25%	40%	40%
Nutrient Management	Efficiency	17%	22%	N/A
Street Sweeping	Efficiency	3%	3%	9%
Urban Stream Restoration	Load reduction/length	0.02lb/ft	0.003lb/ft	2lb/ft

Septic Connections		Systems Change	N/A	N/A	N/A
Septic Denitrification		Efficiency	50%	N/A	N/A
Septic Pumping		Efficiency	5%	N/A	N/A
Bioretention	C/D soils, underdrain	Efficiency	25%	45%	55%
	A/B soils, underdrain	Efficiency	70%	75%	80%
	A/B soils, no underdrain	Efficiency	80%	85%	90%
Vegetated Open Channels	C/D soils, no underdrain	Efficiency	10%	10%	50%
	A/B soils, no underdrain	Efficiency	45%	45%	70%
Bioswale		Efficiency	70%	75%	80%
Permeable Pavement w/o Sand, Veg.	C/D soils, underdrain	Efficiency	10%	20%	55%
	A/B soils, underdrain	Efficiency	45%	50%	70%
	A/B soils, no underdrain	Efficiency	75%	80%	85%
Permeable Pavement w/ Sand, Veg.	C/D soils, underdrain	Efficiency	20%	20%	55%
	A/B soils, underdrain	Efficiency	50%	50%	70%
	A/B soils, no underdrain	Efficiency	80%	80%	85%

Appendix 2 **BMPs**	**Hydrogeomorphic Region(s)**	***TN Reduction Efficiency***	***TP Reduction Efficiency***	***SED Reduction Efficiency***
Forest Buffers	Appalachian Plateau Siliciclastic Non-Tidal; Appalachian Plateau Carbonate Non-Tidal	54%	42%	56%
	Blue Ridge Non-Tidal; Mesozoic Lowlands Non-Tidal; Valley and Ridge Carbonate Non-Tidal	34%	30%	40%
	Coastal Plain Dissected Uplands Non-Tidal	65%	42%	56%
	Coastal Plain Dissected Uplands Tidal; Coastal Plain Lowlands Tidal; Coastal Plain Uplands Tidal; Piedmont Crystalline Tidal	19%	45%	60%
	Coastal Plain Lowlands Non-Tidal	56%	39%	52%
	Piedmont Crystalline Non-Tidal	56%	42%	56%
	Coastal Plain Uplands Non-Tidal	31%	45%	60%
	Piedmont Carbonate Non-Tidal	46%	36%	48%
	Valley and Ridge Siliciclastic Non-Tidal	46%	39%	52%
Grass Buffers	Appalachian Plateau Siliciclastic Non-Tidal; Appalachian Plateau Carbonate Non-Tidal	38%	42%	56%
	Blue Ridge Non-Tidal; Mesozoic Lowlands Non-Tidal; Valley and Ridge Carbonate Non-Tidal	24%	30%	40%

	Coastal Plain Dissected Uplands Non-Tidal	46%	42%	56%
	Coastal Plain Dissected Uplands Tidal; Coastal Plain Lowlands Tidal; Coastal Plain Uplands Tidal; Piedmont Crystalline Tidal	13%	45%	60%
	Coastal Plain Lowlands Non-Tidal	39%	39%	52%
	Piedmont Crystalline Non-Tidal	39%	42%	56%
	Coastal Plain Uplands Non-Tidal	21%	45%	60%
	Piedmont Carbonate Non-Tidal	32%	36%	48%
	Valley and Ridge Siliciclastic Non-Tidal	32%	39%	52%
Prescribed Grazing & PIRG	Coastal Plain Dissected Uplands Non-Tidal; Appalachian Plateau Carbonate Non-Tidal; Coastal Plain Dissected Uplands Tidal; Coastal Plain Lowlands Tidal; Coastal Plain Uplands Tidal; Coastal Plain Lowlands Non-Tidal; Coastal Plain Uplands Non-Tidal; Valley and Ridge Carbonate Non-Tidal; Piedmont Carbonate Non-Tidal	9%	24%	30%
	Appalachian Plateau Siliciclastic Non-Tidal; Blue Ridge Non-Tidal; Mesozoic Lowlands Non-Tidal; Piedmont Crystalline Tidal; Piedmont Crystalline Non-Tidal; Valley and Ridge Siliciclastic Non-Tidal	11%	24%	30%
Wetland Restoration (Ag & Urban)	Appalachian Plateau Siliciclastic Non-Tidal ; Appalachian Plateau Carbonate Non-Tidal	7%	12%	4%
	Coastal Plain Dissected Uplands Non-Tidal; Coastal Plain Dissected Uplands Tidal; Coastal Plain Lowlands Tidal; Coastal Plain Uplands Tidal; Coastal Plain Lowlands Non-Tidal; Coastal Plain Uplands Non-Tidal	25%	50%	15%
	Blue Ridge Non-Tidal; Mesozoic Lowlands Non-Tidal; Valley and Ridge Carbonate Non-Tidal; Piedmont Crystalline Tidal; Piedmont Crystalline Non-Tidal; Piedmont Carbonate Non-Tidal; Valley and Ridge Siliciclastic Non-Tidal	14%	26%	8%
Continuous No-till	Coastal Plain Dissected Uplands Non-Tidal; Coastal Plain Dissected Uplands Tidal; Coastal Plain Lowlands Tidal; Coastal Plain Uplands Tidal; Coastal Plain Lowlands Non-Tidal; Coastal Plain Uplands Non-Tidal	10%	20%	70%
	Appalachian Plateau Siliciclastic Non-Tidal; Appalachian Plateau Carbonate Non-Tidal; Blue Ridge Non-Tidal; Mesozoic Lowlands Non-Tidal; Valley and Ridge Carbonate Non-Tidal; Piedmont Crystalline Tidal; Piedmont Crystalline Non-Tidal; Piedmont Carbonate Non-Tidal; Valley and Ridge Siliciclastic Non-Tidal	15%	40%	70%
Cover Crop Early Drilled Rye (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	45%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	34%	15%	20%

Cover Crop Early Other Rye (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	38%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	29%	15%	20%
Cover Crop Early Aerial Soy Rye (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	31%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	24%	15%	20%
Cover Crop Early Aerial Corn Rye (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	18%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	14%	15%	20%
Cover Crop Standard Drilled Rye (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	41%	7%	10%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	31%	7%	10%
Cover Crop Standard Other Rye (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	35%	7%	10%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	27%	7%	10%
Cover Crop Late Drilled Rye (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	19%	N/A	N/A
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	15%	N/A	N/A
Cover Crop Late Other Rye (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	16%	N/A	N/A
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	12%	N/A	N/A
Cover Crop Early Drilled Wheat (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	31%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	24%	15%	20%
Cover Crop Early Other Wheat (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	27%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	20%	15%	20%

Cover Crop Early Aerial Soy Wheat (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	22%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	17%	15%	20%
Cover Crop Early Aerial Corn Wheat (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	12%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	10%	15%	20%
Cover Crop Standard Drilled Wheat (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	29%	7%	10%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	22%	7%	10%
Cover Crop Standard Other Wheat (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	24%	7%	10%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	19%	7%	10%
Cover Crop Late Drilled Wheat (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	13%	N/A	N/A
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	10%	N/A	N/A
Cover Crop Late Other Wheat (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	11%	N/A	N/A
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	9%	N/A	N/A
Cover Crop Early Drilled Barley (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	38%	20%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	29%	20%	20%
Cover Crop Early Other Barley (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	32%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	25%	15%	20%
Cover Crop Early Aerial Soy	Coastal Plain/Piedmont Crystalline/Karst Settings*	27%	15%	20%

Barley (Low-till gets only TN efficiency)	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	20%	15%	20%
Cover Crop Early Aerial Corn Barley (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	15%	15%	20%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	12%	15%	20%
Cover Crop Standard Drilled Barley (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	29%	7%	10%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	22%	7%	10%
Cover Crop Standard Other Barley (Low-till gets only TN efficiency)	Coastal Plain/Piedmont Crystalline/Karst Settings*	24%	7%	10%
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	19%	7%	10%
Commodity Cover Crop Early Drill Wheat	Coastal Plain/Piedmont Crystalline/Karst Settings*	17%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	13%	(N/A)	(N/A)
Commodity Cover Crop Early Other Wheat	Coastal Plain/Piedmont Crystalline/Karst Settings*	15%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	11%	(N/A)	(N/A)
Commodity Cover Crop Early Aerial Soy Wheat	Coastal Plain/Piedmont Crystalline/Karst Settings*	15%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	12%	(N/A)	(N/A)
Commodity Cover Crop Early Aerial Corn Wheat	Coastal Plain/Piedmont Crystalline/Karst Settings*	7%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	6%	(N/A)	(N/A)
Commodity Cover Crop Standard Drill Wheat	Coastal Plain/Piedmont Crystalline/Karst Settings*	15%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	11%	(N/A)	(N/A)
Commodity Cover Crop	Coastal Plain/Piedmont Crystalline/Karst Settings*	12%	(N/A)	(N/A)

Standard Other Wheat	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	9%	(N/A)	(N/A)
Commodity Cover Crop Late Drill Wheat	Coastal Plain/Piedmont Crystalline/Karst Settings*	7%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	6%	(N/A)	(N/A)
Commodity Cover Crop Late Other Wheat	Coastal Plain/Piedmont Crystalline/Karst Settings*	13%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	11%	(N/A)	(N/A)
Commodity Cover Crop Early Drill Barley	Coastal Plain/Piedmont Crystalline/Karst Settings*	9%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	6%	(N/A)	(N/A)
Commodity Cover Crop Early Aerial Soy Barley	Coastal Plain/Piedmont Crystalline/Karst Settings*	6%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	5%	(N/A)	(N/A)
Commodity Cover Crop Early Aerial Corn Barley	Coastal Plain/Piedmont Crystalline/Karst Settings*	13%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	11%	(N/A)	(N/A)
Commodity Cover Crop Standard Drill Barley	Coastal Plain/Piedmont Crystalline/Karst Settings*	15%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	11%	(N/A)	(N/A)
Commodity Cover Crop Standard Other Barley	Coastal Plain/Piedmont Crystalline/Karst Settings*	12%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	10%	(N/A)	(N/A)
Commodity Cover Crop Standard Other Rye	Coastal Plain/Piedmont Crystalline/Karst Settings*	18%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	14%	(N/A)	(N/A)
Commodity Cover Crop Early Other Rye	Coastal Plain/Piedmont Crystalline/Karst Settings*	21%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	16%	(N/A)	(N/A)

Commodity Cover Crop Early Other Barley	Coastal Plain/Piedmont Crystalline/Karst Settings*	15%	(N/A)	(N/A)
	Mesozoic Lowlands/Valley and Ridge Siliciclastic**	11%	(N/A)	(N/A)

* Appalachian Plateau Carbonate Non-Tidal; Coastal Plain Dissected Uplands Non-Tidal; Coastal Plain Dissected Uplands Tidal; Coastal Plain Lowlands Tidal; Coastal Plain Uplands Tidal; Coastal Plain Lowlands Non-Tidal; Coastal Plain Uplands Non-Tidal; Valley and Ridge Carbonate Non-Tidal; Piedmont Crystalline Non-Tidal; Piedmont Carbonate Non-Tidal

** Appalachian Plateau Siliciclastic Non-Tidal; Mesozoic Lowlands Non-Tidal; Piedmont Crystalline Tidal; Valley and Ridge Siliciclastic Non-Tidal; Blue Ridge Non-Tidal

Recommendations of the Expert Panel to Define Removal Rates for Urban Nutrient Management

CBP APPROVED FINAL REPORT

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Approved by Urban Stormwater Work Group: 2/9/2013
Approved by Watershed Technical Work Group: 3/4/2013
Approved by Water Quality Goal Implementation Team: 3/11/2013

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List of common acronyms used throughout the text:

BMP	Best Management Practice
CAST	Chesapeake Assessment Scenario Tool
CBP	Chesapeake Bay Program
CBWM	Chesapeake Bay Watershed Model
DIY	Do it Yourself
GIS	Geographic Information Systems
HOA	Homeowner Association
MS4	Municipal Separate Storm Sewer System
Rv	Runoff Coefficient
RT VM	Reporting, Tracking, Verification and Monitoring
Sf	Square feet
SRP	Soluble Reactive Phosphorus
TMDL	Total Maximum Daily Load
TN or N	Total Nitrogen
TP or P	Total Phosphorus
TSS	Total Suspended Solids
UNM	Urban Nutrient Management
WIN	Water Insoluble Nitrogen
WIP	Watershed Implementation Plan
WQGIT	Water Quality Goal Implementation Team
WTM	Watershed Treatment Model

Summary of Urban Fertilizer Management Credits for Phosphorus and Nitrogen			
Nutrient	*Statewide with P fertilizer legislation*	*Statewide without P fertilizer legislation*	*Urban Nutrient Management UNM*[2]
Phosphorus	25%	20%	Low risk: 3% High risk: 10% Blended: 4.5%
Notes & Conditions of Credit	Effective 2013 for 3 years. In 2016 , need to show reduction in P using two years of fertilizer sales data		Need to survey high-risk every 5 years; Renew UNM every 3 years
Nitrogen	For States with N fertilizer legislation: 9% reduction for qualifying acres by commercial applicators, 4.5% reduction for do-it-yourselfer acres For all other States: 3% load reduction for every 10% decrease in N urban fertilizer input from CBWM benchmark		Low risk: 6% High risk: 20% Blended: 9%
Notes & Conditions of Credit	Effective 2014, need to show N reduction using two consecutive years sales data		Need to survey high-risk every 5 years; Renew UNM every 3 years

The Panel developed methods for reporting, tracking and verifying the credits to ensure the UNM practices achieve their intended pollutant reduction. The Panel acknowledged that there are still many unknowns when it comes to the UNM practice, and adopted an adaptive management approach as it developed its recommendations.

The Panel also recommended improvements to the CBWM model and priority research projects that could improve confidence in its representation of UNM. Lastly, the Panel recommended several ways to improve Bay-wide communication of the UNM message, and improve the capacity to deliver UNM practices to meet the future demand for this practice.

Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated

Guidance for National Pollutant Discharge Elimination System Stormwater Permits

August 2014

Department of the Environment

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Table 3.E. Alternative Urban BMPs

	Notes	Efficiency Per Acre			Impervious Acre Equivalent
		TN	TP	TSS	
Mechanical Street Sweeping	High density urban areas where sweeping occurs 2x/month	4%	4%	10%	0.07
Regen/Vacuum Street Sweeping	High density urban areas where sweeping occurs 2x/month	5%	6%	25%	0.13
Reforestation on Pervious Urban	Survival rate of 100 trees/acre or greater; at least 50% of trees have two inch diameter or greater (4.5 ft. above ground)	66%	77%	57%	0.38
Impervious Urban to Pervious	Remove pavement and provide vegetative cover for 95% of area	13%	72%	84%	0.75
Impervious Urban to Forest	Survival rate of 100 trees/acre or greater; at least 50% of trees have two inch diameter or greater (4.5 ft. above ground)	71%	94%	93%	1.00
Regenerative Step Pool Storm Conveyance (SPSC)[1]	Located in dry or ephemeral channels; nutrient removal and impervious area credit is based on runoff depth treated	57%	66%	70%	1.00
		Lbs Reduced / Ton			Impervious Acre Equivalent
		TN	TP	TSS	
Catch Basin Cleaning	High density urban areas; storm drains are routinely maintained	3.5	1.4	420	0.40
Storm Drain Vacuuming	High density urban areas; storm drains are routinely maintained	3.5	1.4	420	0.40
Mechanical Street Sweeping	High density urban areas where sweeping occurs 2x/month	3.5	1.4	420	0.40
Regen/Vacuum Street Sweeping	High density urban areas where sweeping occurs 2x/month	3.5	1.4	420	0.40
		Lbs Reduced / Linear Ft			Impervious Acre Equivalent
		TN	TP	TSS	
Stream Restoration: load reductions for interim rate[2]	Schueler and Stack (2014) specify qualifying conditions and protocols to calculate individual load reductions per project	0.075	0.068	15/45	0.01
Outfall Stabilization	Stabilization or repair of localized areas of erosion below a storm drain outfall; max credit is 2 acres per project	n/a	n/a	n/a	0.01
Shoreline Management [3]	Revised protocols are pending CBP approval	0.075	0.068	137	0.04
		Lbs Reduced / Unit			Impervious Acre Equivalent
		TN	TP	TSS	
Septic Pumping	Pumping system is maintained and verified for annual credit	0[4]	0	0	0.03
Septic Denitrification	Permanent credit for installing enhanced septic denitrification	0[4]	0	0	0.26
Septic Connections to WWTP	Permanent credit for septic system connected to a WWTP	0[4]	0	0	0.39

1. Efficiencies and impervious acre equivalents shown are based on treating 1 inch of rainfall. When less than 1 inch of rainfall is treated, then refer to Table 2 for impervious acre equivalent and Table 6 for nutrient and sediment removal efficiencies.
2. Load reductions are based on current proposal under consideration by CBP. TSS is based on coastal plain and non-coastal plain applications. (Refer to Appendix E, Stream Restoration).
3. Load reductions are based on current proposal under consideration by CBP based on Drescher and Stack (2014). (Refer to Appendix E, Shoreline Management).
4. Actual load reductions shall be reported through local health department. Septic system credits only apply to impervious acre requirements.

6. Stream Restoration

a. **Impervious Area Equivalent**: The impervious area equivalent for stream restoration was originally developed using the Spring Branch efficiency data (approved by the CBP in 2003). Using the method described in Appendix D, MDE calculated an impervious acre credit of 0.01 acres per linear foot of restoration (noted in Table 7). MDE believes that this is a fair credit, as stream restoration should not be considered a substitute for providing adequate attenuation of untreated impervious area in the upland. Therefore, the impervious acre credit of 1.0 acre per 100 linear feet of stream channel will remain.

   Outfall stabilization typically entails the repair of localized areas of erosion below a storm drain pipe and often involves exposed infrastructure. Most outfall stabilization activities do not fit the qualifying conditions of a stream restoration project (as noted in Appendix F) because there are insufficient data available to provide allowable nutrient and sediment removal rates. However, MDE will allow these projects to take credit toward impervious area restoration according to the credit of 1 acre per 100 linear feet of the project. The maximum credit granted for these projects is 2 acres.

b. **New Pollutant Load Reduction Efficiencies**: New pollutant removal credits for stream restoration are described in the CBP approved document "Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects" (Schueler and Stack, 2014). This report describes four protocols for defining pollutant load reductions for stream restoration projects. The protocols allow individual project credit toward nutrient and sediment removal through the use of field data and specific calculations. This replaces the former policy of accepting a universal removal rate for all stream restoration projects.

   MDE recommends that the procedures outlined in Schueler and Stack (2014) should be followed for calculating nutrient and sediment load reductions for individual projects. However, MS4 jurisdictions may propose an alternative approach for calculating credit under the protocols. Any MS4 jurisdiction interested in pursuing alternative monitoring or technical procedures to calculate credit under each of the protocols should submit a formal proposal for MDE review and comment.

   Schueler and Stack (2014) provide a literature review, references, and the scientific basis behind the protocols. The design examples provided in the report shall be referenced by all MS4 jurisdictions in order to calculate nutrient and sediment removal credits for individual projects.

c. **Using the Revised Interim Rate for Current Projects and Planning**: In the past, the CBP had approved a universal removal rate for stream restoration based on the Spring Branch studies (Baltimore County Department of Environmental Protection and Sustainability, 2008). This allowed jurisdictions to use a simple calculation to determine nutrient load reductions for any stream restoration project. Schueler and Stack (2014) may be referenced for a historic overview of the universal stream restoration rate and a discussion involving recent revisions. Table E.4 provides the "revised interim rate" which is scheduled for final voting by the CBP WQGIT on August 11, 2014. After the final voting by CBP, MDE will advise MS4 jurisdictions on the status of the approval.

Table E.4 Stream Restoration Revised Interim Removal Rates per Linear Foot (lb/ft/yr)				
Source	**TN**	**TP**	**TSS[1]**	
			Coastal Plain	Non-Coastal Plain
Revised Interim Rate	0.075	0.068	15.1	44.9

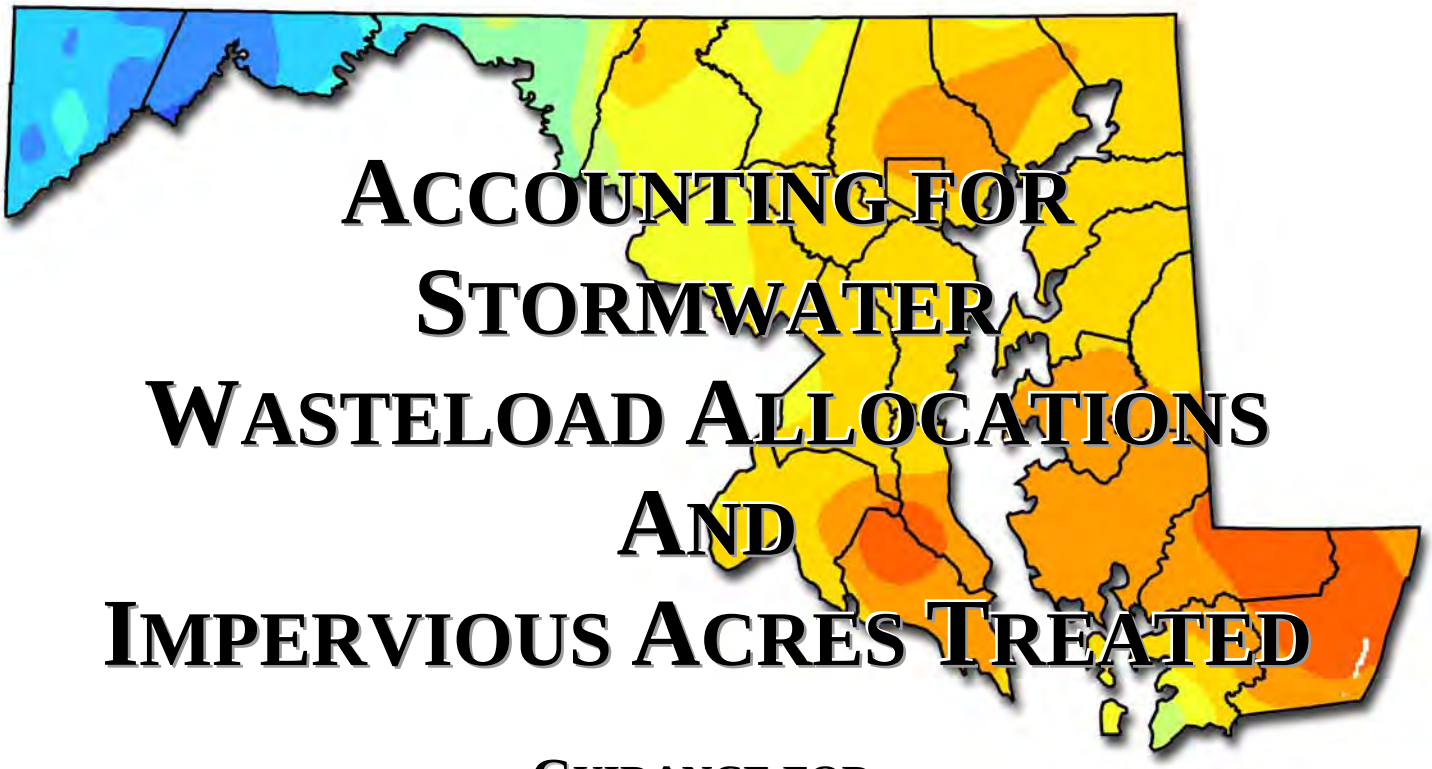
[1] The TSS removal rates are based on whether a project is located in the coastal plain or non-coastal plain. Schueler and Stack (2014) provides a discussion of the TSS removal rate and application of a sediment delivery ratio based on the location of the project. The TSS removal rates shown above were derived by multiplying 248 lb/ft/yr by the average CBWM (version 5.3.2) sediment delivery ratio for projects located in the coastal plain (0.061) and non-coastal plain (0.181).

The revised interim removal rates may be used by local programs for assessing stormwater WLA credit for stream restoration under certain conditions. Some projects may be too far along in the design and planning process to undergo the full evaluation using the procedures outlined in Schueler and Stack (2014). MDE supports allowing projects to proceed without delay (provided that they satisfy all regulatory requirements) and will allow the revised interim rate in Table E.4 to be used for calculating stormwater WLA credit for new stream restoration projects through the end of 2015. MS4 jurisdictions may also use removal rates in Table E.4 to quickly estimate load reductions during the planning phase for future projects. The revised interim rate may also be used for historic projects that meet all of the qualifying conditions described in Schueler and Stack (2014).

After 2015, site specific data must be used to calculate credit according to the protocols outlined in Schueler and Stack (2014). Use of the interim rate in combination with the protocols is not allowed. The interim rate may only be used after 2015 based on exceptional circumstances when compiling the data needed for the protocols may not be practical in order to keep project implementation on schedule. However, the long term use of the interim rate will be limited.

d. Regulatory Authorization of Projects: Page 5 of Schueler and Stack (2014) provides the following disclaimer: "The Panel recognizes that stream restoration projects as defined in this report may be subject to authorization and associated requirements from federal, State, and local agencies. The recommendations in this report are not intended to supersede any other requirements or standards mandated by other government authorities. Consequently, some stream restoration projects may conflict with other regulatory requirements and may not be suitable or authorized in certain locations."

Each State has a regulatory process to address any activity that may result in stream, wetland, floodplain or waterway impacts. MDE's review process evaluates each project on a case by case basis for impacts associated with flooding, adjacent property owners, impacts to high functioning portions of the stream and wetland/floodplain ecosystem, and other regulatory considerations. Stream restoration efforts should focus on areas of severe degradation and demonstrate potential benefits to the stream ecosystem.



ACCOUNTING FOR STORMWATER WASTELOAD ALLOCATIONS AND IMPERVIOUS ACRES TREATED

GUIDANCE FOR NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM STORMWATER PERMITS

JUNE (DRAFT) 2011

MARYLAND
DEPARTMENT OF THE ENVIRONMENT

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localities to demonstrate how the 20% impervious cover restoration requirement is being met and also to prevent the double reporting of structural BMPs. Additionally, local governments shall use the previously calculated baseline pollutant loads, BMP implementation rates, and the efficiencies provided in Table 4 to show progress toward meeting NPDES stormwater WLAs.

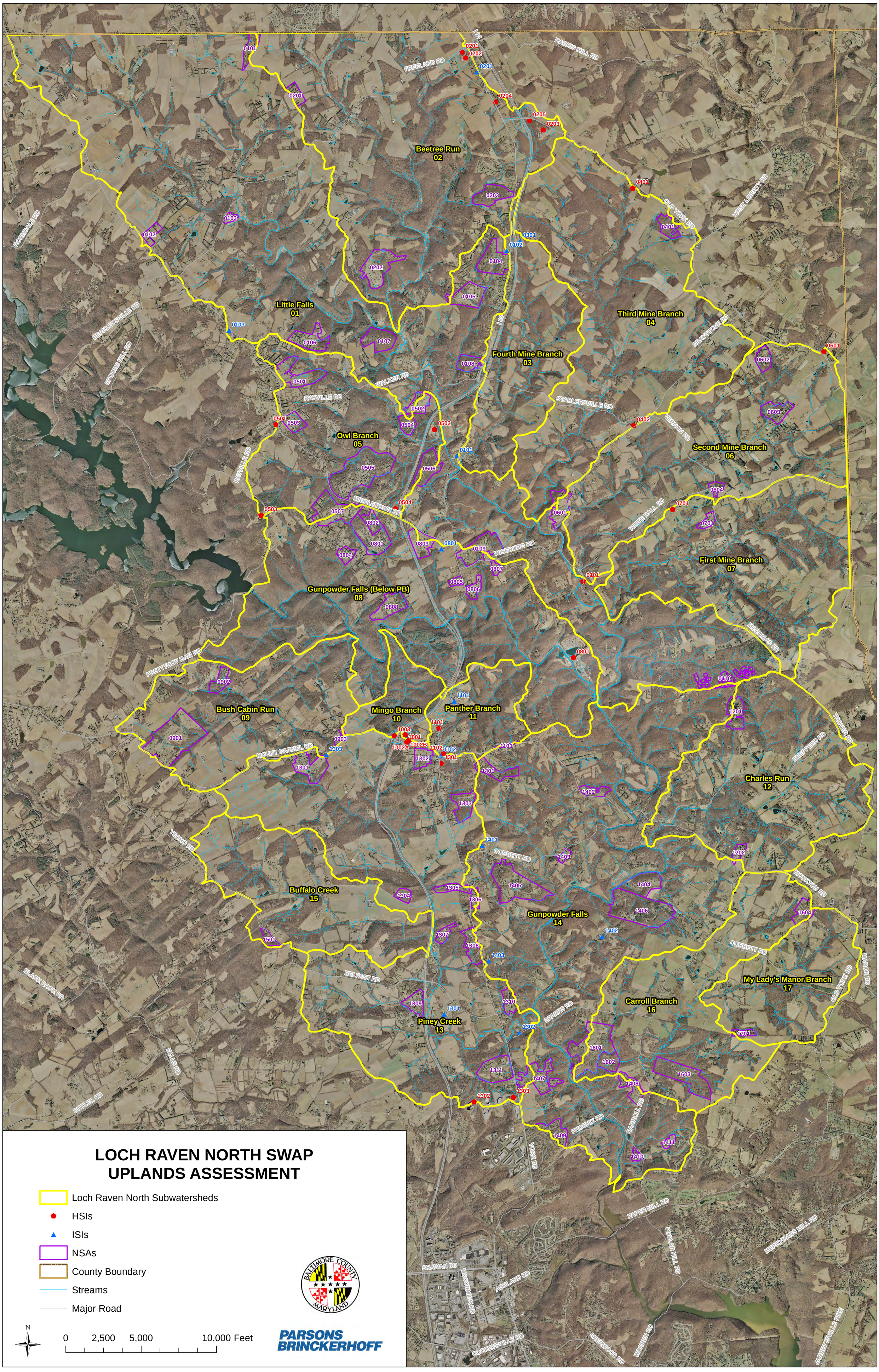
Table 4. Structural BMP Retrofit Matrix

BMP Practice	TN	TP	TSS
CBP Structural BMPs			
Dry Detention Ponds	5%	10%	10%
Hydrodynamic Structures	5%	10%	10%
Dry Extended Detention Ponds	20%	20%	60%
Wet Ponds and Wetlands	20%	45%	60%
Infiltration Practices	80%	85%	95%
Filtering Practices	40%	60%	80%
Vegetated Open Channels	45%	45%	70%
Erosion and Sediment Control	25%	40%	40%
Stormwater Management by Era			
Development Between 1985 - 2002	17%	30%	40%
Urban BMP Retrofit	25%	35%	65%
Development Between 2002 and 2010	30%	40%	80%
Development After 2010	50%	60%	90%
ESD to the MEP from the *Manual*			
Green Roofs	50%	60%	90%
Permeable Pavements	50%	60%	90%
Reinforced Turf	50%	60%	90%
Disconnection of Rooftop Runoff	50%	60%	90%
Disconnection of Non-Rooftop Runoff	50%	60%	90%
Sheetflow to Conservation Areas	50%	60%	90%
Rainwater Harvesting	50%	60%	90%
Submerged Gravel Wetlands	50%	60%	90%
Landscape Infiltration	50%	60%	90%
Infiltration Berms	50%	60%	90%
Dry Wells	50%	60%	90%
Micro-Bioretention	50%	60%	90%
Rain Gardens	50%	60%	90%
Grass, Wet, or Bio-Swale	50%	60%	90%
Enhanced Filters	50%	60%	90%
Additional Structural BMP Guidance			
Redevelopment (MDE)	50%	60%	90%
Existing Roadway Disconnect (MDE)	50%	60%	90%
Step Pool Storm Conveyance (MDE)	50%	60%	90%

(Adapted from CBP Urban BMP Efficiencies, and Stormwater Management by Era, MDE 2009)

APPENDIX D:

Loch Raven North SWAP Uplands Assessment Map


LOCH RAVEN NORTH SWAP
UPLANDS ASSESSMENT
Loch Raven North Subwatersheds
HSIs
ISIs
NSAs
County Boundary
Streams
Major Road
N
0
2,500
5,000
10,000 Feet
BALTIMORE COUNTY MARYLAND
PARSONS BRINCKERHOFF
Beetree Run 02
Little Falls 01
Third Mine Branch 04
Fourth Mine Branch 03
Owl Branch 05
Second Mine Branch 06
First Mine Branch 07
Gunpowder Falls (Below PB) 08
Bush Cabin Run 09
Mingo Branch 10
Panther Branch 11
Charles Run 12
Buffalo Creek 15
Gunpowder Falls 14
Piney Creek 13
Carroll Branch 16
My Lady's Manor Branch 17
I-83
HARRIS MILL RD
FREELAND RD
ROCKDALE RD
BECKLEYSVILLE RD
SPOOKS HILL RD
WALKER RD
RAYVILLE RD
MIDDLETOWN RD
STABLERSVILLE RD
VERNON RD
GRAYSTONE RD
OLD YORK RD
WEST LIBERTY RD
WHITE HALL RD
WISEBURG RD
PRETTYBOY DAM RD
MOUNT CARMEL RD
McCOMAS RD
TROVER RD
SHEPPERD RD
YEOHO RD
CORBETT RD
MONKTON RD
BLACK ROCK RD
BELFAST RD
SPARKS RD
FALLS RD
BUTLER RD
PHOENIX RD
CARROLL RD
YORK RD
PAPER MILL RD
POPLAR HILL RD
MERRYMANS MILL RD
MANOR RD
SHAWAN RD
McCORMICK RD
ASHLAND RD
COCKEYSVILLE RD
SHERWOOD RD
WARREN RD
JARRETTSVILLE PIKE