UPPER GWYNNS FALLS

Final Report

SMALL WATERSHED ACTION PLAN

VOLUME 1

Prepared for
Department of Environmental
Protection and Sustainability

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Baltimore County Executive Kevin Kamenetz and the Baltimore County Council

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Acknowledgements

Upper Gwynns Falls Steering Committee

The Upper Gwynns Falls SWAP was developed with cooperation and input from citizen organizations, local and state agencies that represent the interests of the Gwynns Falls watershed.

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Technical Report	**Representative**
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Although this projected is funded in part by the EPA, it does not necessarily reflect the opinion or position of the EPA.

Executive Summary

The Upper Gwynns Falls watershed encompasses 13,615 acres (21.3 square miles) and lies entirely in the Piedmont physiographic region. The watershed is located in Baltimore County and is primarily urban/residential (46%), forest (23%), commercial (8%), agricultural (7%), industrial (5%) and institutional land (5%). The Upper Gwynns Falls is mostly in the Owings Mills growth area with some rural areas. Water from the Upper Gwynns Falls flows into the main stem of the Gwynns Falls to the Inner Harbor.

The Upper Gwynns Falls watershed is one of the most impacted watersheds in Baltimore County and has degraded water quality in densely populated areas. The Upper Gwynns Falls watershed is listed on the Maryland Department of the Environment 303(d) list of impaired waters as being impaired for nutrients, bacteria, sediment, and listed as being biologically impaired. A Total Maximum Daily Load (TMDL) was developed for nutrient impairment of the Baltimore Harbor, by the Maryland Department of the Environment, and approved by the US Environmental Protection Agency in 2007. This TMDL identified phosphorus and nitrogen as the impairing nutrients in the harbor and determined that a 15% reduction of watershed nitrogen and phosphorus loads are necessary to meet water quality standards. An additional reduction target to meet the Chesapeake Bay Program goals has been identified as a 24% reduction for nitrogen and a 42% reduction of phosphorus from urban stormwater non-point source loads estimated for the average annual TMDL scenario. The TMDL for bacteria approved in 2007 requires a 67.2 – 93.2% reduction of bacteria from human, domestic animals, livestock, and wildlife. A TMDL for sediment was approved in 2010 setting a targeted reduction rate of 23.5% – 44.6% of total suspended sediment. The Upper Gwynns Falls is located entirely in TMDL Segment 1, which targets a 23.5% reduction. Although developed areas have impaired waters, there are streams in rural and recently developed portions of the Red Run subwatershed designated as Tier II waters and are found to support populations of trout, indicating high water quality.

The Upper Gwynns Falls Small Watershed Action Plan (SWAP) includes a watershed restoration plan and implementation strategy that will serve as a work plan for restoring and protecting water quality, and aquatic terrestrial habitats, and for addressing the need for environmental outreach and education in the watershed. The SWAP defines eight goals and 48 associated objectives for water quality, aquatic and terrestrial biodiversity, habitat and recreation enhancement, nutrient and trash management, enhancement of forest and riparian buffer, and promotion of environmentally sensitive development. These goals and objectives have been translated into 58 actions that, when implemented over the next ten years, will result in achieving the goals stated in the SWAP.

Implementation of the Upper Gwynns Falls SWAP will require the cooperative effort of Baltimore County, Blue Water Baltimore, and local citizen based environmental organizations. To facilitate this cooperative effort an Implementation Committee has been formed to coordinate efforts and jointly seek additional funding to increase the rate of implementation. The Implementation Committee will use an Adaptive Management approach to ensure maximum effectiveness in implementing actions, and when necessary adjusting the work plan to meet the goals.

CHAPTER 1

INTRODUCTION

1.1 Purpose

This Small Watershed Action Plan (SWAP) is a strategy for the restoration of the Upper Gwynns Falls watershed. This report presents actions for watershed restoration and preservation and identifies priority projects for implementation. Management strategies are described for each of the five subwatersheds comprising Upper Gwynns Falls. A schedule for implementation over a ten-year time frame is presented in addition to planning level cost estimates where feasible. Financial and technical partners for plan implementation are suggested for the actions. This SWAP is intended to assist the Baltimore County Department of Environmental Protection and Resource Management (DEPRM), Blue Water Baltimore (BWB), which includes the watershed association formerly known as the Gwynns Falls Watershed Association (GFWA), and other partners to keep moving forward with restoration of the Upper Gwynns Falls.

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 stakeholders.

Over the past year, Upper Gwynns Falls watershed partners have worked together to conduct upland assessments, identify restoration opportunities, and engage the community in order to build a successful plan. A Steering Committee consisting of various watershed partners was formed to develop the Upper Gwynns Falls SWAP. This includes Baltimore County personnel, members of the local watershed organization (BWB), and leaders from the local community. The Steering Committee met regularly throughout SWAP development and is acknowledged above. The Steering Committee partners helped to:

- Solicit the involvement of local citizens and groups,
- Set the vision, goals, objectives and action plans,
- Determine the implementation schedule necessary to meet the TMDL requirements,
- Set monitoring schedules and milestones,
- Utilize an adaptive management approach with yearly progress evaluation. The committee can adjust the action strategy to better meet the SWAP goals.

This document follows in the footsteps of prior and continuing efforts to address adverse environmental conditions that exist within the Gwynns Falls Watershed. These efforts include:

- GWFA with Center for Watershed Protection – Gwynns Falls Watershed Restoration Partnership Project (2005)

- Parsons Brinkerhoff – Gwynns Falls Water Quality Management Plan (2004)

The past restoration planning efforts by the County and GFWA mainly detailed Capital Restoration projects, while also documenting citizen based restoration options. These planning efforts did not provide detailed pollution removal estimates, did not follow the EPA A through I watershed planning criteria, nor did they provide planning based on developed Total Maximum Daily Loads (TMDLs); all of which are provided in this report.

1.2.1 Outreach

The participation of many stakeholders is an essential component for effective watershed restoration. Therefore, three stakeholder meetings were held during the SWAP development. Stakeholder meetings intend to raise citizen awareness and solicit feedback from neighborhood residents, community leaders, institution managers and business associations regarding problem locations, watershed restoration goals and acceptable restoration strategies. A description of each stakeholder meeting held including date, approximate number of attendees and topics covered, is provided below.

- Stakeholder Meeting #1 (April 28, 2010; 16 attendees): This meeting included an introduction of the SWAP process, the local watershed organization (BWB, formerly GFWA) and the Upper Gwynns Falls SWAP Steering Committee members. A description of watersheds, history of studies and work performed, county goals, environmental requirements (see Section 1.3) and the SWAP framework was presented. An overview of the field and desktop assessments being performed in the Upper Gwynns Falls watershed was described along with an overview of the watershed condition and pollution sources. The County described the Capital Waterway Improvement Program including environmental restoration projects such as SWM retrofits, stream restoration and other projects already completed within the Gwynns Falls watershed. A survey was conducted during the meeting where attendees were asked to rate the importance of a list of seven watershed goals. Attendees were also given an opportunity to locate their residence in the watershed, note citizen concerns, and report known environmental problems (e.g., dumping, erosion, illicit discharges, etc.) and the location in the watershed.
- Stakeholder Meeting #2 (September 28, 2010; 12 attendees): This meeting started with an overview of the SWAP. Introductions were made and an overview of the SWAP process was given. DEPRM summarized the study currently being performed in the Red Run subwatershed, which is based on a study performed previously. A summary was given of watershed findings based on the field assessments and desktop analysis. Upland assessment methods and results for neighborhoods, institutions, pervious areas, and hotspots were discussed. Potential restoration actions appropriate for the watershed based on data collected were discussed (e.g., downspout disconnection, Bayscaping, tree planting, etc.). The upcoming field trip in the watershed was announced and the next steps in the SWAP process were outlined A citizen action survey was conducted to gage interest in the potential restoration options and help build a successful SWAP
- Stakeholder Meeting #3 (January 13, 2011; 11 attendees): Baltimore County's trash monitoring program was outlined including the implementation in the Upper Gwynns Falls SWAP study area. An overview of the SWAP that has been developed for the Upper Gwynns Falls including the SWAP process, watershed visions and goals, watershed characterization, municipal strategies (stormwater management, reforestation,

street sweeping, etc.), pollutant removal analysis, subwatershed prioritization, and SWAP implementation. The completed stream restoration projects in the SWAP study area were mentioned. Citizen actions (downspout disconnection, storm drain marking, tree planting, etc.) were discussed. The BWB can assist citizens and communities with these actions by providing information and resources.

In addition to the Stakeholder Meetings outreach activities were conducted by the steering committee during the SWAP development process as summarized below:

- Chartley National Night Out (August 3, 2010): The annual event was held at the Reisterstown Elementary School. The Steering Committee had a display booth with display that approximately 60 people visited.
- Reisterstown Festival (September 11 & 12, 2010): The annual event was held at Hannah More Park. The Steering Committee had a booth with information displays and handouts that approximately 200 people visited during the two day festival.
- Field Trip (November 4, 2010): The fall field trip included a visit to the two stream restoration sites (Chartley and Gwynnbrook Avenue) and the new Red Run Trail. There were approximately five attendees at the event.

1.3 Environmental Requirements

This SWAP was developed to satisfy various environmental program requirements while also meeting citizen needs for a biodiverse watershed with healthy, stable and vibrant streams. 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
- Total Maximum Daily Load (TMDL) reductions for fecal bacteria and nutrients (i.e., nitrogen and phosphorus) for the Gwynns Falls
- Upper Gwynns Falls Biological Stressor Identification Analysis
- Anticipated TMDL development 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 (99-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 GIS data
- Determination of current water quality conditions
- Identification and ranking of water quality problems
- Results of visual watershed inspections

- Identification of some structural and non-structural water quality improvement opportunities and
- Specification of overall watershed restoration goals

The county's NPDES permit also requires the county to address 20 percent of the impervious cover by 2010. It is anticipated that an additional 10% impervious cover be addressed over the next 5-year permit term. This SWAP meets the systematic assessment and planning requirements of the NPDES permit and provides strategies for how Baltimore County will meet the goals for addressing impervious cover.

1.3.2 TMDLs

The Gwynns Falls watershed has four impairment listings: nutrients, chlorides, sediments, and fecal coliform. The nutrient and sediment listings were refined to phosphorus and total suspended solids. The stream biological community listing has been replaced by TSS and chlorides. A Biological Stressor Identification analysis was prepared in June 2009 and has indicated what is likely degrading the biological communities within the Gwynns Falls watershed. Inorganic pollutants (chlorides and conductivity), ammonia toxicity, and flow/sediment stressors are associated with impacts to biological communities. The listing for impacts to biological communities will be addressed at a future date after additional data has been collected.

Impairment listings reflect the inability to meet water quality standards for designated uses. The Upper Gwynns Falls SWAP area is designated as Use I (Water Contact Recreation, and Protection of Nontidal Warmwater Aquatic Life) and Use III (Nontidal Cold Water) according to the Maryland water quality standards.

The Gwynns Falls watershed is listed on the 303(d) list as impaired by nutrients, chlorides, sediments, and fecal coliform. The nutrient and sediment listings were refined to phosphorus and total suspended solids. The stream biological community listing has been replaced by the TSS and chlorides. Inorganic pollutants (chlorides and conductivity), ammonia toxicity, and flow/sediment stressors are associated with impacts to biological communities.
The Maryland Department of Environment (MDE) has completed two TMDLs and one Water Quality Assessment (WQA) for addressing water quality impairments within the Upper Gwynns Falls planning area. TMDLs have been developed for bacteria and sediment. It was determined that the reductions in bacteria needed to meet water quality standards range between 67.2% - 93.2%, which includes a 98% reduction from human sources. Biological stressor identification analysis identified sediment-related stressors as probable causes of biological impairment in the Gwynns Falls watershed. A Maximum Daily Load for Sediment/TSS of 13,996.2 tons/year and 558.7 tons/day was determined based on the amount of sediment the watershed would produce in forested conditions. This represents a reduction in sediment loads ranging from 23.5% - 44.6%. The sediment TMDL will not completely resolve the impairment to biological communities since other possible stressors identified by the analysis such as chlorides still need to be addressed after additional data has been collected.

A Water Quality Assessment (WQA) for nutrients (phosphorus) was completed and approved by the U.S. Environmental Protection Agency (USEPA) in 2009. The WQA for nutrients showed that the aquatic life criteria and designated uses associated with nutrients are being met in the

Gwynns Falls and that a TMDL for nutrients is not necessary to achieve water quality standards. This document is included as Appendix J. However, impairment in the tidal waters of Baltimore Harbor is related to pollutants coming from the watershed. Therefore, the Baltimore Harbor TMDL requires nutrient reductions in Gwynns Falls necessary to meet water quality standards in the Harbor. The TMDLs of nitrogen and phosphorus for urban stormwater require a 15% reduction based on the Baltimore Harbor TMDL. An additional reduction target to meet the Chesapeake Bay Program goals has been identified as a 24% reduction for nitrogen and a 42% reduction of phosphorus from urban stormwater non-point source loads estimated for the average annual TMDL scenario. The Chesapeake Bay TMDL may require additional reductions once the draft is approved. In addition, Gwynns Falls is listed under Category 3 of the Integrated Report of Surface Water Quality in Maryland for potential presence of PCBs in fish tissue.

1.3.3 Chesapeake Bay Nutrient and Sediment Impairment

The Chesapeake Bay Program (CBP) is currently developing the Phase 5 Watershed Model. This model, in conjunction with the Estuary Model, will be used to determine the sources and reductions of nitrogen, phosphorus, and sediment needed to meet Chesapeake Bay tidal water quality standards. Maryland has developed tributary strategies for the 10 basins within the state including the Patapsco/Back River basin. Efforts under the previous version, Phase 4.3, Watershed Model and Maryland Tributary Strategy development indicated reductions in excess of 20% for nitrogen and phosphorus. To meet the Chesapeake Bay water quality standards the actions are expected to achieve a 24% reduction in nitrogen and a 42% reduction in phosphorus from urban lands. The Phase 5.3 watershed model, to be complete in December 2010, can be used to assign nutrient and sediment load reductions to individual local jurisdictions based on the segment loads. If this document identifies restoration opportunities that are insufficient in providing the load reductions to meet the Chesapeake Bay TMDL, the Steering Committee will re-convene to update the SWAP as necessary.

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 with focusing 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 roadway maintenance, irrigation practices, 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 nonpoint source pollution using incremental Section 319 funds must meet USEPA's A through I criteria for watershed planning:

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

Table 1-1: 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	✓								

1.5 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 among groups has continued to develop but there is a need for increased coordination to meet common goals in water quality improvement.

The Baltimore Watershed Agreement commits Baltimore County to work with Baltimore City and local watershed associations to address environmental issues in shared watersheds. This agreement provides the framework for continued cooperation and progress in meeting the environmental issues detailed above. Currently, five workgroups are developing action strategies as part of the Baltimore Watershed Agreement to address: stormwater, trash, public health, greening, and development/redevelopment. These action strategies overlap with the actions detailed in this report and provide further incentive to move forward with restoration activities.

1.5.1 Baltimore County

Baltimore County has a waterway restoration program to implement restoration projects, including stream restoration, stormwater management (SWM) facility conversions, BMP retrofits and reforestation enhancement projects. In the Gwynns Falls watershed a total of 1.3 miles of streams have been restored, 284 acres of urban land has been either addressed with new SWM practices or existing SWM has been retrofitted (enhanced) to provide additional water quality improvements. Approximately $2.67 million have been spent to date on restoration activities within the entire Gwynns Falls watershed. An additional $6 million has been allocated for restoration in Gwynns Falls through 2016. Many of the projects have additional funding provided through grant programs.

Baltimore County has an extensive monitoring program that assesses the current ambient water quality and tracks trends over time. The restoration projects are measured for pollutant removal efficiency and biological community improvement. The County also has an Illicit Connection Program that monitors storm drain outfalls, tracks pollution sources, and coordinates remediation. Baltimore County is under a consent decree to address Sanitary Sewer Overflows. The consent decree has specific requirements for improvements to pumping stations, remediation of sanitary sewer lines, maintenance and inspection. Implementation of the consent decree requirements will help reduce bacteria contamination, as well as, reduce nitrogen and phosphorus in the streams. There are no pumping stations in the Upper Gwynns Falls watershed.

The County operates street sweeping and inlet cleaning programs throughout the county to remove sediment, nitrogen and phosphorus before the pollutants reach the waterways. These programs are tracked and measured to calculate the amount of pollution removal.

1.5.2 Blue Water Baltimore

The watershed association for the Gwynns Falls has been known as the Gwynns Falls Watershed Association (GFWA). The association joined with other local watershed groups to create Blue Water Baltimore (BWB). BWB consists of the associations previously operating under the names of the Jones Falls Watershed Association, Herring Run Watershed Association, Gwynns Falls Watershed Association, Baltimore Harbor Watershed Association and the Baltimore Harbor WATERKEEPER. BWB is a grassroots, volunteer-based watershed organization that mobilizes volunteers for environmental stewardship through outreach, public education, and advocacy. Their main focus has been on collecting water quality data and removing trash and debris in streams to improve water quality in the Gwynns Falls. Several community cleanups have been organized by BWB in partnership with Baltimore County.

1.6 Upper Gwynns Falls Watershed Overview

The Upper Gwynns Falls SWAP study area is one of two planning areas that represent the larger Gwynns Falls watershed. The Upper Gwynns Falls planning area comprises the headwaters of the Gwynns Falls and is approximately 13,615 acres (21 square miles) or 34 percent of the Gwynns Falls watershed. The remaining 66 percent is the Lower Gwynns Falls planning area (28,370 acres, 44 square miles). A SWAP for the remaining portions of the Gwynns Falls will be completed in the future.

The Upper Gwynns Falls watershed was subdivided into five subwatersheds for planning and management purposes and is shown in Figure 1-1. The smaller drainage areas are intended to focus restoration, preservation, and monitoring efforts. The Upper Gwynns Falls Watershed Characterization Report includes detailed analyses and descriptions of the current watershed conditions and potential water quality issues. This is included as Appendix E of this report. A summary of the key watershed characteristics for Upper Gwynns Falls based on the Characterization Report is provided in the table below.

Table 1-2: Upper Gwynns Falls Key Watershed Characteristics

Drainage Area:	13,615 acres (21.3 sq. mi.)	
Stream Length:	83.8 miles	
Jurisdiction:	Baltimore County	
Population:	54,552 (2000 Census)	
Land Use/Land Cover:	Very Low Density Residential	1.1%
	Low Density Residential	11.2%
	Medium Density Residential	21.0%
	High Density Residential	14.0%
	Commercial	7.9%
	Industrial	4.7%
	Institutional	5.3%
	Extractive	0.6%
	Open Urban	1.7%
	Forest	23.1%
	Agriculture	6.9%
	Water/Wetlands	0.3%
	Bare Ground	0.2%
	Transportation	2.0%
Impervious Cover:	20.3% of watershed	
Soils:	A Soils (low runoff potential)	0.0%
	B Soils	75.8%
	C Soils	13.3%
	D Soils (high runoff potential)	10.9%

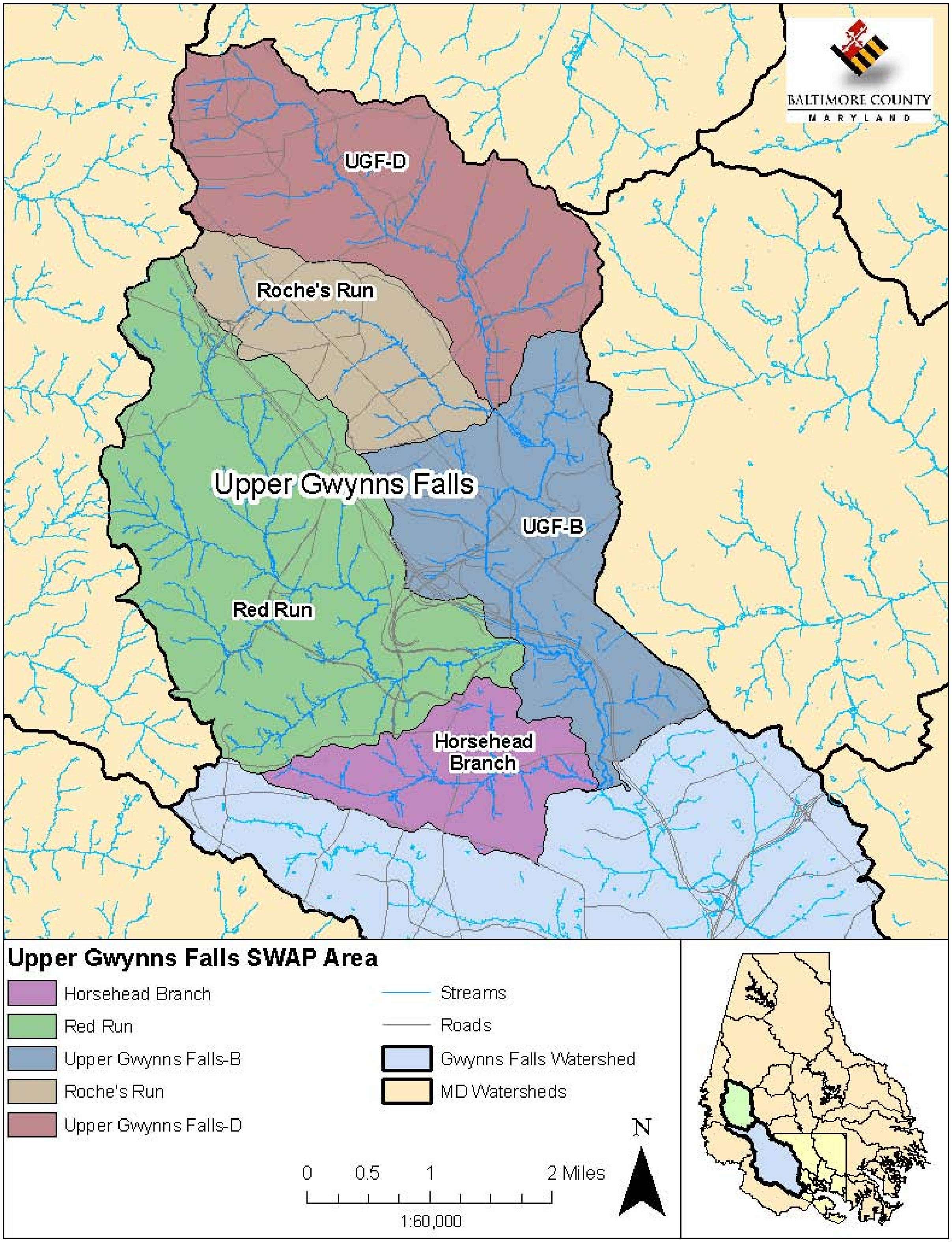

Figure 1-1: Upper Gwynns Falls SWAP Planning Area and Subwatersheds

1.7 Report Organization

This report is organized into the following five chapters:

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

Chapter 2 presents the watershed vision, goals and objectives for restoring and preserving the Upper Gwynns Falls.

Chapter 3 describes the types of watershed restoration practices recommended for Upper Gwynns Falls and estimated pollutant load reductions.

Chapter 4 discusses prioritization of the five subwatersheds in the Upper Gwynns Falls 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: Upper Gwynns Falls Action Strategies
- Appendix B: Cost Analysis and Potential Funding Sources
- Appendix C: Chesapeake Bay Program Pollutant Load Reduction Efficiencies
- Appendix D: U.S. Environmental Protection Agency A Through I Criteria for Watershed Planning

A second volume (Volume II) includes the following appendices with supporting documentation related to the current conditions of the Upper Gwynns Falls watershed:

- Appendix E: Upper Gwynns Falls Watershed Characterization Report (AMT, 2010)
- Appendix F: Gwynns Falls Stream Stability Analysis (PB, 2004)
- Appendix G: Total Maximum Daily Loads of Fecal Bacteria For the Non-Tidal Gwynns Falls Basin, Baltimore County and Baltimore City, Maryland (MDE, 2007)
- Appendix H: Total Maximum Daily Loads of Nitrogen and Phosphorus for the Baltimore Harbor in Anne Arundel, Baltimore, Carroll and Howard Counties and Baltimore City, Maryland (MDE, 2006)
- Appendix I: Watershed Report for Biological Impairment of the Gwynns Falls Watershed in Baltimore City and Baltimore County, Maryland. Biological Stressor Identification Analysis Results and Interpretation (MDE, 2009)
- Appendix J: Water Quality Analysis of Eutrophication for the Gwynns Falls Watershed in Baltimore County and Baltimore City, Maryland
- Appendix K: Total Maximum Daily Load of Sediment in the Gwynns Falls Watershed, Baltimore City and Baltimore County, Maryland (MDE, 2009)

CHAPTER 2

VISIONS, GOALS AND OBJECTIVES

2.1 Vision Statement

The Upper Gwynns Falls Steering Committee adopted the following vision statement that acted as a guide in the development of the SWAP:

> *We envision the Upper Gwynns Falls watershed with a healthy, stable and vibrant stream network that supports diverse aquatic life. Our watershed includes high quality streams and forests, which will be protected to maintain physical, chemical and hydrologic standards. Forest cover will be measured throughout the watershed. Development and redevelopment will be managed to minimize impacts from stormwater and increase infiltration. Improved public access to streams will increase enjoyment and responsible stewardship of the streamside habitat. Our streams will flow free of trash throughout the watershed and on the way to the harbor and Chesapeake Bay.*

2.2 Upper Gwynns Fall SWAP Goals and Objectives

The Steering committee created a vision statement for the Upper Gwynns Falls and identified eight goals to define the desired improvements. The goals were refined based on feedback from watershed residents at Stakeholder meetings. Stakeholders were given the opportunity to rank the importance of goals and raise any additional issues of importance to the community. Stakeholder participation is important to ensure the implementation and success of the plan. To achieve watershed goals, Stakeholders then identified the type of restoration activities that are of interest.

GOALS:

- Goal 1: Improve and Maintain Physical and Chemical Stream Conditions
- Goal 2: Preserve High Quality Streams
- Goal 3: Restore and Maintain Aquatic Biodiversity
- Goal 4: Increase Tree and Forest Coverage
- Goal 5: Promote Environmentally Sensitive Development and Redevelopment
- Goal 6: Restore Stream Hydrology
- Goal 7: Reduce Trash and Promote Recycling
- Goal 8: Improve Access to Streams

The following sections present a discussion of each of the eight goals for restoring the Upper Gwynns Falls watershed. For each goal, a series of objectives was developed to ensure that the plan will meet each goal.

2.2.1 Goal 1: Improve and Maintain Physical and Chemical Stream Conditions

According to the Water Quality Assessment, biological stressor identification analysis did not identify a significant association between nutrient stressors and degraded biological conditions in the Gwynns Falls watershed. These results combined with analysis of recent water quality data indicates that the Gwynns Falls is not being impaired by nutrients. However, the Baltimore Harbor TMDL requires nutrient reductions in Gwynns Falls necessary to meet water quality standards in the Harbor. The TMDLs of nitrogen and phosphorus for urban stormwater require a 15% reduction based on the Baltimore Harbor TMDL. An additional reduction target to meet the Chesapeake Bay Program goals has been identified as a 24% reduction for nitrogen and a 42% reduction of phosphorus from urban stormwater non-point source loads estimated for the average annual TMDL scenario. The reductions needed to meet bacteria water quality standards range between 67.2% - 93.2% and will require a near total elimination of human and domestic pet waste, as well as a significant portion of the wildlife source. These reductions will take a staged approach, working toward a maximum practicable reduction. The sediment TMDL will ensure sediment loads are at a level that supports the Use I/III/IV designations of the Gwynns Falls watershed. A 36.5% reduction in sediment loads is targeted and the reduction requirements range from 23.5% - 44.6%. The sediment TMDL will not completely resolve the impairment to biological communities since other possible stressors identified by the analysis such as chlorides still need to be addressed.

Objectives:

1. Convert old SWM facilities to more efficient best management practices (BMPs) and implement stormwater control practices throughout the watershed to the maximum extent practicable.
2. Implement stream and habitat restoration projects on degraded streams to reduce pollutant laden sediment from eroding.
3. Create riparian buffer and enhance existing stream buffers to filter runoff and provide habitat.
4. Complete sewer projects as identified and scheduled by the Federal Consent Decree. Sewer overflows and inadequate septic systems are targeted and eliminated under this program.
5. Increase oversight of septic system performance and promote proper maintenance of septic systems.
6. Promote proper disposal of pet waste to reduce annual average total nitrogen loads and bacteria from the Upper Gwynns Falls watershed. It is estimated that less than 40% of pet owners dispose of the waste properly and 40% of all citizens are pet owners.
7. Reduce other sources of bacteria.
8. Reduce fertilizer/pesticide/herbicide use from lawn.
9. Promote and increase use of rain barrels, rain gardens and Bayscaping.

2.2.2 Goal 2: Preserve High Quality Streams

Physical, chemical and biological damage to aquatic and terrestrial habitats result over time from development of land, poor land management practices, introduction of exotic invasive species, obstructions to upstream breeding sites, etc. The objectives for this goal include the preservation of Tier II and trout resources waters in Red Run. Preserve riparian buffers, forest cover including the habitat found at Soldier’s Delight Natural Area as they relate to the improvement of degraded river conditions that result in poor conditions for aquatic life.

Objectives:

1. Monitor aquatic populations and if needed implement habitat restoration projects including fish blockage removal and riparian buffer enhancement to remove the biological impairments.
2. Monitor for sources of water pollution and aquatic habitat degradation and trends over time.
3. Preserve upland forest cover to reduce pollutant loads in runoff.
4. Preserve riparian and existing stream buffers filtering runoff and providing habitat. Riparian buffers in Tier II areas provide increased water temperature control, which sustains fish life.
5. Perform stream restoration and stabilization projects to connect high quality stream reaches.
6. Convert old SWM facilities to more efficient best management practices (BMPs) and implement stormwater on control practices throughout the watershed to the maximum extent practicable.

2.2.3 Goal 3: Restore and Maintain Aquatic Biodiversity

An abundance of aquatic biodiversity is a good indicator of a healthy aquatic system. Enhancing the aquatic biodiversity of streams in the Upper Gwynns Falls watershed will preserve habitats and ecosystems in the Baltimore Harbor and Chesapeake Bay. Biodiversity provides the core for long term sustainable ecological communities. The sediment TMDL will ensure sediment loads are at a level that supports the Use I/III/IV designations of the Gwynns Falls watershed. The sediment TMDL will not completely resolve the impairment to biological communities since other possible stressors identified by the analysis such as chlorides still need to be addressed. The Upper Gwynns Falls target is to work towards a 36.5% reduction in sediment loads based on the requirement range of 23.5% - 44.6%.

Objectives:

1. Remove fish blockages, restore and protect portions of the stream network and riparian habitats such that natural biological conditions can support diverse aquatic communities, as can be monitored and assessed by fish and invertebrate community structure and function.
2. Implement stream and habitat restoration projects to help restore aquatic life and biodiversity.
3. Monitor for sources of water pollution and aquatic habitat degradation and trends over time.
4. Monitor water temperature in sensitive areas to track thermal impacts to sensitive waters.
5. Create riparian buffers and enhance existing stream buffers to quality underbrush and forest to filter runoff and provide habitat.

2.2.4 Goal 4: Increase Tree and Forest Coverage

Forests provide the healthy air we breathe and are an important part of the water cycle. Tree canopies intercept rain, which increases evaporation and reduces erosion of topsoil that flows to the stream in storm water runoff. Forests increase the opportunity for precipitation to infiltrate into the ground before runoff carries pollutants to the streams. Tree roots can remove pollutants, sediment and nutrients from stormwater. A healthy riparian buffer will increase nutrient uptake, trap sediments, lower water temperatures, slow floodwaters, increase infiltration and provide valuable habitat for wildlife. Canopy cover increases the dissolved oxygen in streams by reducing the water temperature. The Soldier's Delight Natural Area supports rare, threatened, and endangered species including many types of herbaceous plants, as well as, rare insects, rocks and minerals to be preserved.

Objectives:

1. Convert pervious areas to areas with forest coverage to promote natural habitats and improved natural land resources.
2. Plant trees along streets and unused open areas in neighborhoods to increase the urban tree canopy.
3. Plant trees on institutional properties identified in the upland assessment.
4. Increase riparian buffer in non-forest areas.
5. Promote tree planting on residential properties.

2.2.5 Goal 5: Promote Environmentally Sensitive Development and Redevelopment

Environmentally sensitive development and redevelopment reduces the amount of forest and open land disturbed. Utilizing infiltration stormwater management facilities and porous land cover will reduce the runoff and pollutant loads from sites. Government should "lead by example" to encourage businesses and neighborhood communities to employ best management practices on their sites to reduce and improve polluted runoff. Publicly owned properties should be considered as opportunities for the construction of BMPs and also serve as a demonstration of BMPs being promoted throughout the community.

Objectives:

1. Continue to apply Baltimore County's forest buffer regulations to enhance and protect streams.
2. Continue to enforce sediment control practices and when required by MD law, apply new sediment control regulations to projects.
3. Continue to apply forest buffer regulations to enhance and protect natural resources.
4. Continue implementing stormwater management regulations which increase the use of non-structural techniques using Environmental Site Design (ESD) guidelines to increase infiltration.

2.2.6 Goal 6: Restore Stream Hydrology

The stability of the stream is impacted by higher runoff rates, stream velocities and an increase or decrease of sediment entering the channel. Increasing infiltration rates throughout the watershed can reduce many of the negative effects by reducing rates of runoff entering the stream and allowing a natural means of water to reach the water table.

Objectives:

1. Increase the use of natural non-structural storm design techniques through following the ESD guidelines to increase infiltration.
2. Convert old SWM facilities to more efficient BMPs and add storm water management facilities in areas that were developed without adequate controls.
3. Promote and increase use of rain barrels, rain gardens and Bayscaping on existing and proposed properties to increase infiltration to reduce bank erosion and stream velocities.
4. Balance sediment amounts in streams and reduce biological oxygen demand (BOD) by increasing infiltration.
5. Increase stream stabilization by reconnecting unstable streams to floodplains.
6. Enhance riparian buffers on redeveloped properties along the stream network.
7. Increase forest and tree cover by street and open space tree planting to increase infiltration.

2.2.7 Goal 7: Reduce Trash and Promote Recycling

Trash is one of the most noticeable pollutants in the Upper Gwynns Falls. Trash is generated throughout the watershed and readily moves through storm drains and tributaries and by wind into the river. Trash is often left near trash receptacles, carelessly dropped or dumped intentionally. Besides the negative impact to the stream's natural beauty, trash contributes toxins and presents a hazard to wildlife and people. Reducing trash and increasing recycling is mainly an issue of public awareness and stewardship. By engaging citizens of all ages to help clean up the trash and to dispose of trash responsibly the stage will be set to change behaviors leading to other positive actions for a healthier Upper Gwynns Falls.

Objectives:

1. Develop a baseline trash load through 1-year monitoring period.
2. Implement an effective monitoring program to identify hotspots and document long-term conditions and assess trends.
3. Reduce trash through cleanups and educational activities on proper trash handling.
4. Increase stewardship by students, religious institutions, boy/girl scouts and other community groups through activities such as clean-ups, storm drain marking and recycling awareness.
5. Increase the quantity of material recycled and compost.

6. Utilize code enforcement policies and implement actions for improper handling of trash and improper vehicle storage and maintenance.
7. Increase trash removal maintenance in SWM facilities.

2.2.8 Goal 8: Improve Access to Streams

Improving access to streams and buffers for purposes of public enjoyment will help facilitate awareness, environmental stewardship and encourage citizens to take pride in the streams. This can be done in a way that does not diminish the quality of the ecosystem being restored and protected. Providing access to streams also discourages citizens from creating their own access points, which can harm natural vegetation and buffers.

Objectives:

1. Increase awareness of existing trails and public access points to the Upper Gwynns Falls for recreational use.
2. Implement habitat restoration projects to enhance access to streams by removing invasive species.
3. Develop and promote awareness to protect stream access by reducing trash and improving aesthetics at access points and on trails.
4. Promote natural trail and/or pervious trail connections to existing trails though areas with the least amount of environmental impacts.
5. Connect the Red Run Trail to the Soldier’s Delight Trail.

2.3 Upper Gwynns Fall SWAP Action Strategies

Action strategies describe the method used to achieve the objective and ultimately the water quality goal. An example of an action strategy for phosphorus reduction could be “reducing fertilizer use on 75 acres in neighborhoods identified as high maintenance lawns” 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., acres of impervious area treated by converted SWM facilities). However, the numerical values assigned to these actions are to serve as a guide rather than as an absolute measure in achieving watershed goals and objectives. Chapter 3.5 quantifies the pollutant reduction analysis for achieving the water quality reductions. It is intended that the actions address multiple watershed goals and objectives. Appendix A provides a table that lists the action strategies proposed for the Upper Gwynns Falls and the related goals and objectives.

The general types of restoration strategies proposed for the Upper Gwynns Falls watershed are discussed further in Chapter 3. The SWAP will emphasize an adaptive management approach in the implementation process. This approach includes evaluating the success of SWAP implementation over time (see Chapter 5) and modifying action strategies based on community acceptance and funding availability.

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 the Upper Gwynns Falls watershed. A complete list of actions proposed for the watershed including goals and objectives targeted, timelines, performance measures, cost estimates, and responsible parties is included in Appendix A. The key restoration strategies are the focus of this chapter ranging from capital stream restoration projects to public education and outreach. It is important that a combination and variety of restoration practices are implemented to engage citizens and meet watershed-based goals and objectives.

The Upper Gwynns Falls watershed restoration will occur as a partnership between the local government, watershed groups and citizens. All partners are critical to the success of the overall watershed restoration strategy. Local governments can implement large capital projects such as stormwater retrofits, stream restoration, changes in municipal operations, and large-scale public awareness programs. Watershed groups and citizens can implement locally based programs such as tree planting, and downspout disconnection that require citizen participation and increase awareness. Therefore, key restoration strategies are divided into two categories: municipal strategies (Chapter 3.2) and citizen-based strategies (Chapter 3.3). It is important that all groups are active in restoration activities and that a variety of projects are implemented.

The watershed pollutant loading analysis performed to estimate current nutrient loads generated by the various non-point sources within the Upper Gwynns Falls watershed is discussed in Chapter 3.3. Chapter 3.4 discusses the pollutant removal calculations for proposed BMP strategies discussed in Chapters 3.2 and 3.3 to ensure that TMDL requirements are met in Upper Gwynns Falls.

3.2 Municipal Strategies

The Baltimore County government 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 SWAP implementation process. Key municipal strategies proposed for restoring the Upper Gwynns Falls are discussed in the following sections.

3.2.1 Stormwater Management

Increased importance of water quality and water resource protection led to the development of the Maryland Stormwater Design Manual which provided BMP design standards and environmental incentives (MDE, 2000). The manual was updated to adopt low impact practices that mimic natural hydrologic processes to restore pre-development conditions. The Maryland Stormwater Act of 2007 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 best management practices (BMPs) is to distribute flow throughout a development site and reduce stormwater runoff leaving that site. This will also reduce pollutant loads and sediment caused by erosive velocities.

A total of 457 existing SWM facilities are located within the Upper Gwynns Falls watershed including dry and wet ponds, wetlands, infiltration/filtration practices, extended detention, proprietary BMPs and underground detention facilities. Existing SWM facilities treat a total drainage area of approximately 5,481 acres of urban land or 40 percent of the total urban land use in the watershed.

3.2.2 Stormwater Management Conversions

Detention ponds are typically designed to address water quantity only (flood control) and therefore, provide almost no pollutant removal. Therefore, they are good candidates for conversion to a type of facility that provides water quality benefits in addition to quantity control. The 57 existing detention ponds within the Upper Gwynns Falls watershed were investigated for potential conversion to water quality management facilities. For example, dry extended detention ponds are designed to capture and retain stormwater runoff from a storm to allow sediment and pollutants to settle out while also being able to provide flood control. Out of the 57 detention ponds assessed, 51 were considered to have potential for conversion for water quality.

3.2.3 Stormwater Retrofits

Stormwater retrofits involve implementing BMPs in existing developed areas where SWM practices do not 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 were identified as having sufficient open space for stormwater retrofits to treat runoff from impervious areas. These areas included institutional sites and hot spots showing no evidence of SWM facilities in areas that were larger than 0.25 acres.

Impervious surfaces including roads, parking lots, roofs and other paved surfaces prevent precipitation from naturally infiltrating into the ground. As a result, impervious surface runoff can result in erosion, flooding, habitat destruction, and increased pollutant loads in receiving water bodies. Subwatersheds with high amounts of impervious cover are more likely to have degraded stream systems and are larger contributors to water quality problems in a watershed than those that are less developed as discussed in the Upper Gwynns Falls Characterization Report (Appendix E), Chapter 2.3.2. Removing impervious cover and converting to pervious or forested land will help promote infiltration of runoff and reduce pollutant loads from overland runoff. Unused or unmaintained impervious surfaces with the potential for removal were identified at three faith-based institutions. The areas of these impervious surfaces were used to estimate potential pollutant load reductions as a result of impervious cover removal activities. While not included in pollutant reduction calculations, awareness and outreach tools could 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.

3.2.4 Stream Restoration

Stream restoration practices are used to enhance the appearance, stability and aquatic function of urban stream corridors. Stream restoration practices range from routine stream cleanups and simple stream repairs such as vegetative bank stabilization and localized grade control to comprehensive repairs such as full channel redesign and realignment. Stream stability assessments (SSAs) performed in Upper Gwynns Falls showed opportunities for stream repair, stream cleanups, and buffer reforestation. Stream corridors noted as having significant erosion and channel alteration during the SSAs are used to estimate pollutant load reductions for potential stream repair efforts. Stabilizing the stream channel improves water quality by preventing soils, and the pollutants contained in them, from eroding from the bank and entering the Gwynns Falls. Lengths of eroded and altered channel segments were recorded during SSAs.

3.2.5 Community Reforestation

The Community Reforestation Program (CRP) established by Baltimore County provides a dedicated workforce for planting, monitoring, and maintaining forest mitigation projects. The program is funded through fees-in-lieu of mitigation for forests removed as a result of public and private land development, as required by the implementation of the county's Forest Conservation Act and Chesapeake Bay Critical Area Regulations.

3.2.6 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, oil and metals, in the stream. Excessive organic matter can clog storm drains and fill streams resulting in costly maintenance. In addition, decay of a disproportionate amount of organic matter in the stream can take away oxygen needed to support aquatic life.

Neighborhoods with significant trash and/or organic matter accumulated along curbs were recommended for street sweeping during neighborhood source assessments (NSAs). These areas were referred to Baltimore County Department of Public Works staff to determine whether street sweeping is conducted in the neighborhood and at what frequency. Adding a targeted neighborhood to the sweeping route or increasing frequency of sweeping would address build-up of excessive curb and gutter material.

3.2.7 Illicit Connection Detection/Discussion

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 its 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 analyses due to the uncertainty in the contribution of illicit connections to overall pollutant loading rates. However, this program will provide a margin of safety in the overall nutrient reduction strategy.

3.2.8 Sanitary Sewer Consent Decree

In September 2005, USEPA and MDE issued a consent decree to Baltimore County with deadlines to reduce and eliminate sanitary sewer overflows (SSOs). Implementation of work (capital projects, equipment, operations and maintenance improvements) in compliance with the consent decree will result in a reduction of nutrients and bacteria entering streams in the Upper Gwynns Falls watershed.

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 the watershed that would not be possible otherwise. Citizen participation is critical to the implementation and long-term maintenance of restoration activities. Key citizen-based strategies proposed for restoring Upper Gwynns Falls are discussed in the following sections.

3.3.1 Reforestation

Trees help 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 branches also intercept precipitation which helps to reduce the energy of raindrops and prevent any erosion resulting from their impact on the ground. In addition to water quality improvements, 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 Tree-Mendous Maryland and State Highway Administration's (SHA) Partnership Program for public property and the Growing Home Campaign for private property, can help increase the success of planting efforts. Several areas throughout the watershed are targeted for reforestation opportunities and are described below.

Riparian Buffer

Stream riparian buffers are critical to maintaining healthy streams and rivers. Forested buffer areas along streams can improve water quality and prevent flooding since they can filter pollutants, reduce surface runoff, stabilize stream banks, trap sediment, and provide habitat for various types of terrestrial and aquatic life including fish. Buffer encroachment from development was noted during upland assessments 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 trees and/or create a no-mow area adjacent to streams. Open pervious areas identified within the 100-foot stream buffer areas via a GIS analysis in the Watershed Characterization Report are good candidates for tree planting and are targeted for initial buffer reforestation efforts as per Appendix E, Chapter 2.2.6.2.

Upland Pervious Areas

Converting 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. Large open areas identified in the pervious area assessments (PAAs) should be further investigated for tree planting potential. Publicly-owned lands requiring minimal site preparation are targeted for initial reforestation efforts.

Street and Shade Tree Plantings

Several opportunities for neighborhood street tree plantings were identified during NSAs. Opportunities for open space and shade tree plantings were also identified at several institutional sites and in some multi-family neighborhoods. Street trees and open space shade trees provide aesthetic value and air and water quality benefits. They can 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 a street 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

Downspout disconnection can help reduce runoff and pollutants introduced to storm drains and local streams. This can be achieved through disconnecting downspouts from the storm drains and impervious areas, and redirecting them to pervious areas, rain barrels and/or rain gardens. A combination of outreach/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 the Back River and Jones Falls watersheds by Blue Water Baltimore (BWB) and Center for Watershed Protection (CWP). Results from these programs can be used to determine successful techniques and strategies for Upper Gwynns Falls.

3.3.3 Urban 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 primary citizen-based strategy. Yards and lawns typically represent a significant portion of the pervious cover in an urban subwatershed and therefore, can be a major source of nutrients, pesticides, sediment, and runoff. Maintenance behaviors tend to be similar within individual neighborhoods and certain activities can impact subwatershed quality such as fertilizer, herbicide and pesticide use, watering, landscaping, and trash/yard waste disposal. Urban nutrient management efforts related to lawn maintenance and Bayscaping can help reduce nutrient loads 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 management of herbicides and pesticides, and over-watering resulting in polluted runoff to local streams. Lawns with a dense, uniform grass cover or signs designating poisonous lawn care indicate high lawn maintenance activities. Neighborhoods identified as having high lawn maintenance issues are targeted for awareness programs emphasizing responsible fertilizing techniques such as proper application rates and time of year for fertilization, soil testing for nutrient requirements and keeping fertilizers off of 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.

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, herbicides, 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. A combination of outreach/awareness techniques and financial incentives can be used to implement a Bayscaping program in neighborhoods identified as potential candidates during NSAs.

3.4 Pollutant Loading & Removal Analyses

This section presents results of the watershed pollutant loading analysis performed to estimate current nutrient loads generated by the various non-point sources within the Upper Gwynns Falls watershed. Also discussed are the pollutant removal calculations for proposed BMPs to ensure that TMDL requirements are met in the Upper Gwynns Falls.

3.4.1 Pollutant Loading Analysis

A pollutant loading analysis was performed to estimate total nitrogen and phosphorus loads currently generated by all non-point sources (i.e., runoff from all land uses) present within the Upper Gwynns Falls watershed. Estimates were based on Maryland Department of Planning's (MDP) 2007 Land Use/Land Cover (LU/LC) GIS layer and pollutant loading rates developed by MDE for non-urban land uses and Chesapeake Bay Program (CBP) for urban land uses. The pollutant loading analysis is described in detail in Appendix E, Chapter 3.5. The table below summarizes results from the watershed pollutant loading analysis including areas, nutrient loadings rates, and annual nutrient loads for each nonpoint source/land use type.

Table 3-1: Upper Gwynns Falls Nitrogen and Phosphorus Loads

Source	Area (acres)	Nitrogen Rate (lbs/ac)	Nitrogen Load (lbs/yr)	Phosphorus Rate (lbs/yr)	Phosphorus Load (lbs/yr)
Impervious Urban	2,768	14.10	39,029	2.26	6,256
Pervious Urban	6,595	7.25	47,814	0.43	2,836
Cropland	652	16.55	10,791	0.72	469
Pasture	279	7.35	2,051	0.73	204
Livestock	5	24.87	124	1.18	6
Forest and Wetlands	3,196	1.41	4,506	0.02	64
Water	17	10.05	171	0.57	10
Bare Soil	102	7.35	750	0.73	74
Totals	**13,614**		**123,329**		**12,756**

As discussed in Chapter 1, a TMDL analysis showed that a 15 percent reduction in nitrogen and phosphorus loads from urban stormwater discharges is necessary to meet water quality standards in Baltimore Harbor. The load reductions needed within Upper Gwynns Falls to achieve this additional 15 percent reduction are summarized in the table below. Note that a 15 percent reduction was applied to the pollutant load from urban runoff sources (i.e., impervious and pervious urban), since the nutrient TMDL relates to urban sources only.

Table 3-2: Upper Gwynns Falls Nitrogen and Phosphorus Load Reduction Requirements

Source	Area (acres)	TN Load (lbs/yr)	TP Load (lbs/yr)
Urban	9,363	86,843	9,092
15% Reduction:		**13,026**	**1,363**

When the pollutant load reductions allocations to meet the Chesapeake Bay TMDL are made available in July 2011, the amount of nitrogen and phosphorous reductions needed will be re-assessed.

3.4.2 Pollutant Removal Analysis

The following sections present a quantitative analysis of pollutant removal capabilities of proposed BMPs to ensure that the 15% reduction in nutrient loads from urban runoff in the Upper Gwynns Falls watershed is 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 5.2 CBP Watershed Model. These tables 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 one based on projected participation for each BMP.

3.4.2.1 Implemented Capital Improvement Projects

The County has implemented two stream restorations in the project area, and currently five detention pond conversions are in design. Pollutant loads were estimated by the county based on the contributing drainage area (DA) and corresponding land use-specific pollutant loading rates. Load reduction is calculated as the product of the pollutant load and removal efficiency. Wet pond pollutant removal efficiencies are 20% for total nitrogen and 45% for total phosphorus per the values shown in Appendix C under Urban and Mixed Open BMPs, Stormwater Management. A summary of existing wet pond load reductions are shown in the table below.

Table 3-3: Capital Improvement Project Load Reductions

Project	Facility Type	Year	TN Removal Rate (lbs/yr)	TP Removal Rate (lbs/yr)
UGF 5 Facilities*	SWM Conversion	2011	315.5	74.2
Gwynns Falls @ Chartley	Stream Restoration	2006	404.0	21.4
Gwynns Falls @ Gwynnbrook	Stream Restoration	2009	505.0	26.8
		Totals:	**1,224.5**	**122.4**

* These projects are currently under design / construction and the removal rates are projected using the CBP recommended removal efficiencies.

3.4.2.2 Existing Stormwater Management (SWM)

As described in detail in Appendix E, Chapter 2.3, there are 457 existing SWM facilities in the Upper Gwynns Falls watershed including dry and wet ponds, wetlands, infiltration/filtration practices, extended detention, proprietary BMPs and other types of SWM facilities (i.e., underground detention). The pollutant removal capability of existing SWM 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 CBP recommended removal efficiencies 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:

$$\left[9.28(lbs/ac/yr) \times DA(acres)\right] \times efficiency(\%)$$

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

$$\left[0.97(lbs/ac/yr) \times DA(acres)\right] \times efficiency(\%)$$

The pollutant load received from the drainage area contributing to the SWM facility is denoted by the first expression in brackets in both of the above equations. The pollutant loading rates shown, 9.28 lbs TN/ac/yr and 0.97 lbs TP/ac/yr, represents the weighted average of impervious and pervious urban rates used in the pollutant loading analysis (Table 3.2) since this represents the likely sources of runoff being treated. The nitrogen loading rate was calculated by adding the total load of nitrogen from pervious urban area to the total load of nitrogen from impervious urban area and dividing by the sum of the pervious urban area and impervious urban area. The phosphorous loading rate was calculated by adding the total load of phosphorous from pervious urban area to the total load of phosphorous from impervious urban area and dividing by the sum of the pervious urban area and impervious urban area. Note that impervious and pervious urban loading rates are based on CBP's Watershed Model Phase 5.2. The percent pollutant removal efficiency depends on the type of facility and is based on the values shown in Appendix C under Urban and Mixed Open BMPs, Stormwater Management. 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 the table below.

Table 3-4: Existing SWM Load Reductions

SWM Facility Type	No. (#)	DA (acres)	TN Load from DA (lbs/yr)	TN Removal Efficiency (%)	Max Potential TN Load Reduction (lbs/yr)	TP Load from DA (lbs/yr)	TP Removal Efficiency (%)	Max Potential TP Load Reduction (lbs/yr)
Detention	113	2,004.8	18,604.5	5%	930.2	1,944.7	10%	194.5
Extended Detention	186	2,512.9	23,319.7	20%	4,663.9	2,437.5	20%	487.5
Wet Pond	15	368.2	3,416.9	20%	683.4	357.2	45%	160.7
Infiltration Practices	55	150.3	1,394.8	85%	1,185.6	145.8	85%	123.9
Filtration Practices	88	445.1	4,130.5	40%	1,652.2	431.7	60%	259.0
Totals	457	5,481.3	**50,866.5**		**9,115.3**	**5,316.9**		**1,225.7**

3.4.2.3 Stormwater Management Conversions

As described previously, 51 out of the 57 existing dry detention ponds surveyed have the potential for conversion to wet ponds or wetland type facilities that have a higher capacity for nutrient removal. Pollutant reductions for SWM conversions are calculated based on the approximate pollutant load received from the drainage area (DA) and the increase in removal efficiency based on BMP efficiencies recommended by CBP for detention facilities and wet pond and wetland facilities. The equation used to estimate total nitrogen (TN) load reductions for SWM conversions is expressed as:

$$\left[9.28(lbs/ac/yr)\times DA(acres)\right]\times 15\%$$

The equation used to estimate total phosphorus (TP) load reductions for SWM conversions is expressed as:

$$\left[0.97(lbs/ac/yr)\times DA(acres)\right]\times 35\%$$

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. Similar to existing SWM, the pollutant loading rates shown, 9.28 lbs TN/ac/yr and 0.97 lbs TP/ac/yr, represent the weighted average of impervious and pervious urban rates used in the pollutant loading analysis (Table 3.2) since this represents the likely sources of runoff being treated. The increased pollutant removal capacity is represented by the second expression in the equations above. This is the difference between pollutant removal efficiencies of wet ponds and detention facilities, based on CBP guidance shown in Appendix C under Urban and Mixed Open BMPs, Stormwater Management. A summary of SWM conversion load reduction calculations and results are shown in the table below.

Table 3-5: SWM Conversion Load Reductions

REMOVAL EFFICIENCY					
Pollutant	**Total DA for SWM Conversion (acres)**	**Dry Detention Pond (%)**	**Wet Ponds and Wetlands (%)**	**Increase in Efficiency (%)**	**Max Potential Load Reductions (lbs/yr)**
TN	1,242.7	5	20	15	**1,729.8**
TP	1,242.7	10	45	35	**421.9**

3.4.2.4 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, alleys) which are currently untreated. This includes sites identified for retrofit potential during the uplands surveys for neighborhoods, institutions, hotspots, and pervious areas. Pollutant reductions for stormwater retrofits are calculated based on the approximate pollutant load received from the impervious drainage area (DA) and removal efficiency of infiltration type BMPs. The equation used to estimate total nitrogen (TN) load reductions for stormwater retrofits is expressed as:

$$\left[14.1(lbs/ac/yr)\times DA(acres)\right]\times 85\%$$

The equation used to estimate total phosphorus (TP) load reductions for stormwater retrofits is expressed as:

$$\left[2.26(lbs/ac/yr) \times DA(acres)\right] \times 85\%$$

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, 14.1 lbs TN/ac/yr and 2.26 lbs TP/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 reported for infiltration practices, based on CBP guidance shown in Appendix C under Urban and Mixed Open BMPs, Stormwater Management. A summary of stormwater retrofit load reduction calculations and results are shown in the table below.

Table 3-6: Stormwater Retrofit (Infiltration Practices) Load Reductions

REMOVAL EFFICIENCY					
Pollutant	**Impervious Urban Loading Rate (lbs/ac/yr)**	**Impervious Area for SW Retrofits (acres)**	**Load from DA (lbs/yr)**	**Removal Efficiency (%)**	**Max Potential Load Reductions (lbs/yr)**
TN	14.1	21.5	303.15	85%	**257.7**
TP	2.26	21.5	48.6	85%	**41.3**

3.4.2.5 Impervious Cover Removal

Potential sites for impervious cover removal were identified at several 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 total nitrogen (TN) load reductions for stormwater retrofits is expressed as:

$$\left[14.1(lbs/ac/yr) - 7.255(lbs/ac/yr)\right] \times imperviousArea(acres)$$

The equation used to estimate total phosphorus (TP) load reductions for stormwater retrofits is expressed as:

$$\left[2.26(lbs/ac/yr) - 0.429(lbs/ac/yr)\right] \times imperviousArea(acres)$$

Impervious cover removal would involve converting impervious surfaces to pervious surfaces. 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 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. A summary of impervious cover removal reduction calculations and results are shown in the table below.

Table 3-7: Impervious Cover Removal Load Reductions

REMOVAL EFFICIENCY					
Pollutant	**Impervious Urban Loading Rate (lbs/ac/yr)**	**Pervious Urban Loading Rate (lbs/ac/yr)**	**Reduction in Loading Rate (lbs/ac/yr)**	**Impervious Area (acres)**	**Max Potential Load Reduction (lbs/yr)**
TN	14.1	7.255	6.845	1.0	**6.8**
TP	2.26	0.429	1.831	1.0	**1.8**

3.4.2.6 Stream Buffer Reforestation

The current vegetative condition of the stream riparian buffer (100 feet on either side of stream system) was analyzed in Appendix E, Chapter 2. Buffer conditions were classified as impervious, open pervious or forested areas. Open pervious areas are the best areas to initially target for restoration. Approximately 785 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 (Appendix C). The equation used to estimate the total nitrogen (TN) load reduction for the land use conversion portion of stream buffer reforestation is expressed as:

$$\text{Land Use Conversion (TN)} = \left[7.255(lbs/ac/yr) - 1.41(lbs/ac/yr)\right] \times OpenBufferArea(acres)$$

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

$$\text{Land Use Conversion (TP)} = \left[0.429(lbs/ac/yr) - 0.02(lbs/ac/yr)\right] \times OpenBufferArea(acres)$$

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. This reduction in loading rate is then multiplied by the available open pervious area for reforestation to determine the loads 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 BMP performance guidance in Appendix C, one acre of buffer treats one acre of upland area with a nitrogen reduction efficiency of 25% for urban and mixed open buffers. The total nitrogen (TN) load reductions for the removal efficiency portion of buffer reforestation can be expressed as:

$$\text{Buffer BMP Removal (TN)} = \left[OpenBufferArea(acres) \times 9.06(lbs/ac/yr)\right] \times 25\%$$

Similarly, an efficiency of 50% for P for urban and mixed open buffers is applied to the buffer acreage being reforested. The total phosphorus (TP) load reductions for the removal efficiency portion of buffer reforestation can be expressed as:

$$\text{Buffer BMP Removal (TP)} = \left[OpenBufferArea(acres) \times 0.94(lbs/ac/yr)\right] \times 50\%$$

The loading rates shown in the equations above, 9.06 lbs TN/ac/yr and 0.94 lbs TP/ac/yr, represent overall watershed loading rates. This is estimated as the total watershed nutrient load (123,329 lbs TN/yr and 12,756 lbs TP/yr) divided by the total watershed area (13,614 acres). These are used to calculate the pollutant load from the upland area that would be treated by 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 reduction calculations and results are shown in the table below.

Table 3-8: Stream Buffer Reforestation Load Reductions

		LU CONVERSION		BUFFER BMP REMOVAL			
Pollutant	**Open Pervious Area (acres)**	**Reduced Loading Rate (lbs/ac/yr)**	**Land Use Conversion Reduction (lbs/yr)**	**Reduction Efficiency (%)**	**Overall Watershed Loading Rate (lbs/ac/yr)**	**Efficiency Load Reduction (lbs/yr)**	**Max Potential Load Reduction (lbs/yr)**
TN	785	5.845	4588,3	25	9.06	1778.0	6366.4
TP	785	0.409	321.1	50	0.94	369.0	690.0

3.4.2.7 Pervious Area Reforestation

Nine open pervious areas with reforestation potential were identified in the watershed. Pollutant reductions for pervious area reforestation are calculated based on a land use conversion from pervious urban to forest. The equation used to estimate total nitrogen (TN) load reductions for pervious area reforestation is expressed as:

Land Use Conversion (TN) = $[7.255(lbs/ac/yr) - 1.41(lbs/ac/yr)] \times OpenPerviousArea(acres)$

The equation used to estimate total phosphorus (TP) load reductions for pervious area reforestation is expressed as:

Land Use Conversion (TP) = $[0.429(lbs/ac/yr) - 0.02(lbs/ac/yr)] \times OpenPerviousArea(acres)$

Pervious area reforestation would 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. A summary of pervious area reforestation reduction calculations and results are shown in the table below.

Table 3-9: Pervious Area Reforestation Load Reductions

Pollutant	**Pervious Urban Loading Rate (lbs/ac/yr)**	**Forest Loading Rate (lbs/ac/yr)**	**Reduced Loading Rate (lbs/ac/yr)**	**Open Pervious Area (acres)**	**Max Potential Load Reduction (lbs/yr)**
TN	7.255	1.41	5.845	71.8	419.7
TP	0.429	0.02	0.409	71.8	29.4

3.4.2.8 Stream Corridor Restoration

Stream corridor restoration practices are used to enhance the appearance, stability, and aquatic function of stream corridors. Practices include simple stream cleanups, stream stabilization (including vegetative bank stabilization and grade control) and stream restoration (including redesign and re-alignment). Stream restoration projects can be combined with sewer capital repair projects to obtain additional funding and gain water quality benefits for less cost. Similar projects such as Minebank Run stream restoration have been successfully completed by Baltimore County. The Chartley and Gwynnbrook Avenue stream restoration projects were recently completed in UGF-D to reduce erosion, increase infiltration and enhance the riparian buffer. Areas outside of the stream corridor assessments can be targeted based on citizen complaints and data collected in the upland assessments.

Several potential stream restoration sites were identified during the stream corridor assessments (see Appendix G) to improve water quality and address stream stability issues, such as significant erosion and channel alterations. Pollutant load reduction estimates in pounds per linear foot of stream restoration were developed by the County based on a re-analysis of Spring Branch data presented in the NPDES 2006 Annual Report and also used in other SWAPs prepared by Baltimore County. These were also used to calculate load reductions for proposed stream restoration activities (i.e., restoration lengths [RL]) in the Upper Gwynns Falls. The equation used to estimate total nitrogen (TN) load reductions for stream restoration is expressed as:

$$0.202(lbs/ft) \times RL(ft)$$

The equation used to estimate total phosphorus (TP) load reductions for stream restoration is expressed as:

$$0.0107(lbs/ft) \times RL(ft)$$

The analysis based on the stream corridor assessments determined that 26 percent of streams in UGF-D, 42 percent of streams in Roche's Run, 23 percent of streams in UGF-B, 20 percent of streams in Red Run, and 19 percent of streams in Horsehead Branch are considered unstable. Extrapolating these numbers to the stream length determined in Appendix E, Chapter 2.2.6, it can be determined that there are 19.6 miles (103,494 feet) of stream restoration potential in the SWAP study area. A summary of stream corridor restoration reduction calculations and results are shown in the table below. A weighted percentage of unstable stream miles was used.

Table 3-10: Stream Corridor Restoration Load Reductions

Pollutant	Reduction in Loading Rate (lbs/ft)	Length of Stream (ft)	Unstable Ratio (%)	Estimated Stream Restoration Length (ft)	Max Potential Load Reduction (lbs/yr)
TN	0.202	442,675	23.4	103,494	20,906
TP	0.0107	442,675	23.4	103,494	1,107

3.4.2.9 Downspout Disconnection

A total of 35 neighborhoods (out of 79 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 impervious area and 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 survey, 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 Appendix E, Chapter 4.

Pollutant reductions for downspout disconnection are calculated based on the pollutant load received from the total rooftop drainage area (DA) recommended for disconnection and the removal efficiency of infiltration type BMPs. The equation used to estimate total nitrogen (TN) load reductions for downspout disconnection is expressed as:

$$[14.1(lbs/ac/yr) \times DA(acres)] \times 40\%$$

The equation used to estimate total phosphorus (TP) load reductions for downspout disconnection is expressed as:

$$[2.26(lbs/ac/yr) \times DA(acres)] \times 60\%$$

The pollutant load received from the impervious rooftop drainage area recommended for disconnection is denoted by the first expression in brackets in the equations above. The pollutant loading rates shown, 14.1 lbs TN/ac/yr and 2.26 lbs TP/ac/yr, are the impervious urban rates used in the pollutant loading analysis. Pollutant removal efficiencies are those reported for filtration practices, based on CBP guidance shown in Appendix C under Urban and Mixed Open BMPs, Stormwater Management. A summary of downspout disconnection load reduction calculations and results are shown in the table below.

Table 3-11: Downspout Disconnection Load Reductions

Pollutant	Impervious Urban Loading Rate (lbs/ac/yr)	DA (Rooftop area recommended for downspout disconnect) (acres)	Removal Efficiency (%)	Max Potential Load Reduction (lbs/yr)
TN	14.1	96.5	40	544.3
TP	2.26	96.5	60	130.9

3.4.2.10 Tree Plantings

Approximately 85% of the 79 neighborhoods surveyed had opportunity for planting street and open space shade trees. Similarly, tree planting opportunities were also identified at many institutional sites investigated. For both neighborhood and institutional tree planting opportunities, the number of trees was estimated based on a spacing of one tree per 15 to 20 feet. Pollutant reductions for pervious area reforestation are calculated based on a land use conversion from pervious urban to forest. An approximation of 200 trees per acre is used to calculate the area available for conversion. The equation used to estimate total nitrogen (TN) load reductions for tree plantings is expressed as:

$$[7.255(lbs/ac/yr) - 1.41(lbs/ac/yr)] \times \left[\#Trees \times \frac{1(acre)}{200(trees)} \right]$$

The equation used to estimate total phosphorus (TP) load reductions for tree plantings is expressed as:

$$[0.429(lbs/ac/yr) - 0.02(lbs/ac/yr)] \times \left[\#Trees \times \frac{1(acre)}{200(trees)} \right]$$

Tree plantings would 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). A summary of tree planting load reduction calculations and results are shown in the tables below.

Table 3-12: Neighborhood 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 NSAs (#)	New Forested Area (acres)	Max Potential Load Reduction (lbs/yr)
TN	7.255	1.41	5.845	5,915	29.6	172.9
TP	0.429	0.02	0.409	5,915	29.6	12.1

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 Forested Area (acres)	Max Potential Load Reduction (lbs/yr)
TN	7.255	1.41	5.845	1,296	6.5	37.9
TP	0.429	0.02	0.409	1,296	6.5	2.7

3.4.2.11 Urban Nutrient Management

Urban nutrient management refers to educating citizens about environmentally friendly lawn care techniques. This includes the reduction/elimination of fertilizer and pesticide use and reducing the amount of mowed lawn via Bayscaping. Neighborhoods targeted for fertilizer reduction/education were those where 20% or more of the homes appeared to employ high lawn maintenance practices (39 out of 79 NSAs). Neighborhoods targeted for Bayscaping education were those where the typical lot was at least ¼ acre in size, was less than 25% landscaped, and where there was sufficient grass area available (75 out of 79 NSAs).

Pollutant reductions for urban nutrient management are calculated based on the pollutant load received from the lawn drainage area (DA) recommended for fertilizer reduction. The drainage area of high maintenance lawns recommended for nutrient load reduction was calculated by analyzing the average lot size in each NSA where 20% or more of the homes appeared to employ high lawn maintenance practices. For each neighborhood meeting the 20% requirement, the average area of lawn (pervious area) on a lot was multiplied by the number of lots in the neighborhood appearing to employ high lawn maintenance, and totaled to determine the drainage area of high maintenance lawns per NSA. This area was totaled per subwatershed (see Table 4-3 in the Characterization Report). The five subwatersheds were then totaled to result in the overall high maintenance lawn drainage area for the Upper Gwynns Falls watershed. The equation used to estimate total nitrogen (TN) load reductions for urban nutrient management is expressed as:

$$[7.255(lbs/ac/yr) \times DA(acres)] \times 17\%$$

The equation used to estimate total phosphorus (TP) load reductions for urban nutrient management is expressed as:

$$[0.429(lbs/ac/yr) \times DA(acres)] \times 22\%$$

The pollutant load received from the lawn area recommended for fertilizer reduction is denoted by the first expression in brackets in the equations above. The pollutant loading rates shown, 7.255 lbs TN/ac/yr and 0.429 lbs TP/ac/yr, are the pervious urban rates used in the pollutant loading analysis (Table 3-1) since this represents the source of runoff being addressed. Pollutant removal efficiencies are those reported for urban nutrient management, based on CBP guidance shown in Appendix C under Urban and Mixed Open BMPs. A summary of urban nutrient management reduction calculations and results are shown in the table below. Since the CBP has not recognized a pollutant reduction efficiency for Bayscaping, it is not included in the calculations.

Table 3-14: Urban Nutrient Management Load Reductions

Pollutant	Pervious Urban Loading Rate (lbs/ac/yr)	High Maintenance Lawns (acres)	Removal Efficiency (%)	Max Potential Load Reduction (lbs/yr)
TN	7.255	2,040.2	17	2,516.3
TP	0.429	2,040.2	22	192.6

3.4.2.12 Street Sweeping

28 neighborhoods were recommended for street sweeping in the Upper Gwynns Falls watershed and contain approximately 62.2 miles of road. Records from the Department of Public Works (DPW) Street Sweeping Program (NPDES Section 3) showed that 0.3 tons (600 lbs) of material were removed per mile of street sweeping in Gwynns Falls in 2009. Based on the average removal rate, there is potential for approximately 18.7 tons (37,320 lbs) of material to be removed from the proposed roadways in Upper Gwynns Falls via street sweeping (i.e., 600 lbs/mi/yr x 62.2 miles = 37,320 lbs/yr). Using conversions provided by the Street Sweeping – Inlet Cleaning Study (CWP, 2008) the total nitrogen and total phosphorous loads removed by street sweeping is calculated. The amount of material removed is converted to total nitrogen (TN) load removed using a concentration of 1,825.95 mg/kg, which is expressed by the following equation:

$$37{,}320(lbs/yr) \times 1{,}825.92(mg/kgTN) \times \frac{1(kg)}{1 \times 10^{6}(mg)}$$

The amount of material removed is converted to total phosphorus (TP) load removed using a concentration of 707.95 mg/kg, which is expressed by the following equation:

$$37{,}320(lbs/yr) \times 707.95(mg/kgTP) \times \frac{1(kg)}{1\times10^{6}(mg)}$$

A summary of street sweeping reduction calculations and results are shown in the table below.

Table 3-15: Street Sweeping Load Reductions

Pollutant	Street Sweeping Bulk Removal Rate (lbs/mi/yr)	Proposed Miles of Street Sweeping (miles)	Total Bulk Load (lbs/yr)	Pollutant Concentration (mg/kg)	Max Potential Load Reduction (lbs/yr)
TN	2,074	62.2	129,003	1,825.92 x 10^{-6}	235.5
TP	2,074	62.2	129,003	707.95 x 10^{-6}	91.3

3.4.2.13 Sanitary Sewer Overflows

A total of 30 sanitary sewer overflow (SSO) events were documented between 2000 and 2008 within Upper Gwynns Falls. An estimated 22,705 gallons were discharged over this 9-year period. Pollutant loads associated with these SSO events and volume were calculated based on the following assumptions (more detail can be found in Appendix E, Chapter 3.3):

- Total Phosphorus (TP): A conversion factor of 8.32×10^{-5} was used to convert gallons of overflow to pounds of pollutant. This is based on a 10 mg/L TP concentration and a multiplier $8.32\times10^{-6}\,lb\cdot L/mg\cdot gal$.
- Total Nitrogen (TN): A conversion factor of 2.5×10^{-4} was used to convert gallons of overflow to pounds of pollutant. This is based on a 30 mg/L TN concentration and a multiplier $8.3\times10^{-6}\,lb\cdot L/mg\cdot gal$.

Based on these conversion factors, approximately 5.68 lbs of total nitrogen and 1.89 lbs of total phosphorus were released over the 9-year period as a result of SSOs. This is equivalent to pollutant reduction capabilities of 0.63 lbs TN/yr (i.e., 5.68 lbs TN/9 yrs) and 0.21 lbs TP/yr (i.e., 1.89 lbs TP/9 yrs). Note that TN and TP concentrations shown above are values for waste and wash water combined from CWP's Watershed Treatment Model version 3.1 (Table 7-6).

3.4.2.14 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 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 the table below.

Table 3-16: Projected Participation Factors

BMP	Projected Participation	Basis of Assumption
Wet Ponds	100%	Existing – pond retrofits already implemented
Existing SWM	100%	Existing – BMPs already implemented
SWM Conversions	50%	Complete 2 conversions
SW Retrofits	25%	General estimate to achieve 15% reduction goal
ISI Impervious Cover Removal	50%	General estimate to achieve 15% reduction goal
Reforest Stream Buffer	10%	General estimate to achieve 15% reduction goal
Pervious Area Restoration	33%	General estimate to achieve 15% reduction goal
Stream Restoration	10%	General estimate to achieve 15% reduction goal
NSA Downspout Disconnection	10%	33% willingness factor*
NSA Tree Plantings	33%	33% willingness factor*
ISI Tree Plantings	33%	60% of estimated trees located on public lands
Urban Nutrient Management	5%	10% recall rate (workshop / public meeting) x 54% willingness factor*
Street Sweeping	10%	General estimate to achieve 15% reduction goal
SSO Reduction / Elimination	100%	Consent Decree requirements

* Projected participation is based on a citizens action survey conducted at an Upper Gwynns Falls Stakeholder Meeting held on September 28, 2010 to gage interest in proposed restoration actions.

Table 3-17 presents a summary of estimated pollutant load reductions for both scenarios – maximum implementation and projected practicable – including how reductions were credited, pollutant removal efficiencies, maximum potential load reductions, units available for restoration, projected participation, and projected load reductions.

The projected implementation of practicable BMP restoration projects, shown in Table 3-16, will meet the 15 percent reduction of nitrogen and phosphorus loads needed to meet water quality standards for Upper Gwynns Falls as specified by the Gwynns Falls TMDL (Appendix G). There is opportunity to achieve greater reductions 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., watershed trash and recycling campaign, tours of completed projects and water trails). These types of actions are not included in the pollutant removal analysis because reduction efficiencies are not well known and difficult to estimate.

The Chesapeake Bay TMDL, currently being revised, is anticipated for completion in July 2011 and will include an updated urban nutrient load requirement for the Gwynns Falls. The restoration strategy presented in this SWAP will be reevaluated to determine whether it is sufficient to meet the updated nutrient reduction requirements per the Chesapeake Bay TMDL. If the proposed BMPs are not sufficient, the restoration strategy will be modified within one year of TMDL approval to meet these new nutrient reduction requirements.

Table 3-17: Summary of Pollutant Load Reduction Estimates

BMP	How Credited	TN Efficiency	TP Efficiency	Max Potential TN Load Reduction (lbs/yr)	Max Potential TP Load Reduction (lbs/yr)	Units Available		Projected Participation	Projected TN Load Reduction (lbs/yr)	Projected TP Load Reduction (lbs/yr)
Capital Improvements Load Reductions	Efficiency	Varies	Varies	657	115	10	Units	100%	1,225	122
Existing SWM	Efficiency	Varies	Varies	9,115	1,226	5,481	Acres	100%	9,115	1,226
SWM Conversions	Efficiency	15%	35%	1,730	422	1,243	Acres	50%	865	211
SW Retrofits (ISI, HSI)	Efficiency	85%	85%	258	41	21.5	Acres	25%	64	10
ISI Impervious Cover Removal	LU Conversion	N/A	N/A	7	2	1.0	Acres	50%	3	1
Reforest Stream Buffer	LU Conversion + Efficiency	25%	50%	6,366	690	785	Acres	10%	637	69
Pervious Area Reforestation	LU Conversion	5.845	0.409	420	29	71.8	Acres	33%	140	10
Stream Restoration	Lbs per Ln Ft	0.202	0.0107	20,906	1,107	103,494	Ft	10%	2,091	111
NSA Downspout Disconnection	Efficiency	40%	60%	544	131	96.5	Acres	10%	54	13
NSA Tree Plantings	LU Conversion	N/A	N/A	173	12.1	29.6	Acres	33%	58	4
ISI Tree Plantings	LU Conversion	N/A	N/A	38	2.7	6.5	Acres	33%	13	1
Urban Nutrient Management	Efficiency	17%	22%	2,516	193	2,040	Acres	5%	126	10
Street Sweeping	Direct Removal	N/A	N/A	236	91	62.2	Miles	10%	24	9
SSO Reduction / Elimination	Direct Removal	N/A	N/A	0.63	0.21	22,705	Gal	100%	0.6	0.2
Total Load Reduction (lbs/yr):				**42,966**	**4,062**				**14,414**	**1,797**
Total Existing Urban Load (lbs/yr):				86,843	9,092				86,843	9,092
Reduction Achieved:				**49%**	**45%**				**17%**	**20%**

CHAPTER 4

UPLAND ASSESMENTS

4.1 Introduction

This chapter describes the criteria and methodology used to rank the 5 subwatersheds compromising the Upper Gwynns Falls watershed (see Figure 4-1). The subwatershed ranking provides a tool for targeting restoration actions by location/waterbody. 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 Upper Gwynns Falls Watershed Characterization Report (Appendix E).

4.2 Subwatershed Prioritization

A ranking methodology was developed to prioritize subwatersheds in terms of restoration need and potential. Subwatersheds are represented by an overall prioritization score on a scale of 60, where 0 denotes the least significant impacts to water quality and 60 corresponds to the greatest water quality improvement potential. The total prioritization score for a subwatershed is comprised of the following ranking criteria:

- Phosphorous and Nitrogen Loads
- Impervious Surfaces
- Neighborhood Restoration Opportunity/Pollution Source Indexes
- Neighborhood Lawn Fertilizer Reduction/Awareness
- Neighborhood Downspout Disconnection
- Neighborhood Trash Management
- Institutional Site Index
- Hotspot Site Index
- Pervious Area Restoration
- Municipal Street Sweeping
- Municipal Stormwater Conversions
- Illicit Discharge Data
- Stream Buffer Improvement
- Stream Corridor Restoration

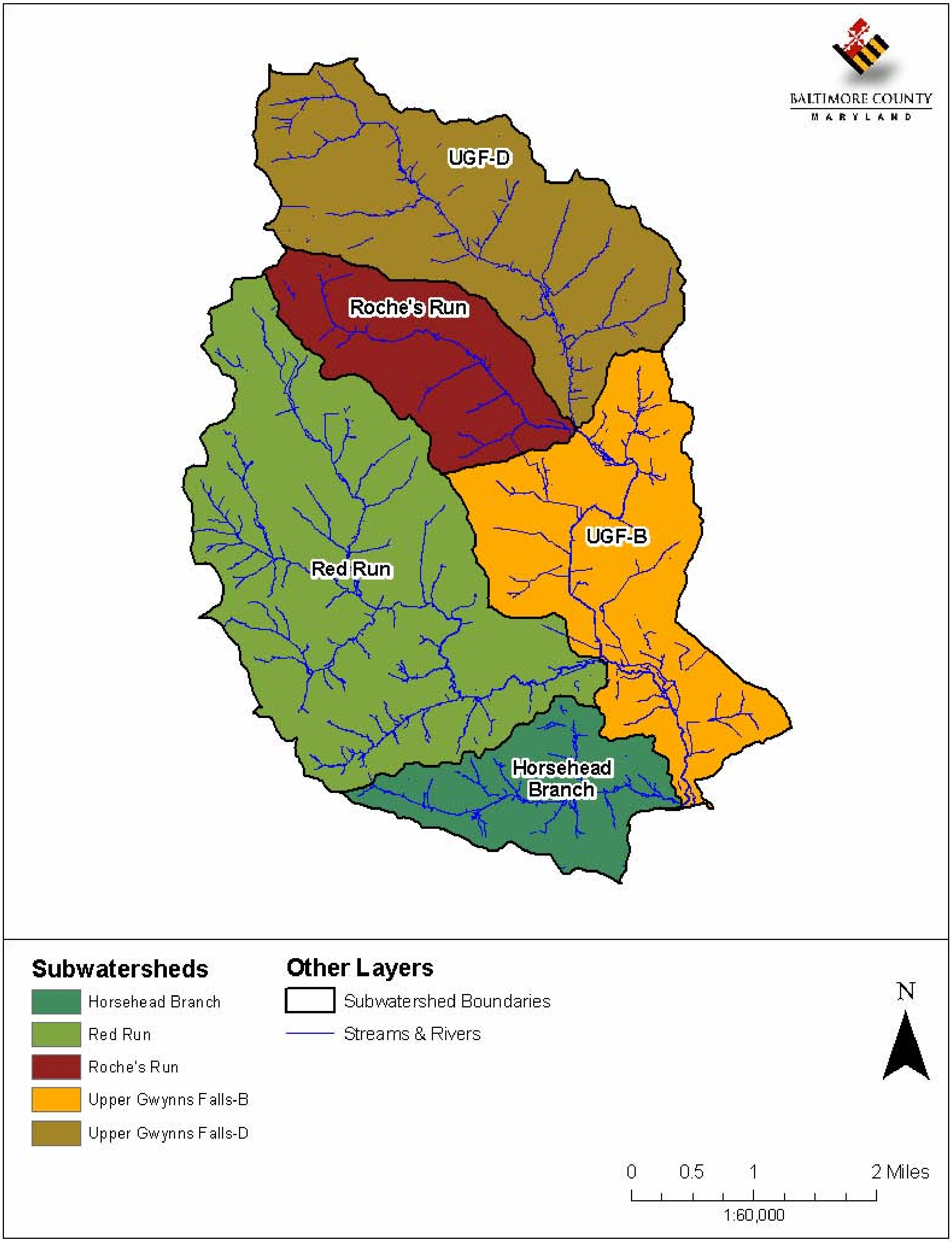

Figure 4-1: Upper Gwynns Falls Subwatershed Breakdown

Each criterion has a maximum possible score of 4. In general, subwatersheds were ranked and grouped based on supporting criterion data to yield a clear distribution of the watersheds per possible score (i.e., 1, 2, 3, 4). In some cases, not all scoring values were used to rank the subwatersheds. Examples include a distribution of data that is too narrow/clustered, on either end of the scale, 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 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 Phosphorous and Nitrogen Loads

One of the objectives to improve and maintain water quality and meet TMDLs in the Gwynns Falls is to reduce annual average total phosphorus and nitrogen loads. Annual pollutant loads (lbs/year) for total nitrogen and total phosphorus were calculated for each subwatershed based on loading rates established by MDE and Chesapeake Bay Program (CBP) for various land use types and subwatershed land use distributions. The pollutant loading analysis for the Upper Gwynns Falls watershed is explained in further detail in Appendix E, Chapter 3.5.

For each subwatershed, annual nitrogen and phosphorus loads were divided by the subwatershed's area. This represents pollutant loadings rates (lbs/acre/year) and allows a direct comparison between the 5 subwatersheds since they vary in size. Subwatersheds with higher pollutant loading rates are higher priorities for restoration within the Upper Gwynns Falls watershed. Therefore, higher pollutant loading rates are assigned high scores to denote greater water quality impacts and restoration need.

Subwatershed nitrogen loading rates ranged from 6.8 to 8.8 lbs/acre/year. The following point system was used to assign nitrogen load scores to the 5 subwatersheds based on the range and distribution of subwatershed nitrogen loading rates:

- ≥ 8.5 lbs/acre/year = 4 pts
- 7.5 – 8.4 lbs/acre/year = 3 pts
- 6.5 – 7.4 lbs/acre/year = 2 pts
- < 6.5 lbs/acre/year = 1 pt

Subwatershed phosphorus loading rates ranged from 0.60 to 0.91 lbs/acre/year. The following point system was used to assign phosphorus load scores to the 5 subwatersheds based on the range and distribution of subwatershed phosphorus loading rates:

- ≥ 0.90 lbs/acre/year = 4 pts
- 0.80 – 0.89 lbs/acre/year = 3 pts
- 0.70 – 0.79 lbs/acre/year = 2 pts
- < 0.70 lbs/acre/year = 1 pt

The point system used for both nitrogen and phosphorus loading rates is a based on data adapted by the Maryland Department of Natural Resources (2005), using loading coefficients reported by Frink (1991). Nitrogen and phosphorus loading rates and corresponding scores are summarized by subwatershed in Table 4-1.

Table 4-1: NSA PSI/ROI Scores

Subwatershed	Nitrogen Loading Rate (lbs/acre/year)	Nitrogen Load Score	Phosphorous Loading Rate (lbs/acre/year)	Phosphorous Load Score
Horsehead Branch	7.6	3	0.63	1
Red Run	6.8	2	0.60	1
UGF-B	8.0	3	0.85	3
Roche's Run	8.8	4	0.91	4
UGF-D	8.3	3	0.76	2

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. Stormwater runoff is concentrated and conveyed directly to the stream system from impervious surfaces, which can cause stream erosion and habitat destruction from the high energy flow and is typically more polluted than runoff generated from pervious areas. Undeveloped watersheds with small amounts of impervious cover typically have better water quality in local streams than urbanized watersheds with greater amounts of impervious cover.

As described in Appendix E, Chapter 2.3.3, 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, percentage of impervious area was used to assign scores as it allows a direct comparison between the 5 subwatersheds. Subwatersheds with higher percentages of impervious cover denote greater water quality impacts and restoration need. These are higher priorities within the Upper Gwynns Falls watershed and are assigned higher scores.

Impervious cover represents about 20 percent of the overall Upper Gwynns Falls watershed. Subwatershed percent impervious values range from 14 to 27 percent. The following point system was used to assign percent impervious scores to the 5 subwatershed based on CWP’s Impervious Cover model and subwatershed impervious surface percentages:

- ≥ 60 percent impervious = 4 pts
- 25 – 59 percent impervious = 3 pts
- 10 – 24 percent impervious = 2 pts
- < 10 percent impervious = 1 pt

The percentage of impervious area and impervious score ratings are summarized for each subwatershed in Table 4-2.

Table 4-2: Percent Impervious Scores

Subwatershed	Total Area (acres)	Roads (acres)	Buildings (acres)	Total Impervious Area (acres)	% Impervious	Impervious Score
Horsehead Branch	1,303.5	107.1	76.0	183.1	14%	2
Red Run	4,753.4	508.4	251.9	760.3	16%	2
UGF-B	2,817.7	511.4	246.6	758.0	27%	3
Roche's Run	1,537.1	252.6	165.3	417.9	27%	3
UGF-D	3,203.1	356.4	292.2	648.6	20%	2

4.2.3 Neighborhood Restoration Opportunity/Pollution Source Indexes

As described in the Appendix E, Chapter 4.2, neighborhood pollution severity and restoration potential were rated during neighborhood source assessments (NSA). The severity of pollution generated by a neighborhood is denoted by the Pollution Severity Index (PSI) and was rated as severe, high, moderate or none. A neighborhood's potential for residential restoration projects was also rated as high, moderate or low according to the Restoration Opportunity Index (ROI). Out of the 78 neighborhoods assessed, 7 were rated with both a high PSI and ROI, 14 neighborhoods were rated with a high PSI and a moderate ROI, 9 neighborhoods were rated with a moderate PSI and a high ROI, and 3 were rated with a moderate PSI and a low ROI. The remaining 45 neighborhoods assessed were considered as having a moderate PSI and a moderate ROI. Neighborhoods with high PSI and high ROI ratings represent the best areas to initially target for restoration.

The highest score (4 points) was given to subwatersheds with 2 or more neighborhoods with both a high PSI and ROI and with 3 or more neighborhoods rated with a high PSI and a moderate ROI. The second highest score (3 points) was given to subwatersheds with two neighborhoods rated with both a high PSI and ROI and less than 3 neighborhoods rated with a high PSI and a moderate ROI. The third highest score (2 points) was given to subwatersheds with only 1 neighborhood rated with both a high PSI and ROI and with less than 3 neighborhoods rated with a high PSI and a moderate ROI. Subwatersheds with no neighborhoods rated with a high ROI were assigned the lowest possible score (1 point). The number of neighborhoods associated with various PSI/ROI ratings and corresponding NSA PSI/ROI scores are summarized by subwatershed in Table 4-3.

Table 4-3: NSA PSI/ROI Scores

Subwatershed	Number of Neighborhoods for PSI/ROI Ratings						NSA PSI/ROI Score
	High/ High	High/ Moderate	High/ Low	Moderate/ High	Moderate/ Moderate	Moderate/ Low	
Horsehead Branch	-	3	-	2	5	-	1
Red Run	2	5	-	4	10	-	4
UGF-B	2	1	-	-	7	1	3
Roche's Run	1	2	-	1	9	1	2
UGF-D	2	3	-	2	14	1	4

4.2.4 Neighborhood Lawn Fertilizer Reduction/Awareness

Lawn maintenance activities often involve over-fertilization, poor pest-management, and overwatering resulting in polluted stormwater runoff to local streams. Lawns with a dense, uniform grass cover or signs designating poisonous lawn care were indicators of high lawn maintenance activities and sources of nutrients originating from lawn fertilizer. Neighborhoods where 20 percent or more of the homes appeared to employ high lawn maintenance practices were recommended for fertilizer reduction/education during the NSAs. This criterion is used for subwatershed prioritization because it has a quantitative pollution reduction efficiency related to nutrient reduction goals.

The acres of lawn addressed if lawn fertilizer reduction/education were initiated in the recommended neighborhoods were calculated in Appendix E, Chapter 4.2.3.2. The percentage of each subwatershed area addressed by lawn fertilizer reduction/education was also calculated and was used to compare the restoration potential among the 5 subwatersheds. Subwatersheds with the highest percentages of lawn addressed through this action denote greatest restoration potential and therefore, were scored the highest. Percentages of subwatershed areas addressed through lawn fertilizer reduction range from 4 to 13 percent. The following point system was used to assign fertilizer reduction scores in each subwatershed based on the distribution and range of percentages of subwatershed area addressed:

- ≥ 30% = 4 pts
- 20 – 29% = 3 pts
- 10 – 19% = 2 pts
- < 10% = 1 pt

The percentage of area addressed by lawn fertilizer reduction and corresponding scores are summarized by subwatershed in Table 4-4.

Table 4-4: NSA Lawn Fertilizer Reduction Scores

Subwatershed	% of Subwatershed Addressed	NSA Lawn Fertilizer Reduction Score
Horsehead Branch	32%	4
Red Run	18%	2
UGF-B	6%	1
Roche's Run	11%	2
UGF-D	19%	2

4.2.5 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. Pervious areas allow runoff to infiltrate into the ground and enter streams through the groundwater system in a more natural and slower fashion. Downspout disconnection is desirable because it decreases flow to local streams during storm events and reduces pollutant loads.

Downspout disconnection was recommended for neighborhoods where at least 25 percent of the downspouts are connected to an impervious area or directly 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. Similar to lawn fertilizer reduction, 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 initiated in the recommended neighborhoods were calculated in Appendix E, Chapter 4.2.3.1. The rooftop acreage addressed through downspout disconnection was calculated for each subwatershed. Subwatersheds with the highest percent of impervious areas that could be addressed through downspout disconnection denote the greatest restoration potential and therefore, were scored the highest. The percent of impervious rooftop that can be redirected ranged from approximately 18 to 64 percent. The following point system was used to assign downspout disconnect scores to the 5 subwatersheds in the Upper Gwynns Falls watershed.

- ≥ 60% = 4 pts
- 40 – 59% = 3 pts
- 20 – 39% = 2 pts
- < 20% = 1 pt

The acreage of impervious rooftop addressed by downspout disconnection and corresponding scores are summarized by subwatershed in Table 4-5.

Table 4-5: NSA Downspout Disconnection Scores

Subwatershed	Percentage of Impervious Rooftop Addressed by Downspout Disconnection	NSA Downspout Disconnect Score
Horsehead Branch	23%	2
Red Run	64%	4
UGF-B	61%	4
Roche's Run	23%	2
UGF-D	18%	1

4.2.6 Neighborhood Trash Management

Trash is one of the major pollutants of concern in the Upper Gwynns Falls watershed. In addition, trash has the potential of becoming a pollutant regulated by USEPA through the TMDL process. For these reasons, NSA results for trash pollution sources and management opportunities were used as a criterion for prioritization. Trash management initiatives involve raising awareness of the trash issue and actions to solve it. Some ways to raise citizen awareness of trash as a problem include community cleanups, trash management awareness (e.g., presentations about recycling, reuse, and disposal options), storm drain markers, and a watershed trash campaign, and/or targeted trash can inspection throughout a neighborhood. Additional strategies to address trash issues within the watershed include end-of-pipe collectors and neighborhood cleanups with dumpsters supplied by Baltimore County.

Neighborhoods where junk or trash was observed in 25 percent of yards were recommended for trash management initiatives. Neighborhoods with less than 25 percent of yards with junk/trash but had other warning signs such as overflowing dumpsters or dumping in alleys or other common areas were also included as a potential source of trash pollution. The acres of land addressed if trash management was implemented in the recommended neighborhoods was calculated for each subwatershed in Appendix E, Chapter 4.2.3.7. The percentages of subwatershed areas addressed via neighborhood trash management were also calculated. This was used to directly compare restoration potential among the 5 subwatersheds with respect to addressing trash issues. Subwatersheds with the highest percentages of area addressed through neighborhood trash management denote the greatest restoration potential and therefore, were scored the highest.

Percentages of subwatershed areas addressed through neighborhood trash management range from approximately 0 to 7 percent. The following point system was used to assign trash management scores to the 5 subwatersheds based on the distribution and range of percentages of subwatershed areas addressed:

- ≥ 7% = 4 pts
- 5.0 – 6.9% = 3 pts
- 3.0 – 4.9% = 2 pts
- < 3.0% = 1 pt

The acreage of land addressed by trash management, percent of NSA area addressed by trash management and the corresponding trash management scores are summarized in Table 4-6 for each subwatershed.

Table 4-6: NSA Trash Management Scores

Subwatershed	Acres of Land Addressed by Trash Management	% of Subwatershed Addressed by Trash Management	NSA Trash Management Score
Horsehead Branch	39.0	7.5%	4
Red Run	57.0	3.5%	2
UGF-B	0.0	0.0%	0
Roche's Run	50.2	6.3%	3
UGF-D	56.0	2.9%	1

4.2.7 Institutional Site Index

Institutions offer unique opportunities for watershed restoration as described in Appendix E, Chapter 4.4. Typically, institutional properties encompass considerable portions of land including various natural resources. In addition, they offer the opportunity to engage in a wide range of citizen restoration activities. This raises citizen awareness while also providing water quality improvement benefits in the watershed. A total of 44 community-based facilities were surveyed during Institutional Site Investigations (ISIs) including cemeteries, faith-based facilities, private schools, public schools, municipal facilities (e.g., fire and rescue stations) and a veterinary hospital. The focus of ISIs is to identify potential restoration opportunities, promote awareness to the community and provide water quality benefits. Subwatersheds with more institutional sites present more opportunities for implementing restoration actions (e.g., 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 of these reasons, subwatershed prioritization for this criterion was based on the number of institutions and considering public over 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 were then added to this number to give a total weighted number. The following point system was used to assign institutional site scores to the five subwatersheds based on the distribution and range ISIs addressed:

- ≥ 15 = 4 pts
- 10 – 14 = 3 pts
- 5 – 9 = 2 pts
- < 5 = 1 pt

The total number of institutions including public versus private ISIs and corresponding institutional site index scores are summarized by subwatershed in Table 4-7.

Table 4-7: Institutional Site Scores

Site ID	# of Public ISIs	Weighted # of Public ISIs (x2)	# of Private ISIs	Total Weighted # of ISIs	ISI Score
Horsehead Branch	0	0	4	4	1
Red Run	3	6	3	9	2
UGF-B	4	8	10	18	4
Roche’s Run	3	6	5	11	3
UGF-D	3	6	9	15	4

4.2.8 Hotspot Site Index

Stormwater hotspots are areas that have potential to generate higher concentrations of stormwater pollutants than typically found in urban runoff and/or have a higher risk of spills, leaks or illicit discharges due to the nature of their operations (CWP 2007). These generally include commercial, industrial, municipal or transport-related operations. Hotspots are either regulated or unregulated. Regulated hotspots are known sources of pollution that abide by applicable federal or state laws (e.g., NPDES permits). Unregulated hotspots are not controlled by any government agency and are potential pollutant sources by the nature of their operations. Stormwater pollutants generated as a result of hotspot operations depend on the specific activities but typically include nutrients, hydrocarbons, metals, chlorides, pesticides, bacteria and trash.

While hotspots have unique operations, drainage systems and pollutant-related risks, the stormwater quality problems can be characterized and evaluated by operations and activities common to most hotspots. Per the USSR manual, the HSI involved an evaluation of six common operations at each potential hotspot: vehicle operations, outdoor materials, waste management, physical plant, turf/landscaping and stormwater infrastructure. The field team investigated the property of each potential hotspot selected for an HSI to determine water quality impacts and restoration opportunities including enforcement measures, follow-up inspections, illicit discharge investigations, retrofits or pollution prevention planning and awareness as described in Appendix E, Chapter 4.3. These six categories were used to standardize the HSI process and be able to prioritize potential restoration efforts. Using these categories each hotspot was ranked as a severe hotspot, confirmed hotspot, potential hotspot or as being not a hotspot. These rankings were used to determine the restoration prioritization score given to each subwatershed. A total of 34 hotspot candidates were investigated.

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 watershed:

- ≥ 15 = 4 pts
- 10 – 14 = 3 pts
- 5 – 9 = 2 pts
- < 5 = 1 pt

Horsehead Branch had one potential hotspot but none confirmed. The Roche’s Run subwatershed scored no points because no hotspots were found. Table 4-8 shows the breakdown of hotspot rankings and scores by subwatershed.

Table 4-8: Hotspot Site Scores

Subwatershed	Not a Hotspot	Potential	Confirmed	Severe	Hotspot Score
Horsehead Branch	0	1	0	0	1
Red Run	1	1	1	0	1
UGF-B	0	10	9	1	4
Roche's Run	0	0	0	0	0
UGF-D	0	6	4	0	3

4.2.9 Pervious Area Restoration

The most likely candidates for successful pervious area restoration efforts are those on public lands with minimal site preparation required. Public sites are eligible for tree planting through DNR’s “Tree-mendous Maryland” program and are good opportunities for volunteer or community projects. 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 number of possible sites, the acreage of land, and ownership of land found in each subwatershed as described in Appendix E, Chapter 4.5. Percentages of subwatershed areas available for pervious area restoration range from approximately 0 to 1.6 percent.

For purposes of this prioritization, sites that are in public ownership are given a greater score because of the greater likelihood that they can be converted to tree cover. The acres of PAAs in public ownership were summed and then multiplied by two to give them a weighted score. The acres of PAAs in private ownership were then added to this number to give a total weighted acreage. The total weighted acreage was then divided by the total acres of the subwatershed to normalize the acreage across the five subwatersheds. The following point system was used to assign pervious area scores to the five subwatersheds based on the distribution and range of percentages of subwatershed areas addressed:

- ≥ 1.5% = 4 pts
- 1.0 – 1.4% = 3 pts
- 0.5 – 0.9% = 2 pts
- < 0.5% = 1 pt

Red Run did not score as there were no potential pervious areas identified. Public pervious area acreages and corresponding scores are summarized by subwatershed in Table 4-9.

Table 4-9: Pervious Area Scores

Site ID	Public Acres	Weighted Public Acres (x2)	Private Acres	Total Weighted Acres	% Acres Per Subwatershed	PAA Score
Horsehead Branch	0.0	0.0	50.0	50.0	1.56%	4
Red Run	0.0	0.0	0.0	0.0	0.00%	0
UGF-B	3.0	6.0	6.2	12.2	0.43%	1
Roche's Run	3.9	7.8	0.5	8.3	0.17%	1
UGF-D	4.9	9.8	3.3	13.1	1.00%	3

4.2.10 Municipal Street Sweeping

Baltimore County provides street sweeping services throughout their jurisdiction to help remove trash, sediment and other organic matter such as leaves and grass clippings from the curb and gutter system. This activity prevents the materials from entering the storm drain system and nearby streams in concentrated amounts. Street sweeping also reduces sediment and other pollutant loads such as oil and metals to the stream system. During the NSAs, neighborhoods where 20 percent or more of the curbs and gutters were covered with excessive trash, sediment, and/or organic matter were recommended for street sweeping. As described in Appendix E, Chapter 4.2.3.6, the miles of street addressed if street sweeping were implemented in the recommended neighborhoods was estimated by subwatershed. Subwatersheds with the most miles of road that could be addressed through street sweeping denote the greatest restoration potential and therefore, were scored the highest. Miles addressed through street sweeping range from 2.5 to 20.2. The following point system was used to assign street sweeping scores to the 5 subwatersheds based on the distribution and range of miles addressed:

- ≥ 15 miles = 4 pts
- 10 – 14 miles = 3 pts
- 5 – 9 miles = 2 pts
- < 5 miles = 1 pt

The miles of road recommended for street sweeping and the corresponding street sweeping scores are summarized by subwatershed in Table 4-10.

Table 4-10: Municipal Street Sweeping Scores

Subwatershed	Miles of Road Recommended for Street Sweeping	Street Sweeping Score
Horsehead Branch	2.55	1
Red Run	20.20	4
UGF-B	5.76	2
Roche's Run	14.25	3
UGF-D	19.48	4

4.2.11 Illicit Discharge Data

Baltimore County tracks illicit discharges through a program of routine outfall screening. Illicit discharges refer to leaking pipes or incorrectly connected pipes. Baltimore County has an outfall prioritization system based on data from the outfall screening. The system allows for a more streamlined approach in selecting outfalls to screen and provides a more efficient use of manpower. In addition, the system allows for outfalls screened once or not at all *(Priority 0)* to be screened sufficiently (three or more times) and properly prioritized. The list of outfalls to be screened is generated by a Microsoft Access query based on the prioritization scheme.

The outfall prioritization system works as follows: (1) Outfalls not screened three times are not prioritized. (2) Outfalls screened three or more times are assigned one of the following three priority ratings:

- *Priority 0 (Not Prioritized)* rating – Outfalls with insufficient data to determine a priority rating. This may be due to inaccessibility or only a single screening.
- *Priority 1 (Critical)* rating - Outfalls with major problems that require immediate correction and/or close monitoring, or outfalls with recurrent problems. These outfalls are sampled four times each year.
- *Priority 2 (High)* rating - Outfalls with moderate to minor problems that have the potential to become severe. These outfalls are sampled once a year.
- *Priority 3 (Low)* rating - Outfalls with minor or no problems that do not require close monitoring. These outfalls are sampled on a ten-year cycle.

There are 49 major outfalls in the Upper Gwynns Falls watershed as described in Appendix E, Chapter 3.2.5. Subwatersheds with the most illicit discharge data and highest prioritization ratings represent the best areas to target for restoration initially. Therefore, subwatersheds with the most major outfalls rated as priority 1 received the highest scores (4 points). Subwatersheds with the second most major outfalls rated as high priority received the second highest scores (3 points). Subwatersheds were then ranked by the number of outfalls ranked priority 2 and priority 3, and were assigned relative scores of 2 points or 1 point. Finally, subwatersheds with only priority 0 or outfalls not prioritized received the lowest score (0 points).

The number of major outfalls associated with various county outfall prioritization ratings and corresponding illicit discharge data scores are summarized by subwatershed in Table 4-11.

Table 4-11: Illicit Discharge Data Scores

County Outfall Prioritization Ratings					
Subwatershed	**Priority 1**	**Priority 2**	**Priority 3**	**Priority 0**	**Illicit Discharge Data Score**
Horsehead Branch	0	0	0	1	0
Red Run	1	6	1	0	3
UGF-B	0	2	8	1	1
Roche's Run	0	3	9	0	2
UGF-D	2	3	12	0	4

4.2.12 Municipal Stormwater Conversions

The existing stormwater management (SWM) facilities located within the Upper Gwynns Falls watershed SWAP area were investigated for potential conversion for increased water quality management. The Baltimore County Department of Environmental Protection and Resource Management (DEPRM) database on stormwater management facilities indicated that a total of 457 stormwater management facilities have been built in the watershed planning area as described in Appendix E, Chapter 3.6. These include dry and wet ponds, wetlands, infiltration/filtration practices, extended detention facilities and proprietary BMPs. Filtration/infiltration practices or extended detention facilities are considered to have higher pollutant removal capabilities, since stormwater has a chance to infiltrate into the ground or through plant roots as compared to conventional SWM techniques that are designed for quantity control without water quality improvement components.

Of the 457 SWM facilities, 57 were determined to be of a type that is potentially suitable for conversion to a type of facility that provides greater water quality benefits. These facilities were designed as dry detention facilities to address water quantity control only. The facilities were field assessed to determine their suitability for conversion. Data was collected on the pond condition and the potential for conversion. The data was then used in a ranking system to prioritize the ponds that had conversion potential. Of the 57 stormwater management facilities assessed, only 51 were found to have conversion potential and ranked for conversion. Of the remaining 6 ponds, 5 were field identified as wet ponds and did not require conversion and one was currently under construction.

The total drainage area to the ponds with potential for conversion were determined for each subwatershed and the resulting nitrogen and phosphorus removal was calculated to prioritize the SWM facility conversions. Subwatersheds with the largest drainage area to the facilities have the highest potential for pollutant removal and therefore, were scored the highest. The following point system was used to assign municipal stormwater conversion scores for each subwatershed based on the drainage area to facilities with conversion potential:

- ≥ 300 acres = 4 pts
- 200 – 299 acres = 3 pts
- 100 – 199 acres = 2 pts
- < 100 acres = 1 pt

The UGF-D subwatershed has the greatest number of facilities and the most potential for pollutant reduction. Horsehead Branch has the lowest number of facilities and pollutant removal.

The subwatershed breakdown of facilities recommended for conversion, total drainage area, increase in nitrogen and phosphorus removal, and conversion points awarded can be found in Table 4-12.

Table 4-12: Municipal Stormwater Conversion Scores

Subwatershed	# of Facilities	Increase in TN Removal (pounds)	Increase in TP Removal (pounds)	Drainage Area (Acres)	Stormwater Conversion Score
Horsehead Branch	4	45.1	8.7	39	1
Red Run	7	154.0	31.7	150	2
UGF-B	9	205.1	51.3	172	2
Roche's Run	8	156.3	37.5	118	2
UGF-D	23	952.7	202.4	764	4

4.2.13 Stream Buffer Improvements

Forested buffer areas along streams play a crucial role in increasing water quality, reducing surface runoff, stabilizing stream banks, trapping sediment, mitigating floods and providing the required habitat for all types of stream life and fish. Tree roots capture and remove pollutants including excess nutrients from shallow flowing water, and their structure helps prevent erosion and slow down water flow, reducing sediment load and the risk of flooding. Shading from the tree canopy provides the cooler water temperatures necessary for much stream life, especially cold-water species like trout that are found in Red Run. In smaller streams, terrestrial plant material falling into the stream is the primary source of plant food for stream life. Trees provide seasonal food in the form of leaves and plant parts for stream life at the base of the food chain. Fallen tree branches and trunks provide a more consistent, slow-release food source throughout the year. Tree roots and snags also provide important habitat for fish and other aquatic species. Maintaining healthy streams and forest buffers are important for reducing the nutrient and sediment loadings to the Chesapeake Bay. When stream buffers are converted from forests to agriculture or residential development, many of these benefits are lost and the health of the stream declines.

The vegetative condition of the riparian buffer based on 100 feet of buffer on either side of the stream was analyzed by subwatershed as described in Appendix E, Chapter 2.2.6.2. Three conditions were used to classify stream buffer conditions: impervious, forested or open pervious. Impervious areas were determined by overlaying the roads and buildings data layers over the 100-foot stream buffer layer. Similarly, the forested areas were determined using the forested GIS layer and removing any impervious area footprint. The remaining areas within the 100-foot stream buffer were classified as open pervious area. Open pervious areas (e.g., mowed lawns) represent 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 36 to 56 and acres of open pervious buffer range from 68 to 269 for the five subwatersheds. The following point system was used to assign stream buffer improvement scores to the five subwatersheds based on the distribution and range of open pervious buffer area percentages:

- ≥ 55% = 4 pts
- 47 – 54% = 3 pts
- 39 – 46% = 2 pts
- < 38% = 1 pt

The acreage and percentage of forested, impervious and open pervious buffer area is summarized by subwatershed in Table 4-13.

Table 4-13: Stream Buffer Improvement Scores

Subwatershed	Forested		Impervious		Open Pervious		Stream Buffer Improvement Score
	Acres	%	Acres	%	Acres	%	
Horsehead Branch	129.8	62.0	2.9	1.4	76.6	36.6	1
Red Run	437.3	59.9	23.5	3.2	268.9	36.9	1
UGF-B	148.7	34.4	41.5	9.6	241.4	55.9	4
Roche's Run	57.2	41.2	13.2	9.5	68.5	49.3	3
UGF-D	185.1	55.9	16.1	4.9	129.8	39.2	2

4.2.14 Stream Corridor Restoration

Baltimore County contracted with Parsons Brinkerhoff to conduct a Stream Stability Assessment (SSA) in the Gwynns Falls watershed to follow up on the U.S. Army Corps of Engineers (USACE) study of the Gwynns Falls mainstem reaches. Parsons Brinckerhoff assessed all tributaries and assessed the accuracy and consistency of the USACE study. Appendix E, Chapter 3.7 summarizes the streams assessed by Parsons Brinckerhoff (Cruised) and the USACE (Corps) that can be found in Appendix F.

The purpose of the SSA was to identify both sources of stream impairment and restoration opportunities. Approximately twenty-six miles of stream were assessed in the Upper Gwynns Falls watershed during the summer of 2004. The results were summarized into four primary categories: physical characteristics, man-made influences, vegetation, threats to private and public structures. Portions of this data were utilized in the evaluation of the restoration opportunities for the Upper Gwynns Falls SWAP study area. The channel morphology (including Rosgen stream classification and phase of stream evolution), stream bank erosion potential, channel disturbances, channel habitat and vegetative stability were scored by subwatershed and used to determine the stream corridor restoration score.

Each subwatershed was rated and given a score for each of the four major categories. These four scores were compiled and used to rank the five subwatersheds for overall restoration opportunity.

Rosgen Stream Classification

The most prevalent stream types found in the Upper Gwynns Falls watershed were type B, E, F and G. Type F and G streams are the most likely to have unstable stream banks and typically have very high erosion rates and sediment loading. Channel degradation and side slope rejuvenation are typical for type F and G streams. Type F and G stream channels have a low width to depth ratio and low sinuosity (except when deeply incised in a previously sinuous channel). Subwatersheds with a prevalence of type F and G streams are the highest priority for restoration due to channel morphology.

Type B streams were also common in the Upper Gwynns Falls watershed and these streams typically have low aggradation/degradation rates. Type B streams are moderately entrenched, have moderate gradients and are riffle dominated channels with infrequently spaced pools. These streams can be thought of as “babbling brooks” that occur on rolling hill landforms. The presence of these streams in a subwatershed is not a major concern, but it does provide limited restoration opportunity.

Type E streams are typically low gradient, meandering, riffle/pool streams with low width to depth ratios and little deposition. They are very efficient and stable. Type E streams typically have a high meander width ratio. While type E streams are highly stable systems, they are sensitive to disturbance and can be converted into other stream types in a relatively short period of time. The greater the percent of type E streams present in a subwatershed, the more ideal the stream morphology.

Type C and D streams were limited to 3 subwatersheds, and did not account for a high percentage of the stream reaches. These streams are slightly entrenched and are typically wider than they are deep. These streams are slightly less stable than B streams, but not near as unstable as type F and G streams. The presence of these streams is notable for possible renovation but type F and G streams should be targeted first.

Subwatersheds with large percentages of type F and G streams have the highest restoration potential and were awarded the highest score (4 points). Subwatersheds with a moderate percentage of type C, F, and G streams still posses a significant restoration potential and received the second highest score (3 points). The remaining subwatersheds were ranked and scored either 1 or 2 points based on the percentage of stable and unstable streams. The Rosgen stream classification scores by subwatershed are summarized in Table 4-14.

Table 4-14: Rosgen Stream Classification Scores

Subwatershed	Rosgen Level II Classification (%)							Rosgen Score
	A	B	C	D	E	F	G	
Horsehead Branch	0	6	9	12	41	16	16	2
Red Run	2	15	5	0	51	11	16	1
UGF-B	0	45	0	0	16	13	26	3
Roche's Run	0	20	0	0	33	27	20	4
UGF-D	0	22	10	0	20	7	41	4

Stream Evolution

The incised channel evolution model (Schumm, et al 1984) was used to classify each of the cruised stream reaches to determine if it is stable, incising, widening or returning to stable form. The five stages describe the evolution of a stream from stable form with terraced floodplain features (Stage I), to headcuts and bank slopes over 45 degrees (Stage II), to bank widening/sloughing and near-vertical bank slopes (Stage III), to new channel forming inside of the widened channel with bank slopes around 45 degrees (Stage IV), to a defined channel with floodplain terraces and bank slopes less than 45 degrees (Stage V).

Stream reaches assessed as Stage I and V are considered stable and therefore have the least potential for water quality enhancement. The stream reaches assessed as Stages II, III and IV are the least stable and have the highest potential for restoration. The percentages of unstable stream reaches range from 42 to 83 in the SWAP study area. The following point system was used to assign stream evolution scores to the five subwatersheds based on the percentage of unstable stream reaches:

- ≥ 80% = 4 pts
- 65 – 79% = 3 pts
- 50 – 64% = 2 pts
- < 50% = 1 pt

Table 4-15 provides a summary of the stream evolution scores for subwatersheds in Upper Gwynns Falls.

Table 4-15: Stream Evolution Scores

Subwatershed	Stream Evolution Stage					% Unstable Reach	Evolution Score
	I	II	III	IV	V		
Horsehead Branch	50	42	0	0	8	42%	1
Red Run	30	30	26	7	7	63%	2
UGF-B	22	11	32	32	3	76%	3
Roche's Run	25	12	50	13	0	75%	3
UGF-D	10	20	48	15	7	83%	4

Erosion Potential

The erosion potential of the cruised stream reaches was evaluated based on the average bank height/bankfull depth, bank angle, density of roots and ration of unstable to stable banks. The factors were combined to determine an erosion potential rating of low, medium-low, medium or high. These ratings described in Appendix E, Chapter 3.7 and Appendix F are summarized in Table 4-16. The following point system was used to assign erosion potential scores to the five subwatersheds:

- High = 4 pts
- Low – Medium = 3 pts
- Medium = 2 pts
- Low = 1 pt

Table 4-16: Erosion Potential Scores

Subwatershed	Erosion Potential Rating	Erosion Potential Score
Horsehead Branch	Low	1
Red Run	Low-Medium	2
UGF-B	Medium	3
Roche's Run	High	4
UGF-D	Medium	3

Channel Habitat

To study the condition of the channel habitats for the streams in the Upper Gwynns Falls watershed, the reach assessment performed a fish blockage analysis during the investigation of the cruised reaches. The data has been compiled per subwatershed into one of three categories for blocking fish: excessive debris, excessive height and shallow flow depth and the totals summarized. The following point system was used to assign stream evolution scores to the five subwatersheds based on the number of blockages:

- ≥ 15% = 4 pts
- 10 – 14% = 3 pts
- 5 – 9% = 2 pts
- < 5% = 1 pt

The results from each subwatershed were compared to prioritize the channel habitat related to restoration opportunities. Fish blockages are summarized in Table 4-17.

Table 4-17: Fish Blockages Scores

Subwatershed	Fish Blockages				Fish Blockages Score
	Excessive Debris	Excessive Height	Shallow Flow Depth	No. of Blockages	
Horsehead Branch	0	0	0	0	0
Red Run	0	4	0	4	1
UGF-B	14	2	10	26	4
Roche's Run	5	1	1	7	2
UGF-D	5	1	7	13	3

Vegetative Stability

The riparian buffer was assessed for both the right and left stream banks for width, composition, and density. Buffers consisting of mowed lawn adjacent to the stream corridor provides less root density than dense vegetation or forested buffer which provides more water quality treatment. These buffers present a good opportunity to educate residents about the benefits and importance of planting and maintaining a riparian stream buffer for aesthetic and water quality purposes. The riparian width scores have been summarized in Table 4-18.

Table 4-18: Riparian Width Scores

Subwatershed	Percent of Reaches by Width (LB = Left Bank, RB = Right Bank)										Riparian Width Score
	$x \leq 10$		$10 < x \leq 25$		$25 < x \leq 50$		$50 < x \leq 75$		> 75		
	LB	RB	LB	RB	LB	RB	LB	RB	LB	RB	
Horsehead Branch	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Red Run	1	1	8	6	5	6	0	1	86	86	1
UGF-B	12	7	15	12	19	19	7	4	47	57	2
Roche's Run	33	43	19	10	33	19	5	0	10	28	4
UGF-D	34	36	11	12	15	12	8	12	32	28	3

Overall Stream Corridor Restoration Score

Stream corridor restoration may involve addressing all three environmental problem categories. Therefore, to determine the overall score for the stream corridor restoration criterion the subwatersheds were ranked according to the sum of the sub-criterion scores. The following point system was used to assign stream corridor scores to the five subwatersheds based on the following score system:

- ≥ 16 = 4 pts
- 11 – 15 = 3 pts
- 5 – 10 = 2 pts
- < 5 = 1 pt

Subwatersheds 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). Table 4-19 summarizes sub-criteria totals and overall stream corridor restoration scores by subwatershed.

Table 4-19: Stream Corridor Restoration Scores

Subwatershed	Total of Sub-Criteria Scores	Overall Stream Corridor Restoration Score
Horsehead Branch	4	1
Red Run	7	2
UGF-B	15	3
Roche's Run	18	4
UGF-D	17	4

4.2.15 Subwatershed Restoration Prioritization Summary

The 5 subwatersheds comprising the Upper Gwynns Falls watershed are ranked according to the total prioritization score (i.e., the sum of prioritization criterion scores). Subwatershed ranking results are summarized in Table 4-20 including criterion scores, total scores and rankings.

Subwatersheds were placed into one of three restoration priority categories based on ranking results: very high, high and medium. These results are summarized in Table 4-21 and illustrated in Figure 4-2. Subwatersheds with a total prioritization score greater than 40 received a very high priority rating for restoration. The UGF-D subwatershed scored the highest and is the best target for improving water quality in the watershed. A high rating was assigned to subwatersheds with total prioritization scores ranging from 35 to 40 (UGF-B and Roche’s Run). A medium rating was assigned to the subwatersheds with total prioritization scores from 30 to 35 (Red Run). A medium-low rating was assigned to the subwatersheds with total prioritization scores from 20 to 30 (Horsehead Branch). Any subwatershed scoring less than 20 would be ranked low priority but this case was not found in the Upper Gwynns Falls SWAP study area. Restoration actions will have to occur throughout the entire Upper Gwynns Falls watershed in order to meet environmental goals and requirements. However, subwatershed prioritization provides a tool/framework for focusing initial restoration efforts.

Table 4-20: Subwatershed Ranking Results

Subwatershed	Nitrogen Load	Phosphorous Load	% Impervious	NSA PSI/ROI	NSA Lawn Fertilizer Reduction	NSA Downspout Disconnect	NSA Trash Management	ISI Site Index	Hotspot Site Index	Pervious Area Restoration	Municipal Street Sweeping	Illicit Discharge Data	Municipal Stormwater Conversion	Stream Buffer Improvement	Stream Corridor Restoration	TOTAL SCORE	SUBWATERSHED RANK
Horsehead Branch	3	1	2	1	4	2	4	1	1	4	1	0	1	1	1	**27**	**5**
Red Run	2	1	2	4	2	4	2	2	1	0	4	3	4	1	2	**34**	**4**
UGF-B	3	3	3	3	1	4	0	4	4	1	2	1	2	4	3	**38**	**3**
Roche's Run	4	4	3	2	2	2	3	3	0	1	3	2	3	3	4	**39**	**2**
UGF-D	3	2	2	4	2	1	1	4	3	3	4	4	4	2	4	**43**	**1**

Table 4-21: Subwatershed Restoration Prioritization

Rank	Subwatershed	Total score	Prioritization Category
1	UGF-D	43	Very High
2	UGF-B	39	High
3	Roche’s Run	38	High
4	Red Run	34	Medium
5	Horsehead Branch	27	Medium-Low

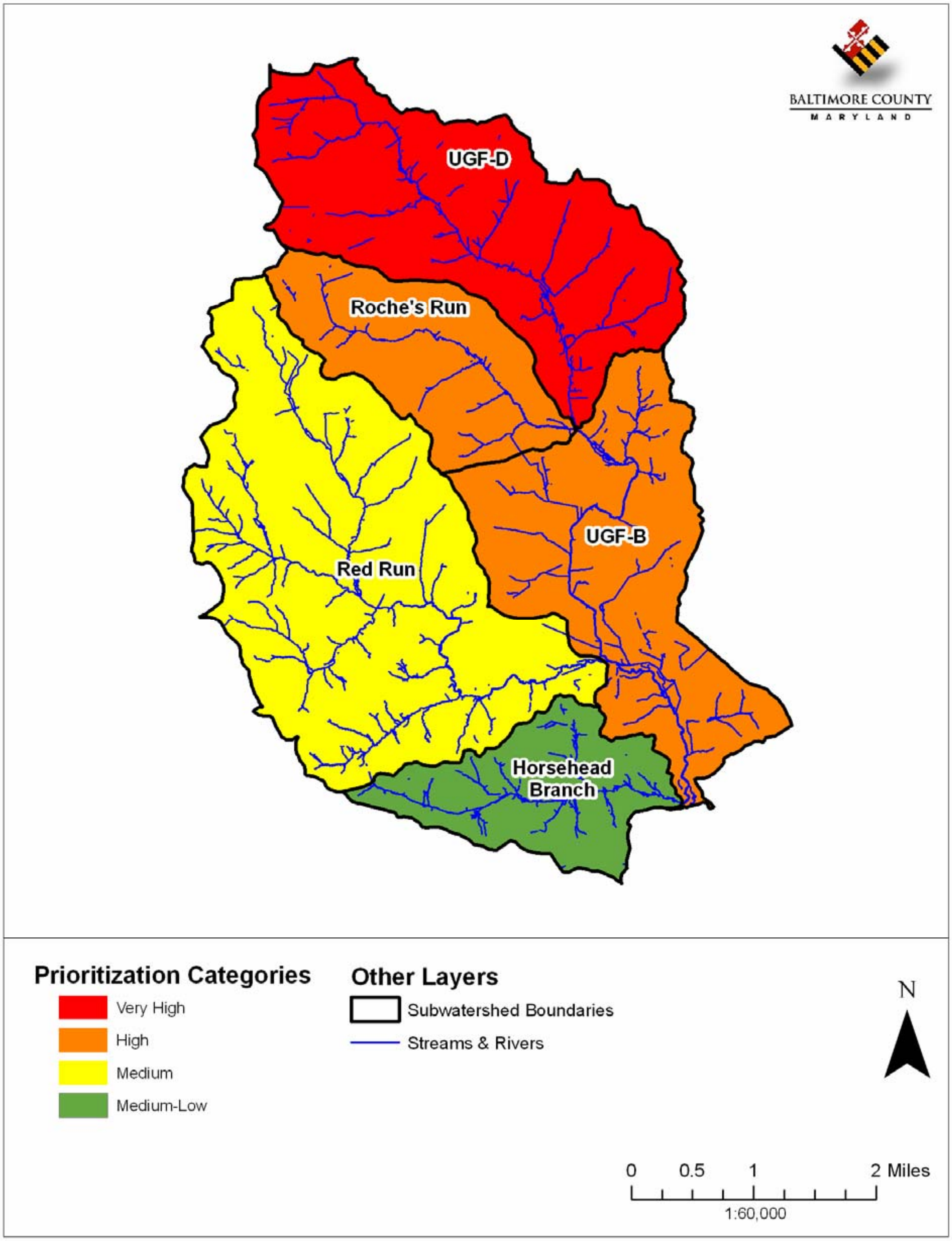

Figure 4-2: Upper Gwynns Falls Subwatershed Restoration Prioritization

4.3 Subwatershed Restoration Strategies

Restoration strategies for each subwatershed are presented in the following subsections. A description of key watershed characteristics is presented for each subwatershed including drainage area, stream length, population, land use/land cover, impervious cover, soils, and stormwater management (SWM) facilities. Assessment results for neighborhoods, hotspots, institutions, pervious areas, stream corridors, illicit discharges, and stormwater conversions 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.

4.3.1 Horsehead Branch

Horsehead Branch is the smallest subwatershed in the Gwynns Falls with a drainage area of just over two square miles and it is located entirely within Baltimore County. It contains the communities of Lyonswood, Owings Choice and Fox Ridge. The existing land use consists primarily of residential development, forest and agricultural land uses. Horsehead Branch drains into the mainstem of the Gwynns Falls inside the forested area in the Owings Mills Corporate Campus just south of McDonogh Road. Much of the development has occurred in the subwatershed since the 1980's. Table 4-22 summarizes the key subwatershed characteristics of Horsehead Branch.

Table 4-22: Key Subwatershed Characteristics – Horsehead Branch

Drainage Area	1,304 acres (2.04 sq. mi.)
Stream Length	10.6 miles
Population	4,867 (2000 Census) 3.7 people/acre
Land Use / Land Cover	Impervious Urban: 14.0% Pervious Urban: 37.8% Cropland: 11.1% Pasture: 9.3% Livestock: 0.3% Forest and Wetlands: 27.4% Water: 0.0% Bare Soil: 0.0%
Impervious Cover	14.0% of Subwatershed
Soils	A Soils (low runoff potential): 0.0% B Soils: 74.0% C Soils: 17.2% D Soils (high runoff potential): 8.8%
SWM Facilities	56 Facilities 58% of urban land use treated
Priority Rating	Medium-Low

Neighborhoods

A total of ten (10) distinct neighborhoods were identified and assessed within Horsehead Branch during the uplands assessment of Upper Gwynns Falls. Characteristics such as lot size, age, and type were used to delineate neighborhoods rather than subwatershed boundaries. As a result, some neighborhoods overlap watershed boundaries. In such a case, the neighborhood is included in the subwatershed in which the majority of the neighborhood is located. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, increasing lot forest canopy cover, and public awareness (i.e., Bayscaping, fertilizer reduction, lawn care, etc.) The results of the Neighborhood Source Assessments (NSA) are presented in the table below.

Table 4-23: NSA Result Summary – Horsehead Branch

NSA_ID	Lot Size (acres)	% Opportunity for Downspout Disconnect	Rain Barrels	Rain Gardens	Storm Drain Marking	Bayscaping	Increase Lot Canopy	# of Street Trees	# of Open Space Trees	Fertilizer Reduction	Trash Management	Street Sweeping	Notes
NSA_V_101	Multi-Family		X		X	X	X	100	200	X			Asphalt repairs needed
NSA_V_102	Multi-Family	66%	X		X	X	X	0	0	X		X	
NSA_V_103	Multi-Family					X	X	0	30	X	X	X	Need trash receptacles
NSA_V_104	Multi-Family				X		X	0	0	X			
NSA_V_105	1/4				X	X	X	0	50	X			Excessive organic material
NSA_V_106	Multi-Family				X	X	X	0	0				
NSA_V_107	Multi-Family				X	X	X	0	50	X			
NSA_V_108	< 1/4		X		X	X	X	35	100	X			Sidewalks broken up by street trees
NSA_V_109	< 1/4		X		X	X	X	100	160				
NSA_V_110	< 1/4				X	X	X	0	20				70% of driveways are breaking up

Every neighborhood studied in Horsehead Branch could use additional lot canopy cover and this can be achieved through encouraging tree planting. Fertilizer overuse is another prominent concern in the Horsehead Branch subwatershed and promoting awareness on the impacts of fertilizer use could help to reduce overuse. More than half of the neighborhoods consist of townhomes or other multi-family homes and will benefit from homeowner management groups implementing awareness programs, tree plantings, and necessary renovations including storm drain marking and downspout redirection. Due to the smaller lot sizes found in this subwatershed, smaller treatment measures like rain barrels could be implemented but larger sized rain gardens would be difficult to implement.

Hotspots

Only one Hotspot Site Investigation (HSI) was performed in the Horsehead Branch subwatershed. The hotspot is a newly built office building that was ranked as a potential hotspot but found to be cleanly operated and constructed with new stormwater management facilities. The table below summarizes the results for hotspots assessed in Horsehead Branch.

Table 4-24: HSI Results Summary – Horsehead Branch

Site ID	HSI Status	HSI Category	Potential Sources of Pollution					Notes
			Vehicle Operations	Outdoor Storage Materials	Waste Management	Physical Plant	Turf / Landscaping	
HSI_V_101	Potential	Commercial	X		X	X	X	Irrigation systems in use

Institutions

A total of four (4) Institutional Site Investigations (ISI) were performed for retrofit opportunities in Horsehead Branch during the uplands assessment of Upper Gwynns Falls. This includes three faith-based facilities and one private school. The table below summarizes the ISI results for institutional sites assessed in Horsehead Branch.

Table 4-25: ISI Results Summary – Horsehead Branch

Site ID	Type	Public / Private	Tree Planting	Stormwater Retrofit	Storm Drain Marking	Downspout Disconnection	Impervious Cover Removal	Stream Buffer Improvement	Invasive Species Removal	Trash Management	Future Awareness Effort	Follow Up On Site Visit
ISI_V_101	Faith-Based	Private	X				X					
ISI_V_102	Faith-Based	Private	X		X		X			X		
ISI_V_103	Faith-Based	Private	X		X					X		
ISI_V_104	School	Private	X	X	X	X					X	

All four of the institutional sites would benefit from tree planting, which is a good opportunity to engage citizens while raising awareness and providing water quality benefits. Three of the four sites were recommended for storm drain marking and half of the sites were recommended for impervious cover removal and better trash management. The two faith-based institutions with impervious cover recommended for removal have old parking lots which are in poor condition and appear to rarely be used with newer parking lots nearby. These overflow lots should be removed to reduce impervious cover in the Horsehead Branch subwatershed. Figure 4-3 shows the impervious cover at ISI_V_101 that should be removed. Figure 4-4 shows a problem associated with vehicle operations at ISI_V_104, an uncovered fueling station.

Figure 4-3: ISI_V_101

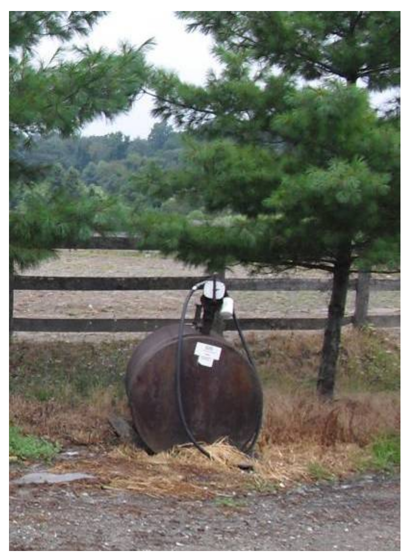

Figure 4-4: ISI_V_104

Pervious Areas

One Pervious Area Assessment (PAA) was made for restoration potential in Horsehead Branch, which is a parcel of property owned by McDonogh School. McDonogh School is located in Horsehead Branch and is maintained by the school. The open area is approximately 50 acres and consists of mostly turf and a stream with some trees. The area was previously used for horseback riding but due to groundhog holes creating danger to the horses it has become unsafe for riding and is no longer a utilized space. This site is recommended for reforestation with minimal site preparation. This site receives full sun exposure and is easily accessible by foot, vehicle and heavy equipment. Reforestation of a portion of the site would require verification that it would not interfere with the future use of the site and tree planting could be a potential school project. A summary is provided in the table below. Figure 4-5 shows the current conditions for the 50 acre lot and the substantial open space for trees or other canopy cover.

Table 4-26: PAA Results Summary – Horsehead Branch

Site ID	Location	Description	Acres	Ownership
PAA_V_101	McDonogh School alongside entrance road	Open land previously used for horseback riding, primarily a grass field with a few trees and a stream present	50	Private

Figure 4-5: PAA_V_101

Stream Corridor Assessments

Horsehead Branch is classified by the Maryland Department of the Environment (MDE) as a Use I stream for water contact recreation and protection of aquatic life (i.e. fishable/swimmable). The condition of the stream habitat was based on two factors: USACE habitat rating from the Corps study and the fish blockage data from the PB cruised reach assessment as described in Appendix F. The Corps study rated the ecological condition of the Gwynns Falls subwatersheds based on macroinvertebrate and finfish sampling data conducted by DNR. The Horsehead Branch subwatershed has consistently received a fair rating.

The channel disturbances and stream conditions in Table 4-27 and 4-28 are a summary of the stream opportunities identified during the stream corridor assessments found in Appendix F, Chapter 3. The erosion and vegetative data collected in the Upper Gwynns Falls watershed is summarized in Appendix E, Chapter 3.7.2.

The vegetative stability of the stream buffer was defined during the cruised reach assessment in four primary categories: canopy cover, riparian width, riparian composition and riparian density. The data was collected for both the right and left overbank areas as the stream channels have different buffer characteristics on each stream bank. Over seventy percent of the streams in the Horsehead Branch subwatershed have more than 75% canopy cover and riparian buffer width of over 150 feet on each side. The riparian buffers are composed of deciduous overstory with grass/brush understory. Buffer enhancements were recommended in five of the cruised stream reaches.

There was one stream reach recommended for restoration and seven that require bank stabilization. There were no fish blockages identified in the cruised reach assessments. No blockages were identified in the mainstem of the Gwynns Falls assessed in the Corps study, as fish blockages were not one of the factors considered in the Corps assessments. There were no utility conflicts but ten of the cruised stream reaches were identified to have grade control issues requiring stream bed stabilization. Two of the stream reaches had been relocated, piped, straightened or otherwise altered making them opportunities for channel improvements.

Table 4-27: Summary of Stream Opportunities – Horsehead Branch

Subwatershed	Opportunities (# of Environmental Problem Sites)						
	Buffer Enhancement	Channel Restoration	Bank Stabilization	Utility Conflict	Fish Blockage	Grade Control	Totals
Horsehead Branch	5	1	7	0	0	10	**23**

Table 4-28: Summary of Stream Conditions – Horsehead Branch

Subwatershed	Unstable Channel Bed (%)	Unstable Banks (%)	Channel Alteration (#)
Horsehead Branch	42	19	2

Illicit Discharges

Horsehead Branch contained one outfall that was rated as priority 0. A prioritization rating of 0 indicates that there is insufficient data on the outfall to determine a priority rating. This could be due to inaccessibility or limited screening. The outfall should be screened to determine a true prioritization rating.

Stormwater Conversions

Four dry detention ponds assessed in the Horsehead Branch subwatershed were found to be potential candidates for conversion. Pond #976 scored the highest for conversion potential. It has a large drainage area of 24.83 acres, which will result in a high increase in effectiveness to treatment. The pond is privately owned which can complicate conversion efforts. Ponds 1190 and 746 both have a high prioritization rank and should be converted to shallow marsh or partial extended detention ponds. Pond 1190 has no riser and tree growth on the embankment of the pond, therefore a riser should be constructed and trees removed. The current layout of pond 1190 is shown in figure 4-6. Pond 746 needs an updated riser structure and excess trees removed from the pond embankment. Pond 1446 is difficult to access so has a lower conversion priority. Figure 4-7 shows the outdated riser structure currently found at Pond 746. A detailed summary of the potential detention pond conversions in Horsehead Branch is found below in Table 4-29.

Table 4-29: Detention Pond Conversions – Horsehead Branch

Pond Number	Ownership	Acres	Total Score	Rank	Subwatershed
976	PRIVATE	24.83	28	High	Horsehead Branch
1190	PUBLIC	4.03	24	High	Horsehead Branch
746	PUBLIC	5.36	19	High	Horsehead Branch
1446	PUBLIC	5.16	6	Low	Horsehead Branch

Figure 4-6: Pond 1190

Figure 4-7: Pond 746

Subwatershed Management Strategy

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

1. Conduct appropriate downspout disconnection, rain barrel and rain garden measures in neighborhoods according to Table 4-23.

2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods and institutions according to Tables 4-23 and 4-25.

3. Plant street trees and open space trees in the neighborhoods as indicated in Table 4-23. Plant trees at the institutions indicated in Table 4-25.

4. Promote awareness of the benefits of Bayscaping and proper lawn care.

5. Encourage community cleanups in the neighborhoods recommended for trash management indicated in Table 4-23.

6. Engage institutional sites listed in Table 4-25 in recommended restoration actions.

7. Investigate the pervious areas described in Table 4-26 for potential tree planting.

8. Promote awareness of the stream watch program.

9. Increase awareness of existing trails and access points to streams in the Horsehead Branch subwatershed.

Municipal Actions

1. Investigate current street sweeping measures in recommended neighborhoods listed in Table 4-23 and increase frequency or implement programs as necessary.

2. Promote awareness to commercial property owners about the importance of proper trash management and outdoor material storage techniques to the hotspot sites identified in Table 4-24.

3. Investigate the potential for stormwater retrofits at the institutions identified in Table 4-25.

4. Convert the dry detention ponds identified in Table 4-29 to shallow marsh or extended detention ponds.

5. Investigate stream restoration potential at sites listed in Table 4-27 and described in the Watershed Characterization Report.

6. Continue to monitor illicit discharges.

7. Explore options for stream buffer enhancements.

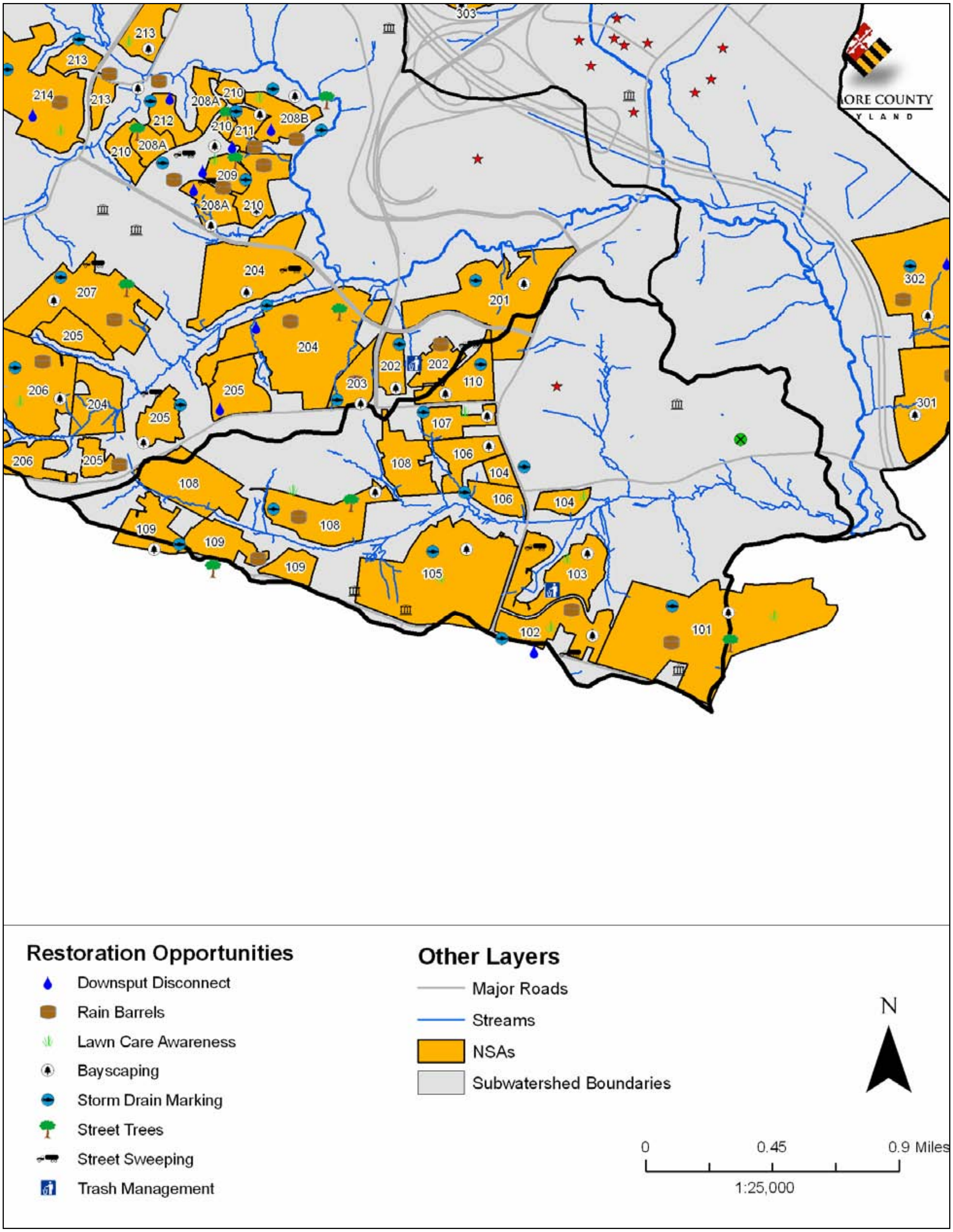

Figure 4-8: Restoration Opportunities in Horsehead Branch

4.3.2 Red Run

The Red Run subwatershed is the most recently developed subwatershed in the Upper Gwynns Falls. This subwatershed underwent significant development during the 1990s, particularly in the Owings Mills/Newtown area. The Soldiers Delight Natural Environment Area is located in the western part of the subwatershed. This is the largest forested area remaining in this subwatershed. The population density in Red Run is the lowest of the subwatersheds in the Upper Gwynns Falls. Table 4-30 summarizes the key subwatershed characteristics of Red Run.

Table 4-30: Key Subwatershed Characteristics – Red Run

Drainage Area	4,753 acres (7.43 sq. mi.)
Stream Length	33.7 miles
Population	11,576 (2000 Census) 2.4 people/acre
Land Use / Land Cover	Impervious Urban: 16.0% Pervious Urban: 41.6% Cropland: 5.5% Pasture: 0.0% Livestock: 0.0% Forest and Wetlands: 34.7% Water: 0.4% Bare Soil: 1.8%
Impervious Cover	16.0% of Subwatershed
Soils	A Soils (low runoff potential): 0.0% B Soils: 71.0% C Soils: 10.8% D Soils (high runoff potential): 18.2%
SWM Facilities	185 Facilities 38% of urban land use treated
Priority Rating	Medium

Neighborhoods

A total of twenty-two (22) distinct neighborhoods were identified and assessed within Red Run during the uplands assessment of Upper Gwynns Falls. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, increasing lot forest canopy cover, both open space and street tree planting and public awareness (i.e., Bayscaping, fertilizer reduction, lawn care, etc). Street sweeping in this subwatershed should also be increased. A summary of the Neighborhood Source Assessment (NSA) recommended actions is presented in the table below.

Table 4-31: NSA Result Summary – Red Run

NSA_ID	Lot Size (acres)	% Opportunity for Downspout Disconnect	Rain Barrels	Rain Gardens	Storm Drain Marking	Bayscaping	Increase Lot Canopy	# of Street Trees	# of Open Space Trees	Fertilizer Reduction	Trash Management	Street Sweeping	Notes
NSA_V_201	Multi-Family	50%			X	X	X	0	0				Excessive fertilizer use
NSA_V_202	< 1/8		X		X	X	X	0	80		X	X	High sediment and trash in streets
NSA_V_203	< 1/8	50%	X		X	X	X	0	30				Newly constructed neighborhood
NSA_V_204	Multi-Family	75%	X		X	X	X	40	40	X		X	Both pond risers need maintenance
NSA_V_205	< 1/8	50%	X	X	X	X	X	0	150			X	Excessive organic material
NSA_V_206	1/4		X	X	X	X	X	0	100	X			
NSA_V_207	< 1/4		X	X	X	X	X	40	40			X	Ponds need fence maintenance
NSA_V_208A	< 1/8	100%	X		X	X	X	20	40	X		X	Pond embankments show erosion
NSA_V_208B	< 1/8	25%	X		X	X	X	30	30				
NSA_V_209	1/4		X	X	X	X	X	30	0			X	
NSA_V_210	Multi-Family	50%	X		X	X	X	0	60	X			
NSA_V_211	< 1/8	75%	X		X	X	X	20	20				Duplexes with attached fronts
NSA_V_212	< 1/4	90%	X		X	X	X	0	0	X			Very well kept
NSA_V_213	Multi-Family		X		X	X	X	0	40	X			Townhomes, Apartments & Condos
NSA_V_214	Multi-Family	30%	X		X	X	X	0	20	X			Pond embankments show erosion
NSA_V_215	1		X	X		X		0	0				Houses range from 1900's to 1990's
NSA_V_216	1	100%	X	X		X		100	300			X	Driveways and sidewalk need repair
NSA_V_217	1/2			X		X		0	0	X	X		
NSA_V_218	< 1/8	100%	X	X	X	X	X	20	10			X	Pond is full of trash
NSA_V_219	> 1		X	X		X		30	40				
NSA_V_220	1/4		X	X	X	X	X	0	30	X			
NSA_V_221	1/4	50%	X	X	X	X	X	40	20				Pond fence maint.

The neighborhoods in Red Run have a variety of potential restoration options. Almost every neighborhood could implement rain barrel use and is in need of storm drain marking. Bayscaping was not present in any of the twenty-two neighborhoods and an awareness program should be run to encourage its use. Lot canopy was lacking and can be addressed in many neighborhoods by planting street trees and open space tress, and fertilizer overuse continues to be an issue needing improvement. It was also noted that street sweeping should be continued or increased in almost half of the neighborhoods. Overall Red Run has very good water quality but implementing these restoration options will help to better the water quality and quality of life.

Hotspots

Three Hotspot Site Investigations (HSI) were performed in Red Run and one of the sites was determined not to be a hotspot. HSI_V_202 ranked the highest and was rated as a confirmed hotspot while HSI_V_201 was ranked as a potential hotspot. HSI_V_202 should be targeted for both the outdoor storage problems and the lack of waste management. It consists of a business center shared by multiple entities so a corporate partnership can be utilized to keep the site cleaner. The table below summarizes results for the hotspots assessed in Red Run.

Table 4-32: HSI Results Summary – Red Run

Site ID	HSI Status	HSI Category	Potential Sources of Pollution					Notes
			Vehicle Operations	Outdoor Storage Materials	Waste Management	Physical Plant	Turf / Landscaping	
HSI_V_201	Potential	Commercial						No visible sources of pollution
HSI_V_202	Confirmed	Commercial		X	X			
HSI_V_203	Not a Hotspot	Transport-Related			X			

Institutions

A total of six (6) institutions were assessed for retrofit opportunities in Red Run during the uplands assessment of Upper Gwynns Falls. This included two public schools, two private schools, one faith-based facility and one municipal facility. Public institutions are the easiest to target for renovations, but private institutions also offer opportunity for renovation. Table 4-33 below summarizes results for Institutional Site Investigations (ISI) performed in Horsehead Branch.

The condition of the stream habitat was based on two factors: USACE habitat rating from the Corps study and the fish blockage data from the PB cruised reach assessment as described in Appendix F. The Corps study rated the ecological condition of the Gwynns Falls subwatersheds based on macroinvertebrate and finfish sampling data conducted by DNR. The Red Run subwatershed received a good to fair rating, which is the highest in the Gwynns Falls. The Corps study rated the instream habitat as fair quality for over 92% of the habitat assessed.

The channel disturbances and stream conditions in Table 4-34 and 4-35 are a summary of the stream opportunities identified during the stream corridor assessments found in Appendix F, Chapter 3. The erosion and vegetative data collected in the Upper Gwynns Falls watershed is summarized in Appendix E, Chapter 3.7.2.

The vegetative stability of the stream buffer was defined during the cruised reach assessment in four primary categories: canopy cover, riparian width, riparian composition and riparian density. The data was collected for both the right and left overbank areas as the stream channels have different buffer characteristics on each stream bank. Over seventy percent of the streams in the Horsehead Branch subwatershed have more than 50% canopy cover and riparian buffer width of over 150 feet on each side. The riparian buffers are of high quality and composed of deciduous overstory with grass/brush understory. Buffer enhancements were recommended in 16 of the cruised stream reaches.

There were four stream reach recommended for restoration and 30 that require bank stabilization. There were four fish blockages identified in the cruised reach assessments. No blockages were identified in the mainstem of the Gwynns Falls assessed in the Corps study, as fish blockages were not one of the factors considered in the Corps assessments. There were no utility conflicts but 22 stream reaches were identified to have grade control issues requiring stream bed stabilization. Seven of the stream reaches had been relocated, piped, straightened or otherwise altered making them opportunities for channel improvements.

Table 4-34: Summary of Stream Opportunities – Red Run

	Opportunities (# of Environmental Problem Sites)						
Subwatershed	**Buffer Enhancement**	**Channel Restoration**	**Bank Stabilization**	**Utility Conflict**	**Fish Blockage**	**Grade Control**	**Totals**
Red Run	16	4	30	0	4	22	**76**

Table 4-35: Summary of Stream Conditions – Red Run

Subwatershed	**Unstable Channel Bed (%)**	**Unstable Banks (%)**	**Channel Alteration (#)**
Red Run	34	20	7

Illicit Discharges

Red Run contains eight outfalls that have been rated by the county. One has been rated as priority 1 which is the critical or highest rating. Priority 1 outfalls have major problems that require immediate correction and/or close monitoring, or outfalls with recurrent problems. These outfalls are sampled four times each year. Of the remaining outfalls, six were classified as priority 2 (high rating) and one was classified as priority 3 (low rating). The six outfalls classified as priority 2 should continue to be monitored once a year. The outfall rated as priority 3 should be monitored on a ten year cycle.

Stormwater Conversions

Seven dry detention ponds assessed in the Red Run subwatershed were found to be potential candidates for conversion. Pond #964 scored the highest for conversion potential out of the dry detention ponds in Red Run, but the pond is privately owned, which can complicate conversion efforts and the drainage area is not as large as the public ponds which scored slightly lower. Public ponds #3127 and #3389 both have a high prioritization rank and should be converted to shallow marsh and at least partial extended detention ponds. Pond #3127 has a riser that was only designed to treat for channel protection volume but not water quality volume. This riser should be updated to treat for water quality. The fence was also noted to need repair by the gate and some wetland vegetation was present in the bottom but more seeding should be added. The ease of access to pond #3127 is high, the drainage area is fairly large at 14.48 acres and a long flow path is present, so it is a very good candidate for retrofit. Figure 4-9 shows the current one stage riser at pond #3127. Pond #3389 also ranked high for retrofit potential and needs an updated riser structure with a low flow orifice. Trees were growing on the embankment of the pond which should be removed and the ease of access is high. Figure 4-10 shows the outdated riser structure in pond #3389. The remaining ponds in the Red Run subwatershed should be targeted for conversion upon completion of retrofits for ponds #3127 and #3389, based on the order ranking displayed below in summary Table 4-36.

Table 4-36: Detention Pond Conversions – Red Run

Pond Number	Ownership	Acres	Total Score	Rank	Subwatershed
964	PRIVATE	4.39	27	High	Red Run
3127	PUBLIC	14.48	22	High	Red Run
3389	PUBLIC	12.85	20	High	Red Run
949	PRIVATE	12.85	17	Medium	Red Run
1715	PUBLIC	15.58	16	Medium	Red Run
261	PRIVATE	6.42	10	Medium	Red Run
1426	PUBLIC	83.59	1	Low	Red Run

Table 4-33: ISI Result Summary – Red Run

Site ID	Type	Public / Private	Tree Planting	Stormwater Retrofit	Storm Drain Marking	Downspout Disconnection	Impervious Cover Removal	Stream Buffer Improvement	Invasive Species Removal	Trash Management	Future Awareness Effort	Follow Up On Site Visit
ISI_V_201	School	Private	X									
ISI_V_202	School	Private	X	X	X					X	X	X
ISI_V_203	Faith-Based	Private		X						X		X
ISI_V_204	School	Public	X	X	X					X	X	
ISI_V_205	School	Public	X	X	X					X	X	
ISI_V_206	Municipal Facility	Public		X	X	X						

The most prevalent need for institutions in Red Run is stormwater retrofits. Of the six institutions assessed, only one had adequate stormwater management. Two of the remaining institutions are private which makes them more difficult to renovate but the two public schools and the municipal facility would be great initial candidates for stormwater retrofit. Tree planting, storm drain making, and increased trash management are also recommended for the majority of the institutions. The two public schools and the municipal facility should be targeted first because they are publicly owned making them easier to retrofit.

Pervious Areas

Red Run was checked numerous times for potential pervious areas but none were found. The majority of undeveloped areas were either already planted with trees or found to be privately owned land which would be difficult to retrofit. Over 5% of the watershed is classified as cropland. This land was noted, but it is not a good candidate for restoration because it is used for farming purposes.

Stream Corridor Assessments

Red Run is classified by the Maryland Department of the Environment (MDE) as a Use III stream, Natural Trout Waters that are to be protected. DNR monitoring has found trout in this subwatershed. Furthermore, Red Run has been identified as a Tier II stream requiring preservation of habitat and water quality in the stream.

Figure 4-9: Pond 3127

Figure 4-10: Pond 3389

Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection, rain barrel and rain garden measures in neighborhoods according to Table 4-31.

2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods and institutions indicated in Tables 4-31 and 4-33.

3. Plant street trees and open space trees in the neighborhoods as indicated in Table 4-31. Plant trees at the institutions indicated in Table 4-33.

4. Promote awareness of the benefits of Bayscaping and proper lawn care.

5. Encourage community cleanups in the neighborhoods recommended for trash management indicated in Table 4-31.

6. Engage institutional sites listed in Table 4-33 in recommended restoration actions.

7. Promote awareness of the stream watch program.

8. Increase awareness of existing trails and access points to streams in the Red Run subwatershed.

Municipal Actions

1. Investigate current street sweeping measures in recommended neighborhoods listed in Table 4-31 and increase frequency or implement programs as necessary.

2. Promote awareness to commercial property owners about the importance of proper trash management and outdoor material storage techniques to the hotspot sites identified in Table 4-32.

3. Investigate the potential for stormwater retrofits at the institutions identified in Table 4-33.

4. Convert the dry detention ponds identified in Table 4-36 to shallow marsh or extended detention ponds.

5. Investigate stream restoration potential at sites listed in Table 4-34 and described in the Watershed Characterization Report.

6. Continue to monitor illicit discharges.

7. Explore options for stream buffer enhancements.

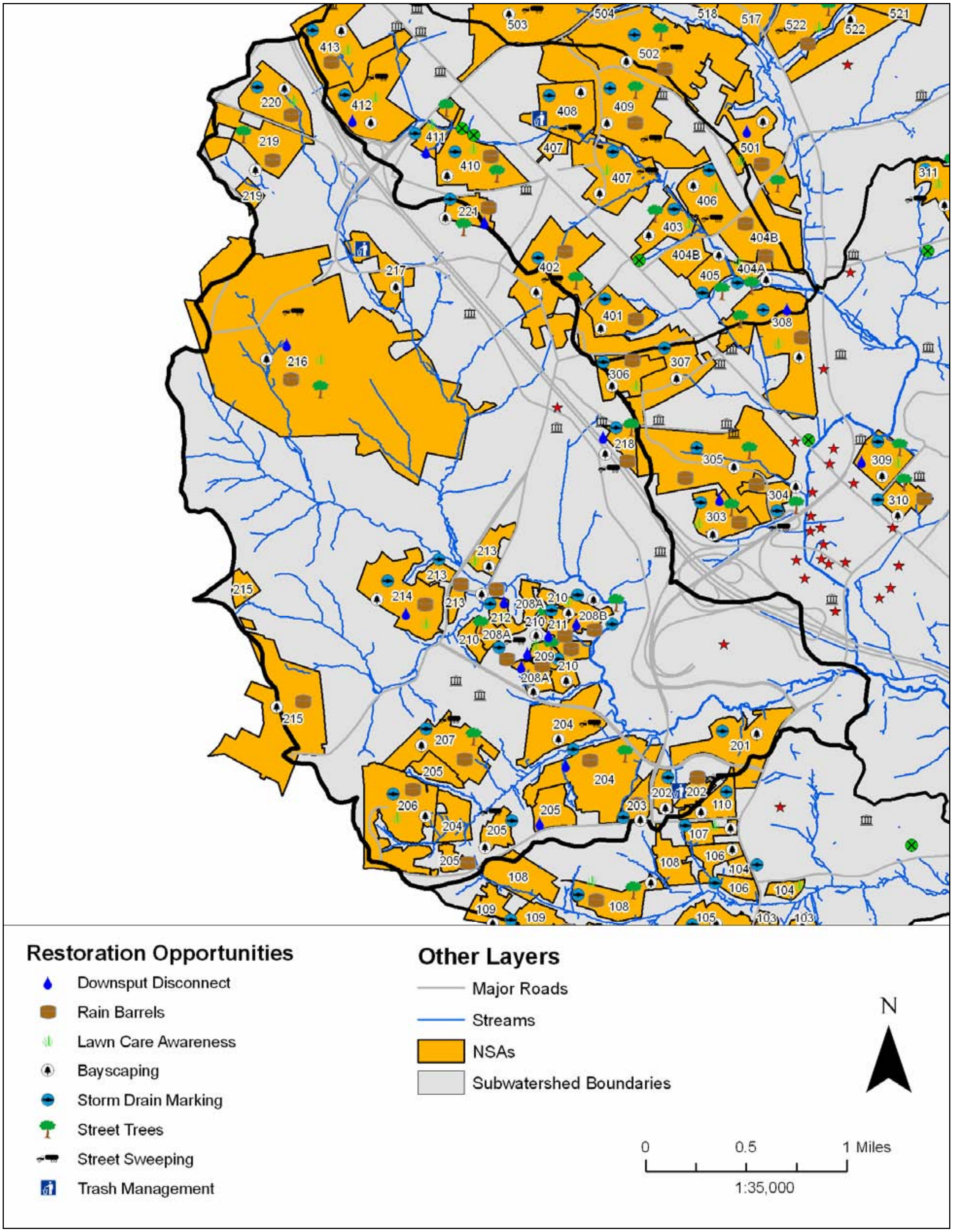

Figure 4-11: Restoration Opportunities in Red Run

4.3.3 UGF-B

The UGF-B subwatershed lies entirely within Baltimore County. The subwatershed is entirely within the limits of Owings Mills, along Reisterstown Road from Pleasant Hill Road to McDonogh Road. Both Rosewood State Center and Owings Mills Corporate Campus are included in the UGF-B subwatershed. Table 4-37 summarizes the general subwatershed conditions. The corridor along Reisterstown Road is the main commercial and industrial zone within the watershed, with additional industrial and commercial areas along Dolfield Road South. Currently, commercial and industrial land uses comprise approximately 39.3% of the subwatershed. This subwatershed has experienced significant growth in the past twenty years, particularly due to transportation improvements such as I-795 and the Metro stop in Owings Mills. 26.1% of the existing land is comprised of residential areas, predominantly medium- and high-density residential housing.

Table 4-37: Key Subwatershed Characteristics – UGF-B

Drainage Area	2,818 acres (4.40 sq. mi.)
Stream Length	18.2 miles
Population	10,572 (2000 Census) 3.8 people/acre
Land Use / Land Cover	Impervious Urban: 26.9% Pervious Urban: 42.0% Cropland: 2.1% Pasture: 5.6% Livestock: 0.0% Forest and Wetlands: 22.8% Water: 0.0% Bare Soil: 0.6%
Impervious Cover	26.9% of Subwatershed
Soils	A Soils (low runoff potential): 0.0% B Soils: 75.8% C Soils: 18.8% D Soils (high runoff potential): 5.4%
SWM Facilities	76 Facilities 27% of urban land use treated
Priority Rating	High

Neighborhoods

A total of eleven (11) distinct neighborhoods were identified and assessed within UGF-B during the uplands assessment of Upper Gwynns Falls. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, increasing lot forest canopy cover, and public awareness (i.e., Bayscaping, fertilizer reduction, lawn care, etc.) A summary of the Neighborhood Source Assessment (NSA) recommended actions is presented in the table below.

Table 4-38: NSA Results Summary – UGF-B

NSA_ID	Lot Size (acres)	% Opportunity for Downspout Disconnect	Rain Barrels	Rain Gardens	Storm Drain Marking	Bayscaping	Increase Lot Canopy	# of Street Trees	# of Open Space Trees	Fertilizer Reduction	Trash Management	Street Sweeping	Notes
NSA_V_301	>1		X	X		X		100	100				Excessive sediment in streets
NSA_V_302	Multi-Family	60%	X		X	X	X	10	30			X	Excessive organic matter in streets
NSA_V_303	Multi-Family	50%	X		X	X	X	30	20	X			
NSA_V_304	Multi-Family		X		X	X	X	100	0			X	
NSA_V_305	< 1/4		X	X	X	X	X	0	30				Stream flows through neighborhood, could not access buffer (no trespassing)
NSA_V_306	1/4				X	X	X	0	0	X			Houses range from 1930's to 2000's
NSA_V_307	1/2		X	X	X	X		60	40				Observed pet waste
NSA_V_308	Multi-Family	50%	X		X	X	X	30	40	X		X	
NSA_V_309	Multi-Family	80%			X	X	X	20	0	X			
NSA_V_310	1/2		X	X	X	X		0	10			X	Driveways are breaking up
NSA_V_311	1/2				X	X	X	100	100	X			

The neighborhoods in the UGF-B subwatershed were similar to other subwatersheds assessed. The majority of the neighborhoods would benefit from rain barrel use, storm draining marking and increasing the lot canopy. The neighborhoods in UGF-B had less downspout redirection opportunities than other subwatersheds but one third of neighborhoods would still benefit from this. Both open space tree planting and street tree planting should be done. Neighborhood NSA_V_305 has a stream running through it and the buffer could not be accessed because it was in between two rows of houses and would require trespassing, but this buffer should be investigated further to ensure that is adequately dense. Five of the neighborhoods would benefit from fertilizer reduction and thus it is recommended that a lawn nutrients awareness session be held in this subwatershed to encourage homeowners to reduce excessive fertilizer use.

Hotspots

With UGF-B containing the main commercial and industrial zone in the Upper Gwynns Falls watershed, and with the significant growth it has experienced in the past twenty years, UGF-B has by far the most hotspots and has the greatest potential for hotspot improvement. Twenty Hotspot Site Investigations (HSI) were performed and of the twenty sites investigated one was rated severe, nine were confirmed as hotspots, and ten were ranked as potential hotspots. The most common problems noted during the hotspot investigations were an excessive amount of improperly stored outdoor materials and poor waste management. Both of these issues are good to target, and can be partially resolved through holding seminars to raise awareness on safe outdoor storage practices and ways to minimize waste from exiting sites. Many of the hotspots in UGF-B were directly adjacent to the stream making this is an important issue to address. Figure 4-12 and 4-13 show HSI_V_317 and HSI_V_314, respectively, two hotspots in need of cleanup that are directly adjacent to the Gwynns Falls. Posting no dumping signs along the stream and ensuring the adjacent commercial hotspots implicate methods to prevent waste and pollutants from entering the Gwynns Falls is critical in reducing pollutant loads in the Upper Gwynns Falls watershed. Table 4-39 provides a summary of the HSI results for UGF-B.

Table 4-39: HSI Results Summary – UGF-B

Site ID	HSI Status	HSI Category	Potential Sources of Pollution					Notes
			Vehicle Operations	Outdoor Storage Materials	Waste Management	Physical Plant	Turf / Landscaping	
HSI_V_301	Confirmed	Commercial		X				
HSI_V_302	Confirmed	Commercial		X	X			
HSI_V_303	Confirmed	Transport-Related	X					
HSI_V_304	Confirmed	Commercial	X	X				
HSI_V_305	Potential	Other						No visible sources of pollution
HSI_V_306	Potential	Commercial						No visible sources of pollution
HSI_V_307	Potential	Commercial						No visible sources of pollution
HSI_V_308	Confirmed	Commercial		X				
HSI_V_309	Potential	Commercial						No visible sources of pollution
HSI_V_310	Confirmed	Commercial	X	X	X			
HSI_V_311	Potential	Commercial						No visible sources of pollution
HSI_V_312	Confirmed	Other			X	X		
HSI_V_313	Confirmed	Commercial	X					

Table 4-39: HSI Results Summary – UGF-B (cont.)

Site ID	HSI Status	HSI Category	Potential Sources of Pollution: Vehicle Operations	Outdoor Storage Materials	Waste Management	Physical Plant	Turf / Landscaping	Notes
HSI_V_314	Potential	Commercial						No visible sources of pollution
HSI_V_315	Potential	Commercial			X			
HSI_V_316	Potential	Other						No visible sources of pollution
HSI_V_317	Severe	Commercial		X	X	X		
HSI_V_318	Potential	Commercial			X			
HSI_V_319	Confirmed	Commercial		X				
HSI_V_320	Potential	Commercial						No visible sources of pollution

Figure 4-12: HSI_V_317

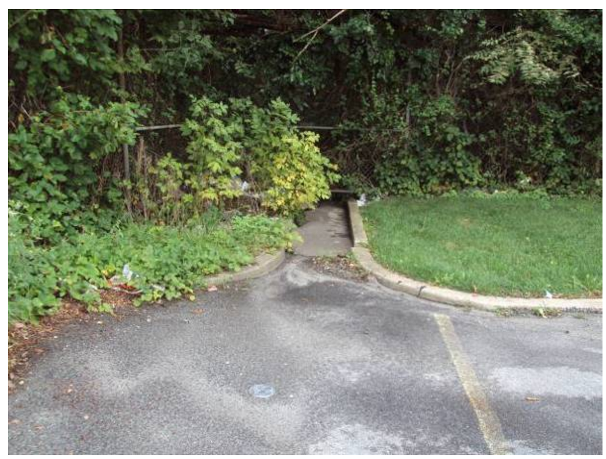

Figure 4-13: HSI_V_314

Institutions

The high population density in UGF-B subwatershed has resulted in a high amount of institutions used by the citizens of Upper Gwynns Falls. Many schools, both private and public, and many faith-based institutions are located along Reisterstown Road. A total of fourteen (14) Institutional Site Investigations (ISI) were assessed for retrofit opportunities in the UGF-B subwatershed. Table 4-40 summarizes the results for retrofitting institutions in UGF-B.

Table 4-40: ISI Results Summary – UGF-B

Site ID	Type	Public / Private	Tree Planting	Stormwater Retrofit	Storm Drain Marking	Downspout Disconnection	Impervious Cover Removal	Stream Buffer Improvement	Invasive Species Removal	Trash Management	Future Awareness Effort	Follow Up On Site Visit
ISI_V_301	School	Private										
ISI_V_302	School	Private	X									
ISI_V_303	Faith-Based	Private	X		X						X	
ISI_V_304	School	Public	X	X	X	X					X	
ISI_V_305	School	Public	X	X		X		X		X	X	X
ISI_V_306	Municipal Facility	Public	X	X		X					X	X
ISI_V_307	Cemetery	Public		X		X						
ISI_V_308	Cemetery	Private		X		X				X		
ISI_V_309	School	Private		X				X	X	X		X
ISI_V_310	Faith-Based	Private				X					X	
ISI_V_311	School	Public	X	X	X	X				X	X	X
ISI_V_312	Faith-Based	Private	X		X			X		X		
ISI_V_313	Faith-Based	Private	X		X					X		X
ISI_V_314	Faith-Based	Private										

The most common needs for the institutions in UGF-B were tree planting, stormwater retrofit, and downspout disconnection. Three of the recommended stormwater retrofits were at public schools and this provides the potential to involve the faculty and students in an awareness program on stormwater BMP's. A lack of trash management is a recurring issue for many institutions in UGF-B. Three of the sites investigated need of stream buffer improvements and a follow up site visit to establish the best ways for enhancing the buffer.

Pervious Areas

Two Pervious Area Assessments (PAA) were made for restoration potential in the UGF-B subwatershed. The larger of the two plots, PAA_V_301, is approximately 6.2 acres and is vacant land owned by Groff & Sons. This site is recommended for reforestation with minimal site preparation based on initial field observations and is also a good candidate for natural regeneration. There is a nearby water source with a stream buffer present and the area receives full sun. See Figure 4-14 for the current layout of PAA_V_301. PAA_V_302 was the second pervious area assessed in UGF-B and consists of a field adjacent to Crondall Lane. It is easily accessible by foot or vehicle and it is mostly covered by turf (90%) with some trees. This site was recommended for reforestation with minimal site preparation based on initial field observations. Verification is required to ensure reforestation does not interfere with the current use of the this state owned land. Figure 4-15 below shows the current layout of PAA_V_302. Table 4-41 provides a summary of the PAA results for UGF-B.

Table 4-41: PAA Results Summary – UGF-B

Site ID	Location	Description	Acres	Ownership
PAA_V_301	Intersection of Groff Lane and Reisterstown Road	Vacant Land	6.2	Private
PAA_V_302	Field adjacent to Crondall Lane	Undeveloped State Property	3.0	Public

Figure 4-14: PAA_V_301

Figure 4-15: PAA_V_302

Stream Corridor Assessments

The Gwynns Falls upstream of Reisterstown Road is classified by the Maryland Department of the Environment (MDE) as a Use III stream, Natural Trout Waters that are to be protected. DNR monitoring has found trout in this subwatershed.

The condition of the stream habitat was based on two factors: USACE habitat rating from the Corps study and the fish blockage data from the PB cruised reach assessment as described in Appendix F. The Corps study rated the ecological condition of the Gwynns Falls subwatersheds based on macroinvertebrate and finfish sampling data conducted by DNR. The UGF-B subwatershed received a very poor to poor ecological rating. The Corps study rated the instream habitat as fair or good quality for over 97% of habitat assessed.

The UGF-D, Roche’s Run, and UGF-B subwatersheds were combined into a single subwatershed, called the Upper Gwynns Falls subwatershed, therefore the summarized results for the UGF-D, Roche’s Run, and UGF-B subwatersheds are derived by percentage of stream length discussed in Appendix E, Chapter 2.2.6.

The channel disturbances and stream conditions in Table 4-42 and 4-43 are a summary of the stream opportunities identified during the stream corridor assessments found in Appendix F, Chapter 3. The erosion and vegetative data collected in the Upper Gwynns Falls watershed is summarized in Appendix E, Chapter 3.7.2.

The vegetative stability of the stream buffer was defined during the cruised reach assessment in four primary categories: canopy cover, riparian width, riparian composition and riparian density. The data was collected for both the right and left overbank areas as the stream channels have different buffer characteristics on each stream bank. Over half of the streams in the UGF-B subwatershed have more than 50% canopy cover and riparian buffer width of over fifty feet on each side. The riparian buffers are composed of deciduous overstory with grass/brush understory. Buffer enhancements were recommended for 19 of the cruised stream reaches.

There were six stream reach recommended for restoration and 24 that require bank stabilization. There were 26 fish blockages identified in the cruised reach assessments. No blockages were identified in the mainstem of the Gwynns Falls assessed in the Corps study, as fish blockages were not one of the factors considered in the Corps assessments. There was one utility conflict in the channel and ten of the cruised stream reaches were identified to have grade control issues requiring stream bed stabilization. 21 of the stream reaches had been relocated, piped, straightened or otherwise altered making them opportunities for channel improvements.

Table 4-42: Summary of Stream Opportunities – UGF-B

Subwatershed	Opportunities (# of Environmental Problem Sites)						
	Buffer Enhancement	Channel Restoration	Bank Stabilization	Utility Conflict	Fish Blockage	Grade Control	Totals
UGF-B	19	6	24	1	26	10	**86**

Table 4-43: Summary of Stream Conditions – UGF-B

Subwatershed	Unstable Channel Bed (%)	Unstable Banks (%)	Channel Alteration (#)
UGF-B	32	23	21

Illicit Discharges

UGF-B contains eleven outfalls that have been rated by the county. Of the eleven outfalls in Roche's Run, two were classified as priority 2 (high rating), eight were classified as priority 3 (low rating), and one was classified as priority 0 (not prioritized). No priority 1, or critical, rated outfalls are present in UGF-B. The two priority 2 outfalls should continue to be monitored once a year. The nine outfalls rated as priority 3 should be monitored on a ten year cycle. The outfall classified as priority 0 does not currently have a prioritization rating and should be screened to determine a true prioritization rating.

Stormwater Conversions

Nine dry detention ponds assessed in the UGF-B subwatershed were found to be potential candidates for conversion. Six of the ponds found to be potential candidates for conversion were ranked high for overall watershed conversion opportunities. Pond #437 scored the highest for conversion potential out of the dry detention ponds in UGF-B. Pond #437 is a privately owned pond with riser damage in the form of cracked mortar needing repair. There are trees on the embankment needing removal, bare soil erosion, no fence is present and there is adequate access resulting in a high conversion potential to shallow marsh or a partial extended detention pond. Figure 4-16 shows the cracking present in the riser needing repairs. Pond #698 is also privately owned and has a large drainage area of over 11 acres. Pond #698 has a damaged riser needing replacement with a two stage riser, trees needing removal on the embankment, and a short flow path that should be extended. Figure 4-17 shows the damaged riser which needs replacement. Ponds #283 and #697 also ranked high for conversion potential and are on privately owned land, both drainage areas are approximately 11 acres, and both have old BCCMP risers similar to Pond #698, which need replacement. Pond #1264 and pond #1278, the remaining ponds to score high for conversion potential are located on publicly owned land and have trees on the embankment needing removal, damaged one stage risers needing replacement with a two stage riser and fences require repair. Table 4-44 summarizes the candidates for detention pond conversion in the UGF-B subwatershed.

Table 4-44: Detention Pond Conversions – UGF-B

Pond Number	Ownership	Acres	Total Score	Rank	Subwatershed
437	PRIVATE	1.20	28	High	UGF-B
698	PRIVATE	11.16	22	High	UGF-B
283	PRIVATE	10.65	21	High	UGF-B
697	PRIVATE	11.00	21	High	UGF-B
1264	PUBLIC	45.58	20	High	UGF-B
1278	PUBLIC	10.32	20	High	UGF-B
775	PUBLIC	2.06	12	Medium	UGF-B
696	PRIVATE	49.88	9	Low	UGF-B
3908	PRIVATE	29.90	5	Low	UGF-B

Figure 4-16: Pond 437

Figure 4-17: Pond 698

Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection, rain barrel and rain garden measures in neighborhoods according to Table 4-38.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods and institutions indicated in Tables 4-38 and 4-40.
3. Plant street trees and open space trees in the neighborhoods as indicated in Table 4-38. Plant trees at the institutions indicated in Table 4-40.
4. Promote awareness of the benefits of Bayscaping and proper lawn care.
5. Engage institutional sites listed in Table 4-40 in recommended restoration actions.
6. Investigate the pervious areas described in Table 4-41 for potential tree planting.
7. Promote awareness of the stream watch program.
8. Increase awareness of existing trails and access points to streams in the UGF-B subwatershed.

Municipal Actions

1. Investigate current street sweeping measures in recommended neighborhoods listed in Table 4-38 and increase frequency or implement programs as necessary.
2. Promote awareness to commercial property owners about the importance of proper trash management and outdoor material storage techniques to the hotspot sites identified in Table 4-39.

3. Investigate the potential for stormwater retrofits at the institutions identified in Table 4-40.

4. Convert the dry detention ponds identified in Table 4-44 to shallow marsh or extended detention ponds.

5. Investigate stream restoration potential at sites listed in Table 4-42 and described in the Watershed Characterization Report.

6. Continue to monitor illicit discharges.

7. Explore options for stream buffer enhancements.

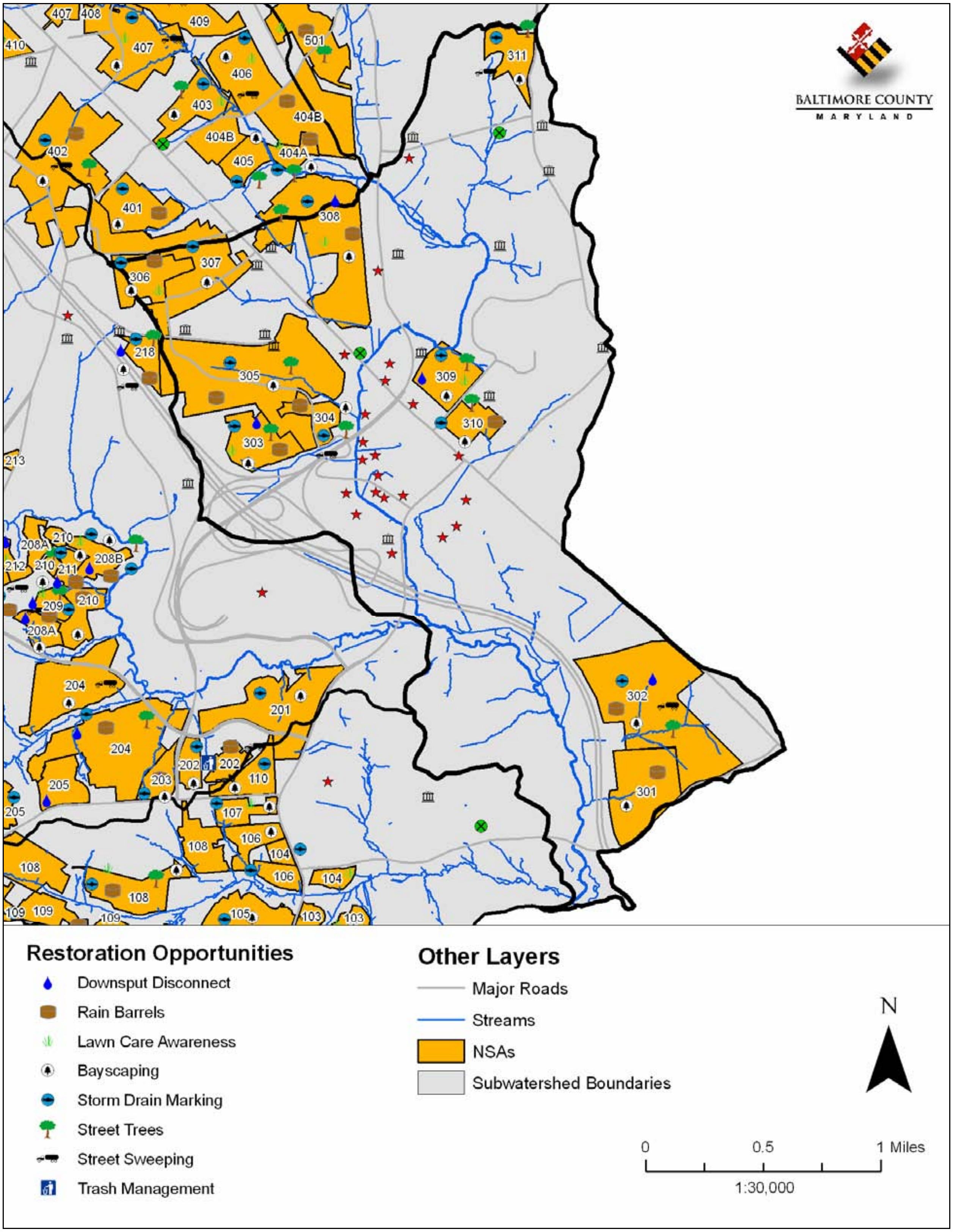

Figure 4-18: Restoration Opportunities in UGF-B

4.3.4 Roche's Run

The Roche's Run watershed lies entirely within Baltimore County. The subwatershed begins in Reisterstown and continues south to Pleasant Hill Road in Owings Mills, with I-795 as its western border and the edge of Gwynnbrook Wildlife Management Area as its eastern border. Table 4-45 summarizes the general subwatershed conditions. The corridor along Reisterstown Road is the main commercial and industrial zone within the watershed. Currently, commercial and industrial land uses comprise approximately 19.7% of the subwatershed. This subwatershed has experienced significant growth in the past twenty years, particularly due to transportation improvements such as I-795. 75.1% of the existing land is comprised of residential areas, predominantly medium- and high-density residential housing.

Table 4-45: Key Subwatershed Characteristics – Roche's Run

Drainage Area	1,537 acres (2.40 sq. mi.)
Stream Length	5.9 miles
Population	11,945 (2000 Census) 7.8 people/acre
Land Use / Land Cover	Impervious Urban: 27.2% Pervious Urban: 68.0% Cropland: 0.1% Pasture: 0.0% Livestock: 0.0% Forest and Wetlands: 4.7% Water: 0.0% Bare Soil: 0.0%
Impervious Cover	27.2% of Subwatershed
Soils	A Soils (low runoff potential): 0.0% B Soils: 83.2% C Soils: 11.1% D Soils (high runoff potential): 5.8%
SWM Facilities	57 Facilities 24% of urban land use treated
Priority Rating	High

Neighborhoods

A total of fourteen (14) distinct neighborhoods were identified and assessed within Roche's Run during the uplands assessment of Upper Gwynns Falls. Lots were typically either multi-family housing or ½-acre sized lots. Recommendations for addressing stormwater volume and pollutants within this subwatershed include downspout disconnection, storm drain marking, increasing lot forest canopy cover, and public awareness (i.e., Bayscaping, fertilizer reduction, lawn care, etc.) A summary of Neighborhood Source Assessments (NSA) recommended actions is presented in the table below.

Table 4-46: NSA Results Summary – Roche's Run

NSA_ID	Lot Size (acres)	% Opportunity for Downspout Disconnect	Rain Barrels	Rain Gardens	Storm Drain Marking	Bayscaping	Increase Lot Canopy	# of Street Trees	# of Open Space Trees	Fertilizer Reduction	Trash Management	Street Sweeping	Notes
NSA_V_401	< 1/8		X		X	X	X	0	40				Dry channel with buffer, SWM?
NSA_V_402	1/4		X		X	X	X	100	80			X	Built in the 1980's, one new cluster
NSA_V_403	Multi-Family				X	X	X	30	20				
NSA_V_404A	1/4		X		X	X	X	40	20	X			
NSA_V_404B	1/4		X	X				0	0				
NSA_V_405	1/4				X	X	X	40	20	X			
NSA_V_406	Multi-Family				X	X	X	0	20			X	
NSA_V_407	Multi-Family				X	X	X	0	60	X		X	Pond bank erosions, needs repair
NSA_V_408	Multi-Family				X	X	X	0	35		X	X	Need more trash receptacles
NSA_V_409	1/4		X	X	X	X	X	100	50			X	
NSA_V_410	< 1/4		X		X	X		100	20	X			
NSA_V_411	Multi-Family	55%			X		X	10	25				
NSA_V_412	Multi-Family	60%			X	X	X	0	90	X		X	
NSA_V_413	1/4		X		X	X	X	0	40	X			Pond bottoms are overgrown

The neighborhoods in the Roche's Run subwatershed were similar to other subwatersheds assessed. Of the neighborhoods assessed only one of fourteen is in need of enhanced trash management and only two have opportunity for downspout disconnection. The implementation of rain barrels, Bayscaping and increasing lot canopy cover by tree planting are the main needs of neighborhoods in the Roche's Run subwatershed. Half of the neighborhoods in the Roche's Run subwatershed would benefit from fertilizer reduction, and this should be implemented by providing awareness sessions to homeowners on how to minimize fertilizer usage.

Hotspots

With Roche's Run containing the main commercial and industrial zone in the Upper Gwynns Falls watershed, and with the significant growth it has experienced in the past twenty years, Roche's Run has by far the most hotspots and has the greatest potential for hotspot improvement. Twenty Hotspot Site Investigations (HSI) were performed and of the twenty sites investigated one was rated severe, nine were confirmed as hotspots, and ten were ranked as potential hotspots. The most common problems noted during the hotspot investigations were an excessive amount of improperly stored outdoor materials and poor waste management. Both of these issues are good to target, and can be partially resolved through holding seminars to raise awareness on safe outdoor storage practices and ways to minimize waste from exiting sites. Many of the hotspots in Roche's Run were directly adjacent to the stream making this is an important issue to address. Figure 4-18 and 4-19 show HSI_V_317 and HSI_V_314, respectively, two hotspots in need of cleanup that are directly adjacent to the Gwynns Falls. Posting no dumping signs along the stream and ensuring the adjacent commercial hotspots implicate methods to prevent waste and pollutants from entering the Gwynns Falls is critical in reducing pollutant loads in the Upper Gwynns Falls watershed. Table 4-46 provides a summary of the HSI results for Roche's Run.

Hotspots

Many sites were investigated for hotspot potential in the Roche's Run subwatershed but none were found which adequately met the requirements for any level of hotspot classification. As a result, no Hotspot Site Investigations (HSI) were performed.

Institutions

A total of eight (8) institutions were assessed for retrofit opportunities in the Roche's Run subwatershed during the uplands assessment of Upper Gwynns Falls. This includes two faith-based facilities, four public schools, and one municipal facility. The table below summarizes results for Institutional Site Investigations (ISI) assessed in Roche's Run.

Table 4-47: ISI Results Summary – Roche's Run

Site ID	Type	Public / Private	Tree Planting	Stormwater Retrofit	Storm Drain Marking	Downspout Disconnection	Impervious Cover Removal	Stream Buffer Improvement	Invasive Species Removal	Trash Management	Future Awareness Effort	Follow Up On Site Visit
ISI_V_401	Faith-Based	Private	X	X		X						
ISI_V_402	Hospital	Private								X		
ISI_V_403	School	Public	X		X			X		X		X
ISI_V_404	School	Public	X		X			X		X		X
ISI_V_405	School	Public		X	X	X			X	X		
ISI_V_406	Faith-Based/School	Private	X				X	X				X
ISI_V_407	Municipal Facility	Private			X						X	
ISI_V_408	School	Public			X	X					X	

The most common need for institutions in Roche's Run is storm drain marking. Half of the institutions need additional tree planting and enhanced trash management. Figure 4-19 shows an example of the trash management problems found at ISI_V_403. Three institutions need stream buffer improvement and a follow up visit to determine the best methods to enhance the buffer. Downspout disconnection is needed at three institutions. A faith-based institution and a public school both need stormwater retrofits due to a lack of existing stormwater management.

Figure 4-19: ISI_V_403

Pervious Areas

Two Pervious Area Assessments (PAA) were identified for restoration potential in the Roche's Run subwatershed. The two pervious areas assessed in Roche's Run are adjacent to one another enabling both projects to be implemented together. The first plot assessed, PAA_V_401, is approximately 0.5 acres and includes a concrete channel and stream that would be ideal for reforestation with minimal site preparation and stream buffer improvement. The area is 80 percent turf cover with partial sun exposure and easy access by foot, vehicle, and heavy equipment. Some invasive species are present and should also be removed. Figure 4-20 shows the current layout of PAA_V_401. The second pervious area assessed in Roche's Run, PAA_V_402, consist of Hathaway Park, a local publicly owned park. The site is approximately 3.9 acres with a stream as a nearby water source. The site is mostly covered by turf (65%) with some birch, maple and pine trees, some of which are in poor health. This site is recommended for reforestation and stream buffer enhancement with minimal site preparation based on initial field observations. The field team observed trash dumping and a minimal amount of invasive species that should be removed. The current use of this park land will need to be further investigated. With the exception of a small playground, it did not appear as though there are any sports fields located here or any reason why reforestation would not be acceptable to the citizens who use the area. The concrete channel and the asphalt path are small constraints and the land must be checked for underground utilities including possible sanitary sewer lines. Figure 4-21 shows the current layout of PAA_V_402. Table 4-40 provides a summary of the PAA results for the Roche's Run subwatershed.

Table 4-48: PAA Results Summary – Roche's Run

Site ID	Location	Description	Acres	Ownership
PAA_V_401	Between Chartley Town Apartments and Hathaway Park	Turf area needing buffer enhancement	0.5	Private
PAA_V_402	Hathaway Park	Park with mostly turf needing reforestation	3.9	Public

Figure 4-20: PAA_V_401

Figure 4-21: PAA_V_402

Stream Corridor Assessments

The Gwynns Falls upstream of Reisterstown Road is classified by the Maryland Department of the Environment (MDE) as a Use III stream, Natural Trout Waters that are to be protected. DNR monitoring has found trout in this subwatershed.

The condition of the stream habitat was based on two factors: USACE habitat rating from the Corps study and the fish blockage data from the PB cruised reach assessment as described in Appendix F. The Corps study rated the ecological condition of the Gwynns Falls subwatersheds based on macroinvertebrate and finfish sampling data conducted by DNR. The UGF-B subwatershed received a very poor to poor ecological rating. The Corps study rated the instream habitat as fair or good quality for over 97% of habitat assessed

The UGF-D, Roche's Run, and UGF-B subwatersheds were combined into a single subwatershed, called the Upper Gwynns Falls subwatershed, therefore the summarized results for the UGF-D, Roche's Run, and UGF-B subwatersheds are derived by percentage of stream length discussed in Appendix E, Chapter 2.2.6.

The channel disturbances and stream conditions in Table 4-49 and 4-50 are a summary of the stream opportunities identified during the stream corridor assessments found in Appendix F, Chapter 3. The erosion and vegetative data collected in the Upper Gwynns Falls watershed is summarized in Appendix E, Chapter 3.7.2.

The vegetative stability of the stream buffer was defined during the cruised reach assessment in four primary categories: canopy cover, riparian width, riparian composition and riparian density. The data was collected for both the right and left overbank areas as the stream channels have different buffer characteristics on each stream bank. Over half of the streams in the Roche's Run subwatershed have more than 50% canopy cover and riparian buffer width of over fifty feet on each side. The riparian buffers are composed of deciduous overstory with grass/brush understory. Buffer enhancements were recommended for 14 of the cruised stream reaches.

One stream reach was recommended for restoration and ten require bank stabilization. There were seven fish blockages identified in the cruised reach assessments. No blockages were identified in the mainstem of the Gwynns Falls assessed in the Corps study, as fish blockages were not one of the factors considered in the Corps assessments. There were no utility conflicts but one of the cruised stream reaches was identified to have grade control issues requiring stream bed stabilization. Seven of the stream reaches had been relocated, piped, straightened or otherwise altered making them opportunities for channel improvements.

Table 4-49: Summary of Stream Opportunities – Roche's Run

Subwatershed	Opportunities (# of Environmental Problem Sites)						
	Buffer Enhancement	Channel Restoration	Bank Stabilization	Utility Conflict	Fish Blockage	Grade Control	Totals
Roche's Run	14	1	10	0	7	1	**33**

Table 4-50: Summary of Stream Conditions – Roche's Run

Subwatershed	Unstable Channel Bed (%)	Unstable Banks (%)	Channel Alteration (#)
Roche's Run	19	42	7

Illicit Discharges

Roche's Run contains twelve outfalls that have been rated by the county. Of the twelve outfalls in Roche's Run, three were classified as priority 2 (high rating) and 9 were classified as priority 3 (low rating). No priority 1 (critical rating) outfalls are present in Roche's Run. The three priority 2 outfalls should continue to be monitored once a year. The nine outfalls rated as priority 3 should be monitored on a ten year cycle.

Stormwater Conversions

Eight (8) dry detention ponds assessed in the Roche's Run subwatershed were found to be potential candidates for conversion. Two of the ponds found to be potential candidates for conversion were ranked high for overall watershed conversion opportunities. Pond #1688 scored the highest for conversion potential out of the dry detention ponds in Roche's Run. Pond #1688 is a publicly owned pond with minor riser damage which would not be difficult to repair, trees on the embankment requiring removal, holes in the embankment requiring filling and the fence around the pond is damaged and needs repair. Access to the pond and riser is clear and repairs will be easy to perform. Figure 4-22 shows the damaged riser at pond #1688. The second pond, pond #1054, is also publicly owned and has a large drainage area of approximately 35 acres. Pond #1054 has a low flow orifice, but it is entirely covered with silt and no flow can pass, therefore requiring maintenance. The fence shows significant damage and requires repair/replacement. There is adequate access to the pond to perform retrofit actions. Figure 4-23 shows a portion of the fence surrounding pond #1054 which has fallen over and requires repair.

Table 4-51: Detention Pond Conversions – Roche's Run

Pond Number	Ownership	Acres	Total Score	Rank	Subwatershed
1688	PUBLIC	5.43	21	High	Roche's Run
1054	PUBLIC	34.87	19	High	Roche's Run
23	PRIVATE	0.84	15	Medium	Roche's Run
28	PUBLIC	5.36	15	Medium	Roche's Run
1687	PUBLIC	3.85	14	Medium	Roche's Run
1754	PUBLIC	1.65	14	Medium	Roche's Run
759	PUBLIC	64.33	11	Medium	Roche's Run
22	PRIVATE	1.52	5	Low	Roche's Run

Figure 4-22: Pond 1688

Figure 4-23: Pond 1054

Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection, rain barrel and rain garden measures in neighborhoods according to Table 4-46.

2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods and institutions indicated in Tables 4-46, and 4-47.

3. Plant street trees and open space trees in the neighborhoods as indicated in Table 4-46. Plant trees at the institutions indicated in Table 4-47.

4. Promote awareness of the benefits of Bayscaping and proper lawn care.

5. Encourage community cleanups in the neighborhoods recommended for trash management indicated in Table 4-46.

6. Engage institutional sites listed in Table 4-47 in recommended restoration actions.

7. Investigate the pervious areas described in Table 4-48 for potential tree planting.

8. Promote awareness of the stream watch program.

9. Increase awareness of existing trails and access points to streams in the Roche's Run subwatershed.

Municipal Actions

1. Investigate current street sweeping measures in recommended neighborhoods listed in Table 4-46 and increase frequency or implement programs as necessary.

2. Investigate the potential for stormwater retrofits at the institutions identified in Table 4-47.

3. Convert the dry detention ponds identified in Table 4-51 to shallow marsh or extended detention ponds.

4. Investigate stream restoration potential at sites listed in Table 4-49 and described in the Watershed Characterization Report.

5. Continue to monitor illicit discharges.

6. Explore options for stream buffer enhancements.

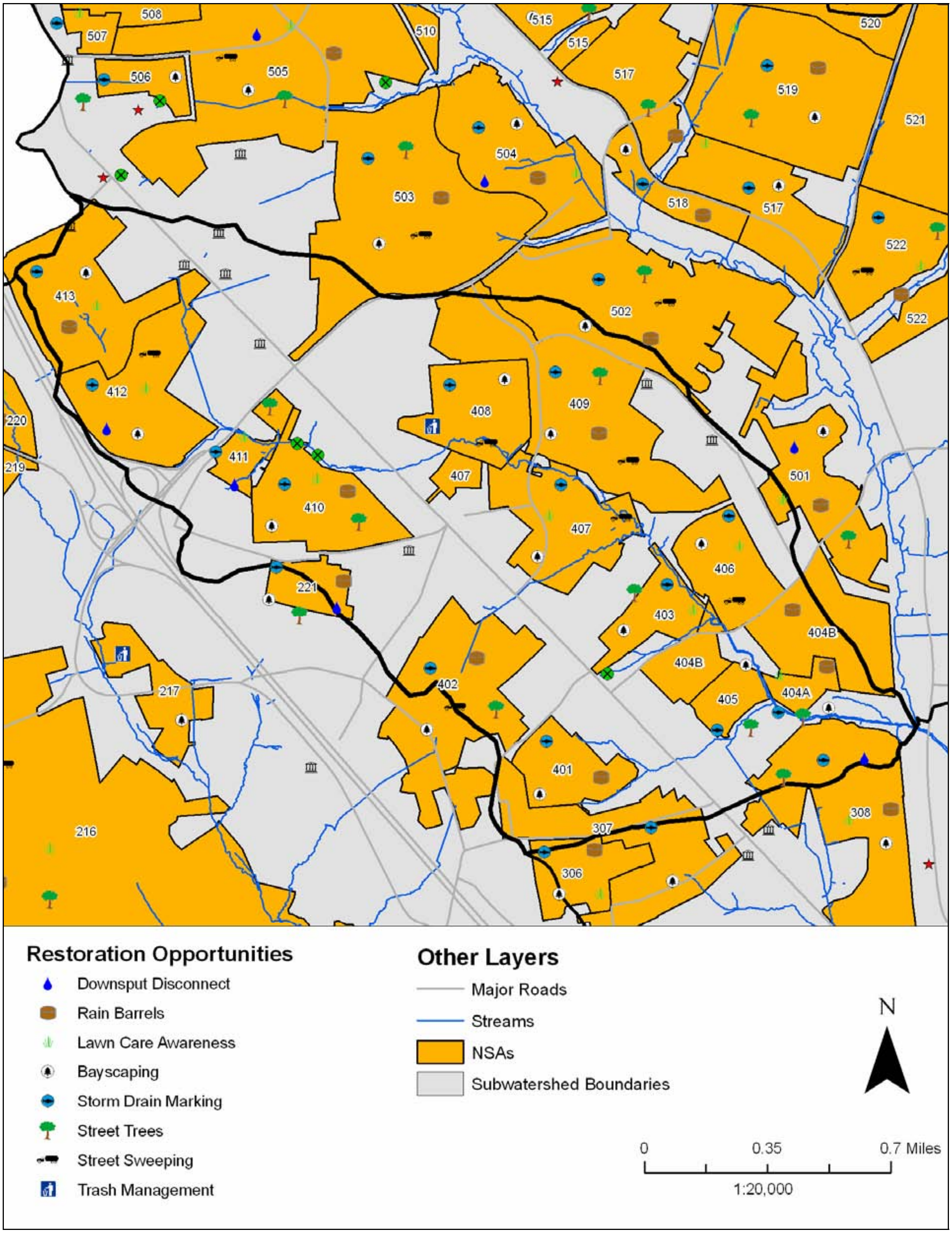

Figure 4-24: Restoration Opportunities in Roche's Run

4.3.5 UGF-D

The UGF-D subwatershed begins in the Glyndon area and continues south through Reisterstown to Walgrove Road, also encompassing the area east of Timber Grove Elementary School south to where Crondall Lane crosses Owings Mills Boulevard. Table 4-52 summarizes the general subwatershed conditions. The corridor along Reisterstown Road is the main commercial and industrial zone within the watershed. Currently, commercial and industrial land uses comprise only approximately 11.3% of the subwatershed. This subwatershed has experienced significant growth in the past twenty years, particularly due to transportation improvements such as I-795. Residential areas, predominantly low- and medium-density residential housing comprises 67.7% of the existing land area.

Table 4-52: Key Subwatershed Characteristics – UGF-D

Drainage Area	3,203 acres (5.00 sq. mi.)
Stream Length	15.4 miles
Population	15,592 (2000 Census) 4.9 people/acre
Land Use / Land Cover	Impervious Urban: 20.3% Pervious Urban: 59.1% Cropland: 5.8% Pasture: 0.0% Livestock: 0.0% Forest and Wetlands: 14.8% Water: 0.0% Bare Soil: 0.0%
Impervious Cover	20.2% of Subwatershed
Soils	A Soils (low runoff potential): 0.0% B Soils: 80.2% C Soils: 11.7% D Soils (high runoff potential): 8.1%
SWM Facilities	83 Facilities 56% of subwatershed
Priority Rating	Very High

Neighborhoods

A total of twenty-two (22) distinct neighborhoods were identified and assessed within UGF-D during the uplands assessment of the Upper Gwynns Falls SWAP study area. Recommendations for addressing stormwater volume and pollutants within this Subwatershed include downspout disconnection, storm drain marking, increasing lot forest canopy cover, and public awareness (i.e., Bayscaping, fertilizer reduction, lawn care, etc). A summary of Neighborhood Source Assessment (NSA) recommended actions is presented in the table below.

Table 4-53: NSA Results Summary – UGF-D

NSA_ID	Lot Size (acres)	% Opportunity for Downspout Disconnect	Rain Barrels	Rain Gardens	Storm Drain Marking	Bayscaping	Increase Lot Canopy	# of Street Trees	# of Open Space Trees	Fertilizer Reduction	Trash Management	Street Sweeping	Notes
NSA_V_501	1/4	25%	X		X	X	X	0	40	X			Downspouts have been manually redirected to impervious areas
NSA_V_502	< 1/4		X		X	X	X	100	80			X	
NSA_V_503	< 1/4		X		X	X	X	30	20				
NSA_V_504	Multi-Family	50%	X		X	X	X	40	20	X			High pesticide use present
NSA_V_505	< 1/4	25%	X			X		0	0				
NSA_V_506	Multi-Family				X	X	X	40	20				Driveways need cleaning / repair
NSA_V_507	Multi-Family				X		X	0	20	X		X	Buffer needs additional plantings
NSA_V_508	< 1/4			X	X	X	X	0	60			X	
NSA_V_509	1/4		X		X	X		0	35		X	X	
NSA_V_510	Multi-Family				X	X	X	100	50			X	
NSA_V_511	Multi-Family	80%			X	X	X	100	20				
NSA_V_512	1/4		X	X	X	X	X	10	25				
NSA_V_513	1/2		X	X	X	X		0	90			X	
NSA_V_514	1/4		X		X	X	X	0	40				Pond embankment has eroded
NSA_V_515	Multi-Family				X	X	X						Excessive oil staining and buffer needs additional plantings
NSA_V_516	1/4		X	X	X	X	X			X			Pond bottom is partially overgrown
NSA_V_517	< 1/4		X		X	X	X			X			
NSA_V_518	Multi-Family		X		X	X	X						
NSA_V_519	1/2		X		X	X	X			X			Many pools are present
NSA_V_520	> 1		X	X	X	X				X			Many pools are present
NSA_V_521	1/2		X	X	X	X	X			X			
NSA_V_522	1/4		X	X	X	X	X			X			

Almost all of the neighborhoods studied in UGF-D require additional lot canopy cover and this can be achieved through encouraging tree planting. Bayscaping was lacking throughout the subwatershed and awareness sessions should be held to promote Bayscaping. Fertilizer overuse is another prominent concern in the UGF-D subwatershed and promoting awareness on the impacts of fertilizer use will help to reduce its overuse. Storm drain marking should be performed in the subwatershed, and street sweeping efforts should be increased in the indicated neighborhoods. Four (4) neighborhoods show a need for downspout disconnection and rain barrels should be implemented in any neighborhoods that are poor candidates for downspout disconnection.

Hotspots

Ten (10) Hotspot Site Investigations (HSI) were performed in the UGF-D subwatershed. Nine of the ten hotspots are commercial sites and one is a transport-related site. Of the ten hotspot investigations performed, four resulted in a confirmed hotspot and six resulted in a potential hotspot with further analysis required. The improper storage of materials outdoors was the most frequent potential pollution source encountered, followed by inefficient vehicle operations and waste management issues. Figure 4-25 and 4-26 show materials stored outdoors improperly at HSI_V_505. The table below summarizes results for hotspots assessed in the UGF-D subwatershed.

Table 4-54: HSI Results Summary – UGF-D

Site ID	HSI Status	HSI Category	Potential Sources of Pollution					Notes
			Vehicle Operations	Outdoor Storage Materials	Waste Management	Physical Plant	Turf / Landscaping	
HSI_V_501	Confirmed	Commercial	X	X				
HSI_V_502	Potential	Transport-Related	X					
HSI_V_503	Potential	Commercial						No visible sources of pollution
HSI_V_504	Confirmed	Commercial		X				
HSI_V_505	Confirmed	Commercial		X				
HSI_V_506	Confirmed	Commercial	X	X				
HSI_V_507	Potential	Commercial						No visible sources of pollution
HSI_V_508	Potential	Commercial			X			
HSI_V_509	Potential	Commercial						No visible sources of pollution
HSI_V_510	Potential	Commercial			X			

Figure 4-25: HSI_V_505

Figure 4-26: HSI_V_505

Institutions

A total of twelve (12) institutions were assessed for retrofit opportunities in the UGF-D subwatershed during the uplands assessment of Upper Gwynns Falls. This includes seven faith-based facilities, three public schools, one private school, and one municipal facility. The table below summarizes results for Institutional Site Investigations (ISI) in UGF-D.

Table 4-55: ISI Results Summary – UGF-D

Site ID	Type	Public / Private	Tree Planting	Stormwater Retrofit	Storm Drain Marking	Downspout Disconnection	Impervious Cover Removal	Stream Buffer Improvement	Invasive Species Removal	Trash Management	Future Awareness Effort	Follow Up On Site Visit
ISI_V_501	Faith-Based	Private	X									
ISI_V_502	Faith-Based	Private	X							X	X	
ISI_V_503	School	Public	X		X							
ISI_V_504	School	Public	X		X	X				X		
ISI_V_505	School	Public				X				X		
ISI_V_506	School	Private			X					X		
*ISI_V_507	Faith-Based/School	Private										
ISI_V_508	Faith-Based	Private	X							X		
ISI_V_509	Faith-Based	Private				X						
ISI_V_510	Faith-Based	Private	X		X			X				X
ISI_V_511	Municipal Facility	Public			X							
ISI_V_512	Faith-Based	Private										

The overall status of the institutions in the UGF-D was in good shape for the Upper Gwynns Falls watershed and there are not excessive needs present at most of the institutions in UGF-D. The three needs that are present in at least one third of the institutions in UGF-D are tree planting, storm drain marking and enhanced trash management. Figure 4-27 shows mop threads found in an inlet at ISI_V_505, a need for awareness sessions to prevent mop dumping from occurring. Twenty-five percent of the institutions are in need of downspout disconnection. One faith-based institution is in need of a stream buffer improvement and a follow up site visit to determine the best methods for enhancing the buffer.

Figure 4-27: ISI_V_505

Pervious Areas

Five Pervious Area Assessments (PAA) were made for restoration potential in the UGF-D subwatershed, the most of any subwatershed in the Upper Gwynns Falls watershed. The first plot assessed, PAA_V_501, is approximately 1 acre and is a grass lot present in front of Glyndon Elementary School. This site is recommended for reforestation with minimal site preparation. Because this site is in front of a public school this is a good candidate for a school program. A possible school program could cover environmental improvements, watershed information and explanations of best management practices with community organizations. This would be a good opportunity for community involvement and awareness. Figure 4-28 shows the current layout of PAA_V_501.

The second pervious area assessed in UGF-D, PAA_V_502, consists of a grass lot near 605 Main Street and is mostly covered by turf but has excessive amounts of bare soil. This site is recommended for reforestation with minimal site preparation based on initial field observations, a nearby water source, and easy access. Figure 4-29 shows the current layout of PAA_V_502.

The remaining three pervious areas assessed in UGF-D are all standard open grass lots of approximately 2.0 acres in size. The three lots all consist of primarily grass turf with approximately 5% of the area planted with trees. Reforestation with minimal site preparation is recommended for these three areas because they have ample access, good sun light and water sources to assist with tree planting and maintenance. Table 4-56 summarizes the PAA results for the UGF-D subwatershed.

Table 4-56: PAA Results Summary – UGF-D

Site ID	Location	Description	Acres	Ownership
PAA_V_501	Front of Glyndon Elementary School	Open grass lot in front of the school	0.9	Public
PAA_V_502	605 Main Street	Open grass lot with excessive erosion needing reforestation	1.3	Private
PAA_V_503	Gynnwest Road	Open grass lot needing reforestation	2.3	Public
PAA_V_504	Glynlee Court	Open grass lot needing reforestation	1.7	Public
PAA_V_505	Chartley Shopping Center	Open grass lot needing reforestation	2.0	Private

Figure 4-28: PAA_V_401

Figure 4-29: PAA_V_402

Stream Corridor Assessments

The Gwynns Falls upstream of Reisterstown Road is classified by the Maryland Department of the Environment (MDE) as a Use III stream, Natural Trout Waters, that are to be protected. DNR monitoring has found trout in this subwatershed.

The condition of the stream habitat was based on two factors: USACE habitat rating from the Corps study and the fish blockage data from the PB cruised reach assessment as described in Appendix F. The Corps study rated the ecological condition of the Gwynns Falls subwatersheds based on macroinvertebrate and finfish sampling data conducted by DNR. The UGF-B subwatershed received a very poor to poor ecological rating. The Corps study rated the instream habitat as fair or good quality for over 97% of habitat assessed.

The UGF-D, Roche’s Run, and UGF-B subwatersheds were combined into a single subwatershed, called the Upper Gwynns Falls subwatershed, therefore the summarized results for the UGF-D, Roche’s Run, and UGF-B subwatersheds are derived by percentage of stream length discussed in Appendix E, Chapter 2.2.6.

The channel disturbances and stream conditions in Table 4-57 and 4-58 are a summary of the stream opportunities identified during the stream corridor assessments found in Appendix F, Chapter 3. The erosion and vegetative data collected in the Upper Gwynns Falls watershed is summarized in Appendix E, Chapter 3.7.2.

The vegetative stability of the stream buffer was defined during the cruised reach assessment in four primary categories: canopy cover, riparian width, riparian composition and riparian density. The data was collected for both the right and left overbank areas as the stream channels have different buffer characteristics on each stream bank. Over half of the streams in the UGF-D subwatershed have more than 50% canopy cover and riparian buffer width of over fifty feet on each side. The riparian buffers are composed of deciduous overstory with grass/brush understory. Buffer enhancements were recommended for 25 of the cruised stream reaches.

There were 13 stream reach recommended for restoration and 31 reaches that require bank stabilization. There were 13 fish blockages identified in the cruised reach assessments. No blockages were identified in the mainstem of the Gwynns Falls assessed in the Corps study, as fish blockages were not one of the factors considered in the Corps assessments. There was one utility conflict in the channel and 24 of the cruised stream reaches were identified to have grade control issues requiring stream bed stabilization. 16 of the stream reaches had been relocated, piped, straightened or otherwise altered making them opportunities for channel improvements.

Table 4-57: Summary of Stream Opportunities – UGF-D

	Opportunities (# of Environmental Problem Sites)						
Subwatershed	**Buffer Enhancement**	**Channel Restoration**	**Bank Stabilization**	**Utility Conflict**	**Fish Blockage**	**Grade Control**	**Totals**
UGF-D	25	13	31	1	13	24	**107**

Table 4-58: Summary of Stream Conditions – UGF-D

Subwatershed	Unstable Channel Bed (%)	Unstable Banks (%)	Channel Alteration (#)
UGF-D	49	26	16

Illicit Discharges

UGF-D contains seventeen (17) outfalls that have been rated by the county, the most of any subwatershed in the Upper Gwynns Falls watershed. Red Run has two outfalls that have been rated as priority 1 which is the critical or highest rating. Priority 1 outfalls have major problems that require immediate correction and/or close monitoring, or outfalls with recurrent problems. These outfalls are sampled four times each year. Of the remaining outfalls, three were classified as priority 2 (high rating), and twelve were classified as priority 3 (low rating). The three priority

2 outfalls should continue to be monitored once a year. The nine outfalls rated as priority 3 should be monitored on a ten year cycle.

Stormwater Conversions

Twenty-three (23) dry detention ponds assessed in the UGF-D subwatershed were found to be potential candidates for conversion, the most of any subwatershed in the Upper Gwynns Falls watershed. Fourteen of the ponds found to be potential candidates for conversion were ranked high for overall watershed conversion opportunities. Pond #42 scored the highest for conversion potential out of the dry detention ponds in UGF-D. It is a publicly owned pond with a drainage area of approximately 10 acres. The pond has an old riser with the low flow orifice being covered and blocked with silt, trees on the embankment needing removal, and the pond bottom is overgrown. Figure 4-30 shows the old riser structure needing replacement with a new riser structure. Pond #870, also ranked high for conversion, has an old riser structure (no low flow pipe orifice) needing replacement, trees on the embankment needing removal, both erosion and holes present in the embankment, and a short flow path which should be extended. This pond is ideal for conversion to a shallow marsh or a partial extended detention pond. Figure 4-31 shows the current riser in pond #870 which needs replacement with an updated riser. Other ponds recommended for conversion in the UGF-D subwatershed are in need of many of the following improvements: replacing old outdated risers with new risers consisting of both a low flow and high flow orifice, removing trees from pond embankments, fixing damaged pond fences, fixing eroded embankments and increasing flow path lengths.

Table 4-59: Detention Pond Conversions – UGF-D

Pond Number	Ownership	Acres	Total Score	Rank	Subwatershed
42	PUBLIC	9.56	30	High	UGF-D
870	PUBLIC	10.85	29	High	UGF-D
25	PUBLIC	17.15	28	High	UGF-D
58	PUBLIC	8.36	25	High	UGF-D
174	PUBLIC	29.85	25	High	UGF-D
17	PRIVATE	1.90	23	High	UGF-D
19	PRIVATE	3.21	23	High	UGF-D
44	PUBLIC	10.19	23	High	UGF-D
15	PRIVATE	8.80	22	High	UGF-D
27	PUBLIC	25.28	22	High	UGF-D
47	PUBLIC	27.50	22	High	UGF-D
865	PUBLIC	156.81	21	High	UGF-D
40	PRIVATE	18.14	20	High	UGF-D
172	PUBLIC	29.24	19	High	UGF-D
281	PRIVATE	12.30	18	Medium	UGF-D
33	PUBLIC	21.56	17	Medium	UGF-D
41	PRIVATE	11.41	16	Medium	UGF-D

Table 4-59: Detention Pond Conversions – UGF-D, Continued

Pond Number	Ownership	Acres	Total Score	Rank	Subwatershed
26	PUBLIC	19.36	14	Medium	UGF-D
93	PUBLIC	215.53	12	Medium	UGF-D
110	PUBLIC	75.52	11	Medium	UGF-D
50	PRIVATE	7.69	8	Low	UGF-D
51	PRIVATE	3.03	8	Low	UGF-D
46	PUBLIC	40.27	3	Low	UGF-D
26	PUBLIC	19.36	14	Medium	UGF-D

Figure 4-30: Pond 42

Figure 4-31: Pond 870

Subwatershed Management Strategy

Engaging Citizens & Watershed Groups

1. Conduct appropriate downspout disconnection, rain barrel and rain garden measures in neighborhoods according to Table 4-53.
2. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods and institutions indicated in Tables 4-53 and 4-55.
3. Plant street trees and open space trees in the neighborhoods as indicated in Table 4-53. Plant trees at the institutions indicated in Table 4-55.
4. Promote awareness of the benefits of Bayscaping and proper lawn care.
5. Encourage community cleanups in the neighborhoods recommended for trash management indicated in Table 4-53.
6. Engage institutional sites listed in Table 4-55 in recommended restoration actions.

7. Investigate the pervious areas described in Table 4-56 for potential tree planting.

8. Promote awareness of the stream watch program.

9. Increase awareness of existing trails and access points to streams in the UGF-D subwatershed.

<u>Municipal Actions</u>

1. Investigate current street sweeping measures in recommended neighborhoods listed in Table 4-53 and increase frequency or implement programs as necessary.

2. Promote awareness to commercial property owners about the importance of proper trash management and outdoor material storage techniques to the hotspot sites identified in Table 4-54.

3. Convert the dry detention ponds identified in Table 4-59 to shallow marsh or extended detention ponds.

4. Investigate stream restoration potential at sites listed in Table 4-57 and described in the Watershed Characterization Report.

5. Continue to monitor illicit discharges.

6. Explore options for stream buffer enhancements.

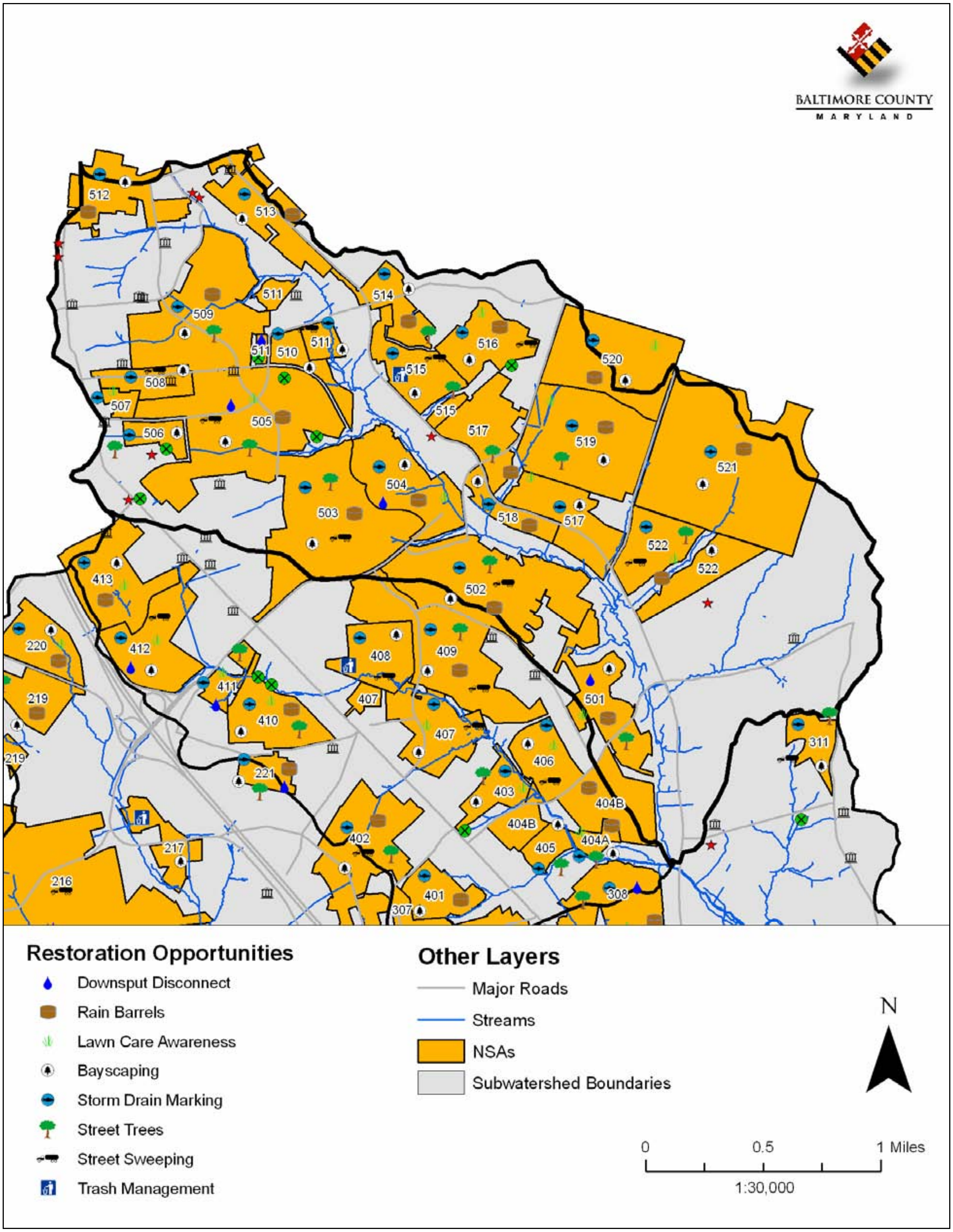

Figure 4-32: Restoration Opportunities in UGF-D

CHAPTER 5

PLAN EVALUATION

5.1 Introduction

The Upper Gwynns Falls SWAP is based on a 10-year implementation schedule (2021 endpoint). This timeframe is necessary to implement restoration measures and meet the Gwynns Falls nutrient, bacteria, chloride, and sediment TMDLs. The ability to implement this plan within the 10-year timeframe is dependent upon the availability of staff and sufficient funding. The Upper Gwynns Falls SWAP Implementation Committee (an outgrowth of the Steering Committee) will meet twice per year to assess progress in meeting watershed goals and objectives and to discuss funding options. In addition, an annual progress report and a biennial report on water quality monitoring results will be produced. If other water quality issues arise, the Upper Gwynns Falls SWAP Implementation Committee will initiate a revision of the plan within six months of TMDL approval. Currently, the Chesapeake Bay TMDL is in draft form with pollutant reduction targets by 2017 and 2025 (2020 in Maryland). Two-year milestones are established to track progress and ensure all practices are in place by 2025. The EPA will review the two-year milestones and determine if milestones are met using the Bay Tracking and Accountability System.

An adaptive watershed management approach will be used to adjust actions as necessary based on implementation success. Progress and success of the Upper Gwynns Falls SWAP will be evaluated during implementation based on the following: interim measurable milestones, pollutant load reduction criteria, implementation tracking, and monitoring. These evaluation components are described in the following sections.

5.2 Interim Measurable Milestones

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 on an annual basis. Action strategies may be modified and/or new actions may be proposed based on this annual evaluation. New actions proposed will also be evaluated on an annual basis and modified as necessary to meet watershed goals and objectives.

5.3 Pollutant Load Reduction Criteria

Current pollutant load reduction scenarios and calculations for proposed actions are presented in Chapter 3. These are mainly based on pollutant removal efficiencies approved by the Chesapeake Bay Program (CBP) for various nonpoint source BMPs. These pollutant removal efficiencies will continue to be used to measure progress in meeting the nutrient TMDL reduction goal (i.e., 15% reduction in total nitrogen and total phosphorus loads from urban stormwater discharges). CBP-approved BMP removal efficiencies are summarized in the tables included as Appendix C. Actions and associated pollutant load reductions will be reevaluated if CBP revises/updates pollutant removal efficiencies within the 10-year timeframe to ensure that the nutrient TMDL reductions are met.

5.4 Implementation Tracking

An implementation tracking tool that accounts for all restoration activities is being developed in conjunction with the Baltimore Watershed Agreement to produce a consistent tracking system for use by Baltimore City and Baltimore County governments and local watershed organizations. This tracking tool will also be used by the Upper Gwynns Falls SWAP Implementation Committee to assess annual progress through a comparison between completed restoration activities and the performance measures detailed in Appendix A. The tracking tool will also provide information regarding pollutant load reductions that have been accomplished through implementation of various restoration projects.

5.5 Monitoring

Baltimore County currently conducts water quality monitoring programs within the Upper Gwynns Falls watershed. Additional monitoring is anticipated to assess the effectiveness of restoration projects and progress in meeting nutrient, chloride, bacteria, and sediment TMDL reductions.

Existing Monitoring

Baltimore County conducts chemical, biological, and illicit connection monitoring within the Upper Gwynns Falls watershed. These are described in detail in Appendix E, Chapter 3.2 and listed below:

- County Baseflow Monitoring Program – 6 sampling locations, in UGF-D, Roche's Run, Red Run, and Horsehead Branch measure baseflows, suspended solids, nutrients, and chloride
- Baltimore Ecosystem Study – 6 sampling locations, in UGF-D, Roche's Run, UGF-B, Red Run, and Horsehead Branch measure suspended solids, nutrients, and chloride
- County Biological Monitoring Program – Randomly selected locations in the Upper Gwynns Falls watershed using characteristics of benthic macroinvertebrates as a water quality indicator
- Illicit Discharge Detection and Elimination Program – Routine outfall screening and prioritization system to track and reduce illicit connections and discharges
- Maryland Biological Stream Survey – A benthic community monitoring program is currently being assessed. The sampling locations throughout Upper Gwynns Falls were sampled between 2003 and 2009. Initial samples confirm presence of trout in Red Run and some good and fair water among the mostly poor quality water leaving the SWAP study area.
- County Bacteria Monitoring – As part of a TMDL development program, two sites are monitored in the Upper Gwynns Falls for E. Coli. Sampling began in June 2010 and is done on a monthly basis.

- County Trash Monitoring – As part of a TMDL development program, 19 sites are monitored in the Upper Gwynns Falls for trash. Sampling began in October 2010 and will be done on a quarterly basis for a total of 5 times.

SWAP Implementation Monitoring

SWAP implementation monitoring activities will focus on project specific monitoring and targeted subwatershed monitoring. Project specific monitoring needs will be identified 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 lawn care 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 there are many existing water quality monitoring stations in the Upper Gwynns Falls watershed. Monitoring activities will be coordinated among SWAP participants (Baltimore County and Blue Water Baltimore) through participation in the Upper Gwynns Falls SWAP Implementation Committee.

CHAPTER 6

REFERENCES

Ibison, N.A., J.C. Baumer, C.L. Hill, J.E. Frye, N.H. Burger. 1992. *Eroding Bank Nutrient Verification Study for the Lower Chesapeake Bay*. Virginia Division of Soil and Water Conservation. Gloucester Point, Virginia.

Center of Watershed Protection (CWP) and Maryland Department of the Environment (MDE). 2000. *2000 Maryland Stormwater Design Manual*. Website: http://www.mde.state.md.us/programs/Water/StormwaterManagementProgram/MarylandStormwaterDesignManual/Pages/Programs/WaterPrograms/SedimentandStormwater/stormwater_design/index.aspx

APPENDIX A:

Upper Gwynns Falls Action Strategies

Appendix A

Upper Gwynns Falls Action Strategies

This appendix presents the actions related to the goals and objectives presented in Chapter 2 of the Upper Gwynns Falls SWAP. A complete list of actions proposed for the watershed including timelines, performance measures, unit cost estimates, and responsible parties is included in Table A-1. In many cases, actions relate to multiple goals and objectives. Table A-2 indicates the goals and objectives targeted for each action. 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
    - Urban Tree Canopy
    - Trash Management
    - Stream Corridor Restoration
- 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.

Timeline

This column denotes the timeline over which an action will be performed.

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 divided by the proposed timeline.

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 by numerals as follows:

1. Baltimore County (DEPRM)
2. Blue Water Baltimore (BWB)
3. Upper Gwynns Falls SWAP Implementation Committee

Table A-1: Upper Gwynns Falls Action Strategies

Goal	Objective	Action	Basis for Performance Measure	Timeline	Performance Measure	Unit Cost	Responsible Party
RESTORATION ACTIONS							
Nutrient Reduction							
1	8,9	Reduce fertilizer use on residential high maintenance lawns in the 39 recommended neighborhoods by implementing an awareness program	Conduct 10 lawn care awareness events targeting 4 recommended neighborhoods per event = 39 neighborhoods (1,307 acres of high maintenance lawn identified x 5% participation rate = 65 acres)	5 years	2 events per year	$500 / event	2, 3
1 4	9 5	Promote Bayscaping in the 75 neighborhoods identified	Conduct 15 Bayscaping awareness events targeting 5 recommended neighborhoods per event (3,536 acres of lawn identified for Bayscaping x 5% participation rate = 177 acres)	5 years	3 events per year	$500 / event	2, 3
1	7	Continue municipal road maintenance street sweeping activities; investigate the 28 neighborhoods recommended for street sweeping to implement activities and/or adjust frequency as needed	63 miles of road identified and reported to Baltimore County DPW; Existing Operations – bulk removal rates reported	On-going	Pounds removed	Existing staff	1
1 2 7	6,7,8,9 1,2,3,4,5 1,2,3,4,5	Develop a community awareness program which discusses the impacts of nutrients to the watershed, Baltimore Harbor and Chesapeake Bay	Community awareness workplan developed	2 years	Awareness program developed	Existing staff	1, 2
Stormwater Management							
1 2 5 6	1 6 4 2	Investigate and convert the 51 existing dry detention ponds identified for water quality treatment	51 existing detention ponds identified as having physical expansion capability x 50% projected participation = 25 conversions	10 years	5 conversions per 2 year period	$3,200 per acre	1
1 3 4 5 6	3 5 4 3,4 1	Work with institutional partners to reduce impervious cover at the 3 institutional sites identified (3 faith-based)	Maximum potential of 1 acre of impervious cover removal identified x 50% participation rate = removal of 0.50 acres	3 years	1 institution per year	$25,000 per acre	1, 2
1 5 6	9 4 1,3	Develop and implement a downspout disconnection program; promote redirection of downspouts for downspout disconnection in the 35 recommended neighborhoods	96.6 acres of impervious rooftop identified x 10% participation rate = 9.7 acres	10 years	Address 1 rooftop acres per year	$8,716 per acre	2, 3
1 5 6	9 4 1,3	Promote rain barrel and rain garden use in the 35 neighborhoods where downspouts cannot be redirected	Conduct 7 rain barrel / rain garden awareness seminars targeting 5 neighborhoods per event (200 acres of area of impervious rooftop identified x 10% participation rate = 20 acres)	7 years	1 event per year	$500 / event	2, 3
1 3 5 6 7	3 5 2,4 1,3,4 2	Investigate the feasibility of implementing stormwater retrofits to treat runoff from impervious surfaces (parking lots) at the 26 hotspots identified	26 Hotspot sites identified as being possible for stormwater retrofits	2 years	Feasible retrofit sites identified	Existing staff	1
1 3 5 6	3 5 2,4 1,3,4	Investigate the feasibility of implementing stormwater retrofits to treat runoff from impervious surfaces (parking lots) at the 15 institutional sites identified (school and faith based)	15 Institutional sites identified as being possible for stormwater retrofits	2 years	Feasible retrofit sites identified	Existing staff	1, 2
1 5 6	3 2,4 1,2,3,4	Design and implement stormwater retrofits at all feasible sites	15 Institutions + 26 Hotspots x 25% participation rate = 10 stormwater retrofits	5 years	2 retrofits per year	$3,200 per acre	1, 2
1 5 6	1 2,4 1,2,3,4	Inspect and maintain stormwater conversions and retrofits	26 conversions + 10 retrofits = 36 projects	9 years	4 inspections per year	Existing staff	1

Table A-1: Upper Gwynns Falls Action Strategies (Cont.)

Goal	Objective	Action	Basis for Performance Measure	Timeline	Performance Measure	Unit Cost	Responsible Party
			Urban Tree Cover				
1 2 3 4 5 6	3 1,4 5 1,3,4 1,3 4,6,7	Investigate the feasibility of planting riparian stream buffers on open pervious land utilizing programs such as Tree-Mendous Maryland	785 acres of open pervious land identified within the 100-foot stream buffer through GIS analysis	2 years	Feasible buffer planting sites identified	Existing staff	1, 2
1 2 3 4 5 6	3 1,4 5 1,3,4 1,3 4,6,7	Reforest stream buffer at feasible sites with a minimum width of 35 feet	785 acres of open pervious land identified in the GIS analysis x 10% participation rate = 78.5 acres	10 years	Reforest 8 acres per year	$15,000 per acre	1, 2
2 4 6	3 1 7	Plant trees on PAA sites, focusing efforts on sites identified as mostly open pervious cover type requiring minimal site preparation; this includes working with MD SHA to plant trees in suitable medians and rights-of-way and utilizing the Tree-Mendous Maryland program	11.8 acres of public PAA sites x 33% = 3.9 acres and 60 acres of private PAA sites x 33% = 20 acres = 23.9 total acres	8 years	Reforest 3 acres per year	$6,000 per acre	2, 3
2 4 6	3 2,5 7	Encourage street and shade tree planting in the 67 recommended neighborhoods	Maximum potential of 5,895 trees x (1 acre/200 trees) = 29.5 acres x 33% participation rate = 9.8 acres (or 1960 trees)	10 years	Plant 200 trees per year	$175 per tree	2, 3
2 4 6	3 3 7	Encourage institutions to plant trees on available open space at the 26 sites identified; (utilizing the Tree-Mendous Maryland program)	Maximum potential of 1,296 trees x (1 acre/200 trees) = 6.48 acres x 33% participation rate = 2.2 acres (or 440 trees)	10 years	Plant 44 trees per year	$175 per tree	2, 3
1 2 3 5 6	3 1,3,4 5 1,3 6	Baltimore County shall continue to require riparian buffers and forest conservation for all new and re-development	On-going, keep track of existing riparian buffer and forest preserved	On-going	Acres preserved	Existing staff	1
2 3 4 6	3 5 1,2,3,4 5,7	Maintain trees planted at reforestation/tree planting sites	Tree maintenance (watering, mowing, weeding, etc.) is required for the first 5 years to ensure successful growth; projected number of acres to be reforested: 78.5+23.9+9.8+2.2 = 114.4 acres	5 years	Maintain 22.9 acres per year	$1300 per acre	1, 2, 3
3 8	1,2,5 2	Improve forest habitat by organizing exotic invasive species removal activities every year	Organize 1 exotic species removal activity addressing 2 acres per year	10 years	Exotic species removed from 2 acres per year	$500 per year	2
			Trash Management				
2 7	2,6 All	Develop a trash and litter management work plan	Work plan developed	2 years	Plan completed	Existing stall	1
2 7	2,6 1,2	Investigate hotspots and institutions identified as having trash management related problems and identify areas where additional trash cans, covered receptacles, and/or better maintenance measures are needed	10 hotspots and 21 institutions with trash management problems identified, schedule site visits to discuss/review trash management solutions	5 years	Perform 6 site visits per year	Existing staff	1
2 7	2,6 3,4,5,6,7	Enforce additional measures and better maintenance	10 hotspots and 21 institutions with trash management problems identified, schedule recurring inspections every other year	On-going	Perform 15 inspections per year	Existing staff	1

Table A-1: Upper Gwynns Falls Action Strategies (Cont.)

Goal	Objective	Action	Basis for Performance Measure	Timeline	Performance Measure	Unit Cost	Responsible Party
7	3,4,5,6,7	Implement recycling and add separate receptacles for recycling on public properties such as parks	Add recycling receptacles at public parks, facilities (i.e., Owings Mills Metro Station) and other feasible sites	5 years	Recycling implemented at feasible sites	Existing staff	1
2 7	2,4 2,3,4,5,6	Post no dumping signs in problem areas identified and enforce no dumping, including cluster of 18 hotspots identified along Gwynns Falls in UGF-B	Signs posted; 30 total	2 years	Post 15 signs per year	$40 per sign	1
Stream Corridor Restoration							
1 2 3 6	2 1,5 1,2,3,4 4,5	Evaluate the restoration potential and feasibility of restoring eroded stream banks and channel alterations identified in the stream corridor assessments	Identify water quality improvement opportunities	2 years	Feasible retrofits identified	Existing staff	1
1 2 3 8	4,5,7 2,4 3 3	Conduct a follow up inspection of the outfalls and exposed pipe locations rated as potentially severe or severe-moderate issues identified during outfall screening in the Illicit Discharge and Elimination Program	3 outfalls locations rated as Priority 1 (Critical) and 14 outfall locations rated as Priority 2 (High) = 17 locations total	3 years	Conduct 6 inspections per year	Existing staff	1
1 2 3 6	2 4,5 1,2,5 4,5,6	Complete stream restoration projects at feasible sites based on 23% unstable streams assessed	Stabilize and restore 2 miles of unstable streams in the Upper Gwynns Falls subwatershed to provide water quality improvement	8 years	0.25 miles (1,294 Ln ft) per year	$350 / Ln ft	1
OUTREACH & AWARENESS							
2 3 4 5 6 7	1,2,4,6 3,4,5 4 2,3,4 1,2,3,7 3,4,5,6	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	10 hotspot sites assessed; Categories identified: Business centers, metro station, commercial services; Conduct 3 workshops and distribute outreach material	6 years	Conduct 1 workshop every 2 years	$500 / workshop	1, 2, 3
1 2 4 6	8 3,4 1,4,5 1,2,3,7	Develop a community outreach campaign to raise awareness about homeowner actions aimed towards nutrient reduction	Publicize several actions in E-News Stream and other media	On-going	4 announcements per year	Existing staff	1, 2, 3
2 5 6 8	6 1,2,3,4 1,2,3,6,7 1,2,3	Form partnerships with institutions and discuss the BMP recommendations from the institutional assessments and implementation options; include implementing/enhancing recycling programs on their properties	15 institutions assessed with potential for stormwater management retrofit	5 years	3 institution meetings per year	Existing staff	1, 2, 3
1 2 6 7	7,8,9 1,2 3,4 2,3,4,5	Work with community groups to install storm drain markers in the 71 recommended neighborhoods.	Mark storm drains in the 71 neighborhoods identified	5 years	15 neighborhoods per year	$400 / neighbor-hood	2, 3
1 2 6 7	7,8,9 1,2 3,4 2,3,4,5	Work with the institutional sites to install storm drain makers at the 22 recommended sites	Mark storm drains in the 22 institutional sites identified	5 years	5 institutions per year	$400 / institution	1, 2, 3

Table A-1: Upper Gwynns Falls Action Strategies (Cont.)

Goal	Objective	Action	Basis for Performance Measure	Timeline	Performance Measure	Unit Cost	Responsible Party
1 2 7 8	7 2 3,4,5,6 1,3	Develop and implement signs and awareness material for the trash campaign in the watershed	Develop signs and post throughout watershed; work on funding and cost to post a billboard (~3 years); post a billboard for 1 year = $9000	1 year	Develop material, post signs	$9000 per year	1, 2, 3
2 7 8	1,2,4 2,3,4,5,6 1,3	Develop and implement signs and educational material for a recycling campaign in the watershed	Develop signs and post throughout watershed	3 years	Develop material, post signs	Existing staff	1, 2, 3
2 3 7	2,6 3 All	Implement trash and litter management work plan	Submit in the NPDES Report the progress toward implementing the trash and litter work plan	5 years	Annual	Existing staff	1
7	1,2,3,45,6	Encourage institutional partners, community groups, and patrons of public properties to sign and support a trash treaty	Have sign-up events	10 years	1 sign-up event per year	Existing staff	1, 2, 3
2 7	2,4 3,4,5	Encourage and support community cleanups in the 5 neighborhoods identified	5 neighborhoods identified as having trash management issues	5 years	1 community cleanup per year	Existing staff	1, 2, 3
1 2 7 8	2,7 1,2,4,5 3,4,7 2,3	Encourage and support waterway cleanups in streams	Conduct at least one waterway cleanup per year; cost includes supplies and tire removal	10 years	1 waterway cleanup per year	$1000 per cleanup	1, 2, 3
1 5	1 4	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, stormwater conversion)	10 years	1 tour per 5 years	Existing staff	1
8	All	Using various media, develop and distribute information about public access points along the Gwynns Falls	Distribute information to the public on access points.	10 years	1 per year	Existing staff	1, 2, 3
1 2 3 7	7 2 3,4 2,6	Distribute NPDES Notice of Intent (NOI) and Pollution Prevention Plan (PPP) information to facilities falling within hotspot categories identified in the watershed and provide guidance	Conduct workshops and distribute outreach material	9 years	1 event every 3 years	Existing staff	1, 2, 3
MONITORING							
1 2 3	4,5,7 1,2 1,3	Continue to remove illicit connections when discovered through the Illicit Connect Program	NPDES Permit	On-going	Reported annually in NDPES permits	Existing staff	1
1 2 3	4,5,7 1,2,4 3,4	Continue the illicit connection monitoring at the major outfalls in the watershed and complete one inspection at each of the minor outfalls	58 major outfall locations and 249 minor outfall locations = 307 outfall inspections	10 years	31 outfalls per year	Existing staff	1
1 2 3 7 8	7 1,2 3,4 2,3,4,5 3	Continue to implement stream watch, a citizen-based program to increase the ability to monitor/identify sources of water quality and habitat degradation	Promote watershed awareness and additional identification on sources of impairment, and potential restoration locations	10 years	# of stream miles adopted	Existing staff	1, 2, 3
1 2 5 6 7	1 6 2,4 2,4 7	Conduct inspection of BMPs and provide on-going maintenance	Assure that each facility is inspected every 3 years	On-going	Inspections completed	Existing staff	1
1 2 3	7 1,2 3,4	Continue probabilistic biological monitoring program	Biological monitoring stations in Upper Gwynns Falls are monitored in even numbered years – report produced	Even numbered years	Stations monitored, report produced	Existing staff	1

Table A-1: Upper Gwynns Falls Action Strategies (Cont.)

Goal	Objective	Action	Basis for Performance Measure	Timeline	Performance Measure	Unit Cost	Responsible Party
1 2 3 7	6,7,8,9 1,2 3,4,5 4,7	Work with teachers to develop water quality monitoring activities for students at Baltimore County public schools	2 public schools identified as having education opportunities for BMP monitoring	10 years	Monitoring activities implemented	Existing staff	2, 3
1 2 3	8 1,2 3,4	Collaborate with state and federal agencies to develop a method to measure and monitor residential fertilizer use	Provides an accounting of nutrient reductions	5 years	Monitoring protocols developed for fertilizer use	Existing staff	1, MDA
FUNDING							
1 2 5	1,2,3,4 1,2,3,4,5,6 2,4	Coordinate grant funding requests to secure funding and implement restoration projects to meet TMDL nutrient reduction requirements	Seek a minimum of 1 grant per year to meet the TMDL requirements within 10 years	10 years	1 grant proposal per year	Existing staff	3
4 5	1,2,3,4 2,4	Increase applications for the Baltimore County – Green Building Tax Credit Program as a model	Provide incentive for landowners to install BMPs to address water quality and habitat	5 years	# of applications	Existing staff	3
REPORTING							
All	All	Upper Gwynns Falls SWAP Implementation Committee will meet to discuss implementation progress and assess any changes needed to meet the goals	Meet on a semi-annual basis	10 years	2 meetings per year	Existing staff	3
All	All	Coordinate restoration activities between and among Baltimore County and Blue Water Baltimore	NPDES annual report	On-going	NPDES annual report	Existing staff	1, 2
1	4,5	Designate county personnel to provide updates to the SWAP Implementation Committee on the status of the consent decree projects for sewer infrastructure repair	Present updates at the semi-annual SWAP Implementation Committee meetings	10 years	2 meetings per year	Existing staff	1
All	All	Produce State of Our Watersheds report in conjunction with the Baltimore Watershed Agreement	Report is produced bi-annually	2 years	Report is produced every 2 years	$11,000 per 2 years	1
All	All	Implement a unified restoration tracking system to track progress toward meeting TMDL reduction requirements	Tracking systems currently being developed for similar SWAPs (e.g., Upper Back River, Jones Falls)	2 years	Tracking system developed	Existing staff	3
1 2 4 6 7	2,3,6,7,8,9 2 All 1,3,6,7 1,3,4,5,6	Update the status of citizen-based restoration projects and BMPs	Provide update of progress made in annual NPDES report	On-going	NPDES annual report	Existing staff	1, 2
1 2 3 4 5 6	1,2,3,4 5,6 1,2,5 1,2 All 2,5	Continue to update status of county capital budget restoration projects and BMPs	Provide update of progress made in annual NPDES report	On-going	NPDES annual report	Existing staff	1

APPENDIX B:

Cost Analysis and Potential Funding Sources

Appendix B

Cost Analysis and Potential Funding Sources

This appendix presents cost estimates and potential funding sources for the implementation of proposed restoration BMPs in the Upper Gwynns Falls 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 costs estimates based on the projected participation rates needed to achieve the 15 percent reduction in nutrient loads from urban runoff, also described in Chapter 3. For both scenarios, estimates provided are in 2009 dollars and represent total cost estimates for the anticipated 10-year implementation timeframe. Unit costs are based on a combination of local information and previous SWAPs completed for other local watersheds (e.g., Upper Back River). BMP costs are not annualized over the 10-year implementation timeframe and do not include costs of existing staff. Costs are also presented in dollars per pound of nitrogen and phosphorus 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 $60,437,452 for maximum implementation and $8,340,095 based on projected participation rates.

Potential Funding Sources

Funding sources for the implementation of the Upper Gwynns Falls SWAP include local government funding for Baltimore County, monetary and time contributions to the Upper Gwynns Falls SWAP Implementation Committee, 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 $4 million per year is allocated for various restoration projects throughout the county. The capital budget is projected for six years, with a two-year cycle for changes. The Upper Gwynns Falls watershed as a whole currently has $2.95 million allocated for restoration projects over the six-year period. 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 Upper Gwynns Falls

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 2010 Trust Fund (2010 Trust Fund):** Established during the 2008 Legislative Session by Senate Bill 213 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 2010 Trust Fund, with multiple state agencies receiving moneys from the 2010 Trust Fund, including Maryland Department of Environment (MDE), Department of Natural Resources (DNR), Maryland Department of Agriculture (MDA), and Maryland Department of Planning (MDP).
- **319 Non-point Pollution Grants:** Approximately $1,000,000 of federal money for restoration implementation is available annually through MDE.
- **Bay Restoration Fund (MDE):** The Bay Restoration Fund offers financial assistance to local governments for voluntary stream and creek restoration projects that improve water quality and restore habitat. Funds are targeted to seriously degraded water bodies in Maryland. Types of projects funded include: stream channel reconstruction; stream bank stabilization; vegetative buffers; wetlands creation; treatment of acid mine drainage; and dredging.
- **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 B-6 of B-8 Tidal Back River SWAP trenches, vegetated swales, extended detention ponds, bioretention basins, wetlands and other innovative structures.
- **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 of between $200,000 and $1,000,000 each 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).

- **MD State Highway Administration (SHA) Transportation Enhancement Program (TEP):** This is a reimbursable, federal-aid funding program for transportation-related community projects designed to strengthen the intermodal transportation system. The TEP 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 TEP categories is environmental mitigation to address water pollution due to highway runoff or to reduce vehicle-caused wildlife mortality while maintaining habitat connectivity.
- **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.

Table B-1: Maximum Estimated Costs for Upper Gwynns Falls SWAP Implementation

BMP or Action	Cost	Unit	Projected	Quantity	Proj. Total Cost	Proj. TN Load Reduction (lbs)	Proj. Cost / Lb of TN Removal	Proj. TP Load Reduction (lbs)	Proj. Cost/Lb of TP Removal
Lawn Care Awareness Events	$ 500	/ event	10	events	$5,000	1608	$3	123	$41
Promote Bayscaping	$ 500	/ event	15	events	$7,500	NA	NA	NA	NA
SWM Conversions	$3,200	/ acre	1,243	acres	$3,977,600	1,730	$2,299	422	$9,426
Impervious Cover Removal	$25,000	/ acre	1.0	acres	$25,000	7	$3,571	2	$12,500
Downspout Disconnection Program	$8716	/ acre	97	acres	$845,452	545	$1551	131	$6,454
Promote Rainbarrel and Rain Garden Use	$500	/ event	7	events	$3,500	NA	NA	NA	NA
SWM Retrofits	$3,200	/ acre	24	acres	$76,800	288	$267	46	$1,670
Reforest Stream Buffer	$15,000	/ acre	785	acres	$11,775,000	6,366	$1,850	690	$17,065
Pervious Area Reforestation	$6,000	/ acre	72	acres	$430,800	420	$1,026	29	$14,855
Neighborhood Tree Planting	$175	/ tree	5,880	trees	$1,029,000	172	$5,983	12	$85,750
Institutional Tree Planting	$175	/ tree	1,296	trees	$226,800	38	$5,983	3	$85,750
Tree Maintenance	$1300	/ acre / year	875	acres	$5,687,500	NA	NA	NA	NA
Exotic/Invasive Species Removal	$250	/ acre	20	acres	$5,000	NA	NA	NA	NA
No Dumping Signs	$40	/ sign	30	signs	$1,200	NA	NA	NA	NA
Stream Restoration	$350	/ Ln ft	103,494	Ln ft	$36,222,900	20,905	$1,733	1,107	$32,722
Pollution Prevention Workshops	$500	/ event	3	event	$1,500	NA	NA	NA	NA
Neighborhood BMP Meetings	$500	/ event	29	event	$14,500	NA	NA	NA	NA
Storm Drain Markers	$400	/ neighbor-hood	71	neighbor-hoods	$28,400	NA	NA	NA	NA
Trash Campaign	$9,000	/ year	1	years	$9,000	NA	NA	NA	NA
Waterway Cleanups	$1,000	/ cleanup	10	cleanups	$10,000	NA	NA	NA	NA
State of Our Watersheds Report	$11,000	/ 2 years	10	years	$55,000	NA	NA	NA	NA
				Total:	**$60,437,452**				

Note: 'NA' denotes not assessed in the pollutant removal analysis.

Table B-2: Projected Estimated Costs for Upper Gwynns Falls SWAP Implementation

BMP or Action	Unit	Cost	Projected	Quantity	Proj. Total Cost	Proj. TN Load Reduction (lbs)	Proj. Cost / Lb of TN Removal	Proj. TP Load Reduction (lbs)	Proj. Cost/Lb of TP Removal
Lawn Care Awareness Events	$ 500	/ event	10	events	$5,000	80	$63	6	$833
Promote Bayscaping	$ 500	/ event	15	events	$7,500	NA	NA	NA	NA
SWM Conversions	$3,200	/ acre	622	acres	$1,990,400	865	$2,299	215	$9,426
Impervious Cover Removal	$25,000	/ acre	0.5	acres	$12,500	4	$3.571	1	$12,500
Downspout Disconnection Program	$8,716	/ acre	9.7	acres	$84,545	55	$1,551	13	$6,454
Promote Rainbarrel and Rain Garden Use	$500	/ event	7	events	$3,500	NA	NA	NA	NA
SWM Retrofits	$3,200	/ acre	6	acres	$19,200	72	$267	12	$1,600
Reforest Stream Buffer	$15,000	/ acre	78.5	acres	$1,177,500	637	$1,850	69	$17,065
Pervious Area Reforestation	$6,000	/ acre	24	acres	$144,000	140	$1,026	10	$14,855
Neighborhood Tree Planting	$175	/ tree	1,960	trees	$343,000	57	$5,983	4	$85,750
Institutional Tree Planting	$175	/ tree	440	trees	$77,000	12	$5,983	1	$85,750
Tree Maintenance	$1,300	/ acre / year	114.4	acres	$743,600	NA	NA	NA	NA
Exotic/Invasive Species Removal	$500	/ year	10	years	$5,000	NA	NA	NA	NA
No Dumping Signs	$40	/ sign	30	signs	$1,200	NA	NA	NA	NA
Stream Restoration	$350	/ Ln ft	10,349	Ln ft	$3,622,150	2,091	$1,732	111	$32,722
Pollution Prevention Workshops	$500	/ event	3	event	$1,500	NA	NA	NA	NA
Neighborhood BMP Meetings	$500	/ event	29	event	$14,500	NA	NA	NA	NA
Storm Drain Markers	$400	/ neighbor-hood	35	neighbor-hoods	$14,000	NA	NA	NA	NA
Trash Campaign Material / Post Billboard	$9,000	/ year	1	years	$9,000	NA	NA	NA	NA
Waterway Cleanups	$1,000	/ cleanup	10	cleanups	$10,000	NA	NA	NA	NA
Water Quality Monitoring Report	$11,000	/ 2 years	10	years	$55,000	NA	NA	NA	NA
				Total:	**$8,340,095**				

Note: 'NA' denotes not assessed in the pollutant removal analysis.

Table B-3: Upper Gwynns Falls 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 which include local organizations; use innovative restorative practices with potential for general application; minimum 20 acre project area	$1 per tree planted	Covers tree planting costs YES	1 year
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	$50 to $200,000	0% YES	1-2 years
Chesapeake Bay Trust	Capacity Building Initiative Grant Program	Non-profit 501(c) with a board on which half the members participate meaningfully and at least one paid staff (or a part-time paid volunteer)	Strengthen an organization through management operations, technology, governance, fundraising and communications	$15,000 per year	0% YES	3 years
Chesapeake Bay Trust	Stewardship Grant Program	Non-profits 501(c) Schools/universities Soil/Water Conservation Districts Local government State government	Raise awareness about watershed restoration; design plans which educate citizens on things they can do to aid watershed restoration; educate students about local watersheds, projects geared towards watershed restoration and protection	$5,000 to $25,000	0% YES	1 year
DNR	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
MDE	Bay Restoration Fund	Local governments	Green restoration projects	None specified	50% YES	None specified
MDE/DNR	Chesapeake and Atlantic Coastal Bays 2010 Trust Fund	Non-profits 501(c) Local government	Non-point source best management practices reducing nitrogen, phosphorous and sediment	None specified	?	Annual

Table B-3: Upper Gwynns Falls SWAP Potential Funding Sources (Cont.)

Managing Agency	Funding Source	Application Eligibility	Eligible Projects	Funding Amount	Cost Share / In – Kind	Project Period
NFWF	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
NFWF	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% YES	2-3 years
NRCS	Watersheds 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	?	None specified
USEPA	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% YES	2 years
USEPA	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% YES	3-5 years

APPENDIX C:

Chesapeake Bay Program Pollutant Load Reduction Efficiencies

Table 1: Nonpoint Source Best Management Practices that have been Peer-Reviewed and CBP-Approved for Phase 5.0 of the Chesapeake Bay Program Watershed Model Revised 1/18/06

Agricultural BMPs	How Credited	TN Reduction Efficiency	TP Reduction Efficiency	SED Reduction Efficiency
Riparian Forest Buffers and Wetland Restoration - Agriculture[1]:	Landuse conversion + efficiency	Efficiency applied to 4 upland acres	Efficiency applied to 2 upland acres	Efficiency applied to 2 upland acres
Coastal Plain Lowlands	Efficiency	25%	75%	75%
Coastal Plain Dissected Uplands	Efficiency	40%	75%	75%
Coastal Plain Uplands	Efficiency	83%	69%	69%
Piedmont Crystalline	Efficiency	60%	60%	60%
Blue Ridge	Efficiency	45%	50%	50%
Mesozoic Lowlands	Efficiency	70%	70%	70%
Piedmont Carbonate	Efficiency	45%	50%	50%
Valley and Ridge Carbonate	Efficiency	45%	50%	50%
Valley and Ridge Siliciclastic	Efficiency	55%	65%	65%
Appalachian Plateau Siliciclastic	Efficiency	60%	60%	60%
Riparian Grass Buffers - Agriculture:	Landuse conversion + efficiency	Efficiency applied to 4 upland acres	Efficiency applied to 2 upland acres	Efficiency applied to 2 upland acres
Coastal Plain Lowlands	Efficiency	17%	75%	75%
Coastal Plain Dissected Uplands	Efficiency	27%	75%	75%
Coastal Plain Uplands	Efficiency	57%	69%	69%
Piedmont Crystalline	Efficiency	41%	60%	60%
Blue Ridge	Efficiency	31%	50%	50%
Mesozoic Lowlands	Efficiency	48%	70%	70%
Piedmont Carbonate	Efficiency	31%	50%	50%
Valley and Ridge Carbonate	Efficiency	31%	50%	50%
Valley and Ridge Siliciclastic	Efficiency	37%	65%	65%
Appalachian Plateau Siliciclastic	Efficiency	41%	60%	60%

[1] These peer-reviewed BMP efficiencies and/or landuse conversions will be refined with more recent data for use in Phase 5.0 of the Chesapeake Bay Program Watershed Model based on results of the EPA CBPO FY2006 BMP Literature Synthesis project. Estimated Completion Date: TBD.

Agricultural BMPs (continued)	How Credited	TN Reduction Efficiency	TP Reduction Efficiency	SED Reduction Efficiency
Conservation Plans - Agriculture[1] (Solely structural practices such as installation of grass waterways in areas with concentrated flow, terraces, diversions, drop structures, etc.):	Efficiency			
Conservation Plans on Conventional-Till	Efficiency	8%	15%	25%
Conservation Plans on Conservation-Till and Hay	Efficiency	3%	5%	8%
Conservation Plans on Pasture	Efficiency	5%	10%	14%
Cover Crops[1]:	Efficiency			
Cereal Cover Crops on Conventional-Till:	Efficiency			
Early-Planting - Up to 7 days prior to published first frost date	Efficiency	45%	15%	20%
Late-Planting - Up to 7 after published first frost date	Efficiency	30%	7%	10%
Cereal Cover Crops on Conservation-Till:	Efficiency			
Early-Planting - Up to 7 days prior to published first frost date	Efficiency	45%	0%	0%
Late-Planting - Up to 7 after published first frost date	Efficiency	30%	0%	0%
Commodity Cereal Cover Crops / Small Grain Enhancement on Conventional-Till:	Efficiency			
Early-Planting - Up to 7 days prior to published first frost date	Efficiency	25%	0%	0%
Late-Planting - Up to 7 after published first frost date	Efficiency	17%	0%	0%
Commodity Cereal Cover Crops / Small Grain Enhancement on Conservation-Till:	Efficiency			
Early-Planting - Up to 7 days prior to published first frost date	Efficiency	25%	0%	0%
Late-Planting - Up to 7 after prior to published first frost date	Efficiency	17%	0%	0%
Off-stream Watering with Stream Fencing (Pasture)[2]	Efficiency	60%	60%	75%
Off-stream Watering with Stream Fencing and Rotational Grazing (Pasture)[3]	Efficiency	20%	20%	40%

[1] These peer-reviewed BMP efficiencies and/or landuse conversions will be refined with more recent data for use in Phase 5.0 of the Chesapeake Bay Program Watershed Model based on results of the EPA CBPO FY2006 BMP Literature Synthesis project. Estimated Completion Date: TBD.

[2] Will be credited as a landuse conversion in the final Phase 5.0 of the Watershed Model.

[3] Will be credited as a landuse conversion and efficiency in the final Phase 5.0 of the Watershed Model.

Agricultural BMPs (continued)	***How Credited***	***TN Reduction Efficiency***	***TP Reduction Efficiency***	***SED Reduction Efficiency***
Off-stream Watering without Fencing (Pasture)	Efficiency	30%	30%	38%
Animal Waste Management Systems - Applied to model manure acre where 1 manure acre = runoff from 145 animal units:[2]	Reduction in manure acres			
Livestock Systems[2]	Reduction in manure acres	100%	100%	N/A
Poultry Systems[2]	Reduction in manure acres	100%	100%	N/A
Barnyard Runoff Control / Loafing Lot Management[2]	Reduction in manure acres	100%	100%	N/A
Conservation-Tillage[1]	Landuse conversion	N/A	N/A	N/A
Land Retirement - Agriculture	Landuse conversion	N/A	N/A	N/A
Tree Planting - Agriculture	Landuse conversion	N/A	N/A	N/A
Carbon Sequestration / Alternative Crops	Landuse conversion	N/A	N/A	N/A
Nutrient Management Plan Implementation - Agriculture	Landuse conversion	135% of modeled crop uptake	135% of modeled crop uptake	N/A
Enhanced Nutrient Management Plan Implementation – Agriculture[1]	Landuse conversion + Built into simulation	115% of modeled crop uptake	115% of modeled crop uptake	N/A
Alternative Uses of Manure / Manure Transport	Built into preprocessing	Reduction in nutrient mass applied to cropland	Reduction in nutrient mass applied to cropland	N/A
Poultry Phytase	Built into preprocessing	N/A	Reduction in nutrient mass applied to cropland	N/A

[1] These peer-reviewed BMP efficiencies and/or landuse conversions will be refined with more recent data for use in Phase 5.0 of the Chesapeake Bay Program Watershed Model based on results of the EPA CBPO FY2006 BMP Literature Synthesis project. Estimated Completion Date: TBD.
[2] Will be credited as a landuse conversion in the final Phase 5.0 of the Watershed Model.

Agricultural BMPs (continued)	How Credited	TN Reduction Efficiency	TP Reduction Efficiency	SED Reduction Efficiency
Dairy Precision Feeding / and Forage Management[1]	Built into preprocessing	Reduction in nutrient mass applied to cropland	Reduction in nutrient mass applied to cropland	N/A
Swine Phytase	Built into preprocessing	N/A	Reduction in nutrient mass applied to cropland	N/A
Continuous No-Till:				
Below Fall Line	Efficiency	10%	20%	70%
Above Fall Line	Efficiency	15%	40%	70%
Water Control Structures	Efficiency	33%	N/A	N/A
Urban and Mixed Open BMPs				
Stormwater Management::	Efficiency			
Wet Ponds and Wetlands[1]	Efficiency	30%	50%	80%
Dry Detention Ponds and Hydrodynamic Structures[1]	Efficiency	5%	10%	10%
Dry Extended Detention Ponds[1]	Efficiency	30%	20%	60%
Infiltration Practices	Efficiency	50%	70%	90%
Filtering Practices	Efficiency	40%	60%	85%
Erosion and Sediment Control[1]	Efficiency	33%	50%	50%

[1] These peer-reviewed BMP efficiencies and/or landuse conversions will be refined with more recent data for use in Phase 5.0 of the Chesapeake Bay Program Watershed Model based on results of the EPA CBPO FY2006 BMP Literature Synthesis project. Estimated Completion Date: TBD.

Urban and Mixed Open BMPs (continued)	***How Credited***	***TN Reduction Efficiency***	***TP Reduction Efficiency***	***SED Reduction Efficiency***
Nutrient Management (Urban)	Efficiency	17%	22%	N/A
Nutrient Management (Mixed Open)	Efficiency	17%	22%	N/A
Abandoned Mine Reclamation[2]	Landuse change converted to efficiency	Varies by model segment	Varies by model segment	Varies by model segment
Riparian Forest Buffers – Urban and Mixed Open	Landuse conversion + efficiency	25%	50%	50%
Wetland Restoration – Urban and Mixed Open	Landuse conversion	N/A	N/A	N/A
Stream Restoration – Urban and Mixed Open[1]	Load reduction converted to efficiency	0.02 lbs/ft	0.0035 lbs/ft	2.55 lbs/ft
Impervious Surface and Urban Growth Reduction / Forest Conservation	Landuse conversion	N/A	N/A	N/A
Tree Planting – Urban and Mixed Open	Landuse conversion	N/A	N/A	N/A
Resource and Septic BMPs				
Forest Harvesting Practices[1]	Efficiency	50%	50%	50%
Septic Denitrification	Efficiency	50%	N/A	N/A
Septic Pumping	Efficiency	5%	N/A	N/A
Septic Connections / Hook-ups	Built into pre-Processing	N/A	N/A	N/A

[1] These peer-reviewed BMP efficiencies and/or landuse conversions will be refined with more recent data for use in Phase 5.0 of the Chesapeake Bay Program Watershed Model based on results of the EPA CBPO FY2006 BMP Literature Synthesis project. Estimated Completion Date: TBD.

[2] Will be credited as a landuse conversion in the final Phase 5.0 of the Watershed Model.

Table 2: Nonpoint Source Best Management Practices Requiring Additional Peer-Review for Phase 5.0 of the Chesapeake Bay Watershed Model Revised 1/12/06

(Note: Credit and Efficiencies are listed in parenthesis since they have not received formal peer review)

Agricultural BMPs Requiring Peer Review	***How Credited***	***TN Reduction Efficiency***	***TP Reduction Efficiency***	***SED Reduction Efficiency***	***CBP Lead Status Estimated Completion Date***
Precision Agriculture	(Built into simulation)	N/A	N/A	N/A	Tributary Strategy Workgroup EPA CBPO FY2006 BMP Literature Synthesis project will determine efficiency for Phase 5.0 Completion Date: TBD Delaware Maryland Agribusiness Association plans to work with CBPO to provide tracking data for this BMP.
Manure Additives	TBD	TBD	TBD	TBD	Agriculture Nutrient Reduction Workgroup TBD TBD
Ammonia Emission Reductions	(Built into preprocessing)	(Reduction in ammonia deposition)	N/A	N/A	Tributary Strategy Workgroup EPA CBPO FY2006 BMP Literature Synthesis project will determine efficiency Completion Date: TBD
Precision Grazing	Efficiency	(25%)	(25%)	(25%)	Agriculture Nutrient Reduction Workgroup Tributary Strategy Workgroup EPA CBPO FY2006 BMP Literature Synthesis project will determine efficiency Completion Date: TBD
Mortality Composters	Efficiency	(14%)	(14%)	N/A	Tributary Strategy Workgroup EPA CBPO 2006/2007 project will determine efficiency June 2008
Horse Pasture Management	Efficiency	(20%)	(20%)	(40%)	Tributary Strategy Workgroup EPA CBPO FY2006 BMP Literature Synthesis project will determine efficiency Completion Date: TBD

Agricultural BMPs Requiring Peer Review (continued)	***How Credited***	***TN Reduction Efficiency***	***TP Reduction Efficiency***	***SED Reduction Efficiency***	***CBP Lead Status Estimated Completion Date***
Non-Urban Stream Restoration	Load reduction converted to efficiency				
Non-Urban Stream Restoration on Conventional-Till and Pasture	Load reduction converted to efficiency	(0.026 lbs/ft)	(0.0046 lbs/ft)	(3.32 lbs/ft)	Tributary Strategy Workgroup EPA CBPO FY2006 BMP Literature Synthesis project will determine efficiency Completion Date: TBD
Non-Urban Stream Restoration on Conservation-Till, Hay	Load reduction converted to efficiency	(0.02 lbs/ft)	(0.0035 lbs/ft)	(2.55 lbs/ft)	Tributary Strategy Workgroup EPA CBPO FY2006 BMP Literature Synthesis project will determine efficiency Completion Date: TBD
Urban and Mixed Open BMPs Requiring Peer Review					
Non-Urban Stream Restoration on Mixed Open	Load reduction converted to efficiency	(0.02 lbs/ft)	(0.0035 lbs/ft)	(2.55 lbs/ft)	Tributary Strategy Workgroup EPA CBPO FY2006 BMP Literature Synthesis project will determine efficiency Completion Date: TBD
Dirt & Gravel Road Erosion & Sediment Control on Mixed Open	Load reduction converted to efficiency	(0.02 lbs/ft)	(0.0035 lbs/ft)	(2.55 lbs/ft)	Tributary Strategy Workgroup EPA CBPO FY2006 BMP Literature Synthesis project will determine efficiency Completion Date: TBD
Roadway Systems	TBD	TBD	TBD	TBD	Urban Stormwater Workgroup (USWG) USWG will meet with Departments of Transportation to identify roadway BMPs and efficiencies TBD
Urban Street Sweeping and Catch Basin Inserts	Efficiency	(10%)	(10%)	(10%)	Urban Stormwater Workgroup EPA CBPO street sweeping project will provide efficiency recommendations for the Urban Stormwater Workgroup review in Fall 2007

Urban and Mixed Open BMPs Requiring Peer Review (continued)	***How Credited***	***TN Reduction Efficiency***	***TP Reduction Efficiency***	***SED Reduction Efficiency***	***CBP Lead Status Estimated Completion Date***
Riparian Grass Buffers – Urban and Mixed Open	TBD	TBD	TBD	TBD	TBD
Resource BMPs Requiring Peer Review					
Non-Urban Stream Restoration on Forest	Load reduction converted to efficiency	(0.02 lbs/ft)	(0.0035 lbs/ft)	(2.55 lbs/ft)	Tributary Strategy Workgroup EPA CBPO FY2006 BMP Literature Synthesis project will determine efficiency Completion Date: TBD
Dirt & Gravel Road Erosion & Sediment Control on Forest	Load reduction converted to efficiency	(0.02 lbs/ft)	(0.0035 lbs/ft)	(2.55 lbs/ft)	Tributary Strategy Workgroup EPA CBPO FY2006 BMP Literature Synthesis project will determine efficiency Completion Date: TBD
Voluntary Air Emission Controls within Jurisdictions (Utility, Industrial, and Mobile)	Built into preprocessing	(Reduction in nitrogen species deposition)	N/A	N/A	Nutrient Subcommittee TBD TBD

Table 3: Nonpoint Source Best Management Practices that have been Peer Reviewed and CBP Approved for the Chesapeake Bay Water Quality Model Revised 1/12/06

Shoreline BMPs	***How Credited***	***TN Reduction Efficiency***	***TP Reduction Efficiency***	***SED Reduction Efficiency***
Structural Tidal Shoreline Erosion Control	Water Quality Model	N/A	N/A	N/A
Non-Structural Tidal Shoreline Erosion Control	Water Quality Model	N/A	N/A	N/A

Table 4: Nonpoint Source Best Management Practices Requiring Additional Peer Review for the Chesapeake Bay Water Quality Model Revised 1/12/06

Resource BMPs	***How Credited***	***TN Reduction Efficiency***	***TP Reduction Efficiency***	***SED Reduction Efficiency***	***CBP Lead Status Estimated Completion Date***
Coastal Floodplain Flooding	TBD	TBD	TBD	TBD	Sediment Workgroup TBD TBD
SAV Planting and Preservation	Water Quality Model	TBD	TBD	TBD	Living Resources Subcommittee TBD TBD
Oyster Reef Restoration and Shellfish Aquaculture	Water Quality Model	TBD	TBD	TBD	TBD TBD TBD
Structural Shoreline Erosion Controls:					Sediment Workgroup TBD TBD
Shoreline hardening	Water Quality Model	TBD	TBD	TBD	Sediment Workgroup TBD TBD

Resource BMPs (continued)	***How Credited***	***TN Reduction Efficiency***	***TP Reduction Efficiency***	***SED Reduction Efficiency***	***CBP Lead Status Estimated Completion Date***
Off-shore breakwater	Water Quality Model	TBD	TBD	TBD	Sediment Workgroup TBD TBD
Headland control	Water Quality Model	TBD	TBD	TBD	Sediment Workgroup TBD TBD
Breakwater systems	Water Quality Model	TBD	TBD	TBD	Sediment Workgroup TBD TBD

APPENDIX D:

U.S. Environmental Protection Agency A Through I Criteria for Watershed Planning

Appendix D

U.S. Environmental Protection Agency A Through I Criteria for Watershed Planning

This appendix will provide information on how the development of the Upper Gwynns Falls Small Watershed Action Plan addresses the USEPA A through I criteria for watershed planning. It will serve as a guide to the location within the document, including appendices, where each criterion is addressed. Table B-1 provides the location information for each of the A through I Criteria and describes how the document meets the A through I Criteria.

The text box below provides a description of each element of the EPA Watershed Planning Criteria.

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 nonpoint source (NPS) management measures

c) A description of the NPS management measures that will need to be implemented

d) An estimate of the amount of technical and financial assistance needed 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 D-1: Where to Locate Information for each USEPA's A-I Criteria Element

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	✓								

The following will provide a discussion on how the development of the Upper Gwynns Falls Small Watershed Action Plan addresses the US Environmental Protection Agency (USEPA) A through I criteria for watershed planning. It will serve as a guide to the location within the document, including the appendices, where each criteria is addressed.

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 this watershed-based plan (and to achieve any other watershed goals identified in the watershed-based plan), as discussed in item (b) below.

The Gwynns Falls watershed is listed on the 303(d) list as impaired by nutrients, chlorides, sediments, and fecal coliform. The nutrient and sediment listings were refined to phosphorus and total suspended solids. The stream biological community listing has been replaced by the TSS and chlorides. Inorganic pollutants (chlorides and conductivity), ammonia toxicity, and flow/sediment stressors are associated with impacts to biological communities. TMDLs have been developed for sediment and bacteria that identify the causes and sources of pollutants that will need to be controlled to meet the load reductions to achieve water quality standards. The Water Quality Assessment concluded that a TMDL for nutrients is not necessary to achieve water quality standards in the Gwynns Falls, and EPA concurred (MDE, 2009a). The listing for impacts to biological communities will be addressed at a future date after additional data has been collected. In addition, Gwynns Falls is listed under Category 3 of the Integrated Report of Surface Water Quality in Maryland for potential presence of PCBs in fish tissue (MDE, 2010). These documents can be found in:

- Appendix G: Total Maximum Daily Loads of Fecal Bacteria For the Non-Tidal Gwynns Falls Basin, Baltimore County and Baltimore City, Maryland (MDE, 2007)

- Appendix H: Total Maximum Daily Loads of Nitrogen and Phosphorus for the Baltimore Harbor in Anne Arundel, Baltimore, Carroll and Howard Counties and Baltimore City, Maryland (MDE, 2006)
- Appendix I: Watershed Report for Biological Impairment of the Gwynns Falls Watershed in Baltimore City and Baltimore County, Maryland. Biological Stressor Identification Analysis Results and Interpretation (MDE, 2009)
- Appendix J: Water Quality Analysis of Eutrophication for the Gwynns Falls Watershed in Baltimore County and Baltimore City, Maryland
- Appendix K: Total Maximum Daily Load of Sediment in the Gwynns Falls Watershed, Baltimore City and Baltimore County, Maryland (MDE, 2009)

In addition, to further refine the sources of pollutants upland source assessments and stream corridor assessments were performed. The upland assessment results are presented in the Upper Gwynns Falls Characterization Report (Appendix E), Chapter 4. The stream corridor assessment results are presented in the Upper Gwynns Falls Characterization Report (Appendix E), Chapter 3 and Appendix F, Gwynns Falls Stream Stability Assessment (PB, 2004).

Further analysis of pollution sources are provided by a GIS analysis of potential landscape indicators of pollution presented in the Upper Gwynns Falls Characterization Report (Appendix E), Chapter 2 and a specific analysis of the contribution of sanitary sewer overflows in Appendix E, Chapter 3.3. Further pollutant load analysis is provided in Appendix E, Chapter 3.5 and 3.6.

b. An estimate of the load reductions expected for the management measures described under paragraph (c) below (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time). Estimates should be provided at the same level as in item (a) above (e.g., the total load reduction expected for dairy cattle feedlots; row crops; or eroded streambanks).

Expected nitrogen and phosphorus load reductions were based on the EPA - Chesapeake Bay Program load reduction criteria used in their Phase 5 model for the water quality impairments of the non-tidal Chesapeake Bay. These load reductions are presented in Appendix C. Using the information in Appendix C, the nitrogen and phosphorus load reductions for the various actions were calculated and summarized in Chapter 3 (Table 3-17).

c. A description of the NPS management measures that will need to be implemented to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in this watershed-based plan), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.

The management measures that will need to be implemented to achieve the goals are detailed in Appendix A. Information on the achievement of the phosphorus and nitrogen reduction goals is provided in Chapter 3.4. Chapter 4 details the management measures for each subwatershed in the SWAP study area.

d. An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and the authorities that will be relied upon, to implement this

plan. As sources of funding, States should consider the use of their 319 programs, State Revolving Funds, USDA's Environmental Quality Incentives Program and Conservation Reserve Program, and other relevant Federal, State, local and private funds that may be available to assist in implementing this plan.

Appendix B provides the cost analysis and the anticipated funding sources to implement the actions. Appendix A details the anticipated cost for each action on an annual or unit basis and details the organizations that will be responsible for implementation of the each action.

e. An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the NPS management measures that will be implemented.

The educational activities to enhance public understanding and encourage participation in restoration implementation planning and the installation of best management practices are detailed in Appendix A. Chapter 3.4 details specific education/awareness focus areas, and Chapter 4 details specific education/awareness activities for each subwatershed.

f. A schedule for implementing the NPS management measures identified in this plan that is reasonably expeditious.

A schedule for each activity is provided in Appendix A. It is anticipated that the restoration will require a 20-year timeframe. Some actions have a shorter time frame based on sequencing of actions, or on the urgency of the actions. However, most management measures have annual performance measures that will determine if the restoration is on pace to be completed within the time frame. The limitations on the pace of the implementation include staffing, and funding. Increases in staffing and funding will be used to accelerate the restoration timeline. Chapter 5 presents an adaptive management approach to implementation.

g. A description of interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented.

Appendix A provides the annual interim measurable milestones for determining the implementation status of the NPS management measures. In addition, an annual report on implementation progress will be produced by the implementation committee.

h. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards, and, if not, the criteria for determining whether this watershed-based plan needs to be revised or, if a NPDES TMDL has been established, whether the NPS TMDL needs to be revised.

The load reductions due to the restoration activities will be calculated via a spreadsheet using the EPA Chesapeake Bay Program – Best Management Practice Pollutant Reduction Efficiencies (Appendix C). These efficiencies will be used in conjunction with the implementation tracking to calculate the load reductions being achieved. The efficiencies used will be modified based on any modifications of the EPA Chesapeake Bay Program efficiencies.

i. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

Chapter 5 details the monitoring that will occur to evaluate the effectiveness of implementation. The monitoring results will be compared to the predicted load reductions determined under item (h) above.