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Acknowledgements

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Executive Summary

The Little Rocky Run – Johnny Moore Creek Watershed Management Plan is a strategic plan that aims to protect and improve the water quality within the watershed over the next 25 years. Fairfax County's first set of watershed plans was completed in the 1970s. Land use has changed significantly since that time. Additionally, there have been many advances in technology and development in the field of stormwater management which have resulted in updates to stormwater policies and regulations. New plans were needed to reflect these changes and to plan for a future in which Fairfax County balances the needs of the environment coupled with a highly developed land area.

This watershed plan provides more targeted strategies for addressing stream health given current and future land uses and evolving regulations. It is one of several tools that enable the County to address program requirements and to improve and maintain watershed health.

Planning Process

The plan includes a prioritized 25-year list of proposed capital improvement projects in addition to non-structural programs and projects. The planning process, initiated by Fairfax County, for development of this watershed management plan included the participation and recommendations of a watershed advisory group.

The principal goals for public involvement were:

- Increase community awareness and understanding of stormwater management
- Provide meaningful participation options for a diversity of stakeholders
- Incorporate community ideas into the scope of the watershed plans
- Strive for community support for the final plans

The first step of the public involvement process was to host an Introductory and Issues Scoping Forum that was open to all residents. The primary purpose of this forum was to solicit informed input on the development of the watershed management plan. Other objectives were to explain the planning process to the community and develop an initial list of watershed issues and concerns.

After the forum, stakeholder groups were invited to be part of a Watershed Advisory Group (WAG) for each plan. These were comprised of local stakeholders who represented various interests (homeowners association (HOA) representatives, environmental groups, etc). The WAG advised County staff about community outreach opportunities, key issues affecting their watershed and potential project locations.

The County selected three overarching goals, or intended outcomes of the watershed management plans:

1. Improve and maintain watershed functions in Fairfax County, including water quality, habitat and hydrology
2. Protect human health, safety and property by reducing stormwater impacts
3. Involve stakeholders in the protection, maintenance and restoration of County watersheds.

Ten objectives were developed related to the three goals. Each objective may achieve one or more goals, and each goal may be achieved by one or more objectives. These ten objectives were grouped into five categories based on certain aspects of watershed management the objectives could influence:

1. **Hydrology** - healthy movement and distribution of water through the environment in a way that is protective of streams and human dwellings
2. **Habitat** - suitable environment for sustaining plants and animals
3. **Stream water quality** - general chemical and physical properties of surface waters
4. **Drinking water quality** - quality of water used for human consumption

5. **Stewardship** - the roles the County, other jurisdictions and members of the general public can play in caring for the environment

Since accomplishment of objectives cannot be directly measured, indicators that are able to detect changes in the watershed were developed. Indicators are used to assess the condition of the environment, as early-warning signals of changes in the environment and to diagnose causes of ecological problems. Each indicator was measured by one or more metrics. A metric is an analytical benchmark that responds in a predictable way to increasing human, climatic or other environmental stress. The indicators used by Fairfax County may be grouped into the following categories:

- **Watershed Impact Indicators** – Measure the extent that reversal or prevention of a particular watershed impact, sought by the goals and objectives, has been achieved ("What's there now, and how is it doing?").
- **Source Indicators** – Quantify the presence of a potential stressor or pollutant source ("Is there a problem, and what's causing it?").
- **Programmatic Indicators** –After the plans are adopted, these will assess outcomes of resource protection and restoration activities ("What's the County doing about the problem, and how is it doing?").

The indicator metric values were translated into scores, and objective, composite and overall composite scores were calculated for use in subwatershed ranking. Weighting factors were used when calculating composite scores to give more importance to certain indicators and objectives.

The composite scores were used to identify problem areas in the watershed and rank subwatersheds for management priority. Subwatersheds were further categorized based on which management opportunities were most likely to restore functions to the problem areas identified. The resulting data were then utilized to identify key issues and select projects that would achieve the watershed planning goals and objectives.

Hydrologic, hydraulic and pollutant load models were used to develop a baseline for existing conditions and to assess the impact of the projects proposed in the watershed management plan.

Watershed Conditions

The Little Rocky Run watershed encompasses 4,605 acres (7.2 square miles) and the Johnny Moore Creek watershed encompasses 3,374 acres (5.3 square miles). Both watersheds are located in the Piedmont physiographic province, a region characterized by gently rolling hills, deeply weathered bedrock and very little solid rock at the surface. The Little Rocky Run watershed is divided into three watershed management areas (WMAs): Little Rocky Run-Upper, Little Rocky Run-Lower and Little Rocky Run-Bull Run. Johnny Moore Creek watershed is similarly divided into two WMAs, Johnny Moore Creek and Johnny Moore-Bull Run. The WMAs are generally three to five square miles in size. The WMAs are further divided into subwatersheds, ranging in size from 100 to 300 acres. Subwatersheds represent the smallest modeling unit for watershed planning.

Both the Little Rocky Run-Bull Run WMA and the Johnny Moore-Bull Run WMA are small areas (less than 200 acres) that drain directly to Bull Run. Because these two WMAs are mostly protected with only a small percentage of low-density development and no projects are identified for these WMAs, they are not discussed further in the watershed management plan.

The entire Johnny Moore Creek watershed is located in the Resource-Conservation (R-C) District established by the Board of Supervisors to protect the Occoquan Reservoir. This area has a designated density of one dwelling unit per five acres. The portions of the Little Rocky Run watershed south of Compton Road and the area south of Braddock Road and east of Union Mill Road are in the R-C District. The Little Rocky Run watershed consists primarily of open space, residential development and roadways.

The water quality analysis is driven by land use and the results reflect the different levels of development and stormwater controls in place in the three WMAs. Johnny Moore Creek, with less impervious areas and

more natural cover, contributes fewer pounds per year of the pollutants of concern than the WMAs in the Little Rocky Run watershed. This watershed is in relatively healthy condition and needs to be protected; even modest changes in land use should be addressed using stormwater controls.

The Little Rocky Run – Lower WMA is a non-homogenous management area. The lower portion of the watershed is primarily open space or part of the R-C District and therefore produces low levels of pollutants. The rest of the WMA contains significant medium- and high-density residential areas and therefore pollutant loading estimates increase.

The subwatersheds located in the Little Rocky Run – Upper WMA are producing relatively high pollutant loadings. The WMA is predominantly medium- to high-density residential and contains commercially zoned parcels as well. This WMA has undergone the most significant development over the past 10 years, owing to medium/high-density residential and commercial areas replacing open space and low-density residential areas.

Watershed Restoration Strategies

Strategies for restoration of the watershed were presented to the Watershed Advisory Group (WAG) and were condensed into categories:

- Stream/Buffer Restoration
- Pond Retrofits
- New Stormwater Management (SWM) Facilities – includes Low Impact Development (LID) Techniques, Ponds, Culvert Retrofits, Outfall Treatment
- Flooding Mitigation

The restoration strategies encompass many different project types. The following table provides a summary of project types for each restoration strategy.

Restoration Strategy	Project Type
Stream Restoration	Stream/Bank Stabilization Stream Realignment Pipe Outfall Stabilization
Pond Retrofits	Regrade pond to provide more storage Remove concrete trickle ditches Redesign pond to include micropools and wetland areas Redesign quantity-only ponds to provide water quality storage
New SWM Facilities	Bioretention areas Vegetated swales Green roofs Underground storage Manufactured BMPs Stormwater Ponds – extended detention dry ponds, wet ponds Constructed wetlands Tree box filters Rain barrel programs
Flooding Mitigation	Resize road crossing structures to convey design discharge Floodproof or purchase structures located in the floodplain

Non-structural projects are a group of projects that do not require traditional construction measures to be implemented and may be programmatic in nature. These projects include but are not limited to the following practices:

- Buffer restorations
- Rain barrel programs
- Dumpsite and obstruction removals
- Community outreach and public education
- Land conservation coordination projects
- Inspection and enforcement projects
- Street sweeping programs
- Recommendation of additional studies, surveys and assessments

In general, non-structural projects represent opportunities to proactively pursue stormwater issues that more traditional structural practices cannot address. The use of non-structural practices aids in fulfilling Fairfax County's MS4 permit requirements and environmental initiatives. The full potential of these projects will be realized through partnerships with County agencies, residents and other interested parties.

To identify projects, the subwatershed ranking results were used in combination with problem areas identified in the County's stream physical assessment, concerns identified by both the WAG and the public forum, and sites discovered during the field reconnaissance. A 'project universe' of nearly 150 candidate projects was compiled as a result of this analysis. Field investigation of the candidate projects was conducted in June 2009 to evaluate feasibility and to gather other data such as site conditions, site constraints and potential construction considerations. Following the field investigation, 82 projects were selected for further prioritization and ranking (Section 4.3). Some of the projects were combined into one project based on their cost and proximity.

The baseline ranking process consisted of setting values in five categories that, when scored according to the following weighting system, resulted in a preliminary project score. The five categories are described as:

1. Effect on Watershed Impact Indicators (30 percent)
2. Effect on Source Indicators (30 percent)
3. Location within Priority Subwatersheds (10 percent)
4. Sequencing (20 percent)
5. Implementability (10 percent)

The benefits of plan implementation were analyzed through the modeling. Projects in the 10-year implementation plan that could impact the stormwater runoff were modeled in the Storm Water Management Model (SWMM) hydrologic model to determine the magnitude of increased storage on discharge rates. These discharge changes were then input into the Hydrologic Engineering Center River Analysis System (HEC-RAS) hydraulic model to assess any changes to flooding elevations. The changes to flood elevations as a result of the projects were minimal. All project impacts on nitrogen, phosphorus and sediment pollutant loadings were modeled in the Spreadsheet Tool for Estimating Pollutant Load (STEPL).

The plan benefits are improved habitat, improved stream conditions and increased pollutant removal. The cost of the 10-year plan is approximately $13 million and it is estimated that the 10-year implementation plan would remove 283 tons per year (33 percent) of sediment, 1,583 pounds per year (5 percent) of nitrogen and 317 pounds per year (8 percent) of phosphorus. The cost of the entire plan (10-year and 25-year implementation plans) is approximately $17.3 million. The pollutant removal of the entire plan is estimated at 348 tons per year (40 percent) of sediment, 2,374 pounds per year (8 percent) of nitrogen and 474 pounds per year (11 percent) of phosphorus. In Little Rocky Run, pollutant loads are reduced below existing condition levels. In Johnny Moore Creek, the future land use changes are due to estate residential development. Because of private property constraints, it was difficult to fully address pollutant removal in these areas through the watershed management plan. As these properties are developed, on-site stormwater measures should be employed to control runoff and pollutant levels.

The following provisions address the funding and implementation of projects and programs in Fairfax County watershed plans. These provisions as recommended by the Board were developed for the Popes Head Creek Watershed Management Plan in February 2006 and have been applied to the Little Rocky Run – Johnny Moore Creek Watershed Management Plan:

i. Projects and programs (both structural and non-structural) will first undergo appropriate review by County staff and the Board (please see iii below) prior to implementation. Board adoption of the Watershed Management Plan will not set into motion automatic implementation of projects, programs or initiatives that have not first been subject to sufficient scrutiny to ensure that the projects that are funded give the County the greatest environmental benefit for the cost.

ii. Road projects not related to protection of streambeds or banks or water quality will not be funded out of the stormwater and watershed budget.

iii. The Watershed Management Plan provides a conceptual master-list of structural capital projects and a list of potential non-structural projects for the watershed. Staff will, on a fiscal year basis, prepare and submit to the Board a detailed work plan to include a description of proposed projects and an explanation of their ranking, based on specific criteria. Criteria used to assemble this list will include, but are not limited to, cost-effectiveness as compared to alternative projects, a clear public benefit, a need to protect public or private lands from erosion or flooding, a need to meet a specific watershed or water quality goal, and ability to be implemented within the same fiscal year that funding is provided. Staff also intends to track the progress of implementation and report back to the Board periodically.

iv. Each project on the annual list of structural projects will be evaluated using basic value-engineering cost effectiveness principles before implementation and the consideration of alternative structural and non-structural means for accomplishing the purposes of the project will be considered before implementation. This process will ensure the County's commitment to being a fiscally responsible public entity.

v. Obstruction removal projects on private lands will be evaluated on a case-by-case basis for referral to the Zoning Administrator and/or County Attorney for action as public nuisances; and otherwise to determine appropriate cost-sharing by any parties responsible for the obstructions.

vi. Stream restoration projects on private lands will be evaluated to determine means for cost-sharing by land owners directly responsible for degradation due to their land uses.

A master list of the projects follows. More detailed cost estimates were prepared for the 40 10-year implementation plan projects and these costs are provided on the following table. The rough cost estimates for the 33 25-year implementation plan projects and the 7 non-structural projects are not provided in the tables.

Priority Structural Projects (Ten Year Implementation Plan)				
Project #	**Project Type**	**WMA**	**Location**	**Cost**
JM9100	Stormwater Pond Retrofit	Johnny Moore Creek	7005 Union Mill Rd Clifton, VA 20124	$ 200,000
JM9200	Stream Restoration	Johnny Moore Creek	13309 Balmoral Greens Av Clifton, VA 20124	$ 770,000
JM9201	Stream Restoration	Johnny Moore Creek	13309 Balmoral Greens Av Clifton, VA 20124	$ 420,000
JM9202	Stream Restoration	Johnny Moore Creek	7029 Union Mill Rd Clifton, VA 20124	$ 320,000
JM9203	Stream Restoration	Johnny Moore Creek	13400 Compton Rd Clifton, VA 20124	$ 770,000
JM9400	Culvert Retrofit	Johnny Moore Creek	13165 Compton Rd Clifton, VA 20124	$ 120,000
JM9500	BMP/LID	Johnny Moore Creek	7051 Balmoral Forest Rd Clifton, VA 20124	$ 120,000
LR9005	Regional Pond Group	Little Rocky Run - Lower	6351 Littlefield Ct Centreville, VA 20121	$ 650,000
LR9010	Regional Pond Group	Little Rocky Run - Upper	5378 Harrow La Fairfax, VA 22030	$ 350,000
LR9013	Regional Pond Group	Little Rocky Run - Lower	13600 Wildflower La Clifton, VA 20124	$ 740,000
LR9100	Stormwater Pond Retrofit	Little Rocky Run - Lower	13943 Stonefield Dr Clifton, VA 20124	$ 100,000
LR9102	Stormwater Pond Retrofit	Little Rocky Run - Lower	6579 Rockland Dr Clifton, VA 20124	$ 220,000
LR9103	Stormwater Pond Retrofit Stream Restoration	Little Rocky Run - Lower	13815 Springstone Dr Clifton, VA 20124	$ 560,000
LR9106	Stormwater Pond Retrofit	Little Rocky Run - Lower	13534 Union Village Ci Clifton, VA 20124	$ 190,000
LR9109	Stormwater Pond Retrofit	Little Rocky Run - Upper	5064 Cavalier Woods La Clifton, VA 20124	$ 40,000
LR9110	Stormwater Pond Retrofit	Little Rocky Run - Lower	13214 Kilby Landing Ct Clifton, VA 20124	$ 120,000
LR9111	Stormwater Pond Retrofit	Little Rocky Run - Lower	13022 Cobble La Clifton, VA 20124	$ 100,000
LR9114	Stormwater Pond Retrofit	Little Rocky Run - Upper	13114 Blue Willow Pl Clifton, VA 20124	$ 60,000
LR9115	Stormwater Pond Retrofit	Little Rocky Run - Upper	5403 Willow Valley Rd Clifton, VA 20124	$ 290,000
LR9117	Stormwater Pond Retrofit	Little Rocky Run - Upper	12837 Lee Hy Fairfax, VA 22030	$ 40,000
LR9201	Stream Restoration	Little Rocky Run - Lower	14104 Sorrel Chase Ct Centreville, VA 20121	$ 830,000
LR9202	Stream Restoration	Little Rocky Run - Lower	6419 Stonehaven Ct Clifton, VA 20124	$ 820,000

Priority Structural Projects (Ten Year Implementation Plan)				
Project #	**Project Type**	**WMA**	**Location**	**Cost**
LR9203	Stream Restoration	Little Rocky Run - Lower	14100 Wood Rock Wy Centreville, VA 20121	$ 310,000
LR9204	Stream Restoration	Little Rocky Run - Lower	5587A Rockpointe Dr Clifton, VA 20124	$ 110,000
LR9205	Stream Restoration	Little Rocky Run - Upper	5217 Whisper Willow Dr Fairfax, VA 22030	$ 510,000
LR9207	Stream Restoration	Little Rocky Run - Upper	5378 Ashleigh Rd Fairfax, VA 22030	$ 650,000
LR9208	Stream Restoration	Little Rocky Run - Upper	5418 Ashleigh Rd Fairfax, VA 22030	$ 800,000
LR9209	Stream Restoration	Little Rocky Run - Upper	12753 Ashleigh Ct Fairfax, VA 22030	$ 380,000
LR9504	BMP/LID	Little Rocky Run - Lower	13916 Rock Brook Ct Clifton, VA 20124	$ 80,000
LR9508	BMP/LID	Little Rocky Run - Lower	6612 Creek Run Dr Centreville, VA 20121	$ 90,000
LR9509	BMP/LID	Little Rocky Run - Lower	6600 La Petite Pl Centreville, VA 20121	$ 140,000
LR9510	BMP/LID	Little Rocky Run - Lower	14330 Green Trails Bv Centreville, VA 20121	$ 260,000
LR9514	BMP/LID	Little Rocky Run - Lower	13611 Springstone Dr Clifton, VA 20124	$ 100,000
LR9516	BMP/LID	Little Rocky Run - Lower	6001 Union Mill Rd Clifton, VA 20124	$ 330,000
LR9521	BMP/LID	Little Rocky Run - Upper	13516 Canada Goose Ct Clifton, VA 20124	$ 180,000
LR9522	BMP/LID	Little Rocky Run - Upper	13340 Leland Rd Centreville, VA 20121	$ 220,000
LR9523	BMP/LID	Little Rocky Run - Upper	13006 Feldspar Ct Clifton, VA 20124	$ 510,000
LR9524	BMP/LID	Little Rocky Run - Upper	5355 Ashleigh Rd Fairfax, VA 22030	$ 210,000
LR9526	BMP/LID	Little Rocky Run - Upper	4864 Muddler Way Fairfax, VA 22030	$ 130,000
LR9527	BMP/LID	Little Rocky Run - Upper	5400 Willow Springs School Rd Fairfax, VA 22030	$ 130,000
				$12,970,000

Long Term Structural Projects (25 Year Implementation Plan)			
Project #	**Project Type**	**WMA**	**Location**
JM9101	Stormwater Pond Retrofit	Johnny Moore Creek	6801 Union Mill Rd Clifton, VA 20124
JM9700	Outfall Improvement	Johnny Moore Creek	6301 Clifton Rd Clifton, VA 20124
LR9005B	BMP/LID	Little Rocky Run - Lower	13905 Green Trails Ct Centreville, VA 20121
LR9013A	Stream Restoration	Little Rocky Run - Lower	5733 Old Clifton Rd Clifton, VA 20124
LR9013B	BMP/LID	Little Rocky Run - Lower	13400 Braddock Road Clifton, VA 20124
LR9013C	New SWM	Little Rocky Run - Lower	13619 Orchard Dr Clifton, VA 20124
LR9101	Stormwater Pond Retrofit	Little Rocky Run - Lower	13909 Warm Spring Ct Clifton, VA 20124
LR9104	Stormwater Pond Retrofit	Little Rocky Run - Lower	13932 Preacher Chapman Pl Centreville, VA 20121
LR9105	Stormwater Pond Retrofit	Little Rocky Run - Lower	13801 Laura Ratcliff Ct Centreville, VA 20121
LR9107	Stormwater Pond Retrofit	Little Rocky Run - Upper	5901 Spruce Run Ct Centreville, VA 20121
LR9108	Stormwater Pond Retrofit	Little Rocky Run - Upper	13660 Forest Pond Ct Centreville, VA 20121
LR9112	Stormwater Pond Retrofit	Little Rocky Run - Upper	13270 Maple Creek La Centreville, VA 20120
LR9113	Stormwater Pond Retrofit	Little Rocky Run - Upper	5324 Sammie Kay La Centreville, VA 20120
LR9116	Stormwater Pond Retrofit	Little Rocky Run - Upper	5130 Myrtle Leaf Dr Fairfax, VA 22030
LR9200	Stream Restoration	Little Rocky Run - Lower	7014 Dalemar Dr Clifton, VA 20124
LR9206	Stream Restoration	Little Rocky Run - Upper	5112 Lincoln Dr Fairfax, VA 22030
LR9500	BMP/LID	Little Rocky Run - Lower	6901 Newby Hall Ct Clifton, VA 20124
LR9501	BMP/LID	Little Rocky Run - Lower	6818 Compton Heights Cr Clifton, VA 20124
LR9502	BMP/LID	Little Rocky Run - Lower	14024 Marblestone Dr Clifton, VA 20124
LR9503	BMP/LID	Little Rocky Run - Lower	14100 Rock Canyon Dr Centreville, VA 20121
LR9505	BMP/LID	Little Rocky Run - Lower	13933 Marblestone Dr Clifton, VA 20124
LR9506	BMP/LID	Little Rocky Run - Lower	6596 Creek Run Dr Centreville, VA 20121
LR9507	BMP/LID	Little Rocky Run - Lower	13930 South Springs Dr Clifton, VA 20124

Long Term Structural Projects (25 Year Implementation Plan)			
Project #	**Project Type**	**WMA**	**Location**
LR9512	BMP/LID	Little Rocky Run - Lower	13905 Springstone Dr Clifton, VA 20124
LR9513	BMP/LID	Little Rocky Run - Lower	13671 Wildflower La Clifton, VA 20124
LR9515	BMP/LID	Little Rocky Run - Lower	13609 Bridgeland La Clifton, VA 20124
LR9517	BMP/LID	Little Rocky Run - Lower	6021 Little Brook Ct Clifton, VA 20124
LR9518	BMP/LID	Little Rocky Run - Upper	13644 Barren Springs Ct Centreville, VA 20121
LR9519	BMP/LID	Little Rocky Run - Upper	5813 Rockdale Ct Centreville, VA 20121
LR9520	BMP/LID	Little Rocky Run - Upper	13660 Bayberry La Centreville, VA 20121
LR9525	BMP/LID	Little Rocky Run - Upper	4895 Annamohr Dr Fairfax, VA 22030
LR9600	Flood Protection/Mitigation	Little Rocky Run - Upper	5416 Arrowhead Park Dr Centreville, VA 20120
LR9700	Outfall Improvement	Little Rocky Run - Lower	6436 Battle Rock Dr Clifton, VA 20124

Non-Structural Projects			
Project #	**Project Type**	**WMA**	**Location**
JM8800	Buffer Restoration	Johnny Moore Creek	13309 Balmoral Greens Av Clifton, VA 20124
JM8801	Buffer Restoration	Johnny Moore Creek	7404 Union Ridge Rd Clifton, VA 20124
LR8800	Buffer Restoration	Little Rocky Run - Upper	12810 Westbrook Dr Fairfax, VA 22030
LR9010A	Buffer Restoration	Little Rocky Run - Upper	12524 Chronical Dr Fairfax, VA 22030
LR9800	Outreach/Education	Little Rocky Run - Lower	14123 Compton Valley Wy Centreville, VA 20121
LR9801	Outreach/Education	Little Rocky Run - Upper	Bent Tree Apartments Centreville, VA 20121
LR9802	Outreach/Education, Street Sweeping Program	Little Rocky Run - Upper	5702 Union Mill Rd Clifton, VA 20124

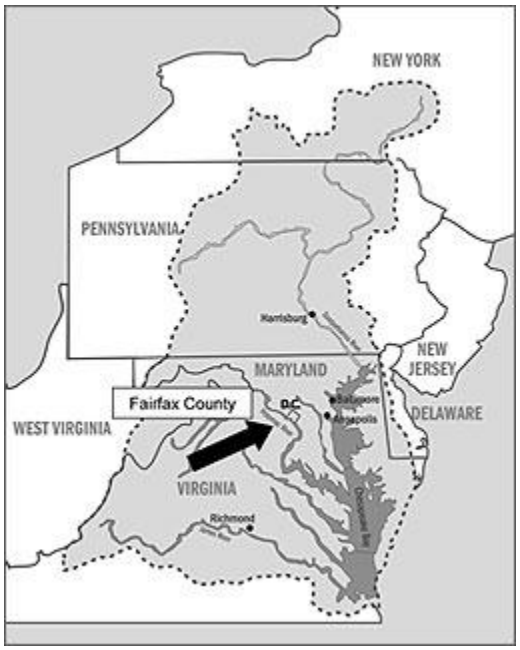
1. Introduction to Watersheds

Figure 1-1 Diagram of a watershed

A watershed is an area of land that drains all of its water to a specific lake or river. As rainwater and melting snow run downhill, they carry sediment and other materials into our streams, lakes, wetlands and groundwater.

The boundary of a watershed is defined by the watershed divide, which is the ridge of highest elevation surrounding a given stream or network of streams. A drop of rainwater falling outside of this boundary will enter a different watershed and will flow to a different body of water.

Streams and rivers may flow through many different types of land use in their paths to the ocean. In the above illustration from the U.S. Environmental Protection Agency (Figure 1-1), water flows from agricultural lands to residential areas to industrial zones as it moves downstream. Each land use presents unique impacts and challenges on water quality.



Map 1-1 The Chesapeake Bay watershed

The size of a watershed can be subjective; it depends on the scale that is being considered. The image to the left depicts the extent of the Chesapeake Bay watershed, "the big picture" that is linked to our local concerns. This watershed covers 64,000 square miles and crosses into six states: New York, Pennsylvania, Delaware, West Virginia, Maryland, Virginia and the District of Columbia.

One of the watersheds that comprise the Chesapeake Bay watershed is the Potomac River watershed. Fairfax County, as shown on the map (Map 1-1), occupies approximately 400 square miles of the Potomac River watershed. This area contains 30 smaller watersheds. Think of watersheds as being "nested" within each successively larger one.

Each watershed in Fairfax County was subdivided to facilitate data management and to promote local awareness of the streams. Watersheds were divided into Watershed Management Areas (WMAs) approximately four square miles in size. WMAs are usually named for the local major tributary. These areas are further divided into subwatersheds, ranging in size from 100 to 300 acres. Subwatersheds represent the smallest modeling unit for watershed planning.

Beginning in the early 1940's, Fairfax County shifted from an agricultural community to an urbanized one whose population exceeds that of several states. While the County continued to develop, the condition of streams and aquatic life declined. In 1999, a Stream Protection Strategy

(SPS) was initiated to monitor stream health and establish a baseline of countywide stream conditions. The results of the baseline monitoring effort indicated that only 25 percent of the County's streams were in good to excellent biological health. Stream condition is determined using an Index of Biological Integrity (IBI) that evaluates ecological health based on the community structure of bottom-dwelling aquatic invertebrates.

The baseline study found that roughly 75 percent of streams within the County had areas negatively impacted by impervious conditions within their watersheds. Due to increasing urbanization prior to implementation of modern stormwater controls, impervious land area rapidly increased, contributing to the degradation of the streams.

1.1 Introduction to Watershed Planning

The County's comprehensive stormwater management program is currently undergoing a transformation that addresses watershed health using a holistic approach. The mission for the stormwater program is dictated by the need to preserve and restore the natural environment and aquatic resources, which is consistent with the Fairfax County Board of Supervisors' Environmental Agenda adopted in June 2004. The County must also comply with all applicable local, state and federal laws and mandates. These include County ordinances and policies, Virginia's Chesapeake Bay Initiatives and the federal Clean Water Act. Under the Virginia Pollutant Discharge Elimination System (VPDES) the County has an individual Municipal Separate Storm Sewer System (MS4) Permit. This permit requires the creation of watershed management plans to facilitate compliance with the Clean Water Act. In addition, the County is doing its part to fulfill Virginia's commitment to the Chesapeake Bay 2000 Agreement to restore the ecological health of the Chesapeake Bay Watershed.

Fairfax County's first set of watershed plans was completed in the 1970s. Land use has changed significantly since that time. Additionally, there have been many advances in technology and development in the field of stormwater management which have resulted in updates to stormwater policies and regulations. New plans were needed to reflect these changes and to plan for a future in which Fairfax County recognizes that there is a direct link between the vitality of ecological resources and the quality of life for our citizens.

The current watershed plans provide more targeted strategies for addressing stream health given current and future land uses and evolving regulations. These plans are one of several tools that enable the County to address program requirements and to improve and maintain watershed health. Each watershed plan includes a prioritized 25-year list of proposed capital improvement projects in addition to non-structural programs and projects. These projects and programs may lead to new and/or revised ordinances, public facilities manual requirements and policies. The plans promote the use of new and innovative practices in stormwater management such as Low Impact Development (LID) techniques and stream restoration using natural channel design. To maximize the effectiveness of these plans, community engagement and involvement from diverse interests were emphasized during the development process.

Watershed management plans were developed by grouping the County's 30 watersheds into 13 planning units (Map 1-2). Watershed planning began in 2003. By 2007, roughly 50 percent of the County land area had completed watershed plans. This plan is part of the second group of watershed plans, which was initiated in 2007 for the remaining land area.

In general, the watershed management planning process consists of the following steps:

1. Review and synthesis of previous studies and data compilation
2. Public involvement to gain input, provide education and build community support
3. Evaluation of current watershed conditions and projection of stormwater runoff from present and ultimate development conditions

4. Development of non-structural and structural watershed improvement projects
5. Development of preliminary cost estimates, cost/benefit analysis and prioritization of capital projects
6. Adoption of the final watershed management plan by the Board of Supervisors

The watershed management planning process has been supported by the Board of Supervisors since its inception in 2003. In fiscal year 2006, the Board of Supervisors dedicated $0.01 per $100 of assessed value from the County's real estate tax revenue towards the overall stormwater management program. This supported the ongoing development and implementation of watershed plans and eventually evolved into the adoption of a stormwater service district starting in fiscal year 2010. The Board recently approved increasing the dedicated amount to a penny and a half for fiscal year 2011.

The following provisions address the funding and implementation of projects and programs in Fairfax County watershed plans. These provisions as recommended by the Board were developed for the Popes Head Creek Watershed Management Plan in February 2006 and have been applied to the Little Rocky Run – Johnny Moore Creek Watershed Management Plan:

i. Projects and programs (both structural and non-structural) will first undergo appropriate review by County staff and the Board (please see iii below) prior to implementation. Board adoption of the Watershed Management Plan will not set into motion automatic implementation of projects, programs or initiatives that have not first been subject to sufficient scrutiny to ensure that the projects that are funded give the County the greatest environmental benefit for the cost.

ii. Road projects not related to protection of streambeds or banks or water quality will not be funded out of the stormwater and watershed budget.

iii. The Watershed Management Plan provides a conceptual master-list of structural capital projects and a list of potential non-structural projects for the watershed. Staff will, on a fiscal year basis, prepare and submit to the Board a detailed work plan to include a description of proposed projects and an explanation of their ranking, based on specific criteria. Criteria used to assemble this list will include, but are not limited to, cost-effectiveness as compared to alternative projects, a clear public benefit, a need to protect public or private lands from erosion or flooding, a need to meet a specific watershed or water quality goal, and ability to be implemented within the same fiscal year that funding is provided. Staff also intends to track the progress of implementation and report back to the Board periodically.

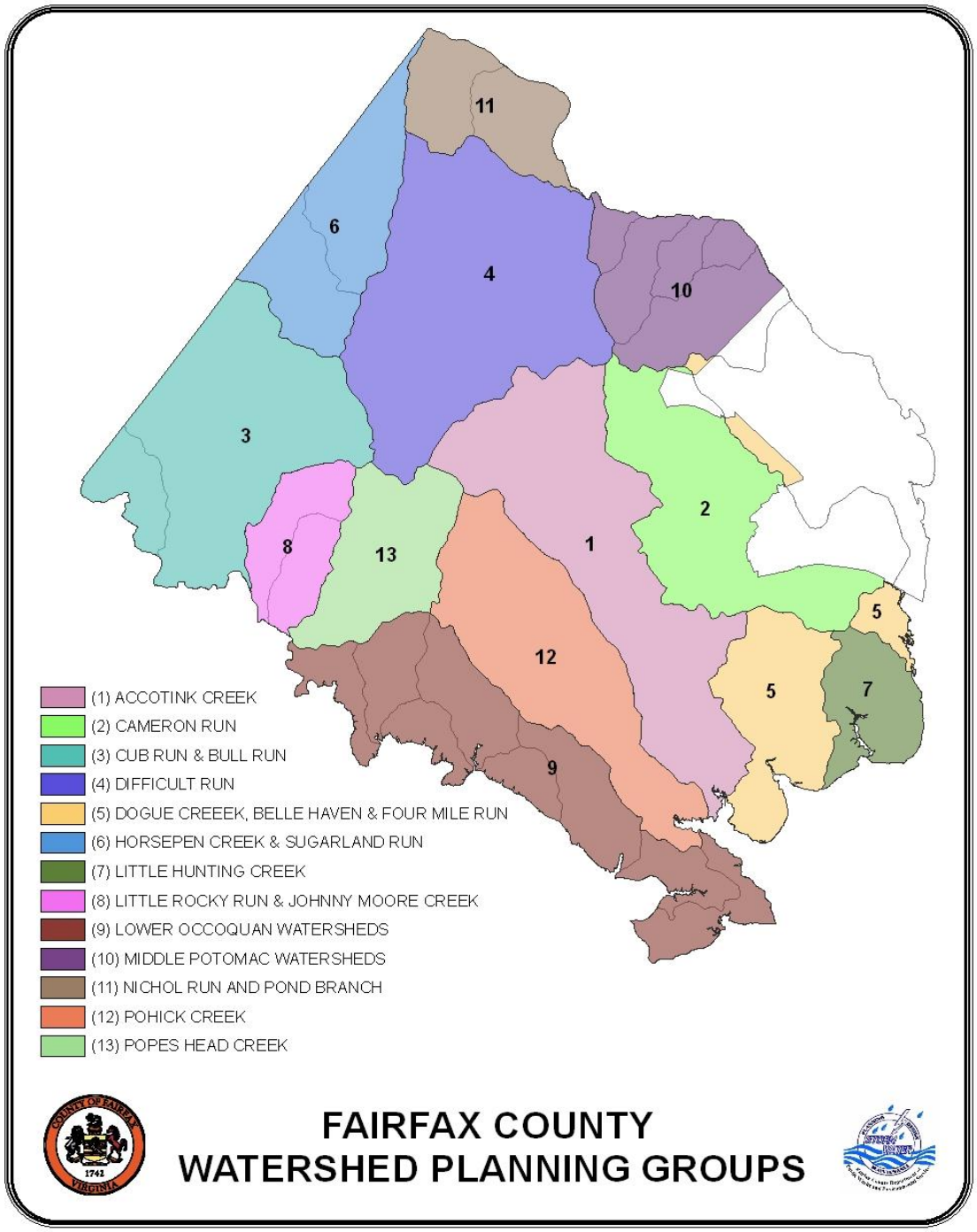
iv. Each project on the annual list of structural projects will be evaluated using basic value-engineering cost effectiveness principles before implementation and the consideration of alternative structural and non-structural means for accomplishing the purposes of the project will be considered before implementation. This process will ensure the County's commitment to being a fiscally responsible public entity.

v. Obstruction removal projects on private lands will be evaluated on a case-by-case basis for referral to the Zoning Administrator and/or County Attorney for action as public

Map 1-2 Watershed planning groups in Fairfax County

nuisances; and otherwise to determine appropriate cost-sharing by any parties responsible for the obstructions.

vi. Stream restoration projects on private lands will be evaluated to determine means for cost-sharing by land owners directly responsible for degradation due to their land uses.


11
6
4
10
3
2
8
13
1
5
12
5
7
9
(1) ACCOTINK CREEK
(2) CAMERON RUN
(3) CUB RUN & BULL RUN
(4) DIFFICULT RUN
(5) DOGUE CREEEK, BELLE HAVEN & FOUR MILE RUN
(6) HORSEPEN CREEK & SUGARLAND RUN
(7) LITTLE HUNTING CREEK
(8) LITTLE ROCKY RUN & JOHNNY MOORE CREEK
(9) LOWER OCCOQUAN WATERSHEDS
(10) MIDDLE POTOMAC WATERSHEDS
(11) NICHOL RUN AND POND BRANCH
(12) POHICK CREEK
(13) POPES HEAD CREEK
FAIRFAX COUNTY
WATERSHED PLANNING GROUPS

2. Watershed Planning Process

2.1 Watershed Goals and Objectives

The County's first six comprehensive watershed management plans outlined intentions for protecting, maintaining or improving streams and the measures that could be taken to meet them. Although the plans conveyed similar aims overall, there were some differences in the way goals and objectives were developed. As a result of these differences, the initial six plans were analyzed to identify common themes in order to create standardized goals and objectives for the remaining watershed management plans. Standardization improved efficiency in the planning process and achieved greater consistency among the plans.

As part of the standardization process, the County selected three overarching goals, or intended outcomes of the watershed management plans:

1. Improve and maintain watershed functions in Fairfax County, including water quality, habitat and hydrology
2. Protect human health, safety and property by reducing stormwater impacts
3. Involve stakeholders in the protection, maintenance and restoration of County watersheds

Ten objectives were developed related to the three goals. Each objective may achieve one or more goals, and each goal may be achieved by one or more objectives. These ten objectives were grouped into five categories based on certain aspects of watershed management the objectives could influence:

1. **Hydrology** - healthy movement and distribution of water through the environment in a way that is protective of streams and human dwellings
2. **Habitat** - suitable environment for sustaining plants and animals
3. **Stream water quality** - general chemical and physical properties of surface waters
4. **Drinking water quality** - quality of water used for human consumption
5. **Stewardship** - the roles the County, other jurisdictions and members of the general public can play in caring for the environment

Under the new approach, County staff and the public had the flexibility to add objectives that were unique and important to a particular watershed, but all plans included the standard goals and objectives as a baseline (Table 2-1).

Table 2-1 Countywide Objectives

Objective	Linked to Goal(s)
CATEGORY 1. HYDROLOGY	
1A. Minimize impacts of stormwater runoff on stream hydrology to promote stable stream morphology, protect habitat and support biota.	**1**
1B. Minimize flooding to protect property and human health and safety.	**2**
CATEGORY 2. HABITAT	
2A. Provide for healthy habitat through protecting, restoring and maintaining riparian buffers, wetlands and instream habitat.	**1**
2B. Improve and maintain diversity of native plants and animals in the County.	**1**
CATEGORY 3. STREAM WATER QUALITY	
3A. Minimize impacts to stream water quality from pollutants in stormwater runoff.	**1, 2**
CATEGORY 4. DRINKING WATER QUALITY	
4A. Minimize impacts to drinking water sources from pathogens, nutrients and toxics in stormwater runoff.	**2**

Objective	Linked to Goal(s)
4B. Minimize impacts to drinking water storage capacity from sediment in stormwater runoff.	**2**
CATEGORY 5 STEWARDSHIP	
5A. Encourage the public to participate in watershed stewardship.	**3**
5B. Coordinate with regional jurisdictions on watershed management and restoration efforts such as Chesapeake Bay initiatives.	**3**
5C. Improve watershed aesthetics in Fairfax County.	**1, 3**

Standardizing the goals and objectives will make it easier to integrate plan recommendations into a countywide data management system for prioritizing projects, tracking implementation and evaluating the long-term influence of the plans on the health of County streams.

2.2 Indicators

Since accomplishment of objectives cannot be directly measured, indicators that are able to detect changes in the watershed were developed. Indicators are used to assess the condition of the environment, as early-warning signals of changes in the environment, and to diagnose causes of ecological problems. *Observed* indicators are based upon data and observations collected in the field/area of interest, and are useful in assessing existing watershed conditions. *Predictive* indicators respond in a predictable manner to ecosystem stressors, and can be used in models of hydrologic and ecosystem processes (such as soil erosion, pollutant loading, etc.) to compare existing and future conditions.

Each indicator was measured by one or more metrics. A metric is an analytical benchmark that responds in a predictable way to increasing human, climatic or other environmental stress. Metrics may be actual numeric values (such as pH or Dissolved Oxygen values) or parameters that have been scored to a numeric scale (such as 1 – 10).

The indicators used by Fairfax County may be grouped into the following categories:

- **Watershed Impact Indicators** – Measure the extent that reversal or prevention of a particular watershed impact, sought by the goals and objectives, has been achieved ("What's there now, and how is it doing?").
- **Source Indicators** – Quantify the presence of a potential stressor or pollutant source ("Is there a problem, and what's causing it?").
- **Programmatic Indicators** –After the plans are adopted, these will assess outcomes of resource protection and restoration activities ("What's the County doing about the problem, and how is it doing?").

2.2.1 Watershed Impact Indicators

One or more watershed impact indicators for each objective were identified, including predictive and observed indicators. These indicators and the objectives to which they are linked are shown in Table 2-2.

Table 2-2 Watershed Impact Indicators

Objective	Indicators
1A Stormwater Runoff	Observed: Benthic Communities, Fish Communities, Aquatic Habitat Predictive: Channel Morphology, Instream Sediment, Hydrology
1B Flooding Hazards	Observed: Flood Complaints Predictive: Number of Road Hazards, Magnitude of Road Hazards, Residential Building Hazards, Non-residential Building Hazards
2A Habitat Health	Observed: Aquatic Habitat Predictive: RPA Riparian Habitat, Headwater Riparian Habitat, Protected Wetland Habitat
2B Habitat Diversity	Observed: Benthic Communities, Fish Communities Predictive: None
3A Stream Water Quality	Observed: *E. coli*, Benthic Communities, Fish Communities Predictive: Upland Sediment, Instream Sediment, Nitrogen, Phosphorus
4A Drinking Water Quality	Observed: *E. coli* Predictive: Nitrogen, Phosphorus, Upland Sediment
4B Storage Capacity	Observed: None Predictive: Upland Sediment, Instream Sediment
5A Public Participation	Programmatic Indicators to be tracked by the County
5B Regional Coordination	Programmatic Indicators to be tracked the County
5C Aesthetics	Programmatic Indicators to be tracked the County

For predictive indicators, three scenarios were considered. Metrics and scores were calculated for:

- Existing Conditions
- Future without project implementation
- Future with project implementation

The future condition metrics and scores reflect the simulated conditions at ultimate build-out based on the County's 25-year Comprehensive Plan.

The watershed impact indicator scores were used at multiple stages of watershed planning. First, they were used to assess current and future conditions without project implementation in the watershed. Indicator scores were then used to identify management needs and problem areas during subwatershed ranking (see Section 2.3). Once candidate projects were identified, the indicators were used to prioritize projects alongside cost and feasibility.

2.2.2 Source Indicators

Source indicators were used to evaluate the sources and stressors that impact watershed processes. Examples include:

- Numeric Source Indicators
    - Amount of Channelized/Piped Streams
    - Amount of Directly Connected Impervious Area (DCIA) (predictive)
    - Amount of Impervious Surface (predictive)
    - Number of Stormwater Outfalls
    - Number of Sanitary Sewer Crossings
    - Streambank Buffer Deficiency
    - Total amount of Nitrogen (predictive)
    - Total amount of Phosphorus (predictive)
    - Total Suspended Solids (predictive)
- Field Reconnaissance Observations
    - Hot Spot Investigations
    - Neighborhood Source Assessments
    - All other field reconnaissance observations

The contributions of these indicators to existing and future watershed impacts were evaluated. Metrics and scores were developed for all source indicators under existing conditions. In addition, three scenarios were considered for the predictive indicators, as noted in the list above.

Metrics and scores were calculated for these scenarios:

- Existing Conditions
- Future without project implementation
- Future with project implementation

The future condition metrics and scores reflect the simulated conditions at ultimate build-out based on the County's Comprehensive Plan.

Like the watershed impact indicators, source indicator scores were used to rank subwatersheds according to their problems and needs and to assist with candidate project identification.

2.2.3 Programmatic Indicators

Once the plan is adopted, programmatic indicators will be used by the County to help evaluate watershed management needs. These indicators illustrate the extent and location of existing and past management efforts. The following types of management in the watershed were inventoried during plan development:

- Detention Facilities
- Stream Restoration
- Riparian Buffer Restoration
- Best Management Practice (BMP) Facilities
- Low Impact Development
- Inspection and Maintenance of Stormwater Management Facilities
- Inspection and Repair of Stormwater Infrastructure and Outfalls
- Dumpsite Removal
- Regional Ponds
- Volunteer Monitoring
- Subarea Treatment (used in watershed modeling studies)

Information for these indicators will be considered to identify and evaluate watershed management needs for individual watersheds and for the County as a whole.

2.2.4 Composite Scores

After metric values are translated into scores, objective, composite and overall composite scores are calculated for use in subwatershed ranking. Weighting factors are used when calculating composite scores to give more importance to certain indicators and objectives. First, watershed impact indicators are grouped by objective. Each metric score is multiplied by a predetermined weighting factor specific to that indicator, and the products are summed within objectives to generate an objective composite score for each objective. Each objective composite score is then multiplied by a predetermined weighting factor specific to that objective, and the products are summed to generate an overall composite score. A similar process is used for source indicators, but without an objective composite score (since source indicators are not directly linked to objectives).

2.3 Subwatershed Ranking

The composite scores calculated under the methods previously described were used to identify problem areas in the watershed and rank subwatersheds for management priority. Subwatersheds were further categorized based on which management opportunities were most likely to restore functions to the problem areas identified. The resulting data were then utilized to identify key issues and select projects that would achieve the watershed planning goals and objectives.

The subwatershed ranking procedure involved reviewing watershed impact objective, composite, overall composite and source indicator scores. Since some of the indicators are predictive, i.e. based on modeling, it was possible to pose "what if?" questions and test future scenarios with and without management actions. Existing management facilities and programs which were inventoried for programmatic indicators and data collected during field reconnaissance were also considered. The ranking process consisted of the following steps:

1. Used the watershed impact overall composite scores and identified subwatersheds that were potential problem areas under existing and future conditions.
2. Used the watershed impact objective composite scores and identified subwatersheds that were potential problem areas under existing and future conditions for each objective.
3. Reviewed source indicator composite scores and identified additional problem areas.
4. Used individual source indicator scores to identify potential sources of impacts in downstream problem areas.
5. In combination with the above data, used the programmatic indicator data inventory to identify subwatersheds where management was most needed.
6. Consulted available field reconnaissance data throughout the above steps to confirm that results reflected conditions in the field.

All this information was combined to rank subwatersheds in order from the most problematic (higher priority for management actions) to the least problematic (lower priority for management actions). Subwatershed ranking can provide guidance as to where management is most needed and can be applied successfully, but the final determination is ultimately based on best professional judgment.

2.4 Stormwater Modeling

Storm events are classified by the amount of rainfall, in inches, that occurs over the duration of a storm. The amount of rainfall depends on how frequently the storm will statistically occur and how long the storm lasts. Based on many years of rainfall data collected, storms of varying strength have been established based on the duration and probability of that event occurring within any given year. In general, smaller storms occur more frequently than larger storms of equal duration. Hence, a 2-year, 24hr storm (having a 50 percent chance of happening in a given year) has less rainfall than a 10-year, 24hr storm (having a 10 percent chance of happening in a given year). Stormwater runoff (which is related to the strength of the storm) is surplus rainfall that does not soak into the ground. This surplus rainfall flows (or 'runs off') from

roof tops, parking lots and other impervious surfaces and is ultimately received by storm drainage systems, culverts and streams.

Modeling is a way to mathematically predict and spatially represent what will occur with a given rainfall event. There are two primary types of models that are used to achieve this goal; hydrologic and hydraulic:

- *Hydrologic models* take into account several factors: the particular rainfall event of interest; the physical nature of the land area where the rainfall occurs and how quickly the resulting stormwater runoff drains this given land area. Hydrologic models can describe both the quantity of stormwater runoff and resulting pollution, such as nutrients (nitrogen and phosphorus) and sediment that are transported by the runoff.

- *Hydraulic models* represent the effect the stormwater runoff from a particular rainfall event has on both man-made and natural systems. These models can predict both the ability of man-made culverts/channels to convey stormwater runoff and the spatial extent of potential flooding.

Table 2-3 shows three storm events and the rationale for being modeling:

Table 2-3 Modeling Rationale

Storm Event	Modeling Rationale
2-year, 24hr	Represents the amount of runoff that defines the shape of the receiving streams.
10-year, 24hr	Used to determine which road culverts will have adequate capacity to convey this storm without overtopping the road.
100-year, 24hr	Used to define the limits of flood inundation zones

2.4.1 Hydrologic Model (SWMM)

The U.S. Environmental Protection Agency (EPA) Storm Water Management Model (SWMM) was first developed in the early 1970s. Over the past 30 years, the model has been updated and refined and is now used throughout the country as a design and planning tool for stormwater runoff. Specifically, SWMM is a dynamic rainfall-runoff simulation model used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas.

The runoff component of SWMM operates on a collection of subwatershed areas where rain falls and runoff is generated. The routing (or hydraulic) portion of SWMM transports this runoff through a conveyance system of pipes, channels and storage/treatment devices. SWMM tracks the quantity and quality of runoff generated within each subwatershed, and the flow rate and depth of water in the conveyance system during a simulation period.

2.4.2. Pollution Model (STEPL)

While the SWMM model can calculate pollutant loads, the Spreadsheet Tool for Estimating Pollutant Load (STEPL) was used to determine pollutant loads for the watershed planning effort. Also developed by EPA, STEPL employs simple algorithms to calculate surface runoff. This includes nutrient loads, such as nitrogen and phosphorus, and sediment loads from various land uses. STEPL also calculates load reductions that would result from the implementation of various Best Management Practices (BMPs). The nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff as influenced by factors such as land use distribution and management practices. Sediment loads are calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using known BMP efficiencies.

2.4.3 Hydraulic Model (HEC-RAS)

The Hydrologic Engineering Center River Analysis System (HEC-RAS) hydraulic model was initially developed by the U.S. Army Corps of Engineers (USACE) in the early 1990s as a tool to manage the rivers and harbors in their jurisdiction. HEC-RAS has found wide acceptance as the standard for simulating the hydraulics of water flow through natural and/or manmade channels and rivers. HEC-RAS is commonly used for modeling water flowing through a system of open channels with the objective of computing water surface elevations.

The geographic input data for the HEC-RAS model was extracted using HEC-GeoRAS. HEC-GeoRAS is a tool that processes the geospatial data within the County's Geographic Information System, specifically as it pertains to physical features such as stream geometry and flow path so that these features can be represented in the model.

Using available County or Virginia Department of Transportation (VDOT) engineering data, bridge and culvert crossings were coded into the model to simulate the effect these facilities have on the water surface elevations or profile. Where data were not available, field reconnaissance was performed to obtain the crossing elevation data. Crossing data were determined relative to a point where the elevation could be estimated accurately from the County's topographic data. Manning's 'n' values, which represent surface roughness, were assigned to the channel and overbank portions of the studied streams based on field visits and aerial photographs.

The hydrologic flow input data and the locations where the flows change were extracted from SWMM. The 2-yr, 10-yr and 100-yr storm flow outputs were determined at several locations in order to provide a detailed flow profile for input into the HEC-RAS hydraulic model.

As stated previously, the 2-year storm discharge is regarded as the channel-forming or dominant discharge that transports the majority of a stream's sediment load and therefore actively forms and maintains the channel. A comparison of stream dynamics and channel geometry for the 2-year discharge provided insight regarding the relative stability of the system and helped to identify areas in need of restoration.

The 10-year storm discharge was included to analyze the level of service of bridge and culvert stream crossings. Occurring less frequently than the 2-year storm, the flood stage associated with this storm can result in more significant safety hazards to residents. All stream crossings (bridges and culverts) were analyzed against this storm to see if they are performing at safe levels.

The 100-year storm discharge is used by the Federal Emergency Management Agency (FEMA) to delineate floodplain inundation zones in order to establish a Flood Insurance Rate Map (FIRM) for a given area. The 100-yr HEC-RAS models were built in compliance with FEMA standards and were included to map the limits of these floodplain inundation zones. This mapping provided a means to assess which properties are at risk to flooding by a 100-yr storm event.

2.5 Public Involvement Plan

A consistent approach for public involvement was important to enable comparisons among planning processes and final watershed management plans. Conversely, as each watershed has unique characteristics, the strategies employed must also address the diverse needs, interests and conditions of the watershed and its community. The principal goals for public involvement were:

- Increase community awareness and understanding of stormwater management
- Provide meaningful participation options for a diversity of stakeholders
- Incorporate community ideas into the scope of the watershed plans
- Strive for community support for the final plans

Recognizing the need for public acceptance of the final plans, County staff created a public involvement process with multiple feedback loops to facilitate informed participation by the public and key stakeholder groups at all development stages. The first step of the public involvement process was to host an Introductory and Issues Scoping forum that was open to all residents. The primary purpose of this forum was to solicit informed input on the development of the watershed management plan. Other objectives were to explain the planning process to the community and develop an initial list of watershed issues and concerns.

After the forum, stakeholder groups were invited to be part of a Watershed Advisory Group (WAG) for each plan. These were comprised of local stakeholders who represented various interests (HOA representatives, environmental groups, etc) and advised County staff about community outreach opportunities and key issues affecting their watershed and potential projects. They also were invited to comment on draft and final versions of the watershed management plan. Each WAG met with County staff five to six times throughout the plan development in order to provide guidance and comments at critical junctures of the process.

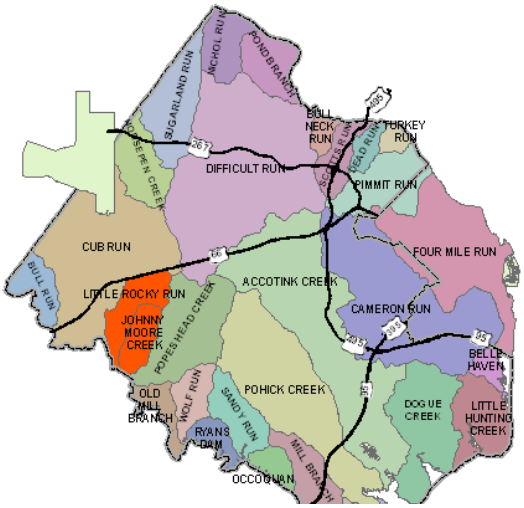
The WAG also provided support at the second public forum, the Draft Plan Review Workshop. The workshop provided the extended community with an opportunity to review the first draft of the watershed plan and provide input. Comments were collected at the end of a 30-day period and addressed as appropriate. The final plan was then adopted by the Board of Supervisors.

More information on the public involvement process including WAG meeting minutes, public forum meeting minutes and public comments and responses can be found in Appendix C.

3. Summary of Watershed Conditions

3.1 Introduction

This section presents a summary of Little Rocky Run and Johnny Moore Creek watershed conditions. More detailed information can be found in the appendices of the Watershed Management Plan. Little Rocky Run and Johnny Moore Creek drain into Bull Run and eventually to Chesapeake Bay, and are located in the southwestern part of Fairfax County, Virginia, as shown in Map 3-1.



Map 3-1 Location of the Little Rocky Run and Johnny Moore Creek watersheds shown in orange

Map 3-1 Location of the Little Rocky Run and Johnny Moore Creek watersheds shown in orange

The Little Rocky Run watershed encompasses 4,605 acres (7.2 square miles) and the Johnny Moore Creek watershed encompasses 3,374 acres (5.3 square miles). Both watersheds are located in the Piedmont physiographic province, a region characterized by gently rolling hills, deeply weathered bedrock and very little solid rock at the surface.

The Little Rocky Run and Johnny Moore Creek watersheds have been subdivided into watershed management areas (WMAs). The WMAs have been used to evaluate portions of the watershed with similar land use and development characteristics. The Little Rocky Run watershed is divided into three WMAs: Little Rocky Run-Upper, Little Rocky Run-Lower and Little Rocky Run-Bull Run. Johnny Moore Creek watershed is similarly divided into two WMAs, Johnny Moore Creek and Johnny Moore-Bull Run. Both Little Rocky Run-Bull Run and Johnny Moore-Bull Run are small areas that drain directly to Bull Run; these two WMAs have no significant development, and no projects are identified for these WMAs in this watershed management plan. Map 3-2 shows the locations of the WMAs used for Little Rocky Run and Johnny Moore Creek.

3.2 Land Use in the Watersheds

On July 26, 1982, the Fairfax County Board of Supervisors approved a rezoning of 40,700 acres in the Occoquan watershed, which includes the Johnny Moore Creek watershed and a portion of the Little Rocky Run watershed, in order to protect the Occoquan Reservoir, which supplies drinking water to the County. Land in the rezoned area is classified as a Residential-Conservation (R-C) District, designating a maximum density of one dwelling unit per five acres. The entire Johnny Moore Creek watershed is located in the R-C District. The portion of Little Rocky Run south of Compton Road, and the area south of Braddock Road and east of Union Mill Road, are in the R-C District. The Little Rocky Run watershed consists primarily of open space, residential development and roadways. Existing and Future Land Use Maps for both watersheds are shown in Map 3-3.

3.3 Modeling Results

Table 3-1 provides a summary of runoff peak values and pollutant loadings at the outlet of each WMA. The bottom portion of the table contains values adjusted to account for the size of each WMA.

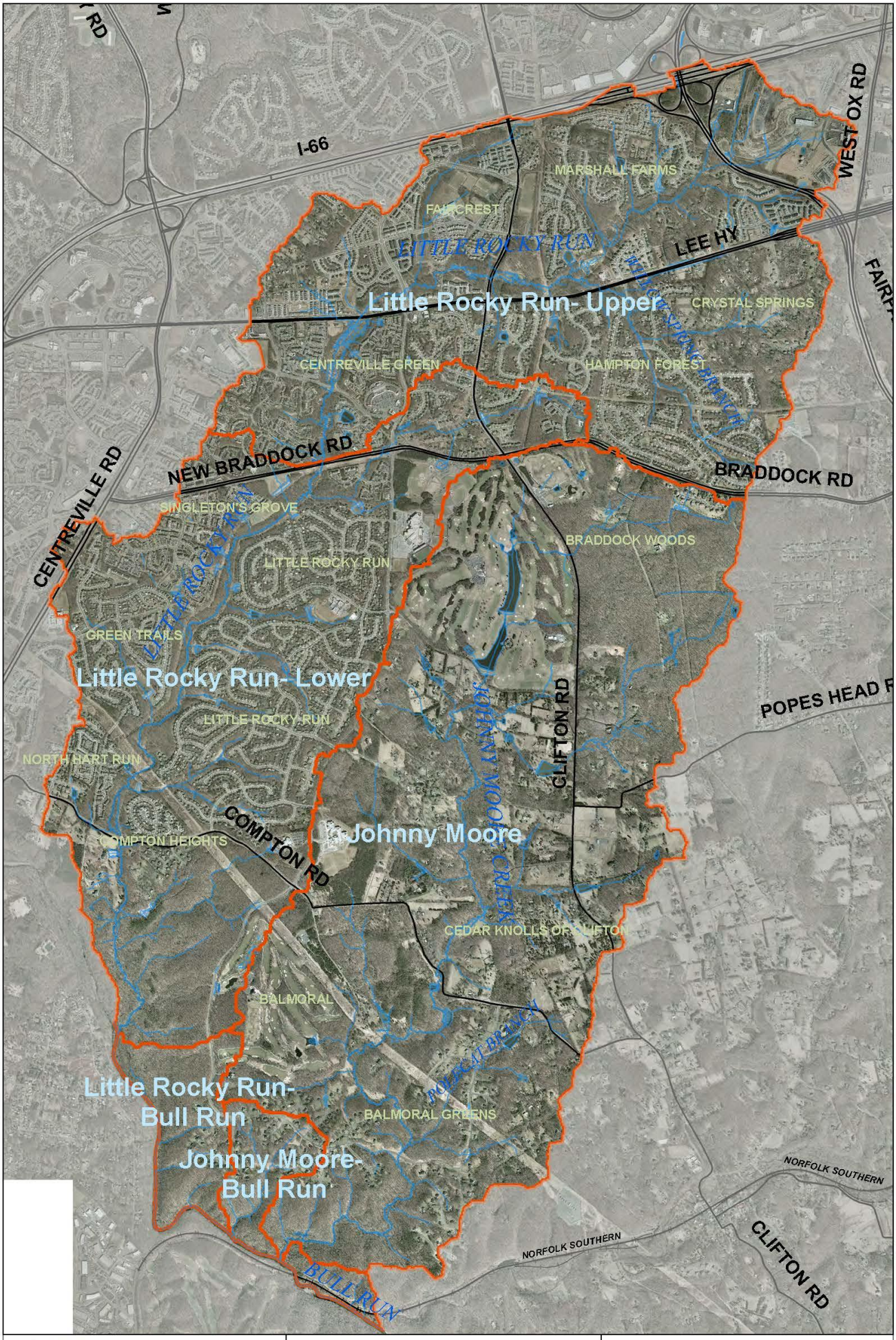
Table 3-1 WMA Stormwater Peak Values and Pollutant Loadings

WMA	Stormwater Runoff Peak Values		Pollutant Loadings		
	2-yr storm (cfs)	10-yr storm (cfs)	TSS (tons/yr)	TN (lbs/yr)	TP (lbs/yr)
Johnny Moore Creek	509	1455	398.4	6444.1	1173.2
Little Rocky Run - Lower	667	1853	174.3	11799.8	1472.0
Little Rocky Run - Upper	330	944	267.0	10694.0	1531.1
Values per WMA Acreage					
WMA	**Stormwater Runoff Peak Values**		**Pollutant Loadings**		
	2-yr storm (cfs/acre)	10-yr storm (cfs/acre)	TSS (tons/acre/ yr)	TN (lbs/acre/ yr)	TP (lbs/acre/ yr)
Johnny Moore Creek	0.15	0.43	0.12	1.91	0.35
Little Rocky Run - Lower	0.30	0.84	0.08	5.34	0.67
Little Rocky Run - Upper	0.14	0.41	0.11	4.59	0.66

The water quality analysis is driven by land use and the results reflect the different levels of development and stormwater controls in place in the three WMAs. Johnny Moore Creek, with less impervious areas and more natural cover, contributes fewer pounds per year of the selected pollutants than the WMAs in the Little Rocky Run watershed. There are a number of private facilities such as the ponds at the Twin Lakes Golf Course that enhance water quality treatment in the Johnny Moore Creek watershed, though not by design. Stormwater controls are sparsely located throughout the watershed because much of the single lot development that occurred was constructed without stormwater controls. Based on the requirements in place at the time of development, stormwater management may not have been required or stormwater management requirements may have been waived. This watershed is in relatively healthy condition and needs to be protected; even modest changes in land use should be addressed using stormwater controls.

Little Rocky Run – Lower is a non-homogenous management area. The lower portion of the watershed is primarily open space or part of the R-C District and therefore produces low levels of pollutants. The rest of the WMA contains significant medium- and high-density residential areas and therefore pollutant loading estimates increase. Areas with more impervious areas and small or non-existent buffer areas will generate more pollutants than undisturbed areas, which is consistent with results. It should be noted that there are few expected changes in land use during future conditions for this WMA.

The subwatersheds located in the Little Rocky Run – Upper are producing relatively high pollutant loadings. The WMA is predominantly medium- to high-density residential and contains commercially zoned parcels as well. With more impervious areas and small or non-existent buffer areas, the results are consistent with expectations. The I-66 Transfer Station Complex is located in the headwaters of this WMA and is the only Virginia Pollutant Discharge Elimination System (VPDES) identified point source in the Little Rocky Run watershed. This WMA has undergone the most significant development over the past 10 years, owing to medium/high-density residential and commercial areas replacing open space and low-density residential areas. The field reconnaissance revealed that this system is still responding to these recent changes.


I-66
WEST OX RD
MARSHALL FARMS
FAIRCREST
LITTLE ROCKY RUN
LEE HY
Little Rocky Run- Upper
CRYSTAL SPRINGS
CENTREVILLE GREEN
HAMPTON FOREST
CENTREVILLE RD
NEW BRADDOCK RD
BRADDOCK RD
SINGLETON'S GROVE
BRADDOCK WOODS
LITTLE ROCKY RUN
GREEN TRAILS
Little Rocky Run- Lower
POPES HEAD R
CLIFTON RD
NORTH HART RUN
COMPTON RD
COMPTON HEIGHTS
Johnny Moore
CEDAR KNOLLS OF CLIFTON
BALMORAL
Little Rocky Run-
Bull Run
BALMORAL GREENS
Johnny Moore-
Bull Run
NORFOLK SOUTHERN
BULL RUN
0
1,000
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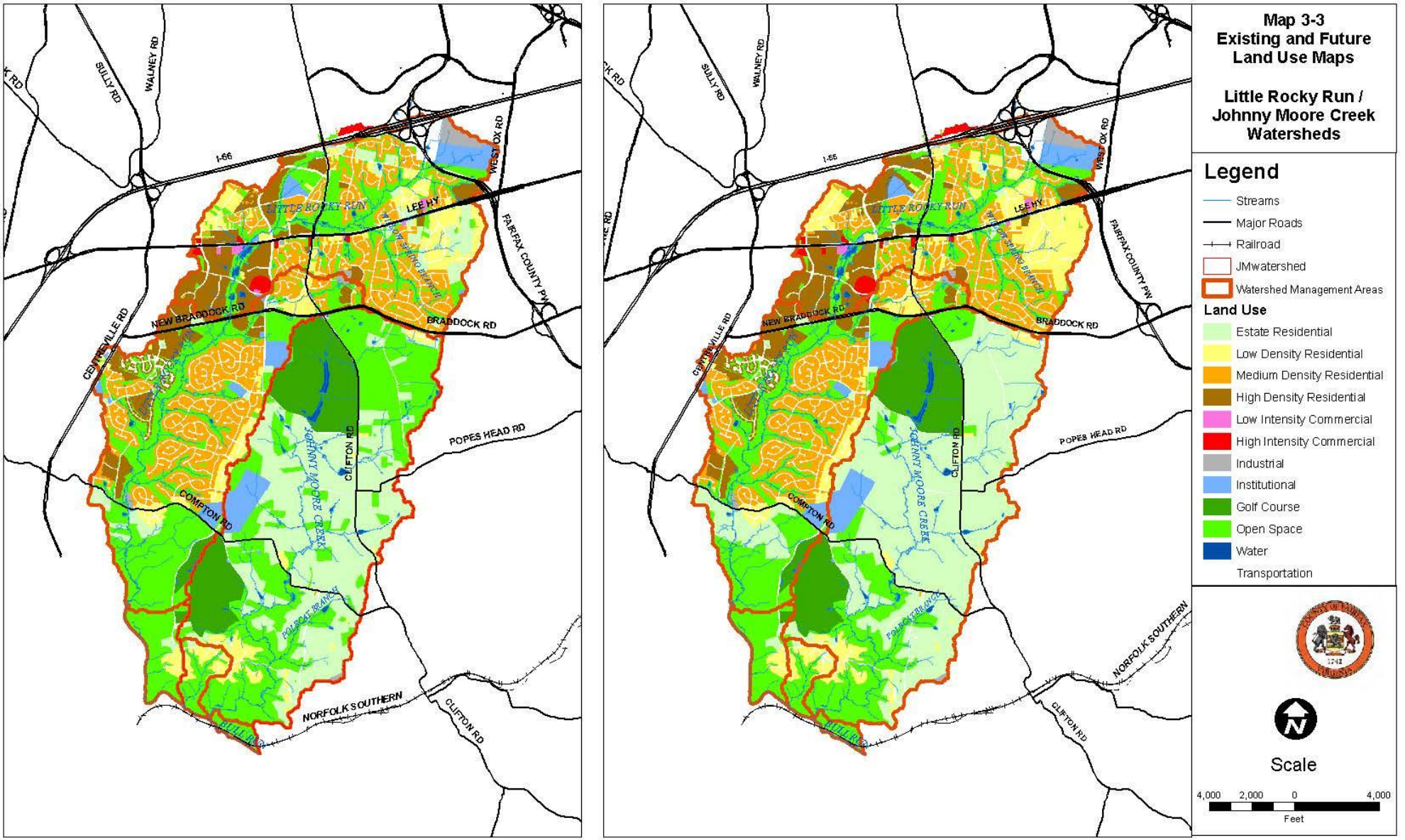
Feet
Streams
Watershed Management Areas
Major Roads
Railroad
Map 3-2
Watershed Management Areas
Little Rocky Run / Johnny Moore Creek

Map 3-3: Existing and Future Land Use

Existing Conditions Land Use Map

Future Conditions Land Use Map



The hydraulic modeling results are summarized as follows:

Johnny Moore Creek:

- Three stream road crossings in the watershed do not have the capacity to pass the 10-year storm without the road being overtopped.
- The 2-year storm exceeds the channel banks in several locations.
- There are seven structures located within the modeled 100-year flood inundation zone.

Little Rocky Run – Lower:

- One of three road crossings identified for analysis does not have the capacity to pass the 10-year discharge.
- The 2-year discharge exceeds the channel banks in several locations.
- There are seven structures located within the modeled 100-year flood inundation zone.

Little Rocky Run – Upper:

- Three of 10 road crossings identified for analysis in the watershed do not have the capacity to pass the 10-year discharge.
- The 2-year discharge exceeds the channel banks in several locations.
- There are 13 structures located within the modeled 100-year flood inundation zone.

3.4 Other Studies and Field Reconnaissance

Fairfax County has collected data on its watersheds for over 20 years. These data were compiled and served as source data for the development of this Watershed Management Plan. The County Stream Physical Assessment (SPA) conducted in 2005 provided invaluable information about the habitat and problem areas in the watershed. Field reconnaissance was also conducted in June 2008 to gather more detailed information about existing stormwater infrastructure and previously identified problem areas. The reconnaissance effort included the identification of pollution sources, current stormwater management practices and potential restoration opportunities throughout the watersheds. Typical sites visited included problem areas identified in the SPA, existing stormwater ponds and other stormwater management facilities to identify their retrofit potential, and other sites identified through the public forum, WAG meetings and a review of drainage complaints. More detailed information about the SPA and field reconnaissance results in each WMA can be found in Appendix A.

3.5 Subwatershed Ranking

A detailed subwatershed ranking was conducted using the process described in Section 2. More detailed scoring information is provided in Appendix B.

The Johnny Moore Creek WMA contains mostly high-quality subwatersheds. The main stressors in this WMA come from two golf courses, which tend to result in higher pollutant loadings while also having a negative impact on natural stream buffers. Also, as noted in the SPA and in the field reconnaissance, there are many gulley formations and unstable banks throughout this watershed, which will increase sediment load, impacting aquatic life. Otherwise, this watershed is of higher quality than its Little Rocky Run counterparts because of significant land use differences. The predominantly low-density residential and open space land use in the watershed provides some protection of stream health.

Little Rocky Run - Lower is the only WMA where subwatershed ranking results are not homogenous. The northern portion of this WMA has similar characteristics to Little Rocky Run - Upper. A sizeable area in the southern portion of the WMA is located on Fairfax County Park Authority land and is therefore undisturbed or very nearly so. These subwatersheds are generally of high quality.

The northern portion of Little Rocky Run - Lower is predominantly comprised of medium and high density residential development. The stream corridor remains forested, but buffers have been impacted by the development. Unlike Little Rocky Run - Upper, most of the development occurred nearly two decades ago, allowing for the system to stabilize. This portion of Little Rocky Run - Lower is relatively built out and was fairly stable between the 2005 SPA and the 2008 field reconnaissance. This stability in land use, along with the fact that there is no VPDES point source or commercial/industrial land use, may explain why the quality of the subwatersheds in this WMA rated slightly higher on average than those in the Little Rocky Run - Upper WMA.

Little Rocky Run - Upper contains the majority of 'low-quality' subwatersheds. The indicator measurements are consistent with a nearly built-out watershed, showing that riparian, wetland and terrestrial forested habitat have been compromised and pollutant loads are relatively high. Little Rocky Run - Upper contains the highest percentage of medium- and high-density residential, commercial/industrial and impervious surfaces, as well as the only VPDES-permitted point source. It contains all but two of the lowest quality subwatersheds.

4. Watershed Restoration Strategies

Strategies for restoration of the watershed were presented to the Watershed Advisory Group (WAG) and were condensed into categories:

- Stream/Buffer Restoration
- Pond Retrofits
- New Stormwater Management (SWM) Facilities – includes Low Impact Development (LID) Techniques, Ponds, Culvert Retrofits, Outfall Treatment
- Flooding Mitigation

Table 4-1 shows the relationship between the County's objectives and the restoration strategies.

Table 4-1 Restoration Strategies

	Restoration Strategies			
County Objectives	**Stream/ Buffer Restoration**	**Pond Retrofits**	**New SWM Facilities**	**Flooding Mitigation**
Minimize impacts of stormwater runoff on stream hydrology to promote stable stream morphology, protect habitat and support biota	■	■	■	
Minimize flooding to protect property, human health and safety				■
Provide for healthy habitat through protecting, restoring, and maintaining riparian buffers, wetlands and instream habitat	■			
Improve and maintain diversity of native plants and animals in the County	■			
Minimize impacts to stream water quality from pollutants in stormwater runoff		■	■	
Minimize impacts to drinking water sources from pathogens, nutrients and toxics in stormwater runoff		■	■	
Minimize impacts to drinking water storage capacity from sediment in stormwater runoff	■	■	■	
Encourage the public to participate in watershed stewardship	■	■	■	■
Coordinate with regional jurisdictions on watershed management and restoration efforts such as Chesapeake Bay initiatives	■	■	■	■
Improve watershed aesthetics in Fairfax County	■	■	■	■

The restoration strategies encompass many different project types. Table 4-2 provides a summary of project types for each restoration strategy.

Table 4-2 Project Types

Restoration Strategy	Project Type
Stream/Buffer Restoration	Stream/Bank Stabilization Stream Realignment Pipe Outfall Stabilization Buffer Reforestation
Pond Retrofits	Regrade pond to provide more storage Remove concrete trickle ditches Redesign pond to include micropools and wetland areas Redesign quantity-only ponds to provide water quality storage
New SWM Facilities	Bioretention areas Vegetated swales Green roofs Underground storage Manufactured BMPs Stormwater Ponds – extended detention dry ponds, wet ponds Constructed wetlands Tree box filters Rain barrel programs
Flooding Mitigation	Resize road crossing structures to convey design discharge Floodproof or purchase structures located in the floodplain

4.1 Watershed Project Descriptions

Many types of structural and non-structural projects are recommended in the watershed management plan. Structural projects involve some construction to implement. Non-structural projects include watershed approaches that do not involve construction, such as buffer restoration, turf management programs, rain barrel programs, public education programs, stream cleanups and parking lot/street sweeping programs.

Descriptions of the various structural project types considered are provided below.

4.1.1 Structural Practices

Stormwater Pond Retrofit
Pond retrofit options that may be suitable for implementation include: • Increasing detention storage by additional excavation and grading/embankment modifications. • Providing water quality improvements to facilities that provide only water quantity control. These facilities could be retrofitted for water quality treatment by installing a micropool, sediment forebay, constructed stormwater wetland or by increasing the riparian buffer. • Modifying or replacing the existing riser structure and outlet controls to reduce the discharge rate from the stormwater management facility. A riser is a structure, typically made of concrete with a metal grate on top, which controls the level of water in the stormwater pond. • Adding other water quality features to enhance the existing pond such as wetland plantings, micropools and sediment forebays. The flow path through the pond can be increased to extend the opportunity for nutrient uptake.

Stormwater Pond Retrofit Project Example:
Braddock Forest Pond 0718DP District: Braddock Watershed: Popes Head Creek
stormwater pond retrofit exampleA Maintenance and Stormwater Management Division Project

PRE-CONSTRUCTION
Problematic Conditions: Stormwater Pond was non-functional due to deterioration of control structures and depleted storage volume.

CONSTRUCTION
Key Project Elements: The height of the dam was increased, new control structures were installed, and a marsh was excavated in the pond floor.

POST-CONSTRUCTION
The pond has been seeded with an approved wetland seed mix and is currently stabilizing. Once it is stable the control devices (BMP plate and Trash Rack) will be installed.

Culvert Retrofit
There are two types of culvert retrofits: one to modify the culvert to address the culvert capacity and road flooding, and another to retrofit the upstream side of the culvert to provide stormwater management. This stormwater retrofit option is installed upstream from existing road culverts by constructing a control structure and excavating a micropool. These projects are designed for intermittent or ephemeral streams. The control structure will consist of a gabion weir that will detain and reduce stormwater flow; the micropool is a small pool that allows infiltration of stormwater runoff, improving water quality.

Culvert Retrofit Example:

Source: Center for Watershed Protection: Urban Stormwater Retrofit Practices Version 1.0, August 2007

Tree Box Filters
Tree box filters allow stormwater to flow through a specially designed filter mixture contained in a landscaped concrete container. The mixture immobilizes pollutants; those pollutants are then decomposed, volatilized and incorporated into the biomass of the tree box filter. Stormwater runoff flows through the media and into an underdrain system at the bottom of the container, where the treated water is discharged. They are useful on highly developed sites such as parking lots and streetscapes.

Tree Box Filter Example:

Low Impact Development (LID)
LID is an approach that duplicates the original hydrology of the watershed and is based on five basic principles: • Conservation and minimization • Storage • Conveyance • Landscaping • Infiltration LID is a lot-level approach to stormwater management with the goal of infiltrating the water on site. LID techniques include bioretention areas, vegetated swales, infiltration trenches, pervious pavement, green roofs and rain barrels.

LID Project Example:

Rain Garden, Porous Pavement and Stormwater Storage System **Watershed: Accotink**
Providence Fire Station 30

PRE-CONSTRUCTION
Problematic Conditions:
Stormwater from impervious surfaces lacked quality and quantity treatment. Installation of a rain garden (bioretention basin) provides for water quality treatment and groundwater recharge through infiltration. The porous pavement provides for greater infiltration of runoff.

CONSTRUCTION
Key Project Elements:
Stormwater runoff is treated by rapid filtering through bioretention soil media, biological and biochemical reactions within the soil matrix and around the root zones of the plants, and infiltration into the underlying soil strata.

POST-CONSTRUCTION
The rain garden was planted with a combination of native trees, shrubs and herbaceous plants that provide nutrient uptake and an aesthetic benefit. The plantings also provide habitat for organisms like birds and butterflies.

Stream Restoration/Stabilization
Natural stream restoration utilizes bioengineering techniques to develop self-sustaining solutions that allow for adjustments over time. These projects incorporate living material into the solution and minimize the use of concrete or stone. Stream restoration is most applicable in a watershed with a stable land use so that the flow rate in the stream is unlikely to increase substantially. The stream restoration designs endeavor to encompass the entire stream reach, rather than apply a band-aid approach to a specific problem area.

Stream Restoration Project Example:
Stream Restoration/Outfall Improvement **District: Mount Vernon** **Watershed: Little Hunting Creek**

PRE-CONSTRUCTION
Problematic Conditions: Large quantities of uncontrolled stormwater caused bank erosion, tree loss and negative impacts to aquatic life.

CONSTRUCTION
Key Project Elements: The eroded stream was filled with suitable material to reconnect the channel to the natural floodplain. The project was designed using "natural stream restoration techniques" which aim at creating habitat for native wildlife.

POST-CONSTRUCTION
The stream was restored to a more natural design. A riparian seed mix and native trees were planted on impacted areas of the site. Continued monitoring of the vegetation and structures (cross veins, log jams, etc.) will occur. Ideally, aquatic organisms will re-inhabit the restored reach.

4.1.2 Non-Structural Practices

Non-structural projects are projects that do not require traditional construction measures to be implemented and may be programmatic in nature. These projects include but are not limited to the following practices:

- Buffer restorations
- Rain barrel programs
- Dumpsite and obstruction removals
- Community outreach and public education
- Land conservation coordination projects
- Inspection and enforcement projects
- Street sweeping programs
- Recommendation of additional studies, surveys and assessments

These projects, in concert with the structural projects, represent a holistic approach to watershed management. Since much of the land area in Fairfax County is privately owned, there is a strong need to work with local communities to promote environmental awareness and recommend projects that can be implemented by residents and other groups.

The fundamental difference between structural and non-structural projects is the ability to predict the result of the project implementation through models. For example, the nitrogen removal of a wet pond may be calculated; however, there is no way to predict the reduction in nitrogen from an outreach campaign on proper fertilizer use. Additionally, these projects and programs should not be confined to any single watershed but could be implemented throughout the County as opportunities occur. Because of these differences, non-structural projects were evaluated and will be implemented using a different process than the structural projects.

There are many advantages of non-structural projects. Some of the key advantages to this projects type are:

- Less costly
- Less disruptive
- Promotes public and community awareness

In general, non-structural projects represent opportunities to proactively pursue stormwater issues that more traditional structural practices cannot address. The use of non-structural practices fulfills Fairfax County's MS4 permit requirements and environmental initiatives. The full potential of these projects will be realized through partnerships with County agencies, residents and other interested parties.

A description of a buffer restoration non-structural project type is provided below.

Buffer Restoration
Buffer restoration involves planting of trees and other riparian vegetation to improve the habitat and quality of the stream corridor. A robust stream buffer provides wildlife habitat, pollution control and protection from stream bank erosion. Riparian forests also provide shade cover that cools water temperatures. These projects can be performed by volunteers if needed.

Buffer Restoration Project Example:
Noman M. Cole Pollution Treatment Plant **Watershed: Pohick Creek**

PRE-CONSTRUCTION
Problematic Conditions:
Lack of a native riparian buffer decreases the amount of rain that infiltrates into the groundwater and increases the amount of pollutants that enter our waterways.

CONSTRUCTION
Key Project Elements:
Establishing a native riparian buffer will reduce the amount of stormwater entering streams and filter nonpoint source pollutants. Educating residents on the importance of riparian buffers is key to the success of the planting. This site had 1005 trees and shrubs planted by 180 volunteers over two days.

POST-CONSTRUCTION
Future monitoring and maintenance is required to ensure survival of the plants. When mature, this area will provide a balanced ecosystem that will help reduce stormwater impacts and create habitat for wildlife.

4.2 Candidate Project Selection Procedure

The watersheds were analyzed using the subwatershed ranking results. Subwatersheds with a poor overall composite score are likely to be deficient for at least one, if not more, County-defined objectives. The individual objectives were analyzed more closely to determine those which were not being achieved. Each objective score is comprised of a combination of individual metrics. Those metrics contributing to a poor objective score helped define the strategy for that particular subwatershed, as well as bringing to light potential project sites. A similar technique was used when evaluating potential stressors. Initially, the overall source composite score was considered in order to address subwatersheds clearly contributing to watershed degradation, but individual source metrics also were analyzed to ensure that any specific stressors were identified.

To develop projects, the subwatershed ranking results were used in combination with 'severe' SPA inventory points, concerns identified by both the WAG and the public forum, and sites discovered during the field reconnaissance. Considering the relatively small size of the watersheds being analyzed, threshold values were not established for strategy development. In other words, candidate projects were considered in all subwatersheds to address identified deficiencies, not just in the subwatersheds that ranked poorly. With only three fairly homogenous WMAs and a majority of subwatersheds classified as headwaters, all 52 subwatersheds were analyzed for their restoration/protection potential using this procedure. A handful of subwatersheds failed to meet several County objectives in the existing or future 'without project' conditions and were slated as target subwatersheds.

A 'project universe' of nearly 150 candidate projects was compiled as a result of this analysis. The procedure for this analysis is described in greater detail in Appendix B.

Field investigation of the candidate projects was conducted in June 2009 to evaluate feasibility and to gather other data such as site conditions, site constraints and potential construction considerations. Field staff noted any recommendations for the project and evaluated the feasibility of the project. Factors affecting feasibility included construction access, permitting issues, land ownership, utility conflicts, the topography of the site and other impacts on the stream, wetlands, trees or floodplain. Following the field investigation, 82 projects were selected for further prioritization and ranking (Section 4.3). Some of the projects were combined into one project based on their cost and proximity.

4.3 Regional Ponds in the Watershed

There were 13 regional ponds recommended in the Little Rocky Run watershed in the County's Regional Stormwater Management Plan, dated January 1989. Nine of the 13 regional ponds have been constructed to date. The remaining four unconstructed regional ponds (R-5, R-10, R-12 and R-13) were analyzed and a brief summary of the recommendations for each regional pond area is presented below:

> **Regional Pond R-5:** This pond is located in an area owned by the Green Trails Homeowners Association (HOA) in subwatershed LR-LR-0010. Two dry ponds have been constructed upstream of the regional pond site, providing water quality and quantity control for 64% of the regional pond drainage area. The proposed alternatives include providing treatment for two untreated storm sewer systems and retrofitting pond 0829DP to enhance the pollutant removal efficiency.
>
> **Regional Pond R-10:** This regional pond site is located on several large residential properties in subwatershed LR-WS-0005. Regional pond R-19 has been constructed and is located downstream of the Pond R-10 site. The feasibility of constructing pond R-10 is low because of the private property issues involved. The low density of the development upstream of the proposed regional pond site does not appear to warrant two regional ponds in series. The proposed alternatives include buffer restoration upstream of the regional pond site and retrofitting Pond R-19 to enhance the pollutant removal efficiency.

Regional Pond R-12: This regional pond site is located on VDOT property near the intersection of the Fairfax County Parkway and Interstate 66. Although a regional pond was not constructed by the County, there is a VDOT pond (VDOT29016) at the site of Regional Pond R-12. This VDOT pond is providing treatment for the entire 46 acre subwatershed. There is another VDOT pond (VDOT29017) just south of VDOT29016 that is treating additional road drainage. These ponds provide the treatment originally proposed in Regional Pond R-12.

Regional Pond R-13: This proposed regional pond is located on private residential property in subwatershed LR-LR-0013. Regional Pond R-11 has been constructed upstream of the site. The feasibility of constructing this pond is low because of its location on private property and space and topography constraints. Four dry ponds have been constructed in the drainage area of Pond R-13. There is also an inline pond (0586DP) downstream of the R-13 site that provides treatment to the R-13 drainage area. The proposed alternatives include stream restoration of an eroded area downstream of Old Clifton Road, buffer restoration, new stormwater management of an untreated system and retrofitting pond 0586DP to enhance the pollutant removal efficiency.

More information is provided in Appendix B and the project fact sheets in Section 5.

4.4 Project Ranking and Prioritization

Seventy-five structural projects and seven non-structural projects were prioritized according to the criteria described below. The top 40 structural projects are categorized as part of the 10-year implementation plan and are supported with Project Fact Sheets in Section 5. The remaining 35 structural projects complete the project proposals for the 25-year implementation period.

The baseline ranking process consisted of setting values in five categories that, when scored according to the County's weighting system, resulted in a preliminary project score. The five categories are:

1. Effect on Watershed Impact Indicators (30 percent)
2. Effect on Source Indicators (30 percent)
3. Location within Priority Subwatersheds (10 percent)
4. Sequencing (20 percent)
5. Implementability (10 percent)

Structural candidate projects were scored from 1 to 5 points in each category, with 5 points representing the highest priority and 1 point representing the lowest priority. A brief synopsis of how scores were developed for each category is provided below. More detail about the ranking process can be found in technical memorandum 3.4/3.5 located in Appendix B.

4.4.1 Watershed Impact Indicators

Each project type was associated with specific watershed impact indicators (described in Section 2). Using modeling results where applicable, a project received a score of five for the greatest positive change in a particular indicator. The individual indicator scores were averaged to determine a project score for 'effect on watershed impact indicators'. Some indicators were based on the County's monitoring information and were not part of any model output, allowing for only a 'snapshot' evaluation. Best professional judgment was employed to determine whether a particular project type would address the nutrient or indicator of concern.

4.4.2 Source Indicators

A methodology similar to that used in evaluating impact indicators was used to determine a score for a project's effect on source indicators (also described in Section 2). Where modeling results were available, they were used to assign higher scores for projects with the greater positive influence on a particular indicator. Source indicator analysis helps to focus in on the cause of watershed degradation, but the source

(or cause) may not be located in the same subwatershed as the impact (or effect). Areas that appear stable may be exacerbating conditions further downstream, commonly seen in streambank erosion along Little Rocky Run and Johnny Moore Creek. While the location of the downcutting/widening channel may be in the middle of an undeveloped subwatershed, the development in headwater areas is a likely culprit. Projects tend to be more expensive and complex further downstream; therefore, if an impact is addressed without paying attention to the cause, it may result in a costly temporary solution. Individual source indicator scores were averaged to determine a final score.

4.4.3 Location within Priority Subwatersheds

Candidate projects located within poor quality subwatersheds have the potential to provide a greater overall impact than a project located within a high quality subwatershed. Therefore, projects located in a poor quality subwatershed received a higher priority and a higher score than projects located in a high quality subwatershed. The quality score of the subwatersheds was based on the subwatershed ranking (see Section 2.3). A map of the priority subwatersheds is in Appendix B.

4.4.4 Sequencing

Sequencing scores were developed by first recording the upstream-downstream order of the subwatersheds. Headwaters subwatersheds (any subwatershed where a stream originates) were given an order of one. Subwatersheds just downstream of headwater subwatersheds were given an order of two. This process continued until all subwatersheds are assigned an order, with the most downstream subwatersheds receiving the highest value. Where subwatersheds of different orders were upstream of a single subwatershed, that subwatershed received the next sequentially highest order.

Once the subwatershed order was established, quintiles were used to assign a project score to each subwatershed order. Those with the lowest subwatershed order were given the highest project score (five). This provides priority to headwater projects and simulates a more natural watershed hydrology. A map of the sequencing scores is included in Appendix B.

4.4.5 Implementability

Scores were assigned according to the following criteria:

- High Implementability (5 points)
    - Tree buffer restoration
    - Debris/trash removal
    - SWM retrofits in County-maintained facilities where no additional land rights are required
    - Stream restorations that do not require upstream runoff quantity reductions and are proposed on sites with significant land owner support
    - LID retrofits at schools and other County facilities
    - Other priority projects that have significant land owner support
- Moderate Implementability (3 points)
    - Pond and LID retrofits and other stream restorations that do not require upstream runoff quantity reductions
- Low Implementability (1 point)
    - Projects that do not fit into the above categories and are likely to be less feasible than the majority of recommended projects

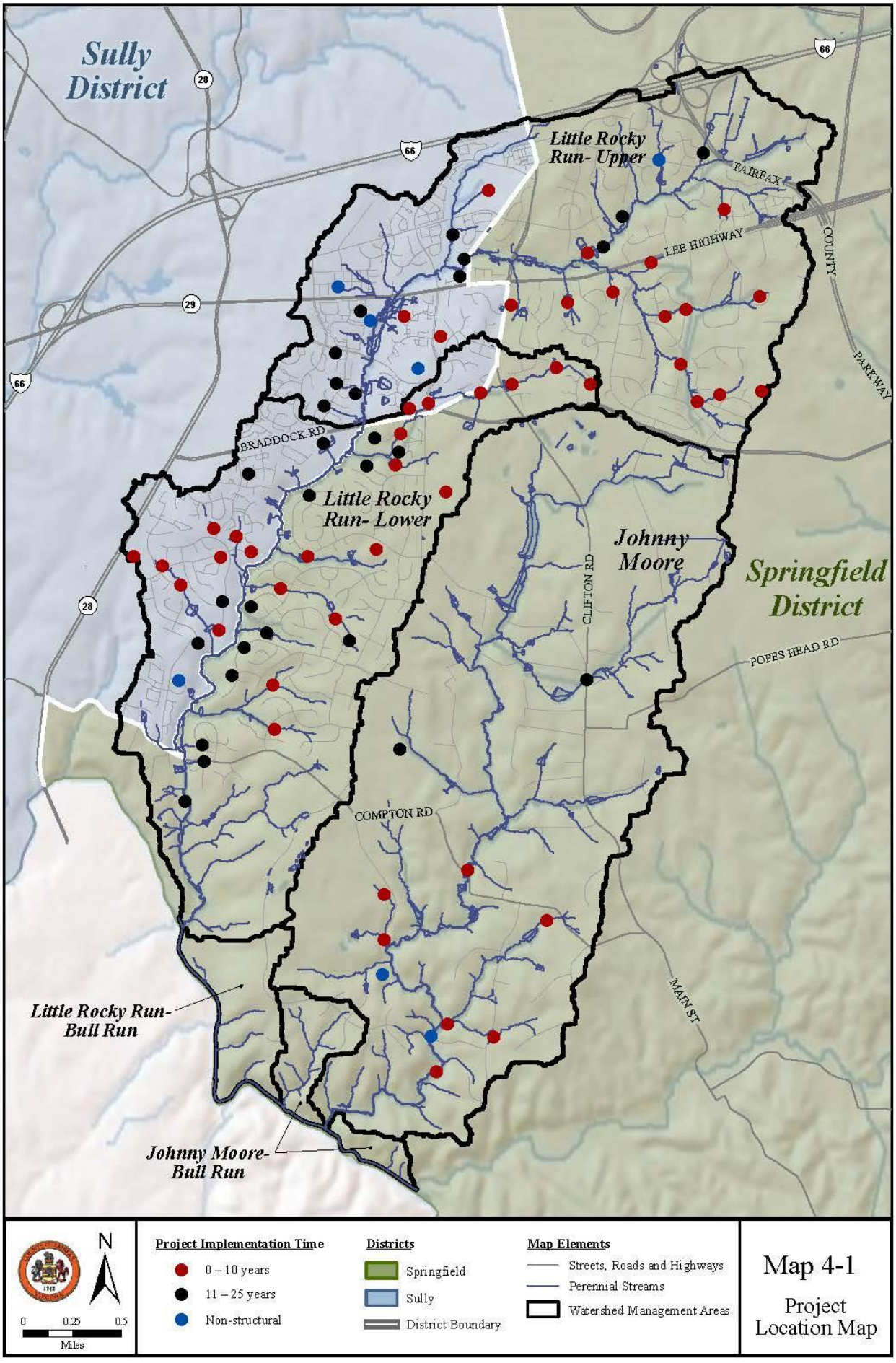
Project scores were developed based on the previously described weighting system. Using these scores, the 75 structural projects were prioritized from 1-75. Some slight adjustments were made based on input from the WAG. The scores also were adjusted based on completed hydrologic and hydraulic modeling of selected projects. The top 40 projects are part of the 10-year implementation timeframe, while the

remaining projects fall within the 25-year implementation period. Project fact sheets for the top 40 projects are located in Section 5.

4.5 Project List

Once the structural candidate projects were prioritized based on the ranking process, the final set of recommended projects and final ranking was adjusted utilizing a cost/benefit analysis. Table 4-3 presents a summary of the Priority (10-Year) Structural, Long-Term (25-Year) Structural, and Non-Structural projects for the Johnny Moore Creek, Little Rocky Run – Lower, and Little Rocky Run – Upper WMAs. Land owners for the projects include private commercial, private residential, Homeowners Association (HOA), Fairfax County Park Authority (FCPA), Fairfax County Public Schools (FCPS) and Virginia Department of Transportation (VDOT).

Map 4-1 shows the location of projects and Fairfax County Supervisor magisterial boundaries.


Sully District
Springfield District
Little Rocky Run- Upper
Little Rocky Run- Lower
Johnny Moore
Little Rocky Run- Bull Run
Johnny Moore- Bull Run
FAIRFAX COUNTY PARKWAY
LEE HIGHWAY
BRADDOCK RD
CLIFTON RD
POPES HEAD RD
COMPTON RD
MAIN ST
66
28
29
N
0 0.25 0.5
Miles
Project Implementation Time
0 – 10 years
11 – 25 years
Non-structural
Districts
Springfield
Sully
District Boundary
Map Elements
Streets, Roads and Highways
Perennial Streams
Watershed Management Areas
Map 4-1
Project Location Map

Priority Structural Projects (10-Year Implementation Plan)						
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**	**Cost**
JM9100	Stormwater Pond Retrofit	Johnny Moore Creek	7005 Union Mill Rd Clifton, VA 20124	Quality/ Quantity	Private Commercial	$ 200,000
JM9200	Stream Restoration	Johnny Moore Creek	13309 Balmoral Greens Av Clifton, VA 20124	Quality	FCPA	$ 770,000
JM9201	Stream Restoration	Johnny Moore Creek	13309 Balmoral Greens Av Clifton, VA 20124	Quality	FCPA	$ 420,000
JM9202	Stream Restoration	Johnny Moore Creek	7029 Union Mill Rd Clifton, VA 20124	Quality	FCPA, Private Residential	$ 320,000
JM9203	Stream Restoration	Johnny Moore Creek	13400 Compton Rd Clifton, VA 20124	Quality	Private Residential	$ 770,000
JM9400	Culvert Retrofit	Johnny Moore Creek	13165 Compton Rd Clifton, VA 20124	Flood	VDOT, Private Residential	$ 120,000
JM9500	BMP/LID	Johnny Moore Creek	7051 Balmoral Forest Rd Clifton, VA 20124	Quality/ Quantity	FCPA	$ 120,000
LR9005	Regional Pond Group	Little Rocky Run - Lower	6351 Littlefield Ct Centreville, VA 20121	Quality/ Quantity	HOA	$ 650,000
LR9010	Regional Pond Group	Little Rocky Run - Upper	5378 Harrow La Fairfax, VA 22030	Quality	HOA	$ 350,000
LR9013	Regional Pond Group	Little Rocky Run - Lower	13600 Wildflower La Clifton, VA 20124	Quality/ Quantity	HOA	$ 740,000
LR9100	Stormwater Pond Retrofit	Little Rocky Run - Lower	13943 Stonefield Dr Clifton, VA 20124	Quality	HOA	$ 100,000
LR9102	Stormwater Pond Retrofit	Little Rocky Run - Lower	6579 Rockland Dr Clifton, VA 20124	Quality/ Quantity	HOA	$ 220,000
LR9103	Stormwater Pond Retrofit Stream Restoration	Little Rocky Run - Lower	13815 Springstone Dr Clifton, VA 20124	Quality	HOA	$ 560,000
LR9106	Stormwater Pond Retrofit	Little Rocky Run - Lower	13534 Union Village Ci Clifton, VA 20124	Quality	HOA	$ 190,000
LR9109	Stormwater Pond Retrofit	Little Rocky Run - Upper	5064 Cavalier Woods La Clifton, VA 20124	Quality	HOA	$ 40,000
LR9110	Stormwater Pond Retrofit	Little Rocky Run - Lower	13214 Kilby Landing Ct Clifton, VA 20124	Quality	HOA	$ 120,000
LR9111	Stormwater Pond Retrofit	Little Rocky Run - Lower	13022 Cobble La Clifton, VA 20124	Quality	HOA	$ 100,000
LR9114	Stormwater Pond Retrofit	Little Rocky Run - Upper	13114 Blue Willow Pl Clifton, VA 20124	Quality/ Quantity	HOA	$ 60,000
LR9115	Stormwater Pond Retrofit	Little Rocky Run - Upper	5403 Willow Valley Rd Clifton, VA 20124	Quality/ Quantity	HOA	$ 290,000
LR9117	Stormwater Pond Retrofit	Little Rocky Run - Upper	12837 Lee Hy Fairfax, VA 22030	Quality	Private Residential	$ 40,000

Priority Structural Projects (10-Year Implementation Plan)						
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**	**Cost**
LR9201	Stream Restoration	Little Rocky Run - Lower	14104 Sorrel Chase Ct Centreville, VA 20121	Quality	HOA	$ 830,000
LR9202	Stream Restoration	Little Rocky Run - Lower	6419 Stonehaven Ct Clifton, VA 20124	Quality	HOA	$ 820,000
LR9203	Stream Restoration	Little Rocky Run - Lower	14100 Wood Rock Wy Centreville, VA 20121	Quality	HOA	$ 310,000
LR9204	Stream Restoration	Little Rocky Run - Lower	5587A Rockpointe Dr Clifton, VA 20124	Quality	HOA	$ 110,000
LR9205	Stream Restoration	Little Rocky Run - Upper	5217 Whisper Willow Dr Fairfax, VA 22030	Quality	FCPA	$ 510,000
LR9207	Stream Restoration	Little Rocky Run - Upper	5378 Ashleigh Rd Fairfax, VA 22030	Quality	HOA	$ 650,000
LR9208	Stream Restoration	Little Rocky Run - Upper	5418 Ashleigh Rd Fairfax, VA 22030	Quality	HOA	$ 800,000
LR9209	Stream Restoration	Little Rocky Run - Upper	12753 Ashleigh Ct Fairfax, VA 22030	Quality	HOA	$ 380,000
LR9504	BMP/LID	Little Rocky Run - Lower	13916 Rock Brook Ct Clifton, VA 20124	Quality	HOA	$ 80,000
LR9508	BMP/LID	Little Rocky Run - Lower	6612 Creek Run Dr Centreville, VA 20121	Quality	HOA, VDOT	$ 90,000
LR9509	BMP/LID	Little Rocky Run - Lower	6600 La Petite Pl Centreville, VA 20121	Quality/ Quantity	HOA	$ 140,000
LR9510	BMP/LID	Little Rocky Run - Lower	14330 Green Trails Bv Centreville, VA 20121	Quality	FCPS	$ 260,000
LR9514	BMP/LID	Little Rocky Run - Lower	13611 Springstone Dr Clifton, VA 20124	Quality	FCPS	$ 100,000
LR9516	BMP/LID	Little Rocky Run - Lower	6001 Union Mill Rd Clifton, VA 20124	Quality	FCPS	$ 330,000
LR9521	BMP/LID	Little Rocky Run - Upper	13516 Canada Goose Ct Clifton, VA 20124	Quality	HOA	$ 180,000
LR9522	BMP/LID	Little Rocky Run - Upper	13340 Leland Rd Centreville, VA 20121	Quality	FCPS	$ 220,000
LR9523	BMP/LID	Little Rocky Run - Upper	13006 Feldspar Ct Clifton, VA 20124	Quality	HOA	$ 510,000
LR9524	BMP/LID	Little Rocky Run - Upper	5355 Ashleigh Rd Fairfax, VA 22030	Quality	HOA	$ 210,000
LR9526	BMP/LID	Little Rocky Run - Upper	4864 Muddler Way Fairfax, VA 22030	Quality	HOA	$ 130,000
LR9527	BMP/LID	Little Rocky Run - Upper	5400 Willow Springs School Rd Fairfax, VA 22030	Quality	FCPS	$ 130,000
						$12,970,000

Long Term Structural Projects (25 Year Implementation Plan)					
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**
JM9101	Stormwater Pond Retrofit	Johnny Moore Creek	6801 Union Mill Rd Clifton, VA 20124	Quality	FCPS
JM9700	Outfall Improvement	Johnny Moore Creek	6301 Clifton Rd Clifton, VA 20124	Quality	VDOT
LR9101	Stormwater Pond Retrofit	Little Rocky Run - Lower	13909 Warm Spring Ct Clifton, VA 20124	Quality	HOA
LR9104	Stormwater Pond Retrofit	Little Rocky Run - Lower	13932 Preacher Chapman Pl Centreville, VA 20121	Quality	HOA
LR9105	Stormwater Pond Retrofit	Little Rocky Run - Lower	13801 Laura Ratcliff Ct Centreville, VA 20121	Quality	HOA
LR9107	Stormwater Pond Retrofit	Little Rocky Run - Upper	5901 Spruce Run Ct Centreville, VA 20121	Quality	HOA
LR9108	Stormwater Pond Retrofit	Little Rocky Run - Upper	13660 Forest Pond Ct Centreville, VA 20121	Quality	HOA
LR9112	Stormwater Pond Retrofit	Little Rocky Run - Upper	13270 Maple Creek La Centreville, VA 20120	Quality	HOA
LR9113	Stormwater Pond Retrofit	Little Rocky Run - Upper	5324 Sammie Kay La Centreville, VA 20120	Quality	HOA
LR9116	Stormwater Pond Retrofit	Little Rocky Run - Upper	5130 Myrtle Leaf Dr Fairfax, VA 22030	Quality	County
LR9200	Stream Restoration	Little Rocky Run - Lower	7014 Dalemar Dr Clifton, VA 20124	Quality	Private Residential
LR9206	Stream Restoration	Little Rocky Run - Upper	5112 Lincoln Dr Fairfax, VA 22030	Quality	FCPA
LR9500	BMP/LID	Little Rocky Run - Lower	6901 Newby Hall Ct Clifton, VA 20124	Quality	VDOT, Private Residential
LR9501	BMP/LID	Little Rocky Run - Lower	6818 Compton Heights Cr Clifton, VA 20124	Quality	HOA
LR9502	BMP/LID	Little Rocky Run - Lower	14024 Marblestone Dr Clifton, VA 20124	Quality	HOA, VDOT, Private Residential
LR9503	BMP/LID	Little Rocky Run - Lower	14100 Rock Canyon Dr Centreville, VA 20121	Quality	VDOT
LR9505	BMP/LID	Little Rocky Run - Lower	13933 Marblestone Dr Clifton, VA 20124	Quality	HOA, VDOT, Private Residential
LR9506	BMP/LID	Little Rocky Run - Lower	6596 Creek Run Dr Centreville, VA 20121	Quality	HOA, VDOT
LR9507	BMP/LID	Little Rocky Run - Lower	13930 South Springs Dr Clifton, VA 20124	Quality	HOA, VDOT
LR9512	BMP/LID	Little Rocky Run - Lower	13905 Springstone Dr Clifton, VA 20124	Quality	HOA, VDOT
LR9513	BMP/LID	Little Rocky Run - Lower	13671 Wildflower La Clifton, VA 20124	Quality	HOA, Private Residential

Long Term Structural Projects (25 Year Implementation Plan)					
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**
LR9515	BMP/LID	Little Rocky Run - Lower	13609 Bridgeland La Clifton, VA 20124	Quality	HOA, VDOT, Private Residential
LR9517	BMP/LID	Little Rocky Run - Lower	6021 Little Brook Ct Clifton, VA 20124	Quality	HOA
LR9518	BMP/LID	Little Rocky Run - Upper	13644 Barren Springs Ct Centreville, VA 20121	Quality	HOA
LR9519	BMP/LID	Little Rocky Run - Upper	5813 Rockdale Ct Centreville, VA 20121	Quality	HOA
LR9520	BMP/LID	Little Rocky Run - Upper	13660 Bayberry La Centreville, VA 20121	Quality	Private Residential
LR9525	BMP/LID	Little Rocky Run - Upper	4895 Annamohr Dr Fairfax, VA 22030	Quality	HOA, VDOT
LR9600	Flood Protection/Mitigation	Little Rocky Run - Upper	5416 Arrowhead Park Dr Centreville, VA 20120	Flood	Private Residential
LR9700	Outfall Improvement	Little Rocky Run - Lower	6436 Battle Rock Dr Clifton, VA 20124	Quality	HOA

Non-Structural Projects					
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**
JM8800	Buffer Restoration	Johnny Moore Creek	13309 Balmoral Greens Av Clifton, VA 20124	Quality	FCPA
JM8801	Buffer Restoration	Johnny Moore Creek	7404 Union Ridge Rd Clifton, VA 20124	Quality	FCPA, HOA
LR8800	Buffer Restoration	Little Rocky Run - Upper	12810 Westbrook Dr Fairfax, VA 22030	Quality	FCPA, HOA
LR9010A	Buffer Restoration	Little Rocky Run - Upper	12524 Chronical Dr Fairfax, VA 22030	Quality	Private Residential
LR9800	Outreach/Education	Little Rocky Run - Lower	14123 Compton Valley Wy Centreville, VA 20121	Quality	HOA
LR9801	Outreach/Education	Little Rocky Run - Upper	Bent Tree Apartments Centreville, VA 20121	Quality	Private Commercial, HOA
LR9802	Outreach/Education, Street Sweeping Program	Little Rocky Run - Upper	5702 Union Mill Rd Clifton, VA 20124	Quality	Private Commercial

5. WMA Restoration Strategies

Strategies for restoration of the watershed for each of the three major WMAs (Johnny Moore Creek, Little Rocky Run – Upper and Little Rocky Run – Lower) are detailed in the following sections. The two smaller WMAs in the watersheds, Little Rocky Run – Bull Run and Johnny Moore Creek – Bull Run, are mostly protected, with only a small percentage of low-density residential development, and have no restoration strategies proposed in this watershed management plan.

5.1 Johnny Moore Creek WMA

The Johnny Moore Creek WMA is located entirely within the County's R-C District for protection of the Occoquan Reservoir. The WMA consists primarily of estate residential development and open space. This WMA also includes most of the Twin Lakes and Westfields golf courses. Estate residential development in this WMA is expected to increase by 20 percent in the future. Existing stormwater treatment in the WMA covers approximately 10 percent of the area, due to the type and age of development. Several facilities in the WMA, such as golf course ponds and old farm ponds, provide some stormwater treatment although they were not designed for this purpose.

The County SPA completed in 2005 provided a categorization of the stream habitat summarized in Table 5-1. The channels were characterized primarily as actively widening with unstable stream banks. A map showing the results of the SPA in this WMA is located in Appendix A.

Table 5-1 Johnny Moore Creek Stream Habitat Ratings

Condition	Miles of Assessed Stream	Percent of Assessed Streams
Very Poor	0.1	1
Poor	1.8	15
Fair	7	60
Good	2.8	24
Excellent	0	0

Based on the subwatershed characterization, the Johnny Moore Creek WMA contains mostly high-quality subwatersheds. The main stressors in this WMA come from the two golf courses, which tend to have higher pollutant loadings and a negative impact on natural stream buffers. In general, this WMA is of higher quality than the Little Rocky Run WMAs because of the significant land-use differences.

5.1.1 Johnny Moore Creek Structural Projects (10-year Plan)

The 10-year structural priority projects recommended for the Johnny Moore Creek WMA are described below. More detailed fact sheets for these projects are provided in Section 5.4.

JM9100: Pond retrofit JM9100 addresses a pond that has fallen into disrepair and currently provides little to no detention or treatment. JM9100 calls for pond embankment repairs, new micropools and wetland plantings, and removal of debris downstream of the pond.

JM9200: Johnny Moore Creek suffers from severe bank erosion downstream of Balmoral Greens Avenue. Project JM9200 will restore the stream to a more stable, natural state to prevent future erosion and promote habitat health and diversity.

JM9201: Stream restoration project JM9201 addresses erosion in a tributary to Willow Spring Branch near the intersection of Balmoral Greens Avenue and Balmoral Forest Road. Project JM9201 will restore the stream to a more stable, natural state to prevent future erosion and promote habitat health and diversity.

JM9202: A tributary to Johnny Moore Creek that crosses Union Mill Road at its southern end suffers from erosion. Project JM9202 will restore the stream to a more stable, natural state to prevent future erosion and promote habitat health and diversity.

JM9203: Johnny Moore Creek suffers from moderate bank erosion at Compton Road Project JM9203 will restore the stream to a more stable, natural state to prevent future erosion and promote habitat health and diversity.

JM9400: Project JM9400 was based on comments regarding road flooding from the WAG. JM9400 will replace a culvert at Compton Road to alleviate the flooding issue.

JM9500: Project JM9500 is a culvert retrofit upstream of Balmoral Forest Road on Polecat Branch. The culvert retrofit will provide water quality treatment for an uncontrolled area.

5.1.2 Johnny Moore Creek Structural Projects (25-year Plan)

The 25-year structural priority projects recommended for the Johnny Moore Creek WMA are described below.

JM9101: Project JM9101 is located at Liberty Middle School and will retrofit an existing stormwater pond to provide improved water quality control. Existing concrete trickle ditches will be removed, and new micropools and wetland plantings will be added.

JM9700: Project JM9700 will improve an outfall at Clifton Road – this project was identified during the Stream Physical Assessment.

5.1.3 Johnny Moore Creek Non-Structural Projects

Non-structural projects recommended in the WMA include two buffer restoration projects listed below:

JM8800: This buffer restoration is located along Johnny Moore Creek at the Balmoral Greens Avenue crossing. Buffer restoration would improve the stream habitat and provide water quality benefits.

JM8801: This buffer restoration is located along Johnny Moore Creek and a tributary to Johnny Moore Creek south of the end of Union Ridge Road. Buffer restoration would improve the stream habitat and provide water quality benefits.

A list of all projects proposed for the WMA is shown in Table 5-2. Please note that only the 10-year priority projects have associated project fact sheets.

Table 5-2 Johnny Moore Creek Restoration Strategies

Structural Projects						
Project #	**Project Type**	**Subwatershed**	**Location**	**Watershed Benefit**	**Land Owner**	**Phase**
JM9100	Stormwater Pond Retrofit	JM-JM-0003	7005 Union Mill Rd Clifton, VA 20124	Quality/ Quantity	Private Commercial	0-10
JM9200	Stream Restoration	JM-JM-0001	13309 Balmoral Greens Av Clifton, VA 20124	Quality	FCPA	0-10
JM9201	Stream Restoration	JM-PC-0001	13309 Balmoral Greens Av Clifton, VA 20124	Quality	FCPA	0-10
JM9202	Stream Restoration	JM-JM-0003	7029 Union Mill Rd Clifton, VA 20124	Quality	FCPA, Private Residential	0-10
JM9203	Stream Restoration	JM-JM-0005	13400 Compton Rd Clifton, VA 20124	Quality	Private Residential	0-10
JM9400	Culvert Retrofit	JM-PC-0001	13165 Compton Rd Clifton, VA 20124	Flood	VDOT, Private Residential	0-10
JM9500	BMP/LID	JM-PC-0002	7051 Balmoral Forest Rd Clifton, VA 20124	Quality/ Quantity	FCPA	0-10
JM9101	Stormwater Pond Retrofit	JM-JM-0009	6801 Union Mill Rd Clifton, VA 20124	Quality	FCPS	11-25
JM9700	Outfall Improvement	JM-JM-0011	6301 Clifton Rd Clifton, VA 20124	Quality	VDOT	11-25
Non-Structural Projects						
Project #	**Project Type**	**Subwatershed**	**Location**	**Watershed Benefit**	**Land Owner**	
JM8800	Buffer Restoration	JM-JM-0001	13309 Balmoral Greens Av Clifton, VA 20124	Quality	FCPA	
JM8801	Buffer Restoration	JM-JM-0002	7404 Union Ridge Rd Clifton, VA 20124	Quality	FCPA, HOA	

Map 5-1 provides an overview of project types and locations.

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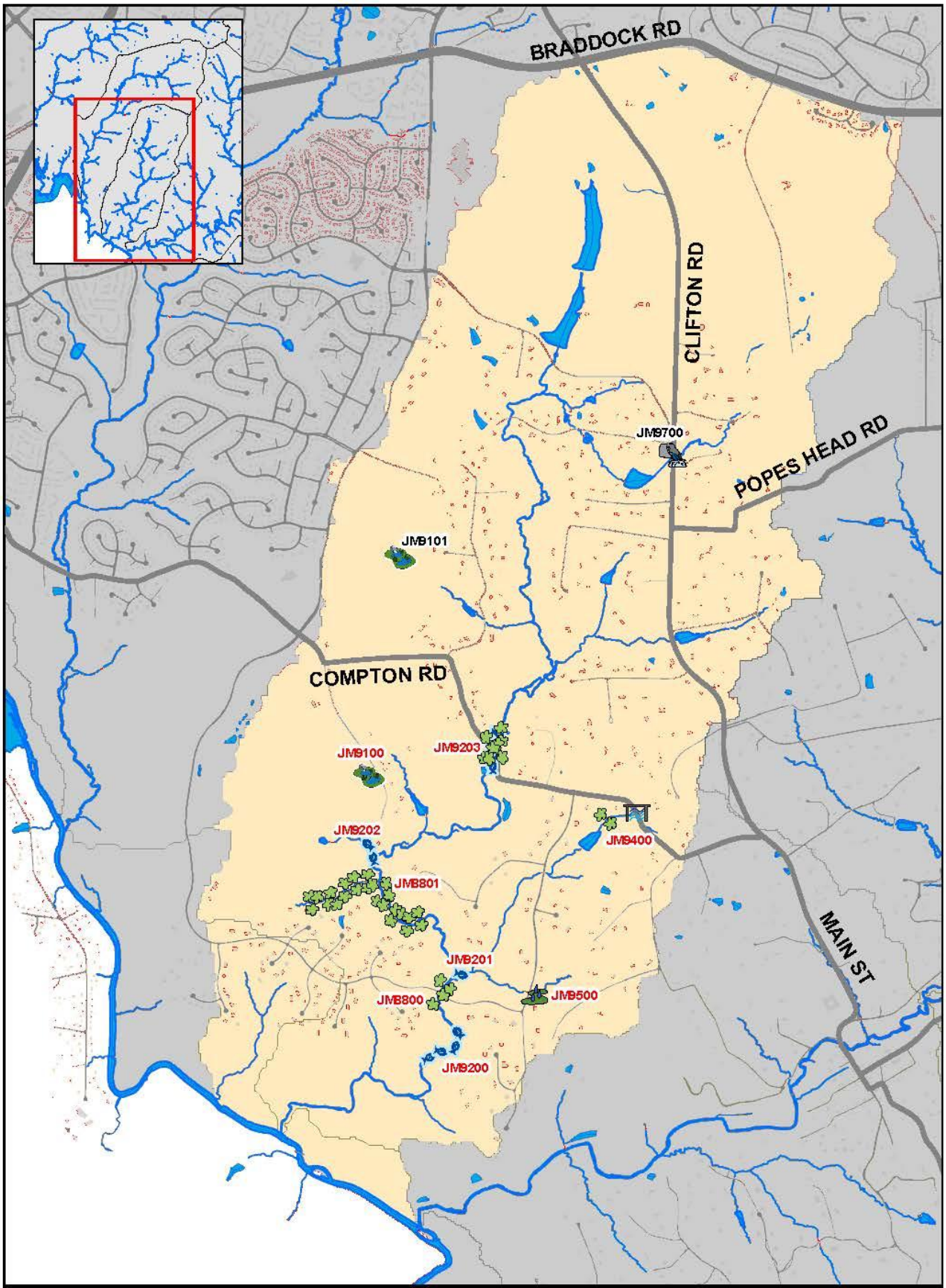


Map 5-1

WMA: Johnny Moore
Proposed Projects

5.2 Little Rocky Run – Lower WMA

The land use in the Little Rocky Run - Lower WMA consists primarily of open space and medium density residential development. Approximately 25 percent of the WMA is located within the County's R-C District for protection of the Occoquan Reservoir. Estate residential development is expected to increase by 4% in the future. Existing stormwater treatment in the WMA covers approximately 44% of the area primarily serving the residential development in the north of the WMA.

The County SPA completed in 2005 provided a categorization of the stream habitat summarized in Table 5-3. The channels were characterized primarily as deeply incised. A map showing the results of the SPA in this WMA is located in Appendix A.

Table 5-3 Little Rocky Run – Lower Stream Habitat Ratings

Condition	Miles of Assessed Stream	Percent of Assessed Streams
Very Poor	0	0
Poor	1.2	18
Fair	3	45
Good	1.8	27
Excellent	0.7	10

Based on the subwatershed characterization, the Little Rocky Run - Lower WMA is not homogeneous. The northern portion of the WMA has lower quality subwatersheds due to higher levels of development and impervious surfaces. The southern portion of the WMA is much less developed and these subwatersheds are generally of high quality. Most of the development in this WMA occurred nearly 20 years ago; therefore, some of the stream systems have stabilized.

5.2.1 Little Rocky Run - Lower Structural Projects (10-year Plan)

The 10-year structural priority projects recommended for the Little Rocky Run - Lower WMA are described below. More detailed fact sheets for these projects are provided in Section 5.4.

LR9005A: LR9005A is a proposed retrofit to existing facility 0829DP. The retrofit consists of removing the existing trickle ditches, adding micropools and wetland plantings and modifying internal pond geometry to extend the low flow path. Adding storage will depend on cooperation from HOA.

LR9005C: LR9005C is an alternative to Regional Pond R-05. This LID suite treats all of the area that drains to the proposed regional facility that is not treated by existing dry pond 0829DP. The HOA expressed opposition to the proposed regional pond during the WAG process, so LID measures are proposed throughout the subwatershed. Treatment is still proposed at the outfall, which consists of a bioretention area that can be constructed with minimal impact to mature trees.

LR9013D: This project is an alternative to Regional Pond R-13. This existing pond is downstream of the proposed regional pond site and controls additional drainage area than that proposed by the regional pond. This project proposes a retrofit to the pond to add capacity and modify plantings to provide additional water quality treatment.

LR9100: Project LR9100 is proposed to retrofit an existing pond to include wetland plantings. The retrofit would include removing the trickle ditch, adding micropools and altering pond geometry to extend the flow path.

LR9102: Project LR9102 is a retrofit of an existing stormwater pond. LR9102 will remove existing trickle ditches, increase storage capacity and lower peak flows, and will add micropools and wetland plantings.

LR9103: The LR9103 project area suffers from channel erosion and a clogged pond riser structure. LR9103 will restore the stream to a more stable, natural state to prevent future erosion and promote habitat health and diversity, clear the riser structure, and retrofit the pond with micropools and wetland plantings.

LR9106: Project LR9106 will retrofit an existing stormwater pond to provide improved water quality control. Existing concrete trickle ditches will be removed, and new micropools and wetland plantings will be added.

LR9110: Project LR9110 will retrofit an existing facility to include wetland plantings and micropools, remove trickle ditches and extend the internal flow path.

LR9111: Project LR9111 will retrofit an existing stormwater pond to provide improved water quality control. Existing concrete trickle ditches will be removed, and new micropools and wetland plantings will be added.

LR9201: During the WAG process, participants from the Green Trails HOA noted that the tributary to Little Rocky Run downstream of Green Trails Boulevard suffers from erosion and poor flow. Subsequent field visits confirmed a stagnant system with little habitat support. Project LR9201 will restore the stream to a more stable, natural state to prevent future erosion and promote habitat health and diversity.

LR9203: Project LR9203 will restore the existing paved ditch upstream of Singletons Way with a natural channel system. This small stream restoration will use step pools to dissipate excess energy and prevent future erosion.

LR9204: Stream restoration LR9204 will restore a concrete ditch to a natural stream channel. This small stream restoration project will consist of linear bioretention basins.

LR9504: Proposed project LR9504 will retrofit an existing culvert crossing to treat water quality using a gabion wall to create a shallow marsh upstream.

LR9508: Project LR9508 proposes LID treatment of an uncontrolled area. The project includes a vegetated swale to collect runoff from behind nearby townhouses and direct the flow to a small bioretention area. A new pipe from the facility to the stream will be placed under an existing paved trail. The project also includes one tree box filter in the cul-de-sac.

LR9509: Project LR9509 proposes to divert flow from an existing outlet into a created wetland detention system designed for water quality and channel protection treatment. Approximately 24 acres of drainage will be diverted to the proposed facility. Relief is set by the culvert invert, but there is room to add storage because common area inside the easement averages 4 feet above the invert.

LR9510: Project LR9510 proposes BMP/LID projects at the Centreville Elementary School. The project includes constructing bioretention areas and a vegetated swale to treat runoff from roofs, parking lots and all-purpose courts, and replacing three curb inlets with tree box filters.

LR9514: The Union Mill Elementary School site drains to existing dry pond 0612DP. Project LR9514 proposes construction of two bioretention areas to collect runoff from highly impervious areas. Two tree box filters will replace existing curb drop inlets.

LR9516: Project LR9516 is located on the Centreville High School site that drains to existing dry pond 0325DP. The project proposes replacement of five curb drop inlets with tree box filters and construction of a bioretention area near the parking lot. The proposed measures drain areas that are nearly 100% impervious.

5.2.2 Little Rocky Run - Lower Structural Projects (25-year Plan)

The 25-year structural priority projects recommended for the Little Rocky Run - Lower WMA are described below.

LR9101: Project LR9101 is proposed to retrofit two existing ponds near Warm Springs Court to include wetland plantings. The retrofit would include removing the trickle ditch, adding micropools and altering pond geometry to extend the flow path.

LR9104: Project LR9104 is proposed to retrofit an existing pond near Singletons Way to include wetland plantings. The retrofit would include removing the trickle ditch, adding micropools and altering pond geometry to extend the flow path.

LR9105: Project LR9105 is proposed to retrofit an existing pond along New Braddock Road to include wetland plantings. The retrofit would include adding micropools and altering pond geometry to extend the flow path.

LR9200: Project LR9200 is proposed to perform restoration of the degraded stream banks and revegetation of the buffer on this segment of Little Rocky Run downstream of Compton Road.

LR9500: Project LR9500 is a proposed bioretention facility at the intersection of Compton Road and Dalemar Drive to provide water quality treatment of uncontrolled flow.

LR9501: Project LR9501 is a proposed combination tree box filters and bioretention along Compton Heights Circle to provide water quality treatment of uncontrolled flow.

LR9502: Project LR9502 is a proposed combination tree box filters and bioretention along southern Marblestone Drive to provide water quality treatment of uncontrolled flow.

LR9503: Project LR9503 is a proposed combination tree box filters and bioretention along Rock Canyon Drive to provide water quality treatment of uncontrolled flow.

LR9505: Project LR9505 is a proposed combination of tree box filters and bioretention along northern Marblestone Drive to provide water quality treatment of uncontrolled flow.

LR9506: Project LR9506 is a proposed combination of tree box filters and bioretention along Creek Run Drive to provide water quality treatment of uncontrolled flow.

LR9507: Project LR9507 is a proposed combination of tree box filters and bioretention along South Springs Drive to provide water quality treatment of uncontrolled flow.

LR9512: Project LR9512 is a proposed combination of tree box filters and bioretention along Springstone Drive to provide water quality treatment of uncontrolled flow.

LR9513: Project LR9513 is a proposed combination of tree box filters and bioretention along Wildflower Lane to provide water quality treatment of uncontrolled flow.

LR9515: Project LR9515 is a proposed combination of tree box filters and bioretention along Bridgeland Lane to provide water quality treatment of uncontrolled flow.

LR9517: Project LR9517 is a proposed combination of tree box filters and bioretention along Little Brook Court to provide water quality treatment of uncontrolled flow.

LR9700: Project LR9700 is an outfall improvement downstream of Battle Rock Drive to address erosion downstream of a concrete channel.

5.2.3 Little Rocky Run - Lower Non-Structural Projects

Non-structural projects recommended in the WMA are listed below:

LR9800: This non-structural project is the result of information gathered from the WAG about litter problems in North Hart Run and Compton Valley Estates. This project will provide targeted education about litter control in the neighborhood and organization of stream clean ups in the area.

A list of all projects proposed for the WMA is shown in Table 5-4. Please note that only the 10-year priority projects have associated project fact sheets.

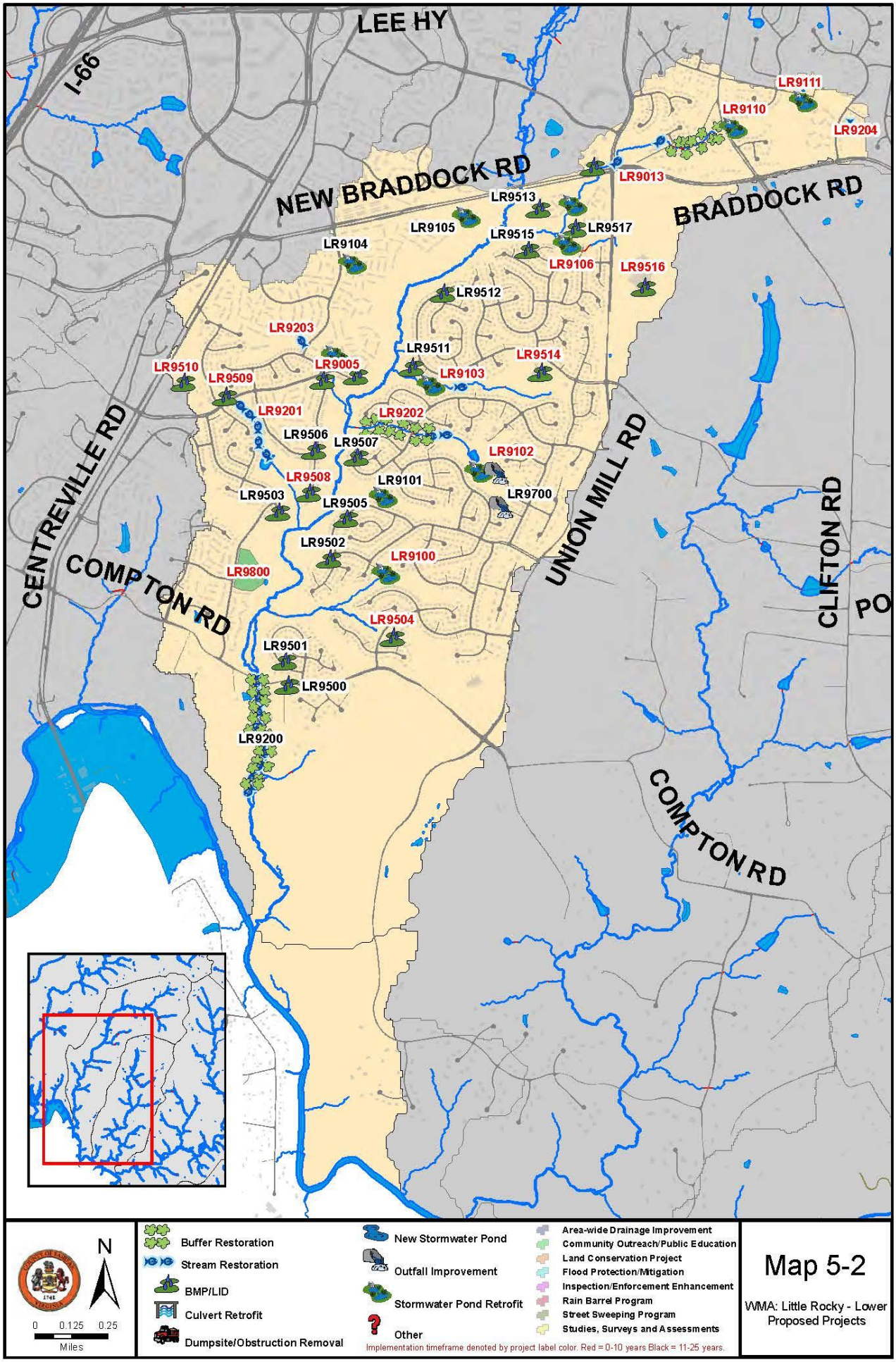
Table 5-4 Little Rocky Run - Lower Restoration Strategies

Structural Projects						
Project #	**Project Type**	**Subwatershed**	**Location**	**Watershed Benefit**	**Land Owner**	**Phase**
LR9005	Regional Pond Group	LR-LR-0010	6351 Littlefield Ct Centreville, VA 20121	Quality/ Quantity	HOA	0-10
LR9013	Regional Pond Group	LR-LR-0012	13600 Wildflower La Clifton, VA 20124	Quality/ Quantity	HOA	0-10
LR9100	Stormwater Pond Retrofit	LR-LR-0005	13943 Stonefield Dr Clifton, VA 20124	Quality	HOA	0-10
LR9102	Stormwater Pond Retrofit	LR-LR-0008	6579 Rockland Dr Clifton, VA 20124	Quality/ Quantity	HOA	0-10
LR9103	Stormwater Pond Retrofit Stream Restoration	LR-LR-0011	13815 Springstone Dr Clifton, VA 20124	Quality	HOA	0-10
LR9106	Stormwater Pond Retrofit	LR-LR-0012	13534 Union Village Ci Clifton, VA 20124	Quality	HOA	0-10
LR9110	Stormwater Pond Retrofit	LR-LR-0014	13214 Kilby Landing Ct Clifton, VA 20124	Quality	HOA	0-10
LR9111	Stormwater Pond Retrofit	LR-LR-0014	13022 Cobble La Clifton, VA 20124	Quality	HOA	0-10
LR9201	Stream Restoration	LR-LR-0007	14104 Sorrel Chase Ct Centreville, VA 20121	Quality	HOA	0-10
LR9202	Stream Restoration	LR-LR-0008	6419 Stonehaven Ct Clifton, VA 20124	Quality	HOA	0-10
LR9203	Stream Restoration	LR-LR-0010	14100 Wood Rock Wy Centreville, VA 20121	Quality	HOA	0-10
LR9204	Stream Restoration	LR-LR-0014	5587A Rockpointe Dr Clifton, VA 20124	Quality	HOA	0-10
LR9504	BMP/LID	LR-LR-0005	13916 Rock Brook Ct Clifton, VA 20124	Quality	HOA	0-10

Structural Projects						
Project #	**Project Type**	**Subwatershed**	**Location**	**Watershed Benefit**	**Land Owner**	**Phase**
LR9508	BMP/LID	LR-LR-0007	6612 Creek Run Dr Centreville, VA 20121	Quality	HOA, VDOT	0-10
LR9509	BMP/LID	LR-LR-0007	6600 La Petite Pl Centreville, VA 20121	Quality/ Quantity	HOA	0-10
LR9510	BMP/LID	LR-LR-0007	14330 Green Trails Bv Centreville, VA 20121	Quality	FCPS	0-10
LR9514	BMP/LID	LR-LR-0011	13611 Springstone Dr Clifton, VA 20124	Quality	FCPS	0-10
LR9516	BMP/LID	LR-LR-0012	6001 Union Mill Rd Clifton, VA 20124	Quality	FCPS	0-10
LR9101	Stormwater Pond Retrofit	LR-LR-0006	13909 Warm Spring Ct Clifton, VA 20124	Quality	HOA	11-25
LR9104	Stormwater Pond Retrofit	LR-LR-0009	13932 Preacher Chapman Pl Centreville, VA 20121	Quality	HOA	11-25
LR9105	Stormwater Pond Retrofit	LR-LR-0009	13801 Laura Ratcliff Ct Centreville, VA 20121	Quality	HOA	11-25
LR9200	Stream Restoration	LR-LR-0003	7014 Dalemar Dr Clifton, VA 20124	Quality	Private Residential	11-25
LR9500	BMP/LID	LR-LR-0003	6901 Newby Hall Ct Clifton, VA 20124	Quality	VDOT, Private Residential	11-25
LR9501	BMP/LID	LR-LR-0004	6818 Compton Heights Cr Clifton, VA 20124	Quality	HOA	11-25
LR9502	BMP/LID	LR-LR-0004	14024 Marblestone Dr Clifton, VA 20124	Quality	HOA, VDOT, Private Residential	11-25
LR9503	BMP/LID	LR-LR-0004	14100 Rock Canyon Dr Centreville, VA 20121	Quality	VDOT	11-25
LR9505	BMP/LID	LR-LR-0006	13933 Marblestone Dr Clifton, VA 20124	Quality	HOA, VDOT, Private Residential	11-25
LR9506	BMP/LID	LR-LR-0006	6596 Creek Run Dr Centreville, VA 20121	Quality	HOA, VDOT	11-25
LR9507	BMP/LID	LR-LR-0006	13930 South Springs Dr Clifton, VA 20124	Quality	HOA, VDOT	11-25
LR9512	BMP/LID	LR-LR-0009	13905 Springstone Dr Clifton, VA 20124	Quality	HOA, VDOT	11-25
LR9513	BMP/LID	LR-LR-0009	13671 Wildflower La Clifton, VA 20124	Quality	HOA, Private Residential	11-25
LR9515	BMP/LID	LR-LR-0012	13609 Bridgeland La Clifton, VA 20124	Quality	HOA, VDOT, Private Residential	11-25

Structural Projects						
Project #	**Project Type**	**Subwatershed**	**Location**	**Watershed Benefit**	**Land Owner**	**Phase**
LR9517	BMP/LID	LR-LR-0012	6021 Little Brook Ct Clifton, VA 20124	Quality	HOA	11-25
LR9700	Outfall Improvement	LR-LR-0008	6436 Battle Rock Dr Clifton, VA 20124	Quality	HOA	11-25
Non-Structural Projects						
Project #	**Project Type**	**Subwatershed**	**Location**	**Watershed Benefit**	**Land Owner**	
LR9800	Outreach/Education	LR-LR-0004	14123 Compton Valley Wy Centreville, VA 20121	Quality	HOA	

Map 5-2 provides an overview of project types and locations.


LEE HY
I-66
NEW BRADDOCK RD
BRADDOCK RD
CENTREVILLE RD
COMPTON RD
UNION MILL RD
CLIFTON RD
COMPTON RD
LR9111
LR9110
LR9204
LR9013
LR9513
LR9105
LR9515
LR9517
LR9104
LR9106
LR9516
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LR9502
LR9100
LR9800
LR9504
LR9501
LR9500
LR9200
N
0 0.125 0.25
Miles
Buffer Restoration
Stream Restoration
BMP/LID
Culvert Retrofit
Dumpsite/Obstruction Removal
New Stormwater Pond
Outfall Improvement
Stormwater Pond Retrofit
Other
Implementation timeframe denoted by project label color. Red = 0-10 years Black = 11-25 years.
Area-wide Drainage Improvement
Community Outreach/Public Education
Land Conservation Project
Flood Protection/Mitigation
Inspection/Enforcement Enhancement
Rain Barrel Program
Street Sweeping Program
Studies, Surveys and Assessments
Map 5-2
WMA: Little Rocky - Lower
Proposed Projects

5.3 Little Rocky Run – Upper WMA

The land use in the Little Rocky Run - Upper WMA consists primarily of medium density residential development and open space. Low-density residential development is expected to increase by 6 percent in the future. Existing stormwater treatment in the WMA covers approximately 34 percent of the area, primarily serving residential development in the WMA.

The County SPA completed in 2005 provided a categorization of the stream habitat summarized in Table 5-5. The channels were characterized primarily as actively widening with unstable stream banks. A map showing the results of the SPA in this WMA is located in Appendix A.

Table 5-5 Little Rocky Run – Upper Stream Habitat Ratings

Condition	Miles of Assessed Stream	% of Assessed Streams
Very Poor	0	0
Poor	1.3	20
Fair	5.2	80
Good	0	0
Excellent	0	0

Based on the subwatershed characterization, the Little Rocky Run - Upper WMA contains the greatest number of lower quality subwatersheds out of all three WMAs. This is due to the density of development and the ongoing disturbance occurring in the watershed that impacts sampling sites. Riparian, wetland and terrestrial forested habitat have been compromised, and pollutant loads are relatively high.

5.3.1 Little Rocky Run - Upper Structural Projects (10-year Plan)

The 10-year structural priority projects recommended for the Little Rocky Run - Upper WMA are described below. More detailed fact sheets for these projects are provided in Section 5.4.

LR9010B: Project LR9010B is an alternative to Regional Pond R-10. The project includes removal of trickle ditches, pond geometry alteration and the addition of micropools and wetland plantings.

LR9109: Project LR9109 is a retrofit of an existing stormwater pond. The existing trickle ditch will be removed, and micropools and wetland plantings will be added.

LR9114: Project LR9114 will retrofit two existing stormwater ponds to provide improved water quality control. Existing concrete trickle ditches will be removed, and new micropools and wetland plantings will be added.

LR9115: Project LR9115 is a retrofit of an existing stormwater pond near Sandy Point Lane. Storage volume will be increased, existing trickle ditches will be removed and micropools and wetland plantings will be added.

LR9117: Project LR9117 will retrofit an existing stormwater pond along Lee Highway to provide improved water quality control. Existing concrete trickle ditches will be removed, and new micropools and wetland plantings will be added.

LR9205: The pond outfalls near Whisper Willow Drive that drain to Little Rocky Run are causing scouring and erosion. Stream restoration project LR9205 will restore the stream to a more stable, natural state to prevent future erosion and promote habitat health and diversity.

LR9207: Stream restoration project LR9207 addresses erosion in the tributary to Willow Spring Branch along Ashleigh Road. Project LR9207 will restore the stream to a more stable, natural state to prevent future erosion and promote habitat health and diversity.

LR9208: The tributary to Willow Spring Branch at Kentstone Way is lined by a concrete trapezoidal channel (currently being undermined) with turf grass on either side. Stream restoration project LR9208 will remove the concrete channel and restore a natural stream system and riparian buffer area.

LR9209: The unnamed tributary to Willow Spring Branch at Ashleigh Road and Heatherford Place is lined by a concrete trapezoidal channel (currently being undermined) with turf grass on either side. Stream restoration project LR9209 will remove the concrete channel and recreate a natural stream system and riparian buffer area. A new channel with a plunge pool and several step pools will help dissipate erosive energy.

LR9521: LID stormwater treatment is proposed for Project LR9521 for this uncontrolled area near Canada Goose Court. The project includes collecting runoff from an existing grassed swale in a bioretention area and replacing two curb inlets with tree box filters.

LR9522: Project LR9522 provides stormwater retrofits at the Colin Powell Elementary School. Retrofits consist of cutting curbs and installing bioretention areas in grassed medians in five locations, and replacing one curb inlet with a tree box filter. This LID suite will treat most of the two parking lots on the property.

LR9523: Project LR9523 is located near Feldspar Court and includes constructing a wetland detention cell to treat for water quality only. This is a large untreated area where more decentralized retrofits would be very difficult due to private property constraints.

LR9524: The stormwater system near Chalkstone Way has no existing water quality treatment and suffers from minor erosion. LR9524 will provide new water quality treatment with a constructed wetland area at the outfall of the system and will prevent future upstream and downstream erosion by dissipating excess energy.

LR9526: Project LR9526 will divert flow from an outfall downstream of Lee Highway into a wetland marsh area. The wetland marsh will treat the water quality volume only; channel protection treatment will require removal of trees or realigning the storm sewer/outfall. A trail and a workout station within the proposed footprint will need to be relocated.

LR9527: Project LR9527 provides stormwater retrofits at the Willow Springs Elementary School. Retrofits consist of altering the pond geometry and adding wetland plantings to three existing dry ponds, and adding a bioretention area to capture impervious runoff from the roof.

5.3.2 Little Rocky Run - Upper Structural Projects (25-year Plan)

The 25-year structural priority projects recommended for the Little Rocky Run - Upper WMA are described below.

LR9107: Project LR9107 is a retrofit of an existing stormwater pond near Little Rocky Run Circle and Clarendon Springs Place. Existing trickle ditches will be removed and micropools and wetland plantings will be added.

LR9108: Project LR9108 is a retrofit of an existing stormwater pond near Little Rocky Run Circle and Rock Forest Court. Storage volume could be increased and micropools and wetland plantings will be added.

LR9112: Project LR9112 is a combination of a retrofit of an existing stormwater pond near Maple Creek Lane and addition of bioretention and/or tree box filters along Matthews Vista Drive to provide water quality treatment. The pond retrofit will include removal of existing trickle ditches and addition of micropools and wetland plantings.

LR9113: Project LR9113 is a retrofit of an existing stormwater pond near Leland Road and Sammie Kay Lane. Wetland plantings should be added to improve habitat and pollutant removal.

LR9116: Project LR9116 is a retrofit of an existing stormwater pond near Myrtle Leaf Drive. Wetland plantings should be added to improve habitat and pollutant removal.

LR9206: Stream restoration project LR9206 will stabilize stream banks in eroded area near Lincoln Drive.

LR9518: Project LR9518 is a proposed combination of tree box filters and bioretention to provide water quality treatment for uncontrolled areas located along Forest Pond Court, Clarendon Springs Court, Orchard Hill Court and Orchard Hill Lane.

LR9519: Project LR9519 is a proposed bioretention area near the intersection of Braddock Road and Rock Forest Court to provide water quality treatment for uncontrolled areas.

LR9520: Project LR9520 is a proposed bioretention area and/or tree box filters near Bayberry Lane to provide water quality treatment for uncontrolled areas.

LR9525: Project LR9525 is a proposed stormwater management facility near Annamohr Drive to provide additional water quality treatment for upstream facilities.

LR9600: Project LR9600 is located along Little Rocky Run downstream of Arrowhead Park Drive. Two residential structures are located in the 100-year floodplain in this area. Because of the proximity of the structures to the floodplain, floodproofing is not a viable option. The proposed project includes purchase of the two properties and restoration of the stream and buffer.

5.3.3 Little Rocky Run - Upper Non-Structural Projects

Non-structural projects recommended in the WMA are listed below:

LR8800: This buffer restoration is located on a tributary to Little Rocky Run at Westbrook Drive. Buffer restoration would improve the stream habitat and provide water quality benefits.

LR9010A: This buffer restoration is an alternative to Regional Pond R-10 and is located along Willow Springs Branch at Chronical Drive. Buffer restoration would improve the stream habitat and provide water quality benefits.

LR9801: This non-structural project is the result of information about litter problems in the area gathered from the WAG. This project is to provide targeted education and stream cleanup opportunities.

LR9802: This non-structural project is the result of information gathered from the WAG about dumpster management and debris at this commercial site. This project is to provide targeted education and enforcement of solid waste regulations.

A list of all projects proposed for the WMA is shown in Table 5-6. Please note that only the 10-year priority projects have associated project fact sheets.

Table 5-6 Little Rocky Run - Upper Restoration Strategies

Structural Projects						
Project #	**Project Type**	**Subwatershed**	**Location**	**Watershed Benefit**	**Land Owner**	**Phase**
LR9010	Regional Pond Group	LR-WS-0004	5378 Harrow La Fairfax, VA 22030	Quality	HOA	0-10
LR9109	Stormwater Pond Retrofit	LR-LR-0016	5064 Cavalier Woods La Clifton, VA 20124	Quality	HOA	0-10
LR9114	Stormwater Pond Retrofit	LR-LR-0020	13114 Blue Willow Pl Clifton, VA 20124	Quality/ Quantity	HOA	0-10
LR9115	Stormwater Pond Retrofit	LR-LR-0021	5403 Willow Valley Rd Clifton, VA 20124	Quality/ Quantity	HOA	0-10
LR9117	Stormwater Pond Retrofit	LR-WS-0002	12837 Lee Hy Fairfax, VA 22030	Quality	Private Residential	0-10
LR9205	Stream Restoration	LR-LR-0020	5217 Whisper Willow Dr Fairfax, VA 22030	Quality	FCPA	0-10
LR9207	Stream Restoration	LR-WS-0003	5378 Ashleigh Rd Fairfax, VA 22030	Quality	HOA	0-10
LR9208	Stream Restoration	LR-WS-0003	5418 Ashleigh Rd Fairfax, VA 22030	Quality	HOA	0-10
LR9209	Stream Restoration	LR-WS-0003	12753 Ashleigh Ct Fairfax, VA 22030	Quality	HOA	0-10
LR9521	BMP/LID	LR-LR-0016	13516 Canada Goose Ct Clifton, VA 20124	Quality	HOA	0-10
LR9522	BMP/LID	LR-LR-0019	13340 Leland Rd Centreville, VA 20121	Quality	FCPS	0-10
LR9523	BMP/LID	LR-WS-0002	13006 Feldspar Ct Clifton, VA 20124	Quality	HOA	0-10
LR9524	BMP/LID	LR-WS-0002	5355 Ashleigh Rd Fairfax, VA 22030	Quality	HOA	0-10
LR9526	BMP/LID	LR-LR-0025	4864 Muddler Way Fairfax, VA 22030	Quality	HOA	0-10
LR9527	BMP/LID	LR-WS-0003	5400 Willow Springs School Rd Fairfax, VA 22030	Quality	FCPS	0-10
LR9107	Stormwater Pond Retrofit	LR-LR-0015	5901 Spruce Run Ct Centreville, VA 20121	Quality	HOA	11-25
LR9108	Stormwater Pond Retrofit	LR-LR-0015	13660 Forest Pond Ct Centreville, VA 20121	Quality	HOA	11-25
LR9112	Stormwater Pond Retrofit	LR-LR-0018	13270 Maple Creek La Centreville, VA 20120	Quality	HOA	11-25
LR9113	Stormwater Pond Retrofit	LR-LR-0019	5324 Sammie Kay La Centreville, VA 20120	Quality	HOA	11-25
LR9116	Stormwater Pond Retrofit	LR-LR-0022	5130 Myrtle Leaf Dr Fairfax, VA 22030	Quality	County	11-25
LR9206	Stream Restoration	LR-LR-0022	5112 Lincoln Dr Fairfax, VA 22030	Quality	FCPA	11-25

Structural Projects						
Project #	**Project Type**	**Subwatershed**	**Location**	**Watershed Benefit**	**Land Owner**	**Phase**
LR9518	BMP/LID	LR-LR-0015	13644 Barren Springs Ct Centreville, VA 20121	Quality	HOA	11-25
LR9519	BMP/LID	LR-LR-0015	5813 Rockdale Ct Centreville, VA 20121	Quality	HOA	11-25
LR9520	BMP/LID	LR-LR-0016	13660 Bayberry La Centreville, VA 20121	Quality	Private Residential	11-25
LR9525	BMP/LID	LR-LR-0024	4895 Annamohr Dr Fairfax, VA 22030	Quality	HOA, VDOT	11-25
LR9600	Buffer Restoration	LR-LR-0018	5416 Arrowhead Park Dr Centreville, VA 20120	Flood	Private Residential	11-25
Non-Structural Projects						
Project #	**Project Type**	**Subwatershed**	**Location**	**Watershed Benefit**	**Land Owner**	
LR8800	Buffer Restoration	LR-LR-0023	12810 Westbrook Dr Fairfax, VA 22030	Quality	FCPA, HOA	
LR9010A	Buffer Restoration	LR-WS-0005	12524 Chronical Dr Fairfax, VA 22030	Quality	Private Residential	
LR9801	Outreach/Education	LR-LR-0016	Bent Tree Apartments Centreville, VA 20121	Quality	Private Commercial, HOA	
LR9802	Outreach/Education, Street Sweeping Program	LR-LR-0016	5702 Union Mill Rd Clifton, VA 20124	Quality	Private Commercial	

Map 5-3 provides an overview of project types and locations.

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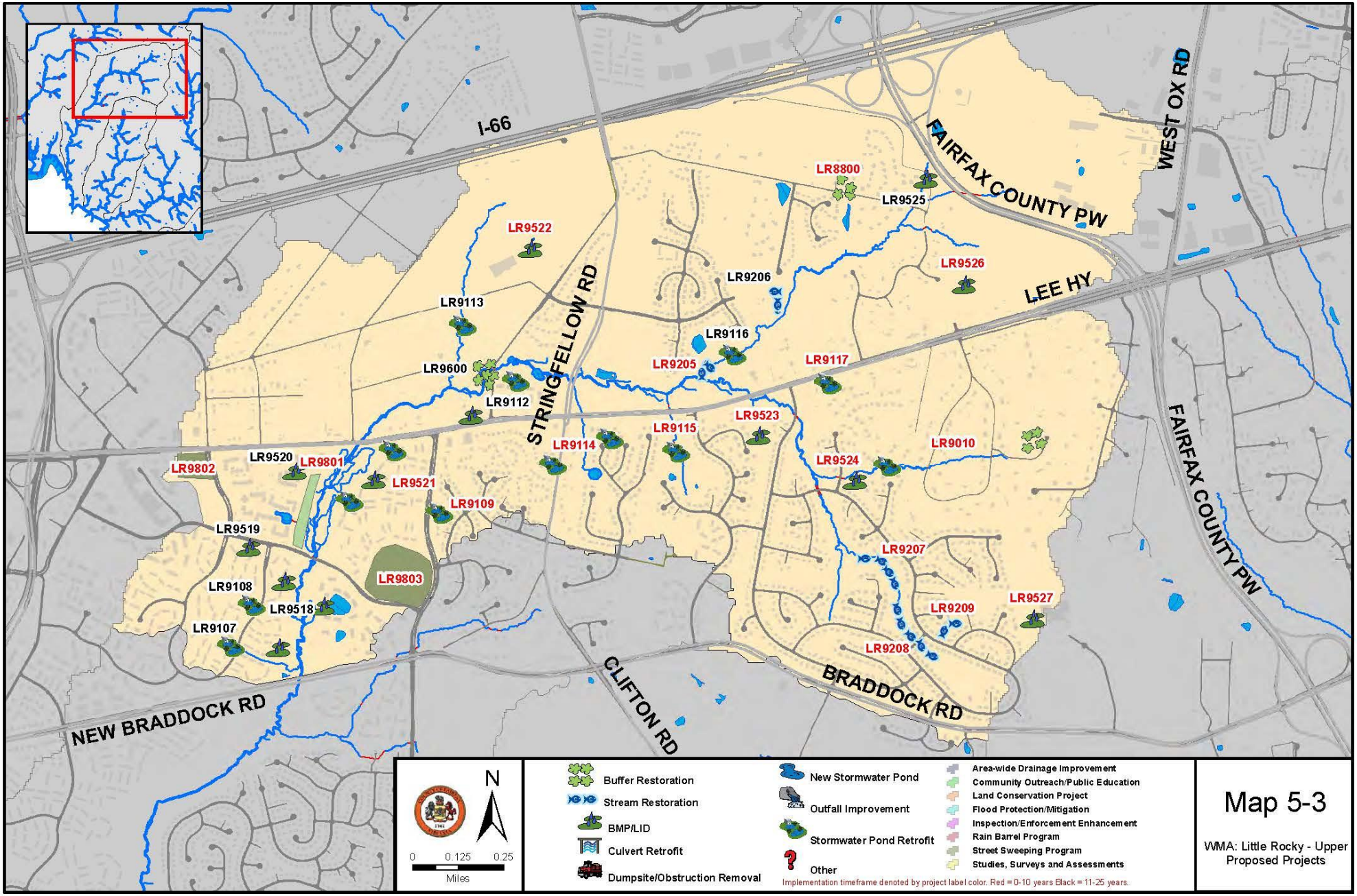
I-66
WEST OX RD
FAIRFAX COUNTY PW
LEE HY
STRINGFELLOW RD
FAIRFAX COUNTY PW
NEW BRADDOCK RD
CLIFTON RD
BRADDOCK RD
LR8800
LR9525
LR9522
LR9526
LR9206
LR9113
LR9116
LR9600
LR9205
LR9117
LR9112
LR9523
LR9115
LR9114
LR9010
LR9520
LR9801
LR9802
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LR9521
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LR9519
LR9207
LR9803
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LR9518
LR9107
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Miles
Buffer Restoration
Stream Restoration
BMP/LID
Culvert Retrofit
Dumpsite/Obstruction Removal
New Stormwater Pond
Outfall Improvement
Stormwater Pond Retrofit
Other
Area-wide Drainage Improvement
Community Outreach/Public Education
Land Conservation Project
Flood Protection/Mitigation
Inspection/Enforcement Enhancement
Rain Barrel Program
Street Sweeping Program
Studies, Surveys and Assessments
Implementation timeframe denoted by project label color. Red = 0-10 years Black = 11-25 years.
Map 5-3
WMA: Little Rocky - Upper
Proposed Projects

5.4 Project Fact Sheets

The project fact sheets for the 10-year Implementation Plan provide more detailed information about each project. The project fact sheets follow in alphabetical order.

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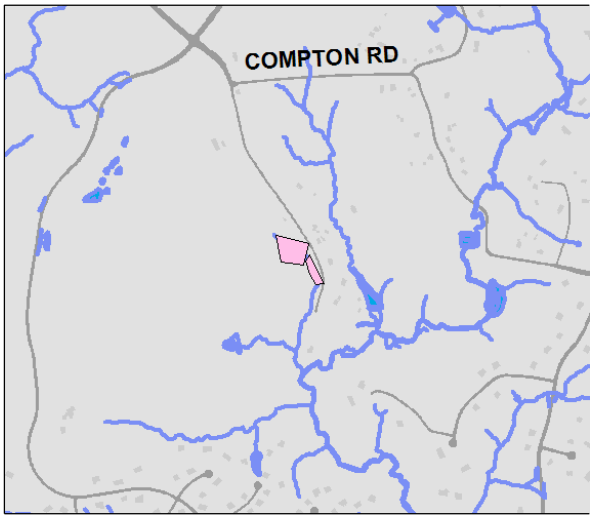
JM9100 Pond Retrofit



Vicinity Map

Address	7005 Union Mill Rd
Location	Golf course
Landowner	Balmoral Golf Assoc LC Garfield Henry TR
PIN	0742 05 B1 0751 06 F
Control Type	Water quality and quantity control
Drainage Area	63 acres
Receiving Waters	Unnamed tributary to Johnny Moore Creek

Description: Pond retrofit JM9100 addresses a stormwater pond that has fallen into disrepair and currently provides little to no detention or treatment. JM9100 calls for pond embankment repairs, new micropools and wetland plantings, and removal of debris downstream of the pond.

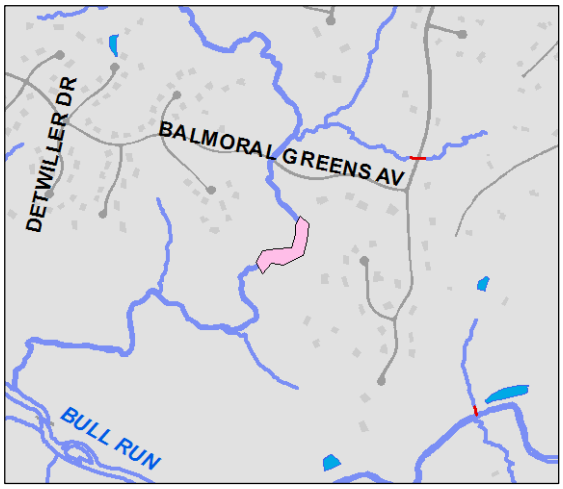
Project Benefits: JM9100 will eliminate a significant amount of water pollution, and will improve wildlife habitat by restoring a wetland area.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Suspended Solids Removed (tons/yr)
36.69	13.41	5.17

Project Design Considerations: Stream restoration JM9202 is located approximately 1200 feet downstream of JM9100. Coordination and sequencing of these projects must be considered. The pond retrofit portion of JM9100 is located on Balmoral Golf Association property and is surrounded by conservation easements. The debris removal portion of JM9100 is located on private property, and is not within any easements. The site has an extremely high potential to contain Native American, historic and Civil War Sites. The Park Authority recommends that Phase I surveys be conducted prior to any work done in these areas. If sites of interest are found, Phase II archaeological testing should be conducted to determine eligibility for inclusion into the National Register of Historic Places. If sites are found eligible, avoidance or Phase III archaeological data recovery is recommended.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Access Road	100	SY	$25.00	$2,500.00
Access Road Gate	1	EA	$2,500.00	$2,500.00
Clear and Grub	0.4	AC	$8,500.00	$3,400.00
Structural BMP and Incidentals	1	LS	$10,000 - $20,000	$15,000.00
New Storm Pipe	30	LF	$100 - $300	$6,000.00
Grading and Excavation	700	CY	$35.00	$24,500.00
Embankment	500	CY	$50.00	$25,000.00
Organic Compost Soil Amendment	175	CY	$40.00	$7,000.00
			Base Construction Cost	**$85,900.00**
			Mobilization (5%)	$4,295.00
			Plantings (5%)	$4,295.00
			Ancillary Items (5%)	$4,295.00
			Erosion & Sediment Control (10%)	$8,590.00
			Subtotal 1	**$107,375.00**
			Contingency (25%)	$26,843.75
			Subtotal 2	**$134,218.75**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$60,398.44
			Total	**$194,617.19**
			Estimated Project Cost	**$200,000.00**

JM9200 Stream Restoration



Vicinity Map

Address	13309 Balmoral Greens Ave
Location	Stream valley park
Landowner	Fairfax County Park Authority
PIN	0744 03 V 0851 07 G
Control Type	Water quality control
Drainage Area	2984 acres
Receiving Waters	Johnny Moore Creek

Description: Johnny Moore Creek suffers from severe bank erosion in the area shown below. Project JM9200 will restore the stream to a more stable, natural state to prevent future erosion and promote habitat health and diversity.

Project Area Map

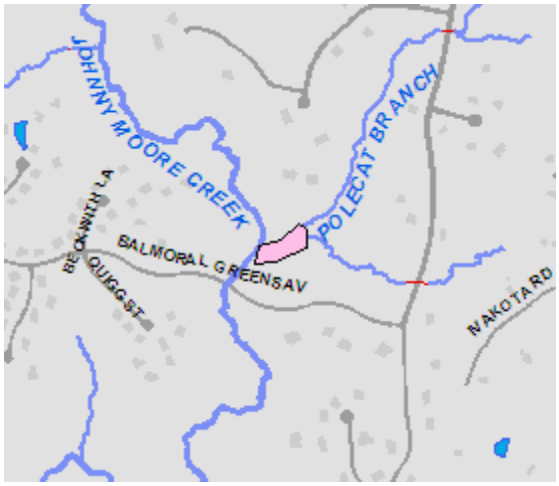
Project Benefits: JM9200 will remove a very large amount of water pollution caused by instream erosion. Higher quality habitat for fish and wildlife will also be provided.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Suspended Solids Removed (tons/yr)
299.08	115.90	186.93

Project Design Considerations: Buffer restoration JM8800 is located just upstream of the project site, where Balmoral Greens Avenue crosses Johnny Moore Creek. Stream restoration JM9201 is also located further upstream. Coordination of these three projects should be considered. The project site can be accessed from Balmoral Greens Avenue, and is located within floodplain/stormwater and conservation easements. Significant construction issues exist – especially site access – such that it may be worthwhile to extend the restoration project even further upstream to where Balmoral Greens Avenue crosses Johnny Moore Creek. As with any stream restoration, there are significant environmental permitting requirements for this project. Impacts to trees will be inevitable, but the long-term environmental benefits of the Johnny Moore Creek Stream Restoration will outweigh the short-term environmental costs. The site has an extremely high potential to contain Native American, historic and Civil War Sites. The Park Authority recommends that Phase I surveys be conducted prior to any work done in these areas. If sites of interest are found, Phase II archaeological testing should be conducted to determine eligibility for inclusion into the National Register of Historic Places. If sites are found eligible, avoidance or Phase III archaeological data recovery is recommended.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Clear and Grub	1.5	AC	$10,000.00	$15,000.00
Construct New Channel	1000	LF	$200.00	$200,000.00
Add'l Cost, first 500 LF	500	LF	$200.00	$100,000.00
Plantings	1.5	AC	$25,000.00	$37,500.00
			Base Construction Cost	**$352,500.00**
			Mobilization (5%)	$17,625.00
			Ancillary Items (5%)	$17,625.00
			Erosion & Sediment Control (10%)	$35,250.00
			Subtotal 1	**$423,000.00**
			Contingency (25%)	$105,750.00
			Subtotal 2	**$528,750.00**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$237,937.50
			Total	**$766,687.50**
			Estimated Project Cost	**$770,000.00**

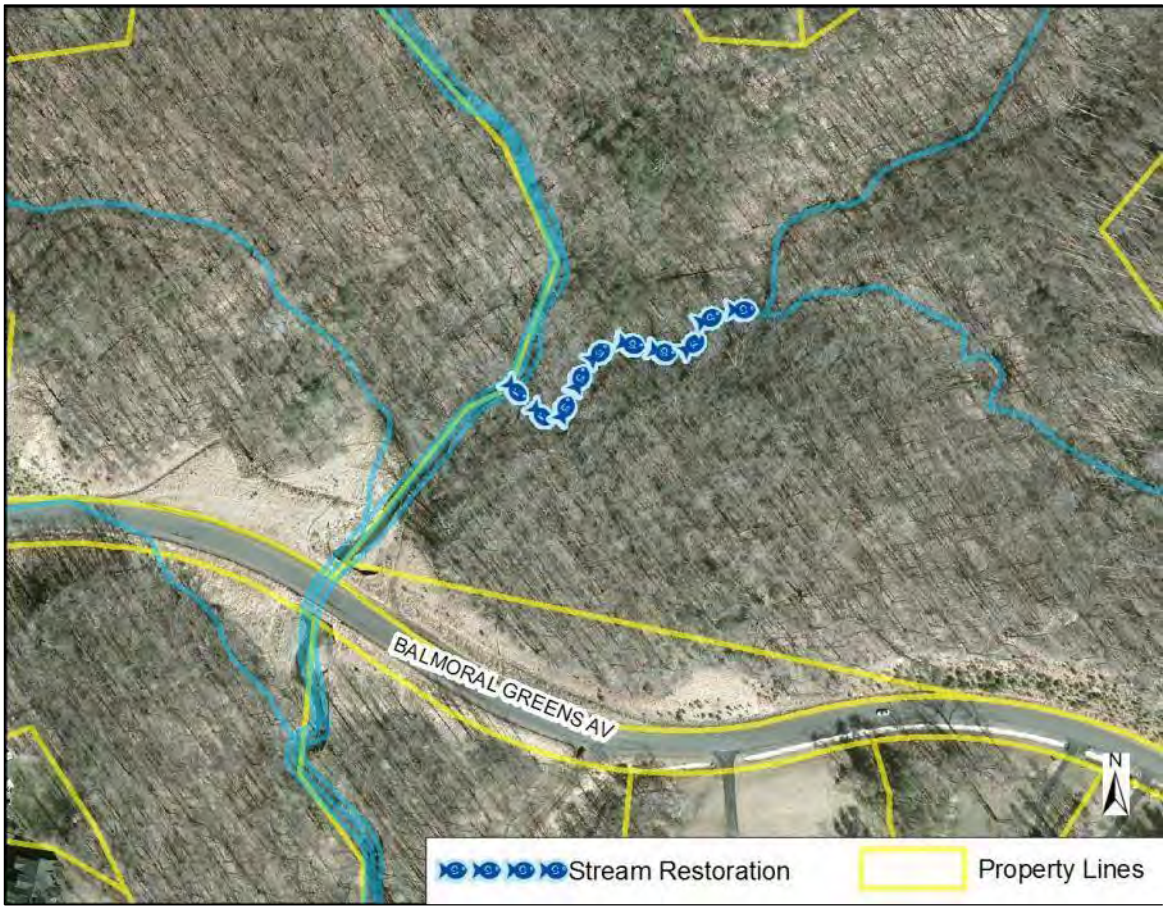
JM9201 Stream Restoration



Vicinity Map

Address	13309 Balmoral Greens Ave
Location	Wooded area
Landowner	Fairfax County Park Authority
PIN	0753 08 A
Control Type	Water quality control
Drainage Area	310 acres
Receiving Waters	Johnny Moore Creek

Description: Stream restoration project JM9201 addresses erosion in the downstream portion of Polecat Branch. Project JM9201 will restore the stream to a more stable, natural state to prevent future erosion and promote habitat health and diversity.



Project Area Map

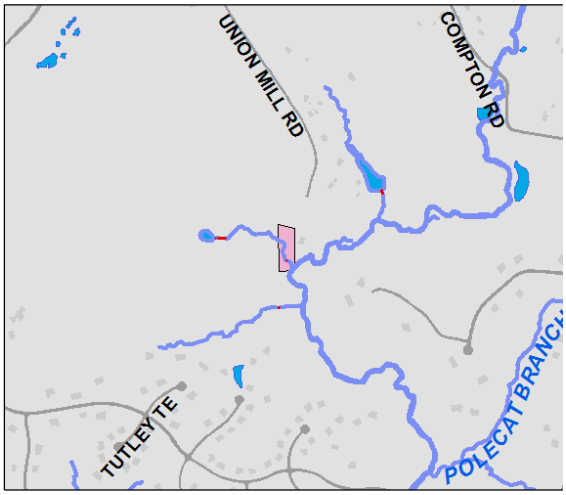
Project Benefits: Project JM9201 will reduce phosphorus and nitrogen loading in the Polecat Branch. Higher quality habitat for wildlife will also be provided.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
4.59	1.78	2.87

Project Design Considerations: Buffer restoration JM8800 is located about 250 feet downstream of the project site, where Balmoral Greens Avenue crosses Johnny Moore Creek. Stream restoration JM9200 is also located further downstream on Johnny Moore Creek. Coordination and sequencing of these three projects should be considered, especially due to site access issues for JM9201 and JM9200 – both are densely wooded and somewhat remote. As with any stream restoration, there are significant environmental permitting requirements for this project. Impacts to mature trees will be inevitable, but the long-term environmental benefits of the Polecat Creek Stream Restoration will outweigh the short-term environmental costs. This project area contains many known cultural resources sites. They consist of important Native American soapstone (steatite) quarries and campsites. The Detwiler Mill Complex is located downstream of the confluence of Johnny Moore Creek and Polecat Branch. It is recommended that the known sites be evaluated with Phase II archaeological testing for eligibility to the National Register of Historic Places prior to any ground disturbing activity. If the sites are found eligible, avoidance or Phase III data recovery is recommended.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Clear and Grub	0.57	AC	$10,000.00	$5,700.00
Construct New Channel	425	LF	$200.00	$85,000.00
Add'l Cost, first 500 LF	425	LF	$200.00	$85,000.00
Plantings	0.57	AC	$25,000.00	$14,250.00
			Base Construction Cost	**$189,950.00**
			Mobilization (5%)	$9,497.50
			Ancillary Items (5%)	$9,497.50
			Erosion & Sediment Control (10%)	$18,995.00
			Subtotal 1	**$227,940.00**
			Contingency (25%)	$56,985.00
			Subtotal 2	**$284,925.00**
Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)				$128,216.25
			Total	**$413,141.25**
			Estimated Project Cost	**$420,000.00**

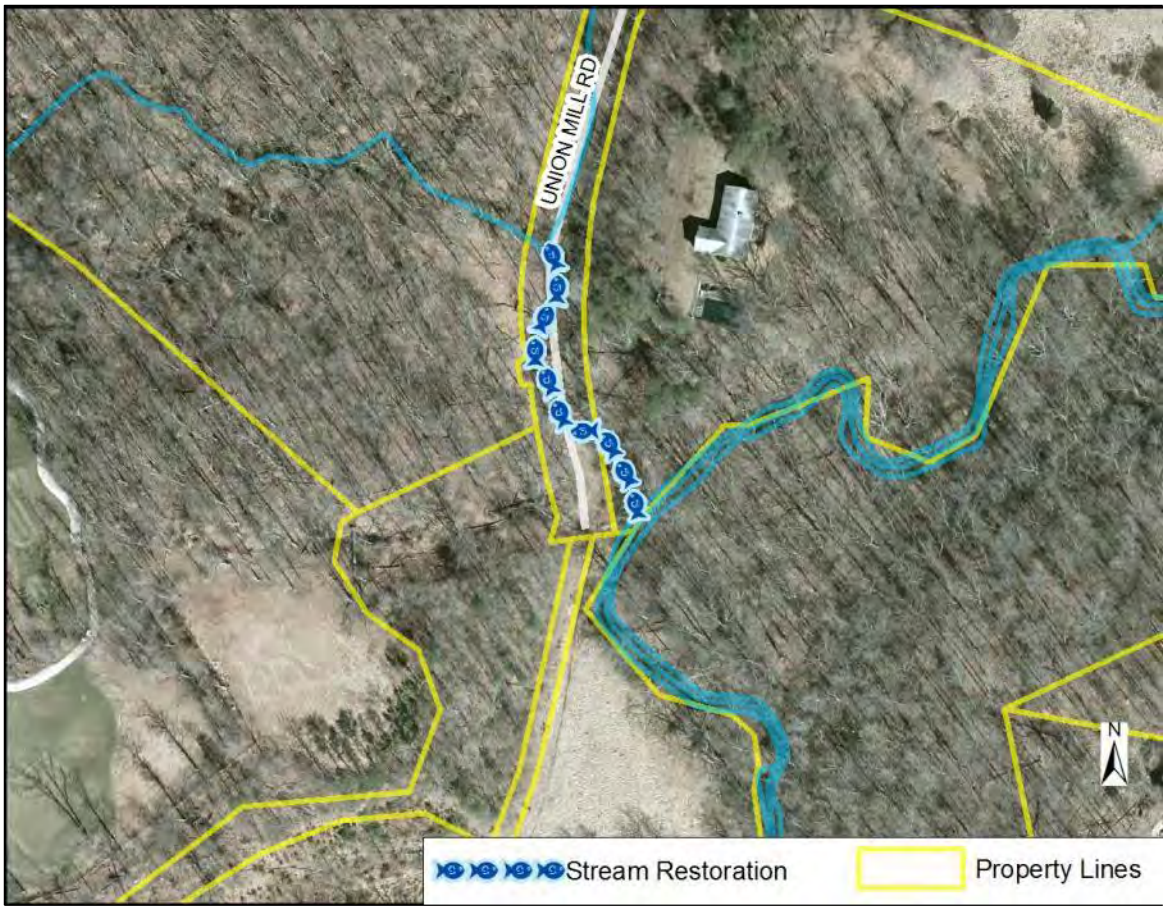
JM9202 Stream Restoration



Vicinity Map

Address	7029 Union Mill Rd
Location	Stream valley park
Landowner	Fairfax County Park Authority Garfield Henry TR
PIN	0744 03 S 0751 06 E
Control Type	Water quality control
Drainage Area	174 acres
Receiving Waters	Johnny Moore Creek

Description: The tributary to Johnny Moore Creek that crosses Union Mill Rd (as shown below) suffers from erosion. Project JM9202 will restore the stream to a more stable, natural state to prevent future erosion and promote habitat health and diversity.



Project Area Map

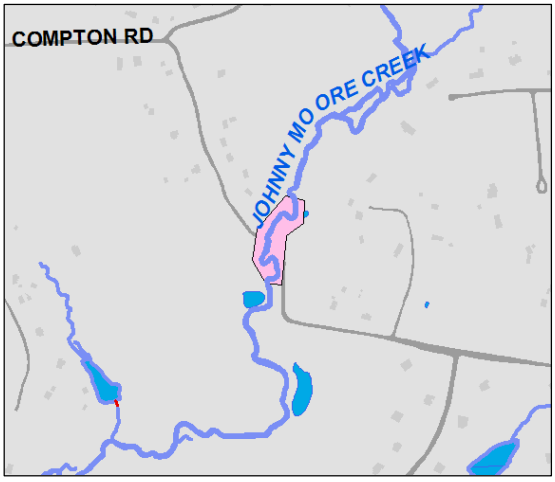
Project Benefits: The Tributary to Johnny Moore Creek Stream Restoration (JM9202) will reduce phosphorus, nitrogen and sediment loading, and restore approximately 325 linear feet of degraded stream channel. Higher quality habitat for fish and wildlife will also be provided.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
3.31	1.28	2.07

Project Design Considerations: Buffer restoration JM8801 is located approximately 500' downstream of JM9202 – coordination of these two projects should be considered. JM9202 is located partially within floodplain/stormwater and conservation easements, and is also partially located on private property. The project site can be accessed from Union Mill Rd. Significant construction issues exist – especially site access. As with any stream restoration, there are significant environmental permitting requirements for this project. Impacts to trees will be inevitable, but the long-term environmental benefits of the Johnny Moore Creek Stream Restoration will outweigh the short-term environmental costs. This area has many known historical sites primarily consisting of important Native American soapstone (steatite) quarries and campsites. In addition, the entire area has potential Civil War resources. The Clifton Soapstone Quarry Complex is located within the project area. It is recommended that all project sites be evaluated with Phase II archaeological testing for eligibility to the National Register of Historic Places prior to any ground disturbing activity. If the sites are found eligible, avoidance or Phase III data recovery is recommended.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Clear and Grub	0.45	AC	$10,000.00	$4,500.00
Construct New Channel	325	LF	$200.00	$65,000.00
Add'l Cost, first 500 LF	325	LF	$200.00	$65,000.00
Plantings	0.45	AC	$25,000.00	$11,250.00
			Base Construction Cost	**$145,750.00**
			Mobilization (5%)	$7,287.50
			Ancillary Items (5%)	$7,287.50
			Erosion & Sediment Control (10%)	$14,575.00
			Subtotal 1	**$174,900.00**
			Contingency (25%)	$43,725.00
			Subtotal 2	**$218,625.00**
Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)				$98,381.25
			Total	**$317,006.25**
			Estimated Project Cost	**$320,000.00**

JM9203 Stream Restoration



Vicinity Map

Address	13400 Compton Rd
Location	Private property
Landowner	Boyd, Donald E. TR MA Properties
PIN	0751 01 0026 0751 01 0011Z
Control Type	Water quality control
Drainage Area	2022 acres
Receiving Waters	Bull Run

Description: Johnny Moore Creek suffers from moderate bank erosion in this area. Project JM9203 will restore the stream to a more stable, natural state to prevent future erosion and promote habitat health and diversity.

Project Area Map

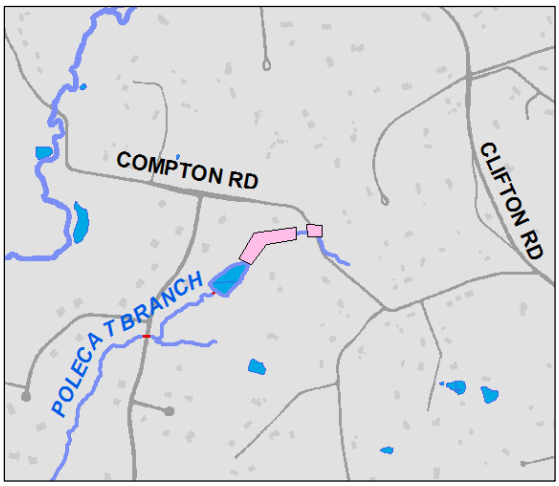
Project Benefits: Stream restoration JM9203 will reduce pollutant loads caused by erosion by restoring about 1070 linear feet of stream channel. Higher quality habitat for fish and wildlife will also be provided.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
16.05	6.22	10.03

Project Design Considerations: Culvert retrofit JM9400 is located approximately 0.6 miles east of JM9203 on Compton Rd. Although these projects are located in separate sub-watersheds, their proximity to each other along Compton Rd. warrants consideration of coordination and sequencing. JM9203 is located on private property. As with any stream restoration, there are significant environmental permitting requirements for this project. Impacts to trees will be inevitable, but the long-term environmental benefits of the Johnny Moore Creek Stream Restoration will outweigh the short-term environmental costs.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Clear and Grub	1.1	AC	$10,000.00	$11,000.00
Construct New Channel	1070	LF	$200.00	$214,000.00
Add'l Cost, first 500 LF	500	LF	$200.00	$100,000.00
Plantings	1.1	AC	$25,000.00	$27,500.00
			Base Construction Cost	**$352,500.00**
			Mobilization (5%)	$17,625.00
			Ancillary Items (5%)	$17,625.00
			Erosion & Sediment Control (10%)	$35,250.00
			Subtotal 1	**$423,000.00**
			Contingency (25%)	$105,750.00
			Subtotal 2	**$528,750.00**
Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)				$237,937.50
			Total	**$766,687.50**
			Estimated Project Cost	**$770,000.00**

JM9400 Culvert Retrofit



Vicinity Map

Address	13165 Compton Rd
Location	Open space
Landowner	Feriozi, Dan J and Anne T Gallotta, Mark A and Pamela Deal, Bruce C and Ilysia D Witschey, John F and Robyn N
PIN	0751 01 0021 0751 01 0034B 0751 01 0033B 0753 01 0018A
Control Type	Water quality control
Drainage Area	75 acres
Receiving Waters	Polecat Branch

Description: Project JM9400 consists of a culvert retrofit where a tributary of Polecat Branch crosses Compton Rd. A small buffer restoration downstream of the culvert retrofit site is also included.

Project Area Map

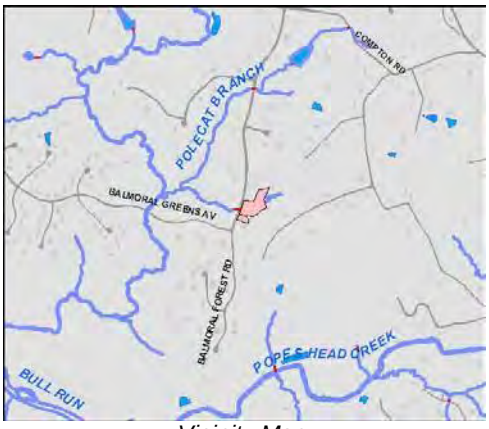
Project Benefits: JM9400 will address flooding issues along Compton Rd by providing more efficient stormwater conveyance at the culvert retrofit site. The buffer restoration portion of the project will reduce erosion and pollutant loading in addition to providing higher quality habitat for native wildlife. Increased shade will also decrease water temperatures, which will better maintain dissolved oxygen, providing better conditions for aquatic life.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
29.60	6.07	1.02

Project Design Considerations: As the buffer restoration portion of JM9400 is located partially on private property, the project will need to be coordinated with the landowners. Coordination with adjacent landowners and VDOT regarding the culvert retrofit may also be required, depending on site topography and access constraints. Permitting requirements for both the culvert retrofit and buffer restoration should be minimal.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Clear and Grub	0.05	AC	$8,500.00	$425.00
Grading and Excavation	100	CY	$35.00	$3,500.00
New Storm Pipe	40	LF	$100 - $300	$8,000.00
Organic Compost Soil Amendment	122	CY	$40.00	$4,880.00
Plantings	0.3	AC	$114,030.00	$34,209.00
			Base Construction Cost	**$51,014.00**
			Mobilization (5%)	$2,550.70
			Plantings (5%)	$2,550.70
			Ancillary Items (5%)	$2,550.70
			Erosion & Sediment Control (10%)	$5,101.40
			Subtotal 1	**$63,767.50**
			Contingency (25%)	$15,941.88
			Subtotal 2	**$79,709.38**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$35,869.22
			Total	**$115,578.59**
			Estimated Project Cost	**$120,000.00**

JM9500 BMP/LID



Vicinity Map

Address	7051 Balmoral Forest Road
Location	Open Space
Landowner	Fairfax County Park Authority
PIN	0753 08 C
Control Type	Water quality control
Drainage Area	78 Acres
Receiving Waters	Unnamed Tributary to Polecat Branch

Description: Project JM9500 is a culvert retrofit upstream of Balmoral Forest Road on Polecat Branch. The culvert retrofit will provide water quality treatment for an uncontrolled area. Road drainage infrastructure may need to be realigned to allow for berm construction.

Project Area Map

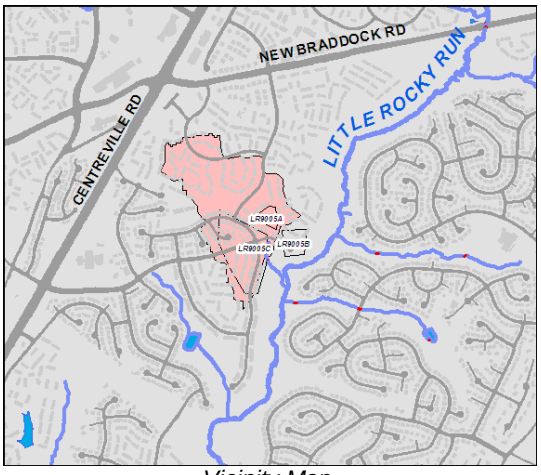
Project Benefits: Project takes advantage of 'free' storage on upstream side of culvert. The project will provide water quality treatment for possible future estate residential development upstream, which is often exempt from stormwater regulations.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
72.85	14.31	3.02

Project Design Considerations: There are access issues owing to steep slopes off the road. The stream valley is also very steep and in a forested area, requiring a clearing/grading effort of the access route as well as for construction of the berm. Consider gabion wall over earthen embankment to reduce footprint. Although it is zoned as Estate residential, the models show a large pollutant removal capacity at this site. There are no sequencing issues. By nature with any culvert retrofit, the project is in-line and more permitting requirements are likely. This is a perennial stream at this location. The site has an extremely high potential to contain Native American, historic and Civil War Sites. The Park Authority recommends that Phase I surveys be conducted prior to any work done in these areas. If sites of interest are found, Phase II archaeological testing should be conducted to determine eligibility for inclusion into the National Register of Historic Places. If sites are found eligible, avoidance or Phase III archaeological data recovery is recommended.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Access Road	1000	SY	$25.00	$25,000.00
Access Road Gate	1	EA	$2,500.00	$2,500.00
Clear and Grub	0.3	AC	$8,500.00	$2,550.00
Structural BMP and Incidentals	1	LS	$10,000 - $20,000	$10,000.00
New Storm Pipe		LF	$100 - $300	$0.00
Grading and Excavation		CY	$35.00	$0.00
Embankment	200	CY	$50.00	$10,000.00
Organic Compost Soil Amendment		CY	$40.00	$0.00
			Base Construction Cost	**$50,050.00**
			Mobilization (5%)	$2,502.50
			Plantings (5%)	$2,502.50
			Ancillary Items (5%)	$2,502.50
			Erosion & Sediment Control (10%)	$5,005.00
			Subtotal 1	**$62,562.50**
			Contingency (25%)	$15,640.63
			Subtotal 2	**$78,203.13**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$35,191.41
			Total	**$113,394.53**
			Estimated Project Cost	**$120,000.00**

LR9005 Regional Pond Alternative Group



Vicinity Map

Address	13915 Green Trails Ct
Location	Subdivision
Landowner	Green Trails Homeowners Association/Heritage Forest Homeowners Association
PIN	0654 0304 K 0654 1004 A 0652 09 L
Control Type	Water quality and quantity control
Drainage Area	65 Acres
Receiving Waters	Little Rocky Run

Description: Project suite is alternative to Regional Pond R-05. LR9005A is a retrofit to existing facility 0829DP. Quality enhancements as well as storage increases are proposed. LR9005B is an LID application (3 tree box filters to replace curb drop inlets) to a small untreated portion of the subdivision. This area was not originally expected to be treated by the regional facility, but was added to the alternative suite because it is a strategic location to manage untreated runoff to obtain similar cumulative pollutant removal results as the original proposed pond. LR9005C involves treating the portion of the drainage area intended to drain to R-05 that is not treated by existing facility 0829DP for water quality. A combination of tree box filters (11) and bioretention areas (3) are proposed in order to eliminate the need for a pond at the outfall.

Project Area Map

Project Benefits: This project suite will simulate removal efficiencies of proposed Regional Pond R-05. Loading summaries can be found in Section 6 of the plan.

Project	Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
LR9005A	24.19	6.14	0.21
LR9005B	12.84	2.85	0.65
LR9005C	38.85	8.17	1.83

Project Design Considerations: LR9005A - Adding storage to existing facility (0829DP) encroaches into HOA property and is not contained within existing easement. LR9005B was not broken out separately below due to its similar nature and proximity to LR9005C. LR9005C - Bioretention areas are proposed within HOA property and outside of existing easements and in some cases are close in proximity to private property as well as existing utilities. Treatment was provided throughout the subwatershed to reduce the footprint of treatment at the outfall (where the original regional facility was proposed).

Total Cost (9005A-9005C):

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Vegetated Swale		SY	$50.00	$0.00
Pervious Pavement		SY	$100.00	$0.00
Vegetated Roof		SY	$450.00	$0.00
Percolation/Infiltration Trench		SY	$75.00	$0.00
Bioretention Filters & Basin	275	SY	$150.00	$41,250.00
Manufactured BMP (i.e. Tree Box Filter)	14	EA	$10,000.00	$140,000.00
Grading and Excavation	2500	CY	$35.00	$87,500.00
Remove Trickle Ditch	150	SY	$10.71	$1,606.50
Organic Compost Soil Amendment	320	CY	$40.00	$12,800.00
			Base Construction Cost	**$283,156.50**
			Mobilization (5%)	$14,157.83
			Plantings (5%)	$14,157.83
			Ancillary Items (5%)	$14,157.83
			Erosion & Sediment Control (10%)	$28,315.65
			Subtotal 1	**$353,945.63**
			Contingency (25%)	$88,486.41
			Subtotal 2	**$442,432.03**
Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)				$199,094.41
			Total	**$641,526.45**
			Estimated Project Cost	**$650,000.00**

Project LR9005A:

Project Area Map

Description: LR9005A is a proposed retrofit to existing facility 0829DP. Remove the existing trickle ditches. Add micropools and wetland plantings. Modify internal pond geometry – focus on extending the low flow path. Adding storage will depend on cooperation from HOA. Costs are summarized below:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Access Road		SY	$25.00	$0.00
Access Road Gate		EA	$2,500.00	$0.00
Clear and Grub		AC	$8,500.00	$0.00
Structural BMP and Incidentals		LS	$10,000 - $20,000	$0.00
New Storm Pipe		LF	$100 - $300	$0.00
Grading and Excavation	2500	CY	$35.00	$87,500.00
Embankment		CY	$50.00	$0.00
Remove Trickle Ditch	150	SY	$10.71	$1,606.50
Organic Compost Soil Amendment	250	CY	$40.00	$10,000.00
			Base Construction Cost	**$99,106.50**
			Mobilization (5%)	$4,955.33
			Plantings (5%)	$4,955.33
			Ancillary Items (5%)	$4,955.33
			Erosion & Sediment Control (10%)	$9,910.65
			Subtotal 1	**$123,883.13**
			Contingency (25%)	$30,970.78
			Subtotal 2	**$154,853.91**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$69,684.26
			Total	**$224,538.16**
			Estimated Project Cost	**$230,000.00**

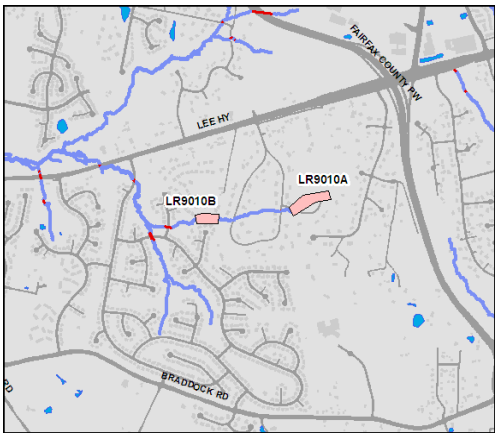
Projects LR9005B and LR9005C:

Project Area Map

Description: LR9005B proposes three tree box filters as shown in the Project Area Map. It's been combined with LR9005C due to its similar nature and proximity with the larger subproject. LR9005C treats all of the area that drains to the proposed regional facility that is not treated by existing 0829DP. The HOA is on record saying that a pond is not a viable solution, so LID measures are proposed throughout the subwatershed. Treatment is still proposed at the outfall, but only a bioretention area that can be constructed with minimal impact to mature trees. The existing StormNet data is inaccurate in this area.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Vegetated Swale		SY	$50.00	$0.00
Pervious Pavement		SY	$100.00	$0.00
Vegetated Roof		SY	$450.00	$0.00
Percolation/Infiltration Trench		SY	$75.00	$0.00
Bioretention Filters & Basin	275	SY	$150.00	$41,250.00
Manufactured BMP (i.e.Tree Box Filter)	14	EA	$10,000.00	$140,000.00
Organic Compost Soil Amendment	70	CY	$40.00	$2,800.00
			Base Construction Cost	**$184,050.00**
			Mobilization (5%)	$9,202.50
			Plantings (5%)	$9,202.50
			Ancillary Items (5%)	$9,202.50
			Erosion & Sediment Control (10%)	$18,405.00
			Subtotal 1	**$230,062.50**
			Contingency (25%)	$57,515.63
			Subtotal 2	**$287,578.13**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$129,410.16
			Total	**$416,988.28**
			Estimated Project Cost	**$420,000.00**

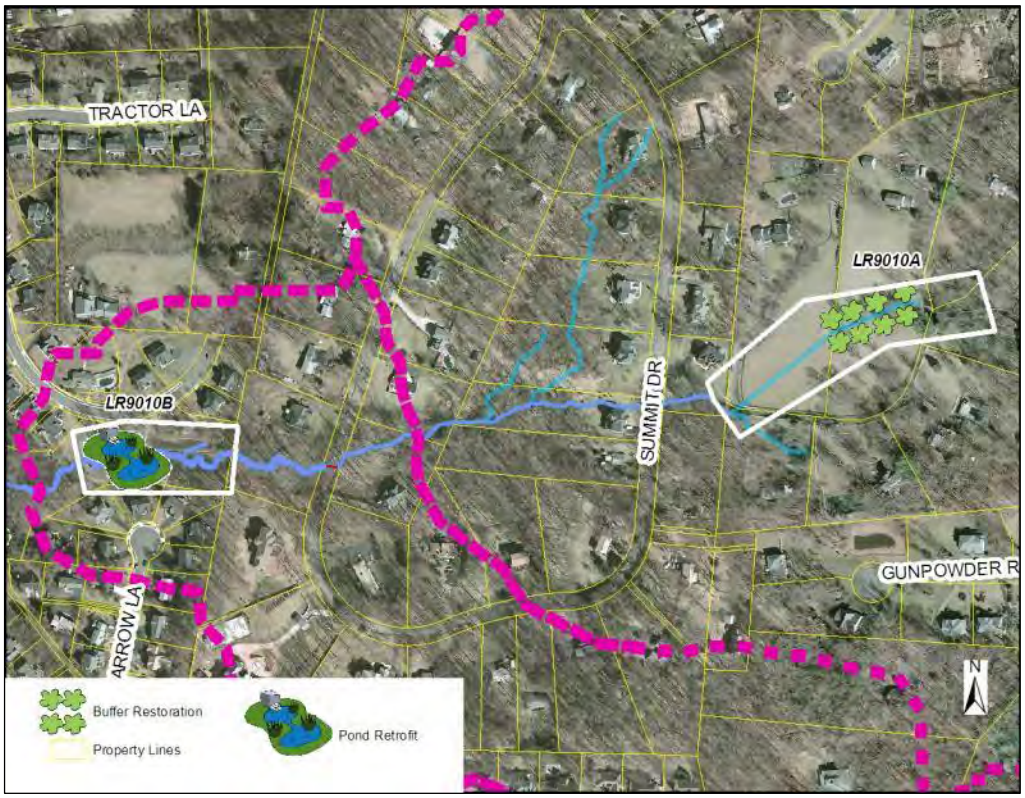
LR9010 Regional Pond Alternative Group



Vicinity Map

Address	5378 Harrow Lane
Location	Subdivision
Landowner	Hampton Woods II Homeowners Association Ellsworth Steven K Smith Arthur Jr (Heirs of)
PIN	0554 13 A 0554 05 0001 0554 05 0002
Control Type	Water quality and quantity control
Drainage Area	162 acres
Receiving Waters	Unnamed Tributary to Willow Springs Branch

Description: This project suite is an alternative to constructing Regional Pond R-10. LR9010A is a buffer restoration project that resides on private property. Just downstream of the proposed buffer restoration, the stream is piped for approximately 350 feet and would benefit from being daylighted, but it also resides on private property. LR9010B is a retrofit of existing stormwater pond 1452DP which proposes removing existing trickle ditches, increasing storage capacity, adding micropools and wetland plantings and altering pond geometry.



Project Area Map

Project Benefits: Project suite will partially simulate pollutant removal of proposed Regional Pond R-10. Loading summaries can be found in Section 6 of the plan. The drainage area consists primarily of private property and the retrofit of the downstream facility is the most practical option. While this suite doesn't achieve the same results as the hypothetical regional, it will still positively impact water quality issues, as described in the individual project components below.

Project	Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
LR9010A*	-	-	-
LR9010B	288.83	38.12	7.04

* Pollutant removals were not calculated for buffer restoration or other non-structural projects.

Project Design Considerations: LR9010A - Main obstacle is that the proposed buffer restoration is on private property. The downstream reach that is piped is currently a mowed lawn for recreational purposes possibly horse riding. There is no existing easement but the site is accessible through Chronical Drive. There are no permitting/sequencing issues. LR9010B - This facility (R-19) is downstream of proposed regional facility R-10. The drainage area primarily consists of low density residential areas. Proposed grading limits are restricted by property boundaries. The available storage volume without acquiring land is small. There are no sequencing/ access issues. A wetland permit may be needed.

Total Cost (9010A & 9010B):

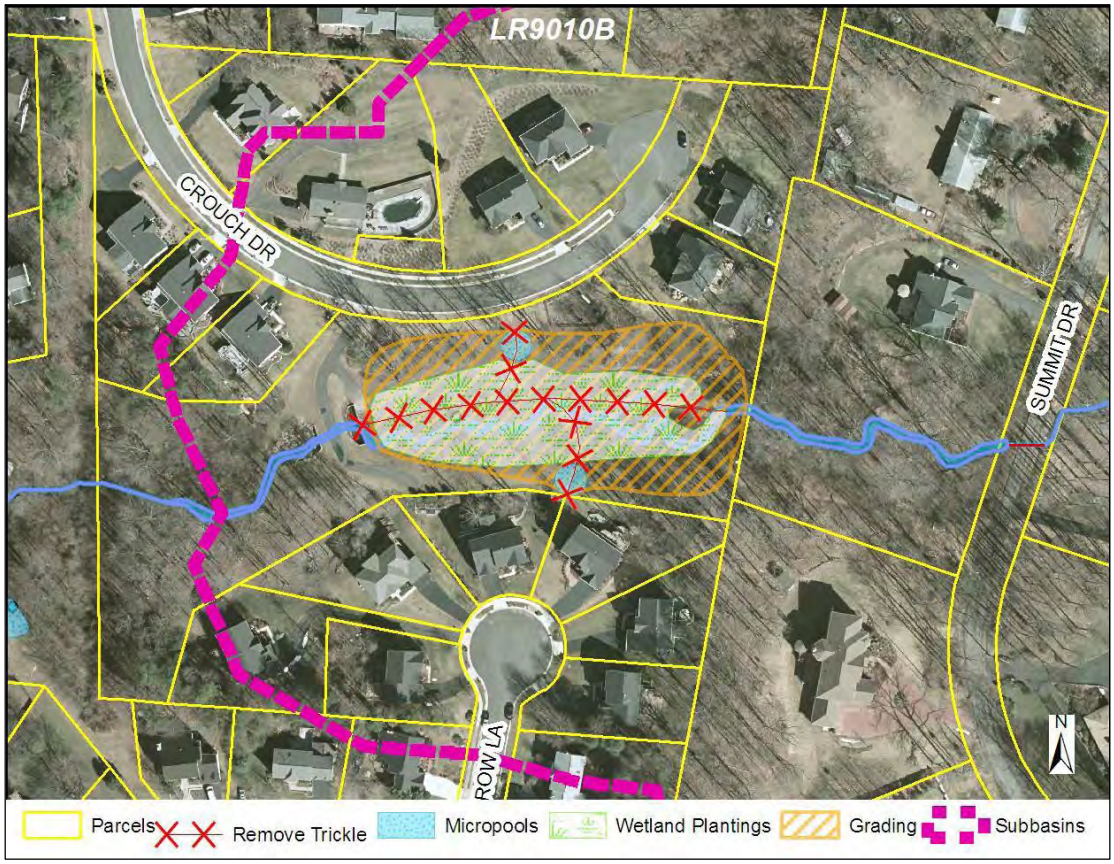
ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Clear and Grub	0.5	AC	$8,500.00	$4,250.00
Grading and Excavation	2500	CY	$35.00	$87,500.00
Structural BMP Retrofit and Incidentals		LS	$10,000 - $20,000	$0.00
Embankment		CY	$50.00	$0.00
Outflow Pipe		LF	$125.00	$0.00
Rip Rap Stabilization		SY	$100.00	$0.00
Organic Compost Soil Amendment	900	CY	$40.00	$36,000.00
Remove Trickle Ditch	335	SY	$10.71	$3,587.85
Plantings	1	AC	$25,000.00	$25,000.00
			Base Construction Cost	**$156,337.85**
			Mobilization (5%)	$7,816.89
			Ancillary Items (5%)	$7,816.89
			Erosion & Sediment Control (10%)	$15,633.79
			Subtotal 1	**$187,605.42**
			Contingency (25%)	$46,901.36
			Subtotal 2	**$234,506.78**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$105,528.05
			Total	**$340,034.82**
			Estimated Project Cost	**$350,000.00**

Project LR9010A:

Description: LR9010A is a proposed buffer restoration. There is insufficient riparian buffer for a 260' reach upstream of Chronical Drive.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Plantings	1	AC	$25,000.00	$25,000.00
Organic Compost Soil Amendment	600	CY	$40.00	$24,000.00
			Base Construction Cost	**$49,000.00**
			Mobilization (5%)	$2,450.00
			Ancillary Items (5%)	$2,450.00
			Invasive Plant Eradication (10%)	$4,900.00
			Erosion & Sediment Control (10%)	$4,900.00
			Subtotal 1	**$63,700.00**
			Contingency (25%)	$15,925.00
			Subtotal 2	**$79,625.00**
Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)				$35,831.25
			Total	**$115,456.25**
			Estimated Project Cost	**$120,000.00**

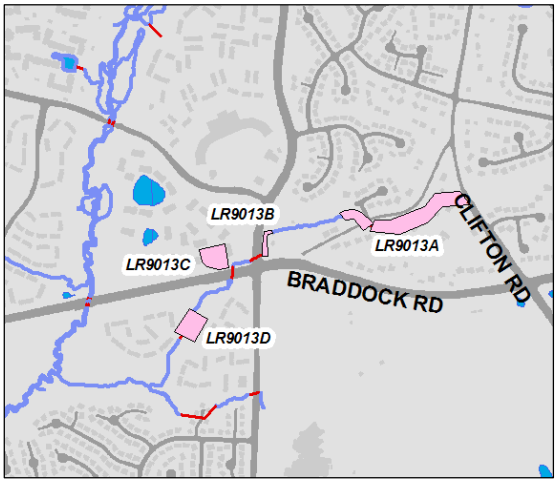
Project LR9010B:



Description: LR9010B is a retrofit to existing facility R-19. Remove the existing trickle ditches. Add micropools and wetland plantings. Modify internal pond geometry – focus on extending the low flow path.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Clear and Grub	0.5	AC	$8,500.00	$4,250.00
Grading and Excavation	2500	CY	$35.00	$87,500.00
Structural BMP Retrofit and Incidentals		LS	$10,000 - $20,000	$0.00
Embankment		CY	$50.00	$0.00
Outflow Pipe		LF	$125.00	$0.00
Rip Rap Stabilization		SY	$100.00	$0.00
Organic Compost Soil Amendment	300	CY	$40.00	$12,000.00
Remove Trickle Ditch	335	SY	$10.71	$3,587.85
			Base Construction Cost	**$107,337.85**
			Mobilization (5%)	$5,366.89
			Ancillary Items (5%)	$5,366.89
			Erosion & Sediment Control (10%)	$10,733.79
			Subtotal 1	**$128,805.42**
			Contingency (25%)	$32,201.36
			Subtotal 2	**$161,006.78**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$72,453.05
			Total	**$233,459.82**
			Estimated Project Cost	**$240,000.00**

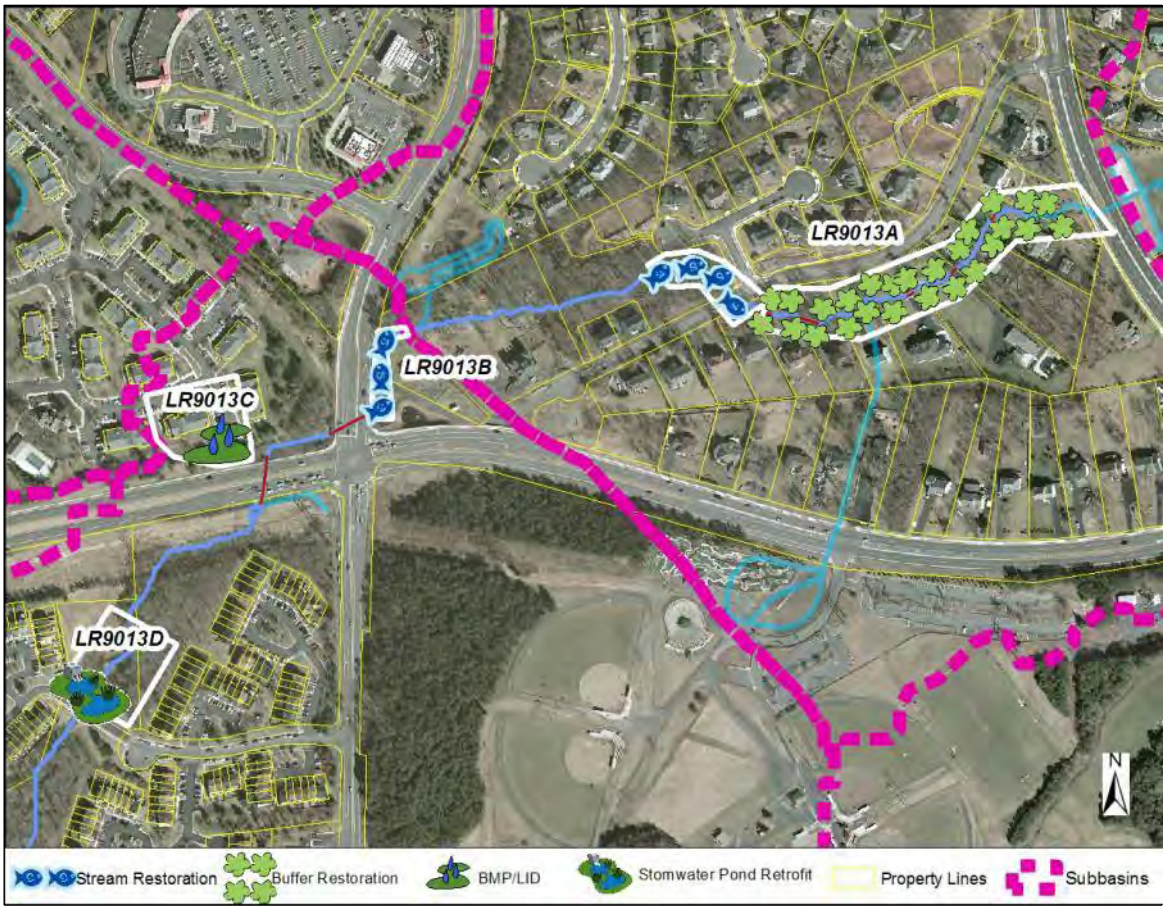
LR9013 Regional Pond Alternative Group



Vicinity Map

Address	13400 Braddock Rd
Location	Subdivision
Landowner	Clifton Pines II HOA VDOT Little Rocky Run HOA The Ponds at Centreville Multiple private landowners
PIN	Multiple PINs
Control Type	Water quality and quantity control
Drainage Area	185 acres
Receiving Waters	Unnamed tributary to Little Rocky Run

Description: The LR9013 Regional Pond Alternative Group is a replacement for regional pond R-13. It consists of a stream and buffer restoration (LR9013A), a second stream restoration (LR9013B), a new BMP (LR9013C) and a pond retrofit (LR9013D).



LR9013 Project Area Map

Project Benefits: Project suite will simulate removal efficiencies from proposed Regional Pond R-13. Loading summaries can be found in Section 6 of the Watershed Management Plan.

Project	Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
LR9013A	1.50	0.58	0.94
LR9013B	2.89	1.12	1.80
LR9013C	13.65	2.18	0.23
LR9013D	16.90	4.18	0.81

Design Considerations: LR9013A: The stream restoration portion of LR9013A is located within a floodplain and stormwater easement on Clifton Pines II HOA property, but most of the buffer restoration is not located within an easement. Coordinate with landowners to restore the riparian buffer. LR9013B: Steep side slopes make access to the project site difficult and must be accounted for in the restoration design, along with the narrow site footprint. LR9013B is partially located on private property (within a storm drainage easement) and is also partially located on VDOT property. LR9013C: LR9013C is not located within an existing easement. The site can be accessed from Orchard Dr. LR9013D: LR9013D is located on Little Rocky Run HOA property within an existing stormwater management easement. The designer must be cautious about expanding either the pond footprint or the floodplain – there appears to be ample room for increased detention, but the pond is surrounded by houses.

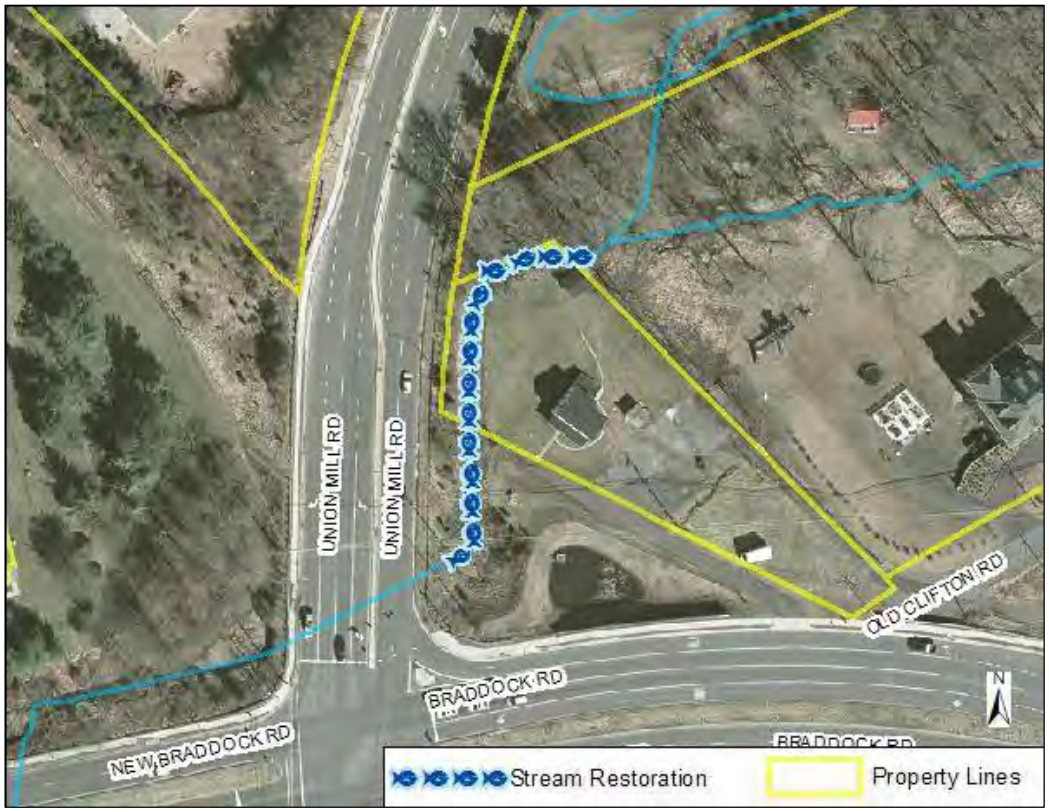
ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Construct New Channel	480	LF	$200.00	$96,000.00
Add'l Cost, first 500 LF	480	LF	$200.00	$96,000.00
Bioretention Filters & Basin	220	SY	$150.00	$33,000.00
Clear and Grub	0.3	AC	$10,000.00	$3,000.00
Grading and Excavation	1400	CY	$35.00	$49,000.00
Organic Compost Soil Amendment	370	CY	$40.00	$14,800.00
Plantings	1	AC	$25,000.00	$25,000.00
Structural BMP Retrofit and Incidentals	1	LS	$10,000 - $20,000	$15,000.00
Vegetated Swale	90	SY	$50.00	$4,500.00
			Base Construction Cost	**$336,300.00**
			Mobilization (5%)	$16,815.00
			Ancillary Items (5%)	$16,815.00
			Erosion & Sediment Control (10%)	$33,630.00
			Subtotal 1	**$403,560.00**
			Contingency (25%)	$100,890.00
			Subtotal 2	**$504,450.00**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$227,002.50
			Total	**$731,452.50**
			Estimated Project Cost	**$740,000.00**

LR9013A Project Area Map

LR9013A Description: LR9013A will reduce pollutant loading, restore eroded areas and prevent future erosion. The riparian buffer will be improved creating important habitat for native wildlife. It will also provide the opportunity to educate property owners about the importance of preserving stream buffers.

LR9013A Costs:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Clear and Grub	0.2	AC	$10,000.00	$2,000.00
Construct New Channel	250	LF	$200.00	$50,000.00
Add'l Cost, first 500 LF	250	LF	$200.00	$50,000.00
Plantings	1	AC	$25,000.00	$25,000.00
			Base Construction Cost	**$127,000.00**
			Mobilization (5%)	$6,350.00
			Ancillary Items (5%)	$6,350.00
			Erosion & Sediment Control (10%)	$12,700.00
			Subtotal 1	**$152,400.00**
			Contingency (25%)	$38,100.00
			Subtotal 2	**$190,500.00**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$85,725.00
			Total	**$276,225.00**
			Estimated Project Cost	**$280,000.00**



LR9013B Project Area Map

LR9013B Description: LR9013B will reduce pollutant loading, provide higher-quality habitat for native wildlife and reduce the potential for future erosion problems.

LR9013B Costs:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Clear and Grub	0.1	AC	$10,000.00	$1,000.00
Construct New Channel	230	LF	$200.00	$46,000.00
Add'l Cost, first 500 LF	230	LF	$200.00	$46,000.00
Plantings	0.1	AC	$25,000.00	$2,500.00
			Base Construction Cost	**$95,500.00**
			Mobilization (5%)	$4,775.00
			Ancillary Items (5%)	$4,775.00
			Erosion & Sediment Control (10%)	$9,550.00
			Subtotal 1	**$114,600.00**
			Contingency (25%)	$28,650.00
			Subtotal 2	**$143,250.00**
Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)				$64,462.50
			Total	**$207,712.50**
			Estimated Project Cost	**$210,000.00**

LR9013C Project Area Map

LR9013C Description: Project LR9013C will provide new water quality treatment for previously untreated stormwater runoff.

LR9013C Costs:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Vegetated Swale	90	SY	$50.00	$4,500.00
Pervious Pavement		SY	$100.00	$0.00
Vegetated Roof		SY	$450.00	$0.00
Percolation/Infiltration Trench		SY	$75.00	$0.00
Bioretention Filters & Basin	220	SY	$150.00	$33,000.00
Manufactured BMP (i.e. Tree Box Filter)	0	EA	$10,000.00	$0.00
Organic Compost Soil Amendment	20	CY	$40.00	$800.00
			Base Construction Cost	**$38,300.00**
			Mobilization (5%)	$1,915.00
			Plantings (5%)	$1,915.00
			Ancillary Items (5%)	$1,915.00
			Erosion & Sediment Control (10%)	$3,830.00
			Subtotal 1	**$47,875.00**
			Contingency (25%)	$11,968.75
			Subtotal 2	**$59,843.75**
Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)				$26,929.69
			Total	**$86,773.44**
			Estimated Project Cost	**$90,000.00**

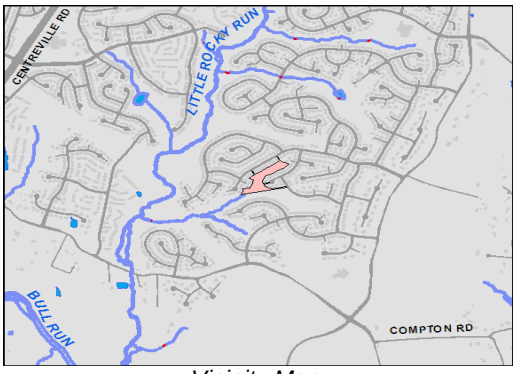
LR9013D Project Area Map

LR9013D Description: Project LR9013D will essentially upgrade an existing pond to a new regional facility. It will eliminate a large amount of phosphorus pollution and will increase storage volume and decrease peak flow. It will also create higher-quality wetland habitat for native wildlife.

LR9013D Costs:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Clear and Grub		AC	$8,500.00	$0.00
Grading and Excavation	1400	CY	$35.00	$49,000.00
Structural BMP Retrofit and Incidentals	1	LS	$10,000 - $20,000	$15,000.00
Embankment		CY	$50.00	$0.00
Outflow Pipe		LF	$125.00	$0.00
Rip Rap Stabilization		SY	$100.00	$0.00
Organic Compost Soil Amendment	350	CY	$40.00	$14,000.00
Remove Trickle Ditch		SY	$10.71	$0.00
			Base Construction Cost	**$78,000.00**
			Mobilization (5%)	$3,900.00
			Plantings (5%)	$3,900.00
			Ancillary Items (5%)	$3,900.00
			Erosion & Sediment Control (10%)	$7,800.00
			Subtotal 1	**$97,500.00**
			Contingency (25%)	$24,375.00
			Subtotal 2	**$121,875.00**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$54,843.75
			Total	**$176,718.75**
			Estimated Project Cost	**$180,000.00**

LR9100 Stormwater Pond Retrofit



Vicinity Map

Address	13943 Stonefield Dr
Location	Subdivision
Landowner	Little Rocky Run Homeowners Association
PIN	0654 02 H1
Control Type	Water quality control
Drainage Area	75 Acres
Receiving Waters	Unnamed Tributary to Little Rocky Run

Description: Project LR9100 involves the retrofit of an existing pond to include wetland plantings and alter the existing pond geometry to extend the flow path. The project will also include removal of existing trickle ditches and the addition of micropools.

Project Area Map

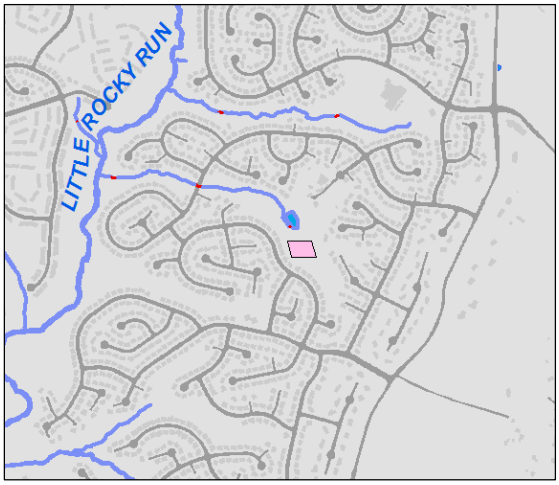
Project Benefits: Nutrient uptake, gravitational settling and sediment trapping will be improved along with pond aesthetics. Wetland plantings can replicate ecosystems for a variety of wildlife (insects, birds, amphibians, etc.).

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
17.69	2.76	0.03

Project Design Considerations: Permitting and access issues are minimal for this existing facility. Stream/Buffer Restoration LR9200 is downstream of this project, but because only quality measures have been proposed, sequencing is not critical. This project can be considered independent from other proposed sites.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Access Road		SY	$25.00	$0.00
Access Road Gate		EA	$2,500.00	$0.00
Clear and Grub	0.05	AC	$8,500.00	$425.00
Structural BMP and Incidentals		LS	$10,000 - $20,000	$0.00
New Storm Pipe		LF	$100 - $300	$0.00
Grading and Excavation	933	CY	$35.00	$32,655.00
Embankment		CY	$50.00	$0.00
Organic Compost Soil Amendment	233	CY	$40.00	$9,320.00
Remove Trickle Ditch	25	SY	$10.71	$267.75
			Base Construction Cost	**$42,667.75**
			Mobilization (5%)	$2,133.39
			Plantings (5%)	$2,133.39
			Ancillary Items (5%)	$2,133.39
			Erosion & Sediment Control (10%)	$4,266.78
			Subtotal 1	**$53,334.69**
			Contingency (25%)	$13,333.67
			Subtotal 2	**$66,668.36**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$30,000.76
			Total	**$96,669.12**
			Estimated Project Cost	**$100,000.00**

LR9102 Stormwater Pond Retrofit



Vicinity Map

Address	6579 Rockland Dr
Location	Subdivision
Landowner	Little Rocky Run HOA
PIN	0654 02 A
Control Type	Water quality control
Drainage Area	57 acres
Receiving Waters	Unnamed tributary to Little Rocky Run

Description: Project LR9102 is a retrofit of an existing stormwater pond. LR9102 will remove existing trickle ditches, increase storage capacity and lower peak flows, and will add micropools and wetland plantings.

Project Area Map

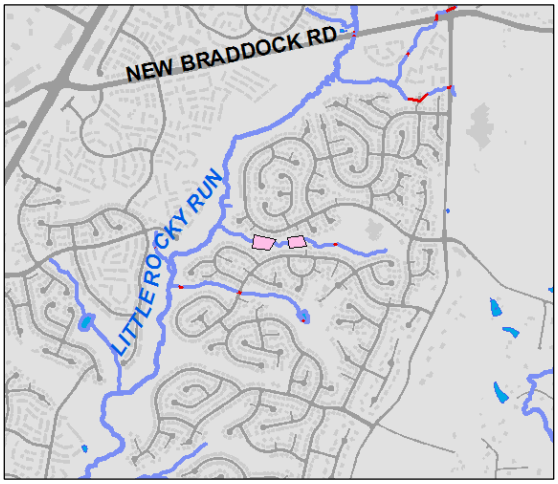
Project Benefits: LR9102 will improve nutrient uptake as well as increase storage volume and decrease peak flow. It will also create higher-quality wetland habitat for native wildlife.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
18.39	4.07	0.12

Project Design Considerations: LR9102 is located upstream of stream restoration project LR9202. Since LR9102 will reduce peak flow, these projects should be coordinated and sequenced so as not to overdesign LR9202. LR9102 is located on Little Rocky Run HOA property, within an existing stormwater management easement.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Access Road		SY	$25.00	$0.00
Access Road Gate		EA	$2,500.00	$0.00
Clear and Grub	0.75	AC	$8,500.00	$6,375.00
Structural BMP and Incidentals	1	LS	$10,000 - $20,000	$15,000.00
New Storm Pipe		LF	$100 - $300	$0.00
Grading and Excavation	1750	CY	$35.00	$61,250.00
Embankment		CY	$50.00	$0.00
Organic Compost Soil Amendment	290	CY	$40.00	$11,600.00
			Base Construction Cost	**$94,225.00**
			Mobilization (5%)	$4,711.25
			Plantings (5%)	$4,711.25
			Ancillary Items (5%)	$4,711.25
			Erosion & Sediment Control (10%)	$9,422.50
			Subtotal 1	**$117,781.25**
			Contingency (25%)	$29,445.31
			Subtotal 2	**$147,226.56**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$66,251.95
			Total	**$213,478.52**
			Estimated Project Cost	**$220,000.00**

LR9103 Stormwater Pond Retrofit



Vicinity Map

Address	13815 Springstone Dr
Location	Subdivision
Landowner	Little Rocky Run HOA
PIN	0652 07 E 0654 04 L 0654 04 O 0654 04 P
Control Type	Water quality control
Drainage Area	147 acres
Receiving Waters	Little Rocky Run

Description: The LR9103 project area suffers from channel erosion and a clogged pond riser structure. LR9103 will restore the stream to a more stable, natural state to prevent future erosion and promote habitat health and diversity. The pond retrofit includes clearing the riser structure, constructing micropools and adding wetland plantings. New BMP/LID facilities will also be installed nearby.

Project Area Map

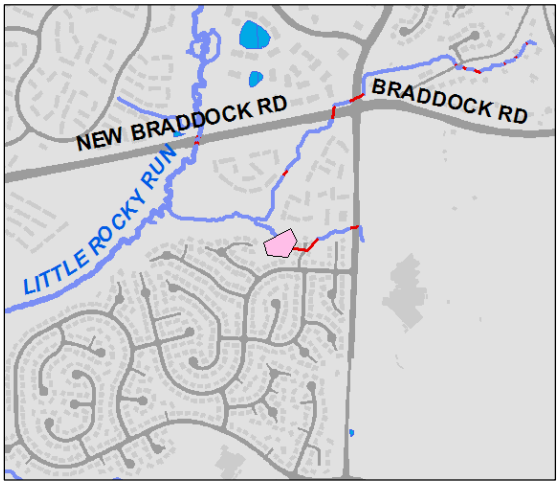
Project Benefits: Project LR9103 will mitigate nitrogen, phosphorus, and sediment by creating micropools, introducing wetland plantings, repairing instream erosion, and by installing tree box filters. Approximately 340 linear feet of stream channel will be restored, providing higher quality habitat for fish and wildlife.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
17.34	4.40	2.52

Project Design Considerations: Project LR9514 is located along Springstone Dr. Coordination and sequencing of these projects should be considered. LR9103 is accessible from Springstone Dr, and is located on Little Rocky Run HOA property within existing floodplain and stormwater management easements. As with any stream restoration, there are significant environmental permitting requirements for this project. Impacts to trees will be inevitable, but the long-term environmental benefits of the LR9103 stream restoration project will outweigh the short-term environmental costs.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Access Road		SY	$25.00	$0.00
Access Road Gate	1	EA	$2,500.00	$2,500.00
Clear and Grub	1	AC	$8,500.00	$8,500.00
Structural BMP and Incidentals		LS	$10,000 - $20,000	$0.00
New Storm Pipe		LF	$100 - $300	$0.00
Grading and Excavation	1025	CY	$35.00	$35,875.00
Embankment		CY	$50.00	$0.00
Organic Compost Soil Amendment	512.5	CY	$40.00	$20,500.00
Construct New Channel	340	LF	$200.00	$68,000.00
Add'l Cost, first 500 LF	340	LF	$200.00	$68,000.00
Manufactured BMP (ie:Tree Box Filter)	3	EA	$10,000.00	$30,000.00
Plantings	0.5	AC	$25,000.00	$12,500.00
			Base Construction Cost	**$245,875.00**
			Mobilization (5%)	$12,293.75
			Plantings (5%)	$12,293.75
			Ancillary Items (5%)	$12,293.75
			Erosion & Sediment Control (10%)	$24,587.50
			Subtotal 1	**$307,343.75**
			Contingency (25%)	$76,835.94
			Subtotal 2	**$384,179.69**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$172,880.86
			Total	**$557,060.55**
			Estimated Project Cost	**$560,000.00**

LR9106 Stormwater Pond Retrofit



Vicinity Map

Address	13534 Union Village Circle
Location	Subdivision
Landowner	Little Rocky Run HOA
PIN	0661 04 B1
Control Type	Water quality control
Drainage Area	103 acres
Receiving Waters	Unnamed tributary to Little Rocky Run

Description: Project LR9106 will retrofit an existing stormwater pond to provide improved water quality control. Existing concrete trickle ditches will be removed in combination with constructing new micropools and adding wetland plantings.

Project Area Map

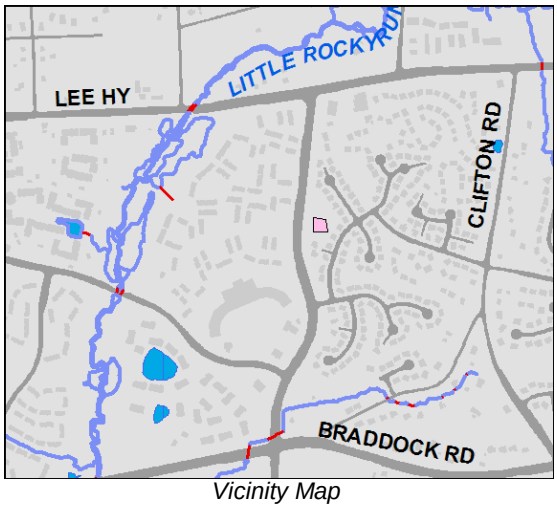
Project Benefits: Pond retrofit will improve nutrient uptake, sediment trapping, pond aesthetics, and wildlife habitat.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
14.51	3.18	0.10

Project Design Considerations: New BMP/LID LR9515 is located approximately 700 ft west of LR9106. Coordination of LR9106 and LR9515 should be considered. Permitting factors should be minimal. The pond is located near several houses, and care should be taken not to disturb adjacent private property.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Access Road		SY	$25.00	$0.00
Access Road Gate		EA	$2,500.00	$0.00
Clear and Grub	1	AC	$8,500.00	$8,500.00
Structural BMP and Incidentals		LS	$10,000 - $20,000	$0.00
New Storm Pipe		LF	$100 - $300	$0.00
Grading and Excavation	1670	CY	$35.00	$58,450.00
Embankment		CY	$50.00	$0.00
Organic Compost Soil Amendment	420	CY	$40.00	$16,800.00
Remove Trickle Ditch	250	SY	$10.71	$2,677.50
			Base Construction Cost	**$83,750.00**
			Mobilization (5%)	$4,187.50
			Plantings (5%)	$4,187.50
			Ancillary Items (5%)	$4,187.50
			Erosion & Sediment Control (10%)	$8,375.00
			Subtotal 1	**$104,687.50**
			Contingency (25%)	$26,171.88
			Subtotal 2	**$130,859.38**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$58,886.72
			Total	**$189,746.09**
			Estimated Project Cost	**$190,000.00**

LR9109 Stormwater Pond Retrofit



Vicinity Map

Address	5604 Cavalier Woods La
Location	Subdivision
Landowner	Cavalier Woods HOA
PIN	0553 05 A
Control Type	Water quality control
Drainage Area	10 acres
Receiving Waters	Unnamed tributary to Little Rocky Run

Description: Project LR9109 is a retrofit of the existing stormwater pond shown below. The existing trickle ditch will be removed in combination with constructing micropools and adding wetland plantings.

Project Area Map

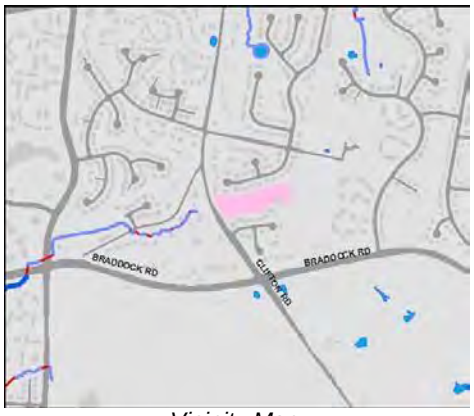
Project Benefits: Stormwater pond retrofit LR9109 will improve nutrient uptake and sediment removal and will also provide critical habitat for birds and other wildlife.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
4.59	1.51	0.97

Project Design Considerations: The stormwater pond, which can be accessed from Cavalier Woods Drive, is located on Cavalier Woods HOA property, within an existing storm drainage easement.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Access Road		SY	$25.00	$0.00
Access Road Gate		EA	$2,500.00	$0.00
Clear and Grub	0.2	AC	$8,500.00	$1,700.00
Structural BMP and Incidentals		LS	$10,000 - $20,000	$0.00
New Storm Pipe		LF	$100 - $300	$0.00
Grading and Excavation	300	CY	$35.00	$10,500.00
Embankment		CY	$50.00	$0.00
Organic Compost Soil Amendment	75	CY	$40.00	$3,000.00
			Base Construction Cost	**$15,200.00**
			Mobilization (5%)	$760.00
			Plantings (5%)	$760.00
			Ancillary Items (5%)	$760.00
			Erosion & Sediment Control (10%)	$1,520.00
			Subtotal 1	**$19,000.00**
			Contingency (25%)	$4,750.00
			Subtotal 2	**$23,750.00**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$10,687.50
			Total	**$34,437.50**
			Estimated Project Cost	**$40,000.00**

LR9110 Stormwater Pond Retrofit



Vicinity Map

Address	13214 Kilby Landing Ct
Location	Subdivision
Landowner	Clifton Manor Homeowners Association, Inc.
PIN	0661 12 A
Control Type	Water quality and quantity control
Drainage Area	82 Acres
Receiving Waters	Unnamed Tributary to Little Rocky Run

Description: Project LR9110 includes the retrofit of an existing facility to include wetland plantings and micropools, removal of trickle ditches and modification of the pond geometry to extend the low flow path.

Project Area Map

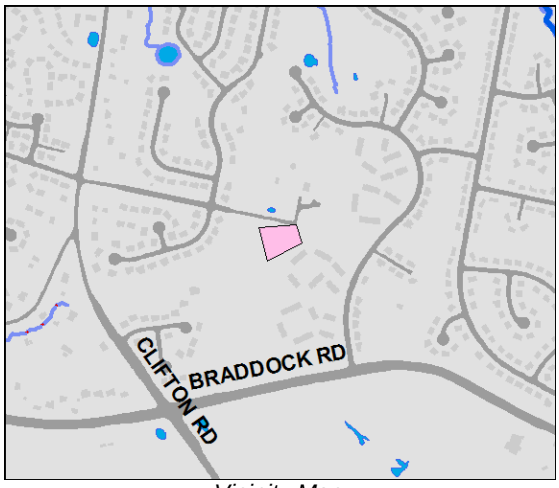
Project Benefits: Nutrient uptake, gravitational settling and sediment trapping will be improved along with pond aesthetics. Wetland plantings can replicate ecosystems for a variety of wildlife (insects, birds, amphibians, etc.).

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
42.21	2.32	0.35

Project Design Considerations: No increase in storage volume has been proposed, but pond geometry changes can be made without affecting storage volumes. Emergency spillway directs the flow across Clifton Road. There is no room to expand the foot print without tree impacts. The project is furthest upstream of a series of projects along this tributary to Little Rocky Run. The proposed measures benefit water quality only and therefore sequencing/coordination with neighboring projects is not critical.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Clear and Grub		AC	$8,500.00	$0.00
Grading and Excavation	1150	CY	$35.00	$40,250.00
Structural BMP Retrofit and Incidentals		LS	$10,000 - $20,000	$0.00
Embankment		CY	$50.00	$0.00
Outflow Pipe		LF	$125.00	$0.00
Rip Rap Stabilization		SY	$100.00	$0.00
Organic Compost Soil Amendment	290	CY	$40.00	$11,600.00
Remove Trickle Ditch	270	SY	$10.71	$2,891.70
			Base Construction Cost	**$54,741.70**
			Mobilization (5%)	$2,737.09
			Ancillary Items (5%)	$2,737.09
			Erosion & Sediment Control (10%)	$5,474.17
			Subtotal 1	**$65,690.04**
			Contingency (25%)	$16,422.51
			Subtotal 2	**$82,112.55**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$36,950.65
			Total	**$119,063.20**
			Estimated Project Cost	**$120,000.00**

LR9111 Stormwater Pond Retrofit



Vicinity Map

Address	13022 Cobble La
Location	Subdivision
Landowner	Hayden Village Community Association
PIN	0661 10 A
Control Type	Water quality control
Drainage Area	25 acres
Receiving Waters	Unnamed tributary to Little Rocky Run

Description: Project LR9111 will retrofit an existing stormwater pond to provide improved water quality control. Existing concrete trickle ditches will be removed in combination with constructing new micropools and adding wetland plantings.

Project Area Map

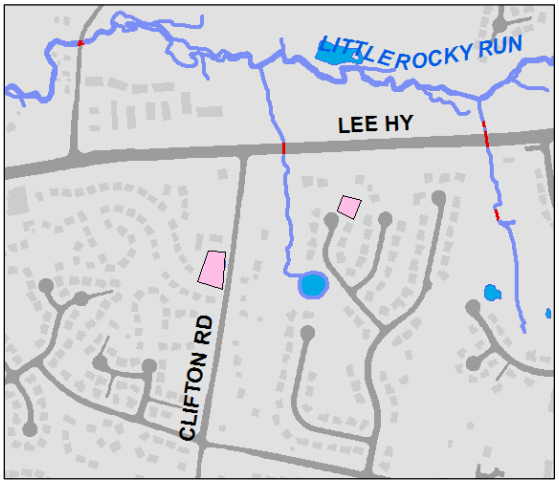
Project Benefits: Pond retrofit LR9111 will improve nutrient uptake, sediment trapping, pond aesthetics and wildlife habitat.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
2.67	0.42	0.01

Project Design Considerations: Spatial constraints for pond retrofit LR9111 should be considered, but are not anticipated to be severe enough to limit the project scope. Overhead lines located approximately 100 feet west of the project site should be avoided.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Access Road		SY	$25.00	$0.00
Access Road Gate		EA	$2,500.00	$0.00
Clear and Grub	0.5	AC	$8,500.00	$4,250.00
Structural BMP and Incidentals		LS	$10,000 - $20,000	$0.00
New Storm Pipe		LF	$100 - $300	$0.00
Grading and Excavation	800	CY	$35.00	$28,000.00
Embankment		CY	$50.00	$0.00
Organic Compost Soil Amendment	200	CY	$40.00	$8,000.00
Remove Trickle Ditch	100	SY	$10.71	$1,071.00
			Base Construction Cost	**$40,250.00**
			Mobilization (5%)	$2,012.50
			Plantings (5%)	$2,012.50
			Ancillary Items (5%)	$2,012.50
			Erosion & Sediment Control (10%)	$4,025.00
			Subtotal 1	**$50,312.50**
			Contingency (25%)	$12,578.13
			Subtotal 2	**$62,890.63**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$28,300.78
			Total	**$91,191.41**
			Estimated Project Cost	**$100,000.00**

LR9114 Stormwater Pond Retrofit



Vicinity Map

Address	13114 Blue Willow Pl 5574 Clifton Crest Way
Location	Subdivision
Landowner	Clifton Farm HOA Clifton Crest HOA
PIN	0553 06 C 0553 16 B
Control Type	Water quality control
Drainage Area	13 acres
Receiving Waters	Unnamed tributary to Little Rocky Run

Description: Project LR9114 will retrofit two existing stormwater ponds to provide improved water quality control. Existing concrete trickle ditches will be removed in combination with constructing new micropools and adding wetland plantings.

Project Area Map

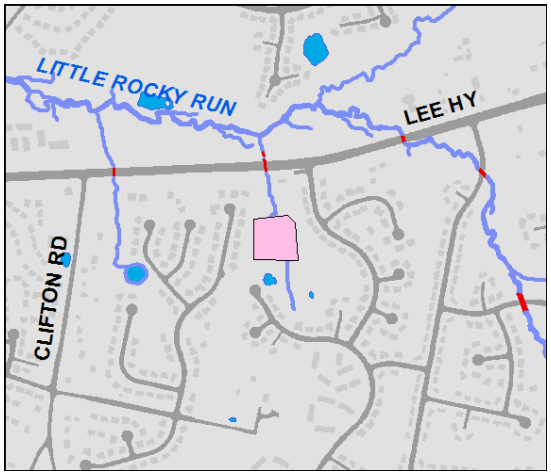
Project Benefits: Pond retrofit suite LR9114 will improve uptake, sediment trapping, pond aesthetics, and wildlife habitat.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
32.46	4.10	0.17

Project Design Considerations: LR9114A is located on Clifton Crest HOA property and LR9114B is located on Clifton Farm HOA property. Both are located within existing stormwater management easements. As space is somewhat limited at both pond retrofit locations, care should be taken to limit increases in ponded area.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Access Road		SY	$25.00	$0.00
Access Road Gate		EA	$2,500.00	$0.00
Clear and Grub		AC	$8,500.00	$0.00
Structural BMP and Incidentals		LS	$10,000 - $20,000	$0.00
New Storm Pipe		LF	$100 - $300	$0.00
Grading and Excavation	500	CY	$35.00	$17,500.00
Embankment		CY	$50.00	$0.00
Organic Compost Soil Amendment	125	CY	$40.00	$5,000.00
Remove Trickle Ditch	100	SY	$10.71	$1,071.00
			Base Construction Cost	**$23,571.00**
			Mobilization (5%)	$1,178.55
			Plantings (5%)	$1,178.55
			Ancillary Items (5%)	$1,178.55
			Erosion & Sediment Control (10%)	$2,357.10
			Subtotal 1	**$29,463.75**
			Contingency (25%)	$7,365.94
			Subtotal 2	**$36,829.69**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$16,573.36
			Total	**$53,403.05**
			Estimated Project Cost	**$60,000.00**

LR9115 Stormwater Pond Retrofit



Vicinity Map

Address	5403 Willow Valley Rd
Location	Subdivision
Landowner	Hayden Village Community Association
PIN	0553 08 L 0553 08 D1
Control Type	Water quality and quantity control
Drainage Area	39 acres
Receiving Waters	Unnamed tributary to Little Rocky Run

Description: Project LR9115 is a retrofit of R-7, an existing regional stormwater pond. Storage volume will be increased, existing trickle ditches will be removed and micropools and wetland plantings will be added.

Project Area Map

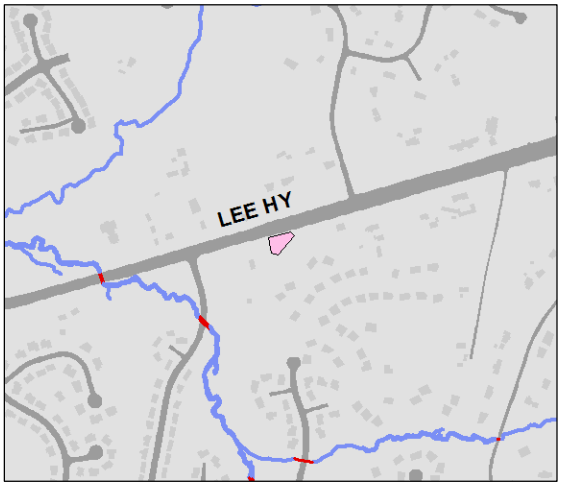
Project Benefits: Pond retrofit LR9115 will improve nutrient uptake and sediment removal, and will increase storage volume and decrease peak flow. It will also create higher-quality wetland habitat for native wildlife.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
66.37	2.02	0.16

Project Design Considerations: Pond retrofit LR9115 is located on Hayden Village Community Association property within an existing storm drainage easement. Sufficient space is available to increase the ponded area. The project site can be easily accessed from Sandy Point Lane. Some impacts to mature trees may occur.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Access Road		SY	$25.00	$0.00
Access Road Gate		EA	$2,500.00	$0.00
Clear and Grub	1	AC	$8,500.00	$8,500.00
Structural BMP and Incidentals	1	LS	$10,000 - $20,000	$15,000.00
New Storm Pipe		LF	$100 - $300	$0.00
Grading and Excavation	2420	CY	$35.00	$84,700.00
Embankment		CY	$50.00	$0.00
Organic Compost Soil Amendment	400	CY	$40.00	$16,000.00
			Base Construction Cost	**$124,200.00**
			Mobilization (5%)	$6,210.00
			Plantings (5%)	$6,210.00
			Ancillary Items (5%)	$6,210.00
			Erosion & Sediment Control (10%)	$12,420.00
			Subtotal 1	**$155,250.00**
			Contingency (25%)	$38,812.50
			Subtotal 2	**$194,062.50**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$87,328.13
			Total	**$281,390.63**
			Estimated Project Cost	**$290,000.00**

LR9117 Stormwater Pond Retrofit



Vicinity Map

Address	12837 Lee Hwy
Location	Highway
Landowner	Herring W W LLLP
PIN	0554 01 0037
Control Type	Water quality control
Drainage Area	29 acres
Receiving Waters	Unnamed tributary to Willow Spring Branch

Description: Project LR9117 will retrofit an existing stormwater pond to provide improved water quality control. Existing concrete trickle ditches will be removed in combination with constructing new micropools and adding wetland plantings.

Project Area Map

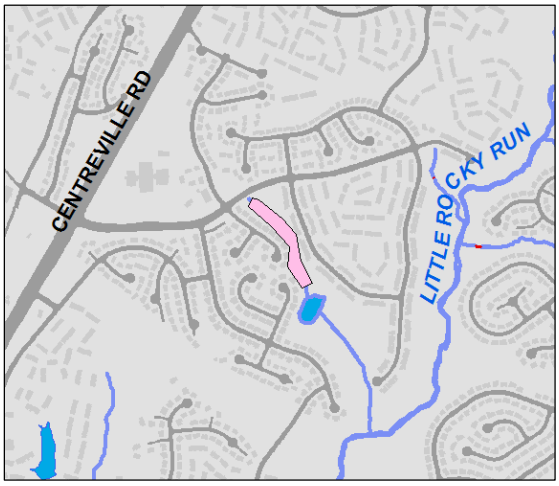
Project Benefits: Pond retrofit LR9117 will improve nutrient uptake, sediment trapping, pond aesthetics and wildlife habitat.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
45.41	11.05	4.46

Project Design Considerations: Due to space constraints, the footprint of the pond cannot be significantly increased. LR9117 is located on private property within existing storm drainage and detention pond easements.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Access Road		SY	$25.00	$0.00
Access Road Gate		EA	$2,500.00	$0.00
Clear and Grub	0.2	AC	$8,500.00	$1,700.00
Structural BMP and Incidentals		LS	$10,000 - $20,000	$0.00
New Storm Pipe		LF	$100 - $300	$0.00
Grading and Excavation	280	CY	$35.00	$9,800.00
Embankment		CY	$50.00	$0.00
Organic Compost Soil Amendment	70	CY	$40.00	$2,800.00
			Base Construction Cost	**$14,300.00**
			Mobilization (5%)	$715.00
			Plantings (5%)	$715.00
			Ancillary Items (5%)	$715.00
			Erosion & Sediment Control (10%)	$1,430.00
			Subtotal 1	**$17,875.00**
			Contingency (25%)	$4,468.75
			Subtotal 2	**$22,343.75**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$10,054.69
			Total	**$32,398.44**
			Estimated Project Cost	**$40,000.00**

LR9201 Stream Restoration



Vicinity Map

Address	14104 Sorrel Chase Ct
Location	Subdivision
Landowner	Green Trails HOA
PIN	0654 03 C 0654 0304 M
Control Type	Water quality control
Drainage Area	188 acres
Receiving Waters	Little Rocky Run

Description: The Green Trails Homeowners Association has noted that the tributary to Little Rocky Run shown below suffers from erosion and poor flow. Subsequent field visits confirmed a stagnant system with little habitat support. Project LR9201 will restore the stream to a more stable, natural state to prevent future erosion and promote habitat health and diversity.

Project Area Map

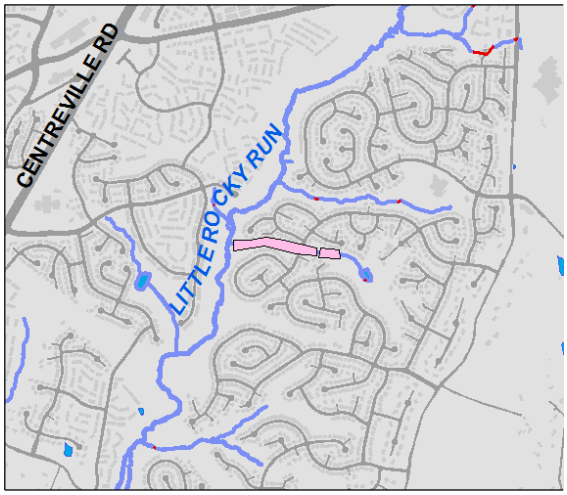
Project Benefits: Project LR9201 will reduce phosphorus, nitrogen and sediment loading in the tributary to Johnny Moore Creek, and restore 1250 linear feet of stream channel. Higher quality habitat for fish and wildlife will also be provided. Successful implementation of LR9201 may also have positive effects on nearby property values.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
12.58	4.87	7.86

Project Design Considerations: New BMP/LID project LR9509 is located just upstream of LR9201, on the north side of Green Trails Blvd. Coordination and sequencing of these two projects should be considered. The project site is accessible from Green Trails Blvd or Palisades Dr, and is located on Green Trails HOA property within existing floodplain/storm drainage easements. Given that the Green Trails HOA brought attention to the site, significant landowner support is likely. As with any stream restoration, there are significant environmental permitting requirements for this project. Impacts to trees will be inevitable, but the long-term environmental benefits of the LR9201 stream restoration project will outweigh the short-term environmental costs.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Clear and Grub	0.85	AC	$10,000.00	$8,500.00
Construct New Channel	1250	LF	$200.00	$250,000.00
Add'l Cost, first 500 LF	500	LF	$200.00	$100,000.00
Plantings	0.85	AC	$25,000.00	$21,250.00
			Base Construction Cost	**$379,750.00**
			Mobilization (5%)	$18,987.50
			Ancillary Items (5%)	$18,987.50
			Erosion & Sediment Control (10%)	$37,975.00
			Subtotal 1	**$455,700.00**
			Contingency (25%)	$113,925.00
			Subtotal 2	**$569,625.00**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$256,331.25
			Total	**$825,956.25**
			Estimated Project Cost	**$830,000.00**

LR9202 Stream Restoration Project Suite



Vicinity Map

Address	6419 Stonehaven Ct
Location	Subdivision
Landowner	Little Rocky Run HOA
PIN	0654 04 N 0654 02 B 0654 04 Q 0654 04 R
Control Type	Water quality control
Drainage Area	141 acres
Receiving Waters	Little Rocky Run

Description: Project suite LR9202 will provide improved water quality control. It incorporates stream restoration, buffer restoration and pond retrofit techniques.

Project Area Map

Project Benefits: Project LR9202 will improve phosphorus, nitrogen and sediment uptake in the unnamed tributary to Little Rocky Run shown in the project area map. It will also provide improved habitat for wildlife.

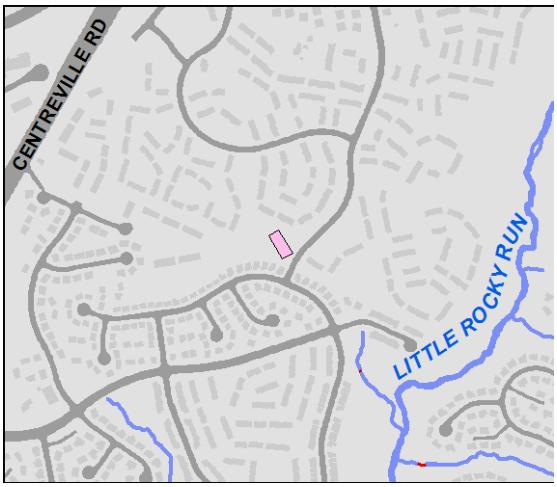
Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
69.41	10.53	0.54

Project Design Considerations: New BMP/LID project LR9507 is located approximately 0.3 miles southwest of LR9202 along South Springs Drive. Pond retrofit LR9102 is also located approximately 0.2 miles upstream of LR9202. Coordination and sequencing of these projects should be considered. Due to ongoing channel erosion, a more extensive site investigation should be conducted before implementation to determine the necessary extent of new stream channel design and construction. As with any stream restoration, there are significant environmental permitting requirements for this project. Impacts to trees will be inevitable, but the long-term environmental benefits of the Stream Restoration will outweigh the short-term environmental costs.

Costs:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Clear and Grub (stream restoration)	0.35	AC	$10,000.00	$3,500.00
Construct New Channel	300	LF	$200.00	$60,000.00
Add'l Cost, first 500 LF	300	LF	$200.00	$60,000.00
Plantings (stream and buffer restoration)	2.35	AC	$25,000.00	$58,750.00
Access Road	3280	SY	$25.00	$82,000.00
Access Road Gate	2	EA	$2,500.00	$5,000.00
Clear and Grub (pond retrofits)	0.8	AC	$8,500.00	$6,800.00
Structural BMP and Incidentals		LS	$10,000 - $20,000	$0.00
New Storm Pipe		LF	$100 - $300	$0.00
Grading and Excavation	1260	CY	$35.00	$44,100.00
Embankment		CY	$50.00	$0.00
Organic Compost Soil Amendment (pond retrofits and buffer restoration)	1120	CY	$40.00	$44,800.00
Remove Trickle Ditch	184	SY	$10.71	$1,970.64
			Base Construction Cost	**$366,920.64**
			Mobilization (5%)	$18,346.03
			Plantings (pond retrofits) (5%)	$9,233.53
			Ancillary Items (5%)	$18,346.03
			Erosion & Sediment Control (10%)	$36,692.06
			Subtotal 1	**$449,538.30**
			Contingency (25%)	$112,384.58
			Subtotal 2	**$561,922.88**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$252,865.29
			Total	**$814,788.17**
			Estimated Project Cost	**$820,000.00**

LR9203 Stream Restoration



Vicinity Map

Address	14100 Wood Rock Way
Location	Subdivision
Landowner	Heritage Forest HOA
PIN	0652 09 F2
Control Type	Water quality control
Drainage Area	20 acres
Receiving Waters	Unnamed tributary to Little Rocky Run

Description: Project LR9203 will restore the existing paved ditch shown below with a natural channel system. This small stream restoration will use step pools to dissipate excess energy and prevent future erosion.

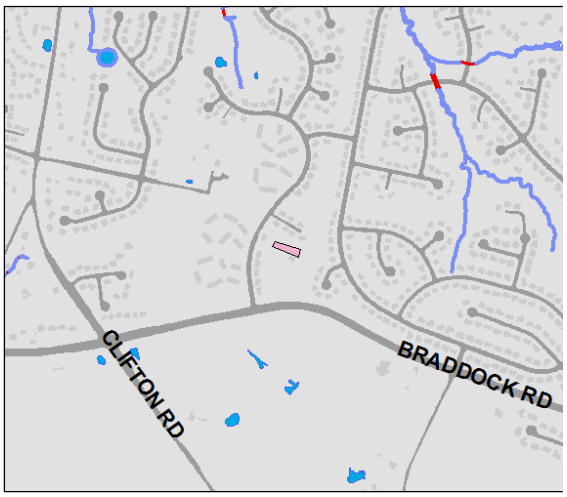
Project Benefits: LR9203 will reduce phosphorus, nitrogen and sediment loading by restoring 330 feet of paved channel with a more natural, permeable system. Higher quality habitat for native wildlife will be created and LR9203 may have beneficial effects on nearby property values.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
3.32	1.29	2.07

Project Design Considerations: The LR9203 project site is located on Heritage Forest HOA property, within an existing storm drainage easement. The site can be easily accessed from Singletons Way. Permitting requirements and impacts to mature trees will be minimal, if any.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Clear and Grub		AC	$10,000.00	$0.00
Remove Concrete Ditch	380	SY	$10.71	$4,069.80
Construct New Channel	330	LF	$200.00	$66,000.00
Add'l Cost, first 500 LF	330	LF	$200.00	$66,000.00
Plantings	0.1	AC	$25,000.00	$2,500.00
			Base Construction Cost	**$138,569.80**
			Mobilization (5%)	$6,928.49
			Ancillary Items (5%)	$6,928.49
			Erosion & Sediment Control (10%)	$13,856.98
			Subtotal 1	**$166,283.76**
			Contingency (25%)	$41,570.94
			Subtotal 2	**$207,854.70**
Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)				$93,534.62
			Total	**$301,389.32**
			Estimated Project Cost	**$310,000.00**

LR9204 Stream Restoration



Vicinity Map

Address	5587A Rockpointe Dr
Location	Subdivision
Landowner	Hayden Village Community Association
PIN	0661 11 K1
Control Type	Water quality control
Drainage Area	4 acres
Receiving Waters	Unnamed tributary to Little Rocky Run

Description: Stream restoration LR9204 will restore the concrete ditch shown below to a natural stream channel. This small restoration stream restoration project will consist of linear bioretention basins – a unique stream restoration technique which will significantly reduce construction costs.

Project Benefits: LR9204 will reduce phosphorus, nitrogen and sediment loading by restoring 230 feet of paved channel with a more natural, permeable system. Higher quality habitat for native wildlife will also be provided.

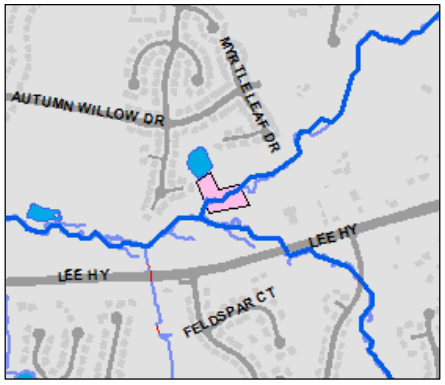
Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
2.44	0.95	1.53

Project Design Considerations: Pond retrofit LR9111 is located approximately 1000 feet downstream of the LR9204 project site. Coordination of these two projects should be considered due to their proximity.

Costs:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Clear and Grub	0.1	AC	$10,000.00	$1,000.00
Remove Concrete Ditch	167	SY	$10.71	$1,788.57
Bioretention Filters & Basins	300	SY	$150.00	$45,000.00
			Base Construction Cost	**$47,788.57**
			Mobilization (5%)	$2,389.43
			Ancillary Items (5%)	$2,389.43
			Erosion & Sediment Control (10%)	$4,778.86
			Subtotal 1	**$57,346.28**
			Contingency (25%)	$14,336.57
			Subtotal 2	**$71,682.86**
Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)				$32,257.28
			Total	**$103,940.14**
			Estimated Project Cost	**$110,000.00**

LR9205 Stream Restoration



Vicinity Map

Address	5217 Whisper Willow Dr
Location	Pond outfalls near subdivision
Landowner	Fairfax County Park Authority
PIN	0553 10 S
Control Type	Water Quality
Drainage Area	632 acres
Receiving Waters	Little Rocky Run

Description: The pond outfalls shown below that drain to Little Rocky Run are causing scouring and erosion. Stream restoration project LR9205 will restore the stream to a more stable, natural state to prevent future erosion and promote habitat health and diversity.

Project Area Map

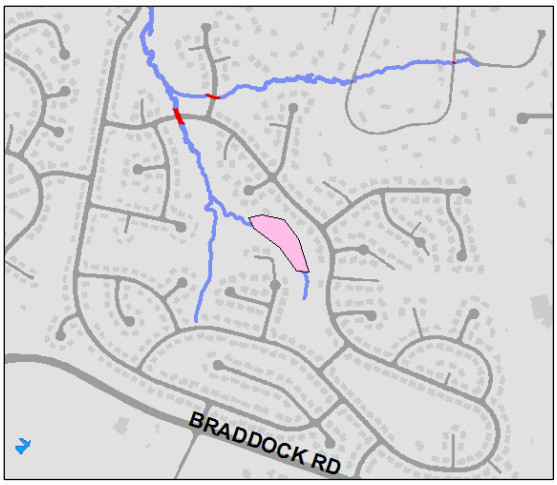
Project Benefits: Stream restoration project will remove nitrogen, phosphorus, and sediment pollution by restoring approximately 580 feet of natural stream channel. Higher quality habitat for fish and wildlife will also be provided.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
30.02	11.61	15.68

Project Design Considerations: Coordination with pond retrofit LR9116 should be considered, as the pond is located just upstream of the project site (and is visible on right side of the project area map for LR9205). The site is accessible from Whisper Willow Dr and is located on Fairfax County Park Authority property. As with any stream restoration, there are significant potential permitting requirements for this project, including dam safety permits. Impacts to trees will be inevitable due to the densely wooded site, but the long-term environmental benefits of stream restoration LR9205 will outweigh the short-term environmental costs. The project design/construction should include provisions to remove or trim trees which the Park Authority determines to have died or to have been irreparably damaged as a result of project impacts for a period of five years after completion of the project.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Clear and Grub	0.46	AC	$10,000.00	$4,600.00
Construct New Channel	580	LF	$200.00	$116,000.00
Add'l Cost, first 500 LF	500	LF	$200.00	$100,000.00
Plantings	0.46	AC	$25,000.00	$11,500.00
			Base Construction Cost	**$232,100.00**
			Mobilization (5%)	$11,605.00
			Ancillary Items (5%)	$11,605.00
			Erosion & Sediment Control (10%)	$23,210.00
			Subtotal 1	**$278,520.00**
			Contingency (25%)	$69,630.00
			Subtotal 2	**$348,150.00**
Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)				$156,667.50
			Total	**$504,817.50**
			Estimated Project Cost	**$510,000.00**

LR9207 Stream Restoration



Vicinity Map

Address	5378 Ashleigh Rd
Location	Subdivision
Landowner	Hampton Chase HOA Hampton Forest HOA
PIN	0662 05 G1 0662 05 D 0554 07 C2
Control Type	Water quality control
Drainage Area	152 acres
Receiving Waters	Unnamed tributary to Willow Spring Branch

Description: The unnamed tributary to Willow Spring Branch shown below suffers from channel erosion. LR9207 will restore the stream to a more stable, natural state to prevent future erosion and promote habitat health and diversity.

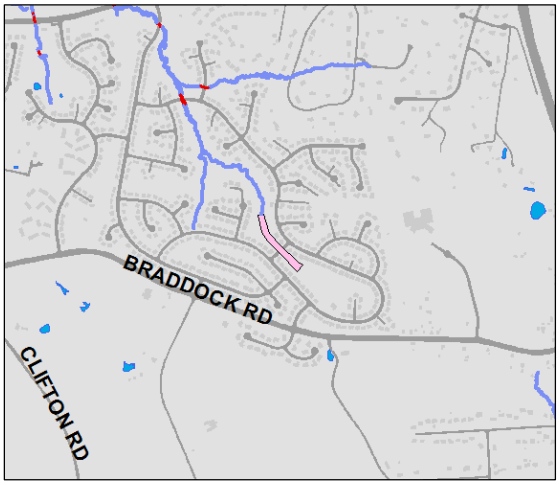
Project Benefits: LR9207 will restore 850 linear feet of stream channel to reduce phosphorus, nitrogen and sediment loading. Higher quality habitat for aquatic and terrestrial wildlife will also be provided. Successful implementation of LR9207 may also have positive effects on nearby property values.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
2.60	0.86	0.64

Project Design Considerations: LR9207 is located downstream of and in close proximity to stream restorations LR9208 and LR9209. Coordination of these projects should be considered to improve design and construction efficiency. It is also located on Hampton Chase HOA and Hampton Forest HOA property, within existing floodplain and stormwater easements. As with any stream restoration there are significant environmental permitting requirements for this project. Impacts to trees will be inevitable, but the long-term environmental benefits of LR9207 will outweigh the short-term environmental costs.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Clear and Grub	0.75	AC	$10,000.00	$7,500.00
Construct New Channel	850	LF	$200.00	$170,000.00
Add'l Cost, first 500 LF	500	LF	$200.00	$100,000.00
Plantings	0.75	AC	$25,000.00	$18,750.00
			Base Construction Cost	**$296,250.00**
			Mobilization (5%)	$14,812.50
			Ancillary Items (5%)	$14,812.50
			Erosion & Sediment Control (10%)	$29,625.00
			Subtotal 1	**$355,500.00**
			Contingency (25%)	$88,875.00
			Subtotal 2	**$444,375.00**
Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)				$199,968.75
			Total	**$644,343.75**
			Estimated Project Cost	**$650,000.00**

LR9208 Stream Restoration



Vicinity Map

Address	5418 Ashleigh Rd
Location	Subdivision
Landowner	Hampton Forest HOA
PIN	0662 05 U 0662 05 V
Control Type	Water quality control
Drainage Area	152 acres
Receiving Waters	Willow Spring Branch

Description: The tributary to Willow Spring Branch shown below is lined by a concrete trapezoidal channel (currently being undermined) with turf grass on both sides. Stream restoration project LR9208 will remove the concrete channel and restore a natural stream system and riparian buffer area.

Project Area Map

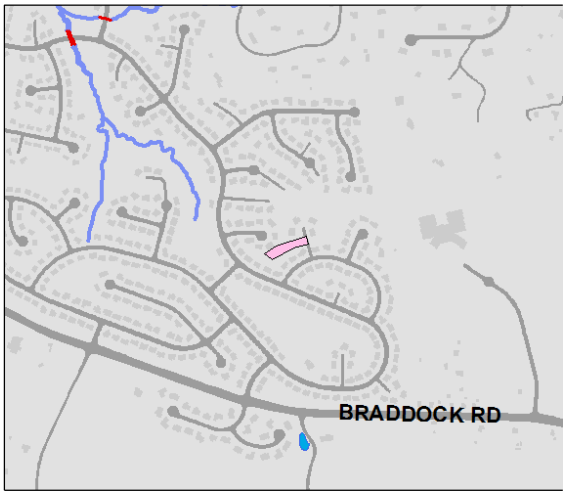
Project Benefits: Project LR9208 will reduce phosphorus and nitrogen loading in the tributary to Little Rocky Run, and will restore approximately 1020 linear feet of natural channel. Higher quality habitat for wildlife will also be provided. Successful implementation of LR9208 may also have positive effects on nearby property values.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
10.87	4.21	6.80

Project Design Considerations: Stream restoration projects LR9207, LR9208 and LR9209 are located in close proximity to each other. LR9207 is located approximately 250 feet downstream of LR9208 and LR9209 is located on a tributary to the north of LR9208. Coordination and sequencing of these three projects should be considered. The project site is located within existing floodplain/storm drainage easements on Hampton Forest Homeowners Association property. Significant design and construction issues exist – especially space constraints. As with any stream restoration, there are significant environmental permitting requirements for this project. Impacts to trees will be inevitable, but the long-term environmental benefits of stream restoration LR9208 will outweigh the short-term environmental costs.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Clear and Grub	1.1	AC	$10,000.00	$11,000.00
Removal of Concrete Channel	2040	SY	$10.71	$21,848.40
Construct New Channel	1020	LF	$200.00	$204,000.00
Add'l Cost, first 500 LF	500	LF	$200.00	$100,000.00
Plantings	1.1	AC	$25,000.00	$27,500.00
			Base Construction Cost	**$364,348.40**
			Mobilization (5%)	$18,217.42
			Ancillary Items (5%)	$18,217.42
			Erosion & Sediment Control (10%)	$36,434.84
			Subtotal 1	**$437,218.08**
			Contingency (25%)	$109,304.52
			Subtotal 2	**$546,522.60**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$245,935.17
			Total	**$792,457.77**
			Estimated Project Cost	**$800,000.00**

LR9209 Stream Restoration



Vicinity Map

Address	12753 Ashleigh Ct
Location	Subdivision
Landowner	Hampton Forest HOA
PIN	0662 05 X
Control Type	Water quality control
Drainage Area	43 acres
Receiving Waters	Unnamed tributary to Willow Springs Branch

Description: The unnamed tributary to Willow Springs Branch shown below is lined by a concrete trapezoidal channel (currently being undermined) with turf grass on both sides. Stream restoration project LR9209 will remove the concrete channel and recreate a natural stream system and riparian buffer area. A new channel with a plunge pool and several step pools will help dissipate erosive energy.

Project Benefits: Project LR9209 will reduce phosphorus and nitrogen loading in the tributary to Johnny Moore Creek, and will restore approximately 400 linear feet of natural channel. Higher quality habitat for wildlife will also be provided. Successful implementation of LR9209 may also have positive effects on nearby property values.

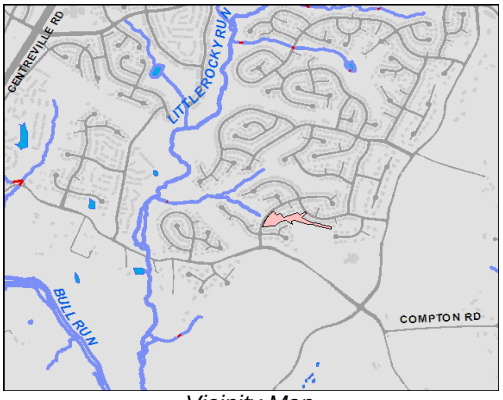
Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
4.03	1.56	2.52

Project Design Considerations: LR9209 is located approximately 250 upstream of stream restoration LR9208. Due to their proximity and similar design aspects (both involve the replacement of a concrete channel with a natural stream system), coordination and sequencing should be considered. The project site is located within an existing storm drainage easement on Hampton Forest Homeowners Association property. Significant design and construction issues exist – especially space constraints. As with any stream restoration, there are significant environmental permitting requirements for this project. Impacts to trees will be inevitable, but the long-term environmental benefits of stream restoration LR9209 will outweigh its short-term environmental costs.

Costs:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Clear and Grub	0.3	AC	$10,000.00	$3,000.00
Construct New Channel	400	LF	$200.00	$80,000.00
Add'l Cost, first 500 LF	400	LF	$200.00	$80,000.00
Plantings	0.3	AC	$25,000.00	$7,500.00
Remove Concrete Ditch	230	SY	$10.71	$2,463.30
			Base Construction Cost	**$172,963.30**
			Mobilization (5%)	$8,648.17
			Ancillary Items (5%)	$8,648.17
			Erosion & Sediment Control (10%)	$17,296.33
			Subtotal 1	**$207,555.96**
			Contingency (25%)	$51,888.99
			Subtotal 2	**$259,444.95**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$116,750.23
			Total	**$376,195.18**
			Estimated Project Cost	**$380,000.00**

LR9504 BMP/LID



Vicinity Map

Address	13916 Rock Brook Ct
Location	Subdivision
Landowner	Little Rocky Run Homeowners Association
PIN	0654 07 E
Control Type	Water quality control
Drainage Area	56 Acres
Receiving Waters	Unnamed Tributary to Little Rocky Run

Description: Proposed project is to retrofit existing culvert crossing to allow for water quality control. Use a gabion wall to create shallow wetland marsh upstream.

Project Area Map

Project Benefits: The created wetland will provide an ideal environment for gravitational settling, biological uptake, and microbial activity. Project LR9504 will also provide habitat enhancement for insects, amphibians, and birds.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
136.51	17.79	1.34

Project Design Considerations: This project is within an existing storm drainage easement and part of Little Rocky Run Homeowners association, but the implementability is still low based on the proposal to remove mature trees in favor of a created wetland environment. The long-term benefits will outweigh the short-term environmental costs. There are a few different access options. There is a proposed retrofit (LR9100) in the same subwatershed, but sequencing/coordination is not an issue since they are both proposed quality control measures only.

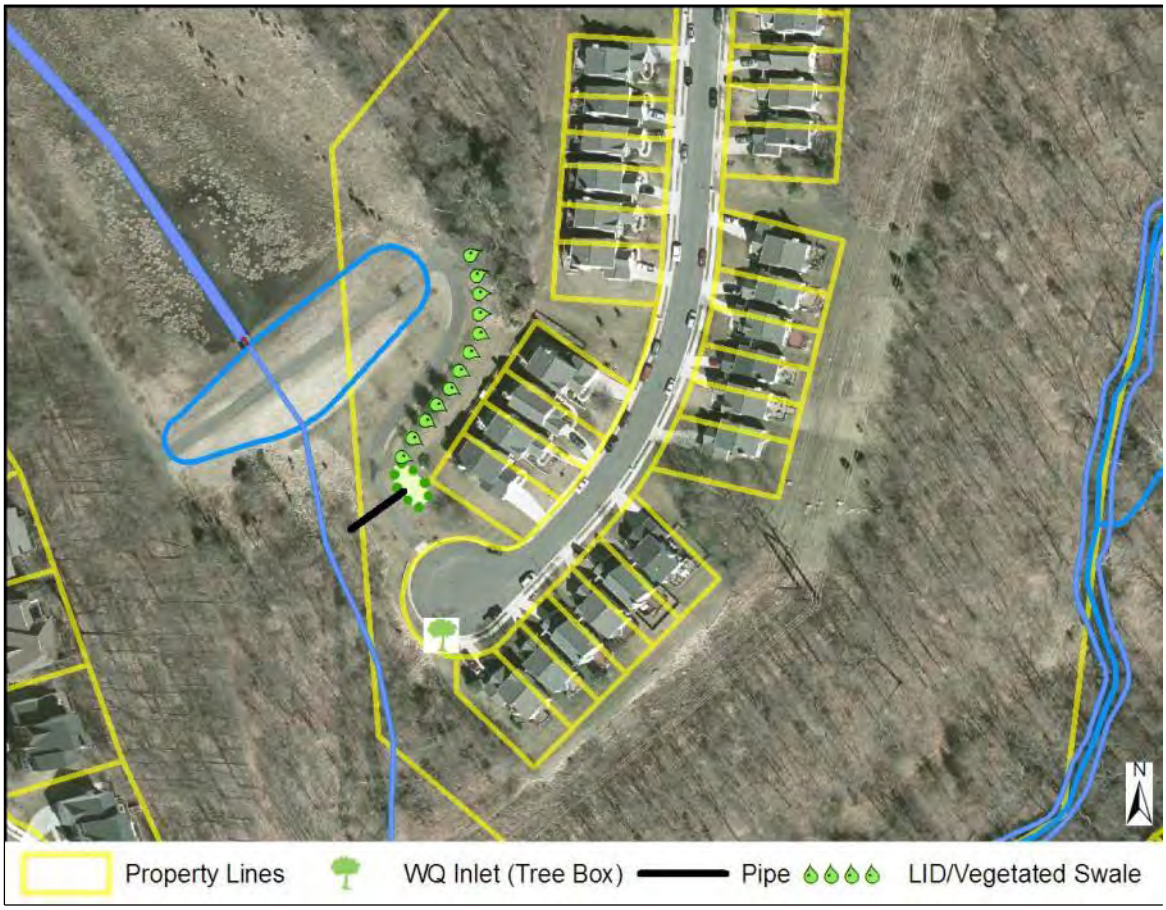
ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Access Road	250	SY	$25.00	$6,250.00
Access Road Gate	1	EA	$2,500.00	$2,500.00
Clear and Grub	0.45	AC	$8,500.00	$3,825.00
Grading and Excavation	450	CY	$35.00	$15,750.00
New Storm Pipe		LF	$100 - $300	
Organic Compost Soil Amendment	100	CY	$40.00	$4,000.00
			Base Construction Cost	**$32,325.00**
			Mobilization (5%)	$1,616.25
			Plantings (5%)	$1,616.25
			Ancillary Items (5%)	$1,616.25
			Erosion & Sediment Control (10%)	$3,232.50
			Subtotal 1	**$40,406.25**
			Contingency (25%)	$10,101.56
			Subtotal 2	**$50,507.81**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$22,728.52
			Total	**$73,236.33**
			Estimated Project Cost	**$80,000.00**

LR9508 BMP/LID

Vicinity Map

Address	6612 Creek Run Drive
Location	Subdivision
Landowner	Green Trails Homeowners Association
PIN	0654 0304 K
Control Type	Water Quality
Drainage Area	1 Acre
Receiving Waters	Unnamed Tributary to Little Rocky Run

Description: LR9508 will construct a vegetated swale to collect runoff from the backside of townhouses (~0.2 acres of impervious surface) and direct flow to a small (~80 square yards) bioretention area. A new pipe will need to be placed through the existing paved trail to outlet to pond outfall. A tree box filter will also be placed at the bottom of the cul-de-sac.



Project Area Map

Project Benefits: Project LR9508 will create an ideal environment for filtration, biological uptake and microbial activity.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
8.95	1.38	0.13

Project Design Considerations: LR9508 is in the vicinity of a large stormwater pond and adjacent to its existing associated easement(s), but is bordered on the opposite side by private property. Access will not be an issue, but the project resides primarily on HOA property. There are no known permitting issues. Sequencing/coordination with neighboring projects is not critical for the proposed water quality measures.

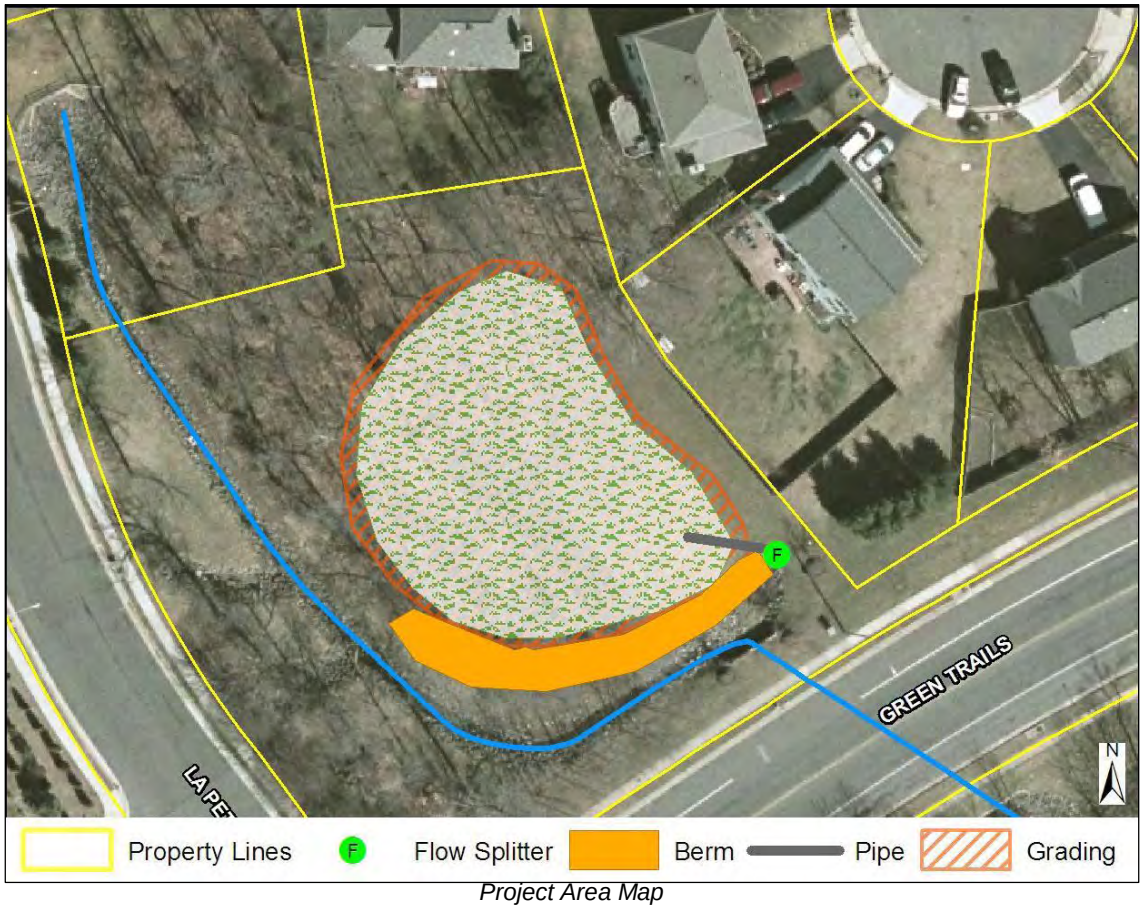
ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Vegetated Swale	275	SY	$50.00	$13,750.00
Pervious Pavement		SY	$100.00	$0.00
Vegetated Roof		SY	$450.00	$0.00
Percolation/Infiltration Trench		SY	$75.00	$0.00
Bioretention Filters & Basin	80	SY	$150.00	$12,000.00
Manufactured BMP (ie:Tree Box Filter)	1	EA	$10,000.00	$10,000.00
Organic Compost Soil Amendment	20	CY	$40.00	$800.00
			Base Construction Cost	**$36,550.00**
			Mobilization (5%)	$1,827.50
			Plantings (5%)	$1,827.50
			Ancillary Items (5%)	$1,827.50
			Erosion & Sediment Control (10%)	$3,655.00
			Subtotal 1	**$45,687.50**
			Contingency (25%)	$11,421.88
			Subtotal 2	**$57,109.38**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$25,699.22
			Total	**$82,808.59**
			Estimated Project Cost	**$90,000.00**

LR9509 BMP/LID

Vicinity Map

Address	6600 La Petite Place
Location	Subdivision
Landowner	Green Trails Homeowners Association
PIN	0651 0403 F
Control Type	Water quality and quantity control
Drainage Area	15 Acres
Receiving Waters	Unnamed Tributary to Little Rocky Run

Description: Divert flow from outlet into a created wetland detention system, designed for water quality and channel protection treatment. Relief is set by culvert invert, but there is room to add storage because common area inside easement averages 4 ft above invert.



Project Area Map

Project Benefits: Project LR9509 will reduce nitrogen, phosphorus, and sediment pollution draining to Little Rocky Run. Project will also result in reduced 2-yr peak flow to degrading stream reach immediately downstream. System drains to an existing regional pond downstream for quality and quantity control.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
32.07	4.73	0.42

Project Design Considerations: Proposed Stream Restoration LR9201 is immediately downstream and addresses erosion area. Adding channel protection at existing culvert will impact this design and footprint. The site can be accessed from several locations; the cost estimate is based on access by way of Green Trails Boulevard (existing floodplain and storage easements). Common area is approximately 4 ft above culvert invert and is full of mature trees. Access and requirement to remove mature trees result in low implementability score.

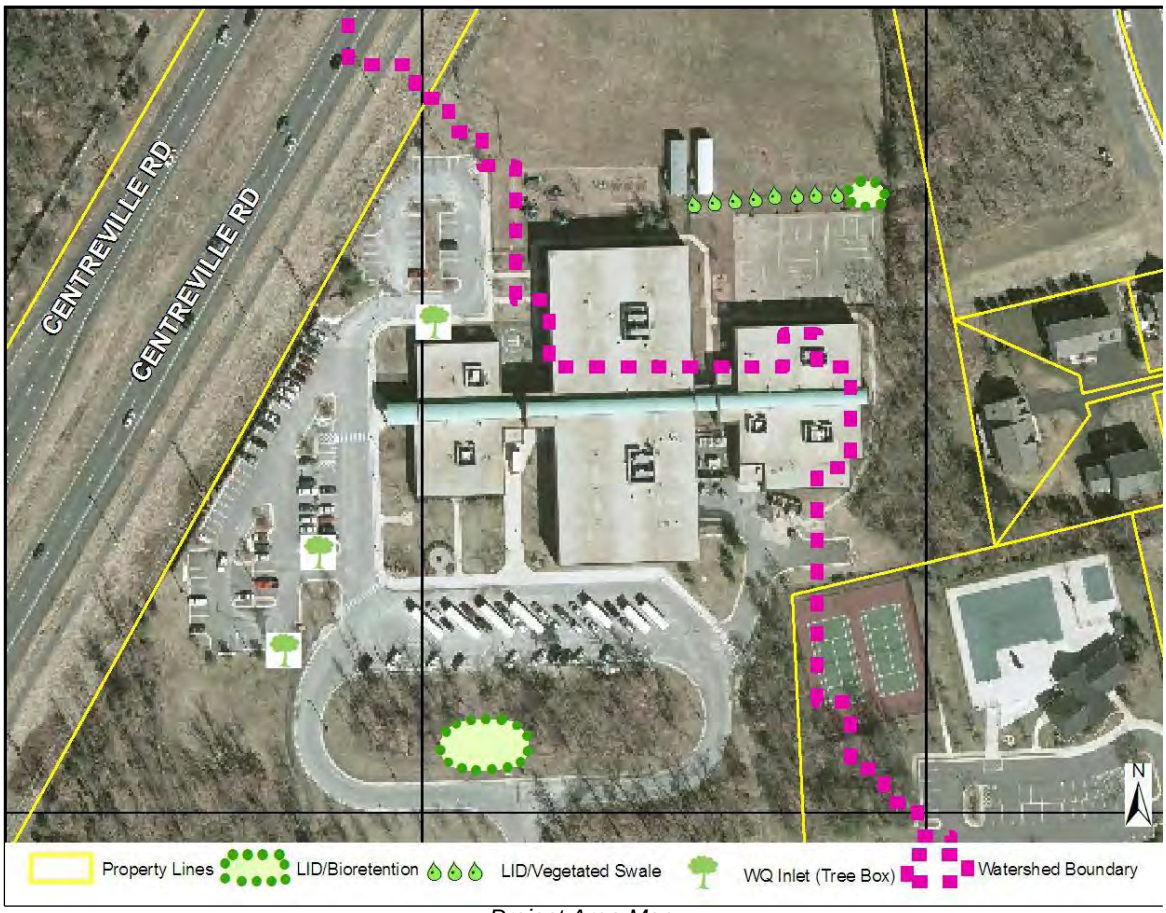
ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Access Road	100	SY	$25.00	$2,500.00
Access Road Gate	1	EA	$2,500.00	$2,500.00
Structural BMP and Incidentals	1	LS	$10,000 - $20,000	$10,000.00
Clear and Grub	0.2	AC	$8,500.00	$1,700.00 Organic
Compost Soil Amendment	300	CY	$40.00	$12,000.00
Grading and Excavation	800	CY	$35.00	$28,000.00
New Storm Pipe	25	LF	$100 - $300	$5,000.00
			Base Construction Cost	**$61,700.00**
			Mobilization (5%)	$3,085.00
			Plantings (5%)	$3,085.00
			Ancillary Items (5%)	$3,085.00
			Erosion & Sediment Control (10%)	$6,170.00
			Subtotal 1	**$77,125.00**
			Contingency (25%)	$19,281.25
			Subtotal 2	**$96,406.25**
Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits			(45%)	$43,382.81
			Total	**$139,789.06**
			Estimated Project Cost	**$140,000.00**

LR 9510 Low Impact Development Project Suite

Vicinity Map

Address	14330 Green Trails Bv
Location	Centreville Elementary School
Landowner	School Board of Fairfax County
PIN	0653 04 A
Control Type	Water Quality
Drainage Area	4.5 Acres
Receiving Waters	Unnamed Tributary to Little Rocky Run

Description: Construct bioretention areas and a vegetated swale to treat runoff from the roof, parking lots and all-purpose courts. Replace three curb inlets with tree box filters. This is a school site, allowing for high visibility and affording educational opportunities.



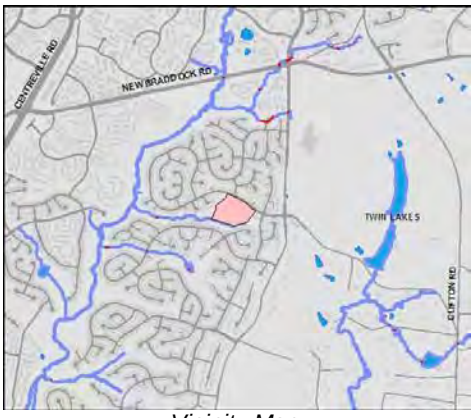
Project Area Map

Project Benefits: Project will enhance filtration, biological uptake and microbial activity. Educational opportunities exist for students.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
1.18	0.22	0.01

Project Design Considerations: This is a headwater site, but the school resides only partially within the Littler Rocky Run watershed. It is adjacent to the Cub Run watershed, where a project was not originally proposed. A field visit was conducted to verify stormwater infrastructure outside of Little Rocky Run and additional LID measures have been included to treat the site as a whole. Bioretention areas were sized based on approximating impervious drainage area and determining the water quality volume, but additional effort is required to accurately determine roof top drainage. Within the Little Rocky Run watershed there are two downstream projects along this tributary, an additional LID retrofit (LR9509L) and a Stream Restoration (LR9201L) that is located downstream of both retrofit sites – coordination and sequencing should be considered. The curb will have to be cut to allow drainage to the larger proposed bioretention area.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Vegetated Swale	120	SY	$50.00	$6,000.00
Pervious Pavement		SY	$100.00	$0.00
Vegetated Roof		SY	$450.00	$0.00
Percolation/Infiltration Trench		SY	$75.00	$0.00
Bioretention Filters & Basin	480	SY	$150.00	$72,000.00
Manufactured BMP (i.e. Tree Box Filter)	3	EA	$10,000.00	$30,000.00
Organic Compost Soil Amendment	150	CY	$40.00	$6,000.00
			Base Construction Cost	**$114,000.00**
			Mobilization (5%)	$5,700.00
			Plantings (5%)	$5,700.00
			Ancillary Items (5%)	$5,700.00
			Erosion & Sediment Control (10%)	$11,400.00
			Subtotal 1	**$142,500.00**
			Contingency (25%)	$35,625.00
			Subtotal 2	**$178,125.00**
Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)				$80,156.25
			Total	**$258,281.25**
			Estimated Project Cost	**$260,000.00**



Vicinity Map

Address	13611 Springstone Dr
Location	Union Mills Elementary School
Landowner	School Board of Fairfax County
PIN	0652 07 B
Control Type	Water Quality
Drainage Area	1 acre
Receiving Waters	Unnamed Tributary to Little Rocky Run

Description: The site drains to existing facility 0612DP. Construct two bioretention areas to collect runoff from highly impervious areas. One will collect runoff currently entering a curb inlet. Two tree box filters will replace existing curb drop inlets.

Project Area Map

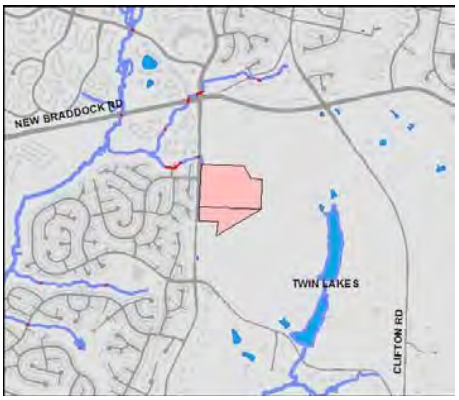
Project Benefits: The bioretention areas promote filtration, biological uptake and microbial activity. Bioretention areas can also have high amenity value. The project affords educational opportunities at the school.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
0.75	0.20	0.01

Project Design Considerations: This site drains directly to existing facility 0612DP. Though for smaller storm events there will be runoff reduction, the primary goal is to provide water quality benefits at an accessible and visible site. As a result, this project is independent of the proposed projects downstream, requiring little emphasis on sequencing/coordination. There are no known construction or permitting constraints. Replacement of existing pavement with pervious pavement can be incorporated into the design, but should be coordinated with typical maintenance/repaving activities and was not included specifically in this conceptual layout.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Vegetated Swale		SY	$50.00	$0.00
Pervious Pavement		SY	$100.00	$0.00
Vegetated Roof		SY	$450.00	$0.00
Percolation/Infiltration Trench		SY	$75.00	$0.00
Bioretention Filters & Basin	130	SY	$150.00	$19,500.00
Manufactured BMP (i.e. Tree Box Filter)	2	EA	$10,000.00	$20,000.00
Organic Compost Soil Amendment	11	CY	$40.00	$440.00
			Base Construction Cost	**$39,940.00**
			Mobilization (5%)	$1,997.00
			Plantings (5%)	$1,997.00
			Ancillary Items (5%)	$1,997.00
			Erosion & Sediment Control (10%)	$3,994.00
			Subtotal 1	**$49,925.00**
			Contingency (25%)	$12,481.25
			Subtotal 2	**$62,406.25**
Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)				$28,082.81
			Total	**$90,489.06**
			Estimated Project Cost	**$100,000.00**

LR9516 BMP/LID



Vicinity Map

Address	6001 Union Mill Road
Location	Centreville High School
Landowner	School Board of Fairfax County
PIN	0661 01 0012A 0661 01 0012B
Control Type	Water quality control
Drainage Area	4 Acres
Receiving Waters	Unnamed Tributary to Little Rocky Run

Description: This site drains to existing facility 0325DP. Replace five curb drop inlets with tree box filters. Construct bioretention area near the parking lot. Proposed measures drain areas that are nearly 100% impervious.

Project Area Map

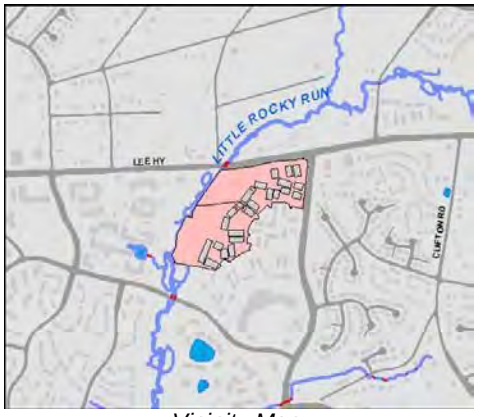
Project Benefits: The bioretention area will promote filtration, biological uptake and microbial activity and has a high amenity value. The project also affords educational opportunities at the school.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
18.74	4.36	0.76

Project Design Considerations: This site drains directly to existing facility 0325DP. Though for smaller storm events there will be runoff reduction, the primary goal is to provide water quality benefits at an accessible and visible site. As a result, this project is independent of the proposed projects downstream, requiring little emphasis on sequencing/coordination. There are no known construction or permitting constraints. Replacement of existing pavement with pervious pavement can be incorporated into the design, but should be coordinated with typical maintenance/repaving activities and was not included specifically in this conceptual layout.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Vegetated Swale		SY	$50.00	$0.00
Pervious Pavement		SY	$100.00	$0.00
Vegetated Roof		SY	$450.00	$0.00
Percolation/Infiltration Trench		SY	$75.00	$0.00
Bioretention Filters & Basin	605	SY	$150.00	$90,750.00
Manufactured BMP (i.e. Tree Box Filter)	5	EA	$10,000.00	$50,000.00
Organic Compost Soil Amendment	101	CY	$40.00	$4,040.00
			Base Construction Cost	**$144,790.00**
			Mobilization (5%)	$7,239.50
			Plantings (5%)	$7,239.50
			Ancillary Items (5%)	$7,239.50
			Erosion & Sediment Control (10%)	$14,479.00
			Subtotal 1	**$180,987.50**
			Contingency (25%)	$45,246.88
			Subtotal 2	**$226,234.38**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$101,805.47
			Total	**$328,039.84**
			Estimated Project Cost	**$330,000.00**

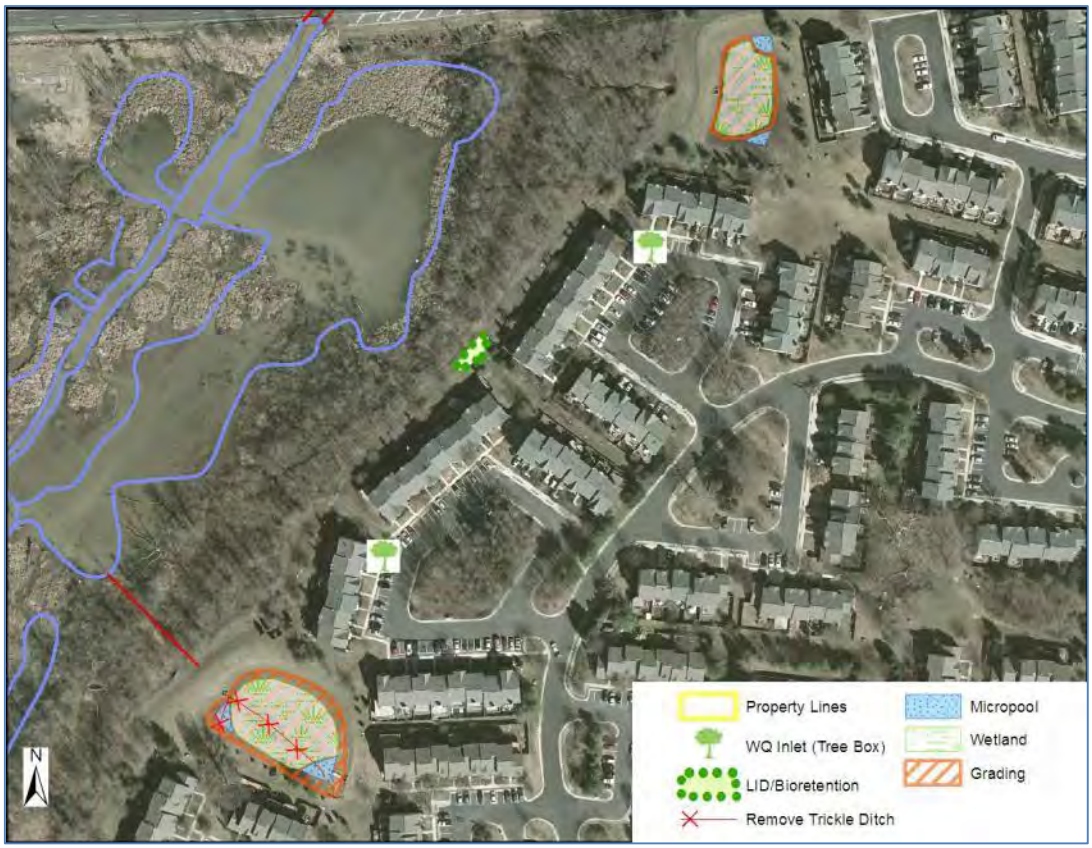
LR9521 BMP/LID



Vicinity Map

Address	13516 Canada Goose Ct
Location	Subdivision
Landowner	Union Mills Community Association
PIN	0553 0701 A1 0553 0702 A1
Control Type	Water quality control
Drainage Area	2 Acres
Receiving Waters	Little Rocky Run

Description: LID stormwater treatment is proposed for Project LR9521 for this uncontrolled area near Canada Goose Court. The project proposes collecting runoff from an existing grass swale in a new bioretention area and replacing two curb inlets with tree box filters. Two existing facilities 0738DP (to the North) and 0739DP will be retrofitted to include wetland plantings, micropools, and improved pond geometry.



Project Area Map

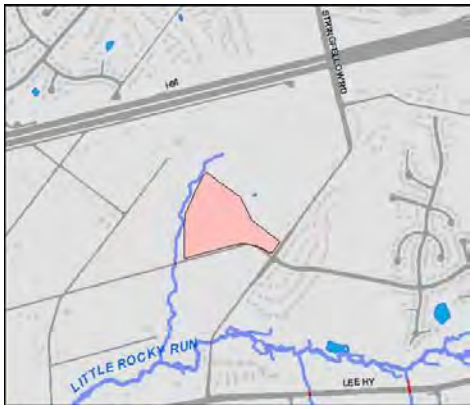
Project Benefits: Bioretention areas and pond retrofits will enhance filtration, biological uptake and microbial activity. The pond retrofits will also provide critical habitat for birds and other wildlife.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
31.43	5.78	1.76

Project Design Considerations: No permitting, construction or access limitations exist. Drainage swale draining to proposed bioretention area was surveyed for potential enhancement, but there are several utility crossings which are likely to prohibit configuring the swale to infiltrate more water. Bioretention area proposed within existing floodplain easement, but outside 100-yr floodplain boundary.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Vegetated Swale		SY	$50.00	$0.00
Pervious Pavement		SY	$100.00	$0.00
Vegetated Roof		SY	$450.00	$0.00
Percolation/Infiltration Trench		SY	$75.00	$0.00
Grading and Excavation	915	CY	$35.00	$32,025.00
Bioretention Filters & Basin	100	SY	$150.00	$15,000.00
Manufactured BMP (i.e. Tree Box Filter)	2	EA	$10,000.00	$20,000.00
Organic Compost Soil Amendment	255	CY	$40.00	$10,200.00
			Base Construction Cost	**$77,225.00**
			Mobilization (5%)	$3,861.25
			Plantings (5%)	$3,861.25
			Ancillary Items (5%)	$3,861.25
			Erosion & Sediment Control (10%)	$7,722.50
			Subtotal 1	**$96,531.25**
			Contingency (25%)	$24,132.81
			Subtotal 2	**$120,664.06**
Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)				$54,298.83
			Total	**$174,962.89**
			Estimated Project Cost	**$180,000.00**

LR9522 BMP/LID



Vicinity Map

Address	13340 Leland Rd
Location	Colin Powell Elementary School
Landowner	School Board of Fairfax County
PIN	0553 01 0020A
Control Type	Water quality control
Drainage Area	3 Acres
Receiving Waters	Unnamed Tributary to Little Rocky Run

Description: Project LR9522 provides stormwater retrofits at the Colin Powell Elementary School. Retrofits include: cutting curbs and installing bioretention areas in grass medians at five locations and replacing one curb inlet with a tree box filter. This LID suite will treat most of the stormwater draining from the two parking lots.

Project Area Map

Project Benefits: Project LR9522 will enhance filtration, biological uptake and microbial activity. Educational opportunities exist for students.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
2.78	0.75	0.51

Project Design Considerations: There are existing yard inlets on either side of the front entrance and behind the school which could be retrofitted for water quality treatment, but additional information on the pipe configuration and depths is required to determine feasibility. Consider collecting and storing roof drainage onsite. This site drains to R-161, where additional plantings have been proposed, but the two projects should not impact one another, nor do they need to be constructed in a particular order. No permitting, construction or access limitations exist. The project has limited impact potential to Arrowhead Park, except for the need to enter the Colin Powell ES grounds from Arrowhead Park Dr. to construct three of the bioretention areas and the tree box filter. The condition of the road/parking lot should be satisfactory to FCPS at completion of the project.

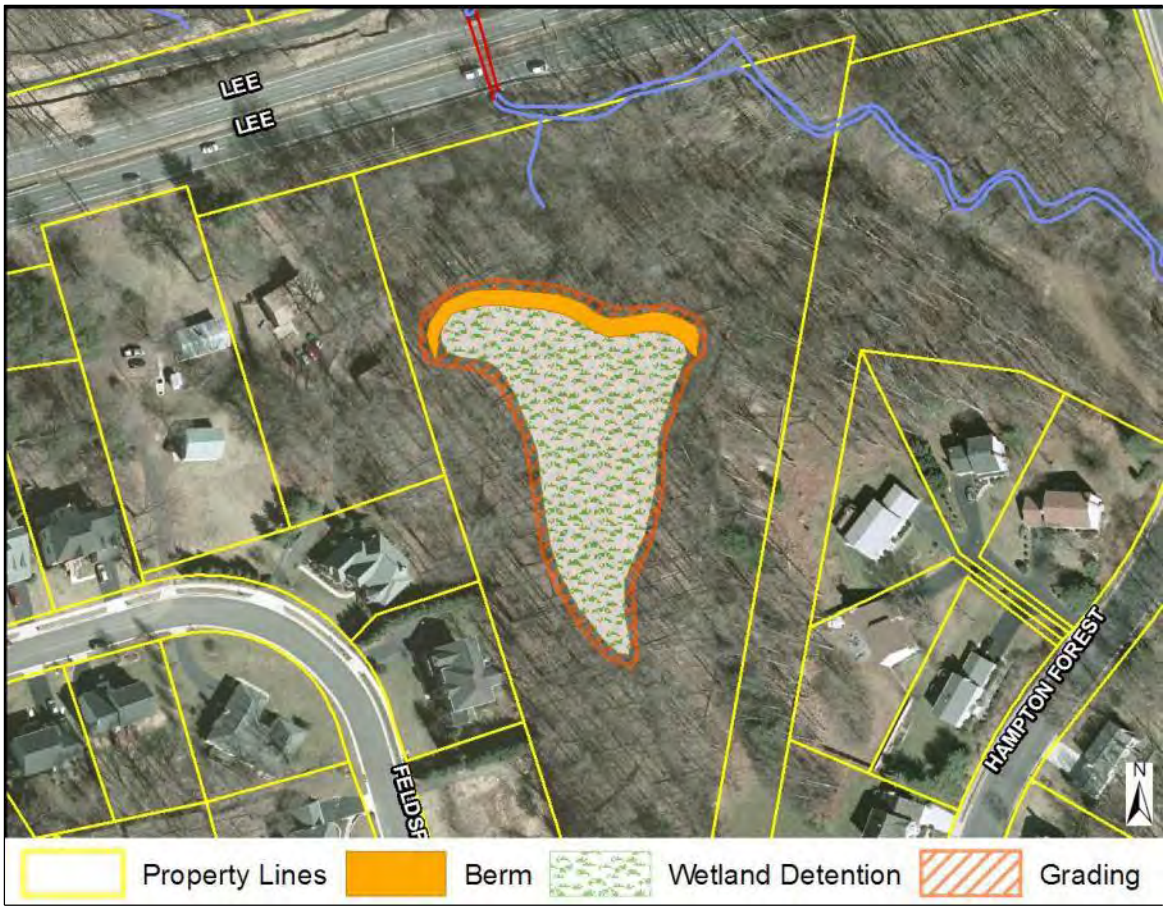
ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Vegetated Swale		SY	$50.00	$0.00
Pervious Pavement		SY	$100.00	$0.00
Vegetated Roof		SY	$450.00	$0.00
Percolation/Infiltration Trench		SY	$75.00	$0.00
Bioretention Filters & Basin	550	SY	$150.00	$82,500.00
Manufactured BMP (i.e. Tree Box Filter)	1	EA	$10,000.00	$10,000.00
Organic Compost Soil Amendment	45	CY	$40.00	$1,800.00
			Base Construction Cost	**$94,300.00**
			Mobilization (5%)	$4,715.00
			Plantings (5%)	$4,715.00
			Ancillary Items (5%)	$4,715.00
			Erosion & Sediment Control (10%)	$9,430.00
			Subtotal 1	**$117,875.00**
			Contingency (25%)	$29,468.75
			Subtotal 2	**$147,343.75**
Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)				$66,304.69
			Total	**$213,648.44**
			Estimated Project Cost	**$220,000.00**

LR9523 BMP/LID

Vicinity Map

Address	13006 Feldspar Ct
Location	Subdivision
Landowner	Hayden Village Community Association
PIN	0553 08 G
Control Type	Water quality control
Drainage Area	43 Acres
Receiving Waters	Willow Springs Branch

Description: Project LR9523 is located near Feldspar Court and includes constructing a wetland detention cell to treat for water quality only. This is a large untreated area where more decentralized retrofits would be very difficult due to private property constraints.



Project Area Map

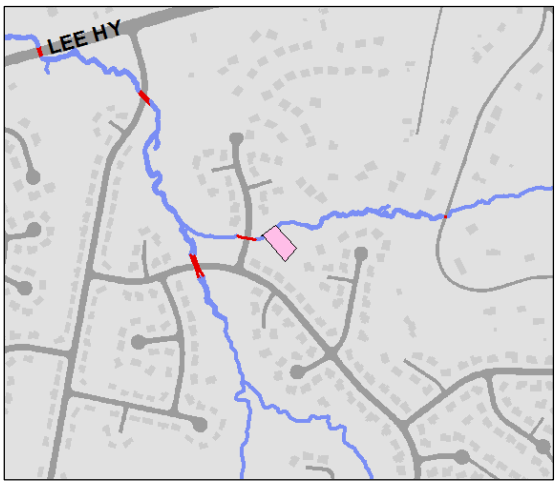
Project Benefits: The constructed wetland will replicate natural wetland ecosystems while allowing for gravitational settling, biological uptake, and microbial activity. It will possess high amenity and habitat value.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
35.94	14.83	5.74

Project Design Considerations: The feasibility of this project is low. There are significant access issues necessitating coordination with VDOT and the HOA. A wetlands permit may need to be obtained. The footprint was selected to avoid the 100 year floodplain and to be set back from existing property owners to the maximum extent practicable. Many mature trees would need to be removed. The project can be designed for channel protection volume or larger events, but the focus of this conceptual was to treat for water quality only. Floodplain and storm drainage easements exist currently. There are no sequencing concerns for this project.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Access Road	1400	SY	$25.00	$35,000.00
Access Road Gate	1	EA	$2,500.00	$2,500.00
Clear and Grub	1.2	AC	$8,500.00	$10,200.00
Structural BMP and Incidentals	bmp riser	LS	$10,000 - $20,000	$10,000.00
New Storm Pipe	40	LF	$ 200.00	$8,000.00
Grading and Excavation	2100	CY	$35.00	$73,500.00
Embankment	800	CY	$50.00	$40,000.00
Organic Compost Soil Amendment	1100	CY	$40.00	$44,000.00
			Base Construction Cost	**$223,200.00**
			Mobilization (5%)	$11,160.00
			Plantings (5%)	$11,160.00
			Ancillary Items (5%)	$11,160.00
			Erosion & Sediment Control (10%)	$22,320.00
			Subtotal 1	**$279,000.00**
			Contingency (25%)	$69,750.00
			Subtotal 2	**$348,750.00**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$156,937.50
			Total	**$505,687.50**
			Estimated Project Cost	**$510,000.00**

LR9524 New BMP/LID



Vicinity Map

Address	5355 Ashleigh Rd
Location	Subdivision
Landowner	Hampton Forest HOA
PIN	0554 07 B1
Control Type	Water quality control
Drainage Area	7 acres
Receiving Waters	Unnamed tributary to Willow Springs Branch

Description: The stormwater outfall shown below provides no water quality treatment and suffers from minor erosion. LR9524 will provide new water quality treatment with a constructed wetland area and will prevent future upstream and downstream erosion by dissipating excess energy.

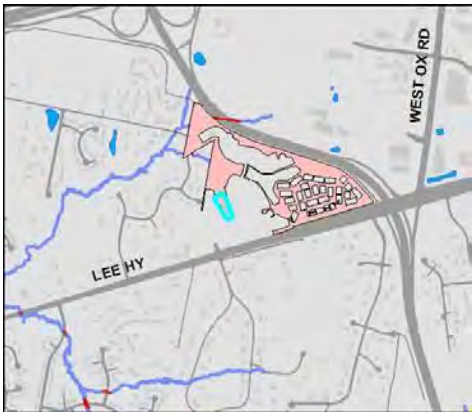
Project Benefits: LR9524 will improve water quality by removing nitrogen, phosphorus, and sediment. It will treat a portion of the flow draining from subwatershed LR-WS-0002. It will also provide critical wetland habitat for native wildlife.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
24.45	6.18	2.43

Project Design Considerations: LR9524 is located on Hampton Forest Homeowners Association property, is mostly contained by an existing floodplain and storm drainage easement. If necessary, the project footprint can easily be manipulated to fit completely within the easement without sacrificing significant water quality treatment. Impacts to mature trees should be minimal.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Vegetated Swale		SY	$50.00	$0.00
Pervious Pavement		SY	$100.00	$0.00
Vegetated Roof		SY	$450.00	$0.00
Percolation/Infiltration Trench		SY	$75.00	$0.00
Bioretention Filters & Basin	500	SY	$150.00	$75,000.00
Manufactured BMP (i.e. Tree Box Filter)		EA	$10,000.00	$0.00
Organic Compost Soil Amendment		CY	$40.00	$0.00
Clear and Grub	0.2	AC	$8,500.00	$1,700.00
Grading and Excavation	250	CY	$35.00	$8,750.00
Embankment	100	CY	$50.00	$5,000.00
			Base Construction Cost	**$90,450.00**
			Mobilization (5%)	$4,522.50
			Plantings (5%)	$4,522.50
			Ancillary Items (5%)	$4,522.50
			Erosion & Sediment Control (10%)	$9,045.00
			Subtotal 1	**$113,062.50**
			Contingency (25%)	$28,265.63
			Subtotal 2	**$141,328.13**
Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)				$63,597.66
			Total	**$204,925.78**
			Estimated Project Cost	**$210,000.00**

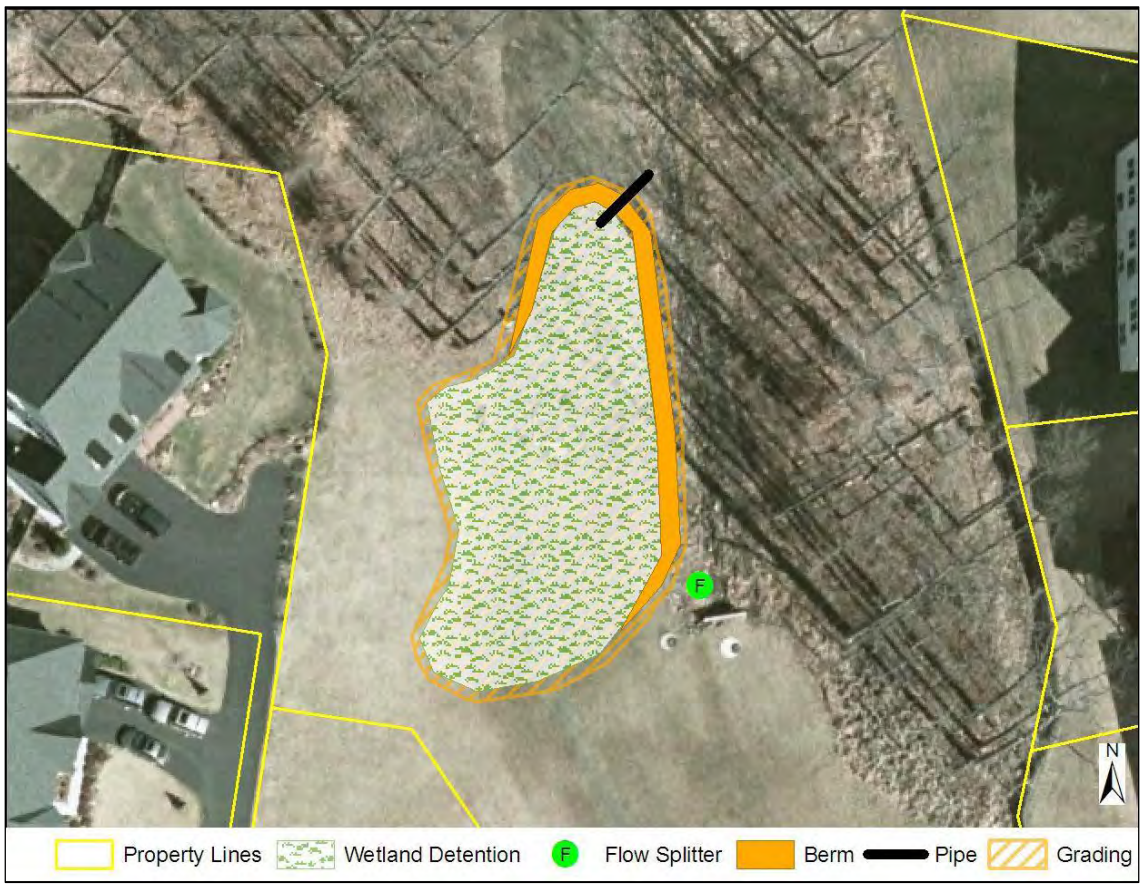
LR9526 BMP/LID



Vicinity Map

Address	4864 Muddler Way
Location	Subdivision
Landowner	Buckley's Reserve Homeowners Association
PIN	0554 17 A
Control Type	Water Quality
Drainage Area	22 Acres
Receiving Waters	Unnamed Tributary to Little Rocky Run

Description: Divert flow from outfall into a wetland marsh area. Wetland marsh to treat water quality volume only, channel protection treatment will require removal of trees or realigning storm sewer/outfall. There is a trail and a workout station within the proposed footprint which will need to be relocated.



Project Area Map

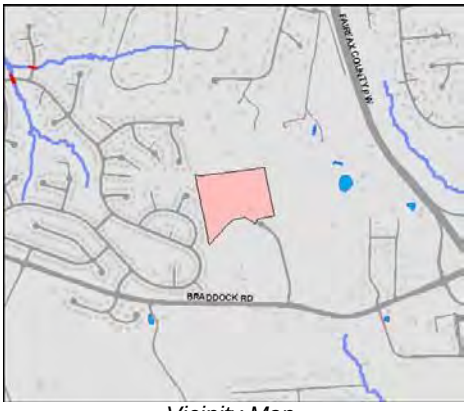
Project Benefits: The created wetland provides ideal environment for gravitational settling, biological uptake, and microbial activity. Signage can be provided and trail can be routed through or around wetland cell to promote quality benefit. Project will provide habitat enhancement for insects, amphibians, and birds.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
40.52	6.29	0.86

Project Design Considerations: This is the only project proposed for this subwatershed and sequencing is not an issue. Though not included as part of this estimate, channel-protection may be achieved at this location. There is an existing storm drainage easement to provide access, but the bulk of the work is on HOA property, outside of the easement.

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Access Road	210	SY	$25.00	$5,250.00
Access Road Gate	1	EA	$2,500.00	$2,500.00
Clear and Grub	0.1	AC	$8,500.00	$850.00
Structural BMP and Incidentals	1	LS	$10,000 - $20,000	$10,000.00
Grading and Excavation	675	CY	$35.00	$23,625.00
Embankment	100	CY	$50.00	$5,000.00
New Storm Pipe	50	LF	$100 - $300	$5,000.00
Organic Compost Soil Amendment	60	CY	$40.00	$2,400.00
			Base Construction Cost	**$54,625.00**
			Mobilization (5%)	$2,731.25
			Plantings (5%)	$2,731.25
			Ancillary Items (5%)	$2,731.25
			Erosion & Sediment Control (10%)	$5,462.50
			Subtotal 1	**$68,281.25**
			Contingency (25%)	$17,070.31
			Subtotal 2	**$85,351.56**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$38,408.20
			Total	**$123,759.77**
			Estimated Project Cost	**$130,000.00**

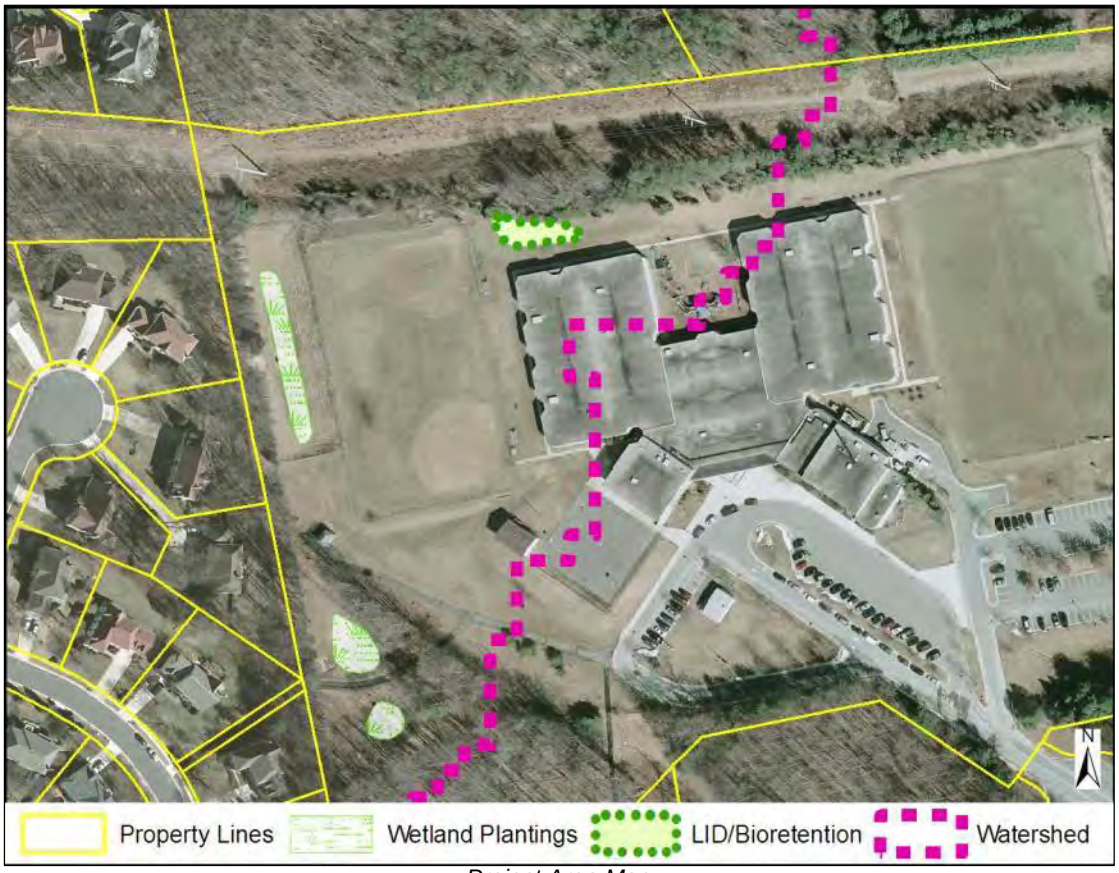
LR9527 BMP/LID



Vicinity Map

Address	5400 Willow Springs School Rd
Location	Willow Springs Elementary School
Landowner	School Board of Fairfax County
PIN	0662 01 0004A
Control Type	Water quality control
Drainage Area	7 Acres
Receiving Waters	Unnamed Tributary to Willow Springs Branch

Description: Project LR9527 provides stormwater retrofits at the Willow Springs Elementary School. Retrofits include altering the pond geometry of three existing dry ponds while adding wetland plantings and constructing a new bioretention area to capture untreated runoff from the roof.



Project Area Map

Project Benefits: Project will reduce phosphorus, nitrogen and sediment loads. Plantings/geometry adjustments will promote gravitational settling, biological uptake and microbial activity while providing habitat enhancement for insects, birds, amphibians, etc. The project will provide educational opportunities for students.

Total Nitrogen Removed (lbs/yr)	Total Phosphorus Removed (lbs/yr)	Total Sediment Removed (tons/yr)
3.95	0.87	0.42

Project Design Considerations: School site is on border between the Little Rocky Run watershed and the Pope's Head Run watershed. A project was proposed in the latter plan on the site, so this proposal focuses solely on the drainage to Little Rocky Run. Roof drainage may need to be diverted to a bioretention area. The proposed measures are for quality treatment only and therefore sequencing/ coordination is not critical. There are no access/permitting issues.

Costs:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Vegetated Swale		SY	$50.00	$0.00
Pervious Pavement		SY	$100.00	$0.00
Vegetated Roof		SY	$450.00	$0.00
Percolation/Infiltration Trench		SY	$75.00	$0.00
Grading and Excavation	400	CY	$35.00	$14,000.00
Bioretention Filters & Basin	250	SY	$150.00	$37,500.00
Manufactured BMP (i.e. Tree Box Filter)	0	EA	$10,000.00	$0.00
Organic Compost Soil Amendment	100	CY	$40.00	$4,000.00
			Base Construction Cost	**$55,500.00**
			Mobilization (5%)	$2,775.00
			Plantings (5%)	$2,775.00
			Ancillary Items (5%)	$2,775.00
			Erosion & Sediment Control (10%)	$5,550.00
			Subtotal 1	**$69,375.00**
			Contingency (25%)	$17,343.75
			Subtotal 2	**$86,718.75**
			Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits (45%)	$39,023.44
			Total	**$125,742.19**
			Estimated Project Cost	**$130,000.00**

6. Benefits of Plan Implementation

The benefits of plan implementation were analyzed through the modeling. Projects in the 10-year implementation plan that could impact stormwater discharge rates through new or increased detention storage were modeled in the SWMM hydrologic model to determine the magnitude of this new or increased storage on discharge rates. The projects analyzed in the SWMM model were: JM9100, JM9500, LR9005A, LR9005C, LR9010B, LR9013D, LR9102, LR9110, LR9115 and LR9509.

These discharge changes were then input into the HEC-RAS hydraulic model to assess any changes to flooding elevations. The changes to flood elevations as a result of the projects were minimal.

All project impacts on nitrogen, phosphorus and sediment pollutant loadings were modeled in the STEPL spreadsheet. The following tables present the pollutant loadings and flow reductions for the WMAs, watersheds and the overall for both watersheds.

Table 6-1 Johnny Moore Creek Pollutant Loading and Flow Reductions by WMA

WMA	Area (ac)	Scenario[3]	Runoff Volume (in)[1]		Peak Flow (cfs/ac)[1]		TSS	TN	TP
			2 Year	10 Year	2 Year	10 Year	(lb/ac/yr)[2]	(lb/ac/yr)[2]	(lb/ac/yr)[2]
Johnny Moore Creek	3373.7	Existing Condition	1.23	2.93	0.15	0.43	236.16	1.91	0.35
		Future Without Projects	1.26	2.97	0.16	0.45	246.04	2.42	0.42
		Future With 10-year Projects	1.22	2.90	0.15	0.44	120.89	2.28	0.37
		Reduction (10-year Plan)	0.04 (3%)	0.07 (2%)	0.01 (3%)	0.01 (2%)	125.15 (51%)	0.14 (6%)	0.05 (11%)
		Future With 25-year Projects	N/A	N/A	N/A	N/A	120.87	2.28	0.37
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	125.17 (51%)	0.14 (6%)	0.05 (11%)

[1] Flow is cumulative
[2] Loads are representative of individual land area contributions
[3] 25-year projects were not evaluated in the hydrologic model

Table 6-2 Little Rocky Run Pollutant Loading and Flow Reductions by WMA

WMA	Area (ac)	Scenario[3]	Runoff Volume (in)[1]		Peak Flow (cfs/ac)[1]		TSS (lb/ac/yr)[2]	TN (lb/ac/yr)[2]	TP (lb/ac/yr)[2]
			2 Year	10 Year	2 Year	10 Year			
Little Rocky Run - Lower	2211.74	Existing Condition	1.69	3.60	0.30	0.84	157.56	5.34	0.67
		Future Without Projects	1.70	3.62	0.31	0.86	159.98	5.50	0.68
		Future With 10-year Projects	1.70	3.61	0.30	0.85	139.99	5.27	0.64
		Reduction (10-year Plan)	0.00 (0%)	0.01 (0%)	0.01 (1%)	0.01 (1%)	19.99 (12%)	0.23 (4%)	0.04 (6%)
		Future With 25-year Projects	N/A	N/A	N/A	N/A	97.03	5.12	0.61
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	62.95 (39%)	0.38 (7%)	0.07 (11%)
Little Rocky Run - Upper	2329.46	Existing Condition	1.37	3.04	0.14	0.41	229.23	4.59	0.66
		Future Without Projects	1.41	3.09	0.15	0.43	230.47	4.71	0.67
		Future With 10-year Projects	1.40	3.08	0.14	0.41	187.42	4.44	0.63
		Reduction (10-year Plan)	0.01 (0%)	0.01 (0%)	0.01 (2%)	0.02 (3%)	43.05 (19%)	0.27 (6%)	0.04 (7%)
		Future With 25-year Projects	N/A	N/A	N/A	N/A	172.79	4.26	0.61
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	57.68 (25%)	0.45 (10%)	0.06 (10%)

[1] Flow is cumulative
[2] Loads are representative of individual land area contributions
[3] 25-year projects were not evaluated in the hydrologic model

Table 6-3 Johnny Moore Creek Overall Pollutant Loading and Flow Reductions

Watershed	Area (ac)	Scenario[3]	Runoff Volume (in)[1]		Peak Flow (cfs/ac)[1]		TSS (lb/ac/yr)[2]	TN (lb/ac/yr)[2]	TP (lb/ac/yr)[2]
			2 Year	10 Year	2 Year	10 Year			
Johnny Moore Creek	3373.65	Existing Condition	1.23	2.93	0.15	0.43	236.16	1.91	0.35
		Future Without Projects	1.26	2.97	0.16	0.45	246.04	2.42	0.42
		Future With 10-year Projects	1.22	2.90	0.15	0.44	120.89	2.28	0.37
		Reduction (10-year Plan)	0.04 (3%)	0.07 (2%)	0.01 (3%)	0.01 (2%)	125.15 (51%)	0.14 (6%)	0.05 (11%)
		Future With 25-year Projects	N/A	N/A	N/A	N/A	120.87	2.28	0.37
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	125.17 (51%)	0.14 (6%)	0.05 (11%)

[1] Flow is cumulative
[2] Loads are representative of individual land area contributions
[3] 25-year projects were not evaluated in the hydrologic model

Table 6-4 Little Rocky Run Overall Pollutant Loading and Flow Reductions

Watershed	Area (ac)	Scenario[3]	Runoff Volume (in)[1]		Peak Flow (cfs/ac)[1]		TSS (lb/ac/yr)[2]	TN (lb/ac/yr)[2]	TP (lb/ac/yr)[2]
			2 Year	10 Year	2 Year	10 Year			
Little Rocky Run	4541.20	Existing Condition	1.69	3.60	0.30	0.84	194.32	4.95	0.66
		Future Without Projects	1.70	3.62	0.31	0.86	196.14	5.10	0.68
		Future With 10-year Projects	1.70	3.61	0.30	0.85	164.32	4.85	0.63
		Reduction (10-year Plan)	0.00 (0%)	0.01 (0%)	0.01 (1%)	0.01 (1%)	31.82 (16%)	0.25 (5%)	0.05 (6%)
		Future With 25-year Projects	N/A	N/A	N/A	N/A	135.89	4.68	0.61
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	60.25 (31%)	0.42 (8%)	0.07 (10%)

[1] Flow is cumulative
[2] Loads are representative of individual land area contributions
[3] 25-year projects were not evaluated in the hydrologic model

Table 6-5 Overall Pollutant Loading and Flow Reductions

Watershed	Area (ac)	Scenario[3]	Runoff Volume (in)[1]		Peak Flow (cfs/ac)[1]		TSS (lb/ac/yr)[2]	TN (lb/ac/yr)[2]	TP (lb/ac/yr)[2]
			2 Year	10 Year	2 Year	10 Year			
Little Rocky Run and Johnny Moore Creek	7914.85	Existing Condition	1.49	3.31	N/A	N/A	212.16	3.66	0.53
		Future Without Projects	1.51	3.34	N/A	N/A	217.41	3.95	0.57
		Future With 10-year Projects	1.49	3.31	N/A	N/A	145.81	3.75	0.52
		Reduction (10-year Plan)	0.02 (1%)	0.03 (1%)	N/A	N/A	71.60 (33%)	0.20 (5%)	0.05 (8%)
		Future With 25-year Projects	N/A	N/A	N/A	N/A	129.49	3.65	0.51
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	87.92 (40%)	0.30 (8%)	0.06 (11%)

[1] Flow is cumulative
[2] Loads are representative of individual land area contributions
[3] 25-year projects were not evaluated in the hydrologic model

The plan benefits are improved habitat, improved stream conditions and increased pollutant removal. The cost of the 10-year plan is approximately $13 million and it is estimated that the 10-year implementation plan would remove 283 tons per year (33 percent) of sediment, 1,583 pounds per year (5 percent) of nitrogen and 317 pounds per year (8 percent) of phosphorus. The cost of the entire plan (10-year and 25-year implementation plans) is approximately $17.3 million. The pollutant removal of the entire plan is estimated at 348 tons per year (40 percent) of sediment, 2,374 pounds per year (8 percent) of nitrogen and 474 pounds per year (11 percent) of phosphorus. In Little Rocky Run, pollutant loads are reduced below existing condition levels. In Johnny Moore Creek, the future land use changes are due to estate residential development. Because of private property constraints, it was difficult to fully address pollutant removal in these areas through the watershed management plan. As these properties are developed, on-site stormwater measures should be employed to control runoff and pollutant levels.

6.1 Cost/Benefit Analysis

The cost/benefit analysis was performed as a simple ratio of the project benefit divided by a cost factor. The benefit value was the project composite score used in the project ranking. The project composite score represents a composite of environmental indicators and other factors such as pollutant removal. The composite scores for some projects were adjusted to account for feasibility issues. The cost factor was calculated by scaling the project costs to match the numeric range of the project composite scores. The results of the cost/benefit analysis were compared to the adjusted composite scores. In situations where the cost benefit rank differed from the adjusted composite rank by more than 25 percent, a cost-based modification of +/- 0.25 was applied to the adjusted composite score and the projects were re-ranked. This resulted in a modified project ranking reflecting cost considerations which are provided in more detail in the Project Prioritization Technical Memorandum in Appendix B.

7. Glossary

A

Acre: A measure of land equating to 43,560 square feet.

Average Land Cover Conditions: The average percent of impervious area within the county, as set forth in the Fairfax County Public Facilities Manual.

B

Benthic Macroinvertebrate: An aquatic animal that lives in the bottom of a stream lacking a backbone and generally visible to the unaided eye.

Best Management Practice (BMP): A structural or non-structural practice that is designed to minimize the impacts of changes in land use on surface and groundwater systems. Structural best management practices refer to basins or facilities engineered for the purpose of reducing the pollutant load in stormwater runoff, such as bioretention, constructed stormwater wetlands, etc. Non-structural best management practices refer to land use or development practices that are determined to be effective in minimizing the impact on receiving stream systems such as the preservation of open space and stream buffers, disconnection of impervious surfaces, etc.

Bioretention Basin: A water quality best management practice engineered to filter the water quality volume through an engineered planting bed consisting of a vegetated surface layer (vegetation, mulch, ground cover), planting soil, and sand bed (optional), and into the in-situ material. Also called rain gardens.

Bioretention Filter: A bioretention basin with the addition of a sand layer and collector pipe system beneath the planting bed.

Buffer: An area of natural or established native vegetation managed to protect other components of a resource protection area and state waters from significant degradation due to land disturbances. See also *resource protection area* and *riparian buffer*.

C

Capacity: The amount of water that a channel can accommodate up to its bankfull condition, which is dependent on its slope, roughness characteristics and geometric shape.

Cfs: cubic feet per second

Channel Evolution Model (CEM): The geomorphologic assessment of the incised stream channels in a watershed; developed by Schumm et al.

Channel: A natural or manmade waterway.

Chesapeake Bay Preservation Areas (CBPA): Any land designated by the County pursuant to Part III of the Chesapeake Bay Preservation Area Designation and Management Regulations and Code of Virginia, Section 10.1-2107. A Chesapeake Bay Preservation Area shall consist of a resource protection area and a resource management area.

Confluence: The joining point where two or more streams create a combined, larger stream.

Constructed Stormwater Wetlands: Areas intentionally designed and created to emulate the water quality improvement function of wetlands for the primary purpose of removing pollutants from stormwater.

Culvert Retrofit: A Culvert Retrofit is installed upstream from existing road culverts by constructing a control structure and excavating a micropool. The control structure consists of a weir that will detain and reduce stormwater flow; the micropool is a small permanent pool that will infiltrate the first 0.1 – 0.2 inches of stormwater runoff, improving water quality.

D

Density: The number of dwelling units per acre.

Design Storm: A selected rainfall hyetograph of specified amount, intensity, duration and frequency that is used as a basis for design.

Detention: The temporary impoundment or holding of stormwater runoff.

Detention Basin: A stormwater management facility that temporarily impounds runoff and discharges it though a hydraulic outlet structure to a downstream conveyance system. While a certain amount of overflow may also occur via infiltration through the surrounding soil, such amounts are negligible when compared to the outlet structure discharge rates and therefore are not considered in the facility's design. Since a detention basin impounds runoff only temporarily, it is normally dry during periods of no rainfall.

Developer: The legal or beneficial owner or owners of all the land proposed to be included in a given development or the authorized agent thereof. In addition, the holder of an option or contract to purchase, a lessee having a remaining term of not less than 30 years, or other persons having an enforceable proprietary interest in such land shall be deemed to be a developer.

Development: The construction, rehabilitation, rebuilding or substantial alteration of residential, commercial, industrial, institutional, recreational, transportation or utility uses, facilities or structures.

Dwelling Unit: One or more rooms in a residential building or residential portion of a building that are arranged, designed, used or intended for use as a complete, independent living facility which includes permanent provisions for living, sleeping, eating, cooking and sanitation.

E

Ecosystem: All of the component organisms of a community and their environment that together form an interacting system.

Effective Imperviousness: The fraction of total impervious area with a direct hydraulic connection to the downstream drainage, such as through the storm drainage system. Effective impervious area is also known as directly connected area.

EPA: United States Environmental Protection Agency

Eutrophication: The process of over-enrichment of water bodies by nutrients often typified by the presence of algal blooms.

Extended Detention Basin: A stormwater management facility that temporarily impounds runoff and discharges it though a hydraulic outlet structure over a specified period of time to a downstream conveyance system for the purpose of water quality enhancement or stream channel erosion control. While a certain amount of overflow may also occur via infiltration through the surrounding soil, such amounts are negligible when compared to the outlet structure discharge rates and therefore are not considered in the facility's design. Since an extended detention basin impounds runoff only temporarily, it is normally dry during periods of no rainfall.

F

FCPA: Fairfax County Park Authority

FCPS: Fairfax County Public Schools

Fecal Coliform Bacteria: A group of organisms common to the intestinal tracts of humans and animals. The presence of fecal coliform bacteria in water is an indicator of pollution and of potentially dangerous bacterial contamination.

FEMA: Federal Emergency Management Agency

FIRM: Flood Insurance Rate Map

First Flush: The first portion of runoff, usually defined as a depth in inches, considered to contain the highest pollutant concentration resulting from a rainfall event.

Floodplain: Those land areas in and adjacent to streams and watercourses subject to continuous or periodic inundation from flood events with a 1% chance of occurrence in any given year (i.e., the 100-year flood frequency event) and having a drainage area greater than 70 acres. Minor floodplains shall be those floodplains that have a drainage area greater than 70 acres but less than 360 acres. Floodplains shall include all areas of the County which are designated as a floodplain by the Federal Insurance Administration, the United States Geological Survey, or Fairfax County.

Frequency (design storm frequency): The recurrence interval of storm events having the same duration and volume. The frequency of a specified design storm can be expressed either in terms of exceedence probability or return period.

Exceedence Probability: The probability that an event having a specified volume and duration will be exceeded in one time period usually assumed to be one year. If a storm has a 1% chance of occurring in any given year, then it has an exceedence probability of 0.01.

G

Gabion: A wire basket or cage that is filled with gravel and generally used to stabilize stream banks.

Geographic Information System (GIS): A method of overlaying spatial land and land use data of different kinds. The data are referenced to a set of geographical coordinates and encoded in a computer software system. GIS is used by many localities to map utilities and sewer lines and to delineate zoning areas.

Geomorphology: A science that deals with the land and submarine relief features of the earth's surface.

Glide: Section of a stream with a relatively high velocity and with little or no turbulence on the surface of the water.

H

Head Cut: The geomorphologic incision of the stream due to the hydraulic effects of a channel from head forces. One example is the accelerated cutting of a stream due a manmade or natural constriction where water velocities are increased substantially. Another example is the outlet of a dam, where extreme velocities can occur due to the high static head forces created by the build-up of water from the dam structure.

Headwater: The source of a stream or watershed.

HEC-RAS: The U.S. Army Corps of Engineers Hydrologic Engineering Center River Analysis System model. This model performs one-dimensional steady flow, unsteady flow and sediment transport calculations.

Highly Erodible Soils: Soils (excluding vegetation) with an erodibility index (EI) from sheet and rill erosion equal to or greater than eight. The erodibility index for any soil is the product of the formula RKLS/T, as defined by the Food Security Act (F.S.A.) Manual of August, 1988, in the Field Office Technical Guide of the U.S. Department of Agriculture Soil Conservation Service, where K is the soil susceptibility to water erosion in the surface layer; R is the rainfall and runoff; LS is the combined effects of slope length and steepness; and T is the soil loss tolerance.

Highly Permeable Soils: Soils with a given potential to transmit water through the soil profile. Highly permeable soils are identified as any soil having a permeability equal to or greater than six inches of water movement per hour in any part of the soil profile to a depth of 72 inches (permeability groups "rapid" and "very rapid") as found in the National Soils Handbook of July 1983, in the Field Office Technical Guide of the U.S. Department of Agriculture Soil Conservation Service.

HOA: Homeowners Association

Hydraulics: The physical science and technology of the static and dynamic behavior of fluids.

Hydrograph: A plot showing the rate of discharge, depth or velocity of flow versus time for a given point on a stream or drainage system.

Hydrology: The science dealing with the distribution and movement of water.

Hyetograph: A graph of time distribution of rainfall over a watershed.

I

Imperviousness or Impervious Cover: A surface composed of any material that significantly impedes or prevents natural infiltration of water into soil. Impervious surfaces include, but are not limited to, roofs, buildings, streets, parking areas and any concrete, asphalt or compacted gravel surface. Impervious areas or impervious surfaces do not include the water surface area of a swimming pool.

Index of Biotic Integrity (IBI): Measurement used in the SPS to evaluate ecological health based on the community structure of bottom-dwelling aquatic macroinvertebrates.

Infill: A residential development that has occurred proximate to, or within, an already established neighborhood.

Infiltration Facility: A stormwater management facility that temporarily impounds runoff and discharges it through the surrounding soil. While an infiltration facility may also be equipped with an outlet structure to discharge impounded runoff, such discharge is normally reserved for overflow and other emergency conditions. Since an infiltration facility impounds runoff only temporarily, it is normally dry during periods of no rainfall. Infiltration basins, infiltration trenches, infiltration dry wells and porous pavement are considered infiltration facilities.

Intensely Developed Area: An area of existing development and infill sites where development is concentrated and little of the natural environment remains as of the date of adoption of the County's Chesapeake Bay Preservation ordinance, and which is so designated on the County's map of Chesapeake Bay Preservation Areas.

Invert: The lowest flow line elevation in any component of a conveyance system, including storm sewer, channels, weirs, etc.

L

Land Development: A manmade change to, or construction on, the land surface that changes its runoff characteristics. Certain types of land development are exempted from stormwater management requirements as provided in the Stormwater Management Act, 10.1-603.8 B of the Code of Virginia.

Land Disturbing Activity: Any land change which may result in soil erosion from water or wind and the movement of sediments into state waters or onto lands in the Commonwealth, including but not limited to, clearing, grading, excavating, permanent flooding associated with the impoundment of water and filling of land.

Landscaping: The improvement of a lot with grass, shrubs, trees, other vegetation and/or ornamental objects. Landscaping may include pedestrian walks, flowerbeds, ornamental objects such as fountains, statues and other similar natural and artificial objects designed and arranged to produce an aesthetically pleasing effect.

Lbs: Pounds

Level Spreader: A Level Spreader is an open channel LID technique that is used to disperse concentrated stormwater runoff over a large area to reduce erosion.

Low-Impact Development (LID): Integrated hydrologically functional site design with pollution prevention measures to compensate for land development impacts on hydrology and water quality. The primary goal of Low Impact Development methods is to mimic the predevelopment site hydrology.

M

Major Floodplain: Those land areas in and adjacent to streams and watercourses subject to continuous or periodic inundation from flood events with a 1% chance of occurrence in any given year (i.e., the 100-year flood frequency event) and having a drainage area equal to or greater than 360 acres.

Marsh: A wet area, periodically inundated.

Mitigation: To make a scenario less harmful in the original condition; or to provide a habitat in another more conducive, larger, or better-suited area, typically in a different location from the original. Mitigation may result due to constructability, cost or other site restriction issues.

Municipal Separate Storm Sewer System (MS4): A conveyance or system of conveyances including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels or storm drains designed or used for collecting or conveying stormwater, that is not a combined sewer and not part of a publicly owned treatment works.

N

National Pollutant Discharge Elimination System (NPDES): The national program for issuing, modifying, monitoring and enforcing permits under Sections 307, 402, 318 and 405 of the Clean Water Act. The NPDES permit is for discharges to the waters of the United States and is administered in Virginia under the Virginia Pollutant Discharge Elimination System.

Nonpoint Source Pollution: Contaminants such as sediment, nitrogen, phosphorous, hydrocarbons, heavy metals and toxics whose sources cannot be pinpointed but rather are washed from the land surface in a diffused manner by stormwater runoff.

O

Off-Site: Any area outside the boundary of a lot.

Open Space: That area within the boundaries of a lot that is intended to provide light and air, and is designed for either scenic or recreational purposes. Open space shall, in general, be available for entry and use by the residents or occupants of the development, but may include a limited proportion of space so located and treated as to enhance the amenity of the development by providing landscaping features, screening for the benefit of the occupants or those in neighboring areas, or a general appearance of openness. Open space may include, but need not be limited to, lawns, decorative planting, walkways, active and passive recreation areas, children's playgrounds, fountains, swimming pools, undisturbed natural areas, agriculture, wooded areas, water bodies and those areas with landscaping. Open space shall not include driveways, parking lots, or other vehicular surfaces, any area occupied by a building, nor areas so located or so small as to have no substantial value for the purposes stated in this definition. Within a residential subdivision, open space shall be composed of only those areas not contained in individually owned lots.

P

Passive Recreation: Recreational activities that are commonly unorganized and noncompetitive, including, but not limited to, picnicking, bird watching, kite flying, bicycling and walking. Site amenities for such activities include, but are not limited to, picnic tables, photo stands, open play areas where substantial clearing is not required, rest rooms, tot lots, boardwalks, paved paths, pathways, benches, pedestrian bridges and appurtenant structures.

Peak Discharge: The maximum rate of flow at an associated point within a given rainfall event or channel condition.

Perennial Streams: A body of water that normally flows year-round in a defined channel or bed, and is capable, in the absence of pollution or other manmade stream disturbances, of supporting bottom-dwelling aquatic animals.

Phosphorus: An element found in fertilizers and sediment runoff that can contribute to the eutrophication of water bodies. It is the keystone pollutant in determining pollutant removal efficiencies for various best management practices as defined by the Virginia Stormwater Management Regulations.

Point Source: The discernible, confined and discrete conveyance, including, but not limited to, any pipe, ditch, channel, tunnel, conduit, well, container, concentrated animal feeding operation, or landfill leachate collection system from which pollutants may be discharged. This term does not include return flows from irrigated agricultural storm water runoff.

Post-Development: Refers to conditions that reasonably may be expected or anticipated to exist after completion of the land development activity on a specific site or tract of land.

Pre-Development: Refers to the conditions that exist at the time that plans for the land development of a tract of land are approved by the plan approval authority. Where phased development or plan approval occurs (preliminary grading, road and utilities, etc.), the existing conditions at the time prior to the first item being approved or permitted establishes the pre-development conditions.

Pro Rata Share (PRS): The payment by a subdivider or developer of land for his share of the cost of providing reasonable and necessary drainage facilities located outside the property limits of the land owned or controlled by the subdivider or developer of land, and necessitated or required, at least in part, by the new construction or improvement of his subdivision or development.

R

Rain Barrel: Rain barrels are low-cost, effective and easily maintainable retention devices that can be used in both residential and commercial/industrial sites. They are connected to gutters and retain rooftop runoff. Rain barrels can be used to store runoff for later use in lawn and garden watering.

Redevelopment: The substantial alteration, rehabilitation or rebuilding of a property for residential, commercial, industrial or other purposes.

Residential – Conservation (R-C) District: County zoning district established in 1982 to protect the Occoquan Reservoir, designating a maximum density of 1 dwelling unit per 5 acres.

Resource Management Area (RMA): As established in accordance with Chapter 118 of the Code of County of Fairfax, Virginia, that component of the Chesapeake Bay Preservation Area comprised of lands that, if improperly used or developed, have a potential for causing significant water quality degradation or for diminishing the functional value of the resource protection area. A resource management area is a Chesapeake Bay Preservation Area, whose land features typically include floodplains, highly erodible soils, highly permeable soils, nontidal wetlands not in the resource protection area, and other land as designated by the locality. See also *resource protection area*.

Resource Protection Area (RPA): As established in accordance with Chapter 118 of the Code of the County of Fairfax, Virginia, that component of the Chesapeake Bay Preservation Area comprised of lands at or near the shoreline or water's edge that have an intrinsic water quality value due to the ecological and biological processes they perform, or are sensitive to impacts which may result in significant degradation of the quality of state waters. In their natural condition, these lands provide for the removal, reduction or assimilation of sediments, nutrients and potentially harmful or toxic substances from runoff entering the Bay and its tributaries, and minimize the adverse effects of human activities on state waters and aquatic resources. Resource protection areas filter pollutants out of stormwater runoff, reduce the volume of stormwater runoff, prevent erosion and perform other important biological and ecological functions. A resource management area is a Chesapeake Bay Preservation Area, whose land features generally include tidal wetlands, nontidal wetlands contiguous to tidal wetlands, tidal shores, tributary streams, a buffer area (of not less than 100 feet) and other lands as designated by the locality.

Retention: The permanent storage of stormwater.

Retention Basin: A stormwater management facility that includes a permanent impoundment, a normal pool of water, for the purpose of enhancing water quality, and therefore is normally wet, even during periods without rainfall. Storm runoff inflows may be temporarily stored above this permanent impoundment for the purpose of reducing flooding or stream channel erosion.

Retrofit: The modification of stormwater management systems through the construction and/or enhancement of wet ponds, wetland plantings or other best management practices designed to improve water quality.

Return Period: The average length of time between events having the same volume and duration. If a storm has a 1% chance of occurring in any given year, then it has a return period of 100 years.

Rezoned Area: On July 26, 1982, the Fairfax County Board of Supervisors approved a rezoning of more than 41,000 acres in the Occoquan Watershed in order to protect the Occoquan Reservoir, which supplies drinking water to the County. Land in the rezoned area is classified as Residential-Conservation (R-C) District, designating a maximum density of one dwelling unit per 5 acres.

Riffle: A reach of stream that is characterized by shallow, fast moving water broken by the presence of rocks and boulders.

Riparian Buffer: Strips of grass, shrubs and/or trees along the banks of rivers and streams that filter polluted runoff and provide a transition zone between water and human land use. Buffers are also complex ecosystems that provide habitat and improve the stream communities they shelter.

Runoff: The portion of precipitation, snow melt or irrigation water that runs off the land into surface waters.

S

Sediment: Material, both mineral and organic, that is in suspension, is being transported, or has been moved from its original site of origin by water or wind. Sediment piles up in reservoirs, rivers and harbors, reducing channel depth, impeding navigability, destroying wildlife habitat and clouding water so that sunlight cannot reach aquatic plants.

Sedimentation (Settling): A pollutant removal method to treat stormwater runoff in which gravity is utilized to remove particulate pollutants. Pollutants are removed from the stormwater as sediment settles or falls out of the water column. An example of a best management practice utilizing sedimentation is an extended detention basin.

Site Plan: A required submission that contains detailed engineering drawings of the proposed uses and improvements required in the development of a given lot.

Stakeholder: Stakeholders include a range of groups within the watershed (residents, industry, local government, agencies, community groups, etc.), as well as those whose livelihoods take them into the watershed.

STEPL: Spreadsheet Tool for Estimating Pollutant Load developed by Tetra Tech, Inc. for the EPA.

Stormwater Management (SWM): Control of stormwater quality and/or quantity.

Stormwater Management Facility: A device that controls stormwater runoff and changes the characteristics of that runoff including, but not limited to, the quantity and quality, the period of release or the velocity of flow.

Stream Physical Assessment (SPA): Assessment of County streams completed in 2005 to assess habitat, impacts and channel morphology.

Stream Protection Strategy (SPS): A County program initiated in 1999 to monitor stream health and establish a baseline of countywide stream conditions.

Stream Rehabilitation: Stream rehabilitation is making the land useful again after a disturbance. It involves the recovery of ecosystem functions and processes in a degraded habitat (Dunster and Dunster 1996). Rehabilitation does not necessarily reestablish the predisturbance condition, but does involve establishing geologically and hydrologically stable landscapes that support the natural ecosystem.

Stream Restoration: Stream restoration is reestablishment of the structure and function of ecosystems (National Research Council, 1992). Ecological restoration is the process of returning an ecosystem as closely as possible to predisturbance conditions and functions. Implicit in this definition is that ecosystems are naturally dynamic. It is therefore not possible to recreate a system exactly. The restoration process reestablishes the general structure, function and dynamic but self-sustaining behavior of the ecosystem.

Stream Valley: A stream and the land extending from either side of it to a line established by the high point of the concave/convex topography as delineated on a map adopted by the Fairfax County Board.

Substantial Alteration: Expansion or modification of a structure or development which would result in disturbance of any land within a resource protection area or land exceeding an area of 2,500 square feet within a resource management area.

Subwatershed: A smaller subsection of a larger watershed, which may have been delineated to describe a particular land use, function or hydrologic condition generally 100-300 acres in size in this plan.

SWMM: Storm Water Management Model – developed by EPA in the early 1970s. SWMM is a dynamic rainfall-runoff simulation model used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas.

T

Total Maximum Daily Load (TMDL): A Total Maximum Daily Load is a tool developed by the U.S. Environmental Protection Agency for implementing water quality standards and is based on the relationship between pollution sources and in-stream water quality conditions. The TMDL establishes the allowable loadings or other quantifiable parameters for a waterbody and thereby provides the basis to establish water quality-based controls. These controls should provide the pollution reduction necessary for a waterbody to meet water quality standards. The Virginia Department of Environmental Quality monitors 130 different pollutants annually to determine whether the waters can be used for swimming, fishing and drinking. If waters do not meet these standards, then they are considered impaired and a TMDL must be implemented.

TN: Total Nitrogen

TP: Total Phosphorus

TSS: Total Suspended Sediment

Tree Cover: The area directly beneath the crown and within the dripline of a tree.

U

USACE: US Army Corps of Engineers

USLE: Universal Soil Loss Equation

Urban Runoff: Stormwater from city streets and adjacent domestic or commercial properties that carries nonpoint source pollutants of various kinds into the sewer systems and receiving waters.

Use: Any purpose for which a structure or a tract of land may be designed, arranged, intended, maintained or occupied; also, any activity, occupation, business or operation carried on, or intended to be carried on, in or on a structure or on a tract of land.

V

VDOT: Virginia Department of Transportation

Vegetated Swale: An earthen conveyance system that is broad and shallow with check dams and vegetated with erosion-resistant and flood-tolerant grasses, engineered to remove pollutants from stormwater runoff by filtration through grass and infiltration into the soil.

Virginia Pollutant Discharge Elimination System (VPDES): This permit program limits pollutant discharges into streams, rivers and lakes. It is administered by the Virginia Department of Environmental Quality as part of the National Pollutant Discharge Elimination System (NPDES) (Section 402 of the Clean Water Act).

W

Water Body with Perennial Flow: A body of water flowing in a natural or manmade channel year-round, except during periods of drought. The term “water body with perennial flow” includes perennial streams, estuaries and tidal embayments. A perennial stream means any stream that is both perennial and so depicted on the map of Chesapeake Bay Preservation Areas adopted by the Board of Supervisors pursuant to Section 118-1-9(a). Streams identified as perennial on the adopted map are based on field studies conducted by the Department of Public Works and Environmental Services. Lakes and ponds that form the source of a perennial stream, or through which the perennial stream flows, are a part of the perennial stream. The width of a perennial stream may be measured from top-of-bank to top-of-bank or at the Ordinary High Water Mark (OHWM) as defined by 33 CFR Part 328.3(e). The aerial extent of a pond or lake is measured at the OHWM. Generally, the water table is located above the streambed for most of the year and groundwater is the primary source for stream flow. In the absence of pollution or other manmade disturbances, a perennial stream is capable of supporting aquatic life.

Watercourse: A stream with incised channel (bed and banks) over which waters are conveyed.

Water Quality Standards: State-adopted and EPA-approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.

Water Quality Volume: The volume equal to the first one-half inch of runoff multiplied by the impervious surface of the land of the land development project as defined by the Virginia Stormwater Management Regulations. It should be noted that the runoff frequency spectrum for Washington D.C. and the surrounding Chesapeake Bay watershed is based on the fact that 90% of the annual runoff is generated by storms of one inch of rainfall or less. Therefore, some of the best management practices will require two times the water quality volume, or, the first one inch of runoff to be treated.

Watershed: A defined land area drained by a river, stream or drainage way, or a system of connecting rivers, streams or drainage ways, such that all surface water within the area flows through a single outlet.

Watershed Advisory Group (WAG): A stakeholder group representing various interests that advised County staff about community outreach opportunities and key issues affecting their watershed and potential projects.

Watershed Management Area (WMA): A subdivision of Fairfax County watersheds (generally 3-5 square miles in size) to facilitate data management and to promote local awareness of the streams.

Wetlands: See *wetlands, tidal* and *wetlands, nontidal*.

Wetlands, Nontidal: Wetlands other than tidal wetlands that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

Wetlands, Nonvegetated: Nonvegetated lands lying contiguous to mean low water and between mean low water and mean high water subject to flooding by normal and wind tides but not hurricane or tropical storm tides.

Wetlands, Vegetated: Lands lying between and contiguous to mean low water and an elevation above mean low water equal to the factor one and one-half times the mean tide range at the site of the proposed project in this County; and upon which is growing any of the species as indicated in Chapter 116, Wetlands Zoning Ordinance, of the Fairfax County Code.

Y

Yr: Year