Cameron Run

Watershed Management Plan

Final

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Prepared for

Fairfax County
Stormwater Planning Division
Department of Public Works and
Environmental Services

Prepared by

Versar, Inc.

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Executive Summary

The *Cameron Run Watershed Plan* is a strategic plan that will protect and improve the condition of water resources in the watershed over the next 25 years. The watershed planning process, initiated by Fairfax County, included characterizing existing stream conditions, modeling conditions in the base year (2001) and for future years, and soliciting the participation of a watershed advisory committee and the public. The Cameron Run Watershed Advisory Committee created the following vision to guide development of the watershed plan:

> *A fishable, swimmable, and biologically diverse Cameron Run watershed that supports a safe and enjoyable environment for people and property.*

The Cameron Run Watershed Plan includes recommended policies and specific projects for mitigating adverse effects on the watershed and its streams, particularly those resulting from impervious surfaces and stormwater runoff.

BACKGROUND

The Cameron Run Watershed Plan is part of a series of planning projects initiated by Fairfax County beginning in 2002. The Cameron Run watershed encompasses 44 square miles, 33 of which are located in Fairfax County, and has a long history of urbanization. Most land within the watershed was developed by the early 1970s, and only an estimated 5 percent remains vacant today. The watershed's large proportion of impervious surface causes substantial physical consequences for streams, such as erosion, flooding, and channel alteration due to the increased volume and rate of flow of stormwater runoff. Several reaches within the watershed fail to meet water quality standards specified in Section 303d of the Clean Water Act (CWA) and, therefore, are included in the Virginia Department of Environmental Quality's list of impaired streams. Two reaches are listed because of the presence of fecal coliform bacteria and require determinations of total maximum daily loads. Two other reaches are listed because they have impaired benthic communities, and a fifth reach is listed because of the presence of both fecal coliform in the water and PCBs in fish tissue. The county's 2001 Stream Protection Strategy (SPS) Baseline Study classified Cameron Run as Watershed Restoration Level II. Primary goals in Watershed Restoration Level II areas are to prevent further degradation and to take active measures for improving water quality to support Chesapeake Bay initiatives and comply with existing water quality standards. In order to support the Chesapeake 2000 Agreement, Fairfax County is committed to developing watershed management plans for all of its watersheds.

PURPOSE

The objectives for developing the Cameron Run Watershed Plan were:

1. To apply a comprehensive approach in addressing multiple regulations, commitments, and community needs.

2. To replace the previous, out-dated watershed management plan.

3. To support Virginia's commitment to the Chesapeake 2000 Agreement.

4. To meet state and federal water quality standards.

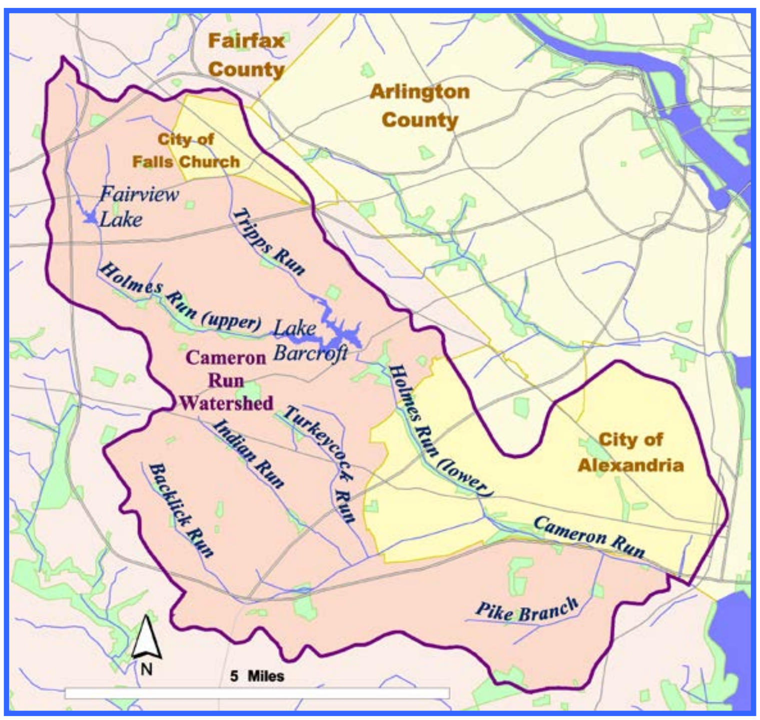
This watershed plan addresses these objectives with a strategy for restoring and protecting the watershed.

The plan was developed with input from the Cameron Run Watershed Advisory Committee and other members of the community. The Advisory Committee comprised members of the local community who represented the views and concerns of various interest groups, including environmental organizations, businesses, and homeowners. The Committee met with the Project Team regularly over 18 months to provide valuable local input and feedback. This public involvement process helped to ensure that the watershed plan will meet the specific needs and desires of residents of Cameron Run watershed.

The developers of this plan recognized that many parcels in older neighborhoods across the county are undergoing "mansionization," as smaller dwellings are replaced with substantially larger structures. Although mansionization is likely to affect stormwater runoff and water quality, this plan does not address that issue directly because the county intends to examine the issue comprehensively in the future.

WATERSHED CONDITION

Today, the mainstem Cameron Run is a flood-control channel whose surrounding area is characterized by medium- to high-density urban development. The Cameron Run watershed encompasses some of the oldest and most highly developed areas in Fairfax County. Nearly 95% of the watershed is developed with homes, strip malls, commercial enterprises, and extensive roadway systems that were built before the advent of modern stormwater management facilities for controlling the quantity and quality of runoff. The effects of this development are evident throughout the watershed. The historic floodplain of lower Cameron Run is primarily a



Map of Cameron Run watershed

transportation corridor throughout which the Capitol Beltway parallels the stream channel. Industrial, commercial, and residential areas have replaced the wetlands and forests that once attenuated floodwaters. Only small remnants of wetlands remain in the watershed. Sections of the Cameron Run mainstem and Holmes Run were channelized to remove floodwaters quickly from developed areas. The poor quality of water within the channels illustrates the effects of these alterations.

Non-point source pollution and urban stormwater runoff greatly affect the health of this watershed. According to the 2001 SPS Baseline Study, the Cameron Run mainstem and its tributaries "have substantially degraded biological and habitat integrity." The SPS study listed Cameron Run as a Watershed Restoration Level II watershed, characterized by dense development, significantly degraded in-stream habitat conditions, and substantially degraded biological communities. Based on the Stream Physical Assessment (SPA) study, the Cameron Run watershed has few adequate riparian buffers. In addition, the watershed has more than five discharge pipes and ditches per mile and a large number of points at which public utility lines and roadways cross over streams. Erosion and instability of stream banks is widespread throughout the watershed, and illegal trash dump sites are common.

PLAN GOALS AND OBJECTIVES

Drawing on knowledge of the ultimate causes and proximate stresses affecting the watershed, the Project Team and Advisory Committee developed the following goals and objectives that are consistent with the vision defined for Cameron Run:

Goal A: Reduce the effects of stormwater runoff from impervious areas to help restore and protect streams within the Cameron Run watershed

Objective A1: Increase the effectiveness of existing Best Management Practices (BMPs) by improving maintenance or "retrofitting" them to further reduce the effects of impervious areas (altered flows and poor water quality).

Objective A2: Install new BMP and Low Impact Development (LID) facilities in areas that do not have existing stormwater management controls.

Objective A3: Require (1) reduction of the rate and volume of runoff following the development of new commercial and residential sites to the minimum possible levels and (2) reduction of post-development runoff at redevelopment sites by targeted percentages from the pre-development rate and volume.

Objective A4: Increase the participation of residents in decreasing the amount of stormwater runoff from impervious surfaces in residential areas.

Objective A5: Reduce the effects of stormwater runoff from existing and proposed roadways by instituting new countywide watershed management requirements.

Goal B: Preserve, maintain, and improve watershed habitats to support appropriate native flora and fauna

Objective B1: Preserve, restore, and manage riparian buffers to benefit appropriate native flora and fauna (and reduce the effects of stormwater runoff).

Objective B2: Preserve, restore, and manage habitat in streams and on stream banks to benefit appropriate native flora and fauna (and water quality).

Objective B3: Preserve, restore, and manage wetlands to benefit appropriate native flora and fauna.

Goal C: Preserve, maintain, and improve water quality within streams to benefit humans and aquatic life

Objective C1: Reduce and mitigate the effects of bank erosion and sedimentation.

Objective C2: Reduce the amount of pollutants such as fecal coliform, phosphorous, and nitrogen in stormwater runoff.

Objective C3: Reduce the amount of trash and number of dumping sites in the watershed to help protect and improve the streams.

Goal D: Improve stream-based quality of life and environmentally friendly recreational opportunities for residents of and visitors to Cameron Run watershed

Objective D1: Create additional access and trails for stream-based recreational opportunities in the watershed.

Objective D2: Increase public awareness and appreciation of streams in the watershed.

POLICY RECOMMENDATIONS

Policy recommendations address the goals and objectives stated above and include proposals that typically would involve amending the County Code and other supporting documents, such as the Public Facilities Manual. These recommendations are part of a series being developed during the first round of watershed planning, and several are in various stages of implementation. The county will undertake a separate effort to combine and refine policy recommendations stemming from the plans. Recommendations developed as part of the Cameron Run Watershed Plan are as follows:

Goal A

- Change the inspection and assessment protocols for stormwater controls.
- Amend inspection and maintenance ordinances for privately owned controls.
- Update the county's list of recommended BMPs.
- Retrofit existing facilities.
- Enact new policy to require on-site water retention for all land-disturbance projects.
- Avoid granting water quality waivers for non-bonded lots that exceed 18% imperviousness.
- Install new BMP and LID facilities for properties without stormwater controls.
- Increase fines for noncompliance with BMP or LID requirements.
- Coordinate stormwater management activities with neighboring jurisdictions, including annual reviews.
- Require 10% net decrease in runoff on commercial and residential redevelopment.
- Amend zoning regulations to promote smarter development and better design.
- Provide incentives for developers to use conservation design and LID to reduce runoff.
- Limit removal of mature trees and native vegetation in any development or renovation.
- Conduct frequent inspections to ensure compliance with permit conditions regarding landscaping and stormwater runoff requirements.
- Allocate sufficient funding for inspection and enforcement
- Facilitate technical assistance and financial incentives for residential LID practices in headwater areas.
- Involve the public in watershed planning from initial conception through implementation.
- Require road-widening projects to control runoff from all paved areas and reduce existing peak runoff by 5%.
- Replace grasses on medians and sides of roadway with native trees and vegetation where possible.

Goal B

- Plant buffers using native vegetation and trees, and monitor those buffers for 5 years.
- Provide additional personnel and resources for protecting buffers in Resource Protection Areas (RPAs), and ensure adequate training.
- Require restoration of buffers at developments within RPAs and mandate the use of native vegetation mixes for restoration.

- Provide educational assistance regarding buffers to owners of properties with tidal shorelines or streams.
- Amend ordinance to expand woodlands and survey existing trees, and amend requirements for builders to protect existing trees.
- Determine current level of mature tree canopy, and establish a reforestation goal.
- Monitor and report on stream condition by performing stream physical assessments.
- Facilitate acquisition/donation of easements to community groups for buffer/stream protection.
- Install natural and water-conserving landscaping at county facilities.
- Educate property owners about steps for improving water quality in their streams.
- Perform wetlands functions-and-values survey to identify characteristics of existing wetlands.
- Construct and restore wetlands at suitable locations as identified in wetlands survey.
- Purchase, designate, and acquire land for conservation of critical wetland habitat areas.
- Provide outreach materials describing the value and benefit of wetlands and identifying which permits are required for wetland activities.
- Discourage further development within native wetlands, and require mitigation when adverse effects are unavoidable.

Goal C

- Increase personnel and resources to inspect development projects regarding erosion and sediment controls.
- Encourage the development community to use bioengineering to stabilize streambanks and improve habitat.
- Reduce the amount of de-icing chemicals and sand entering surface waters of the watershed.
- Identify sources of fecal coliform in the watershed and prepare an action plan to reduce it.
- Perform additional water quality monitoring including surveys of macroinvertebrates and aquatic plants.
- Identify, investigate, and prosecute illicit discharges from commercial and residential activities.
- Educate the public about ways to reduce pollutants in stormwater runoff.
- Create a "green label" program for lawn-care and landscaping companies that use environmentally sound techniques.

- Strengthen enforcement of "pooper scooper" regulation and institute $100 fine for violators.
- Partner to clean up trash, woody debris, and dumpsites throughout watershed.
- Conduct a vigorous public information campaign to deter littering and dumping.
- Place containers at public facilities for recycling along with signs requesting sorting of recyclables and stating the fines for littering.
- Enforce solid waste and erosion and sediment control ordinances against illegal dumping; impose fines, and require restoration of dumping sites.

Goal D

- Identify stream corridors that could be purchased to increase public access to streams and environmentally friendly recreation.
- Develop a master plan for environmentally friendly recreation opportunities in Cameron Run.
- Post signage publicizing the existence and importance of RPAs for stream protection and recreation.
- Install signage explaining benefits of LID and identify sources for further information.
- Conduct a study to determine the most effective program of public education for watershed stewardship.

RECOMMENDED PROJECTS

The proposed projects for the Cameron Run Watershed Plan are based on analyses performed by the Project Team with contributions from the Advisory Committee and the public. The projects were selected to help meet the goals and objectives stated above. The projects recommended in the plan fall into the following four categories:

- **Low Impact Development (LID) –** LID approaches are innovative practices designed to mimic natural flows by reducing the volume of stormwater runoff at the source, not merely by managing flows as they leave a site. Distributed LID involves a series of small landscape features that function as detention areas within a developed area. These features are designed and constructed to detain and treat stormwater through natural processes such as infiltration, soil storage, and uptake by vegetation. In addition to being incorporated into planning for new development, these solutions are being used increasingly to reduce the effects of stormwater runoff and other adverse influences on the environment in previously developed areas.
- **New Storm Water Management (SWM) ponds –** Placing new stormwater management ponds, including small, extended-detention dry ponds, in locations that currently have no mechanisms for controlling the quantity and quality of stormwater runoff.

- **SWM pond retrofits –** Modifying existing SWM ponds to provide additional quantity or quality controls.
- **Stream restoration –** Modifying stream channels, banks, and instream habitat to improve degraded and unstable conditions.

Projects were separated into the following three groups to help define priorities among the approximately 650 opportunities for watershed improvements identified during this study:

- **Tier 1 –** Projects that represent the best opportunities for the county's efforts because they are located on public lands and were selected using SWMD's prioritization framework in rough proportion to the amount of uncontrolled impervious surface within the subwatershed.
- **Tier 2 –** Sites representing lower-priority projects on public land, or sites on private lands that present good opportunities and have received various levels of support from Advisory Committee members or the general public.
- **Tier 3 –** The rest of the sites identified during the initial map review and public involvement process.

The plan focuses on the Tier 1 projects because they represent the best opportunities for the county to implement watershed improvements. The Tier 2 and Tier 3 sites also present good opportunities, particularly if they can be implemented through the development-review process or other means. Information on individual projects is included in Appendix A, including site-specific factsheets for each Tier 1 project, and tables containing descriptive information for Tier 2 and Tier 3 projects.

In a supplemental effort, drainage complaints filed with the Fairfax County's Maintenance and Stormwater Management Division were used to help identify areas with problems related to stormwater drainage, flooding, and streambank erosion. These records provided an initial list of 70 candidate drainage projects. The best opportunities to address drainage problems were selected from the candidates using a ranking process. The 25 drainage projects selected by the ranking process include 21 projects that address localized flooding issues and four projects that address localized streambank erosion in residential backyards. Recommended actions to help alleviate problems at the 25 selected drainage projects are described in project fact sheets found in Appendix A-4.

The breakdown of all projects by project type and tier is shown below.

Project Type	Tier 1	Tier 2	Tier 3	Total
New SWM Pond	1	1	-	2
SWM Pond Retrofit	15	5	78	98
LID	77	54	306	437
Stream Restoration	4	32	2	38
Non-structural Projects & Special Studies	3	-	21	24
Drainage Complaint Projects	25	-	-	-
Total	125	92	407	624

BENEFITS OF THE PLAN

The Cameron Run Watershed Plan provides a set of tools for communities to go beyond minimum regulatory requirements. These tools can be used to help communities ensure the protection of water resources, the reduction of streambank erosion, and the restoration of fish and wildlife habitat. They will also help to meet commitments under the Chesapeake 2000 Agreement, which include the following:

- State signatories will work with local governments, community groups, and watershed organizations to develop and implement locally supported watershed management plans in two-thirds of the bay's watershed.
- Local watershed management plans will address the protection, conservation, and restoration of stream corridors, riparian buffers, and wetlands for the purpose of improving habitat and water quality.

Implementing the recommended policy amendments and projects will provide a range of benefits for the Cameron Run watershed. Policies that are implemented countywide in conjunction with other watershed management plans will be more efficient and should result in improved environmental conditions throughout Fairfax County and the surrounding region. Because these policy recommendations are non-structural, it will be difficult to measure their benefits quantitatively. Generally, the policy recommendations will help to improve the enforcement of existing regulations and laws and to provide additional protection for areas that are environmentally valuable but not necessarily located within an RPA. Instituting programmatic solutions is one of the best ways to deal with the cumulative adverse effects of distributed influences, such as stormwater.

Cameron Run is the most heavily urbanized watershed in the county: impervious surface in every subwatershed exceeds the 10% to 15% threshold considered the minimum for good stream conditions. Most of the development in the watershed occurred before stormwater controls were required; therefore, reducing the effects of stormwater runoff created by uncontrolled impervious surface is the most important benefit that can be achieved through this plan. Each project included in the plan will provide a degree of control for the effects of stormwater runoff. Both the quantity (i.e., reduction in average peak flows) and the quality (i.e., reduction in pollutant loading) of the runoff will be improved .

Model-based estimates of the benefits of the projects indicate that the proposed actions in the Cameron Run Watershed Management Plan will reduce pollutant loadings throughout the Fairfax County portion of the watershed. The model of future conditions with proposed projects shows a 4.9% decrease in total suspended solids, a 3.8% decrease in total phosphorus, and a 3.6% decrease in total nitrogen loads for the entire Cameron Run watershed. The modeled decreases in pollutant loading seem small because the watershed is highly developed, and opportunities for BMPs are limited in many areas. These model-based estimates can be used to evaluate the Plan's contributions to meeting water quality standards (e.g., TMDL implementation) and Chesapeake Bay Tributary goals.

The selected restoration projects will improve habitat and water quality within streams. To quantify the benefits of the proposed stream restoration projects, the U.S. Army Corps of Engineers stream condition index (SCI) rating was applied to determine the increase in stream habitat quality and reduction in erosion and sediment loss. Restoration is anticipated to improve SCI ratings for each project site, resulting in an 11% to 17 % increase in SCI rating among the sites. The stream restoration projects in the plan will improve a number of stream miles from one condition class to another (e.g., very poor habitat to fair habitat); therefore, increases can be expected in the abundance and diversity of stream life in those areas.

PLAN TOTAL COST

The 25-year estimated funding requirements for all the structural and non-structural recommended actions is $47.4 million. The breakdown of funding requirements for each 5-year period of the plan is shown below. Estimated costs included in this plan represent actual costs that, in some cases, may be off-set through the use of existing staff resources, in-kind services, cost-share programs, donated materials, volunteer labor, and other means.

The policy recommendations of this plan will require further evaluation in light of greater countywide implications. The current approach for processing policy recommendations is to consolidate them with similar recommendations included in management plans for other watersheds in the county.

Funding Requirements	
Implementation Period	**Estimated Funding Requirements**
Group A: Fiscal Year 2007 – 2011	$11,468,000
Group B: Fiscal Year 2012 – 2016	$9,174,000
Group C: Fiscal Year 2017 – 2021	$8,840,000
Group D: Fiscal Year 2022 – 2026	$10,028,000
Group E: Fiscal Year 2027 – 2031	$6,833,000
Drainage Complaint Projects: Fiscal Year 2007 – 2011	$1,059,000
Total	$47,402,000

Although this plan proposes a schedule for implementing recommended actions, additional factors may affect the individual projects and the implementation schedule:

1. Members of the county's staff and the Fairfax County Board of Supervisors (Board) will review the projects, programs (both structural and non-structural), and policy recommendations in this plan prior to implementation. The Board's adoption of the Watershed Management Plan will not ensure automatic implementation of projects, programs, initiatives, or policy recommendations that have not first been subjected to sufficient scrutiny to determine if they will provide the greatest environmental benefit for the cost.

2. The Watershed Management Plan provides a conceptual master-list of structural capital projects and a list of potential non-structural projects for the watershed. Each fiscal year, the county's staff will prepare and submit to the Board a detailed spending plan that includes a description of proposed projects and an explanation of their ranking, based on specific criteria that have yet to be established. 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 goal for the watershed or for water quality, and the project's ability to be implemented within the same fiscal year that funding is provided. The staff also intends to track the progress of implementation and report back to the Board periodically.
3. Each project on the annual list of structural projects will be evaluated before implementation using basic value-engineering, cost-effectiveness principles and considering alternative structural and non-structural means for accomplishing the purposes of the project.
4. 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. These projects will also be evaluated to determine appropriate cost-sharing by any parties responsible for the obstructions.
5. Any stream-crossing improvements not related to protecting streambeds or banks or to preventing structure flooding will not be implemented using the county's stormwater improvement funds.
6. Stream restoration projects on private lands will be evaluated to determine means for cost-sharing by landowners who are directly responsible for degradation resulting from their land uses.

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Introduction

1.1 BACKGROUND

In 2001, a baseline evaluation found that 77 percent of Fairfax County's streams were in fair, poor, or very poor condition. The county is currently developing watershed management plans to restore and protect these streams. Watershed planning helps the county look at the whole "water system" in order to better manage these resources. A watershed management plan serves as a tool to identify pollution sources and develop strategies to address them. It also provides goals and objectives for achieving management actions (e.g., restore water quality, reduce flood frequency, improve fish and wildlife habitats) and recommends actions to mitigate or prevent watershed problems.

Fairfax County's watersheds (Figure 1-1) drain into the Potomac River and eventually into the Chesapeake Bay; currently the bay does not meet federal water quality standards. Virginia has signed agreements with other states and federal agencies to work toward restoring the Chesapeake Bay. The latest agreement, Chesapeake 2000, includes the goal of developing watershed plans for two thirds of the bay's watershed by 2010. In order to meet this goal, Virginia has encouraged Fairfax County and other jurisdictions to develop plans for cleaning up their watersheds.

The federal Clean Water Act and Virginia laws require Fairfax County to meet water quality standards for surface streams and groundwater. The county's stormwater permit, called a Virginia Pollution Discharge Elimination System (VPDES) permit, requires the county to develop watershed management plans to address water quality problems. In order to meet state and federal water quality standards, the county's watershed plans will identify strategies to prevent and remove stream pollution. Typically, nutrients such as phosphorus and nitrogen are the most damaging pollutants found in stormwater runoff. Other common pollutants found in runoff include oil, dirt, and trash.

Watershed planning is a way to identify the causes of these problems and then to address them in an integrated fashion. Growth in the county over the last 50 years has resulted in eroded stream channels and, in some cases, impaired waters. As the 1970s-era watershed plans have aged, many newer drainage problems have been addressed on a piecemeal, reactive basis. The county's 25-year old watershed plans are out-of-date and need to be replaced to meet new water quality standards using innovative technologies. The watershed plans currently being developed will propose effective, state-of-the-art solutions for the next 25 years.

Multiple environmental regulations, commitments, and community needs can be addressed comprehensively through the watershed planning process. Because all land surfaces and all land uses are united within a watershed, the watershed planning process provides an opportunity to integrate planning, zoning, and other management strategies in a comprehensive approach to reducing and preventing pollution. Integrated solutions will achieve the broadest range of goals with the greatest efficiency and at the lowest cost. A stream that is clean provides abundant and healthful habitat for fish, wildlife, and people.

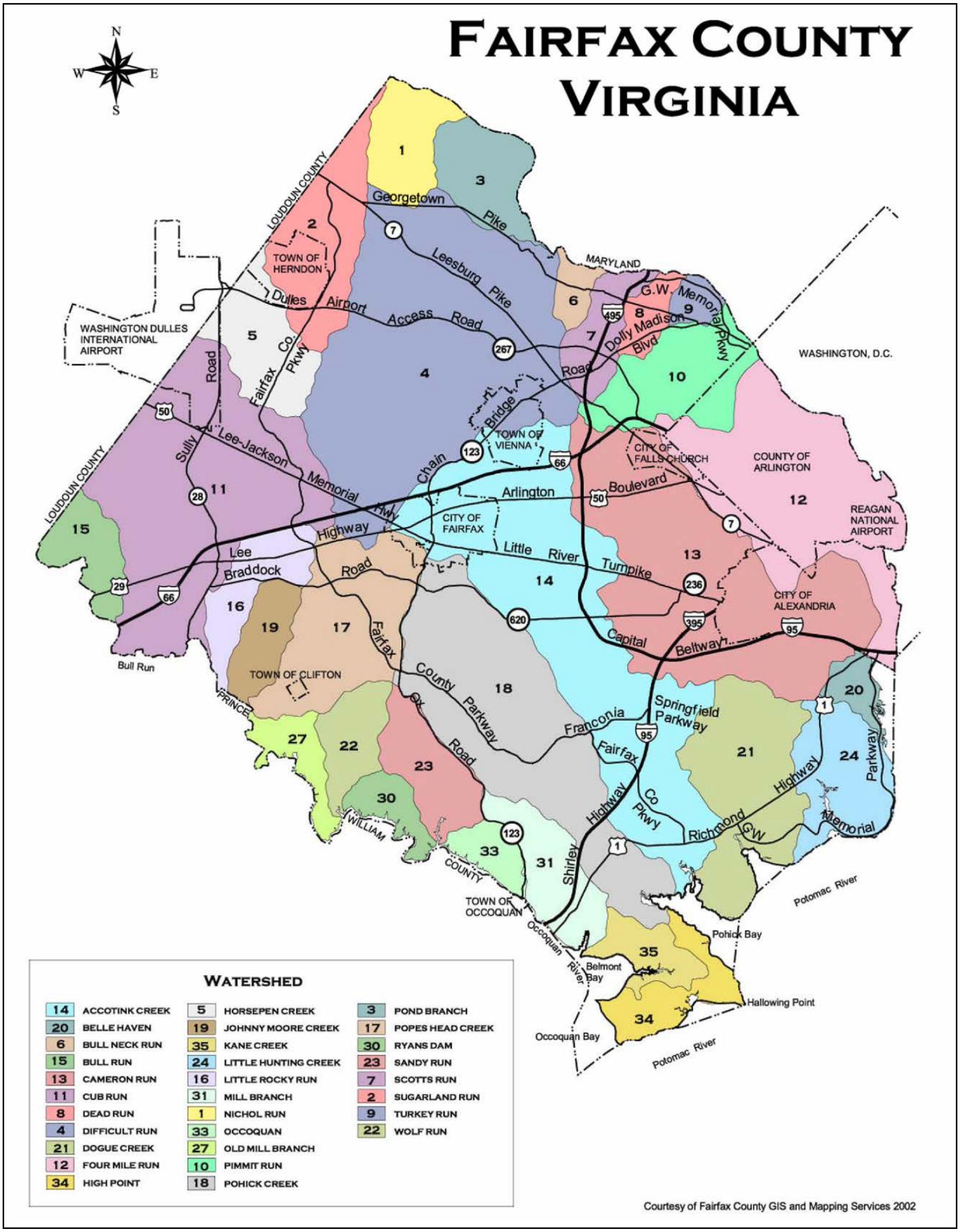


Figure 1-1. Watersheds within Fairfax County, VA

The Cameron Run watershed encompasses 44 square miles, 33 of which are located in Fairfax County. The watershed has a long history of urbanization; most of the land within it was developed by the early 1970s, and only 5 percent remains vacant today. The watershed has a large proportion of impervious surface that has contributed to substantial physical effects, such as erosion, flooding, and channel alteration. Several reaches within the watershed fail to meet water quality standards specified in Section 303d of the Clean Water Act (CWA) and, therefore, are included in the Virginia Department of Environmental Quality's list of impaired streams. Two reaches are listed because of the presence of fecal coliform bacteria and require determinations of total maximum daily loads. Two other reaches are listed because they have impaired benthic communities, and a fifth reach is listed because of the presence of both fecal coliform in the water and PCBs in fish tissue. The county's 2001 Stream Protection Strategy (SPS) Baseline Study classified Cameron Run as Watershed Restoration Level II. Primary goals in Watershed Restoration Level II areas are to prevent further degradation and to take active measures for improving water quality to support Chesapeake Bay initiatives and comply with existing water quality standards. In order to support the Chesapeake 2000 Agreement, Fairfax County is committed to developing watershed management plans for all of its watersheds.

1.2 PURPOSE OF PLAN

Cameron Run watershed has experienced environmental degradation, primarily as a result of urban and suburban development. The Fairfax County government initiated a planning process to improve the quality of Cameron Run, its tributaries, and its watershed. An Advisory Committee and the Cameron Run Watershed Plan Project Team, which consists of members of Fairfax County's staff, its contractor, Versar, Inc., and members of the community, worked together to produce the Cameron Run Watershed Plan. It accomplishes the following:

- acts as a tool for evaluating, assessing, and managing the watershed
- provides goals and objectives for improving the watershed (e.g., to restore water quality, reduce flood frequency, improve fish and wildlife habitats)
- recommends actions to achieve these goals and prevent or mitigate watershed problems
- provides a benchmark for measuring the plan's success

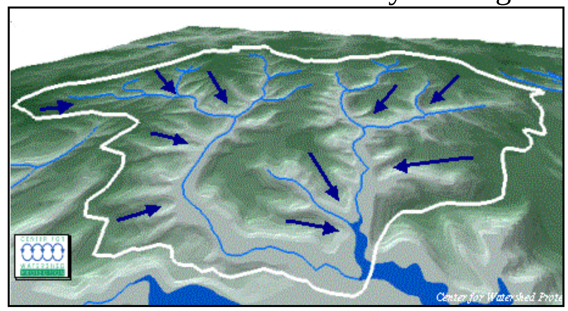
This planning effort is one of five concurrent watershed planning projects undertaken by Fairfax County that used similar data and standardized methods to facilitate consistent planning across the county. Together the Advisory Committee and Project Team reviewed existing reports and studies to describe the current status of the watershed and to highlight key issues of concern. They relied heavily upon readily available data about land use (2003) and imperviousness (1997), and other electronic data available at the outset of the project, which served as the study's base year. Although the Advisory Committee and Project Team recognize that many parcels in older neighborhoods across the county are undergoing "mansionization" (i.e., the replacement of smaller dwellings with substantially larger structures), this plan does not address the effects of mansionization on stormwater runoff and water quality in the Cameron Run watershed. The county intends to examine that issue comprehensively in the future. Computer modeling was used to identify flooding, channel erosion, water quality problems, and other factors affecting the quality of the ecosystem of Cameron Run watershed. Modeling also was used to assess present conditions and predict conditions after the addition of Best Management Practices (BMPs) to assist in identifying and selecting cost-effective BMPs that could provide the greatest improvement in stream water quality. The Project Team used these results to develop recommendations for capital improvement projects and non-structural management strategies. The Cameron Run Watershed Plan is the result of this holistic planning process.

Although this plan proposes a schedule for implementing recommended actions, additional factors may affect the individual projects and the implementation schedule:

1. Members of the county's staff and the Fairfax County Board of Supervisors (Board) will review the projects, programs (both structural and non-structural), and policy recommendations in this plan prior to implementation. The Board's adoption of the Watershed Management Plan will not ensure automatic implementation of projects, programs, initiatives, or policy recommendations that have not first been subjected to sufficient scrutiny to determine if they will provide the greatest environmental benefit for the cost.
2. The Watershed Management Plan provides a conceptual master-list of structural capital projects and a list of potential non-structural projects for the watershed. Each fiscal year, the county's staff will prepare and submit to the Board a detailed spending plan that includes a description of proposed projects and an explanation of their ranking, based on specific criteria that have yet to be established. 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 goal for the watershed or for water quality, and the project's ability to be implemented within the same fiscal year that funding is provided. The staff also intends to track the progress of implementation and report back to the Board periodically.
3. Each project on the annual list of structural projects will be evaluated before implementation using basic value-engineering, cost-effectiveness principles and considering alternative structural and non-structural means for accomplishing the purposes of the project.
4. 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. These projects will also be evaluated to determine appropriate cost-sharing by any parties responsible for the obstructions.
5. Any stream-crossing improvements not related to protecting streambeds or banks or to preventing structure flooding will not be implemented using the county's stormwater improvement funds.
6. Stream restoration projects on private lands will be evaluated to determine means for cost-sharing by landowners who are directly responsible for degradation resulting from their land uses.

1.2.1 Watershed Planning

A watershed can be defined as the land that drains to a particular point along a stream; therefore, each stream has its own watershed. The boundary of a watershed is defined by the highest elevations surrounding the stream, such as mountains. Everyone lives in a watershed, as all land drains to a stream or other waterbody. Watersheds encompassing more than one stream can be broken down into smaller geographic units called subwatersheds. A watershed plan tracks the planning and management within these individual subwatersheds. The Cameron Run watershed has 8 subwatersheds that encompass approximately 44 square miles.



Land draining to a stream forms a watershed

A watershed plan is the best way to protect watersheds. Watershed plans assess current stream conditions and outline strategies to maintain or restore desired conditions. They can be used to direct proposed development to the least sensitive areas or to attempt to control the impervious cover in a watershed as a means of achieving the watershed quality desired by a community. The land and tributaries within a watershed should be considered as a unit for environmental planning. The health of the aquatic communities in the watershed's rivers, lakes, and wetlands can be used to monitor progress in watershed planning.

Protecting and restoring watersheds can provide a variety of benefits depending on the community's goals. A local planning process should be used to develop the plan's unique goals and objectives. For example, a plan may define goals to restore water quality, reduce the frequency of flooding, and improve habitat for fish and wildlife. A watershed plan provides an opportunity to develop targeted strategies and land planning efforts to achieve these goals.

1.2.2 Benefits of Watershed Plans

Effective local planning for watershed management provides a set of tools for communities to go beyond minimum regulatory requirements. Plans can help communities to protect their supplies of surfacewater and groundwater, maintain the quality of their of drinking water , reduce stream-bank erosion, and restore habitat for fish and wildlife habitat. Plans will also help local governments to meet commitments under the Chesapeake 2000 Agreement, which include the following:

- State signatories will work with local governments, community groups, and watershed organizations to develop and implement locally supported watershed management plans in two-thirds of the bay's watershed.
- Local watershed management plans will address the protection, conservation, and restoration of stream corridors, riparian buffers, and wetlands for the purpose of improving habitat and water quality.

Watershed plans can incorporate a community's other goals and related outcomes, such as providing access to rivers or lakes at appropriate locations, protecting current or future water supplies, protecting cultural and historic resources, protecting threatened or endangered species, or providing greenway parks along rivers. Ultimately, an effective watershed plan should lead to healthy streams with diverse aquatic life, stable streambanks, vibrant native vegetation, adequate floodplains, and vegetated buffer areas that reduce flooding and provide recreational opportunities.

1.2.3 Components of an Effective Planning Process

Several key components are shared by all effective watershed plans. A watershed planning process should

- establish the watershed as the management framework;
- identify key stakeholders within the watershed community, define stakeholder roles and responsibilities, and provide a clear participation process;
- assess the current state of the watershed and identify critical issues of concern;
- establish a collective vision for the watershed based on community input;
- set a clear strategy that addresses goals, objectives, action plans, funding, timeframes, and evaluation; and
- provide a process for using and applying the watershed plan and for adapting it as needed over time.

Including these components in the watershed planning process will ensure that the plan results in a comprehensive approach to watershed management that meets the community's needs.

From the outset, effective watershed planning must also account for future trends in land use. Watersheds are dynamic systems and exist within a changing landscape. Unless the watershed lies within a stable land-use pattern, changes in land use, such as new residential and commercial developments, will affect a watershed's hydrology, habitat, wildlife, and water quality. As a result, planning efforts should consider the potential effects of future development scenarios. For example, if every land parcel were developed to its maximum allowed density, would the amount of impervious cover increase to the extent that watershed protection goals for the next decade could not be met?

Based on assessments of future land-use trends, it may be necessary to modify the comprehensive plan goals and zoning regulations. For instance, stream valley wetlands may need to be set aside for protection, or sensitive headwater areas may need to be rezoned to permit less intensive land development. Already developed parcels may be redesignated to provide pollution prevention and mitigation measures, such as planting vegetation to trap and break down pollutants.

A watershed plan is not a static document, but rather a living process that sets goals and steps for better management of the watershed on a daily basis. To ensure that the plan's goals are achieved, the watershed plan should include a method for evaluating the plan's overall implementation and for changing the plan as needed.

1.3 PLAN ORGANIZATION

The Cameron Run Watershed Management Plan integrates environmental management, natural resource protection, and community goals to improve the watershed. The watershed plan chapters contain the following information:

Chapter 1	Background, purpose, and plan organization
Chapter 2	General overview of the watershed, including the history of Cameron Run, a summary of existing reports and data sources, and issues in the watershed
Chapter 3	Summary of how Cameron Run watershed was assessed through stream characterization methods, modeling, and public involvement
Chapter 4	Current state of Cameron Run and its subwatersheds: Tripps Run, Upper Holmes Run, Lower Holmes Run, Turkeycock Run, Indian Run, Backlick Run, Pike Branch, and Cameron Run mainstem and direct tributaries
Chapter 5	Summary of the watershed management plan development process, including methods used to integrate and consolidate information, potential solutions, public involvement, and steps to identify and present solutions
Chapter 6	Cameron Run Watershed Plan: vision, goals and objectives, policy actions, land use actions, programmatic actions, project actions, actions summary, implementation tracks, and benefits summary
References	
Glossary	
Appendix A	Project fact sheets for Tier I projects (organized by stormwater management ponds, low impact development, and stream restoration), tables and maps of Tier II and Tier III projects, and project fact sheets for Group I Drainage Complaint Projects
Appendix B	Modeling Report
Appendix C	Public Involvement Minutes (including the minutes of Advisory Committee meetings and public meetings)

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Chapter 2
Overview of the Cameron Run Watershed

2.1 WHAT IS THE CAMERON RUN WATERSHED?

The Cameron Run watershed drains a 44-square-mile section of Northern Virginia. Thirty-three square miles of this area lie within the jurisdiction of Fairfax County; the remaining area lies within the cities of Falls Church and Alexandria (Figure 2-1). The western part of the watershed is within the Piedmont physiographic province (i.e., just west of the fall line); the eastern part is in the Coastal Plain. The Piedmont is an area of very old crystalline rocks underlying rolling hills. The Coastal Plain is characterized by a recent series of unconsolidated sedimentary strata (sands) typified by flat lands. Holmes Run is the primary headwater stream of the Cameron Run watershed. The headwaters of Holmes Run lie near the junction of the Capital Beltway (I-495) and I-66, approximately 1.5 miles west of the city of Falls Church. Flowing south and east, Holmes Run drains a portion of the area between Tyson's Corner and the cities of Vienna and Falls Church. The stream crosses beneath four major highways before flowing into Lake Barcroft. Lake Barcroft is located at the confluence of Holmes Run and Tripps Run. Tripps Run drains the southeastern half of the city of Falls Church. Other major tributaries of Cameron Run are Backlick Run, Indian Run, and Pike Branch. Lake Barcroft (137 acres), Fairview Lake (15 acres), and four regional ponds are major waterbodies within the watershed.

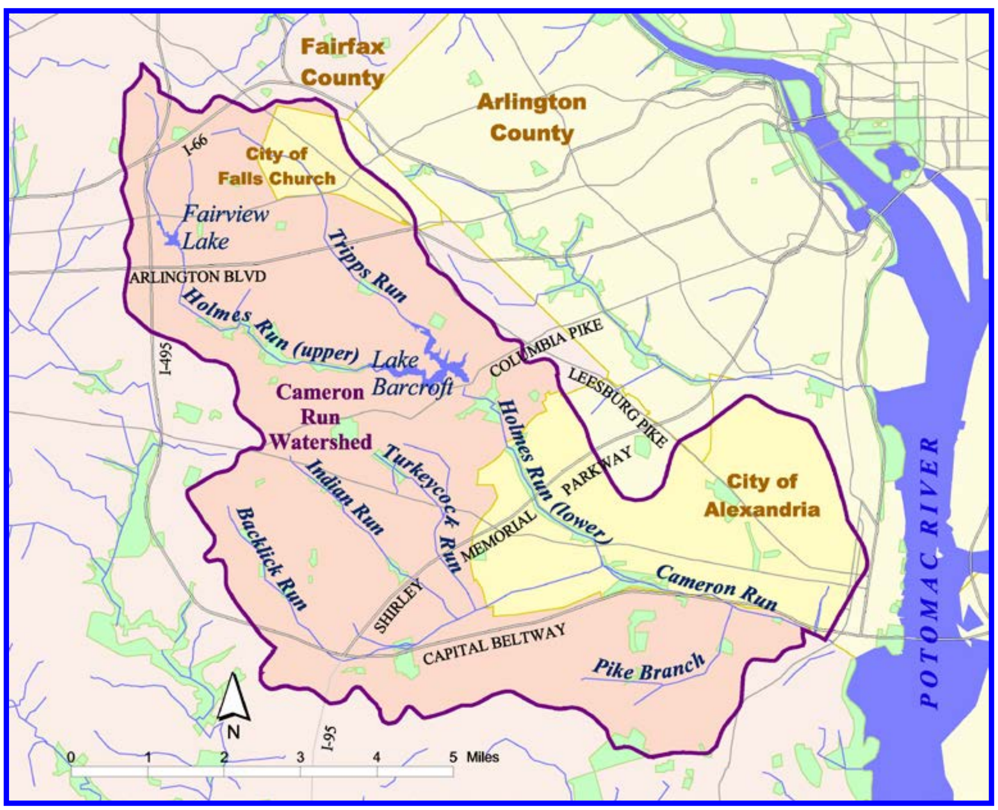


Figure 2-1. Cameron Run watershed

Approximately four miles southeast of Lake Barcroft, Holmes Run meets Backlick Run. Backlick Run and its two major tributaries, Turkeycock Run and Indian Run, drain the south-western portion of the watershed. This area makes up approximately one-third of the watershed and is characterized as a high-density residential area. The headwaters of Backlick Run are located in Annandale and flow in a northeasterly direction to the city of Alexandria, where Backlick Run meets Holmes Run. At the confluence of Backlick Run and Holmes Run the name of the mainstem changes to Cameron Run. In Alexandria, Cameron Run drains the southern and western portions of the city, except areas of Old Town that drain directly to the Potomac River. Cameron Run continues to flow in a southeasterly direction past the point at which Pikes Branch connects with the mainstem. The name of the mainstem changes to Hunting Creek before it reaches the Potomac River.

2.2 HISTORY OF CAMERON RUN WATERSHED

The Cameron Run watershed, like all of eastern North America, was nearly completely forested before the period of human settlement. Until the mid 1600s, the high density of beaver dams and ponds provided a chain of wetlands and ponds that controlled the surfacewater and groundwater in the stream valleys and provided habitat for a wide variety of flora and fauna. Three major plant associations were present in this area. In the northwestern Piedmont part of the watershed, the forest was composed of oaks and hickories. Tripps Run, Lake Barcroft, and much of the Holmes Run and Backlick Run stream corridors are located in the Piedmont. In the southeastern Coastal Plain part, the forest was composed of oaks and pines; in between these areas (i.e., near the fall line) grew American beech forests. Most of the city of Alexandria lies within the Coastal Plain. The Native Americans that lived in this watershed cleared forests and planted crops along the Potomac River. They also hunted game animals in the inland regions, trapped fish, and collected freshwater mussels. When the European settlers arrived, they purchased meat, hides, and crops from the Native Americans. From 1630 to 1650, Europeans hired local Native Americans to trap beaver for pelts. The killings essentially exterminated all beaver, causing the dams to deteriorate and changing the hydrology and ecosystem of the stream valley. As the forest was converted to agriculture, habitats were altered, and many animals disappeared. Around 1723, farms were established that cultivated tobacco, wheat, and corn. In 1850, railroad construction began in the watershed. The first settlement in the watershed was Falls Church in 1699, which became a township in 1875. Fairfax County was formally created in 1742; Alexandria was incorporated in 1779 and became a city in 1852 (Parsons Brinckerhoff 1974).

At the turn of the 20th century, the growth of the federal government in Washington, D.C., expanded into the watershed. Falls Church, Alexandria, and Arlington developed first, and the first subdivision was built by 1891 (Gernand and Netherton 2000). With the development of the watershed came necessary infrastructure such as reservoirs and sewers. Lake Barcroft was created in 1915. The city of Alexandria's increasing need for water led the Alexandria Water Company to build the dam and establish a reservoir to store water from the branches of Holmes Run. In the late 1940s, the reservoir became too small to serve the growing population of Alexandria, and other water sources replaced it. The first sewer lines ran from Falls Church to the Potomac, along Tripps Run, Holmes Run, and Cameron Run. These sewer lines dumped raw sewage into the Potomac until 1954.

By the end of the 1950s, residential subdivisions covered the northern half of the watershed, and by 1965, most land suitable for development had been built upon. By the 1970s, growth around the watershed was directly attributable to the expansion of federal employment and the growth of service industries that assisted that expansion. Private economic interests also contributed to unprecedented commercial growth in Fairfax County.

As the watershed was developed, the floodplains along the perennial streams were altered. Many of the natural stream channels were piped, resulting in a network of storm sewers and culverts. The effects of urbanization (e.g., impervious surfaces, channelization, and storm sewers) led to frequent flash flooding in the lower portion of the watershed. Highly erodible soils and frequent, intense rainstorms also contributed to the flooding. The county addressed this problem by constructing flood-control channels in lower Holmes Run, lower Backlick Run, and Cameron Run.

Marshes were once extensive in both the Piedmont and Coastal Plain parts of the watershed, but today only a few wetlands remain. Sedges, rushes, cattails, grasses, and aquatic shrubs (e.g., tag alder and buttonbush) can be found along the borders of manmade lakes and where normal drainage is blocked. A natural tidal marsh occurs where the lower Cameron Run mainstem flows into the Potomac River. This marsh consists mainly of the yellow water lily, as well as aquatic species such as pickerel weed, cattail, tuckahoe, tearthumb, and knotweed.

The Virginia Department of Forestry reports a 32% decrease in forest resources in the Cameron Run watershed from 1957 to 1992 (Woodrow Wilson Bridge Project 2001). Remaining forest resources are typically small, fragmented, and associated with riparian corridors. No large forested areas remain in the watershed. Prior to development, the forests provided habitat for a variety of wildlife, including black bear, mountain lion, bison, chipmunks, mice, eagles, wild turkey, and the passenger pigeon (Parsons Brinckerhoff 1974). Since the 1970s, the remaining small areas of undeveloped land, combined with suitable forms of development, have provided only limited wildlife habitat for animals such as deer, foxes, raccoons, muskrat, Canada geese, and ducks. Remnant alluvial forest areas sometimes produce spring wildflowers such as dogtooth violets, spring beauties, yellow violets, and toothworts (Parsons Brinckerhoff 1974).

Today, Fairfax County is nearly fully built out; nevertheless, existing residential and commercial buildings are being expanded regularly, and associated paved surfaces are increasing within those building lots. Poor water quality and flooding became a countywide problem during the 1970s as development increased throughout the county. Through the 1930s, the headwater streams were fishable and swimmable. As the population grew, the streams became degraded and were no longer fishable or swimmable. In Fairfax County, protection of stream corridors began in the 1980s. To improve water quality, Fairfax County implemented BMPs that consisted of low-density residential zoning and the creation or maintenance of vegetated stream buffers for its most threatened watersheds. By 1993, the BMPs were implemented countywide with the designation of stream corridors as Resource Protection Areas (RPAs). In the late 1980s, Fairfax County adopted the Regional Stormwater Management Plan for managing stormwater countywide. The original plan identified 134 sites for building regional ponds that would control stormwater runoff to reduce peak flow rates, prevent erosion and flooding, and improve water quality (Bryant et al. 2003).

Recognizing the need to protect the living environment while planning for the orderly development and redevelopment of the county, Fairfax County has increased its watershed planning efforts. The county initiated the SPS and Stream Physical Assessment (SPA) programs were to assess the health of the streams within the county. Fairfax County developed the SPS program to focus recommendations for protecting and restoring subwatersheds, identify priorities for allocating limited resources, establish a framework for long-term stream quality monitoring, and support overall watershed management (Fairfax County 2001). Currently, Fairfax County is developing comprehensive watershed management plans for each of the county's 30 watersheds.

2.3 SUMMARY OF EXISTING REPORTS AND DATA SOURCES

The following sections summarize information available from 16 watershed assessments and planning efforts in Cameron Run watershed. Where available, the web site for the entire report is provided.

- Environmental Baseline Report
- Immediate Action Plan Report
- Future Basin Plan Report
- Lake Barcroft History
- “UrBIN” Urban Biodiversity Study in the Holmes Run/Cameron Run watershed
- UrBIN Gap Analysis of the Holmes Run/Cameron Run watershed
- UrBIN Stream Flow in the Holmes Run/Cameron Run watershed
- Infill and Residential Development Study
- Low Impact Development (LID) As a Watershed Management Tool
- The Role of Regional Ponds in Fairfax County’s Watershed Management
- Perennial Stream Mapping Project
- Stream Water Quality Report
- Annual Report on the Environment 2003
- Fairfax County Park Authority Natural Resource Management Plan, 2004-2008
- Fairfax County Stream Protection Strategy Baseline Study
- Fairfax County Stream Physical Assessment

2.3.1 Environmental Baseline Report

The *Cameron Run Environmental Baseline Report* was written by Parsons, Brinkerhoff, Quade, and Douglas in April 1974. The report presented a comprehensive view of the environmental baseline conditions for the watershed. Development dominated the watershed when this report was written and still does today. The report predicted an increase in stream flow as development density increased and, therefore, the need for on-site stormwater detention. These predictions accurately reflect the condition of the Cameron Run watershed today.

2.3.2 Immediate Action Plan Report

The *Immediate Action Plan Report for the Cameron Run Watershed* was written by Parsons Brinckerhoff, Quade, and Douglas in December 1977. The report identified 40 projects for the Cameron Run watershed at an estimated cost of $7,537,000. The various projects included the replacement of culverts, installation of riprap and gabions along streambanks, and construction of earthen berms. The purposes of these projects included both controlling erosion and protecting houses and roads from flooding. To date, approximately 10% of these projects have been implemented.

2.3.3 Future Basin Plan Report

The *Future Basin Plan Report for the Cameron Run Watershed* was written by Parsons Brinckerhoff, Quade, and Douglas in December 1977. This report, in conjunction with the Immediate Action Plan, specified the watershed's projected needs up to the year 2000. Recommended programs included installation of sanitary sewer lines, channelization, bank protection, stormwater detention, and flood proofing. These programs were estimated to cost $3,831,000.

2.3.4 Lake Barcroft History

This document provided a detailed history of Lake Barcroft and its community. The Barcroft community was named in memory of Dr. John W. Barcroft, who built his home there and operated a mill. Lake Barcroft was created in 1915 in response to the city of Alexandria's increasing demand for water. Construction of the dam began in 1913 and resulted in a 135-acre reservoir. The community surrounding Lake Barcroft was one of the first major real-estate developments in Fairfax County. On February 23, 1954, the residents of Lake Barcroft approved the bylaws of their homeowners association, officially launching the Lake Barcroft Community Association (LABARCA). This association brought the homeowners together to protect their community and the lake. In June of 1972, hurricane Agnes caused a breach in the Lake Barcroft dam, causing the lake to empty. A Watershed Improvement District (WID), a Virginia government agency, was then created in 1973 in an effort to gather funding and staff resources needed to repair the dam and preserve the surrounding land. The WID was able to levy taxes and issue bonds needed to restore the lake. Today, WID taxes are still being used to maintain Lake Barcroft. Recent activities include WID's six-year EPA 319 Grant, which committed $800,000 to identifying and demonstrating stormwater management BMPs. WID has published a 72-page book about BMPs for watersheds and lakes.

2.3.5 Urban Biodiversity Study in the Holmes Run/Cameron Run Watershed

This study was developed for the Urban Biodiversity Information Node Pilot (UrBIN), part of the National Biological Information Infrastructure (NBII) coordinated by the U.S. Geological Survey's Biological Resource Division. UrBIN aims to provide communities with the information and decision-support tools needed to manage urban natural resources proactively. The purpose of the Holmes Run/Cameron Run pilot study was to develop and test a framework for facilitating access to existing data about biodiversity, conservation, and natural resources, but the study also highlighted gaps in knowledge about the watershed. The report was divided into four parts. Part 1 discussed urban biodiversity and contained a description of the watershed and its history and a summary of Virginia's Chesapeake Bay regulations. These regulations were the impetus for much of the natural resource planning in the region. Part 2 contained an inventory of physical and biological resources and analyses of land use and land cover. Part 3 addressed considerations for planning to enhance biodiversity. Part 4 contained reflections on this phase of the UrBIN pilot project.

The study concluded with several findings regarding biodiversity in the Cameron Run watershed:

1. Riparian areas and stream corridors associated with floodplains, parks, and Chesapeake Bay RPAs serve as the main habitats and corridors.
2. Upland habitats are very limited; consequently, those that remain are important.
3. Local jurisdictions have sophisticated planning staffs with a strong interest in environmental protection.
4. Local stakeholders (members of nonprofit organizations and residents) also have a strong interest in environmental protection and apply this interest in advocacy and volunteer activities.
5. A unique set of integrated tools and programs exist that have helped protect the remaining habitats and corridors. These include Chesapeake Bay programs, flood plain management, environmental quality corridors, parks and recreation, the Lake Barcroft WID, land conservation by land trusts and local governments, and citizen volunteer programs.
6. In this highly urbanized watershed, most opportunities for enhancing biodiversity must come from ecological restoration and redevelopment. These activities should focus on remaining habitats and corridors, mainly stream channels, streambanks, riparian areas, and BMP retrofits. De-armoring selected sections of stream and connecting fragmented riparian corridors should be considered.

2.3.6 UrBIN Gap Analysis of the Holmes Run/Cameron Run Watershed

This project was initiated to compile information about biodiversity within the Holmes Run/Cameron Run watershed in Northern Virginia. The UrBIN Gap Analysis Project (GAP) was funded by the National Gap Analysis Program (NGAP) to provide additional biodiversity information to supplement the information compiled in UrBIN. The UrBIN GAP was a cooperative effort between the NGAP and the NBII UrBIN.

The major objective of this project was to apply gap analysis to the Holmes Run/Cameron Run watershed. Sub-objectives of this project were (1) to produce GIS-databases describing the actual kinds of land cover, predicted distributions of terrestrial vertebrates, and land-management status at a target scale of 1:24,000; (2) to identify kinds of land cover and terrestrial vertebrate species that are not represented or are underrepresented in areas managed for biodiversity (i.e., "gaps"); and (3) to facilitate cooperative development and use of information to help institutions, agencies, and private landowners become more effective stewards of natural resources. This project was a preliminary step toward the more detailed efforts and studies needed for long-term planning for biodiversity within Virginia's increasingly urban landscape.

The results emphasized the importance of parks for conserving species within the watershed. Without these refuges, some species may be lost from the watershed. Most parks within the watershed are managed for recreation rather than biodiversity; therefore, the potential for increasing biodiversity protection within the watershed is great.

2.3.7 UrBIN Stream Flow in the Holmes Run/Cameron Run Watershed

This report was prepared by Virginia Tech to support the UrBIN pilot biodiversity study in the Holmes Run/Cameron Run watershed (Estes 2003). The drainage area extending to the dam at Lake Barcroft and the area extending to the USGS gauge station on Cameron Run were analyzed to characterize streamflow and runoff in the watershed. The Lake Barcroft watershed is approximately 15 square miles, or 36 percent of the Fairfax County portion of the Holmes Run/Cameron Run watershed. This area is not as highly urbanized as the southern areas of the watershed. Flow data for Cameron Run are recorded at USGS gauge station 01653000, Cameron Run, at Alexandria, VA. The drainage area to the gauge is 33.7 miles, or 80 percent of the total Holmes Run/Cameron Run watershed. The period of record for flow data at this gauge is June 1, 1955, to the present, with occasional missing dates.

The water level at Lake Barcroft dam is controlled by a bascule gate, a hinged device that is counterbalanced so that when one end is lowered, the other is raised. The gate is operated by a digital controller that receives signals from a lake-level instrument and a gate-position detector. The controller also records the lake level and gate position at constant time increments, thus providing data for calculating the discharge from the dam. A Fortran program was created to convert the data from the controller into usable discharge data (Estes undated). The period of record for the raw data was October 1, 1991, to the present.

Analysis of the period of record indicated an increase in flow over time that was independent of precipitation. The study concluded that the increase in flow probably was due to a significant increase in development within the watershed since 1970. The increase in impervious area in the urban watershed resulted in increased runoff and increased stream flow. The researchers tested for a correlation between recorded flow at the Lake Barcroft Dam and at the USGS gauge on Cameron Run. The correlation was not as high as expected, but the relationship can be used to obtain a reasonable prediction of flow at either location.

2.3.8 Infill and Residential Development Study

The combination of the development patterns in Fairfax County and a growing concern over water quality issues led the Board of Supervisors to request the *Infill and Residential Development Study* in May of 1999. The Board accepted the final recommendations of that study at a public hearing on January 22, 2001. The study included the following recommendations related to stormwater management:

- Improve, in the erosion and sedimentation control process, the awareness, planning, and financial resolution capability of the County for land disturbing projects upstream of sensitive sites in order to reduce impacts.

- Enhance, during the erosion and sedimentation control inspection and enforcement process, the enforcement of violations including, in certain egregious instances, revoking of land disturbing permits.

- Enhance, through education programs, the knowledge and awareness of staff, the development industry, and citizens regarding the importance and capabilities of an erosion and sedimentation (E&S) control program, as well as create an E&S Hotline to improve program responsiveness.

- Improve the design and installation of erosion and sedimentation control silt fences and super silt fences by improving the design standards of the County's regulations.

- Improve the effectiveness of temporary erosion and sedimentation inlet controls on construction sites by reducing the allowable area that may be drained to them, therefore increasing the number of these control devices and improving sediment control.

- Allow the use of an optional Faircloth Floating Skimmer as a dewatering device in temporary sediment traps to increase sediment removal efficiency.

- Allow the use of chemical erosion prevention products on exposed and highly sensitive soils at construction sites in order to reduce erosion which may occur between the time that the exposed area is seeded and mulched and when the grass is fully established.

- Allow the use of bonded fiber matrix products on exposed highly sensitive soils on steep slopes at construction sites in order to reduce erosion which may occur between the time that the exposed area is seeded and mulched and when the grass is fully established.

- Where storm water detention/water quality waivers are deemed appropriate for development projects with proposed land disturbing activities, require conditions as necessary to avoid adverse impacts to downstream properties.

- Require reports to demonstrate adequacy of E&S measures to protect downstream properties.

- Enhance water quality controls and best management practices to maintain good ecological health in the County's streams by enhancing current practice in a variety of ways detailed in this recommendation.

- Amend the current language of the Public Facilities Manual regarding definitions of terms and requirements for adequate outfall analysis; to give the Director of DPWES discretion regarding additional measures where there will be discharge into an inadequate channel; to better define the design procedure for pipe outlets; and to allow consideration of the recent Virginia Dept. of Conservation and Recreation proposal pertaining to hydrologic stormwater design.

- Modify requirements and procedures as they relate to the consideration of stormwater management during the zoning process to include amending submission requirements for residential zoning applications regarding adequate outfall; to provide for more direct DPWES involvement in the zoning process for residential applications; to seek commitments for SWM facility sizes.

Most of these recommendations have been implemented or addressed. The Land Development Services, Department of Public Works and Environmental Services, is tracking the status and disposition of specific recommendations.

2.3.9 Low Impact Development (LID) As a Watershed Management Tool

Two letters on the use of BMPs were sent to all architects, builders, developers, engineers, and surveyors practicing in the county, one in 2001, the other in 2002. These letters were an initial step in adopting and encouraging the use of LID techniques for improving water quality in the county. Procedures for requests to use innovative BMPs in Fairfax County were defined in a letter dated October 2, 2001. This letter detailed the application procedure, discussed the general design standards and application conditions, provided a list of innovative BMPs, and included an Innovative BMP Tracking Form. The second letter, *Innovative BMPs – 3.07 Enhanced Extended Detention Dry Ponds Now Acceptable for Public Maintenance in Residential Areas and on Governmental Sites*, was sent on May 14, 2002. This document provides a comprehensive overview of the application of LID in Fairfax County (see http://www.fairfaxcounty.gov/dpwes/watersheds/rpr/rpr_k-n.pdf).

2.3.10 The Role of Regional Ponds in Fairfax County's Watershed Management

On January 28, 2002, the Board of Supervisors directed county staff to form a multi-agency committee to develop a unified position on the use of regional ponds and other kinds of stormwater controls as watershed management tools. During 2003, the Regional Pond Subcommittee provided recommendations regarding the use of regional ponds and other innovative and nonstructural techniques as part of watershed management. The focus of the effort was to evaluate, deliberately and comprehensively, the potential benefits of modifying watershed management practices, policies, and regulations. A comprehensive list of issues was organized into the following ten categories: ecology; economics; local, state, and federal permits; regulations and policies; hydrology and design; land use and watershed management; parks and recreation; health and safety; aesthetics; construction planning and phasing; and public participation, outreach, and support. Representatives of business, industry, and the public were asked to review and comment on this process.

After much deliberation, research, and consultation with the public and stakeholders, the Subcommittee identified 61 recommendations to improve Fairfax County's stormwater management program and to clarify the role of regional ponds in that program. The general consensus was that regional ponds play a role in the county's stormwater management program, but that they should be designed to address several ecological, economic, and social concerns and should work in concert with better site designs and LID practices. The Subcommittee is coordinating the development of an implementation plan for all recommendations, including a time line and assignments. Several of the recommendations address the need to modify the county's Public Facilities Manual (PFM), stormwater policies, codes, and ordinances (see http://www.fairfaxcounty.gov/dpwes/stormwater/).

2.3.11 Perennial Stream Mapping Project

A project to identify perennial streams was initiated in September of 2001 in response to the Fairfax County Board of Supervisors' direction implementing an Environmental Quality Advisory Council (EQAC) resolution concerning mapping and protecting additional stream segments within the county under the Chesapeake Bay Preservation Ordinance (BPO). A perennial stream is a flowing system that is continuously recharged by groundwater or surface runoff, regardless of weather conditions. Under the Virginia Chesapeake Bay Preservation Act (CBPA), areas designated as RPAs include tidal wetlands, non-tidal wetlands connected by surface flow to tidal wetlands or tributary streams, tidal shores, tributary streambeds (not owned by the Commonwealth of Virginia), and stream buffer areas 100 feet in width. Resource Management Areas (RMAs) include land that has a potential for causing degradation of water quality or of an RPA if it is not used properly. RPAs are defined by the regulation; RMAs are determined by local discretion. Amendments to Chapter 118 of the county's BPO changed the definition of an RPA from "tributary streams" to "water bodies with perennial flow." These amendments included a requirement to identify water bodies with perennial flow by using a scientifically valid method to conduct site-specific surveys. Perennial stream protocols were developed by the county and approved by the state; the county then embarked on a survey of the headwater reaches of streams to designate perennial streams upstream of existing RPAs. The Board of Supervisors adopted the results of the survey as amendments to the county's BPO in November 2003. This extensive perennial stream survey identified an additional 330 miles of perennial streams, a 52% increase (from 638 to 968 miles). This increase in stream miles established 17.06 square miles (or 10,921.57 acres) of new RPAs in the county, an increase of 31% (from 55.3 to 72.3 square miles, http://www.fairfaxcounty.gov/dpwes/stormwater/).

2.3.12 Stream Water Quality Report

The Fairfax County Health Department monitors stream water quality at 84 sampling sites throughout the county (http://www.fairfaxcounty.gov/hd/strannualrpt.htm). The program was introduced at the Fairfax Fair in June 1989 in response to EQAC's recommendations to promote citizens' awareness of the potential hazards of recreational usage of streams and to provide the Health Department with citizen surveillance and reporting of possible pollution problems. The program was awarded the National Association of Counties 1991 Achievement Award and the Virginia Municipal League's 1991 award for Environmental Quality. Seven monitoring sites are shown in Figure 2-2. Site 12-04 is located on Tripps Run. Sites 12-15 and 12-05 are located on Upper Holmes Run. Site 12-07 is located on Lower Holmes Run. Site 12-12 is located on Turkeycock Run, and sites 12-14 and 12-13 are located at the confluence on the Cameron Run mainstem. No samples were taken at site 12-15 in 2002. In 2002, these sites were sampled for fecal coliform, dissolved oxygen, nitrate nitrogen, pH, total phosphorous, and temperature. These parameters indicate the amount of pollution contributed from manmade sources and help to evaluate the quality of the aquatic environment.

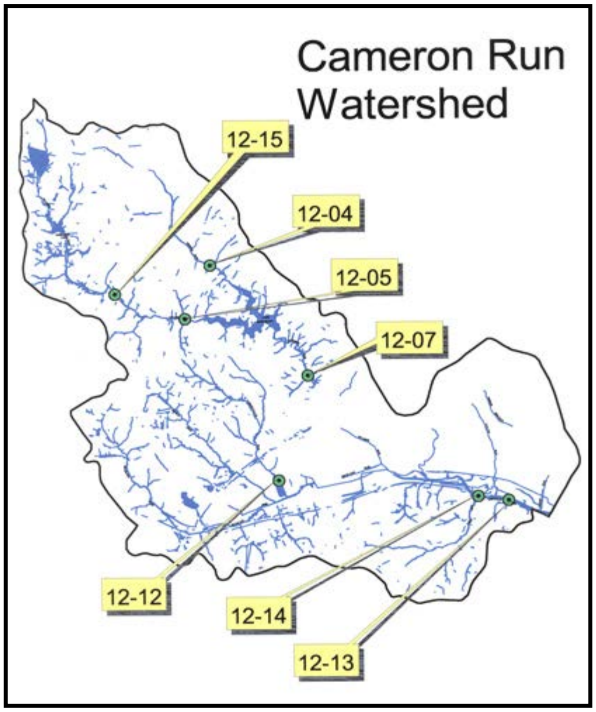


Figure 2-2. Water quality sampling sites located in the Cameron Run watershed

Water quality standards include standards for concentrations of fecal coliform bacteria. These "indicator organisms," although not necessarily harmful themselves, are found in the intestinal tracts of warm-blooded animals, including humans, and can indicate fecal contamination and the possible presence of pathogenic organisms. In surface waters, fecal coliform bacteria should not exceed a geometric mean of 200 fecal coliform bacteria per 100 ml of water. Table 2-1 shows the results of fecal coliform sampling. For each sampling site, more than 70% of the samples had fecal coliform counts greater than 200/100ml.

Table 2-1. Fecal coliform (F.C./100ml)			
Sample Station	**Total Samples Collected**	**Number of Samples with <200/100ml**	**Number of Samples with >200/100ml**
12-04	12	3	9
12-05	12	1	11
12-07	13	2	11
12-12	18	3	15
12-13	16	2	14
12-14	18	3	15

The presence of dissolved oxygen (DO) in water is essential for aquatic life, and the structure of the aquatic community depends to a large extent on the concentration of dissolved oxygen available in the water. Dissolved oxygen standards are established to ensure the growth and propagation of aquatic ecosystems. The minimum standard for dissolved oxygen is 4.0 mg/l. The average dissolved oxygen for each site in the Cameron Run watershed was above the minimum standard. Sampling sites 12-04 and 12-13 exhibited 14.3 and 23.8 percent of samples with less than 4.0 mg/l respectively (Table 2-2).

Table 2-2. Dissolved oxygen (mg/l)			
Sample Station	**Total Samples Collected**	**Average Dissolved Oxygen**	**Percentage of Samples less than 4.0 mg/l**
12-04	14	7.5	14.3
12-05	14	7.7	0
12-07	15	8.2	0
12-12	21	9.1	0
12-13	21	6.9	23.8
12-14	21	8.4	0

Nitrate nitrogen is usually the most prevalent form of nitrogen in water because it is the end product of the aerobic decomposition of organic nitrogen. Nitrate from natural sources is attributed to the oxidation of nitrogen in the air by bacteria and to the decomposition of organic material in the soil. Nitrate concentrations can range from a few tenths of a milligram to several hundred milligrams per liter. In unpolluted water, nitrate seldom exceeds 10 mg/l. Nitrate is a major component of human and animal wastes, and abnormally high concentrations suggest pollution from these sources. Table 2-3 shows the average nitrate nitrogen values at the sampling sites.

Table 2-3. Average nitrate nitrogen (mg/l), pH, and total phosphorus (mg/l)

Sample Station	Average Nitrate Nitrogen (mg/l)	Average pH	Average Total Phosphorus (mg/l)
12-04	1.0	7.0	0.1
12-05	0.5	7.2	0.1
12-07	0.6	7.0	0.1
12-12	0.5	6.8	0.1
12-13	0.4	6.8	0.1
12-14	0.6	7.1	0.1

Stream pH is an important factor in aquatic systems. Biological productivity, stream diversity, metal solubility, the toxicity of certain chemicals, and important chemical and biological activity are strongly related to pH. The pH range of 6.0 to 8.5 generally provides adequate protection for aquatic life and for recreational use of streams. Average pH values for all of the sampling sites were within the range for aquatic life (Table 2-3).

Phosphorus is found naturally in water in the form of various types of phosphates. Phosphorus is essential to the growth of organisms and can be the nutrient that limits the growth that a body of water can support. There is no established limit for total phosphorus content in stream water. Significant increases in total phosphorus may indicate increasing amounts of contaminants entering the stream. The average total phosphorus values for each site are shown in Table 2-3.

2.3.13 Annual Report on the Environment

The *Annual Report on the Environment*, which is an update on the condition of the county's environment, serves a threefold purpose. First, it is intended to assist the Board of Supervisors in evaluating ongoing environmental programs and to provide the basis for proposing new programs. The document also aids public agencies in coordinating programs to jointly address environmental issues. In addition, the report is directed to citizens who are concerned with environmental issues. The report contains chapters on major environmental topics including water resources; air quality; ecological resources; wildlife management; solid waste; hazardous materials; noise, light, and visual pollution; and land use and transportation. Each chapter discusses environmental issues, summarizes relevant data, and identifies applicable government programs. Discussions of legislative issues are provided, where relevant. Most of the chapters conclude with recommendations that identify additional actions that EQAC believes are necessary to address environmental issues. Annual reports from 2001 through 2006 are available on the county's website (see http://www.fairfaxcounty.gov/dpz/eqac/report/).

2.3.14 Fairfax County Park Authority Natural Resource Management Plan, 2004 – 2008

The purpose of this document is to coordinate efforts to achieve the Fairfax County Park Authority's (FCPA) vision for preserving resources. The plan creates a systemwide approach necessary to achieve the Park Authority's goals (http://www.fairfaxcounty.gov/parks/ nrmp.htm). The plan contains seven elements: Natural Resource Management Planning, Vegetation, Wildlife, Water Resources, Air Quality, Human Impact on Parklands, and Education. Each of these elements includes a background section to introduce the topic, as well as the plan's issues and strategies.

FCPA is the county's largest landowner. FCPA's lands represent 8.6% of Fairfax County's total land area of 262,400 acres. Combined with other public parks in Fairfax County, FCPA's holdings represent more than 15% of the county's landmass. Key recommendations of this plan include the following:

- Conduct an inventory of existing vegetative communities, including plants that are designated as threatened, endangered, or of special concern at the federal, state, or local level.
- Develop an FCPA policy to address the planting and cultivation of native plants, and the removal of invasive plants on parkland.
- Assess stream valleys within parks at stormwater outflows to identify sites where corrective actions are needed most urgently.

2.3.15 Fairfax County 2001 Stream Protection Strategy Baseline Study

This study rated four components of stream/watershed condition including benthic macro-invertebrate community integrity, vegetation and instream features, fish taxonomy richness, and percent impervious cover. The 2001 SPS Baseline Study established three broad management categories, Watershed Protection, Watershed Restoration Level I, and Watershed Restoration Level II, for future watershed protection and restoration efforts, based primarily on overall stream rankings of biological quality and projected development. Subwatersheds that fall into the Watershed Protection category tend to be areas of low-density development with biological communities that are relatively healthy. The primary goal of this category is to preserve biological integrity by taking active measures to identify and protect, as much as possible, the conditions responsible for the current high quality rating of these streams. The primary goal of the Watershed Restoration Level I category is to re-establish healthy biological communities by taking active measures to identify and remedy causes of stream degradation, both broad-scale and site-specific. These watersheds generally have fair biological conditions and are in areas of substantial and continuing development, but still hold potential for significant enhancement of stream quality. High development density, significantly degraded instream habitat conditions, and substantially impacted biological communities generally characterize subwatersheds in the Watershed Restoration Level II category. The primary goal for this category is to maintain areas to prevent further degradation and to take active measures to improve water quality.

The study showed that the Cameron Run watershed has substantially degraded biological and habitat integrity (Fairfax County 2001). The Cameron Run watershed was classified as a Watershed Restoration II Area. A summary of 2001 SPS Baseline Study data for Cameron Run watershed is shown in Table 2-4.

Table 2-4. Summary of 2001 SPS Baseline Study data for Cameron Run watershed							
	Tripps Run	**Holmes Run Upper**	**Holmes Run Lower**	**Turkeycock Run**	**Indian Run**	**Backlick Run**	**Pike Branch**
Condition Rating	Very Poor	Very Poor	Very Poor	Poor	Very Poor	Very Poor	Very Poor
Index of Biotic Integrity Score	Very Poor	Very Poor	Fair	Very Poor	Fair	Poor	Fair
Habitat Score	Very Poor	Poor	Very Poor	Fair	Poor	Very Poor	Very Poor
Fish Taxa Richness	Very Low	Variable	Low	Low	Very Low	Low	Very Low

2.3.16 Fairfax County Stream Physical Assessment

The SPA study provided information about the condition of habitats, specific infrastructure and problem areas, and general characteristics of streams throughout the watershed and a geomorphic classification of stream type (CH2M Hill 2004). Based on a length-weighted habitat score of 92, Cameron Run watershed is one of the poorest watersheds in the county. Approximately 6 miles of stream were categorized as having very poor habitat conditions, 23 miles as poor, 17 miles as fair, and 2 miles as good. A summary of SPA data for Cameron Run watershed is shown in Table 2-5. Analysis of the results indicates that the Cameron Run watershed has few adequate riparian buffers, with more than 40 acres of deficient buffer per 10 miles.

Table 2-5. Summary of SPA data for Cameron Run watershed							
	Tripps Run	**Holmes Run Upper**	**Holmes Run Lower**	**Turkeycock Run**	**Indian Run**	**Backlick Run**	**Pike Branch**
Inadequate Buffers (ft.)	37,850	93,950	10,300	51,615	42,850	70,485	27,450
Eroded Streambanks (ft.)	0	4,590	0	4,295	4,840	3,725	75
Stormdrain Pipes	18	124	10	36	25	2	29
Dumping Sites	0	6	0	1	0	1	1
Headcuts	0	0	0	2	0	2	0
Exposed Utilities	2	11	1	4	6	4	2
Obstructions	0	26	1	11	9	7	5
Road Crossings	25	68	3	38	29	59	13

2.4 ISSUES IN THE CAMERON RUN WATERSHED

The Advisory Committee initially identified 16 issues of concern (i.e., watershed problems) in the Cameron Run watershed. For simplicity, the 16 issues were combined into 10 broader issues (Table 2-6). These issues were the starting point for the Cameron Run Watershed Plan and were refined within the Committee and through public involvement. The sources and environmental effects associated with each issue are described in the sections below.

Table 2-6. Cameron Run watershed issues

10 Primary Issues	16 Component Issues
Bank Erosion and Sedimentation	• Bank erosion including infrastructure impacts and channel instability • Sediment loading to watershed and accumulation in streams
Impervious Surfaces	• Impervious surfaces and loss of tree cover • Decreased infiltration and increased runoff
Loss of Riparian Buffer and Wetlands	• Loss or degradation of riparian buffers along streams and shorelines • Loss of wetlands in watershed
Irregular Stream Flows	• Higher peak flows • Lower low flows • Direct inflow from stormwater systems into streams
Loss of Stream Habitat and Stream Life	• Loss or degradation of habitats and biological communities
Pollution	• Discharge or runoff of toxic pollution into streams and lakes • Nutrients loading into watershed
Bacteria	• Bacteria and pathogens in streams and lakes
Flooding	• Flooding of property
Stream Channel Alteration	• Channel alteration of streams • Obstructions to flow and fish passage in streams
Trash	• Dumping and accumulation of trash in streams and lakes

2.4.1 Bank Erosion and Sedimentation


Streambank erosion at Lower Holmes Run

Streambank erosion and the transport of sediment results from the force of water flowing through a stream channel. In undeveloped landscapes, natural streams still erode and alter their course, but this process generally occurs over very long time periods or only during very heavy storms. Urbanization has magnified this erosion and channel alteration process to occur even during light storms as impervious surfaces increase the volume and frequency of storm-water flows. Excessive erosion and the transport of eroded sediment downstream affect streams in a number of ways. Physical effects include degradation of the streambank (e.g., bank erosion, slumping) and changes in the stream channel (e.g., incision or downcutting). As stormwater flows tear away the soil, excess sediment is mobilized, and the natural ability of the stream to transport and store the sediment is overwhelmed. Consequently, sediment is deposited on the bottom, filling in critical habitats for aquatic fish and invertebrates. Large gravel and sediment bars may be formed that deflect stream flow against the streambank, resulting in more erosion. This cycle of erosion degrades the streambank structure until it collapses, introducing additional sediment into the stream. This process can threaten the structural integrity of bridges, buildings, roads, sewer and water pipelines, or other human structures located nearby.

Stream channels and stream life are adapted to natural levels of sediment. Excessive amounts of sediment and particles of certain kinds and sizes (commonly fine silt and clay) disrupt the stream ecosystem. In particular, fine sediment settles into the spaces between the gravel and rock substrate. Insects and small fish need those spaces to graze algae, hide from predators, hunt prey, and shelter themselves from the faster currents above. Sediment accumulating in these spaces may bury plants and animals alive or reduce the amount of living space available for these organisms. As the native species disappear, other more tolerant species that prefer the altered habitat move in.

In addition to affecting the amount and quality of stream habitat, excess sediment can also directly impact the health of aquatic insects and fish. Many fish and insects rely on their vision to detect prey and help avoid predators. As increasing levels of suspended sediment reduce visibility through the water, organisms become less able to find food and avoid being eaten. Fish and many kinds of insects breathe underwater by using gills to gather dissolved oxygen from the water. Gills are sensitive organs, and suspended sediment can clog them, making it harder for the organism to breathe. These organisms are also subject to abrasion from sediment particles. Just as sand can abrade your car's windshield, it can pound and grind down the scales of fish and the shells of insects, as well as their softer, less protected body parts. These physical effects are likely to make it harder for organisms to find food, eat, and grow normally. Organisms that are not growing normally may not have the energy to fight off disease or to reproduce; thus, populations of native species dwindle or disappear from their historical numbers and ranges.

2.4.2 Impervious Surfaces

The primary effect of urbanization (the development of natural or agricultural landscapes) is to convert forests, wetlands, meadows, and farm fields into buildings and other impervious surfaces. Water cannot infiltrate these surfaces as it can natural soils. Common examples of impervious surfaces in urban areas are rooftops, driveways, roads, parking lots, and sidewalks. Compacted soils and lawns also are generally impervious.

Highly developed Seven Corners area

This shift from natural soils and vegetation to impervious surfaces drastically changes the hydrology of an area. In a natural area, only a small amount of rainfall runs off; most is absorbed into the soil. In urbanized areas, the increase in impervious area produces large amounts of stormwater runoff because infiltration is limited. As a result, runoff from the urban landscape conveys a large volume of water to streams in a short time period. The increase in the frequency and magnitude of runoff adversely affects the stability of streams, and ultimately their health.

Natural soil infiltration contributes to recharging groundwater, which helps sustain stream flow between periods of rain. Streams are especially dependant on the influx of groundwater to maintain surface flow and health during summer months. Because urban areas are largely impervious, there is little recharge of the groundwater upon which the streams depend for summer flow. Without an adequate groundwater supply, stream flows in summer may become very low or nonexistent. Such low flows reduce stream habitat available to aquatic communities and may lower water quality (e.g., the amount of dissolved oxygen in the water).

Impervious surfaces also affect stream ecology by increasing water temperature. As rainfall hits asphalt on a hot summer day, the temperature of the rainwater rises before it reaches the stream. Even small temperature changes can affect the activity and life cycles of stream organisms.

2.4.3 Loss of Riparian Buffer and Wetlands

The riparian buffer is the vegetated area along a stream where development is restricted or prohibited. The buffer's primary use is to physically protect and separate the stream from future disturbance or human encroachment. If properly designed, buffers can provide stormwater management benefits, such as reducing property damage from flooding. Additional benefits of riparian buffers include:

- separating the stream from impervious cover
- protecting the streambank from erosion
- shading and reducing stream warming
- reducing the inflow of nutrients and other pollutants to the stream
- providing habitat and migration corridors for fish and wildlife

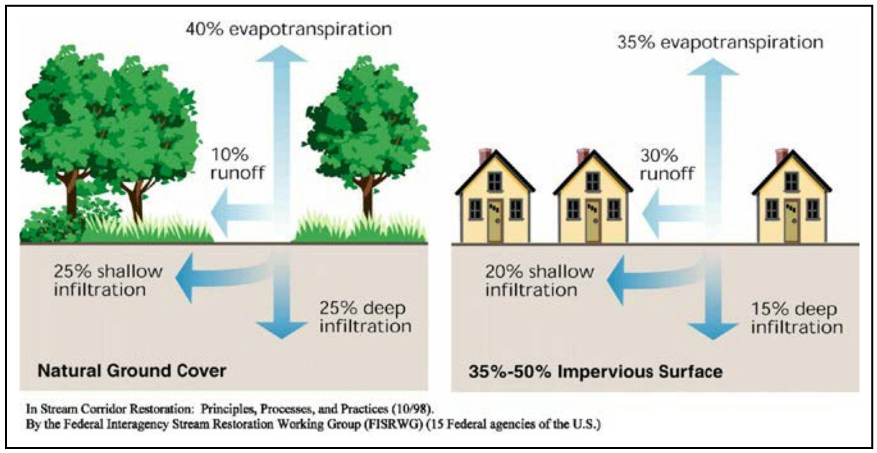
Riparian buffers may be vegetated with grass, shrubs, or forest. The more completely and densely vegetated the buffer is, the more benefits it will provide. Wetlands also act as buffers along streams. Wetlands include marshes, swamps, and bogs, and may be either forested or open. The root systems of wetland plants can hold streambanks and shorelines, while their stems and trunks can reduce erosion by absorbing the energy of the water currents. This energy would otherwise carry soil particles away from the streambank or shoreline.

Riparian buffers are critical to healthy stream ecosystems because they provide space for natural stream dynamics that is physically separated from humans and their structures. Specifically, buffers help contain floodwaters, thereby reducing risks to property and providing storage of flow that would otherwise cause erosion. Wetlands are particularly good at providing temporary storage of floodwaters. Because wetlands typically form in low-lying areas, they often are the first areas to receive water when flooding occurs. Wetland vegetation slows the movement of the floodwaters and acts as a natural sediment trap, as suspended sediment is deposited in the calm water.

Riparian buffers and wetlands can be conserved or restored to protect stream corridors, lakes, and coastal areas. Creating buffers is typically a low-cost means for meeting many stormwater management goals, improving water quality, and providing wildlife habitat. Riparian buffers and wetlands can fit into many different kinds of physical and political landscapes.

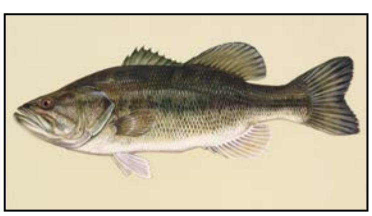
2.4.4 Irregular Stream Flows

The change in landscape from a natural area to an urban area drastically changes the hydrology of a watershed, resulting in flashy streams: ones that have higher maximum and lower minimum flows. The fast flow of the stormwater downstream may result in too little water upstream to sustain aquatic habitats, while the increased amount of water downstream stresses the habitats and aquatic organisms there.



In natural landscapes such as forests and wetlands, rainwater and snowmelt slowly filter into the ground. The infiltration, or absorption of water into the soil, recharges the groundwater supply. In the summer, streams depend on groundwater to prevent them from running dry. In urban areas much of the natural landscape is converted to impervious surfaces such as rooftops and roads. These impervious surfaces prevent rain and snowmelt from infiltrating the ground. Most of the rainfall and snowmelt remains above the surface, where it runs off rapidly. This runoff enters the storm drain system and eventually empties into a stream. The loss of infiltration in urban areas may reduce the amount of groundwater and cause low or nonexistent flows in the stream during the dry summer months. In addition to lower permanent or "base" flows, the large amount of impervious surface in urban areas directs large volumes of water to streams in a short period of time. The increase in the frequency and magnitude of runoff adversely affects the stability of streams, and ultimately their health.

2.4.5 Loss of Stream Habitat and Stream Life



Stream ecosystems and the plant and animal communities they sustain depend upon a wide range of physical and biological factors. Because streams collect water from their watersheds, activities that take place in the watershed can negatively affect the quality of the water entering the stream. If the stream receives poor quality water, then the organisms that live in or use the stream will be adversely affected. Stream organisms, such as fish, salamanders, and invertebrates, have adapted to natural stream conditions and depend upon these conditions for their survival. Natural stream habitats involve clean water, steady and adequate flows, and diverse structures on the bottom and banks. If one or more factors are missing, then stream organisms either will have difficulty surviving, or will not be able to survive at all.

Degradation of stream habitats and ultimately of biological communities results from the well-known list of stresses common in urban areas: bank erosion and sedimentation, irregular stream flows, loss of riparian buffer and wetlands, pollution, and stream alteration. Each of these watershed problems acts to change the natural conditions and degrade or eliminate stream habitats. In the urban setting, stream channelization that replaces natural habitat with concrete channels is the most extreme form of habitat loss. More pervasive, and probably more important, are the bank erosion, sedimentation, and irregular stream flows that result from increases in impervious throughout the watershed. By increasing the volume and frequency of stormwater runoff, impervious surfaces cause erosion and scouring in the stream. Stormwater runoff also picks up pollutants and increases in temperature as it runs across asphalt and concrete before entering the stream or lake. Because the rapid runoff of storm flows depletes groundwater, stream flows in summer may be very small or nonexistent. Obviously, without water, aquatic organisms cannot live.

2.4.6 Pollution

Streams and lakes collect the water that falls as precipitation and flows over and through the land surfaces of the watershed. In urban watersheds, the quality of the water in streams is determined by the pollutants carried in stormwater as it runs off the land and its impervious surfaces. The amounts and kinds of pollutants carried in stormwater reflect the activities occurring within the watershed. Common household activities that affect water quality include automobile maintenance (washing your car and changing the oil), lawn care, and walking your pet. Pollutants generated by these activities wash off the surface into the stormdrain system and end up, untreated, in our streams and lakes.

Outdoor car washing has the potential to contribute a high load of nutrients, metals, and hydrocarbons to the water body. The detergent-rich water used to wash dirty cars flows down the street and into the storm drain to be discharged into the stream. More than 50% of households wash their own cars.

Automobile maintenance generates significant amounts of hydrocarbons, trace metals, and other pollutants that can reach stormwater. Kinds of waste include solvents (paints and paint thinners), antifreeze, brake fluid, batteries, motor oils, fuels, and lubricating grease. Dumping automotive fluids down storm drains is the same as dumping them into the stream.

Lawn care often includes the application of fertilizers and pesticides. Excess fertilizers and pesticides applied to lawns and gardens wash off and pollute streams. Fertilizers contribute a significant amount of phosphorus and nitrogen to water bodies. Even very low levels of insecticides and certain herbicides can be harmful to aquatic life. The major source of pesticides in urban streams is home applications used to kill insects and weeds in the lawn and garden.

Pet waste can be a major source of bacteria and excess nutrients in water bodies. Failure to clean up after your dog can cause water quality problems. A single gram of dog feces can contain 23 million fecal coliform bacteria.

The runoff of nutrients into a waterbody can cause eutrophication (i.e., the proliferation of algae and aquatic weeds that ultimately die and consume dissolved oxygen from the water). The result can be oxygen shortages that cause fish kills. Eutrophication can significantly reduce aquatic biodiversity and interfere with use of the water for fisheries, recreation, industry, agriculture, and drinking. The runoff of toxic chemicals, such as pesticides, can kill small aquatic organisms (such as worms, crustaceans, and insect larvae) or build up in the bodies of larger animals that eat them. When toxic chemicals "bioaccumulate" in fish, ducks, and other food sources, they pose a threat to human health.

2.4.7 Bacteria

Bacteria are single-celled organisms that can cause diseases. High bacteria counts often lead to beach closures during the summer. Bacteria can pollute streams and lakes, making them unsafe for contact and recreation. Fecal coliform, a kind of bacteria, are typically found within the digestive systems of warm-blooded animals. Fecal coliform in water is an indicator that disease-carrying bacteria may be present; therefore, streams are regularly monitored for the presence of bacteria to avoid risks to public health. During storms, fecal coliform are washed off the land into rivers, streams, lakes, or groundwater. Sources of fecal coliform include leaking sewer lines, failing septic systems, coliform-laden sediment in stormdrain pipes, livestock, wildlife, waterfowl, and pets.

2.4.8 Flooding

Floods are natural events that occur when rainfall exceeds the capacity of the streambanks at a given location. In a natural area, rainfall is absorbed by the surrounding vegetation and soil. During the heaviest rains, the floodplain adjacent to the stream stores the excess flow. In urban areas, much of the natural soil and vegetation has been replaced with impervious surfaces in the forms of structures and compacted soils. When rainfall hits an impervious surface, it cannot be absorbed, so it flows downhill toward a waterbody. Curbs and gutters, stormwater drainage pipes, ditches, catch basins, and other drainage systems are designed to convey stormwater directly into receiving waters.

If the amount of rain and flow from upstream exceeds the capacity of the stormwater conveyance system, it overflows, leading to flooding in streets, basements, and backyards. During such flooding, streams may overtop their banks, drainage systems may back up (especially if they are blocked by trash or debris), and sewers may overflow. Human alterations of the landscape in urban areas result in increased frequency and severity of floods. Urban areas typically have few natural floodplains, high-density development, and more paved areas such as roads and rooftops.

Channelized streams generally are wider and straighter than natural stream channels, and they are disconnected from the floodplain. Floodwaters that normally soak into floodplain soils and recharge groundwater are rapidly exported downstream in channelized streams. Because there is less groundwater, stream flows in the summer may be low or nonexistent. Such low flows not only limit habitat for aquatic communities but may also stress or deplete the vegetation that grows alongside the stream.

Natural streams are adapted to the frequency and severity of flooding in undeveloped landscapes. Floods naturally rearrange streambed habitats, uproot aquatic or riparian plants, and increase the drift of aquatic insects. Adaptations of stream inhabitants include sheltering behind rocks or snags, burrowing into the streambed and banks, moving to slower water along the stream's edges and in backwaters, or by having life cycles that are terrestrial or aerial during flood-prone seasons. The more frequent and severe flooding that occurs in developed areas often exceeds the ability of aquatic organisms to survive. Floods also act as a cue for spawning or migration in some fish. When floods occur during the wrong season, spawning may fail, and fish populations can crash.

2.4.9 Stream Channel Alteration

Historically, the reasons for channelizing river systems have included flood control, wetland drainage, erosion prevention, and navigation improvement. In urban environments, channels are usually altered to drain wetland areas and move water away from buildings and infrastructure. These alterations generally produce wide, straight channels with steep streambanks that are disconnected from the floodplain.

Several methods are used to channelize rivers and streams. One method, called re-sectioning, makes rivers wider or deeper to contain water that naturally would spread onto the floodplain. In addition, the slope of the streambank may be altered to increase the volume of water the channel can hold, which helps to accommodate the increased stormwater runoff from urban developments. Another method, realignment, involves straightening a river's channel. Straightening shortens the channel and results in a faster flow downstream. This faster flow removes potentially flood-level flows from one area, but transmits them downstream, where the frequency of flooding may increase.

The banks of altered channels often need to be stabilized to enable them to withstand the erosive forces of the large volumes of water and strong flow in the new channel. Bank stabilization involves protecting streambanks with various materials. Riprap, consisting of large broken rocks piled against the bank, is commonly used reduce the erosive force of water in drainage channels and on steep banks. Gabion baskets, another method of bank stabilization, are wire mesh containers filled with tightly packed rocks. In addition, concrete, vegetation, wood, or other structural materials can be used to protect against erosion.

Channelized section of Tripps Run

Streams that have been channelized offer many fewer habitats for communities of aquatic plants and animal. Habitat diversity is important because organisms use the distinct resources in different habitats to meet their complex life-cycle needs. For example, alternating riffle-pool habitats are important to fish species, because they provide areas for feeding, breeding, and shelter.

2.4.10 Trash

Improper disposal of trash is evident across the landscape. Single littering events accumulate into large "trash areas" when litter is washed into streams and lakes. Trash enters the stream environment from a number of sources, including inadequately treated wastewater, recreation activities, littering, and dumping. During a storm, trash from all sources is carried through the stormwater conveyance system to the local stream.

Trash skimmer on Tripps Run before it enters Lake Barcroft

Illegal dumping to avoid disposal fees at landfills or recycling facilities often occurs in or near streams. Illegal dumping occurs in all settings in all geographic regions but is especially common near abandoned industrial, commercial, or residential buildings; vacant lots; and poorly lit areas such as rural roads and railway lines. The effects of illegal dumping may be more pronounced in areas with heavy rainfall (i.e., where there is a greater volume of runoff). In urban areas, illegal dumping may result from the inaccessibility of recycling centers or solid-waste disposal facilities, which often are located on the suburban-rural fringe.

Dumping sites may contain a wide variety of kinds of trash, depending on how long the site has been used. Manmade materials that float or are suspended in water are especially apparent. These include plastic bags, six-pack rings, bottles, yard waste, and cigarette butts. Once in the stream, the trash can choke, suffocate, or disable aquatic animals such as ducks, fish, turtles, and birds. It also degrades the aesthetic quality of a stream valley or lake, and limits the enjoyment and recreational experience of the community. Collection and disposal of the trash is a burden on the community.

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Chapter 3
Assessing the Condition of Cameron Run Watershed

Developing a successful watershed plan requires accurately assessing the condition of the watershed at scales appropriate for management; therefore, the Project Team undertook a detailed assessment of the condition of the Cameron Run watershed, its subwatersheds, and constituent streams. We applied the following three approaches: (1) characterization of stream condition from field sampling of chemical, physical, and biological parameters; (2) estimation of stream processes by modeling of flow and water quality parameters; and (3) identification of specific problems through local knowledge (i.e., public involvement). This chapter describes the methods employed to assess the condition of the Cameron Run watershed.

3.1 STREAM CHARACTERIZATION

Prior to developing this watershed plan, Fairfax County completed countywide biological and physical habitat sampling.. Data collected from the SPS and the SPA were the primary sources of information used in this plan for characterizing streams throughout the watershed.

3.1.1 Stream Protection Strategy (SPS)

Specifically, the purposes of the SPS program are to

- understand the degree of stream degradation and formulate measures to effectively reverse negative trends,
- identify and rank areas with the greatest needs,
- recommend streams for preservation and restoration efforts where appropriate,
- support detailed comprehensive watershed planning or stormwater master plans from which specific capital improvements may evolve,
- integrate applicable environmental policies, initiatives, and regulatory requirements,
- provide an additional information base to aid future planning efforts, and
- encourage environmental stewardship by supporting established and new citizens' programs for stream monitoring and public education (Fairfax County 2001).

In general, objectives of the program focused on defining recommendations for protecting and restoring subwatersheds by ranking areas according to priority for allocation of limited resources; establishing a framework for long-term, stream-quality monitoring; and supporting overall watershed management. Each of the SPS monitoring sites within the county was ranked according to overall quality based upon its numeric scores for the following four components of stream/watershed condition:

- the Index of Biotic Integrity (IBI), which incorporates 10 separate measures (each scored on a 0 to 10 scale) of the condition of the benthic macroinvertebrate community

- a general evaluation of the watershed features (including vegetation and instream features) and a more specific evaluation of 10 parameters of condition in streams and riparian zones, each scored on a scale of 0 (worst) to 20 (optimal)

- the richness of fish taxa (i.e., number of distinct species present)

- the overall percentage of impervious cover within the contributing drainage area of each site based upon available Fairfax County GIS data layers

The ultimate numeric score for each sampling location reflects the site's degree of departure from reference or "highest-quality" conditions. These composite values were then assigned to one of the following qualitative categories: excellent, good, fair, poor, and very poor.

The 2001 SPS Baseline Study established three broad management categories for future watershed protection and restoration efforts, based primarily on overall stream rankings of biological quality and projected development. The three management categories include Watershed Protection, Watershed Restoration Level I, and Watershed Restoration Level II. The results of this study show that the Cameron Run watershed has substantially degraded biological and habitat integrity. A summary of SPS data for Cameron Run watershed is shown in Table 2-4, and in tables and maps in Chapter 4 for each subwatershed. The Cameron Run watershed is classified as a Watershed Restoration II Area. The primary goal of this category is to maintain areas to prevent further degradation and to take active measures to improve water quality to comply with regulations.

3.1.2 Stream Physical Assessment (SPA)

The SPA study provides information about habitat conditions, specific infrastructure and problem areas, general stream characteristics, and a geomorphic classification of stream type throughout the watershed (CH2M Hill 2004). Stream assessments were performed in all county watersheds for approximately 800 stream miles.

The data were entered into a database and digitized for incorporation into a GIS-based Stream Assessment Tool. Data analysis placed stream reaches into one of five habitat assessment rating categories. Each stream reach was also placed in one of the five stages of geomorphic condition in the Channel Evolution Model (CEM), as shown in Figure 3-1.

The stream assessments comprised a habitat assessment and an inventory of physical stream features based on protocols developed specifically for this project. The habitat assessment (scoring of various habitat parameters) and the inventory (characterization of physical features such as pipelines, utilities, and buffers) together provide a baseline of overall stream conditions, from which watershed conditions can be inferred.

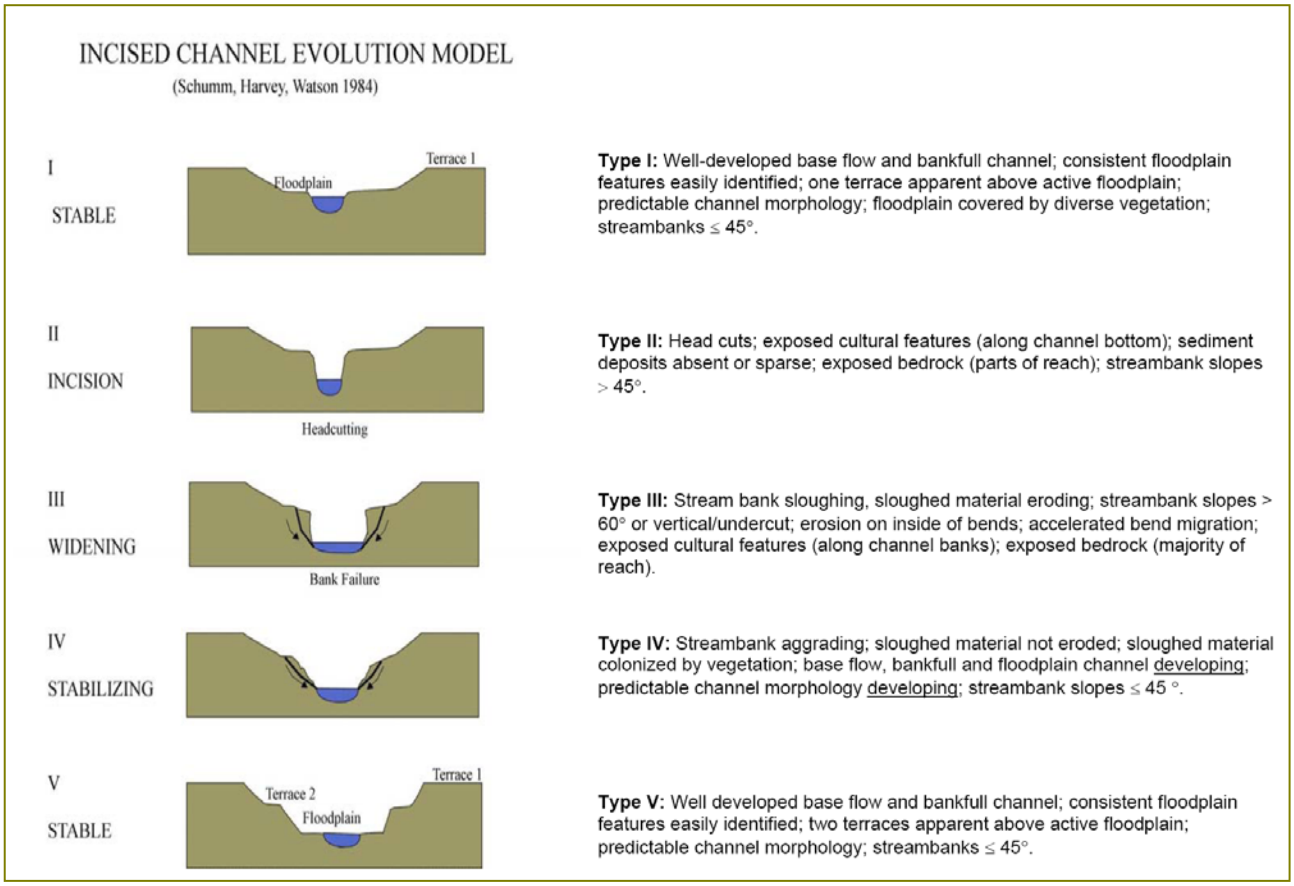

Figure 3-1. Stages in the Channel Evolution Model used in the Fairfax County SPA (CH2M Hill 2004)

Habitat assessments were performed in combination with inventory assessments for 1,523 stream reaches, totaling 720.5 miles. Inventory assessments alone were performed for an additional 304 reaches, totaling 85.7 miles. For 14 additional miles, habitat and inventory assessments could not be performed because of dangerous conditions, the presence of wetlands, and streams that were piped or channelized. The stream habitat data were used to place each stream into one of five habitat assessment rating categories: excellent, good, fair, poor, or very poor.

Based on a length-weighted habitat score of 92, Cameron Run watershed is one of the poorest in the county. Approximately 6 miles of stream were categorized as having very poor habitat conditions, 23 miles as poor, 17 miles as fair, and 2 miles as good. A summary of SPA data for Cameron Run watershed is shown in Table 2-5, and in tables and maps in Chapter 4 for each subwatershed. Analysis of the results indicates that the Cameron Run watershed has few adequate riparian buffers and more than 40 acres of deficient buffer per 10 miles.

3.2 MODELING FLOW AND WATER QUALITY

A Storm Water Management Model (SWMM) was developed for the Cameron Run watershed; the model included all of the watershed areas in Fairfax County, Falls Church, and Alexandria, upstream of the USGS gauge on Cameron Run. The purpose of the model is to represent base-year and future conditions in the watershed, including imperviousness and land use, from which it simulates rainfall-runoff hydrology and water quality. The Hydrologic Engineering Center River Analysis System (HEC-RAS) hydraulic model was developed to simulate 1-, 2-, 10-, 25-, and 100-year design storms. HEC-RAS is used to evaluate road crossing overtopping, structure flooding, analysis of bankfull capacity, and erosion velocities for selected design storms. The full model report is included as Appendix B.

The Cameron Run watershed was divided into 8 subwatersheds and 155 subbasins. The total area in the delineated watershed equals 44.4 square miles, of which 33.9 square miles are upstream of the USGS gauge on Cameron Run in Alexandria. The subbasins range in size from 100 to 290 acres and average 183 acres. Impervious area for the watershed was delineated from Fairfax County's GIS coverages of buildings, roads, and parking lots; SWMM also used Fairfax County's GIS land use coverages to evaluate base-year and future conditions within the watershed. Existing and future stormwater management facilities were simulated with SWMM within the Fairfax County portion of the watershed. The storage and outflow relationships for the facilities in each subbasin were simulated so that peak flows under base year-conditions and future land use were equal to the peak flows for the 2-year and 10-year design storms for undeveloped conditions.

SWMM was used to evaluate the influence of base-year and future development within the watershed on flow rates, velocity, and water quality. Increased flows, velocity, and pollutant loadings were assessed for each of the subwatersheds as well as the entire watershed; summary results are provided in Chapter 4 by subwatershed. For each subwatershed, reported pollutant-loading values are the area-weighted averages of all the subbasins in each subwatershed. Values for peak flow and pollutant loading rates under base-year and future conditions for the eight subwatershed areas are provided in Chapter 4, including the percent increase for each value.

3.3 PUBLIC INVOLVEMENT

The third critical source of information about the condition of the Cameron Run watershed was local knowledge obtained through public involvement. The Project Team solicited information in two ways: (1) frequent meetings with an Advisory Committee representative of major stake-holders in the watershed, and (2) outreach through public meetings and information exchange via the Cameron Run watershed web site.

3.3.1 Advisory Committee

Advisory Committee (AC) meetings were held 13 times. Dates and locations of the meetings held to date are listed below.

- November 20, 2003 John Marshall Library, Alexandria, Virginia
- December 16, 2003 Woodrow Wilson Public Library, Falls Church, Virginia
- January 13, 2004 Woodrow Wilson Public Library, Falls Church, Virginia
- February 12, 2004 Ellen Coolidge Burke Branch Library, Alexandria, Virginia

- April 1, 2004 — Richard Byrd Branch Library, Springfield, Virginia
- April 28, 2004 — Mason District Government Center, Annandale, Virginia
- May 26, 2004 — George Mason Regional Library, Annandale, Virginia
- August 25, 2004 — Mason District Government Center, Annandale, Virginia
- September 20, 2004 — Mason District Government Center, Annandale, Virginia
- November 10, 2004 — Versar Headquarters, Springfield, Virginia
- January 12, 2005 — Woodrow Wilson Public Library, Falls Church, Virginia
- April 7, 2005 — Woodrow Wilson Public Library, Falls Church, Virginia
- June 8, 2006 — Mason District Government Center, Annandale, Virginia

Minutes from these meetings are included as Appendix C. AC members and their affiliations are listed in the acknowledgments section of this plan. Problems identified by the AC are outlined in Chapter 4.

3.3.2 Public Outreach

Four public meetings were scheduled as part of the process of developing the watershed plan. Dates of public meetings and scopes of each are listed below.

- Public Issues Scoping Forum - June 17, 2004, Mason District Government Center, Annandale, VA

  This meeting provided a brief introduction to the watershed planning process, answered questions, and discussed specific issues of concern in break-out groups. Ways to increase public involvement were solicited.

- Community Watershed Forum - October 23, 2004, Holmes Middle School, Alexandria, VA

  This forum presented watershed analysis results and discussed alternative approaches to solving watershed problems.

- Draft Watershed Plan Forum - June 16, 2005, Mason District Government Center, Annandale, VA

  The forum briefly introduced the watershed planning process and summarized the Cameron Run watershed plan. Break-out groups reviewed and discussed the programmatic recommendations and projects selected for each subwatershed in the draft plan.

- Final Watershed Plan Forum - December 4, 2006, Mason District Government Center, Annandale, VA

The final forum reviewed the watershed planning process and the groups involved in developing the plan and summarized the Cameroun Run watershed plan, including the next steps involved in finalizing the plan. Break-out groups reviewed and discussed Tier 1 Projects, Group 1 Drainage Complaint Projects, and Policy Recommendations included in the Draft Final Cameron Run Watershed Plan.

The Project Team also provided comprehensive information about the Cameron Run watershed planning process to the public via the county's website at http://www.fairfaxcounty-watersheds.net/htmls/public/watershed.aspx?indx=11 (Figure 3-2). Information on the web site includes the following:

- Profile of Cameron Run
- Land Use Classification
- Current Announcements
- Current Event Calendar
- Watershed Documents
- Steering Committee
- Relevant Links

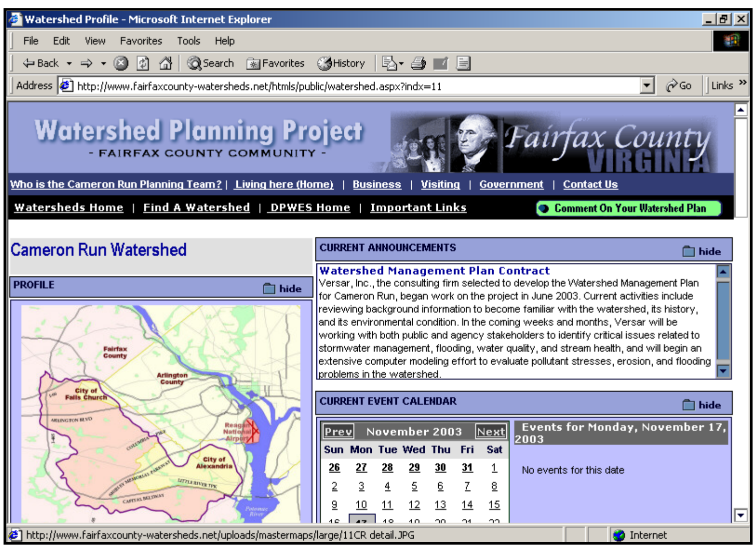

Figure 3-2. Cameron Run watershed web site

Chapter 4
State of Cameron Run and its Subwatersheds

4.1 STATE OF CAMERON RUN WATERSHED

Today, the Cameron Run mainstem is a flood-control channel whose surrounding area is characterized primarily by medium- to high-density urban development. The Cameron Run watershed (Figure 4-1) contains some of the oldest and most highly developed areas in Fairfax County. Nearly 95% of the watershed is developed with homes, strip malls, commercial enterprises, and extensive roadway systems. The major highways in Fairfax County that cross the watershed include the Capitol Beltway, Shirley Highway (I-395), Little River Turnpike (State Route 236), Arlington Boulevard (U.S. Route 50), and Lee Highway (U.S. Route 29). These major arteries contain the largest shopping areas as well as several commercial strip developments on streets throughout the watershed. These include Arlington Boulevard, the intersections of Little River Turnpike and Columbia Pike, and northwest of the Beltway interchange along Gallows Road.

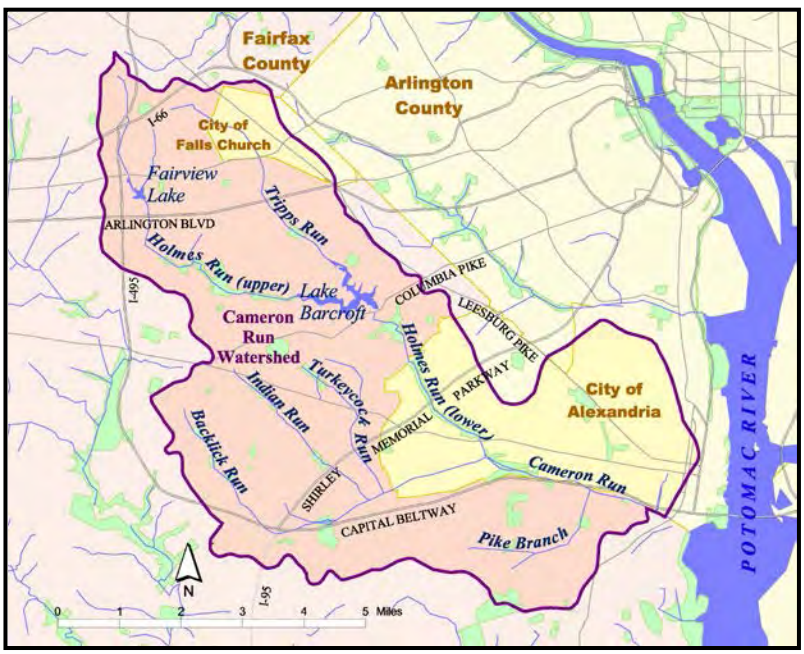

Figure 4-1. Map of Cameron Run watershed

The effects of development are apparent throughout the watershed. The historic floodplain of lower Cameron Run is now primarily a transportation corridor where the Capitol Beltway parallels the stream channel (Woodrow Wilson Bridge Project 2001). Industrial, commercial, and residential areas have replaced the wetlands and forests that once attenuated floodwaters. Small remnants of wetlands remain in the watershed. These include palustrine, lacustrine, and riverine wetlands (associated with tidal wetlands, open water bodies, and free-flowing tributaries, respectively). The channels of Cameron Run and Holmes Run were made into rocklined or concrete channels to remove floodwaters from developed areas quickly. The effects of these alterations are apparent in the degraded water quality within the channels. The channels have experienced an increase in temperature and algal production (potentially leading to lower dissolved oxygen and higher pH), channel instability, and disconnection from the floodplain and wetland areas. Nonpoint-source pollution and urban stormwater runoff greatly affect the health of this watershed.

According to the 2001 SPS Baseline Study, the Cameron Run mainstem and its tributaries “have substantially degraded biological and habitat integrity.” The SPS Baseline Study listed Cameron Run as a Watershed Restoration Level II watershed, which is characterized by high-density development, significantly degraded in-stream habitat conditions, and substantially degraded biological communities (Fairfax County SPS 2001). The number of different fish species was small, and stress-tolerant species dominated these communities. The macroinvertebrate community was dominated by highly stress-tolerant midges; sensitive species indicative of high-quality conditions were absent.

The imperviousness within each subwatershed exceeded 23%. Greater than 10% imperviousness has been shown to significantly diminish habitat quality and biological integrity in stream systems (CWP 1998). Streams have been altered extensively to accommodate the large volumes of stormwater runoff from the watershed. These changes reflect the historical view of streams as stormwater conveyance systems.

The SPA study provides watershed-wide information about the habitat conditions, specific infrastructure and problem areas, general stream characteristics, and a geomorphic classification of stream type (CH2M Hill 2004). Parameters analyzed include

- **Instream habitat** measures the amount of substrate that is available as refuge for aquatic organisms. A wide variety and abundance of submerged structures in the stream creates many niches for macroinvertebrates, increasing the potential for species diversity. As the composition and abundance of cover decrease, habitat structure becomes monotonous, species diversity decreases, and the potential for recovery following disturbance decreases.
- **Epifaunal substrate** measures the availability and quality of benthic habitat for macroinvertebrates (insects and snails) in riffle-prevalent streams. Riffle areas are critical for maintaining a healthy variety of insects..
- **Vegetated buffer zone** measures the width and overall condition of the vegetation or land use along a stream reach. This parameter is measured from the edge of the upper streambank out through, and in some cases, beyond the flood plain and riparian zone. The vegetated area serves as a buffer for pollutants entering a stream in runoff and minimizes erosion. Far fewer useful buffer zones occur when roads, parking lots, fields, heavily used paths, lawns, bare soil, rocks, or buildings are near the bank.
- **Inadequate buffer sites** are specific locations that have been identified as having little or no riparian buffer. Information on this parameter can be used to count the number of stream miles that are inadequate, as well as target future restoration efforts to areas that need better riparian buffer protection.

- **Erosion sites** are specific locations along the stream that have been identified as having erosion problems. A severity rating was also recorded to help evaluate the observed erosion problems.
- **Bank instability** measures the existence of or the potential for detachment of soil from the upper and lower streambanks and its movement into the stream. Steep banks are more likely to collapse and erode than are gently sloping banks and, therefore, are considered to be unstable.
- **Channel alteration** measures large-scale changes in or modification of instream habitat, which affects stream biotic integrity and causes erosion of the stream bottom. Channel alteration is present when artificial embankments, rip rap, and other forms of artificial bank stabilization or structures are present; when dredging has altered bank stability; when dams and bridges are present; when banks and channels have been disturbed by livestock, other agricultural practices, or hydrology; and when other changes have occurred.
- **Embeddedness** measures the degree to which cobble, boulders, and other rock substrate are surrounded by fine sediment and silt. Embeddedness relates directly to the suitability of the stream substrate as habitat for macroinvertebrates and for fish spawning and egg incubation.
- **Sediment deposition** measures the amount of soil, sand, and silt that have accumulated on the bottom of the stream and to how the shape of the stream bottom has changed as a result of deposition. Sediment deposition may create an unstable and continually changing environment that becomes unsuitable for many organisms.
- **Dump sites** counts places where trash has been left illegally in or near a stream.

Habitat conditions in the Cameron Run watershed are shown in Figure 4-2. Loss of instream habitat and epifaunal substrate are shown in Figure 4-3. Analysis of the results indicates that the Cameron Run watershed has few adequate riparian buffers, having more than 40 areas of deficient buffer per 10 miles (Figure 4-4). In addition, the watershed also has more than 50 discharge pipes and ditches per 10 miles, as well as a large number of public utility lines and roadway stream crossings compared with other watersheds in the county. Sites of erosion and instability of streambanks within the watershed are shown in Figure 4-5. Current impact ratings for channel alteration, and embeddedness and sedimentation are shown in Figures 4-6 and 4-7, respectively. Dump sites rated minor to moderate are found within the watershed (Figure 4-8). Threatened infrastructure (e.g. exposed sewer pipes and eroded bridges) and changes in the stability of the stream channel are noted (Figure 4-9).

Water quality problems within the watershed include PCBs in aquatic species, excessive levels of fecal coliform bacteria, and acute ammonia levels. Water quality standards are set by the Environmental Protection Agency (EPA) under the Clean Water Act and administered by the

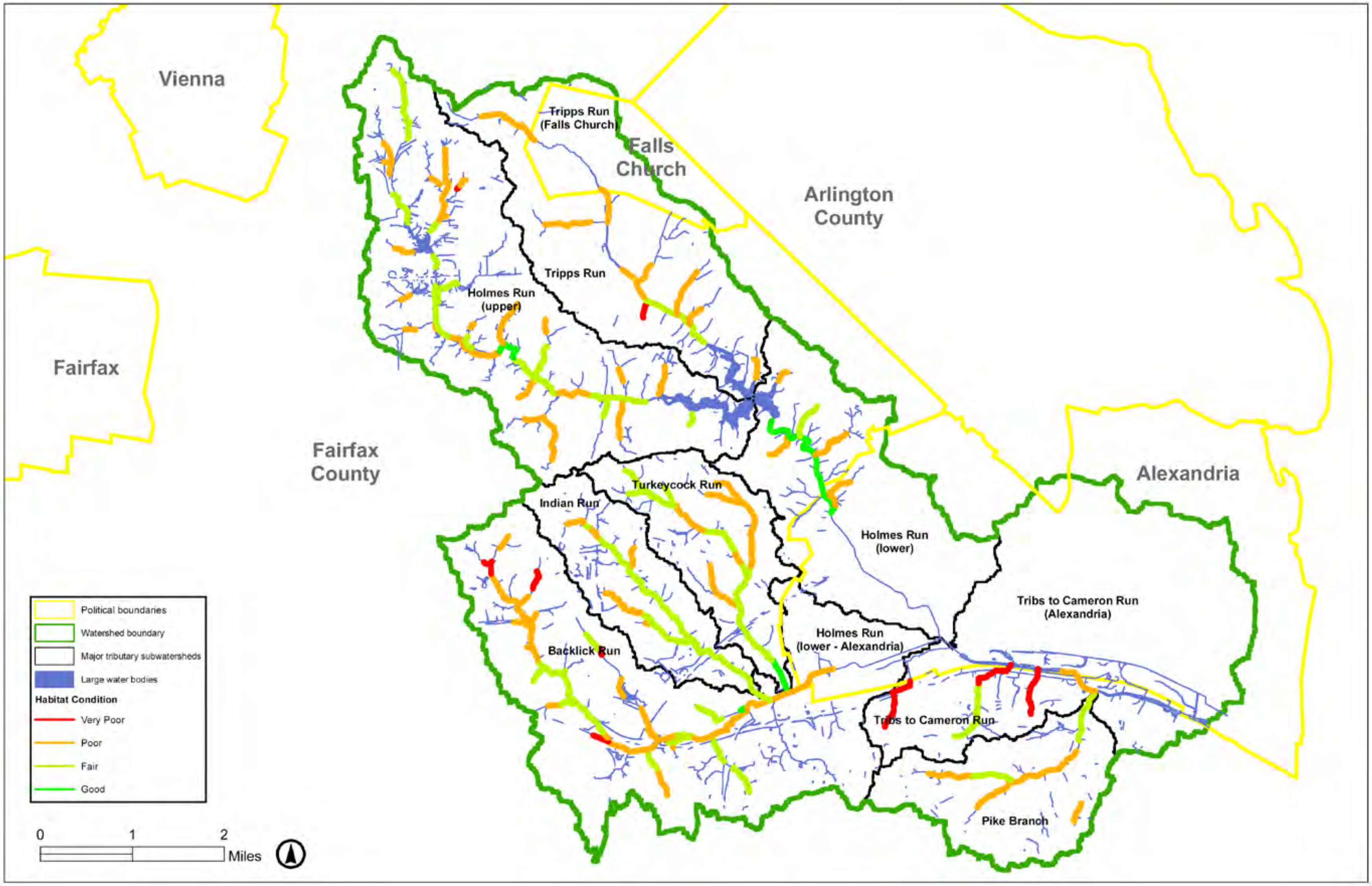

Figure 4-2. Habitat conditions in the Cameron Run watershed

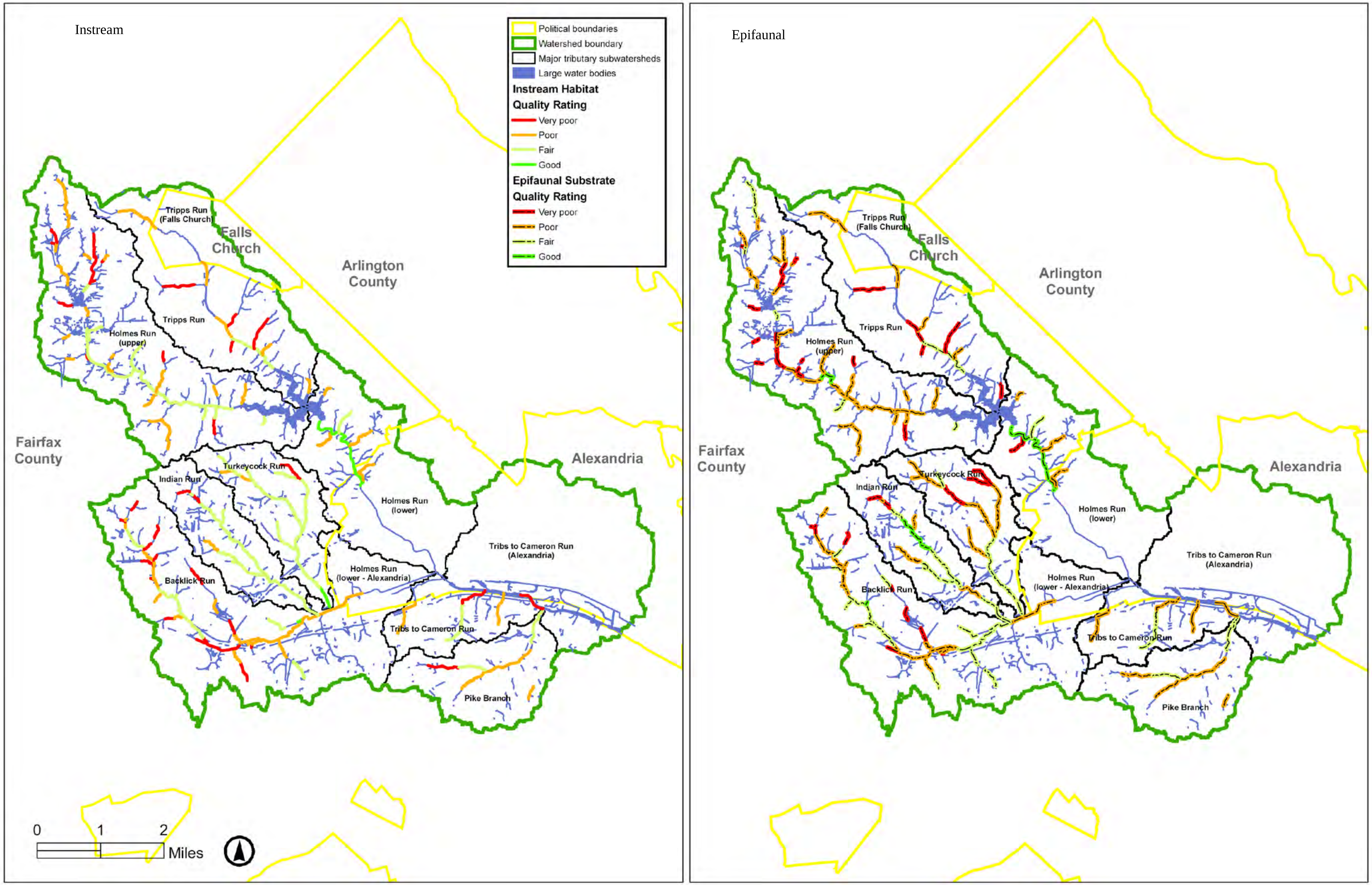

Figure 4-3. Loss of instream habitat and epifaunal substrate in Cameron Run watershed

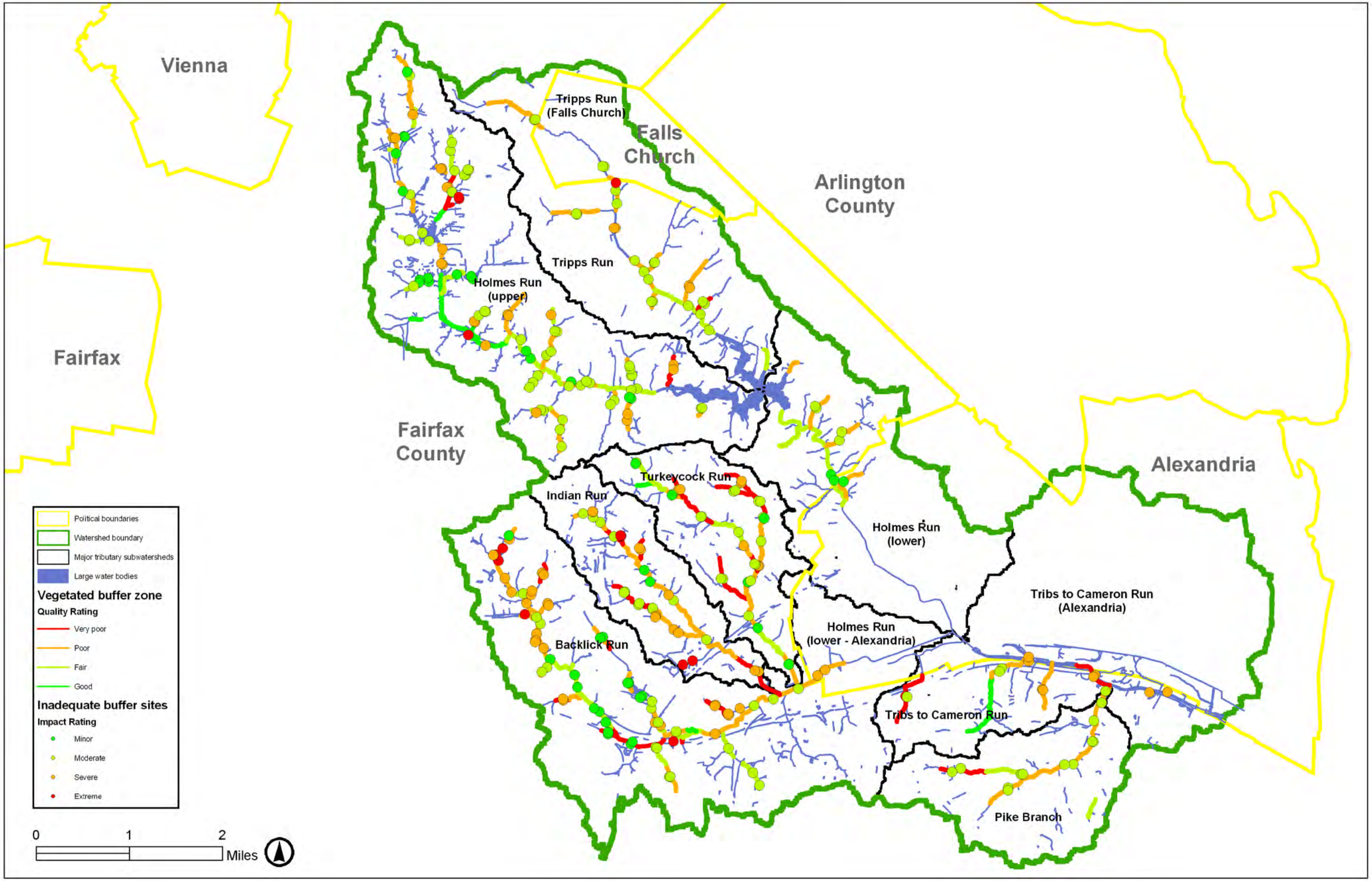

Figure 4-4. Vegetated buffer zone quality rating and inadequate buffer sites in Cameron Run watershed

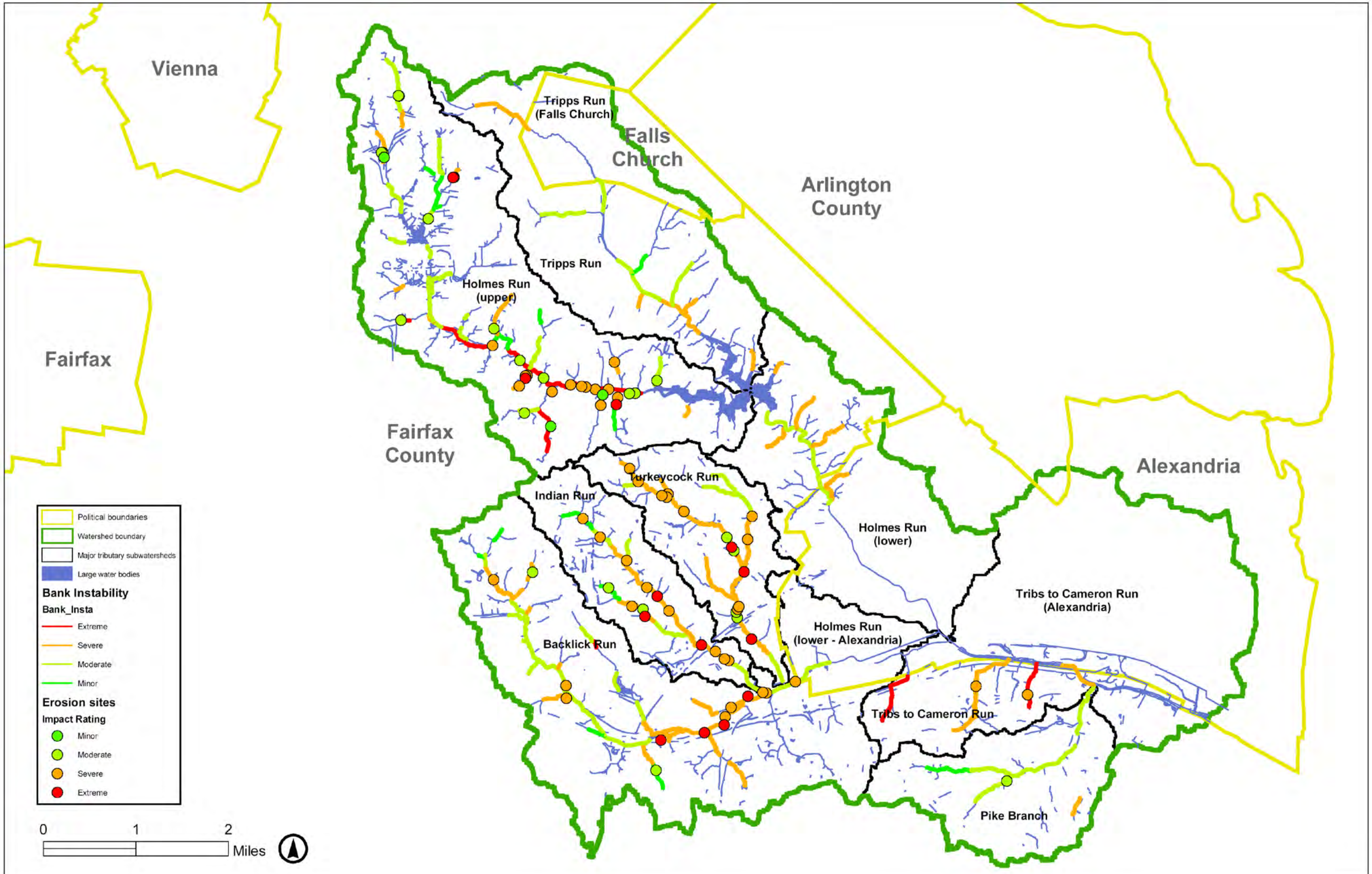

Figure 4-5. Bank instability and erosion sites in Cameron Run watershed

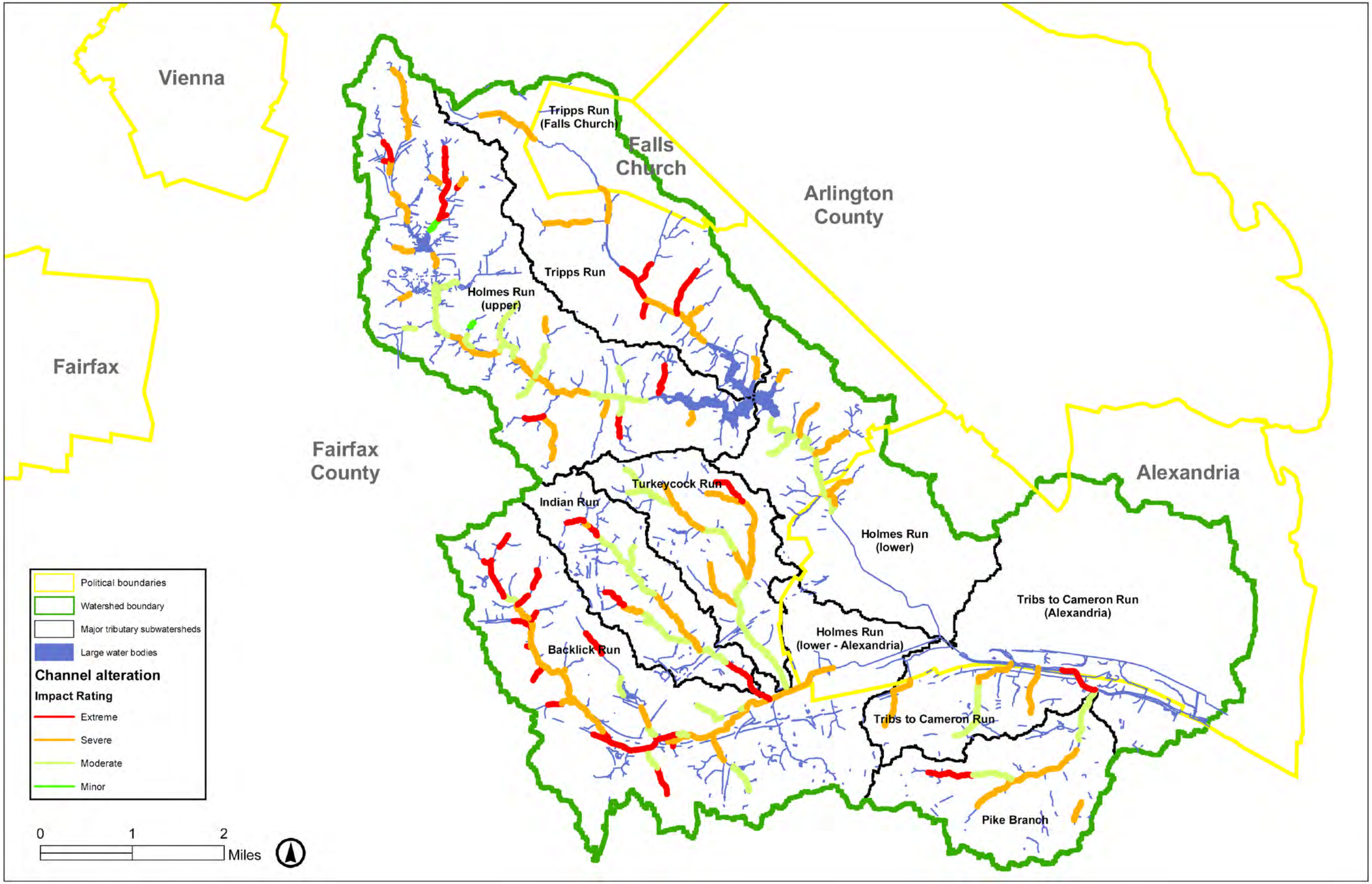

Figure 4-6. Current impact ratings for channel alteration in Cameron Run watershed

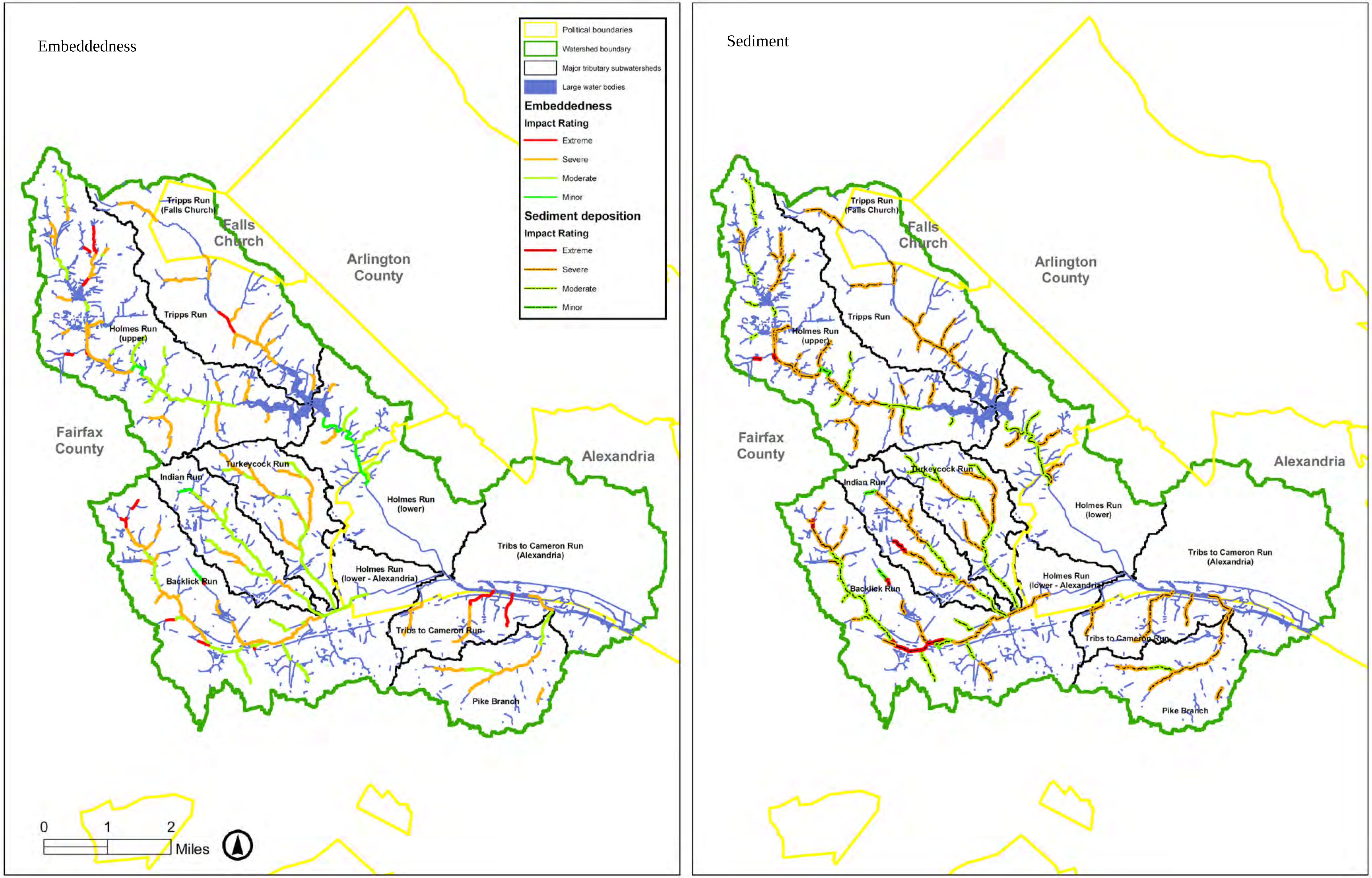

Figure 4-7. Current impact ratings for embeddedness and sediment deposition in Cameron Run watershed

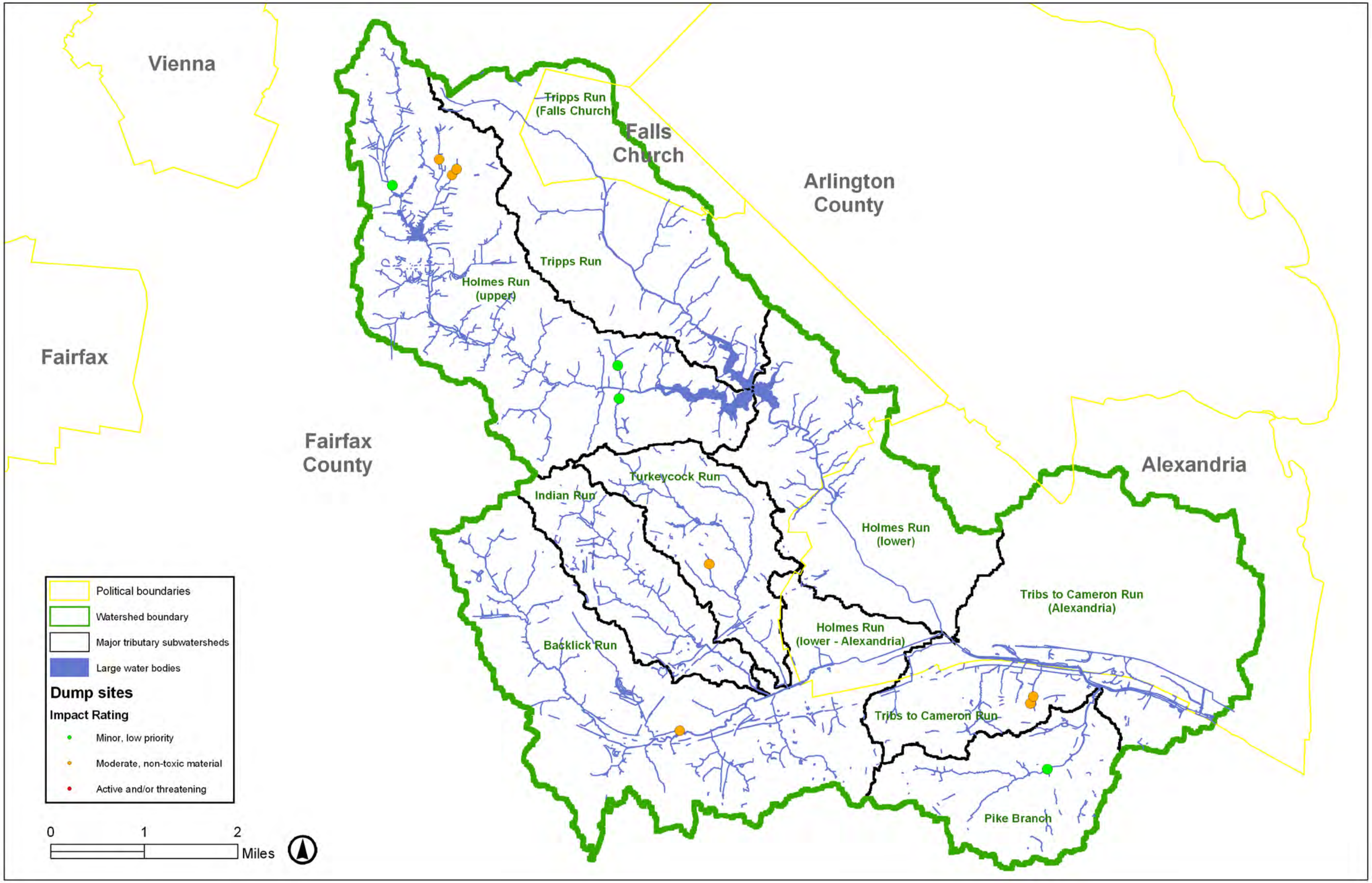

Figure 4-8. Trash dump sites in Cameron Run watershed

Figure 4-9. Threatened infrastructure and Channel Evolution Model (CEM) category in Cameron Run watershed

Virginia Department of Environmental Quality (VADEQ). PCBs were found in white perch, carp, channel cat fish, and American eel, resulting in a health advisory issued by the Virginia Department of Health. Fecal coliform levels were above Virginia's swimmable and fishable water quality standards.

Wildlife habitat conditions in the watershed are favorable for generalists or highly adaptable species. These species include deer, foxes, and raccoons. Large and area-sensitive species have limited habitat in this urban watershed. In 2001, the following wildlife were sighted in the city of Falls Church: raccoons, opossum, rabbits, southern flying squirrels, red and gray foxes, skunks, beavers, deer, muskrats, woodchucks, moles, voles, mice, rats, snapping turtles, and a variety of bats (Parsons Brinckerhoff 1974). This list is representative of wildlife found throughout the watershed.

Vegetation surveys of Cameron Run were conducted in 2001 in the floodplain section between the Metrorail bridge and the Capital Beltway crossing. This section of the stream is characterized by the removal of woody growth from the banks and floodplain, dredging of deposits along the floodplain, rip-rap along the streambanks, and large concrete weirs. There are also storm drains, trash and debris, and large colonies of invasive exotic plants. The sand-and-gravel bars and mudflats support a wide variety of native flora and provide high quality habitat for wildlife. Some of the plant species found growing on the sand-and-gravel bars include floating primrose-willow (*Ludwigia peploides*), marsh seedbox (*Ludwigia palustria*), wing-leaved primrose-willow (*Luswigia decurrens*), bearded flatsedge (*Cyperus squarrosus*), and arrow-leaved tearthumb (*Polygonum sagittatum*) (Bryant et al. 2003).

Land within the watershed is nearly all developed. Approximately 52% of the watershed is occupied by residential land uses (including 5% high-density residential) (Figure 4-10). The watershed has 14% commercial use, and only 1% open water. Open space accounts for 14% of

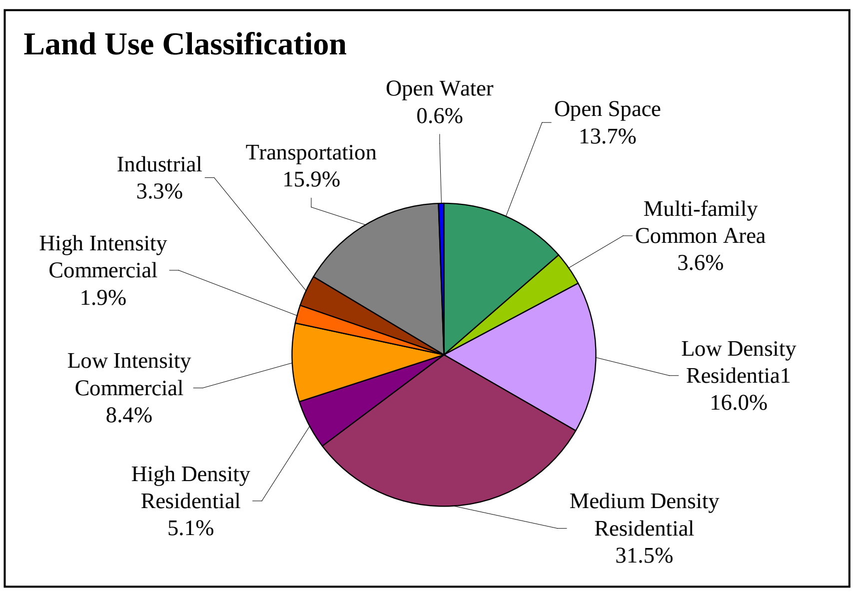

Figure 4-10. Land use in Cameron Run watershed

the watershed, although this land use is highly fragmented throughout the watershed. A few larger areas hold promise for biodiversity conservation (Figure 4-11). Because the watershed is predominantly developed, any new development opportunities involve redevelopment and limited infill. An example of redevelopment could involve converting warehouses into high-rise office buildings. Redevelopment has the potential to create green open space where none previously existed.

Example conditions in the Cameron Run watershed

Stream quality is closely related to the imperviousness of the surrounding landscape. Determining future (ultimate) imperviousness is critical for watershed planning. Fairfax County has developed a robust method for estimating future imperviousness by applying planned or zoned land-use values to underutilized residential/vacant parcels (as determined by the county's comprehensive plan and zoning district designations). Other land parcels are assumed to retain their base-year imperviousness. Figure 4-12 shows estimates of future imperviousness for small subwatersheds within the Cameron Run watershed and its eight large subwatersheds. Table 4-1 combines these values into average imperviousness by large subwatershed and calculates the projected change compared to base-year imperviousness.

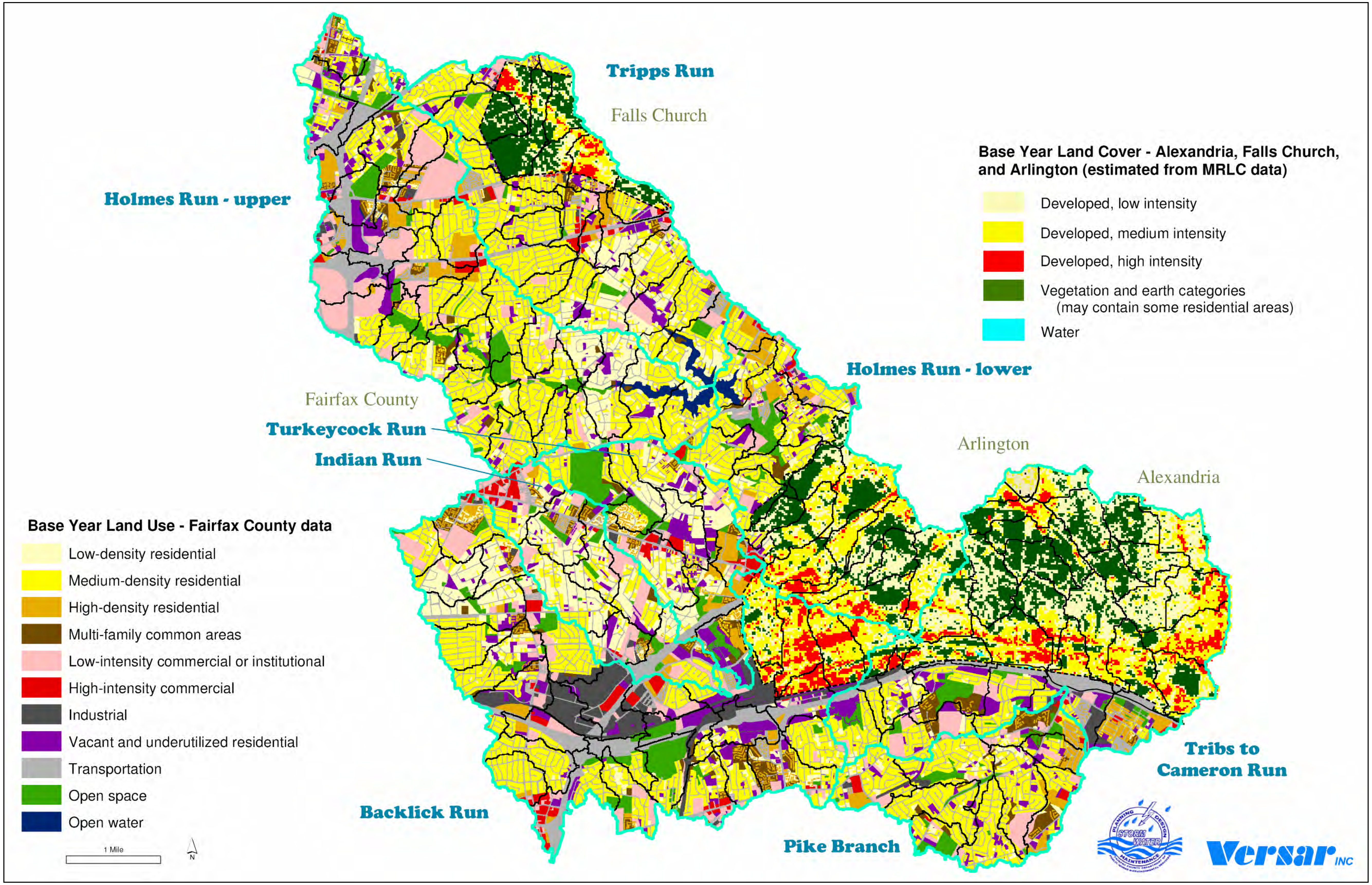

Figure 4-11. Map of land use in the Cameron Run watershed

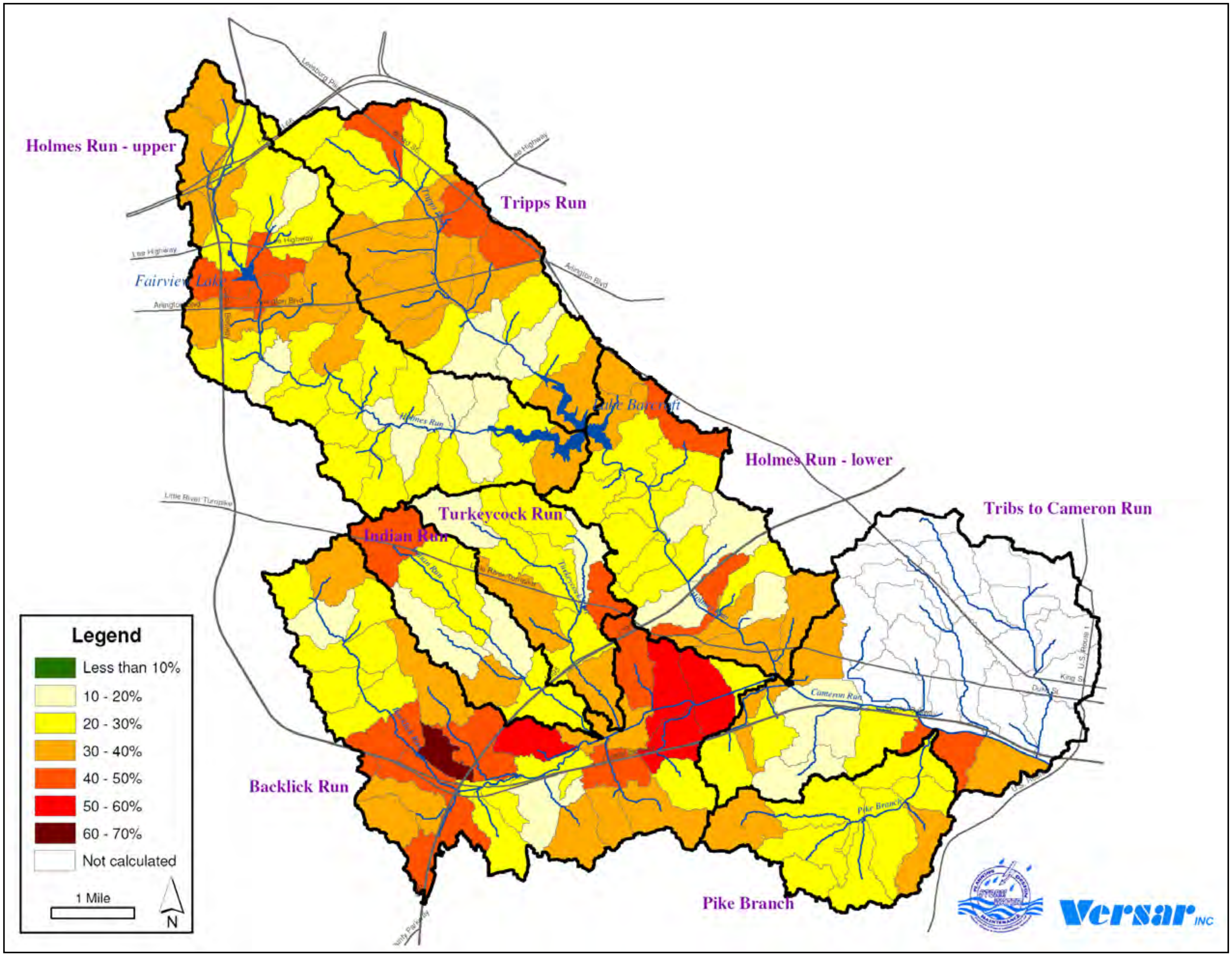

Figure 4-12. Estimates of future imperviousness for small subwatersheds within the Cameron Run watershed

Table 4-1. Cameron Run percent impervious area (Fairfax County area only)			
Subwatershed	**Base Year**	**Future**	**% Increase**
Tripps Run	25.0	29.8	19.1
Holmes Run - Upper	24.5	27.8	13.5
Holmes Run - Lower	25.2	27.5	9.4
Turkeycock Run	21.3	26.3	23.3
Indian Run	25.2	28.6	13.3
Backlick Run	30.7	35.9	16.9
Pike Branch	20.8	25.5	22.5
Tribs to Cameron Run	23.7	29.5	24.6
Weighted Average	25.6	29.8	16.5

As described in Chapter 3 and fully presented in Appendix B, hydrology and pollutant loadings were modeled for the watershed. These models were used to develop estimates of pollutant loads and peak flow for base-year and future conditions in the Cameron Run watershed (Tables 4-2 and 4-3). Peak flows were simulated for storms with estimated recurrence intervals of 1-, 2-, 10-, 25-, and 100-years, which are known as design storms.

Table 4-2. Pollutant loadings in Cameron Run watershed based on SWMM modeling for 1996-1998 hydrologic conditions, for base-year and projected future land use conditions			
	Base Year Land Use (pounds/acre/year)	**Projected Future Land Use** (pounds/acre/year)	**Percent Change**
Total nitrogen	9.8	10.7	9.6%
Total phosphorus	1.14	1.24	8.8%
Dissolved phosphorus	0.81	0.9	11.5%
Biological oxygen demand	64	70	10.5%
Chemical oxygen demand	321	354	10.2%
Total suspended sediment	227	243	6.9%
Lead	0.014	0.015	8.2%
Copper	0.066	0.071	8.1%
Zinc	0.341	0.371	8.8%
Cadmium	0.00056	0.00060	6.2%
Total dissolved solids	276	305	10.3%

Table 4-3. Design storm peak flows in Cameron Run for base year and projected future land use (Fairfax County only)			
Design Storm	**Base Year Land Use** (cfs)	**Projected Future Land Use** (cfs)	**Percent Change**
1-yr	217	229	5.5%
2-yr	287	298	3.8%
10-yr	669	676	1.0%
25-yr	763	779	2.1%
100-yr	1,054	1,089	3.2%

Members of the Advisory Committee and the general public identified the following additional areas of concern for specific locations within the Cameron Run watershed.

- **Sediment inputs and sedimentation**
  - Cameron Run mainstem along I-495
  - Stormwater settling within corrugated pipes located in Falls Church
  - Lake Barcroft dump sites
- **Impervious surfaces (paved land cover)**
  - Baileys Crossroads area, Eisenhower Avenue and Van Dorn Street in Alexandria
  - Cities of Falls Church, Alexandria, and Annandale
  - Seven Corners area, I-395, I-495, and mixing bowl
- **Biological and habitat degradation of good areas**
  - Lake Barcroft area past Columbia Pike (Holmes Run subwatershed)
  - Winkler Pond (Holmes Run subwatershed)
- **Bank erosion and channel instability (with infrastructure impacts)**
  - Tripps Run in Poplar Heights area
  - Inside Mason District Park
  - Backlick Run in the Brookhill area
- **Toxic polluted runoff**
  - Edsall Road Industrial Park
  - Falls Church cement plant
  - Eisenhower trash cogenerator in Culmore
- **High and flashy peak flows**
  - Backlick Run area
- **Riparian buffer loss**
  - Mason District Park
- **Bacteria and pathogens**
  - Dog parks on Eisenhower, Duke Street, and Cameron Station
  - Backlick Run area

- **Flooding**
  - Falls Church
  - Lower/Upper Tripps Run
  - Backlick Road
- **Direct storm inflow**
  - Specific example not given, but members indicated that the city of Falls Church demonstrates all problem issues
- **Trash/dump sites near streams**
  - Culmore area
  - East Telegraph Road
  - Lake Barcroft area
- **Channel alteration of streams**
  - Upper Tripps Run just before entering Falls Church
- **Obstructions in streams**
  - Lake Barcroft area
  - Mainstem obstructions via several dams eastward to Holmes Run
- **Wetlands loss and degradation**
  - Wetlands are virtually nonexistent in Cameron Run watershed
  - Could be loss of wetlands downstream of Alexandria in the Belle Haven watershed

4.2 STATE OF THE SUBWATERSHEDS

Cameron Run watershed comprises the following eight subwatersheds: Tripps Run, Upper Holmes Run, Lower Holmes Run, Turkeycock Run, Indian Run, Backlick Run, Pike Branch, and the Cameron Run mainstem and its direct tributaries. To gain a better understanding of overall conditions in Cameron Run, issues such as flow and contaminant contributions from each of these subwatersheds were evaluated. A detailed examination of these smaller subwatersheds enabled the identification of problem areas and opportunities for conservation, as well as the development of site-specific recommendations targeting such areas. The following sections describe the important characteristics of each subwatershed and summarize land use, stream condition, and problem areas.

4.2.1 State of Tripps Run

4.2.1.1 Subwatershed Characteristics

Tripps Run drains the northern portion of the watershed above Lake Barcroft (Figure 4-13). It covers 14.9 % of the Cameron Run watershed. Its course begins in Fairfax County just north of the Washington and Old Dominion Railroad. Flowing southeast, the stream passes through Falls Church for about one mile (3,000 feet partially underground), reenters Fairfax County adjacent to a commercial area on Lee Highway, and completes its four-mile journey by becoming the north fork of Lake Barcroft. (Before the impoundment was constructed, Tripps Run merged with Holmes Run).

Figure 4-13. Tripps Run subwatershed

The natural stream channel is well defined. During normal, dry-weather flow, the water is about one foot deep. Stream banks rise vertically, averaging about three to four feet above the channel. The stream follows an essentially straight course with gentle curves. Meandering is restricted to the section just above Lake Barcroft. Bottom composition in the natural reaches is a mixture of sand, gravel, and cobble.

The Tripps Run drainage area is the oldest and most developed portion of the watershed, and the stream has suffered from this urbanization. Twenty-five percent (25%) of the subwatershed is impervious; this is estimated to increase to 30% in the future. Medium-density residential development dominates land use within the subwatershed (Figure 4-14). Table 4-4 shows land use, percentages of impervious area for base-year and future conditions, and percent change in land use for the subwatershed. Much of the natural vegetation of the stream valley was cleared during construction; the original woodlands that shaded the stream were replaced with lawns and low brush. The removal of vegetation exacerbated the erosion problems evident throughout the channel. Furthermore, the channel itself was modified. In addition to the 3,000 feet that are piped underground, several sections of Tripps Run in Falls Church are lined with concrete. In Fairfax County, a 4,500-foot section was straightened and lined with concrete from Annandale Rd. to about 3,000 feet upstream of Arlington Blvd. (Parsons Brinckerhoff 1974). In addition, the channel is badly littered with debris, particularly near the commercial area south of Falls Church.

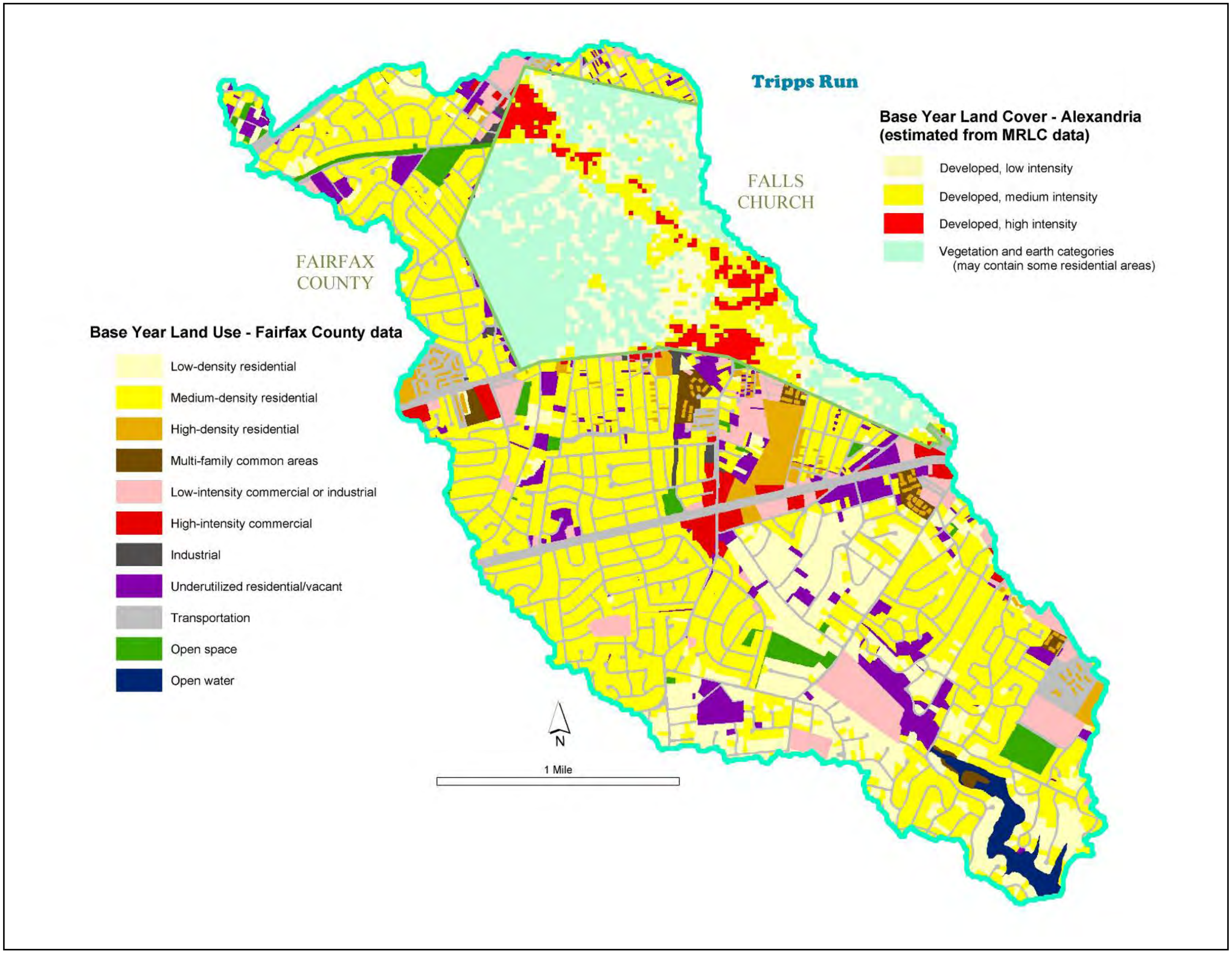

Figure 4-14. Land use map of Tripps Run subwatershed

Table 4-4. Estimates of future land use and percentage of impervious area in the Tripps Run subwatershed

Subwatershed Area (acres)	3,704		
Land Use	**Base Year (% area)**	**Future (% area)**	**% Change**
Open space	16	13.2	-17.3
Multifamily common area	1.7	1.2	-28
Low-density residential	18.7	18	-3.6
Medium-density residential	37.9	41	8.2
High-density residential	2.8	2.9	3.8
Low-intensity commercial	5.55	5.57	0.4
High-intensity commercial	1.6	2.4	45.5
Industrial	0.45	0.37	-16.8
Transportation	14.3	14.3	0
Open water (Lake Barcroft only)	1.1	1.1	0
Impervious area	25	29.8	19.1

Previous watershed planning studies (e.g., *Cameron Run Environmental Baseline Report*, *Immediate Action Plan Report for the Cameron Run Watershed*, and *Future Basin Plan Report for the Cameron Run Watershed)* have identified several drainage projects that are included in the county's master plan. The county's list of drainage projects shows that 7 of the 12 projects in this subwatershed have been completed; 1 project is active with partial funding, and the remaining 4 projects are inactive. Table 4-5 summarizes the kind of drainage project, project name/location, and current status. No cost estimates were available for these projects.

In 2005, homeowners and other community stakeholders in the Poplar Heights and Falls Hill neighborhoods began working with Fairfax County to address problems with stormwater management and flooding in these neighborhoods bordering Tripps Run. A Stormwater Action Committee was formed to propose a feasible, comprehensive approach for resolving stormwater problems in the neighborhoods. Through an extensive series of meetings, work sessions, and other efforts, the committee developed a comprehensive plan in March 2007 that consisted of values ranked according to priority, overarching principles, and 11 recommended projects. These projects included encouraging LID on private property, planting trees, several focused studies to develop solutions for complex areas, and recommendations for immediate county action at specific sites.

Table 4-6 summarizes the condition of Tripps Run. This information is based on data from the 2001 SPS Baseline Study and the SPA. According to the SPS the overall condition of Tripps Run is very poor.

Table 4-5. Drainage projects in the Tripps Run subwatershed	
Type of Work	**Project Name/Location**
Active Project - Partially Funded	
Replace culvert/streambank stabilization	Falls Hill subdivision
Completed	
Streambank stabilization	Upstream of Sleepy Hollow
Riprap/stabilization	Juniper/Valley
Floodproof house	Juniper Lane
Floodproof houses	Poplar Drive, Falls Hill Subdivision
Gabion/stabilization	Bolling Way, Mason Terrace Subdivision
Streambank stabilization	Tripps Run
Streambank stabilization	Upstream of Annandale
Inactive	
Streambank stabilization	Tripps Run
Culvert addition/streambank stabilization	Tripps Run
Streambank stabilization	Juniper/Tripps
Streambank stabilization	Tripps Run

Table 4-6. Summary of 2001 SPS Baseline Study and SPA results for the Tripps Run subwatershed			
SPS Results		**SPA Results**	
Condition rating	V. Poor	Inadequate buffers (ft.)	37,850
Index of Biotic Integrity score	V. Poor	Eroded streambanks (ft.)	0
Fish taxa richness	V. Low	Habitat assessment	Poor
Base year % impervious	32	Stormdrain pipes	18
		Dumping sites	0
		Headcuts	0
		Exposed utilities	2
		Obstructions	0
		Road crossings	25

4.2.1.2 Problems Areas Identified from SPA Data

An analysis of the SPA data indicates that the major problems within the subwatershed are inadequate buffers, numerous stormdrain pipes, and exposed utilities (Figure 4-15).

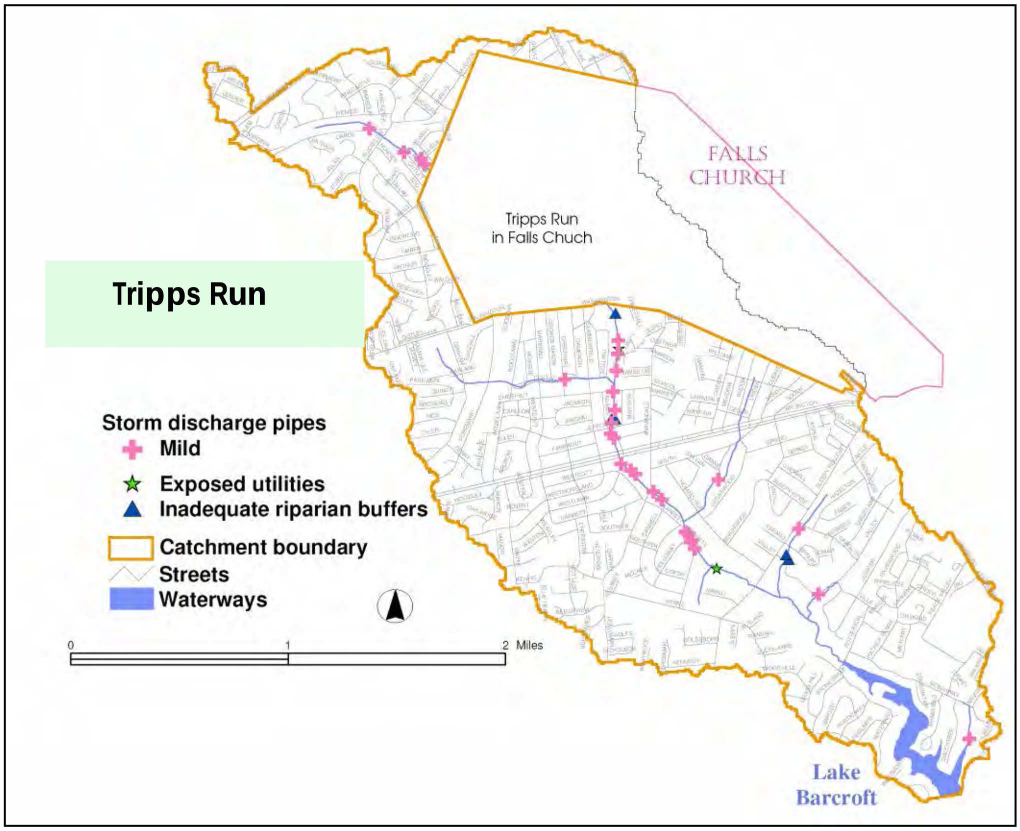

Figure 4-15. Locations of major problems in Tripps Run subwatershed as indicated by SPA data

4.2.1.3 Problem Areas Identified by the Public

Public input about problem areas within Tripps Run was obtained through forums and other avenues. Table 4-7 describes problem areas and potential solutions that were discussed during these meetings.

Channelized portion of Tripps Run

Table 4-7. Problem areas in the Tripps Run subwatershed identified by the public		
Location of Problem	**Description of Problem**	**Potential Solutions**
Between Great Oak Square and adjoining apartment complex	Erosion of stream bank at stormwater drainage and at the entry to Tripps Run.	Provide additional stormwater controls in upland areas to reduce the magnitude and frequency of flows; apply bioengineering and natural stream channel design approaches to stabilize streambanks and bed and improve habitat conditions.
Tripps Run	Channelization throughout the stream	Minimize or mitigate the effects of channelization, especially during maintenance and renovation work, by mimicking natural channel features and function.
Tripps Run (North of Rt. 50)	Channelization	Minimize or mitigate the effects of channelization, especially during maintenance and renovation work, by mimicking natural channel features and function.
Tributary perennial stream from Seven Corners to Tripps Run (Nicholson Lane past Valley Lane along Sleepy Hollow Road)	Spot flooding because the stream receives many storm sewer pipes	Provide additional stormwater controls in upland areas to reduce the magnitude and frequency of flows.
Tributary perennial stream from Seven Corners to Tripps Run (Nicholson Lane past Valley Lane along Sleepy Hollow Road)	Extensive open and closed concrete channels	Minimize or mitigate the effects of channelization, especially during maintenance and renovation work, by mimicking natural channel features and function.
Tripps Run in Poplar Heights area	Bank erosion and channel instability along Tripps Run	Provide additional stormwater controls in upland areas to reduce the magnitude and frequency of flows; apply bioengineering and natural stream channel design approaches to stabilize streambanks and bed, and improve habitat conditions.
Sleepy Hollow area near tributary to Tripps Run	Hazardous waste dumping in tributary to Tripps Run, severe high water flow, erosion, partial concrete channelization	Contact appropriate enforcement officials; provide community hazardous waste collections; install signage with information on collections and consequences of dumping. Provide owners/residents with (1) professional environmental advice, (2) riparian plantings, (3) stormwater controls, (4) retrofitting of concrete channels, (5) pollution monitoring equipment, and (6) neighborhood environmental watch groups.
Far side of Tripps Run behind Bill Page Honda and U.S. Post Office, Annandale Road, and Route 50.	Trash and chemicals in Tripps Run	Implement street sweeping and inlet trash collection program; organize community trash collection events (adopt-a-highway/ adopt-a-stream programs); provide trash receptacles and educational information. Identify chemical source.

Table 4-7. (Continued)		
Location of Problem	**Description of Problem**	**Potential Solutions**
Tributary perennial stream from Seven Corners to Tripps Run (Nicholson Lane past Valley Lane along Sleepy Hollow Road)	Chronic trash pollution in streams	Implement street sweeping and inlet trash collection program; organize community trash collection events (adopt-a-highway/ adopt-a-stream programs); provide trash receptacles and educational information.
Sleepy Hollow	Channelization Storm sewer runoff Pollution	Educate residents about: a) plantings b) stormwater controls c) pollution monitoring equipment d) neighborhood watch and environmental groups e) improving habitat conditions
Poplar Heights	Severe bank erosion Storm runoff	Provide additional stormwater controls in upland areas to reduce the magnitude and frequency of flows; apply bioengineering and natural stream channel design approaches to stabilize streambanks and bed, and improve habitat conditions; construct LID retrofits upstream.
Fairfax County portion of Tripps Run	Stream channelization	Investigate retrofit opportunities and stream restoration.
Custis Parkway	Stream erosion	Stabilize the streambank.
Trips Run south of Holmes Run Road between Annandale and Sleepy Hollow	Abandoned sewer line that occasionally leaches pollutants and other material	Clean up old sewer line.
Opposite side of Tripps Run behind Bill Page Honda and U.S. Post Office, Annandale Road and Route 50	Chemicals and trash in Tripps Run	Find chemical source and clean-up trash.
Potters Drive	Sedimentation	Stabilize streambank and dredge accumulated sediment.
Broad Street office building	Redevelopment of existing office building	Establish controls to minimize deduction of stream and habitat.

4.2.1.4 Modeling Results

Hydrologic modeling for Tripps Run indicates that stormwater runoff is about average within Cameron Run. Imperviousness is slightly below the average for Cameron Run as a whole, but this area has the lowest percentage of area with stormwater controls. The increase in discharges expected due to future development is the highest of the subwatersheds. Table 4-8 compares the existing and future 1-, 2- and 10-year peak discharges in the subwatershed.

The HEC-RAS stream hydraulic model was used to simulate peak water velocity and water levels in stream channels in Cameron Run for storms of various sizes. Peak stream velocities greater than 5 feet per second (fps) indicate the potential for channel erosion. The percentages of stream channels in Tripps Run with peak velocity greater than this value are 44% and 54% for the 1-year and 2-year design storms, respectively. The number of buildings estimated to be in or touching the 100-year floodplain is 208 for the portion of Tripps Run within Fairfax County. Table 4-9 shows the number of roadway crossings in Fairfax County that will be overtopped by storms of various sizes under base-year and future conditions. Complete modeling details and results are provided in Appendix B.

Table 4-8. Peak runoff flows in the Tripps Run subwatershed

Drainage Area (acres)	3,704		
	1-Year Storm	**2-Year Storm**	**10-Year Storm**
Existing peak flow (cfs)	225	298	673
Future peak flow (cfs)	243	317	697
Percent increase in peak flow	8.0	6.3	3.6

Table 4-9. Number of roadway crossings (bridges) overtopped by design flows for Tripps Run subwatershed

	Present	**Future**
1-year	1	1
2-year	1	1
10-year	2	3
25-year	3	3
100-year	4	4

The Tripps Run subwatershed has an average sediment loading rate among the eight subwatersheds. The subwatershed has slightly above average loadings of total nitrogen and phosphorus. Based on anticipated future land-use conditions, the total nitrogen and phosphorus loading rates are predicted to increase by 6.4% and 5.8%, respectively. Table 4-10 compares the existing and future annual average pollutant loadings in the subwatershed.

Table 4-10. Average annual pollutant loadings (pounds/acre/year) in the Tripps Run sub-watershed

Pollutant	**Total Nitrogen**	**Total Phosphorus**	**Total Suspended Solids**	**Lead**	**Copper**	**Zinc**
Base year	10.1	1.2	222	0.013	0.054	0.293
Future	10.8	1.3	233	0.014	0.057	0.309
% Increase	6.4	5.8	4.7	5.2	5.2	5.5

4.2.2 State of Upper Holmes Run

4.2.2.1 Subwatershed Characteristics

Upper Holmes Run and its tributaries form a major subwatershed draining the northern portion of the Cameron Run watershed (Figure 4-16). It covers 19% of the watershed and includes part of the Lake Barcroft community. Twenty-five percent (25%) of the subwatershed is impervious; imperviousness is estimated to increase to 28% in the future. Medium-density residential development dominates land use within the subwatershed (Figure 4-17). Table 4-11 shows land use, percentage of impervious area for base-year and future conditions, and percent change in land use for the subwatershed. The headwaters of Upper Holmes Run originate just north of Interstate Route 66 in the northernmost section of Cameron Run watershed. The upper reach flows for 7.2 miles in a southerly direction paralleling the Capitol Beltway. It then winds eastward and empties into the south fork of Lake Barcroft. This stream section is marked by meandering areas with an associated pattern of scour and deposition. The channel bottom is composed of varying proportions of sand, gravel, cobble, and, in some areas, boulders (Parsons Brinckerhoff 1974).

Figure 4-16. Upper Holmes Run subwatershed

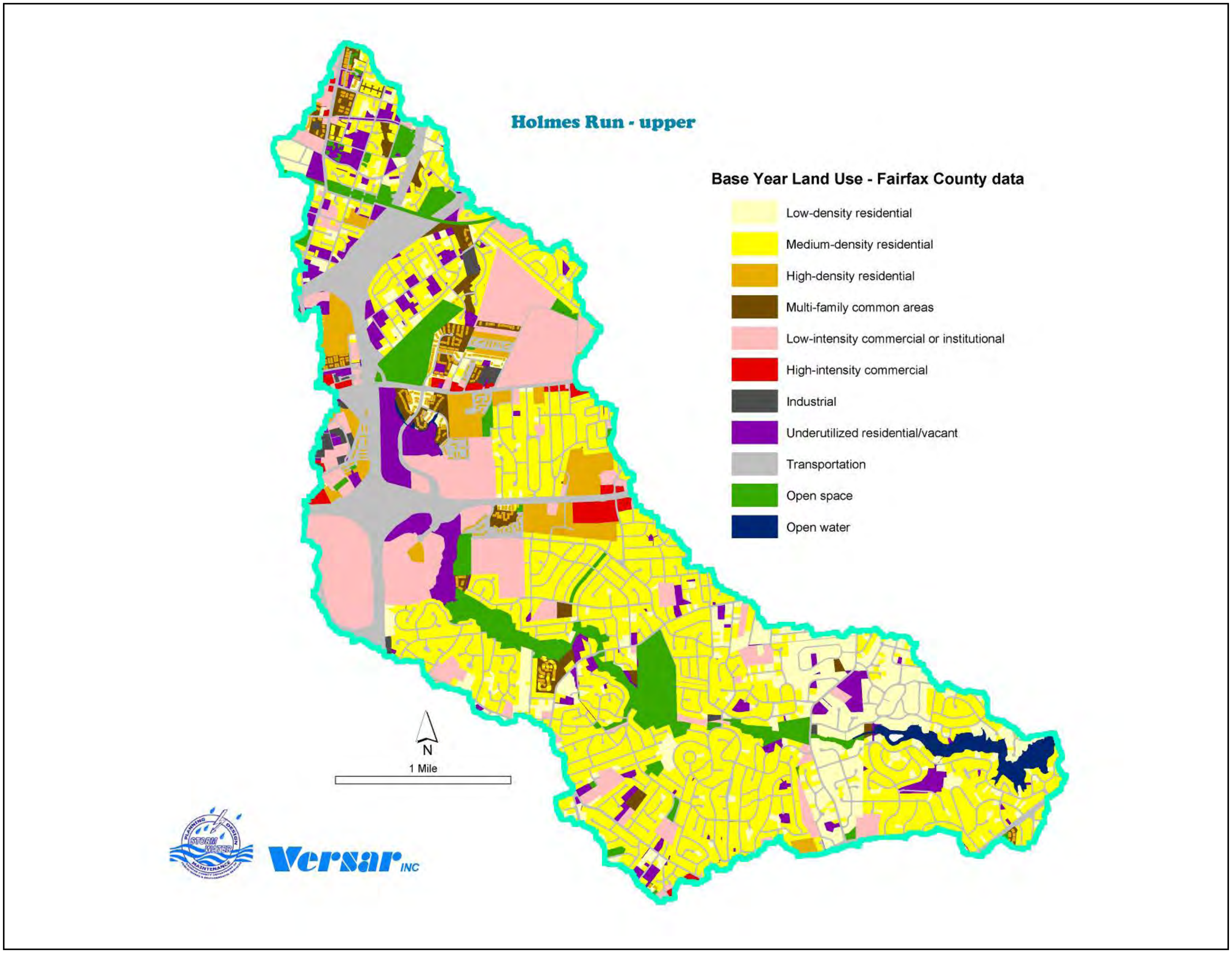

Figure 4-17. Land use map of Upper Holmes Run subwatershed

Table 4-11. Estimates of future land use and percentage of impervious area in the Upper Holmes Run subwatershed			
Subwatershed Area (acres)	5,400		
Land Use	**Base Year (% area)**	**Future (% area)**	**% Change**
Open space	9.7	7.1	-27.1
Multifamily common area	3.5	2.4	-31.4
Low-density residential	12.2	11.7	-4.7
Medium-density residential	33.3	37.2	11.6
High-density residential	4.75	4.82	1.4
Low-intensity commercial	13.2	12.5	-5.2
High-intensity commercial	1.1	1.4	27.6
Industrial	0.7	1.4	121.1
Transportation	19.9	19.9	0
Open water (Lake Barcroft and Fairview Lake)	1.7	1.7	0
Impervious Area	24.5	27.8	13.5

The county's list of drainage projects shows that 7 of the 26 projects in this subwatershed have been completed; 1 project is active with full funding, 2 projects are active with partial funding, 14 projects are inactive, and the status of the remaining 2 projects is not given. Table 4-12 summarizes the kind of drainage project, project name/ location, and current status. No cost estimates were available for these projects.

Table 4-12. Drainage projects in the Upper Holmes Run subwatershed	
Type of Work	**Project Name/Location**
Active Project - Fully Funded	
Replace culvert	Emma Lee Street
Active Project - Partially Funded	
Floodproof houses	Dearborn Drive
Streambank stabilization	Kings Glen Subdivision
Completed	
Streambank stabilization	Holmes Run Phase 1
Stream restoration	Holmes Run E""
Channel improvements	Locker Street
Reservoir construction	Holmes Run Reservoir 2A
Flood relief	Brush Drive
Regional detention pond	Morgan Lane
Regional detention pond	Pinewood Pond

Table 4-12. (Continued)	
Type of Work	**Project Name/Location**
Inactive	
Streambank stabilization with wall	Raleigh Rd. Ph. II
Streambank stabilization	Crest Drive
Streambank stabilization	Shadybrook
Streambank stabilization	Raleigh Road
Streambank stabilization	Brookcrest Place
Streambank stabilization	Rose Lane Holmes Run Ph II
Storm sewer and swale	Locker Street
Floodproof house	Hockett Street
Floodproof houses	Arnold Lane
Gabion/stabilization	Bradley Circle
Streambank stabilization	Annandale Road
Streambank stabilization	Arnold Lane
Streambank stabilization	Crosswoods Drive
Streambank stabilization	Holmes Run Upper
No Status	
Remediation of structure flooding	Holmes Run Upper
Road raising	Holmes Run Upper

Table 4-13 summarizes the condition of Upper Holmes Run. This information is based on data from the 2001 SPS Baseline Study and the SPA. According to the SPS, the overall condition of Upper Holmes Run is very poor.

Table 4-13. Summary of 2001 SPS Baseline Study and SPA results for the Upper Holmes Run subwatershed

SPS Results		**SPA Results**	
Condition rating	V. Poor	Inadequate buffers (ft.)	93,950
Index of Biotic Integrity score	V. Poor	Eroded streambanks (ft.)	4,590
Fish taxa richness	Variable	Habitat assessment	Fair
Base year % impervious	28	Stormdrain pipes	124
		Dumping sites	6
		Headcuts	0
		Exposed utilities	11
		Obstructions	26
		Road crossings	68

4.2.2.2 Problems Areas Identified from SPA Data

An analysis of the SPA data indicates that the major problems within the subwatershed are inadequate buffers, eroded streambanks, and trash dumpsites (Figure 4-18).

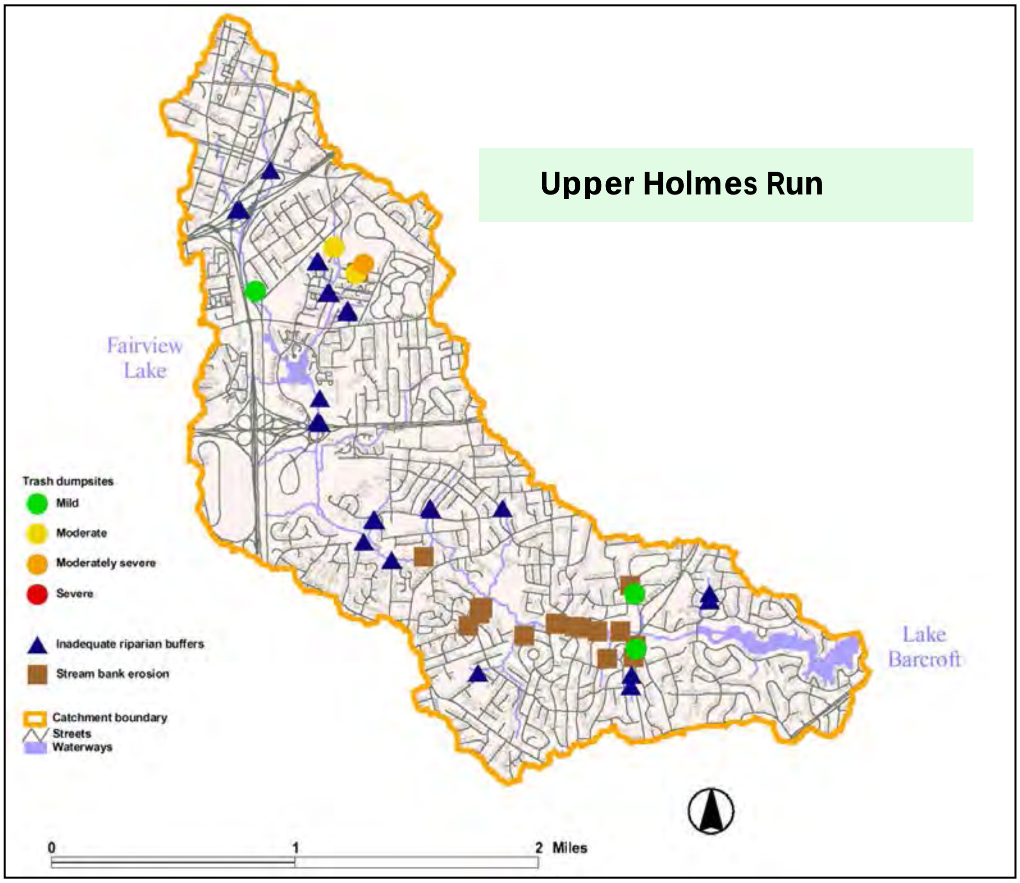

Figure 4-18. Location of major problem areas in Upper Holmes Run subwatershed as indicated by SPA data

4.2.2.3 Problem Areas Identified by the Public

Public input about problem areas within Upper Holmes Run was obtained through forums and other avenues. Table 4-14 describes problem areas and potential solutions discussed during these meetings.

Streambank erosion in Upper Holmes Run

Table 4-14. Problem areas in the Upper Holmes Run subwatershed identified by the public

Location of Problem	Description of Problem	Potential Solution
Holmes Run above Route 29	Dump site	Contact appropriate enforcement officials; provide community hazardous waste collections; install signage with information on collections and consequences of dumping.
Lowemans Plaza	Impervious surface, staging area for winter salting and de-icing	Require clean-up of salt and sand after release by dump trucks (street sweeping).
Valleycrest Drive	Streambank erosion	Stabilize the streambank.
Parcel A of Cloisters	Steep bank erosion	Streambank stabilization.
Glavis Property	Opportunity	Purchase Glavis property land for conservation easement.

4.2.2.4 Modeling Results

Hydrologic modeling for Upper Holmes Run indicates that stormwater runoff is lower than average for the Cameron Run watershed. Upper Holmes Run has a slightly lower than average percentage of imperviousness and the third largest percentage of area with stormwater controls. The expected increase in discharges due to future development is slightly less than average compared with the eight other subwatersheds. Table 4-15 compares the existing and future 1-, 2- and 10-year peak discharges in the subwatershed.

Table 4-15. Peak runoff flows in the Upper Holmes Run subwatershed			
Drainage Area (acres)	5,400		
	1-Year Storm	**2-Year Storm**	**10-Year Storm**
Existing peak flow (cfs)	209	276	647
Future peak flow (cfs)	217	285	649
Percent increase in peak flow	4.2	3.1	0.3

The HEC-RAS stream hydraulic model was used to simulate peak water velocity and water levels in stream channels in Cameron Run for storms of various sizes. Peak stream velocities greater than 5 feet per second (fps) indicate the potential for channel erosion. The percentages of stream channels in Upper Holmes Run with peak velocity greater than this value are 42% and 49%, for the 1-year and 2-year design storms, respectively. The number of buildings estimated to be in or touching the 100-year floodplain is 280 for Upper Holmes Run. Table 4-16 shows the number of roadway crossings overtopped by design storms of various sizes design for base-year and future conditions. Complete modeling details and results are provided in Appendix B.

Table 4-16. Number of roadway crossings (bridges) overtopped by design flows in the Upper Holmes Run subwatershed		
	Present	**Future**
1-year	0	0
2-year	2	2
10-year	2	2
25-year	2	2
100-year	2	2

The Upper Holmes Run subwatershed has a slightly higher than average sediment loading rate, possibly due to the presence of the highest percentage of low-intensity commercial/ institutional area in Cameron Run. The Upper Holmes Run subwatershed has slightly higher than average annual loadings of total nitrogen and phosphorus. For future land use conditions, the total nitrogen and phosphorus loadings are predicted to increase by 6.3% and 5.7%, respectively. Table 4-17 compares the existing and future annual average pollutant loadings in the subwatershed.

Table 4-17. Average annual pollutant loadings (pounds/acre/year) in the Upper Holmes Run subwatershed						
Pollutant	**Total Nitrogen**	**Total Phosphorus**	**Total Suspended Solids**	**Lead**	**Copper**	**Zinc**
Base year	10.0	1.16	236	0.013	0.068	0.350
Future	10.6	1.23	247	0.014	0.072	0.370
% Increase	6.3	5.7	4.7	6.7	4.9	5.7

4.2.3 State of Lower Holmes Run

4.2.3.1 Subwatershed Characteristics

Lower Holmes Run starts below the Barcroft Dam at Columbia Pike (Figure 4-19). The subwatershed covers 12.9% of the Cameron Run watershed and includes most of the Lake Barcroft community. Twenty-five percent (25%) of the subwatershed is impervious; imperviousness is predicted to increase to 28% in the future. Medium-density residential development dominates land use within the subwatershed (Figure 4-20). Table 4-18 shows land use, percentages of impervious area for the base-year and the future, and the percent change in land use for the subwatershed. Lower Holmes Run flows southeast toward its confluence with the mainstem of Cameron Run near the Cameron Station Military Reservation in Alexandria. Only a short portion of this stream lies in Fairfax County proper. This portion of the stream is relatively straight and wide; nevertheless, a few small bends have collected debris and are sites of severe erosion and heavy siltation (Parsons Brinckerhoff 1974).

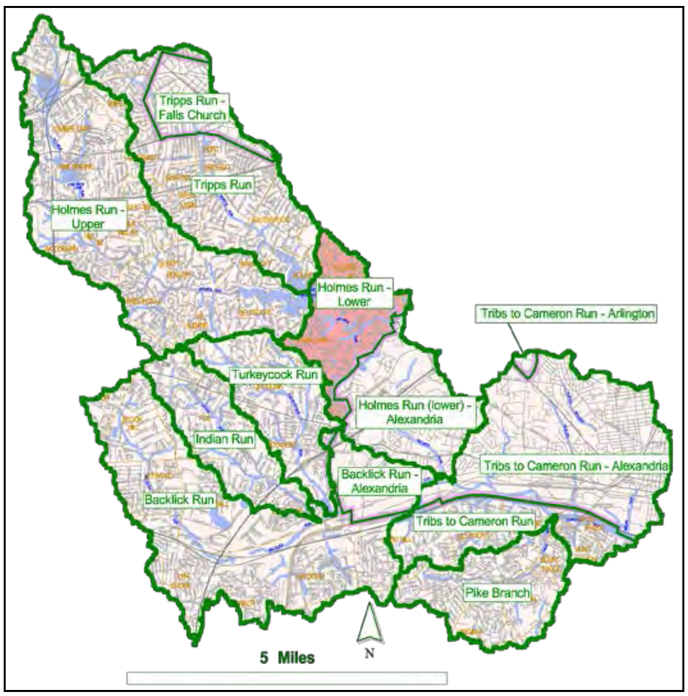

Figure 4-19. Lower Holmes Run subwatershed

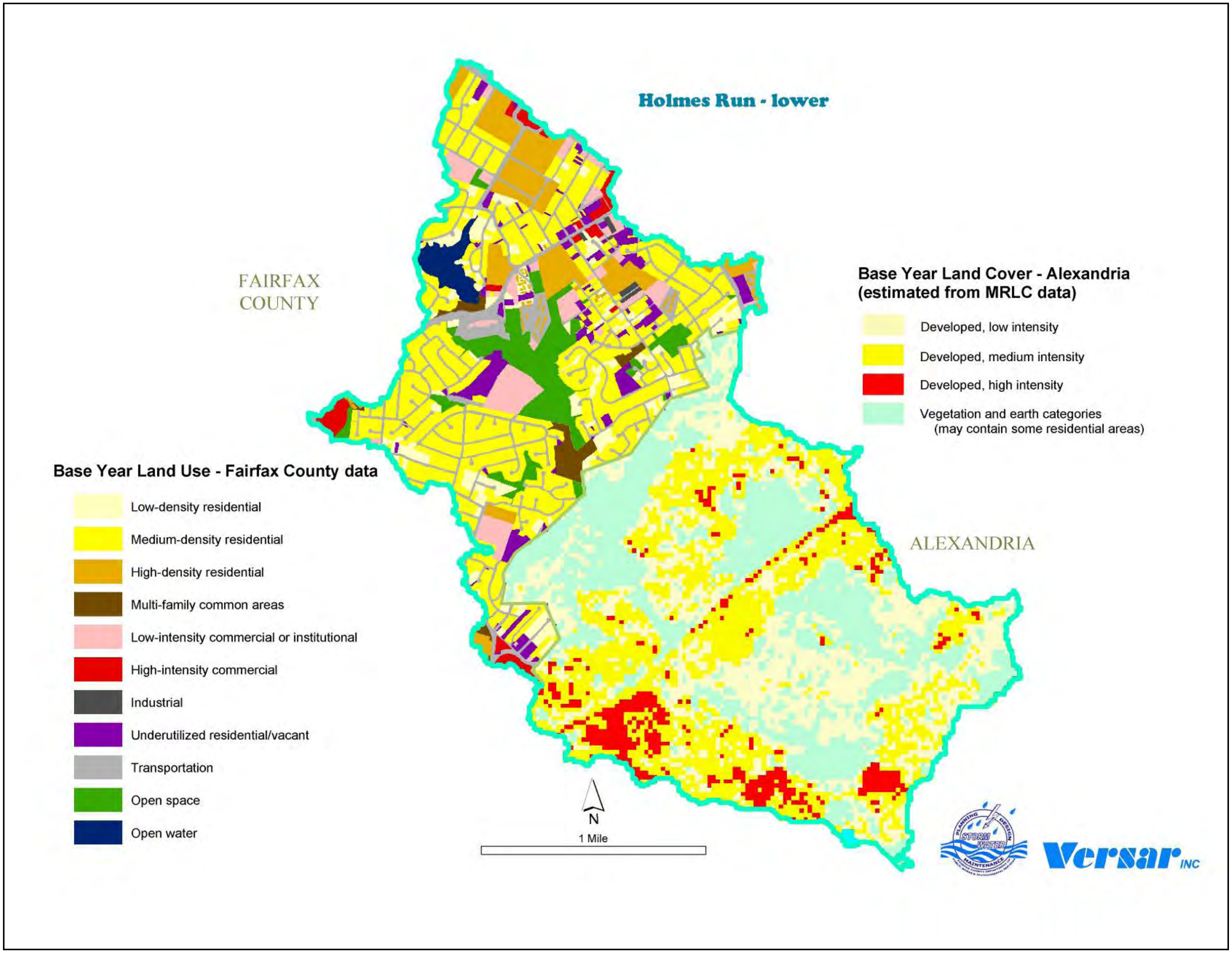

Figure 4-20. Land use map of Lower Holmes Run subwatershed

Table 4-18. Estimates of future land use and percentage of impervious area in the Lower Holmes Run subwatershed			
Subwatershed Area (acres)	3,201		
Land Use	**Base Year (% area)**	**Future (% area)**	**% Change**
Open space	23	20.5	-11.2
Multifamily common area	1	0.8	-22.2
Low-density residential	22.3	22	-1.5
Medium-density residential	34	36.8	8.1
High-density residential	5.40	5.60	3.7
Low-intensity commercial	4.37	4.44	1.7
High-intensity commercial	1.6	1.8	11.2
Industrial	0.7	0.6	-9.4
Transportation	6.7	6.7	-0.1
Open water # (Lake Barcroft only)	0.9	0.9	0
Impervious area	25.2	27.5	9.4

The county's list of drainage projects shows that one of the four projects in this subwatershed has been completed; one project is active with partial funding, and the remaining two projects are inactive. Table 4-19 summarizes the kind of drainage project, project name/location, and current status. No cost estimates were available for these projects.

Table 4-19. Drainage projects in the Lower Holmes Run subwatershed	
Type of Work	**Project Name/Location**
Active Project - Partially Funded	
Flood protection	Magnolia Lane PhII
Completed	
Gabion/stabilization	Downstream of Columbia Pike
Inactive	
Streambank stabilization	Alexandria City Line
Streambank stabilization	Drummond Drive

Table 4-20 summarizes the condition of Lower Holmes Run. This information is based on data from the 2001 SPS Baseline Study and the SPA. According to the SPS the overall condition of Lower Holmes Run is very poor.

Table 4-20. Summary of 2001 SPS Baseline Study and SPA results for the Lower Holmes Run subwatershed

SPS Results		SPA Results	
Condition rating	V.Poor	Inadequate buffers (ft.)	10,300
Index of Biotic Integrity score	Fair	Eroded streambanks (ft.)	0
Fish taxa richness	Low	Habitat assessment	Fair
Base year % impervious	28	Stormdrain pipes	10
		Dumping sites	0
		Headcuts	0
		Exposed utilities	1
		Obstructions	1
		Road crossings	3

4.2.3.2 Problems Areas Identified from SPA Data

An analysis of the SPA data indicates that the major problems within the subwatershed are inadequate buffers and numerous stormdrain pipes (Figure 4-21).

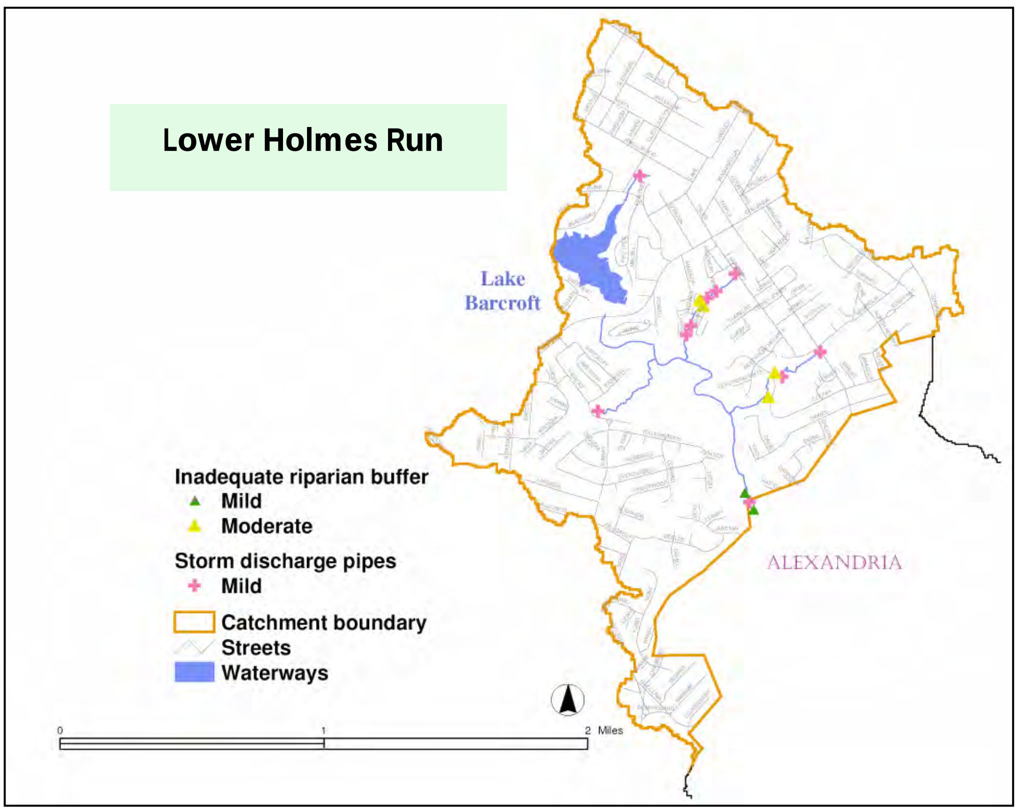

Figure 4-21. Location of problem areas in Lower Holmes Run subwatershed as indicated by SPA data

4.2.3.3 Problem Areas Identified by the Public

Public input about problem areas within Lower Holmes Run was obtained through forums and other avenues. Table 4-21 describes problem areas and potential solutions discussed during these meetings.

Table 4-21. Problem areas in the Lower Holmes Run subwatershed identified by the public

Location of Problem	Description of Problem	Potential Solution
Culmore Residential Area behind Culmore Shopping Center (along Glen Carlyn Road, off Route 7, down to Blair Rd. area)	Trash and oil on street; oil and auto fluids dumped into storm drains	Contact appropriate enforcement officials; provide community hazardous waste collections; install signage with information on collections and consequences of dumping.
Lower Holmes Run Park (below Lake Barcroft)	Degradation of habitats and bank erosion	Provide additional stormwater controls in upland areas to reduce the magnitude and frequency of flows; apply bioengineering and natural stream channel design approaches to stabilize streambanks and bed, and improve habitat conditions.
Culmore Creek	High bacteria levels in stream	Find source.
JEB Stuart Stream Valley	Invasives	Remove invasives and re-establish riparian buffer.
Marshall Property	Uncontrolled dumpsite	Clarify zoning issues and inspect the dumpsite.
"Barcroft Blight" Apartment Complex	Trash Undercut banks	Stabilize the streambank and remove trash.
Holmes Run Trail (below Barcroft Dam) Columbia Pike to Old Towne Alexandria to the Potomac River (ADC map 16/E13 is where the trail stops)	The trail runs from below the Lake Barcroft Dam to the Potomac except where the trail ends around the private pool.	Extend the walking path.
JEB Stuart High School Parking Lot	Excessive runoff	Install permeable pavers and bioretention areas.

4.2.3.4 Modeling Results

Hydrologic modeling for Lower Holmes Run indicates that stormwater runoff is about average. Imperviousness is also about average compared to Cameron Run as a whole. The increase in discharges due to future development is a little above average compared to the other subwatersheds. Table 4-22 compares the existing and future 1-, 2- and 10-year peak discharges in the subwatershed.

Table 4-22. Peak runoff flows in Lower Holmes Run			
Drainage Area (acres)	3201		
	1-Year Storm	**2-Year Storm**	**10-Year Storm**
Existing peak flow (cfs)	219	292	674
Future peak flow (cfs)	232	303	675
Percent increase in peak flow	5.9	3.9	0.1

The HEC-RAS stream hydraulic model was used to simulate peak water velocity and water levels in stream channels in Cameron Run for storms of various sizes. Peak stream velocities greater than 5 feet per second (fps) indicate the potential for channel erosion. The percentages of stream channels in Lower Holmes Run with peak velocity greater than this value are 86% and 89%, for the 1-year and 2-year design storms, respectively. The number of buildings estimated to be in or touching the 100-year floodplain is 16 for the portion of Lower Holmes Run that lies within Fairfax County. No roadway crossings were overtopped by storms of various sizes for base-year or future conditions in Lower Holmes Run. Complete modeling details and results are provided in Appendix B.

The Lower Holmes Run subwatershed has the second lowest sediment loading rate of the eight subwatersheds because it has smaller areas of commercial and industrial development. This subwatershed also has the second lowest annual loadings of total phosphorus and nitrogen of the eight subwatersheds. This can be attributed to the relatively small percentage of highly developed land in the watershed. This subwatershed is among the least in proportion of industrial development. For future land use conditions, the annual loadings of nitrogen and phosphorus are predicted to increase by 10.0% and 9.6%, respectively. Table 4-23 compares the existing and future annual average pollutant loadings in the subwatershed.

Table 4-23. Average annual pollutant loadings (pounds/acre/year) in Lower Holmes Run subwatershed

Pollutant	**Total Nitrogen**	**Total Phosphorus**	**Total Suspended Solids**	**Lead**	**Copper**	**Zinc**
Base year	8.9	1.1	201	0.012	0.061	0.27
Future	9.8	1.2	215	0.013	0.065	0.295
% Increase	10.0	9.6	6.7	6.9	7.3	7.7

4.2.4 State of Turkeycock Run

4.2.4.1 Subwatershed Characteristics

This subwatershed covers 6.1% of the Cameron Run watershed and includes the Mason District Park (Figure 4-22). Twenty-one percent (21%) of the subwatershed is impervious; future imperviousness is estimated to be 26%. Medium-density residential development dominates land use within the subwatershed (Figure 4-23). Table 4-24 shows land use, percentage of impervious area for the base year and the future, and the percent change in land use for the subwatershed. Turkeycock Run is formed by the confluence of two tributaries below Little River Turnpike. The stream follows a southeasterly course toward its confluence with Backlick Run, just north of the Southern Railroad embankment.

Figure 4-22. Turkeycock Run subwatershed

The stream can be divided into three sections defined by changes in character. (1) From Edsall Road to Backlick Run, the stream was straightened, and the channel is about 40 feet wide. There is little vegetative cover within the largely commercial flood plain. The banks are lined with riprap to control erosion. Heavy areas of sedimentation are common due to deposits transported from upstream reaches. (2) The stream meanders extensively in a 20-foot wide channel above Edsall Road and below Little River Turnpike, except for a section that was straightened and passes through culverts under I-395. Below I-395, the stream passes through a relatively undeveloped area; above the highway the land is largely residential. In this section the flood plain is relatively flat, and the vegetative cover varies from dense underbrush to cropped lawn cover. The pattern of meander in this section is accompanied by severe erosion and heavy

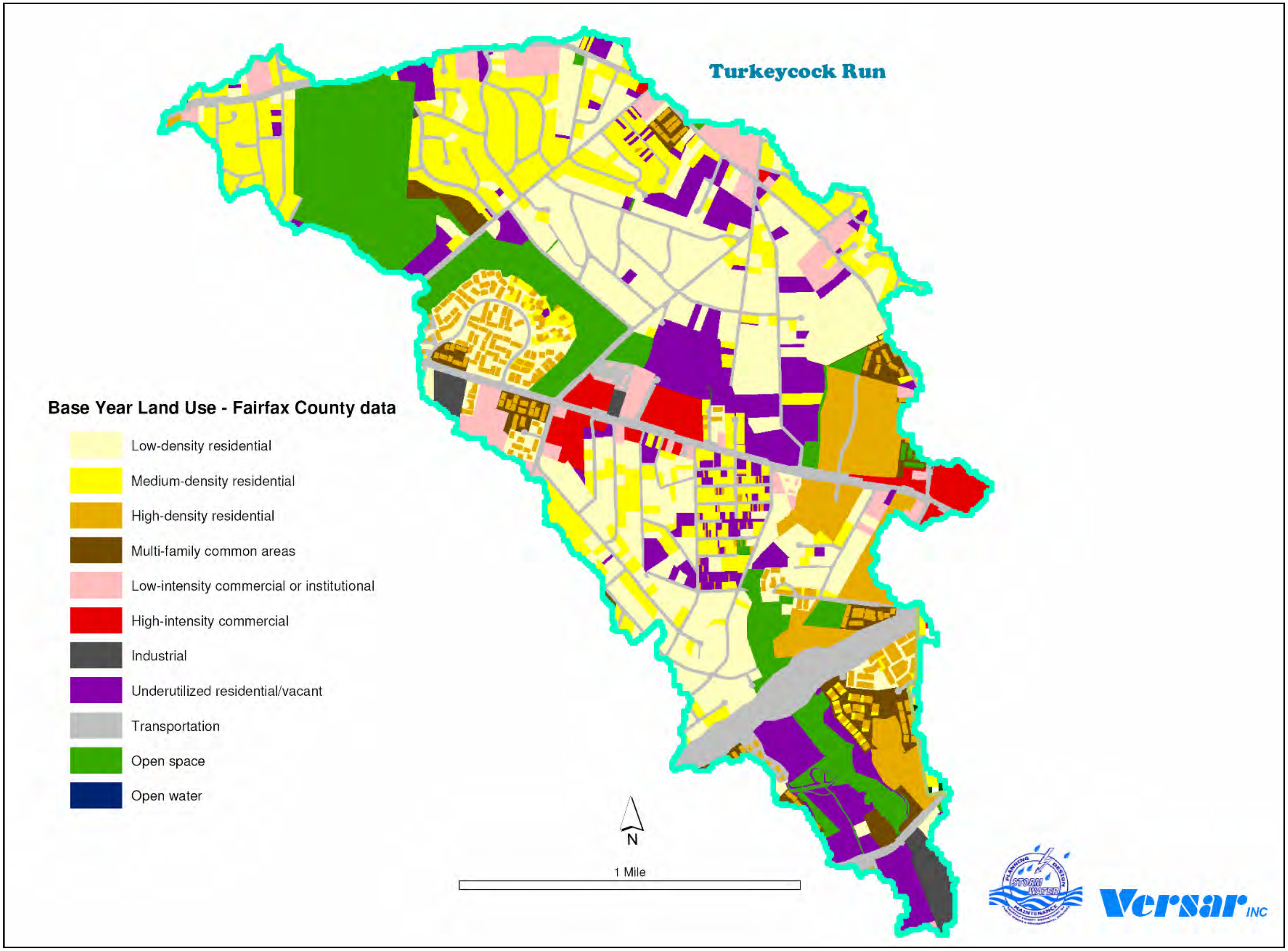

Figure 4-23. Land use map of Turkeycock Run subwatershed

Table 4-24. Estimates of future land use and percentage of impervious area in Turkeycock Run subwatershed			
Subwatershed Area (acres)	1,725		
Land Use	**Base Year (% area)**	**Future (% area)**	**% Change**
Open space	21.4	8.8	-59
Multifamily common area	7.2	4.4	-38.6
Low-density residential	23.0	27.5	19.8
Medium-density residential	15.9	23.2	46.1
High-density residential	9.5	9.6	1.6
Low-intensity commercial	4.5	7.6	69.9
High-intensity commercial	2.9	3.2	9.1
Industrial	1.4	1.4	-0.2
Transportation	14.4	14.4	0
Impervious area	21.3	26.3	23.3

sedimentation. (3) In the tributary headwaters, meander is greatly attenuated, and erosion is correspondingly reduced. The channel's inability to accommodate increased surface runoff causes minor flooding in many areas (Parsons Brinckerhoff 1974).

The county's list of drainage projects shows that 3 of the 11 projects in this subwatershed have been completed, and the remaining 8 projects are inactive. Table 4-25 summarizes the type of drainage project, project name/location, and current status. No cost estimates were available for these projects.

Table 4-25. Turkeycock Run Master Plan drainage projects	
Type of Work	**Project Name/Location**
Completed	
Gabion and riprap/stabilization	Turkeycock Creek
Floodproof houses	Chowan Avenue
Streambank stabilization	6481 Seventh Street
Inactive	
Streambank stabilization	Chowan Avenue
Streambank stabilization	Eighth St
Stormdrain improvement/reinforced concrete box culvert	Holyoke-Piney Lane
Culvert addition	Braddock Road
Culvert addition	Old Columbia Pike
Streambank stabilization	Edsall/Shirley Highway
Streambank stabilization	Downstream of Braddock Road
Streambank stabilization	Upstream of Braddock Road

Table 4-26 summarizes the condition of Turkeycock Run. This information is based on data from the 2001 SPS Baseline Study and the SPA. According to the SPS the overall condition Turkeycock Run is poor.

Table 4-26. Summary of 2001 SPS Baseline Study and SPA results for the Turkeycock Run subwatershed

SPS Results		SPA Results	
Condition rating	Poor	Inadequate buffers (ft.)	51,615
Index of Biotic Integrity score	V.Poor	Eroded streambanks (ft.)	4,295
Habitat score	Fair	Habitat assessment	36
Fish taxa richness	Low	Stormdrain pipes	1
Base year % impervious	23	Dumping sites	2
		Headcuts	4
		Exposed utilities	11
		Obstructions	38
		Road crossings	51,615

4.2.4.2 Problems Areas Identified from SPA Data

An analysis of the SPA data indicates that the major problems within the subwatershed are inadequate buffers, eroded streambanks, and obstructions of stream flow (Figure 4-24).

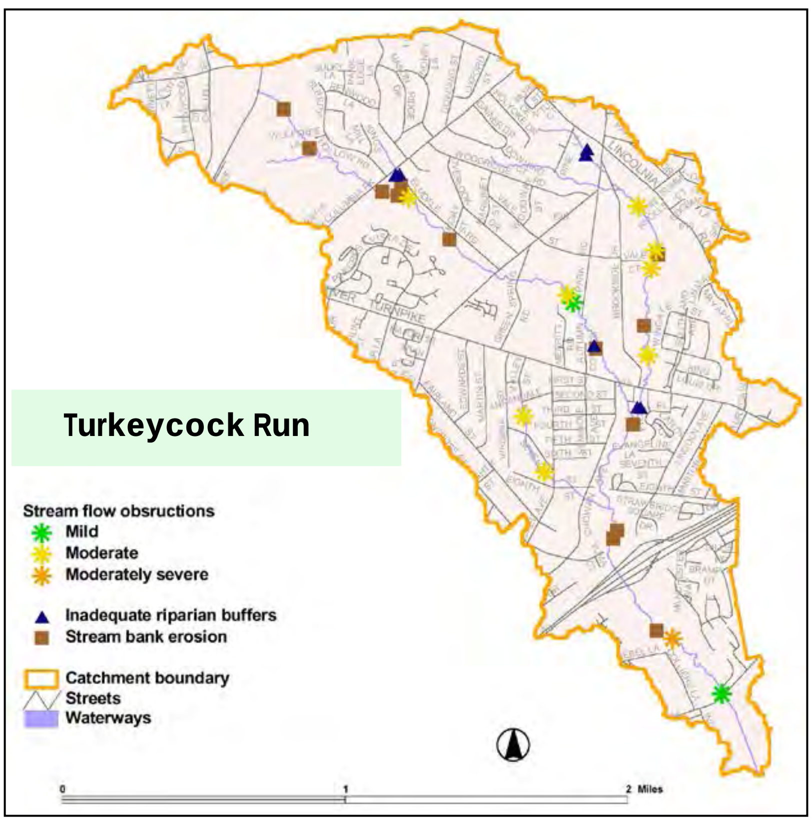

Figure 4-24. Location of major problems in Turkeycock Run subwatershed as indicated by SPA data

4.2.4.3 Problem Areas Identified by the Public

Public input on problem areas within Turkeycock Run was obtained through watershed forums and other avenues. Table 4-27 describes problem areas and potential solutions that were discussed during these meetings.

Streambank erosion along Turkeycock Run

Table 4-27. Problem areas in the Turkeycock Run subwatershed identified by the public

Location of Problem	Description of Problem	Potential Solution
Predominantly industrial area/ boating companies	Collection of upstream trash.	Organize stream clean-up.
Turkeycock/Braddock Rd.	Dog walking. Look into golf course management. Lots of geese, bad water quality downstream of golf course.	Doggy mitts/clean-up.
Mason District Park	Bank erosion and channel instability. Riparian buffer loss in the park.	Provide additional stormwater controls in upland areas to reduce the magnitude and frequency of flows; apply bioengineering and natural stream channel design approaches to stabilize streambanks and bed, and improve habitat conditions. Plant riparian vegetation along stream.

4.2.4.4 Modeling Results

Hydrologic modeling indicates that stormwater runoff in the Turkeycock Run subwatershed is the lowest within Cameron Run due to the lower density of development in this area. This subwatershed has the second lowest imperviousness within Cameron Run as a whole and the greatest percentage of area with stormwater controls. The increase in discharges due to future development is also lowest compared to the other subwatersheds. Table 4-28 compares the existing and future 1-, 2- and 10-year peak discharges in the subwatershed.

Table 4-28. Peak runoff flows in the Turkeycock Run subwatershed			
Drainage Area (acres)	1,725		
	1-Year Storm	**2-Year Storm**	**10-Year Storm**
Existing peak flow (cfs)	182	244	611
Future peak flow (cfs)	185	242	614
Percent increase in peak flow	1.9	-0.7	0.5

The HEC-RAS stream hydraulic model was used to simulate peak water velocity and water levels in stream channels in Cameron Run for storms of various sizes. Peak stream velocities greater than 5 feet per second (fps) indicate the potential for channel erosion. The percentages of stream channels in Turkeycock Run with peak velocity greater than this value are 36% and 59%, for the 1-year and 2-year design storms, respectively. The number of buildings estimated to be in or touching the 100-year floodplain is 46 for Turkeycock Run. No roadway crossings were overtopped by storms of various sizes for base-year or future conditions in Turkeycock Run. Complete modeling details and results are provided in Appendix B.

The Turkeycock Run subwatershed has the lowest sediment loading rate of the eight subwatersheds due to the lower density of development in the area. Turkeycock Run subwatershed also has the lowest annual loadings of total nitrogen and phosphorus of the eight subwatersheds. For future land use conditions, the total nitrogen and phosphorus loadings are predicted to increase by 19.7% and 19.0%, respectively. This is the greatest anticipated increase in loadings within Cameron Run and is due to the greater increase in development expected in the subwatershed. Table 4-29 compares the existing and future annual average pollutant loadings in the subwatershed.

Table 4-29. Average annual pollutant loadings (pounds/acre/year) in the Turkeycock Run subwatershed.						
Pollutant	**Total Nitrogen**	**Total Phosphorus**	**Total Suspended Solids**	**Lead**	**Copper**	**Zinc**
Base year	8.0	1.0	176	0.011	0.057	0.253
Future	9.6	1.1	203	0.012	0.067	0.303
% Increase	19.7	19.0	15.1	12.7	18.2	19.6

4.2.5 State of Indian Run

4.2.5.1 Subwatershed Characteristics

Indian Run subwatershed covers 5.6% of the Cameron Run watershed (Figure 4-25). Twenty-five percent (25%) of the subwatershed is impervious; future imperviousness is estimated to increase to 29%. Medium-density residential development dominates land use within the subwatershed (Figure 4-26). Table 4-30 shows land use and percentages of impervious area for base-year and future conditions, and percent change in land use for the subwatershed. The headwaters of Indian Run originate near Little River Turnpike. From there, the stream flows southeast for approximately 3.6 miles toward its confluence with Backlick Run near Bren Mar Park. Streambank cover below Bren Mar Drive is dense, consisting mainly of low brush and trees. From Bren Mar Drive to Edsall Road the stream flows through a residential park, where the floodplain is covered with cropped lawn.

Severe stream meanders, along with erosion and sedimentation, are characteristic of Indian Run and its main tributary, Poplar Run. Severe erosion, sedimentation, and debris restricts flow at a large bend in the stream about 300 feet upstream of Edsall Road (Parsons Brinckerhoff 1974).

Figure 4-25. Indian Run subwatershed

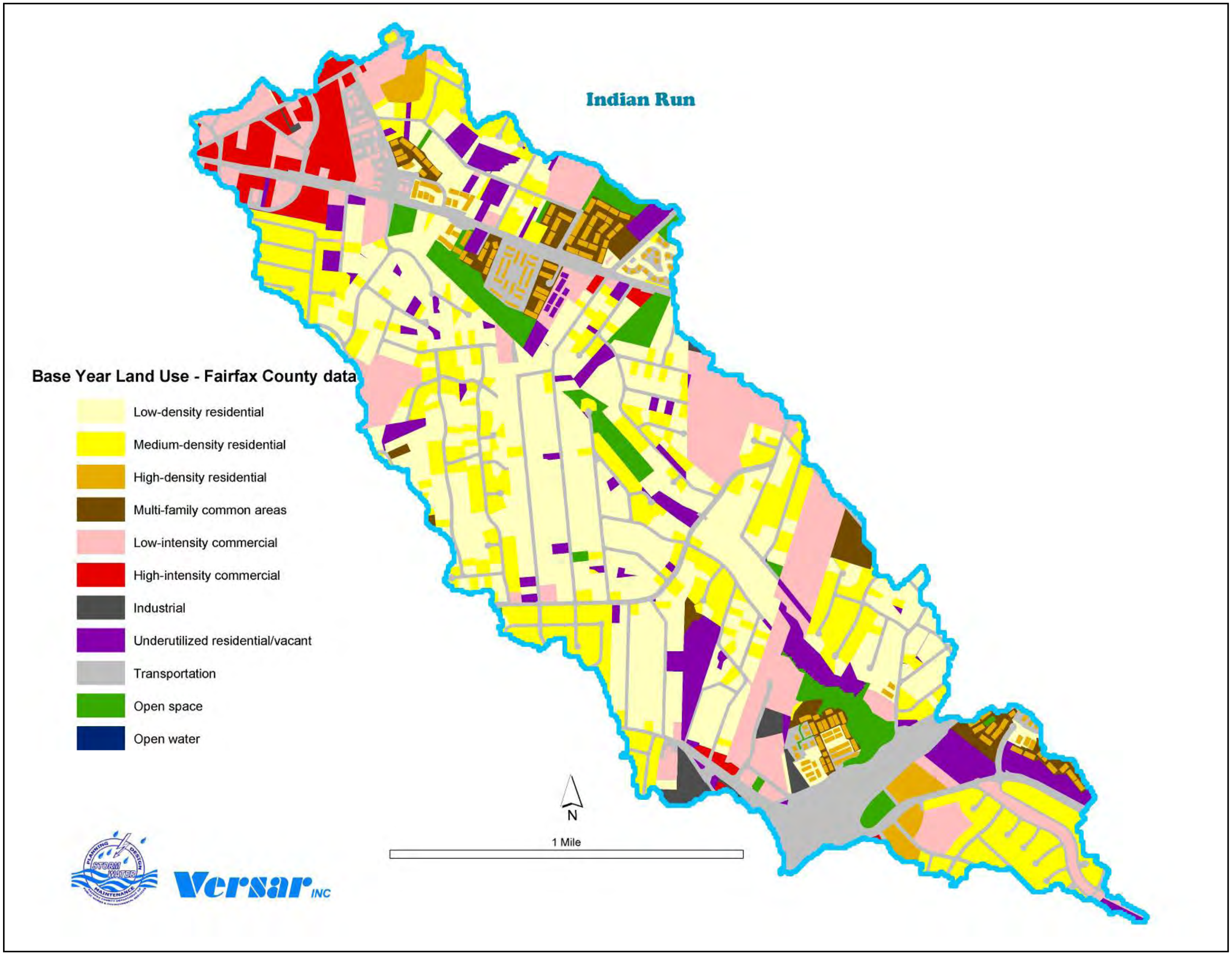

Figure 4-26. Land use map of Indian Run subwatershed

Table 4-30. Estimates of future land use and percentage of impervious area in the Indian Run subwatershed			
Subwatershed Area (acres)	1,586		
Land Use	**Base Year (% area)**	**Future (% area)**	**% Change**
Open space	8.2	4	-51.7
Multifamily common area	4.1	2.8	-30.3
Low-density residential	30.8	32.5	5.2
Medium-density residential	17.8	20.6	15.8
High-density residential	3.7	3.7	0
Low-intensity commercial	13.2	11.8	-10.8
High-intensity commercial	3.2	4.7	45.8
Industrial	0.9	1.9	109.2
Transportation	18	18	0
Impervious area	25.2	28.6	13.3

The county's list of drainage projects shows that 6 of the 16 projects in this subwatershed have been completed; 1 project is active with full funding, and the remaining 9 projects are inactive. Table 4-31 summarizes the kind of drainage project, project name/location, and status. No cost estimates were available for these projects.

Table 4-31. Drainage projects in the Indian Run subwatershed

Type of Work	Project Name/Location
Active Project - Fully Funded	
Streambank stabilization	Indian Run Ph IV
Completed	
Gabion and rip rap/stabilization	Indian Run Ph II
Gabion/stabilization	Upstream of Braddock, Randolph
Streambank stabilization	Indian Run Ph I
Floodproof houses	Ridgewood
Retaining wall	Indian Run, Bren Mar Subdivision
Streambank stabilization	Brekke Property
Inactive	
Stream restoration	Spring Vall
Streambank stabilization	Braddock Hills
Streambank stabilization	Upstream of Braddock Road, Willow Run Subdivision
Channel improvements	Birch Lane
Streambank stabilization	Indian Run Ph III
Install retaining walls	Indian Run
Streambank stabilization	Bren Mar Ph II
Streambank stabilization	Fairland
Streambank stabilization	Indian Run

Table 4-32 summarizes the condition of Indian Run. This information is based on data from the 2001 SPS Baseline Study and the SPA. According to the SPS the overall condition of Indian Run is very poor.

Table 4-32. Summary of 2001 SPS Baseline Study and SPA results for the Indian Run subwatershed

SPS Results		SPA Results	
Condition rating	V.Poor	Inadequate buffers (ft.)	42,850
Index of Biotic Integrity score	Fair	Eroded streambanks (ft.)	4,840
Fish taxa richness	Very Low	Habitat assessment	Fair
Base year % impervious	27	Stormdrain pipes	25
		Dumping sites	0
		Headcuts	0
		Exposed utilities	6
		Obstructions	9
		Road crossings	29

4.2.5.2 Problems Areas Identified from SPA Data

An analysis of the SPA data indicates that the major problems within the subwatershed are inadequate buffers, eroded streambanks, storm discharge pipes, and obstructions of stream flow (Figure 4-27).

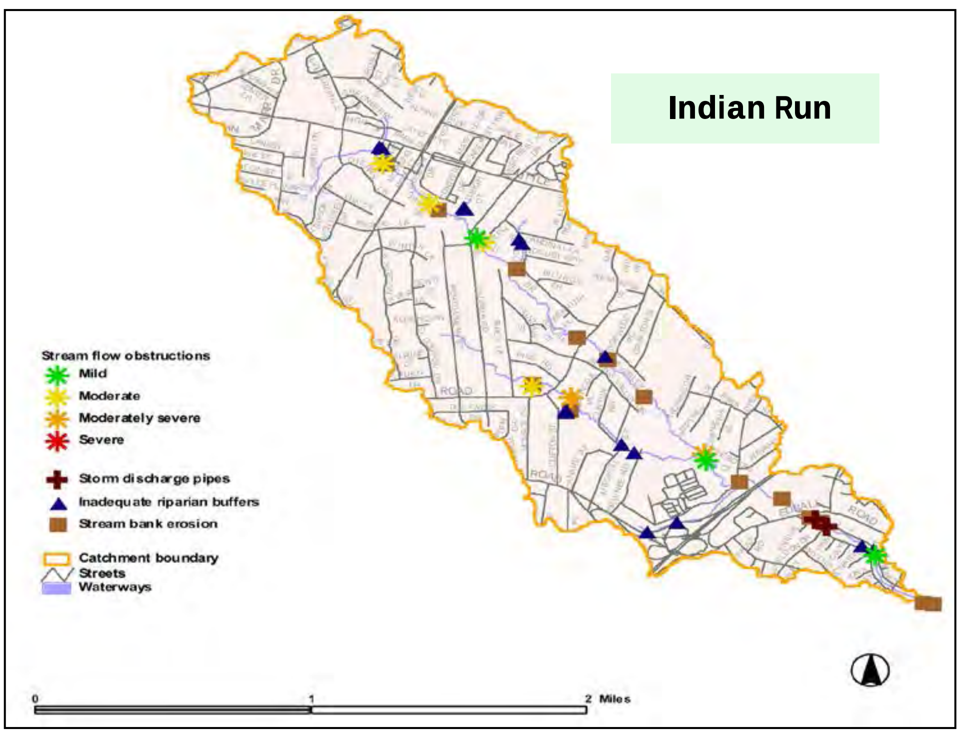

Figure 4-27. Location of the major problem areas in Indian Run subwatershed as indicated by SPA data

4.2.5.3 Problem Areas Identified by the Public

Public input about problem areas within Indian Run was obtained through watershed forums and other avenues. Table 4-33 describes problem areas and potential solutions that were discussed during these meetings.

Bank erosion and inadequate buffer along Indian Run

Table 4-33. Problem areas in the Indian Run subwatershed identified by the public

Location of Problem	Description of Problem	Potential Solution
Dog park	Concern about management	Review management of dog park.
Wooded lots below Holmes Middle School	Streambank erosion and high flows within nice wooded areas south of Holmes Middle School	Stormwater control upstream to increase the good areas.
Turkeycock/Braddock Rd.	Dog walking. Look into golf course management. Lots of geese, bad water quality downstream of golf course.	Doggy mitts/clean-up
Cherokee Rd, Shawnee Rd, Windy Hill Community	Pollution from "abandoned" Atlantic Research site, possibly polluting Indian Run	Investigate potential pollution source and identify opportunities to improve water quality from this site.

4.2.5.4 Modeling Results

Hydrologic modeling indicates that stormwater runoff in the Indian Run subwatershed is the greatest in Cameron Run due to dense development in the upper portions of the area. Overall, imperviousness in the subwatershed is about average compared to all of Cameron Run. The expected increase in discharges due to future development is average compared to the other subwatersheds. Table 4-34 compares the existing and future 1-, 2- and 10-year peak discharges in the subwatershed.

Table 4-34. Indian Run peak runoff flows

Drainage Area (acres)	1586		
	1-Year Storm	**2-Year Storm**	**10-Year Storm**
Existing peak flow (cfs)	263	349	809
Future peak flow (cfs)	277	361	818
Percent increase in peak flow	5.0	3.3	1.2

The HEC-RAS stream hydraulic model was used to simulate peak water velocity and water levels in stream channels in Cameron Run for storms of various sizes. Peak stream velocities greater than 5 feet per second (fps) indicate the potential for channel erosion. The percentages of stream channels in Indian Run with peak velocity greater than this value are 49% and 58%, for the 1-year and 2-year design storms, respectively. The number of buildings estimated to be in or touching the 100-year floodplain is 60 for Indian Run. Table 4-35 shows the number of roadway crossings overtopped by storms of various sizes for base-year and future conditions. Complete modeling details and results are provided in Appendix B.

Table 4-35. Number of roadway crossings (bridges) overtopped by design flows for Indian Run subwatershed

	Present	**Future**
1-year	1	1
2-year	1	1
10-year	2	2
25-year	2	2
100-year	2	2

The Indian Run subwatershed has a sediment loading rate a little below average among the eight subwatersheds and average annual loadings of total nitrogen and phosphorus. This subwatershed contains the greatest proportion of low-density commercial development. For future land use conditions, the total nitrogen and phosphorus loadings are predicted to increase by 9.3% and 8.6%, respectively. Table 4-36 compares the existing and future annual average pollutant loadings in the subwatershed.

Table 4-36. Average annual pollutant loadings (pounds/acre/year) in the Indian Run subwatershed

Pollutant	**Total Nitrogen**	**Total Phosphorus**	**Total Suspended Solids**	**Lead**	**Copper**	**Zinc**
Base year	9.6	1.1	218	0.012	0.063	0.332
Future	10.5	1.2	234	0.014	0.068	0.359
% Increase	9.3	8.6	7.6	11.4	6.6	8.2

4.2.6 State of Backlick Run

4.2.6.1 Subwatershed Characteristics

Backlick Run subwatershed covers 19.9% of the Cameron Run watershed (Figure 4-28). Thirty-one percent (31%) of the subwatershed is impervious; imperiousness is estimated to increase to 36% in the future. Medium-density residential development dominates land use within the subwatershed (Figure 4-29). Table 4-37 shows land use and percentage of impervious area for base-year and future conditions, and percent change in land use for the subwatershed. Backlick Run and its tributaries drain the southwest portion of Cameron Run watershed. Turkeycock and Indian runs are the two major tributaries of this system. The headwaters of Backlick Run originate in the vicinity of Ravensworth Road. The stream flows southeast toward the "mixing bowl," the interchange of I-95, I-395, and I-495, and then east toward its confluence with Holmes Run in Alexandria, a length of 7.2 miles.

Figure 4-28. Backlick Run subwatershed

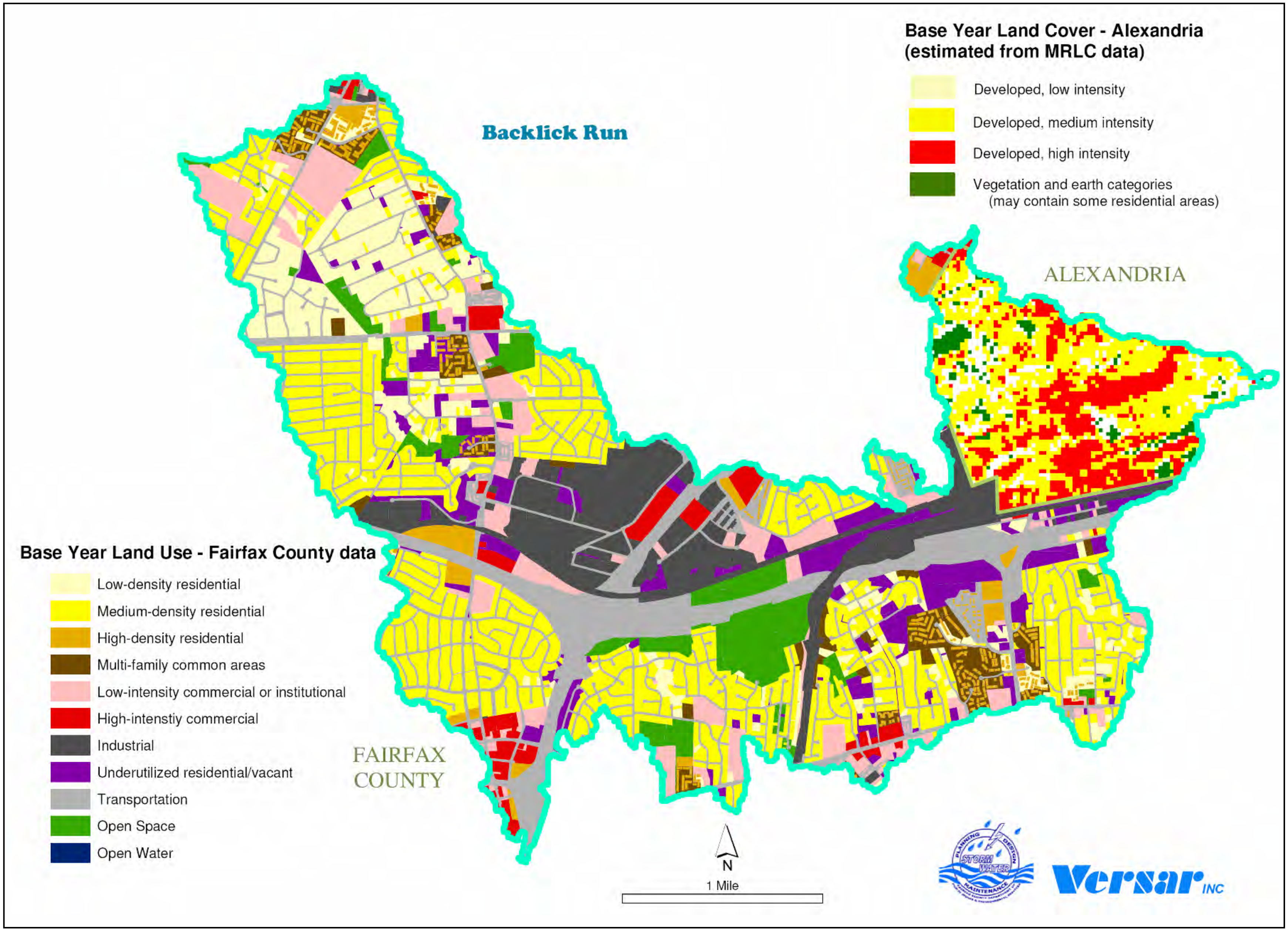

Figure 4-29. Land use map of Backlick Run subwatershed

Table 4-37. Estimates of future land use and percentage of impervious area in the Backlick Run subwatershed			
Subwatershed Area (acres)	5,659		
Land Use	**Base Year (% area)**	**Future (% area)**	**% Change**
Open space	10.8	6.4	-40.7
Multifamily common area	3.4	2.6	-21.8
Low-density residential	11.7	11.9	1.8
Medium-density residential	29.5	31.5	6.7
High-density residential	5.1	5.2	2.4
Low-intensity commercial	7.7	7.7	0.2
High-intensity commercial	2.9	3.3	14.2
Industrial	10.7	13.1	22.3
Transportation	18.1	18.1	0
Impervious area	30.7	35.9	16.9

In the uppermost section of the stream, northwest of Backlick Road, the stream passes through a lightly populated area and wooded stream valleys. From Backlick Road to the mouth of Indian Run, the stream is flanked by the Southern Railroad and the Capitol Beltway. The railroad and highway act as barriers against the encroachment of development. The section of the stream passing through Fairfax County (from the mouth of Indian Run to the confluence with Holmes Run) was channelized when the railroad was built in 1850 and passes through an intensely developed area (Parsons Brinckerhoff 1974).

The county's list of drainage projects shows that 4 of the 15 projects in this subwatershed have been completed; 1 project is active with partial funding, and the remaining projects are inactive. Table 4-38 summarizes the kind of drainage project, project name/location, and status. No cost estimates were available for these projects.

Table 4-38. Drainage projects in the Backlick Run subwatershed	
Type of Work	**Project Name/Location**
Active Project - Partially Funded	
Regional pond	Vine Street - 2
Completed	
Storm sewer	Valley View Drive
Gabion and rip rap/stabilization	Backlick Run
Streambank stabilization	Backlick Run Ph. 4
Gabion/stabilization	Wilburdale Park

Table 4-38. (Continued)	
Type of Work	**Project Name/Location**
Inactive	
Storm sewer	Leewood Subdivision
Storm sewer	Old Rolling/Nedra
Streambank stabilization	Southern Railroad
Streambank stabilization	Southern Railroad/South Van Dorn/Runnymeade
Storm sewer, ditch and berm	Clemons Court
Construction of earthen berm	Bren Mar Drive
Streambank stabilization	Shirley Highway
Streambank stabilization and gabion	RR
Streambank stabilization	Downstream of Backlick Run
Streambank stabilization study	Annandale Acres

Table 4-39 summarizes the condition of Backlick Run. This information is based on data from the 2001 SPS Baseline Study and the SPA. According to the SPS the overall condition of Backlick Run is very poor.

Table 4-39. Summary of 2001 SPS Baseline Study and SPA Results for the Backlick Run subwatershed

SPS Results		**SPA Results**	
Condition rating	V.Poor	Inadequate buffers (ft.)	70,485
Index of Biotic Integrity score	Poor	Eroded streambanks(ft.)	3,725
Fish taxa richness	Low	Habitat assessment	Fair
Base year % impervious	30	Stormdrain pipes	2
		Dumping sites	1
		Headcuts	2
		Exposed utilities	4
		Obstructions	7
		Road crossings	59

4.2.6.2 Problems Areas Identified from SPA Data

An analysis of the SPA data indicates that the major problems within the subwatershed are inadequate buffers, eroded streambanks, exposed utilities, storm discharge pipes, and obstructions of flow (Figure 4-30). Backlick Run was included on EPA's list of impaired waters for fecal coliform contamination.

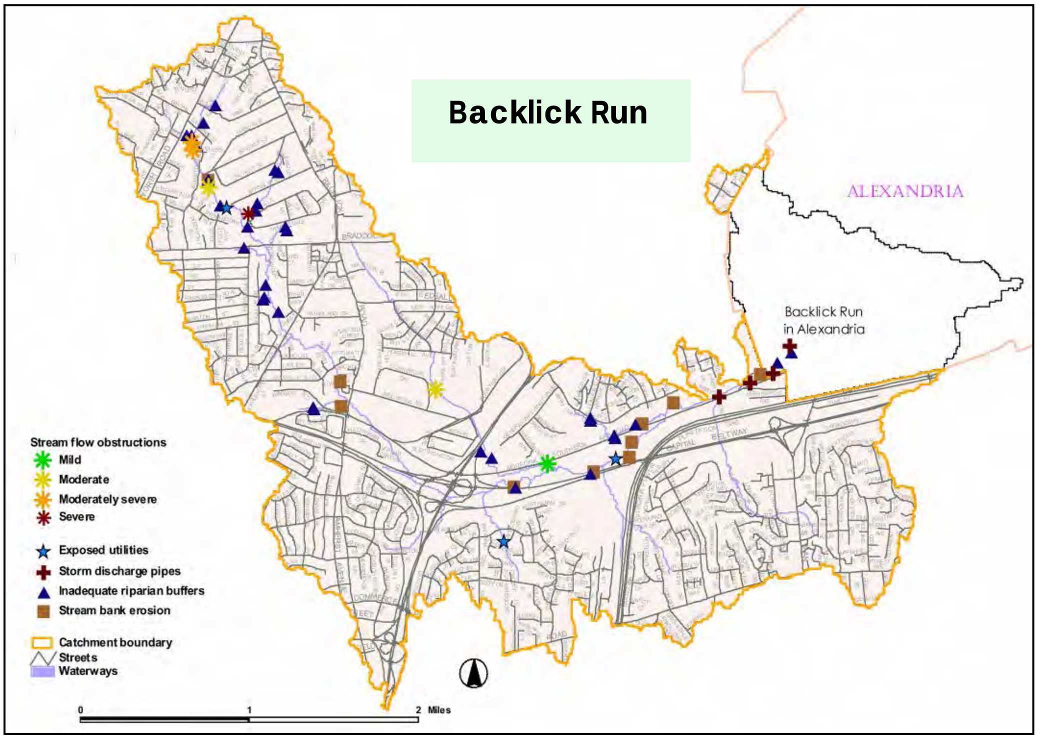

Figure 4-30. Location of major problem areas in Backlick Run subwatershed as indicated by SPA data

4.2.6.3 Problem Areas Identified by the Public

Public input about problem areas within Backlick Run was obtained through forums and other avenues. Table 4-40 describes problem areas and potential solutions discussed during these meetings.

Backlick Run at Interstate 495

Table 4-40. Backlick Run problem areas from public forum

Location of Problem	Description of Problem	Potential Solution
Backlick Run in the Brookhill area	Bank erosion and channel instability along Backlick Run	Provide additional stormwater controls in upland areas to reduce the magnitude and frequency of flows; apply bioengineering approaches and natural stream channel design to stabilize streambanks and bed, and improve habitat conditions.
Edsall Road Industrial Park	Toxic polluted runoff	Implement pollution prevention programs; install stormwater controls to capture and treat runoff.
Cameron Run mainstem	Channelized ditch	River edge park/ dechannelizing (ex. Four Mile Run is in the process of retrofits)
Wilburdale Park	Urbanized stream	Earth Sangha - Stream planting project
Calvert Street.	Severe erosion	Stabilize the streambank.
Wilburdale Park, Backlick Run	Stream degradation and erosion of Backlick Run	Provide additional stormwater controls in upland areas to reduce the magnitude and frequency of flows; apply bioengineering approaches and natural stream channel design to stabilize streambanks and bed, and improve habitat conditions.
I-395 and I-495 intersection at Backlick Run	Impervious surfaces of I-395, I-495, and three industrial parks force heavy runoff into the floodplain area.	Install additional stormwater controls to capture, detain, and treat highway runoff.

4.2.6.4 Modeling Results

Hydrologic modeling indicates that stormwater runoff in the Backlick Run subwatershed is relatively high due to dense development in the middle and lower portions of this subwatershed; this subwatershed also has the largest percentage of impervious area within Cameron Run, at 30.7% overall. The estimated increase in discharges due to future development is average compared to the other subwatersheds. Table 4-41 compares the existing and future 1-, 2- and 10-year peak discharges in the subwatershed.

Table 4-41. Peak runoff flows in the Backlick Run subwatershed

Drainage Area (acres)	5,659		
	1-Year Storm	**2-Year Storm**	**10-Year Storm**
Existing peak flow (cfs)	212	277	622
Future peak flow (cfs)	224	289	626
Percent increase in peak flow	5.4	4.2	0.6

The HEC-RAS stream hydraulic model was used to simulate peak water velocity and water levels in stream channels in Cameron Run for storms of various sizes. Peak stream velocities greater than 5 feet per second (fps) indicates the potential for channel erosion. The percentages of stream channels in Backlick Run with peak velocity greater than this value are 52% and 55%, for the 1-year and 2-year design storms, respectively. The number of buildings estimated to be in or touching the 100-year floodplain is 108 for the county portion of Backlick Run. Table 4-42 shows the number of roadway crossings overtopped by storms of various sizes for base-year and future conditions. Complete modeling details and results are provided in Appendix B.

Table 4-42. Number of roadway crossings (bridges) overtopped by design flows for Backlick Run subwatershed

	Present	**Future**
1-year	0	0
2-year	0	0
10-year	3	3
25-year	3	3
100-year	4	4

The Backlick Run subwatershed has the highest sediment loading rate of the eight subwatersheds due to the larger commercial and industrial areas present. The Backlick Run subwatershed also has large annual loadings of total phosphorus. This can be attributed to the relatively high percentage of developed land in the watershed. This subwatershed contains the greatest proportion of industrial development. For future land use conditions, the nitrogen and phosphorus loadings are predicted to increase by 10.0% and 8.9%, respectively. Table 4-43 compares the existing and future annual average pollutant loadings in the subwatershed.

Table 4-43. Average annual pollutant loadings (pounds/acre/year) in the Backlick Run subwatershed

Pollutant	**Total Nitrogen**	**Total Phosphorus**	**Total Suspended Solids**	**Lead**	**Copper**	**Zinc**
Base year	10.1	1.1	250	0.016	0.075	0.419
Future	11.1	1.3	265	0.017	0.082	0.459
% Increase	10.0	8.9	6.3	8.8	8.6	9.5

4.2.7 State of Pike Branch

4.2.7.1 Subwatershed Characteristics

Pike Branch subwatershed covers 6.4% of the Cameron Run watershed (Figure 4-31). Twenty-one percent (21%) of the subwatershed is impervious; imperviousness is estimated to increase to 26% in the future.. Medium-density residential development dominates land use within the subwatershed (Figure 4-32). Table 4-44 shows land use, percentage of impervious area for base-year and future conditions, and percent change for the subwatershed. Pike Branch drains the extreme southeastern section of the watershed and flows northeast to Cameron Run. Telegraph Road parallels the stream most of the way.

The portion of Pike Branch mainstem that lies to the east of Telegraph Road passes through a developed area. The channel was straightened. About 150 feet of channel have sheet-metal sides and a concrete bottom; concrete walls line 450 feet. Although the improvements have reduced erosion, they have also considerably altered the stream.

The lowest reach of Pike Branch, west of Telegraph Road, shows the effects of its passage through a highly developed commercial area. Upstream of the confluence with Cameron Run, the stream falls sharply at the end of a concrete-lined section, causing bed scour. A sheet of corrugated metal in the channel has created a deep pond (Parsons Brinckerhoff 1974).

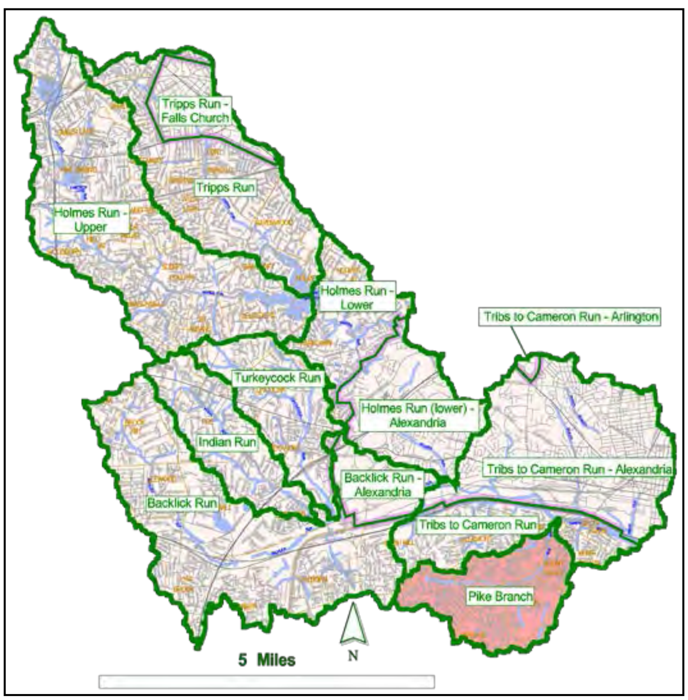

Figure 4-31. Pike Branch subwatershed

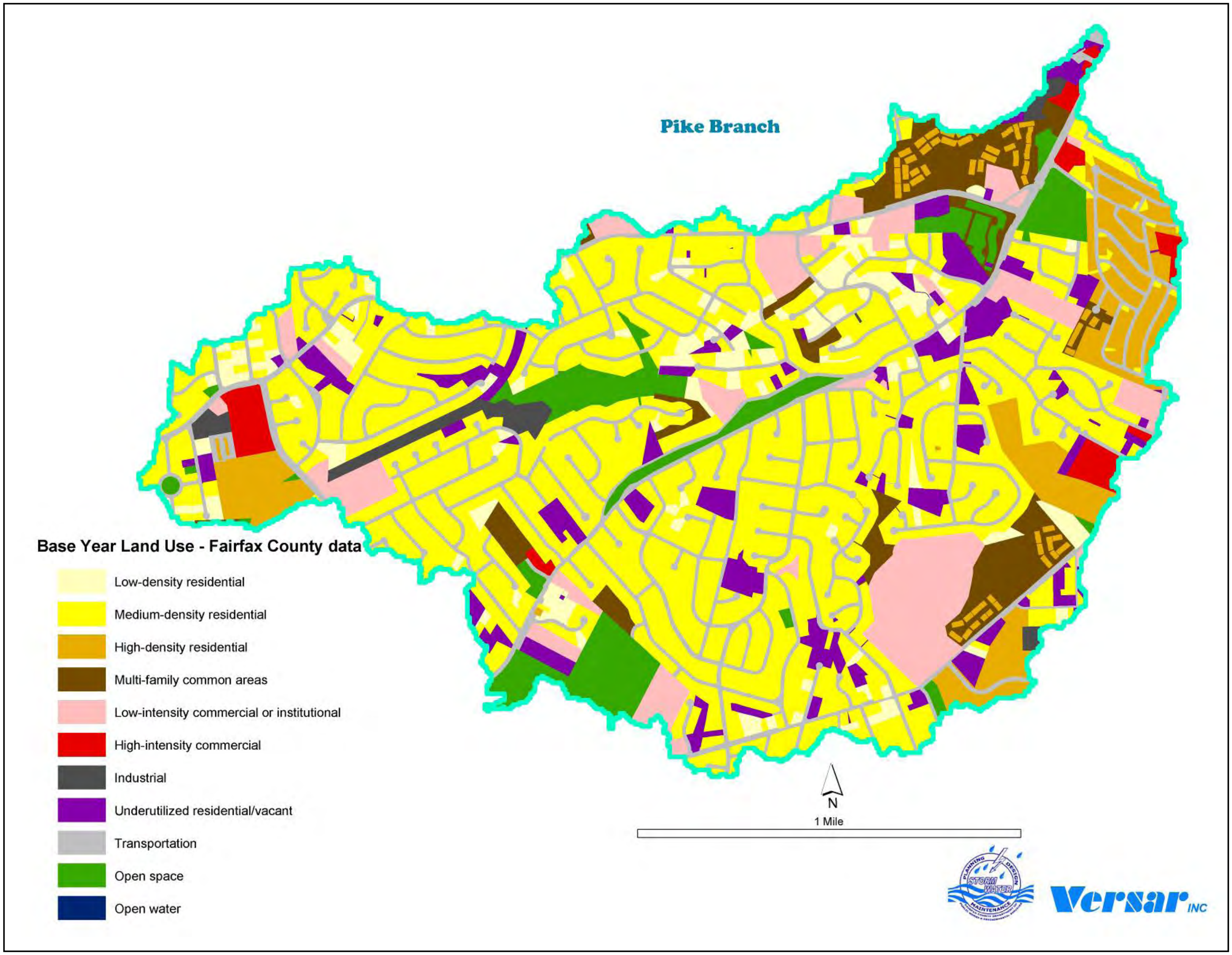

Figure 4-32. Land use map of Pike Branch

Table 4-44. Estimate of future land use and percentage of impervious area in the Pike Branch subwatershed			
Subwatershed Area (acres)	1,814		
Land Use	**Base Year**	**Future**	**% Change**
Open space	7.6	4.2	-44.3
Multifamily common area	6.7	5.2	-22.3
Low-density residential	7.8	5.4	-31.1
Medium-density residential	44.4	51.0	14.8
High-density residential	7.3	7.4	1.5
Low-intensity commercial	8.5	9.0	5.2
High-intensity commercial	1.7	1.8	7.6
Industrial	1.4	1.4	0
Transportation	14.6	14.6	0
Impervious area	20.8	25.5	22.5

The county's list of drainage projects shows that four of the nine projects in this subwatershed have been completed, and the remaining five projects are inactive. Table 4-45 summarizes the kinds of drainage projects, project name/location, and current status. No cost estimates were available for these projects.

Table 4-45. Drainage projects in the Pike Branch subwatershed	
Type of Work	**Project Name/Location**
Completed	
Floodproof house	Wilton Road, Pike Branch Ph 2
Gabion/stabilization	Tipton Lane, Sunny Ridge Estate
Gabion/replace culvert	Pike Branch Ph I
Stream stabilization/gabion repair	Pike Branch I00216
Inactive	
Streambank stabilization	Pike Branch Ph III
Channel improvements	Franconia/Leewood
Channel improvements	Wilton Woods
Stream restoration and stabilization	Pike Branch
Streambank stabilization	Pike Branch

Table 4-46 summarizes the condition of Pike Branch. This information is based on data from the 2001 SPS Baseline Study and the SPA. According to the SPS the overall condition of Pike Branch is very poor.

Table 4-46. Summary of 2001 SPS Baseline Study and SPA results for the Pike Branch Run subwatershed

SPS Results		SPA Results	
Condition rating	V.Poor	Inadequate buffers (ft.)	27,450
Index of Biotic Integrity score	Fair	Eroded streambanks (ft.)	75
Fish taxa richness	V.Low	Habitat assessment	Fair
Base year % impervious	25	Stormdrain pipes	29
		Dumping sites	1
		Headcuts	0
		Exposed utilities	2
		Obstructions	5
		Road crossings	13

4.2.7.2 Problems Areas Identified from SPA Data

An analysis of the SPA data indicates that the major problems within the subwatershed are inadequate buffers, obstructions of stream flow, and stormdrain pipes (Figure 4-33).

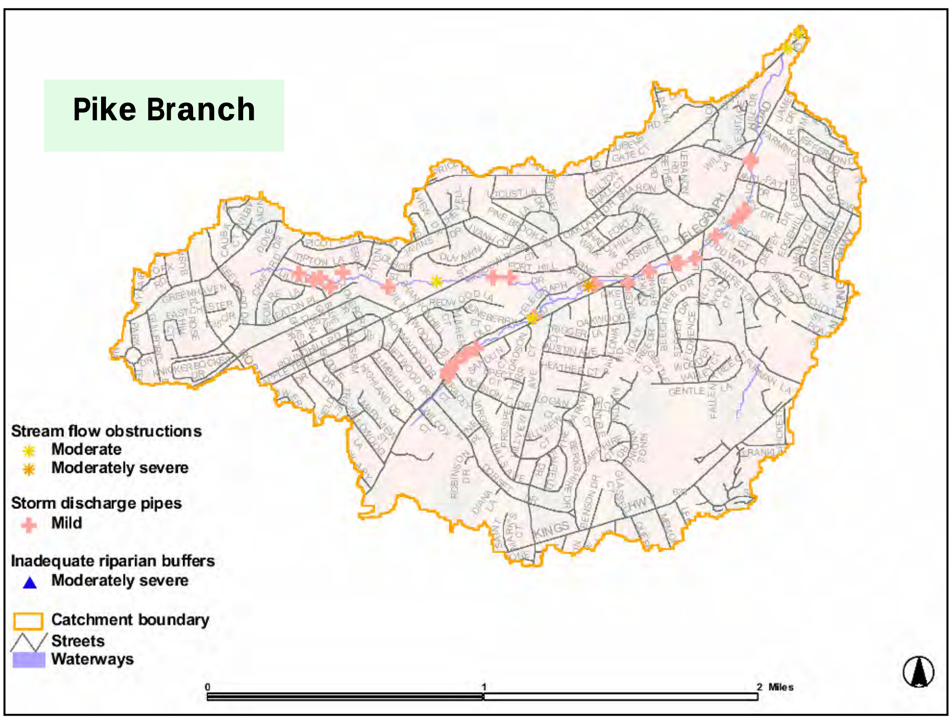

Figure 4-33. Location of major problem areas in Pike Branch subwatershed as indicated by SPA data

4.2.7.3 Problem Areas Identified by the Public

Public input about problem areas within Pike Branch was obtained through forums and other avenues. Table 4-47 describes problem areas and potential solutions discussed during these meetings.

Channelization in Pike Branch

Table 4-47. Problem areas identified by the public in the Pike Branch subwatershed

Location of Problem	Description of Problem	Potential Solution
Pike Branch at Burgundy Road crossing	Concrete wall across stream and banks overrun with porcelain berry; area is part of Woodrow Wilson Bridge Project.	Control exotic plants with assistance from existing or newly formed native plant group; provide resources to replant with native species.
Pike Branch intersection with Cameron Run	Construction run off due to Wilson Bridge project	
Jefferson Manor neighborhood (and many others)	Trash, leaves, and runoff going down stormdrains (many times intentionally)	Stencil stormdrains.
Jefferson Manor Park	Channelized stream	Dechannelize and retrofit (ex. Four Mile Run is in the process of being retrofitted).

4.2.7.4 Modeling Results

Hydrologic modeling indicates that stormwater runoff in the Pike Branch subwatershed is about average among the subwatersheds of Cameron Run, although Pike Branch has the lowest imperviousness within Cameron Run as a whole. The predicted increase in discharges due to future development is average compared to the other subwatersheds. Table 4-48 compares the existing and future 1-, 2- and 10-year peak discharges in the subwatershed.

Table 4-48. Peak runoff flows in the Pike Branch subwatershed

Drainage Area (acres)	1,814		
	1-Year Storm	**2-Year Storm**	**10-Year Storm**
Existing peak flow (cfs)	221	297	742
Future peak flow (cfs)	235	308	742
Percent increase in peak flow	6.4	3.6	0

The HEC-RAS stream hydraulic model was used to simulate peak water velocity and water levels in stream channels in Cameron Run for storms of various sizes. Peak stream velocities greater than 5 feet per second (fps) indicate the potential for channel erosion. The percentages of stream channels in Pike Branch Run with peak velocity greater than this value are 13% and 38%, for the 1-year and 2-year design storms, respectively. The number of buildings estimated to be in or touching the 100-year floodplain is 22 for Pike Branch Run. Table 4-49 shows the number of roadway crossings overtopped by various size design storms for base year and future conditions. Complete modeling details and results are provided in Appendix B.

Table 4-49. Number of roadway crossings (bridges) overtopped by design flows for Pike Branch subwatershed

	Present	**Future**
1-year	0	0
2-year	0	0
10-year	0	0
25-year	0	0
100-year	3	3

The Pike Branch subwatershed has an average sediment loading rate among the eight subwatersheds and relatively high annual loadings of total nitrogen and phosphorus. This can be attributed to the relatively high percentage of medium-density residential development in the watershed. For future land use conditions, the total nitrogen and phosphorus loadings are predicted to increase by 10.1% and 9.2%, respectively. Table 4-50 compares the existing and future annual average pollutant loadings in the subwatershed.

Table 4-50. Average annual pollutant loadings (pounds/acre/year) in the Pike Branch subwatershed

Pollutant	**Total Nitrogen**	**Total Phosphorus**	**Total Suspended Solids**	**Lead**	**Copper**	**Zinc**
Base year	10.1	1.2	222	0.13	0.065	0.314
Future	11.2	1.3	240	0.014	0.071	0.345
% Increase	10.1	9.2	8.1	8.0	9.5	9.9

4.2.8 State of Cameron Run Mainstem and Direct Tributaries

4.2.8.1 Subwatershed Characteristics

The subwatershed of Cameron Run and its direct tributaries covers 18.8% of the Cameron Run watershed (Figure 4-34). Medium-density residential development dominates land use within the subwatershed (Figure 4-35). Table 4-51 shows land use and percentages of impervious area for base-year and future conditions, and percent change for the subwatershed. The mainstem of Cameron Run is the portion of stream that flows from the confluence of Holmes and Backlick runs to a point just upstream of the Jefferson Davis Highway crossing. The stream from here to the Potomac River is known as Hunting Creek and receives drainage from the Belle Haven watershed.

Throughout its length, the stream flows through an area of dense development. The section upstream of Pike Branch is similar to the disturbed, downstream reaches of Backlick Run. The channel is wide, straight, and shallow, with only sporadic vegetative cover. Sections of concrete lining are found throughout the course of the stream.

The tidal effect of the Potomac River is pronounced, extending upstream as far as Telegraph Road. At high tide, this influence is significant in bringing poorer quality water into the lower reaches of the basin. The stream quality is further degraded by the sediment load delivered to this area. It is the heaviest in the basin, having accumulated from upstream feeder tributaries. Concrete walls protect streambanks from scouring in critical areas; consequently, erosion is not a significant problem. The stream receives flows from Alexandria, has tidal influence near the

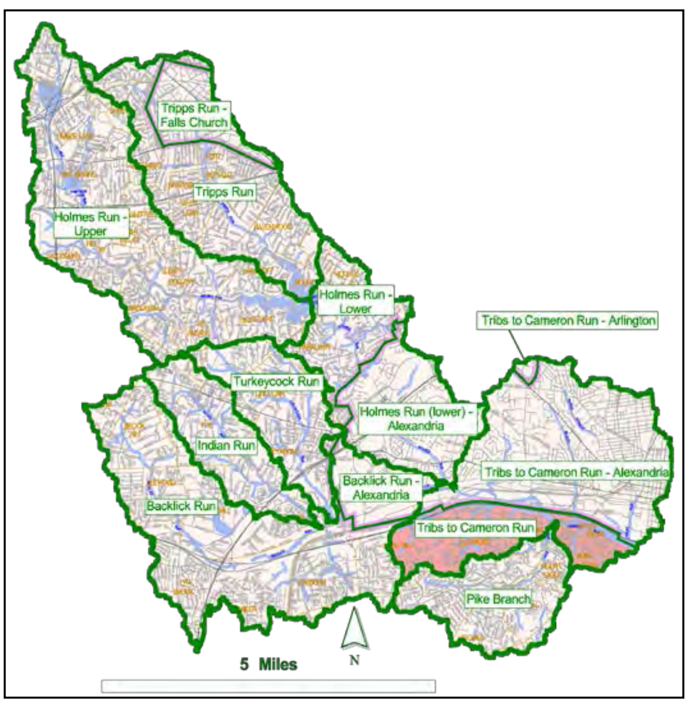

Figure 4-34. Cameron Run subwatershed

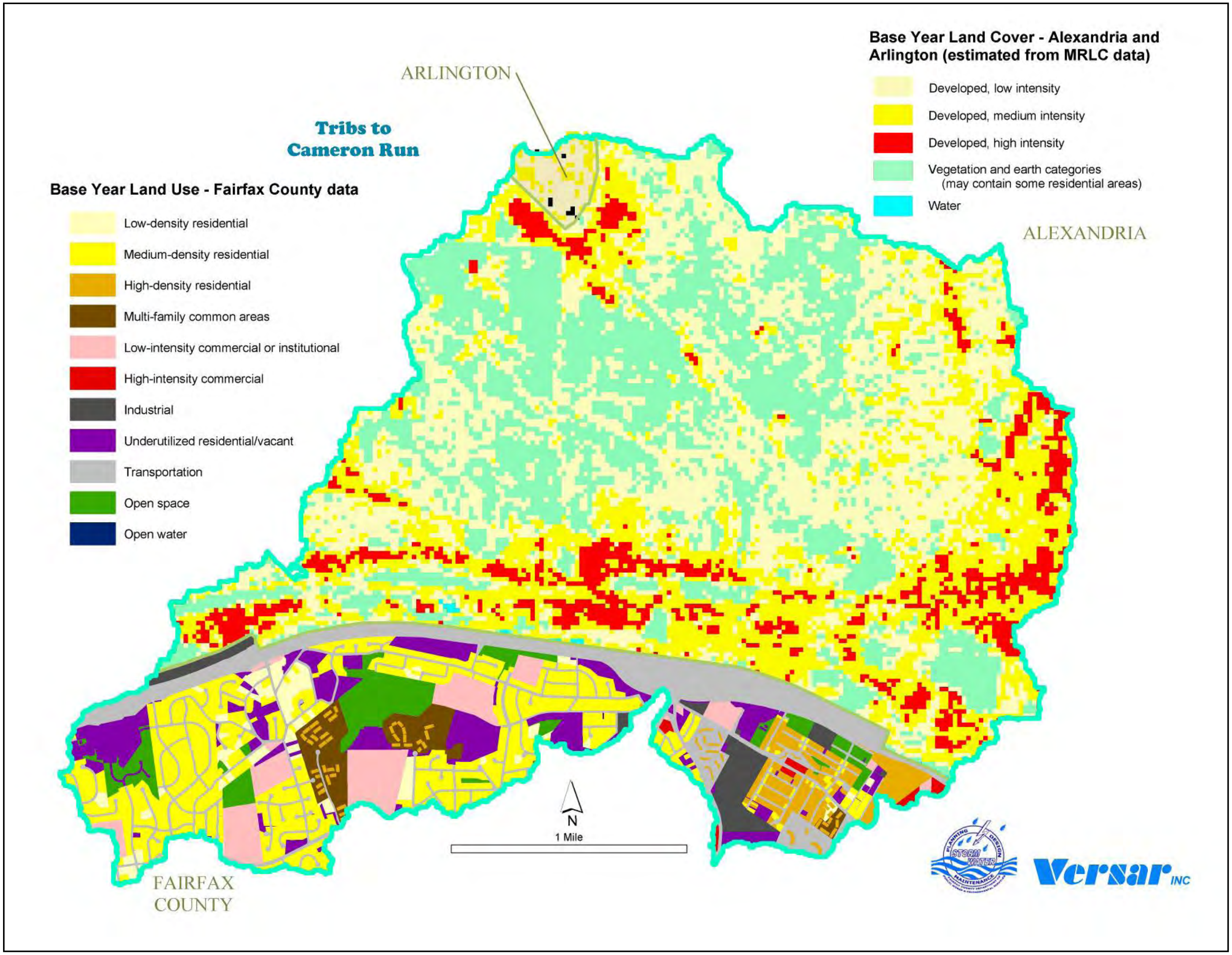

Figure 4-35. Land use map of Cameron Run subwatershed

Wilson Bridge, and includes the proposed Huntington Stream Valley Trail along its mainstem. Many streams are buried or channelized (especially in the lower Capitol Beltway area), disconnecting them from their floodplains (Parsons Brinckerhoff 1974).

Table 4-51. Estimates of future land use and percentage of impervious area in the Cameron Run mainstem and direct tributaries.*

Subwatershed Area (acres)	1,708		
Land Use	**Base Year (% area)**	**Future (% area)**	**% Change**
Open space	16.8	7.8	-53.7
Multifamily common area	6.1	4.0	-34
Low-density residential	12.8	11.0	-14.2
Medium-density residential	28.2	39.2	39
High-density residential	5.8	6.0	5.1
Low-intensity commercial	8.1	9.5	17.8
High-intensity commercial	0.9	1.0	20.6
Industrial	3.9	3.9	0
Transportation	17.5	17.5	-0.1
Impervious area	23.7	29.5	24.6

* Includes area in Alexandria upstream of USGS gage on Cameron Run

The county's list of drainage projects shows that three of the seven projects in this subwatershed have been completed, and the remaining four projects are inactive. Table 4-52 summarizes the kind of drainage project, project name/location, and current status. No cost estimates were available for these projects.

Table 4-52. Drainage projects in the Cameron Run mainstem and direct tributaries

Type of Work	**Project Name/Location**
Completed	
Streambank stabilization	Norton Road
Storm sewer system	Clermont Drive
Streambank stabilization	Burgundy Manor
Inactive	
Infrastructure replacement	Elmwood Drive
Floodwall construction	Arlington Terrace
Streambank stabilization	Telegraph Road/Beltway
Streambank stabilization	Norton Villa

During June, 2006, intense tropical downpours resulted in significant flooding of the Arlington and Huntington communities located adjacent to the Cameron Run mainstem. Approximately 160 duplex homes in the area were severely damaged during the storm.

In September 2006, Fairfax County entered into an agreement with the U.S. Army Corps of Engineers to complete a flood-damage-reduction study for Huntington. This study will investigate structural and combination structural/non-structural alternatives for reducing the effects of flooding and include an economic analysis of various alternatives. The study will be completed in approximately 18 months and will include a 65% engineering design for the recommended improvement.

Table 4-53 summarizes the condition of Cameron Run. This information is based on data from the Fairfax County SPA. The 2001 SPS Baseline Study did not include sites within this subwatershed.

Table 4-53. Summary of SPA results for the Cameron Run subwatershed

Inadequate buffers (ft.)	27,500
Eroded streambanks (ft.)	800
Habitat assessment	Poor
Stormdrain pipes	9
Dumping sites	2
Headcuts	1
Exposed utilities	0
Obstructions	2
Road crossings	17

4.2.8.2 Problems Areas Identified from SPA Data

An analysis of the SPA data indicates that the major problems within the subwatershed are inadequate buffers, trash dumpsites, and stormdrain pipes (Figure 4-36). These waters are included on EPA's list of impaired waters for acute ammonia and fecal coliform contamination. PCBs were found in fish tissues, which prompted the Virginia Department of Health to issue a health advisory. A 1985 study in Alexandria identified poor groundwater conditions (high sodium chloride, iron, and total dissolved solids), which can influence baseflow water quality.

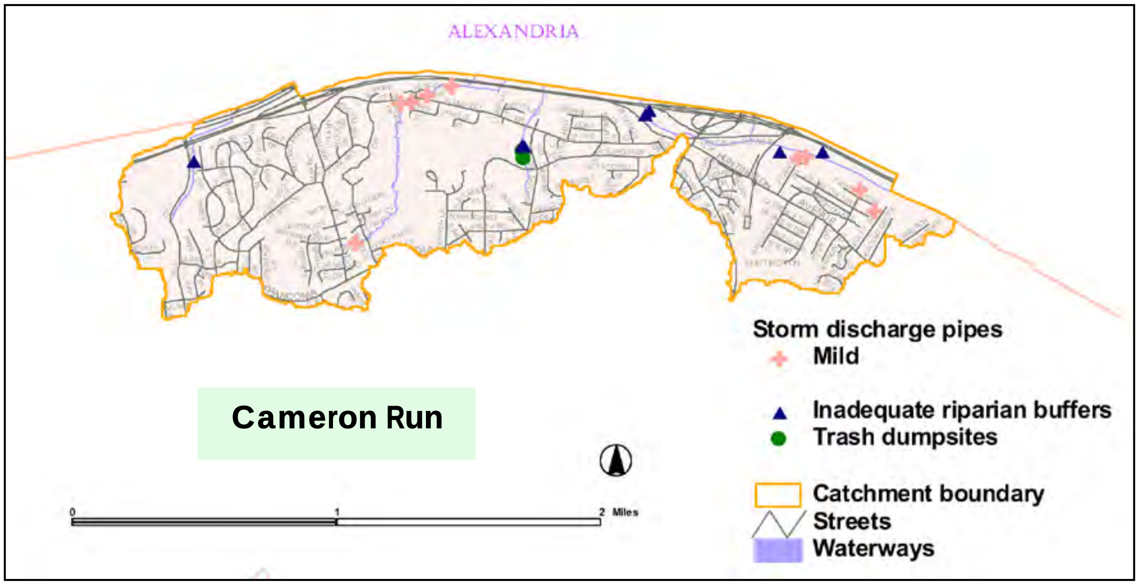

Figure 4-36. Location of major problem areas in Cameron Run subwatershed as indicated by SPA data

4.2.8.3 Problem Areas Identified by the Public

Public input about problem areas within Cameron Run mainstem and direct tributaries was obtained through forums and other avenues. Table 4-54 describes problem areas and potential solutions that were discussed during these meetings.

A view of Cameron Run facing upstream

Table 4-54. Problem areas identified by the public in Cameron Run mainstem and direct tributaries

Location of Problem	Description of Problem	Potential Solution
Cameron Run along Eisenhower Avenue in Alexandria	Cameron Run is an ugly, boulder strewn wasteland; trail is too far from water; water provides no benefit to trail users.	Integrate recreational and aesthetic amenities, as well as stormwater controls, into Cameron Run trail projects during maintenance and upgrade cycles.
Huntington Avenue and Telegraph Road	Woodrow Wilson Bridge construction degrades the area.	Coordinate with the Woodrow Wilson Bridge consultants to discuss and mitigate construction impacts.
Cameron Run mainstem	Lack of recreation opportunities	Integrate recreational and aesthetic

Table 4-54. Problem areas identified by the public in Cameron Run mainstem and direct tributaries		
Location of Problem	**Description of Problem**	**Potential Solution**
	along the Cameron Run mainstem	amenities into future stormwater and flood control projects. Acquire new parkland if possible, and improve existing parks.
Urban areas along Cameron Run, such as Eisenhower East	Along the Cameron Run mainstem, there are no urban areas to enjoy the waterfront.	Integrate recreational, commercial, and aesthetic amenities into an urban redevelopment project along mainstem Cameron Run that will encourage the adoption of Cameron Run as a community focal point.
Cameron Run between Holmes Run and Hunting Creek	Already identified as severely degraded habitat	Add recreational amenities in addition to environmental remedies. Light boating and kayaking could be readily accomplished in conjunction with the Northern Virginia Regional Park Authority.
Cameron Run	Between Telegraph Road and Route 1 access to stream is available only by car.	Create pedestrian walk along the stream and across the stream to Eisenhower Ave.
Tributary to Cameron Run	No public access to stream	

4.2.8.4 Modeling Results

Hydrologic modeling indicates that stormwater runoff in the mainstem of Cameron Run is about average due to the average density of development in this subwatershed. Imperviousness in this area is below average compared to the entire watershed. The predicted increase in discharges due to future development is relatively high compared to the other subwatersheds. Table 4-55 compares the existing and future 1-, 2- and 10-year peak discharges in the subwatershed.

Table 4-55. Peak runoff flows in Cameron Run mainstem			
Drainage Area (acres)	1708		
	1-Year Storm	**2-Year Storm**	**10-Year Storm**
Existing peak flow (cfs)	231	306	711
Future peak flow (cfs)	249	322	731
Percent increase in peak flow	,8.1	5.3	2.8

The HEC-RAS stream hydraulic model was used to simulate peak water velocity and water levels in stream channels in Cameron Run for various size rainfall events. Peak stream velocities greater than 5 feet per second (fps) indicate the potential for channel erosion. The percentages of stream channels in Cameron Run mainstem with peak velocity greater than this value are 50% and 66%, for the 1-year and 2-year design storms, respectively. The number of buildings estimated to be in or touching the 100-year floodplain is 8 for the portion of the Cameron Run mainstem that lies within Fairfax County. Table 4-56 shows the number of roadway crossings overtopped by storms of various sizes for base-year and future conditions. Complete modeling details and results are provided in Appendix B.

Table 4-56. Number of roadway crossings (bridges) overtopped by design flows for Cameron Run mainstem and tributaries

	Present	Future
1-year	0	0
2-year	0	0
10-year	0	1
25-year	1	1
100-year	1	1

The Cameron Run mainstem subwatershed has an average sediment loading rate among the eight subwatersheds due to the average percentage of commercial areas and higher percentage of industrial areas in the subwatershed. This subwatershed receives average loadings of total nitrogen and phosphorus. For future land use conditions, the total nitrogen and phosphorus loadings are predicted to increase by 14.9% and 14.0%, respectively. Table 4-57 compares the existing and future annual average pollutant loadings in the subwatershed.

Table 4-57. Average annual pollutant loadings (pounds/acre/year) in the Cameron Run mainstem

Pollutant	Total Nitrogen	Total Phosphorus	Total Suspended Solids	Lead	Copper	Zinc
Base year	9.9	1.2	229	0.014	0.068	0.343
Future	11.4	1.3	254	0.015	0.076	0.387
% Increase	14.9	14.0	11.0	9.9	12.4	12.9

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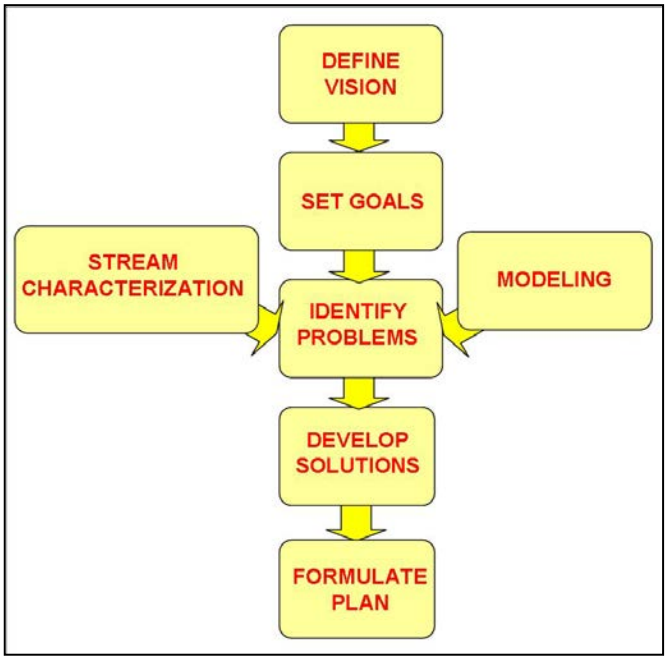
Chapter 5
Development of the Watershed Plan

Development of this management plan for the Cameron Run watershed was a coordinated process involving Fairfax County's Stormwater Planning Division; Versar, Inc., as the consultant; the Advisory Committee of watershed stakeholders (see the Acknowledgments); and the public. At times the process was decidedly iterative; in general, however, the process followed the diagram below:



The vision and goals that guided the development process are presented with the plan in Chapter 6. The results of stream characterizations, modeling, and public meetings that contributed to the assessment of problems throughout the watershed are presented in Chapter 4. This chapter describes the range of solutions considered and the method for selecting specific projects to be included in the plan.

5.1 FINAL LIST OF PROBLEMS

As described earlier, the stream characterization, modeling, and public involvement components of the process produced the following final list of problems to be addressed in the watershed plan:

Ultimate Sources of Stream Problems
- loss of forest cover
- increase in impervious surfaces
- rapid stormwater delivery system
- sources of point and nonpoint pollution

Proximal Stressors Causing Stream Degradation
- lack of riparian buffers
- loss of instream habitat
- bank erosion and sedimentation
- irregular flows
- channel alteration
- pollution
- bacteria
- flooding
- trash

5.2 POTENTIAL SOLUTIONS

Given this list of watershed problems, the Project Team identified two classes of solutions, physical and programmatic:

Physical Solutions

- decrease impervious surfaces
- restore culverts and eroded channels to natural shapes
- preserve or add trees and open space
- sweep streets
- capture storm flows and sediment

Programmatic Solutions

- decrease trash and pollution
- enact new regulations and policies
- tighten enforcement
- increase public awareness and transparency of government projects

Among the physical solutions, four categories of actions were identified:

New or Retrofit Structural Stormwater Controls

- dry pond
- wet pond
- manufactured devices to improve water quality
- sediment forebays and multiple cells
- redesigned control structures

Low Impact Development

- bioretention (e.g., rain gardens)
- grass swale
- green roofs
- cisterns and rain barrels
- porous pavement
- tree box filters
- better site design

Stream and Wetland Restoration

- bank stabilization
- natural channel design
- daylighting piped streams
- wetland restoration and creation
- riparian planting and reforestation

Pollution Reduction

- street sweeping
- trash cleanup
- recycling and dumping facilities
- education in pollution prevention

5.3 FINAL LIST OF SOLUTIONS

The Project Team and Advisory Committee discussed different strategies for managing the watershed management and selecting projects. Overall the group agreed that a balance of preserving the best remaining places, protecting the most vulnerable, restoring degraded places to acceptable condition, and reducing the influence of the worst streams on downstream areas (e.g., via loadings to the Chesapeake Bay) was the best approach.

In addition to developing a diverse list of programmatic ("policy") recommendations, the process focused on the following five categories of physical solutions that address site-specific conditions:

- LID – any of a number of innovative practices integrated into single projects, such as bioretention at the edges of large parking lots, off-line bioretention from stormwater discharge outfalls, or distributed LID techniques (e.g., rain barrels/cisterns) in neighborhoods

- New Ponds or Small Detention Areas – new stormwater management facilities or smaller extended-detention dry ponds in headwaters (streams draining 10 to 50 acres) created by constructing a control structure at the upstream end of a road culvert and excavating a micropool

- Retrofit Existing Ponds – retrofitting existing, dry detention ponds by adding storage (deeper, higher, or smaller outlet) or increasing the flowpath (baffles, earthen berms, microtopography) or incorporating infiltration trenches

- Stream Restoration – physically restoring natural stream morphology and habitat where the stream is stable (i.e., CEM score of 4 or 5) and habitat is degraded (i.e., a low habitat score)

- Riparian Planting and Reforestation – riparian planting will be undertaken as a countywide program

5.4 PROJECT SELECTION APPROACH

Developing the content of the plan involved selecting specific projects from this final list of solutions and designing them to meet the plan's goals and objectives. Selecting projects required choosing actions that will address the goals effectively (e.g., reducing high flows of stormwater) and finding locations where it is practical to implement those actions.

In the urbanized Cameron Run watershed, controlling stormwater flows (and their constituent pollutants) is the primary goal. Reductions in water quantity (peak flow velocities) and improvements of water quality (reductions in pollutant loadings) of 10% were determined to be reasonable goals for the plan. It was also determined that physical stream restoration should be conducted where the likelihood of success is the greatest (i.e., where streams are degraded but are physically stable or stabilizing). This recognizes that attempting to restore stream morphology without controlling hydrology will not succeed.

The number of projects allocated to each subwatershed was based on the amount of uncontrolled impervious surface in the subwatershed. The amount of impervious surface area without storm-water controls (e.g., existing dry or wet ponds) was used to allocate the percentage of all projects that ideally would be selected for each subwatershed. This ideal allocation ranged from 6% to 27% of all projects as follows:

Tripps Run	15
Upper Holmes Run	19
Lower Holmes Run	14
Turkeycock Run	6
Indian Run	5
Backlick Run	27
Tributaries to Cameron Run	8
Pike Branch	6
	100%

It is not feasible to implement actions for every opportunity to improve stormwater management in an older, urbanized watershed like Cameron Run. Therefore, the following three-step process was used to identify, screen, and rank projects according to priority in this watershed plan. Candidate projects were (1) identified by reviewing maps of the watershed, (2) screened to identify an initial list of high-value projects, and (3) ranked to develop a list of projects that offer the best opportunities for implementation via avenues available to the county. This plan identifies projects in three tiers:

- **Tier 1 –** Projects with the highest priority scores that represent the best opportunities for the county's efforts, are located on public land, and were ranked using the Stormwater Management Division's framework for defining priorities in rough proportion to the relative amount of uncontrolled impervious surface within the subwatershed
- **Tier 2 –** Sites with slightly lower priority scores that represent projects on public land or sites on private lands, present good opportunities, and have received various levels of support from members of the Advisory Committee or the public at large
- **Tier 3 –** The rest of the approximately 650 sites identified during the initial map review and public involvement process

The following sections describe the site identification and prioritization process.

5.4.1 Identifying Candidate Projects

The first step in selecting projects was to identify the problem stream segments (i.e., those with degraded conditions determined by stream characterization, modeling results, and local knowledge). In this step, the integrated habitat score from the SPA was mapped and used to identify degraded segments. Additional maps were produced with scores for variables diagnostic of the problems of concern, such as bank instability and erosion. Detailed topographic and aerial maps were then reviewed for the specific cause of these problems, primarily upstream impervious surface (e.g., large parking lots). This process identified hundreds of degraded stream segments and their contributing causes.

The next step in selecting projects was to identify opportunities for addressing these widespread problems. Because stormwater contributes to many discrete problems in Cameron Run watershed, as well as to overall degradation, selecting projects required reviewing maps in detail to search for appropriate locations for the types of solutions planned: LID, new ponds, retrofits of existing ponds and small detention areas, and stream restoration. The key to this step was reviewing the topography and land cover near each stream to find (1) impervious areas in the headwaters of degraded streams and (2) available land (or infrastructure such as culverts) suitable for stormwater-control facilities and LID. Existing ponds were obvious opportunities for retrofits to increase stormwater detention or pollutant removal. Open public lands, such as parks, schools, and Chapter-2 roads, are most suitable for new stormwater facilities. Chapter-2 roads are county-owned rights-of-way that were never developed. In general, constructing new facilities on wooded land is not desirable. This process yielded 647 candidate projects (Figure 5-1).

5.4.2 Screening Projects for Feasibility

After defining candidates, projects were screened to identify those that the county would most likely be able to implement. Projects were grouped by land ownership, with publicly owned land in one group of sites, and privately owned land and area-wide/neighborhood projects in the second group. In most cases, the first group of sites presented the best opportunity for implementing projects and improving water quality and flow conditions expediently. Public ownership avoids costly land acquisition, allowing more resources to be directed toward actual improvements. Through the public involvement and review process, several sites from the second group were moved to the first group because of strong public support and substantial opportunity for improvement. Stream restoration sites were also included in the first group of sites. Stream restoration sites were identified using information about stream condition (e.g., erosion, exposed pipe, riparian buffer width) and stream stability (e.g., a CEM score of 4 [stabilizing] or 5 [stable]). This first group of most feasible sites contained 235 sites.

The remaining 412 projects in the second group (i.e., privately owned land) were not evaluated further and were assigned to Tier 3. Many of the projects in this group represent good opportunities for improving watershed conditions, but their location on private property raises major hurdles for implementation via avenues available to the county. Other avenues of implementation (e.g., non-profit groups, county-funded grant programs) may be more effective and efficient for working with volunteer landowners to implement Tier 3 projects.

5.4.3 Ranking Projects into Tiers

Additional analysis was conducted on the first group of sites to rank them according to the best opportunities for implementation via avenues available to the county, to help refine the conceptual restoration plan, and to estimate cost for each site.

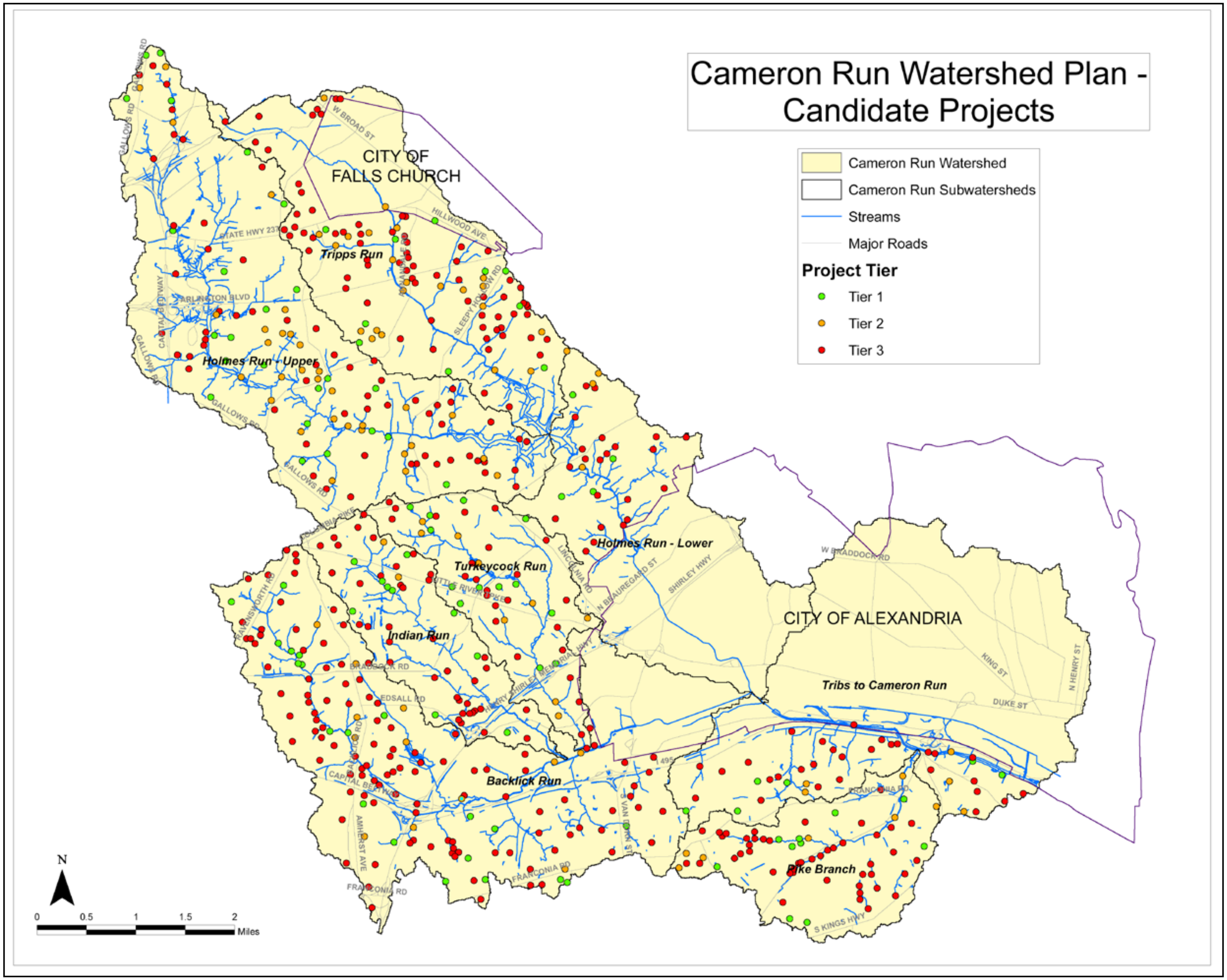


Figure 5-1. Candidate watershed restoration projects identified in Cameron Run

During the fall of 2005, Versar's field crews visited candidate project sites in Cameron Run watershed to visually assess and photograph opportunities for improving stormwater controls. Field crews observed drainage pathways, available space, uses of the site, land cover, and potential constraints (e.g., location of utilities, new buildings) that were not evident on maps and aerial photographs to develop site-specific restoration plans. Approximately 40 sites were found to be unsuitable and were dropped from further consideration. Data on drainage areas and appropriate solutions for specific locations were mapped in GIS for subsequent analysis and presentation.

Versar used guidance developed by Fairfax County's Stormwater Planning Division for the Pope's Head Creek Watershed Plan to rank candidate projects in tiers according to priority for implementation. The procedure scores candidate projects on a scale of 1 (worst) to 5 (best) for each of five criteria. The criteria are weighted to reflect their relative importance to the county. The weighted scores are summed to obtain a total score for each project; higher scores represent better opportunities. The criteria and their weights are as follows:

1. <u>Board-adopted Stormwater Control Project Prioritization Categories (40%)</u>
   - Projects that are mandated by state or federal regulations for immediate implementation and projects that address critical/emergency dam safety issues.
   - Projects that protect structures from damage by flood waters or from being undermined by severe erosion.
   - Projects that achieve stormwater quality improvement in specific conformance with the county's obligation under the Chesapeake Bay initiatives and/or the VPDES permit for storm-sewer discharges.
   - Projects that alleviate severe erosion of streambanks and channels.
   - Projects that alleviate moderate and minor erosion of streambanks and channels.
   - Projects that alleviate yard flooding.
   - Projects that alleviate road flooding.
2. <u>Direct Regulatory Contribution (10%)</u>
   - Hybrid projects that accomplish multiple objectives.
   - Projects that contribute directly to complying with the county's Municipal Stormwater Permit (MS4) and Virginia Tributary Strategies.
   - Projects that contribute to complying only with TMDLs.
   - Projects that have indirect water quality benefits.
   - Projects that mitigate flooding.
3. <u>Public Support (10%)</u>
   - Citizen's Advisory Committee support.
   - Support for projects by affected residents.

4. Effectiveness/Location (25%)
   - Quantity control projects are more desirable in "headwaters" areas that lack stormwater management controls.
   - Quality control projects are desirable in areas that previously lacked controls.
   - An indication of relative costs and benefits of a project, such as pollutant reduction or efficiency, increased retrofit area, etc.

5. Ease of Implementation (15%)
   - Simple projects will be easier to implement than more complex projects.
   - Projects that do not require purchasing land will be easier to implement.

To further define and help rank the candidate projects, Versar worked with the county's staff to perform a cost-benefit analysis to identify projects that would provide the most environmental benefit for the least cost. To accomplish this, costs were normalized per acre, and the following formula was applied:

$$\text{Cost-Benefit} = \frac{\text{Estimated Cost from Draft Report}}{\text{Drainage Area Treated}} \div \text{Total Score for SWPD Prioritization}$$

Because stream restoration projects cannot be considered to treat a particular drainage area, we replaced Drainage Area Treated in this formula with Project-site Footprint (acres), calculated from

$$\text{Project Site Footprint (acres)} = \text{Stream Project Length (feet)} \times 200 \text{ feet} \div 43{,}560 \text{ square feet/acre}$$

to determine the cost-benefit ratio for candidate restoration projects. The project-site footprint assumes that projects will improve conditions within a 100-foot buffer along both sides of the stream. Results from this analysis were ranked in ascending order by subwatershed, noting that a smaller cost-benefit ratio is more desirable than a higher ratio.

The top-ranked sites in each subwatershed became Tier 1. The remaining sites became Tier 2. The final allocation of sites in Tier 1 is as follows:

Watershed-wide	3
Tripps Run	10
Upper Holmes Run	24
Lower Holmes Run	4
Turkeycock Run	13
Indian Run	10
Backlick Run	20
Tributaries to Cameron Run	6
Pike Branch	10
	100

This project selection approach produced 100 Tier 1 projects, 92 Tier 2 projects, and 407 Tier 3 projects, totaling 599 projects in the Cameron Run Watershed Plan (Figure 5-1).

Chapter 6
Watershed Plan

The Cameron Run Watershed Plan is consistent with Fairfax County's Policy Plan (the county-wide element of the comprehensive plan). The Board of Supervisors' goal for environmental protection, as stated in the Policy Plan, reads

> "The amount and distribution of population density and land uses in Fairfax County should be consistent with environmental constraints inherent in the need to preserve natural resources to meet or exceed federal, state, and local standards for water quality, ambient air quality, and other environmental standards. Development in Fairfax County should be sensitive to the natural setting to prevent degradation of the county's natural environment."

The county policy document also notes that

> "The protection and restoration of the ecological quality of streams is important to the conservation of ecological resources in Fairfax County. Therefore, efforts to minimize adverse impacts of land use and development on the county's streams should be pursued."

This Cameron Run Watershed Plan is intended to complement and supplement the county's policies and comprehensive plans over the next 25 years and to support its commitment to the Clean Water Act and Virginia's commitment to the Chesapeake Bay Preservation Ordinance. The county and community members of the Cameron Run watershed are committed to protecting Cameron Run and its tributaries from future degradation by promoting management actions that work to restore streams and other areas throughout the watershed to an environmentally healthy ecosystem. This commitment emphasizes the importance of protecting the county's valuable natural resources, including surface waters, and supports the sustainability and improvement of the environment, which directly affects the quality of life of the county's residents.

Specifically, the Cameron Run Watershed Plan was written to manage changes in the watershed so it can be enjoyed by future generations. The plan also will help the county meet federal, state, and local regulatory water quality requirements. This chapter summarizes the Watershed Plan, providing the vision, goals and objectives, policy recommendations, project actions, implementation, and benefits.

6.1 VISION

The Project Team and Advisory Committee jointly developed the following vision to guide development and implementation of the plan:

> *A fishable, swimmable, and biologically diverse Cameron Run watershed that supports a safe and enjoyable environment for people and property*

6.2 GOALS AND OBJECTIVES

Drawing on knowledge of the ultimate causes and proximate stresses affecting the watershed, the Project Team and Advisory Committee developed the following goals and objectives that are consistent with the vision defined for Cameron Run:

Goal A: Reduce the effects of stormwater runoff from impervious areas to help restore and protect streams within the Cameron Run watershed

Objective A1: Increase the effectiveness of existing BMPs by improving maintenance or "retrofitting" them to further reduce the effects of impervious areas (altered flows and poor water quality).

Objective A2: Install new BMP and LID facilities in areas that do not have existing stormwater management controls.

Objective A3: Require (1) reduction of the rate and volume of runoff following the development of new commercial and residential sites to the minimum possible levels and (2) reduction of post-development runoff at redevelopment sites by targeted percentages from the pre-development rate and volume.

Objective A4: Increase the participation of residents in decreasing the amount of stormwater runoff from impervious surfaces in residential areas.

Objective A5: Reduce the effects of stormwater runoff from existing and proposed roadways by instituting new countywide watershed management requirements.

Goal B: Preserve, maintain, and improve watershed habitats to support appropriate native flora and fauna

Objective B1: Preserve, restore, and manage riparian buffers to benefit appropriate native flora and fauna (and reduce the effects of stormwater runoff).

Objective B2: Preserve, restore, and manage habitat in streams and on stream banks to benefit appropriate native flora and fauna (and water quality).

Objective B3: Preserve, restore, and manage wetlands to benefit appropriate native flora and fauna.

Goal C: Preserve, maintain, and improve water quality within streams to benefit humans and aquatic life

Objective C1: Reduce and mitigate the effects of bank erosion and sedimentation.

Objective C2: Reduce the amount of pollutants such as fecal coliform, phosphorous, and nitrogen in stormwater runoff.

Objective C3: Reduce the amount of trash and number of dumping sites in the watershed to help protect and improve the streams.

Goal D: Improve stream-based quality of life and environmentally friendly recreational opportunities for residents of and visitors to Cameron Run watershed

Objective D1: Create additional access and trails for stream-based recreational opportunities in the watershed.

Objective D2: Increase public awareness and appreciation of streams in the watershed.

The substance of the plan is the policy recommendations and project actions developed by the Project Team, Advisory Committee, and public to accomplish these goals and objectives. Implementation of new or revised policies will be undertaken by Fairfax County on a county-wide basis. Project actions include both government-sponsored and private structural or non-structural initiatives that would be implemented at specific locations. These policy recommendations and project actions are presented in separate sections below.

6.3 POLICY RECOMMENDATIONS FOR CAMERON RUN WATERSHED

Policy recommendations include proposals that would typically involve amendments of the county Code or other supporting documents such as the Public Facilities Manual. The current approach for processing policy recommendations from the Cameron Run Watershed Plan is to combine them with the recommendations that have been developed in the Little Hunting Creek, Popes Head Creek, Cub Run, and Difficult Run watershed plans for consideration by the appropriate county decision makers. It is expected that this separate process will consider policy recommendations in the context of legal and administrative constraints, and will result in more specific and more effective recommendations. This plan advocates that the county consider all policy recommendations from all the plans when deciding how to amend the County Code or other guidance.

Goal A: Reduce the effects of stormwater runoff from impervious areas to help restore and protect streams within the Cameron Run watershed.

Objective A1: Increase the effectiveness of existing BMPs by improving maintenance or "retrofitting" them to further reduce the effects of impervious areas (altered flows and poor water quality).

- *Policy Recommendation A1.1*: The county and the Virginia Department of Transportation (VDOT) should develop an inspection protocol; inspect BMPs, ditches, pipes, and outfalls within the watershed every five years;

and make repairs as necessary. Establish a hotline for citizens to report problems, and fund projects that address citizen-reported problems. Support legislation that provides incentives for VDOT to use LID techniques in its projects and replace grass with more native trees and vegetation along highways. Adopt the same policies for any county-owned roads.

- *Policy Recommendation A1.2:* Provide additional staff and resources to the county for review and inspection of privately owned and county-owned BMPs.

- *Policy Recommendation A1.3:* Increase the frequency of inspection for private BMPs with maintenance agreements from approximately once every three-to-five years to annually and provide education, including written materials, to owners to ensure proper maintenance.

- *Policy Recommendation A1.4:* Evaluate the county's current list of recommended BMPs (dated October 2, 2001) to determine their effectiveness based on current literature. Expand the list to include newer practices such as porous pavement, bioretention, and green rooftops. These practices are currently in use in the county and a number of LID practices have recently been incorporated into the Public Facilities Manual. The county will consider adoption of additional LID measures in the future. Adding them to the recommended list will make it easier for developers to include these in their site plans for review. Allow for the siting of integrated LID management practices on individual residential lots. Prepare materials to give to builders, remodelers, and developers to educate them about these LID practices and the county's preference for them. Adopt a policy preferring these practices where they are effective.

- *Policy Recommendation A1.5:* Retrofit and upgrade existing stormwater management facilities and BMPs, where feasible, to make them more effective in managing stormwater runoff. Construct new public BMPs including LID practices to detain the runoff from surrounding development that does not currently have stormwater management controls. Construct LID demonstration projects at publicly owned locations such as schools, parks, and other county properties.

- *Policy Recommendation A1.6:* Enact a new policy to more stringently require all land disturbance, remodeling, building, and redevelopment to retain on-site all runoff that would normally infiltrate (on natural landscapes), and prevent it from flowing onto adjacent properties, unless an exception is granted (e.g., property is next to a stream or natural area). Do not grant final residency permits until stormwater controls are properly installed and tested.

- *Policy Recommendation A1.7:* Fairfax County should not grant waivers of water quality controls for nonbonded lots exceeding 18% imperviousness. Nonbonded lots refer to existing lots (new construction, redevelopment, expansion, or renovation) that were created as part of an older development project for which the performance bond has been released.

- *Policy Recommendation A1.8:* Increase fines for noncompliance with BMP or LID requirements.

- *Policy Recommendation A1.9:* Coordinate county stormwater management activities with those of neighboring jurisdictions and review this coordination annually.

Objective A2: Install new BMP and LID facilities in areas that do not have existing stormwater management controls.

- *Policy Recommendation A2.1:* Encourage approval of LID facilities as acceptable stormwater management and adopt a policy preferring LID projects where they are effective.

Objective A3: Require development of new commercial and residential sites to reduce the post-development rate and volume of runoff to the minimum possible levels, and redevelopment sites to reduce the post-development runoff by targeted percentages from the pre-development rate and volume.

- *Policy Recommendation A3.1:* Amend the Fairfax County Erosion and Sedimentation Control Ordinance, Chesapeake Bay Preservation Ordinance, and other applicable ordinances to require that commercial and residential redevelopment of sites demonstrate a 10% net decrease in runoff if possible. Adopt graduated incentives for projects that exceed the 10% minimum, and do not allow residency permits until the site owners demonstrate that this has been achieved.

- *Policy Recommendation A3.2:* Amend zoning regulations or plans to encourage better design of new development (both public and private) to reduce or eliminate post-development runoff.

- *Policy Recommendation A3.3:* Consider providing incentives for developers, redevelopers, builders, and remodelers to reduce runoff, through zoning incentives or an expedited review process for developers who include conservation design techniques and LID components in their site plans.

- *Policy Recommendation A3.4:* Limit removal of mature trees and native vegetation in any new development, redevelopment, or renovation of commercial and residential sites by making associated permits contingent on landscape requirements directed by the county.

- *Policy Recommendation A3.5:* Conduct frequent inspections during the building process to ensure compliance with permit conditions pertaining to landscaping requirements and adequate prevention of stormwater runoff. Rigorous fines and Stop Work Orders should be employed for noncompliance.

- *Policy Recommendation A3.6:* Allocate sufficient dedicated funding to adequately staff, educate, and otherwise support county inspection and enforcement related to preventing the removal of native mature trees and landscape or requiring restorative landscaping in accordance with permits.

Objective A4: Increase the participation of residents in decreasing the amount of stormwater runoff from impervious surfaces in residential areas.

- *Policy Recommendation A4.1:* Facilitate, through technical assistance, financial support, and other incentives, the construction and use of LID practices such as rain gardens, cisterns, and rain barrels throughout the watershed, initially targeting areas near the headwaters of streams to detain the runoff from developments that do not have stormwater management controls. The county should investigate mini grants, county tax abatements, or county property tax credits to facilitate implementation of LID practices.

- *Policy Recommendation A4.2:* Involve the public early in the planning of watershed projects and maintain transparency between the county and the public throughout the process. Improve coordination with and early notification of affected residents at both the study and implementation stages of proposed stormwater projects and notify affected civic associations.

Objective A5: Reduce the effects of stormwater runoff from existing and proposed roadways by instituting new countywide watershed management requirements.

- *Policy Recommendation A5.1:* In coordination with VDOT, require that road widening projects be designed to control the runoff from existing paved areas that do not have stormwater management controls and reduce the existing peak runoff rate by a minimum of 5%.

- *Policy Recommendation A5.2:* In coordination with VDOT, replace grasses on medians and sides of roadway with native trees and vegetation where possible.

Goal B: Preserve, maintain, and improve watershed habitats to support appropriate native flora and fauna.

Objective B1: P Preserve, restore, and manage riparian buffers to benefit appropriate native flora and fauna (and reduce the effects of stormwater runoff).

- *Policy Recommendation B1.1:* Plant buffers using native vegetation and trees adjacent to the stream in areas identified as good candidates for riparian buffer restoration. Monitor the condition of restored and existing riparian buffers for at least five years with annual stream walks to evaluate the condition and identify areas needing improvement.

- *Policy Recommendation B1.2:* Provide additional staff and dedicated funding to the county to ensure protection of riparian buffers and adequate review of waivers under the Chesapeake Bay RPA Ordinance. Ensure that county personnel are adequately trained with respect to the requirements of the RPA Ordinance and encourage strict enforcement of such requirements. Grant waivers very judiciously.

- *Policy Recommendation B1.3:* Require restoration of vegetation in the riparian buffer for development or redevelopment sites within the RPA that do not have existing buffer vegetation. Native vegetation mixes, suitable for local habitats, should be mandated in a BMP document identifying specific plants and trees that meet this definition.

- *Policy Recommendation B1.4:* Provide educational and technical assistance, including written materials, to owners of property with tidal shoreline and land adjacent to streams to help them manage existing buffers, including information about Virginia's wetlands' laws and the county's permitting process. Technical and educational assistance may include information about the benefits of riparian buffers, the value of native vegetation, identification and removal of invasive species, and healthy pruning.

- *Policy Recommendation B1.5:* Amend the county's tree cover policy to expand existing woodland habitat and prevent further deforestation. Conduct an inventory of significant native trees in the county. Strengthen the requirements of building permits and site plans to preserve native trees, encourage the planting of native trees, and protect trees with good construction practices. Require the planting of native trees and vegetation on all commercial properties where appropriate.

- *Policy Recommendation B1.6:* Determine the current level of mature tree canopy coverage existing in each subwatershed. Establish a reforestation goal, ensuring new native tree planting throughout each subwatershed to increase its canopy coverage by a minimum of 5% in five years. New reforestation targets should be adopted every five to seven years.

Objective B2: Preserve, restore, and manage habitat in streams and on stream banks to benefit appropriate native flora and fauna (and water quality).

- *Policy Recommendation B2.1:* Monitor and report on the condition of streams by performing a stream physical assessment every five years to track the improvement or degradation of streams from the baseline condition.

- *Policy Recommendation B2.2:* Facilitate the acquisition by and donation of conservation easements to community groups and land trust organizations for protection of streams and riparian buffers, as well as provision of public/private open space, for the environmental quality corridors described in the Fairfax County Comprehensive Plan and not adequately protected through the zoning process.

- *Policy Recommendation B2.3:* Adopt a county policy of implementing natural and water conserving landscaping approaches at all of its facilities in the watershed, implementing these beneficial watershed management approaches as models for future development.

- *Policy Recommendation B2.4:* Notify property owners of steps they could take to improve water quality in their streams (e.g., by providing information on reducing chemicals and fertilizers on lawns, using native plants, and performing natural landscaping).

Objective B3: Preserve, restore, and manage wetlands to benefit appropriate native flora and fauna.

- *Policy Recommendation B3.1:* Perform a wetlands functions-and-values survey to identify the location, size, owner, type, and quality of existing wetlands in the watershed to determine the baseline information.

- *Policy Recommendation B3.2:* Working with local communities, construct and restore wetlands at suitable locations in the watershed as identified by the wetlands functions-and-values survey.

- *Policy Recommendation B3.3:* Purchase private land, designate public land, or acquire easements for land conservation of critical wetland habitat areas as identified in the wetlands functions-and-values survey.

- *Policy Recommendation B3.4:* Create and distribute outreach materials that inform the public about the value and benefit of wetlands, the permits required for activities in wetlands, and the Wetlands Board's preference for LID techniques and "living shorelines."

- *Policy Recommendation B3.5:* Strengthen county policy and ordinances, in the event that impacts to wetlands are unavoidable, to require mitigation such as buying into a wetlands bank or creating compensatory wetlands. Wetland banks used for mitigation should be approved by state and federal regulatory agencies.

Goal C: Preserve, maintain, and improve water quality within streams to benefit humans and aquatic life.

Objective C1: Reduce and mitigate the effects of bank erosion and sedimentation.

- *Policy Recommendation C1.1:* Provide additional staff and resources to the county to inspect development projects and apply necessary penalties to ensure compliance with land disturbance prohibitions (and applicable erosion and sediment requirements) under the Chesapeake Bay Preservation Ordinance. Impose fines on persons or companies not complying with the requirements, and require restoration of the sites. Strengthen the current erosion and sediment control laws, policies, and regulations (e.g., Chapter 104 of the Fairfax County Code) to provide the penalties and restoration requirements described above."

- *Policy Recommendation C1.2:* Encourage application of bioengineering and natural stream channel design approaches to stabilize streambanks and improve stream habitat conditions.

- *Policy Recommendation C1.3:* Reduce the amount of county-applied de-icing materials such as sand and/or chemicals entering surface waters of the watershed, and require that excess de-icing materials be swept up in a timely manner to prevent them from reaching surface waters and causing sedimentation or impacting water quality. Limit the use of de-icing materials that impair water quality and recommend products and practices that will be specified in the county review and update of BMPs. Coordinate with VDOT to achieve the above goals on state roadways within the county.

Objective C2: Reduce the amount of pollutants such as fecal coliform, phosphorous, and nitrogen in stormwater runoff.

- *Policy Recommendation C2.1:* Identify sources of fecal coliform in the watershed (i.e., from humans, domesticated animals, or wildlife) and prepare an action plan to reduce the amount of fecal coliform.

- *Policy Recommendation C2.2:* Perform additional water quality monitoring that includes a macroinvertebrate and aquatic plant survey of Cameron Run and its tributaries, and report the results to the public. Prepare an action plan based on the results.

- *Policy Recommendation C2.3:* Identify and investigate illicit discharges in the watershed from commercial and residential activities such as car repair and painting. Take enforcement actions to stop such illicit discharges.

- *Policy Recommendation C2.4:* Educate the public on ways to reduce the amount of pollutants in stormwater runoff. This can include, but is not limited to, storm drain stenciling, providing 'doggie mitts' in public parks, brochures, advertising, and working with community groups. Provide materials on natural landscaping, using native plants, and reducing use of chemicals and fertilizers.

- *Policy Recommendation C2.5:* Encourage all lawn management companies to participate in the Virginia Water Quality Improvement Program, and sign agreements requiring them to apply nutrients within established criteria to better control application rates and timing, thus creating a "green label" for lawn and landscaping companies. Provide a list of these companies to residential and commercial property owners and homeowners associations. Use only those companies on county-owned properties.

- *Policy Recommendation C2.6:* Strengthen enforcement of the "pooper scooper" regulation by instituting a $100 fine for violators.

Objective C3: Reduce the amount of trash and number of dumping sites in the watershed to help protect and improve the streams.

- *Policy Recommendation C3.1:* Work with community groups to clean up trash, woody debris that impedes stream flow, and dumpsites throughout the watershed.

- *Policy Recommendation C3.2:* Conduct a vigorous public information campaign, including installing signs throughout the watershed and coordinating with community groups, to deter littering and the dumping of trash.

- *Policy Recommendation C3.3:* Place containers at all public and other high-traffic facilities that have openings for recycling paper, glass, and aluminum with signs requesting sorting of trash and stating fines for littering.

- *Policy Recommendation C3.4:* Enforce the solid waste ordinance and the erosion and sedimentation control ordinance prohibitions against illegal dumping. Target locations experiencing frequent dumpings of trash and identify private, potentially illegal dumpsites located in the watershed. Impose fines on persons caught dumping illegally, take legal action against the property owners who create or knowingly allow illegal dumpsites, and require restoration of the sites. Consider fencing or lighting on chronic dumping sites on both public and private land, where they would not cause adverse environmental impacts.

Goal D: Improve stream-based quality of life and environmentally friendly recreational opportunities for residents of and visitors to Cameron Run watershed.

Objective D1: Create additional access and trails for stream-based recreational opportunities in the watershed.

- *Policy Recommendation D1.1:* Identify stream corridors for purchase or acquisition of easements for public access and environmentally friendly recreation.

- *Policy Recommendation D1.2:* Develop a master plan for increased environmentally friendly recreational opportunities along the Cameron Run mainstem and major tributaries.

Objective D2: Increase public awareness and appreciation of streams in the watershed.

- *Policy Recommendation D2.1:* Post signage that publicizes the existence of RPAs and their importance for stream protection and environmentally sensitive recreation.

- *Policy Recommendation D2.2:* Install signage at public facilities to explain the reasons and benefits of rain gardens, green roofs, porous pavement, increased mature tree canopy coverage, and other LID features. Include this information in mailings to park users. Identify sources for interested citizens to obtain more information about these types of BMPs.

- *Policy Recommendation D2.3:* Evaluate, through a literature review or formal study, the effectiveness of public education programs for watershed stewardship. This could result in an addendum to this plan that identifies mechanisms for reaching watershed residents (e.g., through public and private schools, clubs, civic groups, service organizations, foreign-language communities). This addendum would also include the best methods for changing individual behaviors for better watershed stewardship. It would also include methods for monitoring the effectiveness of these methods, and adapting public education programs for success.

6.4 PROJECT ACTIONS

The proposed project actions for the Cameron Run Watershed Plan are based on analysis done by the Project Team with contributions from the Advisory Committee and the public. The actions were selected to help meet the goals and objectives stated above. Specifically, these projects will address the following objectives:

> **Objective A1:** Increase the effectiveness of existing BMPs by improving maintenance or "retrofitting" them to further reduce the effects of impervious areas (altered flows and poor water quality).
>
> **Objective A2:** Install new BMP and LID facilities in areas that do not have existing stormwater management controls.
>
> **Objective A4:** Increase the participation of residents in decreasing the amount of stormwater runoff from impervious surfaces in residential areas.
>
> **Objective B1:** Preserve, restore, and manage riparian buffers to benefit appropriate native flora and fauna (and reduce the effects of stormwater runoff).
>
> **Objective B2:** Preserve, restore, and manage habitat in streams and on stream banks to benefit appropriate native flora and fauna (and water quality).
>
> **Objective C1:** Reduce and mitigate the effects of bank erosion and sedimentation.
>
> **Objective C2:** Reduce the amount of pollutants such as fecal coliform, phosphorous, and nitrogen in stormwater runoff.

These actions may be structural or nonstructural projects of the following types:

- Projects initiated by the county via the Capital Improvement Program
- Projects initiated by developers via the Zoning Approval Process (proffers and development conditions) or waiver approval process
- Projects implemented by volunteer groups

The projects recommended in the plan fall into the following four categories:

- **Low impact development –** LID approaches are innovative practices designed to mimic natural flows by reducing the volume of stormwater runoff at the source, not just by managing flows as they leave a site. Distributed LID features are a series of smaller landscape features that function as retention/detention areas integrated with developed areas. These features are designed and constructed to detain and treat stormwater through natural processes such as infiltration, soil storage, and uptake by vegetation. Special attention should be paid to the composition of existing soils, as well as new soils or amended soils used. These solutions are increasingly being used to reduce the adverse environmental effects of stormwater and other urban stressors in developed areas (in addition to being incorporated into new development).

- **New storm water management ponds** – Placing new stormwater management (SWM) ponds, including small extended detention dry ponds, at locations that currently have no stormwater quantity or quality controls.
- **SWM retrofits** – Modifying existing SWM ponds to provide additional quantity or quality controls.
- **Stream restoration –** Modifying stream channels, banks, and instream habitat to improve degraded and unstable conditions.

As discussed in Chapter 5, the projects were separated into the following three groups to help prioritize the approximately 650 opportunities for watershed improvements identified during this study:

- **Tier 1 –** Projects that represent the best opportunities for the county's efforts because they are located on public lands and were selected using SWMD's prioritization framework and in rough proportion to the amount of uncontrolled impervious surface within the subwatershed.
- **Tier 2 –** Sites representing lower-priority projects on public land, or sites on private lands that present good opportunities and have received various levels of support from Advisory Committee members or the general public.
- **Tier 3 –** The remainder of the approximately 650 sites identified during the initial map review and public involvement process.

The remainder of the plan focuses on the Tier 1 projects because they represent the best opportunities for the county to implement watershed improvements (Figure 6-1). The Tier 2 and Tier 3 sites present additional good opportunities, particularly if projects at these sites could be implemented through the development review process or other means; maps of these sites and tables containing descriptive information are included in Appendix A.2 and Appendix A.3.

In addition, the drainage complaints filed with the Fairfax County Maintenance and Stormwater Management Division were used to develop a supplemental list of projects that addressed drainage-related problems (see Section 6.4.7). Project fact sheets containing recommended actions for the 25 selected drainage complaint projects are included in Appendix A-4.

Table 6-1 shows a breakdown of all projects by project type and tier.

Table 6-1. The number of projects for each project type and tier

Project Type	Tier 1	Tier 2	Tier 3	Total
Non-structural projects and special studies	3	-	21	24
LID	77	54	306	437
New SWM pond	1	1	-	2
SWM pond retrofit	15	5	78	98
Stream restoration	4	32	2	38
Drainage Complaint Projects	25	-	-	25
Total	125	92	407	624

Implementing watershed improvement projects offers an opportunity to educate the surrounding community. To take advantage of this opportunity, the county should consider including an educational component (e.g., interpretive signs, brochures, public meetings, etc.) for each project that is implemented.

The sections that follow describe the various kinds of projects and include tables that list the specific project actions. More detailed information on projects is provided in Appendix A. Project fact sheets for the Tier 1 projects and the Drainage Complaint Projects are located in Appendix A-1 and Appendix A-4, respectively. Information on the Tier 2 and Tier 3 projects are provided in Appendix A-2 and Appendix A-3.

Implementation costs stated in the plan are order-of-magnitude estimates. Structural and non-structural projects will typically require additional design work, possible land rights acquisition, agreements, or other coordination during the implementation phase. It is assumed that the county will hire contractors to execute individual projects. The use of volunteer labor on appropriate projects will reduce costs. As the projects are evaluated further, more detailed cost estimates will be possible. In addition, site conditions may change over time as a result of maintenance, site improvements, natural processes, or other factors, and these changes may require modifying the proposed action at the time of implementation.

The projects for the plan are identified using the county's 6-digit numbering convention (XX9YZZ), where

XX9 = Watershed Code = CA9

Y = 1 for new SWM ponds or SWM retrofits
2 for stream restoration or stabilization projects
6 for flood control projects
7 for nonstructural projects and special studies throughout the watershed
8 and 9 for LID projects

ZZ = Digits representing locations in the watershed starting with 00 indicating the most downstream point in the watershed through 99 indicating the most upstream point.

6.4.1 Nonstructural Projects and Special Studies

Several nonstructural projects have been identified to address widespread issues and opportunities throughout the Cameron Run watershed (Table 6-2). Two of these projects provide educational and funding mechanisms to promote greater community support and participation in watershed improvements annually over the 25-year life of the plan.

6.4.2 Low Impact Development

LID includes the use of innovative practices designed to mimic natural flows by reducing the volume of stormwater runoff at the source. Usually these practices are integrated to fit specific site needs. In this plan, LID projects may include any combination of the practices listed and

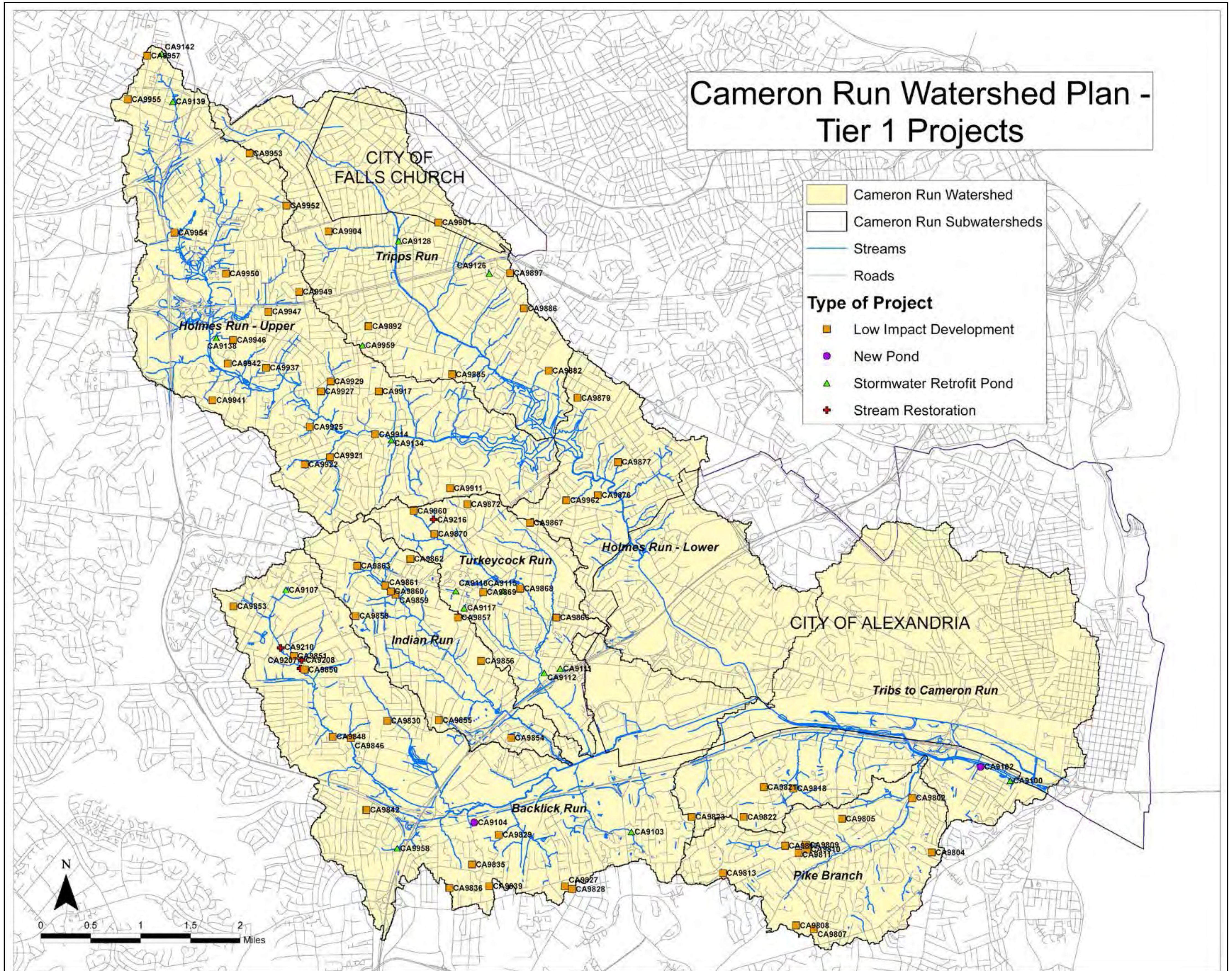


Figure 6-1. Location of Tier 1 candidate watershed restoration projects

Table 6-2. Nonstructural projects and special studies

Project ID	Project Name	Subwatershed	Proposed Action	Benefit	Estimated Cost
CA9700	Debris Jam Removal	Watershed-wide	Locate, evaluate, and remove debris jams observed to cause excessive erosion.	Improve stream stability, erosion, and instream habitat. Prevent property and structural loss. Reduce road flooding. Opportunity for public education.	$286,000
CA9701	Community Watershed Restoration Support	Watershed-wide	Provide education and technical assistance to encourage restoration practices on private property. Explain the need for restoration and describe effective techniques. Distribute "how to" information on creating rain gardens, backyard riparian buffers, and other LID projects. Provide technical assistance with individual LID projects.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Opportunity for public education.	$1,407,000 (over 25 years)
CA9702	Small Watershed Grant Program	Watershed-wide	Establish and administer an annual program that provides small grants to local organizations, residents, and businesses to facilitate education, capacity building, small retrofit and restoration projects, and monitoring activities. For example, grants could be used to off-set the costs to purchase and install rain barrels or other LID projects on private property via a coupon program or other sales mechanism, to cover staff time for a watershed organization, or to provide field equipment for a volunteer watershed monitoring program.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$1,094,000 (over 25 years)

described in more detail below. LID projects have the best potential to control diffuse stormwater problems and restore natural hydrology throughout the watershed. They make up the majority of projects included in the plan.

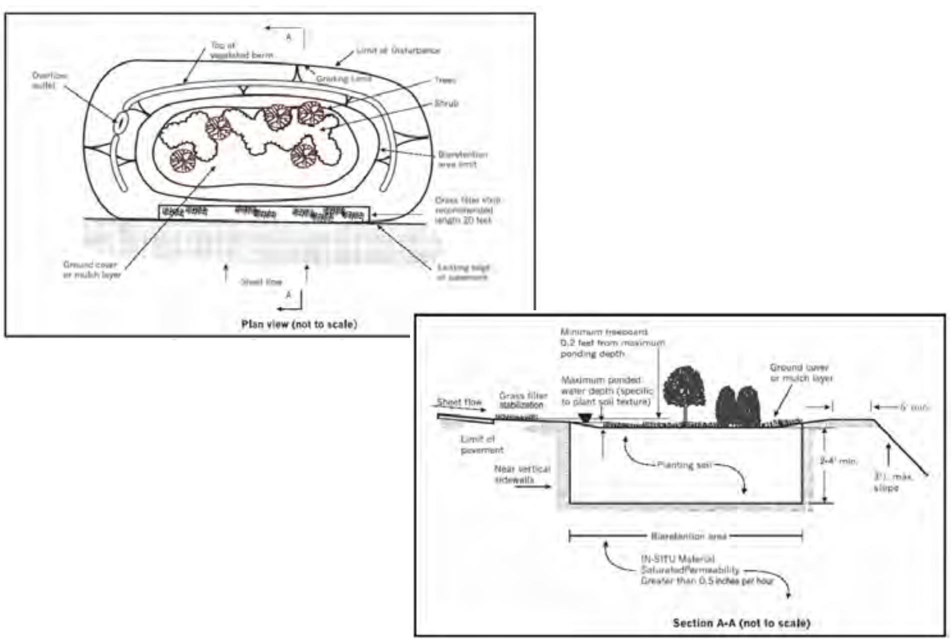
The following sections provide general descriptions of common LID techniques:

- bioretention areas (rain gardens)
- pipe outfall retrofits (off-line bioretention)
- infiltration trenches
- grassed swales
- tree box filters
- rain barrels/cisterns
- permeable pavers

6.4.2.1 Bioretention Area ("Rain Garden")

Description: A bioretention area is a shallow depression designed to detain and treat stormwater runoff from small, frequent storms by using a conditioned planting soil bed and planting materials (AMEC 2005). Pollutants are adsorbed by the soil and plant material, improving water quality. Water slowly infiltrates through the soil bed to recharge ground-water or is used by the plants via transpiration. In some cases, an underdrain system can be installed to carry treated water draining through the system to an existing stormdrain network.

Maintenance: Inspect the treatment area's components and repair or replace as necessary. This area is akin to a landscape feature in general maintenance needs, such as removal of accumulated sediment and debris, replacement of dead or stressed plants, and annual mulching (or as necessary). These facilities have an expected life span of 25 years.

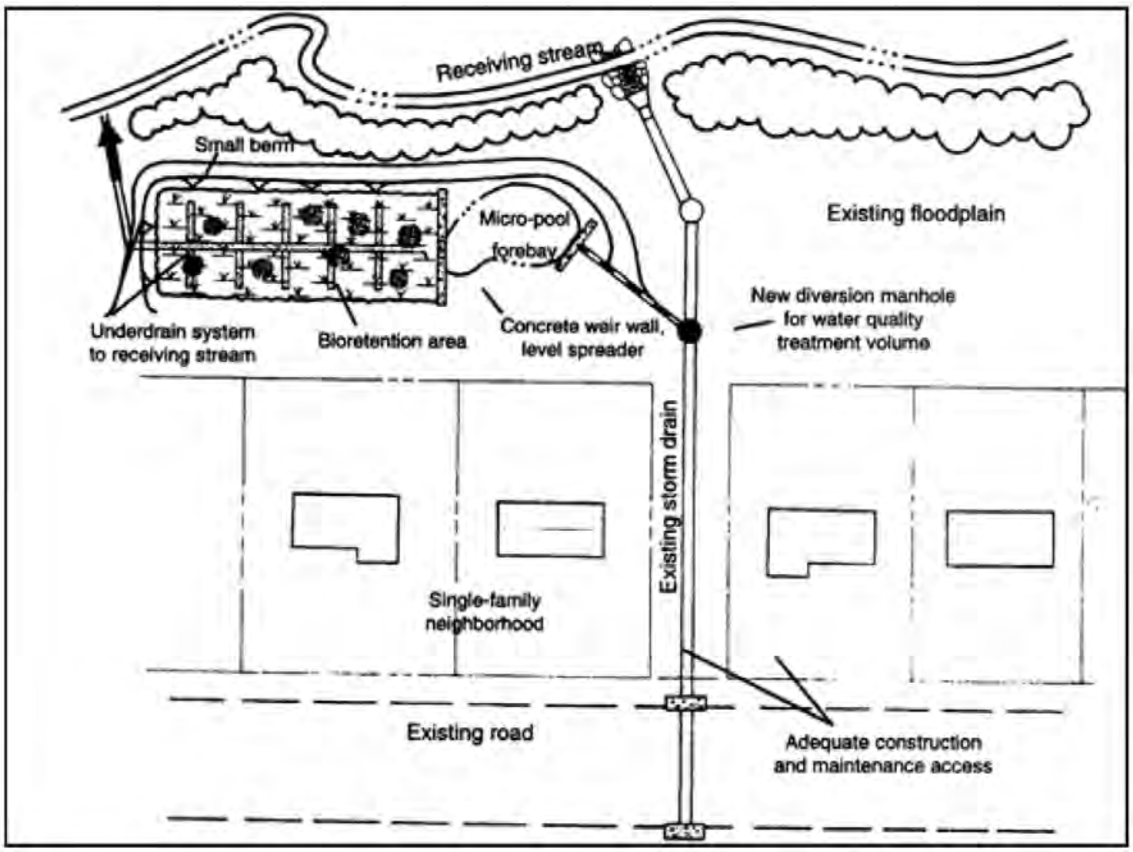


Bioretention Area (Source: Prince George's County 1999)

6.4.2.2 Pipe Outfall Retrofits (Off-line Bioretention)

Description: This retrofit option is installed immediately downstream of a stormwater drainage pipe outfall. Flow splitters can be used to convey water to a sand filter, bioretention area, off-line wetland, or wet pond for water quality treatment, while larger storms that exceed the treatment capacity are allowed to bypass the retrofit (AMEC 2005).

Maintenance: Inspect the treatment area's components and repair or replace as necessary. This area is akin to a landscape feature in general maintenance needs, such as removal of accumulated sediment and debris, replacement of dead or stressed plants, and annual mulching (or as necessary). An observation well can be used to make sure the underdrain is not clogged and is working properly. These facilities have an expected life span of 25 years.

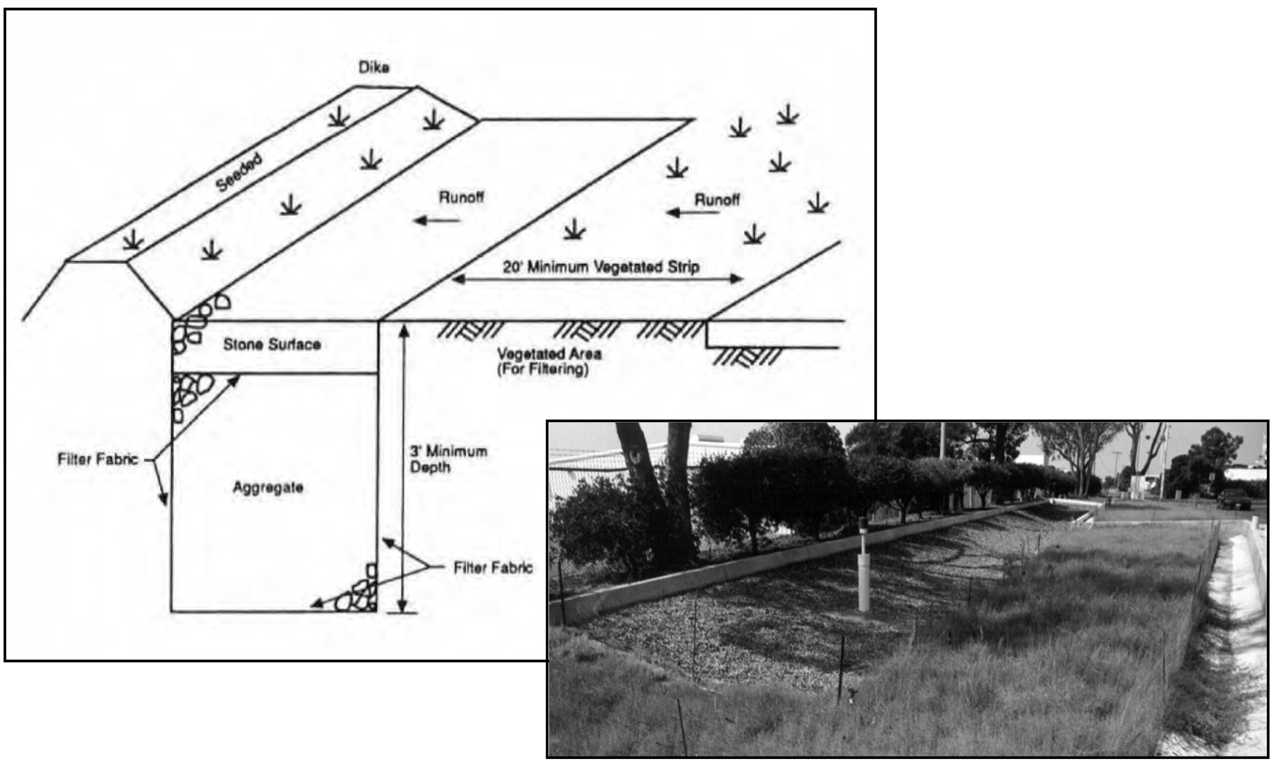


Pipe Outfall Retrofit (Source: Schueler et al. 2000)

6.4.2.3 Infiltration Trench

Description: An infiltration trench is an excavated trench that has been backfilled with stone to form a subsurface basin. Stormwater runoff is diverted into the trench and is stored until it can be infiltrated into the soil, usually over a period of several days. These structures are ideal for small urban drainage areas and have a longer life cycle when some form of pretreatment to remove sediment, such as a grass swale, is included in the design. Infiltration trenches can be installed in areas adjacent to parking lots, roads, and other impermeable surfaces to capture runoff (AMEC 2005).

Maintenance: Prevent sediments and debris from accumulating on the drained area, which could enter and clog the trench. Sediment and debris could be removed by routinely sweeping or by installing a grass filter strip or other pretreatment BMP. Maintenance of the pretreatment BMP is very important to prevent clogging. Filter strip maintenance consists of reseeding any eroded areas and periodically mowing to a height equal to or greater than the design flow height. These trenches have an expected life span of 10 years.

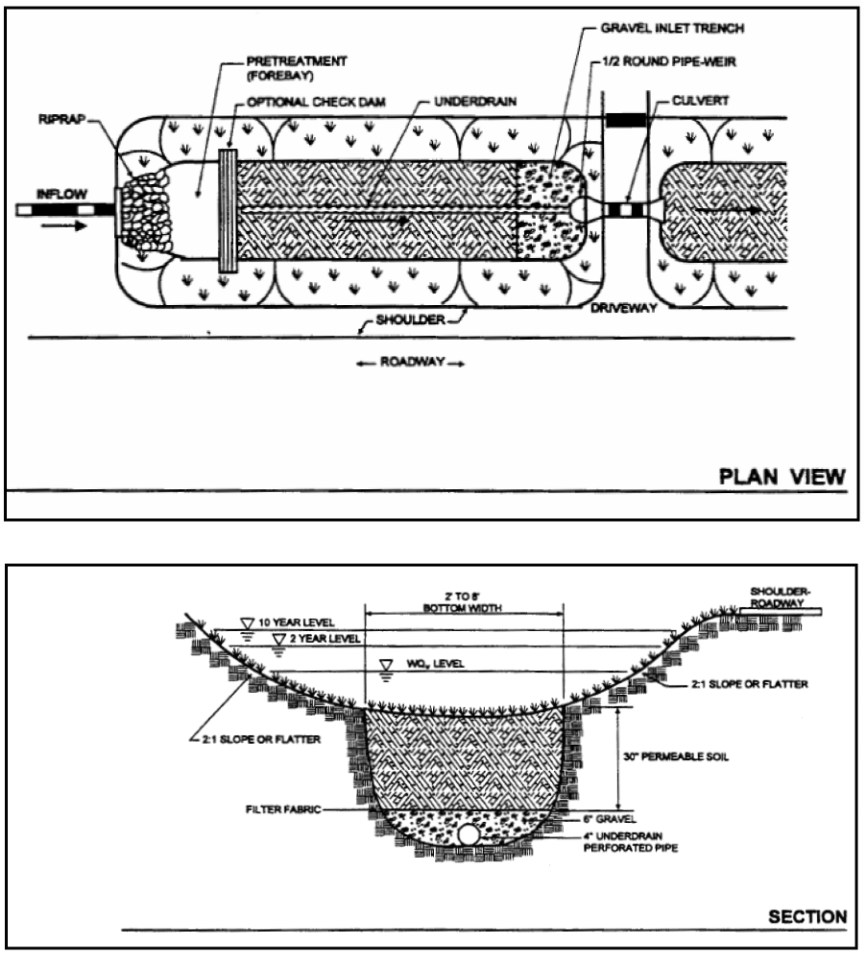


Infiltration Trench (Source: American Groundwater Trust and California Stormwater Quality Association in MAPC Undated)

6.4.2.4 Grassed Swale

Description: Grassed swales control both the quantity and quality of water. Stormwater travels more slowly in a grass swale than it does in a concrete ditch, reducing runoff volume and downstream erosion (AMEC 2005). Stormwater also infiltrates into the soil, further reducing volume and removing pollutants.

Maintenance: Maintain a dense, healthy grass cover through periodic mowing, keeping grass height at or above the design flow depth. In addition, weeding, watering, reseeding of bare areas, and clearing of debris and blockages may be necessary. Swales should be inspected periodically, especially after significant rain storms to correct sediment buildup and erosion. If sediment accumulates, sediments should be removed manually rather than with heavy machinery, which tends to reshape the swale and concentrate erosive flows. Fertilizers and pesticides should be avoided or used only when the grass cover is diseased or dying. Compaction of the swale, from parking cars and other uses, should also be avoided. Swales have an expected life span of 25 years.

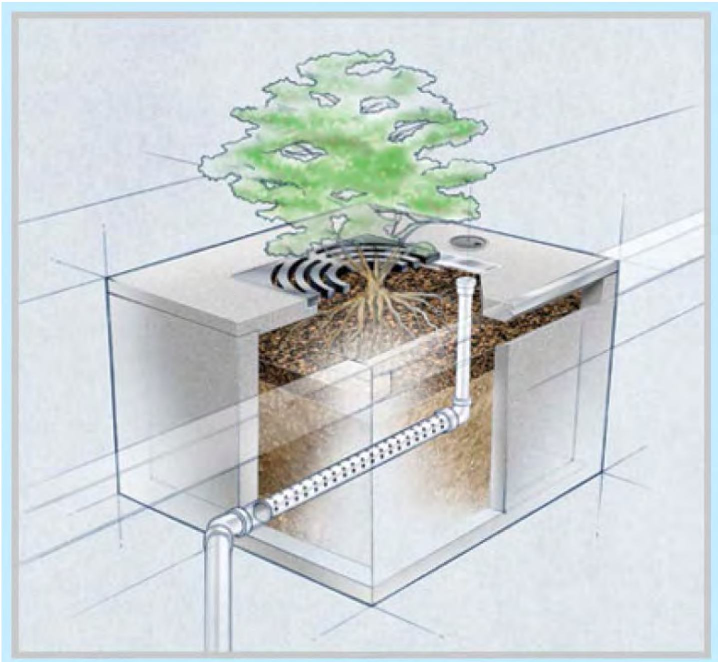


Grassed Swale (Source: Prince George's County 1999)

6.4.2.5 Tree Box Filter

Description: Tree box filters, such as the Filterra® Stormwater Bioretention Filtration System (or a comparable alternative), allow stormwater to flow through a specially designed filter mixture contained in a landscaped concrete container (AMEC 2005). These devices are typically used to retrofit traditional storm drain inlets with a bioretention function. The filter mixture inside the device immobilizes pollutants. Those pollutants are then decomposed, volatilized, and incorporated into the biomass of the unit. Stormwater runoff flows through the media and into an underdrain system at the bottom of the container, where the treated water is discharged to the stormdrain network.

Maintenance: Remove debris and sediment, replace dead or stressed plants, and mulch as necessary. Most manufactured LID devices come with an observation well that is used to make sure the underdrain is not clogged and is working properly. If the system becomes clogged, the filter mixture is replaced. Most manufacturers specify maintenance guidelines to maintain performance level. Manufactured LID devices have an expected life span of 25 years.

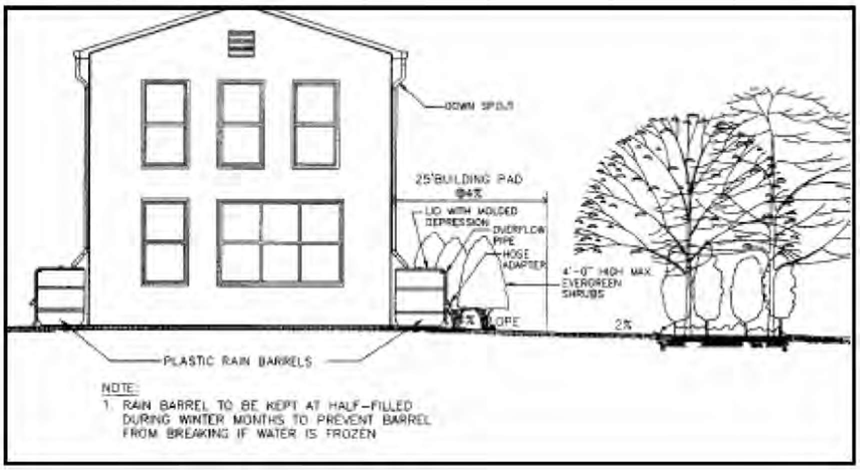


Schematic of a tree box filter in a storm drain inlet and recently installed filter at Providence RECenter (Sources: filterra.com; photo by P. Emerson, Versar, Inc.)

6.4.2.6 Rain Barrels/Cisterns

Description: 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 downspouts to retain rooftop runoff. Rain barrels can be used to store runoff for later use in lawn and garden watering (AMEC 2005). Cisterns are larger rainwater storage containers placed either above or below ground. The water they capture is suitable for nonpotable uses.

Maintenance: Rain barrels and cisterns require very little maintenance. The container and attachments should be inspected for clogging several times a year and after significant storms. Minor parts, including spigots, screens, filters, downspouts, or leaders, may require replacement. Rain barrels and cisterns have an expected life span of 25 years.

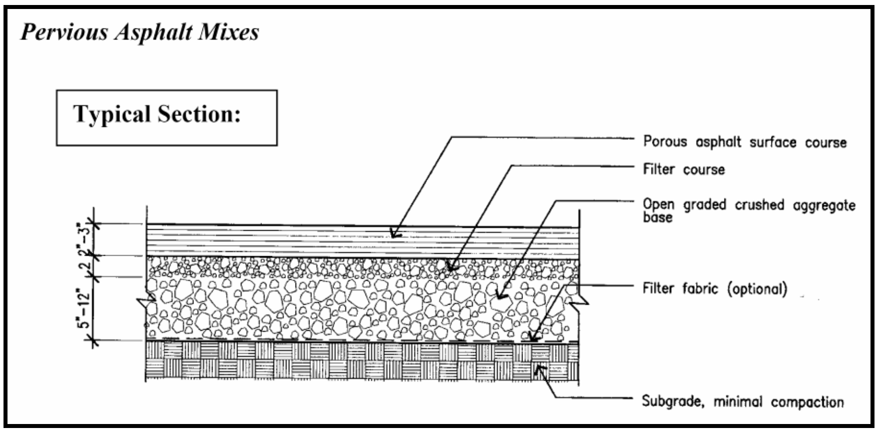


Rain barrel & above-ground cistern (Sources: Prince George's County 1999; www.aridsolutions.com; and www.plastmo.com)

6.4.2.7 Permeable Pavers

Description: Advances in paving technology have provided a variety of paving materials that allow water to move through the pavement section and into the subgrade and underlying soil. Three main types of permeable pavers are interlocking block systems, porous asphalt, and porous concrete. Each paving system is laid down on a specially constructed bed that allows downward and lateral transmission of water to provide a well-drained subgrade. Although such pavers have been used in high traffic and weight-load situations, they are ideal for lower-volume areas such as parking spaces, overflow parking lots, playing surfaces, and footpaths.

Maintenance: Permeable paving systems require periodic vacuum sweeping to keep the pore spaces clear of debris and infiltrating properly. Porous asphalt can be ground and resurfaced as needed, similar to traditional asphalt pavement, to keep the surface free of blemishes.



Permeable pavers – asphalt, concrete, and block (Source: City of Portland 2003)

Specific LID projects in the Cameron Run watershed are shown in Table 6-3.

Table 6-3. Low impact development projects included in the plan

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9802	Jefferson Manor Park Bioretention	Pike Branch	Construct bioretention area below parking lot and detention micro-berm along edge of baseball field.	Provide stormwater quantity controls. Provide stormwater quality controls.	$73,000
CA9804	Mount Eagle Elementary School LID	Pike Branch	Construct bioretention areas in traffic island, at parking lot margins, SW corner of trailers, and SW corner of property; direct roof drains to bioretention areas; install infiltration trench along W side of new parking lot.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$210,000
CA9805	Wilton Administration Center LID	Pike Branch	Construct bioretention areas in traffic islands along front and side parking lot, at inlet on south side of school, and at storm drain outlet on west side; install infiltration trenches and porous pavement in parking lots and asphalt court. This facility may be renovated within the next five years, and these proposed retrofits, or similar stormwater improvements, should be incorporated into the renovation plans.	Provide stormwater quality controls. Improve stormwater quantity controls. Opportunity for public education.	$460,000
CA9807	Virginia Hills Administration Center (School) LID	Pike Branch	Construct linear bioretention areas along outside of bus loop and along rear parking lot; direct roof drains at front wing to bioretention areas; install infiltration trench in NW corner of bus parking area. This facility may be renovated within the next five years, and these proposed retrofits, or similar stormwater improvements, should be incorporated into the renovation plans.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$352,000
CA9808	Lee District Park LID	Pike Branch	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality; construct bioretention areas along N parking lot, in south central swale, and in parking lot islands/road margins; install infiltration trench in tennis court parking lot and porous pavement in E parking lot; convert athletic fields to artificial turf; add tree cover throughout. Note that athletic fields are scheduled for conversion to artificial turf in 2008. Facility maintenance and renovation is an on-going process, and proposed retrofits, or similar stormwater improvements, should be incorporated into site improvement plans.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Improve community usage. Opportunity for public education.	$1,589,000
CA9809	Ridgeview Park LID - A	Pike Branch	Construct off-line bioretention in existing swale; plant meadow in lawn areas that extend into park/ROW; build detention micro-berm parallel to ROW in meadow areas; use integrated vegetation management practices to encourage shrub/low growing trees beneath power lines.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$59,000

Table 6-3. (Continued)

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9810	Ridgeview Park LID - B	Pike Branch	Install off-line bioretention areas to intercept flow before reaching stormwater outfall.	Provide stormwater quality controls. Improve stormwater quantity controls. Opportunity for public education.	$414,000
CA9811	Redwood Lane - LID	Pike Branch	Construct off-line bioretention area at stormwater pipe outfall below Mulberry Ct.; use integrated vegetation management practices to encourage shrub/low growing trees beneath power lines.	Provide stormwater quantity controls. Provide stormwater quality controls.	$211,000
CA9812	Ridge View Drive - LID	Pike Branch	Construct off-line bioretention area at stormwater pipe outfall.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$249,000
CA9813	John Marshall Library LID	Pike Branch	Construct linear bioretention areas along edge of rear parking lot and in swale to NW; construct bioretention areas in islands along front of bldg. and in parking lot; install infiltration trench in rear parking lot.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Opportunity for public education.	$246,000
CA9818	Clermont School Site Park LID	Tributaries to Cameron Run	Construct bioretention area below houses on Gypsy Ct.	Provide stormwater quantity controls. Provide stormwater quality controls.	$49,000
CA9821	Clermont Elementary School LID	Tributaries to Cameron Run	Construct bioretention areas in bus loop traffic island and NW of building; construct linear bioretention area S of building and along west end of fields; replace inlet at NE corner of parking lot with a tree box filter.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$308,000
CA9822	Twain Middle School LID	Tributaries to Cameron Run	Construct bioretention areas in bus loop traffic island and in grass island SW of bldg.; construct linear bioretention areas along E side of property; install infiltration trenches and tree box filters in SE parking lot.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve community usage. Opportunity for public education.	$660,000
CA9823	Bush Hill Elementary School LID	Tributaries to Cameron Run	Construct bioretention areas in traffic/sidewalk islands; install infiltration trenches in parking lots; construct off-line bioretention at end of concrete trench from eastern parking lot and detention micro-berm along northern tree line.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$183,000
CA9827	Lee District Government Center LID	Backlick Run	Construct bioretention areas in traffic islands; install infiltration trench in lane SW of bldg.; install tree box filters and porous pavement.	Provide stormwater quantity controls. Provide stormwater quality controls.	$209,000
CA9828	Fire Station - Company No. 5 LID	Backlick Run	At Fire Station, divert roof drains to cistern for filling fire trucks; install porous pavement in W parking lot; construct bioretention area in SE corner; install tree box filter.	Provide stormwater quantity controls. Provide stormwater quality controls.	$71,000

Table 6-3. (Continued)

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9829	Franconia Park LID	Backlick Run	Construct bioretention areas in islands of both parking lots; plant trees between soccer fields and other locations to provide shade; repair streambank erosion and downcutting. Note that athletic fields are scheduled for conversion to artificial turf. Facility maintenance and renovation is an on-going process, and proposed retrofits, or similar stormwater improvements, should be incorporated into site improvement plans.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Opportunity for public education.	$126,000
CA9830	Edsall Administration Center LID	Backlick Run	Install infiltration trenches in parking lots; construct bioretention areas in islands/borders; install tree box filters.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Improve community usage.	$139,000
CA9835	Springfield Elementary School LID	Backlick Run	Create bioretention areas in bus loop and landscape islands in front of bldg.; install infiltration trenches and tree box filters in parking lot; construct linear bioretention areas and filter strip adjacent to asphalt play yard; convert soccer/football field from grass to artificial turf with cistern and underdrain system.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Improve community usage. Opportunity for public education.	$1,356,000
CA9836	Lee High School LID	Backlick Run	Construct off-line bioretention area at outfall S of Deepford St.; construct infiltration trenches and bioretention areas in parking lots around school bldg.; linear bioretention areas along tennis courts and concrete swale E of trailers; build detention micro-berm around 2 inlets; reforest unused open space.	Provide stormwater quantity controls. Provide stormwater quality controls.	$3,421,000
CA9839	Key Middle School LID	Backlick Run	Construct bioretention areas, infiltration trenches, and tree box filters in parking lots; convert NE parking lot to porous pavement; provide depression storage N of bldg. in trailer area (not shown in aerial); convert two fields from grass to artificial turf with cistern and underdrain system.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Improve community usage. Opportunity for public education.	$2,745,000
CA9842	Lynbrook Elementary School LID	Backlick Run	Construct bioretention in bus loop island, in front of school building, and to E of bldg.; direct roof drainage to cistern to water fields; install infiltration trenches and tree box filters in parking lot.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$254,000
CA9846	Leewood Park LID - A	Backlick Run	Restore grass swale; install bioretention area next to stormwater outfall pipe. Use woodland species.	Provide stormwater quality controls. Opportunity for public education.	$39,000
CA9848	Leewood Park LID - B	Backlick Run	Install riprap and infiltration trench at the end of stormwater outfall.	Provide stormwater quality controls. Opportunity for public education.	$13,000

Table 6-3. (Continued)

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9850	Wilburdale Park LID - A	Backlick Run	Install bioretention areas next to court and along street; construct off-line bioretention area at outfall into concrete ditch; reforest unused areas in park.	Provide stormwater quality controls. Opportunity for public education. Improve community usage.	$156,000
CA9851	Wilburdale Park LID - B	Backlick Run	Develop/restore grass swales along road to deliver runoff to new bioretention area at end of roadway.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$97,000
CA9853	Annandale High School LID	Backlick Run	Incorporate grass swale along roadway; construct linear bioretention areas and infiltration trenches along parking lots and courts; install tree box filters.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Improve community usage. Opportunity for public education.	$420,000
CA9854	Bren Mar Park Elementary School LID	Indian Run	Construct linear bioretention areas in grass areas along Beryl Rd. and along E edge of parking lot; install infiltration trench and tree box filter in rear of parking lot; plant shade trees between new basketball court and baseball field (not shown on aerial).	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$230,000
CA9855	Fire Station - Company No. 26 LID	Indian Run	At Fire Station, divert roof drains to cistern for filling fire trucks; construct bioretention areas in sodded ditch to north and along western edge of parking lot.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$131,000
CA9856	Holmes Middle School LID	Indian Run	Construct linear bioretention areas in grass along Montrose St.; construct area bioretention areas in traffic islands in NW and E lots; install infiltration trenches in road ways and next to rear of bldg.; install tree box filters in front lot and filter strip along edge of rear parking lots; create multisport, artificial-turf playing fields.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve community usage. Opportunity for public education.	$1,593,000
CA9857	Weyanoke Elementary School LID	Indian Run	Construct bioretention area in Braddock Rd. traffic island and at edge of asphalt courts; install filter strip around asphalt courts; install linear bioretention area, tree box filters, and infiltration trenches in S parking lot	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$124,000
CA9858	Poe Middle School LID	Indian Run	Construct linear bioretention area in loop island; install infiltration trenches, tree box filters, and traffic island bioretention areas in parking lots.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$248,000
CA9859	Indian Run Stream Valley Park LID - C	Indian Run	Install off-line bioretention area at end of stormwater outfall.	Provide stormwater quality controls. Improve stormwater quantity controls.	$516,000
CA9860	Indian Run Stream Valley Park LID - A	Indian Run	Install bioretention area at end of stormwater outfall.	Provide stormwater quality controls. Improve stormwater quantity controls.	$334,000

Table 6-3. (Continued)					
Project ID	**Project Name**	**Sub-watershed**	**Proposed Action**	**Benefit**	**Estimated Cost**
CA9861	Indian Run Stream Valley Park LID - B	Indian Run	Install bioretention area at end of stormwater outfall.	Provide stormwater quality controls. Improve stormwater quantity controls.	$543,000
CA9862	Columbia Elementary School LID	Indian Run	Construct linear and area bioretention areas in traffic islands; install infiltration trenches in front parking lots and side road; replace inlets with tree box filters; restore existing grass swale in back of bldg.; add filter strips around two inlets.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Opportunity for public education.	$134,000
CA9863	George Mason Regional Library LID	Indian Run	Construct bioretention in traffic islands along Little River Turnpike, in parking lot, between bldg. and Hillbrook Dr., and at SW corner of bldg.; install infiltration trench along several parking rows; install tree box filter inserts.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$403,000
CA9866	Turkeycock Run Stream Valley Park LID	Turkeycock Run	Install off-line bioretention area at end of stormwater outfall; repair concrete ditch and add riprap protection.	Provide stormwater quality controls. Improve stormwater quantity controls. Opportunity for public education.	$198,000
CA9867	Parklawn Elementary School LID	Turkeycock Run	Retrofit small dry pond to wet detention pond; construct bioretention areas in traffic islands; install infiltration trenches and one tree box filter in parking lots; install linear bioretention strips along large trailer (not shown) SW of bldg.; direct roof drains to cistern to water fields; reforest unused lawn areas.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve community usage. Opportunity for public education.	$168,000
CA9868	Green Spring Gardens LID	Turkeycock Run	Install linear bioretention area along parking spaces and infiltration trenches in traffic circle.	Provide stormwater quality controls. Improve stormwater quantity controls. Opportunity for public education.	$99,000
CA9869	Pinecrest Golf Course LID	Turkeycock Run	Implement stormwater retrofits based on the Park Authority's existing LID retrofit concept plan.	Provide stormwater quality controls. Improve stormwater quantity controls. Opportunity for public education.	$78,000
CA9870	Wolftree Lane LID	Turkeycock Run	Linear bioretention area to capture end of pipe stormwater.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$286,000
CA9872	Mason Government Center LID	Turkeycock Run	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality; construct bioretention area along Columbia Pike to collect roadway runoff; install linear bioretention strips, bioretention areas, and tree box filters in parking lot.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Opportunity for public education.	$220,000

Table 6-3. (Continued)

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9876	Glasgow Middle School LID	Holmes Run - Lower	Install off-line bioretention areas at stormwater pipe outfall on E side of entrance road. Note: school to be rebuilt by fall 2008.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$703,000
CA9877	Baileys Community Center LID	Holmes Run - Lower	Construct linear and area bioretention areas in traffic islands along front and east sides, by tennis courts, west side of building, and end of Summers Lane; build detention micro-berm along north side of baseball field, NW corner of tennis court, and edge of southwestern lot; install tree box filter in inlet on Summers Ln.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$351,000
CA9879	Baileys Elementary School LID	Holmes Run - Lower	Construct bioretention areas in traffic islands for bus loop and parking lots, near asphalt courts, and near portable classrooms; install infiltration trenches in parking areas and porous pavement in play yards; create artificial turf field with underdrains and cistern.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve community usage. Opportunity for public education.	$1,535,000
CA9882	JEB Stuart High School LID	Tripps Run	Construct linear bioretention area along Peace Valley Ln. median; construct a stepped bioretention areas along S edge of parking lot and SE corner of fields; construct bioretention areas in parking islands and around playing fields; plant wildflowers along SE side of baseball field; upgrade fields to multisport artificial turf with underdrains and cistern.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve community usage. Opportunity for public education.	$1,881,000
CA9885	Sleepy Hollow Elementary School LID	Tripps Run	Install infiltration trenches in parking lot and bioretention areas at yard drain inlets.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$455,000
CA9886	Nicholson St - Ch. 2 Street LID	Tripps Run	Construct bioretention area in Chapter-2 street lot, divert road runoff into area.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$100,000
CA9892	Westlawn Elementary School LID	Tripps Run	Install bioretention area, infiltration trenches, and tree box filters in parking lots; construct linear bioretention along asphalt courts; and construct grass swale around two sides of fields.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Opportunity for public education.	$117,000
CA9897	Fire Station - Company No. 28 LID	Tripps Run	At Fire Station, divert roof drains to cistern for filling fire trucks; construct bioretention areas in SW and SE corners of traffic islands in parking lot; con-struct linear bioretention areas on S side of truck entrance and S side of parking lot.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$23,000
CA9901	Larry Graves Park LID	Tripps Run	Construct bioretention areas in grass along Hillwood Ave. and replace inlet with tree box filter.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$41,000

Table 6-3. (Continued)

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9904	Devonshire Administration Center (School) LID	Tripps Run	Construct bioretention areas in traffic circle and in grass areas next to N and S parking lots; construct linear bioretention areas at edges of S lot; construct infiltration trenches and filter strips in N and rear lots; build detention micro-berm along tree line.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$288,000
CA9911	Belvedere Elementary School LID	Holmes Run - Upper	Construct bioretention areas in bus loop island, traffic island, along back edge in side lot, and in landscape islands around bldg.; build detention micro-berm along north side of property; install linear bioretention area and infiltration trench in side parking lot; and convert concrete ditches to grass swales.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$325,000
CA9914	Columbia Pines LID	Holmes Run - Upper	Construct off-line bioretention areas to capture end-of-pipe stormwater prior to entering the stream.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability, erosion, and instream habitat. Improve floodplain and nutrient cycling functions.	$ 96,000
CA9917	Beech Tree Elementary School LID	Holmes Run - Upper	Construct bioretention areas along Beechtree Ln. and in landscape islands around bldg. and trailers; install infiltration trenches in bus loop and drive; install two tree box filters at stormdrain inlets; install filter strip along Beechtree Ln.; build detention micro-berm along SW side of bldg.; convert playing fields to artificial turf with cistern.	Provide stormwater quality controls. Improve stormwater quantity controls. Improve community usage. Opportunity for public education.	$1,409,000
CA9921	Broyhill Crest Park LID	Holmes Run - Upper	Develop detention micro-berm along tree line to slow runoff and induce infiltration; construct bioretention areas with small cistern for watering community garden.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Improve community usage. Opportunity for public education.	$132,000
CA9922	Lacey Admin Center LID	Holmes Run - Upper	Develop playing field using artificial turf with underdrain/cistern system for use as soccer and football field; add bioretention areas and infiltration strips in parking lot islands and margins.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve community usage. Opportunity for public education.	$1,317,000
CA9925	Holmes Run Stream Valley Park LID	Holmes Run - Upper	Construct off-line bioretention areas (stepped) to capture end-of-pipe storm-water prior to entering the stream.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Improve floodplain and nutrient cycling functions.	$87,000

Table 6-3. (Continued)

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9927	Round Tree Park LID - C	Holmes Run - Upper	Convert parking lot traffic islands to bioretention areas and re-route field and court drainage to bioretention areas; construct detention micro-berm in open area along stream.	Provide stormwater quality controls. Improve stormwater quantity controls. Opportunity for public education.	$195,000
CA9929	Round Tree Park LID - A	Holmes Run - Upper	Install off-line bioretention area to capture end of pipe stormwater prior to entering the stream.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Improve floodplain and nutrient cycling functions.	$52,000
CA9937	Walnut Hill Admin Center LID - B	Holmes Run - Upper	Construct linear bioretention strips along road, parking lots, and south side of playing fields; install infiltration trenches in front and rear lots; divert 12 roof drains and courts to bioretention areas; convert fields to artificial turf with underdrains; plantings in unused open space.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve community usage. Opportunity for public education.	$2,953,000
CA9941	Woodburn Elementary School LID	Holmes Run - Upper	Install bioretention areas in landscaped islands along Gallows Rd., Hemlock Dr., and bus loop; install infiltration trenches in front parking lot; install linear bioretention area along bldg. in downspout areas and ditch to N; install porous pavement in asphalt play area; convert soccer/football field from grass to artificial turf.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Improve community usage. Opportunity for public education.	$1,342,000
CA9942	Luria Park LID	Holmes Run - Upper	Install off-line bioretention areas at stormwater pipe outfalls and area bioretention areas at end of streets at Fallowfield Dr., Oak Run Ct., E end of Trail Run Rd., Crest Haven Ct., and W end of Camp Alger Av.	Provide stormwater quality controls. Improve stormwater quantity controls. Opportunity for public education.	$355,000
CA9946	Falls Church High School LID	Holmes Run - Upper	Construct bioretention areas in traffic islands along front of school, in landscape beds, and along side of E parking lot; install infiltration trench along E side of tennis courts, in NW parking lot, and in paved grandstand areas; create two multisport athletic fields with artificial turf; construct linear bioretention areas along S side of rear parking lot; build detention micro-berms around field margins and yard drain.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve community usage. Opportunity for public education.	$2,772,000
CA9947	Thomas Jefferson Library LID	Holmes Run - Upper	Construct bioretention areas in front of library for roof drainage, along row of head-on parking spaces, and at SW and SE corners of lot; install infiltration trench across entrance road.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$179,000

Table 6-3. (Continued)

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9949	Graham Road Elementary School LID	Holmes Run - Upper	Construct bioretention areas in traffic island for bus loop, between sidewalk and building in front, along Monticello Dr., and along north side of back lot; install porous pavement and infiltration trench in deteriorated asphalt play yard.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve community usage. Opportunity for public education.	$127,000
CA9950	Pine Spring Elementary School LID	Holmes Run - Upper	Construct detention micro-berm and bioretention areas along NW property line; construct bioretention areas in bus loop and parking lot islands, NW outfall, and trailers; construct linear bioretention along N parking lot, trailers, and in existing swale on S edge of property; construct off-line bioretention area at outfall S of rear parking lot.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve community usage. Opportunity for public education.	$576,000
CA9952	Timber Lane Elementary School LID	Holmes Run - Upper	Construct bioretention areas in lawn and traffic islands along West Street, in N parking lot, behind bldg., and next to fields; construct linear bioretention areas around building; install infiltration trench and tree box filter in N parking lot.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$606,000
CA9953	Shrevewood Elementary School LID	Holmes Run - Upper	Construct bioretention areas in Shreve Rd. median islands, bus loop island, east side of parking lot, near playground, and at rear of bldg.; construct linear bioretention along NW corner of back field, next to asphalt courts, and in swale at NE corner along road.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$359,000
CA9954	Jefferson District Park & Golf Course LID	Holmes Run - Upper	Install filter strips around SWM pond and 2 central water hazards; construct linear and area bioretention areas and infiltration trenches along parking lots and court surfaces; depress footpath to avoid directing flow from ponds to stream.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve community usage. Opportunity for public education.	$236,000
CA9955	Dunn Loring Center (School) LID	Holmes Run - Upper	Disconnect downspouts and redirect to bioretention areas in landscape beds; construct linear bioretention areas around NW corner of bldg., above berm N of bldg., and at W end of fields; install infiltration trench in N parking lot; construct bioretention areas in traffic islands SW of bldg. and trailers.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$722,000
CA9957	Fire Station - Company No. 13 LID	Holmes Run - Upper	Construct bioretention areas on W side of parking lot prior to inlets; provide rain barrels for downspouts from overhangs at front and rear entrances; install infiltration trenches along N side and in front of bldg.; install linear bioretention area in median along Gallows Rd.	Provide stormwater quantity controls. Provide stormwater quality controls.	$132,000

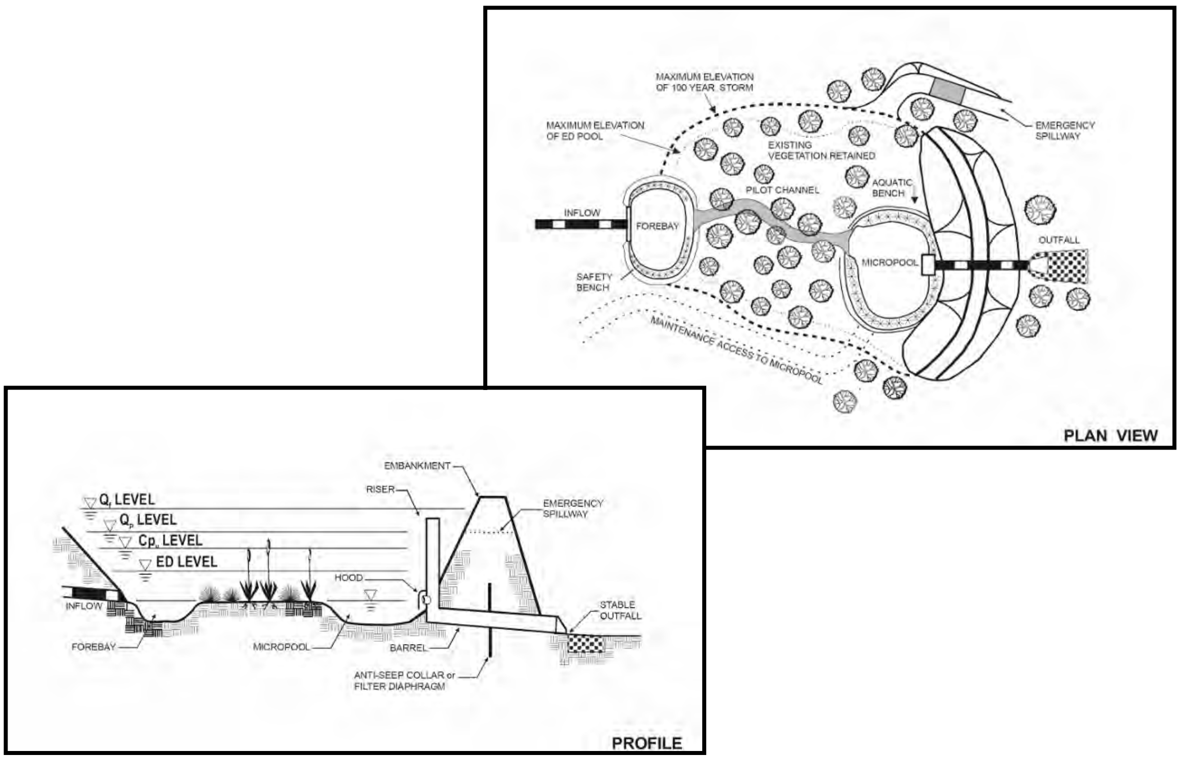
Table 6-3. (Continued)

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9958	Lynbrook Subdivision LID - A	Backlick Run	Add 2 off-line bioretention areas below road to capture flow from two outfalls; repair concrete apron below road culvert.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$89,000
CA9959	Anna Lee Heights LID	Tripps Run	Construct bioretention area within existing swale.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$77,000
CA9960	Mason District Park LID	Turkeycock Run	Implement stormwater retrofits based on the Park Authority's existing LID retrofit concept plan.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Opportunity for public education.	$120,000
CA9962	Holmes Run Park LID	Holmes Run - Lower	Install linear and circular bioretention areas along road and detention micro-berms around two stormwater area drains in park.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$158,000

6.4.3 New SWM Ponds

Description: SWM ponds are the traditional method of controlling stormwater flows. Create new SWM ponds to provide detention and water quality controls in areas where no ponds exist. Although sufficient space for this option may be difficult to obtain in built-out settings, the resulting benefits to flow volume and velocity control, and water quality improvement can be significant. Benefits may vary depending on the specific design features of the individual ponds.

Maintenance: The maintenance requirements of traditional stormwater ponds are well known. A typical pond is inspected by county personnel trained in dam safety and pond maintenance, looking at the dam, pipes, and riser structure to ensure they are functioning properly. Pretreatment facilities need to be inspected for clogging by sediments and large debris. If sediment or debris is evident, the area needs to be cleaned.



New SWM pond (micropool extended detention pond shown) (Source: MDE 2000a)

The new stormwater management pond project included in the plan is shown in Table 6-4.

Table 6-4. New stormwater management pond projects included in the plan

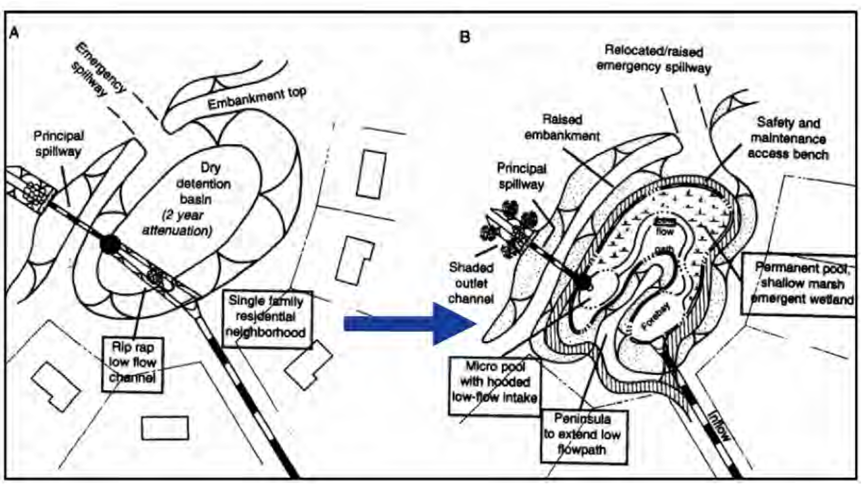
Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9102	Huntington Park SWM Pond	Tributaries to Cameron Run	Install SWM pond with micropool areas in pond bottom to provide water quality and extended detention controls. This project will be re-evaluated by the on-going flood damage reduction study for the Huntington community (Section 4.2.7.1) and recommendations from that study may supersede this project.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$98,000

6.4.4 SWM Pond Retrofits

Description: Options for retrofitting existing SWM ponds (AMEC 2005) that may be suitable for implementation include the following:

1. Increasing detention storage by means of additional excavation and grading.
2. Providing water quality improvements at facilities that currently have only water quantity control. These facilities could be retrofitted to also provide water treatment by installing micropools, sediment forebays, or constructed stormwater wetlands or by increasing the surrounding riparian buffer.
3. Modifying or replacing the existing riser structure and outlet controls to further reduce the discharge rate from the stormwater management facility. A riser is a concrete structure with a metal grate on top, that controls the level of water in the stormwater pond.
4. Adding infiltration features such as sand filters or bioretention to promote greater peak flow reduction, increase groundwater recharge, and improve water quality treatment. A soil survey of the existing facility would be required to verify that this retrofit is suitable. Stormceptors or equivalent LID products could be installed in parking lots or other areas with a large percentage of impervious area. These devices are placed in the manhole and trap sediments and petroleum products before they flow into the pond.

Maintenance: The maintenance requirements of a retrofitted pond are not significantly greater than those for a traditional stormwater pond. A typical pond is inspected by county personnel trained in dam safety and pond maintenance who check the dam, pipes, and riser structure to ensure that they are functioning properly. Any pretreatment facilities need to be inspected for clogging by sediments and large debris items. If sediment or clogging is evident, the area needs to be cleaned. If manufactured LID devices are used, manufacturer's maintenance recommendations should be followed to ensure that devices function as designed.



Stormwater pond retrofit (A. pre-retrofit pond; B. retrofitted pond) (Source: Schueler et al. 2000)

The SWM pond retrofit projects included in the plan are shown in Table 6-5.

Table 6-5. Stormwater management pond retrofit projects included in the plan

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9100	Farrington Park SWM Pond Retrofit	Tributaries to Cameron Run	Expand capacity of existing SWM wet pond and upgrade control structure. This project will be re-evaluated by the on-going flood damage reduction study for the Huntington community (Section 4.2.7.1) and recommendations from that study may supersede this project.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$ 61,000
CA9103	Woodfield SWM Pond Retrofit	Backlick Run	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$276,000
CA9104	Thomas SWM Pond Retrofit	Backlick Run	Expand existing SWM pond control structure to provide additional storage capacity.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stormwater quality controls.	$148,000
CA9107	Jayhawk SWM Pond Retrofit	Backlick Run	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$236,000
CA9111	Beauregard SWM Pond Retrofit	Turkeycock Run	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$25,000
CA9112	Strawbridge Square SWM Pond Retrofit	Turkeycock Run	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$25,000
CA9115	Little River SWM Pond Retrofit	Turkeycock Run	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$33,000
CA9117	Braddock Place SWM Pond Retrofit	Turkeycock Run	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$49,000
CA9118	Pinecrest SWM Pond Retrofit	Turkeycock Run	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$69,000

Table 6-5. Stormwater management pond retrofit projects included in the plan

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9126	Dominion SWM Pond Retrofit	Tripps Run	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$61,000
CA9128	Great Oak SWM Pond Retrofit	Tripps Run	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$89,000
CA9134	Columbia Pines SWM Pond Retrofit	Holmes Run - Upper	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability, erosion, and instream habitat. Improve floodplain and nutrient cycling functions.	$30,000
CA9138	Providence RECenter SWM Pond Retrofit	Holmes Run - Upper	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality; add bioretention areas in existing swale S of bldg.	Improve stormwater quantity controls. Improve stormwater quality controls. Opportunity for public education.	$102,000
CA9139	Kings Glen SWM Pond Retrofit	Holmes Run - Upper	Retrofit SWM pond with micro-pool micropool areas in pond bottom to provide water quality and extended detention controls; add detention micro-berm along contour and margin of mature woods in pond bottom	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$243,000
CA9142	Courts of Tyson SWM Pond Retrofit	Holmes Run - Upper	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality; install two bioretention areas at yard drains in Ch. 2 street (Kelleher Rd.).	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$31,000

6.4.5 Stream Restoration/Bank Stabilization

Description: Streams damaged by erosive flows, excess sedimentation, and disruptive human activities are often not capable of re-establishing a stable form. Techniques to repair these damaged or degraded streams are now based on mimicking natural stream channels and the range of natural variability exhibited by nearby stable streams. Termed natural stream channel design, such repairs focus on establishing natural stream channel shape, size, and habitat features. Restoration can range from minor repairs to restore bank stability to complete reconstruction of the stream channel.

Maintenance: Maintenance of natural stream channel design projects includes periodic inspection and monitoring to ensure that conditions remain within the expected range of variability. Post-construction plantings need to be monitoring to ensure that they become well-established. In addition, periodic channel adjustments may be necessary after large flow events, especially while post-construction plantings become established.

A.

B.

Stream restoration (A. concrete lined urban channel; B. restored stream) (Photos by: A) M. Perot, Versar, Inc.; B) unknown)

The stream restoration/bank stabilization projects included in the plan are listed in Table 6-6.

Table 6-6. Stream Restoration/Bank Stabilization projects included in the plan

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9207	Wilburdale Park Stream Restoration	Backlick Run	Notch two weirs and one concrete ford; redistribute large rocks in reach; control invasive vegetation; reforest buffer.	Improve stream stability and instream habitat. Reduce erosion. Improve floodplain and nutrient cycling functions. Opportunity for public education.	$320,000
CA9208	Wilburdale Park Bank Stabilization	Backlick Run	Remove check dam; enhance buffer through backyards; remove invasive bamboo and other species; implement backyard management program to reduce dumping of yard wastes/trash into streams.	Improve stream stability and instream habitat. Reduce erosion. Improve floodplain and nutrient cycling functions. Opportunity for public education. Improve community usage.	$169,000
CA9210	Brook Hill Stream Restoration	Backlick Run	Notch weirs in gabion lined channel; add rock vanes to straightened and overwidened middle section; cut log pour-overs/debris jams; add toe protection on steep berms in lower third; enhance buffer in localized areas; construct bioretention area at end of two roads; implement backyard management program to reduce dumping of yard wastes/ trash into streams.	Provide stormwater quantity controls. Improve floodplain and nutrient cycling functions. Opportunity for public education. Improve community usage. Greenway opportunity	$1,171,000
CA9216	Mason District Park Stream Restoration - A	Turkeycock Run	Implement Park Authority's stream restoration plans at this location.	Improve stream stability and instream habitat. Reduce erosion. Improve floodplain and nutrient cycling functions. Opportunity for public education. Improve community usage. Greenway opportunity	$996,000

6.4.6 Master Drainage Plan Projects

As discussed in Chapter 4, the county's Master Drainage Plan has identified 57 projects that have not yet been implemented in Cameron Run watershed. Upon review, 22 of the projects are recommended for "rollover" into the Cameron Run Watershed Management Plan (Table 6-7). Additional analysis of these opportunities and their priorities has placed these projects into the Tier 2 group of projects. Two residential flood relief projects are further evaluated in the following Drainage Complaint Projects section. The remaining 35 master drainage plan sites were not included in this plan because 1) more recent data from the SPA indicated that the severity of erosion was moderate or better; 2) county guidance noted that stream restoration potential was low, as indicated by "widening" or "incising" CEM stages; or 3) upstream candidate projects are anticipated to remove stressors from the project location.

Table 6-7. Master drainage plan projects (inactive) incorporated into the Cameron Run Watershed Management Plan

Segment	Tax Map	Type of Work	Old Project Name	Old Project Number	Comments
PIKE BRANCH	82-2, 83-1	STREAM RESTOR & STABIL		CA221	Incorporated with New Project CA9201
PIKE BRANCH	82-3	STREAMBANK STABIL		CA222	Incorporated with New Project CA9203
PIKE BRANCH	82-3	800' CHANN IMPROV	Franconia/Leewood	CA224	Not included in Plan
PIKE BRANCH	82-4	4000' STREAMBANK STABIL	Pike Branch Ph III	CA226	Not included in Plan
PIKE BRANCH	82-4	CHANNEL IMPROVEMENTS	Wilton Woods	CA227	Incorporated with New Project CA9203
CAMERON RUN	82-2	STREAM STABIL@ TELEGRAPH-BELTW		CA231	Incorporated with New Project CA9200
CAMERON RUN	82-2	600' INFRASTRUCTURE RPLMNT	Elmwood Drive	CA235	Not included in Plan
CAMERON RUN	82-2	STREAM STABILIZATION	Norton Villa	CA236	Not included in Plan
MILITARY	81-2	1800' STREAM STAB @ SOUTHERNRR		CA251	Incorporated with New Project CA9204
MILITARY	81-2	350' STREAM STAB SRR/S VAN DOR	Runnymede	CA252	Not included in Plan
MILITARY	81-4	1600' STORM SEWER	Old Rolling/Nedra	CA253	Not included in Plan
BACKLICK	81-1	STREAM STABIL & GABION @ RR		CA261	New Project CA9235
BACKLICK	80-2	STREAM @ SHIRLEY HWY		CA262	Not included in Plan
BACKLICK	80-2	STREAM STABIL D/S BACKLICK		CA263	Not included in Plan
WILBURDALE	71-3	1200' STORM SEWER	Leewood Subd	CA273	Not included in Plan
WILBURDALE	71-3	600' STORM SEWER, DITCH & BERM	Clemons Court	CA274	Incorporated with New Project CA9209
WILBURDALE	71-1	STUDY	Annandale Acres	CA276	Not included in Plan; area surveyed by SPA
INDIAN RUN	71-4	STREAMBANK STABIL		CA280	Not included in Plan
INDIAN RUN	72-3	800' STREAMBANK STABIL	Indian Run Ph III	CA281	Not included in Plan
INDIAN RUN	71-4	650' CHANNEL IMPROVEMENTS	Birch Lane	CA282	Not included in Plan
INDIAN RUN	71-4	400' STREAMBANK STABIL	Braddock Hills	CA283	Not included in Plan
INDIAN RUN	71-4	1000'STREAM REST @ SPRING VALL		CA284	Not included in Plan
INDIAN RUN	71-4	4000'STREAM ST U/S BRADDOCK RD	Willow Run Sub/Rndlp	CA285	Not included in Plan

Table 6-7. (Continued)

Segment	Tax Map	Type of Work	Old Project Name	Old Project Number	Comments
TURKEYCOCK	72-3	STREAM STAB @ EDSAL/SHIRLEY HW		CA291	Incorporated with New Project CA9211
TURKEYCOCK	72-3	1450'STREAM STAB @ CHOWEN AVE	Chowan Ave	CA292	Incorporated with New Project CA9212
TURKEYCOCK	72-3	60' STREAMBANK STABIL	Eighth St	CA293	Incorporated with New Project CA9212
TURKEYCOCK	72-1	STREAM STAB D/S BRADDOCK RD		CA295	Incorporated with New Project CA9213
TURKEYCOCK	72-1	STREAM STAB U/S BRADDOCK RD		CA296	Not included in Plan
TURKEYCOCK	72-1	650' STORM DRAIN IMP 250' RCBC	Holyoke-Piney Lane	CA298	Not included in Plan
PARKLAWN	72-2	800'STREAM ST @ ALEX CITY LINE		CA301	Not included in Plan
PARKLAWN	61-4	STREAM STABIL @ DRUMMOND DR		CA302	Incorporated with New Project CA9218
BARCROFT	60-4	STREAMBANK STABIL, ONE SIDE		CA312	Not included in Plan
BARCROFT	60-2	STREAM STABILIZATION	Crosswoods Dr.	CA314	Incorporated with New Project CA9228
BARCROFT	60-4	STREAM STABILIZATION	Juniper/Tripps	CA315	Incorporated with New Project CA9220
TRIPPS RUN	50-2	STREAMBANK STABIL		CA325	Incorporated with New Project CA9225
WEST FALLS CHUR	40-3	1000' STREAMBANK STABIL		CA331	Not included in Plan
HOLMES RUN	60-4	600' STREAM STABIL @ ROSE LANE	Holmes Run Ph II	CA342	Not included in Plan
HOLMES RUN	60-3	GABION @ BRADLEY CIRCLE		CA343	Not included in Plan
HOLMES RUN	60-3	200' STREAM BANK STABIL	Brookcrest Place	CA344	Not included in Plan
HOLMES RUN	60-1	STREAM STABIL @ ANNANDALE RD		CA345	Not included in Plan
HOLMES RUN	60-1	STREAM STABIL @ ARNOLD LANE		CA346	Not included in Plan
HOLMES RUN	60-1	90' STORM SEWER 370' SWALE	Locker Street	CA348	Not included in Plan
HOLMES RUN	60-4	200' STREAM BANK STABIL	Raleigh Road	CA349	Not included in Plan
HOLMES RUN	60-3	125' STREAM STABIL	Crest Drive	CA350	Not included in Plan
				CA353	Not included in Plan
MEMORIAL	39-4	150 L.F. STREAMBANK STABIL	Shadybrook	CA354	Incorporated with New Project CA9234
HOLMES RUN	60-3	100' STREAM STABIL / WALL	Raleigh Rd. Ph. II	CA361	Not included in Plan
INDIAN RUN	71-4	STREAM STABILIZATION	Fairland	CA381	Not included in Plan
INDIAN RUN	81-1	STREAM STABILIZATION	Bren Mar Ph II	CA382	Not included in Plan
TURKEYCOCK	72-1	ADD CULV @ BRADDOCK RD		CA491	New Project CA9236
TURKEYCOCK	72-1	ADD CULV @ OLD COLUMBIA PIKE		CA492	Not included in Plan
WEST FALLS CHUR	50-2	ADD CULV & STREAM STABIL		CA531	Incorporated with New Project CA9225
ALEXANDRIA	83-1	CONSTRUCT FLOODWALL ALONG CAME	Arlington Terrace	CA601	Additional evaluation underway by USACE study
BACKLICK	81-1	CONST EARTHEN BERM	Bren Mar Drive	CA661	Incorporated with New Project CA9205
INDIAN RUN	81-1	INSTALL RETAINING WALLS		CA681	Not included in Plan

Note: Master drainage plan projects not recommended for inclusion in this plan are shaded gray

6.4.7 Drainage Complaint Projects

Fairfax County's Maintenance and Stormwater Management Division (MSMD) maintains a database of storm drainage problems reported to the county. The county maintains the public storm drainage system contained within dedicated storm drainage easements, however, many of the drainage complaints received by the county are located outside these easements and cannot be addressed through existing maintenance programs. This watershed plan provides an alternate avenue for examining these citizen complaints and for developing recommendations to help alleviate problems in these areas.

Versar reviewed the county's drainage complaint database for flooding and erosion complaints, and found nearly 600 citizen complaints in Cameron Run watershed. Almost 75 percent of these complaints were related to house, yard, or road flooding issues, while the remaining complaints pertained to streambank and other erosion problems. Using the drainage complaints as an indicator of problem areas, Versar analyzed the location and nature of these complaints in combination with erosion and stream channel stability information from the SPA. As a result, Versar identified 57 locations that had a concentration of flooding complaints and 13 locations that had considerable erosion problems. Candidate projects were then developed for these identified problem areas (i.e., 70 candidate projects shown in Figure 6-2).

The county also maintains historical paper copy records on drainage complaints in the MSMD offices that date from the 1970s to the late 1990s, prior to creation of the electronic database. Versar reviewed these historical records for additional drainage complaint information on the 70 identified candidate projects.

Versar then applied a prioritization process similar to that described in Chapter 5.4 to help target restoration efforts to the biggest problem areas. Candidate drainage projects for flooding and erosion problems used different ranking criteria. Flooding project ranks were based on the size of the study area around the parcels with drainage complaints, the number of parcels with drainage complaints and the number of parcels with house flooding. Erosion project ranks were based on erosion site lengths, severity of erosion scores and CEM scores. Most criteria were converted to a 1 to 4 score with a 4 indicating the biggest problems. Erosion sites with a CEM score of 4 or 5 were assigned a score of 4; a score of 1 was assigned to the remaining sites. The 1 to 4 scores for each criterion were then summed within each flooding or erosion project.

The best opportunities to address drainage-related issues were chosen from the 70 candidate drainage complaint projects by selecting those that scored 8 or higher out of 12 on the selection criteria. This resulted in a list of 25 selected drainage complaint projects, including 21 flooding projects and four erosion projects (Figure 6-3 and Table 6-8). Project fact sheets for each of the selected project sites describe the recommended action to help alleviate drainage problems in these areas (Appendix A-4).

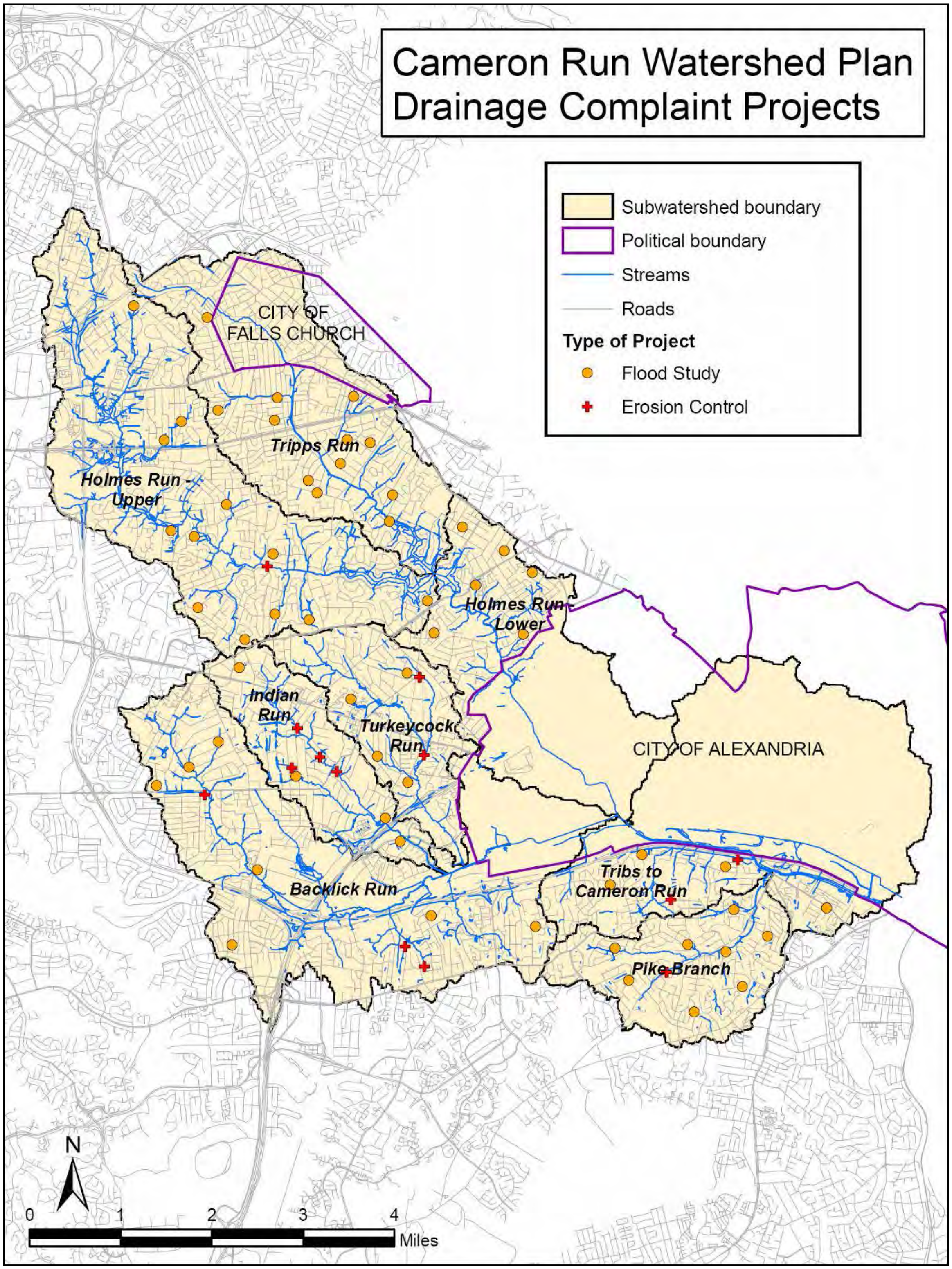


Figure 6-2. Location of candidate projects identified using the county's drainage complaint records

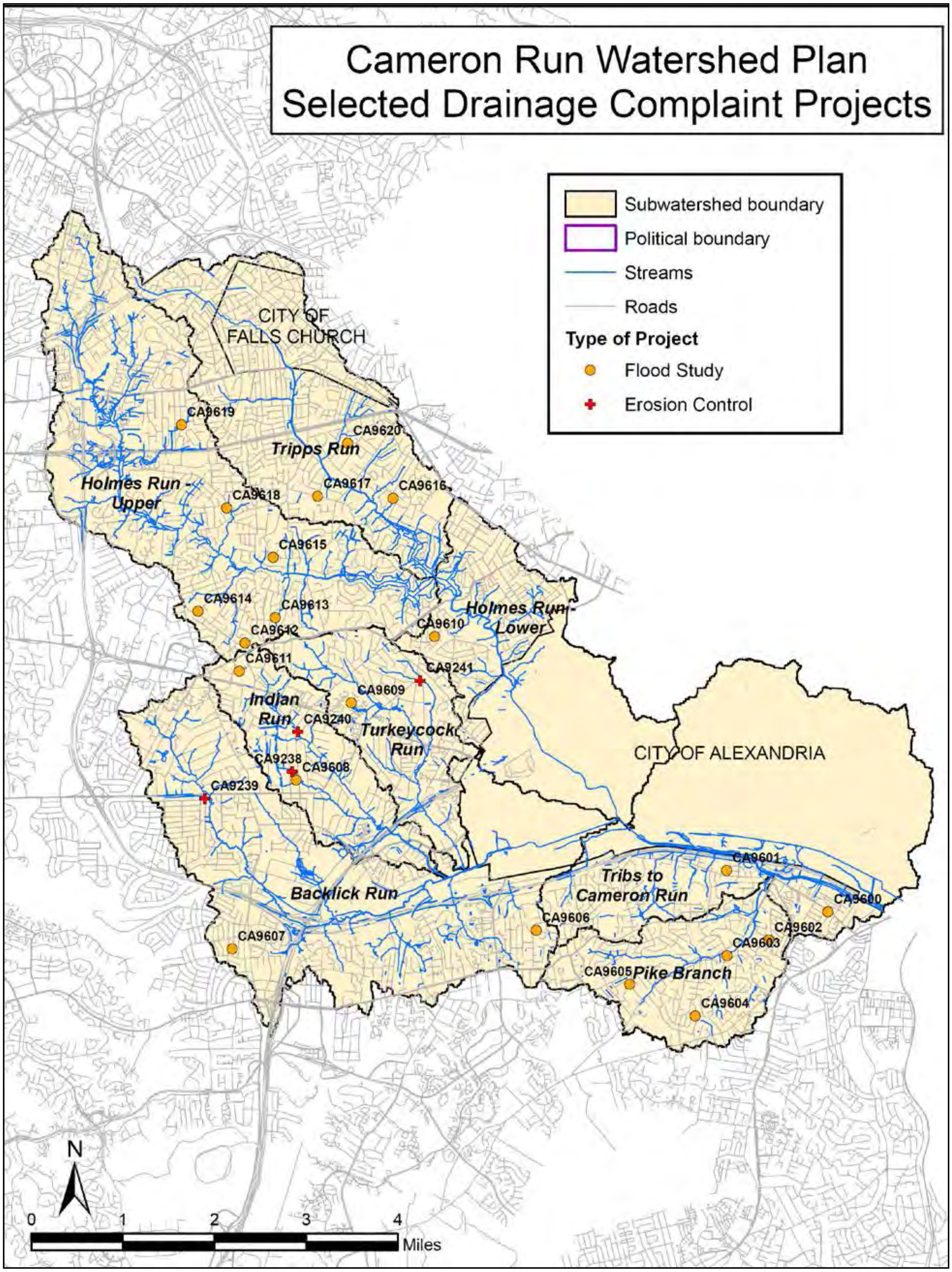


Figure 6-3. Selected project locations to address drainage related problems from the county's drainage complaint records

Table 6-8. Summary of selected projects to address drainage related problems from the county's drainage complaint records

Project ID	Project Name	Subwatershed	Proposed Action	Estimated Cost
CA9238	Indian Run Streambank Stabilization - B	Indian Run	Restore natural stream channel morphology, stabilize banks, and enhance riparian buffer.	$50,000
CA9239	Backlick Run Streambank Stabilization	Backlick Run	Restore natural stream channel morphology, stabilize banks, and enhance riparian buffer.	$69,000
CA9240	Indian Run Streambank Stabilization - A	Indian Run	Restore natural stream channel morphology, stabilize banks, and enhance riparian buffer.	$84,000
CA9241	Turkeycock Run Stream Stabilization	Turkeycock Run	Restore natural stream channel morphology, stabilize banks, and enhance riparian buffer.	$77,000
CA9600	Huntington Drainage Study	Tributaries to Cameron Run	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements. This drainage study is being completed as part of an on-going flood damage reduction study for the Huntington community (Section 4.2.7.1).	$38,000
CA9601	Burgundy Village Drainage Study	Tributaries to Cameron Run	Conduct a neighborhood drainage improvement study to investigate reported house, yard, and road flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$38,000
CA9602	Jefferson Garden & Wilton Hall Drainage Study	Pike Branch	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements. Improvements to the curb and gutter system have been initiated in this area since the analysis was performed, and evaluation of their effectiveness and the need for any additional improvements should be considered during the recommended drainage study.	$38,000
CA9603	Wilton Woods & Millwood Estates Drainage Study	Pike Branch	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$57,000
CA9604	Virginia Hills Drainage Study	Pike Branch	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$57,000
CA9605	Rose Hill Drainage Study	Pike Branch	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements. Additional complaints about this area have been received since the analysis was performed, and all complaints will be considered during the detailed drainage study recommended for this area.	$38,000
CA9606	Brookland Estates Drainage Study	Backlick Run	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements. Possible cross-connections between the storm drainage network and sanitary sewer system have also been reported for this area and should be investigated as part of the recommended drainage study.	$38,000
CA9607	Crestwood Drainage Study	Backlick Run	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$38,000
CA9608	Braddock Hills Drainage Study	Indian Run	Conduct a neighborhood drainage improvement study to investigate reported house, yard, and road flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$57,000
CA9609	Pinecrest Drainage Study	Turkeycock Run	Conduct a neighborhood drainage improvement study to investigate reported house, yard, and road flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$38,000
CA9610	Parklawn Drainage Study	Holmes Run - Lower	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$19,000
CA9611	Evergreen Heights Drainage Study	Indian Run	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$38,000
CA9612	Webbwood Drainage Study	Holmes Run - Upper	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$19,000

Table 6-8. Summary of selected projects to address drainage related problems from the county's drainage complaint records

Project ID	Project Name	Subwatershed	Proposed Action	Estimated Cost
CA9613	Sleepy Hollow Woods Drainage Study	Holmes Run - Upper	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$38,000
CA9614	Kenwood Drainage Study	Holmes Run - Upper	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$38,000
CA9615	Valley Brook Drainage Study	Holmes Run - Upper	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$19,000
CA9616	Ravenwood Drainage Study	Tripps Run	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$38,000
CA9617	Marlo Heights Drainage Study	Tripps Run	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$38,000
CA9618	Anna Lee Heights Drainage Study	Holmes Run - Upper	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$19,000
CA9619	Fenwick Park Drainage Study	Holmes Run - Upper	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$38,000
CA9620	Sleepy Hollow Drainage Study	Tripps Run	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$38,000

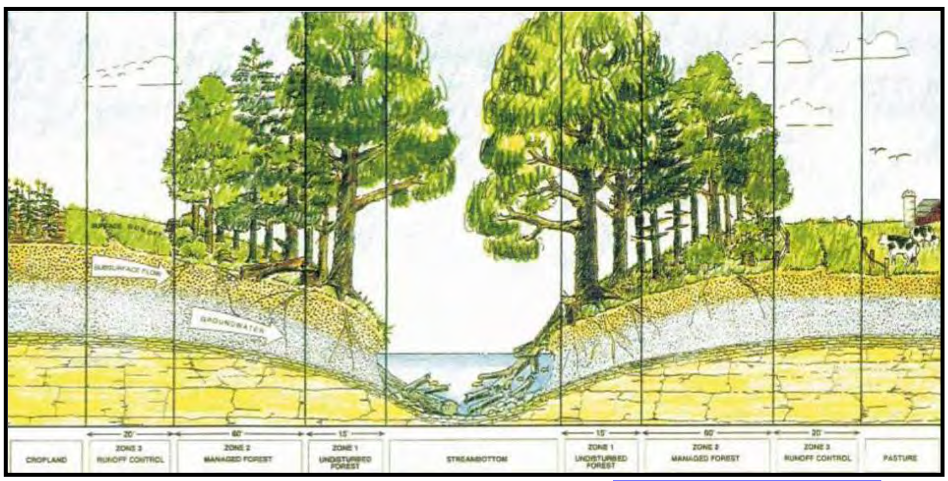
6.4.8 Other Opportunities

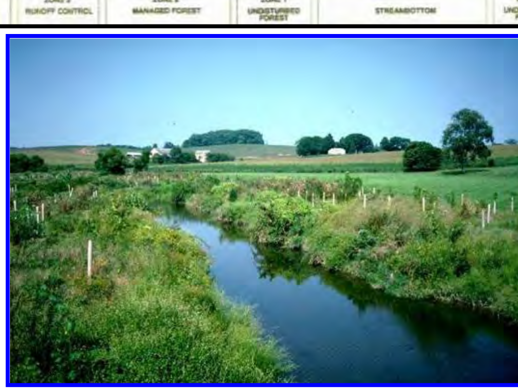
Planting riparian buffers is a high priority for the Cameron Run watershed, but this action will be addressed by the existing countywide riparian buffer planting program and is not included explicitly as a plan project. The concept and benefits of riparian buffer planting are described as below.

6.4.8.1 Riparian Buffer Enhancement

Description: Enhancing existing streamside vegetation by planting native varieties of trees, shrubs, and wildflowers restores many of the water quality, wildlife, and aesthetic benefits associated with riparian buffers. Vegetation filters sediments and other pollutants from storm-water runoff, moderates water temperatures in streams, improves aesthetics, and provides shelter and food to both terrestrial and stream organisms.

Maintenance: Maintenance of buffer enhancement projects includes periodic watering, removal of invasive species, and trash clean-up to ensure that plantings become well-established.






Buffer enhancement (Sources: Palone and Todd 1998; MDE 2000b; M. Southerland, Versar, Inc.)

6.4.8.2 Green Roof

Description: Green roof technology, which involves placing a layer of soil and vegetation on top of an impervious rooftop, can be applied to buildings to provide several benefits.

Economic Benefits –

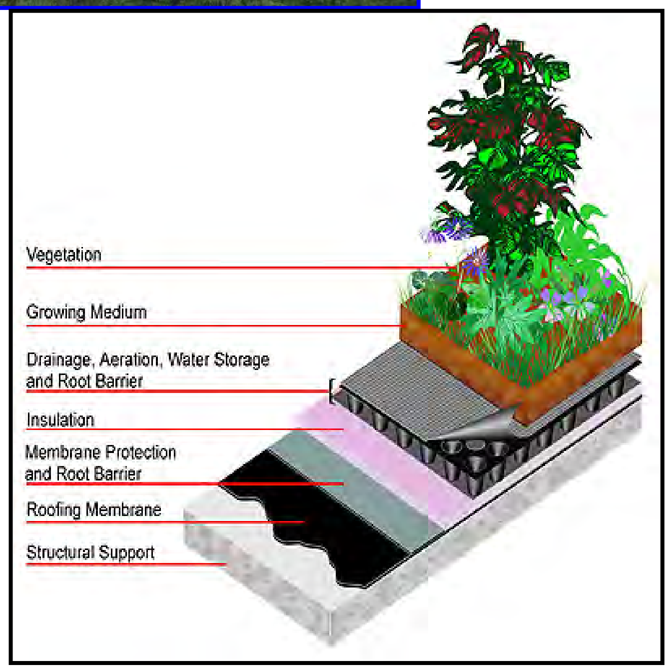
- increases the life expectancy of rooftop and waterproofing (2-5 times) by providing protection against temperature extremes and ultraviolet light. The increased life span of the roof off-sets the somewhat higher up-front installation costs
- conserves energy by moderating building temperatures

Ecological Benefits –

- reduces stormwater runoff (30% to 100% of annual rainfall can be stored, relieving stormdrains and feeder streams)
- reduces heat island effect (cooler air temperatures and higher humidity can be achieved through natural evaporation)
- improves air quality (up to 85% of dust particles can be filtered out of the air)
- provides new habitat for plants, insects, and birds

Amenities –

- reduces noise level by limiting reverberation and improving insulation
- improves the aesthetics of the landscape



Green roof construction

Maintenance: Once a green roof is well-established, its maintenance requirements are usually minimal. Initial watering and occasional fertilization are required until the plants have fully established themselves, and periodically thereafter during drought conditions. Periodic trimming, weeding, inspection, and plant replacement is necessary.

Several county facilities present good opportunities for green roof technology (Figure 6-4, Table 6-9). Given the greater up-front expense of green roofs, it is recommended that the county consider this option on a case-by-case basis as each facility’s roof approaches the end of its current life span. Scheduled roof replacement costs could substantially off-set the initial cost of a green roof, making this multipurpose roofing option more attractive.

Figure 6-4. Example of a county facility (Shrevewood Elementary School) that could present a good opportunity for a green roof

Table 6-9. County facilities that could be considered for a green roof during future renovation cycles

Project ID	Project Name	Subwatershed	Parcel ID No.
CA9805	Wilton Administration Center LID	Pike Branch	0824 01 0004A
CA9813	John Marshall Library LID	Pike Branch	0823 12 B
CA9822	Twain Middle School LID	Tributaries to Cameron Run	0823 01 0020
CA9823	Bush Hill Elementary School LID	Tributaries to Cameron Run	0823 01 0001
CA9830	Edsall Administration Center LID	Backlick Run	0714 01 0042
CA9835	Springfield Elementary School LID	Backlick Run	0813 01 0005B
CA9836	Lee High School LID	Backlick Run	0804 01 0037
CA9839	Key Middle School LID	Backlick Run	0813 01 0022B
CA9853	Annandale High School LID	Backlick Run	0711 01 0068
CA9854	Bren Mar Park Elementary School LID	Indian Run	0811 01 0006
CA9856	Holmes Middle School LID	Indian Run	0723 01 0014
CA9857	Weyanoke Elementary School LID	Indian Run	0721 01 0013
CA9858	Poe Middle School LID	Indian Run	0711 01 0131
CA9862	Columbia Elementary School LID	Indian Run	0712 05 0084A
CA9872	Mason Government Center LID	Turkeycock Run	0613 01 0003
CA9876	Glasgow Middle School LID	Holmes Run - Lower	0614 01 0151A
CA9879	Baileys Elementary School LID	Holmes Run - Lower	0612 01 0002
CA9882	JEB Stuart High School LID	Tripps Run	0611 01 0013
CA9892	Westlawn Elementary School LID	Tripps Run	0504 01 0002
CA9911	Belvedere Elementary School LID	Holmes Run - Upper	0604 01 0037
CA9917	Beech Tree Elementary School LID	Holmes Run - Upper	0602 38 A
CA9941	Woodburn Elementary School LID	Holmes Run - Upper	0592 01 0044
CA9946	Falls Church High School LID	Holmes Run - Upper	0503 01 0001A
CA9950	Pine Spring Elementary School LID	Holmes Run - Upper	0494 01 0060
CA9952	Timber Lane Elementary School LID	Holmes Run - Upper	0501 01 0044

CA9953	Shrevewood Elementary School LID	Holmes Run - Upper	0501 01 0002
CA9954	Jefferson District Park & Golf Course LID	Holmes Run - Upper	0492 01 0088

6.4.9 Watershed Projects By Subwatershed

The Cameron Run Watershed Plan Tier 1 candidate projects are shown in the following series of maps (Figs. 6-5 through 6-12) so that their location within each subwatershed can be readily determined. Detailed fact sheets for each Tier 1 candidate project are provided in Appendix A-1.

6.5 BENEFITS OF THE PLAN

As described in Chapter 5, estimating the benefits of the policy and project actions is critical to developing a plan that meets the county's and community's goals. The types of projects and their locations were selected to maximize benefits for stream protection and restoration. In the tables and fact sheets provided, we include estimates of benefits and costs.

6.5.1 Benefits of the Policy Recommendations

The policy recommendations will provide a range of benefits to the Cameron Run watershed. Policies that are implemented countywide in conjunction with other watershed management plans will be most efficient and should result in improved environmental conditions throughout Fairfax County and the surrounding region. Because these policy recommendations are non-structural, it is difficult to quantify the benefits to the watershed. Generally, the policy recommendations will help to improve the enforcement of existing regulations and laws and provide additional protection for areas that are environmentally valuable, but not necessarily located within an RPA. Institution of programmatic solutions is one of the best ways to deal with adverse cumulative effects from distributed sources such as stormwater.

6.5.2 Benefits of the Project Actions

Cameron Run is the most heavily urbanized watershed in the county, with impervious surface in each subwatershed exceeding the 10% to 15% threshold considered the minimum for good stream conditions. Most of the development in the watershed occurred before stormwater controls were required; therefore, reducing the effects of excessive runoff of stormwater is the most important benefit that can be achieved through project actions. Each stormwater-control project included in the plan has been scored based on the area of impervious surface controlled and the effectiveness of the recommended practice to help prioritize projects. Both water quantity improvement (i.e., reduction in average peak flows) and water quality improvement (i.e., reduction in pollutant loading) are included. More precise estimates of project benefits have been modeled (Appendix B). These model-based estimates can be used to evaluate the Plan's contributions to meeting water quality standards (e.g., TMDL implementation) and Chesapeake Bay Tributary goals.

Future conditions with proposed BMP projects were modeled to compare the condition of the watershed as development continues and when projects identified above are completed. The proposed actions in the Cameron Run Watershed Management Plan will reduce pollutant loadings throughout the county portion of the watershed. The model of future conditions with proposed projects shows a 4.9% decrease in total suspended solids, a 3.8% decrease in total phosphorus, and a 3.6% decrease in total nitrogen pollutant loads for the entire Cameron Run watershed. It is important to note that the model shows only small decreases in pollutant loading

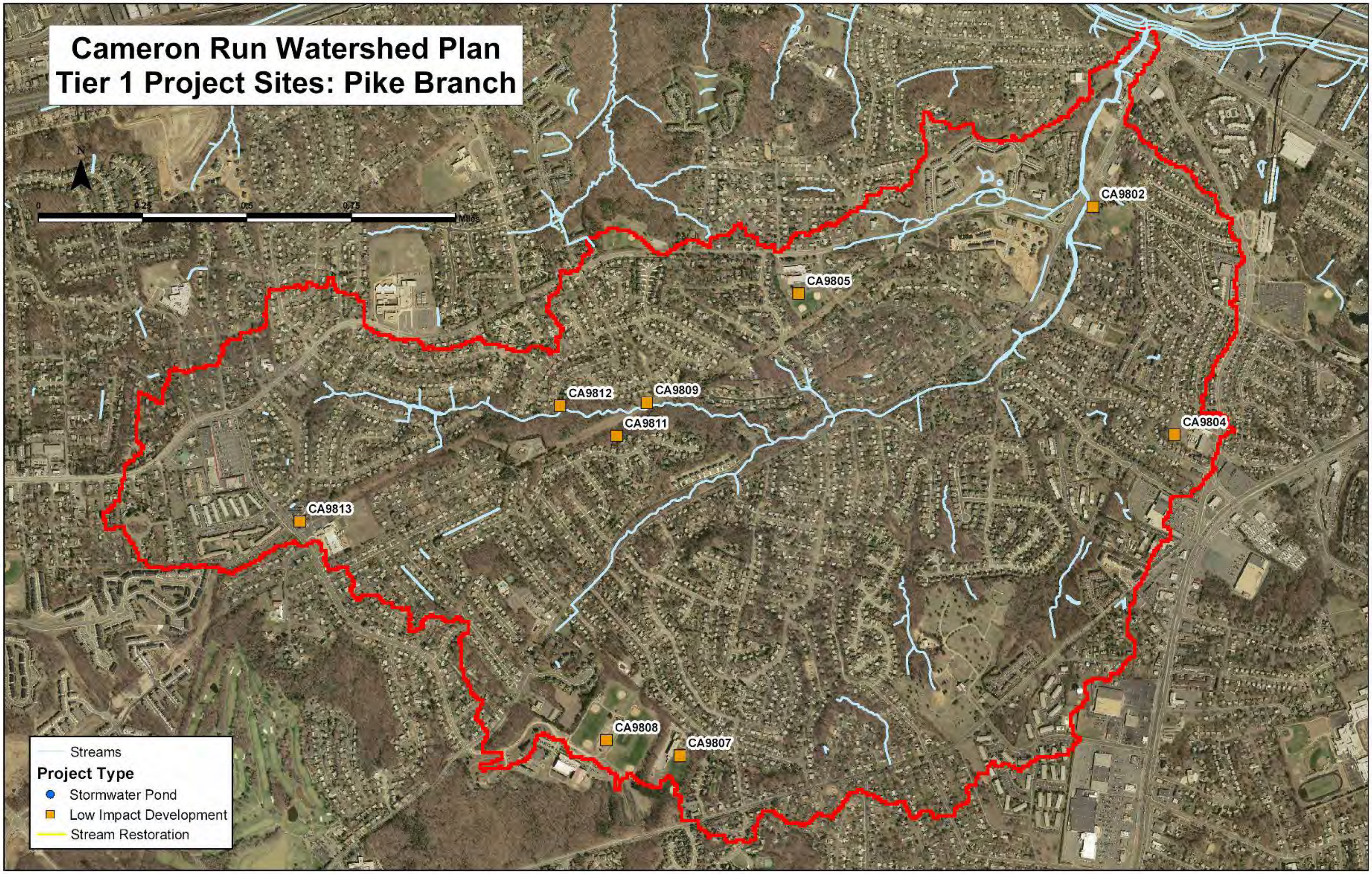


Figure 6-5. Pike Branch – Tier 1 candidate restoration sites

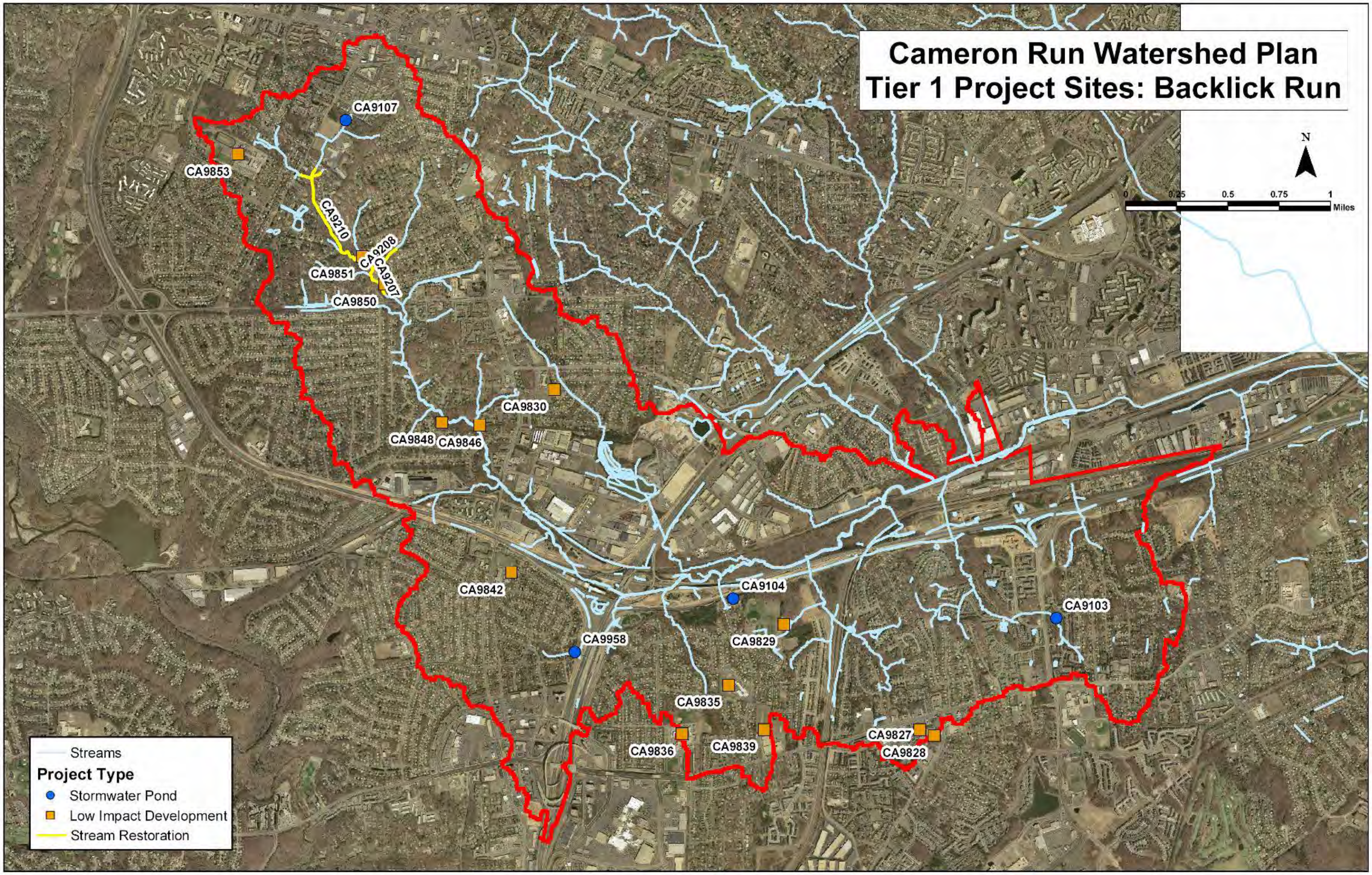


Figure 6-6. Backlick Run – Tier 1 candidate restoration sites

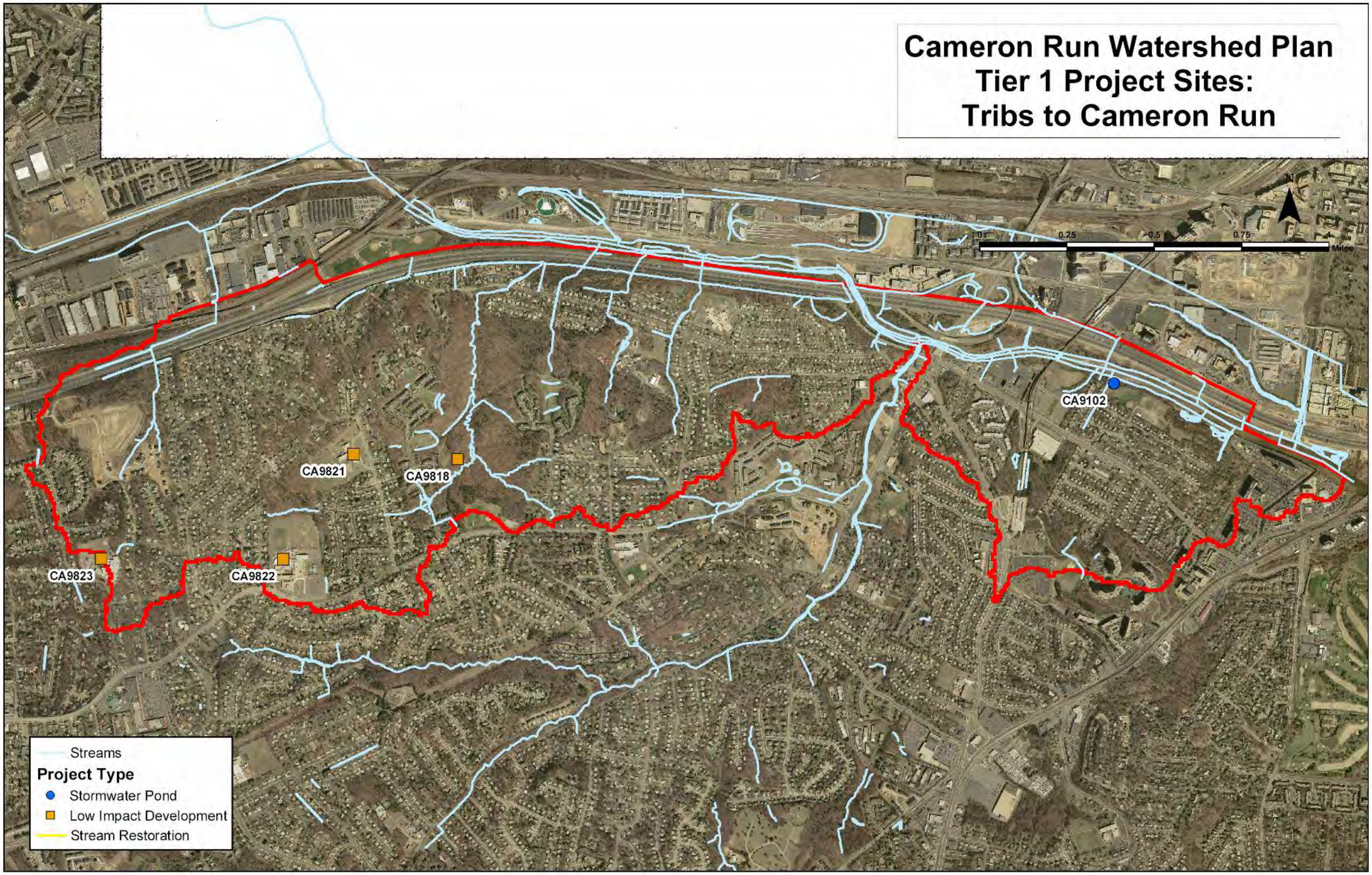


Figure 6-7. Tributaries to Cameron Run – Tier 1 candidate restoration sites

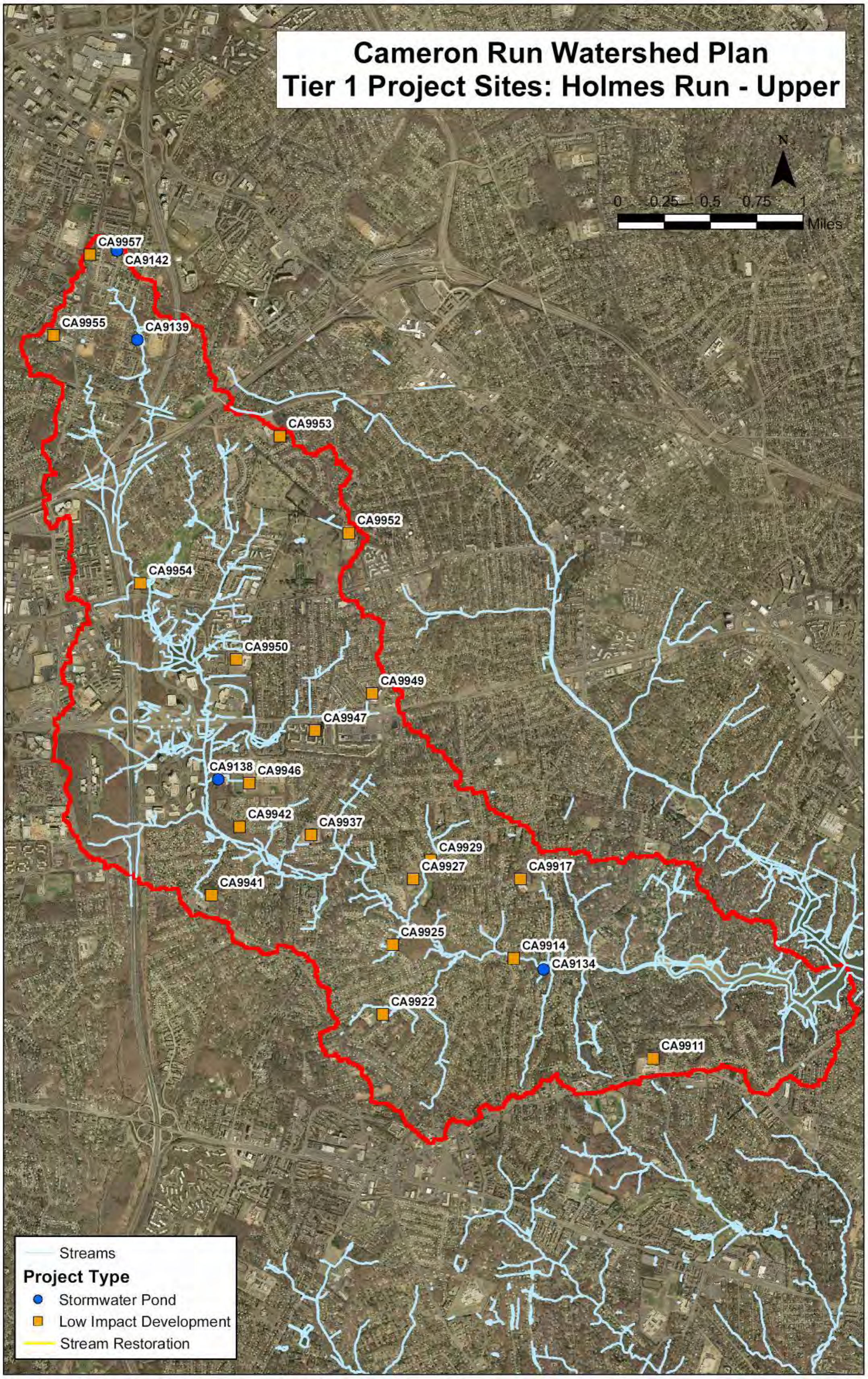


Figure 6-8. Holmes Run (Upper) – Tier 1 candidate restoration sites

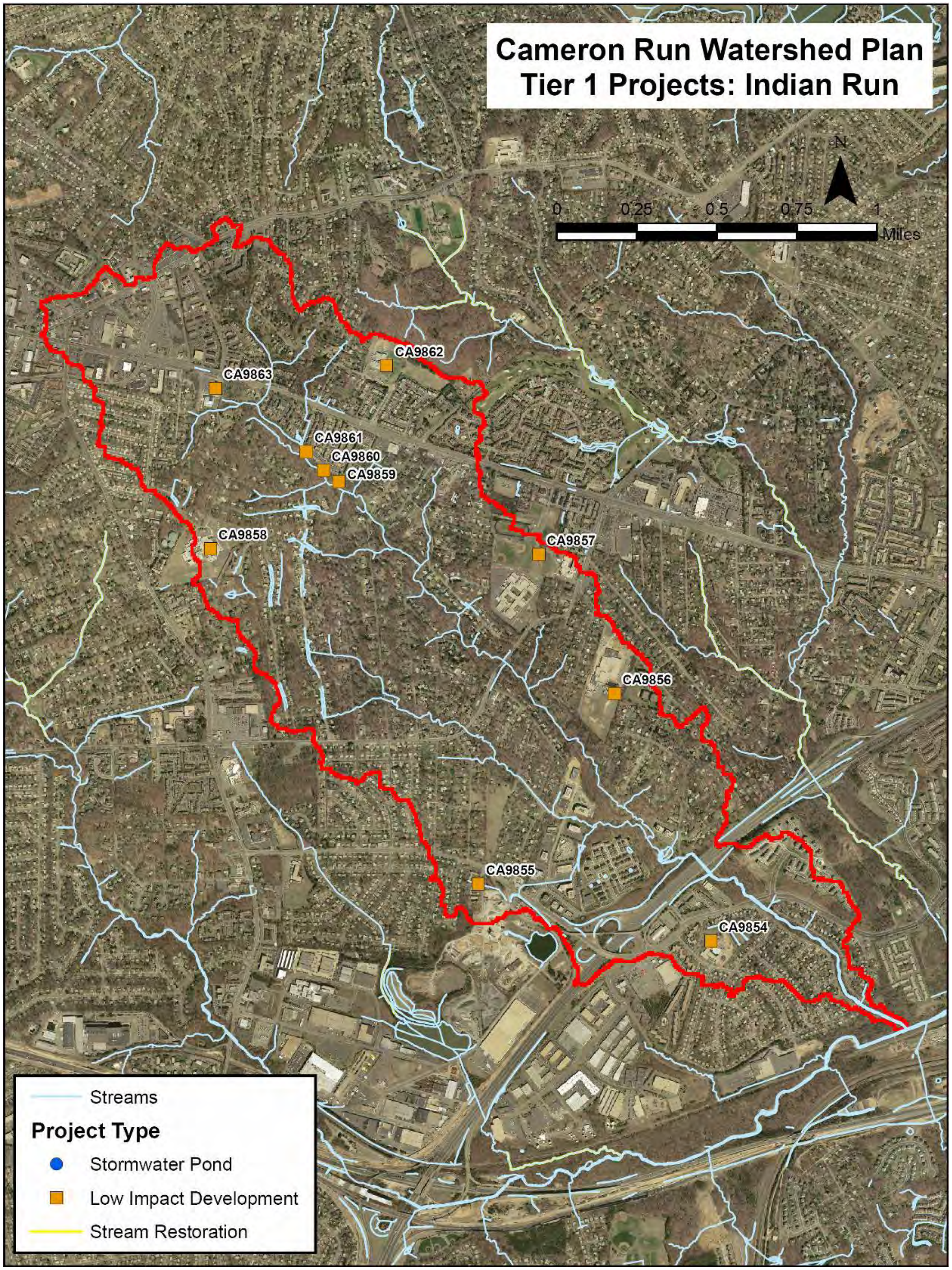


Figure 6-9. Indian Run – Tier 1 candidate restoration sites

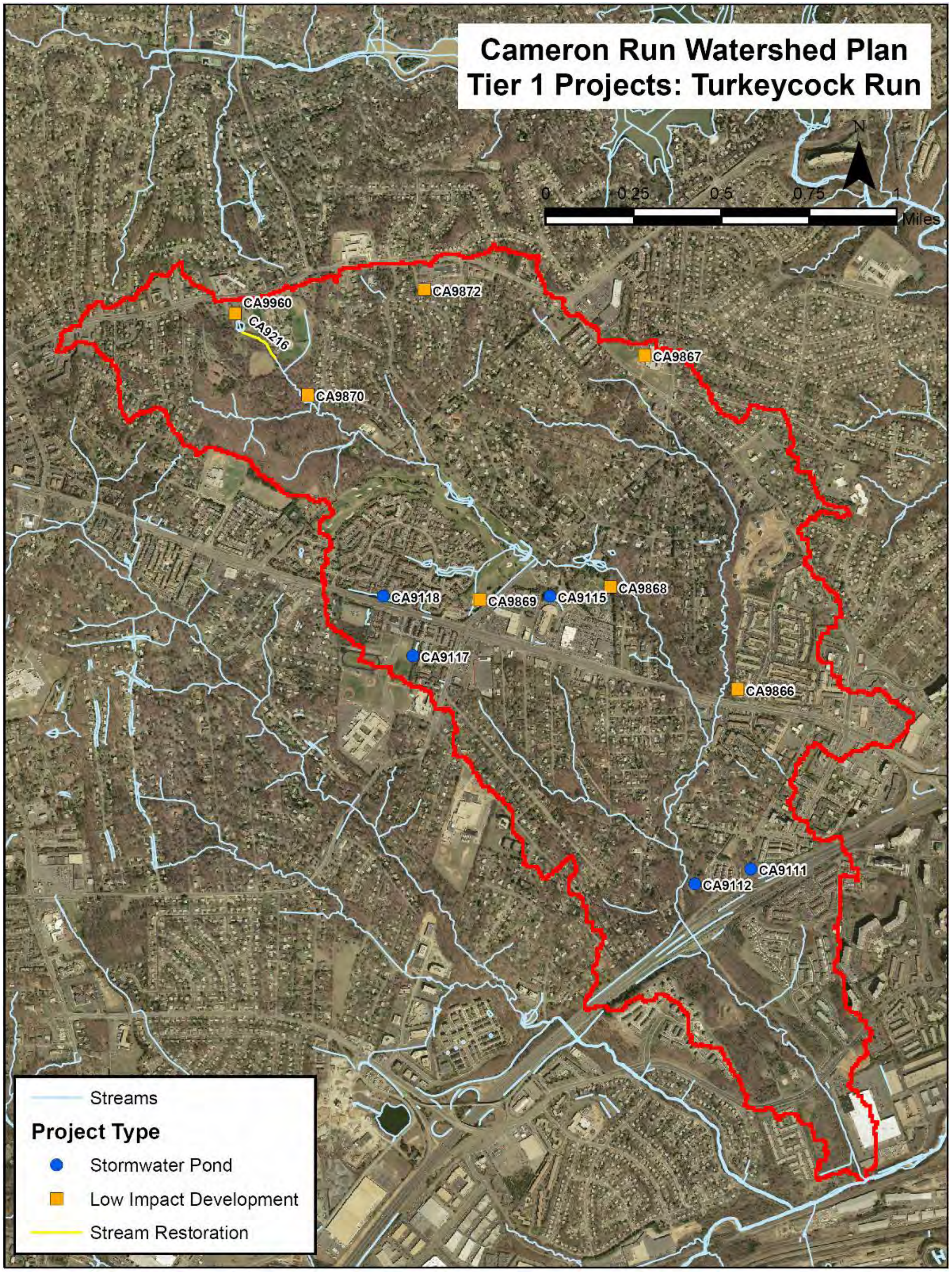


Figure 6-10. Turkeycock Run – Tier 1 candidate restoration sites

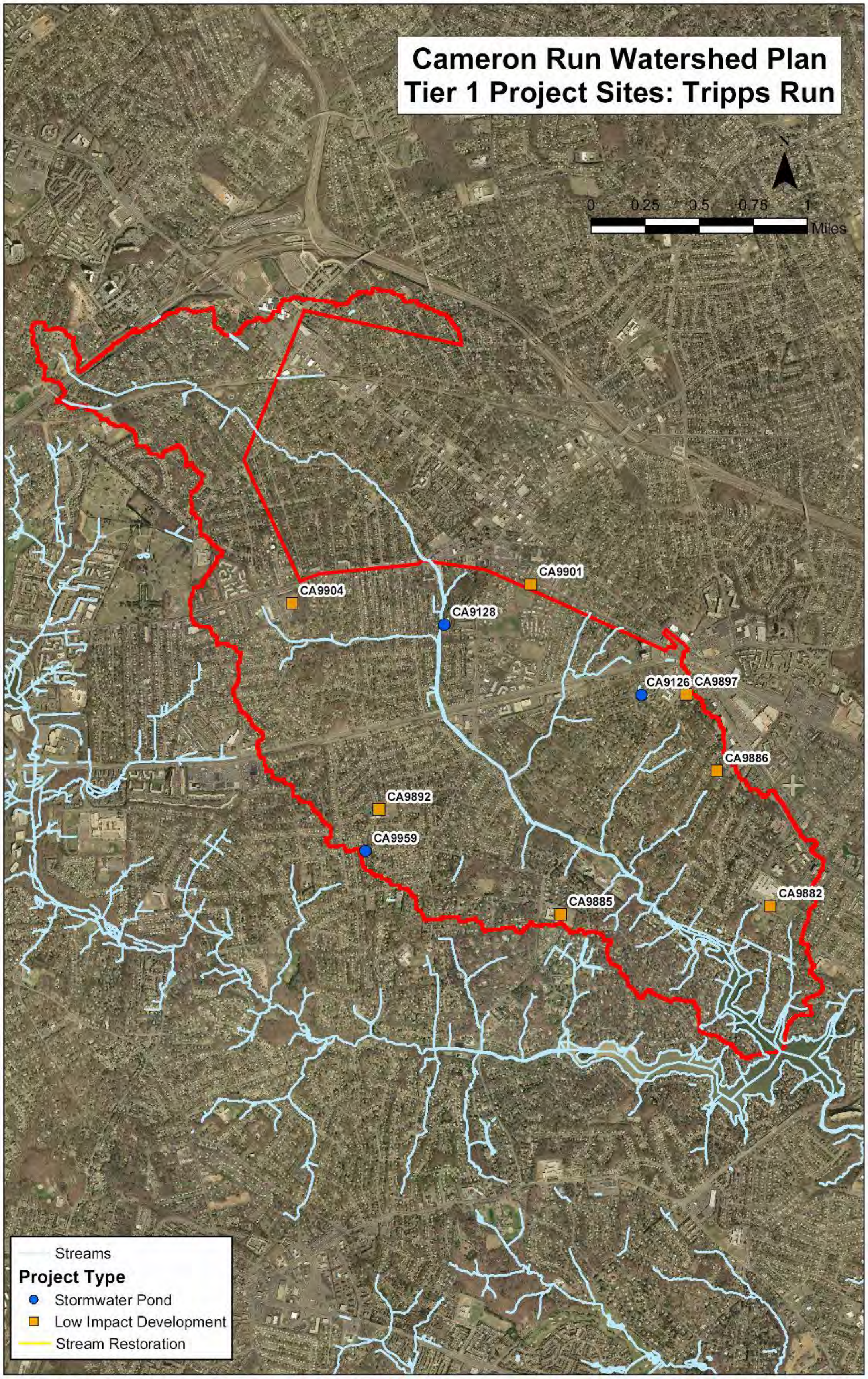


Figure 6-11. Tripps Run – Tier 1 candidate restoration sites

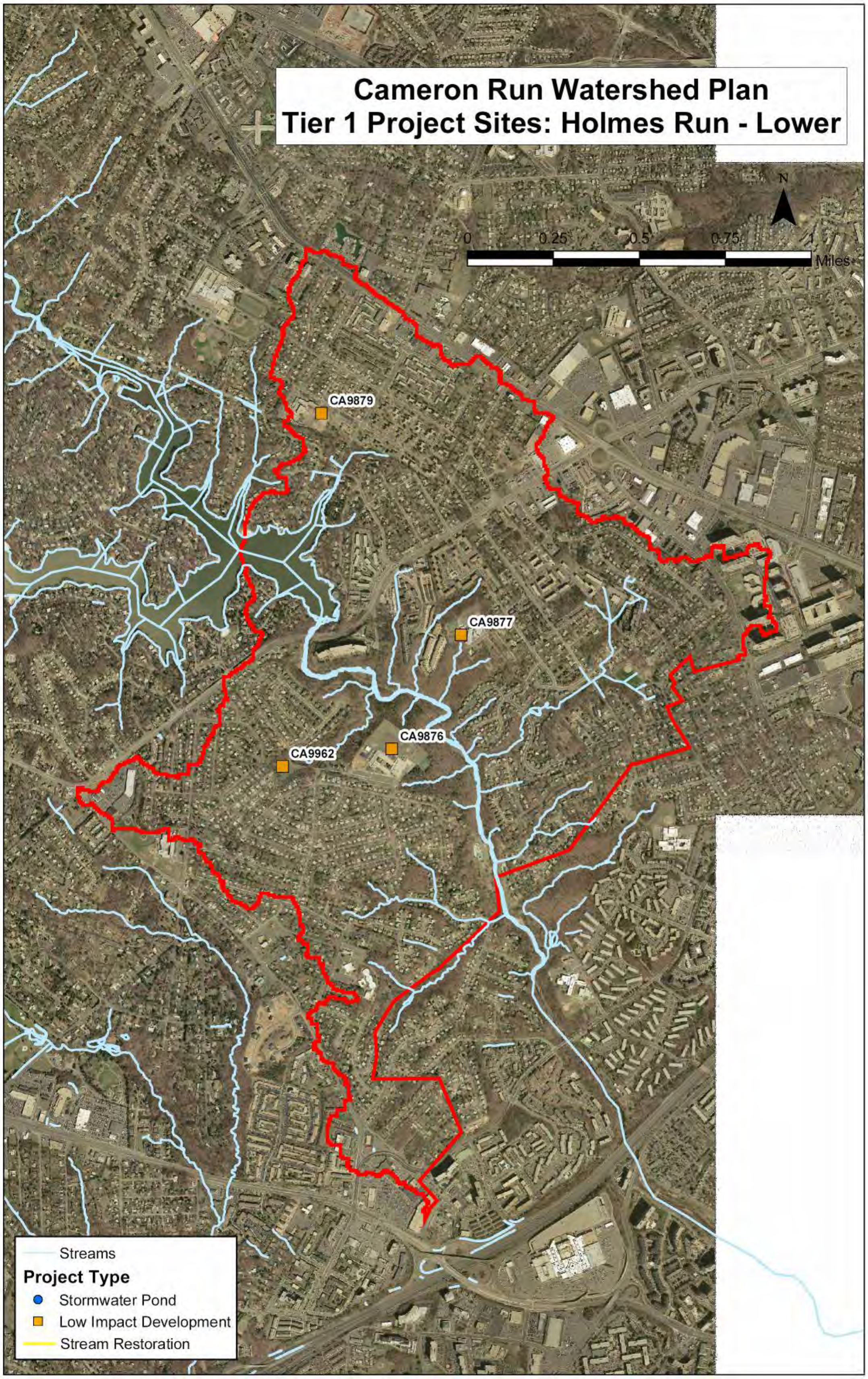


Figure 6-12. Holmes Run (Lower) – Tier 1 candidate restoration sites

because the Cameron Run watershed is highly developed; therefore, opportunities for BMPs are limited in many areas. Table 6-10 shows pollutant reductions by subwatershed if the proposed BMP projects are all implemented.

The selected stream restoration projects are expected to improve stream habitat and water quality. To quantify the benefits of the proposed stream restoration projects, the county's stream condition index (SCI) rating (modified from USACE and VDEQ 2003) was applied to determine the increase in stream habitat and reduction in erosion and sediment loss (Table 6-11). Briefly, the SCI is determined by looking at five variables within the stream and rating them from 1.0 (worst) to 5.0 (best). Each stream restoration project will gain a certain number of habitat units per the SCI index. In addition, the stream restoration projects in the plan will improve a certain number of stream miles from one condition class to another (e.g., very poor habitat to fair habitat), with assumed increases in the abundance and diversity of stream life. The county's application of the SCI index was based on stream condition data gathered during the 2002 SPA. Although the stream in Mason District Park (Project ID CA9216) was not surveyed during the SPA and sufficient data were not available to calculate the SCI for this project, similar improvements of stream condition as a result of the restoration project are anticipated.

6.6 IMPLEMENTATION OF THE PLAN

The policy recommendations and project actions will be implemented over the 25-year life of the Cameron Run Watershed Plan. This plan should serve as guidance for all county agencies and officials to protect and maintain the health of the Cameron Run watershed. The plan should be considered as an active, or "living," document that is revisited every five years. Most of the selected projects are on property owned by Fairfax County. This facilitates the coordination needed for implementation. Selected projects that would require access to privately owned property will be coordinated with landowners to obtain their approval early in the design phase.

6.6.1 Policy Recommendations

Fairfax County will review the policy recommendations described in Section 6.3 to evaluate countywide implications and to compare them with similar recommendations provided in other watershed management plans for the county. If ordinance amendments are needed, they will be developed to include other county initiatives and address the common ground that can be established between the various policy recommendations.

The first step in developing an implementation schedule was to prioritize the recommendations and evaluate how well they meet the goals of the plan. A weighted set of five criteria was used to prioritize each recommendation. The following criteria were used: Board Adopted Stormwater Control Project Prioritization Categories (40%); Direct Regulatory Contribution (10%); Effectiveness/Location (25%); and Ease of Implementation (15%). The recommendations in the plan were scored on a scale of 1 (worst) to 5 (best) for each of the criteria. The recommendations were ranked according to their total score, from highest to lowest. Table 6-12 shows the resulting priority of policy recommendations.

Table 6-10. Pollutant loading by subwatershed in Cameron Run

Subwatershed	Total Suspended Solids				Total Phosphorus				Total Nitrogen			
	Future (lb/ac/yr)	Future with Proposed BMPs (lb/ac/yr)	Reduction (lb/ac/yr)	% Decrease	Future (lb/ac/yr)	Future with Proposed BMPs (lb/ac/yr)	Reduction (lb/ac/yr)	% Decrease	Future (lb/ac/yr)	Future with Proposed BMPs (lb/ac/yr)	Reduction (lb/ac/yr)	% Decrease
Backlick Run	265	253	13	4.7	1.25	1.21	0.04	3.2	11.1	10.8	0.3	2.7
Holmes Run Lower	215	209	6	2.6	1.16	1.13	0.03	2.3	9.8	9.6	0.2	2.3
Holmes Run Upper	247	231	16	6.3	1.23	1.16	0.07	5.3	10.6	10.0	0.6	5.3
Indian Run	234	220	15	6.2	1.23	1.17	0.06	5.1	10.5	10.0	0.5	5.2
Pike Branch	240	235	5	2.0	1.32	1.29	0.02	1.8	11.2	11.0	0.2	1.8
Tributaries to CR	254	247	7	2.6	1.33	1.31	0.02	1.4	11.4	11.2	0.1	1.3
Tripps Run	233	223	10	4.3	1.29	1.25	0.04	2.8	10.8	10.5	0.3	2.7
Turkeycock Run	203	186	17	8.3	1.13	1.06	0.07	6.5	9.6	9.0	0.6	6.3
Cameron Run Weighted Average	243	231	12	4.9	1.24	1.20	0.05	3.8	10.7	10.3	0.4	3.6

Table 6-11. Stream Condition Index scores

Project ID	Project Name	Existing SCI	Proposed SCI	Increase in SCI
CA9210	Brook Hill Stream Restoration	2.98	3.35	11%
CA9208	Wilburdale Park Bank Stabilization	2.65	3.20	17%
CA9207	Wilburdale Park Stream Restoration	2.95	3.35	12%
CA9216	Mason District Park Stream Restoration - A	*	*	*

* Insufficient data to calculate SCI

Table 6-12. Priority of policy recommendations							
Recommen-dation ID	**Project Name**	**Board Adopted Categories** (40%)	**Direct Regulatory Contribution** (10%)	**Public Support** (10%)	**Effectiveness/ Location Rating** (25%)	**Ease of Implementa-tion Rating** (15%)	**Total Score**
A2.1	Encourage approval of LID facilities as acceptable SWM; adopt policy preferring LID projects	3	4	4	4	5	3.75
A1.5	Retrofit and upgrade SWM facilities and BMPs; construct new BMPs including LID practices	3	4	4	4	3	3.45
A3.3	Provide incentives to developers, builders, etc. to reduce runoff by using conservation design/LID	3	4	4	4	3	3.45
A4.1	Facilitate construction and use of LID practices, initially targeting areas near headwaters	3	4	4	4	3	3.45
A1.4	Evaluate current list of recommended BMPs; add some newer practices (LID)	3	4	4	3	4	3.35
A1.8	Increase fines for noncompliance with BMP or LID requirements	3	4	4	3	4	3.35
A3.1	Amend ordinances to require that redevelopment demonstrate 10% net decrease in runoff	3	4	4	4	2	3.3
A3.2	Amend zoning regulations to encourage better design of new development to reduce runoff	3	4	4	4	2	3.3
A1.6	Enact new policy to require on-site water retention in all land disturbance projects	3	4	4	3	3	3.2
A1.9	Coordinate SWM activities with neighboring jurisdictions, including annual reviews	3	4	4	3	3	3.2
A3.5	Conduct frequent inspections to ensure compliance with permit conditions concerning landscaping	3	4	4	3	3	3.2
D2.3	Evaluate, through a literature review or formal study, the effectiveness of public education programs for watershed stewardship.	2	4	4	4	4	3.2
A1.1	Inspect BMPs and perform assessments every 5 years (county and VDOT)	3	4	4	4	1	3.15

Table 6-12. (Continued)

Recommen-dation ID	Project Name	Board Adopted Categories (40%)	Direct Regulatory Contribution (10%)	Public Support (10%)	Effectiveness/ Location Rating (25%)	Ease of Implementation Rating (15%)	Total Score
B1.3	Require restoration of buffer for RPA development; mandate native vegetation mixes	2	2	4	4	5	3.15
A1.2	Provide additional staff/resources to county for BMP review and inspection	3	4	4	2	4	3.1
A1.3	Increase frequency of inspection of BMPs to annually; provide maintenance education	3	4	4	2	4	3.1
A1.7	Do not grant waivers of water quality controls for nonbonded lots with > 18% imperviousness	3	4	4	2	4	3.1
A4.2	Involve the public in early stages of planning of watershed projects; maintain communication	3	4	4	2	4	3.1
A5.1	Require road widening projects to control runoff from existing paved areas w/o SWM controls	3	4	4	3	2	3.05
C1.1	Provide additional staff/resources to inspect development projects for erosion/ sediment controls	2	3	3	4	4	3
B1.1	Plant buffers using native vegetation and trees; monitor buffers for 5 years	2	2	4	4	4	3
B1.2	Provide additional staff/resources for buffer protection in RPAs; ensure adequate training	2	2	4	4	4	3
B2.3	Implement natural and water conserving landscaping at county facilities	2	2	4	4	4	3
C1.3	Reduce the amount of de-icing chemicals and sand entering surface waters of watershed	2	3	3	3	4	2.75
C2.2	Perform additional water quality monitoring including macroinvertebrate/aquatic plant surveys	2	3	3	3	4	2.75
C2.3	Identify, investigate, and prosecute illicit discharges from commercial and residential activities	2	3	3	3	4	2.75
A3.4	Limit removal of mature trees and native vegetation in any development or renovation	2	2	4	3	4	2.75
B1.4	Provide educational assistance regarding buffers to property owners with tidal shorelines or streams	2	2	4	3	4	2.75

Table 6-12. (Continued)

Recommen-dation ID	Project Name	Board Adopted Categories (40%)	Direct Regulatory Contribution (10%)	Public Support (10%)	Effectiveness/ Location Rating (25%)	Ease of Implementation Rating (15%)	Total Score
B2.1	Monitor and report on stream condition by performing stream physical assessments	2	2	4	3	4	2.75
B2.2	Facilitate acquisition/donation of easements to community groups for buffer/stream protection	2	2	4	3	4	2.75
B3.1	Perform wetlands functions-and-values survey to identify characteristics of existing wetlands	2	2	4	3	4	2.75
C3.3	Place containers at public facilities for recycling and install signs requesting sorting, fines for littering	2	2	4	3	4	2.75
B3.3	Purchase, designate, acquire land for conservation of critical wetland habitat areas	2	2	4	4	2	2.7
C2.1	Identify sources of fecal coliform in watershed; prepare action plan to reduce it	2	3	3	3	3	2.6
C2.5	Encourage all lawn management companies to participate in VA Water Quality Improvement Program; create a “green label” program for lawn/landscaping companies	2	3	3	3	3	2.6
A5.2	Replace grasses on medians and sides of roadway with native trees and vegetation where possible	2	2	4	3	3	2.6
B1.5	Amend ordinance to expand woodlands; survey existing trees and builder requirements	2	2	4	3	3	2.6
B1.6	Determine current level of mature tree canopy; establish a reforestation goal	2	2	4	3	3	2.6
B3.2	Construct and restore wetlands at suitable locations as identified in wetland survey	2	2	4	3	3	2.6
A3.6	Allocate sufficient funding for county inspection and enforcement of landscaping regulations	2	2	4	2	4	2.5
B2.4	Notify property owners on steps for improving water quality in their streams	2	3	3	2	4	2.5
B3.4	Provide outreach materials for value/benefit of wetlands, permits required for wetland activities	2	2	4	2	4	2.5
B3.5	Discourage further development in native wetlands; require mitigation when impacts are unavoidable	2	2	4	2	4	2.5

Table 6-12. (Continued)							
Recommen-dation ID	**Project Name**	**Board Adopted Categories** (40%)	**Direct Regulatory Contribution** (10%)	**Public Support** (10%)	**Effectiveness/ Location Rating** (25%)	**Ease of Implementation Rating** (15%)	**Total Score**
C1.2	Encourage application of bioengineering to stabilize streambanks and improve habitat	2	3	3	2	4	2.5
C2.4	Educate public on ways to reduce pollutants in stormwater runoff	2	3	3	2	4	2.5
C2.6	Strengthen enforcement of "pooper scooper" regulation; institute $100 fine for violators	2	3	3	2	4	2.5
C3.1	Partner to clean up trash, woody debris, dumpsites throughout watershed	2	2	4	2	4	2.5
C3.2	Conduct vigorous public info campaign to deter littering and trash dumping	2	2	4	2	4	2.5
C3.4	Enforce solid waste and ESC ordinances against illegal dumping; impose fines/require restoration	2	3	3	2	4	2.5
D2.1	Post signage publicizing existence and importance of RPAs for stream protection and recreation	2	2	2	2	4	2.3
D2.2	Install signage at public facilities explaining benefits of LID; identify sources for further information	2	2	2	2	4	2.3
D1.2	Develop master plan for environmentally friendly recreation opportunities in Cameron Run	1	1	2	3	4	2.05
D1.1	Identify stream corridors for purchase for public access and environmentally friendly recreation	1	1	2	2	4	1.8

6.6.2 Project Actions

As described in Section 5.4.3, the county's stormwater project prioritization guidance, in conjunction with a cost-benefit analysis, was used to select and rank the Tier 1 candidate projects. Projects are listed by subwatershed, with those having a better cost-benefit ratio listed first (Table 6-13). Drainage complaint projects are not included in this table because they were prioritized using a separate process (see Section 6.4.7).

Table 6-13. Priority of proposed projects

Project ID	Project Name	Board Adopted Categories (40%)	Direct Regulatory Contribution (10%)	Public Support (10%)	Effectiveness/ Location Rating (25%)	Ease of Implementation Rating (15%)	Total Score	Acres Treated	Site Footprint (Acres)	Estimated Cost	Cost (Normalized)/ Benefit Ratio
Watershed-wide											
CA9700	Instream Debris Jam Evaluation and Removal	4	2	3	3	2	3.15	28,400		$286,000	3
CA9702	Small Watershed Grant Program	4.5	5	5	4	3	4.25	28,400		$1,094,000	9
CA9701	Community Watershed Restoration Support	4.5	5	5	4	3	4.25	28,400		$1,407,000	12
Pike Branch											
CA9802	Jefferson Manor Park Bioretention	4.5	4	5	4	5	4.45	9.2		$ 73,000	1,783
CA9809	Ridgeview Park LID – A	4.5	4	3	4	4	4.1	2.9		$ 59,000	4,962
CA9804	Mount Eagle Elementary School LID	4.5	5	3	5	5	4.6	5.9		$210,000	7,738
CA9808	Lee District Park LID	4.5	5	3	5	5	4.6	43.4		$1,589,000	7,959
CA9810	Ridgeview Park LID - B	4.5	4	3	5	4	4.35	7.6		$414,000	12,523
CA9805	Wilton Administration Center LID	4.5	5	3	5	5	4.6	6.6		$460,000	15,152
CA9807	Virginia Hills Administration Center (School) LID	4.5	5	3	5	5	4.6	4.8		$352,000	15,942
CA9811	Redwood Lane - LID	4.5	4	3	4	4	4.1	2.9		$211,000	17,746
CA9812	Ridge View Drive - LID	4.5	4	3	5	5	4.5	3.1		$249,000	17,849
CA9813	John Marshall Library LID	4.5	5	3	5	5	4.6	1.8		$246,000	29,710
Backlick Run											
CA9848	Leewood Park LID - B	4.5	4	3	3	4	3.85	6.6		$ 13,000	512
CA9103	Woodfield SWM Pond Retrofit	4.5	4	3	4	4	4.1	102.1		$276,000	659
CA9104	Thomas SWM Pond Retrofit	4.5	5	3	4	5	4.35	39.3		$148,000	866
CA9846	Leewood Park LID - A	4.5	4	3	3	4	3.85	11.4		$ 39,000	889
CA9107	Jayhawk SWM Pond Retrofit	4.5	5	3	4	5	4.35	46.3		$236,000	1,172
CA9850	Wilburdale Park LID - A	4.5	4	5	5	5	4.7	25.6		$156,000	1,297
CA9958	Lynbrook Subdivision LID - A	4.5	4	3	4	5	4.25	14.7		$ 89,000	1,425
CA9829	Franconia Park LID	4.5	5	3	4	5	4.35	12.8		$126,000	2,263
CA9851	Wilburdale Park LID - B	4.5	4	3	4	5	4.25	6.0		$ 97,000	3,804
CA9853	Annandale High School LID	4.5	5	3	5	5	4.6	17.7		$420,000	5,158
CA9842	Lynbrook Elementary School LID	4.5	5	3	4	5	4.35	11.0		$254,000	5,308
CA9828	Fire Station - Company No. 5 LID	4.5	4	3	4	5	4.25	2.6		$ 71,000	6,425
CA9830	Edsall Administration Center LID	4.5	5	3	5	5	4.6	4.5		$139,000	6,715
CA9827	Lee District Government Center LID	4.5	5	3	5	5	4.6	3.1		$209,000	14,656
CA9208	Wilburdale Park Bank Stabilization	4	5	3	3	4	3.75	-	2.8	$169,000	16,359
CA9836	Lee High School LID	4.5	5	3	5	5	4.6	42.1		$3,421,000	17,665
CA9207	Wilburdale Park Stream Restoration	4	5	3	3	4	3.75	-	3.6	$320,000	23,556
CA9210	Brook Hill Stream Restoration	3	5	5	4	3	3.65	-	12.6	$1,171,000	25,530

Table 6-13. (Continued)

Project ID	Project Name	Board Adopted Categories (40%)	Direct Regulatory Contribution (10%)	Public Support (10%)	Effectiveness/ Location Rating (25%)	Ease of Implementation Rating (15%)	Total Score	Acres Treated	Site Footprint (Acres)	Estimated Cost	Cost (Normalized)/ Benefit Ratio
Backlick Run (Continued)											
CA9839	Key Middle School LID	4.5	5	3	5	5	4.6	21.3		$2,745,000	28,016
CA9835	Springfield Elementary School LID	4.5	5	3	5	5	4.6	10.2		$1,356,000	28,900
Tributaries to Cameron Run											
CA9100	Farrington Park SWM Pond Retrofit	4.5	5	3	4	5	4.35	13.8		$ 61,000	1,016
CA9102	Huntington Park SWM Pond	4.5	5	3	4	5	4.35	16.7		$ 98,000	1,349
CA9823	Bush Hill Elementary School LID	4.5	5	3	5	5	4.6	9.6		$183,000	4,144
CA9821	Clermont Elementary School LID	4.5	5	3	5	5	4.6	12.4		$308,000	5,400
CA9818	Clermont School Site Park LID	4.5	4	3	3	4	3.85	1.1		$ 49,000	11,570
CA9822	Twain Middle School LID	4.5	5	3	5	5	4.6	9.6		$660,000	14,946
Holmes Run - Upper											
CA9139	Kings Glen SWM Pond Retrofit	4.5	5	3	4	4	4.2	81.8		$243,000	707
CA9929	Round Tree Park LID - A	4.5	4	3	5	4	4.35	16.0		$ 52,000	747
CA9914	Columbia Pines LID	4.5	4	3	5	4	4.35	28.1		$ 96,000	785
CA9954	Jefferson District Park & Golf Course LID	4.5	5	5	4	5	4.55	59.7		$236,000	869
CA9134	Columbia Pines SWM Pond Retrofit	4.5	5	3	4	4	4.2	7.7		$ 30,000	928
CA9142	Courts of Tyson SWM Pond Retrofit	4.5	5	3	4	4	4.2	6.5		$ 31,000	1,136
CA9942	Luria Park LID	4.5	4	3	5	5	4.5	57.1		$355,000	1,382
CA9138	Providence RECenter SWM Pond Retrofit	4.5	5	5	4	5	4.55	4.5		$102,000	4,982
CA9949	Graham Road Elementary School LID	4.5	5	3	5	5	4.6	4.7		$127,000	5,874
CA9953	Shrevewood Elementary School LID	4.5	5	3	5	5	4.6	11.8		$359,000	6,614
CA9927	Round Tree Park LID - C	4.5	4	3	4	5	4.25	6.8		$195,000	6,747
CA9911	Belvedere Elementary School LID	4.5	5	3	5	5	4.6	9.9		$325,000	7,137
CA9950	Pine Spring Elementary School LID	4.5	5	3	5	5	4.6	11.1		$576,000	11,281
CA9921	Broyhill Crest Park LID	4.5	4	3	4	5	4.25	2.4		$132,000	12,941
CA9952	Timber Lane Elementary School LID	4.5	5	3	5	5	4.6	9.7		$606,000	13,581
CA9946	Falls Church High School LID	4.5	5	3	5	5	4.6	38.1		$2,772,000	15,817
CA9955	Dunn Loring Center (School) LID	4.5	5	3	5	5	4.6	9.1		$722,000	17,248
CA9947	Thomas Jefferson Library LID	4.5	5	3	5	5	4.6	2.2		$179,000	17,688
CA9957	Fire Station - Company No. 13 LID	4.5	4	3	5	5	4.5	1.5		$132,000	19,556
CA9925	Holmes Run Stream Valley Park LID	4.5	4	3	4	5	4.25	0.9		$ 87,000	22,745
CA9917	Beech Tree Elementary School LID	4.5	5	3	5	5	4.6	7.8		$1,409,000	39,270
CA9922	Lacey Admin Center LID	4.5	5	3	5	5	4.6	6.7		$1,317,000	42,732
CA9941	Woodburn Elementary School LID	4.5	5	3	5	5	4.6	6.1		$1,342,000	47,826

Table 6-13. (Continued)

Project ID	Project Name	Board Adopted Categories (40%)	Direct Regulatory Contribution (10%)	Public Support (10%)	Effectiveness/ Location Rating (25%)	Ease of Implementation Rating (15%)	Total Score	Acres Treated	Site Footprint (Acres)	Estimated Cost	Cost (Normalized)/ Benefit Ratio
Holmes Run – Upper (Continued)											
CA9937	Walnut Hill Admin Center LID - B	4.5	5	3	5	5	4.6	8.7		$2,953,000	73,788
Indian Run											
CA9857	Weyanoke Elementary School LID	4.5	5	3	5	5	4.6	5.9		$124,000	4,569
CA9862	Columbia Elementary School LID	4.5	5	3	5	5	4.6	5.5		$134,000	5,296
CA9858	Poe Middle School LID	4.5	5	3	5	5	4.6	9.6		$248,000	5,616
CA9860	Indian Run Stream Valley Park LID - A	4.5	4	3	4	5	4.25	9.9		$334,000	7,938
CA9854	Bren Mar Park Elementary School LID	4.5	5	3	4	5	4.35	5.5		$230,000	9,613
CA9855	Fire Station - Company No. 26 LID	4.5	4	3	5	5	4.5	1.8		$131,000	16,173
CA9863	George Mason Regional Library LID	4.5	5	3	5	5	4.6	5.1		$403,000	17,178
CA9856	Holmes Middle School LID	4.5	5	3	5	5	4.6	17.5		$1,593,000	19,789
CA9859	Indian Run Stream Valley Park LID - C	4.5	4	3	4	5	4.25	3.9		$516,000	31,131
CA9861	Indian Run Stream Valley Park LID - B	4.5	4	3	4	5	4.25	3.6		$543,000	35,490
Turkeycock Run											
CA9118	Pinecrest SWM Pond Retrofit	4.5	5	3	4	5	4.35	13.3		$ 69,000	1,193
CA9866	Turkeycock Run Stream Valley Park LID	4.5	4	3	4	4	4.1	34.4		$198,000	1,404
CA9117	Braddock Place SWM Pond Retrofit	4.5	5	3	4	5	4.35	7.4		$ 49,000	1,522
CA9111	Beauregard SWM Pond Retrofit	4.5	5	3	3	4	3.95	3.5		$ 25,000	1,808
CA9115	Little River SWM Pond Retrofit	4.5	5	3	4	5	4.35	3.9		$ 33,000	1,945
CA9112	Strawbridge Square SWM Pond Retrofit	4.5	5	3	3	5	4.1	2.0		$ 25,000	3,049
CA9867	Parklawn Elementary School LID	4.5	5	3	5	5	4.6	11.1		$168,000	3,290
CA9960	Mason District Park LID	4.5	4	3	5	5	4.5	5.1		$120,000	5,229
CA9872	Mason Government Center LID	4.5	5	3	5	5	4.6	6.6		$220,000	7,246
CA9870	Wolftree Lane LID	4.5	4	3	5	5	4.5	8.6		$286,000	7,390
CA9869	Pinecrest Golf Course LID	4.5	4	3	4	4	4.1	1.9		$ 78,000	10,013
CA9868	Green Spring Gardens LID	4.5	4	3	3	5	4	1.1		$ 99,000	22,500
CA9216	Mason District Park Stream Restoration - A	3	5	5	5	5	4.2	-	4.8	$996,000	49,378
Tripps Run											
CA9959	Anna Lee Heights LID	4.5	4	3	5	4	4.35	16.8		$ 77,000	1,054
CA9128	Great Oak SWM Pond Retrofit	4.5	5	3	4	5	4.35	18.9		$ 89,000	1,083
CA9126	Dominion SWM Pond Retrofit	4.5	5	5	4	4	4.4	8.3		$ 61,000	1,670
CA9892	Westlawn Elementary School LID	4.5	5	3	5	5	4.6	8.0		$117,000	3,179
CA9901	Larry Graves Park LID	4.5	5	3	4	5	4.35	1.2		$ 41,000	7,854
CA9886	Nicholson St - Ch. 2 Street LID	4.5	4	5	4	5	4.45	2.4		$100,000	9,363

Table 6-13. (Continued)

Project ID	Project Name	Board Adopted Categories (40%)	Direct Regulatory Contribution (10%)	Public Support (10%)	Effectiveness/ Location Rating (25%)	Ease of Implementation Rating (15%)	Total Score	Acres Treated	Site Footprint (Acres)	Estimated Cost	Cost (Normalized)/ Benefit Ratio
Tripps Run (Continued)											
CA9897	Fire Station - Company No. 28 LID	4.5	5	3	5	5	4.6	0.5		$ 23,000	10,000
CA9885	Sleepy Hollow Elementary School LID	4.5	5	3	5	5	4.6	9.2		$455,000	10,751
CA9904	Devonshire Administration Center (School) LID	4.5	5	3	5	5	4.6	5.3		$288,000	11,813
CA9882	JEB Stuart High School LID	4.5	5	5	5	5	4.8	23.6		$1,881,000	16,605
Holmes Run - Lower											
CA9962	Holmes Run Park LID	4.5	4	3	5	5	4.5	8.0		$158,000	4,389
CA9876	Glasgow Middle School LID	4.5	5	3	5	5	4.6	22.6		$703,000	6,762
CA9877	Baileys Community Center LID	4.5	5	3	5	5	4.6	6.9		$351,000	11,059
CA9879	Baileys Elementary School LID	4.5	5	3	5	5	4.6	9.6		$1,535,000	34,760

The 25-year implementation plan for structural and nonstructural projects is shown in Table 6-14. Projects have been placed into one of five implementation groups, based on relative priority. The five-year implementation groups are listed below:

Group A:	Fiscal Year 2007 – 2011
Group B:	Fiscal Year 2012 – 2016
Group C:	Fiscal Year 2017 – 2021
Group D:	Fiscal Year 2022 – 2026
Group E:	Fiscal Year 2027 – 2031

The dates for implementation are target dates, beginning with Board approval of the plan, and subject to County funding approval and ongoing updates to the plan. Implementation groupings for projects with specific locations are shown in Figures 6-13 through 6-17. Although not included in the following table or figures, implementation of the separate drainage complaint projects is targeted for the initial five-year period,

Some of the actions in the implementation plan were scheduled with the assistance of the Advisory Committee according to the following important factors in addition to the priority ratings:

- high visibility and opportunity for public education at a variety of kinds of facilities
- logical progression of actions, such as starting upstream flow-reduction actions before downstream restoration actions
- spreading of actions throughout the watershed during the plan period, not concentrating early actions in one area
- spreading costs out throughout the plan period

Table 6-14. Implementation of proposed projects

Project ID	Project Name	Implementation Timeframe	Estimated Cost
Watershed-wide			
CA9700	Instream Debris Jam Evaluation and Removal	A	$286,000
CA9702	Small Watershed Grant Program	A	$1,094,000
CA9701	Community Watershed Restoration Support	A	$1,407,000
Pike Branch			
CA9802	Jefferson Manor Park Bioretention	B	$73,000
CA9809	Ridgeview Park LID - A	B	$59,000
CA9804	Mount Eagle Elementary School LID	B	$210,000
CA9808	Lee District Park LID	A	$1,589,000
CA9810	Ridgeview Park LID - B	C	$414,000
CA9805	Wilton Administration Center LID	A	$460,000
CA9807	Virginia Hills Administration Center (School) LID	A	$352,000
CA9811	Redwood Lane - LID	D	$211,000
CA9812	Ridge View Drive - LID	D	$249,000
CA9813	John Marshall Library LID	A	$246,000

Table 6-14. (Continued)

Project ID	Project Name	Implementation Timeframe	Estimated Cost
Backlick Run			
CA9848	Leewood Park LID - B	A	$13,000
CA9103	Woodfield SWM Pond Retrofit	A	$276,000
CA9104	Thomas SWM Pond Retrofit	A	$148,000
CA9846	Leewood Park LID - A	A	$39,000
CA9107	Jayhawk SWM Pond Retrofit	A	$236,000
CA9850	Wilburdale Park LID - A	A	$156,000
CA9958	Lynbrook Subdivision LID - A	B	$89,000
CA9829	Franconia Park LID	B	$126,000
CA9851	Wilburdale Park LID - B	B	$97,000
CA9853	Annandale High School LID	B	$420,000
CA9842	Lynbrook Elementary School LID	B	$254,000
CA9828	Fire Station - Company No. 5 LID	B	$71,000
CA9830	Edsall Administration Center LID	A	$139,000
CA9827	Lee District Government Center LID	A	$209,000
CA9208	Wilburdale Park Bank Stabilization	C	$169,000
CA9836	Lee High School LID	D	$3,421,000
CA9207	Wilburdale Park Stream Restoration	D	$320,000
CA9210	Brook Hill Stream Restoration	D	$1,171,000
CA9839	Key Middle School LID	D	$2,745,000
CA9835	Springfield Elementary School LID	E	$1,356,000
Tributaries to Cameron Run			
CA9100	Farrington Park SWM Pond Retrofit	A	$61,000
CA9102	Huntington Park SWM Pond	A	$98,000
CA9823	Bush Hill Elementary School LID	B	$183,000
CA9821	Clermont Elementary School LID	B	$308,000
CA9818	Clermont School Site Park LID	C	$49,000
CA9822	Twain Middle School LID	C	$660,000
Holmes Run - Upper			
CA9139	Kings Glen SWM Pond Retrofit	B	$243,000
CA9929	Round Tree Park LID - A	A	$52,000
CA9914	Columbia Pines LID	A	$96,000
CA9954	Jefferson District Park & Golf Course LID	A	$236,000
CA9134	Columbia Pines SWM Pond Retrofit	A	$30,000
CA9142	Courts of Tyson SWM Pond Retrofit	C	$31,000
CA9942	Luria Park LID	B	$355,000
CA9138	Providence RECenter SWM Pond Retrofit	B	$102,000
CA9949	Graham Road Elementary School LID	C	$127,000
CA9953	Shrevewood Elementary School LID	B	$359,000
CA9927	Round Tree Park LID - C	B	$195,000
CA9911	Belvedere Elementary School LID	B	$325,000
CA9950	Pine Spring Elementary School LID	C	$576,000
CA9921	Broyhill Crest Park LID	E	$132,000
CA9952	Timber Lane Elementary School LID	C	$606,000
CA9946	Falls Church High School LID	C	$2,772,000
CA9955	Dunn Loring Center (School) LID	A	$722,000
CA9947	Thomas Jefferson Library LID	A	$179,000

Table 6-14. (Continued)

Project ID	Project Name	Implementation Timeframe	Estimated Cost
Holmes Run – Upper (Continued)			
CA9957	Fire Station - Company No. 13 LID	D	$132,000
CA9925	Holmes Run Stream Valley Park LID	D	$87,000
CA9917	Beech Tree Elementary School LID	E	$1,409,000
CA9922	Lacey Admin Center LID	A	$1,317,000
CA9941	Woodburn Elementary School LID	E	$1,342,000
CA9937	Walnut Hill Admin Center LID - B	B	$2,953,000
Indian Run			
CA9857	Weyanoke Elementary School LID	B	$124,000
CA9862	Columbia Elementary School LID	B	$134,000
CA9858	Poe Middle School LID	B	$248,000
CA9860	Indian Run Stream Valley Park LID - A	B	$334,000
CA9854	Bren Mar Park Elementary School LID	C	$230,000
CA9855	Fire Station - Company No. 26 LID	C	$131,000
CA9863	George Mason Regional Library LID	A	$403,000
CA9856	Holmes Middle School LID	D	$1,593,000
CA9859	Indian Run Stream Valley Park LID - C	E	$516,000
CA9861	Indian Run Stream Valley Park LID - B	E	$543,000
Turkeycock Run			
CA9118	Pinecrest SWM Pond Retrofit	B	$69,000
CA9866	Turkeycock Run Stream Valley Park LID	B	$198,000
CA9117	Braddock Place SWM Pond Retrofit	C	$49,000
CA9111	Beauregard SWM Pond Retrofit	B	$25,000
CA9115	Little River SWM Pond Retrofit	B	$33,000
CA9112	Strawbridge Square SWM Pond Retrofit	B	$25,000
CA9867	Parklawn Elementary School LID	B	$168,000
CA9960	Mason District Park LID	A	$120,000
CA9872	Mason Government Center LID	A	$220,000
CA9870	Wolftree Lane LID	B	$286,000
CA9869	Pinecrest Golf Course LID	C	$78,000
CA9868	Green Spring Gardens LID	D	$99,000
CA9216	Mason District Park Stream Restoration - A	A	$996,000
Tripps Run			
CA9959	Anna Lee Heights LID	C	$77,000
CA9128	Great Oak SWM Pond Retrofit	B	$89,000
CA9126	Dominion SWM Pond Retrofit	C	$61,000
CA9892	Westlawn Elementary School LID	B	$117,000
CA9901	Larry Graves Park LID	B	$41,000
CA9886	Nicholson St - Ch. 2 Street LID	C	$100,000
CA9897	Fire Station - Company No. 28 LID	C	$23,000
CA9885	Sleepy Hollow Elementary School LID	C	$455,000
CA9904	Devonshire Administration Center (School) LID	A	$288,000
CA9882	JEB Stuart High School LID	C	$1,881,000
Holmes Run - Lower			
CA9962	Holmes Run Park LID	B	$158,000
CA9876	Glasgow Middle School LID	B	$703,000
CA9877	Baileys Community Center LID	C	$351,000
CA9879	Baileys Elementary School LID	E	$1,535,000

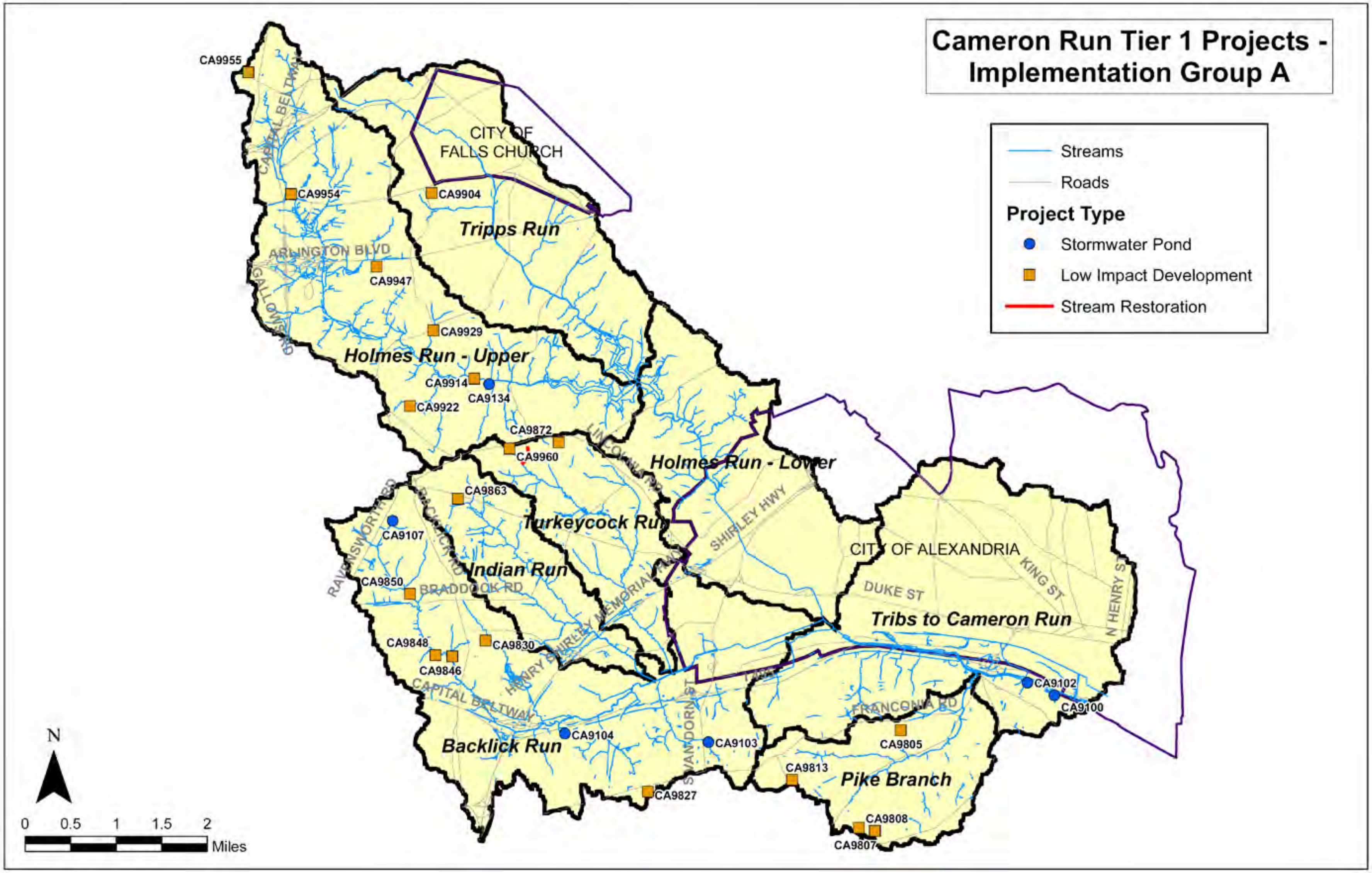


Figure 6-13. Implementation Group A (2007 – 2011)

Figure 6-14. Implementation Group B (2012 – 2016)

Figure 6-15. Implementation Group C (2017 – 2021)

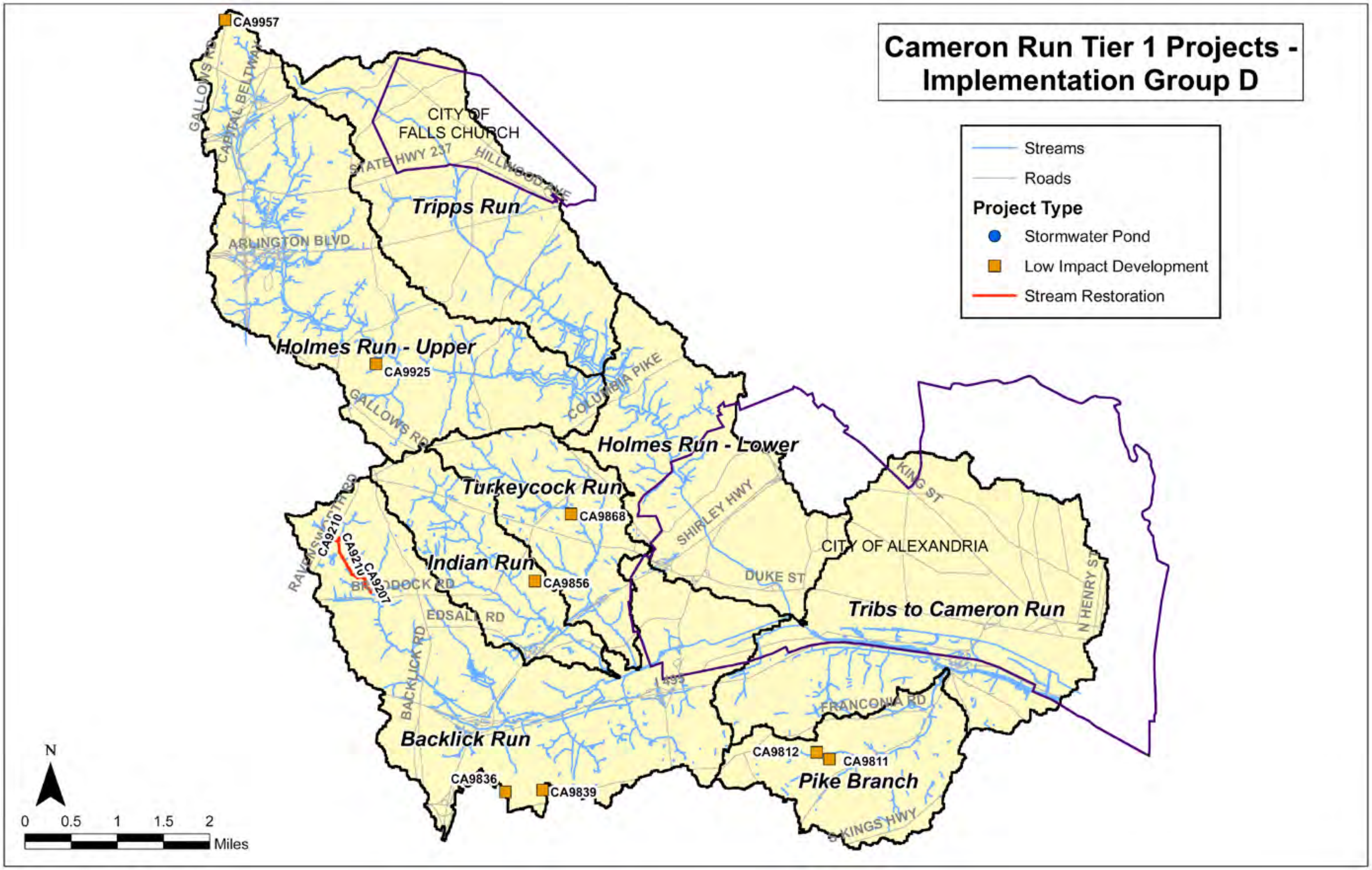


Figure 6-16. Implementation Group D (2022 – 2026)

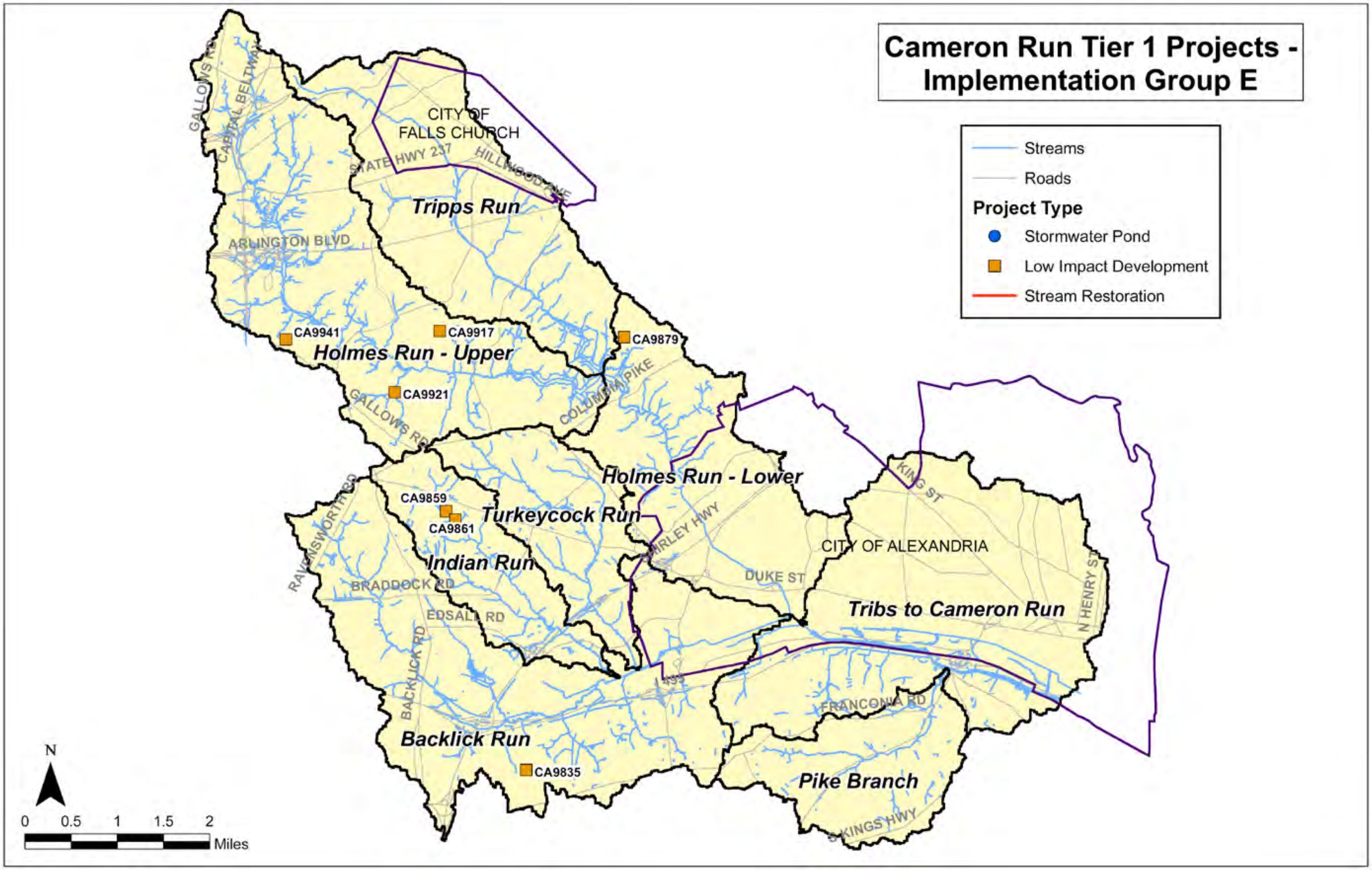


Figure 6-17. Implementation Group E (2027 – 2031)

The 25-year estimated funding requirements for all the structural and nonstructural recommended actions is $47.4 million. The breakdown of funding requirements for each five-year period of the plan is shown in Table 6-15. Estimated costs included in this plan represent actual costs that, in many cases, can be off-set or eliminated through the use of existing staff resources, in-kind services, cost-share programs, donated materials, volunteers, and other means.

Table 6-15. Funding requirements

Implementation Period	Estimated Funding Requirements
Group A: Fiscal Year 2007 – 2011	$11,468,000
Group B: Fiscal Year 2012 – 2016	$9,174,000
Group C: Fiscal Year 2017 – 2021	$8,840,000
Group D: Fiscal Year 2022 – 2026	$10,028,000
Group E: Fiscal Year 2027 – 2031	$6,833,000
Drainage Complaint Projects: Fiscal Year 2007 – 2011	$1,059,000
Total	$47,402,000

During the process of reviewing of the plan, members of the public frequently asked how the plan will be funded. Possible funding sources for the proposed actions in this plan include the general fund, a bond referendum, grants, cost sharing, and a stormwater environmental utility fee. Annual allocations of the general fund for controlling stormwater have ranged from $760,000 to $2.2 million over the past three years. The last stormwater bond referendum to be approved was in 1988 in the amount of $12 million subject to cash flow restrictions. As part of the county Board of Supervisors Environmental Agenda, an additional $17.9 million has been allocated in Fiscal Year 2006 for stormwater program implementation. The county has also signed a memorandum of agreement with the U.S. Army Corps of Engineers to share the cost of restoration projects in the watershed.

6.7 MONITORING PLAN

Monitoring the progress of implementation and the results of individual projects is critical to determining the success or failure of future structural and nonstructural projects and the overall success of the watershed management plan. Evaluation of project actions can also help to determine if the plan should be modified because of a low success rate or as watershed conditions change. As such, the plan should be reviewed annually to evaluate the progress of initiated projects, the overall implementation schedule, funding and staff availability, and future funding needs, using this information to revise the plan as needed.

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Glossary

Abatement: Reducing the degree or intensity of, or eliminating, pollution, as in a water pollution abatement program.

Annual Flood Series: A list of annual floods for a given period of time.

Annual Low-Flow: The lowest flow occurring each year, usually the lowest average flow for periods of perhaps 3, 7, 15, 30, 60, 120, or 180 consecutive days.

Annual Runoff: The total quantity of water in runoff for a drainage area for the year. Data reports may use any of the following units of measurement in presenting annual runoff data: (1) acre-feet (AC-FT, acre-ft, af)– the quantity of water required to cover 1 acre to a depth of 1 foot and is equal to 43,560 cubic feet, 325,851 gallons, or 1,234 cubic meters; (2) cubic feet per second per square mile (CFSM, $(ft^3/s)\ mi^2$) – the average number of cubic feet of water flowing per second from each square mile of area drained, assuming the runoff is distributed uniformly in time and area; (3) inch (In., in.) – the depth to which a drainage area would be covered with water if all the runoff for a given time period was uniformly distributed on it.

Aqueduct: (1) A pipe, conduit, or channel designed to transport water from a remote source, usually by gravity. (2) A bridge-like structure supporting a conduit or canal passing over a river or low ground.

Bacteria: Single celled organisms that can cause diseases.

Berm: (1) A narrow ledge or path as at the top or bottom of a slope, stream bank, or along a beach. (2) (Dam) A horizontal step or bench in the upstream or downstream face of an *Embankment Da*m.

Best Management Practice (BMP): A structural or nonstructural practice that is designed to prevent or reduce the discharge of pollutants to waterbodies and 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. Nonstructural 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. BMPs also include treatment requirements, operating procedures, and practice to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

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 vegetation managed to protect other components of a resource protection area and save waters from significant degradation due to land disturbances, also a R*iparian Buffer*.

Chesapeake Bay Preservation Areas: 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.

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

Channel: A natural or manmade waterway.

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.

Detention Basin: A stormwater management facility that temporarily impounds runoff and discharges it through 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.

Easement: A legal instrument enabling the giving, selling, of taking or certain land or water rights without transfer of title, such as for the passage of utility lines. An affirmative easement gives the owner of the easement the right to use the land for a stated purpose. A negative easement is an agreement with a private property owner to limit the development of his land in specific ways.

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

Embeddedness: The extent to which the spaces between particles on the streambed are filled with sediment.

Environmental Quality Corridor (ECQ): A county policy that aims to protect sensitive areas in stream valleys during the rezoning process. It was the precursor to Resource Protection Areas and is still applied when possible. The EQC policy does not directly address stormwater discharges; however, it is particularly relevant to the County's overall water quality management program as it serves to identify, protect, and, in some cases, restore environmentally-sensitive resources. Specifically, the EQC policy recommends the preservation and restoration of areas including floodplains, steep slopes (slope gradients of 15% or greater) adjacent to streams or floodplains, wetlands connected to stream valleys, minimum stream buffers (variable in width depending on topography), and sensitive habitat areas. While there is no County regulation requiring EQC protection (Resource Protection Area and floodplain provisions in the County Code protect many, but not all, EQC areas), the application of the EQC policy during the zoning process has been effective in protecting, and in some cases restoring, environmentally-sensitive areas.

Erosion: (1) Detachment of soil particles under the influence of water and/or wind. (2) The wearing away and removal of materials of the earth's crust by natural means. (3) The process by which flood waters lower the ground surface in an area by removing upper layers of soil. As usually employed, the term includes weathering, solution, corrosion, and transportation. The agents that accomplish the transportation and cause most of the wear are running water, waves, moving ice, and wind currents. Most writers include under the term all the mechanical and chemical agents of weathering that loosen rock fragments before they are acted on by the transportation agents; a few authorities prefer to include only the destructive effects of the transporting agents. Various types of water erosion include:

- ***Accelerated*** – Erosion much more rapid than normal, natural, or geologic erosion, primarily as a result of the influence of the activities of man or, in some cases, of other animals or natural catastrophes that expose bare surfaces, for example, forest fires;
- ***Geological*** – The normal or natural erosion caused by geological processes acting over long geologic periods and resulting in the wearing away of mountains, the building up of floodplains, coastal plains, etc., and also referred to as natural erosion;
- ***Gross*** – A measure of the potential for soil to be dislodged and moved from its place of origin, not necessarily the amount of soil that actually reaches a stream or lake, but the amount of soil that can be calculated from water and wind equations;
- ***Gully*** – The erosion process whereby water accumulates in narrow channels and, over short periods of time, removes soil from this narrow area to considerable depths, ranging from 1–2 feet (0.3–0.6 meters) to as much as 75–100 feet (23–31 meters);
- ***Natural*** – The wearing away of the earth's surface by water, ice, or other natural agents under natural environmental conditions of climate, vegetation, etc., undisturbed by man, and also referred to as geological erosion;
- ***Normal*** – The gradual erosion of land used by man that does not greatly exceed natural erosion;
- ***Rill*** – An erosion process in which numerous small channels only several inches deep are formed; occurs mainly on recently cultivated soils and/or recent cuts and fills;
- ***Sheet*** – The removal of a thin, fairly uniform layer of soil from the land surface by runoff waters;
- ***Shore*** – Removal of soil, sand, or rock from the land adjacent to a body of water due to wave action;
- ***Splash*** – The spattering of small soil particles caused by the impact of raindrops on wet soils. The loosened and spattered particles may or may not be subsequently removed by surface runoff;

- ***Streambank*** – Scouring of material and the cutting of channel banks by running water;
- ***Streambed*** – Scouring of material and cutting of channel beds by running water;
- ***Undercutting*** – Removal of material at the base of a steep slope or cliff by falling water, a stream, wind erosion, or wave action; the removal steepens the slope or produces an overhanging cliff.

Eutrophication: The process by which a body of water becomes enriched in dissolved nutrients (as phosphates) that stimulate the growth of aquatic plant life usually resulting in the depletion of dissolved oxygen.

Exceedance: (Water Quality) The violation of the pollutant levels permitted by environmental protection standards.

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.

First Flush: The first portion of runoff 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.

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.

Grassed 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.

Headwater: The source of a stream or watershed.

Hydrology: A science dealing with the properties, distribution, and circulation of water on and below the earth's surface and in the atmosphere.

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.

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

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.

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.

Modeling: The application of a mathematical process or simulation framework, to describe various phenomenon and analyze the effects of changes in independent (i.e., explanatory) variables on dependent variables.

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.

Peak Flows: The maximum instantaneous discharge of a stream or river at a given location. It usually occurs at or near the time of maximum stage.

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

Pervious Cover: Any ground cover material that allows water to penetrate to the soil below.

Point Source: Any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or 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.

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

Resource Protection Area (RPA): RPAs are the corridors of environmentally sensitive land that lie alongside or near the shorelines of streams, rivers and other waterways. In their natural condition, RPAs protect water quality by filtering pollutants out of stormwater runoff, reducing the volume of stormwater runoff, preventing erosion and performing other important biological and ecological functions. State Regulations and county ordinances allow certain limited activities within areas mapped as RPA, however, larger land disturbing activities are prohibited unless a special exception is granted.

Retention: The permanent storage of stormwater.

Riparian Area: Land adjacent to a stream that is saturated by ground water or intermittently inundated by surface water at a frequency and duration sufficient to support the prevalence of vegetation typically adapted for life in saturated soil. It is the transition area between the aquatic ecosystem and the nearby, upland terrestrial ecosystem. Zones are identified by soil characteristics and/or plant communities and include the wet areas in and near streams, ponds, lakes, springs and other surface waters.

Riparian Buffer: Strips of grass, shrubs, and/or trees along the banks of rivers and streams 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.

Rip Rap: A layer rock or stone randomly placed on banks and swales that is used to prevent erosion. Rocks size is chosen to withstand erosive forces, with larger sizes used in areas subjected to higher energies.

Runoff: The portion of precipitation that flows across the land surface that ultimately reaches streams often with dissolved or suspended material.

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.

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.

Stormwater: Stormwater discharges are generated by runoff from land and impervious areas such as paved streets, parking lots, and building rooftops during rainfall and snow events that often contain pollutants in quantities that could adversely affect water quality.

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.

Subwatershed: A smaller subsection of a larger watershed, which may have been delineated to describe a particular land use, function, or hydrologic condition.

Total Maximum Daily Load (TMDL): A TMDL is a tool used to improve the water quality of water bodies that do not meet water quality standards. These water bodies are listed in Section 303(d) of the Clean Water Act as Impaired Water Bodies. The tool limits the pollutant loads allowable from each pollutant contributor in the watershed to levels that will ensure that the water quality standard is achieved.

Urbanization: The process of changing the landscape from one dominated by natural, undeveloped areas to developed areas with less natural area and more paved surfaces.

Water Quality Standard (WQS): A law or regulation that consists of the beneficial use or uses of a waterbody, the numeric and narrative water quality criteria that are necessary to protect the use or uses of that particular waterbody, and an antidegradation statement.

Watershed: The area of land that catches rain and snow and drains or seeps into a marsh, stream, river, lake or groundwater.

Wetlands: Areas that are inundated or saturated by surface or groundwater 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 generally include swamps, marshes, bogs, and similar areas.

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APPENDIX A

Cameron Run Watershed Plan
Candidate Projects

A-1 **Project Fact Sheets for Tier 1 Projects**

A-2 **Tier 2 Projects**

A-3 **Tier 3 Projects**

A-4 **Project Fact Sheets for Selected Drainage Complaint Projects**

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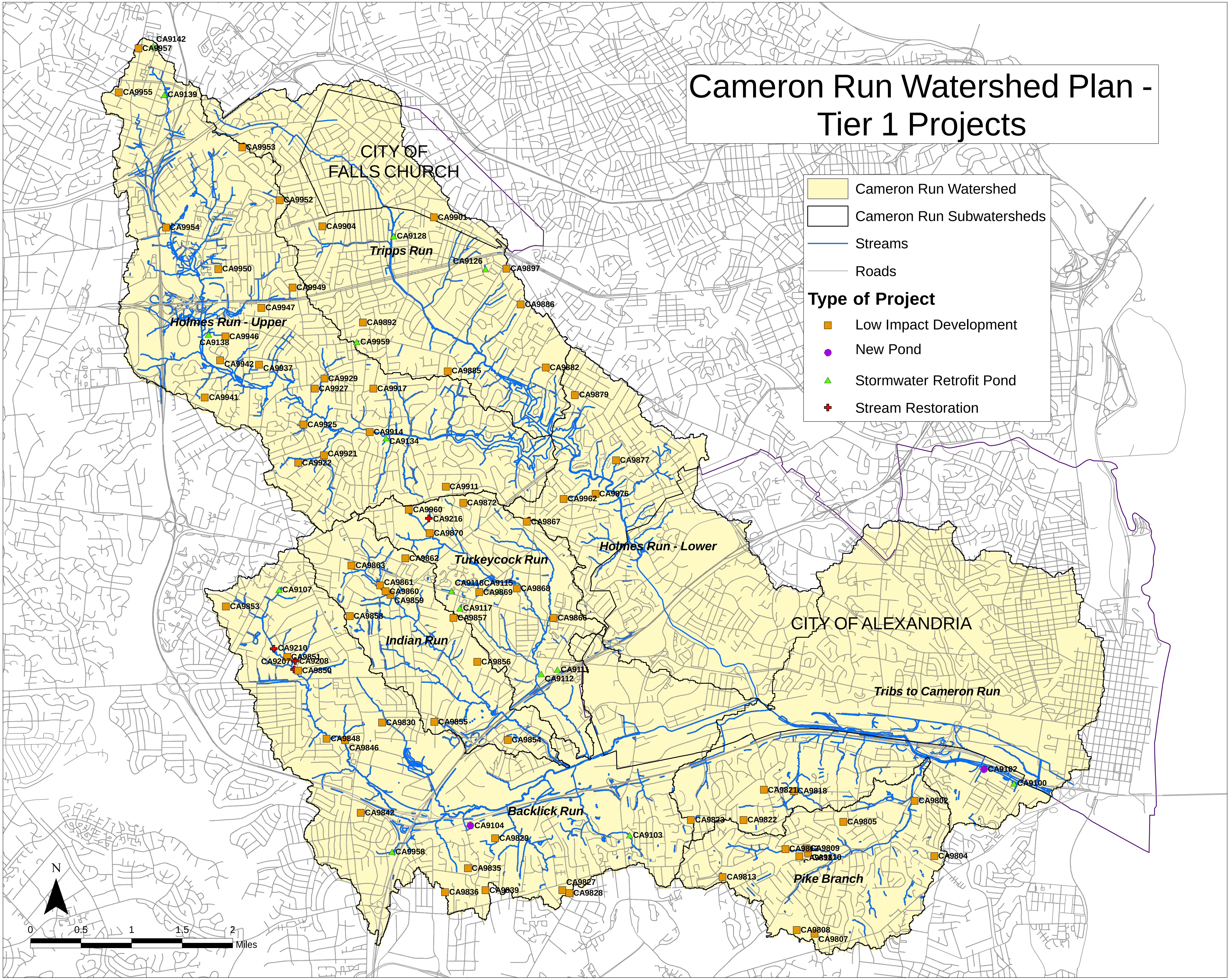
APPENDIX A-1

Project Fact Sheets for Tier 1 Projects



Cameron Run Watershed Plan - Tier 1 Projects
Cameron Run Watershed
Cameron Run Subwatersheds
Streams
Roads
Type of Project
Low Impact Development
New Pond
Stormwater Retrofit Pond
Stream Restoration
CITY OF FALLS CHURCH
CITY OF ALEXANDRIA
Holmes Run - Upper
Tripps Run
Holmes Run - Lower
Turkeycock Run
Indian Run
Tribs to Cameron Run
Backlick Run
Pike Branch
N
0
0.5
1
1.5
2
Miles

Farrington Park SWM Pond Retrofit

Project ID: CA9100

Project Name: Farrington Park SWM Pond Retrofit
Project Location: Mount Vernon Dr. & Arlington Terr.
Parcel ID No.:

Project Type: Stormwater Pond Retrofit

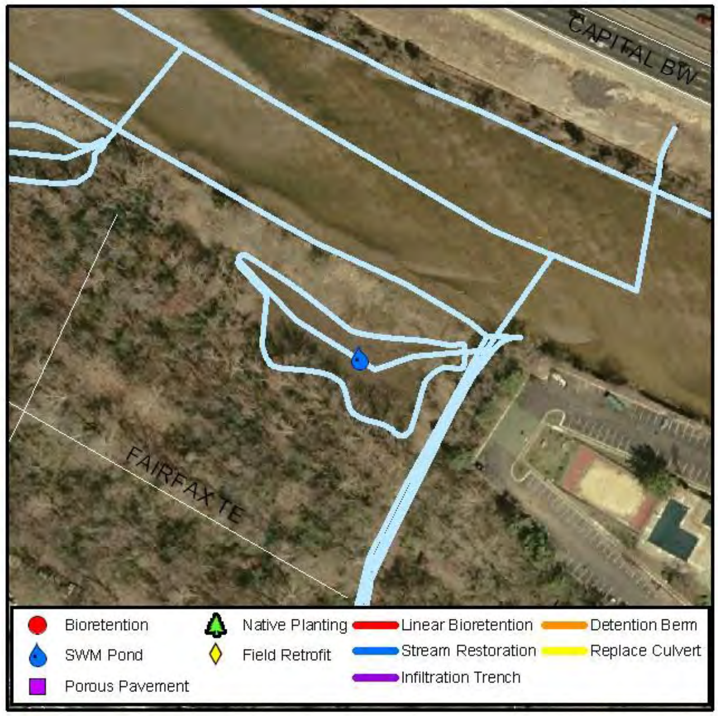
Subwatershed: Tributaries to Cameron Run
Drainage Area: 13.8 acres

Project Location:

Proposed Action:

Expand capacity of existing SWM wet pond and upgrade control structure. This project will be re-evaluated by the on-going flood damage reduction study for the Huntington community (see Section 4.2.7.1) and recommendations from that study may supersede this project.

Proposed Project:



Outfall into SWM pond

Wetlands adjacent to SWM pond and mainstem Cameron Run

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.

Estimated Cost: $61,000

Farrington Park SWM Pond Retrofit

Project ID: CA9100

Project Name: Farrington Park SWM Pond Retrofit

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grading and Excavation	475	CY	$35.00	$16,625
Structural Improvements & Incidentals	1	LS	$10,000.00	$10,000
Erosion & Sediment Control - Minimum	1	LS	$3,000.00	$3,000
Landscaping - Minimum	1	LS	$2,000.00	$2,000
			Base Cost =	$31,625
			Mobilization (5%) =	$1,581
			Subtotal 1 =	$33,206
			Contingency (25%) =	$8,302
			Subtotal 2 =	$41,508
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$18,679
			Total =	$60,186
			Estimated Project Cost =	$61,000

Huntington Park SWM Pond

Project ID: CA9102

Project Type: New Pond

Project Name: Huntington Park SWM Pond
Project Location: Huntington Park
Parcel ID No.: 0831 14C 0110A

Subwatershed: Tributaries to Cameron Run
Drainage Area: 16.7 acres

Project Location:

Proposed Action:

Install SWM pond with micropool areas in pond bottom to provide water quality and extended detention controls. This project will be re-evaluated by the on-going flood damage reduction study for the Huntington community (see Section 4.2.7.1) and recommendations from that study may supersede this project.

Proposed Project:

Location of small stream meeting mainstem Cameron Run

Stormwater inlet in park

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.

Estimated Cost: $98,000

Huntington Park SWM Pond

Project ID: CA9102

Project Name: Huntington Park SWM Pond

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grading and Excavation	525	CY	$50.00	$26,250
Structural Improvements & Incidentals	1	LS	$20,000.00	$20,000
Erosion & Sediment Control - Minimum	1	LS	$3,000.00	$3,000
Landscaping - Minimum	1	LS	$2,000.00	$2,000
			Base Cost =	$51,250
			Mobilization (5%) =	$2,563
			Subtotal 1 =	$53,813
			Contingency (25%) =	$13,453
			Subtotal 2 =	$67,266
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$30,270
			Total =	$97,535
			Estimated Project Cost =	$98,000

Woodfield SWM Pond Retrofit

Project ID: CA9103

Project Type: Stormwater Pond Retrofit

Project Name: Woodfield SWM Pond Retrofit
Project Location: Van Dorn St. & Woodfield Estates Dr.
Parcel ID No.: 0814 33 C

Subwatershed: Backlick Run
Drainage Area: 102.1 acres

Project Location:

Proposed Action:
Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.

Proposed Project:

Outfall entering pond

Outfall entering pond

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.

Estimated Cost: $276,000

Woodfield SWM Pond Retrofit

Project ID: CA9103

Project Name: Woodfield SWM Pond Retrofit

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grading and Excavation	3100	CY	$35.00	$108,500
Structural Improvements & Incidentals	1	LS	$20,000.00	$20,000
Erosion & Sediment Control	3100	CY	$3.50	$10,850
Landscaping	3100	CY	$1.75	$5,425

Base Cost =	$144,775
Mobilization (5%) =	$7,239
Subtotal 1 =	$152,014
Contingency (25%) =	$38,003
Subtotal 2 =	$190,017
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$85,508
Total =	$275,525
Estimated Project Cost =	$276,000

Thomas SWM Pond Retrofit

Project ID: CA9104

Project Type: Stormwater Pond Retrofit

Project Name: Thomas SWM Pond Retrofit
Project Location: Northanna Dr. & Thomas Dr.
Parcel ID No.: 0813 01 0003

Subwatershed: Backlick Run
Drainage Area: 39.3 acres

Project Location:

Proposed Project:

Proposed Action:

Expand existing SWM pond control structure to provide additional storage capacity.

Existing stormwater pond

Outfall

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve stormwater quality controls.

Estimated Cost: $148,000

Project ID: CA9104

Project Name: Thomas SWM Pond Retrofit

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grading and Excavation	1550	CY	$35.00	$54,250
Structural Improvements & Incidentals	1	LS	$15,000.00	$15,000
Erosion & Sediment Control	1550	CY	$3.50	$5,425
Landscaping	1550	CY	$1.75	$2,713

Base Cost =	$77,388
Mobilization (5%) =	$3,869
Subtotal 1 =	$81,257
Contingency (25%) =	$20,314
Subtotal 2 =	$101,571
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$45,707
Total =	$147,278
Estimated Project Cost =	$148,000

Jayhawk SWM Pond Retrofit

Project ID: CA9107

Project Type: Stormwater Pond Retrofit

Project Name: Jayhawk SWM Pond Retrofit
Project Location: Ravensworth Rd. & Jayhawk St.
Parcel ID No.: 0711 09 0007A

Subwatershed: Backlick Run
Drainage Area: 46.3 acres

Project Location:

Proposed Project:

Proposed Action:

Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.

Outlets filled with trash and debris

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.

Estimated Cost: $236,000

Project ID: CA9107

Project Name: Jayhawk SWM Pond Retrofit

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grading and Excavation	2575	CY	$35.00	$90,125
Structural Improvements & Incidentals	1	LS	$20,000.00	$20,000
Erosion & Sediment Control	2600	CY	$3.50	$9,100
Landscaping	2600	CY	$1.75	$4,550

Base Cost =	$123,775
Mobilization (5%) =	$6,189
Subtotal 1 =	$129,964
Contingency (25%) =	$32,491
Subtotal 2 =	$162,455
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$73,105
Total =	$235,559
Estimated Project Cost =	$236,000

Beauregard SWM Pond Retrofit

Project ID: CA9111

Project Type: Stormwater Pond Retrofit

Project Name: Beauregard SWM Pond Retrofit
Project Location: Strawbridge Square Dr.
Parcel ID No.: 0723 01 0040

Subwatershed: Turkeycock Run
Drainage Area: 3.5 acres

Project Location:

Proposed Project:

Proposed Action:

Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.

Stormwater outfall

SWM pond

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.

Estimated Cost: $25,000

Beauregard SWM Pond Retrofit

Project ID: CA9111

Project Name: Beauregard SWM Pond Retrofit

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grading and Excavation	75	CY	$35.00	$2,625
Structural Improvements & Incidentals	1	LS	$5,000.00	$5,000
Erosion & Sediment Control - Minimum	1	LS	$3,000.00	$3,000
Landscaping - Minimum	1	LS	$2,000.00	$2,000
			Base Cost =	$12,625
			Mobilization (5%) =	$631
			Subtotal 1 =	$13,256
			Contingency (25%) =	$3,314
			Subtotal 2 =	$16,570
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$7,457
			Total =	$24,027
			Estimated Project Cost =	$25,000

Strawbridge Square SWM Pond Retrofit

Project ID: CA9112

Project Type: Stormwater Pond Retrofit

Project Name: Strawbridge Square SWM Pond Retrofit

Project Location: Strawbridge Square Dr. & Lincoln Ave.

Parcel ID No.: 0723 01 0040

Subwatershed: Turkeycock Run

Drainage Area: 2 acres

Project Location:

Proposed Project:

Proposed Action:

Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.

SWM dry pond

Inlet in parking lot to east leading to pond

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.

Estimated Cost: $25,000

Strawbridge Square SWM Pond Retrofit

Project ID: CA9112

Project Name: Strawbridge Square SWM Pond Retrofit

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grading and Excavation	75	CY	$35.00	$2,625
Structural Improvements & Incidentals	1	LS	$5,000.00	$5,000
Erosion & Sediment Control - Minimum	1	LS	$3,000.00	$3,000
Landscaping - Minimum	1	LS	$2,000.00	$2,000
			Base Cost =	$12,625
			Mobilization (5%) =	$631
			Subtotal 1 =	$13,256
			Contingency (25%) =	$3,314
			Subtotal 2 =	$16,570
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$7,457
			Total =	$24,027
			Estimated Project Cost =	$25,000

Little River SWM Pond Retrofit

Project ID: CA9115

Project Type: Stormwater Pond Retrofit

Project Name: Little River SWM Pond Retrofit
Project Location: Little River Turnpike & Green Spring Rd.
Parcel ID No.: 0721 01 0022B

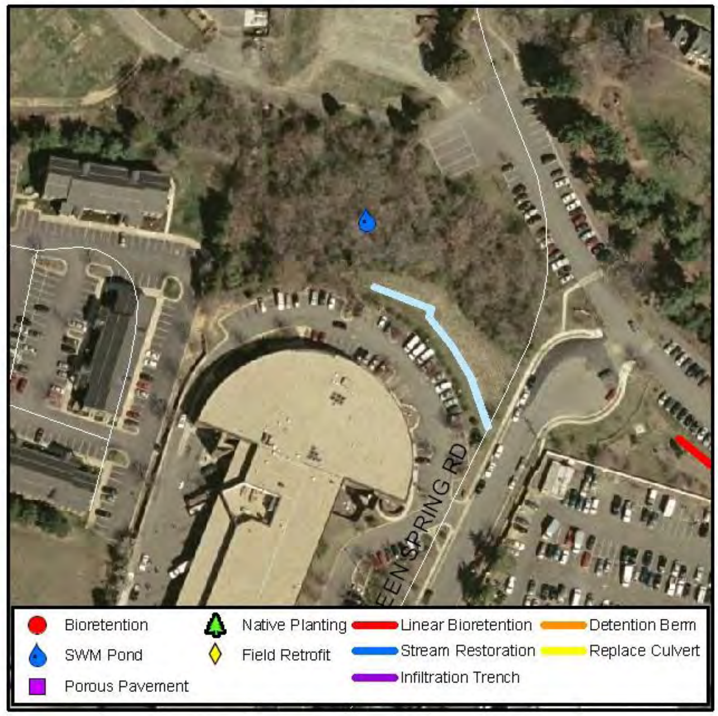
Subwatershed: Turkeycock Run
Drainage Area: 3.9 acres

Project Location:

Proposed Action:

Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.

Proposed Project:



Concrete ditch below roadway

SWM dry pond

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.

Estimated Cost: $33,000

Little River SWM Pond Retrofit

Project ID: CA9115

Project Name: Little River SWM Pond Retrofit

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grading and Excavation	200	CY	$35.00	$7,000
Structural Improvements & Incidentals	1	LS	$5,000.00	$5,000
Erosion & Sediment Control - Minimum	1	LS	$3,000.00	$3,000
Landscaping - Minimum	1	LS	$2,000.00	$2,000
			Base Cost =	$17,000
			Mobilization (5%) =	$850
			Subtotal 1 =	$17,850
			Contingency (25%) =	$4,463
			Subtotal 2 =	$22,313
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$10,041
			Total =	$32,353
			Estimated Project Cost =	$33,000

Braddock Place SWM Pond Retrofit

Project ID: CA9117

Project Type: Stormwater Pond Retrofit

Project Name: Braddock Place SWM Pond Retrofit
Project Location: Irvin Pl. & Irvin Ct.
Parcel ID No.: 0721 30 A

Subwatershed: Turkeycock Run
Drainage Area: 7.4 acres

Project Location:

Proposed Project:

Proposed Action:

Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.

View of pond and trickle ditch looking at inlet

Inlet

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.

Estimated Cost: $49,000

Braddock Place SWM Pond Retrofit

Project ID: CA9117

Project Name: Braddock Place SWM Pond Retrofit

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grading and Excavation	300	CY	$35.00	$10,500
Structural Improvements & Incidentals	1	LS	$10,000.00	$10,000
Erosion & Sediment Control - Minimum	1	LS	$3,000.00	$3,000
Landscaping - Minimum	1	LS	$2,000.00	$2,000
			Base Cost =	$25,500
			Mobilization (5%) =	$1,275
			Subtotal 1 =	$26,775
			Contingency (25%) =	$6,694
			Subtotal 2 =	$33,469
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$15,061
			Total =	$48,530
			Estimated Project Cost =	$49,000

Pinecrest SWM Pond Retrofit

Project ID: CA9118

Project Type: Stormwater Pond Retrofit

Project Name: Pinecrest SWM Pond Retrofit
Project Location: Little River Turnpike & Pinecrest
Parcel ID No.: 0712 3404 A

Subwatershed: Turkeycock Run
Drainage Area: 13.3 acres

Project Location:

Proposed Action:

Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.

Proposed Project:

SWM dry pond

Grassy swale and outlet

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.

Estimated Cost: $69,000

Project ID: CA9118

Project Name: Pinecrest SWM Pond Retrofit

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grading and Excavation	600	CY	$35.00	$21,000
Structural Improvements & Incidentals	1	LS	$10,000.00	$10,000
Erosion & Sediment Control - Minimum	1	LS	$3,000.00	$3,000
Landscaping - Minimum	1	LS	$2,000.00	$2,000
			Base Cost =	$36,000
			Mobilization (5%) =	$1,800
			Subtotal 1 =	$37,800
			Contingency (25%) =	$9,450
			Subtotal 2 =	$47,250
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$21,263
			Total =	$68,513
			Estimated Project Cost =	$69,000

Dominion SWM Pond Retrofit

Project ID: CA9126

Project Type: Stormwater Pond Retrofit

Project Name: Dominion SWM Pond Retrofit

Project Location: Crook Oak Ln. & Sleepy Hollow Rd.

Parcel ID No.: 0513 31 A1

Subwatershed: Tripps Run

Drainage Area: 8.3 acres

Project Location:

Proposed Action:

Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.

Proposed Project:

SWM dry pond

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.

Estimated Cost: $61,000

Dominion SWM Pond Retrofit

Project ID: CA9126

Project Name: Dominion SWM Pond Retrofit

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grading and Excavation	475	CY	$35.00	$16,625
Structural Improvements & Incidentals	1	LS	$10,000.00	$10,000
Erosion & Sediment Control - Minimum	1	LS	$3,000.00	$3,000
Landscaping - Minimum	1	LS	$2,000.00	$2,000
			Base Cost =	$31,625
			Mobilization (5%) =	$1,581
			Subtotal 1 =	$33,206
			Contingency (25%) =	$8,302
			Subtotal 2 =	$41,508
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$18,679
			Total =	$60,186
			Estimated Project Cost =	$61,000

Great Oak SWM Pond Retrofit

Project ID: CA9128

Project Name: Great Oak SWM Pond Retrofit
Project Location: Great Oak & James Lee St.
Parcel ID No.: 0502 14 A

Project Type: Stormwater Pond Retrofit

Subwatershed: Tripps Run
Drainage Area: 18.9 acres

Project Location:

Proposed Project:

Proposed Action:

Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.

SWM dry pond

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.

Estimated Cost: $89,000

Great Oak SWM Pond Retrofit

Project ID: CA9128

Project Name: Great Oak SWM Pond Retrofit

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grading and Excavation	900	CY	$35.00	$31,500
Structural Improvements & Incidentals	1	LS	$10,000.00	$10,000
Erosion & Sediment Control	925	CY	$3.50	$3,238
Landscaping	900	CY	$1.75	$1,575
			Base Cost =	$46,313
			Mobilization (5%) =	$2,316
			Subtotal 1 =	$48,628
			Contingency (25%) =	$12,157
			Subtotal 2 =	$60,785
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$27,353
			Total =	$88,138
			Estimated Project Cost =	$89,000

Columbia Pines SWM Pond Retrofit

Project ID: CA9134

Project Type: Stormwater Pond Retrofit

Project Name: Columbia Pines SWM Pond Retrofit

Project Location: Sprucedale Dr. & Sprucedale Ct.

Parcel ID No.: 0604 01 0003

Subwatershed: Holmes Run - Upper

Drainage Area: 7.7 acres

Project Location:

Proposed Project:

Proposed Action:

Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.

Outfall into SWM pond

SWM pond area

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.
Improve floodplain and nutrient cycling functions.

Estimated Cost: $30,000

Project ID: CA9134

Project Name: Columbia Pines SWM Pond Retrofit

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grading and Excavation	150	CY	$35.00	$5,250
Structural Improvements & Incidentals	1	LS	$5,000.00	$5,000
Erosion & Sediment Control - Minimum	1	LS	$3,000.00	$3,000
Landscaping - Minimum	1	LS	$2,000.00	$2,000

Base Cost =	$15,250
Mobilization (5%) =	$763
Subtotal 1 =	$16,013
Contingency (25%) =	$4,003
Subtotal 2 =	$20,016
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$9,007
Total =	$29,023
Estimated Project Cost =	$30,000

Providence RECenter SWM Pond Retrofit

Project ID: CA9138

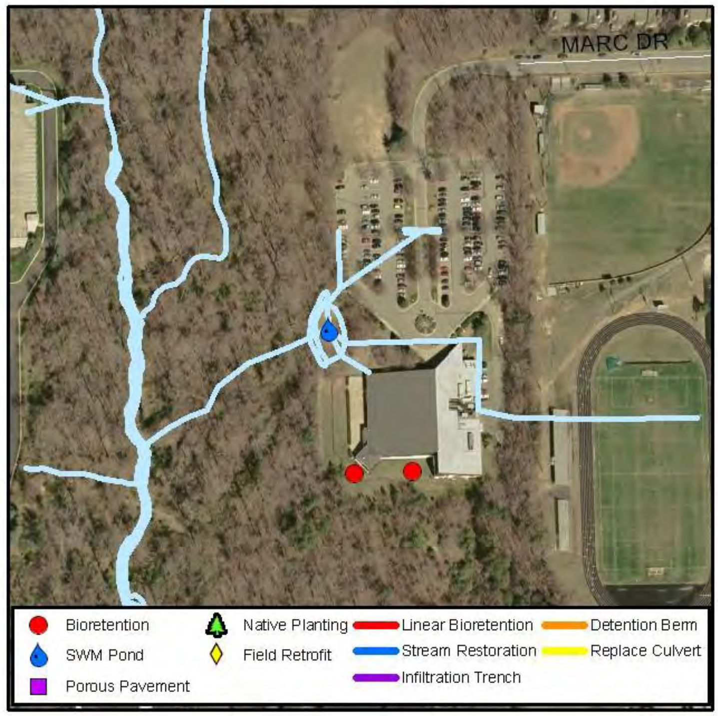
Project Type: Stormwater Pond Retrofit

Project Name: Providence RECenter SWM Pond Retrofit
Project Location: March Rd. & Jaguar Tr.
Parcel ID No.: 0494 01 0068

Subwatershed: Holmes Run - Upper
Drainage Area: 4.5 acres

Project Location:

Proposed Project:



Proposed Action:

Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality; add bioretention areas in existing swale S of bldg.

SWM pond and control structure

Newly constructed parking lot with existing tree box filter, underdrain, and infiltration

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Estimated Cost: $102,000

Providence RECenter SWM Pond Retrofit

Project ID: CA9138

Project Name: Providence RECenter SWM Pond Retrofit

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grading and Excavation	100	CY	$35.00	$3,500
Structural Improvements & Incidentals	1	LS	$5,000.00	$5,000
Erosion & Sediment Control - Minimum	1	LS	$3,000.00	$3,000
Landscaping - Minimum	1	LS	$2,000.00	$2,000
Bioretention Area	1600	SF	$25.00	$40,000
			Base Cost =	$53,500
			Mobilization (5%) =	$2,675
			Subtotal 1 =	$56,175
			Contingency (25%) =	$14,044
			Subtotal 2 =	$70,219
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$31,598
			Total =	$101,817
			Estimated Project Cost =	$102,000

Kings Glen SWM Pond Retrofit

Project ID: CA9139

Project Type: Stormwater Pond Retrofit

Project Name: Kings Glen SWM Pond Retrofit
Project Location: Foxmore Dr. & Morgan Ln.
Parcel ID No.: 0394 29 A1

Subwatershed: Holmes Run - Upper
Drainage Area: 81.8 acres

Project Location:

Proposed Action:

Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality; add detention micro-berm along contour and margin of mature woods in pond bottom.

Proposed Project:

SWM pond control structure

Detention berms could be installed along contour and margin of mature woods

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.

Estimated Cost: $243,000

Kings Glen SWM Pond Retrofit

Project ID: CA9139

Project Name: Kings Glen SWM Pond Retrofit

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grading and Excavation	2650	CY	$35.00	$92,750
Structural Improvements & Incidentals	1	LS	$20,000.00	$20,000
Erosion & Sediment Control	2600	CY	$3.50	$9,100
Landscaping	2650	CY	$1.75	$4,638
Detention Berm	410	LF	$2.00	$820
			Base Cost =	$127,308
			Mobilization (5%) =	$6,365
			Subtotal 1 =	$133,673
			Contingency (25%) =	$33,418
			Subtotal 2 =	$167,091
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$75,191
			Total =	$242,282
			Estimated Project Cost =	$243,000

Courts of Tyson SWM Pond Retrofit

Project ID: CA9142

Project Type: Stormwater Pond Retrofit

Project Name: Courts of Tyson SWM Pond Retrofit

Project Location: Arden Ct. & Trevor Pl.

Parcel ID No.: 0394 21 A

Subwatershed: Holmes Run - Upper

Drainage Area: 6.5 acres

Project Location:

Proposed Action:

Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality; install two bioretention areas at yard drains in Ch. 2 street (Kelleher Rd.).

Proposed Project:

Existing SWM pond

Yard drain in undeveloped road

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.

Estimated Cost: $31,000

Courts of Tyson SWM Pond Retrofit

Project ID: CA9142

Project Name: Courts of Tyson SWM Pond Retrofit

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grading and Excavation	25	CY	$35.00	$875
Structural Improvements & Incidentals	1	LS	$5,000.00	$5,000
Erosion & Sediment Control - Minimum	1	LS	$3,000.00	$3,000
Landscaping - Minimum	1	LS	$2,000.00	$2,000
Bioretention Area	200	SF	$25.00	$5,000
			Base Cost =	$15,875
			Mobilization (5%) =	$794
			Subtotal 1 =	$16,669
			Contingency (25%) =	$4,167
			Subtotal 2 =	$20,836
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$9,376
			Total =	$30,212
			Estimated Project Cost =	$31,000

Wilburdale Park Stream Restoration

Project ID: CA9207

Project Name: Wilburdale Park Stream Restoration
Project Location: Wilburdale Park
Parcel ID No.: 0713 09 A

Project Type: Stream Restoration

Subwatershed: Backlick Run
Drainage Area: 0 acres

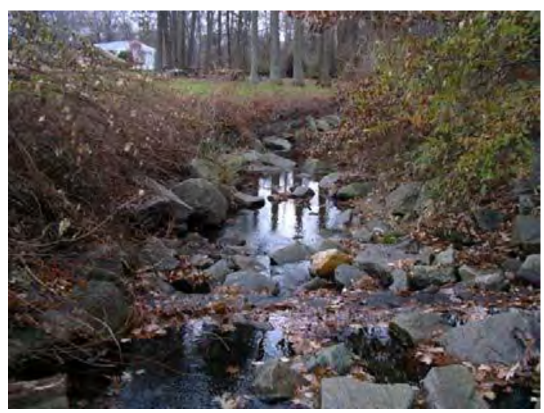
Project Location:

Proposed Project:

Proposed Action:

Notch two weirs and one concrete ford; redistribute large rocks in reach; control invasive vegetation; reforest buffer.

Concrete ford to be notched



Large rocks in reach to be redistributed in stream

Benefits: Improve stream stability and instream habitat. Reduce erosion.
Improve floodplain and nutrient cycling functions.
Opportunity for public education.
Other.

Estimated Cost: $320,000

Wilburdale Park Stream Restoration

Project ID: CA9207

Project Name: Wilburdale Park Stream Restoration

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Stream Restoration	800	LF	$200.00	$160,000
Riparian Buffer Restoration	790	LF	$10.00	$7,900
			Base Cost =	$167,900
			Mobilization (5%) =	$8,395
			Subtotal 1 =	$176,295
			Contingency (25%) =	$44,074
			Subtotal 2 =	$220,369
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$99,166
			Total =	$319,535
			Estimated Project Cost =	$320,000

Wilburdale Park Bank Stabilization

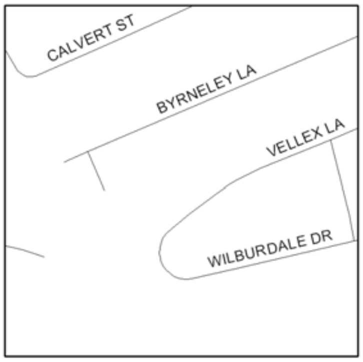
Project ID: CA9208

Project Type: Stream Restoration

Project Name: Wilburdale Park Bank Stabilization
Project Location: Wilburdale Park
Parcel ID No.: 0713 09 0097

Subwatershed: Backlick Run
Drainage Area: 0 acres

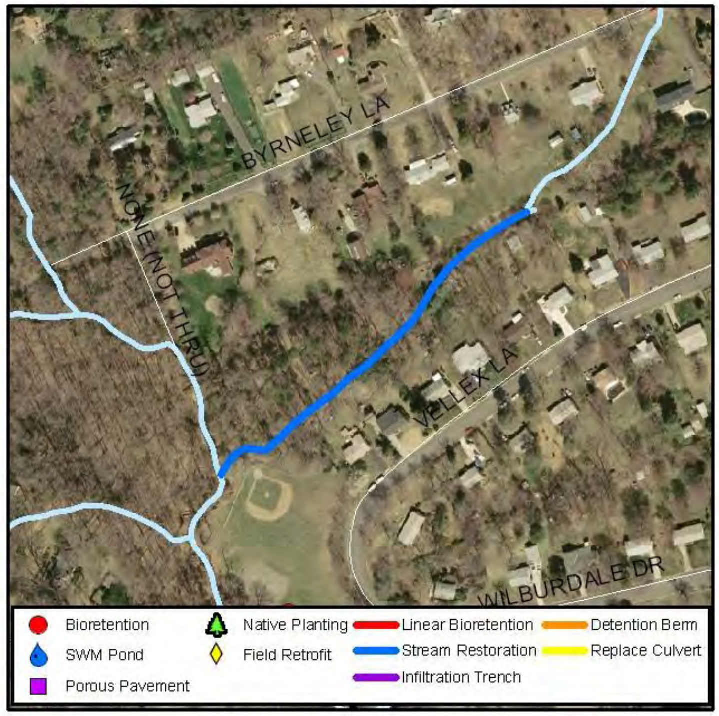
Project Location:



Proposed Action:

Remove check dam; enhance buffer through backyards; remove invasive bamboo and other species; implement backyard management program to reduce dumping of yard wastes/trash into streams.

Proposed Project:



Eroding streambanks to be restored with woody riparian buffer and removal of invasive bamboo

Streambanks to be stabilized and buffers planted to reestablish connection with floodplain

Benefits: Improve stream stability and instream habitat. Reduce erosion.
Improve floodplain and nutrient cycling functions.
Opportunity for public education.
Improve community usage.

Estimated Cost: $169,000

Project ID: CA9208

Project Name: Wilburdale Park Bank Stabilization

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Remove: small dam, invasive species	800	LF	$100.00	$80,000
Planting	1.1	AC	$8,000.00	$8,800
			Base Cost =	$88,800
			Mobilization (5%) =	$4,440
			Subtotal 1 =	$93,240
			Contingency (25%) =	$23,310
			Subtotal 2 =	$116,550
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$52,448
			Total =	$168,998
			Estimated Project Cost =	$169,000

Brook Hill Stream Restoration

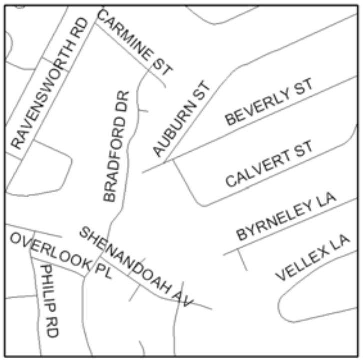
Project ID: CA9210

Project Type: Stream Restoration

Project Name: Brook Hill Stream Restoration
Project Location: Rapidan Place, Wilburdale Park
Parcel ID No.: 0713 01 0004

Subwatershed: Backlick Run
Drainage Area: 0 acres

Project Location:



Proposed Project:

Proposed Action:

Notch weirs in gabion lined channel; add rock vanes to straightened and overwidened middle section; cut log pourovers/debris jams; add toe protection on steep berms in lower third; enhance buffer in localized areas; construct bioretention area at end of two roads; implement backyard management program to reduce dumping of yard wastes/ trash into streams.

Stream lined with gabion baskets and concrete weirs

Install toe protection on steep banks. Restore woody riparian buffer

Benefits: Provide stormwater quantity controls.
Improve floodplain and nutrient cycling functions.
Opportunity for public education.
Improve community usage.

Greenway opportunity

Estimated Cost: $1,171,000

Brook Hill Stream Restoration

Project ID: CA9210

Project Name: Brook Hill Stream Restoration

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	2	EA	$15,000.00	$30,000
Stream Restoration	2750	LF	$200.00	$550,000
Planting	4.4	AC	$8,000.00	$35,200
			Base Cost =	$615,200
			Mobilization (5%) =	$30,760
			Subtotal 1 =	$645,960
			Contingency (25%) =	$161,490
			Subtotal 2 =	$807,450
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$363,353
			Total =	$1,170,803
			Estimated Project Cost =	$1,171,000

Mason District Park Stream Restoration - A

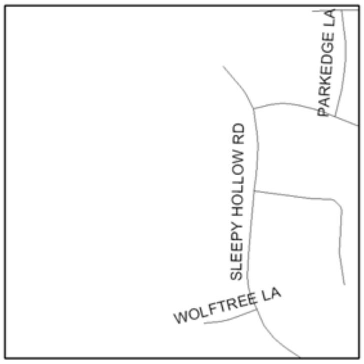
Project ID: CA9216

Project Type: Stream Restoration

Project Name: Mason District Park Stream Restoration - A
Project Location: Mason District Park
Parcel ID No.: 0604 01 0028

Subwatershed: Turkeycock Run
Drainage Area: 10 acres

Project Location:



Proposed Project:

Proposed Action:

Implement Park Authority's stream restoration plans at this location.

Benefits: Improve stream stability and instream habitat. Reduce erosion.
Improve floodplain and nutrient cycling functions.
Opportunity for public education.
Improve community usage.

Greenway opportunity

Estimated Cost: $996,000

Mason District Park Stream Restoration - A

Project ID: CA9216

Project Name: Mason District Park Stream Restoration - A

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Stream Restoration	1	LS	$523,000.00	$523,000
			Base Cost =	$523,000
			Mobilization (5%) =	$26,150
			Subtotal 1 =	$549,150
			Contingency (25%) =	$137,288
			Subtotal 2 =	$686,438
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$308,897
			Total =	$995,334
			Estimated Project Cost =	$996,000

Instream Debris Jam Evaluation and Removal

Project ID: CA9700

Project Type: Non-Structural Watershed-

Project Name: Instream Debris Jam Evaluation and Removal

Subwatershed: wide

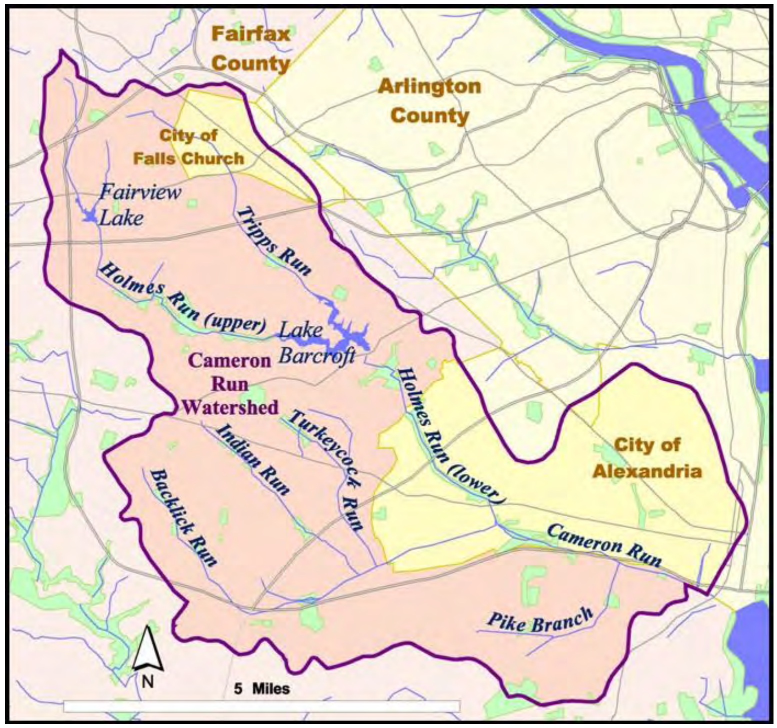
Project Location: Cameron Run Watershed

Drainage Area: 28400 acres

Parcel ID No.:

Project Location:

Proposed Project:



Proposed Action:

Locate, evaluate, and remove debris jams observed to cause excessive erosion.

Example of a debris blockage from Holmes Run, as identified in the Stream Physical Assessment

Benefits: Improve stream stability and instream habitat. Reduce erosion.
Prevent property and structural loss.
Reduce road flooding.
Opportunity for public education.

Estimated Cost: $286,000

Instream Debris Jam Evaluation and Removal

Project ID: CA9700

Project Name: Instream Debris Jam Evaluation and Removal

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Instream debris-jam identification and removal	5	YR	$30,000.00	$150,000
			Base Cost =	$150,000
			Mobilization (5%) =	$7,500
			Subtotal 1 =	$157,500
			Contingency (25%) =	$39,375
			Subtotal 2 =	$196,875
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$88,594
			Total =	$285,469
			Estimated Project Cost =	$286,000

Community Watershed Restoration Support

Project ID: CA9701

Project Type: Non-Structural Watershed-

Project Name: Community Watershed Restoration Support

Subwatershed: wide

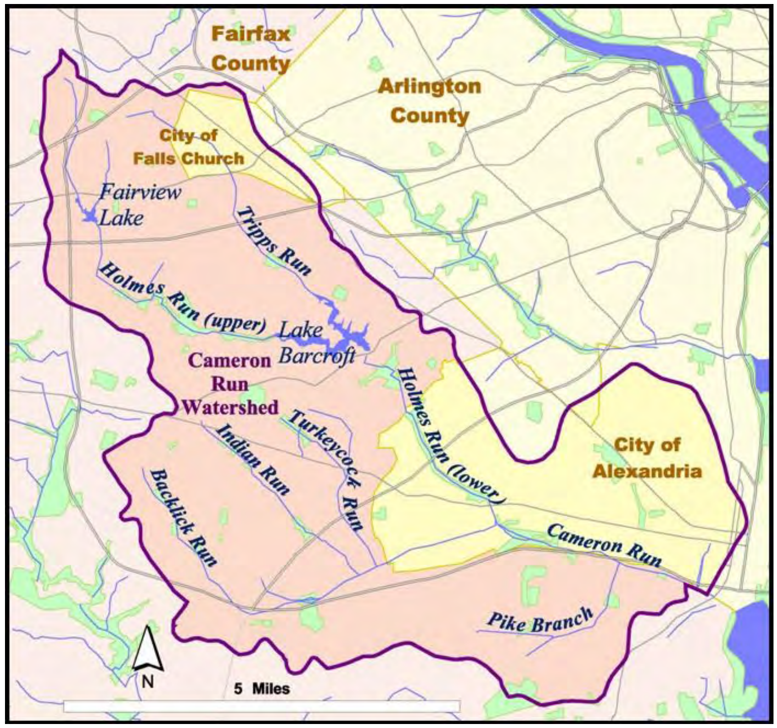
Project Location: Cameron Run Watershed

Drainage Area: 28400 acres

Parcel ID No.:

Project Location:

Proposed Project:



Proposed Action:

Provide education and technical assistance to encourage restoration practices on private property. Explain the need for restoration and describe effective techniques. Distribute "how to" information on creating rain gardens, backyard riparian buffers, and other LID projects. Provide technical assistance with individual LID projects.

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.
Opportunity for public education.

Estimated Cost: $1,407,000

Project ID: CA9701

Project Name: Community Watershed Restoration Support

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Informational Brochures	25	YR	$20,000.00	$500,000
County Website support	25	YR	$15,000.00	$375,000
Technical Assistance	25	YR	$10,000.00	$250,000

Base Cost =	$1,125,000
Mobilization (0%) =	$0
Subtotal 1 =	$1,125,000
Contingency (25%) =	$281,250
Subtotal 2 =	$1,406,250
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
Total =	$1,406,250
Estimated Project Cost =	$1,407,000

Small Watershed Grant Program

Project ID: CA9702

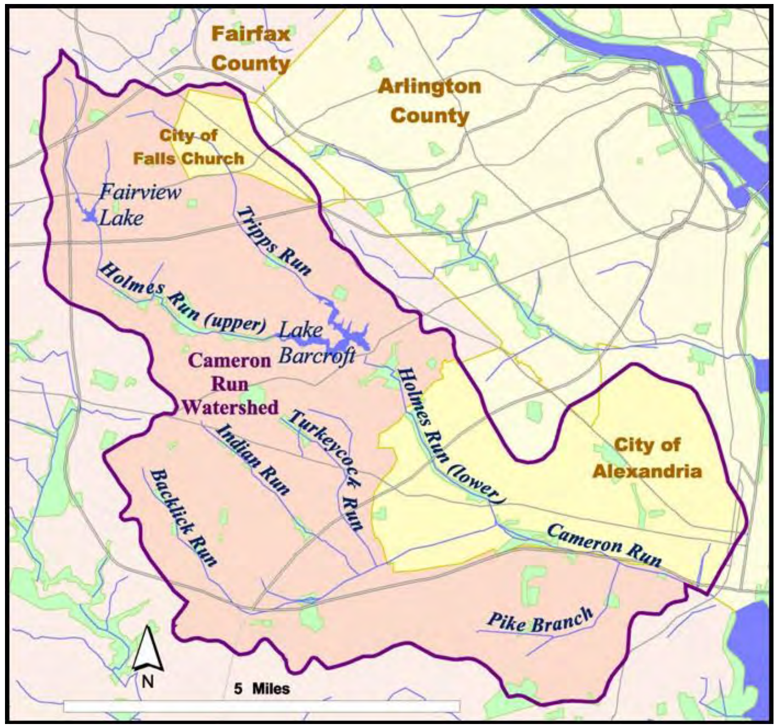
Project Type: Non-Structural

Project Name: Small Watershed Grant Program
Project Location: Cameron Run Watershed
Parcel ID No.:

Subwatershed: Watershed-wide
Drainage Area: 28400 acres

Project Location:

Proposed Project:



Proposed Action:

Establish and administer an annual program that provides small grants to local organizations, residents, and businesses to facilitate education, capacity building, small retrofit and restoration projects, and monitoring activities. For example, grants could be used to off-set the costs to purchase and install rain barrels or other LID projects on private property via a coupon program or other sales mechanism, to cover staff time for a watershed organization, or to provide field equipment for a volunteer watershed monitoring program.

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.
Opportunity for public education.

Estimated Cost: $1,094,000

Project ID: CA9702

Project Name: Small Watershed Grant Program

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Create/Administer Program	25	YR	$35,000.00	$875,000

Base Cost =	$875,000
Mobilization (0%) =	$0
Subtotal 1 =	$875,000
Contingency (25%) =	$218,750
Subtotal 2 =	$1,093,750
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
Total =	$1,093,750
Estimated Project Cost =	$1,094,000

Jefferson Manor Park Bioretention

Project ID: CA9802

Project Type: Low Impact Development

Project Name: Jefferson Manor Park Bioretention
Project Location: Jefferson Manor Park
Parcel ID No.: 0831 01 0015

Subwatershed: Pike Branch
Drainage Area: 9.2 acres

Project Location:

Proposed Action:

Construct bioretention area below parking lot and detention micro-berm along edge of baseball field.

Proposed Project:

Construct bioretention area below parking lot

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.

Estimated Cost: $73,000

Jefferson Manor Park Bioretention

Project ID: CA9802

Project Name: Jefferson Manor Park Bioretention

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Detention Berm	190	LF	$2.00	$380
Bioretention Area	1500	SF	$25.00	$37,500
			Base Cost =	$37,880
			Mobilization (5%) =	$1,894
			Subtotal 1 =	$39,774
			Contingency (25%) =	$9,944
			Subtotal 2 =	$49,718
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$22,373
			Total =	$72,090
			Estimated Project Cost =	$73,000

Mount Eagle Elementary School LID

Project ID: CA9804

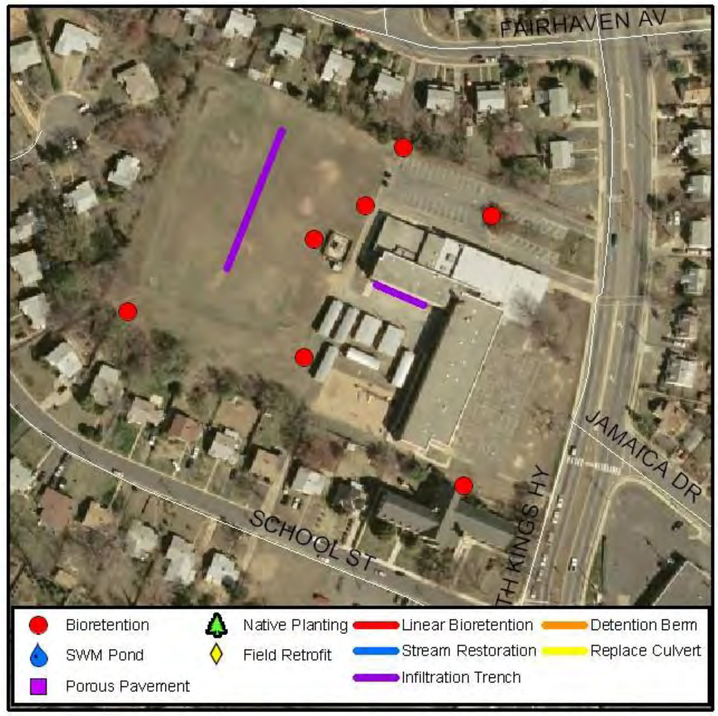
Project Type: Low Impact Development

Project Name: Mount Eagle Elementary School LID
Project Location: Mount Eagle Elementary School
Parcel ID No.: 0833 01 0004

Subwatershed: Pike Branch
Drainage Area: 5.9 acres

Project Location:

Proposed Project:



Proposed Action:

Construct bioretention areas in traffic island, at parking lot margins, SW corner of trailers, and SW corner of property; direct roof drains to bioretention areas; install infiltration trench along W side of new parking lot.

Convert concrete ditch to linear bioretention area and collect water from downspouts

Potential bioretention areas in rear parking lot and playing fields

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $210,000

Mount Eagle Elementary School LID

Project ID: CA9804

Project Name: Mount Eagle Elementary School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	3150	SF	$25.00	$78,750
Infiltration Trench	315	LF	$100.00	$31,500
			Base Cost =	$110,250
			Mobilization (5%) =	$5,513
			Subtotal 1 =	$115,763
			Contingency (25%) =	$28,941
			Subtotal 2 =	$144,703
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$65,116
			Total =	$209,820
			Estimated Project Cost =	$210,000

Wilton Administration Center LID

Project ID: CA9805

Project Name: Wilton Administration Center LID
Project Location: Wilton Administration Center
Parcel ID No.: 0824 01 0004A

Project Type: Low Impact Development

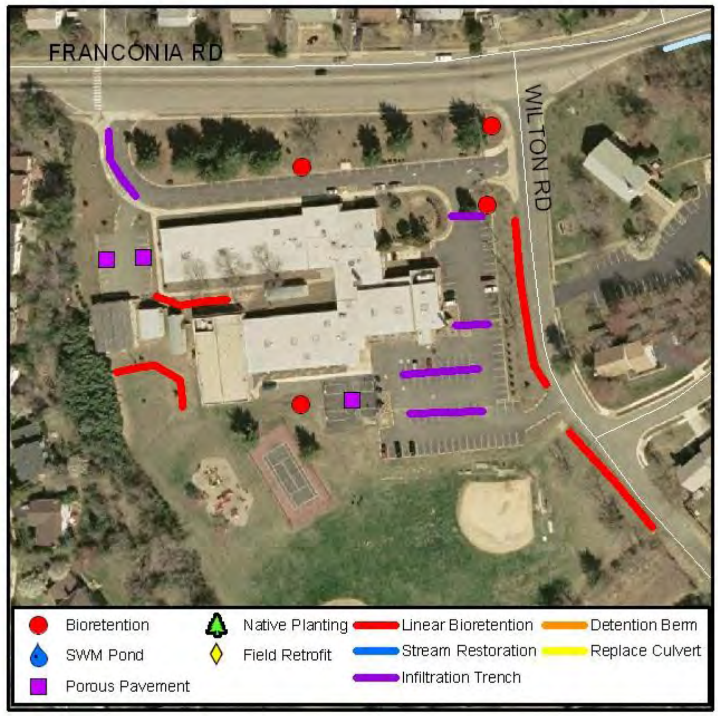
Subwatershed: Pike Branch
Drainage Area: 6.6 acres

Project Location:

Proposed Action:

Construct bioretention areas in traffic islands along front and side parking lot, at inlet on south side of school, and at storm drain outlet on west side; install infiltration trenches and porous pavement in parking lots and asphalt court. This facility may be renovated within the next five years and these proposed retrofits, or similar stormwater improvements, should be incorporated into the renovation plans.

Proposed Project:



Bioretention area location in traffic islands

Locations for infiltration trenches and porous pavement in parking lots and asphalt courts

Benefits: Provide stormwater quality controls.
Improve stormwater quantity controls.
Opportunity for public education.

Estimated Cost: $460,000

Project ID: CA9805

Project Name: Wilton Administration Center LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	5470	SF	$25.00	$136,750
Infiltration Trench	350	LF	$100.00	$35,000
Porous Pavement	260	SY	$15.00	$3,900
Bioretention Area, Linear	2625	SF	$25.00	$65,625
			Base Cost =	$241,275
			Mobilization (5%) =	$12,064
			Subtotal 1 =	$253,339
			Contingency (25%) =	$63,335
			Subtotal 2 =	$316,673
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$142,503
			Total =	$459,176
			Estimated Project Cost =	$460,000

Virginia Hills Administration Center (School) LID

Project ID: CA9807
Project Type: Low Impact Development

Project Name: Virginia Hills Administration Center (School) LID
Subwatershed: Pike Branch
Project Location: Virginia Hills Administration Center (School)
Drainage Area: 4.8 acres
Parcel ID No.: 0922 01 0002A

Project Location:

Proposed Project:

Proposed Action:

Construct linear bioretention areas along outside of bus loop and along rear parking lot; direct roof drains at front wing to bioretention areas; install infiltration trench in NW corner of bus parking area. This facility may be renovated within the next five years and these proposed retrofits, or similar stormwater improvements, should be incorporated into the renovation plans.

Potential bioretention area along NW corner of school

Potential linear bioretention areas along outside edge of traffic circle

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $352,000

Project ID: CA9807

Project Name: Virginia Hills Administration Center (School) LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Linear	4690	SF	$25.00	$117,250
Bioretention Area	2215	SF	$25.00	$55,375
Infiltration Trench	120	LF	$100.00	$12,000
			Base Cost =	$184,625
			Mobilization (5%) =	$9,231
			Subtotal 1 =	$193,856
			Contingency (25%) =	$48,464
			Subtotal 2 =	$242,320
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$109,044
			Total =	$351,364
			Estimated Project Cost =	$352,000

Lee District Park LID

Project ID: CA9808

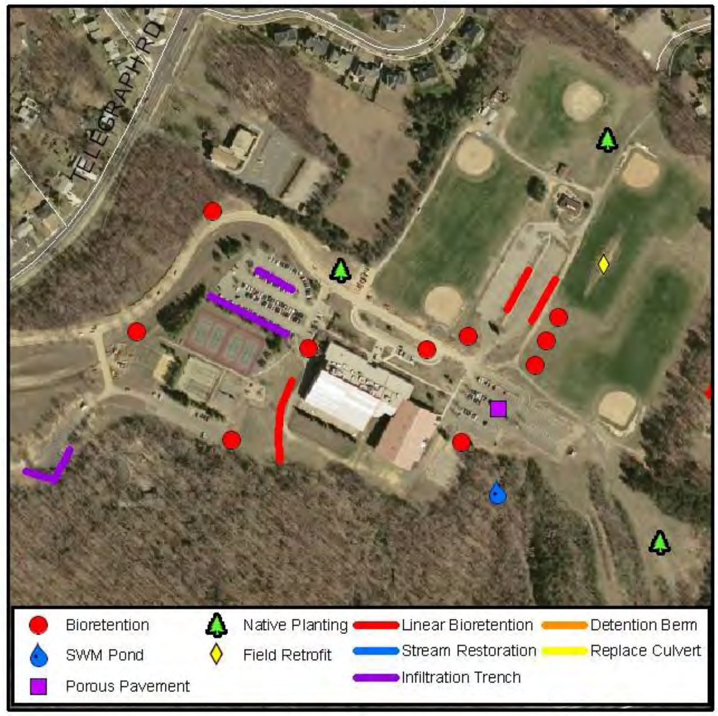
Project Type: Low Impact Development

Project Name: Lee District Park LID
Project Location: Dorset Dr. & Robinson Dr.
Parcel ID No.: 0921 01 0021

Subwatershed: Pike Branch
Drainage Area: 43.4 acres

Project Location:

Proposed Project:



Proposed Action:

Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality; construct bioretention areas along N parking lot, in south central swale, and in parking lot islands/road margins; install infiltration trench in tennis court parking lot and porous pavement in E parking lot; convert athletic fields to artificial turf; add tree cover throughout. Note that athletic fields are scheduled for conversion to artificial turf in 2008. Facility maintenance and renovation is an on-going process and proposed retrofits, or similar stormwater improvements, should be incorporated into site improvement plans.

Convert athletic fields to artificial turf with underdrain and cistern

Incorporate bioretention and additional tree cover throughout the site, including in this traffic circle

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.
Improve community usage.
Opportunity for public education.

Estimated Cost: $1,589,000

Lee District Park LID

Project ID: CA9808

Project Name: Lee District Park LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grading and Excavation	800	CY	$35.00	$28,000
Reforestation	0.63	AC	$25,000.00	$15,750
Structural Improvements & Incidentals	1	LS	$10,000.00	$10,000
Erosion & Sediment Control - Minimum	1	LS	$3,000.00	$3,000
Landscaping - Minimum	1	LS	$2,000.00	$2,000
Artificial Turf, Underdrains and Cistern	1	EA	$600,000.00	$600,000
Bioretention Area, Linear	530	SF	$25.00	$13,250
Infiltration Trench	570	LF	$100.00	$57,000
Bioretention Area	2725	SF	$25.00	$68,125
Porous Pavement	2500	SY	$15.00	$37,500

Base Cost = $834,625

Mobilization (5%) = $41,731

Subtotal 1 = $876,356

Contingency (25%) = $219,089

Subtotal 2 = $1,095,445

Engineering Design, Surveys, Land Acquisition,
Utility Relocation, and Permits (45%) = $492,950

Total = $1,588,396

Estimated Project Cost = $1,589,000

Ridgeview Park LID - A

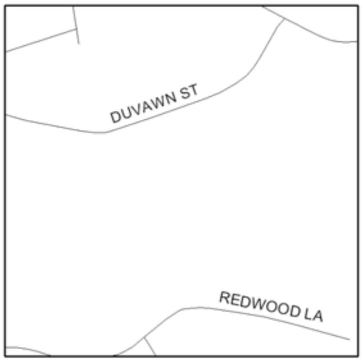
Project ID: CA9809

Project Type: Low Impact Development

Project Name: Ridgeview Park LID - A
Project Location: Duvawn St. & Ridge View Dr.
Parcel ID No.: 0823 10 C

Subwatershed: Pike Branch
Drainage Area: 2.9 acres

Project Location:



Proposed Project:

Proposed Action:

Construct off-line bioretention in existing swale; plant meadow in lawn areas that extend into park/ROW; build detention micro-berm parallel to ROW in meadow areas; use integrated vegetation management practices to encourage shrub/low growing trees beneath power lines.

Create detention berm and bioretention area in transmission line ROW; replant unused mowed areas

Enhance habitat in ROW - control regrowth to encourage a low-growth, climax community

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.

Estimated Cost: $59,000

Ridgeview Park LID - A

Project ID: CA9809

Project Name: Ridgeview Park LID - A

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Off-line	1210	SF	$25.00	$30,250
Detention Berm	320	LF	$2.00	$640
Wildflower Planting	0.02	AC	$3,000.00	$60
			Base Cost =	$30,950
			Mobilization (5%) =	$1,548
			Subtotal 1 =	$32,498
			Contingency (25%) =	$8,124
			Subtotal 2 =	$40,622
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$18,280
			Total =	$58,902
			Estimated Project Cost =	$59,000

Ridgeview Park LID - B

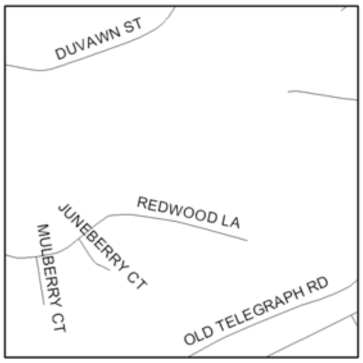
Project ID: CA9810

Project Type: Low Impact Development

Project Name: Ridgeview Park LID - B
Project Location: Ridgeview Park
Parcel ID No.: 0824 29 A

Subwatershed: Pike Branch
Drainage Area: 7.6 acres

Project Location:



Proposed Project:

Proposed Action:

Install off-line bioretention areas to intercept flow before reaching stormwater outfall.

Divert stormwater into off-line bioretention areas above this eroded pipe outfall

View of eroded outfall from above

Benefits: Provide stormwater quality controls.
Improve stormwater quantity controls.
Opportunity for public education.

Estimated Cost: $414,000

Ridgeview Park LID - B

Project ID: CA9810

Project Name: Ridgeview Park LID - B

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Off-line	8690	SF	$25.00	$217,250

Base Cost =	$217,250
Mobilization (5%) =	$10,863
Subtotal 1 =	$228,113
Contingency (25%) =	$57,028
Subtotal 2 =	$285,141
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$128,313
Total =	$413,454
Estimated Project Cost =	$414,000

Redwood Lane - LID

Project ID: CA9811
Project Type: Low Impact Development

Project Name: Redwood Lane - LID
Subwatershed: Pike Branch
Project Location: Redwood Ln. at Shannon Hill Rd. and Mulberry Ct
Drainage Area: 2.9 acres
Parcel ID No.: 0824 29 A

Project Location:

Proposed Project:

Proposed Action:

Construct off-line bioretention area at stormwater pipe outfall below Mulberry Ct.; use integrated vegetation management practices to encourage shrub/low growing trees beneath power lines.

Mulberry Court - off-line bioretention garden to be constructed at stormwater pipe outfall

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.

Estimated Cost: $211,000

Redwood Lane - LID

Project ID: CA9811

Project Name: Redwood Lane - LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Off-line	4425	SF	$25.00	$110,625
			Base Cost =	$110,625
			Mobilization (5%) =	$5,531
			Subtotal 1 =	$116,156
			Contingency (25%) =	$29,039
			Subtotal 2 =	$145,195
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$65,338
			Total =	$210,533
			Estimated Project Cost =	$211,000

Ridge View Drive - LID

Project ID: CA9812
Project Type: Low Impact Development

Project Name: Ridge View Drive - LID
Project Location: Ridge View Drive after Dubois Street
Parcel ID No.: 0823 01 0037B

Subwatershed: Pike Branch
Drainage Area: 3.1 acres

Project Location:

Proposed Action:

Construct off-line bioretention area at stormwater pipe outfall.

Proposed Project:

Divert flow from concrete channel into off-line bioretention area

Space for off-line bioretention area at end of street

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $249,000

Ridge View Drive - LID

Project ID: CA9812

Project Name: Ridge View Drive - LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Off-line	5230	SF	$25.00	$130,750

Base Cost =	$130,750
Mobilization (5%) =	$6,538
Subtotal 1 =	$137,288
Contingency (25%) =	$34,322
Subtotal 2 =	$171,609
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$77,224
Total =	$248,834
Estimated Project Cost =	$249,000

John Marshall Library LID

Project ID: CA9813

Project Type: Low Impact Development

Project Name: John Marshall Library LID

Project Location: Rose Hill Dr. & Celtic Dr.

Parcel ID No.: 0823 12 B

Subwatershed: Pike Branch

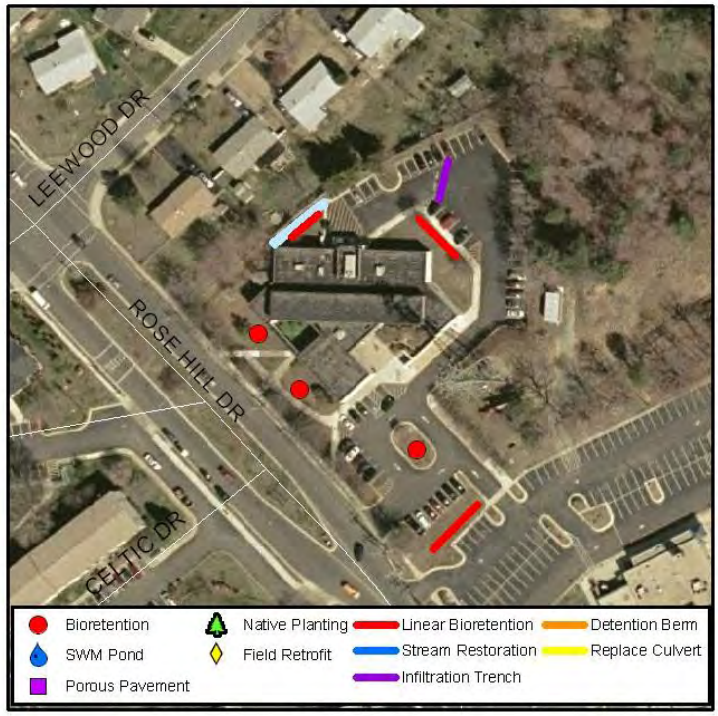
Drainage Area: 1.8 acres

Project Location:

Proposed Action:

Construct linear bioretention areas along edge of rear parking lot and in swale to NW; construct bioretention areas in islands along front of bldg. and in parking lot; install infiltration trench in rear parking lot.

Proposed Project:



Potential bioretention areas in island in east parking lot

Convert concrete swale to linear bioretention area along NW side of building

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.
Opportunity for public education.

Estimated Cost: $246,000

John Marshall Library LID

Project ID: CA9813

Project Name: John Marshall Library LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Linear	1575	SF	$25.00	$39,375
Bioretention Area	3365	SF	$25.00	$84,125
Infiltration Trench	55	LF	$100.00	$5,500
			Base Cost =	$129,000
			Mobilization (5%) =	$6,450
			Subtotal 1 =	$135,450
			Contingency (25%) =	$33,863
			Subtotal 2 =	$169,313
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$76,191
			Total =	$245,503
			Estimated Project Cost =	$246,000

Clermont School Site Park LID

Project ID: CA9818

Project Type: Low Impact Development

Project Name: Clermont School Site Park LID
Project Location: Clermont School Site Park - Gypsy Ct.
Parcel ID No.: 0822 01 0003B

Subwatershed: Tributaries to Cameron Run
Drainage Area: 1.1 acres

Project Location:

Proposed Action:

Construct bioretention area below houses on Gypsy Ct.

Proposed Project:

Potential bioretention area behind houses

Concrete ditch behind houses

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.

Estimated Cost: $49,000

Clermont School Site Park LID

Project ID: CA9818

Project Name: Clermont School Site Park LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	1020	SF	$25.00	$25,500

Base Cost =	$25,500
Mobilization (5%) =	$1,275
Subtotal 1 =	$26,775
Contingency (25%) =	$6,694
Subtotal 2 =	$33,469
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$15,061
Total =	$48,530
Estimated Project Cost =	$49,000

Clermont Elementary School LID

Project ID: CA9821

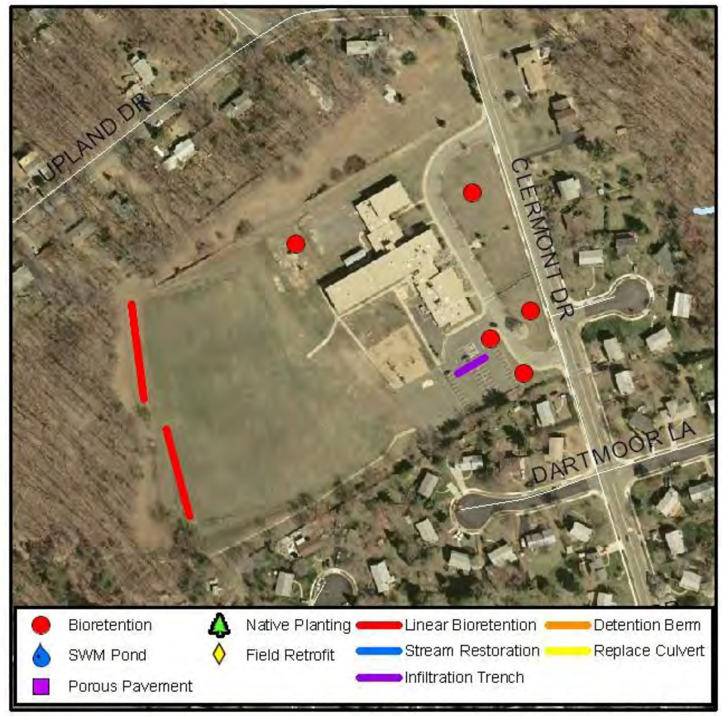
Project Type: Low Impact Development

Project Name: Clermont Elementary School LID
Project Location: Clermont Elementary School
Parcel ID No.: 0821 01 0005B

Subwatershed: Tributaries to Cameron Run
Drainage Area: 12.4 acres

Project Location:

Proposed Project:



Proposed Action:

Construct bioretention areas in bus loop traffic island and NW of building; construct linear bioretention area S of building and along west end of fields; replace inlet at NE corner of parking lot with a tree box filter.

Bus loop where bioretention gardens could be constructed

Potential bioretention area at inlet in front of school

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $308,000

Clermont Elementary School LID

Project ID: CA9821

Project Name: Clermont Elementary School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Linear	3940	SF	$25.00	$98,500
Bioretention Area	1675	SF	$25.00	$41,875
Tree Box Filter	1	EA	$3,000.00	$3,000
Infiltration Trench	180	LF	$100.00	$18,000

Base Cost =	$161,375
Mobilization (5%) =	$8,069
Subtotal 1 =	$169,444
Contingency (25%) =	$42,361
Subtotal 2 =	$211,805
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$95,312
Total =	$307,117
Estimated Project Cost =	$308,000

Twain Middle School LID

Project ID: CA9822

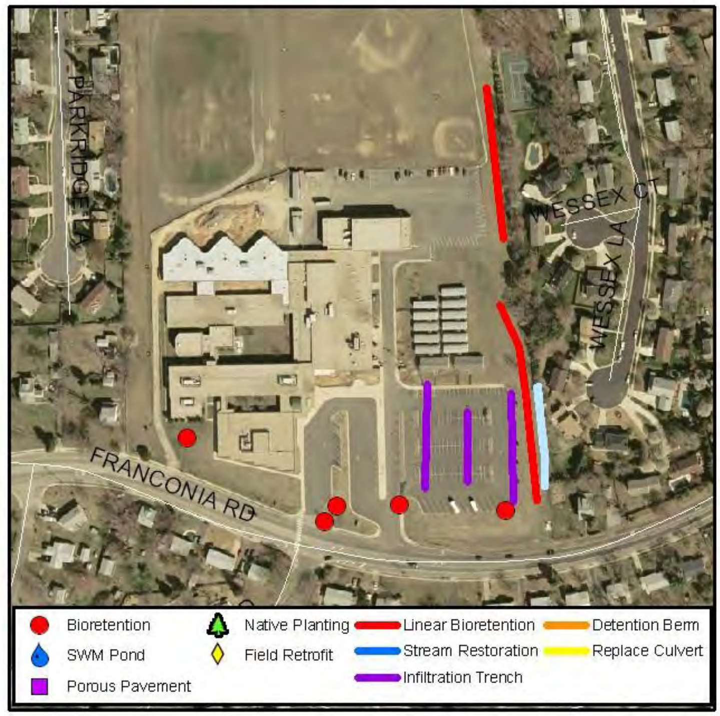
Project Type: Low Impact Development

Project Name: Twain Middle School LID
Project Location: Twain Middle School
Parcel ID No.: 0823 01 0020

Subwatershed: Tributaries to Cameron Run
Drainage Area: 9.6 acres

Project Location:

Proposed Project:



Proposed Action:

Construct bioretention areas in bus loop traffic island and in grass island SW of bldg.; construct linear bioretention areas along E side of property; install infiltration trenches and tree box filters in SE parking lot.

Construct bioretention areas in bus loop traffic island and along parking lots

Add bioretention areas in this traffic island, and replace inlet with a tree box filter

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve community usage.
Opportunity for public education.

Estimated Cost: $660,000

Project ID: CA9822

Project Name: Twain Middle School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Linear	8740	SF	$25.00	$218,500
Bioretention Area	2600	SF	$25.00	$65,000
Tree Box Filter	3	EA	$3,000.00	$9,000
Infiltration Trench	540	LF	$100.00	$54,000

Base Cost =	$346,500
Mobilization (5%) =	$17,325
Subtotal 1 =	$363,825
Contingency (25%) =	$90,956
Subtotal 2 =	$454,781
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$204,652
Total =	$659,433
Estimated Project Cost =	$660,000

Bush Hill Elementary School LID

Project ID: CA9823

Project Type: Low Impact Development

Project Name: Bush Hill Elementary School LID
Project Location: Bush Hill Elementary School
Parcel ID No.: 0823 01 0001

Subwatershed: Tributaries to Cameron Run
Drainage Area: 9.6 acres

Project Location:

Proposed Action:

Construct bioretention areas in traffic/sidewalk islands; install infiltration trenches in parking lots; construct off-line bioretention at end of concrete trench from eastern parking lot and detention micro-berm along northern tree line.

Proposed Project:

Potential bioretention area in bus circle

Potential bioretention area south of parking lot

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $183,000

Bush Hill Elementary School LID

Project ID: CA9823

Project Name: Bush Hill Elementary School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Detention Berm	590	LF	$2.00	$1,180
Bioretention Area, Off-line	915	SF	$25.00	$22,875
Bioretention Area	1445	SF	$25.00	$36,125
Tree Box Filter	3	EA	$3,000.00	$9,000
Infiltration Trench	265	LF	$100.00	$26,500
			Base Cost =	$95,680
			Mobilization (5%) =	$4,784
			Subtotal 1 =	$100,464
			Contingency (25%) =	$25,116
			Subtotal 2 =	$125,580
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$56,511
			Total =	$182,091
			Estimated Project Cost =	$183,000

Lee District Government Center LID

Project ID: CA9827
Project Type: Low Impact Development

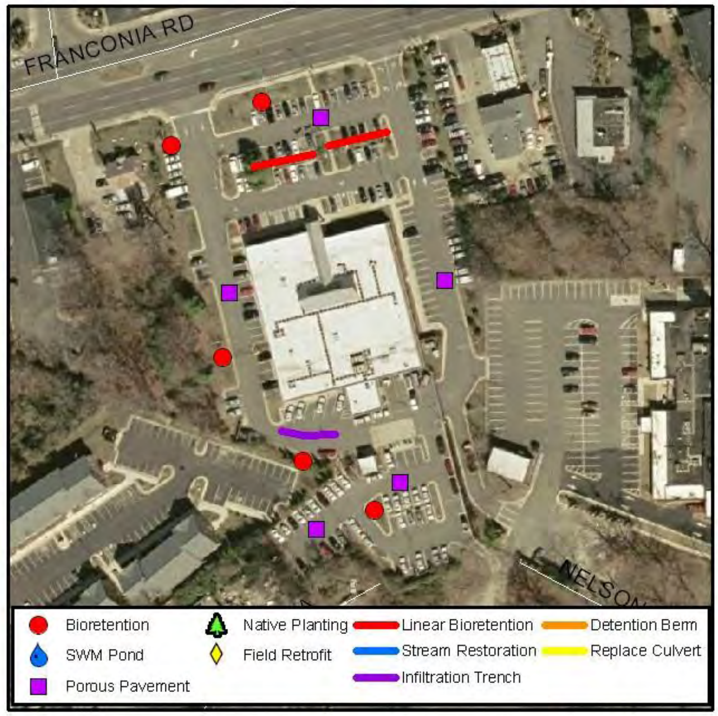
Project Name: Lee District Government Center LID
Project Location: Lee District Government Center, Franconia Road
Parcel ID No.: 0813 05 0002A
Subwatershed: Backlick Run
Drainage Area: 3.1 acres

Project Location:

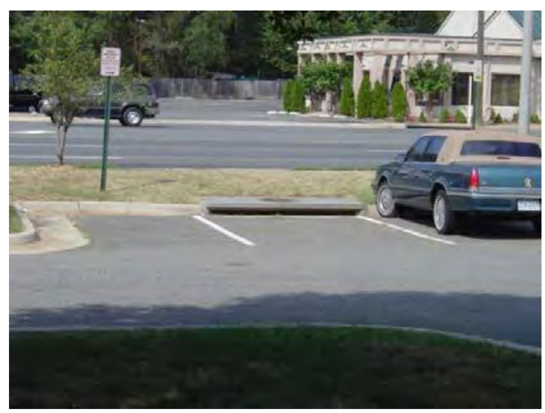
Proposed Action:

Construct bioretention areas in traffic islands; install infiltration trench in lane SW of bldg.; install tree box filters and porous pavement.

Proposed Project:



Traffic island conversion to bioretention areas



Replace inlet with tree box filter

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.

Estimated Cost: $209,000

Lee District Government Center LID

Project ID: CA9827

Project Name: Lee District Government Center LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Linear	1345	SF	$25.00	$33,625
Porous Pavement	3400	SY	$15.00	$51,000
Bioretention Area	150	SF	$25.00	$3,750
Tree Box Filter	2	EA	$3,000.00	$6,000
Infiltration Trench	150	LF	$100.00	$15,000

Base Cost =	$109,375
Mobilization (5%) =	$5,469
Subtotal 1 =	$114,844
Contingency (25%) =	$28,711
Subtotal 2 =	$143,555
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$64,600
Total =	$208,154
Estimated Project Cost =	$209,000

Fire Station - Company No. 5 LID

Project ID: CA9828

Project Type: Low Impact Development

Project Name: Fire Station - Company No. 5 LID

Project Location: Franconia Rd. and Beulah St. (VA 613)

Parcel ID No.: 0813 05 0020

Subwatershed: Backlick Run

Drainage Area: 2.6 acres

Project Location:

Proposed Action:

At Fire Station, divert roof drains to cistern for filling fire trucks; install porous pavement in W parking lot; construct bioretention area in SE corner; install tree box filter.

Proposed Project:

Roof drains at Fire Station can be diverted to cistern for filling fire trucks

Location for bioretention area

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.

Estimated Cost: $71,000

Fire Station - Company No. 5 LID

Project ID: CA9828

Project Name: Fire Station - Company No. 5 LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Cistern	2	EA	$5,000.00	$10,000
Porous Pavement	560	SY	$15.00	$8,400
Bioretention Area	625	SF	$25.00	$15,625
Tree Box Filter	1	EA	$3,000.00	$3,000

Base Cost =	$37,025
Mobilization (5%) =	$1,851
Subtotal 1 =	$38,876
Contingency (25%) =	$9,719
Subtotal 2 =	$48,595
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$21,868
Total =	$70,463
Estimated Project Cost =	$71,000

Franconia Park LID

Project ID: CA9829

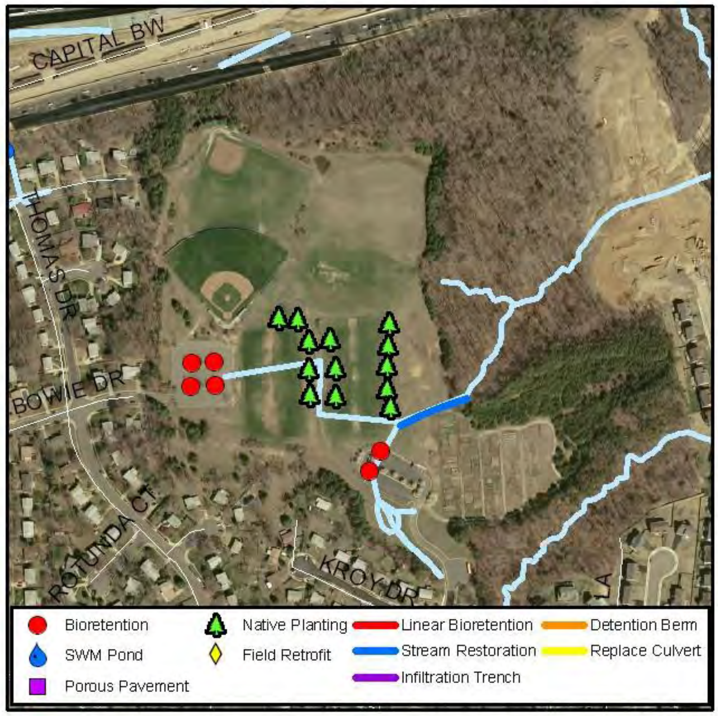
Project Name: Franconia Park LID
Project Location: Franconia Park
Parcel ID No.: 0813 01 0041

Project Type: Low Impact Development

Subwatershed: Backlick Run
Drainage Area: 12.8 acres

Project Location:

Proposed Project:



Proposed Action:

Construct bioretention areas in islands of both parking lots; plant trees between soccer fields and other locations to provide shade; repair streambank erosion and downcutting. Note that athletic fields are scheduled for conversion to artificial turf. Facility maintenance and renovation is an on-going process and proposed retrofits, or similar stormwater improvements, should be incorporated into site improvement plans.

Eroded cut along streambank

Outfall

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.
Opportunity for public education.

Estimated Cost: $126,000

Project ID: CA9829

Project Name: Franconia Park LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Streambank Stabilization	250	LF	$80.00	$20,000
Bioretention Area	1100	SF	$25.00	$27,500
Shade Tree	0.5	AC	$25,000.00	$12,500
Tree Box Filter	2	EA	$3,000.00	$6,000

Base Cost =	$66,000
Mobilization (5%) =	$3,300
Subtotal 1 =	$69,300
Contingency (25%) =	$17,325
Subtotal 2 =	$86,625
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$38,981
Total =	$125,606
Estimated Project Cost =	$126,000

Edsall Administration Center LID

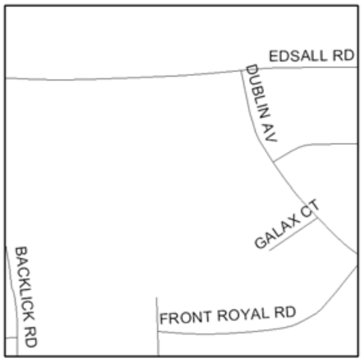
Project ID: CA9830

Project Type: Low Impact Development

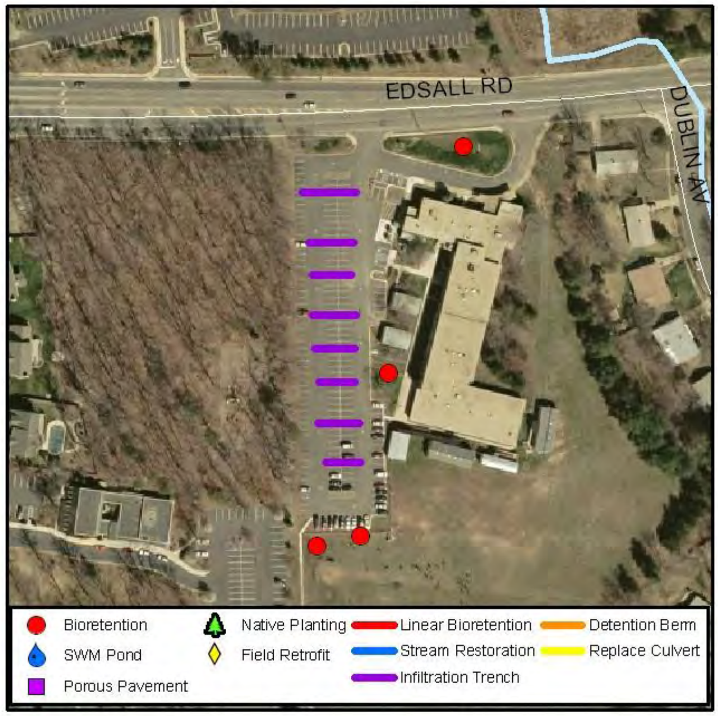
Project Name: Edsall Administration Center LID
Project Location: Edsall Rd. & Dublin Av.
Parcel ID No.: 0714 01 0042

Subwatershed: Backlick Run
Drainage Area: 4.5 acres

Project Location:

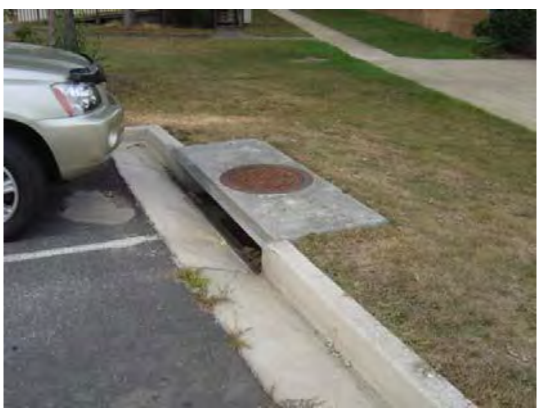


Proposed Project:



Proposed Action:

Install infiltration trenches in parking lots; construct bioretention areas in islands/borders; install tree box filters.



Inlet where tree box filter could be installed

Depressed area where bioretention area could be installed

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.
Improve community usage.

Estimated Cost: $139,000

Project ID: CA9830

Project Name: Edsall Administration Center LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	150	SF	$25.00	$3,750
Tree Box Filter	1	EA	$3,000.00	$3,000
Infiltration Trench	660	LF	$100.00	$66,000

Base Cost =	$72,750
Mobilization (5%) =	$3,638
Subtotal 1 =	$76,388
Contingency (25%) =	$19,097
Subtotal 2 =	$95,484
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$42,968
Total =	$138,452
Estimated Project Cost =	$139,000

Springfield Elementary School LID

Project ID: CA9835

Project Type: Low Impact Development

Project Name: Springfield Elementary School LID
Project Location: Deepford St. & Crozet Ct.
Parcel ID No.: 0813 01 0005B

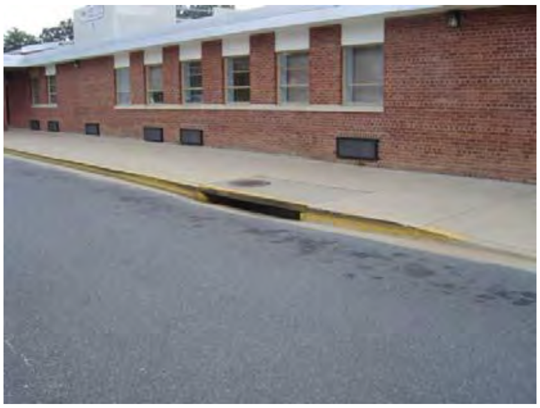
Subwatershed: Backlick Run
Drainage Area: 10.2 acres

Project Location:

Proposed Project:

Proposed Action:

Create bioretention areas in bus loop and landscape islands in front of bldg.; install infiltration trenches and tree box filters in parking lot; construct linear bioretention areas and filter strip adjacent to asphalt play yard; convert soccer/football field from grass to artificial turf with cistern and underdrain system.



Inlet in front of school where tree box filter could be installed

Inlet in grassy area where bioretention area could be installed. Note parking lot island in background where bioretention can be used

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.
Improve community usage.
Opportunity for public education.

Estimated Cost: $1,356,000

Springfield Elementary School LID

Project ID: CA9835

Project Name: Springfield Elementary School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Artificial Turf, Underdrains and Cistern	1	EA	$600,000.00	$600,000
Filter Strip	70	LF	$2.00	$140
Bioretention Area	1800	SF	$25.00	$45,000
Tree Box Filter	2	EA	$3,000.00	$6,000
Infiltration Trench	610	LF	$100.00	$61,000

Base Cost =	$712,140
Mobilization (5%) =	$35,607
Subtotal 1 =	$747,747
Contingency (25%) =	$186,937
Subtotal 2 =	$934,684
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$420,608
Total =	$1,355,291
Estimated Project Cost =	$1,356,000

Lee High School LID

Project ID: CA9836

Project Type: Low Impact Development

Project Name: Lee High School LID

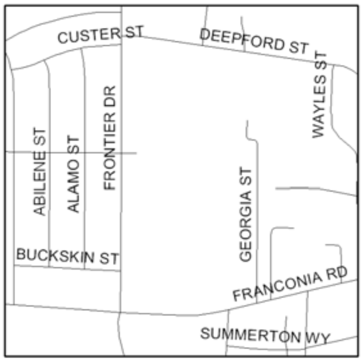
Project Location: Lee High School and Lee Park

Parcel ID No.: 0804 01 0037

Subwatershed: Backlick Run

Drainage Area: 42.1 acres

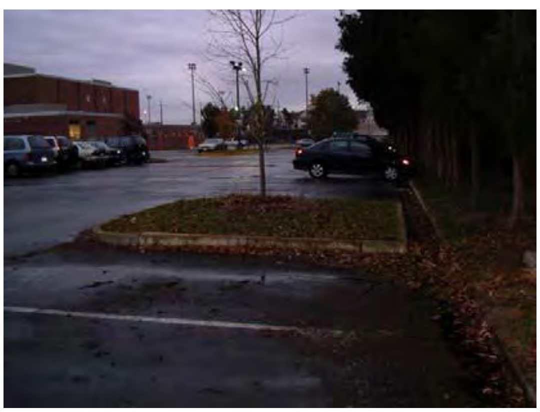
Project Location:



Proposed Project:

Proposed Action:

Construct off-line bioretention area at outfall S of Deepford St.; construct infiltration trenches and bioretention areas in parking lots around school bldg.; linear bioretention areas along tennis courts and concrete swale E of trailers; build detention micro-berm around 2 inlets; reforest unused open space.



Parking lot island conversion to bioretention area

Stormwater pipe inlet at Deepford St where bioretention area could be utilized

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.

Estimated Cost: $3,421,000

Project ID: CA9836

Project Name: Lee High School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Detention Berm	540	LF	$2.00	$1,080
Bioretention Area, Off-line	31250	SF	$25.00	$781,250
Bioretention Area, Linear	12500	SF	$25.00	$312,500
Bioretention Area	20000	SF	$25.00	$500,000
Reforestation	1	AC	$25,000.00	$25,000
Infiltration Trench	1775	LF	$100.00	$177,500

Base Cost = $1,797,330

Mobilization (5%) = $89,867

Subtotal 1 = $1,887,197

Contingency (25%) = $471,799

Subtotal 2 = $2,358,996

Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) = $1,061,548

Total = $3,420,544

Estimated Project Cost = $3,421,000

Key Middle School LID

Project ID: CA9839

Project Type: Low Impact Development

Project Name: Key Middle School LID
Project Location: Franconia Rd. & Thomas Dr.
Parcel ID No.: 0813 01 0022B

Subwatershed: Backlick Run
Drainage Area: 21.3 acres

Project Location:

Proposed Action:

Construct bioretention areas, infiltration trenches, and tree box filters in parking lots; convert NE parking lot to porous pavement; provide depression storage N of bldg. in trailer area (not shown in aerial); convert two fields from grass to artificial turf with cistern and underdrain system.

Proposed Project:

Grassy swale leading to inlet

Inlet in parking lot where tree box could be installed

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.
Improve community usage.
Opportunity for public education.

Estimated Cost: $2,745,000

Key Middle School LID

Project ID: CA9839

Project Name: Key Middle School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Artificial Turf, Underdrains and Cistern	2	EA	$600,000.00	$1,200,000
Depression Storage	4000	SF	$10.00	$40,000
Bioretention Area, Linear	1440	SF	$25.00	$36,000
Porous Pavement	3750	SF	$15.00	$56,250
Bioretention Area	2600	SF	$25.00	$65,000
Tree Box Filter	5	EA	$3,000.00	$15,000
Infiltration Trench	300	LF	$100.00	$30,000

Base Cost =	$1,442,250
Mobilization (5%) =	$72,113
Subtotal 1 =	$1,514,363
Contingency (25%) =	$378,591
Subtotal 2 =	$1,892,953
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$851,829
Total =	$2,744,782
Estimated Project Cost =	$2,745,000

Lynbrook Elementary School LID

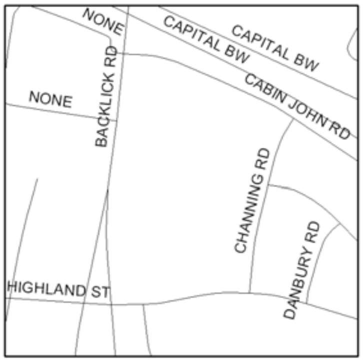
Project ID: CA9842

Project Type: Low Impact Development

Project Name: Lynbrook Elementary School LID
Project Location: Backlick Road
Parcel ID No.: 0802 01 0021

Subwatershed: Backlick Run
Drainage Area: 11 acres

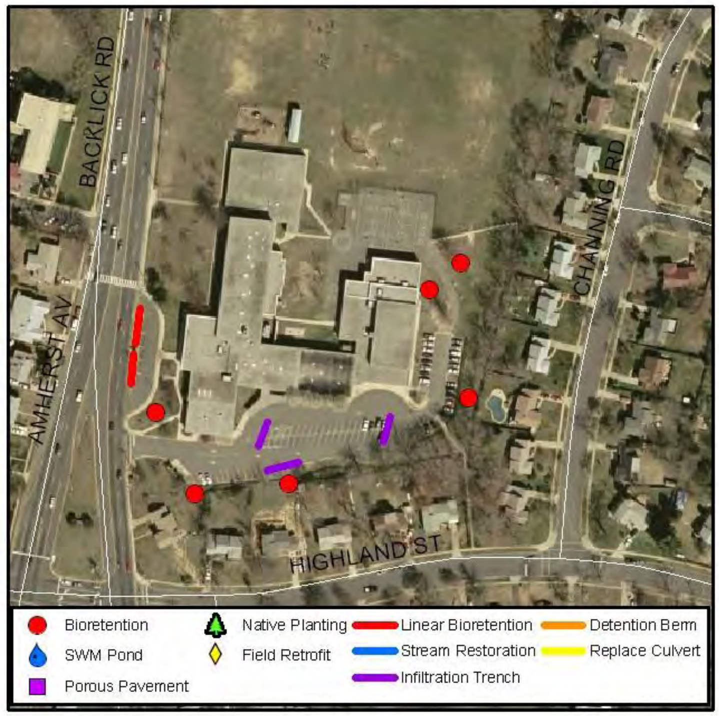
Project Location:



Proposed Action:

Construct bioretention in bus loop island, in front of school building, and to E of bldg.; direct roof drainage to cistern to water fields; install infiltration trenches and tree box filters in parking lot.

Proposed Project:



Inlet in parking lot

Stormwater inlet in lawn

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $254,000

Lynbrook Elementary School LID

Project ID: CA9842

Project Name: Lynbrook Elementary School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Cistern	5	EA	$5,000.00	$25,000
Bioretention Area, Linear	490	SF	$25.00	$12,250
Bioretention Area	2300	SF	$25.00	$57,500
Tree Box Filter	3	EA	$3,000.00	$9,000
Infiltration Trench	295	LF	$100.00	$29,500

Base Cost =	$133,250
Mobilization (5%) =	$6,663
Subtotal 1 =	$139,913
Contingency (25%) =	$34,978
Subtotal 2 =	$174,891
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$78,701
Total =	$253,591
Estimated Project Cost =	$254,000

Leewood Park LID - A

Project ID: CA9846

Project Type: Low Impact Development

Project Name: Leewood Park LID - A
Project Location: Leewood Park
Parcel ID No.: 0801 04 0004A

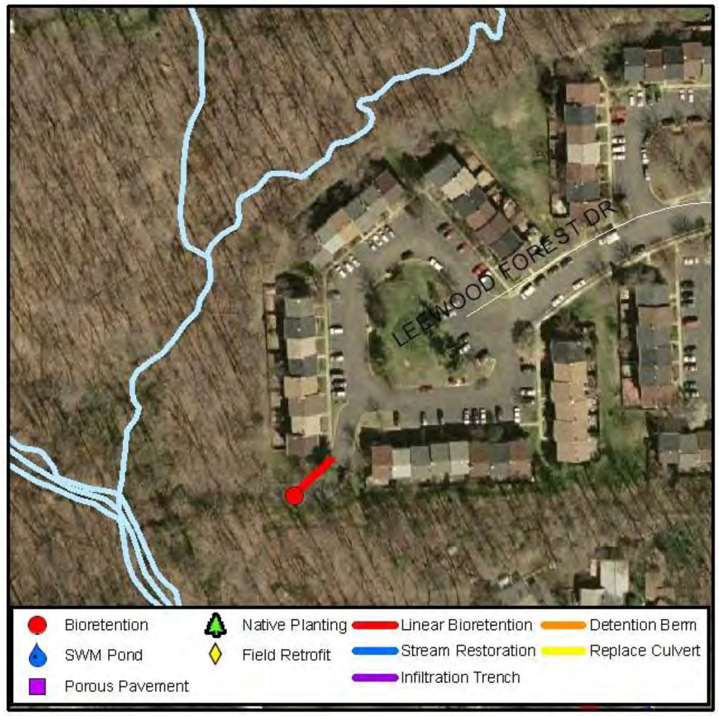
Subwatershed: Backlick Run
Drainage Area: 11.4 acres

Project Location:

Proposed Action:

Restore grass swale; install bioretention area next to stormwater outfall pipe. Use woodland species.

Proposed Project:



Proposed bioretention area adjacent to outfall

Channel below outfall

Benefits: Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $39,000

Leewood Park LID - A

Project ID: CA9846

Project Name: Leewood Park LID - A

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grass Swale	50	LF	$6.00	$300
Bioretention Area	800	SF	$25.00	$20,000
			Base Cost =	$20,300
			Mobilization (5%) =	$1,015
			Subtotal 1 =	$21,315
			Contingency (25%) =	$5,329
			Subtotal 2 =	$26,644
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$11,990
			Total =	$38,633
			Estimated Project Cost =	$39,000

Leewood Park LID - B

Project ID: CA9848

Project Name: Leewood Park LID - B
Project Location: Leewood Park
Parcel ID No.: 0801 13 E

Project Type: Low Impact Development

Subwatershed: Backlick Run
Drainage Area: 6.6 acres

Project Location:

Proposed Project:

Proposed Action:

Install riprap and infiltration trench at the end of stormwater outfall.

View of spillway

Top of spillway looking down

Benefits: Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $13,000

Leewood Park LID - B

Project ID: CA9848

Project Name: Leewood Park LID - B

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Rip-Rap lining	50	LF	$30.00	$1,500
Infiltration Trench	50	LF	$100.00	$5,000

Base Cost =	$6,500
Mobilization (5%) =	$325
Subtotal 1 =	$6,825
Contingency (25%) =	$1,706
Subtotal 2 =	$8,531
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$3,839
Total =	$12,370
Estimated Project Cost =	$13,000

Wilburdale Park LID - A

Project ID: CA9850

Project Type: Low Impact Development

Project Name: Wilburdale Park LID - A
Project Location: Wilburdale Park
Parcel ID No.: 0713 09 A

Subwatershed: Backlick Run
Drainage Area: 25.6 acres

Project Location:

Proposed Action:

Install bioretention areas next to court and along street; construct off-line bioretention area at outfall into concrete ditch; reforest unused areas in park.

Proposed Project:

Ditch and outfall

Ditch leading into stream

Benefits: Provide stormwater quality controls.
Opportunity for public education.
Improve community usage.

Estimated Cost: $156,000

Wilburdale Park LID - A

Project ID: CA9850

Project Name: Wilburdale Park LID - A

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Off-line	2500	SF	$25.00	$62,500
Bioretention Area	600	SF	$25.00	$15,000
Reforestation	0.16	AC	$25,000.00	$4,000
			Base Cost =	$81,500
			Mobilization (5%) =	$4,075
			Subtotal 1 =	$85,575
			Contingency (25%) =	$21,394
			Subtotal 2 =	$106,969
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$48,136
			Total =	$155,105
			Estimated Project Cost =	$156,000

Wilburdale Park LID - B

Project ID: CA9851

Project Type: Low Impact Development

Project Name: Wilburdale Park LID - B
Project Location: Byrneley La. & Backlick Rd.
Parcel ID No.: 0713 10 0018

Subwatershed: Backlick Run
Drainage Area: 6 acres

Project Location:

Proposed Action:

Develop/restore grass swales along road to deliver runoff to new bioretention area at end of roadway.

Proposed Project:

Proposed location for bioretention area

Swale and outlet

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.

Estimated Cost: $97,000

Wilburdale Park LID - B

Project ID: CA9851

Project Name: Wilburdale Park LID - B

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grass Swale	270	LF	$6.00	$1,620
Bioretention Area	1960	SF	$25.00	$49,000
			Base Cost =	$50,620
			Mobilization (5%) =	$2,531
			Subtotal 1 =	$53,151
			Contingency (25%) =	$13,288
			Subtotal 2 =	$66,439
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$29,897
			Total =	$96,336
			Estimated Project Cost =	$97,000

Annandale High School LID

Project ID: CA9853

Project Type: Low Impact Development

Project Name: Annandale High School LID
Project Location: Four Year Run & Heritage Dr.
Parcel ID No.: 0711 01 0068

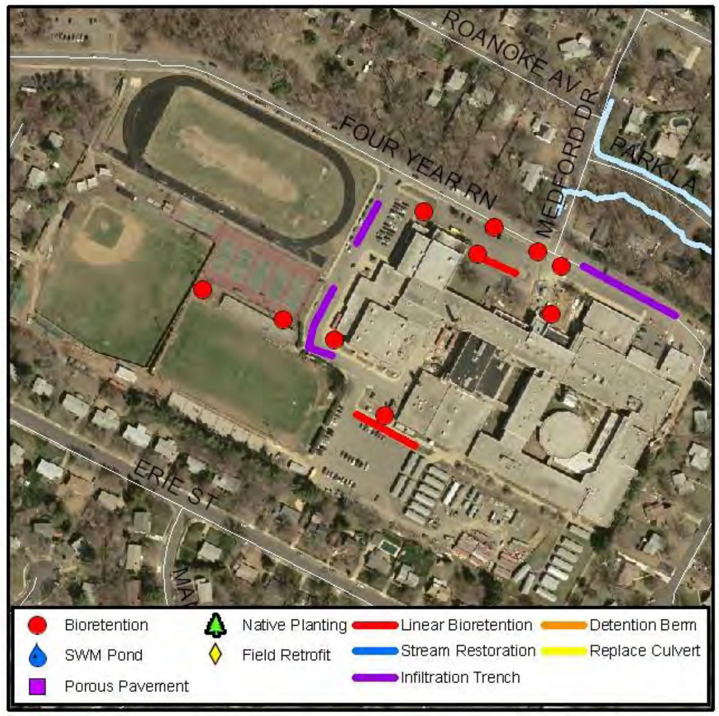
Subwatershed: Backlick Run
Drainage Area: 17.7 acres

Project Location:

Proposed Action:

Incorporate grass swale along roadway; construct linear bioretention areas and infiltration trenches along parking lots and courts; install tree box filters.

Proposed Project:



Partial sidewalk along Four Year Run could be converted to a grass filter strip

Potential bioretention area

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.
Improve community usage.
Opportunity for public education.

Estimated Cost: $420,000

Annandale High School LID

Project ID: CA9853

Project Name: Annandale High School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Filter Strip	190	LF	$2.00	$380
Bioretention Area, Linear	2560	SF	$25.00	$64,000
Bioretention Area	2500	SF	$25.00	$62,500
Tree Box Filter	2	EA	$3,000.00	$6,000
Infiltration Trench	875	LF	$100.00	$87,500
			Base Cost =	$220,380
			Mobilization (5%) =	$11,019
			Subtotal 1 =	$231,399
			Contingency (25%) =	$57,850
			Subtotal 2 =	$289,249
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$130,162
			Total =	$419,411
			Estimated Project Cost =	$420,000

Bren Mar Park Elementary School LID

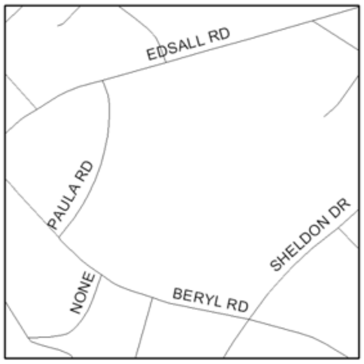
Project ID: CA9854

Project Type: Low Impact Development

Project Name: Bren Mar Park Elementary School LID
Project Location: Bren Mar Park Elementary School
Parcel ID No.: 0811 01 0006

Subwatershed: Indian Run
Drainage Area: 5.5 acres

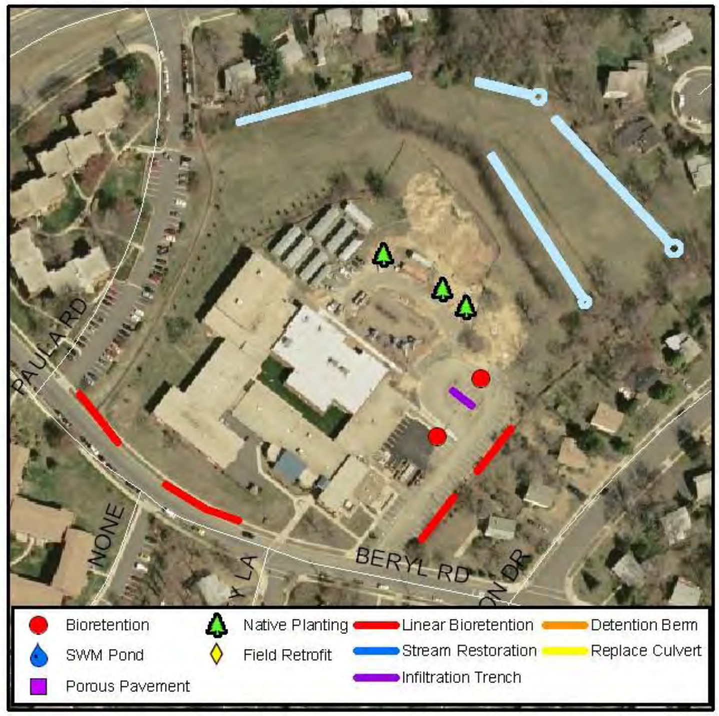
Project Location:



Proposed Action:

Construct linear bioretention areas in grass areas along Beryl Rd. and along E edge of parking lot; install infiltration trench and tree box filter in rear of parking lot; plant shade trees between new basketball court and baseball field (not shown on aerial).

Proposed Project:



Install linear bioretention area along Beryl Road

Potential linear bioretention area along parking lot

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $230,000

Bren Mar Park Elementary School LID

Project ID: CA9854

Project Name: Bren Mar Park Elementary School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Linear	4000	SF	$25.00	$100,000
Shade Tree	0.28	AC	$25,000.00	$7,000
Tree Box Filter	2	EA	$3,000.00	$6,000
Infiltration Trench	75	LF	$100.00	$7,500

Base Cost =	$120,500
Mobilization (5%) =	$6,025
Subtotal 1 =	$126,525
Contingency (25%) =	$31,631
Subtotal 2 =	$158,156
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$71,170
Total =	$229,327
Estimated Project Cost =	$230,000

Fire Station - Company No. 26 LID

Project ID: CA9855

Project Type: Low Impact Development

Project Name: Fire Station - Company No. 26 LID
Project Location: Fire Station - Company No. 26 - Edsall Rd.
Parcel ID No.: 0802 01 0048

Subwatershed: Indian Run
Drainage Area: 1.8 acres

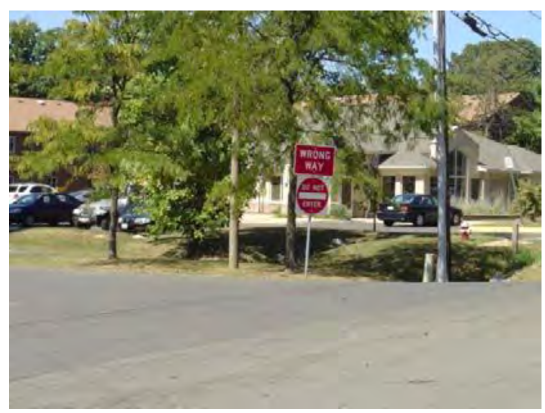
Project Location:

Proposed Project:

Proposed Action:

At Fire Station, divert roof drains to cistern for filling fire trucks; construct bioretention areas in sodded ditch to north and along western edge of parking lot.

Fire station



Potential linear bioretention area in ditch north of fire station

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $131,000

Fire Station - Company No. 26 LID

Project ID: CA9855

Project Name: Fire Station - Company No. 26 LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Cistern	1	EA	$5,000.00	$5,000
Bioretention Area, Linear	2550	SF	$25.00	$63,750
			Base Cost =	$68,750
			Mobilization (5%) =	$3,438
			Subtotal 1 =	$72,188
			Contingency (25%) =	$18,047
			Subtotal 2 =	$90,234
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$40,605
			Total =	$130,840
			Estimated Project Cost =	$131,000

Holmes Middle School LID

Project ID: CA9856

Project Type: Low Impact Development

Project Name: Holmes Middle School LID
Project Location: Holmes Middle School
Parcel ID No.: 0723 01 0014

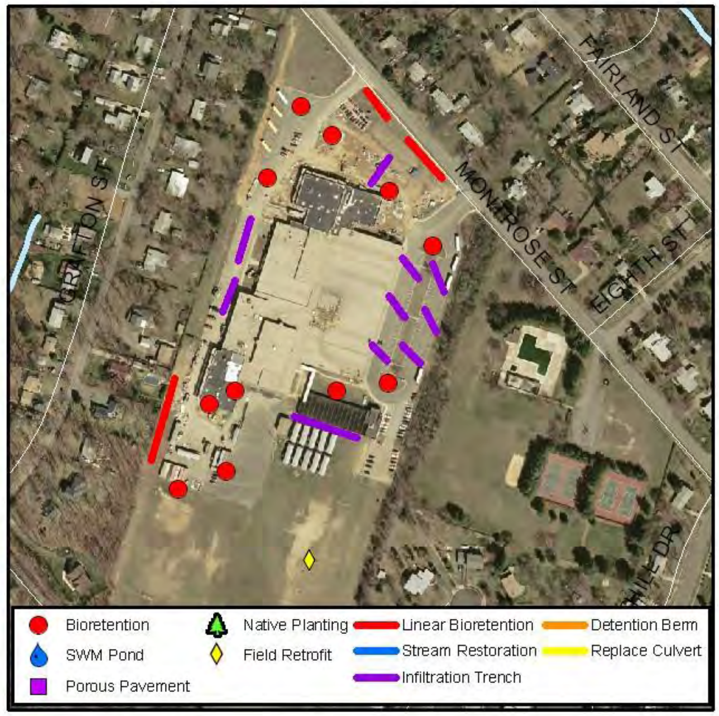
Subwatershed: Indian Run
Drainage Area: 17.5 acres

Project Location:

Proposed Action:

Construct linear bioretention areas in grass along Montrose St.; construct area bioretention areas in traffic islands in NW and E lots; install infiltration trenches in road ways and next to rear of bldg.; install tree box filters in front lot and filter strip along edge of rear parking lots; create multisport, artificial-turf playing fields.

Proposed Project:



Linear bioretention and filter strips could be installed along tennis courts

Install infiltration trench along portable buildings

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve community usage.
Opportunity for public education.

Estimated Cost: $1,593,000

Holmes Middle School LID

Project ID: CA9856

Project Name: Holmes Middle School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Linear	2330	SF	$25.00	$58,250
Bioretention Area	3550	SF	$25.00	$88,750
Infiltration Trench	825	LF	$100.00	$82,500
Tree Box Filter	2	EA	$3,000.00	$6,000
Filter Strip	135	LF	$2.00	$270
Artificial Turf, Underdrains and Cistern	1	EA	$600,000.00	$600,000
Grass Swale	210	LF	$6.00	$1,260
			Base Cost =	$837,030
			Mobilization (5%) =	$41,852
			Subtotal 1 =	$878,882
			Contingency (25%) =	$219,720
			Subtotal 2 =	$1,098,602
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$494,371
			Total =	$1,592,973
			Estimated Project Cost =	$1,593,000

Weyanoke Elementary School LID

Project ID: CA9857

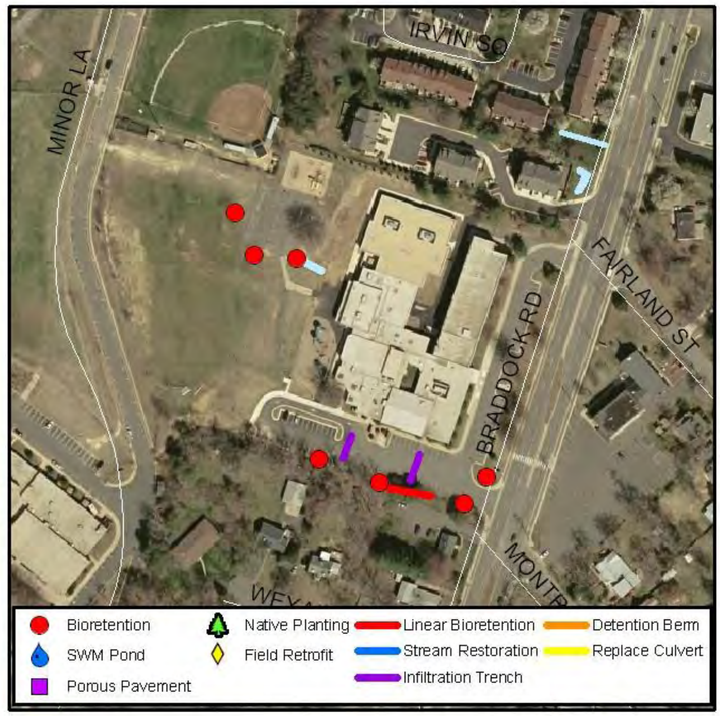
Project Type: Low Impact Development

Project Name: Weyanoke Elementary School LID
Project Location: Weyanoke Elementary School
Parcel ID No.: 0721 01 0013

Subwatershed: Indian Run
Drainage Area: 5.9 acres

Project Location:

Proposed Project:



Proposed Action:

Construct bioretention area in Braddock Rd. traffic island and at edge of asphalt courts; install filter strip around asphalt courts; install linear bioretention area, tree box filters, and infiltration trenches in S parking lot

Proposed location for stepped bioretention area at edge of courts

Potential bioretention area in traffic island

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $124,000

Weyanoke Elementary School LID

Project ID: CA9857

Project Name: Weyanoke Elementary School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Filter Strip	180	LF	$2.00	$360
Bioretention Area, Linear	1020	SF	$25.00	$25,500
Bioretention Area	825	SF	$25.00	$20,625
Tree Box Filter	2	EA	$3,000.00	$6,000
Infiltration Trench	125	LF	$100.00	$12,500

Base Cost =	$64,985
Mobilization (5%) =	$3,249
Subtotal 1 =	$68,234
Contingency (25%) =	$17,059
Subtotal 2 =	$85,293
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$38,382
Total =	$123,675
Estimated Project Cost =	$124,000

Poe Middle School LID

Project ID: CA9858

Project Type: Low Impact Development

Project Name: Poe Middle School LID
Project Location: Poe Middle School - Monterey Dr.
Parcel ID No.: 0711 01 0131

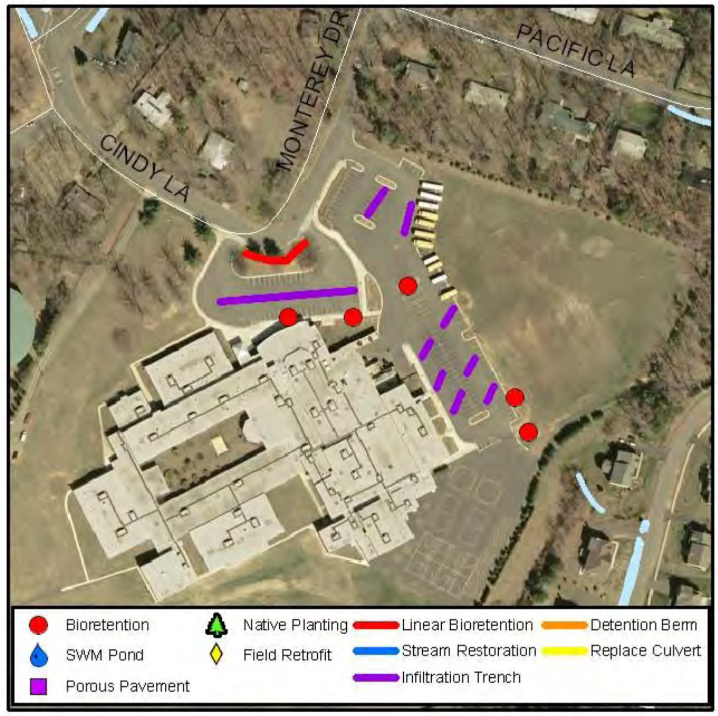
Subwatershed: Indian Run
Drainage Area: 9.6 acres

Project Location:

Proposed Action:

Construct linear bioretention area in loop island; install infiltration trenches, tree box filters, and traffic island bioretention areas in parking lots.

Proposed Project:



East parking lot where bioretention could be used in islands and along parking lot edge

Inlet in east parking lot

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $248,000

Poe Middle School LID

Project ID: CA9858

Project Name: Poe Middle School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Linear	1200	SF	$25.00	$30,000
Infiltration Trench	510	LF	$100.00	$51,000
Tree Box Filter	3	EA	$3,000.00	$9,000
Bioretention Area	1600	SF	$25.00	$40,000

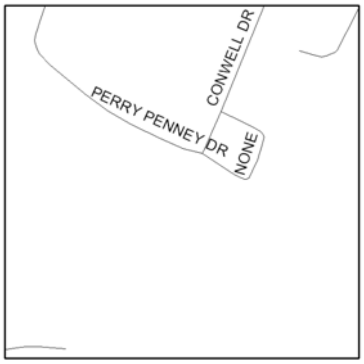
Base Cost =	$130,000
Mobilization (5%) =	$6,500
Subtotal 1 =	$136,500
Contingency (25%) =	$34,125
Subtotal 2 =	$170,625
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$76,781
Total =	$247,406
Estimated Project Cost =	$248,000

Indian Run Stream Valley Park LID - C

Project ID: CA9859
Project Type: Low Impact Development

Project Name: Indian Run Stream Valley Park LID - C
Subwatershed: Indian Run
Project Location: Indian Run Stream Valley Park, Logsdon Drive
Drainage Area: 3.9 acres
Parcel ID No.: 0712 01 0025A

Project Location:



Proposed Action:

Install off-line bioretention area at end of stormwater outfall.

Proposed Project:

Stormwater outfall

Benefits: Provide stormwater quality controls.
Improve stormwater quantity controls.

Estimated Cost: $516,000

Indian Run Stream Valley Park LID - C

Project ID: CA9859

Project Name: Indian Run Stream Valley Park LID - C

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Off-line	10830	SF	$25.00	$270,750
			Base Cost =	$270,750
			Mobilization (5%) =	$13,538
			Subtotal 1 =	$284,288
			Contingency (25%) =	$71,072
			Subtotal 2 =	$355,359
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$159,912
			Total =	$515,271
			Estimated Project Cost =	$516,000

Indian Run Stream Valley Park LID - A

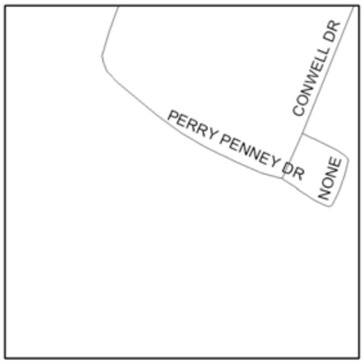
Project ID: CA9860

Project Type: Low Impact Development

Project Name: Indian Run Stream Valley Park LID - A
Project Location: Indian Run Stream Valley Park
Parcel ID No.: 0712 01 0025R

Subwatershed: Indian Run
Drainage Area: 9.9 acres

Project Location:



Proposed Project:

Proposed Action:

Install bioretention area at end of stormwater outfall.

Stormwater pipe outfall

Benefits: Provide stormwater quality controls.
Improve stormwater quantity controls.

Estimated Cost: $334,000

Indian Run Stream Valley Park LID - A

Project ID: CA9860

Project Name: Indian Run Stream Valley Park LID - A

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Off-line	7000	SF	$25.00	$175,000
			Base Cost =	$175,000
			Mobilization (5%) =	$8,750
			Subtotal 1 =	$183,750
			Contingency (25%) =	$45,938
			Subtotal 2 =	$229,688
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$103,359
			Total =	$333,047
			Estimated Project Cost =	$334,000

Indian Run Stream Valley Park LID - B

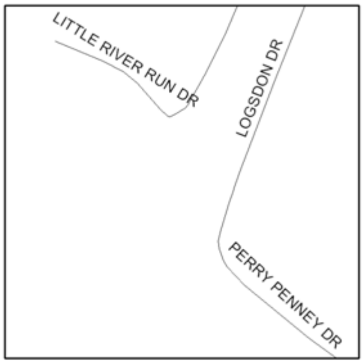
Project ID: CA9861

Project Type: Low Impact Development

Project Name: Indian Run Stream Valley Park LID - B
Project Location: Indian Run Stream Valley Park
Parcel ID No.: 0712 32 C

Subwatershed: Indian Run
Drainage Area: 3.6 acres

Project Location:



Proposed Project:

Proposed Action:

Install bioretention area at end of stormwater outfall.

Potential bioretention area at end of stormwater outfalls

Benefits: Provide stormwater quality controls.
Improve stormwater quantity controls.

Estimated Cost: $543,000

Indian Run Stream Valley Park LID - B

Project ID: CA9861

Project Name: Indian Run Stream Valley Park LID - B

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Off-line	11400	SF	$25.00	$285,000
			Base Cost =	$285,000
			Mobilization (5%) =	$14,250
			Subtotal 1 =	$299,250
			Contingency (25%) =	$74,813
			Subtotal 2 =	$374,063
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$168,328
			Total =	$542,391
			Estimated Project Cost =	$543,000

Columbia Elementary School LID

Project ID: CA9862

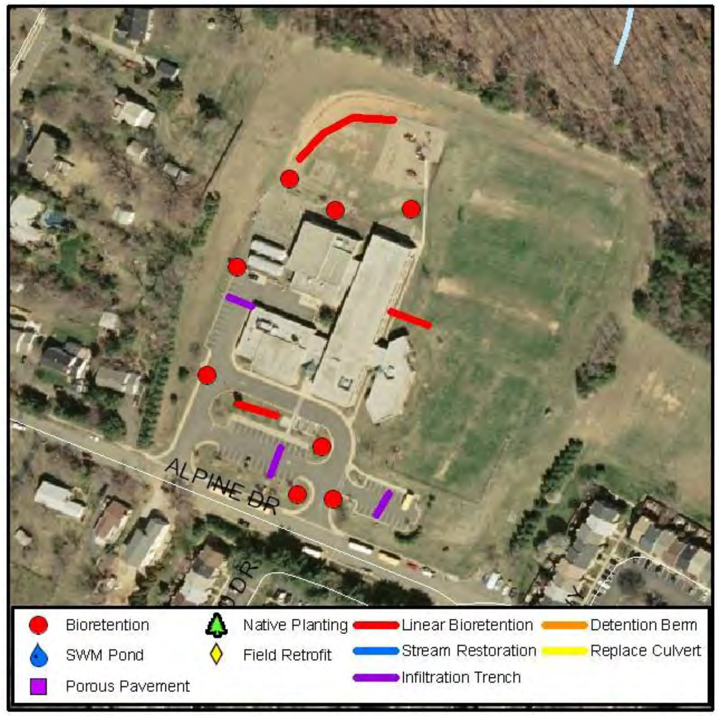
Project Type: Low Impact Development

Project Name: Columbia Elementary School LID
Project Location: Alpine Dr. & Pinecrest Pkwy
Parcel ID No.: 0712 05 0084A

Subwatershed: Indian Run
Drainage Area: 5.5 acres

Project Location:

Proposed Project:



Proposed Action:

Construct linear and area bioretention areas in traffic islands; install infiltration trenches in front parking lots and side road; replace inlets with tree box filters; restore existing grass swale in back of bldg.; add filter strips around two inlets.

Replace inlet with tree box filter insert

Stressed vegetation in existing grass swale on property

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.
Opportunity for public education.

Estimated Cost: $134,000

Columbia Elementary School LID

Project ID: CA9862

Project Name: Columbia Elementary School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	1350	SF	$25.00	$33,750
Bioretention Area, Linear	600	SF	$25.00	$15,000
Infiltration Trench	110	LF	$100.00	$11,000
Tree Box Filter	3	EA	$3,000.00	$9,000
Grass Swale	225	LF	$6.00	$1,350
Filter Strip	60	LF	$2.00	$120

Base Cost =	$70,220
Mobilization (5%) =	$3,511
Subtotal 1 =	$73,731
Contingency (25%) =	$18,433
Subtotal 2 =	$92,164
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$41,474
Total =	$133,637
Estimated Project Cost =	$134,000

George Mason Regional Library LID

Project ID: CA9863

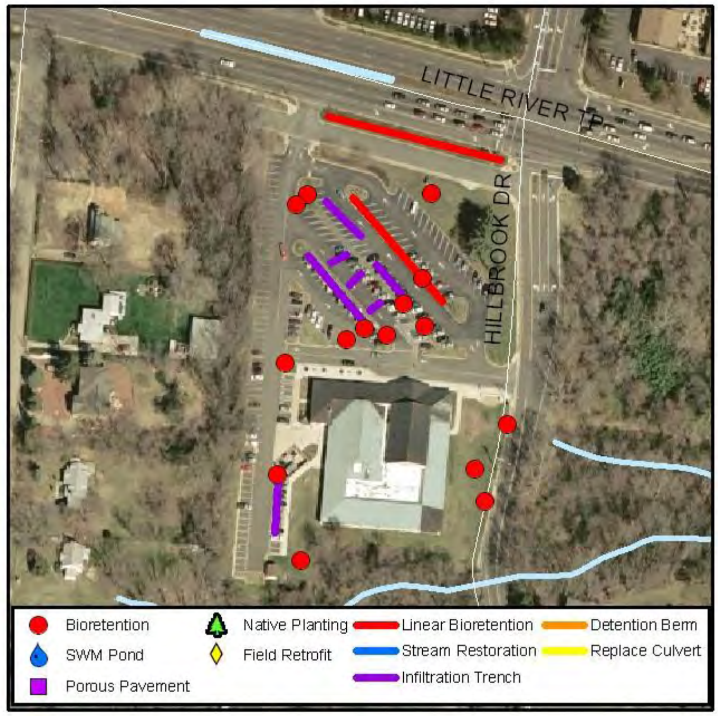
Project Type: Low Impact Development

Project Name: George Mason Regional Library LID
Project Location: George Mason Regional Library
Parcel ID No.: 0712 07 0001

Subwatershed: Indian Run
Drainage Area: 5.1 acres

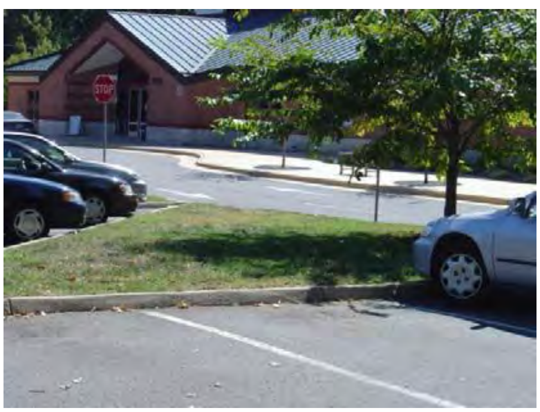
Project Location:

Proposed Project:



Proposed Action:

Construct bioretention in traffic islands along Little River Turnpike, in parking lot, between bldg. and Hillbrook Dr., and at SW corner of bldg.; install infiltration trench along several parking rows; install tree box filter inserts.



Potential bioretention area in traffic island

Divert downspouts on West side of library to bioretention areas

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $403,000

George Mason Regional Library LID

Project ID: CA9863

Project Name: George Mason Regional Library LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	2100	SF	$25.00	$52,500
Infiltration Trench	360	LF	$100.00	$36,000
Tree Box Filter	11	EA	$3,000.00	$33,000
Bioretention Area, Linear	3595	SF	$25.00	$89,875

Base Cost =	$211,375
Mobilization (5%) =	$10,569
Subtotal 1 =	$221,944
Contingency (25%) =	$55,486
Subtotal 2 =	$277,430
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$124,843
Total =	$402,273
Estimated Project Cost =	$403,000

Turkeycock Run Stream Valley Park LID

Project ID: CA9866
Project Type: Low Impact Development

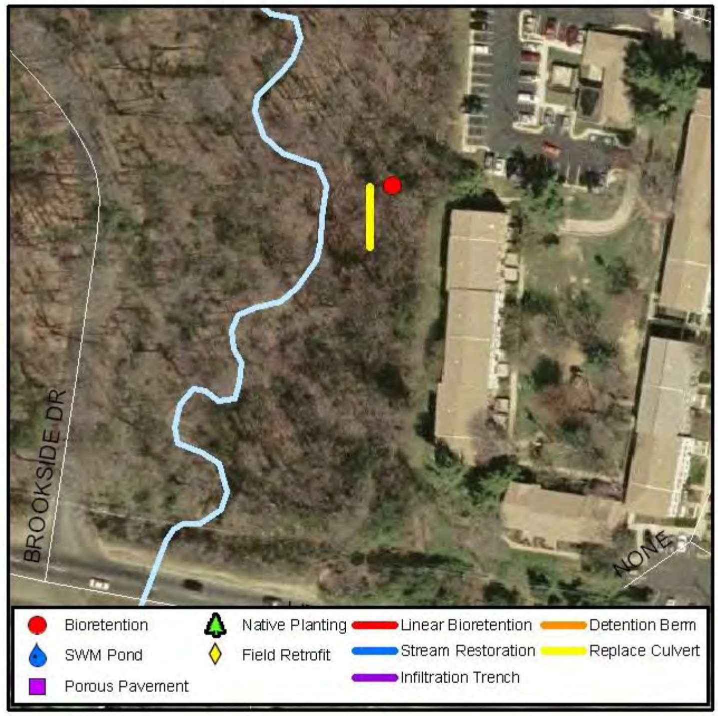
Project Name: Turkeycock Run Stream Valley Park LID
Project Location: Turkeycock Run Stream Valley Park
Parcel ID No.: 0721 01 0044
Subwatershed: Turkeycock Run
Drainage Area: 34.4 acres

Project Location:

Proposed Action:

Install off-line bioretention area at end of stormwater outfall; repair concrete ditch and add riprap protection.

Proposed Project:



Existing concrete ditch at stormwater outfall

Broken concrete at the end of the channel

Benefits: Provide stormwater quality controls.
Improve stormwater quantity controls.
Opportunity for public education.

Estimated Cost: $198,000

Turkeycock Run Stream Valley Park LID

Project ID: CA9866

Project Name: Turkeycock Run Stream Valley Park LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Off-line	3750	SF	$25.00	$93,750
Repair concrete ditch and add riprap protection	1	EA	$10,000.00	$10,000

Base Cost =	$103,750
Mobilization (5%) =	$5,188
Subtotal 1 =	$108,938
Contingency (25%) =	$27,234
Subtotal 2 =	$136,172
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$61,277
Total =	$197,449
Estimated Project Cost =	$198,000

Parklawn Elementary School LID

Project ID: CA9867

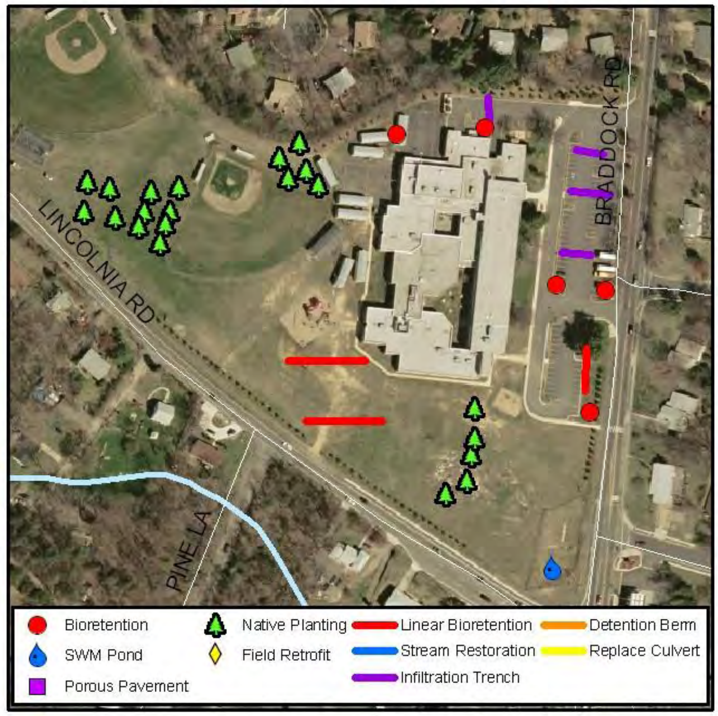
Project Type: Low Impact Development

Project Name: Parklawn Elementary School LID
Project Location: Parklawn Elementary School
Parcel ID No.: 0613 01 0012

Subwatershed: Turkeycock Run
Drainage Area: 11.1 acres

Project Location:

Proposed Project:



Proposed Action:

Retrofit small dry pond to wet detention pond; construct bioretention areas in traffic islands; install infiltration trenches and one tree box filter in parking lots; install linear bioretention strips along large trailer (not shown) SW of bldg.; direct roof drains to cistern to water fields; reforest unused lawn areas.

Dry pond with outlets and inlet structure

Linear bioretention areas could be incorporated along trailer for roof drainage

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve community usage.
Opportunity for public education.

Estimated Cost: $168,000

Project ID: CA9867

Project Name: Parklawn Elementary School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grading and Excavation	325	CY	$35.00	$11,375
Cistern	1	EA	$5,000.00	$5,000
Structural Improvements & Incidentals	1	LS	$10,000.00	$10,000
Erosion & Sediment Control - Minimum	1	LS	$3,000.00	$3,000
Landscaping - Minimum	1	LS	$2,000.00	$2,000
Bioretention Area, Linear	320	SF	$25.00	$8,000
Bioretention Area	800	SF	$25.00	$20,000
Infiltration Trench	195	LF	$100.00	$19,500
Tree Box Filter	1	EA	$3,000.00	$3,000
Shade Tree	0.25	AC	$25,000.00	$6,250
			Base Cost =	$88,125
			Mobilization (5%) =	$4,406
			Subtotal 1 =	$92,531
			Contingency (25%) =	$23,133
			Subtotal 2 =	$115,664
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$52,049
			Total =	$167,713
			Estimated Project Cost =	$168,000

Green Spring Gardens LID

Project ID: CA9868

Project Name: Green Spring Gardens LID
Project Location: Green Spring Gardens, Lincolnia
Parcel ID No.: 0721 01 0024

Project Type: Low Impact Development

Subwatershed: Turkeycock Run
Drainage Area: 1.1 acres

Project Location:

Proposed Action:

Install linear bioretention area along parking spaces and infiltration trenches in traffic circle.

Proposed Project:

Potential linear bioretention area along parking lot

Traffic circle

Benefits: Provide stormwater quality controls.
Improve stormwater quantity controls.
Opportunity for public education.

Estimated Cost: $99,000

Green Spring Gardens LID

Project ID: CA9868

Project Name: Green Spring Gardens LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Linear	1600	SF	$25.00	$40,000
Infiltration Trench	120	LF	$100.00	$12,000
			Base Cost =	$52,000
			Mobilization (5%) =	$2,600
			Subtotal 1 =	$54,600
			Contingency (25%) =	$13,650
			Subtotal 2 =	$68,250
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$30,713
			Total =	$98,963
			Estimated Project Cost =	$99,000

Pinecrest Golf Course LID

Project ID: CA9869

Project Type: Low Impact Development

Project Name: Pinecrest Golf Course LID
Project Location: Pinecrest Golf Course
Parcel ID No.: 0721 26 D

Subwatershed: Turkeycock Run
Drainage Area: 1.9 acres

Project Location:

Proposed Project:

Proposed Action:

Implement stormwater retrofits based on the Park Authority's existing LID retrofit concept plan.

Parking lot with traffic islands

Benefits: Provide stormwater quality controls.
Improve stormwater quantity controls.
Opportunity for public education.

Estimated Cost: $78,000

Pinecrest Golf Course LID

Project ID: CA9869

Project Name: Pinecrest Golf Course LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	750	SF	$25.00	$18,750
Tree Box Filter	1	EA	$3,000.00	$3,000
Infiltration Trench	190	LF	$100.00	$19,000
			Base Cost =	$40,750
			Mobilization (5%) =	$2,038
			Subtotal 1 =	$42,788
			Contingency (25%) =	$10,697
			Subtotal 2 =	$53,484
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$24,068
			Total =	$77,552
			Estimated Project Cost =	$78,000

Wolftree Lane LID

Project ID: CA9870

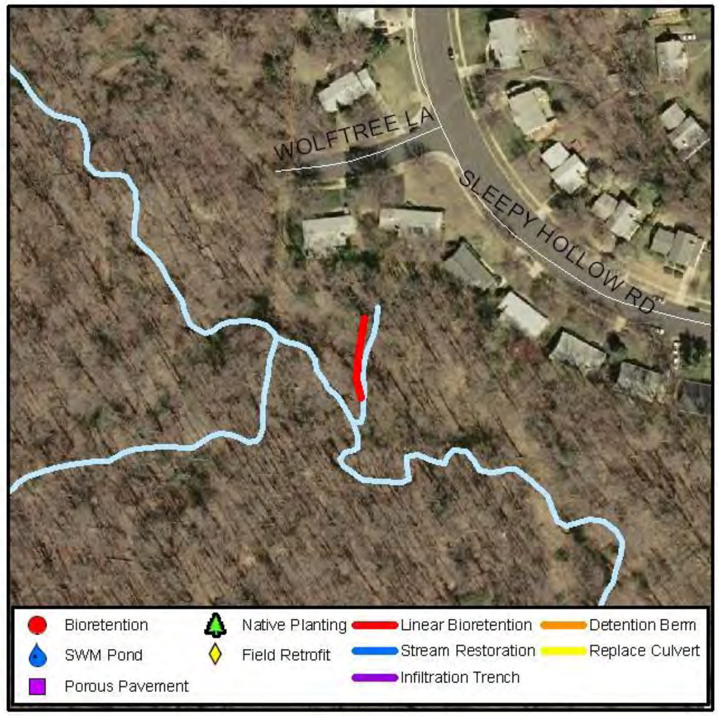
Project Type: Low Impact Development

Project Name: Wolftree Lane LID
Project Location: Wolftree Ln. & Sleepy Hollow Rd.
Parcel ID No.: 0712 01 0059A

Subwatershed: Turkeycock Run
Drainage Area: 8.6 acres

Project Location:

Proposed Project:



Proposed Action:

Linear bioretention area to capture end of pipe stormwater.

Potential location for off-line bioretention at stormwater pipe outfall

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.

Estimated Cost: $286,000

Project ID: CA9870

Project Name: Wolftree Lane LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Linear	6000	SF	$25.00	$150,000
			Base Cost =	$150,000
			Mobilization (5%) =	$7,500
			Subtotal 1 =	$157,500
			Contingency (25%) =	$39,375
			Subtotal 2 =	$196,875
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$88,594
			Total =	$285,469
			Estimated Project Cost =	$286,000

Mason Government Center LID

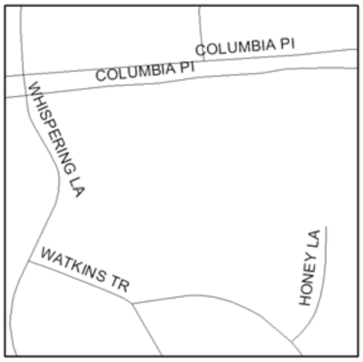
Project ID: CA9872

Project Type: Low Impact Development

Project Name: Mason Government Center LID
Project Location: Columbia Pike & Downing St.
Parcel ID No.: 0613 01 0003

Subwatershed: Turkeycock Run
Drainage Area: 6.6 acres

Project Location:



Proposed Action:

Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality; construct bioretention area along Columbia Pike to collect roadway runoff; install linear bioretention strips, bioretention areas, and tree box filters in parking lot.

Proposed Project:

SWM dry pond

Potential linear bioretention areas along parking lot medians

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.
Opportunity for public education.

Estimated Cost: $220,000

Mason Government Center LID

Project ID: CA9872

Project Name: Mason Government Center LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grading and Excavation	350	CY	$35.00	$12,250
Structural Improvements & Incidentals	1	LS	$10,000.00	$10,000
Erosion & Sediment Control - Minimum	1	LS	$3,000.00	$3,000
Landscaping - Minimum	1	LS	$2,000.00	$2,000
Bioretention Area, Linear	875	SF	$25.00	$21,875
Bioretention Area	2400	SF	$25.00	$60,000
Tree Box Filter	2	EA	$3,000.00	$6,000

Base Cost =	$115,125
Mobilization (5%) =	$5,756
Subtotal 1 =	$120,881
Contingency (25%) =	$30,220
Subtotal 2 =	$151,102
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$67,996
Total =	$219,097
Estimated Project Cost =	$220,000

Glasgow Middle School LID

Project ID: CA9876

Project Type: Low Impact Development

Project Name: Glasgow Middle School LID
Project Location: Glasgow Middle School
Parcel ID No.: 0614 01 0151A

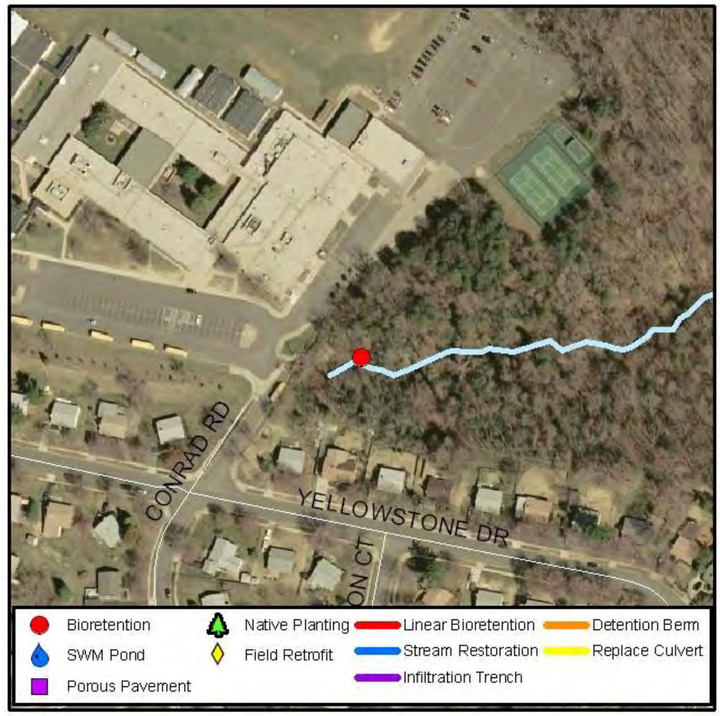
Subwatershed: Holmes Run - Lower
Drainage Area: 22.6 acres

Project Location:

Proposed Action:

Install off-line bioretention areas at stormwater pipe outfall on E side of entrance road. Note: school to be rebuilt by fall 2008.

Proposed Project:



Stormwater pipe draining area south of Yellowstone Dr outlets in woods adjacent to school parking lot

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $703,000

Glasgow Middle School LID

Project ID: CA9876

Project Name: Glasgow Middle School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Off-line	14770	SF	$25.00	$369,250

Base Cost =	$369,250
Mobilization (5%) =	$18,463
Subtotal 1 =	$387,713
Contingency (25%) =	$96,928
Subtotal 2 =	$484,641
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$218,088
Total =	$702,729
Estimated Project Cost =	$703,000

Baileys Community Center LID

Project ID: CA9877

Project Type: Low Impact Development

Project Name: Baileys Community Center LID
Project Location: Baileys Community Center
Parcel ID No.: 0614 01 0042

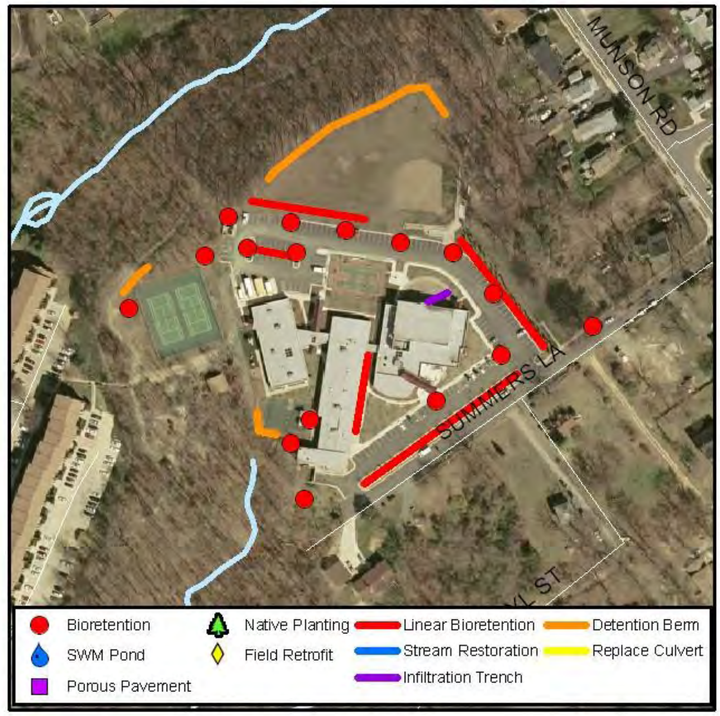
Subwatershed: Holmes Run - Lower
Drainage Area: 6.9 acres

Project Location:

Proposed Action:

Construct linear and area bioretention areas in traffic islands along front and east sides, by tennis courts, west side of building, and end of Summers Lane; build detention micro-berm along north side of baseball field, NW corner of tennis court, and edge of southwestern lot; install tree box filter in inlet on Summers Ln.

Proposed Project:



Linear bioretention can be added to this ditch surrounding the tennis courts

Convert street inlet to a tree box filter

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $351,000

Project ID: CA9877

Project Name: Baileys Community Center LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Detention Berm	465	LF	$2.00	$930
Bioretention Area, Linear	4760	SF	$25.00	$119,000
Bioretention Area	2450	SF	$25.00	$61,250
Tree Box Filter	1	EA	$3,000.00	$3,000
			Base Cost =	$184,180
			Mobilization (5%) =	$9,209
			Subtotal 1 =	$193,389
			Contingency (25%) =	$48,347
			Subtotal 2 =	$241,736
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$108,781
			Total =	$350,518
			Estimated Project Cost =	$351,000

Baileys Elementary School LID

Project ID: CA9879

Project Type: Low Impact Development

Project Name: Baileys Elementary School LID
Project Location: Baileys Elementary School
Parcel ID No.: 0612 01 0002

Subwatershed: Holmes Run - Lower
Drainage Area: 9.6 acres

Project Location:

Proposed Action:

Construct bioretention areas in traffic islands for bus loop and parking lots, near asphalt courts, and near portable classrooms; install infiltration trenches in parking areas and porous pavement in play yards; create artificial turf field with underdrains and cistern.

Proposed Project:

Asphalt play yard with athletic field in background

Traffic islands for the bus loop

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve community usage.
Opportunity for public education.

Estimated Cost: $1,535,000

Project ID: CA9879

Project Name: Baileys Elementary School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Artificial Turf, Underdrains and Cistern	1	EA	$600,000.00	$600,000
Bioretention Area, Linear	3050	SF	$25.00	$76,250
Porous Pavement	1640	SY	$15.00	$24,600
Bioretention Area	2700	SF	$25.00	$67,500
Infiltration Trench	380	LF	$100.00	$38,000
			Base Cost =	$806,350
			Mobilization (5%) =	$40,318
			Subtotal 1 =	$846,668
			Contingency (25%) =	$211,667
			Subtotal 2 =	$1,058,334
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$476,250
			Total =	$1,534,585
			Estimated Project Cost =	$1,535,000

JEB Stuart High School LID

Project ID: CA9882

Project Type: Low Impact Development

Project Name: JEB Stuart High School LID
Project Location: JEB Stuart High School
Parcel ID No.: 0611 01 0013

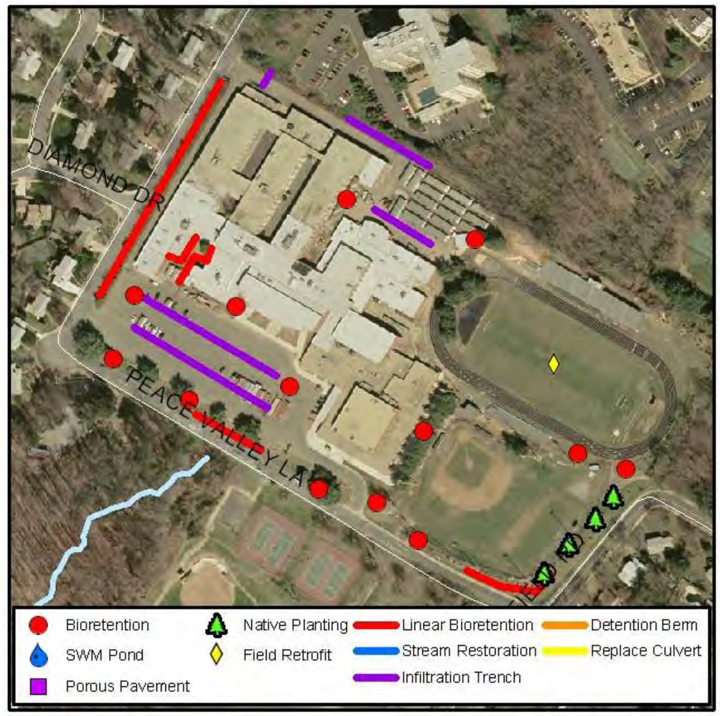
Subwatershed: Tripps Run
Drainage Area: 23.6 acres

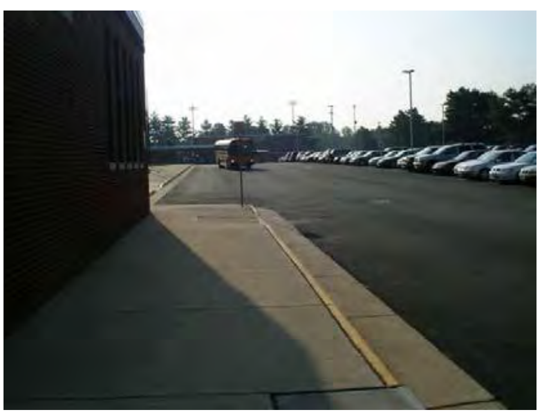
Project Location:

Proposed Action:

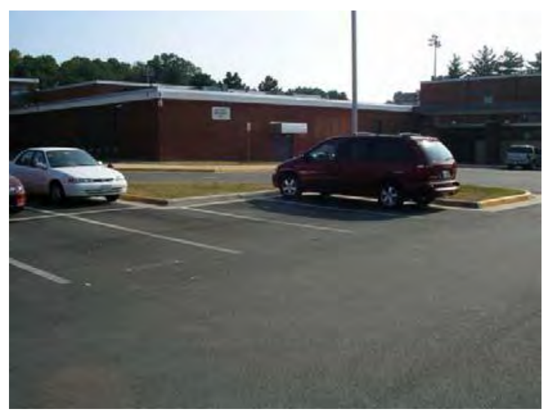
Construct linear bioretention area along Peace Valley Ln. median; construct a stepped bioretention areas along S edge of parking lot and SE corner of fields; construct bioretention areas in parking islands and around playing fields; plant wildflowers along SE side of baseball field; upgrade fields to multisport artificial turf with underdrains and cistern.

Proposed Project:





Infiltration trenches could be incorporated into parking lots



Bioretention gardens could be incorporated into traffic islands

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve community usage.
Opportunity for public education.

Estimated Cost: $1,881,000

JEB Stuart High School LID

Project ID: CA9882

Project Name: JEB Stuart High School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Linear	6275	SF	$25.00	$156,875
Infiltration Trench	1060	LF	$100.00	$106,000
Bioretention Area	5000	SF	$25.00	$125,000
Wildflower Planting	0.03	AC	$3,000.00	$90
Artificial Turf, Underdrains and Cistern	1	EA	$600,000.00	$600,000
			Base Cost =	$987,965
			Mobilization (5%) =	$49,398
			Subtotal 1 =	$1,037,363
			Contingency (25%) =	$259,341
			Subtotal 2 =	$1,296,704
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$583,517
			Total =	$1,880,221
			Estimated Project Cost =	$1,881,000

Sleepy Hollow Elementary School LID

Project ID: CA9885

Project Type: Low Impact Development

Project Name: Sleepy Hollow Elementary School LID

Project Location: Sleepy Hollow Road

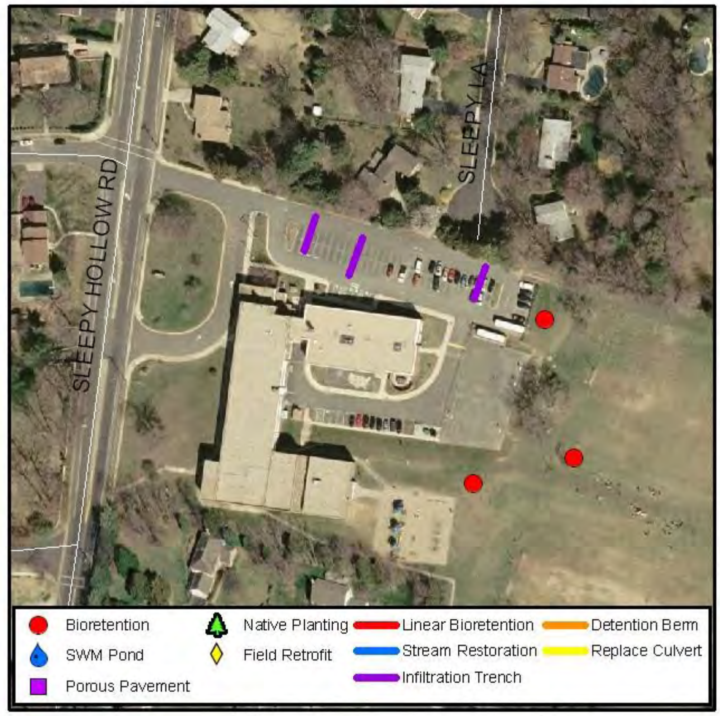
Parcel ID No.: 0602 01 0039

Subwatershed: Tripps Run

Drainage Area: 9.2 acres

Project Location:

Proposed Project:



Proposed Action:

Install infiltration trenches in parking lot and bioretention areas at yard drain inlets.

Construct bioretention area at yard drain inlet

Convert traffic island to a bioretention area

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $455,000

Sleepy Hollow Elementary School LID

Project ID: CA9885

Project Name: Sleepy Hollow Elementary School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	8100	SF	$25.00	$202,500
Infiltration Trench	365	LF	$100.00	$36,500
			Base Cost =	$239,000
			Mobilization (5%) =	$11,950
			Subtotal 1 =	$250,950
			Contingency (25%) =	$62,738
			Subtotal 2 =	$313,688
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$141,159
			Total =	$454,847
			Estimated Project Cost =	$455,000

Nicholson St - Ch. 2 Street LID

Project ID: CA9886

Project Type: Low Impact Development

Project Name: Nicholson St - Ch. 2 Street LID

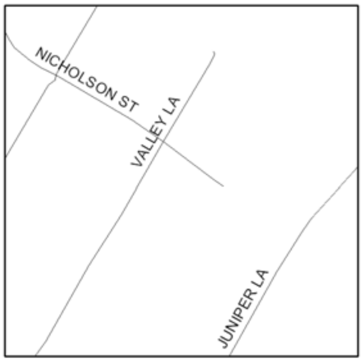
Project Location: Nicholson St. east of Valley Ln.

Parcel ID No.:

Subwatershed: Tripps Run

Drainage Area: 2.4 acres

Project Location:



Proposed Project:

Proposed Action:

Construct bioretention area in Chapter-2 street lot, divert road runoff into area.

Potential location for bioretention area in unfinished road

View looking into street

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $100,000

Nicholson St - Ch. 2 Street LID

Project ID: CA9886

Project Name: Nicholson St - Ch. 2 Street LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	2090	SF	$25.00	$52,250
			Base Cost =	$52,250
			Mobilization (5%) =	$2,613
			Subtotal 1 =	$54,863
			Contingency (25%) =	$13,716
			Subtotal 2 =	$68,578
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$30,860
			Total =	$99,438
			Estimated Project Cost =	$100,000

Westlawn Elementary School LID

Project ID: CA9892

Project Type: Low Impact Development

Project Name: Westlawn Elementary School LID
Project Location: Westley Rd. & Ridge Rd.
Parcel ID No.: 0504 01 0002

Subwatershed: Tripps Run
Drainage Area: 8 acres

Project Location:

Proposed Action:

Install bioretention area, infiltration trenches, and tree box filters in parking lots; construct linear bioretention along asphalt courts; and construct grass swale around two sides of fields.

Proposed Project:

Potential location for infiltration trench

Convert concrete ditch to linear bioretention area

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.
Opportunity for public education.

Estimated Cost: $117,000

Project ID: CA9892

Project Name: Westlawn Elementary School LID

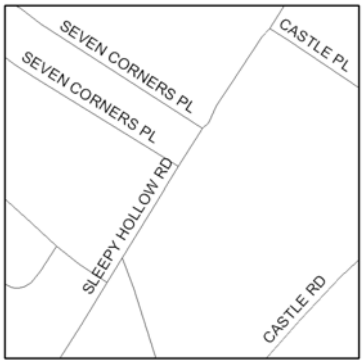
Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	150	SF	$25.00	$3,750
Infiltration Trench	225	LF	$100.00	$22,500
Tree Box Filter	3	EA	$3,000.00	$9,000
Bioretention Area, Linear	900	SF	$25.00	$22,500
Grass Swale	535	LF	$6.00	$3,210
			Base Cost =	$60,960
			Mobilization (5%) =	$3,048
			Subtotal 1 =	$64,008
			Contingency (25%) =	$16,002
			Subtotal 2 =	$80,010
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$36,005
			Total =	$116,015
			Estimated Project Cost =	$117,000

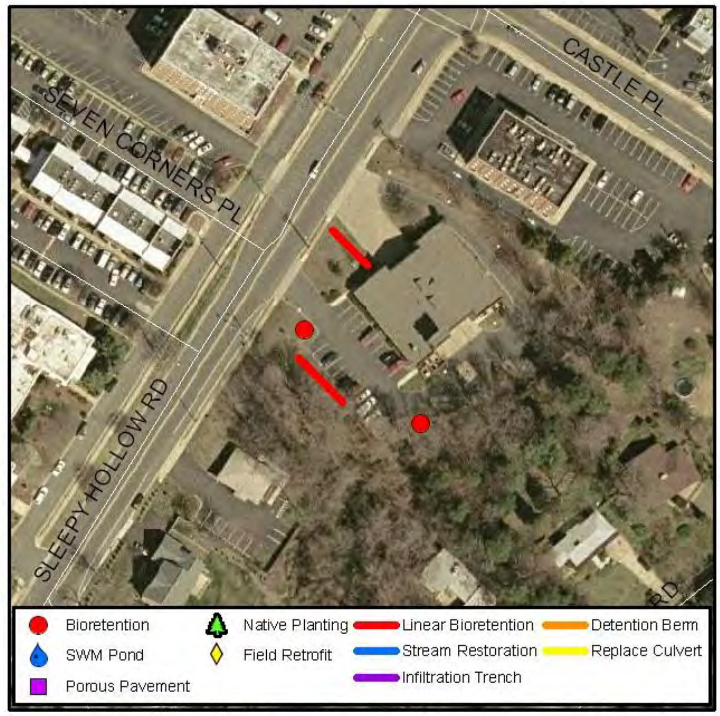
Fire Station - Company No. 28 LID

Project ID:	CA9897	**Project Type:**	Low Impact Development
Project Name:	Fire Station - Company No. 28 LID	**Subwatershed:**	Tripps Run
Project Location:	Fire Station - Company No. 28 - Sleepy Hollow Rd	**Drainage Area:**	0.5 acres
Parcel ID No.:	0513 15 0004		

Project Location:



Proposed Project:



Proposed Action:

At Fire Station, divert roof drains to cistern for filling fire trucks; construct bioretention areas in SW and SE corners of traffic islands in parking lot; construct linear bioretention areas on S side of truck entrance and S side of parking lot.

Rain gutter on side of building

Back parking lot

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $23,000

Fire Station - Company No. 28 LID

Project ID: CA9897

Project Name: Fire Station - Company No. 28 LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Cistern	1	EA	$5,000.00	$5,000
Bioretention Area, Linear	140	SF	$25.00	$3,500
Bioretention Area	140	SF	$25.00	$3,500

Base Cost =	$12,000
Mobilization (5%) =	$600
Subtotal 1 =	$12,600
Contingency (25%) =	$3,150
Subtotal 2 =	$15,750
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$7,088
Total =	$22,838
Estimated Project Cost =	$23,000

Larry Graves Park LID

Project ID: CA9901

Project Type: Low Impact Development

Project Name: Larry Graves Park LID
Project Location: Hillwood Ave. & Hunton Ave.
Parcel ID No.:

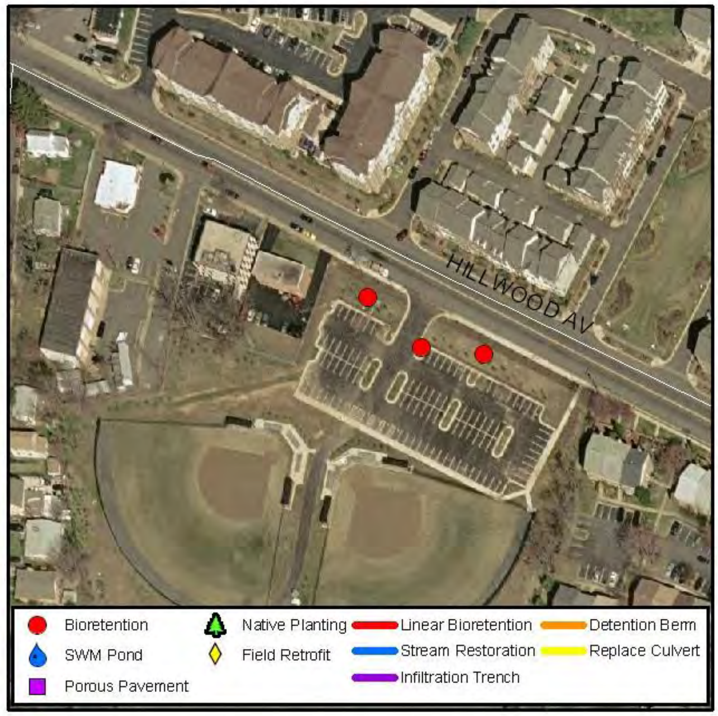
Subwatershed: Tripps Run
Drainage Area: 1.2 acres

Project Location:

Proposed Action:

Construct bioretention areas in grass along Hillwood Ave. and replace inlet with tree box filter.

Proposed Project:



Add bioretention areas to parking lot islands

Add bioretention areas along northern parking lot margin

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $41,000

Larry Graves Park LID

Project ID: CA9901

Project Name: Larry Graves Park LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	850	SF	$25.00	$21,250
			Base Cost =	$21,250
			Mobilization (5%) =	$1,063
			Subtotal 1 =	$22,313
			Contingency (25%) =	$5,578
			Subtotal 2 =	$27,891
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$12,551
			Total =	$40,441
			Estimated Project Cost =	$41,000

Devonshire Administration Center (School) LID

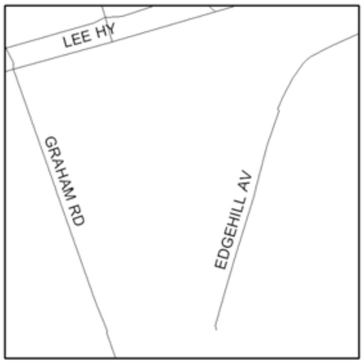
Project ID: CA9904

Project Type: Low Impact Development

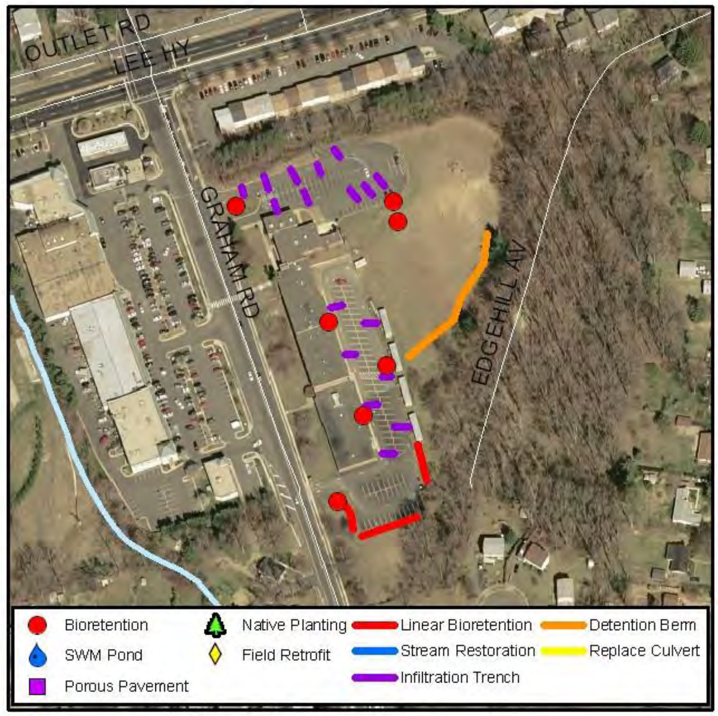
Project Name: Devonshire Administration Center (School) LID
Project Location: Devonshire Administration Center (School)
Parcel ID No.: 0501 01 0052

Subwatershed: Tripps Run
Drainage Area: 5.3 acres

Project Location:



Proposed Project:



Proposed Action:

Construct bioretention areas in traffic circle and in grass areas next to N and S parking lots; construct linear bioretention areas at edges of S lot; construct infiltration trenches and filter strips in N and rear lots; build detention micro-berm along tree line.

Add bioretention areas to traffic circle

Potential bioretention area at stormwater outlet

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $288,000

Devonshire Administration Center (School) LID

Project ID: CA9904

Project Name: Devonshire Administration Center (School) LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	3065	SF	$25.00	$76,625
Bioretention Area, Linear	1530	SF	$25.00	$38,250
Infiltration Trench	350	LF	$100.00	$35,000
Filter Strip	200	LF	$2.00	$400
Detention Berm	270	LF	$2.00	$540

Base Cost =	$150,815
Mobilization (5%) =	$7,541
Subtotal 1 =	$158,356
Contingency (25%) =	$39,589
Subtotal 2 =	$197,945
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$89,075
Total =	$287,020
Estimated Project Cost =	$288,000

Belvedere Elementary School LID

Project ID: CA9911

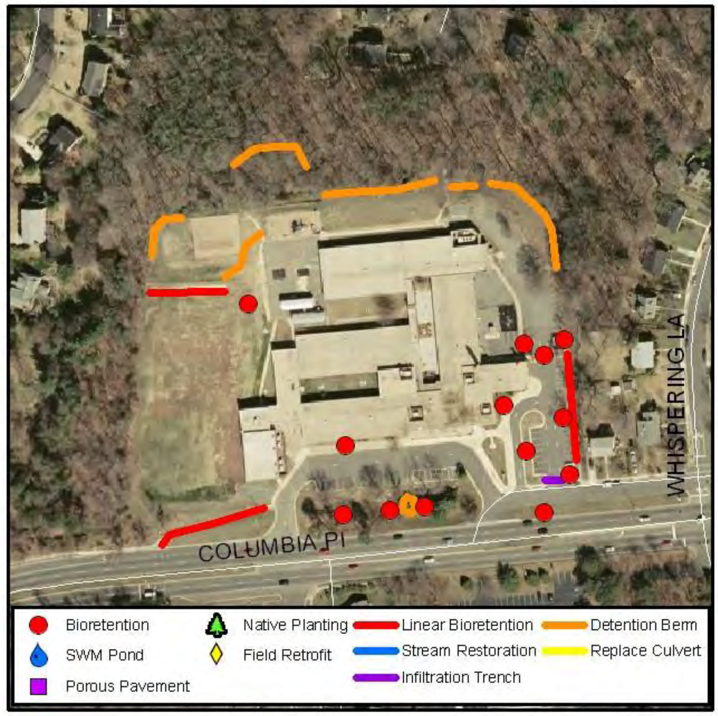
Project Type: Low Impact Development

Project Name: Belvedere Elementary School LID
Project Location: Belvedere Elementary School
Parcel ID No.: 0604 01 0037

Subwatershed: Holmes Run - Upper
Drainage Area: 9.9 acres

Project Location:

Proposed Project:



Proposed Action:
Construct bioretention areas in bus loop island, traffic island, along back edge in side lot, and in landscape islands around bldg.; build detention micro-berm along north side of property; install linear bioretention area and infiltration trench in side parking lot; and convert concrete ditches to grass swales.

Potential bioretention area in bus loop island

Divert downspouts into bioretention areas alongside building

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $325,000

Project ID: CA9911

Project Name: Belvedere Elementary School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Linear	3260	SF	$25.00	$81,500
Detention Berm	790	LF	$2.00	$1,580
Bioretention Area	3300	SF	$25.00	$82,500
Infiltration Trench	30	LF	$100.00	$3,000
Grass Swale	290	LF	$6.00	$1,740
			Base Cost =	$170,320
			Mobilization (5%) =	$8,516
			Subtotal 1 =	$178,836
			Contingency (25%) =	$44,709
			Subtotal 2 =	$223,545
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$100,595
			Total =	$324,140
			Estimated Project Cost =	$325,000

Columbia Pines LID

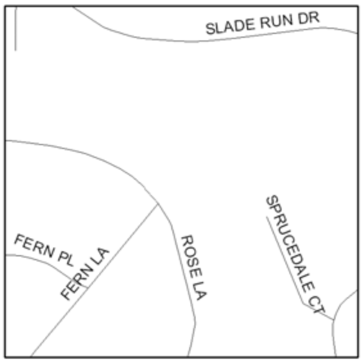
Project ID: CA9914

Project Name: Columbia Pines LID
Project Location: Rose La. & Fern La.
Parcel ID No.: 0602 30 P

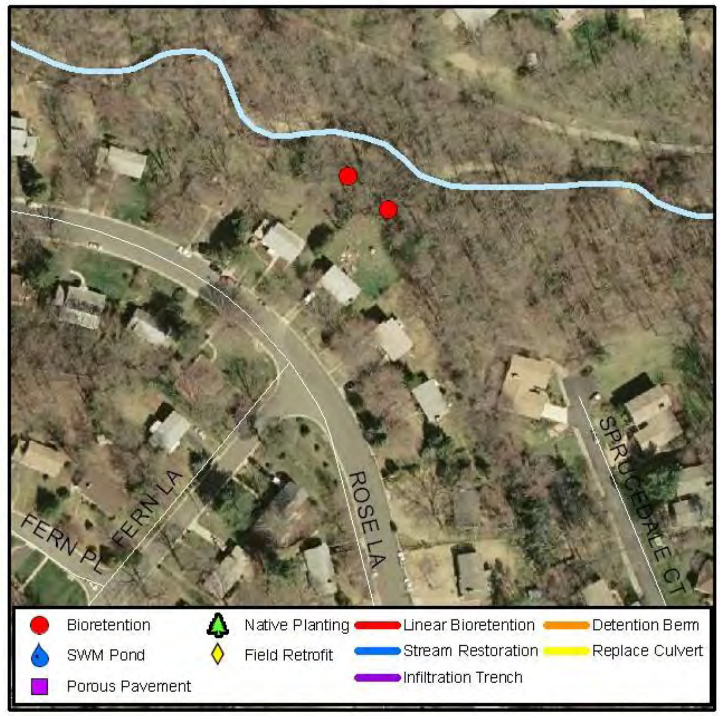
Project Type: Low Impact Development

Subwatershed: Holmes Run - Upper
Drainage Area: 28.1 acres

Project Location:



Proposed Project:



Proposed Action:

Construct off-line bioretention areas to capture end-of-pipe stormwater prior to entering the stream.

Stream below outfall

Evidence of bank erosion

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.
Improve floodplain and nutrient cycling functions.

Estimated Cost: $96,000

Columbia Pines LID

Project ID: CA9914

Project Name: Columbia Pines LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Off-line	2000	SF	$25.00	$50,000

Base Cost =	$50,000
Mobilization (5%) =	$2,500
Subtotal 1 =	$52,500
Contingency (25%) =	$13,125
Subtotal 2 =	$65,625
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$29,531
Total =	$95,156
Estimated Project Cost =	$96,000

Beech Tree Elementary School LID

Project ID: CA9917

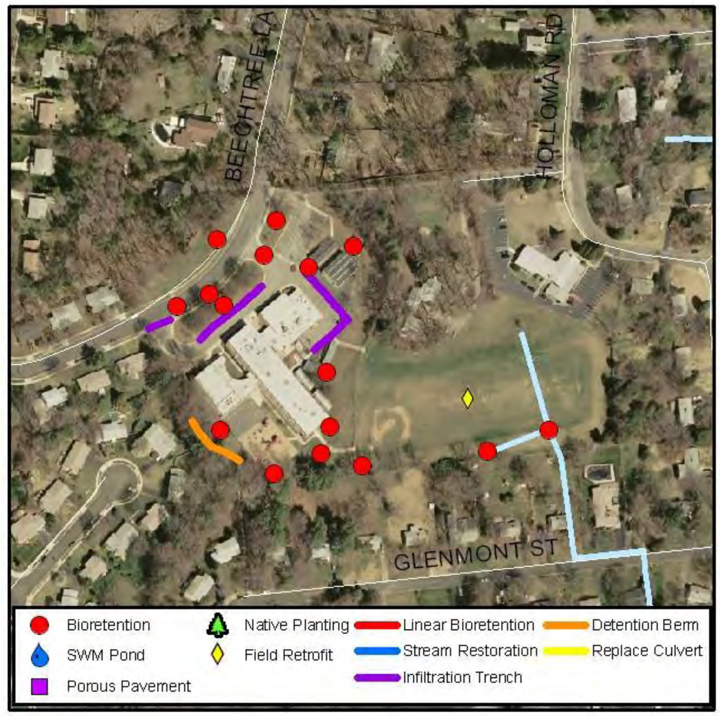
Project Type: Low Impact Development

Project Name: Beech Tree Elementary School LID
Project Location: Beech Tree Elementary School
Parcel ID No.: 0602 38 A

Subwatershed: Holmes Run - Upper
Drainage Area: 7.8 acres

Project Location:

Proposed Project:



Proposed Action:

Construct bioretention areas along Beechtree Ln. and in landscape islands around bldg. and trailers; install infiltration trenches in bus loop and drive; install two tree box filters at stormdrain inlets; install filter strip along Beechtree Ln.; build detention micro-berm along SW side of bldg.; convert playing fields to artificial turf with cistern.

Traffic islands provide space for bioretention areas

Grate inlet on athletic field could be surrounded by a rain garden

Benefits: Provide stormwater quality controls.
Improve stormwater quantity controls.
Improve community usage.
Opportunity for public education.

Estimated Cost: $1,409,000

Beech Tree Elementary School LID

Project ID: CA9917

Project Name: Beech Tree Elementary School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	3550	SF	$25.00	$88,750
Infiltration Trench	450	LF	$100.00	$45,000
Tree Box Filter	2	EA	$3,000.00	$6,000
Filter Strip	150	LF	$2.00	$300
Detention Berm	130	LF	$2.00	$260
Artificial Turf, Underdrains and Cistern	1	EA	$600,000.00	$600,000
			Base Cost =	$740,310
			Mobilization (5%) =	$37,016
			Subtotal 1 =	$777,326
			Contingency (25%) =	$194,331
			Subtotal 2 =	$971,657
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$437,246
			Total =	$1,408,902
			Estimated Project Cost =	$1,409,000

Broyhill Crest Park LID

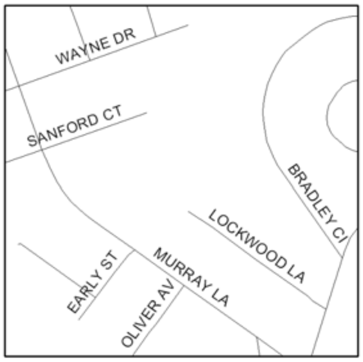
Project ID: CA9921

Project Type: Low Impact Development

Project Name: Broyhill Crest Park LID
Project Location: Lockwood LA at community garden
Parcel ID No.: 0603 20 B

Subwatershed: Holmes Run - Upper
Drainage Area: 2.4 acres

Project Location:



Proposed Project:

Proposed Action:

Develop detention micro-berm along tree line to slow runoff and induce infiltration; construct bioretention areas with small cistern for watering community garden.

Berms developed along streambanks will capture runoff and induce infiltration.

Community garden at end of street

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.
Improve community usage.
Opportunity for public education.

Estimated Cost: $132,000

Broyhill Crest Park LID

Project ID: CA9921

Project Name: Broyhill Crest Park LID

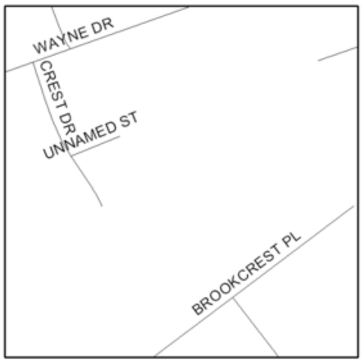
Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Detention Berm	225	LF	$2.00	$450
Bioretention Area	2750	SF	$25.00	$68,750
			Base Cost =	$69,200
			Mobilization (5%) =	$3,460
			Subtotal 1 =	$72,660
			Contingency (25%) =	$18,165
			Subtotal 2 =	$90,825
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$40,871
			Total =	$131,696
			Estimated Project Cost =	$132,000

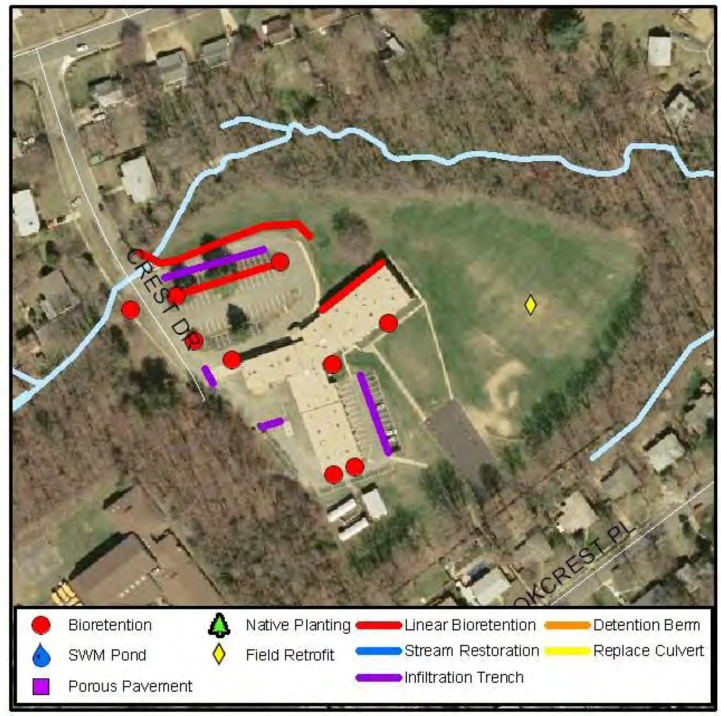
Lacey Admin Center LID

Project ID:	CA9922	**Project Type:**	Low Impact Development
Project Name:	Lacey Admin Center LID	**Subwatershed:**	Holmes Run - Upper
Project Location:	Crest Dr. & Wayne Dr.	**Drainage Area:**	6.7 acres
Parcel ID No.:	0603 24 0004A		

Project Location:



Proposed Project:



Proposed Action:

Develop playing field using artificial turf with underdrain/cistern system for use as soccer and football field; add bioretention areas and infiltration strips in parking lot islands and margins.

Divert downspouts into linear bioretention areas alongside building

Potential bioretention area at stormwater inlet

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve community usage.
Opportunity for public education.

Estimated Cost: $1,317,000

Lacey Admin Center LID

Project ID: CA9922

Project Name: Lacey Admin Center LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Artificial Turf, Underdrains and Cistern	1	EA	$600,000.00	$600,000
Bioretention Area, Linear	510	SF	$25.00	$12,750
Bioretention Area	1900	SF	$25.00	$47,500
Infiltration Trench	315	LF	$100.00	$31,500

Base Cost =	$691,750
Mobilization (5%) =	$34,588
Subtotal 1 =	$726,338
Contingency (25%) =	$181,584
Subtotal 2 =	$907,922
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$408,565
Total =	$1,316,487
Estimated Project Cost =	$1,317,000

Holmes Run Stream Valley Park LID

Project ID: CA9925

Project Type: Low Impact Development

Project Name: Holmes Run Stream Valley Park LID
Project Location: Charleson St & Masonville Dr.
Parcel ID No.: 0601 01 0063

Subwatershed: Holmes Run - Upper
Drainage Area: 0.9 acres

Project Location:

Proposed Project:

Proposed Action:

Construct off-line bioretention areas (stepped) to capture end-of-pipe stormwater prior to entering the stream.

Stormwater pipe outfall

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.
Improve floodplain and nutrient cycling functions.

Estimated Cost: $87,000

Project ID: CA9925

Project Name: Holmes Run Stream Valley Park LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Off-line	1815	SF	$25.00	$45,375
			Base Cost =	$45,375
			Mobilization (5%) =	$2,269
			Subtotal 1 =	$47,644
			Contingency (25%) =	$11,911
			Subtotal 2 =	$59,555
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$26,800
			Total =	$86,354
			Estimated Project Cost =	$87,000

Round Tree Park LID - C

Project ID: CA9927

Project Type: Low Impact Development

Project Name: Round Tree Park LID - C
Project Location: Round Tree Park
Parcel ID No.: 0601 01 0069

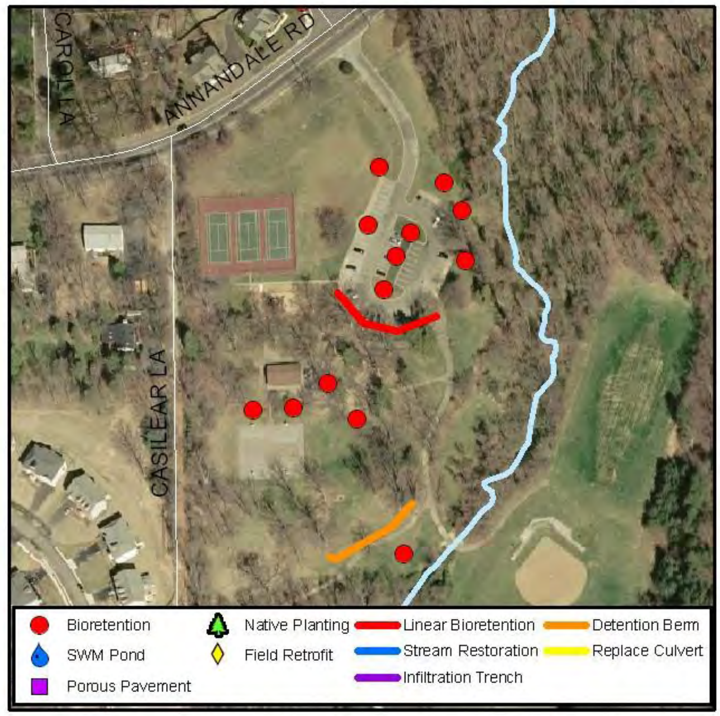
Subwatershed: Holmes Run - Upper
Drainage Area: 6.8 acres

Project Location:

Proposed Action:

Convert parking lot traffic islands to bioretention areas and re-route field and court drainage to bioretention areas; construct detention micro-berm in open area along stream.

Proposed Project:



Potential bioretention areas in parking lot traffic islands

Potential bioretention areas next to field and court areas

Benefits: Provide stormwater quality controls.
Improve stormwater quantity controls.
Opportunity for public education.

Estimated Cost: $195,000

Round Tree Park LID - C

Project ID: CA9927

Project Name: Round Tree Park LID - C

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Detention Berm	160	LF	$2.00	$320
Bioretention Area, Linear	480	SF	$25.00	$12,000
Bioretention Area	3600	SF	$25.00	$90,000
			Base Cost =	$102,320
			Mobilization (5%) =	$5,116
			Subtotal 1 =	$107,436
			Contingency (25%) =	$26,859
			Subtotal 2 =	$134,295
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$60,433
			Total =	$194,728
			Estimated Project Cost =	$195,000

Round Tree Park LID - A

Project ID:	CA9929	**Project Type:**	Low Impact Development
Project Name:	Round Tree Park LID - A	**Subwatershed:**	Holmes Run - Upper
Project Location:	Annandale Rd. & Lee Park Ct.	**Drainage Area:**	16 acres
Parcel ID No.:	0601 01 0069		

Project Location:

Proposed Project:

Proposed Action:

Install off-line bioretention area to capture end of pipe stormwater prior to entering the stream.

Stormwater pipe outfall

Bluestar Ivy alongside stream

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.
Improve floodplain and nutrient cycling functions.

Estimated Cost: $52,000

Round Tree Park LID - A

Project ID: CA9929

Project Name: Round Tree Park LID - A

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Off-line	1090	SF	$25.00	$27,250
			Base Cost =	$27,250
			Mobilization (5%) =	$1,363
			Subtotal 1 =	$28,613
			Contingency (25%) =	$7,153
			Subtotal 2 =	$35,766
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$16,095
			Total =	$51,860
			Estimated Project Cost =	$52,000

Walnut Hill Admin Center LID - B

Project ID: CA9937

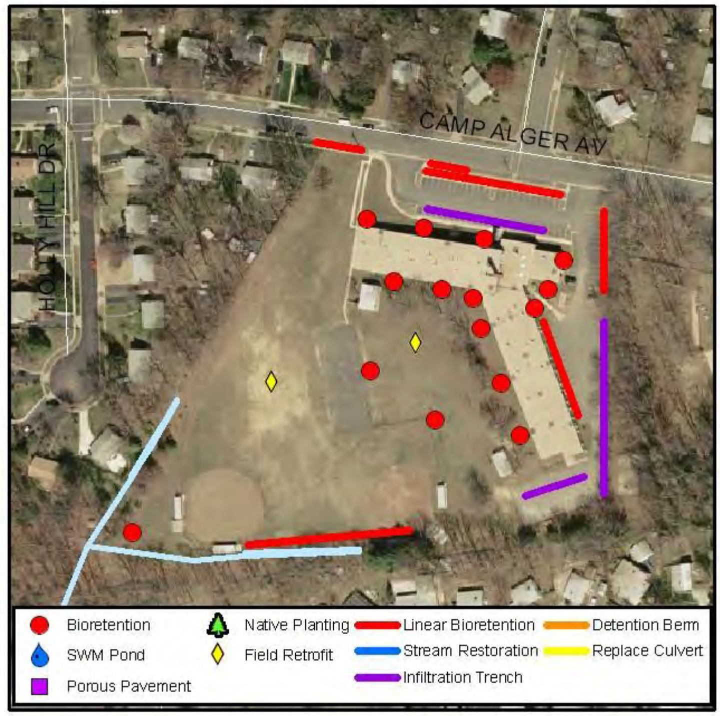
Project Type: Low Impact Development

Project Name: Walnut Hill Admin Center LID - B
Project Location: Camp Alger Ave & Holly Hill Dr.
Parcel ID No.: 0601 01 0004

Subwatershed: Holmes Run - Upper
Drainage Area: 8.7 acres

Project Location:

Proposed Project:



Proposed Action:

Construct linear bioretention strips along road, parking lots, and south side of playing fields; install infiltration trenches in front and rear lots; divert 12 roof drains and courts to bioretention areas; convert fields to artificial turf with underdrains; plantings in unused open space.

Install linear bioretention areas along Camp Alger Ave

Convert concrete ditch along back of school property to infiltration trench

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve community usage.
Opportunity for public education.

Estimated Cost: $2,953,000

Walnut Hill Admin Center LID - B

Project ID: CA9937

Project Name: Walnut Hill Admin Center LID - B

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Linear	10420	SF	$25.00	$260,500
Infiltration Trench	510	LF	$100.00	$51,000
Artificial Turf, Underdrains and Cistern	2	EA	$600,000.00	$1,200,000
Bioretention Area	1590	SF	$25.00	$39,750
			Base Cost =	$1,551,250
			Mobilization (5%) =	$77,563
			Subtotal 1 =	$1,628,813
			Contingency (25%) =	$407,203
			Subtotal 2 =	$2,036,016
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$916,207
			Total =	$2,952,223
			Estimated Project Cost =	$2,953,000

Woodburn Elementary School LID

Project ID: CA9941

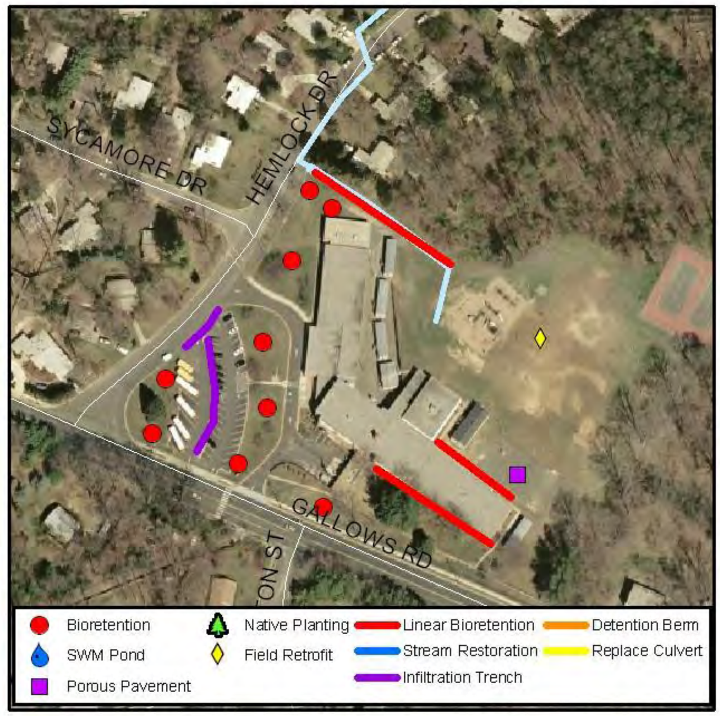
Project Type: Low Impact Development

Project Name: Woodburn Elementary School LID
Project Location: Hemlock Dr. & Gallows Rd.
Parcel ID No.: 0592 01 0044

Subwatershed: Holmes Run - Upper
Drainage Area: 6.1 acres

Project Location:

Proposed Project:



Proposed Action:

Install bioretention areas in landscaped islands along Gallows Rd., Hemlock Dr., and bus loop; install infiltration trenches in front parking lot; install linear bioretention area along bldg. in downspout areas and ditch to N; install porous pavement in asphalt play area; convert soccer/football field from grass to artificial turf.

Divert downspouts into linear bioretention areas alongside building

Install linear bioretention areas along roadway incorporating increased tree density

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.
Improve community usage.
Opportunity for public education.

Estimated Cost: $1,342,000

Project ID: CA9941

Project Name: Woodburn Elementary School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	100	SF	$25.00	$2,500
Infiltration Trench	240	LF	$100.00	$24,000
Porous Pavement	1230	SY	$15.00	$18,450
Artificial Turf, Underdrains and Cistern	1	EA	$600,000.00	$600,000
Bioretention Area, Linear	2390	SF	$25.00	$59,750
			Base Cost =	$704,700
			Mobilization (5%) =	$35,235
			Subtotal 1 =	$739,935
			Contingency (25%) =	$184,984
			Subtotal 2 =	$924,919
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$416,213
			Total =	$1,341,132
			Estimated Project Cost =	$1,342,000

Luria Park LID

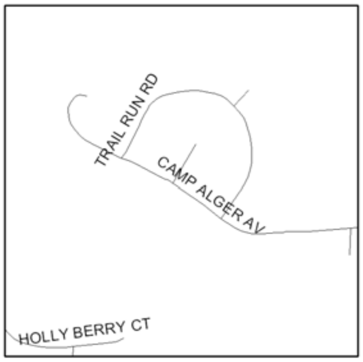
Project ID: CA9942

Project Name: Luria Park LID
Project Location: Luria Park
Parcel ID No.: 0592 19 B

Project Type: Low Impact Development

Subwatershed: Holmes Run - Upper
Drainage Area: 57.1 acres

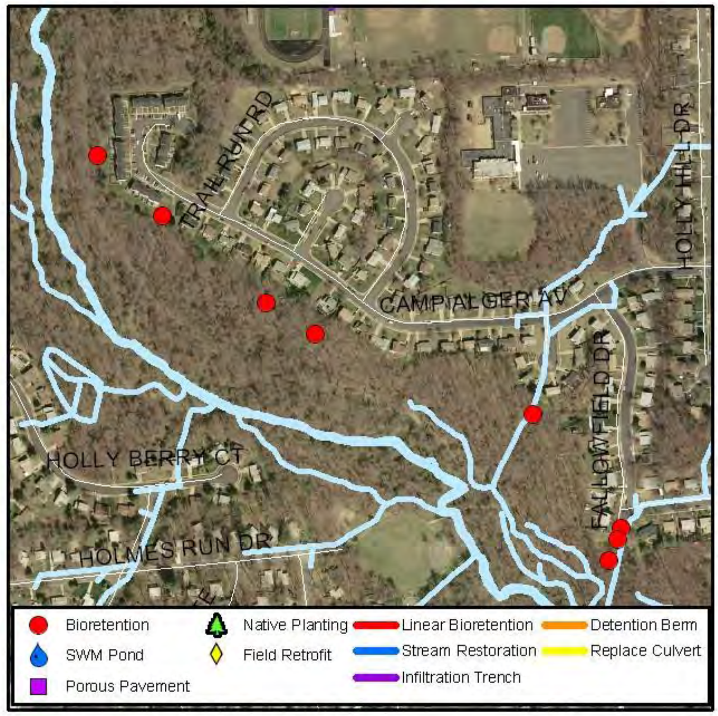
Project Location:



Proposed Action:

Install off-line bioretention areas at stormwater pipe outfalls and area bioretention areas at end of streets at Fallowfield Dr., Oak Run Ct., E end of Trail Run Rd., Crest Haven Ct., and W end of Camp Alger Av.

Proposed Project:



Outfall at end of Trail Run Road

Potential location for off-line bioretention area next to outfall

Benefits: Provide stormwater quality controls.
Improve stormwater quantity controls.
Opportunity for public education.

Estimated Cost: $355,000

Luria Park LID

Project ID: CA9942

Project Name: Luria Park LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Off-line	7460	SF	$25.00	$186,500

Base Cost =	$186,500
Mobilization (5%) =	$9,325
Subtotal 1 =	$195,825
Contingency (25%) =	$48,956
Subtotal 2 =	$244,781
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$110,152
Total =	$354,933
Estimated Project Cost =	$355,000

Falls Church High School LID

Project ID: CA9946

Project Type: Low Impact Development

Project Name: Falls Church High School LID

Project Location: Falls Church High School

Parcel ID No.: 0503 01 0001A

Subwatershed: Holmes Run - Upper

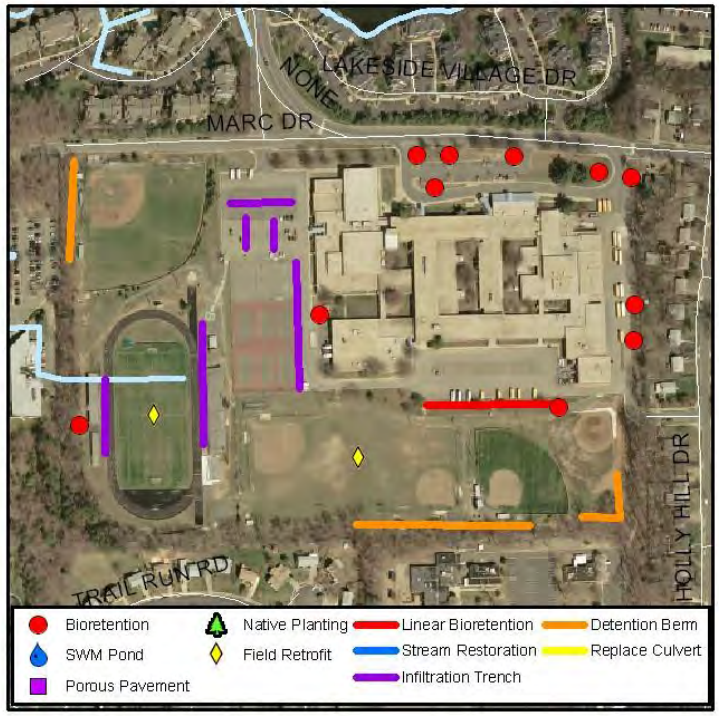
Drainage Area: 38.1 acres

Project Location:

Proposed Action:

Construct bioretention areas in traffic islands along front of school, in landscape beds, and along side of E parking lot; install infiltration trench along E side of tennis courts, in NW parking lot, and in paved grandstand areas; create two multisport athletic fields with artificial turf; construct linear bioretention areas along S side of rear parking lot; build detention micro-berms around field margins and yard drain.

Proposed Project:



Potential bioretention areas in traffic islands along front of school

Convert asphalt apron west of track to a bioretention area

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve community usage.
Opportunity for public education.

Estimated Cost: $2,772,000

Falls Church High School LID

Project ID: CA9946

Project Name: Falls Church High School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	2200	SF	$25.00	$55,000
Infiltration Trench	1210	LF	$100.00	$121,000
Artificial Turf, Underdrains and Cistern	2	EA	$600,000.00	$1,200,000
Bioretention Area, Linear	3125	SF	$25.00	$78,125
Detention Berm	980	LF	$2.00	$1,960
			Base Cost =	$1,456,085
			Mobilization (5%) =	$72,804
			Subtotal 1 =	$1,528,889
			Contingency (25%) =	$382,222
			Subtotal 2 =	$1,911,112
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$860,000
			Total =	$2,771,112
			Estimated Project Cost =	$2,772,000

Thomas Jefferson Library LID

Project ID: CA9947

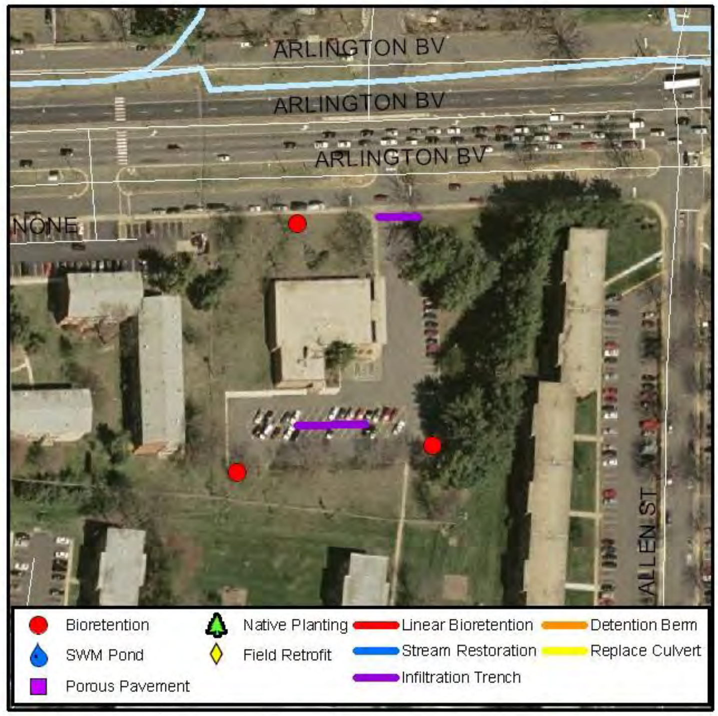
Project Type: Low Impact Development

Project Name: Thomas Jefferson Library LID
Project Location: Thomas Jefferson Library
Parcel ID No.: 0503 01 0004

Subwatershed: Holmes Run - Upper
Drainage Area: 2.2 acres

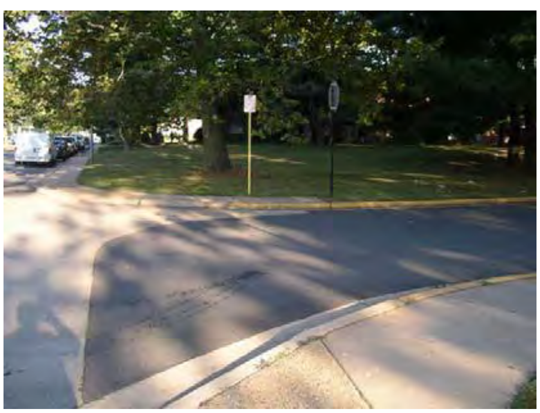
Project Location:

Proposed Project:

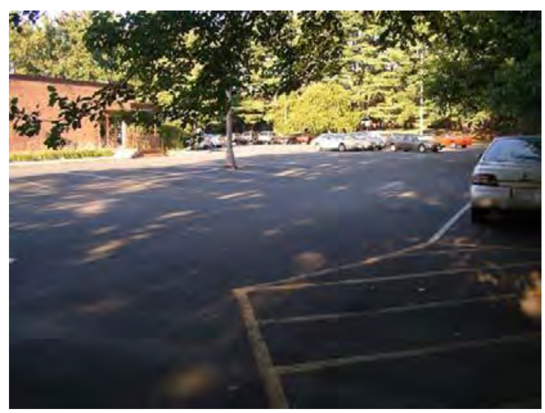


Proposed Action:

Construct bioretention areas in front of library for roof drainage, along row of head-on parking spaces, and at SW and SE corners of lot; install infiltration trench across entrance road.



Install infiltration trench across entrance



Bioretention areas and infiltration trenches to be installed in rear parking lot

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $179,000

Thomas Jefferson Library LID

Project ID: CA9947

Project Name: Thomas Jefferson Library LID

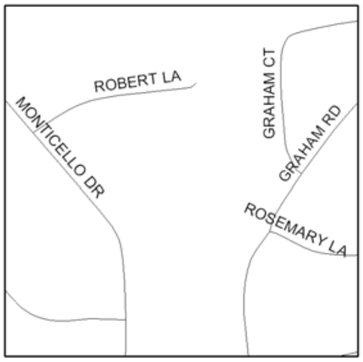
Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	2500	SF	$25.00	$62,500
Infiltration Trench	315	LF	$100.00	$31,500
			Base Cost =	$94,000
			Mobilization (5%) =	$4,700
			Subtotal 1 =	$98,700
			Contingency (25%) =	$24,675
			Subtotal 2 =	$123,375
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$55,519
			Total =	$178,894
			Estimated Project Cost =	$179,000

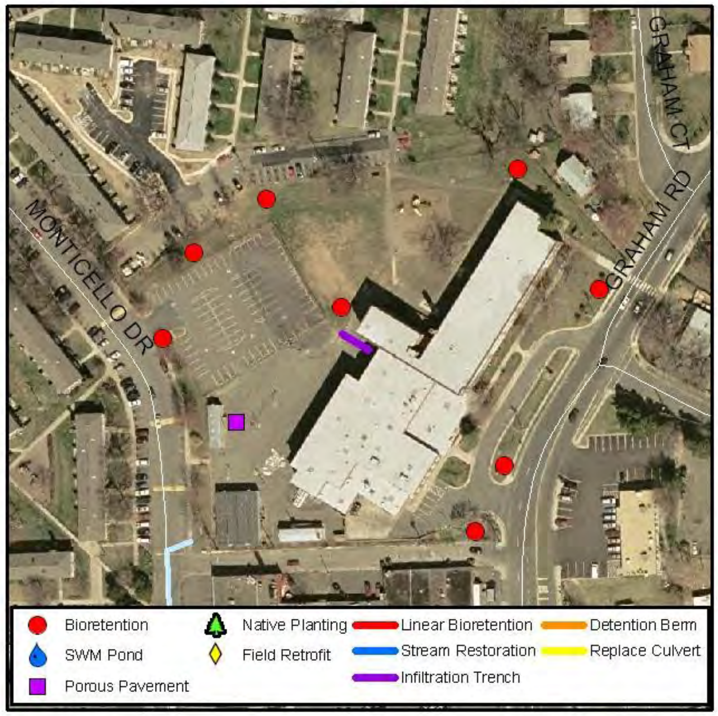
Graham Road Elementary School LID

Project ID:	CA9949	**Project Type:**	Low Impact Development
Project Name:	Graham Road Elementary School LID	**Subwatershed:**	Holmes Run - Upper
Project Location:	Graham Road Elementary School	**Drainage Area:**	4.7 acres
Parcel ID No.:	0503 12 0011A		

Project Location:



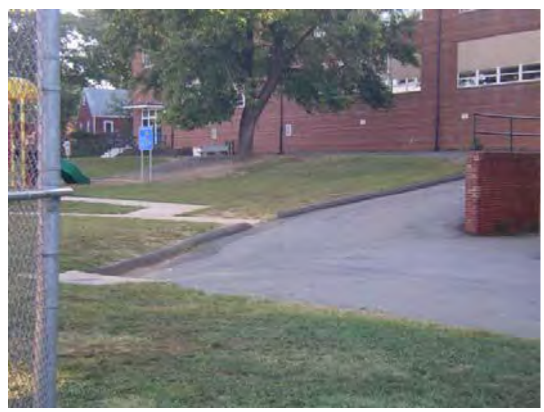
Proposed Project:



Proposed Action:

Construct bioretention areas in traffic island for bus loop, between sidewalk and building in front, along Monticello Dr., and along north side of back lot; install porous pavement and infiltration trench in deteriorated asphalt play yard.

Bioretention areas and swales to be installed in traffic island for bus loop



Divert downspouts into bioretention areas alongside building

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve community usage.
Opportunity for public education.

Estimated Cost: $127,000

Graham Road Elementary School LID

Project ID: CA9949

Project Name: Graham Road Elementary School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	2400	SF	$25.00	$60,000
Porous Pavement	190	SY	$15.00	$2,850
Infiltration Trench	35	LF	$100.00	$3,500
			Base Cost =	$66,350
			Mobilization (5%) =	$3,318
			Subtotal 1 =	$69,668
			Contingency (25%) =	$17,417
			Subtotal 2 =	$87,084
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$39,188
			Total =	$126,272
			Estimated Project Cost =	$127,000

Pine Spring Elementary School LID

Project ID: CA9950

Project Type: Low Impact Development

Project Name: Pine Spring Elementary School LID
Project Location: Pine Spring Elementary School
Parcel ID No.: 0494 01 0060

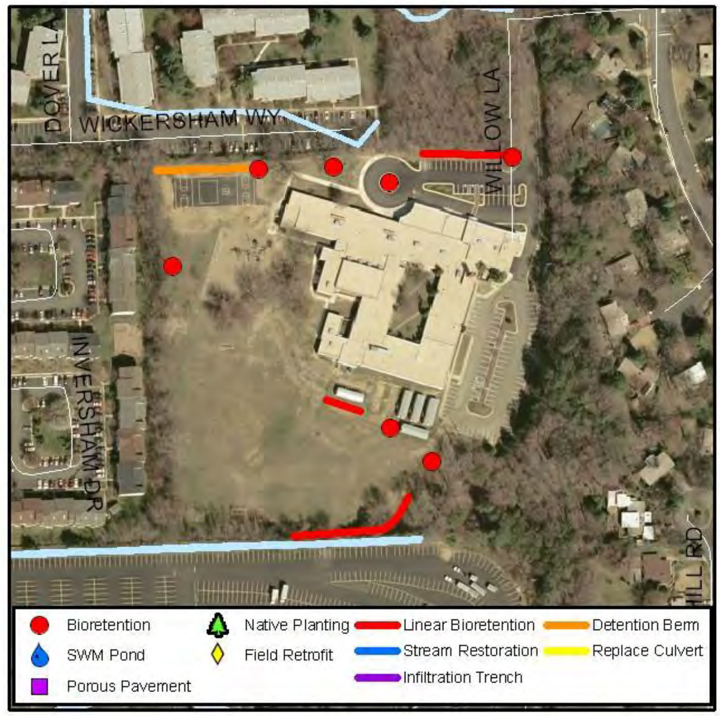
Subwatershed: Holmes Run - Upper
Drainage Area: 11.1 acres

Project Location:

Proposed Action:

Construct detention micro-berm and bioretention areas along NW property line; construct bioretention areas in bus loop and parking lot islands, NW outfall, and trailers; construct linear bioretention along N parking lot, trailers, and in existing swale on S edge of property; construct off-line bioretention area at outfall S of rear parking lot.

Proposed Project:



Potential bioretention area in traffic island

Potential location for bioretention area and detention berm along tree line

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve community usage.
Opportunity for public education.

Estimated Cost: $576,000

Pine Spring Elementary School LID

Project ID: CA9950

Project Name: Pine Spring Elementary School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Detention Berm	175	LF	$2.00	$350
Bioretention Area	2500	SF	$25.00	$62,500
Bioretention Area, Linear	5520	SF	$25.00	$138,000
Bioretention Area, Off-line	4060	SF	$25.00	$101,500

Base Cost =	$302,350
Mobilization (5%) =	$15,118
Subtotal 1 =	$317,468
Contingency (25%) =	$79,367
Subtotal 2 =	$396,834
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$178,575
Total =	$575,410
Estimated Project Cost =	$576,000

Timber Lane Elementary School LID

Project ID: CA9952

Project Name: Timber Lane Elementary School LID
Project Location: Timber Lane Elementary School
Parcel ID No.: 0501 01 0044

Project Type: Low Impact Development

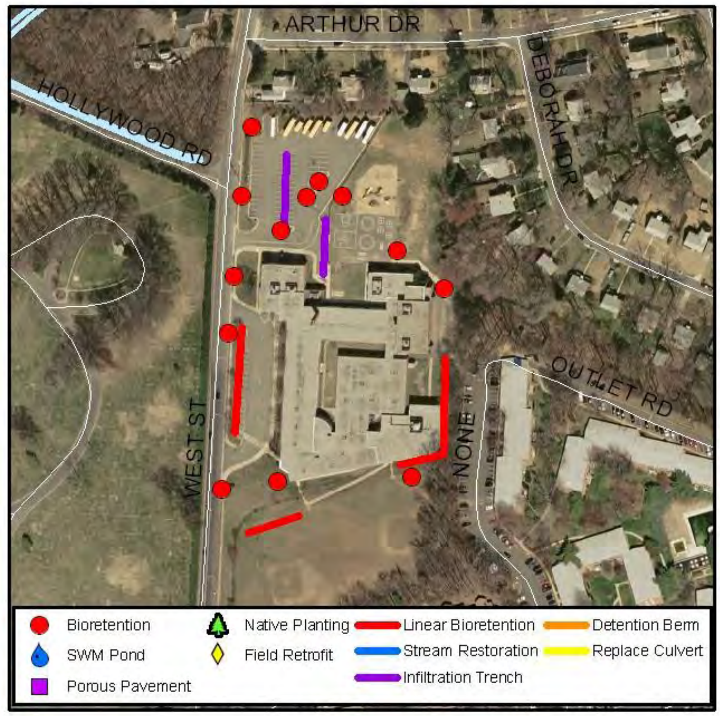
Subwatershed: Holmes Run - Upper
Drainage Area: 9.7 acres

Project Location:

Proposed Action:

Construct bioretention areas in lawn and traffic islands along West Street, in N parking lot, behind bldg., and next to fields; construct linear bioretention areas around building; install infiltration trench and tree box filter in N parking lot.

Proposed Project:



Add infiltration trench to parking rows

Convert traffic islands in parking lot to bioretention areas

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $606,000

Timber Lane Elementary School LID

Project ID: CA9952

Project Name: Timber Lane Elementary School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Linear	8045	SF	$25.00	$201,125
Bioretention Area	3570	SF	$25.00	$89,250
Infiltration Trench	250	LF	$100.00	$25,000
Tree Box Filter	1	EA	$3,000.00	$3,000

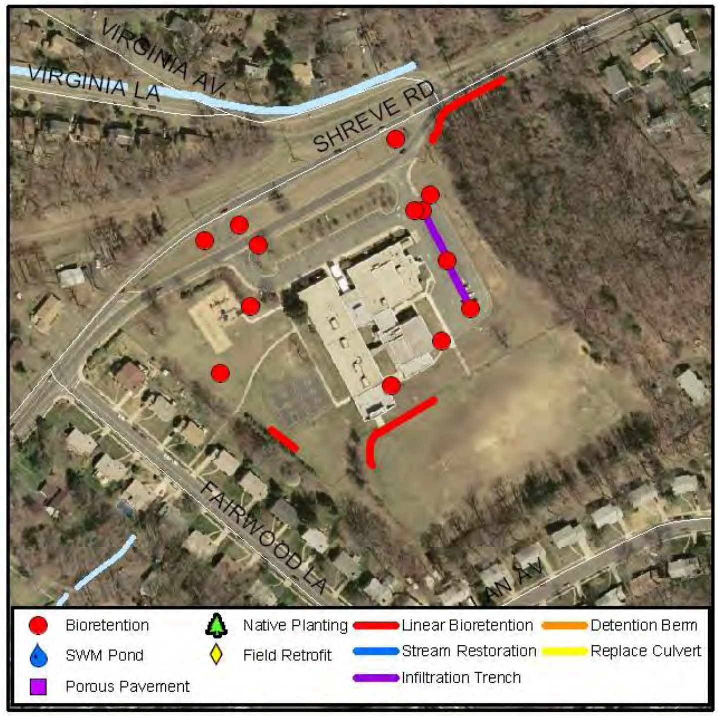
Base Cost =	$318,375
Mobilization (5%) =	$15,919
Subtotal 1 =	$334,294
Contingency (25%) =	$83,573
Subtotal 2 =	$417,867
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$188,040
Total =	$605,907
Estimated Project Cost =	$606,000

Shrevewood Elementary School LID

Project ID:	CA9953	**Project Type:**	Low Impact Development
Project Name:	Shrevewood Elementary School LID	**Subwatershed:**	Holmes Run - Upper
Project Location:	Shrevewood Elementary School	**Drainage Area:**	11.8 acres
Parcel ID No.:	0501 01 0002		

Project Location:

Proposed Project:



Proposed Action:

Construct bioretention areas in Shreve Rd. median islands, bus loop island, east side of parking lot, near playground, and at rear of bldg.; construct linear bioretention along NW corner of back field, next to asphalt courts, and in swale at NE corner along road.

Install linear bioretention area next to asphalt courts

Potential bioretention areas located behind school building

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $359,000

Shrevewood Elementary School LID

Project ID: CA9953

Project Name: Shrevewood Elementary School LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	1450	SF	$25.00	$36,250
Bioretention Area, Linear	5245	SF	$25.00	$131,125
Infiltration Trench	210	LF	$100.00	$21,000
			Base Cost =	$188,375
			Mobilization (5%) =	$9,419
			Subtotal 1 =	$197,794
			Contingency (25%) =	$49,448
			Subtotal 2 =	$247,242
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$111,259
			Total =	$358,501
			Estimated Project Cost =	$359,000

Jefferson District Park & Golf Course LID

Project ID: CA9954

Project Type: Low Impact Development

Project Name: Jefferson District Park & Golf Course LID
Project Location: Lee Hwy. & Shreve Rd.
Parcel ID No.: 0492 01 0088

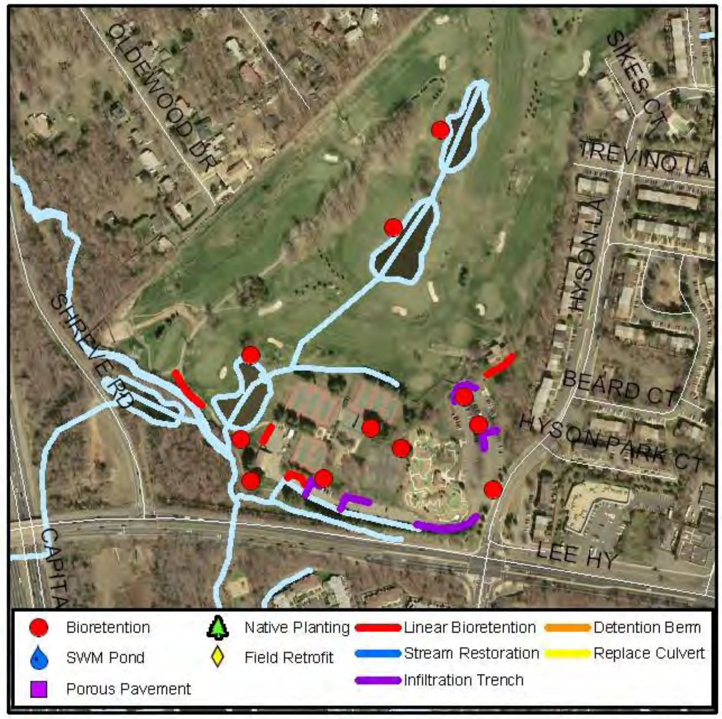
Subwatershed: Holmes Run - Upper
Drainage Area: 59.7 acres

Project Location:

Proposed Action:

Install filter strips around SWM pond and 2 central water hazards; construct linear and area bioretention areas and infiltration trenches along parking lots and court surfaces; depress footpath to avoid directing flow from ponds to stream.

Proposed Project:



Existing stormwater pond on golf course could be surrounded by filter strips

Infiltration trenches could be installed along parking lot

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Improve community usage.
Opportunity for public education.

Estimated Cost: $236,000

Jefferson District Park & Golf Course LID

Project ID: CA9954

Project Name: Jefferson District Park & Golf Course LID

Estimated Project Cost:

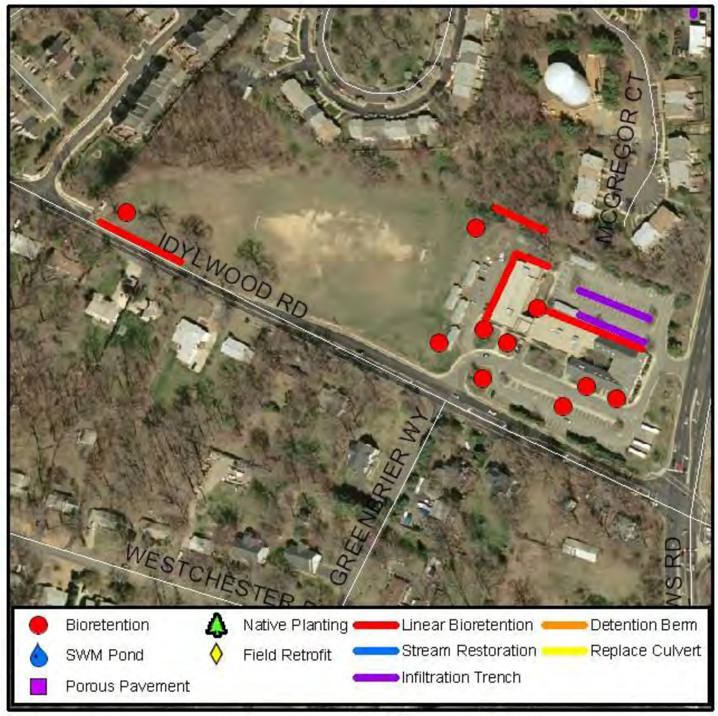
ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Linear	370	SF	$25.00	$9,250
Bioretention Area	2000	SF	$25.00	$50,000
Filter Strip	750	LF	$2.00	$1,500
Infiltration Trench	630	LF	$100.00	$63,000
			Base Cost =	$123,750
			Mobilization (5%) =	$6,188
			Subtotal 1 =	$129,938
			Contingency (25%) =	$32,484
			Subtotal 2 =	$162,422
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$73,090
			Total =	$235,512
			Estimated Project Cost =	$236,000

Dunn Loring Center (School) LID

Project ID:	CA9955	**Project Type:**	Low Impact Development
Project Name:	Dunn Loring Center (School) LID	**Subwatershed:**	Holmes Run - Upper
Project Location:	Dunn Loring Center (School)	**Drainage Area:**	9.1 acres
Parcel ID No.:	0394 01 0024		

Project Location:

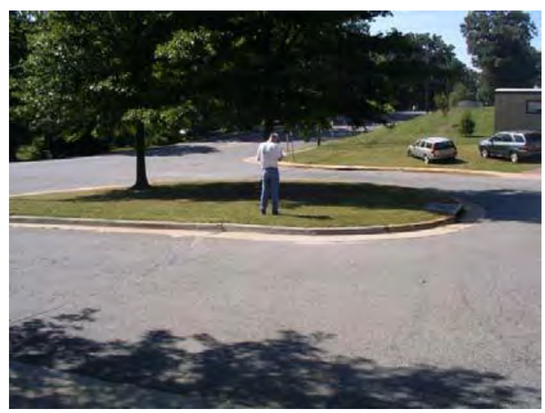
Proposed Project:



Proposed Action:

Disconnect downspouts and redirect to bioretention areas in landscape beds; construct linear bioretention areas around NW corner of bldg., above berm N of bldg., and at W end of fields; install infiltration trench in N parking lot; construct bioretention areas in traffic islands SW of bldg. and trailers.

Existing infiltration trench alongside parking lot



Potential bioretention area in traffic island

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $722,000

Dunn Loring Center (School) LID

Project ID: CA9955

Project Name: Dunn Loring Center (School) LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area, Linear	12115	SF	$25.00	$302,875
Infiltration Trench	290	LF	$100.00	$29,000
Bioretention Area	1890	SF	$25.00	$47,250
			Base Cost =	$379,125
			Mobilization (5%) =	$18,956
			Subtotal 1 =	$398,081
			Contingency (25%) =	$99,520
			Subtotal 2 =	$497,602
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$223,921
			Total =	$721,522
			Estimated Project Cost =	$722,000

Fire Station - Company No. 13 LID

Project ID:	CA9957	**Project Type:**	Low Impact Development
Project Name:	Fire Station - Company No. 13 LID	**Subwatershed:**	Holmes Run - Upper
Project Location:	Gallows Rd. and Wolftrap Rd.	**Drainage Area:**	1.5 acres
Parcel ID No.:	0392 08 0007		

Project Location:

Proposed Project:

Proposed Action:

Construct bioretention areas on W side of parking lot prior to inlets; provide rain barrels for downspouts from overhangs at front and rear entrances; install infiltration trenches along N side and in front of bldg.; install linear bioretention area in median along Gallows Rd.

Install bioretention areas in traffic islands and along center of parking rows

Divert downspouts into linear bioretention areas alongside building

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.

Estimated Cost: $132,000

Project ID: CA9957

Project Name: Fire Station - Company No. 13 LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	1420	SF	$25.00	$35,500
Rain Barrel	2	EA	$150.00	$300
Infiltration Trench	225	LF	$100.00	$22,500
Bioretention Area, Linear	425	SF	$25.00	$10,625
			Base Cost =	$68,925
			Mobilization (5%) =	$3,446
			Subtotal 1 =	$72,371
			Contingency (25%) =	$18,093
			Subtotal 2 =	$90,464
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$40,709
			Total =	$131,173
			Estimated Project Cost =	$132,000

Lynbrook Subdivision LID - A

Project ID: CA9958

Project Type: Low Impact Development

Project Name: Lynbrook Subdivision LID - A
Project Location: Augusta Dr. & Flanders St.
Parcel ID No.: 0804 0211 A1

Subwatershed: Backlick Run
Drainage Area: 14.7 acres

Project Location:

Proposed Action:

Add 2 off-line bioretention areas below road to capture flow from two outfalls; repair concrete apron below road culvert.

Proposed Project:

Stream area

Outfall

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.

Estimated Cost: $89,000

Lynbrook Subdivision LID - A

Project ID: CA9958

Project Name: Lynbrook Subdivision LID - A

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Grading and Excavation	425	CY	$50.00	$21,250
Structural Improvements & Incidentals	1	LS	$20,000.00	$20,000
Erosion & Sediment Control - Minimum	1	LS	$3,000.00	$3,000
Landscaping - Minimum	1	LS	$2,000.00	$2,000
			Base Cost =	$46,250
			Mobilization (5%) =	$2,313
			Subtotal 1 =	$48,563
			Contingency (25%) =	$12,141
			Subtotal 2 =	$60,703
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$27,316
			Total =	$88,020
			Estimated Project Cost =	$89,000

Anna Lee Heights LID

Project ID: CA9959
Project Type: Low Impact Development

Project Name: Anna Lee Heights LID
Project Location: Blue Heron Dr. & Kingwood Dr.
Parcel ID No.:
Subwatershed: Tripps Run
Drainage Area: 16.8 acres

Project Location:

Proposed Action:
Construct bioretention area within existing swale.

Proposed Project:

Existing swale

Outlet entering swale

Benefits: Improve stormwater quantity controls.
Improve stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.

Estimated Cost: $77,000

Anna Lee Heights LID

Project ID: CA9959

Project Name: Anna Lee Heights LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Bioretention Area	1600	SF	$25.00	$40,000

Base Cost =	$40,000
Mobilization (5%) =	$2,000
Subtotal 1 =	$42,000
Contingency (25%) =	$10,500
Subtotal 2 =	$52,500
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$23,625
Total =	$76,125
Estimated Project Cost =	$77,000

Mason District Park LID

Project ID: CA9960

Project Name: Mason District Park LID
Project Location: Columbia Pike & Mason District Park Entrance
Parcel ID No.: 0604 01 0028

Project Type: Low Impact Development

Subwatershed: Turkeycock Run
Drainage Area: 5.1 acres

Project Location:

Proposed Action:

Implement stormwater retrofits based on the Park Authority's existing LID retrofit concept plan.

Proposed Project:

Existing stormwater pond with roadway in background

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Improve stream stability and instream habitat. Reduce erosion.
Opportunity for public education.

Estimated Cost: $120,000

Mason District Park LID

Project ID: CA9960

Project Name: Mason District Park LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
LID Retrofits	1	LS	$63,000.00	$63,000
			Base Cost =	$63,000
			Mobilization (5%) =	$3,150
			Subtotal 1 =	$66,150
			Contingency (25%) =	$16,538
			Subtotal 2 =	$82,688
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$37,209
			Total =	$119,897
			Estimated Project Cost =	$120,000

Holmes Run Park LID

Project ID: CA9962

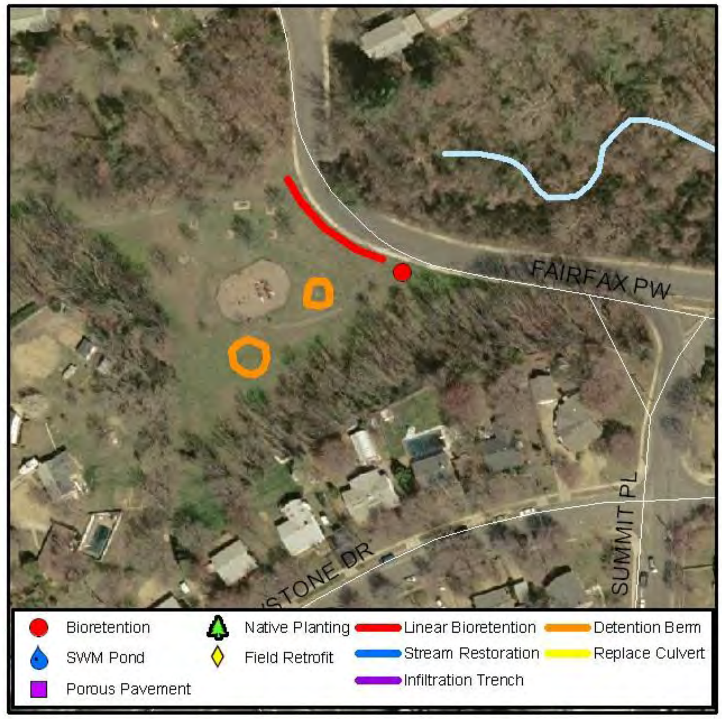
Project Type: Low Impact Development

Project Name: Holmes Run Park LID
Project Location: Holmes Run Park near Fairfax Parkway
Parcel ID No.: 0613 16 A

Subwatershed: Holmes Run - Lower
Drainage Area: 8 acres

Project Location:

Proposed Project:



Proposed Action:

Install linear and circular bioretention areas along road and detention micro-berms around two stormwater area drains in park.

Detention berms can encircle grate inlets like this one to slow flows

Potential locations for linear bioretention area and tree box filter

Benefits: Provide stormwater quantity controls.
Provide stormwater quality controls.
Opportunity for public education.

Estimated Cost: $158,000

Holmes Run Park LID

Project ID: CA9962

Project Name: Holmes Run Park LID

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Detention Berm	215	LF	$2.00	$430
Bioretention Area, Linear	1430	SF	$25.00	$35,750
Bioretention Area	1870	SF	$25.00	$46,750
			Base Cost =	$82,930
			Mobilization (5%) =	$4,147
			Subtotal 1 =	$87,077
			Contingency (25%) =	$21,769
			Subtotal 2 =	$108,846
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$48,981
			Total =	$157,826
			Estimated Project Cost =	$158,000

APPENDIX A-2

Tier 2 Projects

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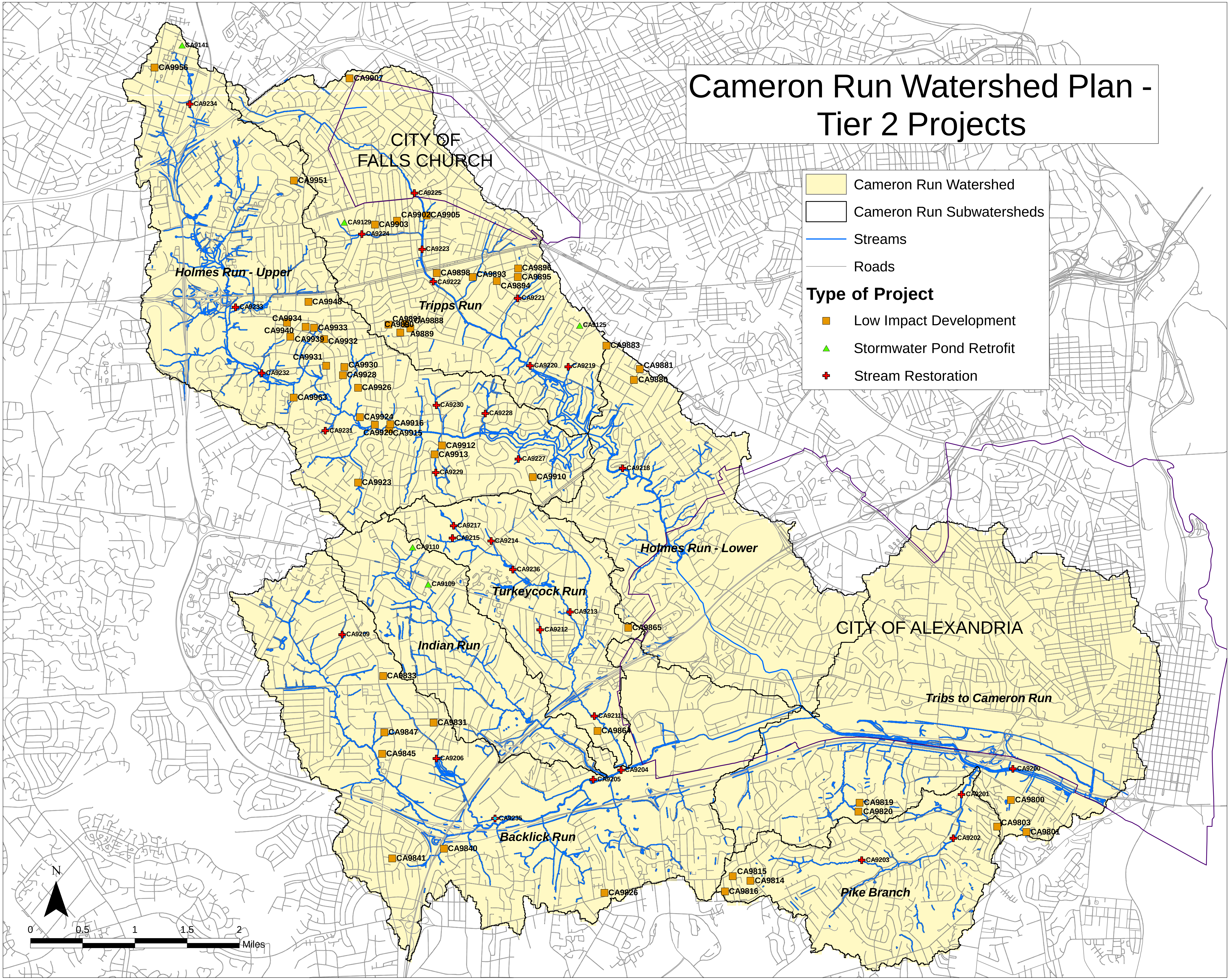
Cameron Run Watershed Plan -
Tier 2 Projects
Cameron Run Watershed
Cameron Run Subwatersheds
Streams
Roads
Type of Project
Low Impact Development
Stormwater Pond Retrofit
Stream Restoration
CITY OF
FALLS CHURCH
CITY OF ALEXANDRIA
Holmes Run - Upper
Tripps Run
Holmes Run - Lower
Turkeycock Run
Indian Run
Backlick Run
Tribs to Cameron Run
Pike Branch
CA9141
CA9956
CA9234
CA9907
CA9951
CA9225
CA9129
CA9903
CA9902
CA9905
CA9224
CA9223
CA9898
CA9893
CA9896
CA9895
CA9894
CA9222
CA9221
CA9948
CA9233
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CA9228
CA9924
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CA9205
CA9200
CA9201
CA9800
CA9819
CA9820
CA9235
CA9803
CA9801
CA9202
CA9840
CA9841
CA9203
CA9815
CA9814
CA9816
CA9826
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2
Miles

Candidate Watershed Restoration Projects - Tier 2

Project ID	Subwatershed	Project Name	Location	Proposed Action	Drainage Area (acres)	Estimated Cost
CA9109	Indian Run	Brentleigh SWM Pond Retrofit	Brentleigh Ct & Little River Turnpike	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	3.1	$67,000
CA9110	Indian Run	Wynfield SWM Pond Retrofit	Alpine Dr & Webster Ct	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	4.11	$30,000
CA9125	Tripps Run	Vine Forest Court SWM Pond Retrofit	Vine Forest Ct & Peace Valley Ln	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality; infiltration trench in private road; bioretention area in grassy open space.	2.9	$70,000
CA9129	Tripps Run	Lee Graham Shopping Center SWM Pond Retrofit	Graham Rd & Lee Hwy	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	60.84	$300,000
CA9135	Holmes Run - Upper	Luria Park - SWM Pond	Dye Dr & Brad St	Develop new "3-cell" stormwater bioretention; linear bioretention areas west along Brad St.	39.1	$160,000
CA9141	Holmes Run - Upper	Parsons Grove SWM Pond Retrofit	Parsons Grove & Arden St	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality; add three detention micro-berms and bioretention area in flow path from north.	14.8	$81,000
CA9200	Tributaries to Cameron Run	Mainstem Weir Removal	Off Huntington Avenue	Remove existing weirs that are barriers to fish passage and replace with bed-level grade control structures in the low flow channel; restore natural stream channel morphology to improve hydrologic and ecological function, and prevent in-channel erosion and downstream sedimentation; enhance riparian buffer; and integrate project design with the Huntington Stream Valley Trail, including the use of porous pavers.	0	$4,700,000
CA9201	Pike Branch	Heritage Hill Stream Restoration	Confluence to Franconia Road	Restore stream channel morphology, stabilize eroding stream banks, enhance riparian buffer, remove invasive species.	0	$1,800,000
CA9202	Pike Branch	Browne Academy Stream Restoration	Telegraph Road	Restore natural stream channel morphology and riparian buffer. Minimize stream bank erosion.	0	$1,000,000

Project ID	Subwatershed	Project Name	Location	Proposed Action	Drainage Area (acres)	Estimated Cost
CA9203	Pike Branch	Ridgewood Park Stream Restoration	Ridgewood Park	Restore stream channel morphology, plant enhance riparian buffer, stabilize eroding streambanks, re-establish connection with floodplain.	0	$1,400,000
CA9204	Backlick Run	Fairfax County Park Authority Stream Restoration	Between confluences of Indian and Turkeycock Runs	Enhance riparian forested buffer. Minimize stream bank erosion and re-establish connection to floodplain.	0	$1,500,000
CA9205	Backlick Run	Railroad Stream Restoration	Mar Drive, above confluence with Indian Run	Restore natural stream channel morphology and enhance riparian forested buffer. Minimize stream bank erosion and re-establish connection to floodplain.	0	$850,000
CA9206	Backlick Run	Shirley Industrial Park Stream Restoration	Commercial Drive	Restore natural stream channel morphology and enhance riparian forested buffer. Minimize stream bank erosion and re-establish connection to floodplain.	0	$60,000
CA9209	Backlick Run	Annandale Acres Stream Restoration	Calvert Street, Clemons Court	Plant 50-foot woody riparian buffer. Add micro-berm in back yards to slow stormwater flow. Stabilize stream banks to minimize erosion.	0	$1,500,000
CA9211	Turkeycock Run	Turkeycock Run Stream Valley Park Restoration	Turkeycock Run Stream Valley Park	Restore natural stream channel morphology, plant riparian buffer, and reduce streambank erosion.	0	$1,300,000
CA9212	Turkeycock Run	Hanna Park Stream Restoration	Valley Street	Restore natural stream channel morphology, plant riparian buffer, and reduce streambank erosion.	0	$1,824,000
CA9213	Turkeycock Run	Autumn Glen Stream Restoration	Autumn Cove Court	Restore natural stream channel morphology, plant riparian buffer, and reduce streambank erosion.	0	$562,000
CA9214	Turkeycock Run	Kings Mill Stream Restoration	Kings Mill Lane	Restore natural stream channel morphology, plant riparian buffer, reduce streambank erosion.	0	$640,000
CA9215	Turkeycock Run	Mason District Park Stream Restoration - B	Mason District Park	Restore natural stream channel morphology, reconnect floodplain, enhance riparian buffer, and reduce stream bank erosion.	0	$550,000
CA9217	Turkeycock Run	Mason District Park Stream Restoration - C	Mason District Park	Restore natural stream channel morphology, plant riparian buffer, reduce streambank erosion.	0	$1,300,000
CA9218	Holmes Run - Lower	Holmes Run Park Stream Restoration	Holmes Run Park	Stabilize stream channel and prevent bank erosion, remove trash.	0	$2,100,000

Project ID	Subwatershed	Project Name	Location	Proposed Action	Drainage Area (acres)	Estimated Cost
CA9219	Tripps Run	JEB Stuart Park Riparian Buffer	JEB Stuart Park	Remove English Ivy and other invasive plant species; reforest mowed areas; remove log check dam; stabilize toe of several very steep banks with local wood found in/near stream; and off-line bioretention area at Peace Valley Ln outfall.	25.65	$300,000
CA9220	Tripps Run	Lake Backwater Stream Restoration	Potterton Drive	Re-establish flow channel, enhance wetland plantings.	0	$1,800,000
CA9221	Tripps Run	Sleepy Hollow Manor Stream Restoration	Sleepy Hollow Road (3100)	Mitigate channelization, re-establish channel connection with floodplain, reduce bank erosion, enhance riparian buffer.	0	$800,000
CA9222	Tripps Run	Westlawn Stream Restoration	Barrett Rd Road, Mosby	Re-establish natural stream channel and floodplain, plant riparian buffer.	0	$1,900,000
CA9223	Tripps Run	Jefferson Village Altered Channel Mitigation	Adams Place, Monroe Place	Dissipate flow energy, re-establish channel connection with floodplain, reduce bank and bed erosion, enhance riparian buffer.	0	$1,100,000
CA9224	Tripps Run	Devonshire Gardens Stream Restoration	Rosemary Lane	Dissipate flow energy, re-establish channel connection with floodplain, reduce bank and bed erosion, enhance riparian buffer.	0	$1,500,000
CA9225	Tripps Run	Lee Stream Bank Stabilization	Maple Street	Restore natural stream channel morphology and floodplain connections; enhance riparian buffer; and upgrade road culverts to convey bankfull discharge and sediment load, and provide floodplain drainage.	0	$1,255,000
CA9227	Holmes Run - Upper	Lakeview Stream Restoration	Lakeview Drive	Stabilize stream channel to prevent erosion, enhance riparian buffer.	0	$500,000
CA9228	Holmes Run - Upper	Crosswoods Stream Restoration	Crosswoods Drive	Restore natural stream channel morphology, enhance riparian buffer.	0	$1,000,000
CA9229	Holmes Run - Upper	Holmes Run Stream Valley Park Restoration - B	Ivydale Drive	Restore natural stream channel morphology, enhance riparian buffer, reconnect floodplain.	0	$1,000,000
CA9230	Holmes Run - Upper	Tansey Stream Restoration	Tansey Drive	Stabilize stream channel to prevent erosion, enhance riparian buffer.	0	$400,000

Project ID	Subwatershed	Project Name	Location	Proposed Action	Drainage Area (acres)	Estimated Cost
CA9231	Holmes Run - Upper	Holmes Run Stream Valley Park Restoration - A	Holmes Run Stream Valley Park, Joel Drive	Restore natural stream channel morphology, enhance riparian buffer, reduce bank erosion, reconnect floodplain.	0	$900,000
CA9232	Holmes Run - Upper	Luria Park Stream Restoration	Luria Park	Restore natural stream channel morphology, consolidate multiple channels, stabilize banks, and enhance riparian buffer.	0	$600,000
CA9233	Holmes Run - Upper	Willow Point Stream Restoration	Willow Point Drive	Restore natural stream channel morphology, stabilize banks, and enhance riparian buffer.	0	$1,200,000
CA9234	Holmes Run - Upper	Idylwood Stream Restoration	Idylwood Road	Restore stream channel morphology; and upgrade road culverts to convey bankfull discharge and sediment load, and provide floodplain drainage.	0	$533,000
CA9235	Backlick Run	Backlick Run Stream Restoration	Backlick Stream Valley Park	Restore natural stream channel morphology, protect adjacent railroad grade, and enhance riparian buffer.	0	$910,000
CA9236	Turkeycock Run	Pinecrest Park Stream Restoration	Pinecrest Park at Braddock Road	Restore natural stream channel morphology and floodplain connections; enhance riparian buffer; and upgrade Braddock Road culverts to convey bankfull discharge and sediment load, and provide floodplain drainage.	0	$1,399,000
CA9800	Tributaries to Cameron Run	Huntington Metro LID	Kings Highway & Shady Oak Dr	Install infiltration trenches in bus and car parking areas; and install two bioretention areas in traffic islands on S side of Huntington Ave.	6.5	$75,000
CA9801	Tributaries to Cameron Run	Blane Drive LID	Blane Drive	Construct bioretention area in traffic island	3.2	$125,000
CA9803	Pike Branch	Post Office LID - A	Kings Highway & Fort Dr	Provide infiltration trench along roadway, between parking rows, and along N and W sides; add bioretention areas to traffic islands in front parking lot.	3	$52,000
CA9814	Pike Branch	Rose Hill Shopping Center LID	Rose Hill Dr and Franconia Rd	Add infiltration trenches in parking lot rows; linear bioretention areas behind building and along Franconia Rd; and bioretention areas in traffic islands in parking lot.	12.7	$120,000
CA9815	Pike Branch	Post Office LID - B	Franconia Rd & Rose Hill Dr	Infiltration trenches should be installed along parking rows in W lot. Porous pavement should be used in vehicle parking area and front lot. Linear bioretention area along E side of property.	3.4	$123,000

Project ID	Subwatershed	Project Name	Location	Proposed Action	Drainage Area (acres)	Estimated Cost
CA9816	Pike Branch	Park Terrace Traffic Circle LID	Park Terrace	Redirect road drainage to bioretention area on north side of traffic circle; retain large trees in southern part of circle.	7.8	$263,000
CA9819	Tributaries to Cameron Run	Towanda Road LID	Towanda Rd	Provide tree box insert in storm drain inlet.	3.9	$12,000
CA9820	Tributaries to Cameron Run	Lakota Road LID	Lakota Rd	Provide tree box insert in storm drain inlets.	2.8	$18,000
CA9826	Backlick Run	Franconia Station LID	Franconia Rd and Wild Way	Install infiltration trenches along parking rows and tree box filters at inlets.	2.04	$90,000
CA9831	Backlick Run	Edsall Park Subdivision LID	Edsall Park Subdivision at Edsall Rd	Install tree box filters throughout neighborhood.	61.8	$138,000
CA9833	Backlick Run	Bradlick Shopping Center LID	Braddock Rd & Backlick Rd	Incorporate infiltration trenches throughout parking lot and tree box filters at inlets.	11.8	$147,000
CA9840	Backlick Run	Trailside Park LID	Trailside Park on Stagecoach St	Construct bioretention areas at two stormwater pipe outfalls; incorporate trash collection device/program to minimize trash from I-95	6.1	$316,000
CA9841	Backlick Run	Lynbrook Subdivision LID - B	Edgebrook Dr and Backlick Rd	Enhance depressed median to improve bioretention functions.	3.7	$317,000
CA9845	Backlick Run	Appomattox Court LID	Appomattox Ct and Leesburg Blvd	Convert traffic island at Appomattox Ct to bioretention area; construct infiltration trenches in median strip on Leesburg Blvd; and tree box filters in two curb inlets.	3.5	$159,000
CA9847	Backlick Run	St. Johns Methodist Church LID	Woodland Dr and Backlick Rd	Construct bioretention areas in woods S of parking lot; add infiltration trenches along parking lot margins.	2	$52,000
CA9864	Turkeycock Run	Bren Mar Park LID	Bren Mar Park	Redirect runoff from parking lots, courts, and Edsall Rd. to bioretention areas; expand capacity of possible existing bioretention area in parking lot median strip.	4.8	$166,000
CA9865	Turkeycock Run	Plaza at Landmark LID	Little River Turnpike & Beauregard St	Development of parking lot islands into bioretention areas. Infiltration trenches under all parking areas. Replace inlets with tree box filters.	7.9	$218,000
CA9880	Holmes Run - Lower	Culmore Subdivision LID	Glen Carlyn Drive - median	Construct linear bioretention areas in four median islands between traffic lanes.	1.8	$253,000

Project ID	Subwatershed	Project Name	Location	Proposed Action	Drainage Area (acres)	Estimated Cost
CA9881	Holmes Run - Lower	Culmore Shopping Center - Post Office LID	Culmore Shopping Center - Post Office	Create infiltration trenches and linear bioretention strips along parking rows; and bioretention areas in landscape/traffic islands.	6.4	$60,000
CA9883	Tripps Run	Munson Hill Towers LID	Munson Hill Towers - Leesburg Pike	Bioretention areas in parking lots - along edges and down center of rows; detention micro-berm along S side of property.	13	$90,000
CA9888	Tripps Run	Anna Lee Traffic Island LID - D	Driver Circle	Depress area of traffic islands and plant bioretention area.	4.7	$96,000
CA9889	Tripps Run	Anna Lee Traffic Island LID - B	Glenroy Circle	Depress area of traffic island and plant bioretention area.	3	$15,000
CA9890	Tripps Run	Anna Lee Traffic Island LID - C	Chepstown La & Kenfig Dr	Depress area of traffic island and plant bioretention area.	3.9	$20,000
CA9891	Tripps Run	Anna Lee Traffic Island LID - A	Kenfig Dr	Depress area of traffic island and plant bioretention area.	3.5	$8,000
CA9893	Tripps Run	Sleepy Hollow Traffic Island LID - C	Crane Dr	Depress area of traffic island and plant bioretention area.	5.8	$86,000
CA9894	Tripps Run	Sleepy Hollow Traffic Island LID - B	Beechwood Lane	Depress area of traffic island and plant bioretention area.	2.8	$20,000
CA9895	Tripps Run	Sleepy Hollow Traffic Island LID - A	Ichabod Place	Depress area of traffic island and plant bioretention area.	1	$37,000
CA9896	Tripps Run	Sleepy Hollow Traffic Island LID - D	Quinch Pl	Depress area of traffic island and plant bioretention area.	6.4	$48,000
CA9898	Tripps Run	Mosby Post Office LID	Westlawn Shopping Center - Annandale Rd & RT 50	Bioretention areas along center of 4 parking rows, edge of lot parallel to Tripps Run, and in traffic island along Rt 50.	3.05	$90,000
CA9902	Tripps Run	Greenway Downs Subdivision LID	Greenway Blvd	Curbside bioretention areas.	20.19	$135,000

Project ID	Subwatershed	Project Name	Location	Proposed Action	Drainage Area (acres)	Estimated Cost
CA9903	Tripps Run	Devonshire Gardens Subdivision LID	Woodlawn Ave & Custis Pkwy	Bioretention areas in median between traffic lanes on Woodlawn Ave.	12.88	$90,000
CA9905	Tripps Run	Great Oak LID	Raymond Ct	Divert discharge to bermed bioretention area.	13.61	$15,000
CA9907	Tripps Run	George Mason Middle & High Schools LID	George Mason Middle & High Schools	Infiltration trenches in parking lots; linear and area bioretention areas in traffic islands; multi-sport artificial turf with underdrains and cisterns in center of track.	35.2	$748,000
CA9910	Holmes Run - Upper	Belvedere Subdivision LID	Pinewood Terrace and Lakewood Drive	Replace 4 inlets along road with tree box filters.	21.2	$76,000
CA9912	Holmes Run - Upper	Buckwood LID	Sleepy Hollow Rd & Fern La	Install off-line bioretention areas to capture end of pipe stormwater prior to entering the stream.	0.5	$29,000
CA9913	Holmes Run - Upper	Chanel Road LID	Chanel Rd & Elwood Dr.	Install off-line bioretention area to capture end of pipe stormwater prior to entering the stream.	4.9	$30,000
CA9915	Holmes Run - Upper	Columbia Pines Subdivision - Rose Ln LID	Rose Lane (south of Holmes Run) - Chapter 2 street	Construct off-line bioretention area at stormwater pipe outfall in Chapter 2 street	2.5	$52,000
CA9916	Holmes Run - Upper	Valley Brook Subdivision LID	Rose Lane (north of Holmes Run) - Chapter 2 street	Construct off-line bioretention areas in Chapter 2 street and a bioretention area at N side of corner of Slade Run and Rose Ln	9.7	$244,000
CA9920	Holmes Run - Upper	Mildred Drive LID - A	Elvira Ct & Mildred Dr	Install off-line bioretention area to capture end of pipe stormwater prior to entering the stream.	2.4	$125,000
CA9923	Holmes Run - Upper	Latter Day Saints - Parking Lot LID	Latter Day Saints, off Gallows Road	Install bioretention areas (linear and area) and infiltration trenches in parking lots.	4.7	$132,000
CA9924	Holmes Run - Upper	Mildred Drive LID - B	Mildred Dr & Elvira Ct	Install off-line bioretention areas to capture end of pipe stormwater prior to entering the stream.	14.2	$920,000
CA9926	Holmes Run - Upper	Round Tree Park LID - B	Vagabond Dr & Roundtree Rd	Install off-line bioretention areas to capture end of pipe stormwater and area bioretention areas at end of street.	16.1	$230,000
CA9928	Holmes Run - Upper	Raymondale LID - B	Brandy Court	Install linear bioretention areas in sidewalk median strips and replace two inlets with tree box filters.	2.5	$65,000
CA9930	Holmes Run - Upper	Raymondale LID - A	Roundtree Estates Court	Install linear bioretention areas in sidewalk median strips.	3.3	$24,000

Project ID	Subwatershed	Project Name	Location	Proposed Action	Drainage Area (acres)	Estimated Cost
CA9931	Holmes Run - Upper	Raymondale Sidewalk LID	Brandy Ct and St James Pl	Construct sidewalk bioretention areas along roads.	7	$419,000
CA9932	Holmes Run - Upper	Broyhill Park Subdivision LID - D	Broyhill Park Subdivision - Dye Dr and Marc Dr	Construct sidewalk bioretention areas along roads and in traffic island at Marc Dr/Graham Rd/Strathmore St.	5.27	$180,000
CA9933	Holmes Run - Upper	Broyhill Park Subdivision LID - B	Broyhill Park Subdivision - Nealon Dr	Construct sidewalk bioretention areas along roads.	9.1	$142,000
CA9934	Holmes Run - Upper	Broyhill Park Subdivision LID - C	Broyhill Park Subdivision - Norfolk Ln	Construct sidewalk bioretention areas along roads.	8	$374,000
CA9939	Holmes Run - Upper	Broyhill Park Subdivision LID - A	Broyhill Park Subdivision - Kenney Drive	Construct sidewalk bioretention areas along roads.	7.3	$75,000
CA9940	Holmes Run - Upper	Broyhill Park Subdivision LID - E	Parkwood Terrace	Construct sidewalk bioretention areas along roads.	4.97	$46,000
CA9948	Holmes Run - Upper	Loehmann's Plaza LID	Loehmann's Plaza, Arlington Blvd	Install infiltration trenches along parking rows and in alleys between buildings; add bioretention areas at front and rear of courtyard near County offices.	20.8	$158,000
CA9951	Holmes Run - Upper	Hollywood Road Park LID	Fairwood Ln & West St	Provide off-line bioretention at pipe outfall and a linear bioretention area along Hollywood Rd.	31.8	$222,000
CA9956	Holmes Run - Upper	Dunn Loring Post Office LID	Dunn Loring Post Office - Gallows Rd & Electric Av	Provide linear bioretention area along edge of parking lot by Electric Ave; infiltration trenches in W and E parking areas, and along N side of bldg.	0.3	$32,000
CA9963	Holmes Run - Upper	Walnut Hill Lane LID	Walnut Hill La & Annandale Rd	Replace inlets along road with tree box filters; filter strip and bioretention area N of traffic circle; revegetate open areas with shade trees and wildflowers.	24.2	$93,000

APPENDIX A-3

Tier 3 Projects

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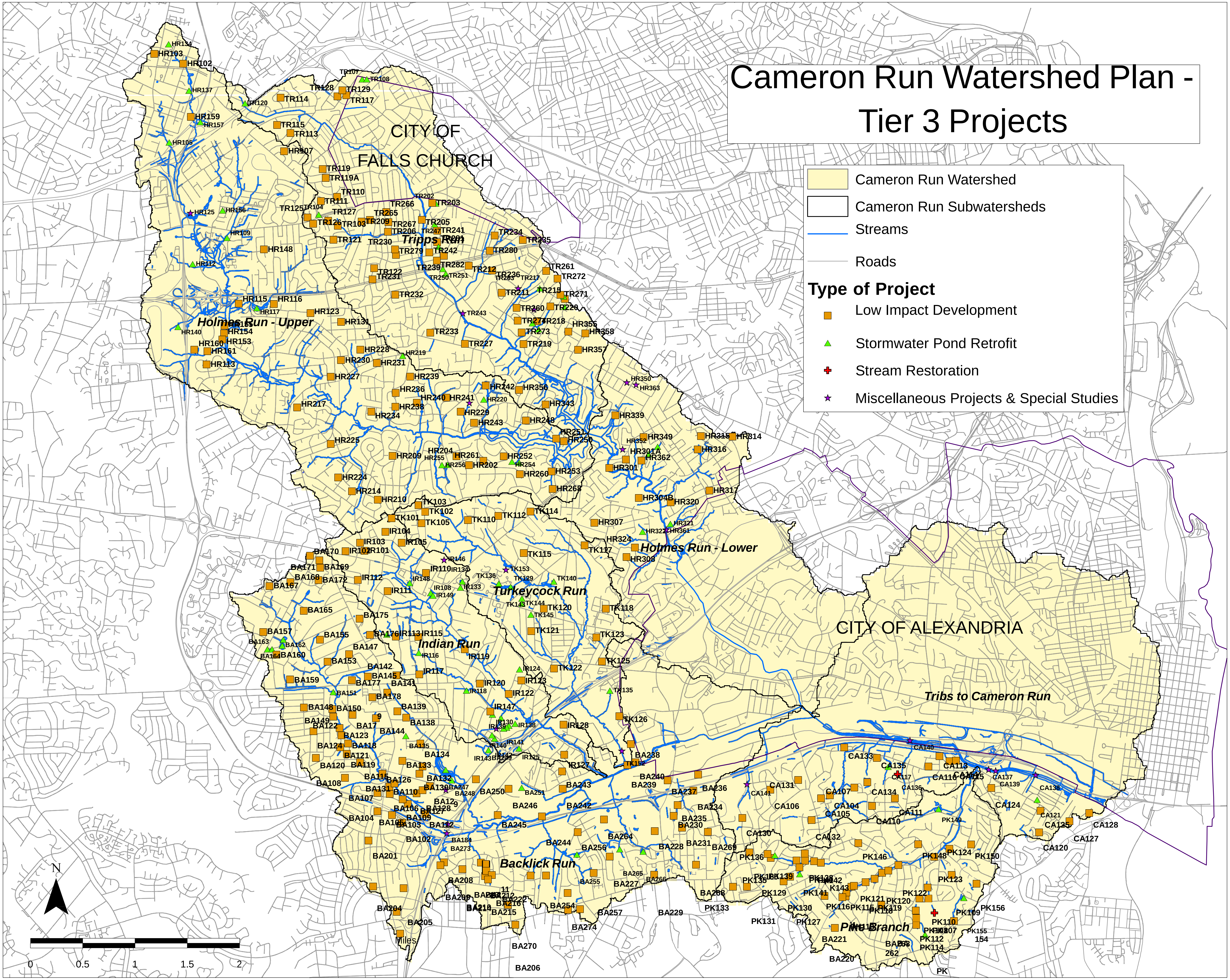

Cameron Run Watershed Plan - Tier 3 Projects
Cameron Run Watershed
Cameron Run Subwatersheds
Streams
Roads
Type of Project
Low Impact Development
Stormwater Pond Retrofit
Stream Restoration
Miscellaneous Projects & Special Studies
CITY OF FALLS CHURCH
CITY OF ALEXANDRIA
Holmes Run - Upper
Tripps Run
Holmes Run - Lower
Turkeycock Run
Indian Run
Tribs to Cameron Run
Backlick Run
Pike Branch
N
Miles
0 0.5 1 1.5 2

PK117

PK
10
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PK
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PK
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K1
03

PK101

Candidate Watershed Restoration Projects - Tier 3

Site ID	Project Type	Proposed Action
Backlick Run		
BA102	Low Impact Development	Curb Gardens, Rain Barrels
BA103	Low Impact Development	Tree Boxes
BA104	Low Impact Development	Rain Garden
BA105	Low Impact Development	End of Pipe Rain Garden
BA106	Low Impact Development	Filter Strips, Median Gardens or Dry Pond
BA107	Low Impact Development	Tree Boxes, End of Pipe Rain gardens, Filter Strips
BA108	Low Impact Development	Green Roof, Median Gardens, End of Pipe
BA109	Low Impact Development	End of Pipe Rain Garden
BA110	Low Impact Development	End of Pipe Rain Garden
BA112	Low Impact Development	Dry Pond
BA115	Low Impact Development	Curb Gardens, Rain Barrels
BA118	Low Impact Development	End of Pipe Rain Garden
BA119	Low Impact Development	Curbside rain gardens
BA120	Low Impact Development	Curbside rain gardens
BA121	Low Impact Development	End of Pipe Rain Garden
BA122	Low Impact Development	End of Pipe Rain Garden
BA123	Low Impact Development	End of Pipe Rain Garden
BA124	Low Impact Development	Curbside rain gardens
BA126	Low Impact Development	End of Pipe Rain Garden
BA127	Low Impact Development	Green Roof
BA128	Low Impact Development	Area Drain Inserts, Median Gardens
BA129	Low Impact Development	Filter/Infiltration Trench
BA130	Low Impact Development	Green Roof
BA131	Low Impact Development	End of Pipe Rain Garden
BA132	Low Impact Development	Median Gardens, Trenches
BA133	Low Impact Development	Green Roofs, Filter Trenches
BA134	Low Impact Development	Median Gardens, Rain Barrels
BA135	Stormwater Pond Retrofit	Dry Pond
BA138	Low Impact Development	Median Garden
BA139	Low Impact Development	Median Gardens, Filter Strips
BA141	Low Impact Development	Median Gardens
BA142	Low Impact Development	Infiltration Trench
BA144	Low Impact Development	End of Pipe Rain Garden
BA145	Low Impact Development	Median Gardens, Rain Gardens
BA147	Low Impact Development	Rain Gardens, Curb Gardens
BA148	Low Impact Development	Rain Barrels, Curb Gardens
BA149	Low Impact Development	End of Pipe Rain Garden
BA150	Low Impact Development	End of Pipe Rain Garden
BA151	Stormwater Pond Retrofit	Dry Pond
BA153	Low Impact Development	Rain Gardens
BA155	Low Impact Development	Rain Gardens, Rain Barrels
BA157	Low Impact Development	Parking Lot Rain Gardens
BA159	Low Impact Development	Rain Barrels, Curb Rain Gardens

Site ID	Project Type	Proposed Action
BA160	Low Impact Development	Rain Barrels, Curb Rain Gardens
BA161	Stormwater Pond Retrofit	SWM Pond Retrofits
BA162	Stormwater Pond Retrofit	SWM Pond Retrofits
BA163	Stormwater Pond Retrofit	SWM Pond Retrofits
BA164	Stormwater Pond Retrofit	SWM Pond Retrofits
BA165	Low Impact Development	Roof Drains to Rain Gardens; Curb Rain Gardens
BA167	Low Impact Development	Rain Barrels and Sidewalk Rain Gardens
BA168	Low Impact Development	Rain Barrels, Yard Drains to Rain Gardens, Curb Rain Gardens
BA169	Low Impact Development	Roof Drains to Rain Gardens; Curb Rain Gardens
BA170	Low Impact Development	Roof Drains to Rain Gardens; Curb Rain Gardens
BA171	Low Impact Development	Roof Drains to Rain Gardens; Curb Rain Gardens
BA172	Low Impact Development	Rain Barrels, Yard Drains to Rain Gardens, Curb Rain Gardens
BA175	Low Impact Development	Rain Barrels; Sidewalk, Curb and Yard Drain Rain Gardens
BA176	Low Impact Development	Rain Barrels; Sidewalk, Curb and Yard Drain Rain Gardens
BA177	Low Impact Development	Green Roof, Cistern, Rain Gardens
BA178	Low Impact Development	Rain Barrels; Sidewalk, Curb and Yard Drain Rain Gardens
BA179	Low Impact Development	Rain Barrels; Rain Gardens at End of Pipe and Downspout
BA182	Other	Implement Pollution Prevention Programs; Control Runoff of Toxics
BA184	Other	Provide Additional Control of Highway Runoff at I-495 and I-395
BA201	Low Impact Development	Curb Gardens, Rain Barrels, Rain Gardens
BA204	Low Impact Development	Rain Gardens
BA205	Low Impact Development	Filter Strips, Infiltration Trench
BA206	Low Impact Development	Info Car Dealer - Porous Pavement
BA208	Low Impact Development	Berm with Gardens
BA209	Low Impact Development	End of Pipe Rain Garden
BA210	Low Impact Development	Curb Gardens, Rain Barrels
BA211	Low Impact Development	Rain Garden
BA212	Low Impact Development	End of Pipe Rain Garden
BA213	Low Impact Development	End of Pipe Rain Garden
BA214	Low Impact Development	End of Pipe Rain Garden
BA215	Low Impact Development	End of Pipe Rain Garden
BA216	Low Impact Development	End of Pipe Rain Garden
BA220	Low Impact Development	Curb Gardens, Rain Barrels
BA221	Low Impact Development	Curb Gardens, Rain Barrels
BA222	Low Impact Development	End of Pipe Rain Garden
BA227	Low Impact Development	Rain Garden
BA228	Low Impact Development	Rain Gardens
BA229	Low Impact Development	Retrofit Detention into Cistern to Water Fields
BA230	Low Impact Development	Paved Ditch into Grass Swale
BA231	Low Impact Development	Rain Barrel, Rain Gardens
BA234	Low Impact Development	Berm with Gardens
BA235	Low Impact Development	End of Pipe Rain Garden
BA236	Low Impact Development	Infiltration Ditches
BA237	Low Impact Development	Porous Pavement
BA238	Low Impact Development	Green Roof

Site ID	Project Type	Proposed Action
BA239	Low Impact Development	Filter Strips
BA240	Low Impact Development	Filter Berms
BA242	Low Impact Development	Green Roof, Median Gardens, Berms
BA243	Low Impact Development	Curb Gardens, Rain Barrels
BA244	Low Impact Development	Detention/ Rain Garden
BA245	Low Impact Development	Detention/ Rain Garden
BA246	Low Impact Development	Green Roofs, Infiltration
BA247	Stormwater Pond Retrofit	SWM Pond retrofits
BA248	Stormwater Pond Retrofit	SWM Pond retrofits
BA249	Stormwater Pond Retrofit	SWM Pond retrofits
BA250	Low Impact Development	Green Roof: Downspout and Traffic Island/Curb Rain Gardens with Infiltration
BA251	Stormwater Pond Retrofit	SWM Pond retrofit
BA254	Low Impact Development	Rain barrels; Sidewalk Rain Gardens
BA255	Stormwater Pond Retrofit	SWM Pond Retrofit
BA256	Low Impact Development	Rain Barrels; Sidewalk and Curb Rain Gardens
BA257	Low Impact Development	Rain Barrels; Sidewalk and Curb Rain Gardens
BA262	Low Impact Development	Downspout, Curb, Median and Island Rain Gardens
BA263	Low Impact Development	Downspout, Curb, Median and Island Rain Gardens
BA264	Low Impact Development	Rain Barrels; Sidewalk and Curb Rain Gardens
BA265	Stormwater Pond Retrofit	SWM Pond Retrofit
BA266	Stormwater Pond Retrofit	SWM Pond Retrofit
BA268	Low Impact Development	Rain Barrels; Sidewalk and Curb Rain Gardens
BA269	Low Impact Development	Rain Barrels; Sidewalk and Curb Rain Gardens
BA270	Low Impact Development	Green Roof; Downspout, Curb, Median, and Island Rain Gardens
BA273	Other	Work with VDOT to Provide Additional SWM Controls for I395 and I495
BA274	Low Impact Development	Rain Barrels; Sidewalk and Curb Rain Gardens
Holmes Run - Lower		
HR201	Stormwater Pond Retrofit	End of pipe - 1-yr EDD or rain garden
HR202	Low Impact Development	Grass median, rain garden, rain barrels
HR204	Low Impact Development	Backyard retention/rain garden/barrels
HR209	Low Impact Development	Curbside rain gardens
HR210	Low Impact Development	Filter strips, contours, and rain gardens
HR214	Low Impact Development	Rain barrels/gardens, curb gardens
HR217	Low Impact Development	Tree boxes, rain barrels, curb gardens
HR219	Stormwater Pond Retrofit	Pond retrofit
HR220	Stormwater Pond Retrofit	Pond retrofit
HR224	Low Impact Development	Island gardens
HR225	Low Impact Development	Rain barrels, sidewalk and curb gardens
HR227	Low Impact Development	Rain barrels, sidewalk and curb gardens
HR228	Low Impact Development	Church parking lot retrofit, curb rain garden
HR229	Low Impact Development	Church parking lot retrofit, curb rain garden
HR230	Low Impact Development	Rain barrels, sidewalk and curb gardens
HR231	Low Impact Development	Rain barrels, sidewalk and curb gardens
HR234	Low Impact Development	Yard draining to rain garden with under drains, rain barrels, curb rain garden

Site ID	Project Type	Proposed Action
HR236	Low Impact Development	Sidewalk rain garden and rain barrels
HR238	Low Impact Development	Sidewalk and curb rain gardens
HR239	Low Impact Development	Sidewalk and curb rain gardens
HR240	Low Impact Development	Rain barrels, sidewalk, and curb gardens
HR241	Low Impact Development	Yard drains to rain garden with under drains; rain barrels; curb and sidewalk rain gardens
HR242	Low Impact Development	Yard drains to rain garden with under drains; rain barrels; curb and sidewalk rain gardens; paved ditches to linear rain garden with cells
HR243	Low Impact Development	Rain barrels, curb rain garden
HR246	Other	Purchase 10 acre Glavis property for conservation
HR248	Low Impact Development	Rain barrels, rain garden
HR250	Low Impact Development	Backyard rain garden
HR251	Low Impact Development	Berm backyards
HR252	Low Impact Development	Street grass swale rain gardens
HR253	Low Impact Development	End of pipe rain garden
HR254	Stormwater Pond Retrofit	End of pipe - 1-yr EDD or rain garden
HR255	Stormwater Pond Retrofit	End of pipe - 1-yr EDD or rain garden
HR256	Stormwater Pond Retrofit	End of pipe - 1-yr EDD or rain garden
HR260	Low Impact Development	Grass median, rain garden, rain barrels
HR261	Low Impact Development	Backyard retention/rain garden/barrels
HR268	Low Impact Development	End of pipe rain garden
HR301	Low Impact Development	Extended retrofit, green roof, tree boxes
HR301A	Low Impact Development	Rain garden
HR304B	Low Impact Development	Strip filter in parking lot
HR307	Low Impact Development	Tree boxes at storm drain inlets
HR308	Low Impact Development	End of pipe rain garden
HR311	Stormwater Pond Retrofit	Pond Retrofit
HR312	Stormwater Pond Retrofit	Retention before pipe
HR314	Low Impact Development	Rain garden
HR315	Low Impact Development	Swale gardens or rain barrels
HR316	Low Impact Development	Dry pond rain garden
HR317	Low Impact Development	Swale Rain gardens
HR320	Low Impact Development	Rain barrels/rain gardens
HR321	Stormwater Pond Retrofit	New dry pond
HR322	Stormwater Pond Retrofit	Redirect stream into dry pond
HR324	Low Impact Development	Rain barrels
HR339	Low Impact Development	End of pipe rain garden - bacteria sewer tracking
HR343	Low Impact Development	Rain barrels, rain garden
HR349	Low Impact Development	Downspout and parking lot rain garden
HR350	Other	Signage and outreach on hazardous waste collections, especially motor oil disposal
HR352	Other	Marshall property dump site - inspection clean up
HR355	Low Impact Development	Sidewalk rain garden, rain barrels, tree box filters
HR356	Low Impact Development	Rain barrels and rain gardens
HR357	Low Impact Development	Green roof or route drainage to park via: cistern to water fields and park; infiltration; 1-year EDD

Site ID	Project Type	Proposed Action
HR358	Low Impact Development	Parking lot retrofit with: infiltration trench and rain gardens; cistern for building
HR360	Stormwater Pond Retrofit	Pond retrofit
HR361	Other	Extend stream valley park and trail to close last gap between parks
HR362	Low Impact Development	Outfall rain garden
HR363	Other	Signage and outreach on hazardous waste collections, especially motor oil disposal
Holmes Run - Upper		
HR102	Low Impact Development	End of pipe rain garden
HR103	Low Impact Development	Parking lot retrofits
HR105	Stormwater Pond Retrofit	End of pipe/dry pond
HR107	Low Impact Development	Rain barrels/gardens
HR109	Stormwater Pond Retrofit	Dry pond - off to side of main stream
HR112	Stormwater Pond Retrofit	Side discharge pond
HR113	Low Impact Development	Tree boxes, rain barrels
HR115	Low Impact Development	Overflow stream retention
HR116	Low Impact Development	Dry pond/tree boxes
HR117	Stormwater Pond Retrofit	BMP retrofit to increase retention quantity
HR123	Low Impact Development	Retention
HR125	Other	Locate dump site and clean up; provide information on collections
HR131	Low Impact Development	Sidewalk strip retention/rain barrels
HR134	Stormwater Pond Retrofit	Pond retrofit
HR137	Stormwater Pond Retrofit	Pond retrofit
HR140	Stormwater Pond Retrofit	Pond retrofit
HR148	Low Impact Development	Sidewalk strip retention/rain barrels
HR153	Low Impact Development	End of pipe retention/rain garden
HR154	Low Impact Development	End of pipe retention/rain garden
HR155	Low Impact Development	End of pipe retention/rain garden
HR156	Stormwater Pond Retrofit	End of pipe/dry pond
HR157	Stormwater Pond Retrofit	End of pipe/dry pond
HR159	Low Impact Development	End of pipe rain garden
HR160	Low Impact Development	End of pipe retention/rain garden
HR161	Low Impact Development	End of pipe retention/rain garden
Indian Run		
IR101	Low Impact Development	Green Roof (K-Mart)
IR102	Low Impact Development	Green Roof (Giant)
IR103	Low Impact Development	Filter Strips, Island Gardens
IR104	Low Impact Development	Roof Retrofit, Cistern
IR105	Low Impact Development	Grass Swale, Rain Gardens, Rain Barrels
IR108	Stormwater Pond Retrofit	Detention Pond Upgrade
IR110	Low Impact Development	Rain Barrels, Rain Gardens
IR111	Low Impact Development	Rain Barrels, Rain Gardens
IR112	Low Impact Development	Curb Gardens, Rain Barrels, Tree Boxes
IR113	Low Impact Development	Pre Pipe Rain Garden
IR115	Low Impact Development	Rain Gardens, Rain Barrels
IR116	Stormwater Pond Retrofit	End of Pipe Retention

Site ID	Project Type	Proposed Action
IR117	Low Impact Development	Tree Boxes, Curb Gardens, Rain Barrels
IR118	Stormwater Pond Retrofit	End of Pipe Retention
IR119	Low Impact Development	Backyard Rain Gardens
IR120	Low Impact Development	Rain Gardens
IR122	Low Impact Development	End of Pipe Rain Garden
IR123	Low Impact Development	Curb Gardens, Rain Barrel
IR124	Stormwater Pond Retrofit	Retention Pond
IR125	Stormwater Pond Retrofit	SWM Pond Retrofit
IR127	Low Impact Development	Sidewalk Rain Gardens, Curb Rain Gardens, Rain Barrels
IR128	Low Impact Development	Sidewalk Rain Gardens, Curb Rain Gardens, Rain Barrels
IR130	Stormwater Pond Retrofit	Pond retrofits
IR133	Stormwater Pond Retrofit	SWM Pond Retrofit
IR134	Stormwater Pond Retrofit	SWM Pond Retrofit
IR135	Stormwater Pond Retrofit	SWM Pond Retrofit
IR137	Stormwater Pond Retrofit	SWM Pond Retrofit
IR138	Stormwater Pond Retrofit	SWM Pond Retrofit
IR139	Stormwater Pond Retrofit	SWM Pond Retrofit
IR140	Stormwater Pond Retrofit	SWM Pond Retrofit
IR141	Stormwater Pond Retrofit	SWM Pond Retrofit
IR142	Stormwater Pond Retrofit	SWM Pond Retrofit
IR143	Stormwater Pond Retrofit	SWM Pond Retrofit
IR145	Other	Investigate Status of Atlantic Research Site for Potential Pollution Source to Indian Run and Opportunities to Improve Water Quality from Site
IR146	Other	Review Dog Park Management for Opportunities to Improve Water Quality
IR147	Low Impact Development	Island Gardens, Curb Gardens
IR148	Stormwater Pond Retrofit	Retrofit
IR149	Stormwater Pond Retrofit	Detention Pond Upgrade
Pike Branch		
PK101	Low Impact Development	End of Pipe Rain Garden/Detention
PK102	Stream Restoration	Tree Planting
PK103	Stormwater Pond Retrofit	Dry Pond/Rain Gardens
PK104	Low Impact Development	End of Pipe Rain Gardens
PK105	Low Impact Development	End of Pipe Rain Gardens
PK106	Low Impact Development	End of Pipe Rain Gardens
PK107	Low Impact Development	End of Pipe Rain Gardens
PK108	Low Impact Development	Rain Garden
PK109	Low Impact Development	Curb Gardens/Rain Barrels
PK110	Low Impact Development	Property Berms
PK112	Low Impact Development	End of Pipe Trench
PK113	Low Impact Development	End of Pipe Trench
PK114	Low Impact Development	End of Pipe Trench
PK115	Low Impact Development	Tree Box
PK116	Low Impact Development	End of Pipe Trench
PK117	Low Impact Development	Tree Boxes, Rain Barrels, Rain Gardens, Curb Gardens
PK118	Low Impact Development	End of Pipe Rain Garden

Site ID	Project Type	Proposed Action
PK119	Low Impact Development	End of Pipe Rain Garden
PK120	Low Impact Development	End of Pipe Rain Garden
PK121	Low Impact Development	End of Pipe Rain Garden
PK122	Low Impact Development	End of Pipe Rain Garden
PK123	Low Impact Development	End of Pipe Rain Garden
PK124	Low Impact Development	End of Pipe Rain Garden
PK127	Low Impact Development	Rain barrels, Curb Garden, Tree Boxes
PK129	Low Impact Development	Rain barrels, Curb Garden, Tree Boxes
PK130	Low Impact Development	School - Rain Garden/Cistern - Water Fields, Median Garden, Filter Strips
PK131	Low Impact Development	Rain Gardens, Filter Strips
PK133	Low Impact Development	Rain Garden, Rain Barrels
PK135	Low Impact Development	End of Pipe - Rain Garden
PK136	Low Impact Development	Filter Strips
PK137	Stormwater Pond Retrofit	Pond
PK138	Low Impact Development	Rain Barrels, Curb Garden
PK139	Low Impact Development	End of Pipe Rain Garden
PK140	Low Impact Development	End of Pipe Rain Garden
PK141	Low Impact Development	End of Pipe Rain Garden
PK142	Low Impact Development	End of Pipe Rain Garden
PK143	Low Impact Development	End of Pipe Rain Garden
PK146	Low Impact Development	Rain Barrels/Rain Gardens
PK148	Low Impact Development	Curbside rain gardens
PK149	Stormwater Pond Retrofit	Retrofit Pond
PK150	Low Impact Development	Rain Gardens/Barrels, Storm Drain Stenciling
PK152	Stormwater Pond Retrofit	1-yr EDD
PK154	Low Impact Development	Curb Gardens/Rain Barrels
PK155	Stormwater Pond Retrofit	Off Line EDD
PK156	Low Impact Development	Green Roof: Downspout and Curb Rain Gardens
PK160	Low Impact Development	Green Roof: Downspout and Curb Rain Gardens
Tributaries to Cameron Run		
CA104	Low Impact Development	Grass Swale Infiltration Trench
CA105	Low Impact Development	Rain Garden
CA106	Low Impact Development	Rain Gardens, Curb Gardens, Rain Barrels
CA107	Low Impact Development	Rain Garden - End of Pipe
CA110	Low Impact Development	Curbside rain gardens
CA111	Low Impact Development	Rain Gardens, Curb Gardens, Rain Barrels
CA113	Low Impact Development	Rain Garden
CA114	Low Impact Development	Rain Garden
CA115	Low Impact Development	Rain Garden
CA116	Low Impact Development	Rain Gardens, Curb Gardens, Rain Barrels
CA117	Stormwater Pond Retrofit	Retrofit
CA120	Low Impact Development	Curb and End of Pipe, Rain Gardens
CA121	Stormwater Pond Retrofit	SWM Pond Retrofit
CA124	Low Impact Development	Downspout to Curb Rain Garden, Sidewalk Gardens
CA125	Low Impact Development	Downspout to Curb Rain Garden, Sidewalk Gardens

Site ID	Project Type	Proposed Action
CA127	Low Impact Development	Downspout and Curb Rain Garden
CA128	Low Impact Development	Downspout and Curb Rain Garden
CA130	Low Impact Development	Rain Barrels, Sidewalk and Curb Gardens, Tree Boxes
CA131	Low Impact Development	Rain Barrels, Sidewalk and Curb Gardens, Tree Boxes
CA132	Low Impact Development	Rain Barrels, Sidewalk and Curb Gardens, Tree Boxes
CA133	Low Impact Development	Rain Barrels, Sidewalk and Curb Gardens, Tree Boxes
CA134	Low Impact Development	Concrete v Ditches to Rain Gardens
CA135	Low Impact Development	Rain Barrels and Sidewalk Rain Gardens
CA136	Stream Restoration	Riprap Channel to Stepped Rain Garden
CA137	Other	Coordinate with Woodrow Wilson Bridge Project Consultants to Discuss and Mitigate Construction Impacts
CA138	Other	Integrate Recreational and Aesthetic Amenities into Ports along Mainstem Explore Redevelopment of Waterfront to Serve as Community Focal Point
CA139	Other	Provide Pedestrian Access to Stream; Connect to Eisenhower Ave. Across Stream
CA140	Other	Integrate Recreational and Aesthetic Amenities into Ports along Mainstem Explore Redevelopment of Waterfront to Serve as Community Focal Point
CA141	Other	Provide Access to Stream
Tripps Run		
TR103	Low Impact Development	BMP retrofit
TR104	Stormwater Pond Retrofit	BMP retrofit
TR107	Stormwater Pond Retrofit	BMP retrofit
TR108	Stormwater Pond Retrofit	BMP retrofit
TR110	Low Impact Development	Rain barrels, tree box filters, curb rain gardens
TR111	Low Impact Development	Downspout, traffic island, and curb rain gardens; infiltration trenches
TR113	Low Impact Development	Rain barrels, tree box filters
TR114	Low Impact Development	Rain barrels, tree box filters, curb rain gardens
TR115	Low Impact Development	Rain barrels, tree box filters
TR117	Low Impact Development	Downspout, traffic island, and curb rain gardens; infiltration trenches; porous pavers for car dealership
TR119	Low Impact Development	Tree boxes, sidewalk garden rain barrels
TR119A	Low Impact Development	Area drain rain garden
TR120	Stormwater Pond Retrofit	BMP retrofit
TR121	Low Impact Development	Rain barrels, curb gardens
TR122	Low Impact Development	Rain barrels, curb gardens
TR125	Low Impact Development	Downspout, traffic island, and curb rain gardens; infiltration trenches
TR126	Low Impact Development	Downspout, traffic island, and curb rain gardens; infiltration trenches
TR127	Low Impact Development	Downspout, traffic island, and curb rain gardens; infiltration trenches
TR128	Low Impact Development	Downspout, traffic island, and curb rain gardens; infiltration trenches
TR129	Low Impact Development	Downspout, traffic island, and curb rain gardens; infiltration trenches
TR202	Stormwater Pond Retrofit	1-yr EDD pond
TR203	Low Impact Development	Divert discharge in garden to bermed rain garden
TR205	Low Impact Development	Divert discharge in garden to bermed rain garden
TR206	Low Impact Development	End of pipe restriction with water retention in pipe. Include tree or sediment trap boxes to filter sediment
TR209	Low Impact Development	Tree boxes, rain gardens

Site ID	Project Type	Proposed Action
TR211	Low Impact Development	Curb & downspout rain gardens; rain barrels; street sweeping and inlet cleanout program; start community trash collectionevents; provide trash bins and education information
TR212	Low Impact Development	Roof gardens, infiltration trench, parking lot islands
TR215	Low Impact Development	Parking lot retrofit - trench along front of parking spaces to rain gardens, curb rain gardens, tree box filters
TR217	Stormwater Pond Retrofit	Stilling basin - retrofit to provide detention
TR218	Low Impact Development	Rain barrels, tree box filters, curb rain garden
TR219	Low Impact Development	Sink traffic island to rain garden, rain barrels, curb rain garden
TR220	Low Impact Development	Rain barrels, retrofit controls on concrete ditch, curb rain gardens
TR227	Low Impact Development	Rain barrels, tree box filters, and rain garden; or EDD in park for riprap ditch and concrete ditch
TR228	Stormwater Pond Retrofit	Yard drain to EDD
TR230	Low Impact Development	Tree box filters; rain barrels; sidewalk, curb and traffic island rain gardens
TR231	Low Impact Development	Parking lot retrofit with infiltration trench and rain garden at lot margin
TR232	Low Impact Development	Tree box filters; rain barrels; sidewalk, curb and traffic island rain gardens
TR233	Low Impact Development	Tree box filters; rain barrels; sidewalk, curb and traffic island rain gardens
TR234	Low Impact Development	Tree box filters
TR235	Low Impact Development	Parking lot retrofit: infiltration trench; rain gardens and cistern for building; traffic island rain gardens; roof gardens; and permeable pavers at car dealership
TR236	Low Impact Development	Curb & downspout rain gardens; rain barrels; street sweeping and inlet cleanout program; start community trash collectionevents; provide trash bins and education information
TR239	Low Impact Development	Porous pavement/blocks under car dealerships
TR241	Low Impact Development	Green roof, downspout rain garden, parking lot rain garden with infiltration trenches
TR242	Low Impact Development	Trash collection - street sweeping and inlet cleanout program; start community trash collection events; provide trash bins and education information
TR243	Other	Locate and clean up leaking, abandoned sewer line
TR246	Other	Investigate hazardous waste dumping; provide outreach and hazardous/municipal waste collection information; street sweeping and inlet cleanout program; start community trash collection events
TR247	Stormwater Pond Retrofit	Pond retrofit
TR249	Stormwater Pond Retrofit	Pond retrofit
TR250	Stormwater Pond Retrofit	Pond retrofit
TR251	Stormwater Pond Retrofit	Pond retrofit
TR253	Stormwater Pond Retrofit	Pond retrofit
TR260	Low Impact Development	Rain barrels; retrofit yard drains to rain gardens; curb and tree box rain gardens
TR261	Low Impact Development	Rain barrels; retrofit yard drains to rain gardens; curb and tree box rain gardens
TR263	Other	Facilitate neighborhood watch and environmental groups; volunteer and County monitoring of pollution, trash, and stream health
TR265	Low Impact Development	Tree boxes, rain gardens
TR266	Low Impact Development	Tree boxes, rain gardens
TR267	Low Impact Development	Tree boxes, rain gardens
TR271	Low Impact Development	Parking lot retrofit - trench along front of parking spaces to rain gardens, curb rain gardens, tree box filters

Site ID	Project Type	Proposed Action
TR272	Low Impact Development	Parking lot retrofit - trench along front of parking spaces to rain gardens, curb rain gardens, tree box filters
TR273	Low Impact Development	Rain barrels, tree box filters, curb rain garden
TR274	Low Impact Development	Rain barrels, tree box filters, curb rain garden
TR278	Stormwater Pond Retrofit	Yard drain to EDD
TR279	Low Impact Development	Tree box filters; rain barrels; sidewalk, curb and traffic island rain gardens
TR280	Low Impact Development	Parking lot retrofit: infiltration trench; rain gardens and cistern for building; traffic island rain gardens; roof gardens; and permeable pavers at car dealership
TR281	Low Impact Development	Green roof, downspout rain garden, parking lot rain garden with infiltration trenches
TR282	Low Impact Development	Green roof, downspout rain garden, parking lot rain garden with infiltration trenches
Turkeycock Run		
TK101	Low Impact Development	Rain Garden
TK102	Low Impact Development	Tree Boxes
TK103	Low Impact Development	Parking and Roof Retrofit Rain Garden
TK105	Low Impact Development	Tree Boxes, Rain Barrels
TK110	Low Impact Development	Rain Barrels, Curb Gardens, Tree Boxes
TK112	Low Impact Development	Rain Barrels, Curb Gardens, Tree Boxes
TK114	Low Impact Development	End of Pipe Rain Garden
TK115	Low Impact Development	Street Rain Gardens, Rain Barrels
TK117	Low Impact Development	Rain Gardens
TK118	Low Impact Development	Tree Boxes
TK120	Low Impact Development	Porous Pavers
TK121	Low Impact Development	Street Gardens, Rain Barrels
TK122	Low Impact Development	Street Gardens, Rain Barrels
TK123	Low Impact Development	Detention Ponds, Rain Barrels (End of Pipe & Median)
TK125	Low Impact Development	Roof Gardens, Cistern
TK126	Low Impact Development	Convert Concrete Swale into Grass Swale
TK129	Stormwater Pond Retrofit	Pond Retrofit
TK135	Stormwater Pond Retrofit	SWM Pond Retrofit
TK136	Stormwater Pond Retrofit	SWM Pond Retrofit
TK140	Stormwater Pond Retrofit	SWM Pond Retrofit
TK143	Stormwater Pond Retrofit	SWM Pond Retrofit
TK144	Stormwater Pond Retrofit	SWM Pond Retrofit
TK145	Stormwater Pond Retrofit	SWM Pond Retrofit
TK152	Other	Organize Stream Clean-up Program for Trash
TK153	Other	Pinecrest Park Golf Course - Pursue Audubon Certification; Provide Pet Waste Information and Clean-up Mitts

APPENDIX A-4

Project Fact Sheets for Selected Drainage Complaint Projects

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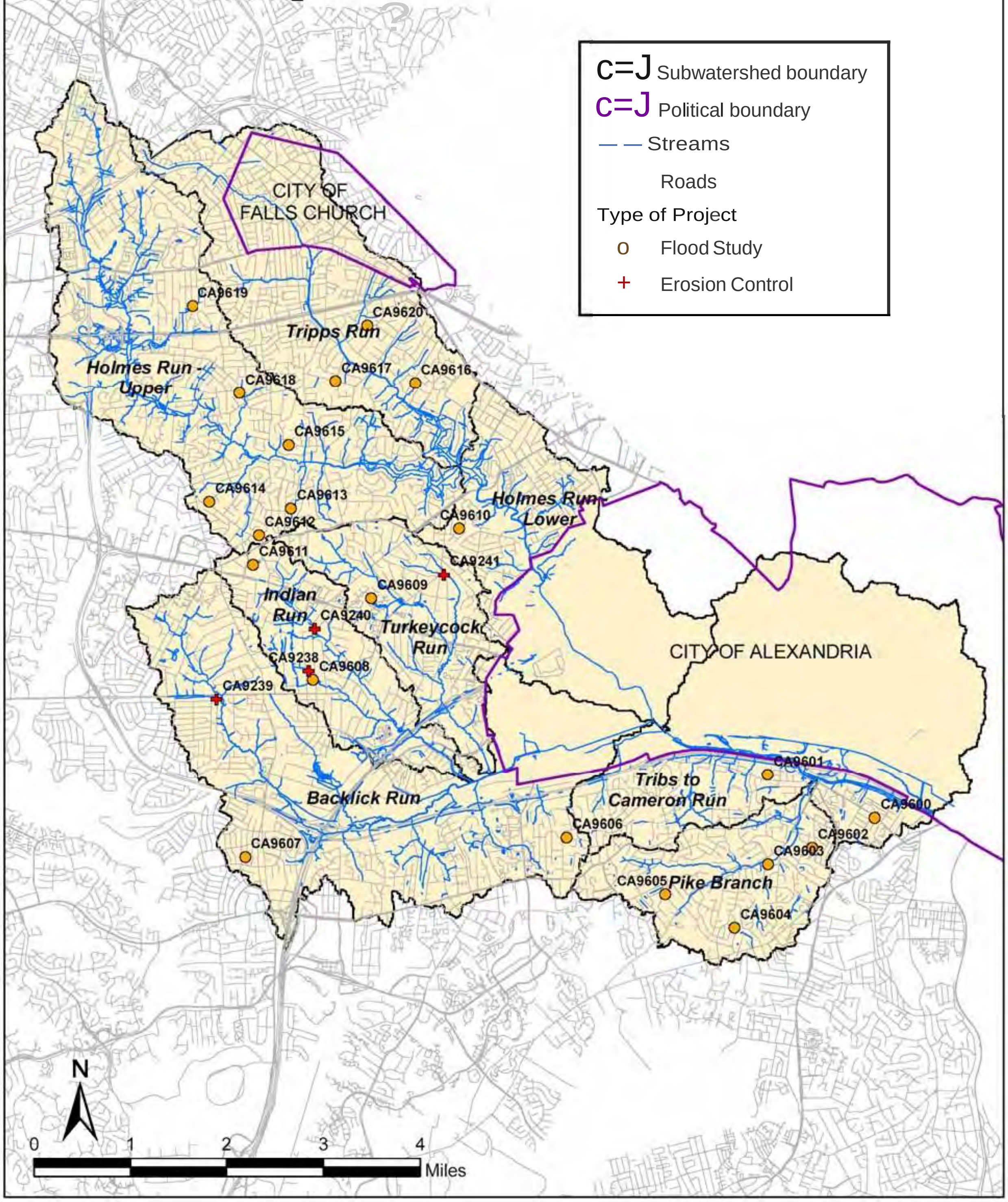
Cameron Run Watershed Plan
Group 1 Drainage Complaint Projects



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Indian Run Streambank Stabilization - B

Project ID: CA9238

Project Type: Erosion

Project Name: Indian Run Streambank Stabilization - B

Project Location: Montgomery Street

Subwatershed: Indian Run

Study Area acres

Parcel ID No.: 0714 10 0059

Project Location:

Proposed Action:

Restore natural stream channel morphology, stabilize banks, and enhance riparian buffer.

Proposed Project:

Benefits: Prevent property and structural loss.
Improve stream stability and instream habitat. Reduce erosion.
Improve floodplain and nutrient cycling functions.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Streambank Stabilization	325	LF	$80.00	$26,000
			Base Cost =	$26,000
			Mobilization (5%) =	$1,300
			Subtotal 1 =	$27,300
			Contingency (25%) =	$6,825
			Subtotal 2 =	$34,125
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$15,356
			Total =	$49,481
			Estimated Project Cost =	$50,000

Backlick Run Streambank Stabilization

Project ID: CA9239

Project Type: Erosion

Project Name: Backlick Run Streambank Stabilization

Project Location: Braddock Road

Subwatershed: Backlick Run

Study Area acres

Parcel ID No.: 0713 07 0030

Project Location:

Proposed Project:

Proposed Action:

Restore natural stream channel morphology, stabilize banks, and enhance riparian buffer.

Benefits: Prevent property and structural loss.
Improve stream stability and instream habitat. Reduce erosion.
Improve floodplain and nutrient cycling functions.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Streambank Stabilization	450	LF	$80.00	$36,000

Base Cost =	$36,000
Mobilization (5%) =	$1,800
Subtotal 1 =	$37,800
Contingency (25%) =	$9,450
Subtotal 2 =	$47,250
Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$21,263
Total =	$68,513
Estimated Project Cost =	$69,000

Indian Run Streambank Stabilization - A

Project ID: CA9240

Project Type: Erosion

Project Name: Indian Run Streambank Stabilization - A

Subwatershed: Indian Run

Project Location: Indian Run below Columbia Road

Study Area acres

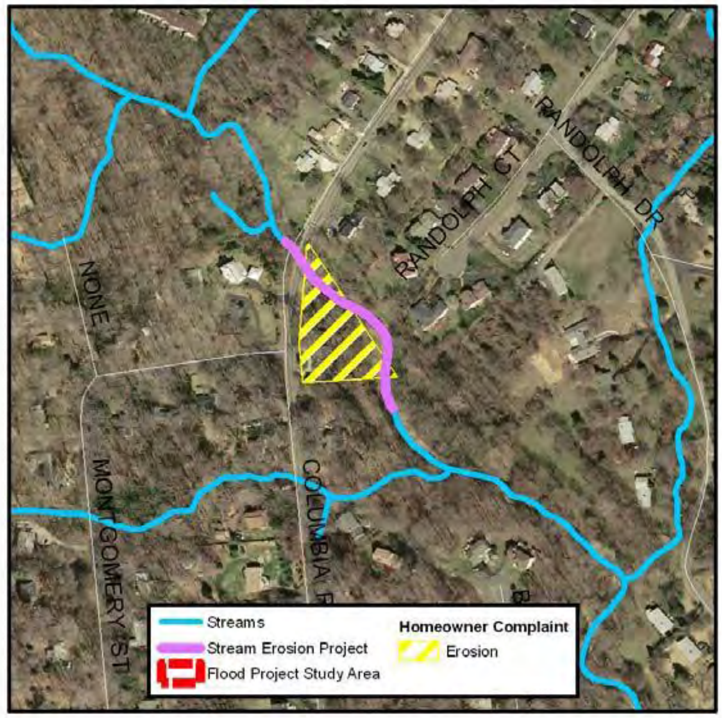
Parcel ID No.: 0712 08 0029A

Project Location:

Proposed Action:

Restore natural stream channel morphology, stabilize banks, and enhance riparian buffer.

Proposed Project:



Benefits: Prevent property and structural loss.
Improve stream stability and instream habitat. Reduce erosion.
Improve floodplain and nutrient cycling functions.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Streambank Stabilization	550	LF	$80.00	$44,000
			Base Cost =	$44,000
			Mobilization (5%) =	$2,200
			Subtotal 1 =	$46,200
			Contingency (25%) =	$11,550
			Subtotal 2 =	$57,750
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$25,988
			Total =	$83,738
			Estimated Project Cost =	$84,000

Turkeycock Run Stream Stabilization

Project ID: CA9241

Project Type: Erosion

Project Name: Turkeycock Run Stream Stabilization

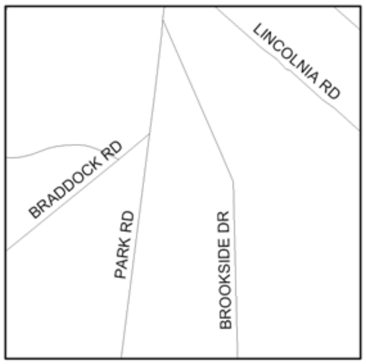
Subwatershed: Turkeycock Run

Project Location: Brookside Drive

Study Area acres

Parcel ID No.: 0721 06 0065B

Project Location:



Proposed Action:

Restore natural stream channel morphology, stabilize banks, and enhance riparian buffer.

Proposed Project:

Benefits: Prevent property and structural loss.
Improve stream stability and instream habitat. Reduce erosion.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Streambank Stabilization	200	LF	$200.00	$40,000
			Base Cost =	$40,000
			Mobilization (5%) =	$2,000
			Subtotal 1 =	$42,000
			Contingency (25%) =	$10,500
			Subtotal 2 =	$52,500
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (45%) =	$23,625
			Total =	$76,125
			Estimated Project Cost =	$77,000

Huntington Drainage Study

Project ID: CA9600

Project Type: Flooding

Project Name: Huntington Drainage Study

Subwatershed: Tributaries to Cameron Run

Project Location: Huntington Avenue

Study Area 53.22 acres

Parcel ID No.: 0831 10 0019A; 0831 10 0038A; 0831 10 0039B; 0831 12 0006A; 0831 14B 0058B; 0831 20 0003A; 0833 20 0015A; 0833 29 0010B

Project Location:

Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements. This drainage study is being completed as part of an on-going flood damage reduction study for the Huntington community (see Section 4.2.7.1).

Proposed Project:

Benefits:
Prevent property and structural loss.
Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$30,000.00	$30,000
			Base Cost =	$30,000
			Mobilization (0%) =	$0
			Subtotal 1 =	$30,000
			Contingency (25%) =	$7,500
			Subtotal 2 =	$37,500
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
			Total =	$37,500
			Estimated Project Cost =	$38,000

Burgundy Village Drainage Study

Project ID:	CA9601	**Project Type:**	Flooding
Project Name:	Burgundy Village Drainage Study	**Subwatershed:**	Tributaries to Cameron Run
Project Location:	Elmwood Drive	**Study Area**	38.14 acres
Parcel ID No.:	0822 03A 0003; 0822 03B 0005; 0822 13 0147; 0822 13 0166; 0822 13 0194		

Project Location:

Proposed Project:

Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house, yard, and road flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.

Benefits: Prevent property and structural loss.
Reduce road flooding.
Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$30,000.00	$30,000
			Base Cost =	$30,000
			Mobilization (0%) =	$0
			Subtotal 1 =	$30,000
			Contingency (25%) =	$7,500
			Subtotal 2 =	$37,500
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
			Total =	$37,500
			Estimated Project Cost =	$38,000

Jefferson Garden & Wilton Hall Drainage Study

Project ID:	CA9602	**Project Type:**	Flooding
Project Name:	Jefferson Garden & Wilton Hall Drainage Study	**Subwatershed:**	Pike Branch
Project Location:	Fairhaven Avenue; Madison Hill Court	**Study Area**	47.96 acres
Parcel ID No.:	0824 30 0011; 0824 30 0017; 0833 02020003A; 0833 02020011A; 0833 02070019B; 0833 024B0030A		

Project Location:

Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements. Improvements to the curb and gutter system have been initiated in this area since the analysis was performed, and evaluation of their effectiveness and the need for any additional improvements should be considered during the recommended drainage study.

Benefits: Prevent property and structural loss.
Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Proposed Project:

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$30,000.00	$30,000
			Base Cost =	$30,000
			Mobilization (0%) =	$0
			Subtotal 1 =	$30,000
			Contingency (25%) =	$7,500
			Subtotal 2 =	$37,500
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
			Total =	$37,500
			Estimated Project Cost =	$38,000

Wilton Woods & Millwood Estates Drainage Study

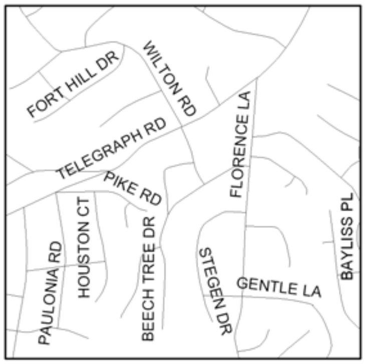
Project ID: CA9603 **Project Type:** Flooding

Project Name: Wilton Woods & Millwood Estates Drainage Stud **Subwatershed:** Pike Branch

Project Location: Wilton Road; Beach Tree Drive **Study Area** 99.56 acres

Parcel ID No.: 0824 01 0027; 0824 06 0017; 0824 07 0015; 0824 07 0016; 0824 07 0018; 0824 12 0012; 0824 35 0009; 0824 35 0014; 0824 35 0015; 0824 36 0010; 0824 36 0082; 0824 40 0007A

Project Location:



Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.

Proposed Project:

Benefits:
Prevent property and structural loss.
Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$45,000.00	$45,000
			Base Cost =	$45,000
			Mobilization (0%) =	$0
			Subtotal 1 =	$45,000
			Contingency (25%) =	$11,250
			Subtotal 2 =	$56,250
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
			Total =	$56,250
			Estimated Project Cost =	$57,000

Virginia Hills Drainage Study

Project ID: CA9604

Project Type: Flooding

Project Name: Virginia Hills Drainage Study

Subwatershed: Pike Branch

Project Location: Berkshire Drive

Study Area 131.9 acres

Parcel ID No.: 0824 14010051; 0824 14070029; 0824 14160010; 0824 14170010; 0922 02010034; 0922 02010039; 0922 02010041; 0922 02070024; 0922 05 0501; 0922 06 0005; 0922 22 0020; 0922 23 0008; 0922 24 0083

Project Location:

Proposed Project:

Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.

Benefits: Prevent property and structural loss.
Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Estimated Project Cost:

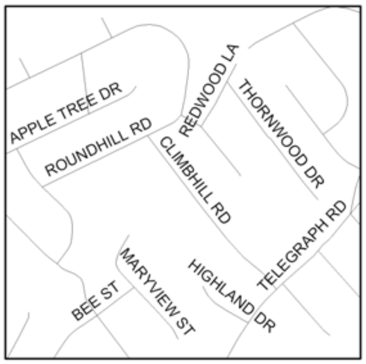
ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$45,000.00	$45,000
			Base Cost =	$45,000
			Mobilization (0%) =	$0
			Subtotal 1 =	$45,000
			Contingency (25%) =	$11,250
			Subtotal 2 =	$56,250
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
			Total =	$56,250
			Estimated Project Cost =	$57,000

Rose Hill Drainage Study

Project ID:	CA9605	**Project Type:**	Flooding
Project Name:	Rose Hill Drainage Study	**Subwatershed:**	Pike Branch
Project Location:	Roundhill Road	**Study Area**	28.47 acres

Parcel ID No.: 0823 13 0071; 0823 13 0112; 0823 13 0141; 0823 13 0172; 0823 25 0008

Project Location:



Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements. Additional complaints have been received from this area since the analysis was performed and all complaints will be considered during the detailed drainage study recommended for this area.

Proposed Project:

Benefits: Prevent property and structural loss.
Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$30,000.00	$30,000
			Base Cost =	$30,000
			Mobilization (0%) =	$0
			Subtotal 1 =	$30,000
			Contingency (25%) =	$7,500
			Subtotal 2 =	$37,500
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
			Total =	$37,500
			Estimated Project Cost =	$38,000

Brookland Estates Drainage Study

Project ID: CA9606

Project Type: Flooding

Project Name: Brookland Estates Drainage Study

Subwatershed: Backlick Run

Project Location: Brookland Road

Study Area 56.02 acres

Parcel ID No.: 0812 06080022; 0812 07 0127; 0814 01 0090; 0814 01 0090B; 0814 07 0048; 0814 18 0011; 0814 20 0114; 0814 20 0119

Project Location:

Proposed Project:

Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.

Benefits: Prevent property and structural loss.
Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$30,000.00	$30,000

Base Cost = $30,000

Mobilization (0%) = $0

Subtotal 1 = $30,000

Contingency (25%) = $7,500

Subtotal 2 = $37,500

Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) = $0

Total = $37,500

Estimated Project Cost = $38,000

Crestwood Drainage Study

Project ID: CA9607 **Project Type:** Flooding

Project Name: Crestwood Drainage Study **Subwatershed:** Backlick Run

Project Location: Floyd Avenue **Study Area** 51.25 acres

Parcel ID No.: 0803 02050006; 0803 02050012; 0803 02190002; 0803 02200014; 0803 03110014; 0804 04020020

Project Location:

Proposed Project:

Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements. Possible cross-connections between the storm drainage network and sanitary sewer system have also been reported for this area, and should be investigated as part of the recommended drainage study.

Benefits:
Prevent property and structural loss.
Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$30,000.00	$30,000
			Base Cost =	$30,000
			Mobilization (0%) =	$0
			Subtotal 1 =	$30,000
			Contingency (25%) =	$7,500
			Subtotal 2 =	$37,500
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
			Total =	$37,500
			Estimated Project Cost =	$38,000

Braddock Hills Drainage Study

Project ID:	CA9608	**Project Type:**	Flooding
Project Name:	Braddock Hills Drainage Study	**Subwatershed:**	Indian Run
Project Location:	Dodson Drive	**Study Area**	93.2 acres

Parcel ID No.: 0714 06 A; 0714 06 0003A; 0714 09 0006; 0714 09 0030; 0714 10 0011; 0714 13 0017; 0714 13 0064; 0714 15 0005

Project Location:

Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house, yard, and road flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.

Proposed Project:

Benefits:
Prevent property and structural loss.
Reduce road flooding.
Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$45,000.00	$45,000
			Base Cost =	$45,000
			Mobilization (0%) =	$0
			Subtotal 1 =	$45,000
			Contingency (25%) =	$11,250
			Subtotal 2 =	$56,250
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
			Total =	$56,250
			Estimated Project Cost =	$57,000

Pinecrest Drainage Study

Project ID:	CA9609	**Project Type:**	Flooding
Project Name:	Pinecrest Drainage Study	**Subwatershed:**	Turkeycock Run
Project Location:	Pinecrest Vista Drive	**Study Area**	22.93 acres
Parcel ID No.:	0712 34060053; 0712 34090047; 0721 26020001; 0721 26020027; 0721 26090035		

Project Location:

Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house, yard, and road flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.

Proposed Project:

Benefits:
- Prevent property and structural loss.
- Reduce road flooding.
- Improve stormwater quantity controls.
- Improve stormwater quality controls.
- Opportunity for public education.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$30,000.00	$30,000
			Base Cost =	$30,000
			Mobilization (0%) =	$0
			Subtotal 1 =	$30,000
			Contingency (25%) =	$7,500
			Subtotal 2 =	$37,500
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
			Total =	$37,500
			Estimated Project Cost =	$38,000

Parklawn Drainage Study

Project ID:	CA9610	**Project Type:**	Flooding
Project Name:	Parklawn Drainage Study	**Subwatershed:**	Holmes Run - Lower
Project Location:	Arcadia Road	**Study Area**	17.27 acres
Parcel ID No.:	0613 07B 0001; 0613 07C 0010; 0613 16 0001		

Project Location:

Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.

Proposed Project:

Benefits: Prevent property and structural loss.
Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$15,000.00	$15,000
			Base Cost =	$15,000
			Mobilization (0%) =	$0
			Subtotal 1 =	$15,000
			Contingency (25%) =	$3,750
			Subtotal 2 =	$18,750
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
			Total =	$18,750
			Estimated Project Cost =	$19,000

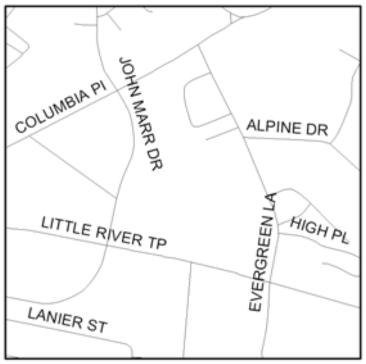
Evergreen Heights Drainage Study

Project ID: CA9611
Project Type: Flooding

Project Name: Evergreen Heights Drainage Study
Subwatershed: Indian Run
Project Location: John Marr Drive
Study Area 44.19 acres

Parcel ID No.: 0711 01 0096; 0711 01 0110; 0712 02 0030; 0712 02 0034

Project Location:



Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.

Proposed Project:

Benefits: Prevent property and structural loss.
Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Estimated Project Cost:

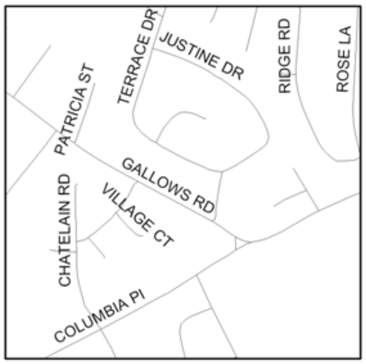
ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$30,000.00	$30,000
			Base Cost =	$30,000
			Mobilization (0%) =	$0
			Subtotal 1 =	$30,000
			Contingency (25%) =	$7,500
			Subtotal 2 =	$37,500
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
			Total =	$37,500
			Estimated Project Cost =	$38,000

Webbwood Drainage Study

Project ID:	CA9612	**Project Type:**	Flooding
Project Name:	Webbwood Drainage Study	**Subwatershed:**	Holmes Run - Upper
Project Location:	Columbia Pike	**Study Area**	19.23 acres

Parcel ID No.: 0603 17 0010R; 0603 18 0052; 0604 04B 0001; 0604 04C 0001; 0604 06 0001; 0604 07 0118

Project Location:



Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.

Proposed Project:

Benefits: Prevent property and structural loss.
Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$15,000.00	$15,000
			Base Cost =	$15,000
			Mobilization (0%) =	$0
			Subtotal 1 =	$15,000
			Contingency (25%) =	$3,750
			Subtotal 2 =	$18,750
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
			Total =	$18,750
			Estimated Project Cost =	$19,000

Sleepy Hollow Woods Drainage Study

Project ID: CA9613 **Project Type:** Flooding

Project Name: Sleepy Hollow Woods Drainage Study **Subwatershed:** Holmes Run - Upper

Project Location: Murray Lane **Study Area** 32.19 acres

Parcel ID No.: 0604 04B 0008; 0604 16E 0003; 0604 16F 0018; 0604 16L 0012

Project Location:

Proposed Project:

Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.

Benefits: Prevent property and structural loss.
Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$30,000.00	$30,000
			Base Cost =	$30,000
			Mobilization (0%) =	$0
			Subtotal 1 =	$30,000
			Contingency (25%) =	$7,500
			Subtotal 2 =	$37,500
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
			Total =	$37,500
			Estimated Project Cost =	$38,000

Kenwood Drainage Study

Project ID: CA9614

Project Type: Flooding

Project Name: Kenwood Drainage Study

Subwatershed: Holmes Run - Upper

Project Location: Gallows Road

Study Area 43.13 acres

Parcel ID No.: 0603 23 0002; 0603 27 0003; 0603 28 0017; 0603 28 0037; 0603 28 0042; 0603 28 0072; 0603 28 0073; 0603 34 0001

Project Location:

Proposed Project:

Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.

Benefits:
Prevent property and structural loss.
Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$30,000.00	$30,000
			Base Cost =	$30,000
			Mobilization (0%) =	$0
			Subtotal 1 =	$30,000
			Contingency (25%) =	$7,500
			Subtotal 2 =	$37,500
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
			Total =	$37,500
			Estimated Project Cost =	$38,000

Valley Brook Drainage Study

Project ID:	CA9615	**Project Type:**	Flooding
Project Name:	Valley Brook Drainage Study	**Subwatershed:**	Holmes Run - Upper
Project Location:	Slade Run Drive	**Study Area**	19.17 acres
Parcel ID No.:	0602 30 C1; 0602 30 0019; 0602 30 0020; 0602 30 0031; 0602 30 0056; 0602 30 0057; 0602 30 0062		

Project Location:

Proposed Project:

Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.

Benefits: Prevent property and structural loss.
Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$15,000.00	$15,000
			Base Cost =	$15,000
			Mobilization (0%) =	$0
			Subtotal 1 =	$15,000
			Contingency (25%) =	$3,750
			Subtotal 2 =	$18,750
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
			Total =	$18,750
			Estimated Project Cost =	$19,000

Ravenwood Drainage Study

Project ID:	CA9616	**Project Type:**	Flooding
Project Name:	Ravenwood Drainage Study	**Subwatershed:**	Tripps Run
Project Location:	Potterton Drive	**Study Area**	44.64 acres
Parcel ID No.:	0513 23 0088; 0611 03 0053A; 0611 03 0064; 0611 04 0075A; 0611 11 1052		

Project Location:

Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.

Proposed Project:

Benefits: Prevent property and structural loss.
Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$30,000.00	$30,000
			Base Cost =	$30,000
			Mobilization (0%) =	$0
			Subtotal 1 =	$30,000
			Contingency (25%) =	$7,500
			Subtotal 2 =	$37,500
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
			Total =	$37,500
			Estimated Project Cost =	$38,000

Marlo Heights Drainage Study

Project ID:	CA9617	**Project Type:**	Flooding
Project Name:	Marlo Heights Drainage Study	**Subwatershed:**	Tripps Run
Project Location:	Kerns Road	**Study Area**	67.32 acres

Parcel ID No.: 0504 20 0176; 0504 20 0158; 0602 13 0016; 0504 20 0160; 0504 20 0163; 0602 15 0079; 0602 12 0001; 0504 20 0162; 0504 20 0155; 0602 37 0037; 0602 40 0005

Project Location:

Proposed Project:

Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.

Benefits: Prevent property and structural loss.
Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$30,000.00	$30,000
			Base Cost =	$30,000
			Mobilization (0%) =	$0
			Subtotal 1 =	$30,000
			Contingency (25%) =	$7,500
			Subtotal 2 =	$37,500
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
			Total =	$37,500
			Estimated Project Cost =	$38,000

Anna Lee Heights Drainage Study

Project ID: CA9618

Project Type: Flooding

Project Name: Anna Lee Heights Drainage Study

Subwatershed: Holmes Run - Upper

Project Location: Graham Road

Study Area 11.93 acres

Parcel ID No.: 0601 11 0005; 0601 20 0010; 0601 11 0016

Project Location:

Proposed Project:

Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.

Benefits: Prevent property and structural loss.
Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$15,000.00	$15,000
			Base Cost =	$15,000
			Mobilization (0%) =	$0
			Subtotal 1 =	$15,000
			Contingency (25%) =	$3,750
			Subtotal 2 =	$18,750
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
			Total =	$18,750
			Estimated Project Cost =	$19,000

Fenwick Park Drainage Study

Project ID: CA9619

Project Type: Flooding

Project Name: Fenwick Park Drainage Study

Subwatershed: Holmes Run - Upper

Project Location: Elmwood Drive

Study Area 56.19 acres

Parcel ID No.: 0503 09 0198; 0503 15 0060; 0503 15 0067; 0503 15 0080; 0503 15 0108; 0503 15 0122; 0503 15 0133; 0503 15 0160; 0503 15 0161; 0503 15 0176; 0503 15 0187; 0503 17 0081

Project Location:

Proposed Project:

Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.

Benefits: Prevent property and structural loss.
Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$30,000.00	$30,000
			Base Cost =	$30,000
			Mobilization (0%) =	$0
			Subtotal 1 =	$30,000
			Contingency (25%) =	$7,500
			Subtotal 2 =	$37,500
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
			Total =	$37,500
			Estimated Project Cost =	$38,000

Sleepy Hollow Drainage Study

Project ID: CA9620

Project Type: Flooding

Project Name: Sleepy Hollow Drainage Study

Project Location: Beechwood Land; Quincy Place

Subwatershed: Tripps Run

Study Area 30.54 acres

Parcel ID No.: 0504 23 0061; 0504 21 0029; 0513 07 0015; 0504 21 0043; 0513 06 0007; 0513 06 0008

Project Location:

Proposed Action:

Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.

Proposed Project:

Benefits:
Prevent property and structural loss.
Improve stormwater quantity controls.
Improve stormwater quality controls.
Opportunity for public education.

Estimated Project Cost:

ITEM	QUANTITY	UNITS	UNIT COST	TOTAL
Neighborhood Drainage Improvement Study	1	EA	$30,000.00	$30,000
			Base Cost =	$30,000
			Mobilization (0%) =	$0
			Subtotal 1 =	$30,000
			Contingency (25%) =	$7,500
			Subtotal 2 =	$37,500
			Engineering Design, Surveys, Land Acquisition, Utility Relocation, and Permits (0%) =	$0
			Total =	$37,500
			Estimated Project Cost =	$38,000

APPENDIX B

MODELING REPORT:
CAMERON RUN WATERSHED PLAN

Prepared for

Fairfax County
Stormwater Planning Division
Department of Public Works
and Environmental Services

Prepared by

Versar, Inc.

In association with

WEST Consultants, Inc.

March 2007

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1.0 SWMM-RUNOFF MODEL DEVELOPMENT

1.1 INTRODUCTION

This section documents the procedures used to develop the SWMM-RUNOFF model of the Cameron Run watershed. The SWMM-RUNOFF model simulates the watershed runoff produced by rainfall. Groundwater routines included in the model are used to simulate stream baseflow. The SWMM-RUNOFF model is also used to simulate nonpoint washoff by storm runoff as well as baseflow water quality. SWMM-RUNOFF model simulations produce time histories of flow and pollutant loads. These data files are transferred to SWMM-TRANSPORT model(s) to simulate instream water quality impacts. Ultimately, SWMM-TRANSPORT and HEC-RAS are applied to simulate conditions in the streams in response to the simulated flows and loads calculated by SWMM-RUNOFF.

The procedures used to delineate the subbasin (catchment) boundaries and to develop data on the subbasins for input to the models are described in the following sections. These procedures are based on the guidelines and recommendations contained in CDM's Technical Memorandum No. 3 – Stormwater Model and GIS Interface Guidelines (TM3) (CDM 2003).

As a result of the stormwater control regulations that have been in place in Fairfax County over the years, there are hundreds of stormwater control facilities (primarily wet ponds and dry ponds) throughout the Cameron Run study area. For a watershed planning study, it is not feasible to collect design information and simulate each of these stormwater facilities individually. For this reason, the selected approach is to model a composite stormwater control for each subbasin to approximate the effects of multiple facilities on stormwater quantity and quality.

As described in TM3 (CDM 2003) Fairfax County assigned portions of the watershed areas in the county to one of the following subarea categories based on the type of stormwater controls (these parcel areas were provided to Versar as GIS files):

A. Parcels developed after 1972 are assumed to be served by stormwater detention control facilities that control the peak flows from the upstream developed area.

B. Parcels that were developed after 1993 are assumed to have peak flow control and water quality stormwater control facilities.

C. Parcels developed prior to 1972 are assumed to have no stormwater controls.

Portions of the cities of Falls Church, Alexandria, and Arlington are included in the Cameron Run watershed. Stormwater facilities data for these cities are not available. The SWMM-RUNOFF model set up assumes that these areas have no stormwater controls.

1.2 SUBBASIN DELINEATION

To simulate runoff, the watershed is subdivided into subbasins ranging from 100 to 300 acres. The first step in the model setup was the subbasin delineation. Fairfax County Stormwater Planning Division provided digital elevation data in DEM format with a grid size of 30 feet by 30 feet. A DEM format consists of a uniform grid of elevation data that covers the watershed. The data were obtained by processing data for a detailed elevation model including elevation points and breaklines developed as part of the County topographic mapping project. Portions of the watershed outside of Fairfax County were delineated using DEM data from the cities of Falls Church, Alexandria, and Arlington.

Generalized procedures are available to develop subbasin boundaries from digital elevation data in DEM format. These procedures require that the DEM data be further processed before the subbasins can be defined. Much of this processing was performed by the County as described below. The County had preprocessed these data to "burn" in the major stream network using the Fairfax Hydrograph Dataset Stream layer. The County had also used generic routines to identify and "fill" low spots within the grid. Generic flow-direction and flow-accumulation grids were also generated. The flow-direction grid defines the direction in which flow will leave the grid cell based on the elevation in the grid cell and elevations of surrounding grid cells. The flow-accumulation grid identifies the number of grid cells located upstream from each grid cell.

ArcView Version 3 (PrePRO) scripts were obtained from Dodson & Associates, Inc. These tools were used to develop the subbasin boundaries. The PrePRO tools define subbasin areas located above outlet points. Initially, automated tools were used to develop watershed outlet points for the subbasins. The outlet point locations were edited and additional points were added to represent the locations of Fairview Lake, Lake Barcroft, and the USGS gaging station on Cameron Run in Alexandria, VA. The automatically generated subbasins were compared with the GIS layer of stormwater facilities (STORMNET) provided by the County. This GIS layer provides an accurate mapping of stormwater facilities, including stormwater pipes, in the Cameron Run watershed. The subbasin boundaries were examined for situations where the constructed storm drainage network caused the subbasin boundaries to be significantly different from that generated from the DEM data; no significant adjustments were needed based on this analysis.

The delineation processes resulted in 155 subbasins. The total area in the final watershed is 44.39 square miles of which an area of 33.9 square miles is upstream of the USGS gage and is included in the model. The subbasins range from 99 to 289 acres and average 183.3 acres; subbasins are grouped by the major tributaries into subwatersheds (e.g., Tripps Run). The final subbasin boundaries are shown in Figure 1-1. A GIS layer will be provided to the County with the drainage boundaries including data such as area in acres, slope, and width (this includes subbasins in portions of Alexandria, Falls Church, and Arlington).

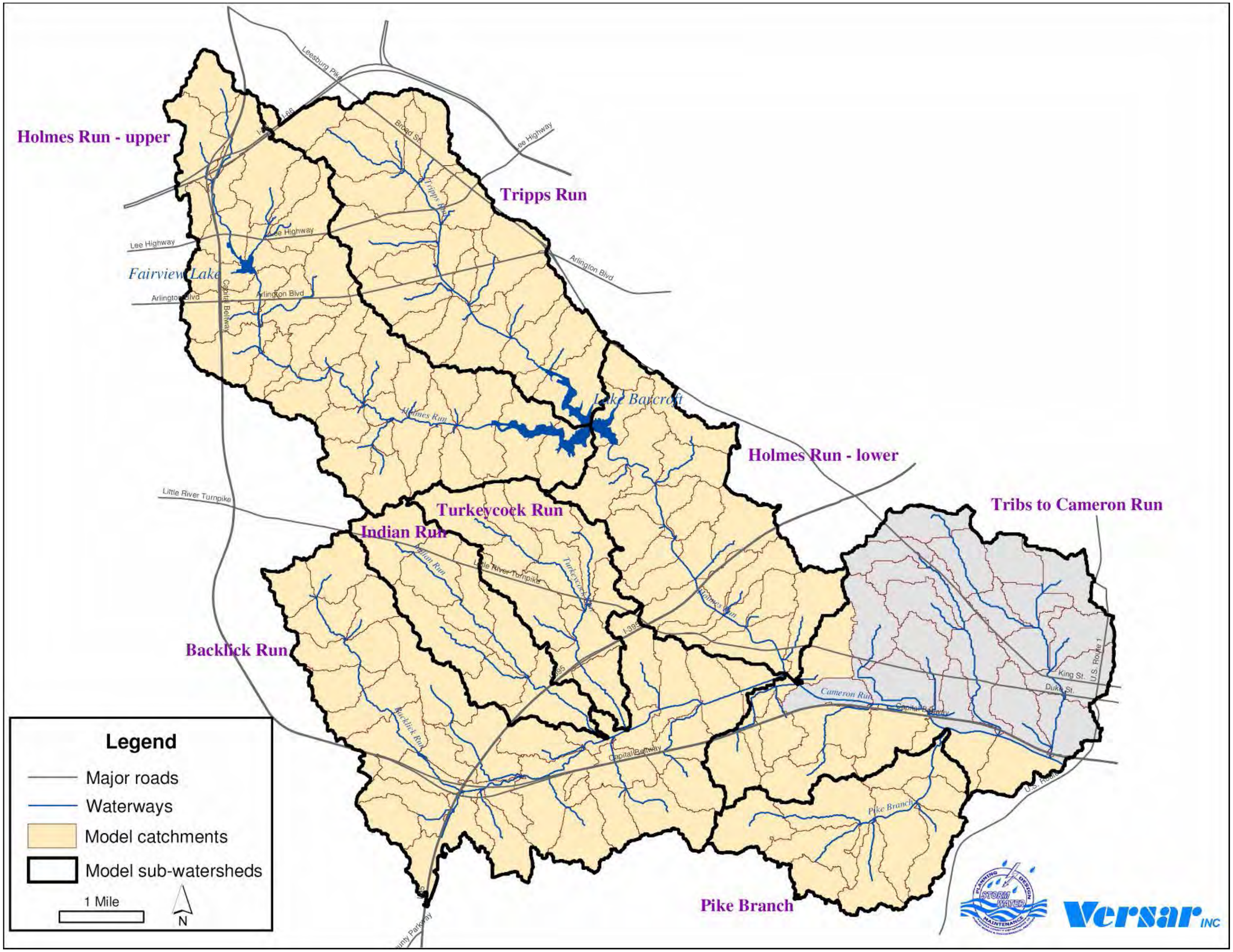

Figure 1-1. Cameron Run subwatershed and subbasin delineation

1.3 SUBBASIN IDENTIFIERS

Subbasin identifiers were generated based on recommendations in the TM3. The identifiers include three parts:

- A two-character watershed name. CA for subbasins in the Cameron Run watershed.
- A two-character subwatershed or stream tributary identifier. These are the stream names developed for the Stream Physical Assessment Study. Named streams in the Cameron Run watershed are identified below:
  - BA (Backlick Run)
  - CA (Cameron Run)
  - CW (Cow Branch)
  - HO (Hooff Run)
  - HR (Holmes Run)
  - IR (Indian Run)
  - PK (Pike Branch)
  - PR (Poplar Run)
  - TA (Taylor Run)
  - TR (Tripps Run)
  - TK (Turkeycock Run)
- A four-digit subbasin identifier. The subbasins within a named tributary are numbered sequentially generally starting at the bottom of the tributary and proceeding upstream.

As an example, CAPK0001 is one of the subbasins in the Pike Branch subwatershed.

The SWMM-RUNOFF and TRANSPORT models limit the maximum number of characters in a subbasin ID to 10. As discussed further in Section 2.2, additional identifiers are required to distinguish portions of the watershed that have peak shaving and water quality control best management practices. Therefore, a shortened version of the subbasin identifiers was used for input to the models. The shortened identifier was created from the long identifier by eliminating the leading two characters in the basin identifier portion of the name. All of the subbasins in the Cameron Run watershed start with CA.

Using these procedures, the long subbasin name CAPK0001 is shortened to PK0001 for input to the SWMM-RUNOFF model. The leading zeros in the four-digit subbasin identifier are eliminated in the name to identify junctions in the SWMM-TRANSPORT models.

Each subbasin is subdivided by the three stormwater control subarea types based on the year that the parcel was developed and the corresponding types of stormwater controls that were required (A, B, or C). These identifiers are appended to the shortened subbasin name in the SWMM input file. For example, subareas in PK0001 are named as PK0001A, PK0001B, PK0001C and to represent the separately simulated subbasin subareas as needed (however, not all subbasins have stormwater controls).

1.4 PHYSICAL SUBBASIN PARAMETERS

The SWMM-RUNOFF model uses a kinematic wave methodology to simulate runoff from the subbasin which requires the input of the following parameters:

- Subbasin Width
- Subbasin Slope

Width was calculated using SWMMTools. SWMMTools is an ArcView extension that allows users of SWMM to visualize a SWMM model in conjunction with existing GIS data. The tool permits viewing of model input and output summary data within ArcView. Two scripts work with a stormwater subbasin theme to facilitate subbasin parameterization. One estimates RUNOFF subbasin widths.

Subbasin width is a measure of the length of the main drainage channel in a subbasin and the level of aggregation of the prototype drainage network. The algorithm used computes the subbasin width as a user-specified factor times the longer of the height or width of the subbasin polygon. This approach is loosely based upon a methodology in the SWMM manual (James et al. 2003), which suggested an initial subbasin width of 1.7 times the length of the main drainage channel. As ArcView only computes the axis lengths of a polygon along the X- and Y- axes, the polygon extent does not necessarily correspond with the length of the principal axis; however, the method yields a reasonable value for a typical model, and is intended as an initial estimate rather than a fixed specification. The suggested value of 1.7 was the factor used to run the script for this project. Values between 1 and 2 can be used in the calculation.

Slope was calculated using the Profile Extractor ArcView extension and a path-length weighted calculation referenced in the SWMM user manual (James et al. 2003). The procedure starts with determination of the line of maximum depression through the subbasin. The stream layer was used as the primary source for this. Subbasins were then divided into equal increments drawn perpendicularly, through the line of maximum depression, with the number of increments increasing based on the complexity of the subbasins. The Profile Extractor tool was then used to derive the change in elevation along each line by extracting a cross-section profile from the filled DEM. The sum of these values was used to compute a weighted slope in feet per foot for each subbasin.

The physical subbasin parameters were computed for each of the subbasins. The same slope is used for each of the three subareas (A, B, and C) that represent the type of stormwater control. The subbasin width is adjusted proportionally to the area of the subareas such that the flow length for the subareas equals the length computed for the entire subbasin.

1.5 SOIL INFILTRATION PARAMETERS

The Fairfax County soil GIS layers were investigated for use in developing infiltration parameters for input to the models. Approximately twenty-five percent of soils in Fairfax County is not mapped. The missing areas are currently being surveyed by the Natural Resources Conservation Service (NRCS) of the United States Department of Agriculture. The majority of the Cameron Run watershed is located in the unmapped area of the County. Also, the soils for the areas of the included cities of Falls Church, Alexandria, and Arlington are not included in the County soil map layer. Regional data available from the NRCS in the State Soil Geographic Database (STATSGO) was used in lieu of County soil information and in the cities of Falls Church, Alexandria, and Arlington.

The STATSGO data were intersected with the subbasin boundary layer to determine the acres of each type of soil in each subbasin. Data tables provided in STATSGO soils information include the hydrologic soil group (A, B, C, or D). These were used to develop the subbasin area in each of the four hydrologic soil groups. These data were applied to Table 4-2 in TM3 to develop area-weighted Horton soil parameters WLMAX, WLMIN, and DECAY for input to the SWMM-RUNOFF model according to the procedure listed in TM3. The hydrologic soil group indicates the ability of the soil to infiltrate water. Soils in hydrologic soil group A (A soils) will typically be sandy soils with a high infiltration rate and lower runoff rates. D soils will be clay soils with low infiltration rates and high runoff rates. Soil type can have significant effects on the annual runoff volumes and the peak runoff rates.

Since the STATSGO soils data do not vary greatly within a particular subbasin, the weighted soil infiltration parameters computed for the entire subbasin are applied to the individual subareas (A, B, and C) for onsite stormwater facilities.

1.6 IMPERVIOUS AREA ESTIMATES

1.6.1 Introduction

Impervious area includes manmade facilities such as roads, parking lots, buildings, driveways, and sidewalks that do not allow rainfall to infiltrate into the soil. Besides reducing infiltration, impervious area produces faster runoff flow rates compared to pervious areas such as woodlands and grassy areas. For the SWMM-RUNOFF model impervious areas are subdivided into two categories:

1. **Directly Connected Impervious Area (DCIA) –** Impervious areas where the runoff either directly enters a stream or enters a stormwater drain or swale that discharges the flows to a stream or drainage way. The key is that the runoff does not have the opportunity to infiltrate into the soils before entering the drainage system. These areas are modeled separately from the pervious area in the SWMM-RUNOFF model.

2. **Not Directly Connected Impervious Area (NDCIA) –** Impervious areas where the runoff discharges to a pervious area that allows the runoff to infiltrate. An example is a single-family home where the downspouts discharge to a large lawn area. The net effect of NDCIA is to reduce the surface area through which water can infiltrate; infiltration parameters for the pervious area are adjusted to account for NDCIA.

Impervious area is a good indicator of the density of development within various portions of the watershed and the potential for this development to impact the stream hydrology and habitat.

The procedures described in the following sections allow the percent impervious area estimates to be accurate for each of the three categories – detention, detention and water quality controls, and no controls. This required processing the data at the parcel level.

Impervious area estimates were developed for existing and future land use conditions. Section 1.6.3 describes the development of future land use conditions. Existing land use impervious area estimates are described below.

Existing Land Use: This represents land use conditions in the 1997 to 2001 time frame. The fact that data were obtained from various sources results in this range in years. The GIS data on which impervious area is based were derived from 1997 planimetric layers, while current land use is based on 2003 Fairfax County Department of Tax Administration parcel-level data. Existing land cover for the cities of Falls Church, Alexandria, and Arlington was based on data from the National Land Cover Database developed by the Multi-Resolution Land Characteristics (MRLC) Consortium. The MRLC Consortium is a partnership of federal agencies (www.mrlc.gov), consisting of the U.S. Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Environmental Protection Agency (EPA), the U.S. Department of Agriculture (USDA) Forest Service (USFS), the National Park Service (NPS), the

U.S. Fish and Wildlife Service (FWS), the Bureau of Land Management (BLM) and the USDA Natural Resources Conservation Service (NRCS). One of the primary goals of the project is to generate a current, consistent, seamless, and accurate National Land cover Database (NLCD), circa 2001, for the United States at medium spatial resolution. A summary of the percent existing land use within each subwatershed is shown in Table 1-1 and illustrated in Figure 1-2.

1.6.2 Current Conditions

1.6.2.1 Fairfax County Portions of the Watershed

Impervious area estimates for existing conditions were derived from GIS layers depicting impervious areas that were developed by Fairfax County from aerial photography taken in 1997:

- Buildings – This polygon coverage includes building footprints. Buildings are classified by building type – commercial, industrial, public, multi-family residential, single-family residential, and other. Building impervious areas are classified into DCIA and NDCIA based on recommend values in Table 4-3 of TM3.

- Major Transportation (Transmaj) – This polygon coverage includes the footprint of roads and highways. Paved roads and bridges were assumed 100% DCIA; medians and unpaved roads were assumed 50% DCIA.

- Minor Transportation (Transmin) – This polygon coverage includes parking lots for commercial and industrial areas as well as parking lots for multi-family residential development (condominiums and town houses). Paved parking lots were assumed 100% DCIA; unpaved parking lots were assumed 50% DCIA.

- Sidewalks – This line coverage includes the edge of sidewalks. The total length is multiplied by the half-sidewalk width (assumed to be 2 feet) to compute the sidewalk area. It is assumed that sidewalks are 85% DCIA.

The above layers include all impervious areas except for single-family residential driveways. These were accounted for by adding 1,000 square feet of impervious area for each single-family residential building.

The existing percent impervious was computed at the parcel control level. The County existing land use layer was processed in the following way prior to this work:

- The existing land use layer includes “holes” that primarily include roads, highways, highway interchanges, etc. The parcel layer was modified to have these holes filled in with a polygon which was assigned to a “Transportation” land use. It is assumed that 100% of this area is DCIA.

Table 1-1. Cameron Run subwatershed land use percentages - current conditions

Subwatershed	Area (acres)	Open Space	Multi-family Common Area	Low Density Residential	Medium Density Residential	High Density Residential	Low Intensity Commercial	High Intensity Commercial	Industrial	Trans-portation	Open Water #
Tripps Run	3704	16.0	1.7	18.7	37.9	2.8	5.6	1.6	0.4	14.3	1.1
Holmes Run-Upper	5400	9.7	3.5	12.2	33.3	4.8	13.2	1.1	0.7	19.9	1.7
Holmes Run-Lower	3201	23.0	1.0	22.3	34.0	5.4	4.4	1.6	0.7	6.7	0.9
Indian Run	1586	8.2	4.1	30.8	17.8	3.7	13.2	3.2	0.9	18.0	0.0
Turkeycock Run	1725	21.4	7.2	23.0	15.9	9.5	4.5	2.9	1.4	14.4	0.0
Backlick Run	5659	10.8	3.4	11.7	29.5	5.1	7.7	2.9	10.7	18.1	0.0
Tribs to Cameron Run*	1708	16.8	6.1	12.8	28.2	5.8	8.1	0.9	3.9	17.5	0.0
Pike Branch	1814	7.6	6.7	7.8	44.4	7.3	8.5	1.7	1.4	14.6	0.0
Weighted Average		13.7	3.6	16.0	31.5	5.1	8.4	1.9	3.3	15.9	0.6

* includes area in Alexandria upstream of USGS gage on Cameron Run
# includes Lake Barcroft and Fairview Lake only

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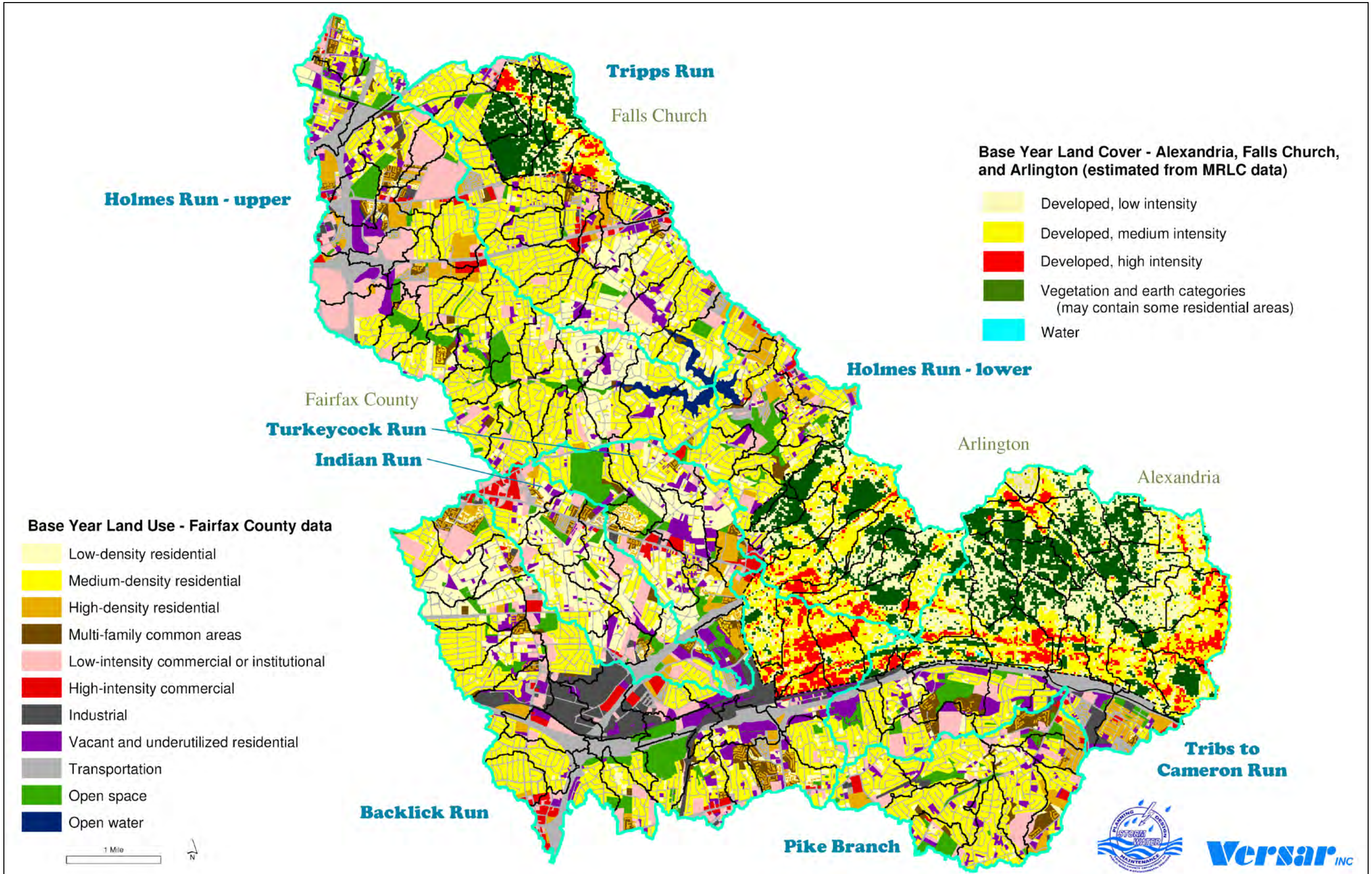

Figure 1-2. Current land use in Cameron Run watershed

- Unknown, other and missing landuse is not accurately defined in the existing landuse file. This results in areas that essentially have a defined landuse being classified as none. Using recent aerial photography, the existing and future land use codes for these areas were changed to the appropriate land use.

- Initial calculations of imperviousness in the parcel areas with detention and water quality controls (DBMP) were lower than expected. A sampling of 5 subbasins indicates that land use in these parcels showed they have been developed, based on 2003 aerial photography, while imperviousness was based on 1997 aerial photography. To correct for development which occurred during the intervening years, all the DBMP parcel areas were identified which contained few or no impervious layers within them. For these parcels only, imperviousness was calculated based on land use categories. A description of the processing steps used to develop land-use-based imperviousness for areas within the Cameron Run watershed is included in Section 1.6.3.1. These revised DBMP parcels were added to those that already had impervious layers within them, creating a revised impervious percentage for each subbasin for the DBMP category.

- The Cameron Run watershed has two major water bodies, Fairview Lake and Lake Barcroft. These two water bodies were incorporated into the landuse layer as open water.

GIS processing was performed to develop the percent impervious for each stormwater control parcel, including the Transportation areas, and to associate parcels with the appropriate subbasin. Codes developed for each parcel that assign them to one of three classes of stormwater controls based on the date of development were used to subdivide the percent impervious to these three subareas within each subbasin.

1.6.2.2 The Cities of Falls Church, Alexandria, and Arlington Portions of the Watershed

The following procedures were used to estimate the existing impervious areas for the cities of Alexandria, Falls Church, and Arlington portions of the Cameron Run watershed. The cities do not have comparable GIS impervious layers available for analysis; therefore, the GIS layers provided by Fairfax County were used. A weighted average DCIA for each land use type in Fairfax County was calculated. These values were then applied to the equivalent land cover in the areas of the watershed in the cities of Falls Church, Alexandria, and Arlington. No stormwater control data were available for the cities of Falls Church, Alexandria, and Arlington; these areas were defined as not having any stormwater controls.

1.6.2.3 Summary of Existing Percent Impervious Area

Existing total percent impervious was computed for each subbasin. The directly connected impervious area (DCIA) percentage for the subareas of the subbasin that have A) detention only, B) detention and BMP coverage, and C) have no detention or water quality BMPs were also computed for input to the SWMM-RUNOFF models.

1.6.3 Future Conditions

Future impervious area estimates were developed to evaluate the impact of future development on the streams in the Cameron Run watershed. Impervious area estimates were derived for a “buildout” land use condition where the land in the watershed is developed in accordance with the recommended land use in Fairfax County’s Comprehensive Plan. While it is recognized that the land use plans are subject to revisions, it would not be possible to estimate potential future changes at this time. A summary of the percent future land use within each subwatershed is shown in Table 1-2 and future land use is illustrated in Figure 1-3; changes from present to future are listed in Table 1-3.

The following generalized land use categories derived from land use designations in the County’s Comprehensive Plan are used in these analyses:

- OS – Open Space
- MFC – Multi-family Common Areas – Common areas within High Density Residential areas
- LDR – Low Density Residential – Single-family detached with 0.5-2 acres per residence.
- MDR – Medium Density Residential – Single-family detached less than 0.5 acres per residence and multi-family less than 8 dwelling units per acre.
- HDR – High Density Residential – All residential less than 0.125 acres per residence.
- LIC – Low Intensity Commercial/Institutional
- HIC – High Intensity Commercial/Institutional
- IND – Industrial
- OW – Open Water
- TRA – Transportation

Table 1-2. Cameron Run subwatershed land use percentages - future conditions

Subwatershed	Area (acres)	Open Space	Multi-family Common Area	Low Density Residential	Medium Density Residential	High Density Residential	Low Intensity Commercial	High Intensity Commercial	Industrial	Trans-portation	Open Water #
Tripps Run	3704	13.2	1.2	18.0	41.0	2.9	5.6	2.4	0.4	14.3	1.1
Holmes Run-Upper	5400	7.1	2.4	11.7	37.2	4.8	12.5	1.4	1.4	19.9	1.7
Holmes Run-Lower	3201	20.5	0.8	22.0	36.8	5.6	4.4	1.8	0.6	6.7	0.9
Indian Run	1586	4.0	2.8	32.5	20.6	3.7	11.8	4.7	1.9	18.0	0.0
Turkeycock Run	1725	8.8	4.4	27.5	23.2	9.6	7.6	3.2	1.4	14.4	0.0
Backlick Run	5659	6.4	2.6	11.9	31.5	5.2	7.7	3.3	13.1	18.1	0.0
Tribs to Cameron Run*	1708	7.8	4.0	11.0	39.2	6.0	9.5	1.0	3.9	17.5	0.0
Pike Branch	1814	4.2	5.2	5.4	51.0	7.4	9.0	1.8	1.4	14.6	0.0
Weighted Average		9.3	2.6	15.9	35.5	5.3	8.5	2.4	4.0	15.9	0.6

* includes area in Alexandria upstream of USGS gage on Cameron Run
# includes Lake Barcroft and Fairview Lake only

Table 1-3. Cameron Run subwatershed land use percentages - change from current percentage to future percentage

Subwatershed	Area (acres)	Open Space	Multi-family Common Area	Low Density Residential	Medium Density Residential	High Density Residential	Low Intensity Commercial	High Intensity Commercial	Industrial	Trans-portation	Open Water #
Tripps Run	3704	-17.3	-28.0	-3.6	8.2	3.8	0.4	45.5	-16.8	0.0	0.0
Holmes Run-Upper	5400	-27.1	-31.4	-4.7	11.6	1.4	-5.2	27.6	121.1	0.0	0.0
Holmes Run-Lower	3201	-11.2	-22.2	-1.5	8.1	3.7	1.7	11.2	-9.4	-0.1	0.0
Indian Run	1586	-51.7	-30.3	5.2	15.8	0.0	-10.8	45.8	109.2	0.0	0.0
Turkeycock Run	1725	-59.0	-38.6	19.8	46.1	1.6	69.9	9.1	-0.2	0.0	0.0
Backlick Run	5659	-40.7	-21.8	1.8	6.7	2.4	0.2	14.2	22.3	0.0	0.0
Tribs to Cameron Run*	1708	-53.7	-34.0	-14.2	39.0	5.1	17.8	20.6	0.0	-0.1	0.0
Pike Branch	1814	-44.3	-22.3	-31.1	14.8	1.5	5.2	7.6	0.0	0.0	0.0
Weighted Average		-31.7	-28.8	-0.7	12.9	2.4	1.5	22.0	23.3	0.0	0.0

* includes area in Alexandria upstream of USGS gage on Cameron Run
# includes Lake Barcroft and Fairview Lake only

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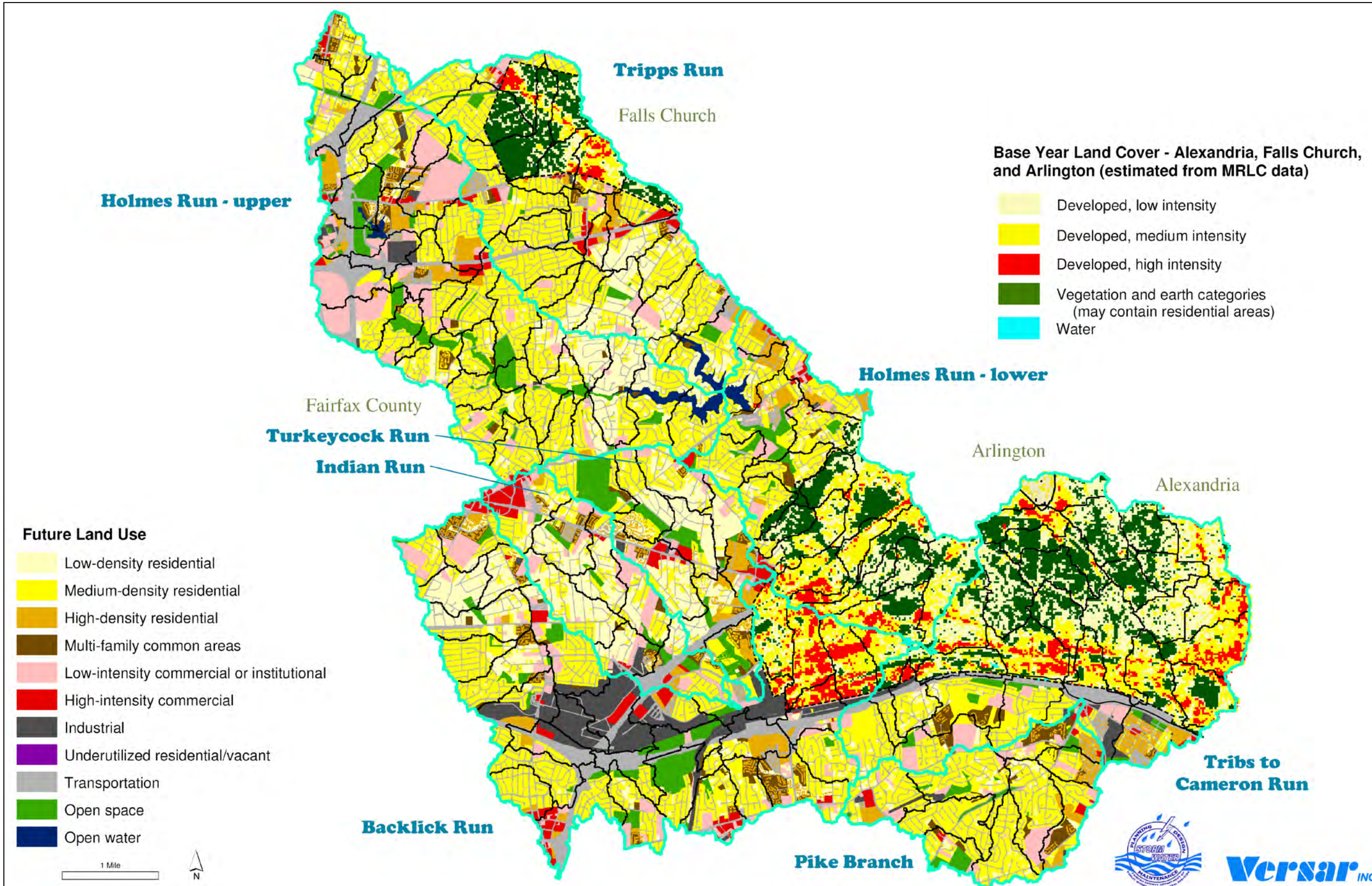

Figure 1-3. Projected future land use in Cameron Run watershed

1.6.3.1 Fairfax County Portions of the Watershed

Residential Land Use

The procedures used to develop future land use impervious areas assume that existing residential parcels that are currently developed at or near the density allowed by the planned land use will remain unchanged.

New residential development will occur in vacant parcels planned for residential development. Future impervious area estimates assume that these are developed at the density allowed in the existing land use plan.

The future impervious area estimates also assume that redevelopment will occur in parcels where the existing density is less than the density allowed by the land use designation. These procedures account for infill development. For example, a one-acre parcel with a single house in an area where the planned land use is four residents per acres is assumed to be redeveloped at the higher density.

Fairfax County previously performed an analysis that compares the existing and planned density and identifies underutilized parcels. Underutilized parcels were assumed to be developed as defined by the planned land use code. The underutilized parcels provided by the County apply only to residential areas.

The County has GIS layers that summarize parcels that are vacant based on the existing land use codes. The County also has an ‘underutilized’ layer that defines parcels where the existing land use is significantly less than the zoned or planned land use for residential areas of the County. The procedures for estimating DCIA and NDCIA for future buildout land use conditions assume that development within the vacant and underutilized parcels will be removed and the parcels will be developed to the densities described by the planned land use or zoning classification, whichever is greater. The impervious area for existing parcels that are not expected to undergo development as well as streets, highways, and water will remain unchanged.

To calculate future buildout impervious area estimates for non-residential land uses, these areas were assigned their future land use. Areas identified as having a lower density land use in the future were assigned their current land use. This step assures that future land use areas will not decrease in density. The existing impervious estimates do not account for the replacement of smaller homes with larger homes on the same lot (“mansionization”).

Impervious Area Assignments

The impervious area to be assigned to the various land use categories was developed by sampling the estimated existing impervious area for developed parcels in the Fairfax County portions of the Cameron Run watershed. The existing impervious area was estimated by parcel as described in Section 1.6.2. These data were analyzed to estimate the typical impervious area for each land use category based on representative conditions for developed areas in the Fairfax County portion of the Cameron Run watershed. The estimates include allowances for roads associated with the development. These estimates of the average impervious area for each land use are summarized in Table 1-4.

1.6.3.2 Cities of Falls Church, Alexandria, and Arlington Portions of the Watershed

Future land use data for the cities of Falls Church, Alexandria, and Arlington are not readily available for inclusion in this watershed plan. Existing current impervious area previously calculated was also used as future buildout impervious area as discussed in Section 1.6.2.

1.6.4 Summary and Discussion of Impervious Area Estimates

Figures 1-4 and 1-5 show the existing and buildout impervious area for each subbasin. Figure 1-6 illustrates the increase in impervious area between existing and buildout land use conditions. GIS layers with these results will be delivered to the County upon project completion. Tables 1-5, 1-6, and 1-7 summarize existing and future impervious area for the entire watershed broken down by subwatershed and showing the amount of parcel-controlled areas. Tables 1-8 and 1-9 summarize future impervious area by subwatershed for the parcel-controlled areas including the projects proposed as listed in Chapter 6 of the main report.

1.6.5 Other SWMM-RUNOFF Input Parameters

The RUNOFF model requires other input parameters for computing runoff from directly connected pervious and impervious areas. Pervious area roughness coefficients were determined for each subwatershed area based on the proportion of land use types and the values listed in Table 4-8 of TM3. The initial values of these coefficients are as follows:

Parameter	Value
Impervious Area Manning’s Roughness	0.015
Pervious Area Manning’s Roughness	0.25-0.35
Impervious Area Depression Storage (Inches)	0.10
Pervious Area Depression Storage (Inches)	0.20

Table 1-4. Cameron Run subwatershed directly connected impervious area percentages by land use type

Subwatershed	Area (acres)	Open Space	Multi-family Common Areas	Low Density Residential	Medium Density Residential	High Density Residential	Low Intensity Commercial	High Intensity Commercial	Industrial	Trans-portation	Open Water #
Tripps Run	3704	7.3	12.1	8.2	18.3	39.7	31.8	80.2	45.8	100.0	100.0
Holmes Run-Upper	5399	3.8	12.9	9.0	16.3	37.5	21.8	83.9	45.0	100.0	100.0
Holmes Run-Lower	3201	2.4	5.6	10.1	16.8	37.8	33.9	85.0	32.1	100.0	100.0
Indian Run	1585	6.4	13.8	9.8	15.3	33.1	37.8	87.0	51.3	100.0	-
Turkeycock Run	1725	3.1	7.0	11.9	15.6	32.8	33.8	85.6	48.3	100.0	-
Backlick Run	5657	5.4	19.0	9.3	16.9	41.2	35.2	80.7	37.8	100.0	-
Tribs to Cameron Run*	1708	4.7	6.9	7.9	16.7	36.0	18.3	85.4	29.3	100.0	-
Pike Branch	1814	4.9	5.9	8.0	16.2	30.9	15.9	77.7	10.7	100.0	-
Weighted Average		4.5	11.4	9.4	16.8	36.5	27.5	82.6	37.2	100.0	100.0

* includes area in Alexandria upstream of USGS gage on Cameron Run
\# includes Lake Barcroft and Fairview Lake only

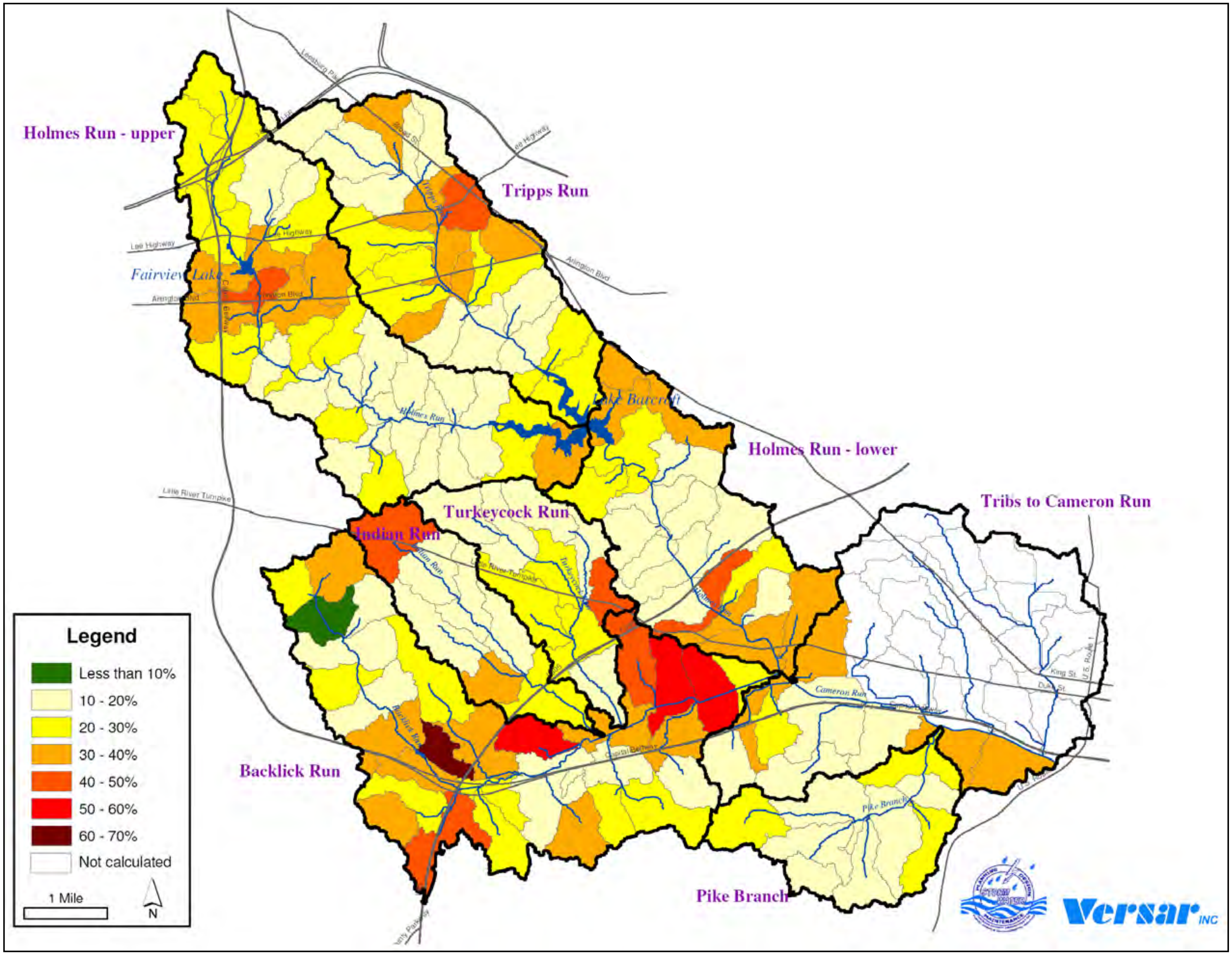

Figure 1-4. Existing impervious area within Cameron Run watershed

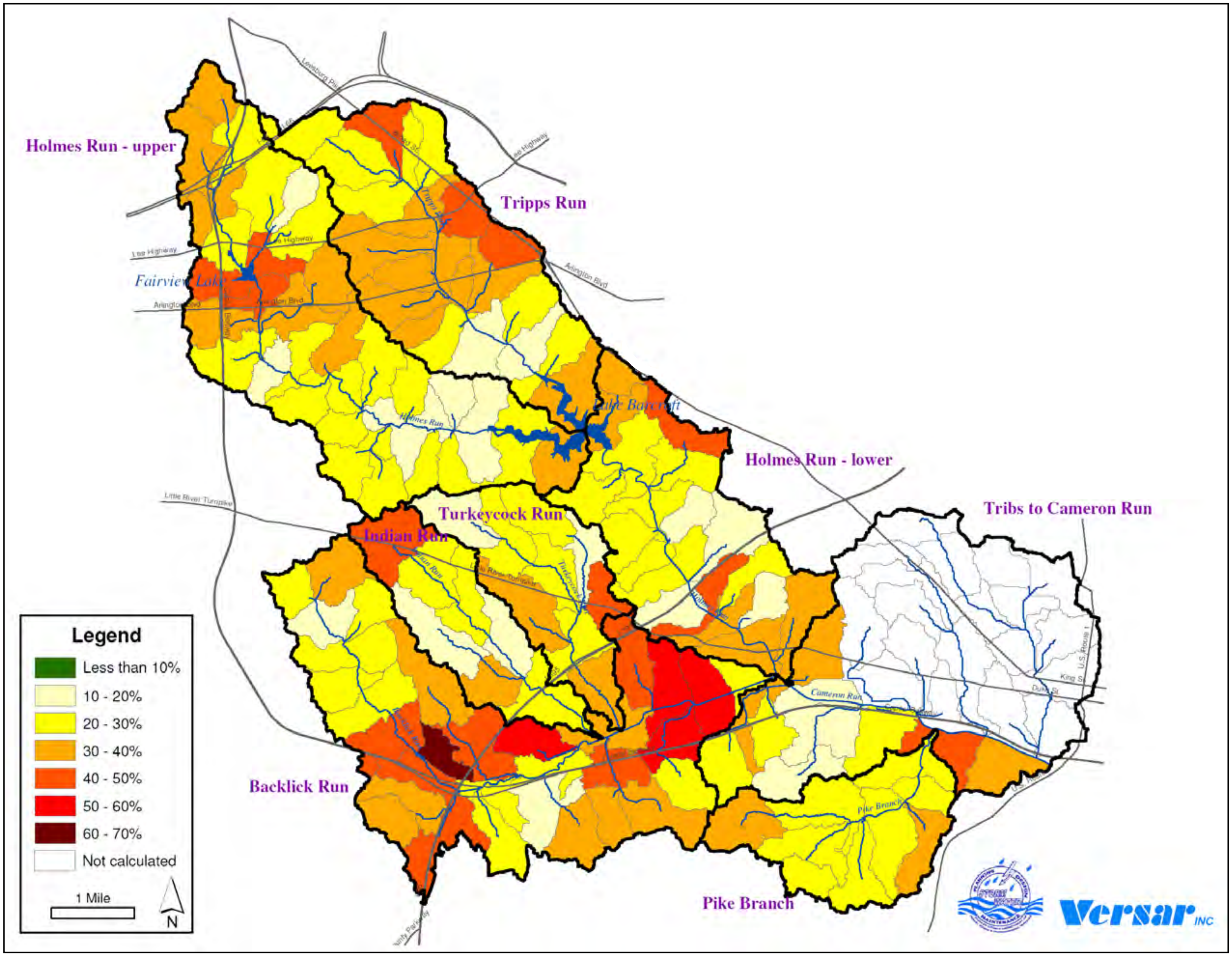

Figure 1-5. Projected future impervious area within Cameron Run watershed

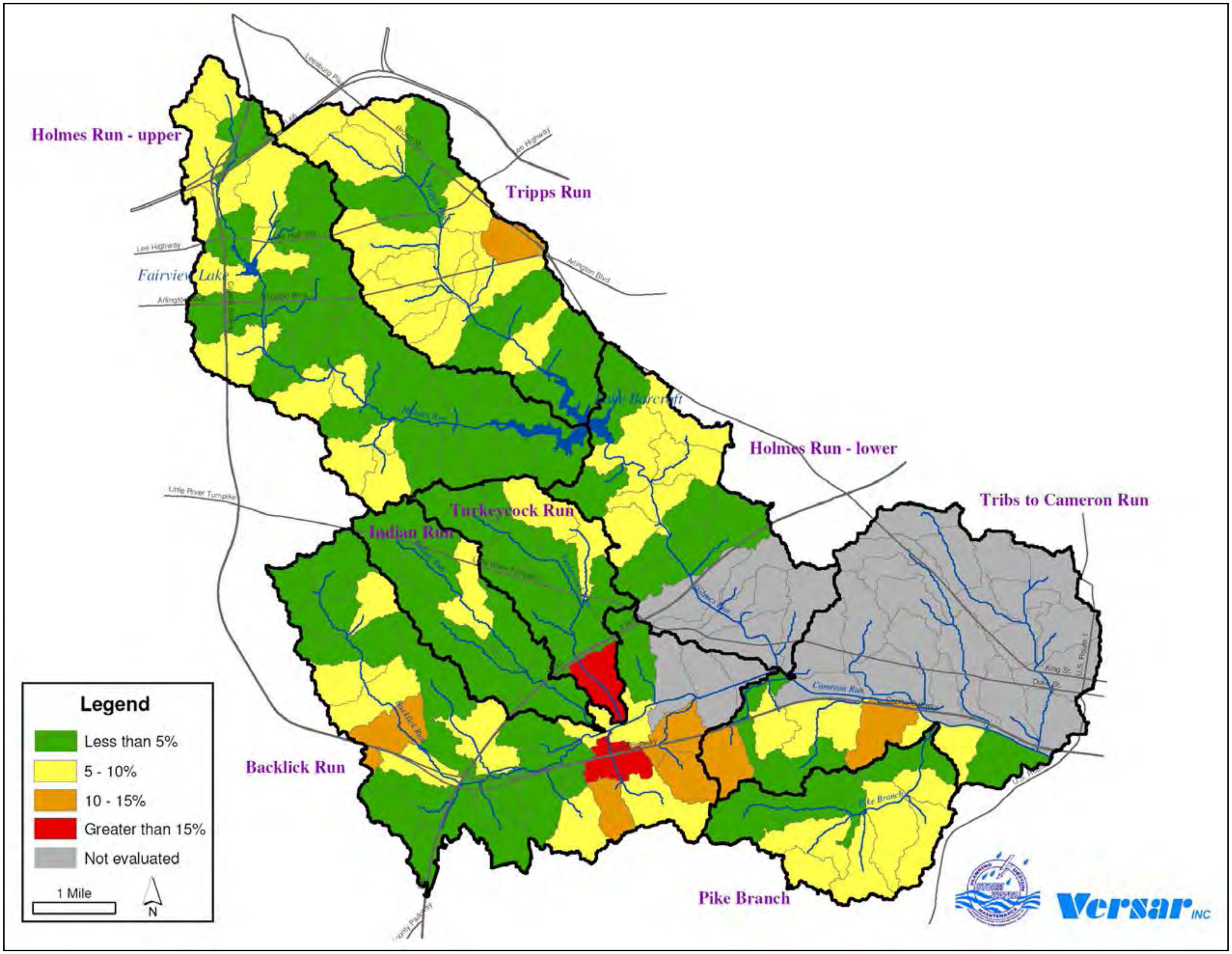

Figure 1-6. Net increase in imperviousness under future land use conditions within Cameron Run watershed

Table 1-5. Impervious area estimates for major subwatersheds in Cameron Run (BMPs evaluated only in Fairfax County) - current conditions									
Subwatershed	**Area (acres)**	**Overall Subwatershed Imperviousness (%)**	**Detention-controlled Area Imperviousness (%)**	**Detention- and Water Quality Controlled Area Imperviousness (%)**	**Uncontrolled Area Imperviousness (%)**	**Area with Detention Controls (% of area)**	**Area with Water Quality Control (% of area)**	**Total with Controls (% area)**	**Total with No Control (% area)**
Tripps Run	3704	25.0	20.9	25.2	25.1	2.7	0.6	3.3	96.7
Holmes Run-Upper	5399	24.5	24.7	34.5	24.1	9.3	2.8	12.1	87.9
Holmes Run-Lower	3201	25.2	20.3	32.7	25.2	3.1	0.8	3.9	96.2
Indian Run	1585	25.2	47.6	37.9	23.0	7.4	2.7	10.0	90.0
Turkeycock Run	1725	21.3	28.8	21.8	19.9	14.9	2.9	17.8	82.2
Backlick Run	5657	30.7	44.0	21.4	29.7	8.3	2.7	11.0	89.1
Tribs to Cameron Run*	1708	23.7	24.0	18.4	23.8	5.8	2.2	8.1	91.9
Pike Branch	1814	20.8	15.7	23.2	21.3	10.1	3.5	13.6	86.4
Weighted Average		25.6	30.3	27.0	25.1	7.4	2.2	9.6	90.5
* Includes Alexandria only upstream of USGS gage on Cameron Run									

Table 1-6. Impervious area estimates for major subwatersheds in Cameron Run (BMPs evaluated only in Fairfax County) - future conditions									
Subwatershed	**Area (acres)**	**Overall Subwatershed Imperviousness (%)**	**Detention-controlled Area Imperviousness (%)**	**Detention- and Water Quality-Controlled Area Imperviousness (%)**	**Uncontrolled Area Imperviousness (%)**	**Area with Detention Controls (% of area)**	**Area with Water Quality Control (% of area)**	**Total with Controls (% area)**	**Total with No Control (% area)**
Tripps Run	3704	29.8	27.9	27.8	29.9	2.6	4.8	7.4	92.6
Holmes Run-Upper	5399	27.8	29.5	29.0	27.5	9.2	6.8	16.0	84.0
Holmes Run-Lower	3201	27.5	26.8	29.6	27.5	3.1	3.6	6.6	93.4
Indian Run	1585	28.6	54.5	26.4	26.6	7.3	7.9	15.2	84.8
Turkeycock Run	1725	26.3	38.1	20.0	25.1	14.4	13.4	27.8	72.2
Backlick Run	5657	35.9	48.8	40.5	34.2	8.2	7.6	15.8	84.3
Tribs to Cameron Run*	1708	29.5	28.5	31.7	29.3	5.7	10.5	16.2	83.8
Pike Branch	1814	25.5	20.3	26.9	26.0	9.8	9.4	19.2	80.8
Weighted Average		29.8	36.0	30.4	29.2	7.2	7.2	14.5	85.6
* Includes Alexandria only upstream of USGS gage on Cameron Run									

Table 1-7. Present to future change in impervious area estimates for major subwatersheds in Cameron Run (BMPs evaluated only in Fairfax County)

Subwatershed	Area (acres)	Overall Subwatershed Imperviousness (%)	Detention-controlled Area Imperviousness (%)	Detention- and Water Quality-Controlled Area Imperviousness (%)	Uncontrolled Area Imperviousness (%)	Area with Detention Controls (% change)	Area with Water Quality Control (% change)	Total Area with Controls (% change)	Total Area with No Control (% change)
Tripps Run	3704	19.1	33.1	10.6	19.2	-1.2	674.3	125.6	-4.2
Holmes Run-Upper	5399	13.5	19.3	-16.1	13.9	-1.1	145.7	32.3	-4.4
Holmes Run-Lower	3201	9.4	32.4	-9.7	8.8	-0.7	326.6	69.0	-2.8
Indian Run	1585	13.3	14.7	-30.4	15.4	-1.1	197.7	51.7	-5.8
Turkeycock Run	1725	23.3	32.3	-8.4	25.9	-3.7	363.2	55.8	-12.1
Backlick Run	5657	16.9	10.8	89.3	15.1	-1.2	182.4	43.9	-5.4
Tribs to Cameron Run*	1708	24.6	18.7	72.4	23.1	-1.4	369.8	101.4	-8.9
Pike Branch	1814	22.5	29.3	15.6	21.9	-2.8	170.2	41.6	-6.5
Weighted Average		16.5	19.0	12.5	16.2	-1.7	229.5	51.4	-5.4

* Includes Alexandria only upstream of USGS gage on Cameron Run

Table 1-8. Impervious area estimates for major subwatersheds in Cameron Run (BMPs evaluated only in Fairfax County) - future with projects (includes new ponds and pond retrofits in Detention and Water Quality controlled area and Low Impact Development (LID) projects)

Subwatershed	Area (acres)	Overall Subwatershed Impervious-ness (%)	Detention-controlled Area Impervious-ness (%)	Detention and Water Quality-Controlled Area Impervious-ness (%)	LID Area Impervious ness (%)	Uncontrolled Area Impervious-ness (%)	Area with Detention controls (% area)	Area with Water Quality Control (% area)	Area with LID Control (% area)	Total with Controls (% area)	Total with No Control (% area)
Tripps Run	3704	29.8	28.1	28.7	38.0	29.7	2.4	5.9	1.5	9.8	90.2
Holmes Run-Upper	5399	27.7	29.9	29.0	22.3	27.7	8.7	7.9	4.6	21.2	78.6
Holmes Run-Lower	3201	27.5	26.9	29.6	27.7	27.5	3.0	3.5	1.5	8.1	92.0
Indian Run	1585	28.6	54.8	26.3	40.9	25.9	7.2	7.9	4.1	19.2	80.9
Turkeycock Run	1725	26.3	37.7	22.0	40.3	24.3	12.8	15.0	3.9	31.7	68.3
Backlick Run	5657	35.9	48.9	37.4	26.9	34.7	7.7	10.9	2.7	21.4	78.7
Tribs to Cameron Run*	1708	29.6	28.7	29.9	22.3	29.6	5.7	12.7	2.2	20.6	80.0
Pike Branch	1814	25.5	21.1	27.0	20.0	26.1	8.3	9.3	3.8	21.4	78.6
Weighted Average		29.8	36.4	30.3	27.8	29.2	6.8	8.6	3.0	18.4	81.6

* Includes Alexandria only upstream of USGS gage on Cameron Run

Table 1-9. Future to future with projects change in impervious area estimates for major subwatersheds in Cameron Run (BMPs evaluated only in Fairfax County)

Subwatershed	Area (acres)	Area with Detention Controls (% change)	Area with Water Quality Control (% change)	Total Area with Controls (% change)	Total area with No Control (% change)
Tripps Run	3704	-7%	24%	33%	-3%
Holmes Run-Upper	5399	-6%	17%	32%	-6%
Holmes Run-Lower	3201	0%	0%	22%	-2%
Indian Run	1585	-1%	-1%	26%	-5%
Turkeycock Run	1725	-11%	12%	14%	-5%
Backlick Run	5657	-5%	43%	35%	-7%
Tribs to Cameron Run*	1708	-1%	21%	27%	-5%
Pike Branch	1814	-15%	-1%	11%	-3%
Weighted Average		-7%	20%	27%	-5%

* Includes Alexandria only upstream of USGS gage on Cameron Run

1.7 SIMULATION OF PEAK SHAVING AND WATER QUALITY CONTROLS

Procedures for simulating peak shaving and water quality controls are described in TM3–Stormwater Model and GIS Interface Guidelines (CDM 2003). These procedures were used to simulate facilities in the Cameron Run watershed. The reader is referred to Section 5.3 of TM3 for additional information on these procedures for using the TRANSPORT storage unit method for simulating onsite detention facilities. The application of these procedures to the Cameron Run watershed Plan is described in this section.

Fairfax County Stormwater Management Division developed procedures for assigning individual parcels to the type of stormwater controls based on the year that the parcel was developed:

A. Parcels that are developed after 1972 that may be assumed to be served stormwater detention control facilities that control the peak flow from the upstream developed area. These were identified as DET in the layers provided by the County.

B. Parcels that were developed after 1994 are assumed to have peak flow control and water quality stormwater control facilities. These were identified as DBMP in the GIS layers provided by the County.

C. Parcels that were developed prior to 1972 are assumed to have no stormwater controls. These were excluded or identified as NONE in the GIS layer files provided by the County.

Figure 1-7 presents the percentage of the subbasins with both peak flow and water quality stormwater controls.

Parameters used for the simulation of surface runoff water quality include:

QFACT(1): See Table 1-10. Values by Pollutant and Land Use (lb/acre)
QFACT(2): 0.15
RCOEFF: 4.6 per inch
WASHPO: 1.0

1.8 GROUNDWATER ROUTINE DATA INPUTS

The SWMM-RUNOFF model was used to simulate groundwater effects on stream baseflows and variations from year to year. SWMM-RUNOFF includes groundwater simulation routines that allow the simulation of percolation of infiltrated rainfall through the unsaturated soil zone, storage in the shallow groundwater zone, and release of groundwater to the stream system. Parameters were set uniformly over the study area to simulate observed base flow recession curves at the flow gage located on Cameron Run in Alexandria. The parameter values listed in Table 1-11 were used for the initial model setup for all subbasins to simulate baseflow with SWMM-RUNOFF; these values were based on CDM's SWMM model guidelines (CDM 2005).

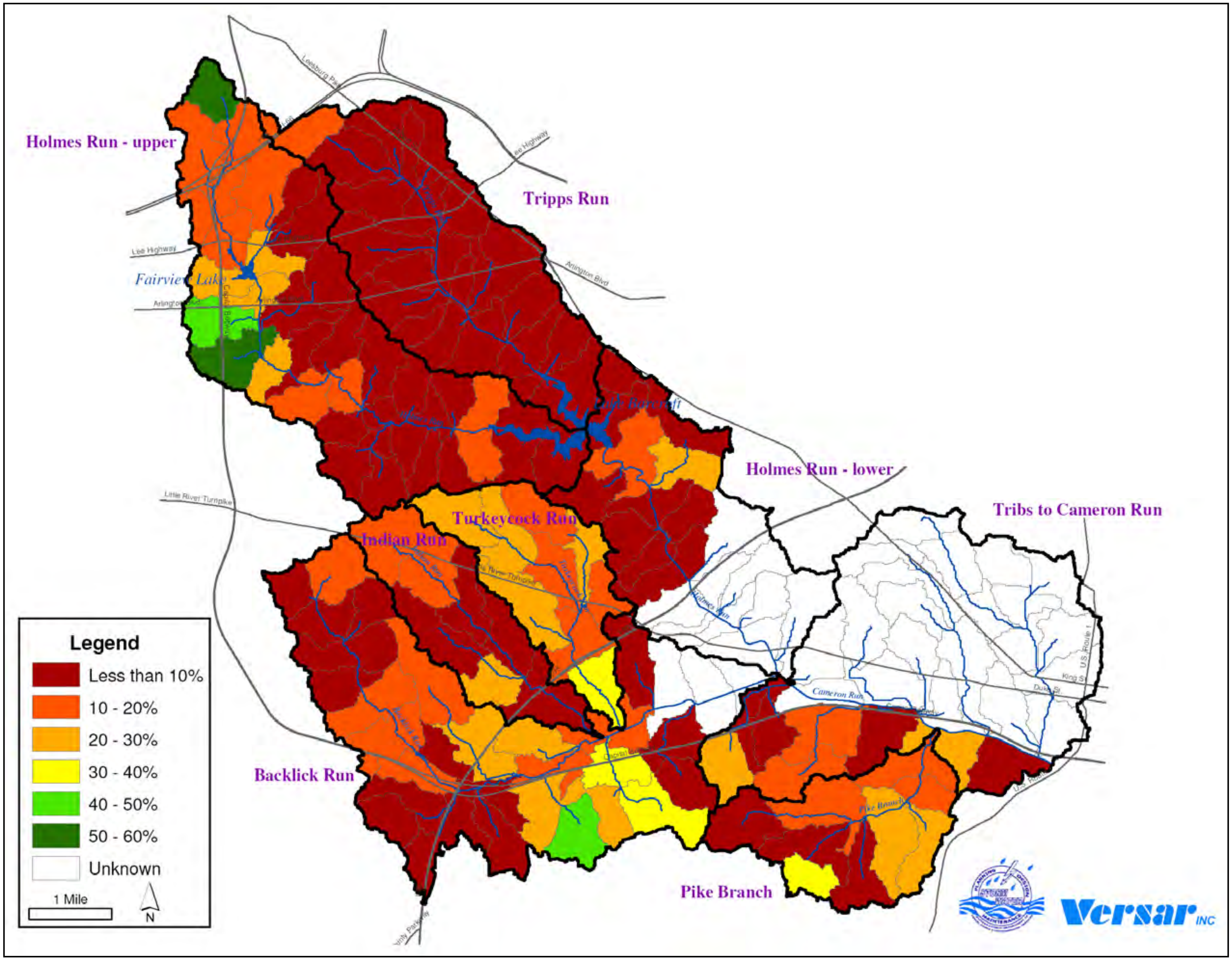

Figure 1-7. Cameron Run subbasin BMP coverage

TABLE 1-10. QFACT(1) VALUES BY POLLUTANT AND LAND USE (LB/ACRE; FROM LIMNO-TECH, 2004, AS REVISED IN CDM, 2005)

Land Use	BOD	COD	TSS	TDS	DP	TP	TKN	TN	TCD	TCU	TPB	TZN
Open Space	0.4	3.1	2	5.2	0.005	0.0075	0.04	0.055	0.000011	0.0003	0.00009	0.0016
Estate Residential	0.6	3.2	1.7	2.3	0.028	0.04	0.23	0.3	0.000025	0.0003	0.00009	0.0016
Low Density Residential	1.2	6.7	3.6	4.8	0.035	0.05	0.26	0.35	0.000026	0.0006	0.0002	0.0034
Medium Density Residential	2.4	13.5	7.3	9.7	0.039	0.55	0.32	0.425	0.00003	0.0011	0.0004	0.0068
High Density Residential	4.5	36.5	12.8	21.2	0.046	0.065	0.36	0.55	0.00004	0.0096	0.0008	0.0197
Low Intensity Commercial	2.7	16.2	16.7	16.6	0.042	0.06	0.36	0.55	0.000025	0.0074	0.00049	0.0369
Industrial	5.5	21.5	17.7	23.6	0.045	0.065	0.3	0.65	0.000011	0.0075	0.00155	0.0476
High Intensity Commercial	5.6	21.5	20.7	21	0.043	0.065	0.3	0.65	0.000024	0.0048	0.00143	0.0297
Transportation	5.6	21.5	20.7	21	0.045	0.065	0.3	0.65	0.000024	0.0048	0.00143	0.0297
Water	0.4	3.1	2	5.2	0.005	0.0075	0.04	0.055	0.00005	0.0006	0.00032	0.0025

TABLE 1-11. GROUNDWATER PARAMETER VALUES

Parameter	Description	Value
BELEV	Elevation of bottom of aquifer (feet)	0
GRELEV	Elevation of ground surface (feet)	20
STG	Elevation of initial water table stage (feet)	5
BC	Elevation of channel bottom or threshold stage for groundwater flow (feet)	5
TW	Average elevation of water in channel over run (feet)	5
A1	Groundwater flow coefficient (in/hr-ft^B1)	0.0001
B1	Groundwater flow exponent, dimensionless	32
A2	Coefficient for channel water influence, dimensionless	0
B2	Exponent for channel water influence, dimensionless	1
A3	Coefficient for the cross product between groundwater flow and channel water (in/hr-ft^2)	0
POR	Porosity expressed as a fraction	0.46
WP	Wilting point expressed as a fraction	0.15
FC	Field capacity expressed as a fraction	0.3
HKSAT	Saturated hydraulic conductivity (in/hr)	10
TH1	Initial upper zone moisture expressed as a fraction	0.3
HCO	Hydraulic conductivity vs. moisture content curve-fitting parameter, dimensionless	10
PCO	Average slope of tension versus soil moisture curve (ft/fraction)	15
CET	Fraction of maximum evapotranspiration rate assigned to the upper zone	0.35
DP	Coefficient for unquantified losses (in/hr)	0.002
DET	Maximum depth over which significant lower zone transportation occurs (feet)	14

2.0 SWMM-TRANSPORT MODEL

2.1 INTRODUCTION

The SWMM-TRANSPORT model was used to perform several functions in the models for the Cameron Run watershed. The following section provides a brief overview of the SWMM-TRANSPORT model. A TRANSPORT model was developed for each of the Cameron Run subwatersheds. The functions and data input to this model are summarized below in Sections 2.1.2 and 2.1.3. The development of the model is described in Section 2.2.

2.1.1 Introduction to SWMM-TRANSPORT

The SWMM-TRANSPORT model performs flow and water quality routing through ponds and streams. The conduit and open channel flow routing computations use a kinematic wave approach in which disturbances are allowed to propagate only in the downstream direction. As a result, backwater effects are not modeled and downstream conditions do not affect upstream computations. These assumptions allow a more efficient solution technique compared to more sophisticated hydraulic simulation models such as SWMM-EXTRAN and the Army Corps of Engineers HEC-RAS model. The stream flow routing methodology permits longer time steps which allow the model to be used to simulate flows and water quality for long-duration simulations. The model provides sufficiently accurate routing to evaluate flows, velocities, and stormwater pollution loads in the system. A more detailed hydraulic model such as EXTRAN or HEC-RAS is required to simulate the water surface elevations in the streams. The TRANSPORT model also has other types of elements. As described below, stage-storage-outflow relations defined for storage elements are used to simulate the effects of onsite and regional ponds on flows in the system. The model includes “flow divider” elements that allow pollutant loads to be removed at water quality BMPs.

2.1.2 SWMM-TRANSPORT Model Network

The SWMM-TRANSPORT network developed for the Cameron Run Watershed Plan provides the following functions:

- Routes flows generated in RUNOFF through peak flow shaving and water quality control BMPs

- Routes flows through the major stream system in Fairfax County, and the watershed portions of the cities of Falls Church, Alexandria, and Arlington

- Combines flows from subareas that comprise individual subbasins for input to downstream model segments

The TRANSPORT model network is used in all simulations as an interface between the SWMM-RUNOFF model and the HEC-RAS model. The SWMM-TRANSPORT model network includes the major stream segments modeled in the Fairfax County and the portions of the cities of Falls Church, Alexandria, and Arlington in the study area. This model network includes the same reaches incorporated into the HEC-RAS model and is used to perform flow routing and water quality routing through the stream system. This TRANSPORT model network is used for performing long-duration simulations (e.g., multi-year) of flows and stormwater pollution loads in the streams. The TRANSPORT model network of the Cameron Run watershed streams is a simplified version of the network included in the HEC-RAS model. This TRANSPORT model network does not include nearly the number of stream cross-sections and stream segments. This model network also includes stage-storage relationships for two lakes located within the modeled stream network, Fairview Lake and Lake Barcroft.

The Stormwater Model and GIS Interface Guidelines Technical Memorandum (CDM 2003) summarizes the procedures used to simulate onsite and regional detention facilities. As described in the Technical Memorandum and in Section 2 of this report, each subbasin in the Cameron Run study area is divided into three subareas where required:

A. Parcels developed after 1972 and before 1994 that have peak shaving stormwater controls but no water quality controls.

B. Parcels that were developed after 1994 that have both water quality and peak shaving stormwater controls.

C. Parcels developed before 1972 that have no stormwater controls.

Section 2.2 provides a description of the procedures for developing stage-storage-discharge curves used to simulate the peak shaving stormwater controls from subarea types A and B.

TRANSPORT uses stream cross-section data in a format similar to the HEC-RAS program for natural stream sections. Stream segment length, slope, and Manning's Roughness coefficient are also input to the model. These were derived from the HEC-RAS model; see Section 3.0.

2.2 DEVELOPMENT OF PEAK-SHAVING STORMWATER CONTROLS

There are several hundred onsite detention facilities in the Fairfax County portions of the study area; no data were available for ponds in the Falls Church, Alexandria, or Arlington portions of the watershed. It was not feasible to develop detailed stage-volume-discharge input data to simulate all of these, so they were simulated using a lumped parameter approach.

Peak-shaving storage was simulated as a storage element in the SWMM-TRANSPORT model. The stage-storage-discharge relationships were developed based on the following assumptions:

1. Storage volume and outlet structures are designed to limit the peak flows for existing development to the undeveloped peak flows for the 2-year and 10-year design storms.

2. Ponds in subarea type A (peak-shaving control only) and B (peak-shaving and water quality controls) include extended detention as defined by the County Public Facilities Manual (Fairfax County 2001)

The TRANSPORT storage element input data include a table of depth, surface area, storage volume, and discharge. A SAS program was developed to automate the generation of the stage-storage volume and stage discharge curves. The following steps were used to develop the input data:

1. Simulate peak flows for 2-year and 10-year storms for existing land use conditions. The NRCS Type II 24-hour rainfall distribution was used in these simulations. The 2-year, 24-hour rainfall volume is 3.2 inches; the 10-year, 24-hour rainfall volume is 5.5 inches; and the 100-year, 24-hour rainfall volume is 7.7 inches (NRCS, 2002).

2. Simulate peak flows for 2-year and 10-year storms for a natural undeveloped (forested) condition. This assumes a zero impervious area (DCIA) using the default SWMM runoff parameters as previously described.

3. Compute storage volume required to control the 10-year storm flow for existing development by subtracting the RUNOFF volume for the undeveloped condition from the current condition. The RUNOFF module was used simulate and compute the total volume of the 10-year, 24-hour storm using current impervious conditions for each parcel subarea.

4. Set the storage element surface area to a constant value (e.g., 10,000 square feet) and calculate the depth of the 10-year storage computed in step 3.

5. It is assumed that detention storage facilities are extended dry detention ponds. Compute the extended drawdown volume based on the impervious area and compute the outflow rate to de-water the storage volume over 48 hours. Set this de-watering outflow rate at zero depth and at a depth corresponding to the extended detention volume. Then linearly ramp up outflow from zero to the 2-year predevelopment peak flow over the computed depth for that volume.

6. Ramp linearly up to the 10-year undeveloped peak flow over the constant-area computed depth.

7. Define the storage facility to have a constant outflow equal to the 10-year undeveloped peak flow. Perform a simulation of the 10-year storm for existing development to determine the maximum storage volume required.

8. Set a storage outflow point with the outflow equal to the 10-year undeveloped peak flow and the depth associated with the storage volume determined in step 7 above.

9. Linearly ramp flows up to 3 times the 10-year post-development peak flow over a volume 10% higher than the 10-year developed storage requirement.

This procedure results in a synthetic stage-storage-outflow relationship that effectively simulates the effect of the detention facilities. This approach was applied to all locations where the year of development indicates that detention storage is required in Fairfax County.

Areas indicated for future development were estimated as described in Section 1.6. These areas were re-assigned to subarea type B. The procedure for computing the peak shaving input data for these areas was repeated, assuming that all future development will be fully controlled for both 2- and 10-year peak flow detention and water quality. Thus, a new set of synthetic ponds was developed based on the future impervious area estimates.

Fairview Lake and Lake Barcroft were included in the TRANSPORT model as regional ponds within the stream channel network. Tables 2-1 and 2-2 show the storage-area-depth relationships for these lakes. Fairview Lake is located in Holmes Run Upper subwatershed and is simulated as a storage area between stream segments in that reach. Lake Barcroft is simulated as a storage area with inputs from Holmes Run Upper and from Tripps Run, in addition to several subbasins which drain directly to it.

For subarea B ponds, water quality treatment is simulated in addition to peak flow control. Pollutant removals were simulated using a water quality divider element. Removal efficiencies for each pollutant are listed in Table 2-3.

The purpose of this RUNOFF/TRANSPORT model is to perform long-duration simulations of flows and water quality in the stream segments. The TRANSPORT model uses at least one transport segment between locations where flows from a subbasin enter the modeled stream network or where modeled streams join. Each stream segment was modeled as a trapezoidal cross-section, using the stream length and slope from a subset of the TIN-derived cross-sections in HEC-RAS. Stream cross-sections are numbered consecutively within a subbasin, with the section number indicating its distance in feet from the most downstream portion of each subwatershed or from its connection to the main subwatershed channel for tributary streams. Figure 2-1 illustrates the SWMM RUNOFF and TRANSPORT model network for Cameron Run with each of its subwatershed model components. The RUNOFF and TRANSPORT models are named for the subwatersheds that they represent. SWMM COMBINE elements are used to join tributaries together as shown. Raincode files provide the appropriate rainfall data to each RUNOFF subwatershed model. The final model (including proposed

Table 2-1. Fairview Lake stage discharge-storage values for use in SWMM and HEC-RAS (adapted from HEC1 data file called 1BSN-REV.IH1 from Fairfax County)

Feet Stage	cfs Flow	Acre-ft Storage	ft^3 Storage
310	0	16.1	699138
311	46	18.4	799326
312	131	20.7	899514
313	240	23.0	999702
314	368	25.3	1099890
315	510	27.6	1200078
316	661	30.3	1318213
317	821	33.0	1436347
318	987	35.7	1554482
319	1308	38.4	1672617
320	2181	41.1	1790752
321	3430	51.0	2220166
322	4997	60.8	2649581
323	6840	70.7	3078995
324	8940	80.5	3508410
325	11284	90.4	3937824
326	13594	98.0	4268009
327	16043	105.6	4598194
328	18622	113.1	4928378
330	24131	128.3	5588748

Table 2-2. Lake Barcroft stage-discharge-storage values for use in SWMM and HEC-RAS. Adapted from outflow rating from Table 4 of Lake Barcroft Phosphorus Study by GKY, (GKY 1993), assuming goal to keep lake level constant at 208.5 feet. Surface area and storage from page 3 of the same report, assumed at elevation 208.5, assuming vertical sides within 208-210.5 ft., with a maximum depth of about 50 feet.

Elevation, ft	Flow, cfs	Surface Area, ft^2	Storage, ft^3	Depth, ft
208	1.1	5892750	84173625	53
208.25	1.1	5892750	85646813	53.25
208.33	2.8	5892750	86118233	53.33
208.5	1081	5892750	87120000	53.5
209	4219	5892750	90066375	54
209.5	7956	5892750	93012750	54.6
210	11693	5892750	95959125	55
210.5	18086	5892750	98905500	55.5

projects) includes 379 RUNOFF subbasins, 1071 TRANSPORT elements with 246 storage units, 83 LID elements, and 38 miles of stream segments modeled as trapezoidal channels. Table 2-4 lists the RUNOFF and TRANSPORT model elements for each subwatershed in the Cameron Run watershed SWMM model.

Table 2-3. Percent removal of pollutants for SWMM simulation of extended detention ponds

TN	TP	DP	BOD	COD	TSS	Pb	Cu	Zn	Cd	TDS
30	40	-11#	20	25	80	80	50	50	50	0*

Information sources:

Values from CDM 2005 except as follows:

Pb from: TM3, CDM 2003.

DP from: Winer, R. 2000. National Pollutant Removal Performance Database for Stormwater Treatment Practices, 2nd Edition. Prepared by Center for Watershed Protection for USEPA Office of Science and Technology.

COD from: Schueler, T.R., 1997. Technical Note 95. Comparative Pollutant Removal Capability of Urban BMPs: A Reanalysis. Watershed Protection Techniques. Vol. 2, No. 4. June 1997.

model cannot simulate pollutant generation, so zero assumed

* No data available, so zero assumed

Table 2-4. SWMM model elements in the Cameron Run watershed model

Subwatershed Name	RUNOFF Subbasins	TRANSPORT Elements	Storage Units	Modeled Stream Length, miles
Holmes Run Upper	85	242	57	23
Tripps Run	54	121	36	8
Lake Barcroft*	18	42	13	5
Backlick Run	88	224	57	15
Indian Run	21	74	14	6
Turkeycock Run	27	80	18	7
Holmes Run Lower	35	121	18	4
Cameron Run Tribs	24	64	15	6
Pike Branch	27	103	18	9
TOTAL	379	1071	246	83

* Separately modeled subbasins draining directly to the lake (from subwatersheds Holmes Run Upper, Tripps Run, and Holmes Run Lower).

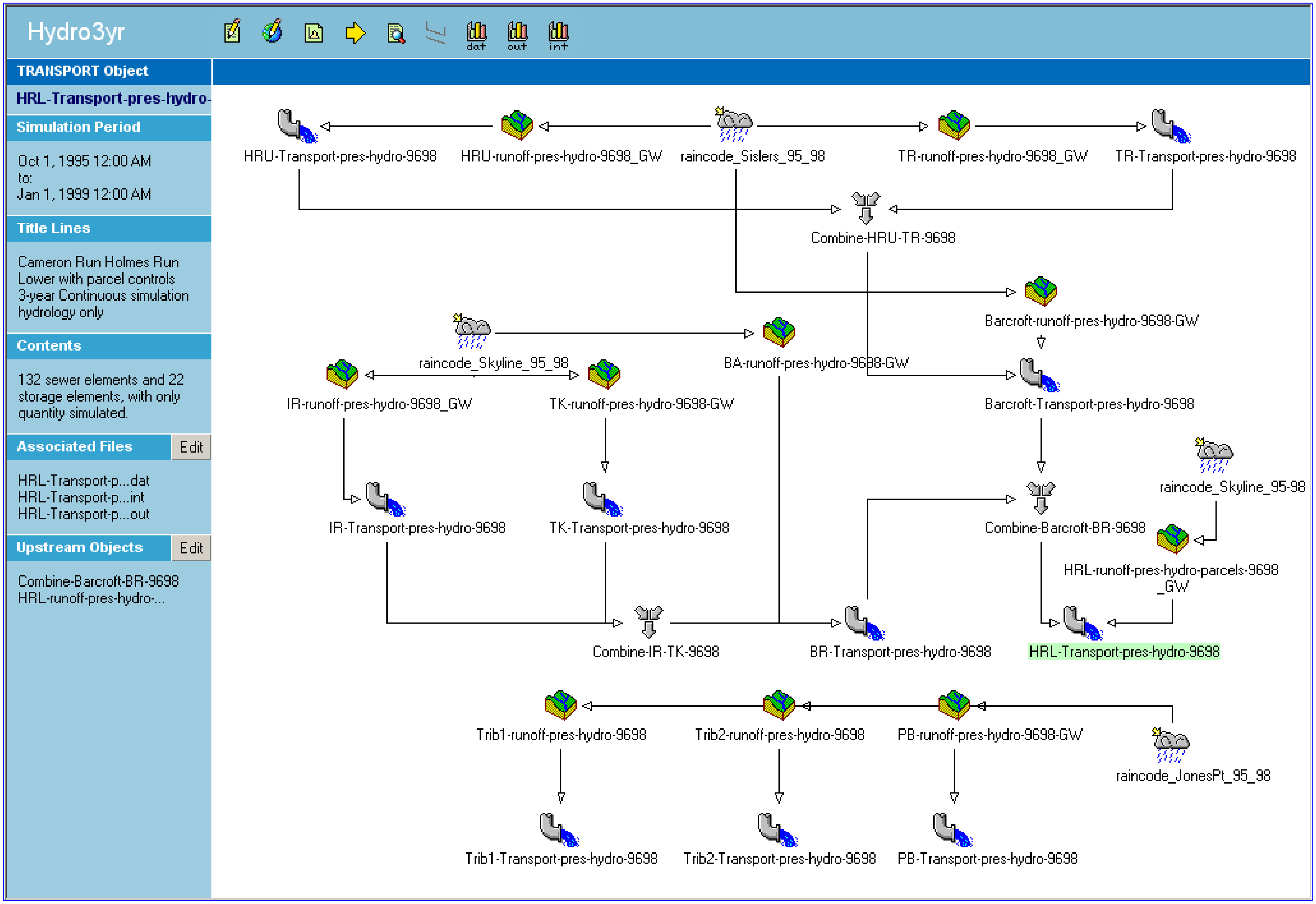

Figure 2-1. Cameron Run watershed SWMM model components as shown in the PCSWMM Object Manager

A second set of SWMM-TRANSPORT models for each subwatershed was developed to provide input to the HEC-RAS model. This model includes the same RUNOFF inputs and storage areas that are included in the overall SWMM hydrology model. Peak flows at cross-sections in the SWMM model downstream of each subbasin were output to provide flows for the HEC-RAS model for single-event simulations of the entire watershed.

2.3 SIMULATION OF TIER-1 PROJECTS IN SWMM

Tier-1 projects consist of four basic types: new stormwater management (SWM) ponds, SWM pond retrofits, low-impact development (LID) projects such as bioretention areas, and stream restoration; the latter were not simulated as detailed designs would be required for this purpose. New SWM ponds are assumed to have both water quality and peak shaving stormwater controls; pond retrofits are assumed to involve conversion of ponds with only peak-shaving benefits into those which also have water quality controls. These facilities are simulated as described in the previous section. Land areas draining to these facilities were digitized in GIS and the imperviousness and landuse fractions for the SWM pond drainages in each subbasin were calculated using the future land use projections as described in the previous section. Similarly, land areas draining to LID facilities in each subbasin which had them were digitized in GIS and the impervious and land use fractions for these drainages were calculated. As described in the Stormwater Model and GIS Interface Guidelines (CDM 2003), the SWMM RUNOFF Model interconnected subbasin method was used to simulate LID controls. This method uses two interconnected subbasins, one representing the land development area controlled by the LID facilities in a subbasin, and one representing the total surface area of the LID facilities in that subbasin. The size of the LID facility was estimated based on the Virginia Stormwater Management Handbook (VACDR 1999) by applying the average of the storage requirement of 0.5-1.0 inch per impervious acre of tributary area, using a maximum ponding depth of 6 inches. The area representing the LID facilities in a subbasin was assumed to be 100% pervious, with pervious depression storage equal to the calculated storage area, up to the maximum ponding depth of 6 inches. RUNOFF flows and pollution loads which do not exceed this available depression storage capacity are removed from the surface runoff, while flows and loads that exceed this capacity overflow untreated to the downstream TRANSPORT channel. Further details of this modeling approach are described in Section 5.5.2 of the Stormwater Model guidelines (TM-3; CDM 2003).

2.4 CONTINUOUS SIMULATION RESULTS

2.4.1 SWMM Hydrology Calibration and Verification

The SWMM-RUNOFF and SWMM-TRANSPORT models were set up to perform a continuous simulation for a three-year calibration period (1996 through 1998). The simulation used 15-minute rainfall recorded at three Fairfax County rainfall gages (Sislers, Skyline, and Jones Point) located in the watershed (Figure 2-2). Each subwatershed was assigned to the closest rain gage for input to the model (Sislers: Holmes Run Upper, Tripps Run; Skyline: Backlick Run, Holmes Run Lower, Indian Run, Turkeycock Run; Jones Point: Cameron Tribs, Pike Branch).

The USGS operates a stream gage on Cameron Run in Alexandria at the Norfolk Southern Railway Bridge. The station is located on the downstream and left side of the bridge. The simulation results were compared with observed flows from the stream gage.

Several iterations were made to calibrate the groundwater parameters to obtain the best fit for baseflows observed during dry weather periods. The best fit was obtained with the following adjusted groundwater parameter values (modified from the default values in Table 1.8): B1=16; A3=.0035; DP=.005. Runoff parameters were also adjusted to obtain the best fit of flow peaks for small, medium, and large storm events; the best fit was obtained with PCTZER=100% (percent of impervious area with zero detention); WSTORE1=0.01 (impervious area depression storage); WSTORE2=0.02 (pervious area depression storage); WLMAX=2.5 (maximum initial infiltration rate); WLMIN=0.03 (minimum infiltration rate).

Figures 2-3 through 2-6 present plots of observed flows and simulated flows for the final calibration, for each of the four quarters of 1996. Figure 2-7 presents the observed and simulated flow-frequency curves for 1996 through 1998.

Flow frequency curves present the fraction of the time that flows are less than or equal to a given flow rate. These results use the parameters and procedures used in the SWMM-RUNOFF and TRANSPORT models as described previously in this report. Tables 2-5 and 2-6 show the results of a statistical comparison of the model simulation results and the gage data for the 3-year calibration period (1996-1998) and for the 3-year verification period (1999-2001). The last quarter of 2001 was not simulated due to missing rainfall data for that period.

The simulation for the portion of the watershed draining to the gage is based on two rainfall gages located within the watershed. The USGS gage reflects the rainfall that fell over the watershed upstream of the gage, including Backlick Run, Holmes Run Lower and Upper, Indian Run, Tripps Run, and Turkeycock Run. Cameron Run (lower mainstem) Tributaries and Pike Branch drain below this gage. Rainfall from the three gages in or near the watershed are quite variable, with the greatest seasonal variability in April through June and lowest variability in October through December. Table 2-7 shows rainfall variability among these three gages and the gage at National Airport to the east of the watershed. An example of rainfall variability in one particular storm is shown in Figure 2-8, which shows a range of total event rainfall of 0.14 to 3.79 inches for an 8-hour event.

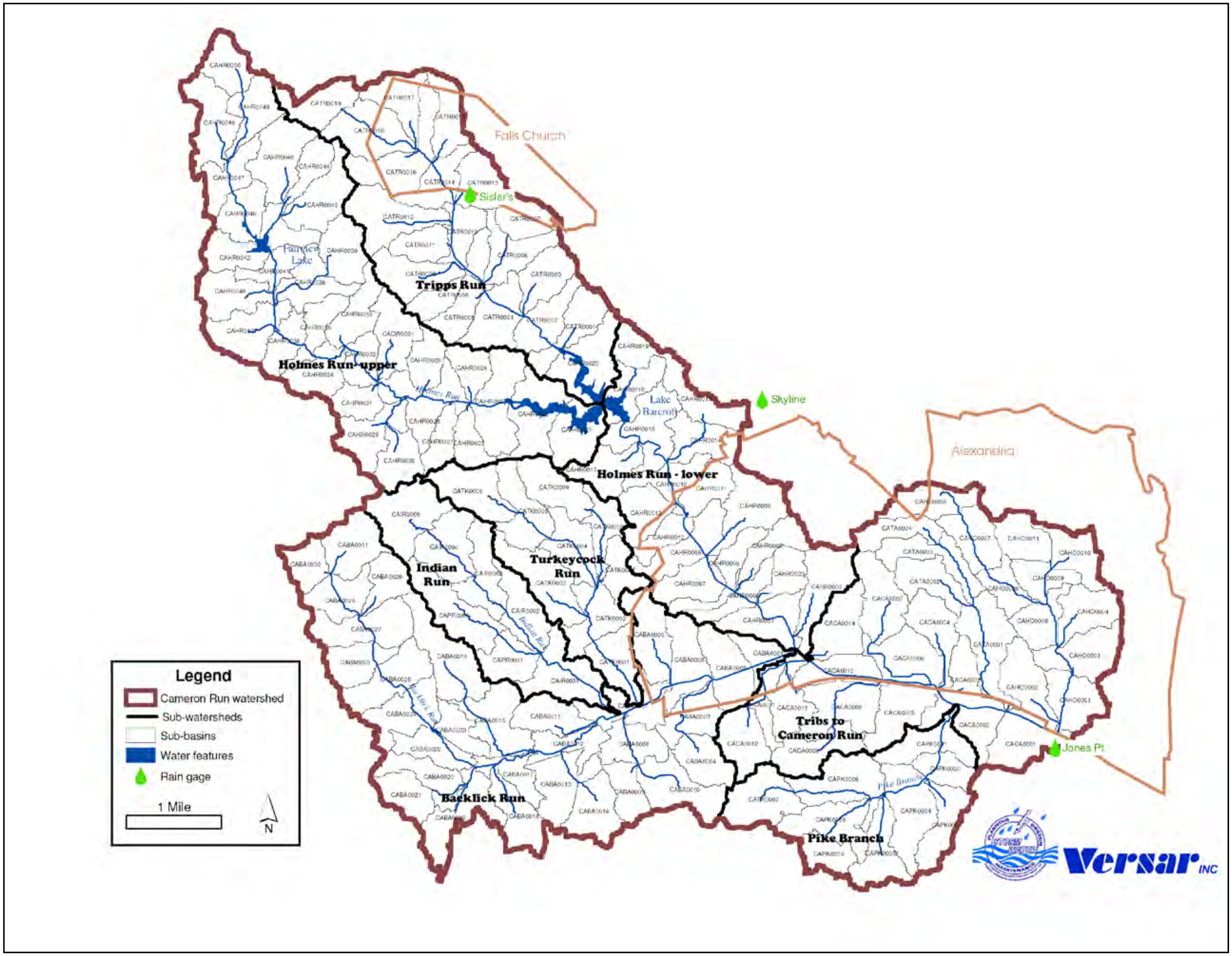

Figure 2-2. Cameron Run watershed showing subwatersheds, subbasins, and rain gages

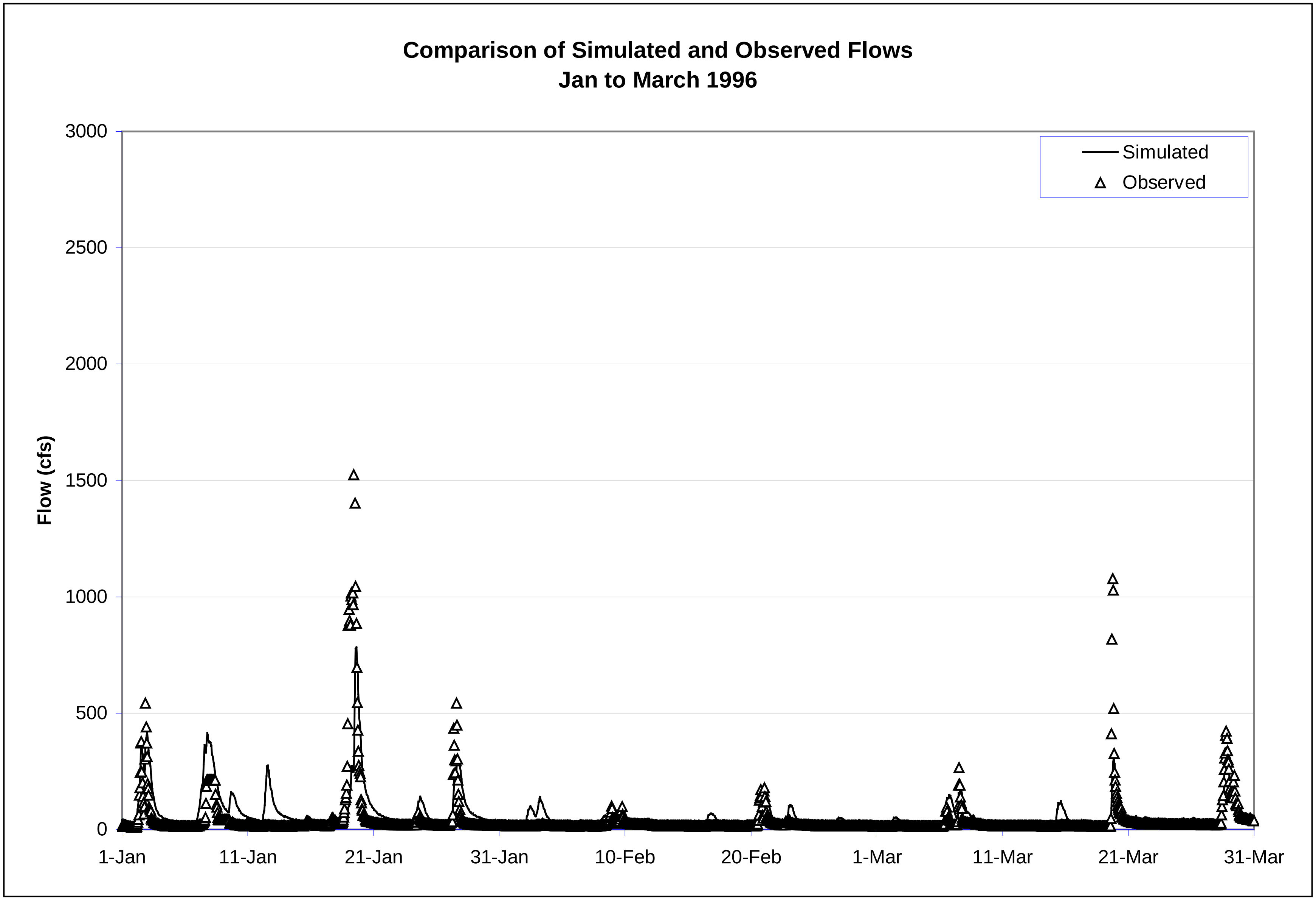

Figure 2-3. Comparison of simulated and observed flows January to March 1996

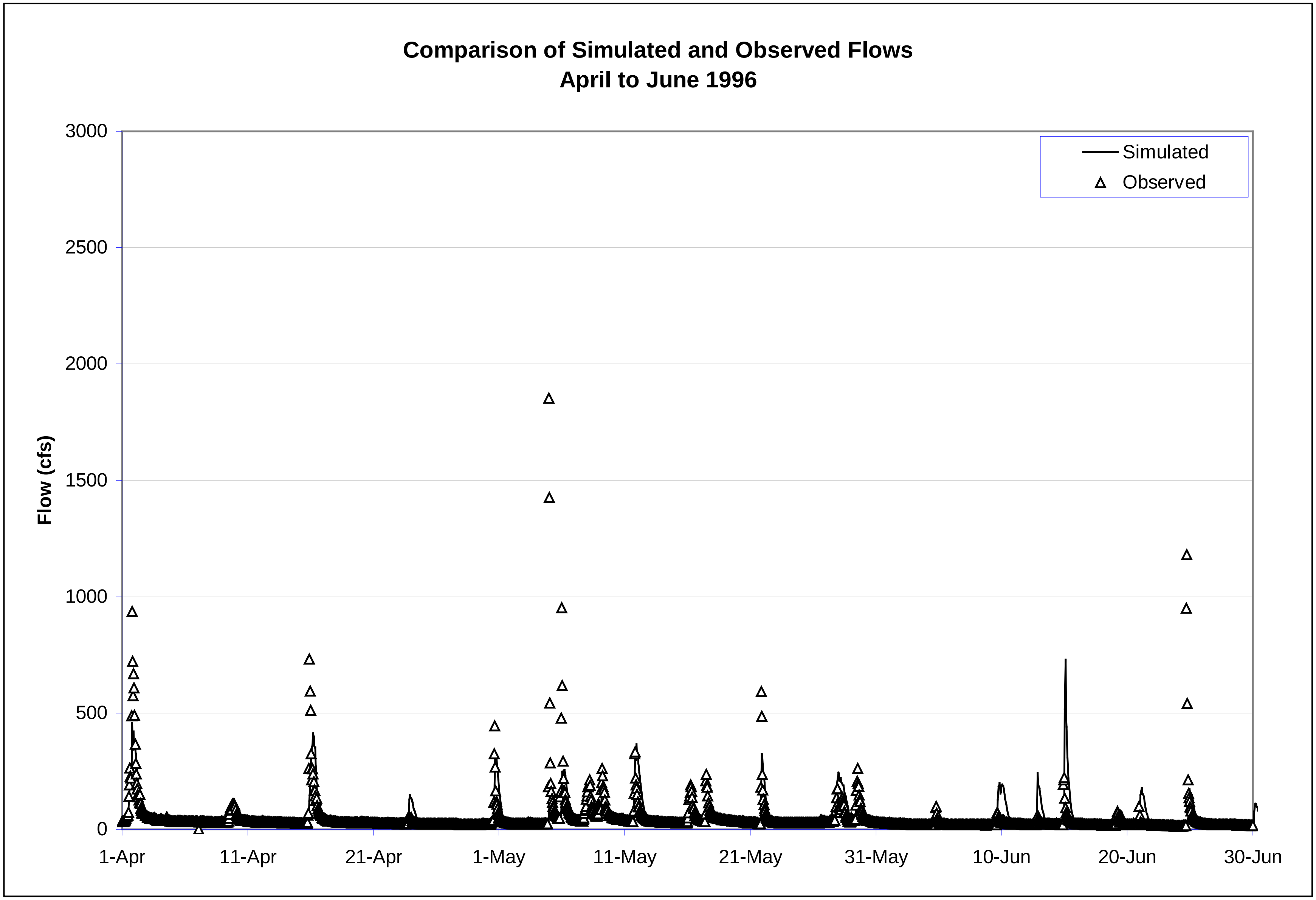

Figure 2-4. Comparison of simulated and observed flows April to June 1996

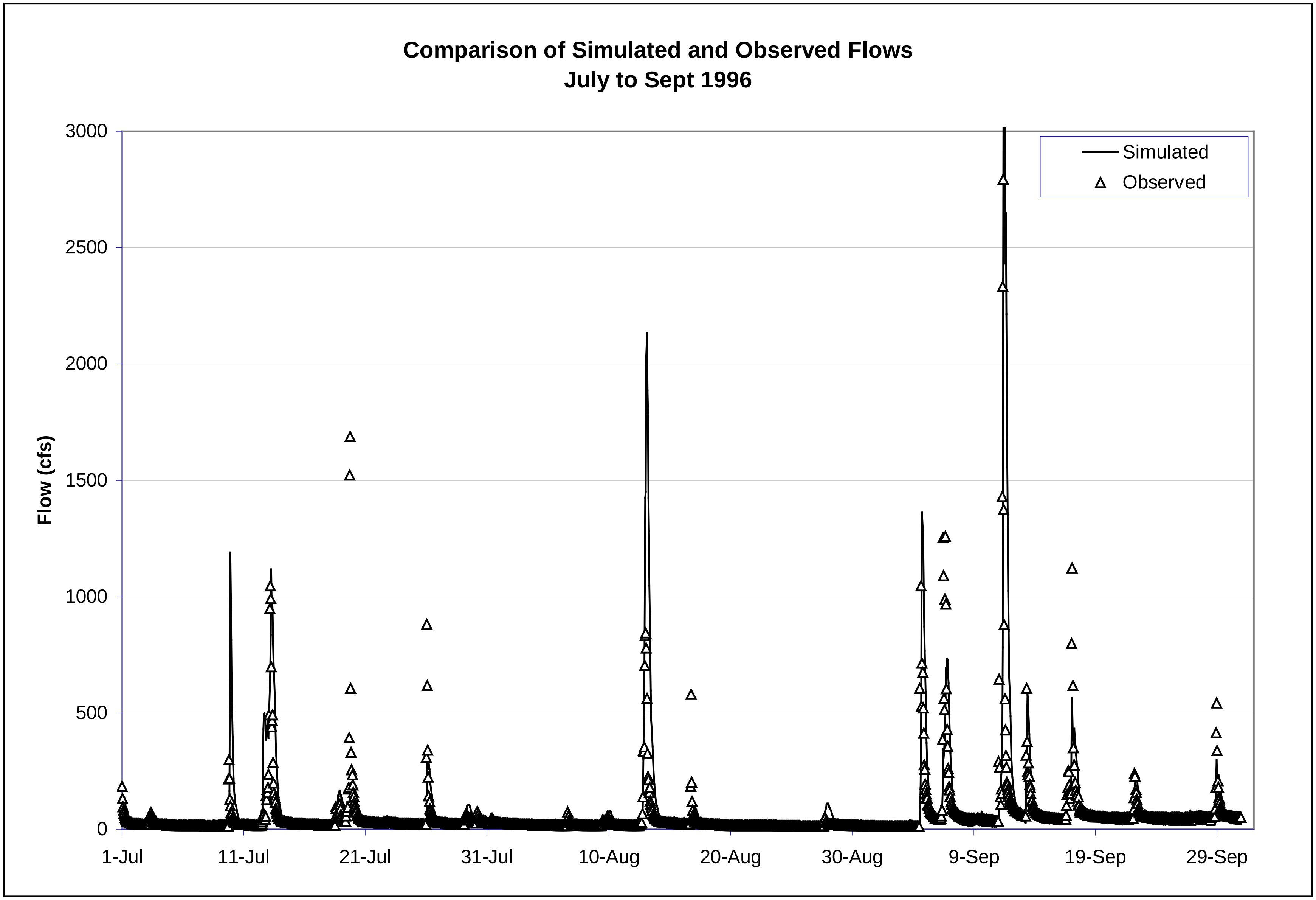

Figure 2-5. Comparison of simulated and observed flows July to September 1996

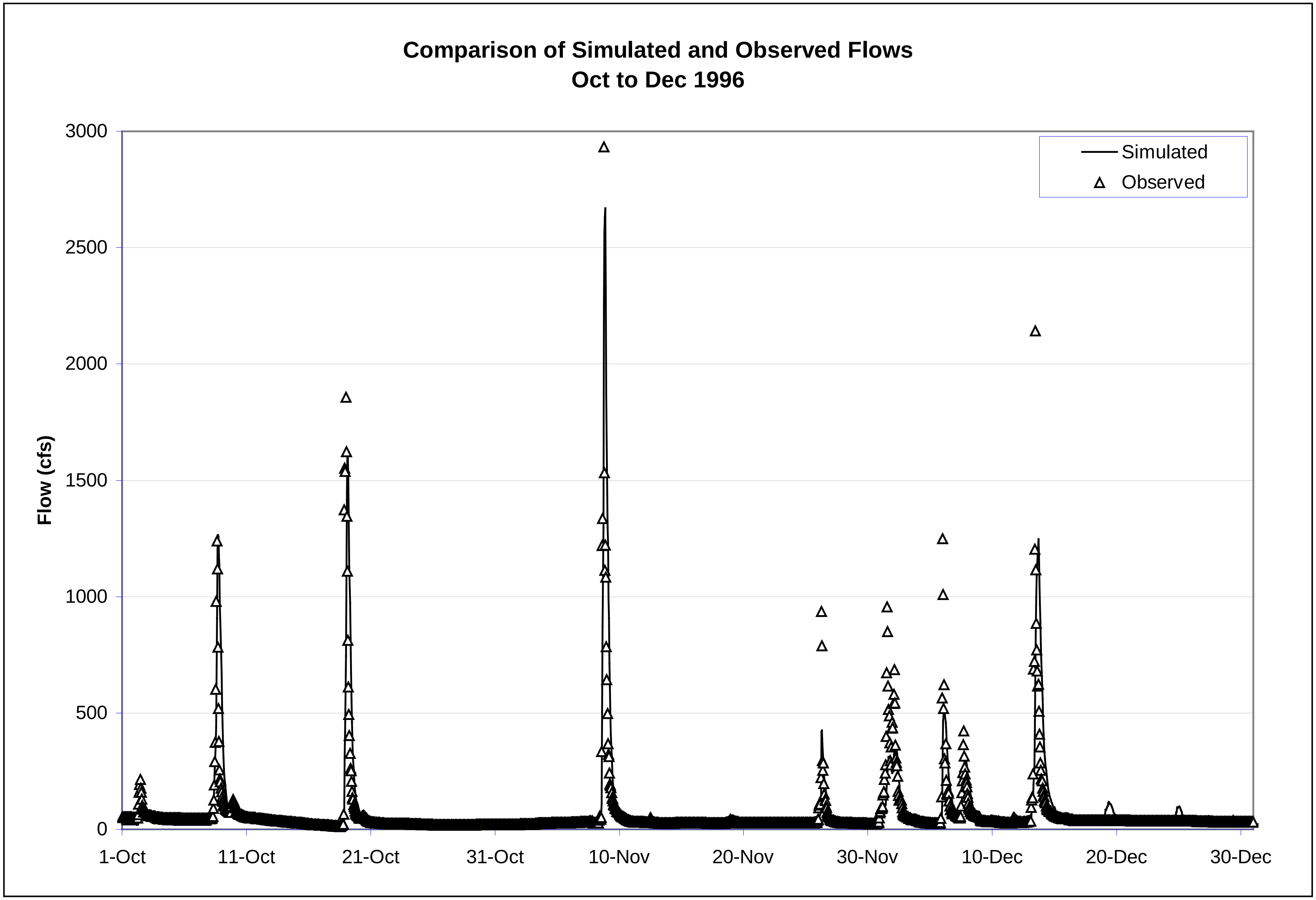

Figure 2-6. Comparison of simulated and observed flows October to December 1996

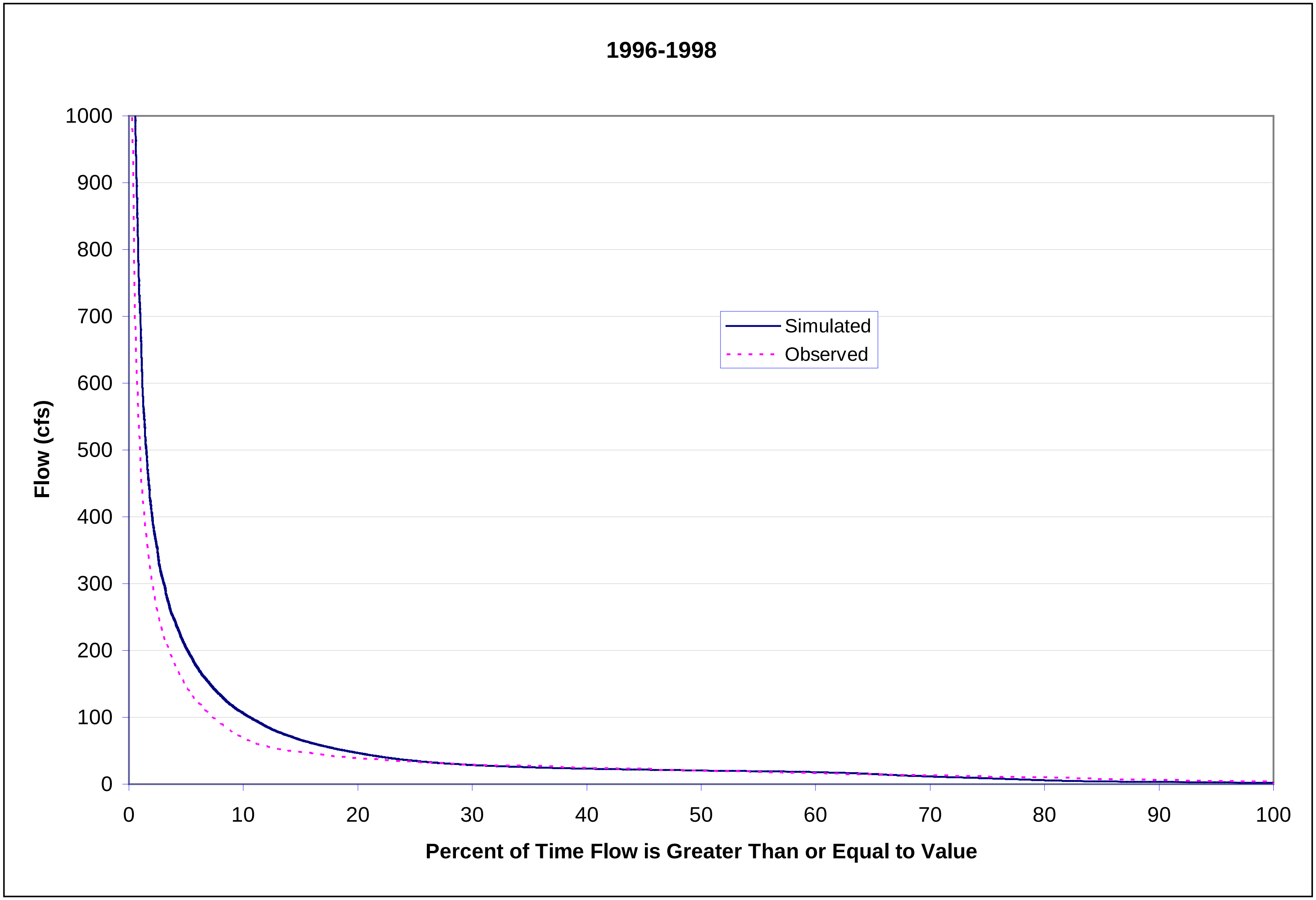

Figure 2-7. Comparison of simulated and observed flows, frequency (1996-1998)

Table 2-5. Cameron Run SWMM model calibration: statistical comparison of simulation results and observed gage data for 1996-1998

Year	Season	Model						Gage						% error
		n	**Volume, cubic feet**	**Mean Flow, cfs**	**stddev**	**min**	**max**	**n**	**Volume, cubic feet**	**Mean Flow, cfs**	**stddev**	**min**	**max**	
1996-1998	All	26305	5.1E+09	54	156	2	5930	26304	4.1E+09	43	118	0	4993	23.8
1996	All	8784	2.0E+09	63	163	5.3	3604	8784	1.8E+09	56	158	0	4993	12.0
1997	All	8760	1.3E+09	42	154	2.1	5930	8760	1.0E+09	32	67	0	1783	31.0
1998	All	8760	1.7E+09	55	152	2	3024	8760	1.3E+09	41	111	0	2548	34.2
1996	Jan-Mar	2184	4.6E+08	58	77	16.9	783	2184	3.6E+08	45	167	10	4993	27.9
1997	Jan-Mar	2160	4.0E+08	52	77	18.1	904	2160	3.5E+08	44	66	17	1075	16.9
1998	Jan-Mar	2160	8.3E+08	107	228	4.5	2384	2160	6.8E+08	88	173	12	2548	21.6
1996	Apr-Jun	2184	3.7E+08	47	63	8.2	731	2184	3.7E+08	48	88	0	1853	-2.4
1997	Apr-Jun	2184	3.7E+08	47	221	3.8	5930	2184	2.5E+08	32	78	0	1783	46.2
1998	Apr-Jun	2184	6.4E+08	82	172	16.5	3024	2184	4.3E+08	55	119	0	2198	49.8
1996	Jul-Sep	2208	5.9E+08	75	234	5.3	3604	2208	5.0E+08	62	176	11	3343	19.7
1997	Jul-Sep	2208	2.1E+08	26	112	2.1	1803	2208	1.4E+08	17	43	4	772	53.9
1998	Jul-Sep	2208	1.8E+08	22	60	2.7	984	2208	1.0E+08	13	36	3.5	634	70.9
1996	Oct-Dec	2208	5.7E+08	72	201	13.3	2670	2208	5.5E+08	69	179	12	3055	4.6
1997	Oct-Dec	2208	3.6E+08	45	163	2.1	2192	2208	2.9E+08	37	72	3.7	1089	23.8
1998	Oct-Dec	2208	9.5E+07	12	34	2	423	2208	8.5E+07	11	23	3.5	306	11.3

Table 2-6. Cameron Run SWMM model verification: statistical comparison of simulation results and observed gage data for 1999-2001

Year	Season	Model						Gage						% error
		n	**Volume, cubic feet**	**Mean Flow, cfs**	**stddev**	**min**	**max**	**n**	**Volume, cubic feet**	**Mean Flow, cfs**	**stddev**	**min**	**max**	
1999-2001	All	24096	4.23E+09	49	181	2.1	12518	24094	3.52E+09	41	148	2.2	6605	20.0
1999	All	8760	1.5E+09	48	164	2.1	4433	8759	1.06E+09	34	106	2.6	2603	42.0
2000	All	8784	1.54E+09	49	124	2.7	1986	8784	1.48E+09	47	189	2.2	6605	4.0
2001	Jan-Sep	6552	1.19E+09	50	254	3	12518	6551	9.85E+08	42	134	4.6	3720	20.5
1999	Jan-Mar	2160	4.09E+08	53	90	3.7	970	2160	3.38E+08	43	93	6.8	1293	20.9
2000	Jan-Mar	2184	3.13E+08	40	89	5	1350	2184	3.63E+08	46	92	8.6	1885	-13.6
2001	Jan-Mar	2160	2.71E+08	35	87	3	1197	2160	3.78E+08	49	146	4.6	2153	-28.3
1999	Apr-Jun	2184	2.2E+08	28	56	2.6	739	2183	1.37E+08	17	36	2.6	667	60.7
2000	Apr-Jun	2184	4.87E+08	62	135	15.6	1986	2184	4.51E+08	57	156	10.3	4455	7.9
2001	Apr-Jun	2184	4.04E+08	51	110	3.6	1908	2183	3.58E+08	46	147	6	3720	12.8
1999	Jul-Sep	2208	6.41E+08	81	300	2.1	4433	2208	3.79E+08	48	172	3.5	2603	69.4
2000	Jul-Sep	2208	6.02E+08	76	171	3.8	1817	2208	4.9E+08	62	295	2.2	6605	22.7
2001	Jul-Sep	2208	5.12E+08	64	414	5.8	12518	2208	2.48E+08	31	105	4.6	1788	106.1
1999	Oct-Dec	2208	2.3E+08	29	57	6	675	2208	2.03E+08	26	69	6.8	783	13.3
2000	Oct-Dec	2208	1.38E+08	17	63	2.7	1222	2208	1.76E+08	22	145	3	4923	-21.8

Table 2-7. Rainfall variability in 1996-1998, as recorded at these rain gages: Sisler's, Skyline, Jones Point, and National Airport

Year	Season	Min Rain	Max Rain	% Variability	Seasonal Average % Variability
All	All	109.0	121.0	10.2	
1996	All	41.4	52.2	22.5	
1997	All	32.0	34.0	5.9	
1998	All	33.8	38.6	13.7	
1996	Jan-Mar	8.8	11.2	23.6	
1997	Jan-Mar	8.6	10.0	14.1	
1998	Jan-Mar	14.3	17.4	20.0	19.2
1996	Apr-Jun	7.7	12.2	42.6	
1997	Apr-Jun	7.1	8.9	22.8	
1998	Apr-Jun	10.8	14.2	26.1	30.5
1996	Jul-Sep	14.1	15.9	12.0	
1997	Jul-Sep	5.7	6.0	5.3	
1998	Jul-Sep	3.0	4.7	42.3	19.9
1996	Oct-Dec	10.7	13.4	21.6	
1997	Oct-Dec	9.3	10.9	15.4	
1998	Oct-Dec	3.2	3.4	4.8	14.0

The model does not simulate snowmelt and therefore cannot simulate snowfall and snowmelt events during the winter months. As an example, this is shown in January 1996 when snow fell in the early part of the month and melted in middle to late January (see Figure 2-3); thus, the gage shows less response to precipitation than the model in early January and a greater response in the middle and later events of the month than does the model.

The model represents the rising limb and recession limb reasonably well for most of the major events. Base flow rates are also reasonably represented by the SWMM-RUNOFF groundwater routines. The flow-frequency distribution shows that the model overestimates the observed flows about 15-20% of the time; total flow was overestimated by about 24% for the calibration period (1996-1998) and by about 20% for the verification period (1999-2001).

2.5 SWMM WATER QUALITY RESULTS

Average annual loadings for each model subbasin for the period 1996-1998 were calculated by summing the loadings from the detention-controlled areas and uncontrolled areas of each subbasin for current and future imperviousness and land use conditions. (Details concerning calculation of current and future imperviousness and land use are described in Section 1.6). These loadings include the influence of the areas assumed to contain detention controls with water quality treatment. Since these are subbasin loadings, they do not include simulation of pollutant removals by Fairview Lake or Lake Barcroft. Figures 2-9 through 2-23 illustrate loadings for Total Suspended Sediment (TSS), Total Nitrogen (TN) and Total

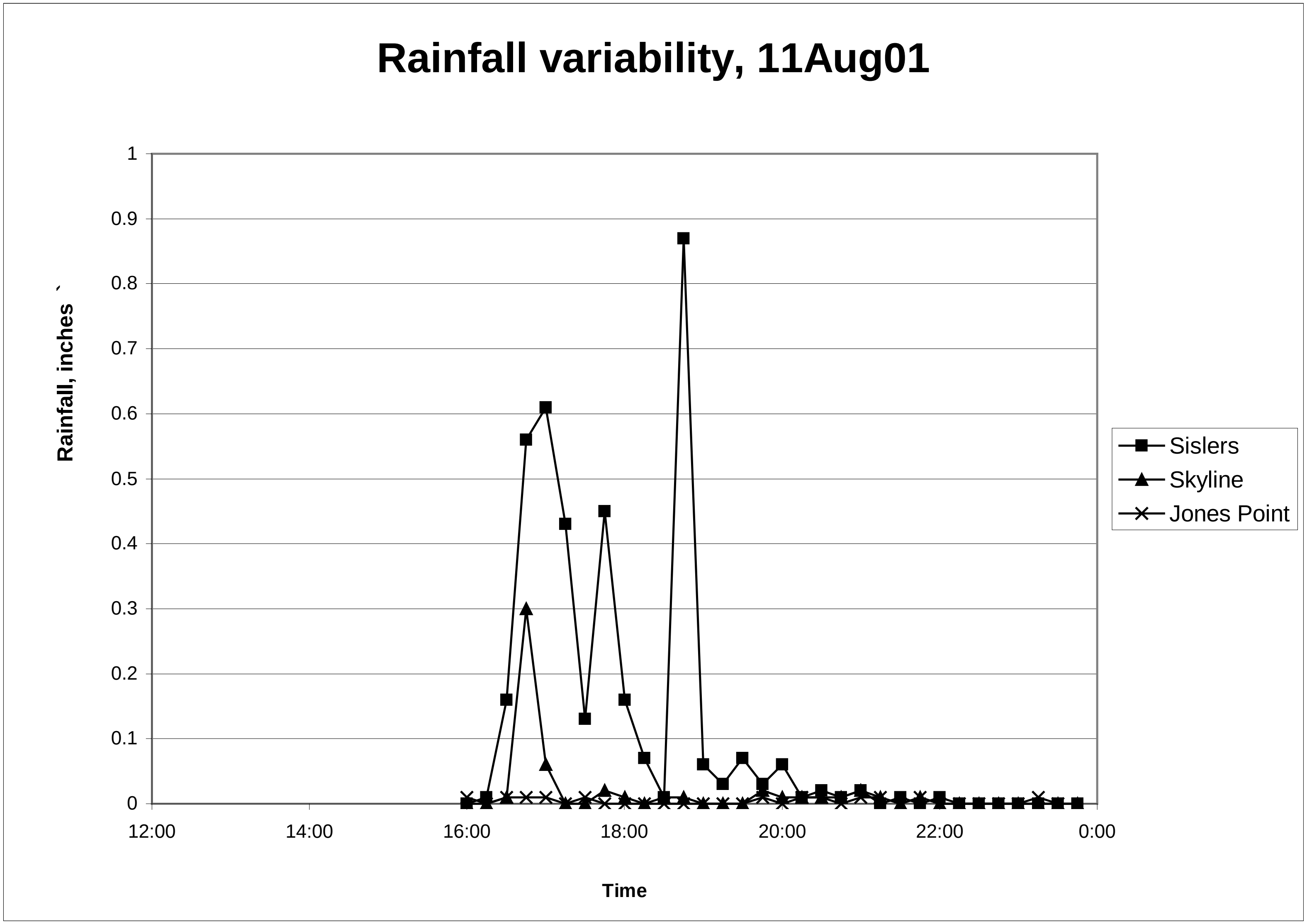

Figure 2-8. Example of rainfall variability at raingages in or near Cameron Run watershed

Phosphorus (TP) in each modeled subbasin throughout the watershed for current and future land use conditions and with the proposed projects, and the changes in loadings between these scenarios.

Average annual loadings for all 11 simulated water quality constituents within each subbasin are shown in Tables 2-8 to 2-10 for current and future land use conditions and for the proposed projects. Table 2-11 summarizes these results by subwatershed.

Results show moderate to high pollutant loadings, as expected from a highly developed watershed such as Cameron Run, which has only a modest amount of stormwater management due to its development prior to implementation of these types of controls. Results also show a relatively small increase in loadings from current to future conditions since most of the watershed has already been developed. The proposed projects show a small decrease in loadings from future conditions.

The model calculates a concentration value for each parameter and instream velocities at each hour. These results were used to develop water quality concentration and velocity distribution curves from the SWMM model outputs at the downstream end of each subwatershed. To focus these results on stormwater effects and its management, the water quality values for the upper 50^{th} percentile of flows were used for this assessment. This results in excluding values during low baseflow conditions, when the model cannot accurately calculate concentration values, since its focus is on stormwater runoff. Figures 2-24 through 2-26 illustrate these results.

2.6 DESIGN STORM SWMM RESULTS

The calibrated SWMM hydrology model was used to generate design storm hydrographs for each subbasin within each subwatershed of the model. Twenty-four-hour design storm (Type-II, NRCS 2002) rainfall for the 1-, 2-, 10-, 25-, and 100-year recurrence intervals were used as input to the model in place of the continuous rainfall data. All calibration parameters remained the same for these simulations. Simulations were made for imperviousness in the current, future, and future with projects scenarios for each subbasin, as previously described for the continuous model. These results can be used to evaluate the change in peak storm flows as a result of changes in land use and potential management measures designed for peak flow reduction. These results are also used as input to the HEC-RAS model (Section 3.0). Tables 2-12 and 2-13 summarize the results by subwatershed for Fairfax County areas; Table 2-14 lists results for each subbasin within each subwatershed. For example, two-year design storm peak flows for each subwatershed ranged from 244 to 349 cfs, with an area-weighted average for the whole watershed of 287 cfs, for current conditions. These peak flows increased an average of 3.8% for the projected future for the whole watershed, with the increase ranging from 0 to 6.3% for the various subwatersheds. This relatively modest increase in peak flow for future conditions is a result of this watershed already being mostly developed. Ten-year peak flows increased from 669 to 676 cfs from present to future over the entire watershed, a 1.0% increase; 100-year peak flows increased from 1054 to 1059 cfs, a 3.0% increase.

Simulation results for the proposed projects are listed in these tables by subwatershed. Results show a modest decrease in peak flows with the proposed projects, ranging from a 5.0% decrease for the 1-year storm over the entire watershed to 2.6% decrease for the 100-year storm for the future watershed.

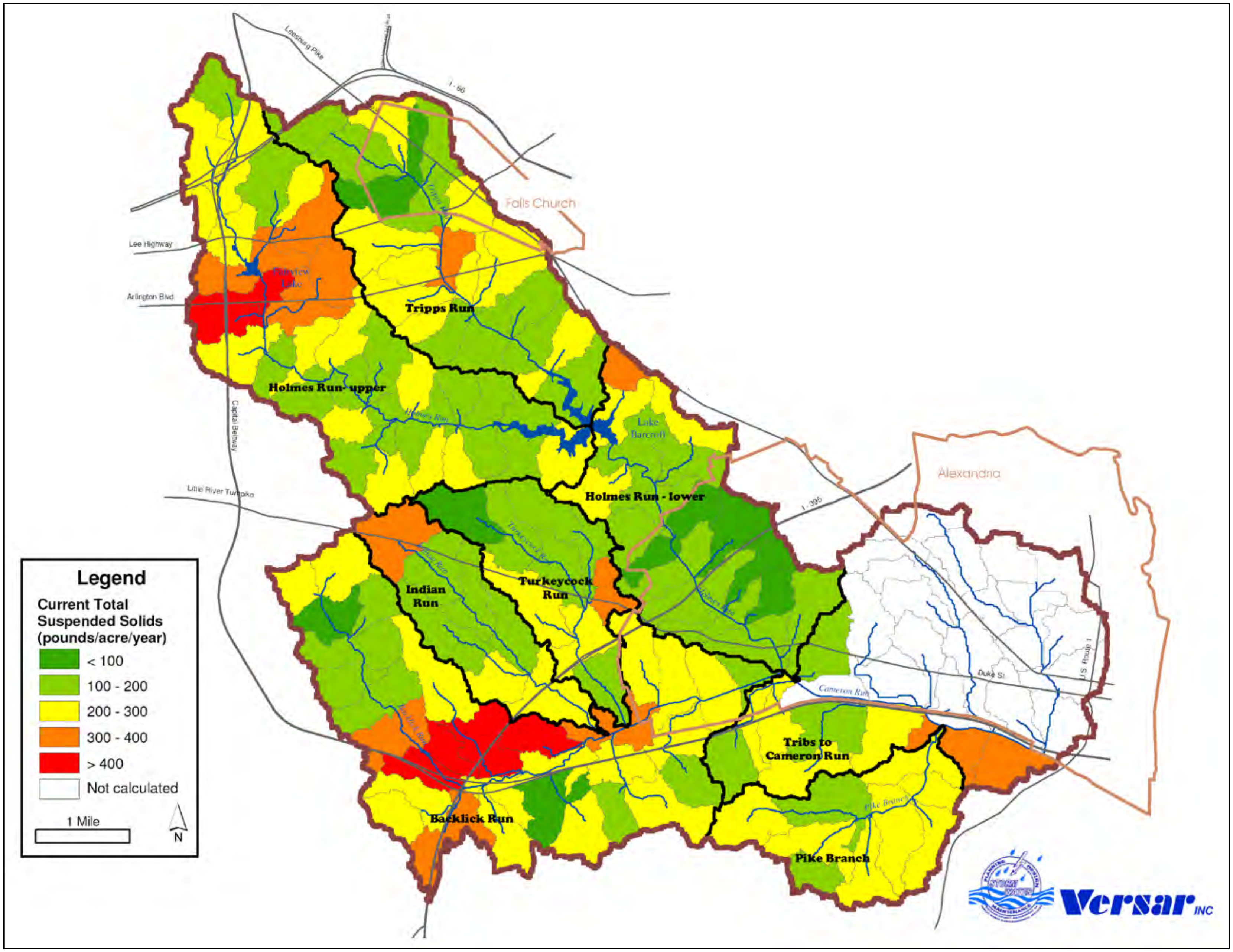

Figure 2-9. Average annual current Total Suspended Solids loadings in Cameron Run watershed based on simulation of rainfall-runoff events in 1996-1998 using SWMM

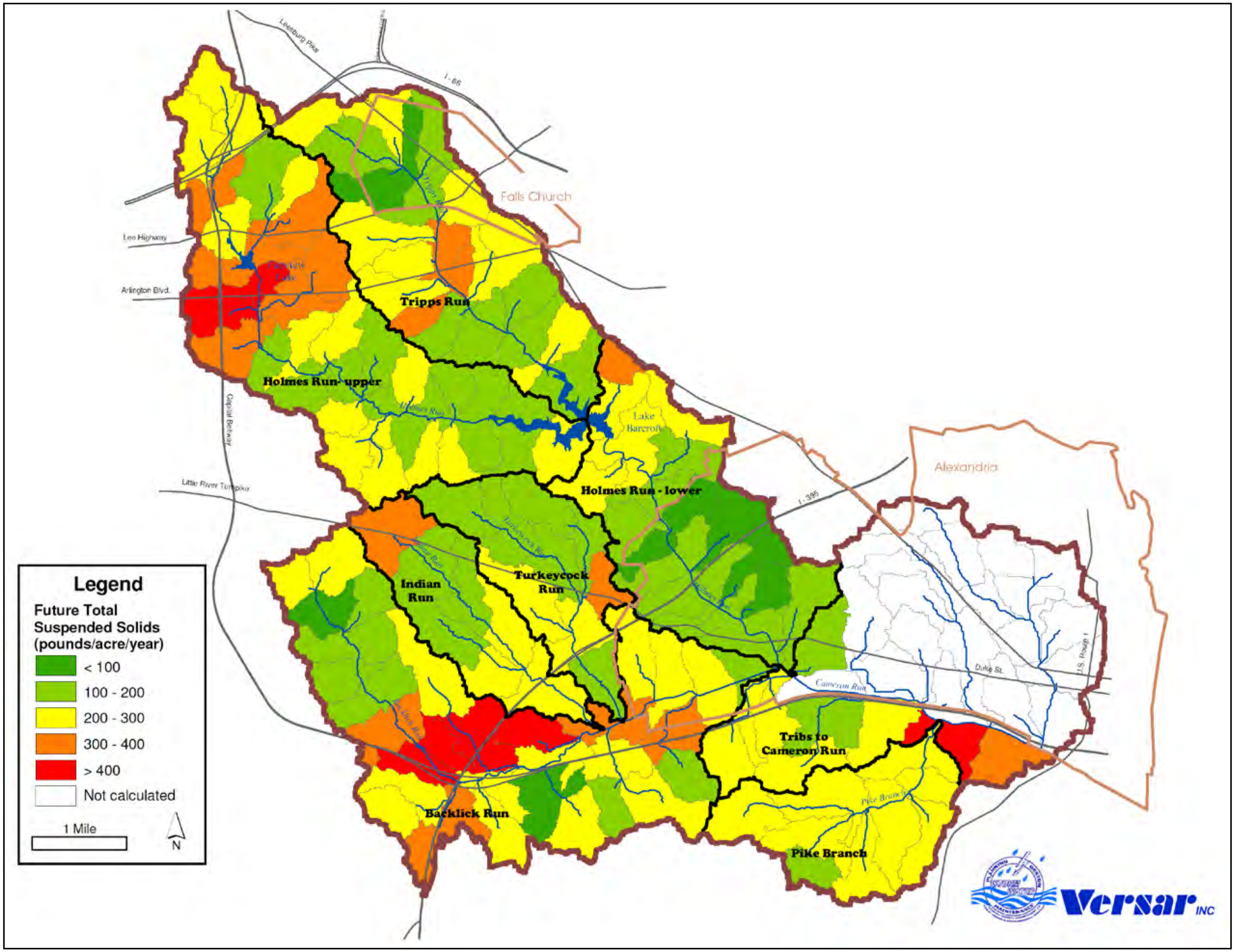

Figure 2-10. Average annual future Total Suspended Solids loadings in Cameron Run watershed based on simulation of rainfall-runoff events in 1996-1998 using SWMM

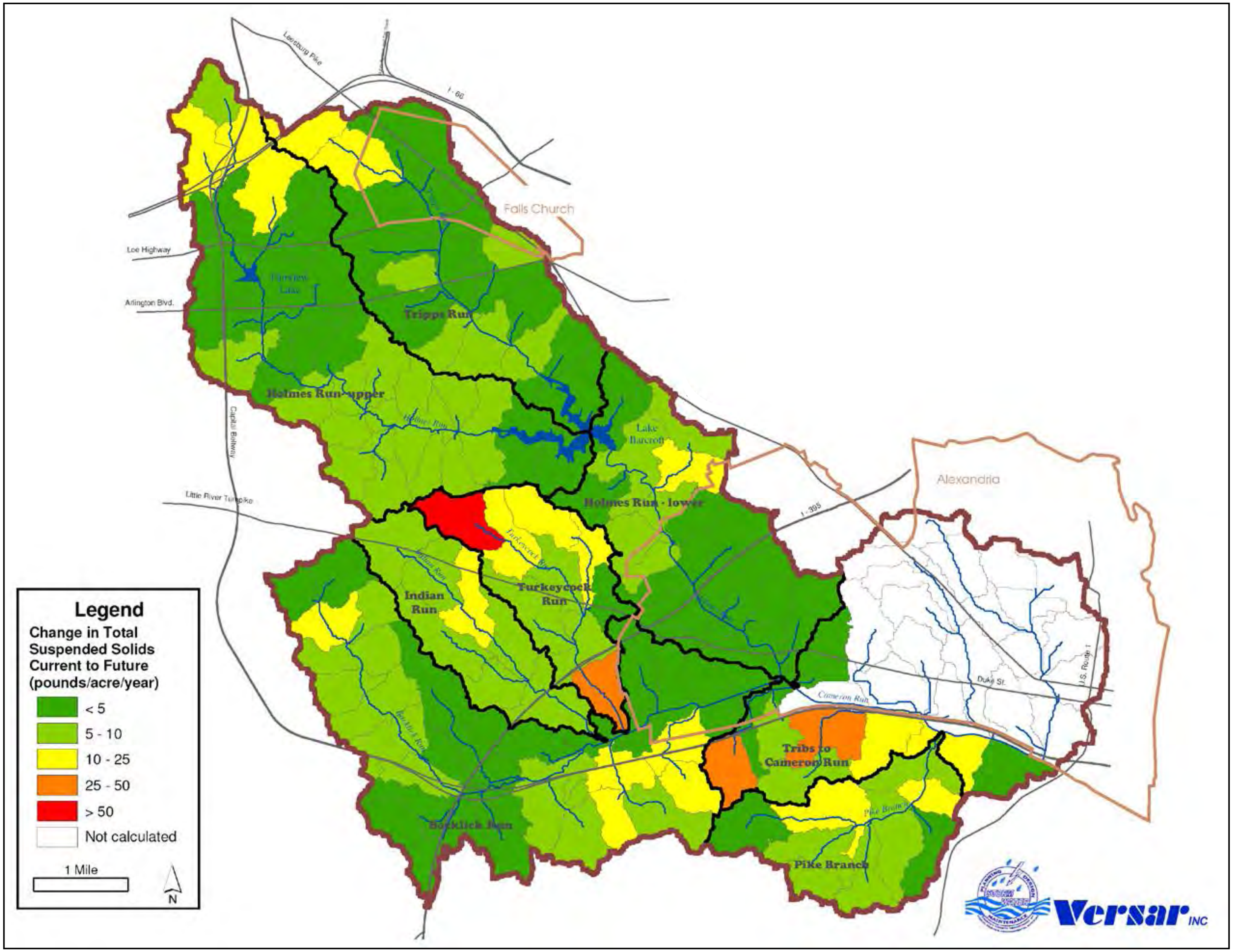

Figure 2-11. Average annual change in Total Suspended Solids loadings in Cameron Run watershed based on simulation of rainfall-runoff events in 1996-1998 using SWMM

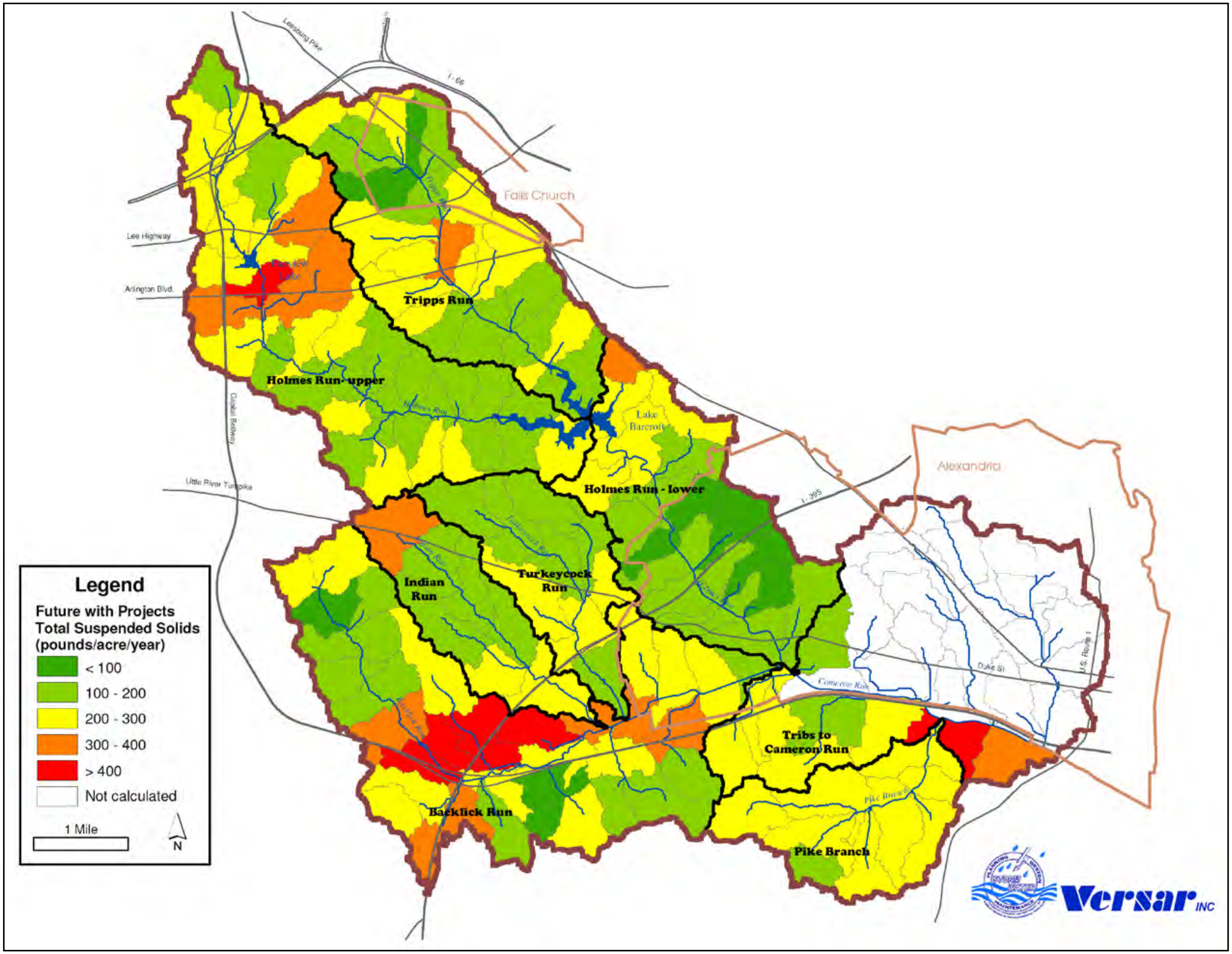

Figure 2-12. Average annual Total Suspended Solids loadings in Cameron Run watershed based on simulation of rainfall-runoff events in 1996-1998 using SWMM simulating future land use conditions with proposed projects

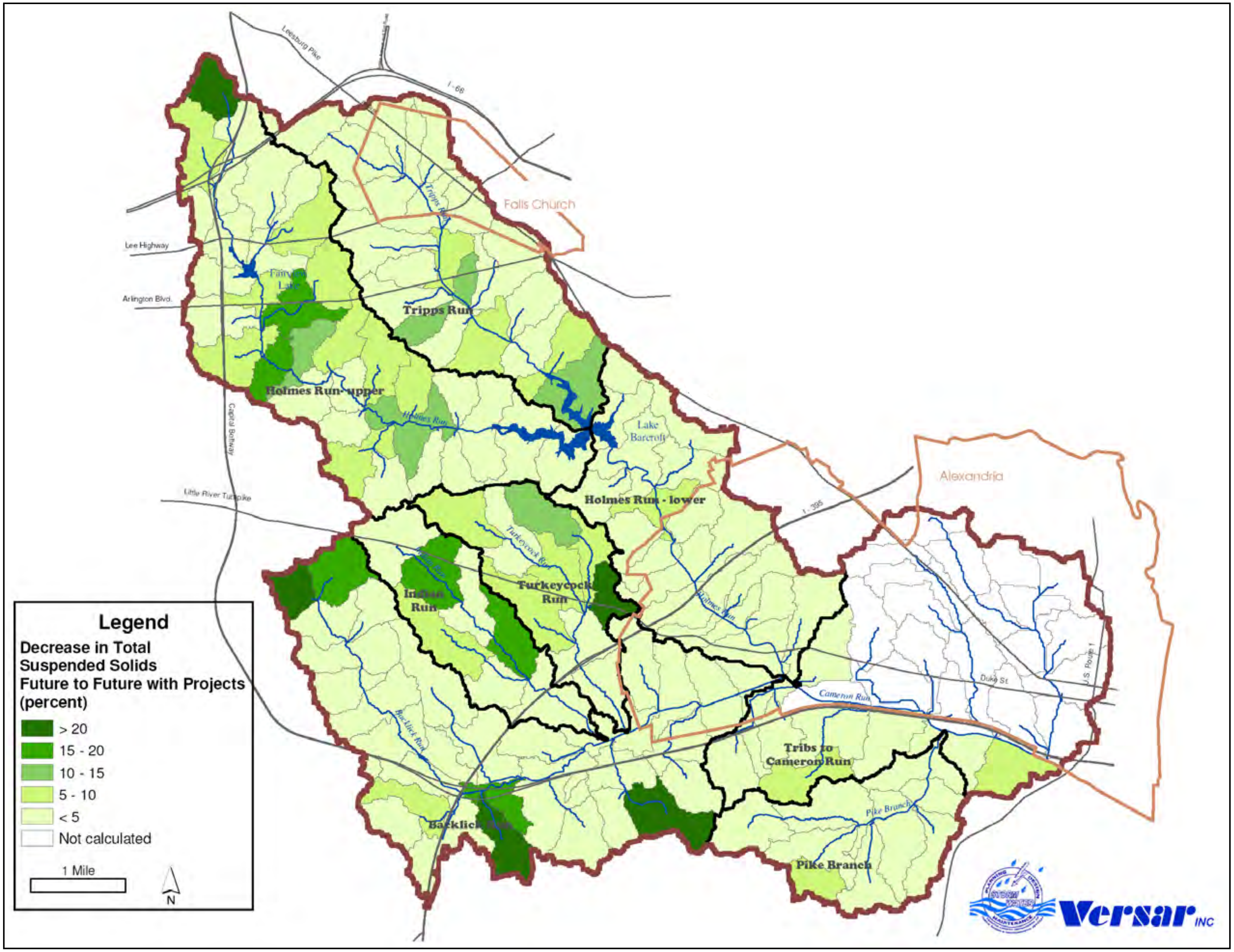

Figure 2-13. Average annual percent decrease in Total Suspended Solids loadings in Cameron Run watershed based on simulation of rainfall-runoff events in 1996-1998 using SWMM simulating future land use conditions with proposed projects

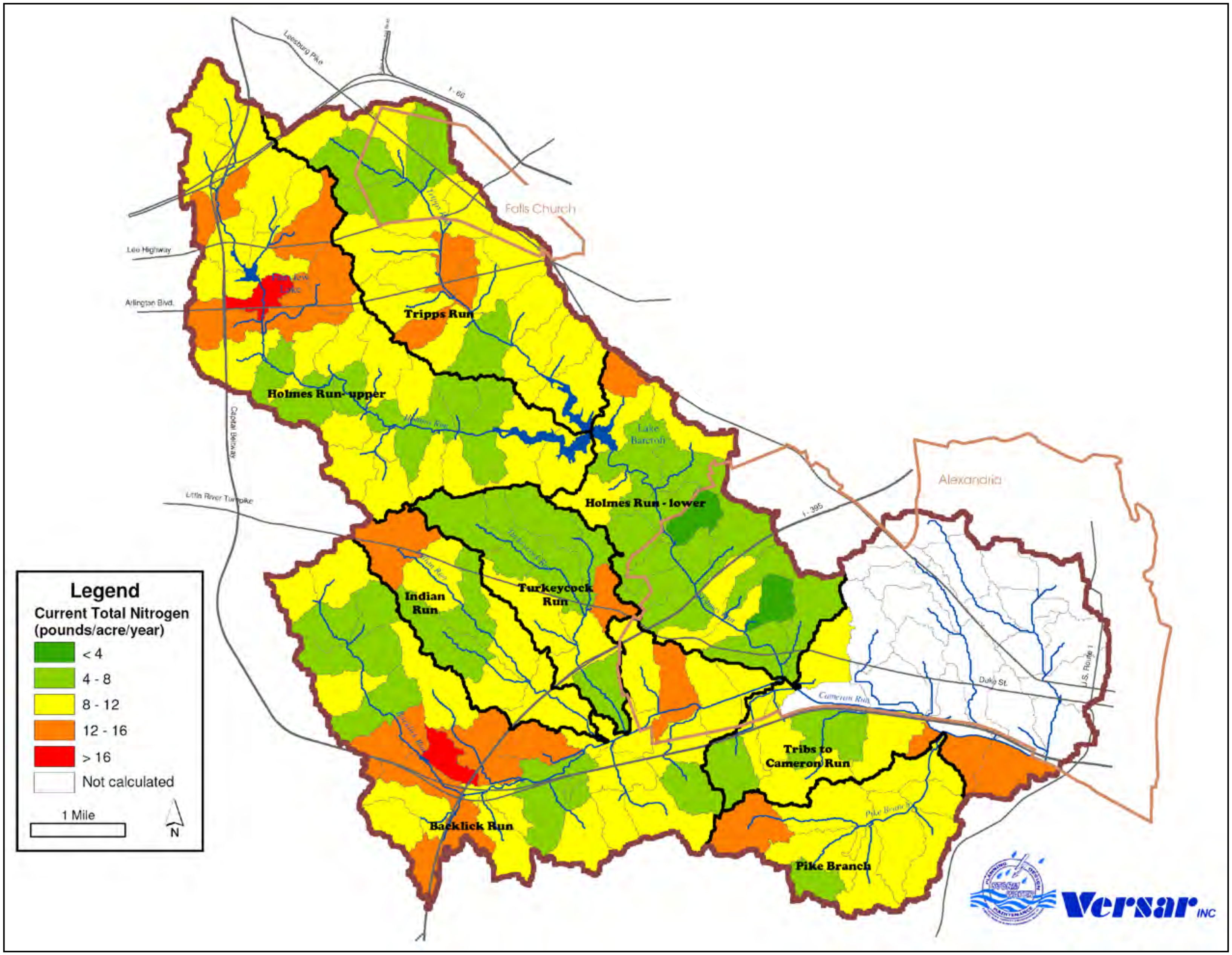

Figure 2-14. Average annual current Total Nitrogen loadings in Cameron Run watershed based on simulation of rainfall-runoff events in 1996-1998 using SWMM

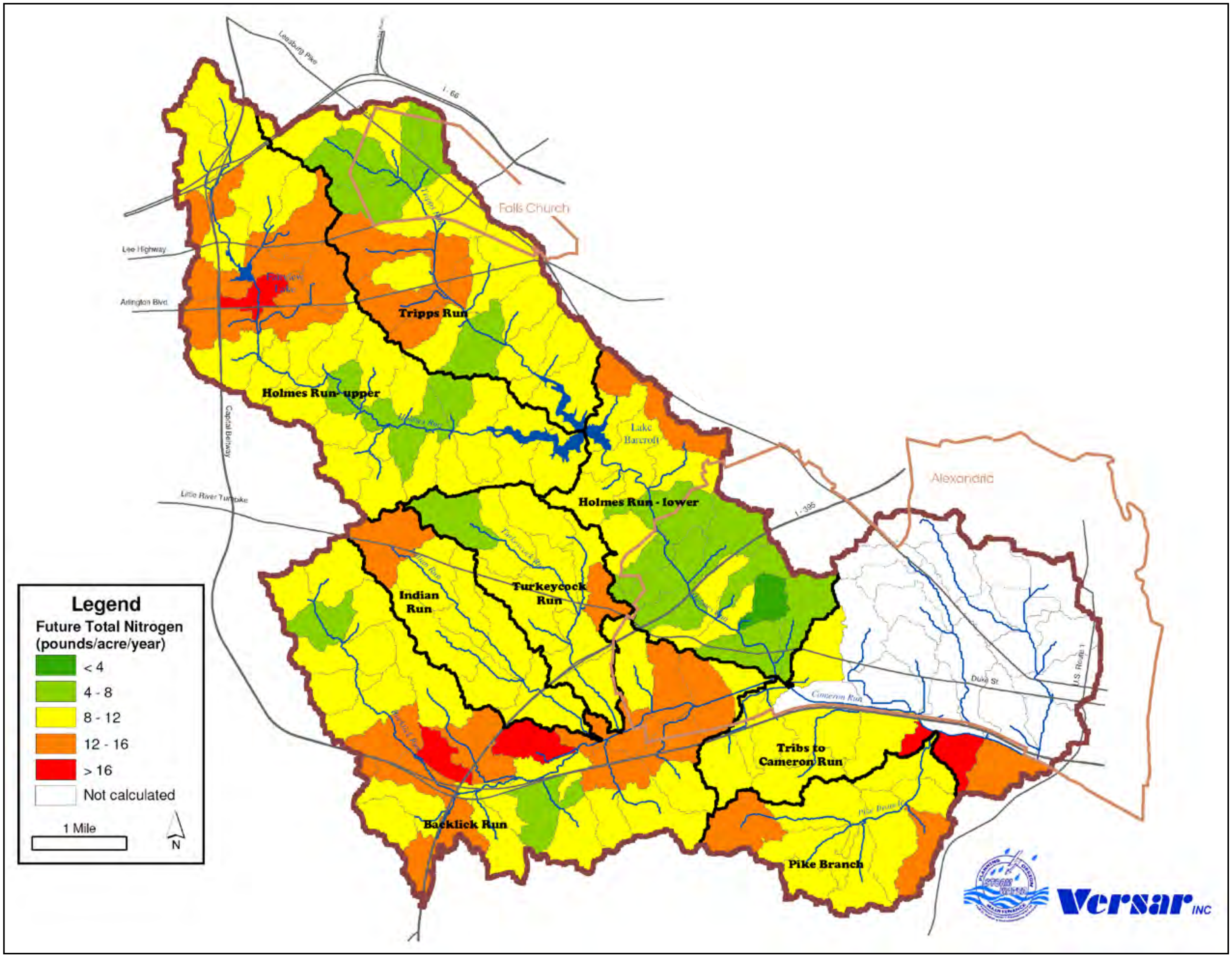

Figure 2-15. Average annual future Total Nitrogen loadings in Cameron Run watershed based on simulation of rainfall-runoff events in 1996-1998 using SWMM

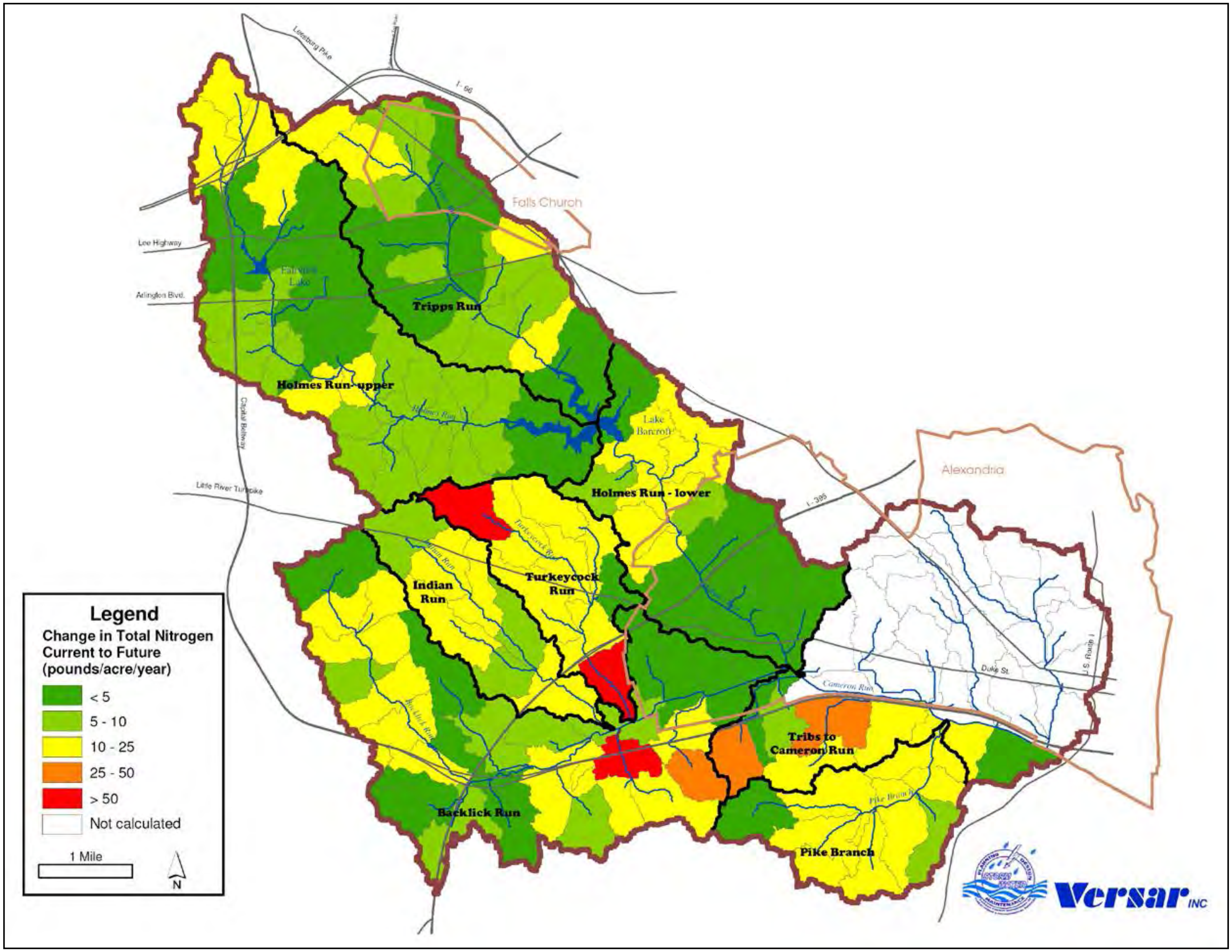

Figure 2-16. Average annual change in Total Nitrogen loadings in Cameron Run watershed based on simulation of rainfall-runoff events in 1996-1998 using SWMM

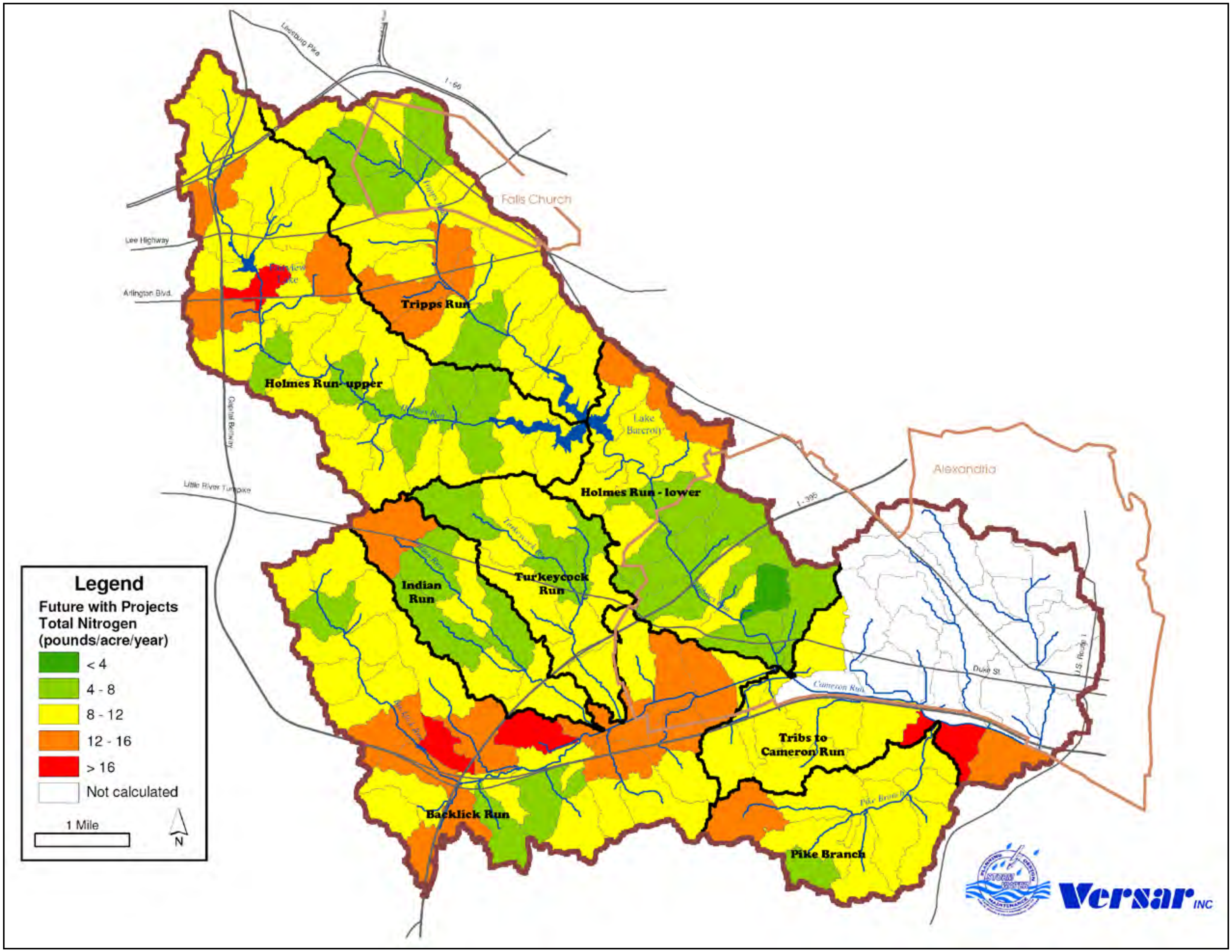

Figure 2-17. Average annual Total Nitrogen loadings in Cameron Run watershed based on simulation of rainfall-runoff events in 1996-1998 using SWMM simulating future landuse conditions with proposed projects

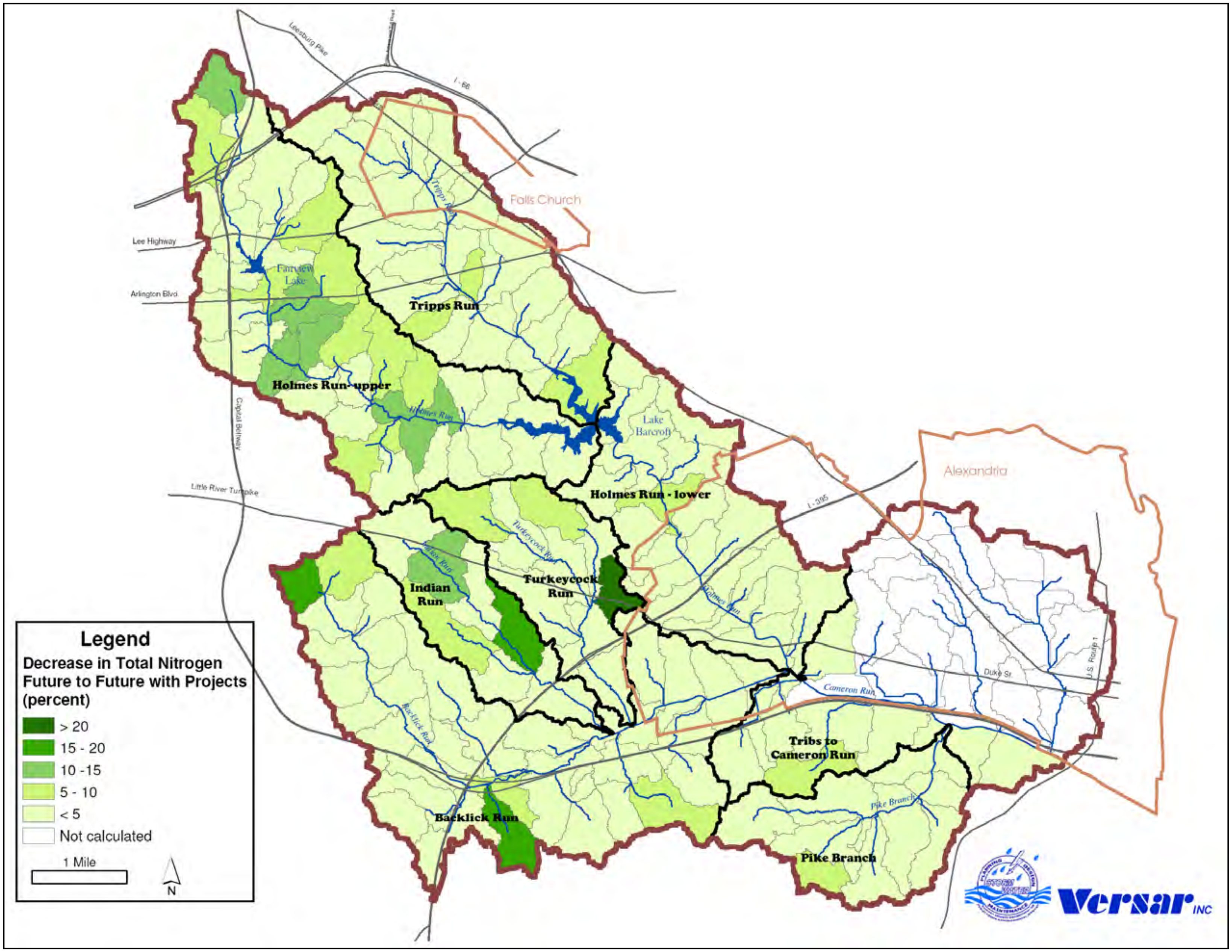

Figure 2-18. Average annual percent decrease in Total Nitrogen loadings in Cameron Run watershed based on simulation of rainfall-runoff events in 1996-1998 using SWMM simulating future landuse conditions with proposed projects

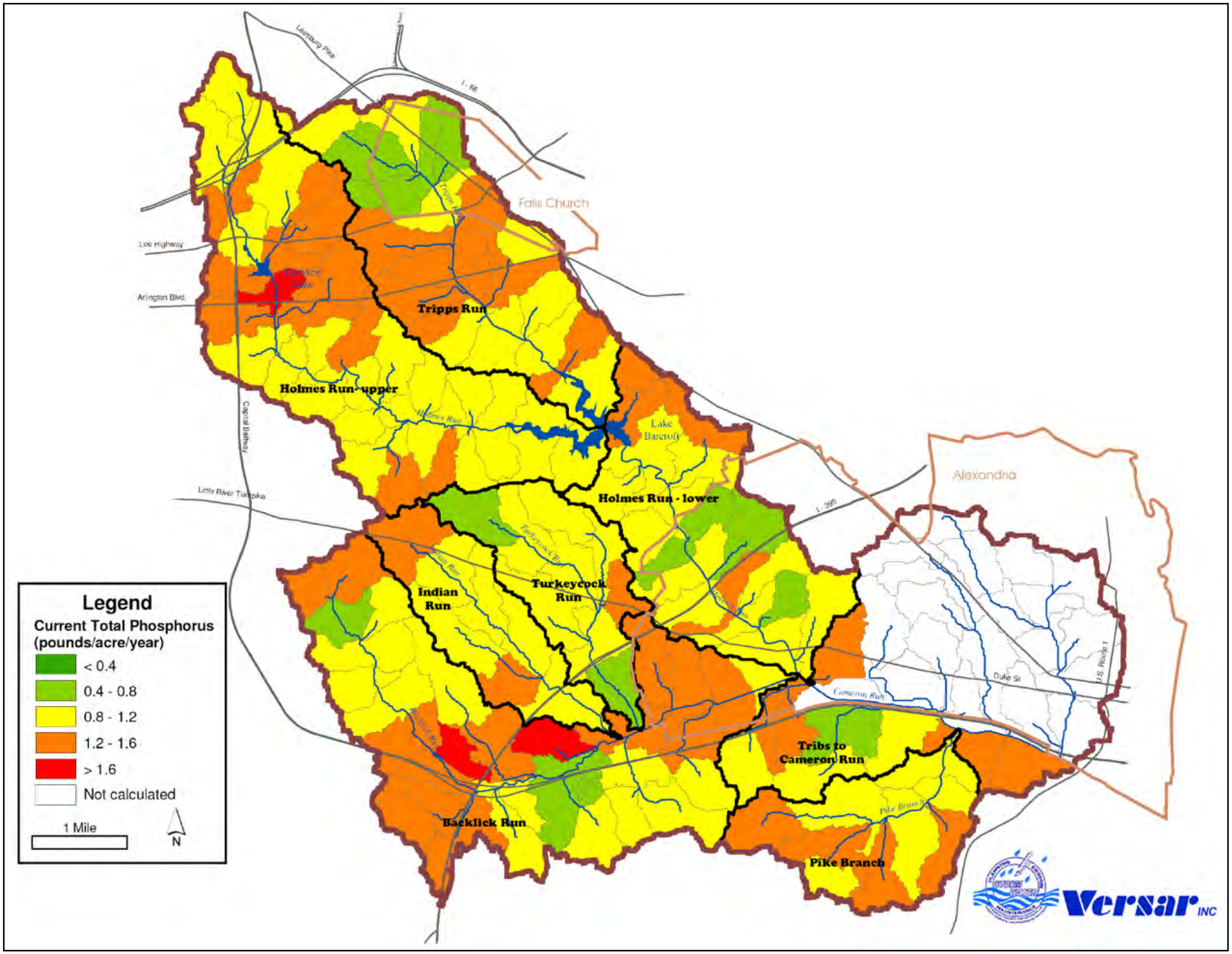

Figure 2-19. Average annual current Total Phosphorus loadings in Cameron Run watershed based on simulation of rainfall-runoff events in 1996-1998 using SWMM

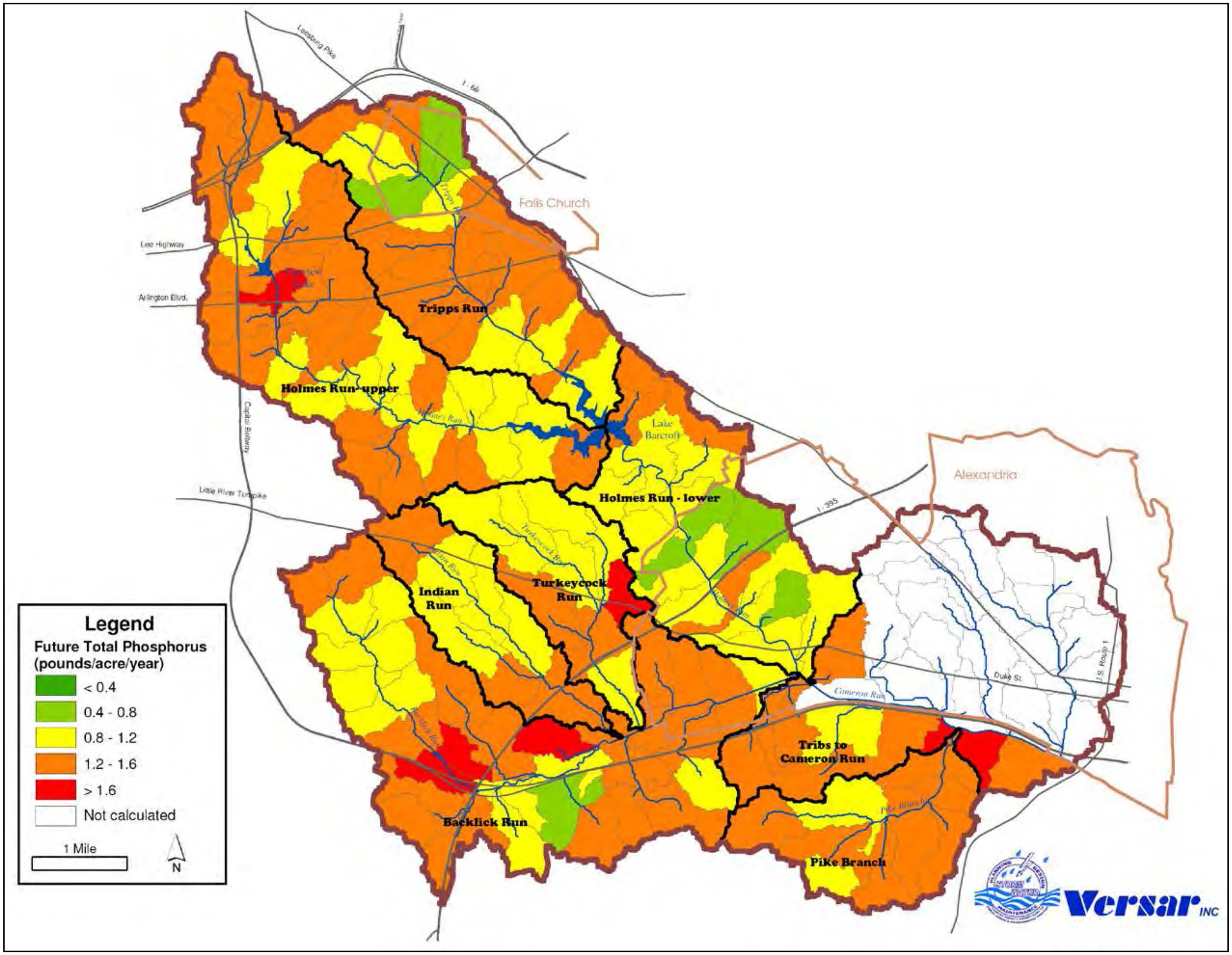

Figure 2-20. Average annual future Total Phosphorus loadings in Cameron Run watershed based on simulation of rainfall-runoff events in 1996-1998 using SWMM

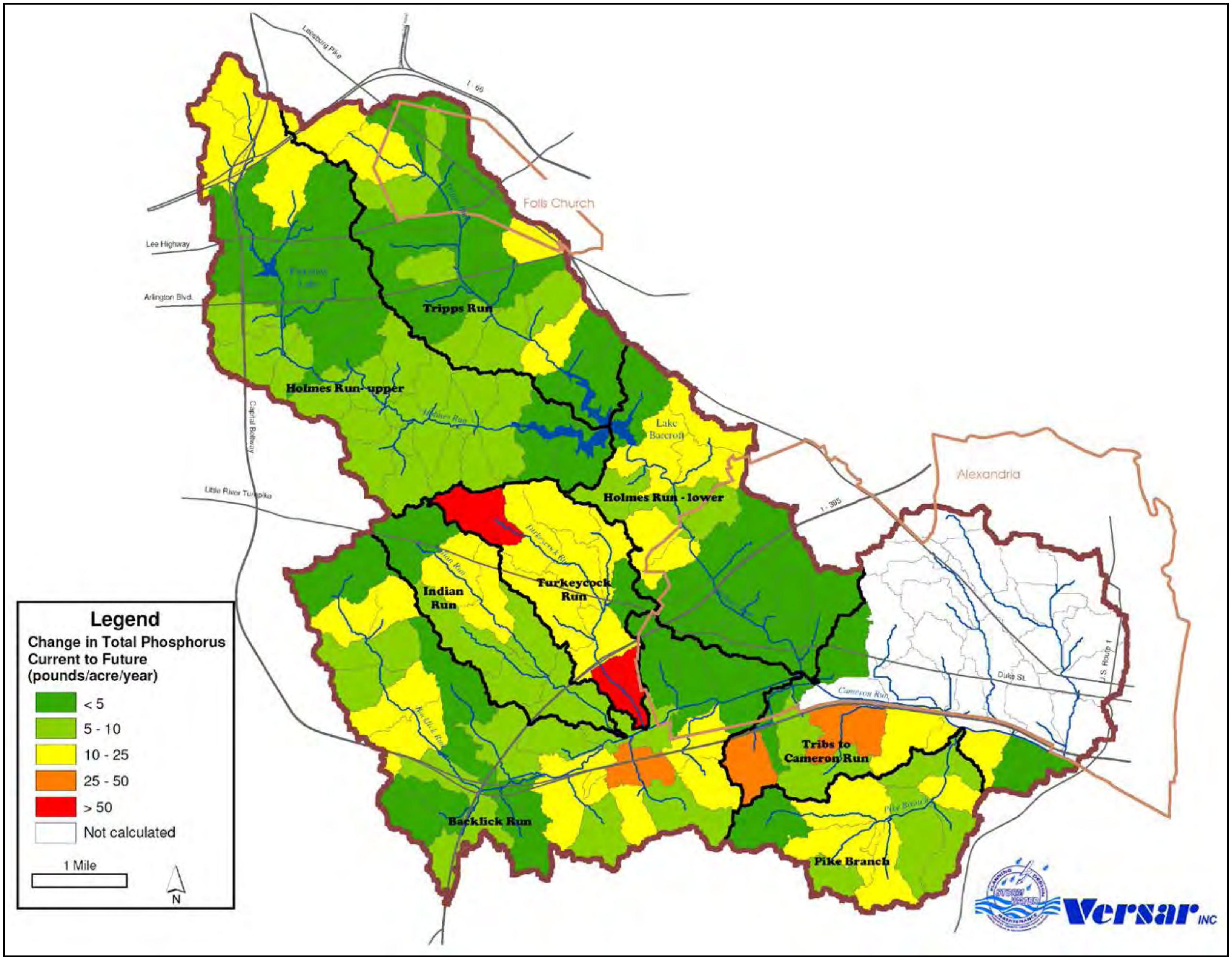

Figure 2-21. Average annual change in Total Phosphorus loadings in Cameron Run watershed based on simulation of rainfall-runoff events in 1996-1998 using SWMM

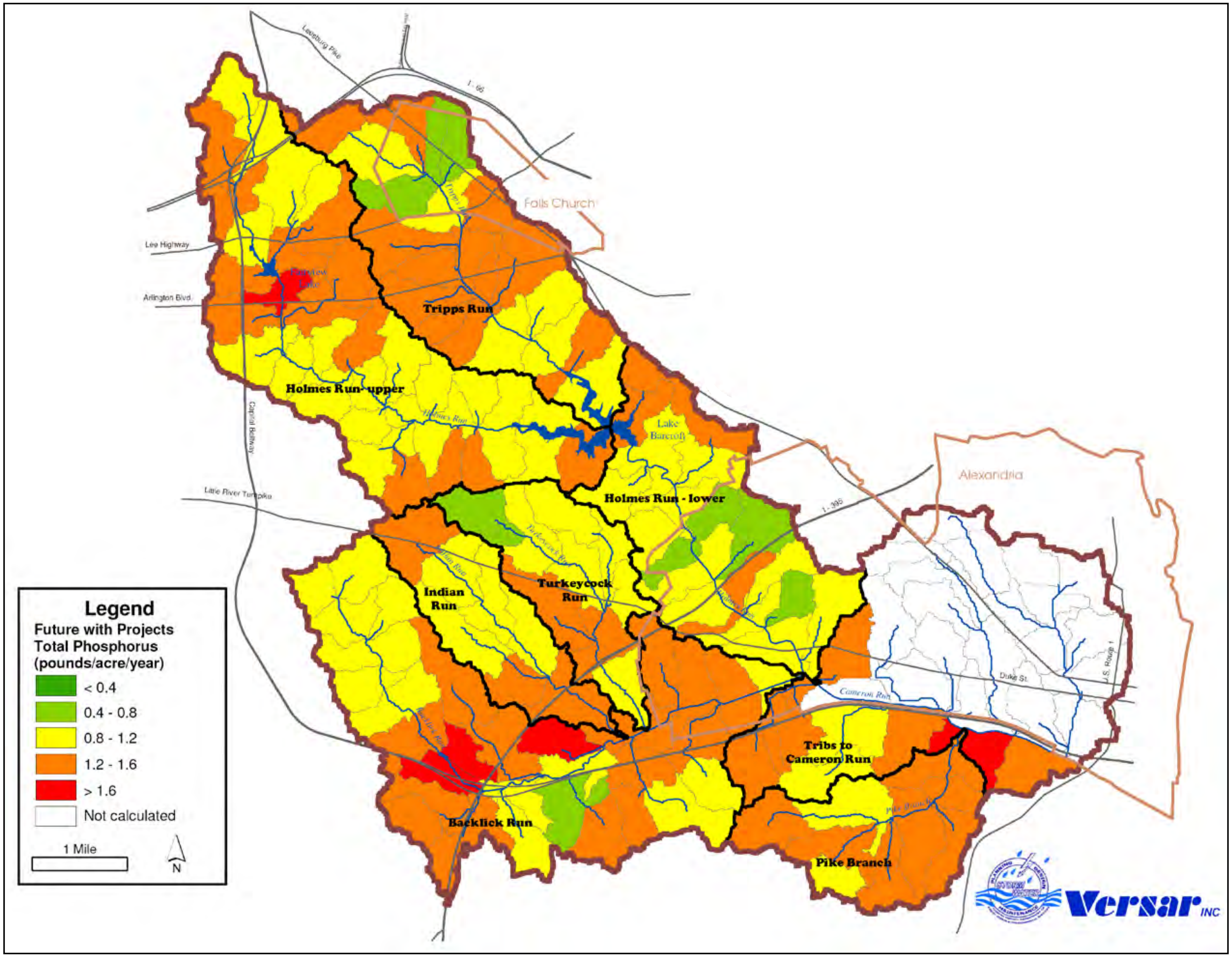

Figure 2-22. Average annual Total Phosphorus loadings in Cameron Run watershed based on simulation of rainfall-runoff events in 1996-1998 using SWMM simulating future landuse conditions with proposed projects

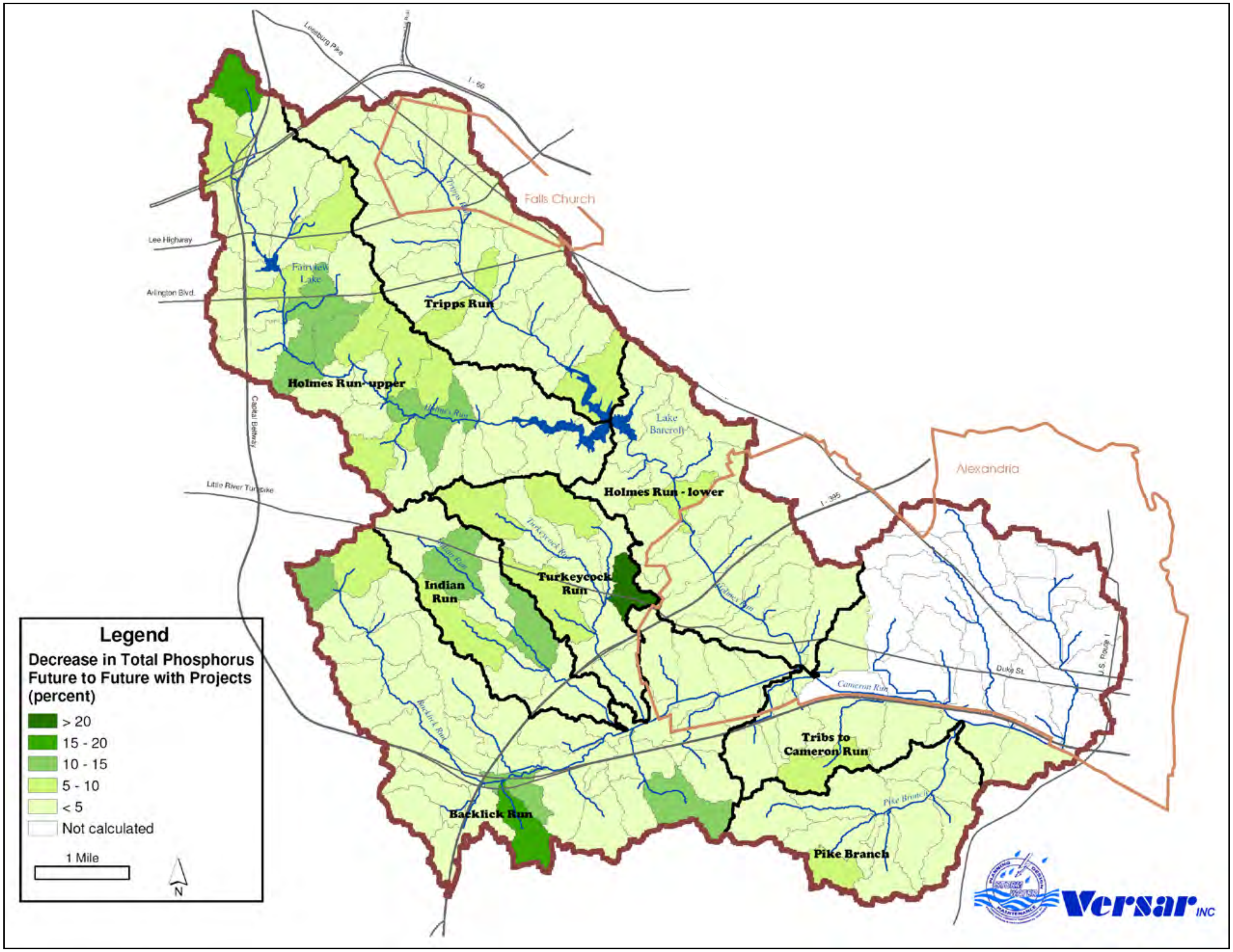

Figure 2-23. Average annual percent decrease in Total Phosphorus loadings in Cameron Run watershed based on simulation of rainfall-runoff events in 1996-1998 using SWMM simulating future landuse conditions with proposed projects

Table 2-8. Pollutant loadings (pounds/acre/year) for subbasins in Cameron Run watershed based SWMM modeling for 1996-1998 hydrologic conditions, for current land use conditions

Subwatershed	Subbasin	Area, Acres	Pollutant										
			TN	TP	DP	BOD	COD	TSS	PB	CU	ZN	CD	TDS
Backlick Run	BA1	100	8.31	1.08	0.76	46	263	146	0.008	0.037	0.181	0.0006	200
	BA2	218	11.92	1.43	1.01	78	442	259	0.016	0.095	0.420	0.0007	349
	BA3	170	11.01	1.22	0.85	82	378	294	0.019	0.087	0.472	0.0005	349
	BA4	165	7.78	0.94	0.67	48	244	166	0.010	0.035	0.206	0.0005	203
	BA5	198	13.08	1.57	1.11	85	496	283	0.017	0.107	0.455	0.0008	377
	BA6	229	10.51	1.33	0.93	62	376	202	0.012	0.066	0.264	0.0007	277
	BA7	194	11.76	1.27	0.88	89	395	305	0.023	0.110	0.649	0.0004	392
	BA8	160	8.36	0.89	0.65	66	294	225	0.016	0.068	0.374	0.0004	286
	BA9	129	8.56	1.05	0.74	50	269	173	0.010	0.047	0.228	0.0005	215
	BA10	248	9.57	1.13	0.81	61	342	204	0.012	0.072	0.292	0.0006	265
	BA11	163	15.26	1.62	1.13	117	519	433	0.028	0.138	0.779	0.0006	493
	BA12	134	7.28	0.76	0.53	57	244	209	0.015	0.072	0.439	0.0003	266
	BA13	219	4.38	0.50	0.40	30	146	92	0.006	0.024	0.145	0.0003	150
	BA14	200	10.23	1.16	0.84	67	317	243	0.014	0.069	0.394	0.0005	293
	BA15	244	14.26	1.43	0.99	121	471	407	0.033	0.150	0.941	0.0003	505
	BA16	290	10.44	1.20	0.84	69	326	252	0.015	0.070	0.412	0.0005	296
	BA17	116	9.71	1.05	0.73	76	322	273	0.018	0.060	0.370	0.0005	304
	BA18	184	9.15	1.08	0.76	55	291	216	0.011	0.066	0.336	0.0005	251
	BA19	242	12.86	1.38	0.97	100	434	366	0.024	0.090	0.520	0.0006	403
	BA20	163	10.82	1.27	0.89	72	346	250	0.015	0.052	0.315	0.0006	288
	BA21	146	11.42	1.34	0.94	79	383	265	0.017	0.059	0.331	0.0006	312
	BA22	143	14.08	1.50	1.05	106	483	408	0.025	0.119	0.637	0.0006	443
	BA23	112	18.57	1.86	1.29	158	615	518	0.044	0.203	1.289	0.0004	668
	BA24	219	12.15	1.33	0.92	92	441	322	0.022	0.116	0.604	0.0005	401
	BA25	227	7.71	0.94	0.68	44	232	153	0.009	0.039	0.205	0.0005	194
	BA26	161	8.97	1.10	0.77	56	277	182	0.011	0.034	0.207	0.0006	221
	BA27	245	7.89	0.98	0.68	45	226	158	0.009	0.040	0.209	0.0005	188
	BA28	132	7.44	0.94	0.66	39	206	135	0.008	0.040	0.196	0.0005	168
	BA29	168	5.54	0.72	0.51	26	131	89	0.005	0.019	0.112	0.0004	109
	BA30	125	10.21	1.20	0.85	59	313	247	0.011	0.074	0.400	0.0006	275
	BA31	215	10.77	1.24	0.87	67	387	261	0.014	0.103	0.443	0.0006	315

Table 2-8. (Continued)

Subwatershed	Subbasin	Area, Acres	Pollutant										
			TN	TP	DP	BOD	COD	TSS	PB	CU	ZN	CD	TDS
Holmes Run Lower	HR1	210	7.70	0.98	0.69	41	243	150	0.008	0.042	0.204	0.0006	206
	HR2	243	6.92	0.94	0.66	32	188	107	0.006	0.021	0.113	0.0005	154
	HR3	119	3.71	0.52	0.37	15	93	53	0.003	0.008	0.047	0.0003	93
	HR4	119	8.21	1.09	0.77	40	229	134	0.007	0.031	0.158	0.0006	184
	HR5	135	5.95	0.81	0.56	28	164	95	0.005	0.018	0.098	0.0005	145
	HR6	147	10.55	1.35	0.95	57	328	196	0.010	0.050	0.252	0.0007	254
	HR7	166	7.49	0.95	0.67	43	248	141	0.008	0.038	0.184	0.0005	192
	HR8	243	5.00	0.66	0.46	26	154	86	0.005	0.018	0.094	0.0004	130
	HR9	210	6.73	0.87	0.61	37	205	121	0.007	0.028	0.139	0.0005	166
	HR10	101	4.33	0.59	0.41	20	121	71	0.004	0.012	0.068	0.0004	119
	HR11	126	3.97	0.54	0.38	20	118	66	0.004	0.011	0.064	0.0003	110
	HR12	147	7.18	0.90	0.64	41	209	133	0.008	0.024	0.146	0.0005	171
	HR13	160	7.54	0.93	0.66	44	237	154	0.008	0.038	0.201	0.0005	195
	HR14	185	7.12	0.88	0.62	42	220	144	0.008	0.032	0.175	0.0005	186
	HR15	180	11.09	1.28	0.91	76	410	267	0.016	0.088	0.398	0.0006	335
	HR16	265	7.73	0.89	0.64	53	291	191	0.011	0.062	0.278	0.0005	250
	HR17	176	9.34	1.11	0.79	60	298	212	0.012	0.048	0.279	0.0006	255
	HR18	168	10.12	1.22	0.86	67	406	226	0.014	0.084	0.309	0.0008	307
	HR19	104	13.17	1.52	1.07	98	586	323	0.020	0.131	0.457	0.0008	420
Holmes Run Upper	HR21	211	9.53	1.17	0.82	60	301	202	0.013	0.041	0.237	0.0008	254
	HR22	261	8.59	1.07	0.75	51	259	172	0.011	0.034	0.202	0.0007	216
	HR23	265	7.66	0.98	0.69	39	193	134	0.008	0.029	0.169	0.0005	160
	HR24	117	6.98	0.91	0.63	33	162	112	0.007	0.024	0.141	0.0005	132
	HR25	110	9.79	1.19	0.84	58	306	212	0.012	0.062	0.306	0.0006	248
	HR26	246	7.09	0.87	0.61	43	219	147	0.009	0.030	0.179	0.0005	185
	HR27	105	9.79	1.20	0.85	61	309	203	0.012	0.039	0.235	0.0006	246
	HR28	129	9.72	1.18	0.83	57	287	205	0.011	0.048	0.277	0.0006	237
	HR29	196	9.18	1.11	0.79	55	279	196	0.011	0.045	0.259	0.0006	234
	HR30	156	10.71	1.29	0.91	68	335	236	0.014	0.053	0.307	0.0006	280
	HR31	109	9.63	1.16	0.82	62	309	209	0.012	0.041	0.249	0.0006	252
	HR32	114	7.24	0.89	0.65	44	224	142	0.009	0.028	0.167	0.0005	192

Table 2-8. (Continued)													
Subwatershed	**Subbasin**	**Area, Acres**	**Pollutant**										
			TN	**TP**	**DP**	**BOD**	**COD**	**TSS**	**PB**	**CU**	**ZN**	**CD**	**TDS**
Holmes Run Upper (continued)	HR33	161	11.51	1.36	0.96	76	387	262	0.016	0.064	0.339	0.0007	312
	HR34	165	7.89	0.99	0.70	44	230	146	0.009	0.034	0.178	0.0005	186
	HR35	132	10.03	1.19	0.83	62	326	240	0.012	0.067	0.359	0.0006	279
	HR36	122	7.85	0.94	0.66	48	253	186	0.009	0.048	0.266	0.0005	225
	HR37	227	10.45	1.15	0.82	65	333	288	0.014	0.100	0.522	0.0005	325
	HR38	179	13.29	1.50	1.05	93	519	349	0.019	0.131	0.551	0.0007	417
	HR39	183	13.00	1.51	1.06	93	514	313	0.019	0.102	0.426	0.0008	387
	HR40	189	13.05	1.37	0.96	90	424	401	0.020	0.134	0.718	0.0006	423
	HR41	106	16.33	1.71	1.22	111	521	489	0.025	0.167	0.890	0.0007	517
	HR42	253	11.95	1.31	0.96	86	469	301	0.018	0.118	0.516	0.0007	409
	HR43	221	12.48	1.39	0.98	77	421	343	0.016	0.134	0.645	0.0006	378
	HR44	109	10.76	1.22	0.85	62	356	293	0.012	0.116	0.551	0.0006	317
	HR45	244	8.36	0.99	0.73	50	262	173	0.010	0.054	0.268	0.0005	225
	HR46	163	8.02	0.87	0.61	62	284	230	0.015	0.059	0.323	0.0005	282
	HR47	155	12.33	1.40	1.01	89	489	293	0.018	0.105	0.426	0.0007	383
	HR48	242	10.09	1.14	0.82	68	315	248	0.015	0.066	0.363	0.0005	288
	HR49	173	9.76	1.07	0.77	73	312	260	0.017	0.057	0.352	0.0005	298
	HR50	154	9.65	1.13	0.84	59	300	198	0.012	0.056	0.291	0.0006	265
	CW1	204	8.42	1.02	0.72	53	269	182	0.011	0.038	0.223	0.0005	227
Indian Run	262	10.36	1.17	0.83	72	354	260	0.016	0.076	0.384	0.0006	314	262
	192	8.52	1.02	0.73	44	240	191	0.008	0.062	0.331	0.0005	220	192
	199	7.50	0.94	0.66	42	213	147	0.009	0.037	0.193	0.0005	180	199
	230	8.13	1.00	0.70	46	241	170	0.010	0.050	0.247	0.0005	204	230
	282	13.52	1.52	1.07	92	434	348	0.020	0.100	0.529	0.0007	386	282
	157	11.14	1.28	0.93	66	327	249	0.014	0.085	0.459	0.0006	311	157
	264	7.50	0.96	0.68	38	194	134	0.007	0.031	0.176	0.0005	160	264
Pike Branch	190	10.38	1.19	0.85	67	376	235	0.014	0.088	0.373	0.0006	309	190
	114	10.16	1.20	0.84	67	406	230	0.013	0.093	0.340	0.0006	304	114
	181	11.43	1.35	0.98	74	448	244	0.014	0.102	0.372	0.0007	331	181
	270	9.92	1.18	0.85	59	308	218	0.011	0.062	0.323	0.0006	258	270
	198	10.21	1.24	0.88	64	319	215	0.013	0.043	0.260	0.0006	258	198
	274	8.68	1.05	0.74	53	268	185	0.011	0.042	0.250	0.0005	229	274
	248	12.10	1.42	1.00	81	421	279	0.017	0.083	0.408	0.0007	340	248

Table 2-8. (Continued)														
		Area,	**Pollutant**											
Subwatershed	**Subbasin**	**Acres**	**TN**	**TP**	**DP**	**BOD**	**COD**	**TSS**	**PB**	**CU**	**ZN**	**CD**	**TDS**
Pike Branch (cont'd)	PK8	218	10.22	1.25	0.88	63	316	211	0.012	0.042	0.254	0.0006	254
	PK9	123	7.48	0.89	0.65	45	232	165	0.009	0.041	0.232	0.0005	213
Tribs	CA1	202	13.60	1.50	1.05	109	625	361	0.024	0.154	0.563	0.0007	475
	CA2	169	14.28	1.53	1.06	110	481	392	0.027	0.118	0.691	0.0006	464
	CA5	215	9.45	1.12	0.78	59	287	215	0.012	0.050	0.291	0.0006	250
	CA8	249	6.29	0.76	0.54	35	187	128	0.007	0.036	0.176	0.0004	166
	CA9	207	9.41	1.10	0.77	53	286	231	0.010	0.076	0.394	0.0005	259
	CA11	125	10.70	1.30	0.91	68	340	231	0.015	0.056	0.319	0.0007	295
	CA12	192	7.55	0.89	0.65	50	245	170	0.010	0.037	0.219	0.0005	224
	CA13	138	10.45	1.24	0.88	67	311	229	0.015	0.054	0.325	0.0006	275
	CA14	211	9.41	1.25	0.88	45	260	154	0.008	0.037	0.188	0.0007	208
Tripps Run	TR0	271	8.87	1.08	0.76	54	280	190	0.012	0.049	0.252	0.0007	238
	TR1	185	10.50	1.27	0.89	65	326	229	0.013	0.053	0.300	0.0006	267
	TR2	174	8.07	1.00	0.71	43	221	162	0.008	0.043	0.237	0.0005	188
	TR3	173	9.19	1.14	0.80	54	272	182	0.011	0.039	0.224	0.0006	219
	TR4	216	7.11	0.90	0.63	37	188	135	0.007	0.033	0.185	0.0005	160
	TR5	137	9.19	1.14	0.80	55	272	183	0.011	0.035	0.213	0.0006	219
	TR6	177	11.18	1.35	0.94	70	378	244	0.015	0.080	0.346	0.0007	297
	TR7	148	9.32	1.12	0.79	60	318	213	0.012	0.058	0.282	0.0006	275
	TR8	157	12.81	1.51	1.06	85	444	296	0.017	0.084	0.406	0.0007	356
	TR9	199	11.93	1.43	1.00	79	383	266	0.016	0.052	0.318	0.0007	313
	TR10	125	13.23	1.48	1.04	92	427	341	0.021	0.090	0.508	0.0007	383
	TR11	119	11.17	1.33	0.94	74	355	247	0.015	0.048	0.295	0.0007	290
	TR12	267	11.77	1.37	0.97	80	395	278	0.017	0.068	0.366	0.0007	325
	TR13	164	10.21	1.28	0.90	55	329	205	0.010	0.066	0.302	0.0007	266
	TR14	161	9.17	1.15	0.81	54	294	183	0.011	0.049	0.241	0.0006	246
	TR15	162	5.11	0.67	0.46	28	159	100	0.005	0.020	0.112	0.0004	152
	TR16	271	4.37	0.57	0.39	25	142	90	0.005	0.016	0.094	0.0004	144
	TR17	167	9.79	1.17	0.83	58	321	225	0.012	0.071	0.353	0.0006	288
	TR18	254	6.06	0.76	0.53	36	189	123	0.007	0.023	0.137	0.0004	172
	TR19	179	9.01	1.09	0.78	56	276	189	0.011	0.038	0.229	0.0005	231

Table 2-8. (Continued)

Subwatershed	Subbasin	Area, Acres	Pollutant										
			TN	**TP**	**DP**	**BOD**	**COD**	**TSS**	**PB**	**CU**	**ZN**	**CD**	**TDS**
Turkeycock Run	TK1	183	5.94	0.67	0.50	44	269	131	0.009	0.064	0.243	0.0004	227
	TK2	198	10.02	1.17	0.82	70	372	236	0.015	0.078	0.323	0.0006	296
	TK3	268	10.1	1.20	0.84	64	316	228	0.014	0.066	0.337	0.00057	270
	TK3	268	10.09	1.20	0.84	64	316	228	0.014	0.066	0.337	0.0006	270
	TK4	183	7.21	0.87	0.61	42	203	156	0.009	0.037	0.212	0.0004	188
	TK5	209	7.52	0.94	0.66	45	251	148	0.009	0.042	0.183	0.0005	197
	TK6	234	4.15	0.50	0.35	25	135	93	0.005	0.020	0.113	0.0003	135
	TK7	119	13.80	1.56	1.11	105	661	345	0.022	0.168	0.526	0.0008	464
	TK8	135	7.19	0.87	0.64	37	193	136	0.007	0.038	0.198	0.0004	166

Table 2-9. Pollutant loadings (pounds/acre/year) for subbasins in Cameron Run watershed based SWMM modeling for 1996-1998 hydrologic conditions, for projected future land use conditions

Subwatershed	Subbasin	Area, acres	Pollutant										
			TN	TP	DP	BOD	COD	TSS	PB	CU	ZN	CD	TDS
Backlick Run	BA1	100	8.3	1.08	0.76	46	263	146	0.008	0.037	0.181	0.0006	200
	BA2	218	12.4	1.47	1.05	81	458	264	0.016	0.099	0.442	0.0007	366
	BA3	170	13.6	1.45	1.08	100	459	325	0.022	0.109	0.600	0.0006	447
	BA4	165	9.8	1.17	0.86	60	304	198	0.011	0.046	0.270	0.0006	259
	BA5	198	13.1	1.57	1.11	85	497	283	0.017	0.107	0.456	0.0008	377
	BA6	229	10.5	1.33	0.93	62	376	202	0.012	0.066	0.264	0.0007	277
	BA7	194	12.7	1.36	0.98	96	426	318	0.023	0.117	0.695	0.0005	428
	BA8	160	12.7	1.30	1.09	92	435	280	0.019	0.106	0.570	0.0005	444
	BA9	129	10.2	1.22	0.92	61	330	196	0.011	0.056	0.270	0.0006	265
	BA10	248	10.7	1.24	0.92	68	385	219	0.013	0.081	0.326	0.0006	301
	BA11	163	16.4	1.70	1.20	134	564	447	0.033	0.144	0.855	0.0006	549
	BA12	134	8.4	0.86	0.62	67	281	229	0.017	0.080	0.498	0.0003	309
	BA13	219	4.8	0.55	0.44	33	161	100	0.006	0.026	0.158	0.0003	164
	BA14	200	11.2	1.26	0.94	76	357	261	0.016	0.073	0.419	0.0006	329
	BA15	244	15.4	1.54	1.09	131	513	426	0.035	0.160	1.012	0.0003	558
	BA16	290	10.9	1.24	0.89	73	341	261	0.016	0.073	0.429	0.0006	312
	BA17	116	9.9	1.07	0.74	77	329	279	0.019	0.061	0.377	0.0005	310
	BA18	184	9.5	1.12	0.79	57	309	224	0.011	0.070	0.351	0.0006	267
	BA19	242	13.7	1.47	1.05	107	468	379	0.025	0.096	0.540	0.0006	427
	BA20	163	11.3	1.33	0.93	76	362	261	0.016	0.054	0.329	0.0006	301
	BA21	146	11.9	1.39	0.98	82	398	275	0.017	0.060	0.341	0.0007	324
	BA22	143	15.8	1.65	1.19	126	550	434	0.029	0.131	0.736	0.0006	521
	BA23	112	18.9	1.88	1.31	161	626	522	0.044	0.206	1.308	0.0004	681
	BA24	219	14.2	1.50	1.10	111	499	353	0.026	0.128	0.719	0.0005	486
	BA25	227	8.6	1.04	0.78	49	261	166	0.009	0.044	0.231	0.0005	219
	BA26	161	9.7	1.19	0.85	61	307	197	0.012	0.037	0.226	0.0006	246
	BA27	245	8.7	1.07	0.77	50	250	169	0.010	0.043	0.227	0.0005	207
	BA28	132	8.3	1.04	0.76	44	232	147	0.008	0.044	0.216	0.0005	189
	BA29	168	6.2	0.81	0.58	29	148	99	0.006	0.022	0.125	0.0004	122
	BA30	125	10.6	1.25	0.88	61	326	256	0.012	0.077	0.415	0.0006	285
	BA31	215	11.1	1.28	0.91	70	399	272	0.014	0.104	0.446	0.0006	324

Table 2-9. (Continued)

Subwatershed	Subbasin	Area, acres	Pollutant										
			TN	TP	DP	BOD	COD	TSS	PB	CU	ZN	CD	TDS
Holmes Run Lower	HR1	210	7.7	0.98	0.69	41	243	150	0.008	0.042	0.204	0.0006	206
	HR2	243	6.9	0.94	0.66	32	188	107	0.006	0.021	0.113	0.0005	154
	HR3	119	3.7	0.52	0.37	15	93	53	0.003	0.008	0.047	0.0003	93
	HR4	119	8.2	1.09	0.77	40	229	134	0.007	0.031	0.158	0.0006	184
	HR5	135	5.9	0.81	0.56	28	164	95	0.005	0.018	0.098	0.0005	145
	HR6	147	10.6	1.35	0.95	57	328	196	0.010	0.050	0.252	0.0007	254
	HR7	166	7.5	0.95	0.67	43	248	141	0.008	0.038	0.184	0.0005	192
	HR8	243	5.0	0.66	0.46	26	155	87	0.005	0.018	0.094	0.0004	131
	HR9	210	7.0	0.90	0.64	38	215	123	0.007	0.029	0.143	0.0005	173
	HR10	101	4.9	0.66	0.48	23	137	76	0.004	0.013	0.075	0.0004	132
	HR11	126	4.2	0.57	0.40	21	125	69	0.004	0.012	0.067	0.0004	116
	HR12	147	7.9	0.99	0.72	46	235	145	0.009	0.026	0.161	0.0005	193
	HR13	160	8.6	1.05	0.77	50	273	169	0.009	0.043	0.224	0.0005	226
	HR14	185	8.3	1.01	0.74	50	257	159	0.009	0.036	0.198	0.0005	216
	HR15	180	12.5	1.42	1.05	87	467	288	0.017	0.096	0.434	0.0007	379
	HR16	265	8.9	1.03	0.76	61	335	208	0.012	0.069	0.305	0.0005	281
	HR17	176	9.8	1.17	0.83	63	314	222	0.013	0.051	0.293	0.0006	268
	HR18	168	10.4	1.26	0.89	69	418	230	0.014	0.085	0.315	0.0009	315
	HR19	104	13.6	1.57	1.11	101	604	331	0.020	0.135	0.476	0.0008	437
Holmes Run Upper	HR21	211	9.9	1.20	0.85	62	312	207	0.014	0.042	0.244	0.0008	263
	HR22	261	8.9	1.11	0.78	53	267	177	0.011	0.035	0.208	0.0007	223
	HR23	265	8.1	1.03	0.74	42	207	142	0.008	0.031	0.180	0.0005	172
	HR24	117	7.5	0.98	0.70	37	179	122	0.007	0.026	0.155	0.0005	147
	HR25	110	10.4	1.26	0.90	62	329	224	0.012	0.066	0.325	0.0006	268
	HR26	246	7.5	0.93	0.65	46	234	157	0.009	0.032	0.190	0.0005	198
	HR27	105	10.5	1.28	0.91	65	331	215	0.013	0.041	0.250	0.0007	264
	HR28	129	10.2	1.25	0.88	60	303	215	0.012	0.051	0.291	0.0006	250
	HR29	196	10.0	1.21	0.88	61	308	210	0.012	0.049	0.283	0.0006	260
	HR30	156	11.4	1.36	0.98	73	362	249	0.014	0.055	0.326	0.0007	303
	HR31	109	10.2	1.23	0.88	66	327	221	0.013	0.044	0.264	0.0006	268

Table 2-9. (Continued)

Subwatershed	Subbasin	Area, acres	Pollutant										
			TN	TP	DP	BOD	COD	TSS	PB	CU	ZN	CD	TDS
Holmes Run Upper (continued)	HR32	114	8.0	0.97	0.73	49	253	154	0.009	0.030	0.184	0.0005	218
	HR33	161	11.9	1.40	0.99	79	400	272	0.016	0.066	0.349	0.0007	323
	HR34	165	8.7	1.08	0.79	50	262	159	0.009	0.037	0.197	0.0006	213
	HR35	132	10.5	1.24	0.87	64	341	250	0.013	0.071	0.376	0.0006	293
	HR36	122	8.3	0.99	0.70	51	268	195	0.010	0.051	0.280	0.0005	237
	HR37	227	11.4	1.26	0.92	71	364	303	0.014	0.105	0.550	0.0006	349
	HR38	179	13.8	1.55	1.10	98	543	354	0.021	0.135	0.574	0.0007	436
	HR39	183	13.4	1.56	1.10	96	532	323	0.020	0.107	0.441	0.0008	399
	HR40	189	13.9	1.45	1.06	95	448	407	0.021	0.136	0.731	0.0006	440
	HR41	106	17.4	1.77	1.26	139	576	499	0.035	0.168	0.995	0.0005	589
	HR42	253	12.0	1.32	0.97	87	476	302	0.018	0.119	0.517	0.0007	415
	HR43	221	12.6	1.40	0.99	79	430	348	0.016	0.135	0.650	0.0006	389
	HR44	109	10.8	1.22	0.86	63	359	293	0.012	0.116	0.551	0.0006	318
	HR45	244	9.3	1.09	0.82	56	298	192	0.011	0.061	0.305	0.0005	256
	HR46	163	8.0	0.87	0.61	62	289	227	0.015	0.061	0.323	0.0005	282
	HR47	155	12.9	1.46	1.08	94	518	303	0.019	0.110	0.447	0.0007	408
	HR48	242	11.6	1.30	0.98	80	376	280	0.017	0.077	0.428	0.0006	344
	HR49	173	11.2	1.23	0.90	83	357	288	0.019	0.067	0.404	0.0005	333
	HR50	154	11.0	1.26	0.99	71	349	216	0.014	0.057	0.307	0.0006	304
	CW1	204	9.1	1.10	0.79	58	292	196	0.011	0.040	0.240	0.0006	247
Indian Run	IR1	262	11.4	1.28	0.93	80	390	281	0.017	0.082	0.417	0.0006	343
	IR2	192	9.1	1.09	0.78	47	256	202	0.009	0.066	0.352	0.0005	234
	IR3	199	9.0	1.11	0.81	50	254	169	0.010	0.045	0.232	0.0006	210
	IR4	230	9.1	1.11	0.79	51	271	186	0.010	0.056	0.274	0.0005	227
	IR5	282	14.2	1.58	1.13	101	464	366	0.022	0.100	0.541	0.0007	413
	PR1	157	12.0	1.35	1.01	78	359	263	0.017	0.090	0.514	0.0005	349
	PR2	264	8.3	1.05	0.75	42	213	146	0.008	0.034	0.192	0.0005	175
Pike Branch	PK1	190	11.4	1.31	0.96	74	416	251	0.015	0.095	0.403	0.0007	340
	PK2	114	11.8	1.36	1.03	80	487	258	0.015	0.105	0.391	0.0007	370
	PK3	181	12.2	1.42	1.06	79	483	256	0.015	0.109	0.397	0.0007	360
	PK4	270	10.9	1.29	0.95	66	348	237	0.012	0.068	0.358	0.0006	293
	PK5	198	11.4	1.38	1.00	72	361	236	0.014	0.048	0.289	0.0007	293

Table 2-9. (Continued)

Subwatershed	Subbasin	Area, acres	Pollutant										
			TN	TP	DP	BOD	COD	TSS	PB	CU	ZN	CD	TDS
Pike Branch (continued)	PK6	274	9.9	1.18	0.86	61	309	209	0.012	0.050	0.293	0.0006	263
	PK7	248	12.7	1.48	1.06	85	443	290	0.018	0.086	0.425	0.0007	358
	PK8	218	11.4	1.37	1.00	71	358	231	0.014	0.047	0.283	0.0007	290
	PK9	123	8.4	0.98	0.74	51	262	177	0.010	0.045	0.256	0.0005	240
Tribs	CA1	202	14.2	1.56	1.12	114	660	368	0.025	0.161	0.584	0.0008	499
	CA2	169	16.9	1.82	1.27	126	562	464	0.030	0.145	0.825	0.0007	529
	CA5	215	11.2	1.31	0.97	72	357	248	0.014	0.059	0.342	0.0006	310
	CA8	249	8.6	1.03	0.77	50	265	161	0.009	0.044	0.222	0.0005	221
	CA9	207	10.4	1.21	0.87	59	317	247	0.011	0.081	0.423	0.0006	284
	CA11	125	10.7	1.30	0.91	68	341	231	0.015	0.056	0.320	0.0007	297
	CA12	192	11.1	1.29	1.03	71	355	215	0.013	0.052	0.305	0.0006	312
	CA13	138	11.3	1.33	0.98	74	348	242	0.016	0.058	0.351	0.0006	309
	CA14	211	9.4	1.24	0.87	45	260	153	0.008	0.037	0.187	0.0007	207
Tripps Run	TR0	271	9.1	1.10	0.78	55	286	194	0.012	0.050	0.259	0.0007	245
	TR1	185	10.7	1.29	0.91	67	336	233	0.014	0.055	0.306	0.0006	275
	TR2	174	9.0	1.10	0.81	49	256	177	0.009	0.048	0.263	0.0005	219
	TR3	173	9.8	1.21	0.87	57	291	190	0.011	0.041	0.236	0.0006	234
	TR4	216	7.7	0.98	0.70	40	205	145	0.008	0.036	0.200	0.0005	174
	TR5	137	10.1	1.25	0.89	60	298	197	0.012	0.038	0.232	0.0006	239
	TR6	177	11.8	1.40	1.01	76	403	252	0.016	0.082	0.354	0.0007	317
	TR7	148	10.5	1.24	0.90	70	359	230	0.014	0.061	0.303	0.0006	312
	TR8	157	13.4	1.58	1.13	89	464	305	0.018	0.087	0.423	0.0008	373
	TR9	199	12.4	1.48	1.05	82	401	276	0.017	0.055	0.335	0.0007	327
	TR10	125	13.8	1.55	1.10	96	446	349	0.021	0.091	0.514	0.0007	395
	TR11	119	11.9	1.43	1.01	80	384	262	0.016	0.051	0.315	0.0007	314
	TR12	267	12.2	1.41	1.01	84	410	286	0.018	0.070	0.376	0.0007	341
	TR13	164	10.7	1.33	0.96	59	347	207	0.010	0.069	0.315	0.0007	284
	TR14	161	9.4	1.16	0.83	55	303	185	0.011	0.050	0.246	0.0006	253
	TR15	162	5.3	0.68	0.48	29	165	102	0.005	0.021	0.114	0.0004	156
	TR16	271	4.6	0.60	0.43	27	151	94	0.005	0.017	0.099	0.0004	152
	TR17	167	10.3	1.22	0.89	63	347	230	0.012	0.074	0.363	0.0006	309
	TR18	254	6.8	0.84	0.60	41	215	138	0.008	0.028	0.165	0.0005	195

Table 2-9. (Continued)

Subwatershed	Subbasin	Area, acres	Pollutant										
			TN	**TP**	**DP**	**BOD**	**COD**	**TSS**	**PB**	**CU**	**ZN**	**CD**	**TDS**
Tripps Run	TR19	179	10.4	1.24	0.92	65	321	214	0.013	0.046	0.275	0.0006	269
Turkeycock Run	TK1	183	10.0	1.12	0.96	67	395	171	0.012	0.078	0.317	0.0005	327
	TK2	198	11.1	1.30	0.93	77	410	254	0.016	0.085	0.350	0.0006	320
	TK3	268	11.1	1.32	0.94	70	345	244	0.015	0.071	0.360	0.0006	290
	TK4	183	8.2	0.99	0.72	48	231	170	0.010	0.041	0.234	0.0005	211
	TK5	209	8.5	1.06	0.76	51	294	164	0.010	0.050	0.205	0.0006	222
	TK6	234	7.0	0.81	0.59	40	220	170	0.008	0.054	0.286	0.0004	210
	TK7	119	14.2	1.60	1.15	108	684	353	0.022	0.173	0.539	0.0008	480
	TK8	135	8.2	0.99	0.76	44	229	155	0.008	0.044	0.230	0.0005	196
	TK9	197	9.2	1.12	0.82	51	261	181	0.010	0.048	0.260	0.0005	220

Table 2-10. Pollutant loadings (pounds/acre/year) for subbasins in Cameron Run watershed based SWMM modeling for 1996-1998 hydrologic conditions, for projected future with projects land use conditions

Subwatershed	Subbasin	Area, acres	Pollutant										
			TN	**TP**	**DP**	**BOD**	**COD**	**TSS**	**PB**	**CU**	**ZN**	**CD**	**TDS**
Backlick Run	BA1	100	8.3	1.08	0.76	46	263	146	0.008	0.037	0.181	0.0006	200
	BA2	218	12.4	1.47	1.05	81	458	264	0.016	0.099	0.442	0.0007	366
	BA3	170	13.6	1.45	1.09	100	460	326	0.022	0.109	0.600	0.0006	447
	BA4	165	9.6	1.14	0.85	59	299	189	0.011	0.044	0.256	0.0006	256
	BA5	198	13.1	1.58	1.11	85	497	283	0.017	0.108	0.456	0.0008	377
	BA6	229	10.5	1.33	0.93	63	376	202	0.012	0.066	0.264	0.0007	277
	BA7	194	12.8	1.37	0.98	97	430	321	0.024	0.118	0.702	0.0005	432
	BA8	160	12.7	1.31	1.09	92	436	280	0.019	0.106	0.570	0.0005	445
	BA9	129	10.2	1.23	0.92	61	330	196	0.011	0.056	0.270	0.0006	266
	BA10	248	9.6	1.08	0.93	61	353	156	0.009	0.068	0.272	0.0005	301
	BA11	163	16.4	1.71	1.20	134	564	448	0.034	0.145	0.856	0.0006	550
	BA12	134	8.4	0.86	0.62	68	282	229	0.017	0.080	0.498	0.0003	310
	BA13	219	4.8	0.54	0.45	32	160	97	0.006	0.026	0.156	0.0003	163
	BA14	200	11.0	1.23	0.92	75	349	256	0.016	0.071	0.408	0.0005	321
	BA15	244	15.4	1.54	1.09	131	513	426	0.035	0.161	1.015	0.0003	558
	BA16	290	10.8	1.23	0.88	72	339	257	0.016	0.072	0.424	0.0005	310
	BA17	116	9.0	0.93	0.76	72	306	224	0.015	0.055	0.337	0.0004	311
	BA18	184	7.7	0.92	0.66	49	256	169	0.010	0.047	0.233	0.0005	211
	BA19	242	13.9	1.49	1.06	108	475	386	0.025	0.097	0.547	0.0006	431
	BA20	163	10.9	1.27	0.93	73	350	242	0.015	0.051	0.309	0.0006	297
	BA21	146	11.9	1.39	0.98	82	398	276	0.017	0.060	0.341	0.0007	325
	BA22	143	15.5	1.62	1.16	125	542	424	0.029	0.126	0.713	0.0006	512
	BA23	112	18.9	1.89	1.32	161	626	523	0.044	0.207	1.308	0.0004	681
	BA24	219	13.8	1.46	1.07	108	498	339	0.025	0.129	0.701	0.0005	477
	BA25	227	8.4	1.02	0.76	48	254	162	0.009	0.043	0.226	0.0005	214
	BA26	161	9.7	1.19	0.86	61	308	197	0.012	0.037	0.226	0.0006	247
	BA27	245	8.3	1.02	0.74	48	239	164	0.010	0.041	0.221	0.0005	200
	BA28	132	8.2	1.03	0.75	43	228	144	0.008	0.043	0.210	0.0005	186
	BA29	168	6.1	0.80	0.57	29	147	98	0.006	0.022	0.124	0.0004	121
	BA30	125	8.9	1.06	0.75	53	274	204	0.010	0.055	0.305	0.0005	231
	BA31	215	10.4	1.17	0.91	66	371	229	0.012	0.089	0.401	0.0006	325

Table 2-10. Pollutant loadings (pounds/acre/year) for subbasins in Cameron Run watershed based SWMM modeling for 1996-1998 hydrologic conditions, for projected future with projects land use conditions

Subwatershed	Subbasin	Area, acres	Pollutant										
			TN	TP	DP	BOD	COD	TSS	PB	CU	ZN	CD	TDS
Holmes Run Lower	HR1	210	7.7	0.98	0.69	41	243	150	0.008	0.042	0.204	0.0006	206
	HR2	243	6.9	0.94	0.66	32	188	107	0.006	0.021	0.113	0.0005	154
	HR3	119	3.7	0.52	0.37	15	93	53	0.003	0.008	0.047	0.0003	93
	HR4	119	8.2	1.09	0.77	40	229	134	0.007	0.031	0.158	0.0006	184
	HR5	135	5.9	0.81	0.56	28	164	95	0.005	0.018	0.098	0.0005	145
	HR6	147	10.6	1.35	0.95	57	328	196	0.010	0.050	0.252	0.0007	254
	HR7	166	7.5	0.95	0.67	43	248	141	0.008	0.038	0.184	0.0005	192
	HR8	243	5.0	0.66	0.46	26	155	87	0.005	0.018	0.094	0.0004	131
	HR9	210	7.0	0.90	0.64	38	215	123	0.007	0.029	0.143	0.0005	173
	HR10	101	4.9	0.66	0.48	23	137	76	0.004	0.013	0.075	0.0004	132
	HR11	126	4.2	0.57	0.40	21	125	69	0.004	0.012	0.067	0.0004	116
	HR12	147	7.4	0.92	0.66	42	217	133	0.008	0.024	0.148	0.0005	179
	HR13	160	8.6	1.05	0.77	50	274	169	0.009	0.043	0.224	0.0005	226
	HR14	185	8.1	1.00	0.73	49	254	156	0.009	0.034	0.192	0.0005	213
	HR15	180	12.5	1.42	1.05	87	467	288	0.017	0.096	0.434	0.0007	379
	HR16	265	8.6	0.99	0.73	59	321	200	0.012	0.065	0.292	0.0005	271
	HR17	176	9.4	1.12	0.80	60	301	212	0.012	0.048	0.278	0.0006	256
	HR18	168	10.3	1.24	0.88	69	413	224	0.014	0.083	0.302	0.0009	309
	HR19	104	13.4	1.54	1.10	101	598	325	0.020	0.133	0.464	0.0008	431
Holmes Run Upper	HR21	211	9.9	1.21	0.85	62	312	207	0.014	0.042	0.244	0.0008	263
	HR22	261	8.7	1.09	0.77	52	263	173	0.011	0.033	0.200	0.0007	219
	HR23	265	7.8	1.00	0.71	40	199	135	0.008	0.029	0.169	0.0005	165
	HR24	117	7.3	0.96	0.68	36	174	119	0.007	0.026	0.151	0.0005	143
	HR25	110	10.0	1.21	0.86	60	318	216	0.012	0.063	0.314	0.0006	260
	HR26	246	6.7	0.82	0.58	40	207	137	0.008	0.028	0.167	0.0004	176
	HR27	105	10.1	1.22	0.88	63	319	205	0.012	0.040	0.240	0.0006	256
	HR28	129	9.6	1.18	0.83	57	284	200	0.011	0.045	0.263	0.0006	234
	HR29	196	9.5	1.14	0.83	57	291	197	0.011	0.045	0.260	0.0006	244
	HR30	156	11.1	1.32	0.96	71	352	242	0.014	0.054	0.316	0.0006	294
	HR31	109	9.9	1.19	0.85	63	318	214	0.013	0.042	0.255	0.0006	260

Table 2-10. (Continued)

Subwatershed	Subbasin	Area, acres	Pollutant										
			TN	**TP**	**DP**	**BOD**	**COD**	**TSS**	**PB**	**CU**	**ZN**	**CD**	**TDS**
Holmes Run Upper (continued)	HR32	114	7.8	0.94	0.71	48	245	150	0.009	0.029	0.179	0.0005	212
	HR33	161	11.3	1.33	0.93	75	380	255	0.016	0.060	0.321	0.0007	304
	HR34	165	8.4	1.05	0.77	48	255	155	0.009	0.036	0.191	0.0006	207
	HR35	132	9.3	1.10	0.78	58	305	217	0.011	0.058	0.309	0.0006	258
	HR36	122	7.1	0.85	0.60	44	229	162	0.009	0.040	0.221	0.0005	202
	HR37	227	10.9	1.20	0.88	68	345	287	0.014	0.098	0.520	0.0005	333
	HR38	179	12.0	1.35	0.96	88	484	301	0.019	0.113	0.465	0.0007	378
	HR39	183	12.7	1.48	1.04	92	507	306	0.019	0.100	0.410	0.0007	380
	HR40	189	13.5	1.41	1.03	92	435	395	0.020	0.133	0.711	0.0006	427
	HR41	106	16.4	1.66	1.18	133	545	468	0.034	0.155	0.929	0.0005	557
	HR42	253	11.5	1.26	0.93	84	461	288	0.018	0.114	0.490	0.0007	398
	HR43	221	11.8	1.31	0.93	74	404	323	0.015	0.126	0.601	0.0006	360
	HR44	109	10.5	1.18	0.83	61	350	285	0.012	0.113	0.536	0.0005	310
	HR45	244	9.0	1.06	0.80	54	288	183	0.010	0.058	0.288	0.0005	244
	HR46	163	8.2	0.88	0.62	63	287	229	0.015	0.062	0.330	0.0005	274
	HR47	155	12.5	1.41	1.04	91	502	294	0.019	0.106	0.434	0.0007	396
	HR48	242	11.0	1.23	0.93	77	358	263	0.016	0.072	0.396	0.0005	326
	HR49	173	10.9	1.19	0.88	80	346	280	0.018	0.065	0.392	0.0005	323
	HR50	154	9.4	1.02	0.95	61	310	141	0.009	0.046	0.244	0.0005	294
	CW1	204	8.3	1.00	0.72	52	266	178	0.010	0.037	0.221	0.0005	226
Indian Run	IR1	262	11.3	1.26	0.91	79	383	277	0.017	0.079	0.407	0.0006	338
	IR2	192	7.7	0.93	0.67	40	214	162	0.008	0.050	0.268	0.0005	193
	IR3	199	8.9	1.11	0.80	49	252	168	0.010	0.044	0.230	0.0005	208
	IR4	230	7.8	0.97	0.70	43	226	153	0.008	0.045	0.222	0.0005	189
	IR5	282	13.9	1.54	1.11	99	456	356	0.022	0.097	0.524	0.0007	405
	PR1	157	11.8	1.33	0.99	76	352	259	0.017	0.088	0.504	0.0005	342
	PR2	264	7.8	0.99	0.71	39	200	135	0.008	0.030	0.172	0.0005	163
Pike Branch	PK1	190	11.2	1.28	0.95	73	408	244	0.014	0.093	0.391	0.0006	332
	PK2	114	11.7	1.35	1.02	80	483	256	0.015	0.105	0.389	0.0007	367
	PK3	181	11.9	1.39	1.04	78	474	249	0.015	0.106	0.381	0.0007	352

Table 2-10. (Continued)

Subwatershed	Subbasin	Area, acres	Pollutant										
			TN	TP	DP	BOD	COD	TSS	PB	CU	ZN	CD	TDS
	PK4	270	10.9	1.28	0.94	65	346	236	0.012	0.068	0.354	0.0006	291
	PK5	198	11.3	1.37	0.99	71	358	233	0.014	0.047	0.285	0.0007	290
Pike Branch (continued)	PK6	274	9.5	1.13	0.82	59	297	201	0.012	0.048	0.283	0.0006	252
	PK7	248	12.6	1.47	1.05	84	439	286	0.017	0.085	0.420	0.0007	354
	PK8	218	11.3	1.36	0.99	70	355	229	0.013	0.047	0.280	0.0007	287
	PK9	123	7.9	0.92	0.70	48	244	164	0.009	0.041	0.233	0.0005	220
Tribs	CA1	202	13.7	1.49	1.11	111	641	337	0.023	0.152	0.556	0.0007	501
	CA2	169	17.0	1.82	1.27	127	565	467	0.031	0.146	0.832	0.0007	532
	CA5	215	11.2	1.31	0.97	72	354	248	0.014	0.059	0.342	0.0006	310
	CA8	249	8.6	1.03	0.77	49	264	160	0.009	0.043	0.220	0.0005	221
	CA9	207	9.6	1.12	0.81	54	294	224	0.010	0.072	0.376	0.0005	261
	CA11	125	10.8	1.30	0.91	68	342	232	0.015	0.056	0.321	0.0007	298
	CA12	192	11.0	1.28	1.02	70	352	211	0.013	0.050	0.295	0.0006	309
	CA13	138	11.3	1.33	0.98	74	348	243	0.016	0.058	0.352	0.0006	309
	CA14	211	9.4	1.25	0.88	45	260	154	0.008	0.037	0.188	0.0007	208
Tripps Run	TR0	271	8.3	1.02	0.72	51	264	172	0.011	0.041	0.215	0.0007	223
	TR1	185	10.2	1.23	0.87	64	320	220	0.013	0.051	0.283	0.0006	260
	TR2	174	9.0	1.10	0.80	49	253	176	0.009	0.047	0.261	0.0005	217
	TR3	173	9.6	1.19	0.86	56	285	183	0.011	0.039	0.227	0.0006	231
	TR4	216	7.5	0.95	0.68	38	197	137	0.008	0.033	0.185	0.0005	167
	TR5	137	10.0	1.24	0.89	60	296	195	0.012	0.038	0.231	0.0006	238
	TR6	177	11.6	1.38	1.00	75	397	246	0.015	0.079	0.346	0.0007	315
	TR7	148	10.5	1.24	0.90	70	358	229	0.014	0.060	0.302	0.0006	311
	TR8	157	12.6	1.47	1.09	85	441	274	0.016	0.079	0.380	0.0007	358
	TR9	199	12.4	1.47	1.04	82	397	275	0.017	0.055	0.334	0.0007	326
	TR10	125	13.3	1.47	1.10	92	430	321	0.019	0.085	0.488	0.0007	392
	TR11	119	11.9	1.42	1.01	79	383	261	0.016	0.051	0.314	0.0007	313
	TR12	267	11.9	1.38	0.99	81	393	277	0.017	0.064	0.360	0.0007	329
	TR13	164	10.6	1.30	0.96	58	343	203	0.010	0.068	0.311	0.0007	283
	TR14	161	9.3	1.16	0.82	55	301	184	0.011	0.049	0.245	0.0006	252
	TR15	162	5.2	0.68	0.48	29	164	101	0.005	0.020	0.114	0.0004	156
	TR16	271	4.6	0.60	0.42	27	150	93	0.005	0.017	0.098	0.0004	151

Table 2-10. (Continued)

Subwatershed	Subbasin	Area, acres	Pollutant										
			TN	TP	DP	BOD	COD	TSS	PB	CU	ZN	CD	TDS
	TR17	167	10.3	1.22	0.89	63	346	229	0.012	0.074	0.362	0.0006	308
	TR18	254	6.7	0.83	0.60	40	214	138	0.008	0.028	0.164	0.0005	194
Tripps Run	TR19	179	10.2	1.22	0.90	64	316	209	0.013	0.045	0.268	0.0006	264
Turkeycock Run	TK1	183	9.8	1.10	0.94	66	386	167	0.011	0.077	0.310	0.0005	320
	TK2	198	10.8	1.26	0.92	75	394	243	0.016	0.079	0.337	0.0006	314
	TK3	268	10.7	1.25	0.92	67	323	225	0.014	0.063	0.339	0.0006	281
	TK4	183	7.9	0.96	0.71	47	225	161	0.010	0.039	0.222	0.0005	207
	TK5	209	8.4	1.05	0.75	50	289	161	0.010	0.049	0.202	0.0006	218
	TK6	234	6.5	0.75	0.55	37	204	158	0.007	0.051	0.269	0.0004	195
	TK7	119	10.6	1.17	0.84	78	454	264	0.017	0.112	0.405	0.0006	341
	TK8	135	7.9	0.95	0.73	42	214	146	0.008	0.039	0.214	0.0005	184
	TK9	197	8.4	1.03	0.76	47	238	159	0.009	0.038	0.213	0.0005	197

Table 2-11. Pollutant loadings (pounds/acre/year) in Cameron Run watershed based on SWMM modeling for 1996-1998 hydrologic conditions, for current, projected future, and projected future with projects land use conditions

Subwatershed	**TN**	**TP**	**DP**	**BOD**	**COD**	**TSS**	**PB**	**CU**	**ZN**	**CD**	**TDS**
	Current land use										
Backlick Run	10.1	1.14	0.81	70	332	250	0.016	0.075	0.419	0.00050	302
Holmes Run Lower	8.9	1.06	0.75	58	319	201	0.012	0.061	0.274	0.00058	258
Holmes Run Upper	10.0	1.16	0.83	64	327	236	0.013	0.068	0.350	0.00059	282
Indian Run	9.6	1.14	0.81	58	291	218	0.012	0.063	0.332	0.00054	257
Pike Branch	10.1	1.21	0.86	64	342	222	0.013	0.065	0.314	0.00061	277
Tribs	9.9	1.16	0.82	64	329	229	0.014	0.068	0.343	0.00058	284
Tripps Run	10.1	1.22	0.86	64	320	222	0.013	0.054	0.293	0.00062	265
Turkeycock Run	8.0	0.95	0.68	51	277	176	0.011	0.057	0.253	0.00049	229
Weighted Average	9.8	1.14	0.81	64	321	227	0.014	0.066	0.341	0.00056	276
	Projected future land use										
Backlick Run	11.1	1.25	0.90	78	366	265	0.017	0.082	0.459	0.00053	337
Holmes Run Lower	9.8	1.16	0.84	64	352	215	0.013	0.065	0.295	0.00062	283
Holmes Run Upper	10.6	1.23	0.89	69	350	247	0.014	0.072	0.370	0.00061	302
Indian Run	10.5	1.23	0.89	65	320	234	0.014	0.068	0.359	0.00057	281
Pike Branch	11.2	1.32	0.97	71	381	240	0.014	0.071	0.345	0.00066	310
Tribs	11.4	1.33	0.97	74	381	254	0.015	0.076	0.387	0.00064	325
Tripps Run	10.8	1.29	0.92	68	342	233	0.014	0.057	0.309	0.00065	284
Turkeycock Run	9.6	1.13	0.84	60	327	203	0.012	0.067	0.303	0.00056	268
Weighted Average	10.7	1.24	0.90	70	354	243	0.015	0.071	0.371	0.00060	305
	Percentage change, current to future land use										
Backlick Run	10.0	8.9	11.9	11.1	10.4	6.3	8.8	8.6	9.5	5.2	11.7
Holmes Run Lower	10.0	9.6	12.4	10.1	10.2	6.7	6.9	7.3	7.7	7.2	9.9
Holmes Run Upper	6.3	5.7	7.5	7.6	7.1	4.7	6.7	4.9	5.7	3.8	7.1
Indian Run	9.3	8.6	10.5	11.6	9.9	7.6	11.4	6.6	8.2	5.7	9.5
Pike Branch	10.1	9.2	12.3	11.2	11.6	8.1	8.0	9.5	9.9	7.5	11.9
Tribs	14.9	14.0	18.1	14.8	15.6	11.0	9.9	12.4	12.9	10.6	14.4
Tripps Run	6.4	5.8	7.6	7.1	6.8	4.7	5.2	5.2	5.5	4.4	7.0
Turkeycock Run	19.7	19.0	23.9	18.0	18.3	15.1	12.7	18.2	19.6	13.6	17.0
Weighted Average	9.6	8.8	11.5	10.5	10.2	6.9	8.2	8.1	8.8	6.2	10.3
	Projected future with projects land use										
Backlick Run	10.8	1.21	0.89	77	357	253	0.017	0.078	0.442	0.00050	332
Holmes Run Lower	9.6	1.13	0.82	63	344	209	0.012	0.063	0.286	0.00061	277
Holmes Run Upper	10.0	1.16	0.85	65	332	231	0.013	0.067	0.345	0.00058	287
Indian Run	10.0	1.17	0.85	62	303	220	0.013	0.062	0.332	0.00055	266
Pike Branch	11.0	1.29	0.95	70	375	235	0.014	0.069	0.336	0.00064	304
Tribs	11.2	1.31	0.96	73	375	247	0.015	0.074	0.377	0.00063	322
Tripps Run	10.5	1.25	0.91	66	332	223	0.013	0.054	0.293	0.00063	277
Turkeycock Run	9.0	1.06	0.79	56	298	186	0.011	0.059	0.278	0.00052	249
Weighted Average	10.3	1.20	0.88	68	341	231	0.014	0.067	0.352	0.00057	295

Table 2-11. (Continued)

Subwatershed	TN	TP	DP	BOD	COD	TSS	PB	CU	ZN	CD	TDS
	Percentage change, future to future with projects land use										
Backlick Run	-2.7	-3.2	-1.5	-2.2	-2.4	-4.7	-3.5	-4.3	-3.7	-4.2	-1.6
Holmes Run Lower	-2.3	-2.3	-2.2	-2.1	-2.1	-2.6	-2.2	-2.7	-3.1	-1.9	-2.2
Holmes Run Upper	-5.3	-5.3	-4.8	-4.9	-5.0	-6.3	-5.3	-6.7	-6.8	-5.3	-5.1
Indian Run	-5.2	-5.1	-4.9	-4.9	-5.4	-6.2	-4.7	-8.0	-7.5	-5.1	-5.5
Pike Branch	-1.8	-1.8	-1.8	-1.6	-1.7	-2.0	-1.6	-2.2	-2.4	-1.9	-2.0
Tribs	-1.3	-1.4	-0.7	-1.3	-1.4	-2.6	-2.1	-3.0	-2.5	-1.5	-0.8
Tripps Run	-2.7	-2.8	-2.0	-2.8	-2.9	-4.3	-3.4	-6.0	-5.0	-2.8	-2.6
Turkeycock Run	-6.3	-6.5	-5.5	-7.1	-9.0	-8.3	-7.8	-12.2	-8.3	-7.4	-7.1
Weighted Average	-3.6	-3.8	-3.0	-3.3	-3.7	-4.9	-4.0	-5.6	-5.0	-4.0	-3.3

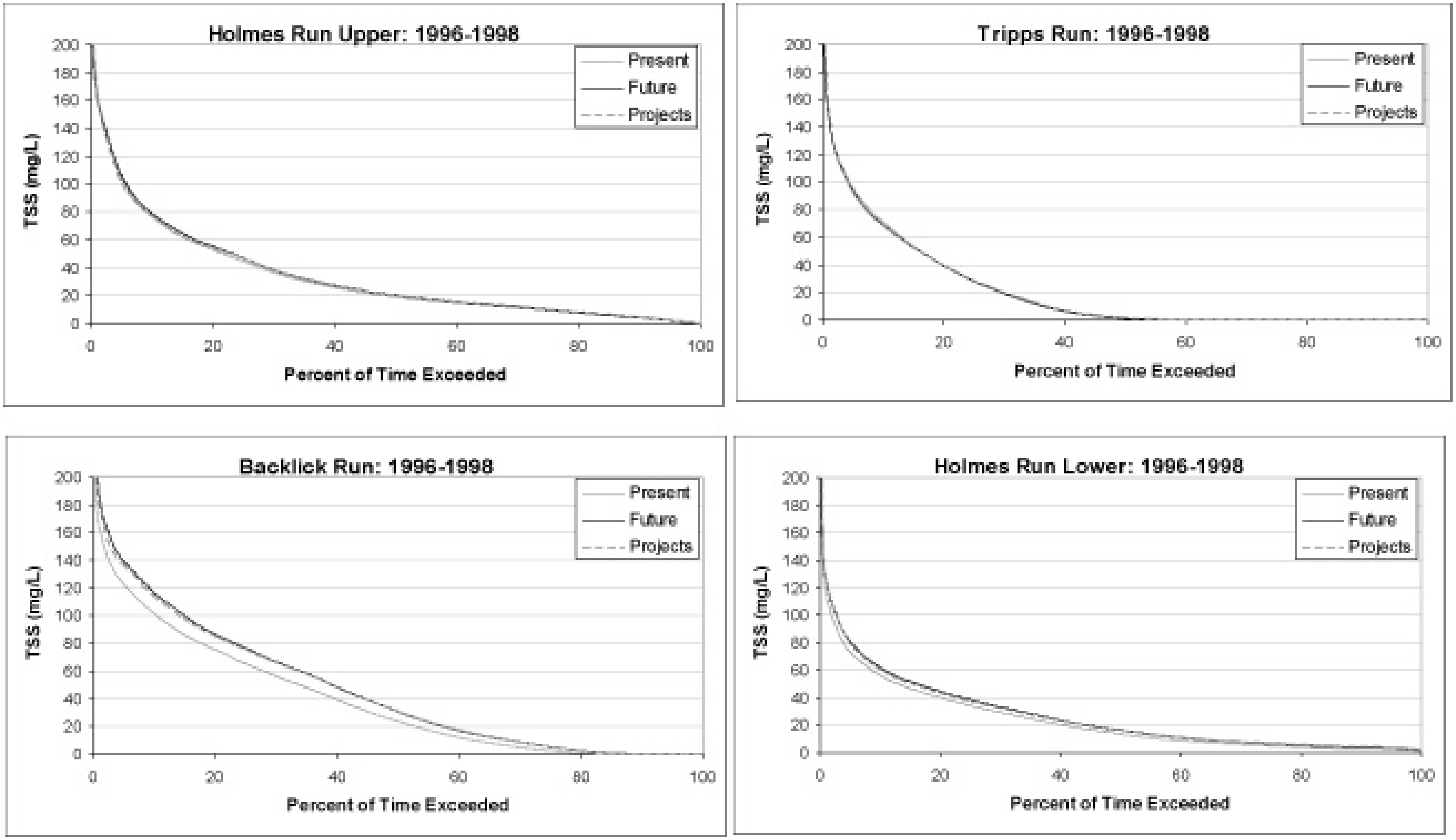

Figure 2-24. Total Suspended Solids exceedance curves for subwatersheds in Cameron Run

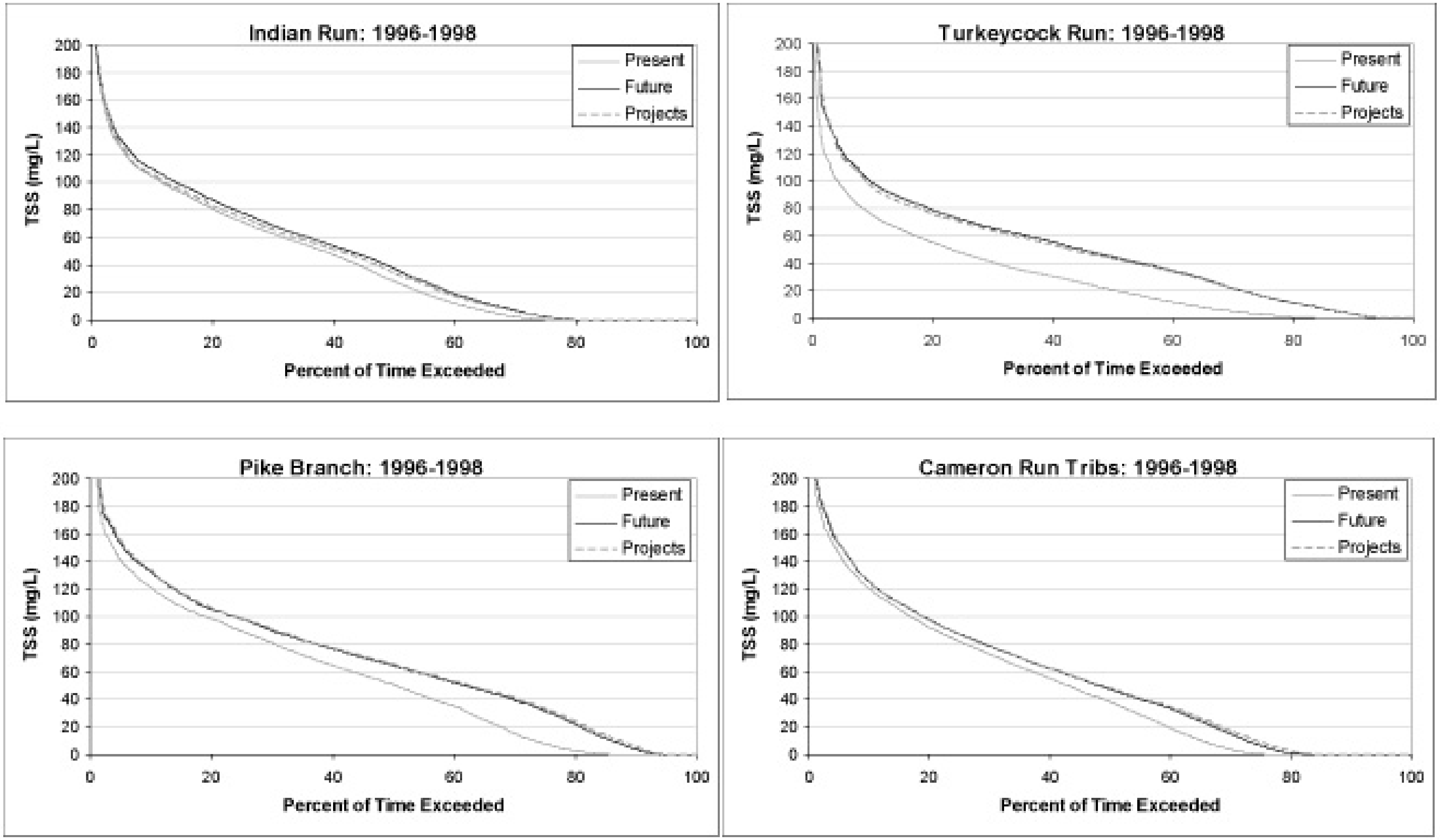

Figure 2-24. (Continued)

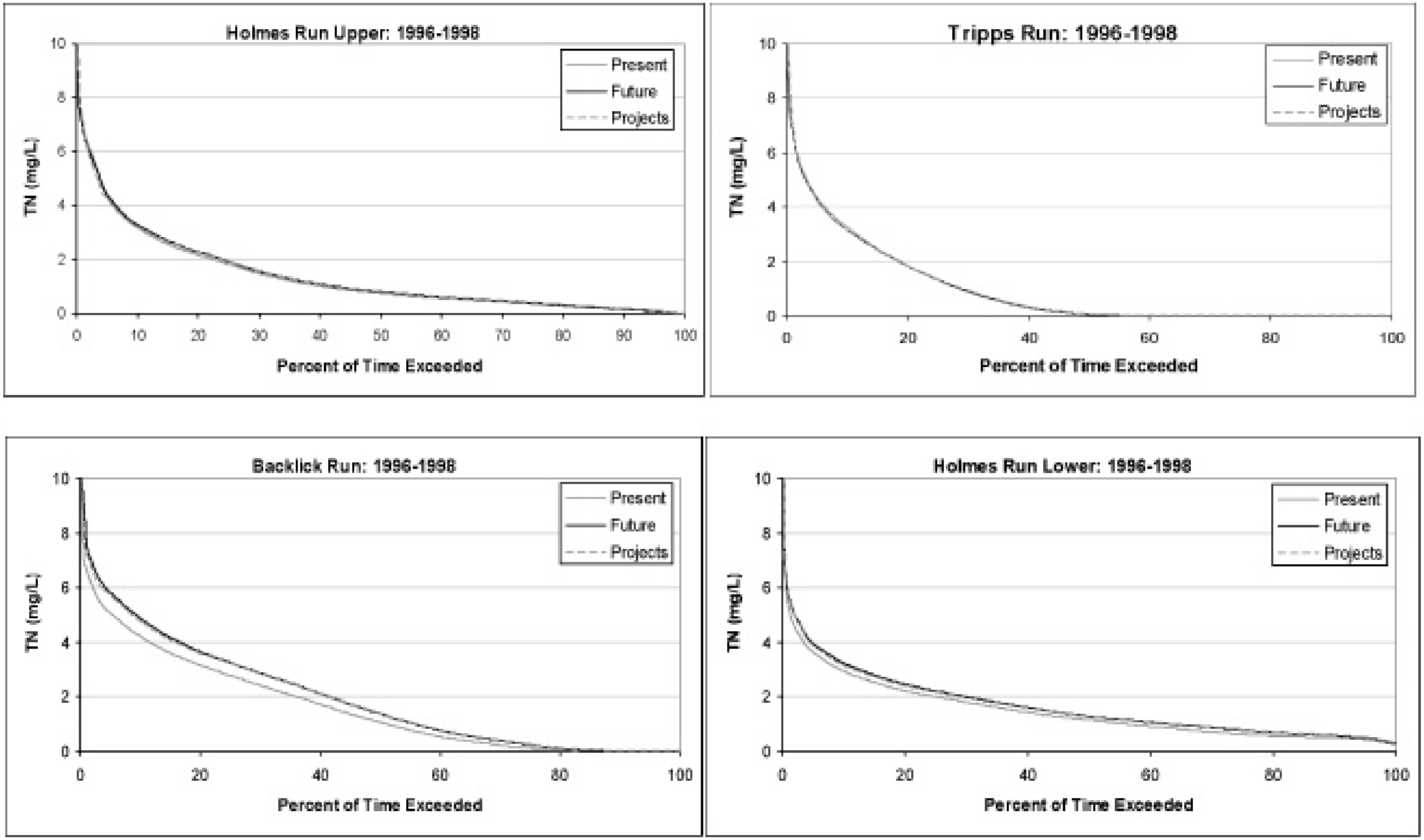

Figure 2-25. Total Nitrogen exceedance curves for subwatersheds in Cameron Run

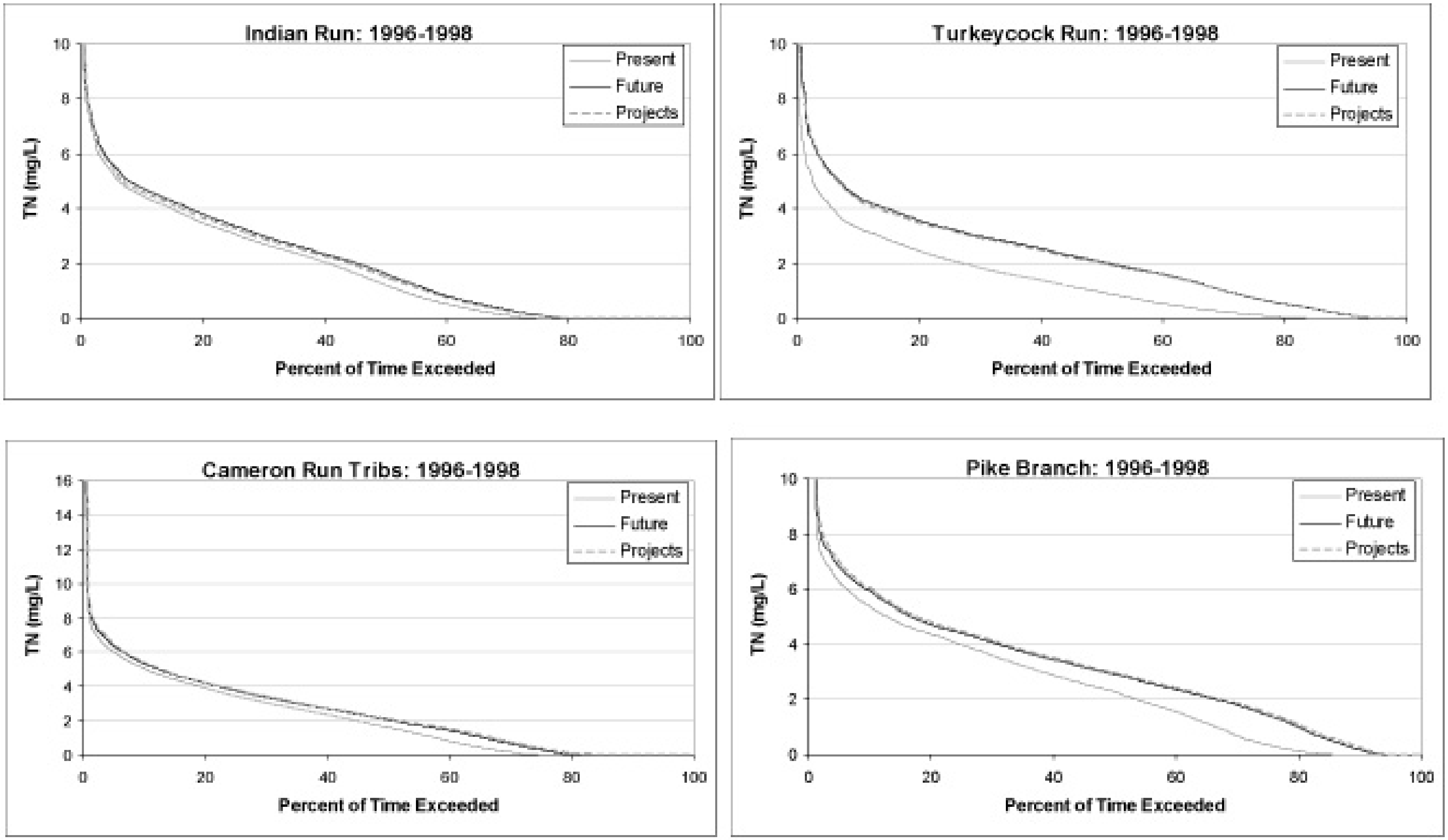

Figure 2-25. (Continued)

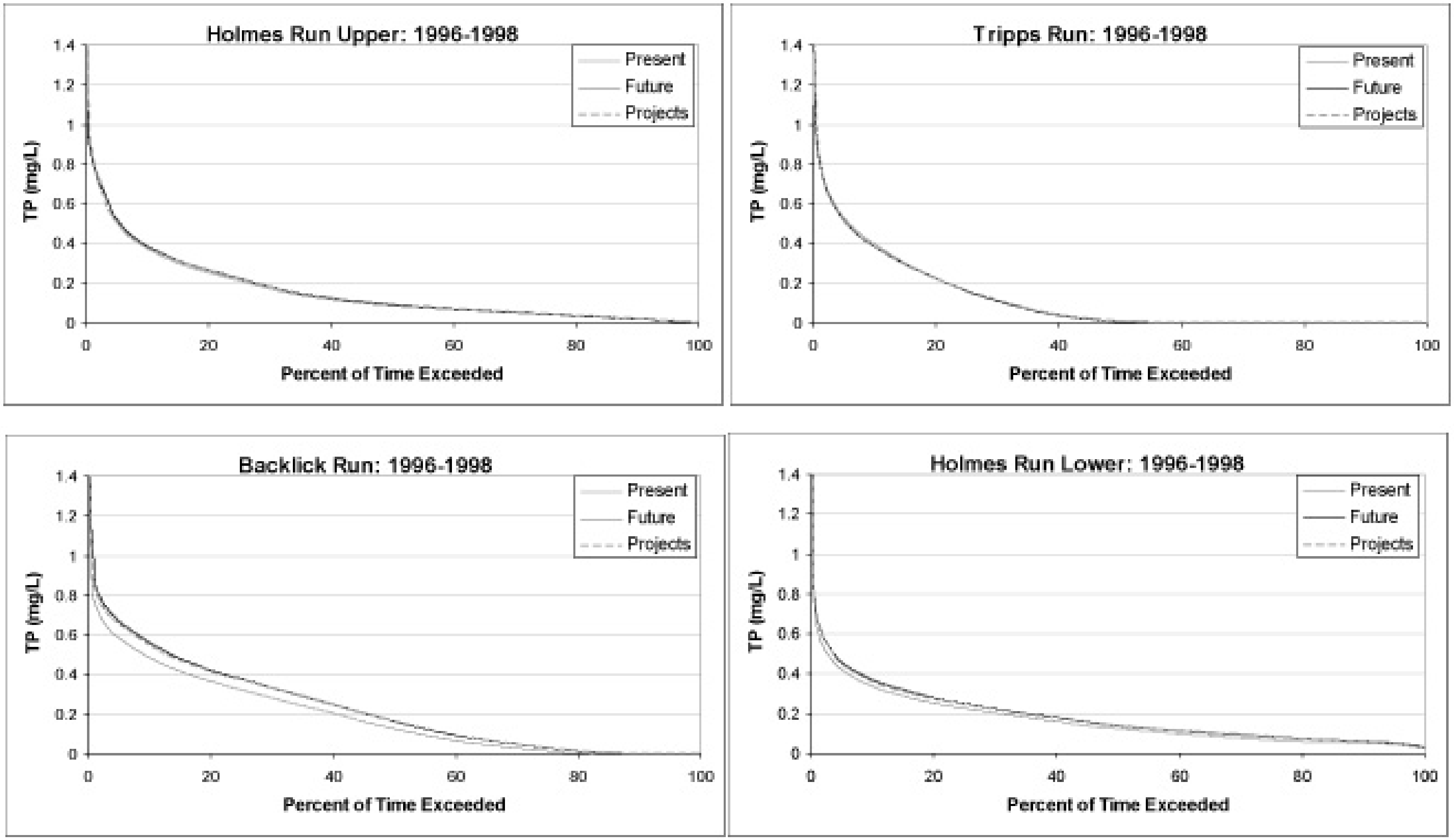

Figure 2-26. Total Phosphors exceedance curves for subwatersheds in Cameron Run

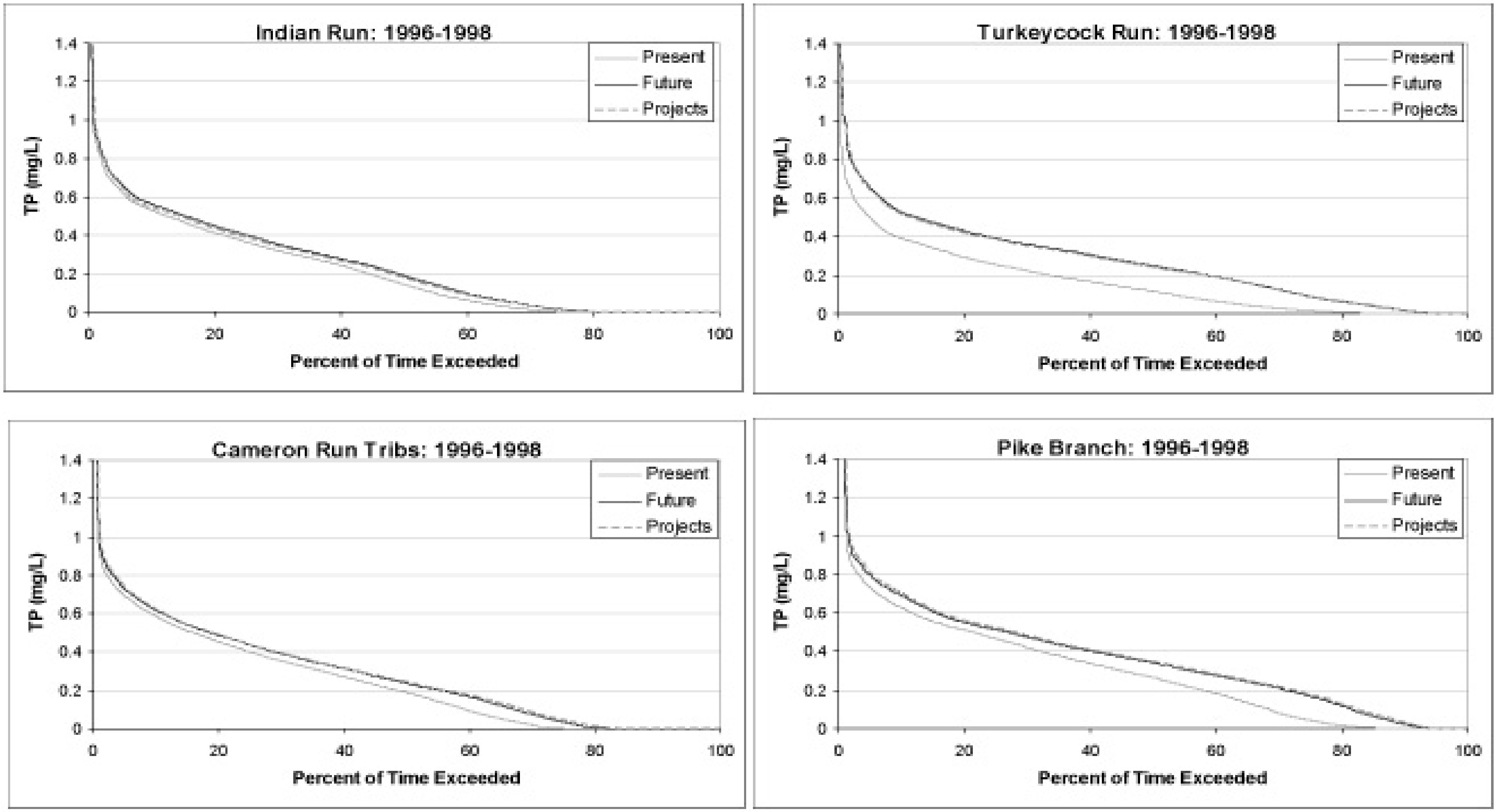

Figure2-26. (Continued)

Table 2-12. Weighted average of design storm peak flows (cfs) in Cameron Run summarized by subwatershed, for current, projected future, and projected future with projects land use (Fairfax County only)

Subwatershed	1 year			2 year`			10 year			25 year			100 year		
	Cur-rent	Future	Future Projects	Cur-rent	Future	Future Projects	Cur-rent	Future	Future Projects	Cur-rent	Future	Future Projects	Cur-rent	Future	Future Projects
Backlick Run	212	224	209	277	289	270	622	626	592	708	711	683	993	1018	991
Cameron Rub Tribs	231	249	241	306	322	311	711	731	715	811	864	846	1105	1193	1168
Holmes Run Lower	219	232	224	292	303	293	674	675	662	773	782	769	1046	1077	1056
Holmes Run Upper	209	217	206	276	285	270	647	649	630	739	751	732	1015	1038	1004
Indian Run	263	277	260	349	361	343	809	818	795	913	923	900	1291	1331	1303
Pike Branch	221	235	229	297	308	301	742	742	730	851	870	856	1153	1190	1175
Tripps Run	225	243	233	298	317	304	673	697	677	755	786	765	1038	1078	1045
Turkeycock Run	182	185	174	244	242	229	611	614	591	710	723	703	1006	1032	1007
Cameron Run Average	217	229	217	287	298	284	669	676	654	763	779	758	1054	1089	1061

Table 2-13. Percent change of design storm peak flows (cfs) in Cameron Run summarized by subwatershed, for current, projected future, and projected future with projects land use (Fairfax County subbasins only)

Subwatershed	1 year		2 year		10 year		25 year		100 year	
	Current vs Future	Future vs Projects	Current vs Future	Future vs Projects	Current vs Future	Future vs Projects	Current vs Future	Future vs Projects	Current vs Future	Future vs Projects
Backlick Run	5.4	-6.5	4.2	-6.6	0.6	-5.5	0.4	-3.9	2.6	-2.7
Cameron Rub Tribs	8.1	-3.3	5.3	-3.3	2.8	-2.1	6.6	-2.1	7.9	-2.1
Holmes Run Lower	5.9	-3.6	3.9	-3.2	0.1	-1.9	1.2	-1.7	3.0	-2.0
Holmes Run Upper	4.2	-5.2	3.1	-5.0	0.3	-3.0	1.7	-2.5	2.2	-3.3
Indian Run	5.0	-5.9	3.3	-5.0	1.2	-2.9	1.1	-2.5	3.1	-2.1
Pike Branch	6.4	-2.6	3.6	-2.1	0.0	-1.6	2.2	-1.6	3.2	-1.3
Tripps Run	8.0	-4.2	6.3	-3.8	3.6	-2.9	4.1	-2.7	3.9	-3.0
Turkeycock Run	1.9	-5.8	-0.7	-5.5	0.5	-3.8	1.9	-2.8	2.5	-2.4
Cameron Run Average	5.5	-5.0	3.8	-4.7	1.0	-3.3	2.1	-2.7	3.2	-2.6

Table 2-14. Subbasin design storm peak flows (cfs) in Cameron Run grouped by subwatershed, for current and projected future land use

			1 year					2 year					10 year					25 year					100 year				
Sub-watershed	Subbasin	Area, Acres	Current	% Change Current vs Future	Future	% Change Future vs Projects	Projects	Current	% Change Current vs Future	Future	% Change Future vs Projects	Projects	Current	% Change Current vs Future	Future	% Change Future vs Projects	Projects	Current	% Change Current vs Future	Future	% Change Future vs Projects	Projects	Current	% Change Current vs Future	Future	% Change Future vs Projects	Projects
Backlick Run	BA1	100	143	0.0	143	0.0	143	195	0.0	195	0.0	195	429	0.0	429	0.0	429	478	0.0	478	0.0	478	649	0.0	649	0.0	649
	BA2	218	467	0.7	471	0.0	471	591	0.5	593	0.0	593	1173	-0.3	1170	0.0	1170	1297	-0.3	1292	0.0	1292	1724	-0.5	1716	0.0	1716
	BA3	170	232	4.2	241	0.0	241	295	3.2	304	0.0	304	618	-0.1	618	0.0	618	690	-0.5	686	0.0	686	939	-1.7	923	0.0	923
	BA4	165	131	30.1	170	-4.0	163	172	26.8	218	-4.0	210	434	8.2	469	-3.8	451	500	8.3	541	-3.2	524	691	11.3	769	-2.0	753
	BA5	198	447	0.0	447	0.0	447	566	0.0	566	0.0	566	1115	0.0	1114	0.0	1114	1231	0.0	1230	0.0	1230	1631	0.0	1631	0.0	1631
	BA6	229	428	0.0	428	0.0	428	542	0.0	542	0.0	542	1099	0.0	1099	0.0	1099	1219	0.0	1219	0.0	1219	1631	0.0	1631	0.0	1631
	BA7	194	265	2.8	273	2.5	279	347	1.8	354	2.3	362	746	-0.6	742	1.7	754	831	-0.9	824	1.6	837	1182	1.8	1203	0.7	1211
	BA8	160	147	12.2	165	0.0	165	193	8.6	210	0.0	210	586	-26.6	430	0.0	430	687	-26.6	504	0.1	505	871	5.0	915	0.1	916
	BA9	129	130	11.8	145	0.0	145	172	8.4	186	0.0	186	431	-3.8	414	0.1	414	517	-5.1	491	0.1	491	690	5.1	726	0.1	726
	BA10	248	234	-2.2	229	-31.2	157	300	-2.9	291	-32.3	197	646	-4.7	616	-32.8	414	735	-6.4	688	-17.5	567	1100	-0.2	1097	-10.8	979
	BA11	163	231	3.7	239	0.0	239	293	3.1	302	0.0	302	589	1.4	597	0.0	597	652	1.2	660	0.0	660	917	1.1	927	0.4	930
	BA12	134	150	2.7	154	0.0	154	211	1.0	213	0.0	213	487	-0.8	483	0.0	483	558	-0.5	555	0.0	555	833	2.5	853	0.1	854
	BA13	219	132	4.9	139	-7.7	128	189	3.7	196	-7.1	182	549	1.8	559	-3.9	537	702	0.0	702	-2.6	684	956	1.8	973	-2.5	948
	BA14	200	175	1.1	177	-3.5	171	221	0.4	222	-3.1	215	493	-7.5	456	-0.6	453	605	-9.1	550	2.6	564	901	1.2	912	-1.5	898
	BA15	244	237	6.7	253	0.0	253	303	5.9	321	0.0	321	649	3.5	672	0.0	672	726	3.2	750	0.0	750	1097	2.3	1122	0.1	1123
	BA16	290	293	5.6	309	-2.3	302	377	5.0	395	-2.2	387	813	3.4	840	-1.9	824	915	2.6	938	-1.9	921	1358	2.5	1392	-1.2	1376
	BA17	116	150	2.3	153	-27.2	111	206	1.8	210	-28.4	150	461	1.1	466	-12.4	408	514	1.2	520	1.9	531	698	1.7	710	-0.3	708
	BA18	184	199	4.1	207	-23.8	158	260	3.4	269	-23.8	205	583	1.9	594	-17.3	491	654	1.7	665	-16.0	558	908	1.8	924	-12.9	805
	BA19	242	363	2.5	372	1.8	379	461	2.1	470	1.6	478	948	0.8	956	1.2	967	1055	0.6	1061	1.2	1074	1429	1.2	1446	1.1	1462
	BA20	163	217	8.8	236	-9.3	214	285	7.9	308	-9.4	279	627	5.7	662	-9.9	596	700	5.4	738	-5.7	696	954	5.1	1003	-3.8	964
	BA21	146	186	9.0	203	-0.1	203	239	8.5	259	-0.1	259	512	6.8	547	-0.1	547	573	6.6	610	-0.1	610	780	6.1	828	-0.1	827
	BA22	143	252	4.7	264	-3.1	256	327	3.1	337	-3.1	326	664	-0.3	662	-3.0	642	735	-0.7	730	-3.0	708	1005	0.1	1005	-1.3	992
	BA23	112	279	0.3	280	0.0	280	350	0.0	350	0.0	350	661	-0.5	657	0.0	657	726	-0.5	722	0.0	722	953	-0.7	947	0.0	947
	BA24	219	276	4.5	288	-5.5	272	352	3.4	364	-5.5	344	740	0.4	743	-4.7	709	826	0.0	826	-4.6	788	1120	1.6	1138	-3.1	1103
	BA25	227	200	8.6	218	-4.7	207	265	6.7	282	-4.6	269	637	1.6	647	-2.8	629	740	3.4	765	-2.3	747	1048	3.6	1085	-2.3	1060
	BA26	161	172	11.2	192	0.0	192	229	9.4	250	0.0	250	533	3.3	550	0.0	550	600	5.6	633	0.0	634	822	7.0	879	0.0	879
	BA27	245	223	7.0	239	-8.6	218	298	4.8	313	-8.9	285	729	3.2	752	-5.3	712	844	3.4	873	-5.0	829	1173	2.9	1207	-4.5	1152
	BA28	132	129	6.2	137	-3.2	133	180	2.3	184	-2.1	180	444	4.6	464	-1.3	458	498	7.8	537	-1.2	530	689	3.7	715	-1.1	707
	BA29	168	133	4.2	139	-2.6	135	193	1.1	195	-2.2	191	512	4.4	534	-1.5	526	583	4.8	611	-1.5	602	804	1.8	818	-1.2	808
	BA30	125	153	7.6	165	-23.2	127	202	6.8	216	-22.4	167	449	4.9	471	-14.9	401	503	4.8	527	-14.3	452	690	4.9	723	-13.9	623
	BA31	215	242	3.6	251	-21.7	197	312	3.3	322	-22.0	252	673	2.5	690	-22.3	536	753	2.4	771	-21.2	607	1044	2.0	1066	-8.3	977
Cameron Run Tribs	CA1	202	292	5.7	309	-6.2	289	379	4.4	396	-8.0	364	804	1.5	816	1.4	828	913	4.0	950	6.0	1007	1244	3.0	1281	3.7	1328
	CA2	169	303	4.7	318	0.0	318	386	1.2	391	0.0	391	773	-1.4	763	0.2	764	932	-0.6	926	0.2	928	1312	8.4	1422	0.1	1422
	CA5	215	210	30.7	275	-5.0	261	281	23.8	348	-3.9	335	665	24.0	824	-9.7	744	749	36.3	1021	-13.7	881	1040	29.1	1343	-12.4	1177
	CA8	249	185	8.8	201	-1.1	199	258	3.8	267	-1.0	265	692	3.1	713	-0.6	709	807	11.0	896	-0.6	890	1122	8.4	1216	-0.6	1209
	CA9	207	210	4.2	218	-12.8	190	286	2.2	293	-11.2	260	757	2.9	779	-5.6	735	841	6.9	899	-5.1	853	1122	8.2	1215	-4.6	1159
	CA11	125	241	2.2	247	0.0	247	321	1.8	326	0.0	326	663	1.2	671	0.0	671	734	1.2	743	0.0	743	982	1.1	992	0.0	992
	CA12	192	151	15.0	174	-3.0	168	207	8.2	224	-3.0	217	587	-10.2	527	-1.7	518	681	-10.0	613	-1.7	603	899	5.6	949	-1.3	937
	CA13	138	165	6.2	175	0.1	175	220	4.1	229	0.0	229	526	-0.7	522	0.1	523	591	4.7	619	0.1	619	799	4.6	835	0.1	836
	CA14	211	318	0.0	318	0.0	318	408	0.0	408	0.0	408	861	0.0	861	0.0	861	960	0.0	960	0.0	960	1298	0.0	1298	0.0	1298

Table 2-14. Subbasin design storm peak flows (cfs) in Cameron Run grouped by subwatershed, for current and projected future land use

			1 year					2 year					10 year					25 year					100 year				
Sub-watershed	**Sub-basin**	**Area, Acres**	**Cur-rent**	**% Change Current vs Future**	**Future**	**% Change Future vs Projects**	**Projects**	**Cur-rent**	**% Change Current vs Future**	**Future**	**% Change Future vs Projects**	**Projects**	**Cur-rent**	**% Change Current vs Future**	**Future**	**% Change Future vs Projects**	**Projects**	**Cur-rent**	**% Change Current vs Future**	**Future**	**% Change Future vs Projects**	**Projects**	**Cur-rent**	**% Change Current vs Future**	**Future**	**% Change Future vs Projects**	**Projects**
Holmes Run Lower	HR1	210	318	0.0	318	0.0	318	410	0.0	410	0.0	410	868	0.0	868	0.0	868	967	0.0	967	0.0	967	1307	0.0	1307	0.0	1307
	HR2	243	322	0.0	322	0.0	322	416	0.0	416	0.0	416	896	0.0	896	0.0	896	1001	0.0	1001	0.0	1001	1362	0.0	1362	0.0	1362
	HR3	119	121	0.0	121	0.0	121	169	0.0	169	0.0	169	406	0.0	406	0.0	406	456	0.0	456	0.0	456	631	0.0	631	0.0	631
	HR4	119	211	0.0	211	0.0	211	276	0.0	276	0.0	276	580	0.0	580	0.0	580	643	0.0	643	0.0	643	863	0.0	863	0.0	863
	HR5	135	190	0.0	190	0.0	190	250	0.0	250	0.0	250	545	0.0	545	0.0	545	607	0.0	607	0.0	607	824	0.0	824	0.0	824
	HR6	147	302	0.0	302	0.0	302	387	0.0	387	0.0	387	779	0.0	779	0.0	779	862	0.0	862	0.0	862	1147	0.0	1147	0.0	1147
	HR7	166	170	0.1	171	0.0	171	234	0.1	234	0.0	234	551	0.0	551	0.0	551	619	0.0	619	0.0	619	855	0.0	856	0.0	856
	HR8	243	197	0.7	198	0.0	198	269	0.5	271	0.0	271	659	0.3	661	0.0	661	746	0.3	748	0.0	748	1050	0.2	1052	0.0	1052
	HR9	210	228	0.4	229	0.0	229	314	-0.5	313	0.0	313	730	-0.7	725	0.0	725	822	0.2	824	0.0	824	1145	0.7	1153	0.0	1153
	HR10	101	120	6.1	127	0.0	127	165	3.0	170	0.0	170	395	1.6	401	0.0	401	442	3.6	458	0.0	459	596	3.1	615	0.0	615
	HR11	126	120	2.5	123	0.0	123	169	1.7	171	0.0	171	412	0.9	415	0.0	415	463	1.7	471	0.0	471	643	1.3	651	0.0	651
	HR12	147	188	3.4	195	-8.7	178	260	1.5	264	-6.3	247	623	2.1	636	-3.4	614	695	3.7	721	-3.2	697	926	3.4	957	-2.8	930
	HR13	160	166	10.9	184	0.1	184	227	6.2	241	0.1	242	550	1.5	559	0.1	559	623	5.4	657	0.1	657	849	4.2	884	0.1	885
	HR14	185	163	10.7	180	-2.1	177	215	8.5	234	-2.0	229	579	-6.0	544	-1.1	538	675	0.3	677	-0.9	671	891	3.9	926	-0.9	918
	HR15	180	236	8.2	255	0.0	255	303	6.9	324	0.0	324	642	3.2	663	0.0	663	716	2.8	736	0.0	736	980	3.9	1018	0.0	1018
	HR16	265	284	3.8	295	-5.3	279	388	0.5	390	-5.0	370	929	-1.1	919	-2.4	896	1111	-1.9	1089	-2.1	1066	1503	2.3	1537	-1.9	1508
	HR17	176	216	7.3	231	-6.7	216	284	6.5	302	-6.5	282	642	1.5	652	-4.7	622	729	2.4	747	-3.5	721	1000	3.9	1039	-4.9	988
	HR18	168	279	2.7	286	-2.7	279	360	2.2	368	-2.5	359	755	0.7	761	-1.4	750	841	0.8	847	-1.6	834	1143	1.7	1163	-3.1	1127
	HR19	104	164	3.1	169	-2.0	165	210	2.7	216	-0.6	215	440	1.6	447	-1.1	442	490	1.3	497	-1.2	491	668	0.9	674	-2.2	659
Holmes Run Upper	HR21	211	332	4.6	347	0.3	348	426	4.1	444	0.2	445	894	2.8	920	0.1	921	995	2.7	1022	0.1	1023	1346	3.1	1387	-0.4	1381
	HR22	261	325	5.6	343	-1.4	338	424	5.1	446	-1.4	440	954	2.4	977	-3.2	946	1072	2.8	1103	-4.3	1055	1488	3.2	1536	-6.9	1431
	HR23	265	239	2.3	245	-1.9	240	334	0.7	336	-1.7	331	886	4.2	923	-0.8	916	1007	5.5	1062	-0.7	1055	1354	3.1	1396	-1.8	1370
	HR24	117	106	3.4	109	0.0	109	151	1.3	153	0.0	153	375	4.7	392	0.0	393	423	5.3	445	-0.2	444	589	2.2	602	-0.5	599
	HR25	110	167	0.7	168	-0.3	168	231	-0.9	229	-0.2	228	497	2.8	511	-0.1	511	552	2.5	565	-0.1	565	749	3.3	774	-0.2	773
	HR26	246	223	6.2	236	-13.6	204	314	5.0	329	-12.1	289	791	1.5	803	-6.8	748	895	2.4	916	-6.3	859	1235	2.1	1261	-5.5	1191
	HR27	105	140	4.9	146	-2.9	142	193	3.4	199	-3.3	193	433	2.4	443	1.7	451	483	2.8	497	1.1	502	652	3.7	677	0.6	681
	HR28	129	142	6.8	152	-6.3	142	196	4.4	204	-4.3	196	465	3.4	481	-2.8	467	520	3.9	540	-2.9	525	713	2.6	731	-2.7	712
	HR29	196	194	9.6	212	-5.2	201	257	8.1	278	-5.0	264	621	0.7	626	-3.0	607	703	0.8	709	-2.9	688	962	3.6	996	-2.8	969
	HR30	156	202	8.3	218	-0.1	218	268	6.6	286	-0.1	286	616	1.6	626	-0.1	625	699	3.5	723	0.1	724	946	4.5	989	0.3	992
	HR31	109	122	11.2	136	-0.6	135	167	8.0	181	-0.6	180	396	3.8	411	-0.3	410	445	3.6	461	-0.3	460	605	4.6	633	-0.4	630
	HR32	114	90	11.7	100	-0.1	100	122	7.2	131	-0.1	131	318	0.4	319	-0.2	318	377	2.0	385	0.4	387	515	3.8	535	-0.5	532
	HR33	161	220	6.9	235	-4.5	225	290	6.2	308	-4.1	295	634	4.6	663	-3.4	641	708	4.5	739	-3.4	715	963	4.1	1002	-3.2	970
	HR34	165	159	4.0	165	-0.2	165	220	1.4	223	-0.1	223	586	-4.0	563	0.1	563	675	3.1	696	0.2	697	904	3.1	932	-0.6	927
	HR35	132	162	6.4	172	-13.5	149	220	4.2	229	-9.9	206	529	2.0	539	-5.1	512	599	1.1	606	-4.8	577	792	3.6	820	-5.8	773
	HR36	122	118	1.7	120	-15.3	102	162	1.2	164	-11.1	146	471	-4.8	448	-8.6	409	533	0.8	537	-8.1	493	701	1.8	713	-7.1	663
	HR37	227	151	7.0	162	-1.4	160	191	5.6	202	-1.4	199	600	-6.0	564	3.7	585	736	-1.6	724	2.0	739	963	2.4	986	-1.9	968
	HR38	179	274	1.4	278	-14.4	237	354	1.0	357	-14.3	306	745	-0.1	745	-11.3	661	828	-0.2	827	-11.1	735	1129	0.2	1131	-9.8	1021
	HR39	183	258	8.8	280	-3.1	272	331	8.2	358	-2.9	348	703	6.5	749	-2.5	730	784	6.3	833	-2.5	813	1063	5.9	1126	-2.4	1099
	HR40	189	167	-6.0	157	-0.4	156	210	-7.1	195	-0.3	194	489	-5.8	460	-0.6	458	649	-4.6	620	1.2	627	904	-0.7	898	-1.5	884
	HR41	106	166	0.5	166	-5.8	157	212	0.3	213	-5.6	201	429	-0.2	428	-5.1	406	474	-0.2	474	-5.0	450	671	0.9	677	-1.9	665

Table 2-14. Subbasin design storm peak flows (cfs) in Cameron Run grouped by subwatershed, for current and projected future land use

			1 year					2 year					10 year					25 year					100 year				
Sub-water-shed	Sub-basin	Area, Acres	Cur-rent	% Change Current vs Future	Future	% Change Future vs Projects	Projects	Cur-rent	% Change Current vs Future	Future	% Change Future vs Projects	Projects	Cur-rent	% Change Current vs Future	Future	% Change Future vs Projects	Projects	Cur-rent	% Change Current vs Future	Future	% Change Future vs Projects	Projects	Cur-rent	% Change Current vs Future	Future	% Change Future vs Projects	Projects
Holmes Run Upper (Continued)	HR42	253	352	-0.2	351	-1.7	345	449	-0.3	448	-1.6	441	923	-0.5	919	-1.3	907	1025	-0.5	1020	-1.3	1006	1464	0.0	1464	-1.3	1446
	HR43	221	264	0.9	266	-6.5	249	344	0.8	347	-6.2	325	758	0.3	761	-4.9	724	848	0.3	851	-4.8	810	1169	-0.4	1164	-3.1	1128
	HR44	109	124	-0.3	123	0.0	123	173	-0.3	172	0.0	172	405	-1.0	400	0.0	400	456	-1.8	448	0.0	448	626	-1.7	615	0.0	615
	HR45	244	197	6.3	209	-6.2	196	261	4.1	272	-6.5	254	683	-3.2	662	-4.5	632	806	1.8	821	-3.1	796	1104	2.6	1133	-4.0	1088
	HR46	163	186	-6.2	174	-15.9	146	245	-5.8	230	-16.1	193	544	-4.6	519	-10.3	466	609	-4.1	584	-9.9	527	869	-5.5	821	-8.9	748
	HR47	155	200	3.2	207	0.0	207	263	1.9	268	0.0	268	569	-0.9	563	0.0	563	633	-0.7	629	-0.1	628	925	2.2	945	-0.5	940
	HR48	242	243	7.1	261	-5.0	248	318	4.8	333	-5.0	316	754	-2.2	737	-3.4	712	902	0.4	906	-2.8	881	1218	3.0	1254	-3.0	1216
	HR49	173	183	3.6	189	-0.1	189	243	2.3	248	-0.1	248	585	-0.8	580	-0.2	579	678	2.1	692	0.2	694	916	1.9	933	0.0	933
	HR50	154	126	-0.8	125	-44.6	69	162	-2.1	158	-46.6	85	388	-8.0	357	-11.9	314	468	-2.2	458	8.4	496	737	0.8	743	-11.4	658
	CW1	204	201	11.7	224	-10.9	200	267	10.0	294	-11.0	262	645	2.7	662	-6.7	618	733	4.9	769	-6.2	721	1006	5.1	1057	-6.7	986
Indian Run	IR1	262	333	5.8	352	-2.3	344	442	4.5	462	-2.1	452	977	1.7	994	-1.8	976	1097	1.0	1108	-1.0	1097	1554	2.9	1599	-0.9	1585
	IR2	192	188	4.8	197	-17.0	164	261	3.1	269	-15.5	227	623	1.4	632	-8.3	579	705	1.6	716	-7.9	660	989	2.1	1010	-6.9	941
	IR3	199	146	11.6	163	0.0	163	196	8.4	213	0.0	213	584	-0.8	579	-0.1	579	692	-1.4	682	0.0	682	1053	4.3	1098	0.1	1100
	IR4	230	310	0.8	313	-12.8	272	425	-0.7	422	-9.0	384	1018	-1.6	1002	-3.8	964	1132	-1.6	1115	-3.6	1074	1515	3.3	1565	-3.4	1512
	IR5	282	389	3.3	402	-2.5	392	489	2.6	502	-2.4	490	992	0.7	999	-2.1	977	1102	0.4	1106	-2.1	1083	1532	2.7	1573	-1.3	1552
	PR1	157	185	1.6	188	-1.7	185	240	-0.1	239	-1.6	236	507	-0.2	506	-0.8	502	584	3.6	605	0.2	607	952	3.1	981	-0.6	976
	PR2	264	209	11.2	233	-8.1	214	287	6.9	306	-6.6	286	748	6.2	794	-3.2	768	853	5.4	899	-3.1	871	1177	3.6	1220	-2.8	1186
Pike Branch	PK1	190	233	1.8	238	-6.6	222	317	-0.1	317	-4.7	302	756	-4.6	721	-2.7	702	870	-6.8	810	-2.6	789	1186	1.6	1205	-2.1	1180
	PK2	114	146	3.5	151	-0.3	151	200	-0.2	200	-0.3	199	479	-2.0	469	-0.4	467	533	6.2	566	-0.4	563	711	6.5	758	-0.4	754
	PK3	181	197	3.8	205	-3.7	197	258	2.5	264	-3.5	255	595	-1.1	589	-1.9	577	702	1.6	713	-1.7	701	998	2.0	1019	-1.5	1004
	PK4	270	240	3.8	249	-0.3	248	326	0.1	327	-0.3	326	962	-1.6	946	0.0	946	1126	2.4	1152	0.0	1152	1467	2.3	1501	0.0	1500
	PK5	198	205	12.2	230	-0.7	228	276	9.0	301	-0.7	298	685	1.2	694	-0.3	691	779	4.7	816	-0.3	813	1045	5.6	1104	-0.5	1099
	PK6	274	226	10.7	250	-6.4	234	311	6.1	330	-6.3	309	811	1.0	819	-3.5	790	931	3.3	962	-4.3	921	1271	3.6	1317	-3.3	1273
	PK7	248	276	5.8	292	-0.1	292	355	5.2	374	0.0	373	768	3.5	795	0.0	796	861	3.2	889	0.1	889	1201	3.6	1244	-0.1	1243
	PK8	218	257	8.5	279	-0.4	277	354	4.7	371	-0.4	369	837	1.6	851	-0.3	848	949	4.6	992	-0.2	990	1280	4.1	1332	-0.2	1330
	PK9	123	102	2.5	105	-10.3	94	132	0.9	134	-3.9	129	419	-2.2	410	-14.5	351	476	0.5	479	-12.4	420	631	-0.2	630	-8.2	578
Tripps Run	TR0	271	363	3.3	376	-7.8	346	472	2.9	486	-7.7	448	1028	1.5	1043	-5.4	987	1154	1.1	1167	-5.8	1100	1586	2.1	1620	-8.1	1488
	TR1	185	238	2.0	243	-7.3	225	317	1.6	322	-4.2	308	712	-0.4	709	-1.3	700	798	-0.8	792	-1.3	782	1098	-0.4	1094	-3.5	1055
	TR2	174	146	6.9	156	-1.0	154	204	2.9	210	-0.7	208	525	1.1	530	-0.5	528	593	6.0	629	-0.4	626	819	4.5	856	-0.4	852
	TR3	173	162	8.7	176	-4.1	169	218	6.2	232	-3.9	223	539	0.0	539	-2.7	524	613	2.1	625	-4.4	598	838	3.0	863	-1.3	852
	TR4	216	187	4.8	196	-4.7	187	265	2.6	272	-4.0	261	676	5.0	709	-2.4	692	758	6.7	808	-2.3	790	1056	2.0	1077	-2.1	1054
	TR5	137	143	12.7	161	-0.6	160	197	7.8	213	-0.6	212	476	6.9	509	0.0	509	530	9.3	580	-0.3	578	729	7.1	781	-0.5	777
	TR6	177	225	3.9	233	-2.2	228	294	2.7	302	-2.2	295	644	0.0	644	-2.2	629	720	-0.3	717	-2.2	701	990	1.1	1001	-0.9	992
	TR7	148	210	15.4	243	0.0	243	270	13.9	307	0.0	307	568	9.6	622	0.0	622	633	9.1	690	0.0	690	863	8.4	935	0.0	936
	TR8	157	278	8.0	300	-10.3	269	366	6.3	389	-10.4	349	763	2.9	784	-10.9	699	849	2.2	867	-5.9	816	1157	2.3	1183	-7.0	1100
	TR9	199	267	12.2	299	0.0	299	346	11.1	385	0.0	385	751	8.2	813	0.0	813	840	7.9	905	0.0	905	1143	7.2	1225	0.0	1225
	TR10	125	204	5.3	215	-8.4	197	265	4.3	276	-8.7	252	556	1.8	566	-9.2	514	618	1.7	629	-9.4	569	836	3.7	867	-8.7	792
	TR11	119	149	15.0	171	0.0	171	197	12.9	223	0.0	223	441	8.1	477	0.0	477	494	7.7	531	0.0	531	675	8.3	731	0.0	731
	TR12	267	299	10.1	329	-2.6	321	388	9.0	423	-2.5	412	847	6.2	899	-2.1	880	948	5.8	1004	-2.1	983	1324	5.1	1392	-1.9	1365
	TR13	164	270	4.1	282	-2.2	275	345	3.4	357	-2.3	348	713	1.4	723	-2.5	705	793	1.2	802	-2.6	782	1071	1.3	1085	-1.9	1065

Table 2-14. Subbasin design storm peak flows (cfs) in Cameron Run grouped by subwatershed, for current and projected future land use

			1 year					2 year					10 year					25 year					100 year				
Sub-watershed	**Sub-basin**	**Area, Acres**	**Current**	**% Change Current vs Future**	**Future**	**% Change Future vs Projects**	**Projects**	**Current**	**% Change Current vs Future**	**Future**	**% Change Future vs Projects**	**Projects**	**Current**	**% Change Current vs Future**	**Future**	**% Change Future vs Projects**	**Projects**	**Current**	**% Change Current vs Future**	**Future**	**% Change Future vs Projects**	**Projects**	**Current**	**% Change Current vs Future**	**Future**	**% Change Future vs Projects**	**Projects**
Tripps Run	TR14	161	242	7.2	260	0.0	260	314	6.3	334	0.0	334	671	3.9	697	0.0	697	748	3.7	776	0.0	776	1015	4.5	1061	0.0	1061
	TR15	162	166	4.8	174	0.0	174	229	2.8	235	0.0	235	544	1.1	550	0.0	550	613	2.0	626	0.0	626	844	1.7	859	0.0	859
	TR16	271	257	10.7	284	0.0	284	353	6.9	377	0.0	377	843	3.7	874	0.0	874	950	3.9	987	0.0	987	1321	3.4	1365	0.0	1365
	TR17	167	269	6.8	288	0.0	288	344	6.0	365	0.0	365	715	3.5	740	0.0	740	794	3.3	820	0.0	821	1073	3.5	1110	0.0	1110
	TR18	254	237	13.0	268	0.0	268	321	9.5	352	0.0	352	795	3.8	824	0.0	825	901	4.7	943	0.0	944	1234	4.3	1287	0.0	1287
	TR19	179	160	12.8	181	-2.5	176	216	8.9	236	-2.3	230	551	0.7	555	-1.2	548	639	3.9	664	-1.1	657	865	4.6	905	-1.0	896
Turkey-cock	TK1	183	138	-2.1	135	0.0	135	196	-13.4	170	0.0	170	504	7.9	544	0.4	546	605	18.8	719	0.3	722	1006	10.9	1116	0.1	1117
	TK2	198	241	4.3	252	0.0	252	317	3.1	327	0.0	327	734	1.4	744	-2.2	727	855	0.3	857	2.3	878	1158	0.3	1162	2.3	1189
	TK3	268	258	2.1	264	-8.0	243	334	1.4	339	-7.9	312	732	-0.4	729	-7.6	674	821	0.1	822	-7.4	761	1214	1.3	1229	-3.2	1190
	TK4	183	156	-0.2	155	-2.8	151	217	-3.2	210	-2.6	205	526	6.6	561	0.1	561	618	7.1	661	0.2	663	964	3.4	997	-0.6	991
	TK5	209	185	-5.1	176	-0.1	176	253	-4.7	242	-0.1	241	681	-13.6	589	0.0	589	818	-14.5	700	-0.1	699	1087	-1.3	1073	0.0	1073
	TK6	234	145	4.9	152	-7.9	140	199	2.5	204	-6.3	191	663	-0.6	659	-4.2	631	774	0.7	779	-5.0	740	999	2.1	1020	-3.5	984
	TK7	119	210	0.2	210	-29.9	147	266	0.1	266	-30.0	186	532	-0.3	530	-23.9	404	596	-0.9	590	-20.0	472	831	0.0	831	-22.2	647
	TK8	135	122	1.3	124	-6.3	116	168	-3.8	162	-4.8	154	489	6.8	522	-2.2	511	563	9.6	617	-2.1	604	724	4.8	759	-3.1	735
	TK9	197	147	10.2	162	-2.7	158	199	5.7	210	-2.8	204	496	6.5	528	0.8	532	572	9.7	628	1.4	636	833	4.0	867	-2.3	846

3.0 HEC-RAS MODEL DEVELOPMENT

3.1 INTRODUCTION

This section documents procedures used to develop the HEC-RAS model of the Cameron Run watershed. HEC-RAS is the U.S. Army Corps of Engineers River Analysis System developed by the Hydrologic Engineering Center. The HEC-RAS hydraulic model is used for 1-, 2-, 10-, 25-, and 100-year single event flow simulations. HEC-RAS is used to evaluate road crossing overtopping, structure flooding, detailed analysis of bankfull capacity, and erosion velocities for selected design storms. The model can be used to evaluate the benefits of low-impact development (LID), and regional and onsite detention on hydraulic conditions in streams. The model can also be used to optimize the location of peak shaving detention storage facilities and other stormwater facilities to provide the greatest reduction in peak flows in the stream mainstem.

Procedures used to develop data on the stream network for input to the model are described in the following sections. These procedures are based partly on guidelines and recommendations contained in CDM's Technical Memorandum No.3 – Stormwater Model and GIS Interface Guidelines (TM3; CDM 2003).

3.1.1 Background

WEST Consultants, Inc. was tasked to complete the comprehensive steady flow HEC-RAS (Hydrologic Engineering Center, River Analysis System) hydraulic model of the major streams within the Cameron Run watershed. This section of the model report discusses development of the model, its execution, and results to be used for the overall watershed study.

Two major reservoirs exist within the watershed. Lake Barcroft is the biggest reservoir with a storage volume of about 2270 acre-ft, and it is fed by Holmes Run from the west and Tripps Run from the northwest. Fairview Lake is located in Holmes Run about 4 miles upstream of Lake Barcroft and has a storage volume of about 130 acre-ft.

WEST Consultants, Inc., constructed a steady-state HEC-RAS hydraulic model of Cameron Run and its major tributary streams. In addition, a number of unnamed third-order streams are included. A SWMM model of the watershed was used to supply boundary condition flows for the HEC-RAS model. Both current and future conditions were modeled for 1-, 2-, 10-, 25-, and 100-year recurrence interval storms (since SWMM results did not show a great reduction in peak flows with the proposed projects, these were not simulated in HEC-RAS). The lower end of Holmes Run and portions of Cameron Run flow through the City of Alexandria, which is outside of Fairfax County. These sections were not modeled in HEC-RAS with enough detail to provide flood inundation and stream velocity coverage; however, to maintain continuity of the comprehensive HEC-RAS model, portions of the streams that flow through the City of Alexandria were included at a minimum level of detail required to provide adequate results at the Fairfax County boundaries.

3.2 MODEL DEVELOPMENT

3.2.1 Survey Data

The extent of the stream network included in the model was based on the Fairfax Hydrography Dataset (FHD). The FHD is a GIS data set comprised of nodes, points, lines and polygon themes that were derived from 1997 aerial photography. The FHD contains a polyline stream network layer used to define the stream channel network which was used to develop the geometric data in HEC-RAS. The hydraulic model network starts at the outlets of the headwater subbasins and only includes major stream segments. In HEC-RAS, each river and reach is given a unique identifier. The river and reach labels define in which reach the cross-section is located.

i.e River: Pike Branch
Reach: PK001

A digital terrain model (DTM) was constructed using a compilation of 2-foot contour plots from the cities of Falls Church and Alexandria, and the portion of Fairfax County that falls within the Cameron Run watershed. The DTM was compiled in the form of a Triangular Irregular Network (TIN) for use in HEC-RAS model development. In addition to the DTM, field-surveyed cross-sections were collected near many of the crossings in the watershed. Contour plots were developed from aerial photogrammetry and do not include bathymetry; therefore, the TIN does not provide coverage for “submerged” terrain. Most of the streams in the watershed are very small, and an absence of bathymetric data will make little difference in the results; however, larger streams such as Cameron Run and lower Holmes Run may show results that skew towards higher water surface elevations. When field survey cross-sections were taken, they were merged with DTM-generated cross-sections to capture the bathymetry.

3.2.2 Geometry

The Cameron Run watershed was broken into three HEC-RAS models as (1) Pike Branch, (2) Cameron Run Unnamed Tributary # 2, and (3) the rest of the watershed upstream of the USGS gage on Cameron Run (called Cameron Run). Figure 3-1 illustrates the scope of the three models.

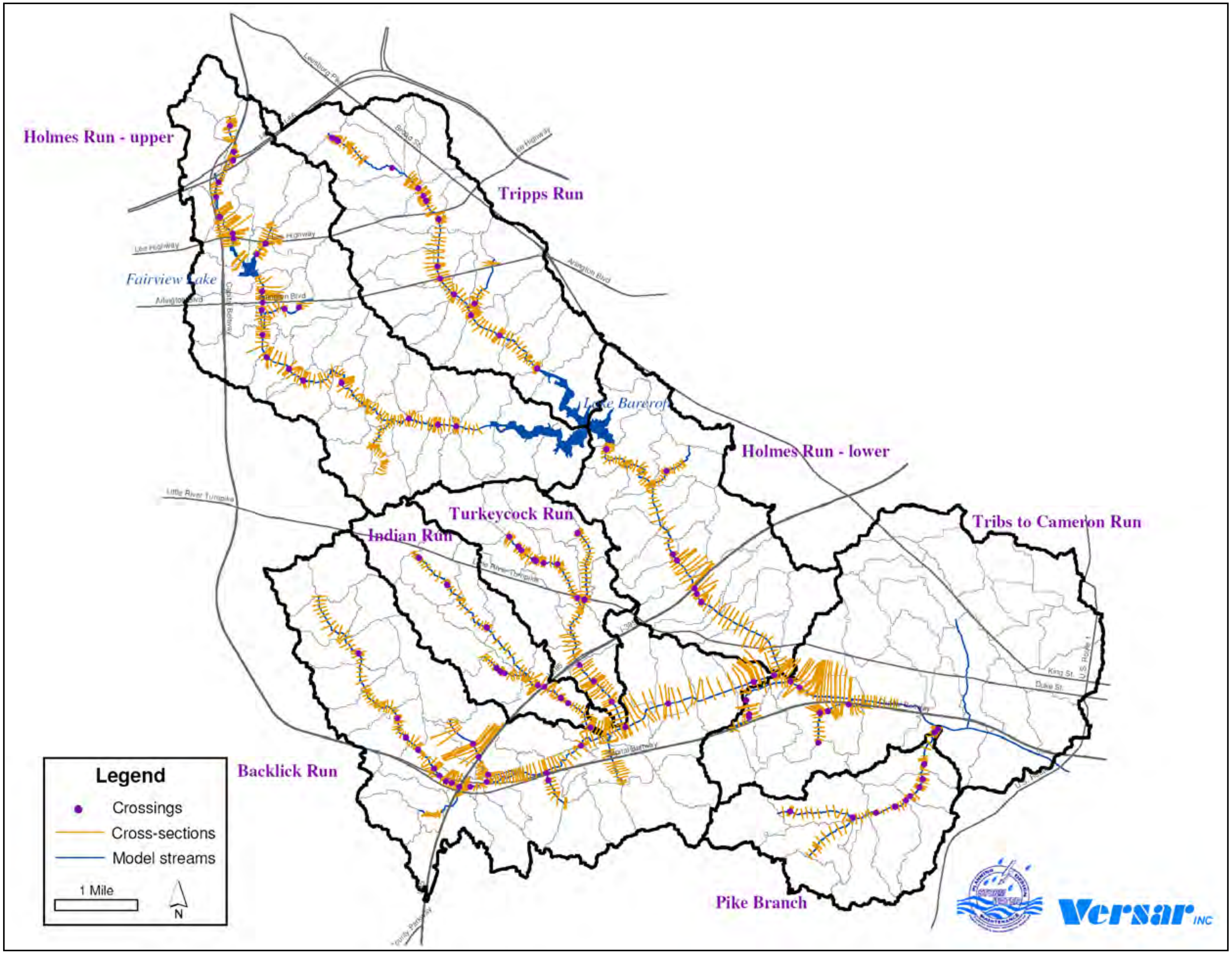

Figure 3-1. Cameron Run watershed model cross-sections and crossings

3.2.3 Cross-sections

Cross-sections are used to define the shape of the stream and its characteristics, such as roughness, expansion and contraction losses, and ineffective flow areas. Over 1000 cross-sections were defined as a GIS layer to characterize the terrain in the Cameron Run watershed. Additionally, fifty cross-sections were surveyed in the field. Field cross-sections were typically taken near crossings and include bathymetric data. Where possible, these cross-sections were merged with DTM cross-sections to produce composite cross-sections that include terrain as well as bathymetric survey points.

Each stream cross-section was assigned a unique identifier Section ID which was based on the stream segment identifier established by the Stream Physical Assessment (SPA) Project. The identifier is tied to the corresponding location in the HEC-RAS models and includes the River-Reach-station. The River Station tag defines where the cross-section is located within the specified reach. Cross-sections are ordered in the reach from the highest river station upstream to lowest river station downstream, with the value of the river station being the distance (in feet) from the downstream end of the stream reach.

i.e. River: Pike Branch
Reach: PK001
River Station: 11979.90

The locations of stream cross-sections were placed according to the guidelines. Stream cross-sections were added as needed; additional stream cross-sections were inserted at the end of stream reaches and near junctions.

3.2.4 Crossings

Field data investigations were conducted at each stream crossing to be modeled within the watershed using traditional surveying techniques. Benchmark elevations of stream crossing locations (point features of crossing locations from the SPA) were calculated using TIN data. A GPS unit was used to navigate to the crossing and recover benchmark locations identified in the office, and capture new field data. Field data were recorded in GIS and included replacement benchmark locations (if needed), actual cross-section endpoints, corrected crossing locations, new crossings encountered in the field that were not in the SPA dataset, and, on occasion, conveyance length.

At each site, field crews recovered the GIS-generated benchmark location and based subsequent rod and level surveys on this benchmark elevation. Field crews measured conveyance slope and length, conveyance dimensions, channel roughness, cross-sectional profiles, and other site details on field data sheets, and documented site conditions with digital photographs. In total, 153 crossings were surveyed. Included in this total were 26 additional sites that were either new crossings or crossings located in the cities of Alexandria or Falls Church that were needed for the model. In the HEC-RAS model, crossings include bridges, culverts, and inline weirs. Each crossing was included as a structural element in the RAS models; the Cameron Run HEC-RAS models included 113 crossings.

In the HEC-RAS model, bridges are defined by station-elevation points of high and low chords, piers, overflow weir coefficient, and modeling approach. High and low chords were determined using a combination of field survey data for the structure and points taken from the TIN for the roadway elevation. Weir coefficients were initially set to the default value of 2.6, which represents a relatively inefficient broad-crested weir. Some of the coefficients were adjusted on a case-by-case basis, using photographs and survey notes.

Culverts are defined by station elevation points of the embankment, size and shape of the culvert, and its energy loss coefficients. Most of the culverts in the Cameron Run watershed were box culverts, frequently consisting of multiple boxes in parallel. The watershed also has some circular pipes, pipe arches, and conspan structures. All culverts are lined with concrete or corrugated metal. Loss coefficients were set for each culvert based on entrance and exit conditions, shape, and degree of blockage. Severely blocked culverts were assigned entrance loss coefficients as high as 1.0. Very efficient, unblocked culverts had entrance coefficients as low as 0.2. Exit loss coefficients were normally left at the default value of 1.0. When a culvert was partially blocked with sediment along its length, an average blockage depth was used and the roughness of the sediment was considered in selecting coefficients to define culvert bottom roughness.

One inline weir was entered into the model. This weir is located at the downstream end of Holmes Run, just upstream of its confluence with Backlick Run. The weir is constructed of sheet piling and has a drop of about 7 feet. A discharge coefficient of 3.0 was used to define the structure's rating curve.

3.2.5 Roughness Values

Manning's *n* values were used in the model to define roughness for each cross-section. The *n* values were assigned in two steps. The first step involved defining land use characteristics for common areas throughout the watershed. Each land use characteristic was given an *n* value based on published values for similar conditions (Chow 1959; Barnes 1967) and on engineering judgment and experience. In-stream *n* values for small streams were not assigned in the first step. Once land use was defined for the entire watershed, representative *n* values were assigned to the portion of each cross-section that intersects the respective land use area. These *n* values were then exported to the HEC-RAS model using HEC-GeoRAS. The following land use and corresponding *n* values were used in the GIS model are given in Table 3-1.

The second step involved entering in-stream *n* values. These *n* values were based on field inspections and ranged from 0.015 for some concrete-lined channels to 0.07 for steep, cobbly streams with a lot of overhanging vegetation and debris.

TABLE 3-1. LAND USE AND CORRESPONDING MANNINGS *N* VALUES USED IN THE HEC-RAS MODEL

LAND USE CHARACTERISTIC	*N* VALUE
BACKLICK RUN	0.045
LOWER BACKLICK RUN	0.045
LOWER CAMERON RUN	0.035
CONCRETE CANAL	0.018
FIELD 1: OPEN AND MAINTAINED FIELDS, PARKS	0.030
FIELD 2: OPEN FIELDS WITH SCATTERED BRUSH, NOT MOWED	0.045
FIELD 3: FIELDS WITH THICK VEGETATION, NOT MAINTAINED	0.065
FOREST 1: LIGHT TREES AND UNDERBRUSH	0.070
FOREST 2: MEDIUM TREES AND DENSE UNDERBRUSH	0.085
FOREST 3: THICK TREES AND VERY DENSE UNDERBRUSH	0.120
INDUSTRIAL	0.100
PAVEMENT	0.015
RAILWAYS	0.020
RESERVOIRS	0.030
RESIDENTIAL, TYPICALLY WITH LANDSCAPED BACKYARDS	0.050
SPARSE RESIDENTIAL AND WITH FORESTED BACKYARDS	0.085

3.2.6 Ineffective Flow Area

Ineffective flow areas define portions of a cross-section in which water does not move effectively in the downstream direction. Examples of ineffective flow areas include flow separation zones at constrictions such as bridges and culverts, backwater eddies, overbank areas shadowed by obstructions, etc. These areas were defined in the GIS model using aerial photos to locate zones of potential ineffective flow. A 1:1 contraction ratio and a 2:1 expansion ratio were typically used to define ineffective flow areas bounding bridges and culverts. Ineffective flow areas were also defined where significant infrastructure existed within a cross-section and appreciable downstream conveyance was not expected. Once these areas were defined in the GIS model, they were intersected with the cross-sections and exported to the HEC-RAS model via HEC-GeoRAS.

3.2.7 Flows

HEC-RAS requires flows to be entered at all upstream boundaries in the model. In addition, flow changes can be specified along any of the streams. Flows were provided to the model for 1-, 2-, 10-, 25-, and 100-year recurrence interval storm events for both present and future (complete build-out of the watershed) conditions.

3.2.8 Hydrologic Model

The SWMM model of the Cameron Run watershed was developed as described in Sections 1 and 2 above. Rainfall hyetographs for each storm event were entered into the SWMM model. After defining hydrologic characteristics of the watershed and routing method for the streams, watershed-wide peak discharges were specified for each cross-section in the HEC-RAS model. These discharges were provided to WEST Consultants by Versar, Inc. for inclusion in the model.

3.2.9 Reservoirs

There are two major reservoirs in the Cameron Run watershed: Lake Barcroft and Fairview Lake, both on Holmes Run. No bathymetric data were available for these reservoirs, so defining them with cross-sections was not possible. It was possible to model the reservoirs as storage areas; however, the storage area element in HEC-RAS was developed for use in unsteady flow applications, and was not originally intended for steady flow modeling. For the Cameron Run watershed, reservoirs were modeled using a single cross-section, with a specified water surface for a given flow. In other words, reservoirs are treated as internal boundary conditions. Water surface elevations were programmed into flow files and were taken from storage elevation curves as described in Tables 2-1 and 2-2.

3.2.10 External Boundary Conditions

For steady flow models, upstream boundary conditions are entered as discharges. Downstream boundary conditions can be set to normal depth, a rating curve, a known water surface elevation, or critical depth. Since no gage data information was available at the down-stream end of the model, normal depth was selected for the Cameron Run watershed model downstream boundary condition. The normal depth option requires an energy slope be entered by the user, and then the program back-calculates a starting water surface elevation using Manning’s equation. Error involved in selection of the energy slope is normally minimized by placing the downstream boundary far from the area of interest in the model. In this case, the downstream boundary for the Cameron Run Tributary model was set about 1800 feet downstream of the first tributary and over 1 mile downstream of the calibration gage.

3.2.11 Calibration

Model calibration is a necessary technique used to increase confidence in uncertain parameters used in the model. Uncertain parameters include roughness values, coefficients of contraction and expansion, weir and culvert coefficients, and ineffective flow area definitions. Since these uncertain parameters are used throughout the watershed, the widest application of calibration data is preferable in constructing a hydraulic model. Calibration data typically come in the form of stage gage readings or high water marks. Unfortunately, historical stream gage data and high water marks are not widely available in the Cameron Run watershed. A USGS gage located near crossing CA003.C018 in Cameron Run provided the only calibration data for this model.

A storm event was selected for model calibration from the SWMM model long-term calibration period. An event on September 11, 1996 (Figure 2-5) resulted in a peak flow at the Cameron Run gage of 3,690 cfs, which corresponds to a peak flow recurrence interval of slightly less than the 4,020-cfs 2-year recurrence interval reported by USGS for this gage (USGS, 1994). Rainfall on that date ranged from 1.8 inches at the Sislers rain gage to 2.8 inches at the Skyline rain gage and averaged 2.3 inches which was slightly less than the 2.7 inch NRCS 1-year 24-hour rainfall amount.

Since there was only one calibration mark, calibrating uncertain parameters in the HEC-RAS model was not possible for most of the watershed; however, being located on the downstream portion of the watershed, the calibration mark at crossing CA003.C018 did provide a good measure for timing of peak flood waves through the system. The SWMM model supplied boundary condition flows for the HEC-RAS model. SWMM can simulate lag times in peak flows traveling through the watershed. As a result, the peak at the calibration gage on Cameron Run was not a summation of the peaks of Holmes Run and Backlick Run, but rather some quantity less than that. SWMM was able to capture this reduction in peak due to timing and was calibrated to the gage on Cameron Run. This provided sufficient confidence in the flows used in HEC-RAS model.

Calculated water surface elevations should be accepted with caution. Until further calibration data are retrieved and used to increase confidence of the results, the HEC-RAS model should be used as a comparison tool between different flow conditions and for ranking purposes of different alternatives, not necessarily for design work where quantification of hydraulic parameters is important.

3.3 POST-PROCESSING

Once the HEC-RAS model was complete, output data were exported to GIS. HEC-GeoRAS was used to compile data into useful graphical output such as floodplain polygon shape files and velocity line plots.

To generate floodplain shape files, GeoRAS first creates a water surface TIN for each of the flood events. The water surface TIN is clipped to fall within the bounds of the cross-sections (i.e., it does not extend beyond the end points of any cross-section), and is completely independent of the terrain TIN. After the water surface TIN is created, rasterization of the water surface TIN and the terrain TIN takes place, and the floodplain is delineated where the water surface exceeds the terrain elevations.

Because the resulting floodplain GIS file is only as good as the TINs that are used to create it, some manual adjustment of the floodplain boundary is necessary for the final product. Isolated "ponds" are removed from the floodplain file if it is determined that water cannot enter the ponds as surface water. There were areas where the floodplain extended beyond the extent of some of the cross-sections. Because the water surface TIN is clipped at the end of the cross-sections, manual extension of the floodplain was necessary. This process involved starting at a point within the water surface TIN bounds and tracing the floodplain boundary outside the TIN along a consistent contour elevation. This was continued until the floodplain boundary returned within the bounds of the water surface TIN (Figure 3-2).

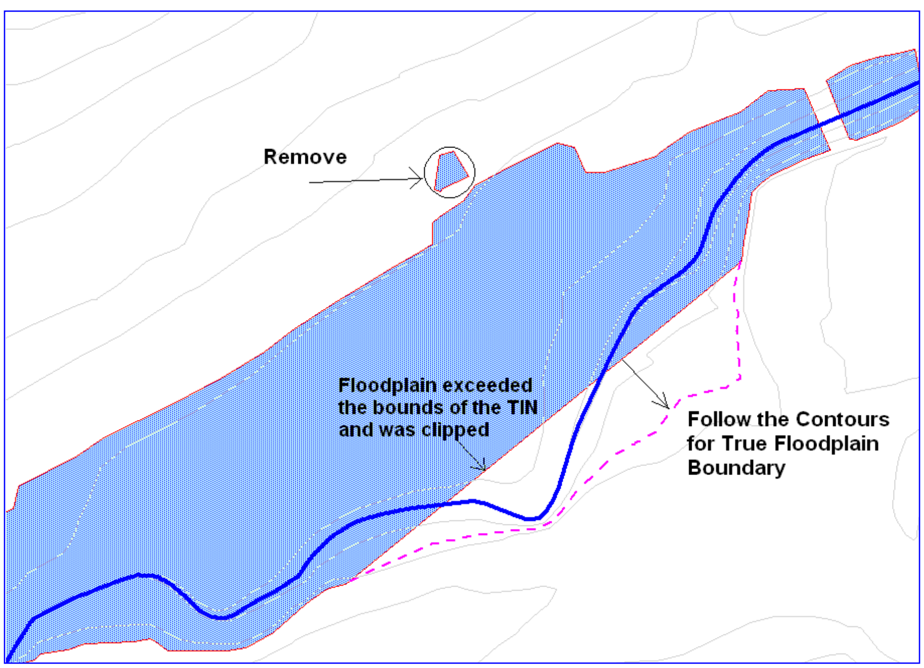

Figure 3-2. Manual adjustment of floodplain delineation

Velocity line plots were also created based on average channel velocities for 1- and 2-year events. After the HEC-RAS model is run, each cross-section has an average channel velocity. Every point that defines the streamline in GIS is then associated with the nearest cross-section and given the velocity of that cross-section. The resulting line plot is actually a series of points, each with its own velocity.

3.4 RESULTS AND CONCLUSIONS

At relatively low recurrence interval floods (1- and 2-year events), Holmes Run just downstream of Arlington Boulevard comes out of bank, creating a large floodplain. The majority of the overbank of this reach is forested and reserved as park land (Figure 3-3). Other areas of significant overbank flooding at low flows are the middle Backlick Run and the unnamed Backlick tributary, BA048, as well as a small unimproved stretch of Turkeycock Run between I-395 and Edsall Road. Most of the flooding at the low recurrence interval floods occurs in undeveloped parks and wetland areas.

Figure 3-3. 1-year flood event on Holmes Run downstream of Arlington Boulevard

Significant flooding occurs for the 100-year event on the lower Backlick Run and its confluence with Holmes Run. As shown in Figure 3-4, this location is mostly industrial and a substantial area is inundated. Interstate 395 initiates a large amount of flooding on Backlick Run, Indian Run, Turkeycock Run, and Holmes Run during the 100-year flood event. These areas are characterized by industrial and residential land uses with some park areas.

A long tunnel exists in the City of Fall Church on the upper section of Tripps Run where survey data were limited. The analysis indicates that the capacity of the tunnel is exceeded during the 10-year flood event. As a result, water spills over the embankment and flows overland. Where the overflow goes and how much reenters the main channel is unknown. An analysis of this kind would require a much more sophisticated model. For this study, no floodplain output is presented over the tunnel.

Figure 3-4. 100-year flood event in the Lower Backlick Run

Velocities for 1- and 2-year flood events for current and future conditions generally are less than 10 feet per second (fps) throughout the watershed (Figures 3-5 through 3-8). Areas of higher velocities (higher than 10 fps) include Holmes Run just below Fairview Lake, and Holmes Run from Lake Barcroft to its confluence with Backlick Run. Middle and lower sections of Backlick Run have some areas of high velocities as does Cameron Run downstream of Eisenhower Avenue. Figures 3-9 and 3-10 illustrate stream segments where velocities are greater than 5 fps for the 1- and 2-year design storms, indicating where erosion is more likely to occur. Table 3-2 lists the percentage of each stream reach that exceeds a peak velocity of 5 fps, grouped by subwatershed.

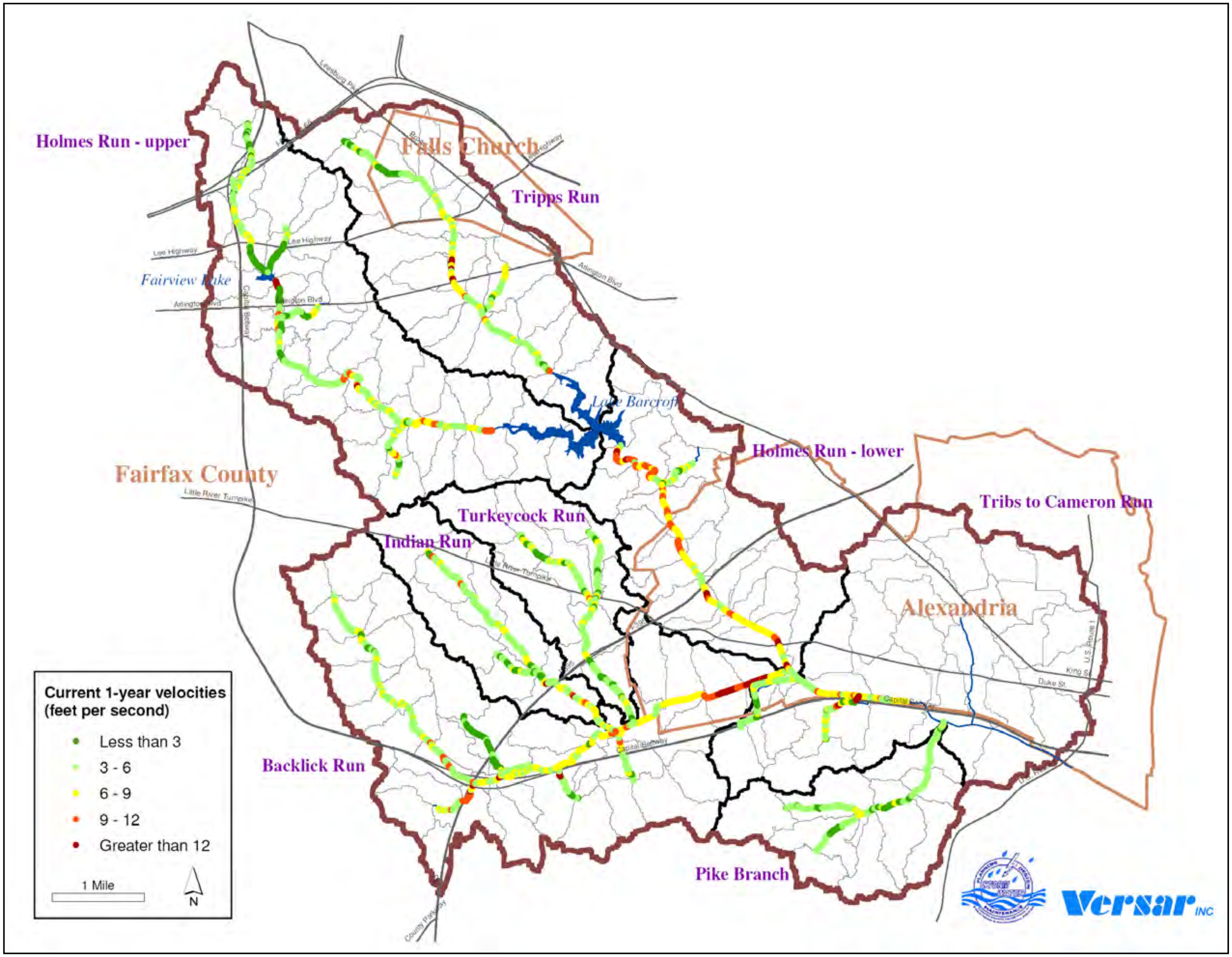

Figure 3-5. Peak stream velocities in the Cameron Run watershed for current conditions for a storm with a 1-year recurrence interval

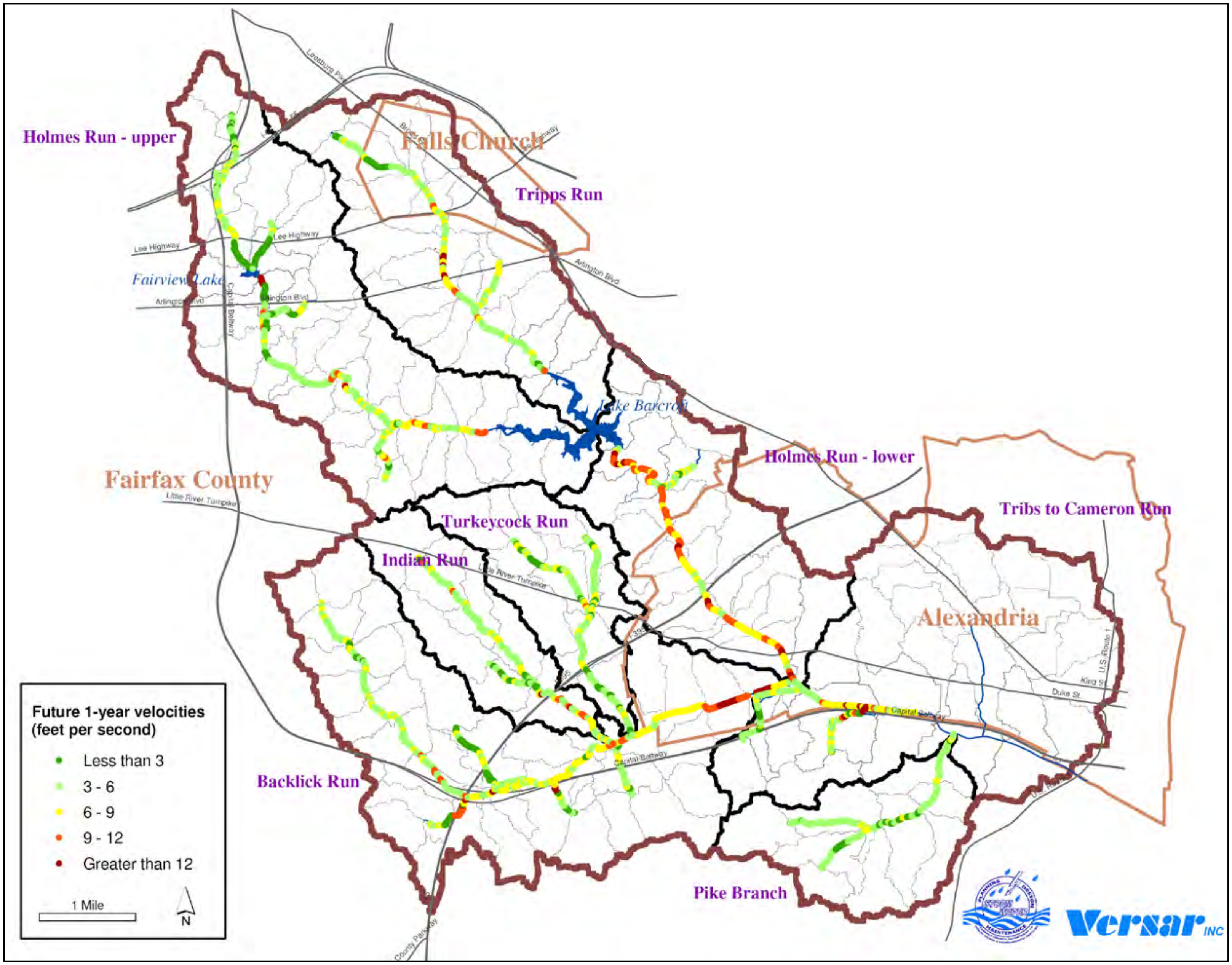

Figure 3-6. Peak stream velocities in the Cameron Run watershed for future conditions for a storm with a 1-year recurrence interval

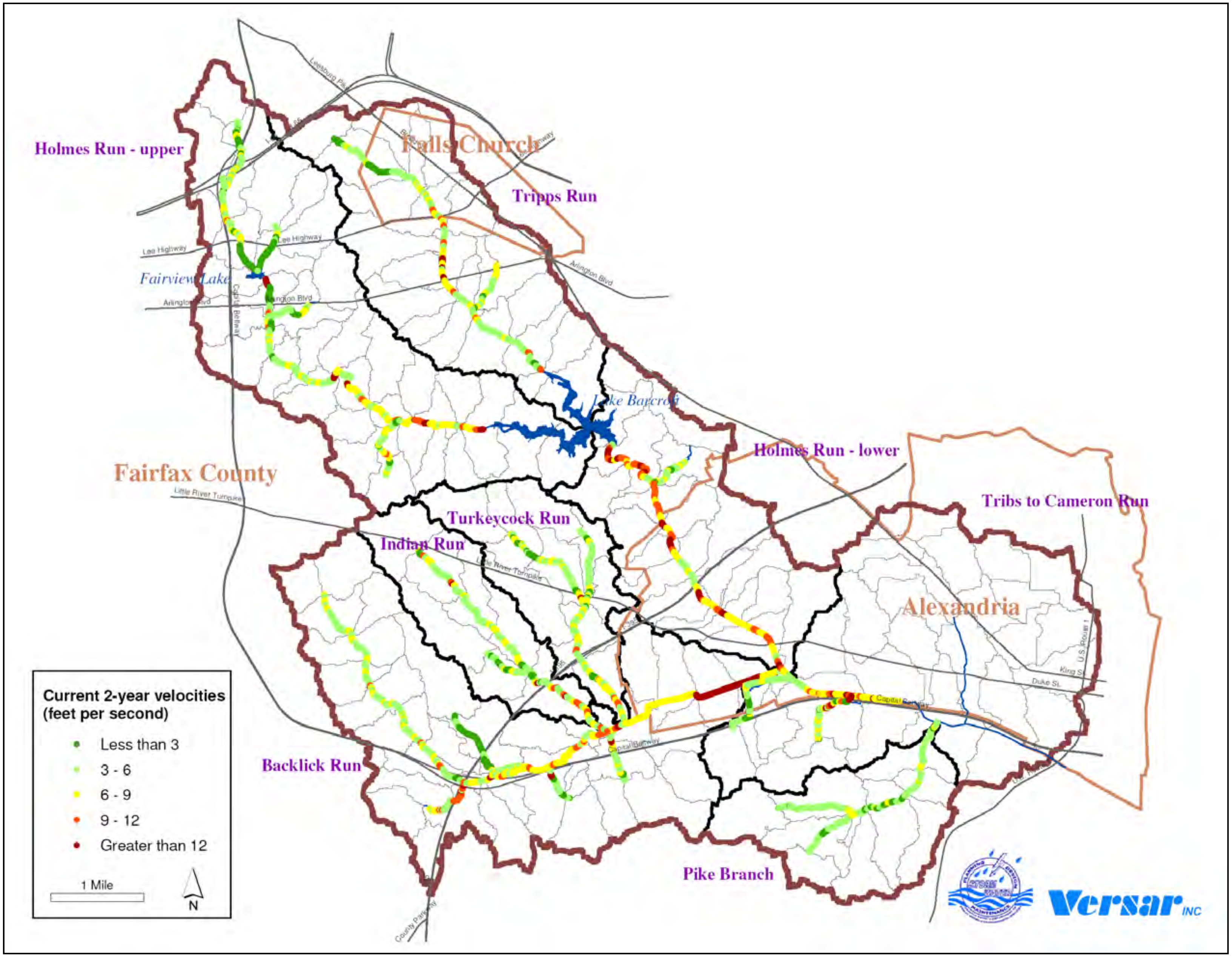

Figure 3-7. Peak stream velocities in the Cameron Run watershed for current conditions for a storm within a 2-year recurrence interval

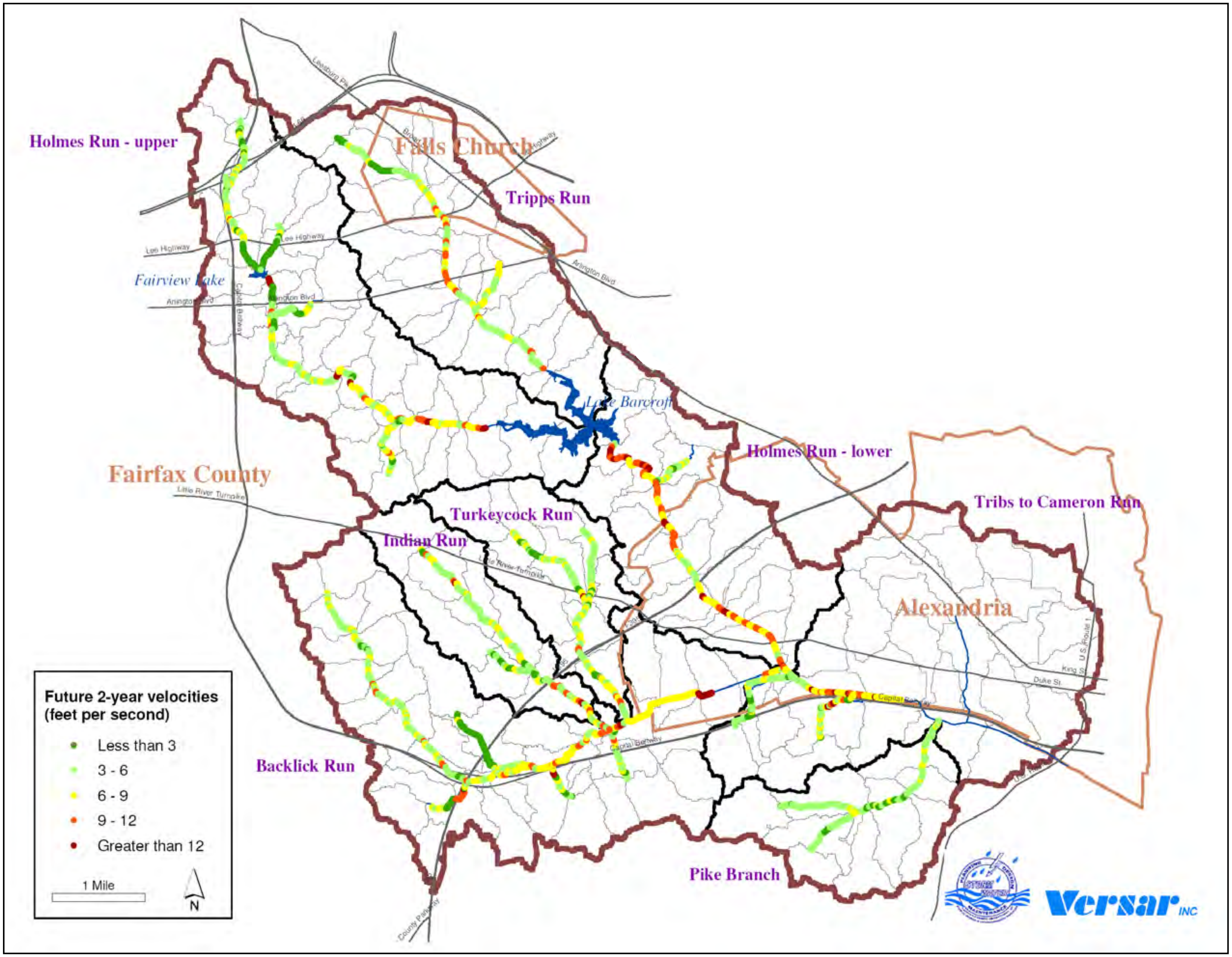

Figure 3-8. Peak stream velocities in the Cameron Run watershed for future conditions for a storm with a 2-year recurrence interval

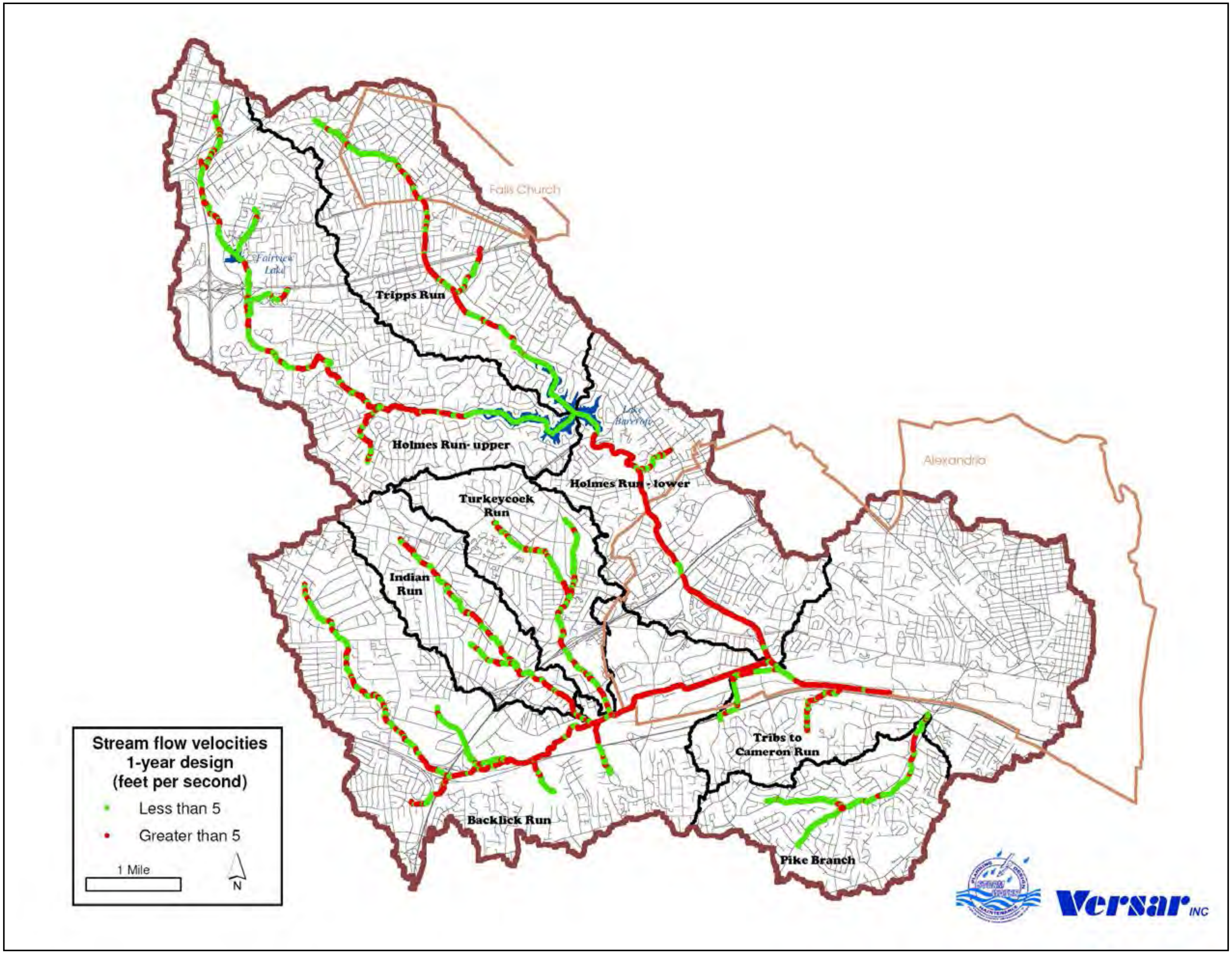

Figure 3-9. Peak stream velocities greater than 5 feet per second (fps) in the Cameron Run watershed for current conditions, for a storm with a 1-year recurrence interval

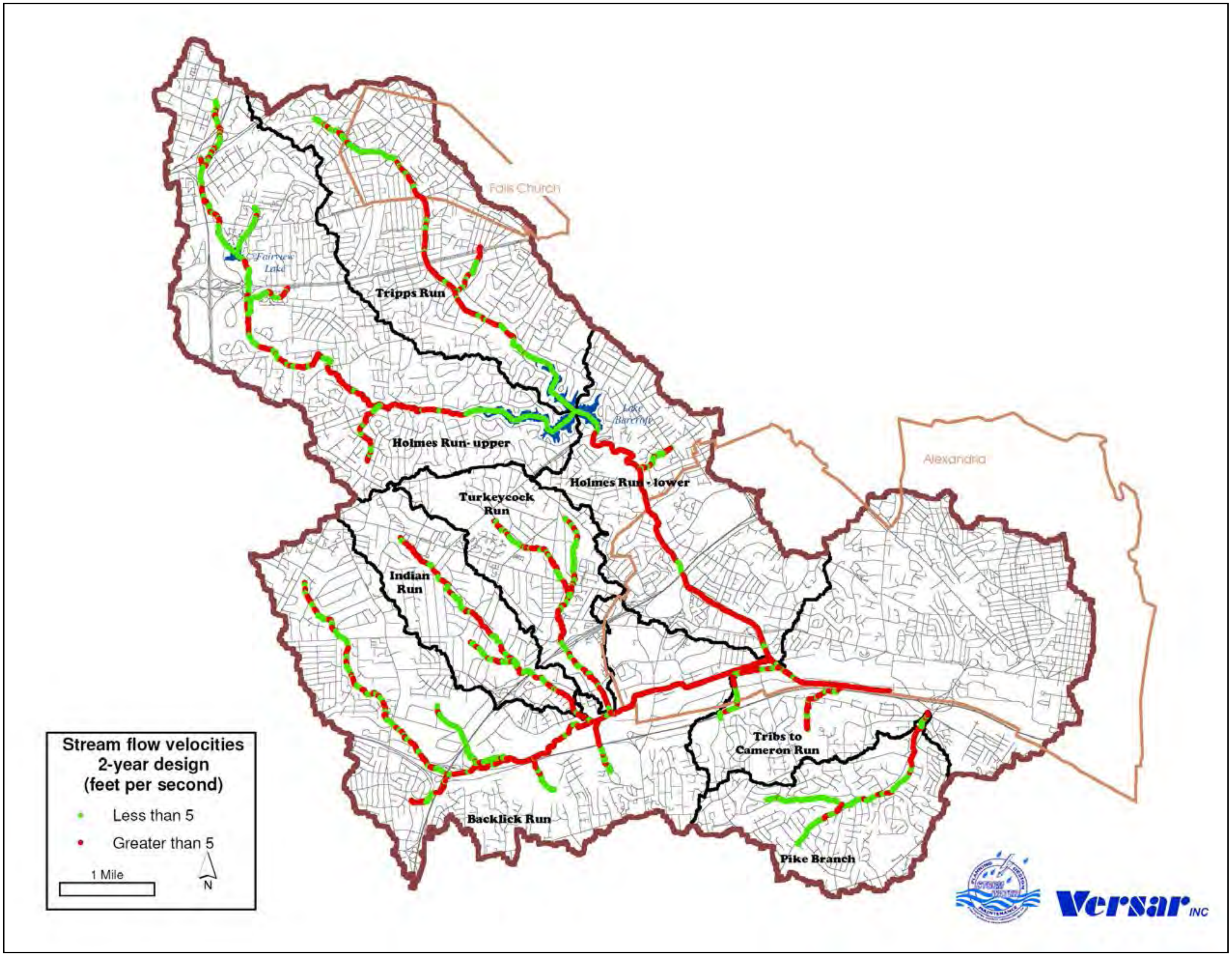

Figure 3-10. Peak stream velocities greater than 5 feet per second (fps) in the Cameron Run watershed for current conditions, for a storm with a 2-year recurrence interval

Table 3-2. HEC-RAS model stream reaches showing percentage of cross-sections exceeding a peak velocity of 5 feet per second (fps) for 1- and 2-year design storms			
Subwatershed	**Reach**	**Design Storm**	
		1-year	**2-year**
		Percent > 5 fps	
Pike Branch	CA008	0	100
	PK001	0	14
	PK002	24	80
	PK003	2	2
	PK004	5	18
	PK005	15	48
	PK006	0	0
	PK007	9	23
	PK008	34	100
	PK009	64	100
	PK010	0	32
	PK011	17	17
	PK012	26	68
	PK017	0	0
	PK018	0	0
	PK019	9	10
Pike Branch Average		13	38
Tribs to Cameron Run	CA001	62	67
	CA002	0	100
	CA003	39	81
	CA004	100	100
	CA005	92	100
	CA006	100	100
	CA027	0	0
	CA028	30	30
	CA029	38	38
	CA030	0	0
	CA031	0	35
	CA032	37	78
	CA033	38	71
	CA039	79	79
	CA040	54	76
	CA041	59	59
	CA043	100	100
	CA044	81	81
Tribs Average		50	66

Table 3-2. (Continued)			
Subwatershed	**Reach**	**Design Storm**	
		1-year	**2-year**
		Percent > 5 fps	
Backlick Run	BA001	56	68
	BA002	0	45
	BA003	0	0
	BA004	51	51
	BA005	0	0
	BA006	63	63
	BA007	0	0
	BA008	9	9
	BA009	100	100
	BA010	59	59
	BA011	41	41
	BA012	0	0
	BA013	53	53
	BA014	59	59
	BA015	57	57
	BA016	39	60
	BA017	78	37
	BA018	0	0
	BA019	40	40
	BA020	71	71
	BA021	47	47
	BA022	20	68
	BA023	61	71
	BA024	100	100
	BA025	68	49
	BA026	80	80
	BA027	83	83
	BA028	67	100
	BA029	93	93
	BA030	87	87
	BA031	99	99
	BA032	100	100
	BA033	90	90
	BA034	83	83
	BA035	80	80
	BA036	100	100
	BA037	65	65
	BA038	99	99

Table 3-2. (Continued)			
Subwatershed	**Reach**	**Design Storm**	
		1-year	**2-year**
		Percent > 5 fps	
Backlick Run (Continued)	BA039	100	100
	BA040	100	100
	BA041	86	89
	BA042	57	71
	BA043	17	17
	BA044	100	100
	BA045	63	63
	BA046	98	98
	BA048	31	31
	BA049	0	0
	BA050	0	0
	BA051	0	0
	BA052	0	0
	BA053	0	0
	BA054	11	11
	BA059	0	0
	BA060	0	0
	BA061	60	60
	BA062	75	75
	BA066	13	13
	BA067	0	43
	BA068	86	100
Backlick Average		52	55
Holmes Run - Upper	HR003	0	0
	HR004	27	27
	HR005	13	13
	HR006	86	86
	HR007	49	49
	HR008	15	15
	HR009	47	47
	HR010	44	44
	HR011	32	32
	HR012	0	0
	HR013	0	0
	HR014	0	0
	HR015	27	27
	HR016	67	67
	HR017	43	43

Table 3-2. (Continued)			
Subwatershed	**Reach**	**Design Storm**	
		1-year	**2-year**
		Percent > 5 fps	
Holmes Run – Upper (Continued)	HR018	68	68
	HR019	85	85
	HR020	27	27
	HR021	68	68
	HR022	17	17
	HR023	0	0
	HR024	0	0
	HR025	0	0
	HR026	0	0
	HR027	0	0
	HR028	0	0
	HR029	75	75
	HR030	51	51
	HR031	50	50
	HR032	95	95
	HR033	14	73
	HR034	100	100
	HR035	43	69
	HR036	0	0
	HR037	0	0
	HR038	0	28
	HR039	34	68
	HR040	26	26
	HR041	41	46
	HR042	0	100
	HR043	0	60
	HR044	0	23
	HR045	97	97
	HR046	16	16
	HR047	66	66
	HR048	100	100
	HR049	74	52
	HR050	0	0
	HR051	98	98
	HR052	100	100
	HR053	39	100
	HR054	75	100
	HR055	70	100

Table 3-2. (Continued)			
Subwatershed	**Reach**	**Design Storm**	
		1-year	**2-year**
		Percent > 5 fps	
Holmes Run – Upper (Continued)	HR056	46	62
	HR057	100	100
	HR058	67	100
	HR059	70	100
	HR060	100	100
	HR061	100	100
	HR062	100	100
	HR063	80	96
	HR064	97	97
	HR065	25	25
	HR066	100	100
	HR067	79	73
	HR068	100	44
	HR069	72	100
	HR070	11	11
	HR100	72	72
	HR106	15	15
	HR107	0	0
	HR108	0	0
	HR109	0	0
	HR110	0	0
	HR113	26	89
	HR114	44	44
	HR115	37	37
	HR116	6	28
	HR117	0	0
	HR118	0	0
	HR120	61	60
Holmes Run - Upper Average		42	49
Holmes Run - Lower	HR071	53	53
	HR072	100	100
	HR073	100	100
	HR074	100	100
	HR075	100	100
	HR076	100	100
	HR077	100	100
	HR078	41	100
	HR079	69	100

Table 3-2. (Continued)			
Subwatershed	**Reach**	**Design Storm**	
		1-year	**2-year**
		Percent > 5 fps	
Holmes Run – Lower (Continued)	HR080	100	100
	HR081	100	100
	HR082	100	100
	HR083	100	100
	HR084	100	100
	HR085	100	100
	HR086	100	100
	HR087	100	100
	HR088	100	100
	HR089	100	100
	HR090	100	100
	HR091	37	37
	HR092	0	0
	HR093	93	93
	HR094	100	100
	HR095	83	83
	HR096	91	91
	HR123	46	38
Holmes Run - Lower Average		86	89
Indian Run	IR004	52	80
	IR005	100	100
	IR006	17	100
	IR007	62	100
	IR008	100	100
	IR009	12	12
	IR010	65	65
	IR011	23	89
	IR012	21	21
	IR013	28	28
	IR014	0	0
	IR015	0	0
	IR016	63	63
	IR017	100	100
	IR018	100	100
	IR019	33	53
	IR020	38	38
	IR021	89	89
	IR022	68	68

Table 3-2. (Continued)			
Subwatershed	**Reach**	**Design Storm**	
		1-year	**2-year**
		Percent > 5 fps	
Indian Run (Continued)	IR023	0	0
	IR024	0	0
	IR025	82	56
	IR026	48	69
	IR027	92	92
	IR028	52	69
	PR003	16	29
	PR004	70	70
	PR005	32	32
Indian Run Average		49	58
Turkeycock Run	TK002	16	23
	TK003	54	54
	TK004	44	44
	TK005	42	69
	TK006	0	100
	TK007	34	59
	TK008	48	85
	TK009	37	45
	TK014	38	38
	TK015	46	62
	TK016	13	65
	TK017	61	61
Turkeycock Run Average		36	59
Tripps Run	TR001	0	0
	TR002	0	0
	TR003	19	24
	TR004	35	48
	TR005	100	100
	TR006	52	52
	TR007	17	17
	TR008	89	89
	TR009	50	50
	TR010	68	91
	TR011	100	88
	TR012	100	100
	TR013	26	66
	TR014	99	99
	TR015	23	34

Table 3-2. (Continued)

Subwatershed	Reach	Design Storm 1-year	Design Storm 2-year
		Percent > 5 fps	
Tripps Run (Continued)	TR016	0	100
	TR017	61	80
	TR018	0	0
	TR019	0	0
	TR020	2	2
	TR021	89	89
	TR022	32	49
Tripps Run Average		44	54

Results presented in the form of ArcView shapefile polygons and lines were generated in the steady flow version of HEC-RAS, which is a one-dimensional model. Because the steady flow version of HEC-RAS was used, no time-dependant hydrodynamic effects were captured in calculated water surface profiles, such as flow attenuation and lag times; however, flow attenuation was simulated by manually including lateral inflows throughout the watershed based on the results from the SWMM model, which does provide a method for estimating flow attenuation and lag time. The SWMM model results were calibrated to a gage at the downstream end of the watershed, which provides some confidence in both overall magnitudes and peak flow timing.

Being a one-dimensional model, HEC-RAS computes single water surface elevations for each cross-section. In other words, water surface elevation presented in the HEC-RAS results will not vary along the length of a cross-section because overbanks and the main channel will have the same water surface elevation. In reality, overbanks typically have a higher water surface elevation than the main channel. As a result, model flow will come out of bank earlier than in reality and water surface elevation in overbanks will be slightly lower than in reality. Errors due to the one-dimensionality of HEC-RAS are typically inconsequential for watershed-level analyses, and the results are generally accepted for use in planning and design.

Complete floodplain maps for each of the design storm simulations for current and future conditions in the watershed are shown in Figures 3-11 through 3-15. Figure 3-15 shows the 100-year design storm simulations for current and future conditions along with the buildings which are within or touching the peak water level resulting from this size storm. Table 3-3 lists the number of buildings in each subwatershed within or touching the 100-year floodplain for current conditions. There is little difference between current and future conditions since this watershed is already mostly built-out. Table 3-4 lists all crossings included in the model, their locations, and which are impacted or overtopped at various recurrence intervals. Crossings that may be overtopped are illustrated in Figures 3-16 and 3-17 for current and future conditions; Figures 3-18 and 3-19 list roadway bridges that may be overtopped by various design storms. Table 3-5 summarizes the number of roadway bridges that may be overtopped by various design storms. Table 3-6 lists crossings that were surveyed but not included in the model.

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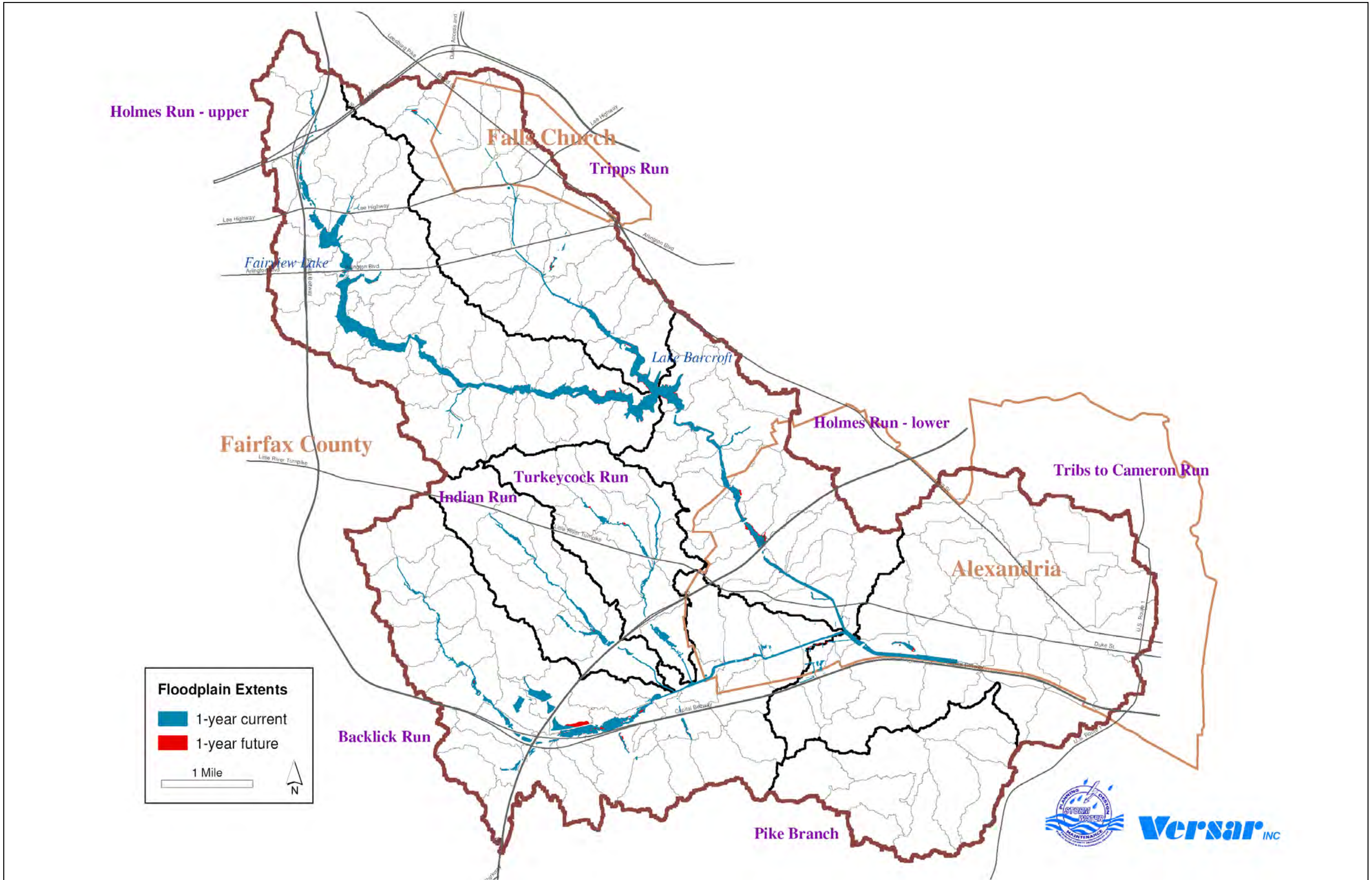

Figure 3-11. 1-year floodplain for Cameron Run watershed for current and future land use conditions

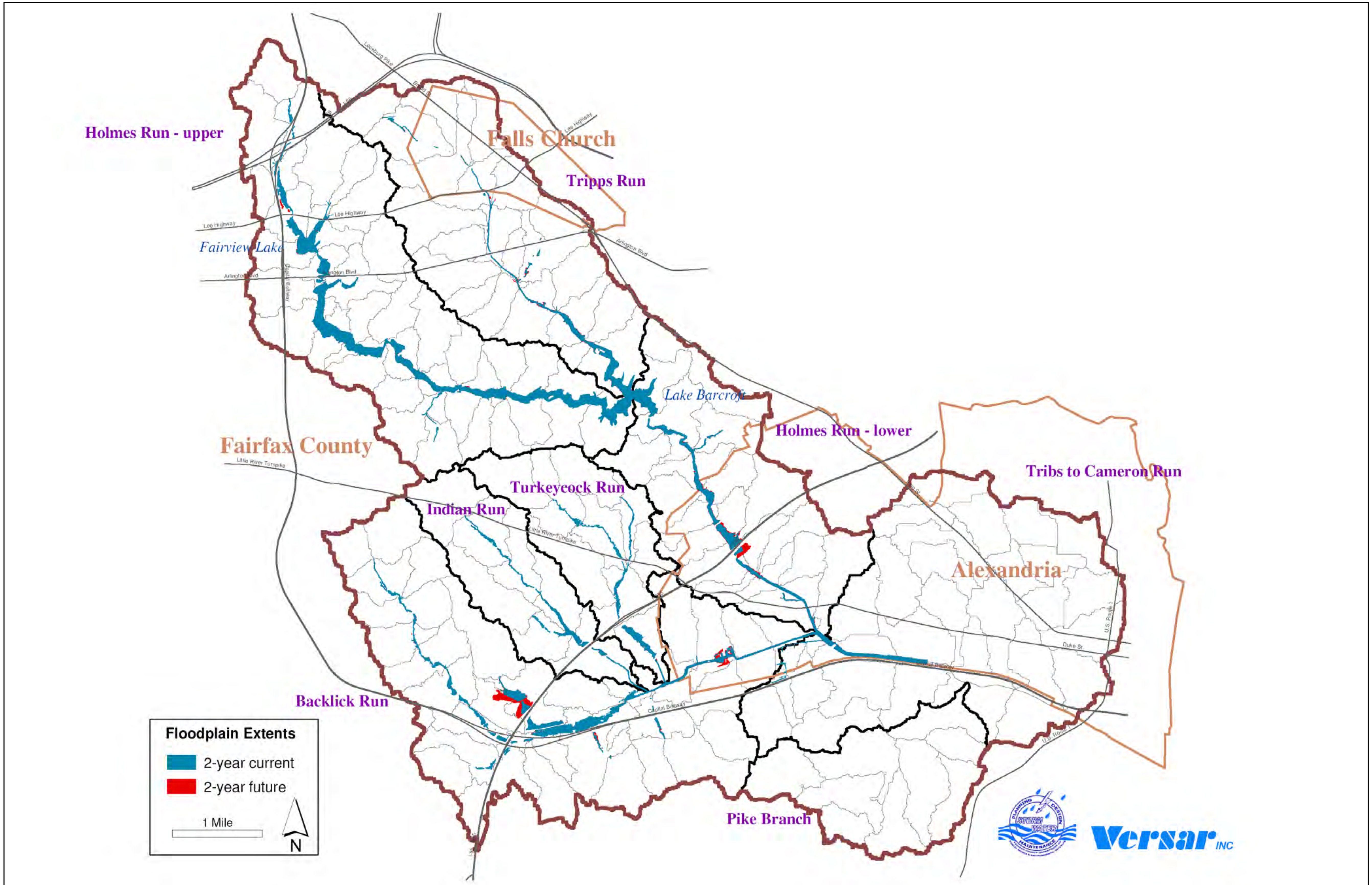

Figure 3-12. 2-year floodplain for Cameron Run watershed for current and future land use conditions

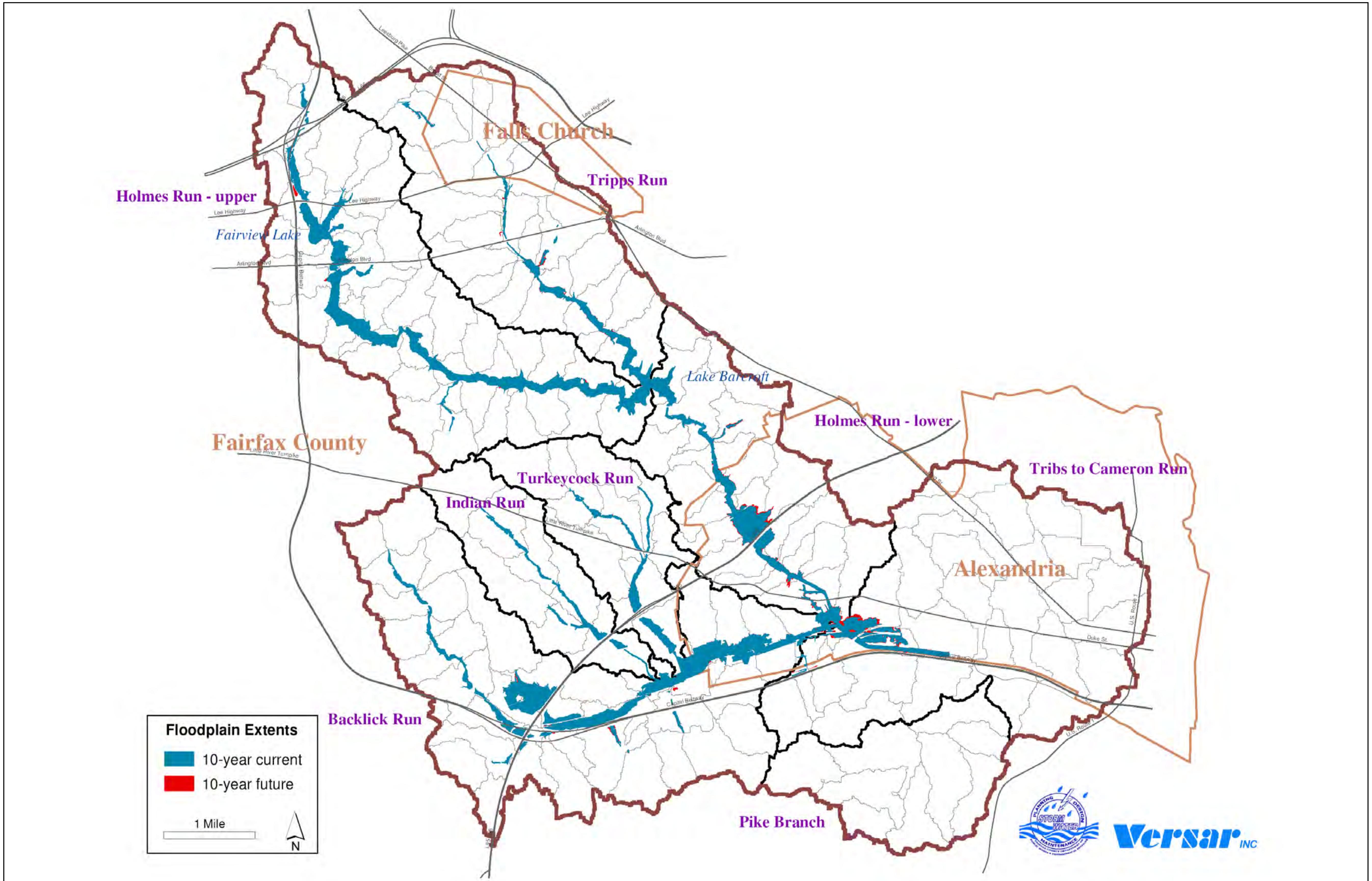

Figure 3-13. 10-year floodplain for Cameron Run watershed for current and future land use conditions

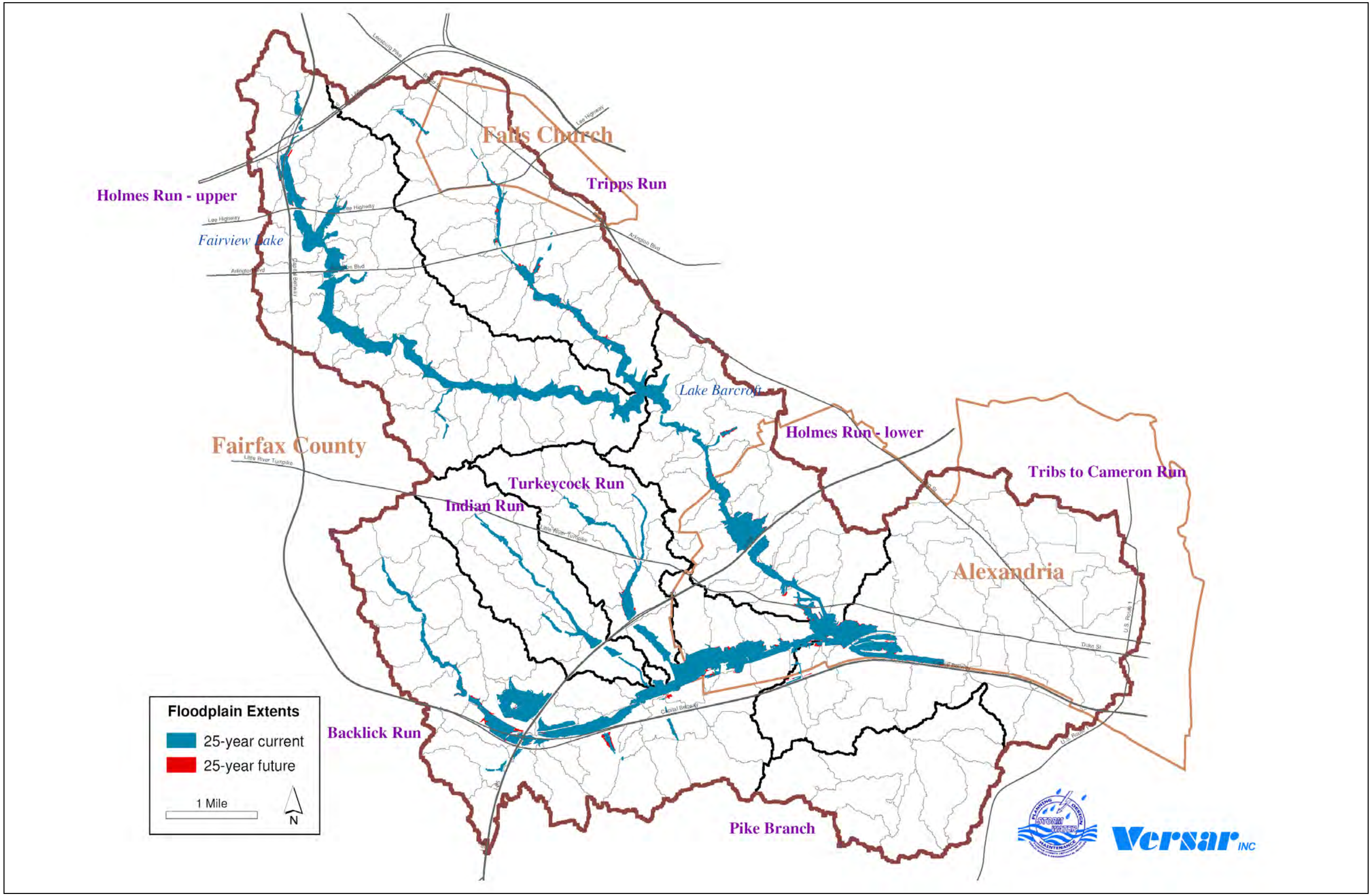

Figure 3-14. 25-year floodplain for Cameron Run watershed for current and future land use conditions

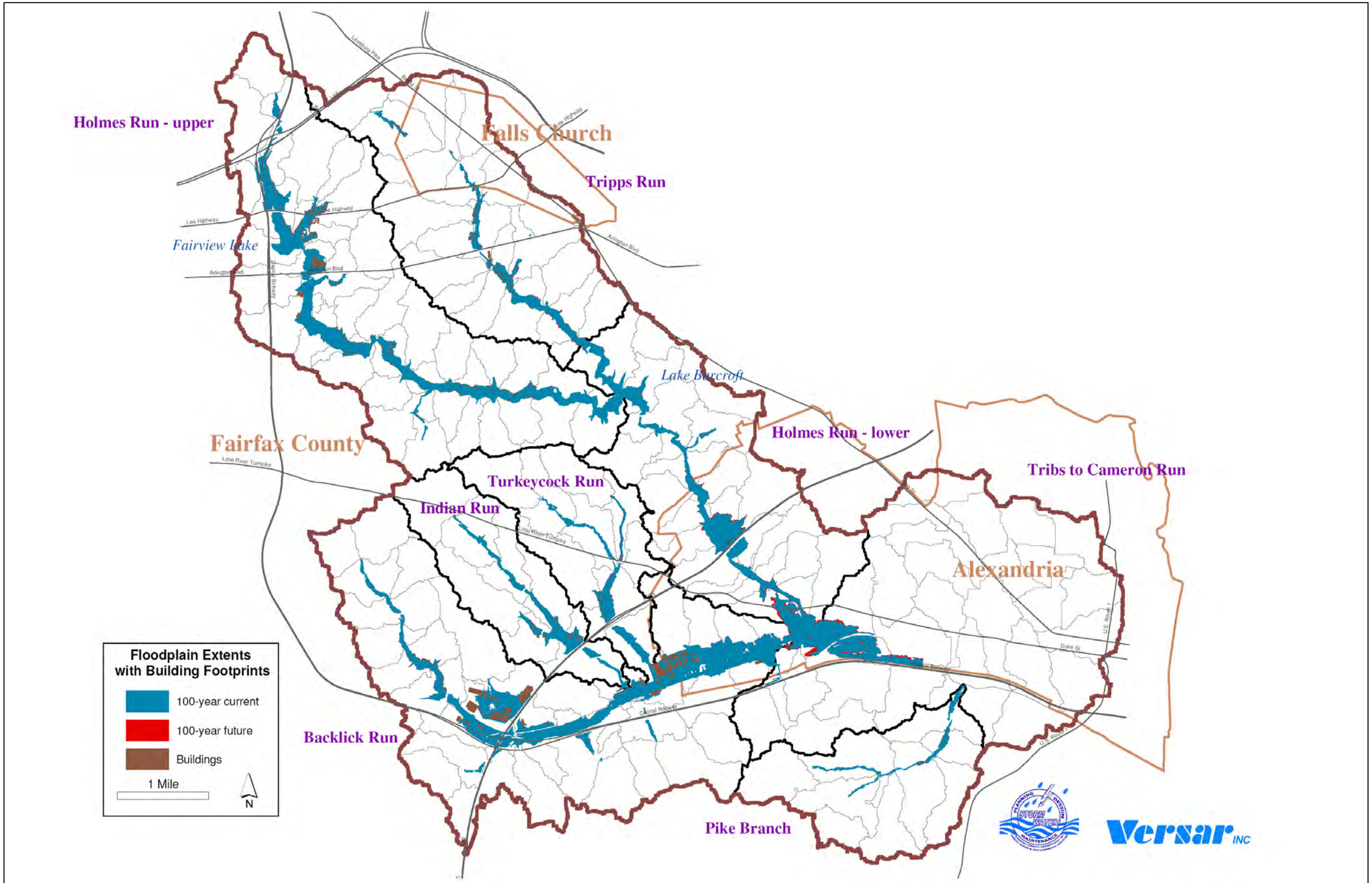

Figure 3-15. 100-year floodplain for Cameron Run watershed for current and future land use conditions; buildings in or adjacent to the 100-year floodplain are also shown

Table 3-3. Number of buildings intersecting the 100-year floodplain for current conditions in the Fairfax County areas of Cameron Run watershed

Subwatershed	Buildings in Floodplain	Buildings in Subwatershed
Backlick Run	108	7554
Cameron Run Tributaries and Mainstem	8	2477
Holmes Run - Upper	280	9329
Holmes Run - Lower	16	3362
Indian Run	60	2488
Pike Branch	22	3936
Turkeycock Run	46	2297
Tripps Run	208	9040

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Table 3-4. Crossings in Cameron Run HEC-RAS model, including IDs, location information, type, and flood impact and overtopping results

Crossing ID	Map ID	X Coordinate	Y Coordinate	Stream Name	Reach	Station	Description	Subtype	Present Impacted	Present Overtopped	Future Impacted	Future Overtopped	Street Location Detail	ADC Map and Grid #
BACKLICK RUN														
CABA010.C001	1	11854874.2	6981307.9	BackLick Run	BA001	32400	Culvert	3 concrete box	100-Year	N/A	100-Year	N/A	Braddock nr. Ferndale	19 F-4
CABA007.C003	2	11857061.3	6977666.4	BackLick Run	BA001	27100	Culvert	concrete arch	100-Year	100-Year	N/A	100-Year	Leesville nr. Backlick Rd.	19 G-6
CABA007.C002	3	11857541.5	6976572.3	BackLick Run	BA001	25600	Culvert	3 concrete box	25-Year	100-Year	25-Year	100-Year	Backlick nr. Wimsatt	19 G-6
CABA007.C001	4	11858220.0	6975870.3	BackLick Run	BA001	24600	Bridge	0 pier rr bridge	25-Year	100-Year	25-Year	100-Year	Hechinger nr. Backlick Rd.	19 H-7
CABA005.C008	5	11859118.8	6974818.4	BackLick Run	BA001	23100	Bridge	0 pier roadway bridge	10-Year	10-Year	N/A	10-Year	Versar Center Drive	19 H-7
CABA005.C007	6	11859412.6	6974423.1	BackLick Run	BA001	22600	Culvert	4 concrete box	10-Year	10-Year	N/A	10-Year	I-495 WB west of I-395	19 H-7
CABA005.C006	7	11859788.6	6974126.0	BackLick Run	BA001	22000	Culvert	3 concrete box	10-Year	10-Year	N/A	10-Year	I-495 WB to I-395 SB ramp	19 H-7
CABA005.C005	8	11860115.9	6974029.7	BackLick Run	BA001	21700	Culvert	3 corrugated plastic pipe	1-Year	1-Year	N/A	1-Year	between I-495 EB and WB lanes, west of I-395	19 J-8
CABA005.C004	9	11860533.3	6973809.9	BackLick Run	BA001	21200	Culvert	2 concrete box	10-Year	10-Year	N/A	10-Year	I-395 between I-495 EB and WB lanes	19 J-8
CABA005.C002	10	11861151.1	6973798.6	BackLick Run	BA026	20500	Culvert	4 concrete box	10-Year	100-Year	10-Year	100-Year	I-495 EB to I-395 NB ramp	19 J-8
CABA005.C001	11	11862061.1	6974095.5	BackLick Run	BA026	19600	Culvert	4 concrete box	10-Year	10-Year	N/A	10-Year	I-495 WB to I-395 NB ramp	19 K-8
CABA030.C002	12	11861309.7	6976216.2	BA Unnamed2	BA048	4500	Culvert	2 RCP	1-Year	1-Year	N/A	1-Year	Industrial @ Electronic	19 J-6
CABA030.C001	13	11861613.5	6975486.7	BA Unnamed2	BA048	3500	Culvert	drop culvert inlet; 1 chamber concrete box outlet	10-Year	10-Year	2-Year	10-Year	I-395 between Exit 1 and Exit 2	19 J-7
CABA028.C001	14	11862136.0	6974485.9	BA Unnamed2	BA048	2200	Culvert	1 stone/concrete arch/box	1-Year	1-Year	N/A	1-Year	railroad bed nr I-495 WB to I-395 NB ramp	19 K-7
CABA035.C002	15	11865518.3	6974166.9	BA Unnamed3	BA059	600	Culvert	1 concrete box	25-Year	100-Year	10-Year	25-Year	I-495 east of I-395 jct.	20 B-7
CABA035.C001	16	11865429.9	6974562.4	BA Unnamed3	BA059	300	Culvert	2 concrete box	25-Year	N/A	10-Year	N/A	I-495 east of I-395 jct.	20 A-7
CABA002.C001	17	11867352.7	6976117.3	BackLick Run	BA032	12900	Bridge	1 pier rr bridge	10-Year	10-Year	N/A	10-Year	Rear Shirley Edsall Indus. Park.	20 B-6
CABA001.C002	18	11869822.1	6977167.1	BackLick Run	BA038	9860	Bridge	3 pier rr bridge	10-Year	10-Year	N/A	10-Year	Rear office park on Pickett	20 D-6
CABA001.C001	19	11872233.7	6978474.0	BackLick Run	BA038	6800	Culvert	4 concrete box	1-Year	1-Year	N/A	1-Year	S. Van Dorn nr. Pickett	20 E-5
CABA118.C001	20	11877028.1	6979704.7	BackLick Run	BA038	1730	Bridge	0 pier footbridge	100-Year	100-Year	N/A	100-year	Somerville St. end	20 H-5
CABA118.C002	21	11878163.7	6980079.2	BackLick Run	BA038	532	Bridge	0 pier footbridge	10-Year	10-Year	10-Year	25-Year	Holmes Run Parkway nr Backlick Run & Holmes Run confluence	20 H-4
CAMERON RUN TRIBUTARIES AND MAINSTEM														
CACA118.C002	1	11876756.2	6977713.2	CA Unnamed1	CA027	4400	Culvert	1 RCP inlet; 1 CMP outlet	2-Year	2-Year	N/A	2-Year	railroad bed nr I-495 west of Exit 174	20 G-6
CACA118.C001	2	11876767.8	6977882.1	CA Unnamed1	CA027	4090	Culvert	1 concrete box	10-Year	10-Year	N/A	10-Year	Driveway south of Eisenhower west of Connector	20 G-5
CACA118.C003	3	11876621.2	6978680.0	CA Unnamed1	CA027	3250	Culvert	1 concrete box inlet; 1 RCP outlet	1-Year	1-Year	N/A	1-Year	Eisenhower Ave west of Connector	20 G-5
CACA003.C017	4	11879088.1	6979750.5	Cameron Run	CA001	6500	Bridge	8 pier rr bridge	25-Year	25-Year	N/A	10-Year	railroad bridge downstream of Backlick Run & Holmes Run confluence, upstream of Eisenhower Ave. crossing	20 J-5
CACA003.C018	5	11879592.0	6979394.2	Cameron Run	CA003	5800	Culvert	7 RCP + brick/concrete arch	25-Year	N/A	10-Year	N/A	railroad bridge downstream of Backlick Run & Holmes Run confluence, upstream of Eisenhower Ave. crossing	20 J-5
CACA002.C001	6	11880642.3	6976288.0	CA Unnamed2	CA039	4200	Culvert	1 CMP	1-Year	2-Year	1-Year	2-Year	Paved pedestrian path nr. Marjoram Ct.	20 K-6
CACA001.C004	7	11880736.4	6977971.0	CA Unnamed2	CA039	2160	Culvert	1 CMP	1-Year	1-Year	N/A	1-Year	Dirt drive off Elmwood Dr. nr Peaceful Terr.	20 K-6
CACA001.C003	8	11881181.8	6978062.3	CA Unnamed2	CA039	1700	Culvert	1 concrete box	1-Year	1-Year	N/A	1-Year	Elmwood Dr. nr Peaceful Terr.	20 K-6
CACA001.C001	9	11882349.3	6978440.9	CA Unnamed2	CA039	300	Culvert	4 concrete box	N/A	N/A	N/A	N/A	I-495 between Exit 174 & 176	21 A-6
HOLMES RUN UPPER														
CAHR021.C001	1	11847672.1	7010882.3	Holmes Run	HR003	60200	Culvert	2 concrete box	10-Year	10-Year	N/A	10-Year	Idylwood nr. Shreve Hill Rd.	13 B-2
CAHR038.C001	2	11847887.0	7009436.0	Holmes Run	HR003	58500	Culvert	3 concrete box	100-Year	N/A	100-Year	N/A	I-495 NB to I-66 WB ramp	13 B-3
CAHR037.C002	3	11847843.4	7008954.4	Holmes Run	HR003	58000	Culvert	3 concrete box	25-Year	N/A	25-Year	N/A	I-66 WB east of I-495 interchange	13 B-3
CAHR037.C001	4	11847041.7	7007726.8	Holmes Run	HR003	56500	Culvert	3 concrete box	10-Year	100-Year	25-Year	100-Year	I 495 NB south of I-66 interchange	13 B-4
CAHR020.C004	5	11846895.9	7006852.2	Holmes Run	HR012	55000	Culvert	3 concrete box	10-Year	25-Year	10-Year	25-Year	I 495 NB south of I-66 interchange	13 B-4
CAHR020.C003	6	11847106.5	7005757.5	Holmes Run	HR012	54300	Culvert	2 concrete box	10-Year	10-Year	N/A	10-Year	Shreve 0.5 mi. n of US 29	13 B-5
CAHR020.C002	7	11847823.8	7004835.3	Holmes Run	HR012	52950	Bridge	0 pier footbridge	1-Year	1-Year	N/A	1-Year	Jefferson Dist. Park nr. US 29 at Shreve	13 B-5
CAHR020.C001	8	11847864.8	7004562.0	Holmes Run	HR012	52600	Culvert	2 concrete box	25-Year	N/A	25-Year	N/A	US 29 nr Shreve	13 B-5
CAHR022.C002	9	11849674.9	7004289.5	HR Unnamed2	HR106	1800	Culvert	4 concrete box	1-Year	10-Year	1-Year	10-Year	US 29 nr Mary St.	13 C-5
CAHR022.C001	10	11849170.6	7003689.0	HR Unnamed2	HR106	900	Culvert	3 concrete box	1-Year	10-Year	1-Year	2-Year	New Providence Drive	13 C-6
CAHR017.C002	11	11849473.5	7001589.1	Holmes Run	HR017	48860	Culvert	3 concrete box	1-Year	1-Year	N/A	1-Year	US 50 WB ramp to Fairview Park Dr.	13 C-7
CAHR017.C001	12	11849505.0	7000964.2	Holmes Run	HR017	48000	Culvert	3 concrete box	1-Year	1-Year	N/A	1-Year	US 50 east of Fairview Park Dr.	13 C-7
HOLMES RUN UPPER (Cont'd)														

Table 3-4. Crossings in Cameron Run HEC-RAS model, including IDs, location information, type, and flood impact and overtopping results

Crossing ID	Map ID	X Coordinate	Y Coordinate	Stream Name	Reach	Station	Description	Subtype	Present Impacted	Present Overtopped	Future Impacted	Future Overtopped	Street Location Detail	ADC Map and Grid #
CAHR016.C003	13	11849461.9	7000544.9	Holmes Run	HR017	47500	Culvert	3 concrete box	1-Year	10-Year	1-Year	10-Year	Fairview Park to US 50 EB ramp	13 C-7
CAHR053.C002	14	11851537.9	7000669.4	HR Unnamed3	HR112	3400	Bridge	0 pier footbridge	1-Year	2-Year	N/A	1-Year	Lakeside Village Dr. end	13 D-7
CAHR053.C001	15	11850739.0	7000612.2	HR Unnamed3	HR112	2400	Culvert	3 concrete box	100-Year	N/A	100-Year	N/A	Jaguar Terr	13 D-7
CAHR016.C002	16	11849497.6	6999132.6	Holmes Run	HR033	46130	Bridge	0 pier footbridge	1-Year	1-Year	N/A	1-Year	Fairview Park Drive S, rear of office building	13 C-8
CAHR016.C001	17	11849737.9	6997894.2	Holmes Run	HR033	44720	Bridge	0 pier footbridge	10-Year	10-Year	N/A	10-Year	Holly Berry Ct. in apartment complex	13 C-9
CAHR005.C002	18	11850983.3	6997225.2	Holmes Run	HR033	43140	Bridge	0 pier footbridge	1-Year	1-Year	N/A	1-Year	Hartwell Ct. end	13 D-9
CAHR005.C001	19	11851794.2	6996578.1	Holmes Run	HR033	41950	Bridge	0 pier footbridge	1-Year	1-Year	N/A	1-Year	Arnold La. end, s. side of stream	13 E-9
CAHR004.C001	20	11853923.9	6996454.2	Holmes Run	HR033	38500	Bridge	0 pier roadway bridge	1-Year	2-Year	1-Year	2-Year	Annandale Rd. nr. Sheffield	13 F-9
CAHR002.C001	21	11857708.9	6994437.6	Holmes Run	HR063	32710	Bridge	0 pier footbridge	10-Year	10-Year	N/A	10-Year	Rose La. end, s. side Slade Run	13 H-10
CAHR001.C002	22	11859335.3	6994126.1	Holmes Run	HR063	30990	Bridge	0 pier footbridge	1-Year	1-Year	N/A	1-Year	Devon Dr. s. side Valley Brook, behind health spa	13 H-10
CAHR001.C001	23	11860355.8	6994033.7	Holmes Run	HR063	29800	Bridge	2 pier roadway bridge	2-Year	2-Year	N/A	2-Year	Sleepy Hollow near Dearborn	13 J-11
HOLMES RUN LOWER														
CAHR201.C001	1	11868778.4	6992734.3	Holmes Run	HR072	18900	Culvert	1 concrete arch	N/A	N/A	N/A	N/A	Columbia Pike at Lake Barcroft Dam	14 C-11
CAHR204.C001	2	11872125.1	6991532.3	HR Unnamed5	HR122	1400	Culvert	2 RCP	N/A	N/A	N/A	10-Year	Colfax Ave. nr Reservoir Heights	14 E-12
CAHR087.C008	3	11872495.3	6986837.5	Holmes Run	HR080	9680	Culvert	2 plastic pipes under ford	1-Year	1-Year	N/A	1-Year	Beauregard nr North Morgan St.	20 E-1
CAHR087.C009	4	11872726.2	6986496.7	Holmes Run	HR080	9270	Culvert	3 CM arches on concrete piers	10-Year	10-Year	N/A	10-Year	Beauregard nr North Morgan St.	20 E-1
CAHR093.C010	5	11873716.7	6984944.8	Holmes Run	HR080	7360	Culvert	2 concrete arches + 1 CMP	10-Year	10-Year	N/A	10-Year	I-395 between Exit 3 and Exit 4	20 F-2
CAHR093.C011	6	11873839.5	6984626.9	Holmes Run	HR080	7000	Culvert	4 concrete box + 1 CMP inlet; 3 concrete box outlet	2-Year	10-Year	N/A	2-Year	Van Dorn north of Landmark Mall	20 F-2
CAHR093.C012	7	11874091.1	6984175.3	Holmes Run	HR080	6460	Culvert	3 RCP under ford	1-Year	1-Year	N/A	1-Year	Holmes Run Parkway nr Ripley St.	20 F-2
INDIAN RUN														
CAIR013.C001	1	11858280.0	6986651.3	Indian Run	IR004	16917	Bridge	1 pier footbridge	10-Year	25-Year	10-Year	25-Year	Morning Wind Ct. end	19 H-1
CAIR010.C003	2	11859836.6	6985146.7	Indian Run	IR004	14416	Culvert	2 CMP on concrete base	10-Year	25-Year	10-Year	25-Year	Columbia Rd. between Braddock & Little River	19 J-2
CAIR010.C001	3	11862057.5	6982744.6	Indian Run	IR004	10490	Culvert	2 concrete box	100-Year	100-Year	N/A	100-Year	Braddock Rd. nr Randolph Dr.	19 K-3
CAIR004.C003	4	11862615.8	6980488.5	Poplar Run	PR003	2160	Culvert	1 RCP	1-Year	1-Year	N/A	1-Year	Under Clinton, outlet at Mitchell	19 K-4
CAIR004.C002	5	11862826.1	6980268.4	Poplar Run	PR003	1958	Bridge	2 pier footbridge	10-Year	10-Year	N/A	10-Year	Between Shawnee and Mitchell	19 K-4
CAIR004.C001	6	11863058.7	6980179.3	Poplar Run	PR003	1698	Culvert	3 RCP	10-Year	100-Year	10-Year	100-Year	Shawnee Rd. end	19 K-4
CAIR002.C002	7	11864942.7	6979515.4	Indian Run	IR024	5166	Bridge	0 pier roadway bridge	1-Year	1-Year	N/A	1-Year	Cherokee Ave. nr I 395 Exit 2	20 A-5
CAIR002.C001	8	11865287.5	6979416.9	Indian Run	IR024	4718	Culvert	2 concrete box	10-Year	100-Year	10-Year	100-Year	I 395 between Exit 2 and Exit 3	20 A-5
CAIR001.C003	9	11866214.1	6978790.1	Indian Run	IR024	3486	Culvert	2 concrete box	10-Year	10-Year	N/A	10-Year	Edsall @ Indian Run Pkwy	20 B-5
CAIR001.C002	10	11866627.7	6978497.9	Indian Run	IR024	2951	Bridge	2 pier footbridge	100-Year	100-Year	N/A	100-Year	Indian Run Pkwy nr Sheldon Dr.	20 B-5
CAIR001.C001	11	11867892.5	6977120.7	Indian Run	IR024	924	Bridge	1 pier roadway bridge	N/A	10-Year	N/A	10-Year	Bren Mar nr Indian Run Pkwy	20 C-6
PIKE BRANCH														
CAPK007.C001	1	11879064.7	6972440.2	PK Unnamed1	PK017	4143	Bridge	0 pier footbridge	N/A	N/A	N/A	N/A	Eaton Pl. end nr Lillian Dr.	20 J-8
CAPK006.C001	2	11882571.8	6972086.9	PK Unnamed1	PK017	158	Culvert	2 RCP	10-Year	10-Year	N/A	10-Year	Old Telegraph nr Pine Brook Rd.	21 A-9
CAPK003.C005	3	11883886.0	6972349.0	Pike Branch	PK003	7000	Culvert	2 concrete box	N/A	N/A	N/A	N/A	Telegraph nr Pike Rd.	21 A-8
CAPK003.C004	4	11884926.5	6972694.1	Pike Branch	PK003	5853	Bridge	0 pier roadway bridge	10-Year	100-Year	10-Year	100-Year	Wilton Rd. nr Telegraph	21 B-8
CAPK003.C003	5	11884961.7	6972697.5	Pike Branch	PK003	5817	Bridge	0 pier roadway bridge	10-Year	N/A	10-Year	N/A	nr Wilton Rd. nr Telegraph	21 B-8
CAPK003.C002	6	11885550.4	6973034.2	Pike Branch	PK003	5092	Bridge	3 concrete box	25-Year	100-Year	25-Year	100-Year	Florence La. nr Telegraph	21 B-8
CAPK003.C001	7	11885782.1	6973283.6	Pike Branch	PK003	4747	Bridge	0 pier roadway bridge	10-Year	100-Year	10-Year	100-Year	Driveway off Telegraph near Florence	21 B-8
CAPK002.C002	8	11886318.1	6973784.8	Pike Branch	PK003	3982	Culvert	0 pier roadway bridge	10-Year	10-Year	N/A	10-Year	Otley Dr. nr Telegraph	21 B-8
CAPK002.C001	9	11886487.7	6974243.6	Pike Branch	PK003	3487	Culvert	0 pier roadway bridge	10-Year	100-Year	10-Year	100-Year	Marl-Pat Dr. nr Telegraph	21 C-8
CAPK001.C003	10	11886579.2	6975093.8	Pike Branch	PK003	2234	Culvert	5 concrete box	N/A	N/A	N/A	N/A	Telegraph nr Franconia	21 C-7
CAPK001.C002	11	11887165.4	6976841.0	Pike Branch	PK003	478	Culvert	4 concrete box	100-Year	100-Year	N/A	100-Year	Burgundy Rd. nr Telegraph	21 C-6
CAPK001.C001	12	11887341.5	6977067.9	Pike Branch	PK003	186	Culvert	4 concrete box	100-Year	100-Year	N/A	100-Year	I 495 EB ramp to Telegraph/Huntington jct.	21 C-6

Table 3-4. Continued

Crossing ID	Map ID	X Coordinate	Y Coordinate	Stream Name	Reach	Station	Description	Subtype	Present Impacted	Present Overtopped	Future Impacted	Future Overtopped	Street Location Detail	ADC Map and Grid #
TURKEYCOCK RUN														
CATK013.C004	1	11863332.7	6987850.8	TK Unnamed1	TK014	6780	Bridge	0 pier footbridge	N/A	N/A	N/A	N/A	Elmdale between Emory and Old Columbia Pike	20 A-1
CATK013.C003	2	11863840.8	6987288.9	TK Unnamed1	TK014	6000	Culvert	2 CMP	10-Year	10-Year	N/A	10-Year	Golf course nr Elmdale & Emory	20 A-1
CATK013.C002	3	11864004.3	6987071.9	TK Unnamed1	TK014	5440	Culvert	2 RCP	1-Year	1-Year	N/A	1-Year	Golf course nr Elmdale & Emory	20 A-1
CATK012.C004	4	11864790.1	6986495.7	TK Unnamed1	TK014	4720	Bridge	0 pier footbridge	1-Year	1-Year	N/A	1-Year	Braddock nr Elmdale	20 A-1
CATK013.C001	5	11864726.3	6986541.2	TK Unnamed1	TK014	4800	Culvert	2 CMP	1-Year	2-Year	1-Year	2-Year	Golf course nr Braddock & Elmdale	20 A-1
CATK012.C003	6	11864818.5	6986465.4	TK Unnamed1	TK014	4650	Culvert	3 RCP	1-Year	2-Year	1-Year	2-Year	Braddock nr Elmdale	20 A-1
CATK012.C002	7	11865256.4	6986375.9	TK Unnamed1	TK014	4100	Culvert	2 CMP on concrete base	10-Year	10-Year	N/A	10-Year	Green Spring Gardens, nr Elmdale & Braddock	20 A-1
CATK012.C001	8	11866033.1	6986303.0	TK Unnamed1	TK014	3050	Bridge	0 pier footbridge	10-Year	10-Year	N/A	10-Year	Merritt Rd. end	20 B-1
CATK006.C001	9	11867147.1	6984398.5	TK Unnamed1	TK014	700	Culvert	1 concrete box	N/A	N/A	N/A	N/A	Little River nr Chowan	20 B-2
CATK008.C001	10	11867160.3	6988053.8	Turkey Cock Run	TK002	14320	Culvert	1 concrete box	10-Year	10-Year	N/A	10-Year	Brookside Dr. nr Braddock	20 B-1
CATK004.C001	11	11867541.6	6984308.2	Turkey Cock Run	TK002	9300	Culvert	1 concrete box	10-Year	N/A	25-Year	N/A	Little River nr Brookside Dr.	20 C-2
CATK003.C001	12	11867268.2	6980660.3	Turkey Cock Run	TK003	5000	Culvert	2 concrete box	10-Year	100-Year	10-Year	100-Year	I 395 between Exit 2 and Exit 3	20 B-4
CATK002.C001	13	11868066.6	6979740.4	Turkey Cock Run	TK003	3280	Bridge	0 pier footbridge	10-Year	10-Year	N/A	10-Year	Colliers La. End	20 C-5
CATK001.C001	14	11869066.5	6978603.9	Turkey Cock Run	TK003	1600	Culvert	4 concrete box	10-Year	10-Year	N/A	10-Year	Edsall nr Winter View	20 C-5
TRIPPS RUN														
CATR014.C004	1	11853409.6	7010229.7	Tripps Run	TR001	24700	Culvert	1 stone/concrete arch/box	1-Year	2-Year	1-Year	1-Year	railroad bed nr Shreve Rd. & Buckelew	13 F-2
CATR014.C003	2	11853405.5	7010206.6	Tripps Run	TR001	24700	Culvert	1 RCP	1-Year	2-Year	1-Year	1-Year	Shreve Rd. nr Buckelew	13 F-2
CATR014.C002	3	11853645.5	7010103.5	Tripps Run	TR001	24442	Bridge	0 pier footbridge	1-Year	1-Year	N/A	1-Year	Buckelew Dr. nr Shreve	13 F-2
CATR014.C001	4	11853741.1	7010030.8	Tripps Run	TR001	24280	Culvert	1 CMP	2-Year	2-Year	N/A	1-Year	Buckelew Dr. nr Shreve	13 F-2
CAFC000.C001	5	11856763.7	7008505.9	Tripps Run	TR001	20840	Culvert	2 CMP on concrete base inlet; 0 pier roadway bridge outlet	25-Year	25-Year	N/A	10-Year	West nr Randolph inlet; Oak St. outlet	13 G-3
CAFC000.C007	6	11858240.7	7007368.7	Tripps Run	TR001	18510	Culvert	4 CMP on concrete base	N/A	N/A	N/A	N/A	Sherrow Ave. nr Cameron Rd.	13 H-4
CATR006.C002	7	11858512.1	7006959.3	Tripps Run	TR001	18020	Bridge	0 pier footbridge	100-Year	100-Year	N/A	100-Year	Westmoreland Rd. end	13 H-4
CATR006.C001	8	11858678.4	7006670.5	Tripps Run	TR001	17700	Brigde	0 pier footbridge	100-Year	100-Year	N/A	100-Year	Westmoreland Rd. end	13 H-4
CATR005.C001	9	11859369.9	7005647.1	Tripps Run	TR001	16380	Culvert	2 concrete box	10-Year	10-Year	N/A	10-Year	off US 29 nr Maple Ave. (landscaping co.)	13 H-5
CATR004.C002	10	11859303.8	7002971.5	Tripps Run	TR001	13690	Bridge	0 pier roadway bridge	100-Year	100-Year	N/A	100-Year	Adams @ Jefferson	13 H-6
CATR004.C001	11	11859452.5	7002321.3	Tripps Run	TR001	13000	Culvert	4 concrete box	100-Year	100-Year	25-Year	100-Year	US 50 nr Tripps Run Rd.	13 J-6
CATR003.C002	12	11860232.7	7001424.4	Tripps Run	TR001	11800	Bridge	0 pier roadway bridge	100-Year	N/A	100-Year	N/A	Annandale Rd. nr Barrett	13 J-7
CATR010.C001	13	11861385.0	7000919.4	TR Unnamed1	TR021	350	Culvert	2 concrete box	10-Year	25-Year	N/A	10-Year	Holmes Run Rd. nr Cedarwood	13 K-7
CATR003.C001	14	11861187.4	7000253.8	Tripps Run	TR011	10230	Bridge	0 pier roadway bridge	10-Year	10-Year	2-Year	10-Year	Holloway Rd. @ Barrett	13 J-7
CATR001.C002	15	11862772.0	6999113.4	Tripps Run	TR011	8140	Bridge	0 pier roadway bridge	10-Year	25-Year	N/A	10-Year	Sleepy Hollow nr Holmes Run Rd.	13 K-8
CATR001.C001	16	11864890.9	6997277.5	Tripps Run	TR011	4950	Bridge	1 pier roadway bridge	1-Year	1-Year	N/A	1-Year	Potterton Dr. nr Waterway Dr.	14 A-9

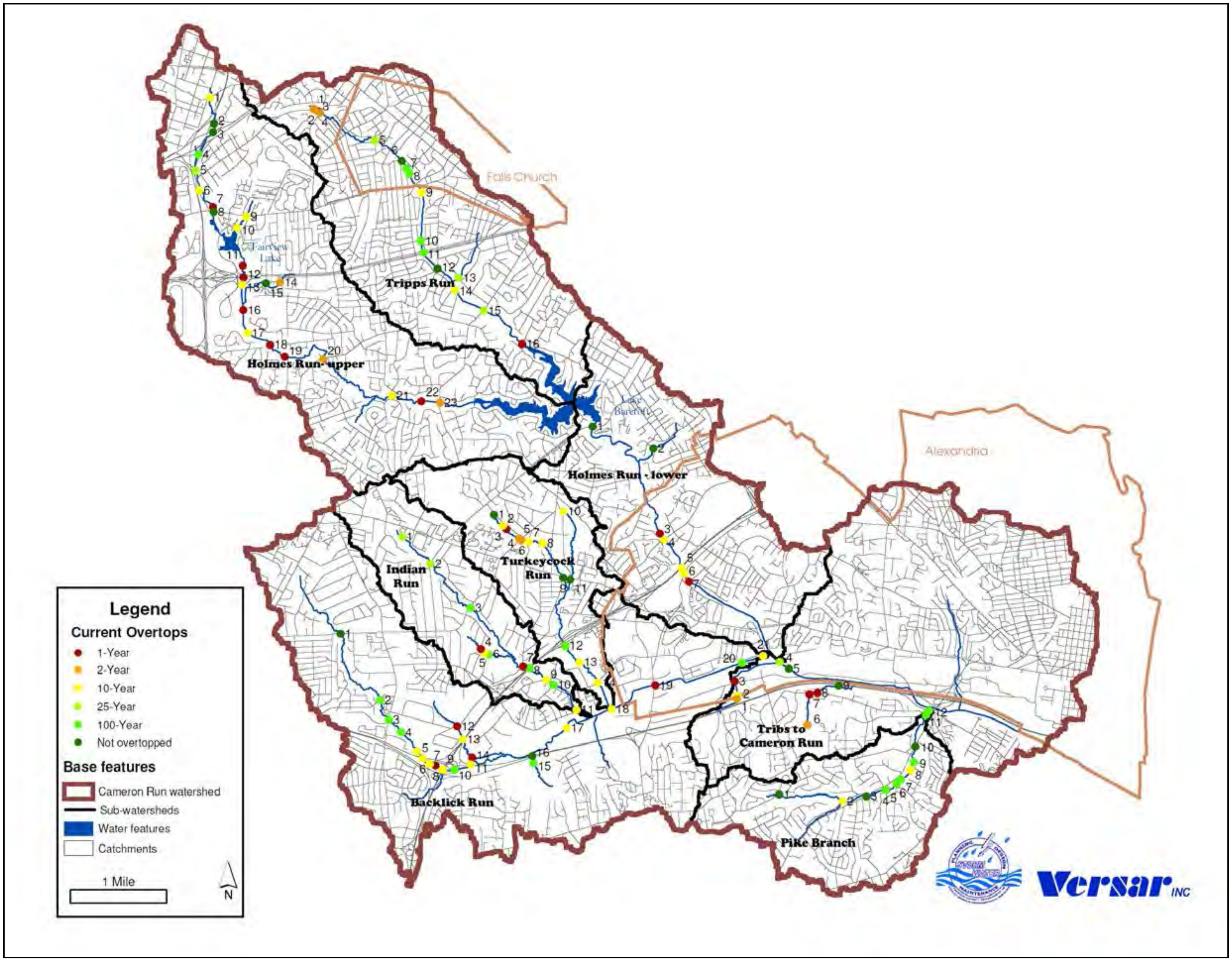

Figure 3-16. Stream crossings in Cameron Run which may be overtopped under current conditions. Crossings are labeled with a Map ID number by subwatershed as listed in Table 3-4.

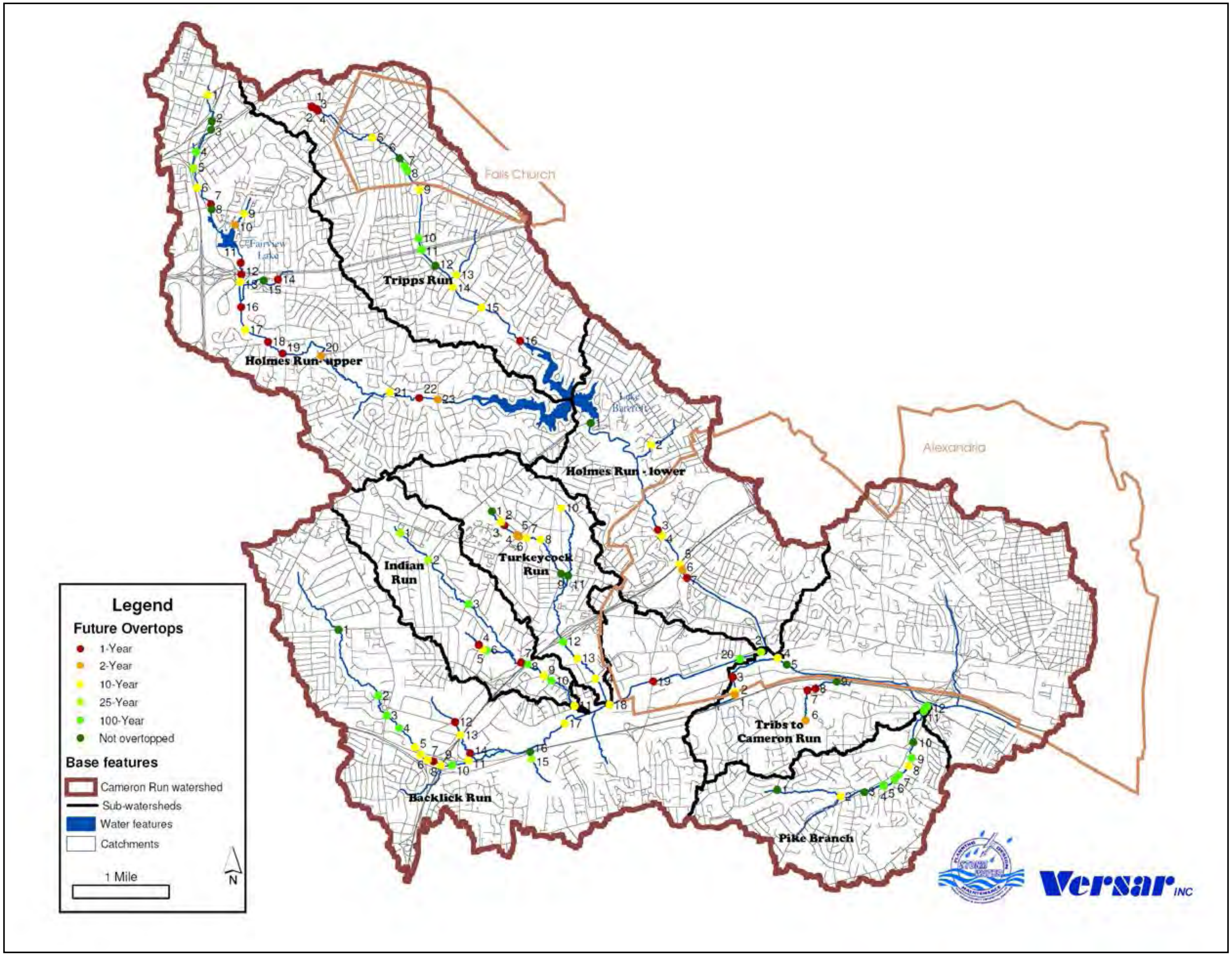

Figure 3-17. Stream crossings in Cameron Run which may be overtopped under future conditions. Crossings are labeled with a Map ID number by subwatershed as listed in Table 3-4.

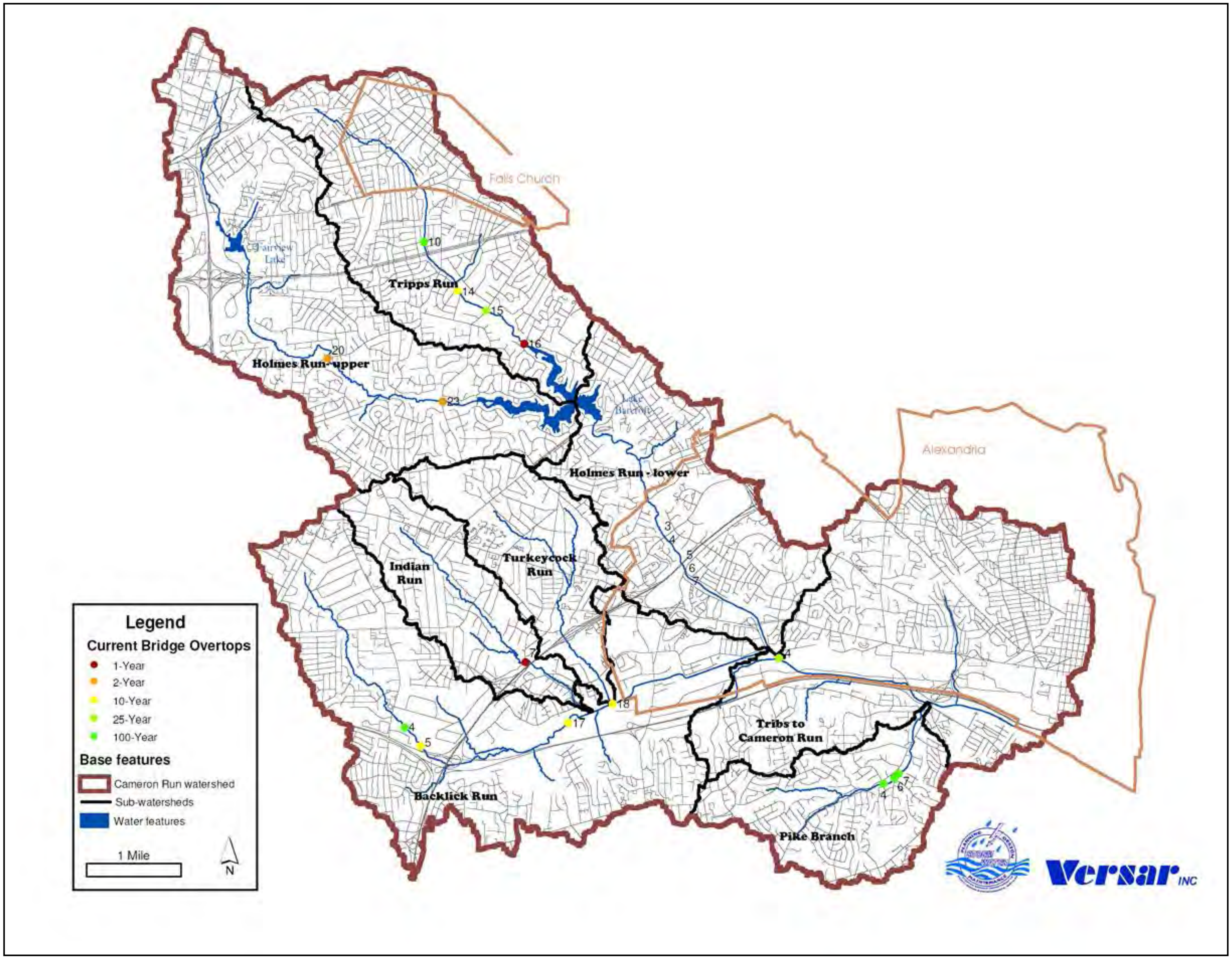

Figure 3-18. Roadway bridges in the Fairfax County portion upstream of the USGS gage in Cameron Run and in Pike Branch, which may be overtopped under current conditions for various design storms. Bridges are labeled with a Map ID number by subwatershed as listed in Table 3-4.

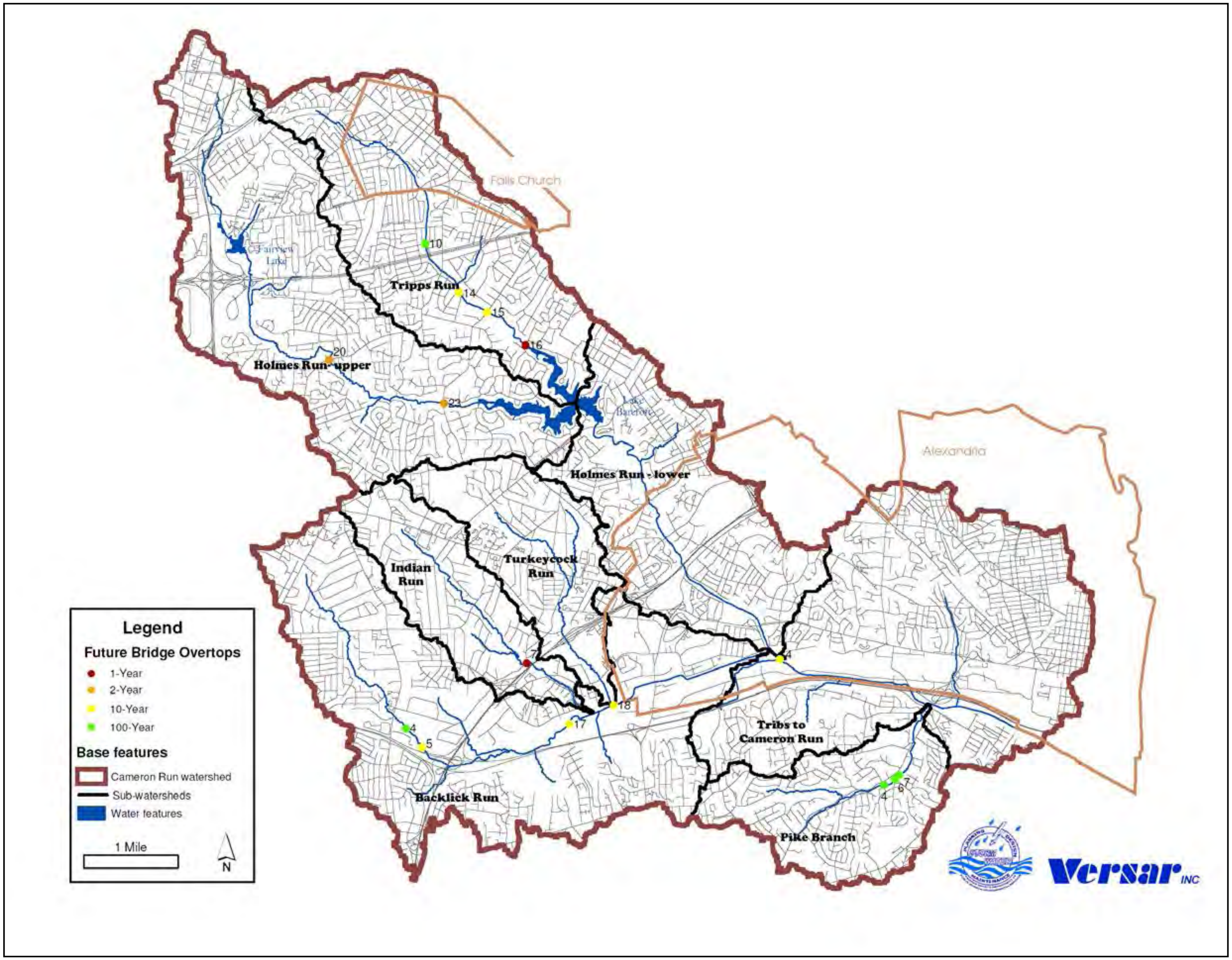

Figure 3-19. Roadway bridges in the Fairfax County portion upstream of the USGS gage in Cameron Run and in Pike Branch, which may be overtopped under future conditions for various design storms. Bridges are labeled with a Map ID number by subwatershed as listed in Table 3-4.

Table 3-5. Number of roadway crossings (bridges) overtopped by design flows for subwatersheds in Cameron Run

Subwatershed	Present				
	1-year	2-year	10-year	25-year	100-year
Backlick Run	0	0	3	3	4
Cameron Run Tributaries and Mainstem	0	0	0	1	1
Holmes Run - Upper	0	2	2	2	2
Holmes Run - Lower	0	0	0	0	0
Indian Run	1	1	2	2	2
Pike Branch	0	0	0	0	3
Turkeycock Run	0	0	0	0	0
Tripps Run	1	1	2	3	4
Subwatershed	**Future**				
	1-year	**2-year**	**10-year**	**25-year**	**100-year**
Backlick Run	0	0	3	3	4
Cameron Run Tributaries and Mainstem	0	0	1	1	1
Holmes Run - Upper	0	2	2	2	2
Holmes Run - Lower	0	0	0	0	0
Indian Run	1	1	2	2	2
Pike Branch	0	0	0	0	3
Turkeycock Run	0	0	0	0	0
Tripps Run	1	1	3	3	4

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Table 3-6. Crossings surveyed but not included in model

Crossing ID	X Coordinate	Y Coordinate	Stream Name	Reach	Station	Description	Subtype	Reason Not Included	Street Location Detail	ADC Map and Grid #
CABA005.C003	11860820.4	6973762.0	BackLick Run	N/A	N/A	Ford	concrete slab	Ford modeled as cross-section	Downstream of I-395 crossing of I-495	19 J-8
CABA010.C002	11855312.3	6979178.4	BackLick Run	N/A	N/A		not located	small footbridge	Between Atlee and Homestead	19 F-5
CACA001.C002	11881548.5	6978327.9	CA unnamed2	N/A	N/A		crossing removed	no crossing here	Peaceful Terr. end	20 K-5
CACA001.C016	11879023.9	6979800.2	Cameron Run	N/A	N/A	Bridge	8 pier rr bridge	combined with CA003.017	railroad bridge downstream of Backlick Run & Holmes Run confluence, upstream of Eisenhower Ave. crossing	20 J-5
CAHR001.C003	11859144.0	6994109.4	Holmes Run Upper	N/A	N/A	Ford	concrete slab	Ford modeled as cross-section	Devon Dr. s. side Valley Brook, behind health spa	13 H-10
CAHR003.C001	11855381.4	6995187.4	Holmes Run Upper	N/A	N/A	Ford	concrete slab	Ford modeled as cross-section	Valleycrest Blvd end	13 F-10
CAHR030.C001	11856638.8	6994236.2	HR Unnamed	N/A	N/A	Ford	broken concrete chunk	Ford modeled as cross-section	Raleigh Rd. end	13 G-10
CAHR038.C002	11847807.8	7009633.5	HR Unnamed	N/A	N/A	Culvert	2 concrete box	Combined with CA038.C001	I 495 NB north of I 66 interchange	13 B-3
CAHR038.C003	11847732.3	7009860.1	HR Unnamed	N/A	N/A	Culvert	2 concrete box	Combined with CA038.C001	I 495 SB north of I 66 interchange	13 B-3
CAHR055.C001	11846876.3	7008007.3	HR Unamed	N/A	N/A	Culvert	2 concrete box	no distinguishable stream above crossing	I 66 EB amid I 495 lanes	13 B-3
CAHR093.C013	11876437.3	6982765.6	Holmes Run Lower	N/A	N/A	Bridge	1 pier footbridge	in Alexandria	Pickett St. @ Holmes Run Pkwy	20 G-3
CAHR095.C014	11877988.0	6981638.4	Holmes Run Lower	N/A	N/A	Bridge	2 pier roadway bridge	in Alexandria	Duke St. nr Holmes Run Pkwy	20 H-4
CAHR096.C015	11878379.6	6980645.9	Holmes Run Lower	N/A	N/A	Bridge	0 pier footbridge	in Alexandria	Holmes Run Pkwy nr Jordan St.	20 H-4
CAIR010.C002	11860646.8	6984301.7	Indian Run	N/A	N/A	Bridge	0 pier footbridge (half-crossing)	half a footbridge	Randolph Dr. nr Locust Way	19 J-2
CATK003.C002	11867049.8	6980974.2	Turkey Cock Run	N/A	N/A		upstream end of CATK003.C001	Combined with CATK003.C001	I395 between Exit 2 and Exit 3	20 B-4
CATR005.C002	11859169.8	7005970.8	Tripps Run	N/A	N/A	Culvert	2 concrete box	Combined with CATR005.C001	US 29 nr Maple Ave.	13 H-5
CATR005.C003	11859065.4	7006023.0	Tripps Run	N/A	N/A	Culvert	Retail furniture store	Combined with CATR005.C001	Between US 29 @ Maple Ave.	13 H-5
CATR005.C004	11858986.1	7006052.0	Tripps Run	N/A	N/A	Culvert	2 concrete box	Combined with CATR005.C001	Maple Ave. nr US 29	13 H-5
CATR005.C005	11859315.2	7005785.4	Tripps Run	N/A	N/A	Bridge	0 pier footbridge	Same as TR008.C001	off US 29 nr Maple Ave. (landscaping co.)	13 H-5

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APPENDIX C

PUBLIC INVOLVEMENT MINUTES

C-1 Advisory Committee Meetings

C-2 Public Meetings

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C-1 Advisory Committee Meetings

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Cameron Run Advisory Committee Meeting
John Marshall Library, Alexandria, Virginia
November 20, 2003

Advisory Committee Members in Attendance:
Diane Davidson, Lake Barcroft Association
Don Demetrius, Fairfax County Stormwater Division
Susan Ellicott, Huntington Community Association
Phyllis Evans, Huntington Community Association
Robert Glass, Braddock District Supervisor's Office
Bill Hicks, Northern Virginia Regional Commission
Bob Jordan, Fairfax Trails and Streams/Potomac River Greenways Coalition
George Madill, Bren Mar Civic Association
Mack Rhoades, President, Huntington Community Association
Harry Shepler, Huntington Community Association
Kevin Shunk, City of Alexandria
Michael Wing, Supervisor Connolly/Providence District

Project Team Staff in Attendance:
Dipmani Kumar, Fairfax County Department of Public Works and Environmental Services (DPWES)
Amanda Peyton, Horne Engineering Services, Inc.
Fred Rose, Fairfax County DPWES
Nancy Roth, Versar, Inc.
Jennifer Shore, Versar, Inc.
Mark Southerland, Versar, Inc.

The Cameron Run Watershed Plan:

The Cameron Run watershed has experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the creek and its watershed. The Cameron Run Advisory Committee advises the Cameron Run Watershed Plan project team. Versar, Inc., prepares watershed plan drafts and engineering studies. Versar, Inc., and Horne Engineering Services, Inc. serve as facilitators for the public meetings. For more information, contact cameronrun@versar.com or visit www.fairfaxcounty.gov/watersheds

"The opinions represented herein do not necessarily represent those of Fairfax County or its agents."

Meeting Purpose*:*

Attendees of the meeting were individuals invited by project team staff to serve on the Cameron Run Advisory Committee. The purpose of this meeting was to introduce the Cameron Run Watershed and discuss the overall watershed planning process. The overall goal of the Advisory Committee is to help Fairfax County develop a watershed management plan for Cameron Run that incorporates community interests in the evaluation and implementation of solutions for protecting and restoring the streams and other natural resources of the watershed. This process is also being implemented in other watersheds in Fairfax County, providing a consistent basis for watershed decision-making

Key Decisions and Outcomes:

- Advisory Committee Meetings will be held:
  - Once per month
  - At different locations within the watershed
  - On an alternating Tuesday-Thursday schedule
  - All meetings will be at 7:00 PM.
- The next meeting of the Advisory Committee will be held on December 16, 2003 at 7:00 PM. A meeting location and agenda will be sent prior to the meeting.
- The next meeting will include a brief primer on watershed concepts and how streams become degraded.

Action Items:

- Project staff will prepare a brief primer on watershed concepts and how streams become degraded for presentation at the next meeting.
- Project staff will search for information on projects identified by committee members as concerns in the watershed and will present findings to the Advisory Committee.
- Committee members will identify other individuals or groups that should be invited to participate in the Advisory Committee.
- Committee members will prepare general thoughts about issues to be addressed by the Cameron Run Watershed Management Plan, for discussion at the next meeting.

Meeting Discussion:

Mr. Rose of DPWES welcomed attendees to this initial meeting of the Cameron Run Advisory Committee. It was emphasized that this committee will assist the County in the development of the Cameron Run Watershed Management Plan. Through this committee, Fairfax County and the community will form a partnership that will result in a plan that is not only good for the environment, but good for the community as well.

Mr. Kumar of DPWES gave attendees an overview and status of the county watershed planning process. Fairfax County has 30 designated watersheds, or natural drainage areas. The stream networks within these watersheds were assessed during a recently completed (October, 2003) countywide study. The assessment considered habitat and geomorphic conditions and inventoried problems such as deficient stream buffers and accelerated in-stream erosion as indicators of problems facing watersheds within Fairfax County. Of the 30 watersheds within Fairfax County, six have initiated the planning process: Cub Run, Bull Run, Popes Head Creek, Difficult Run, Cameron Run, and Little Hunting Creek.

Ms. Shore of Versar, Inc. initiated an introduction session between committee and project staff members. Ms. Roth, also of Versar, presented an overview of the Cameron Run watershed and an introduction to the watershed planning process. The presentation covered the following topics:

- Background information about Fairfax County watersheds
- Steps for creating a Watershed Management Plan
- A “Visual Tour” of the Cameron Run watershed
- Public involvement in watershed planning process

A watershed is an area of land that drains either directly, or through tributary streams into a particular river or water body. Fairfax County has designated 10 watersheds, representing 60% of the area in the county, as Phase I watersheds where planning has begun or will be initiated soon, including Cameron Run. Cameron Run, one of the largest watersheds in the county, measures a total of 44 square miles (33 square miles in Fairfax County) and includes several tributary systems (Holmes Run, Tripps Run, Lake Barcroft, Backlick Run, Indian Run, Turkeycock Run, and Pike Branch).

A watershed plan is a tool that uses available watershed data to assess and manage the watershed. These plans provide goals and objectives for achieving management actions and recommending actions to prevent further watershed problems. In addition, these plans provide a benchmark against which the County can measure the progress of watershed solutions in the future.

Fairfax County is undertaking development of Watershed Management Plans because 70% of the streams within the County are either in fair or poor condition as characterized by biological indicators (as assessed in the County’s Stream Protection Strategy baseline survey). Development of a plan will help Fairfax County meet Federal and State water quality standards, and help Virginia meet commitments in the Chesapeake 2000 agreement. Plans currently used by the County are outdated and do not take advantage of available stormwater management technology. Finally, a management plan will ensure that a comprehensive approach is taken to address regulations, commitments, and community needs.

Cameron Run has a long history of urbanization with many impervious areas that create a large stormwater problem for the watershed area. Within the watershed area, two streams are located on the Environmental Protection Agency's list of impaired waters. Under Section 303(d) of the 1972 Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters that do not meet established water quality standards even after point sources of pollution (e.g., water treatment plants) have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for waters on the 303(d) list and develop total maximum daily loads (TMDLs) for these waters. A TMDL specifies the maximum amount of a pollutant that a body of water can receive and still meet water quality standards, and allocates pollutant loadings among point and nonpoint (e.g., fertilizer runoff from yards) pollutant sources (Environmental Protection Agency 2003).

The Cameron Run watershed comprises primarily residential land uses with few patches of forest. Urbanization has resulted in substantial physical impacts to the watershed including, but not limited to, erosion, flooding, and stream channel alteration. The County's 2001 *Stream Protection Strategy* report listed Cameron Run as a Watershed Restoration Level II watershed. A Restoration Level II watershed is a watershed that is characterized by high development density, significantly degraded in-stream habitat conditions, and substantially degraded biological communities (DPWES 2001). A watershed management plan for Cameron Run will be designed to prevent further degradation to the watershed, improve water quality to meet Chesapeake Bay Program standards, as well as standards set by Federal, state, and local jurisdictions.

Ms. Roth next explained why Fairfax County is interested in engaging the community during the development of the Cameron Run Watershed Management Plan. Community feedback will aid the County in pinpointing local problems (e.g., flooding or erosion) and then helping to facilitate solutions for those problems. Through the plan development process, the community as a whole will become more educated about the watershed and will be able to make more informed decisions. These decisions will ensure that the final management plan is effective in meeting water quality standards mentioned above, and that the watershed community can implement the plan.

The Cameron Run Watershed Management Plan is in the early stages of the development process, i.e., in the data gathering and analysis phases. This meeting commenced the public involvement component of plan development. By involving the community in the planning stages, Fairfax County can ensure that a community supported plan can be developed in a timely and efficient manner.

The planning process will be conducted in the following manner:

- Develop Goals and Objectives (public involvement is being initiated at the beginning of the planning process and will continue throughout the development of the plan)
- Evaluate Alternatives (e.g., public infrastructure improvements, regulatory changes, and voluntary measures)
- Develop Implementation Strategy (e.g., costs, schedules, and standards)

Ms. Roth presented an overview of overall stream quality for the Cameron Run watershed. The Cameron Run watershed has very few natural buffers (56% of streams lack riparian buffer areas) and the aquatic habitat is very poor. Cameron Run also has numerous urban stressors (e.g., impervious surfaces) that result in noticeable streambank erosion in the majority of the watershed area (Tripps Run and the southeastern portion of the watershed do not have as great an erosion problem). Twenty-nine sites within the watershed have exposed utilities.

During this part of the presentation, committee members raised a number of concerns that project staff will research and report findings to the committee. These concerns include the following:

- Proposal in Falls Church to remove vegetation along waterways that could transmit more runoff downstream.
- Woodrow Wilson Bridge construction and the impact of construction on stormwater overflow in the community. This is especially timely after the recent rain events in the area and has implications for the trail extension.
- House flooding and its affect on the watershed (e.g., upper Tripps Run). Supporting data will be provided to project staff by Fairfax County for analysis.
- Impact of EPA cleanup project at Indian Run (old Atlantic Research site).
- Results of U.S. Geological Survey National Biological Information Infrastructure (NBII) project and integrating this into the watershed management plan.

Ms. Roth continued her presentation by giving an overview of the public involvement approach and the role of the Advisory Committee in the plan development process. The public involvement approach includes (1) forming an Advisory Committee whose members represent different groups within the watershed community; (2) conducting public workshops to inform the community about watershed plan development, to solicit feedback, and to provide an avenue for the community to find information on the progress of the watershed plan; and (3) utilizing a project website to distribute information about the plan and to solicit feedback. The Advisory Committee has the highest level of involvement with Fairfax County for developing a management plan for the Cameron Run watershed. The role of this committee is as follows:

- Advise project team members about watershed and community issues on which to focus and additional sources of information concerning those issues
- Advise project team members about community outreach including additions to the advisory committee and groups and individuals to invite to workshops
- Help develop agendas for public workshops to maximize relevance and applicability to the watershed area
- Conduct outreach to constituency groups (e.g., civic associations)
- Provide suggestions on the topics and formats for public education materials and publicity
- Review and comment on various drafts of the watershed management plan

There will be four public workshops conducted to solicit feedback from the community. These workshops include:

- An Issues Forum: Discuss and prioritize key watershed issues for the plan to address

- A Community Watershed Forum: Present draft approaches for plan development to key stakeholder groups
- A Draft Plan Review Session: Gain input on the proposed plan
- A Final Plan Review Session: Present the final plan to the community

Dr. Southerland of Versar opened a discussion for committee members to voice their thoughts on the overall watershed planning approach.

One committee member suggested that a list of resources be sent to committee members prior to committee meetings so that members could become familiar with issues facing the watershed and feel more prepared for meetings. Dr. Southerland emphasized that not all committee members need to be familiar with every issue facing the watershed (e.g., biological indicators). The committee was designed to include members from a mix of backgrounds (e.g., civic, scientific, housing) to ensure that the plan addresses all community issues. Dr. Southerland suggested presenting at the next meeting a 20-minute primer on how streams become degraded to familiarize committee members with watershed concepts. The group concurred with the suggestion.

Another committee member asked how the Advisory Committee will engage members of the business and development community in the plan development process. Project staff agreed that this involvement was important and asked that specific suggestions from Committee members be forwarded to the project team. The Baileys Crossroads Beautification Alliance was mentioned as a possibility. The member noted that it was important for that the business community be encouraged to follow recommendations rather than simply following current Fairfax County regulations, which are sometimes outdated. Mr. Rose stated that through the activities of the watershed planning process, updating current outdated County requirements and regulations will be considered.

In reference to retrofits, one committee member suggested that the management plan provide recommendations for using green roofs to reduce the impact of urban stresses on the watershed. The committee member explained what a green roof was and gave examples of green roofs in the watershed community. Mr. Rose indicated that the County is already evaluating the efficacy and practicality of green roofs. In general, committee members expressed an interest in exploring the possibility of recommending such management techniques, and other Low Impact Development measures, in the management plan.

The committee decided that committee meetings be held once a month, including this December. Meetings will be held at different locations within the watershed, to balance the travel demands on committee members, and will be held on an alternate Tuesday-Thursday schedule. All meetings will be held at 7:00 PM. The next meeting of the Advisory Committee will be held on Tuesday, December 16, 2003 at 7:00 PM. A meeting location and agenda will be sent prior to the meeting.

Dr. Southerland closed the meeting by asking committee members to (1) come up with additional individuals or groups that should be invited to participate in the Advisory Committee and (2) identify issues that the watershed management plan for Cameron Run should address.

Information about Cameron Run and the Cameron Run Watershed Management Plan can be found on the Fairfax County watershed plans website at www.fairfaxcounty.gov/watersheds. Under this page, visitors can access the 2001 *Stream Protection Strategy Baseline Study*. Under pages specifically dedicated to the Cameron Run watershed plan, readers will be able to access other supporting documents for the watershed, a meeting and event calendar, and meeting minutes for the Advisory Committee. The Cameron Run website also contains a message board that community members can use to share ideas and comment on plan drafts. Comments may also be sent to the watershed email address at cameronrun@versar.com, or called into the watershed hotline at (703) 642-6902.

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Cameron Run Advisory Committee Meeting

Woodrow Wilson Public Library, Falls Church, Virginia
December 16, 2003

ADVISORY COMMITTEE MEMBERS IN ATTENDANCE:

Michael Aho – Lee District Board of Supervisors
***Diane Davidson* –** Lake Barcroft Association
Eric Eckl – Citizen
***Phyllis Evans* –** Huntington Community Association
Richard Hartman – Citizen
***Bill Hicks* –** Northern Virginia Regional Commission
***Bob Jordan* –** Fairfax Trails and Streams/Potomac River Greenways Coalition
***George Madill* –** Bren Mar Civic Association
Liz McKeeby – Supervisor Gross/Mason District
Mia Musolino – Citizen
Russell Rosenberger – President of Madison Homes
F. Wyatt Shields – Assistant City Manager City of Falls Church
***Bob Slusser* –** Virginia Tech / Watershed Resident
Moe Wadda – Falls Church Engineer

PROJECT TEAM STAFF IN ATTENDANCE:

***Fred Rose* --** Fairfax County Department of Public Works and Environmental Services (DPWES)
***Nancy Roth* --** Versar, Inc.
Steve Schreiner – Versar, Inc.
Jennifer Shore – Versar, Inc.
Mark Southerland – Versar, Inc.
Brian Feeney – Horne Engineering Services, Inc.
Helene Merkel – Horne Engineering Services, Inc.
***Amanda Peyton* –** Horne Engineering Services, Inc.

THE CAMERON RUN WATERSHED PLAN

The Cameron Run watershed has experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the creek and its watershed. The Cameron Run Advisory Committee advises the Cameron Run Watershed Plan project team. Versar, Inc., prepares watershed plan drafts and engineering studies. Versar, Inc., and Horne Engineering Services, Inc. serve as facilitators for the public meetings. For more information, contact cameronrun@versar.com or visit http://www.fairfaxcounty-watersheds.net.

The opinions represented herein do not necessarily represent those of Fairfax County or its agents.

MEETING PURPOSE

Attendees of the advisory committee are individuals who represent diverse stakeholder groups that reside within the Cameron Run watershed community. The purposes of this advisory committee meeting was to identify any additional groups, agencies, or organizations that should be represented on the committee and to discuss key issues facing the watershed for inclusion in the watershed management plan. The overall goal of the advisory committee is to help Fairfax County develop a watershed management plan for Cameron Run that incorporates community interests in the evaluation of problems and implementation of solutions for protecting and restoring the streams and other natural resources of the watershed.

KEY DECISIONS AND OUTCOMES

- The Cameron Run Advisory Committee identified additional community groups, agencies, organizations, and academic institutions that should be represented at committee meetings (see *Advisory Committee Representation* below).
- The Cameron Run Advisory Committee identified watershed issues that should be addressed in the watershed management plan (see *Watershed Management Plan Issues and Solutions* below).
- Email is the best method for relaying information to advisory committee members.
- The next meeting of the Cameron Run Advisory Committee will be held on January 13, 2004 at 7:00 PM. The meeting location and agenda will be sent prior to the meeting.
- The Public Issues Forum will be held on February 12, 2004. Content for the Issues Forum will be discussed at the next meeting of the advisory committee along with proposed meeting locations.

ACTION ITEMS

- Project staff will generate a list of proposed venues for the February 2004 Public Issues Forum and present this to the committee at the January 2004 meeting.
- Project staff will research issues identified by committee members as concerns in the watershed, along with issues identified through other background research, and will present findings to the advisory committee.
- Project staff will prepare a presentation discussing results of baseline studies conducted on the Cameron Run watershed.
- Committee members will prepare ideas about issues that should be discussed at the Public Issues Forum, as well as how to publicize the meeting to the community.
- Project staff and committee members will identify contacts for the groups, agencies, and organizations that were identified as additional representatives on the advisory committee.

MEETING DISCUSSION

Introduction

Ms. Shore of Versar opened the advisory committee meeting by initiating an introductory session between committee and project staff members. During this introduction, Mr. Rose of DPWES, re-iterated the advisory committee role, which is to help Fairfax County develop a watershed management plan for Cameron Run that is based on community needs and sound water quality management practices. Cameron Run is the third watershed in Fairfax County that is in the process of developing a watershed management plan. Ms. Roth, also of Versar, closed the introductory session by calling attention to the many handouts that were available to meeting attendees. These handouts included the following:

- Cameron Run Advisory Committee Agenda for the November 20, 2003 Kick-off Meeting
- Fact Sheet on Five Reasons for Developing Watershed Plans in Fairfax County
- Cameron Run Advisory Committee Roles and Ground Rules
- Versar's November 20, 2003 presentation entitled, *Cameron Run Watershed Plan: Overview for Advisory Committee Kickoff Meeting*
- Cameron Run Advisory Committee Agenda for the December 16, 2003 Meeting
- Article from the March 1994 issue of the *Mt. Vernon Gazette* entitled, *Restoring the Ecology of Cameron Run Stream*
- Map showing the boundaries of the Cameron Run watershed
- Scope of work for the development of watershed management plans
- Versar's December 16, 2003 presentation entitled, *General Impacts of Urbanization on Streams*

Of these handouts, she highlighted the scope of work for the project staff, and discussed the role Versar and Horne Engineering will play in the development of Cameron Run's Watershed Management Plan. Also highlighted was a 1994 article in the EarthWatch Alexandria section of the *Mt. Vernon Gazette* that discusses the history of Cameron Run and the need to restore watershed health to pre-development standards. Ms. Roth noted that many of the issues in this article are still relevant today.

Stream Degradation

Ms. Roth presented an overview of how a stream can become degraded through urbanization and the challenges faced in managing urban watersheds. The biggest stressor facing the Cameron Run watershed is non-point sources of pollution (e.g., runoff from parking lots and lawns). Examples of watershed degradation include (1) physical impairment through such practices as channelization or sedimentation;(2) loss of streamside vegetation such as riparian buffers or forests; (3) poor water quality from increased nutrient loads, such as fertilizers, and an increase in bacteria or pathogens, such as fecal coliform; (4) changes in natural hydrologic flow, or water flow, from an increase in impervious surfaces such as buildings, parking lots, and roads, which causes destabilization of streams through erosion and increased sedimentation; (5) biological impacts such as a decline in the number and diversity of aquatic species; and (6) a tendency for streams to become repositories for community trash. Streams that are degraded through urbanization tend to have poor water quality (excessive nutrients and toxic substances, and poor clarity), poor water quantity (faster runoff speed, more frequent high flow rates, and more erosive power), and overall poor stream health (increases in bank erosion, reduced aesthetics, less diverse and vital aquatic community). Stream restoration and sound stormwater management practices can reverse the negative impacts caused by excessive urbanization and improve the health of the watershed. Some examples of management tools that could improve watershed health include, but are not limited to, community education, using conservation landscaping and Low Impact Development (LID), and restoring riparian buffers along stream banks.

At the conclusion of Ms. Roth's presentation, one committee member raised the question of how do environmentally friendly stormwater retrofit practices such as underground retention ponds, compare to traditional urban stormwater retrofits such as curb and gutter. The committee member also asked what studies have been conducted and are available to support environmentally friendly urbanization. Dr. Southerland of Versar stated that there are several good analytical studies that have been conducted and that discuss solutions to urban watershed stressors. Dr. Southerland also noted that having the right knowledge is one step in the watershed management planning process; the other is having the right mix of people present to develop the plan.

Advisory Committee Representation

Dr. Southerland led a committee discussion about community representation on the advisory committee. He queried the group and indicated that there was already a diverse representation of stakeholder as shown by the present members below:

- Academic Sector – 1 member (7%)
- Business Sector – 1 member (7%)
- Citizen Groups – 4 members (27%)
- Community Citizens – 2 members (13%)
- Elected Representatives – 2 members (13%)
- Government Sector – 4 members (27%)
- Non-profit Organizations – 1 member (7%)

He asked which groups, agencies, or organizations, in addition to committee members present at this meeting, should be represented on the Cameron Run Advisory Committee. Advisory committee and project team members suggested that a representative from the following community groups, agencies, organizations, and academic institutions attend future advisory committee meetings:

- Commercial/Residential Real Estate
- County Water Conservation Office or other Stream Monitor Group
- Fairfax County Park Authority
- Heavy Industry
- Metro and Railroad
- Nature Advocacy Group(s)
- Northern Virginia Regional Park Authority
- Recreation Groups (e.g., hunting and fishing advocates)
- Stream Ecology and Fisheries Biology Experts from George Mason University
- Virginia Department of Transportation (VDOT)
- Contractor from Woodrow Wilson Bridge Construction Project

One member strongly suggested that a member from the contractors constructing the Woodrow Wilson Bridge be present to address overall community concerns and the impact the bridge system will have on the Cameron Run watershed. Even though the actual bridge is outside of the watershed management area, entrance and exit ramps will be within the watershed area, and therefore, the committee should assess both aesthetic and water quality impacts. Project staff has reviewed a copy of the Environmental Impact Statement (EIS) developed for the Woodrow Wilson bridge construction project.

Another member presented lessons learned from the Little Hunting Creek Advisory Committee who did not engage VDOT at the beginning of the watershed management planning process. VDOT manages the majority of roads in Fairfax County and their input is important to developing a watershed management plan for implementation in the Cameron Run watershed. The VDOT representative can also address committee questions about determining which streams will be impacted during transportation construction.

Another member also voiced that the Fairfax County water and park authorities should be included in the advisory committee since they own and manage the majority of parkland and water in the Cameron Run watershed. Input from these groups would be invaluable for developing a management plan.

Mr. Rose advised the committee to limit representatives from government organizations and other groups to only those that would be active participants in the watershed management planning process. Many of these representatives have busy schedules and would only be able to attend a meeting or two at best and the advisory committee should be composed of active community members who have a desire to promote sound watershed management processes. Dr. Southerland supported Mr. Rose by stating that the ideal advisory committee would consist of watershed "champions" and have 15 to 20 active members dedicated to developing a sound watershed management plan for Cameron Run.

Watershed Management Plan Issues and Solutions

Dr. Southerland led a group dialogue discussing key issues and solutions that should be addressed in the Cameron Run Watershed Management Plan. Key issues discussed by the committee included the following:

- Identify solutions for urban vs. suburban communities within the watershed. Management of each area will be different based on land use constraints.
- Evaluate current jurisdictional coordination.
- Review and revise County development building ordinances, codes, and subdivision regulations, and develop a mechanism for enforcing ordinances, codes, and regulations.
- Incorporate watershed management practices into the Fairfax County Master Plan.
- Minimize or eliminate current stormwater waivers.
- Decrease the amount of impervious surfaces in the watershed area to minimize runoff to watershed streams.
- Reduce erosion and sedimentation from headwaters of the watershed and reduce urban runoff. Sediment from headwaters of the watershed, as well as urban runoff, are major issues for Cameron Run.
    - This could become a regulatory issue once tributary strategies are finalized.
    - Programs such as street sweeping and using trash booms should be encouraged to reduce contributions of sediment and trash into streams.
    - Lake Barcroft is a good example of a private lake within the watershed community that receives a great deal of sediment and trash via runoff from other parts of the County. The community has to bear the burden of removing excess sediment and trash from the lake, because Fairfax County does not manage private lakes within the county.
- Resolve the conflict between flood conveyance requirements and water quality requirements.
- Identify bacteria and pathogen issues.
- Increase opportunities for public access to streams and rivers.

Potential solutions proposed by the committee to resolve some of the issues facing the watershed include:

- Encourage public behavior modification through engagement and education.
  - 90% of the public does not know what a watershed is, or which watershed they reside in.
  - The public is also unaware of stresses affecting a watershed, and how their actions add to those impacts.
  - In terms of overall watershed health, Cameron Run is one of the poorest watersheds in Fairfax County.
- Teach children at the grade school level about environmental stewardship.
- Identify and then reach out to members of the landscaping and grounds maintenance community to educate them on environmentally friendly techniques.
- Develop an incentive program for developers and landowners to adopt environmentally friendly practices.
  - Tax incentives for homeowners who use conservation landscaping or LID techniques, or who buy properties with these features.
  - Incentives for developers to design and build using environmentally friendly practices.
- Renovate or expand school grounds to include LID techniques, or conservation landscaping.
  - Benefits the school by providing better stormwater management.
  - Areas could be used to educate students about watershed health.
  - Provides a demonstration project for the community on practices that could improve stream and watershed health.
- Develop innovative approaches to current urban infill practices using creative environmentally friendly techniques.
  - Fairfax County performed a pollution prevention study in 2000 that addressed infill vs. non-infill issues.
  - Update the existing stormwater manual, or develop a new stormwater manual.
- Evaluate and improve designs for failing infrastructure by using techniques such as daylighting (practice that exposes previously buried rivers, streams, or other waterways).
- Use the public sector to set the example for environmental stewardship in the watershed.

Mr. Rose reminded committee members that fostering solutions for inclusion in the watershed management plan is a group effort, and that it is up to the committee to come up with solutions that can be implemented using Fairfax County resources. Fairfax County has limited resources so solutions will have to benefit the entire community.

Meeting Adjournment

The committee decided that the next meeting be held on Tuesday, January 13, 2004 at 7:00 PM. A meeting location and agenda will be sent prior to the meeting. The committee also set a date of Thursday February 12, 2004 for the first community public meeting – the Issues Forum.

Dr. Southerland closed the meeting by asking committee members to begin developing ideas for the Issues Forum that will be held in February 2004. Specifically, committee members were asked to think about (1) Cameron Run watershed issues that should be discussed at the public forum, and (2) how best to publicize the forum to the community at large. Content for the Issues Forum will be determined by the committee in January.

Information about Cameron Run and the Cameron Run Watershed Management Plan can be found on the Fairfax County watershed plans website at www.fairfaxcounty-watersheds.net. Under pages specifically dedicated to the Cameron Run watershed plan, readers will be able to access other supporting documents for the watershed, a meeting and event calendar, and meeting minutes for the Cameron Run Advisory Committee. The Cameron Run website also contains a message board that community members can use to share ideas and comment on plan drafts. Comments may also be sent to the watershed email address at cameronrun@versar.com, or called into the watershed hotline at (703) 642-6902.

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Cameron Run Advisory Committee Meeting

Woodrow Wilson Public Library, Falls Church, Virginia
January 13, 2004

ADVISORY COMMITTEE MEMBERS IN ATTENDANCE:

***Diane Davidson* –** Lake Barcroft Association
Dave Eckert – Falls Church Stream Stewards
Eric Eckl – Citizen
***Phyllis Evans* –** Huntington Community Association
Richard Hartman – Citizen
***Bill Hicks* –** Northern Virginia Regional Commission
Allan Hudson, Baileys Crossroads Revitalization
***Bob Jordan* –** Fairfax Trails and Streams/Potomac River Greenways Coalition
Russell Rosenberger – President of Madison Homes
F. Wyatt Shields – Assistant City, Manager City of Falls Church
Peter Silva – Lake Barcroft Watershed Improvement District

PROJECT TEAM STAFF IN ATTENDANCE:

***Dipmani Kumar* --** Fairfax County Department of Public Works and Environmental Services (DPWES)
Fred Rose – DPWES
***Gayle England* --** DPWES
Jennifer Shore – Versar, Inc.
Mark Southerland – Versar, Inc.
***Amanda Peyton* –** Horne Engineering Services, Inc.

THE CAMERON RUN WATERSHED PLAN

The Cameron Run watershed has experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the creek and its watershed. The Cameron Run Advisory Committee advises the Cameron Run Watershed Plan project team. Versar, Inc., prepares watershed plan drafts and engineering studies. Versar, Inc., and Horne Engineering Services, Inc. serve as facilitators for the public meetings. For more information, contact cameronrun@versar.com or visit http://www.fairfaxcounty-watersheds.net.

The opinions represented herein do not necessarily represent those of Fairfax County or its agents.

MEETING PURPOSE

Attendees of the advisory committee are individuals who represent diverse stakeholder groups that reside within the Cameron Run watershed community. The purposes of this meeting of the advisory committee was to discuss overall stream quality conditions in the Cameron Run watershed based on analysis of water quality data collected by Fairfax County. The advisory committee also began identifying priority issues that should be addressed in the watershed management plan. The overall goal of the advisory committee is to help Fairfax County develop a watershed management plan for Cameron Run that incorporates community interests in the evaluation of problems and implementation of solutions for protecting and restoring the streams and other natural resources of the watershed.

KEY DECISIONS AND OUTCOMES

- The Cameron Run Advisory Committee will tour areas of the Cameron Run watershed on Sunday, February 29, 2004. Project staff will contact committee members for an appropriate group meeting location and time during the week of February 19, 2004. A finalized meeting location and time will be sent to Committee members prior to the tour.
- The Cameron Run Advisory Committee identified priority watershed concerns that should be addressed in the watershed management plan (see *Watershed Management Plan Priority Issues* below). These priorities will be discussed further at the February meeting.
- The next meeting of the Cameron Run Advisory Committee will be held on February 12, 2004 at 7:00 PM. The meeting location and agenda will be sent prior to the meeting.
- The Public Issues Forum will be held in March or April 2004. Content for the Issues Forum will be discussed at the next meeting of the advisory committee along with proposed meeting locations.

ACTION ITEMS

- Project staff will generate a list of proposed venues for the March/April 2004 Public Issues Forum and will present this to the committee at the February 2004 meeting.
- Project staff will research issues identified by committee members as concerns in the watershed, along with issues identified through other background research, and will present findings to the advisory committee.
- Project staff will research more stream quality data and present this to the committee.
- Project staff will contact committee members regarding the February 29, 2004 watershed tour during the week of February 19, 2004 to discuss group meeting locations and times. Project staff will inform committee members of the finalized meeting location and time prior to the tour. Potential tour sites include the Lake Barcroft debris catcher area, the Poplar Heights area, and a heavily impacted area in Tripps Run.
- Project staff will also investigate inviting a member of the press to join the advisory committee on the watershed tour in February.
- Committee members will give contact information for the groups, agencies, and organizations that were identified to project staff. Project staff will then contact these individuals for inclusion on the advisory committee.

- Committee members will prepare ideas about issues that should be discussed at the Public Issues Forum, as well as how to publicize the meeting to the community.

MEETING DISCUSSION

Introduction and Overview of Committee Activities to Date

Ms. Shore of Versar opened the advisory committee meeting by initiating an introductory session between committee and project staff members. Following the introductory session, Dr. Mark Southerland of Versar, presented an overview of advisory committee activities to date. In his presentation, Dr. Southerland gave a brief overview of the following:

- The watershed basics presentation presented by Nancy Roth at the November meeting
- Steps for developing a watershed management plan
- An introduction to the Cameron Run watershed
- Roles of the advisory committee
- General watershed issues of concern, as raised by advisory committee members
- Advisory committee representation
- Outcomes and action items from the November and December meetings of the advisory committee.

During the advisory committee representation overview, committee members suggested specific individuals be contacted from the Northern Virginia Park Authority, the Virginia Soil and Water Conservation District, and from a local beautification alliance community group. Contact information for all of these individuals will be given to project staff. Project staff will then contact these individuals for inclusion on the advisory committee.

Upcoming Schedule for the Advisory Committee

The Public Issues Forum will be held in either March or April 2004 as opposed to the original February 12, 2004 date. Fairfax County decided to reschedule the first of three public meetings after advisory committee membership has been finalized, and once the committee has determined what priority issues will be included in the watershed management plan. In an effort to facilitate finalizing priority issues for inclusion in the plan, the committee will be conducting a tour of the Cameron Run watershed to see first hand some of the problem areas and issues facing the watershed. The committee decided that the tour would be held on Sunday, February 29, 2004. Project staff will contact all members of the advisory committee to discuss potential meeting locations and times.

Condition of Cameron Run Watershed

Dr. Southerland presented an overview of data findings and overall water quality conditions in the Cameron Run watershed. Cameron Run has a long history of urbanization with a high amount of impervious surfaces. Intense urbanization has placed substantial stress on the watershed, including, but not limited to, physical impacts, increased erosion, flooding, and channel alteration. Overall, stream quality for Cameron Run is poor, as determined through the Stream Protection Strategy (SPS) and Stream Physical Assessment (SPA) analysis conducted by Fairfax County in 2001 and 2002. Specifically, the Cameron Run watershed area was found to have very few natural buffers, poor aquatic habitat, and degraded fish and benthic communities, as a result of the numerous urban stressors that have affected the watershed through development. Water quality is so poor in some areas that two reaches of the watershed (Backlick Run and the Cameron Run mainstem) have been included on the U.S. Environmental Protection Agency (EPA)'s list of impaired waters for fecal coliform contamination. As the land in the Cameron Run watershed continues to be developed, the potential for further water quality decline is very likely. Fred Rose of DPWES supplemented Dr. Southerland's observations by stating that older, densely populated areas in the eastern regions of Fairfax County generally have poorer water quality than those in the western regions because of the rate of development. There are pockets of problems in the western regions of the county because of increasing development. The Cameron Run watershed is one of the most degraded watersheds in terms of water quality in Fairfax County. The following list provides an overview of water quality conditions for the major tributary subwatersheds in the Cameron Run watershed:

- **Tripps Run:** Covers 10.3% of the Cameron Run watershed and includes the city of Falls Church. Tripps Run is the oldest and most developed tributary in the watershed and is the most degraded. The overall subwatershed condition rating was very poor, with very poor Index of Biotic Integrity (IBI), habitat, and fish taxa richness scores. Thirty-two percent (32%) of the subwatershed is impervious with a future estimate of 35% imperviousness. Future imperviousness is based on current zoning permits. There is always some uncertainty with future planning and zoning allocations; and estimates of future imperviousness are generally high.
- **Upper Holmes Run:** Covers 27.2% of the Cameron Run watershed and includes part of the Lake Barcroft community. The overall subwatershed condition rating was very poor, with a very poor IBI score, a poor habitat score, and a variable fish taxa richness score. Twenty-eight percent (28%) of the subwatershed is impervious with a future estimate of 45% imperviousness.
- **Lower Holmes Run:** Covers 5.0% of the Cameron Run watershed and includes the majority of the Lake Barcroft community. Lower Holmes Run also includes some portions of the city of Alexandria. The overall subwatershed condition rating was very poor, with a fair IBI score, a very poor habitat score, and a low fish taxa richness score. Twenty-eight percent (28%) of the subwatershed is impervious with a future estimate of 33% imperviousness.
- **Turkeycock Run:** Covers 27.2% of the Cameron Run watershed and includes the Mason District Park area. The overall subwatershed condition rating was poor, with a very poor IBI score, a fair habitat score, and a low fish taxa richness score. Twenty-three percent (23%) of the subwatershed is impervious with a future estimate of 35% imperviousness.
- **Indian Run:** Covers 9.9% of the Cameron Run watershed and includes the headwaters near Little River Turnpike. The overall subwatershed condition rating was very poor, with a fair IBI score, a poor habitat score, and a very low fish taxa richness score. Twenty-seven percent (27%) of the subwatershed is impervious with a future estimate of 35% imperviousness.
- **Backlick Run:** Covers 20.6% of the Cameron Run watershed, is the most industrial area of the watershed, and includes the I-95/495/395 "mixing bowl" area. Backlick Run was included on the EPA list of impaired waters for fecal coliform contamination. The overall subwatershed condition rating was very poor, with a poor IBI score, a very poor habitat score, and a low fish taxa richness score. Thirty percent (30%) of the subwatershed is impervious with a future estimate of 42% imperviousness.
- **Pike Branch:** Covers 6.1% of the Cameron Run watershed and drains the southeastern portion of the watershed. The overall subwatershed condition rating was very poor, with a fair IBI score, a very poor habitat score, and a very low fish taxa richness score. Twenty-five percent (25%) of the subwatershed is impervious with a future estimate of 32% imperviousness.
- **Cameron Run and Direct Tributaries:** Covers 6.7% of the Cameron Run watershed, receives flows from the remainder of the city of Alexandria, and is near the Wilson Bridge and the

proposed Huntington Stream Valley Trail along the Cameron Run stream. This area was not included in the 2001 SPS analysis conducted by the county, but data collected from the city of Alexandria, the Virginia Department of Health, and national water quality data were used to characterize stream conditions. Many of the streams in this area are buried or channelized thereby disconnecting them from the floodplain. These waters have been listed on the EPA list of impaired waters for acute ammonia and fecal coliform contamination. Polychlorinated Biphenyls (PCBs) have been found in fish tissues and prompted the Virginia Department of Health to issue a health advisory.

One committee member stated that over two cubic yards of silt, sediment, and debris flows from Tripps Run into Lake Barcroft on an annual basis. The burden of cleaning up the lake falls on the community. The lake has also become a repository of trash from the northern regions of the watershed area collecting trash items such as Styrofoam coffee cups, tennis balls, and plastic grocery bags.

Another member brought to the attention of the group that the Tripps Run subwatershed truly starts at an area north of I-66 called Falls Hills, but some of the subwatershed has been buried by development. An inquiry was raised about how the county came to the 32% impervious surface estimate for Tripps Run because the subwatershed includes the city of Falls Church, which is heavily developed. Dipmani Kumar of DPWES addressed this question by stating that Fairfax County did not assess the Falls Church area of the subwatershed, but instead made estimates on impervious surfaces based on national data.

Another member suggested visiting the Popular Heights area located at the headwaters of Tripps Run, because the streambanks in this area are severely eroded. Project staff will coordinate with this member to determine the exact location of this area and its potential to be included in the group watershed tour. This same member attended a conference by the National Park Service concerning water quality. The member discovered at this conference that the number one issue facing watersheds is sedimentation and the number two issue is overall water quality. To his dismay, the accumulation of trash in our waters was ranked at number 13.

Another member suggested an additional area in Tripps Run be visited that is heavily affected by debris and damming. This area is located around a highly industrial area. Project staff will coordinate with this member to determine the exact location of this area and its potential to be included in the group watershed tour.

Another member asked if there was any type of stream configuration data available for the Cameron Run watershed area. Project staff will research this and present findings to the committee.

Another member raised the concern of not seeing the degree of chemical contamination in the data Dr. Southerland presented to the committee. This member was particularly interested in finding out the impact of chemical spills to the watershed. Project staff is looking into water quality issues via chemical impacts. In the meantime, Dr. Southerland indicated that chemical impacts are reflected in the biological indicators, which act as integrators of cumulative impacts (of all types) over time. Comprehensive chemical testing is expensive and impractical because it varies temporally more than biology. Currently, streams are only tested for hydrocarbons based on odor and/or color of water.

Another member was interested in finding how many miles of stormdrain pipes and the resulting number of stormwater inlets and outlets are in the watershed. This member indicted that these numbers can be easily determined using Geographic Information Systems (GIS) data layers. Through the committee discussion, it was determined that there are 300 stormwater outfalls along nine miles of the 4-mile Run area, and that there are generally 450 inlets per square mile in Fairfax County. Mr. Kumar indicated that complete stormwater infrastructure maps are available but not yet completely digitized.

Another member would be interested in finding out how many miles of inadequate riparian buffers are found on private vs. public lands. Project staff will research and give estimates to the committee once determined.

Another member was interested in how the SPA study was conducted, particularly how the data was gathered. Mr. Kumar and Dr. Southerland informed the committee that all data was gathered from physical assessments performed at the stream. Fairfax County personnel physically walked the entire area of the Cameron Run watershed and noted physical impacts and other stressors as seen visually.

Another member raised the question of how did the assessors know the exact number of exposed utilities in a particular area of the watershed. Mr. Kumar addressed this question by stating that if an exposed utility was found during the physical assessment of the watershed, the exposed utility was marked. All exposed utilities in the watershed have probably been noted, but whether or not they are active is not known.

Another member stated that PCB and ammonium found at the Cameron Run stream and surrounding tributaries is actually located further down the stream than in the Cameron Run watershed area. Project staff will coordinate with this member and validate this statement.

A copy of Dr. Southerland's presentation can be found on the Fairfax County watershed plans website under Cameron Run.

Watershed Management Plan Priority Issues

Dr. Southerland developed a "Strawman" list of priority issues identified through analysis of baseline data. Advisory committee members commented on the list, combining some issues and adding others. The committee was then asked to vote on those issues that they considered a top priority for discussion in the watershed management plan. Each committee member was asked to vote five times (for one or more issues) they individually thought were a priority to address in the watershed management plan. The list of priority issues as identified by the committee is as follows:

1. Sediment loss into streams of watershed – 9 votes (16%)
2. Impervious surfaces (paved land cover) – 8 votes (15%)
3. Loss and/or degradation of habitats and biological communities – 7 votes (13%)
4. Bank erosion including infrastructure impacts and channel instability – 6 votes (11%)
5. Polluted runoff/non-point sources of pollution, including inorganic toxins – 6 votes (11%)
6. Peak flow issues – 4 votes (7%)
7. Riparian buffer loss along stream banks – 3 votes (5%)
8. Bacteria and pathogens – 3 votes (5%)
9. Flooding – 2 votes (4%)
10. Direct inflow from stormwater systems into streams within watershed – 2 votes (4%)
11. Trash/Dump sites along and within streams in watershed – 2 votes (4%)
12. Channel alteration of streams in watershed– 1 vote (2%)
13. Low flow of streams in watershed– 1 vote (2%)
14. Obstructions in streams – 1 vote (2%)
15. Nutrients/organic loading into watershed from urban and non-urban sources– 0 votes (0%)

16. Fate of wetlands in watershed – 0 votes (0%)

At the February meeting, the committee will discuss voting findings and finalize the list of priority issues that will be included in the watershed management plan. Dr. Southerland also asks the committee to think of specific places in the watershed that epitomize the issues on the priority list. The project team will endeavor to include these examples in the watershed tour.

One member raised a concern regarding how activities in other watersheds can overwhelm beneficial efforts employed by the Cameron Run watershed community in the watershed management plan (e.g., on the Chesapeake Bay). Mr. Rose addressed this question by stating that the advisory committee is developing a watershed management plan for the benefit of the Cameron Run watershed community. The committee will address this concern further in future meetings of the advisory committee.

Meeting Adjournment

The committee decided that the next meeting be held on Thursday, February 12, 2004 at 7:00 PM. A meeting location and agenda will be sent prior to the meeting. The committee also set a date of Sunday, February 29, 2004 for a tour of the Cameron Run watershed.

Dr. Southerland closed the meeting by asking committee members to begin developing ideas for the Public Issues Forum that will be held in either March or April 2004. Specifically, committee members were asked to think about (1) Cameron Run watershed issues that should be discussed at the public forum, and (2) how best to publicize the forum to the community at large. Content for the Issues Forum will be determined by the committee in February. The committee will also finalize membership for the Cameron Run Advisory Committee at the February meeting.

Information about Cameron Run and the Cameron Run Watershed Management Plan can be found on the Fairfax County watershed plans website at www.fairfaxcounty-watershed.net. Under pages specifically dedicated to the Cameron Run watershed plan, readers will be able to access other supporting documents for the watershed, a meeting and events calendar, and meeting minutes for the Cameron Run Advisory Committee. The Cameron Run website also contains a message board that community members can use to share ideas and comment on plan drafts. Comments may also be sent to the watershed email address at cameronrun@versar.com, or called into the watershed hotline at (703) 642-6902.

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Cameron Run Advisory Committee Meeting

Ellen Coolidge Burke Branch Library, Alexandria, Virginia
February 12, 2004

ADVISORY COMMITTEE MEMBERS IN ATTENDANCE:

Than Bawcombe – Fairfax County Stormwater Planning
Glenda Booth – Fairfax County Wetlands Board
Vince Cusumano – Pinecrest HOA
Diane Davidson – Lake Barcroft Association
Don Demetrius **--** Fairfax County Department of Public Works and Environmental Services (DPWES)
Gayle England **--** Fairfax County DPWES SWPD
Richard Hartman – Berkshire HOA/Huntington Community Association
Bill Hicks – Northern Virginia Regional Commission
Bob Jordan – Fairfax Trails and Streams/Potomac River Greenways Coalition
Liz McKeeby – Supervisor Gross/Mason District
Moe Wadda – Falls Church Engineer
Norine Walker – Woodrow Wilson Bridge Project

PROJECT TEAM STAFF IN ATTENDANCE:

Dipmani Kumar -- Fairfax County Department of Public Works and Environmental Services (DPWES)
Fred Rose – DPWES
Jennifer Shore – Versar, Inc.
Mark Southerland – Versar, Inc.
Julie Tasillo -- Versar, Inc.
Amanda Peyton – Horne Engineering Services, Inc.

THE CAMERON RUN WATERSHED PLAN

The Cameron Run watershed has experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the creek and its watershed. The Cameron Run Advisory Committee advises the Cameron Run Watershed Plan project team. Versar, Inc., prepares watershed plan drafts and engineering studies. Versar, Inc., and Horne Engineering Services, Inc. serve as facilitators for the public meetings. For more information, contact cameronrun@versar.com or visit www.fairfaxcounty.gov/watersheds

The opinions represented herein do not necessarily represent those of Fairfax County or its agents.

MEETING PURPOSE

Attendees of the advisory committee are individuals who represent diverse stakeholder groups that reside within the Cameron Run watershed community. The purpose of this meeting of the advisory committee was to finalize the list of stakeholder groups and their corresponding representatives that should be invited to future committee meetings. The committee also identified specific problem sites within the watershed that exhibit one or more of the priority issues of concern identified by the committee at the January 13, 2004 meeting. The overall goal of the advisory committee is to help Fairfax County develop a watershed management plan for Cameron Run that incorporates community interests in the evaluation of problems and implementation of solutions for protecting and restoring the streams and other natural resources of the watershed.

KEY DECISIONS AND OUTCOMES

- Due to current weather conditions, the Cameron Run watershed tour will be conducted sometime during the spring. Project staff will contact committee members for potential meeting dates, locations, and times prior to the tour.
- The Cameron Run Advisory Committee identified problem areas specific to the individual subwatersheds within the Cameron Run watershed (see *Problem Areas Specific to Subwatersheds* below). These areas will be further discussed at the March committee meeting and will be considered as areas to visit during the spring watershed tour.
- The next meeting of the Cameron Run Advisory Committee will be held in late March (committee members will be queried for dates that will be best attended), again at 7:00 PM. The meeting date, location, and agenda will be sent prior to the meeting.
- The Public Issues Forum will be held in April 2004. Content for the Issues Forum will be discussed at the April advisory committee meeting along with a finalized meeting location.

ACTION ITEMS

- Project staff will continue to summarize background studies, will research issues identified by committee members as concerns in the watershed, and will present detailed findings to the advisory committee at the March meeting.
- Project staff will contact committee members during the remainder of February reminding them to either forward contact information for the groups, agencies, and organizations that were identified for inclusion on the advisory committee, or to contact these stakeholder groups themselves.
- Committee members will identify additional ways to bring more stakeholder representatives to future advisory committee meetings.
- Committee members will prepare ideas about issues that should be discussed at the Public Issues Forum, as well as how to publicize the meeting to the community.

MEETING DISCUSSION

Introduction and Overview of Committee Activities to Date

Ms. Shore of Versar opened the advisory committee meeting by initiating an introductory session between committee and project staff members. Following the introductory session, Dr. Southerland of Versar presented a brief overview of advisory committee activities to date. He indicated that this meeting would focus more on group discussion and interaction and less on presenting data. Dr. Southerland reiterated the overall purpose of the advisory committee and the roles assigned to the committee. The roles of the advisory committee are as follows:

- Advising the consultant team about community outreach including additions to the advisory committee, and groups and individuals to invite to workshops.
- Helping to formulate agendas for public meetings to maximize relevance and applicability to the local watershed.
- Conducting outreach to their own constituency groups (e.g. neighborhood associations, civic and church groups, Chamber of Commerce, etc.).
- Advising the consultant team about key watershed issues on which to focus and additional sources of information.
- Providing suggestions on the topics and formats for public education materials and publicity.
- Reviewing and commenting on various initial and final drafts of the watershed management plan.

One member stressed that committee members should not take their roles lightly and that the review and comment role is especially important to the development of the Cameron Run watershed management plan. The review and comment role is more than simply reviewing the draft plan. It also means that committee members make recommendations on plan content.

Dr. Southerland made the following announcements concerning scheduling of future activities for the advisory committee:

- The watershed tour has been postponed from the original February 29, 2001 date due to the potential for inclement weather and to allow more time for the committee to study the issues facing the watershed.
- The next meeting of the advisory committee will be in late March (committee members will be queried for dates that will be best attended), again at 7:00 PM. The meeting date, location, and agenda will be sent prior to the meeting.
- The advisory committee will prepare for the Public Issues Forum at the April committee meeting.
- The Public Issues Forum will be held in late April 2004. A finalized location will be discussed at the April advisory committee meeting.

Finalization of Advisory Committee Representation

Ms. Shore asked each committee member to identify which stakeholder group they represented in order to open a dialogue about committee stakeholder representation. To re-cap, during the December 16, 2003 advisory committee meeting, committee members developed a list of stakeholders groups whose representatives should have a voice in the watershed plan development process. These stakeholder groups were as follows:

- Academic sector

- Business sector
- Citizen groups
- Community members
- Elected representatives/officials
- Woodrow Wilson Bridge construction project staff
- Virginia Department of Transportation (VDOT)
- Northern Virginia Park Authority
- Government/Public sector
- Non-profit organizations
- Commercial/Residential real estate
- Heavy industry
- Metro/Railroad
- Recreation groups
- Nature advocacy groups

Of all the members present at this meeting, more than fifty (50%) percent were in the government/public sector. At least one representative from each of the stakeholder groups above has attended an advisory committee meeting to date, with the exception of the heavy industry, business sectors (except real estate developers) , and VDOT. To date neither project staff nor committee members have been able to get a representative from these stakeholder groups to attend a meeting.

One member raised the point that the groups and individuals who have been attending these meetings thus far have been concerned about the environment and the overall health of the watershed. Members from the heavy industry and business sectors may not see the benefits of participating in the planning process, though decisions could results in greater costs to them. They may not understand that development of a watershed management plan not only benefits the community environmentally but can also directly benefit citizens and businesses economically (e.g., by increased real estate values).

Mr. Rose of DPWES concurred by stating that business representatives do not understand the role of the advisory committee and how their input will shape the Cameron Run watershed plan. He suggested that project staff and committee members employ a different outreach approach for contacting stakeholder groups that are not represented at the advisory committee. Thus far outreach has been limited to phone calls by project staff and committee members and word of mouth. Mr. Rose suggested that a fact sheet or brochure describing the Cameron Run watershed and the purpose and roles of the advisory committee be developed for distribution to stakeholder groups without a representative on the advisory committee.

Another member supported Mr. Rose's comments by begging the question, "What can improving the Cameron Run watershed do for me?" This member suggested developing a message specific to each stakeholder group. A message for nature advocates might focus on watershed health and aesthetic benefits, while a message for business advocates might focus on economic benefits.

This same member also asked how the health of the Cameron Run watershed could be improved without spending a massive amount of money and raising tax dollars? The watershed is over-developed, in poor health, and not aesthetically pleasing. How can the committee convey both tangible and less tangible benefits of improving the watershed to the diverse stakeholder groups within the watershed and develop a plan that ties all of these benefits together? This member is specifically interested in aesthetically improving the Cameron Run watershed, but members of other stakeholder groups may not share this view. How will the committee meet the challenge of conveying the connection between environmental and economic benefits of improving the Cameron Run watershed to the community ?

Mr. Rose addressed this member's concern by stating that the committee will have to find the connection between environmental benefits and everyday life of watershed community members. This will be a challenge because members of the community may be preoccupied with day-to-day activities and not see the big picture. The Public Issues Forum is a vehicle for the advisory committee to discuss watershed issues and potential solutions while educating the public on the environmental and economic benefits of improving the Cameron Run watershed.

Another member reminded the committee that one of the roles of the committee is to make recommendations for improving the health of the watershed, not to make recommendations for the cost of improvements. The purpose of the advisory committee is to help develop a plan that will improve the overall health of the watershed. The costs of implementing this plan are beyond the scope of this committee and should be addressed as a separate issue.

Another member suggested that a representative from George Mason University would be appropriate for the academic sector because George Mason University is in Fairfax County. This representative would have a good handle on the issues facing the watershed and could provide insights on possible solutions.

Another member stated that the City of Alexandria would like to have a representative attend future advisory committee meetings. The previous representative can no longer attend the meetings and the city is in the process of finding a new representative.

Likewise, another member stated that representatives of the Braddock area want to be informed of all committee activities, but are unable to consistently send a representative to committee meetings because of other issues facing the area.

Another member stressed the importance of having a member from the business sector attend future advisory committee meetings. This member suggested that current committee members go to their respective community groups and make an effort to reach out to the business community.

Another member suggested project staff contact a specific individual employed at Recreational Equipment Incorporated (REI) who is connected to a diverse array of environmental and nature groups. This member will provide contact information for this individual to project staff.

Another member strongly suggested that the committee contact representatives from heavy industry and implore them to attend future advisory committee meetings. This same member also suggested that a representative from the Alexandria Chamber of Commerce attend meetings.

Another member suggested that the committee invite principals from various schools to future advisory committee meetings. Utilizing school groups to plant riparian forest buffers along streambanks would help get the community involved in improving watershed health.

Another member suggested inviting members from community religious groups, and members from different ethnic communities. Having a representative present from different religious and ethnic groups opens the door to educating a larger audience in the watershed community. This member offered to give project staff contact information for various community centers.

Another member noted that while it is good to ask representatives from all of these groups to attend future advisory committee meetings, we need to ask, what will bring those representatives to the meetings? What can project staff and committee members tell stakeholder representatives to encourage them to attend committee meetings?

Another member responded to the above question by stating that the advisory committee is helping influence policy change by helping Fairfax County develop regulations that could impact the community in the future.

In response, Mr. Rose stated that the committee and the watershed community are tasked with not only influencing policy change, but with finding solutions to improve the watershed as well. The advisory committee is not a government function, but a group composed of community stakeholder groups who have come together to develop a watershed management plan for Cameron Run.

Another member asked project staff what documents or studies are available to use as reference points when talking with representatives from other stakeholder groups. Should committee members use old county watershed management plans as references when discussing the tangible benefits of a new watershed management plan?

Dr. Southerland addressed this question by stating that while the old county management plans are available to the public and could be used as an initial reference point during outreach efforts, they are outdated. New regulations that specifically address watershed health have been passed, and new technologies have been developed to improve watershed health since the old plans were developed. The project team will provide summary materials on the condition of Cameron Run watershed at the March meeting.

Another member stated that the Little Hunting Creek watershed management plan is in draft form and could be used as a reference point for committee members when reaching out to other stakeholders.

Another member suggested that once specific issues have been identified for the Cameron Run watershed, that the committee develop a vision statement for the improvement of the Cameron Run watershed. The vision statement should be flexible enough to be applied to other watersheds in the County.

Dr. Southerland stated that the goal of the committee is to develop a watershed plan that makes Cameron Run a more livable watershed for the community. Each watershed community has issues specific to their watershed and these should be included in the vision statement if it is to have much utility. For example, developing a watershed management plan can improve the aesthetics of the watershed and increase recreational opportunities for the entire community.

Problem Areas Specific to Subwatersheds

In an effort to begin preparations for the April Public Issues Forum, Dr. Southerland asked committee members to identify specific problem areas within the Cameron Run watershed. Committee members were asked to identify problem areas in various subwatersheds that exhibit one or more of the priority issues of concern identified by the committee at the January 13, 2004 meeting. Issues were ranked by priority as determined by committee members at the January committee meeting. A specific problem area could represent more than one priority issue, and these areas will be considered as sites the committee could visit during the spring watershed tour. Discussion results are as follows:

- **Sediment inputs and sedimentation**
  - Cameron Run mainstem along I-495
  - Stormwater settling within corrugated pipes located in Falls Church
  - Lake Barcroft dump sites

- **Impervious surfaces (paved land cover)**
  - Baileys Crossroads area, Eisenhower Avenue and Van Dorn Street in Alexandria
  - Cities of Falls Church, Alexandria, and Annandale
  - Seven Corners area, I-395, I-495, and mixing bowl

- **Biological and habitat degradation – examples of good areas**
  - Lake Barcroft area past Columbia Pike (Holmes Run subwatershed)
  - Winkler Pond (Holmes Run subwatershed)

- **Bank erosion and channel instability (with infrastructure impacts**)
  - Tripps Run in Poplar Heights area
  - Inside Mason District Park
  - Backlick Run in the Brookhill area

- **Toxic polluted runoff**
  - Edsall Road Industrial Park
  - Falls Church cement plant
  - Eisenhower trash cogenerator in Culmore
  - See impervious surface category above

- **High and flashy peak flows**
  - Backlick Run area

- **Riparian buffer loss**
  - Mason District Park

- **Bacteria and pathogens**
  - Dog parks on Eisenhower, Duke Street, and Cameron Station
  - Backlick Run area

- **Flooding**
  - Falls Church
  - Lower/upper Tripps Run
  - Backlick Road

- **Direct storm inflow**
  - Specific example not given, but members indicated that the city of Falls Church demonstrates all problem issues

- **Trash/dump sites near streams**
  - Culmore area
  - East Telegraph road
  - Lake Barcroft area

- **Channel alteration of streams**
  - Upper Tripps Run just before enter Falls Church

- **Low flow of streams**
  - See direct storm inflow above

- **Obstructions in streams**
  - Lake Barcroft area
  - Mainstem obstructions via several dams eastward to Holmes Run

- **Wetlands loss and degradation**
  - Wetlands are virtually non-existent in Cameron Run watershed
  - Could be loss of wetlands downstream of Alexandria in the Belle Haven watershed

One member mentioned that when the Lake Barcroft community annually dredges out accumulated sedimentation in the lake, the community does not have a designated disposal site for the dredged material. This is particularly problematic during extremely wet years because the lake must be dredged more frequently. This member is concerned about sedimentation from areas north of the Lake Barcroft community and the burden placed on community members to keep the lake healthy.

Another member addressed this concern by stating that the City of Alexandria gives dredged materials to the VDOT for use in their ongoing projects in the metro area.

Mr. Kumar of DPWES addressed the concern of the member above by stating that between forty (40%) and seventy (70%) percent of the sedimentation in a water body originates in the stream channels connected to it. Most sedimentation comes from the stream channels and not over the land surrounding the water body.

Another member suggested that the committee should look at an urban diversity study that Virginia Tech released in March 2003. This study was distributed to the Committee via email and will be incorporated in the summary materials on the condition of Cameron Run watershed to be distributed by the project team at the March meeting.

Another member mentioned that a condo complex in Appleton has a "green roof," and that this might be a good site for the group to visit during the watershed tour.

Meeting Adjournment

Dr. Southerland closed the meeting by asking committee members to continue to identify problem areas within the watershed that demonstrate the priority issues of concern identified by the committee., He also asked members to finalize their ideas on the content for the upcoming Public Issues Forum. Content for the Issues Forum will be discussed by the committee in the March and April meetings.

Information about Cameron Run and the Cameron Run Watershed Management Plan can be found on the Fairfax County watershed plans website at www.fairfaxcounty.gov/watersheds . Under pages specifically dedicated to the Cameron Run watershed plan, readers will be able to access other supporting documents, a meeting and events calendar, and meeting minutes for the Cameron Run Advisory Committee. The Cameron Run website also contains a message board that community members can use to share ideas and comment on plan drafts. Comments may also be sent to the watershed email address at cameronrun@versar.com, or by calling the watershed hotline at (703) 642-6902.

Cameron Run Watershed
Advisory Committee Meeting No. 5

Richard Byrd Branch Library, Springfield, Virginia
April 1, 2004

ADVISORY COMMITTEE MEMBERS IN ATTENDANCE:

Michael Aho – Providence District Board of Supervisors
Than Bawcombe **–** Fairfax County Stormwater Planning
Todd Benson **–** Fairfax County Park Authority
Glenda Booth – Fairfax County Wetlands Board
Diane Davidson **–** Lake Barcroft Association
Jonathan Daw **–** Citizen
Don Demetrius -- Fairfax County Department of Public Works and Environmental Services (DPWES)
Phyllis Evans – Huntington Community Association
Bob Jordan – Fairfax Trails and Streams/Potomac River Greenways Coalition
Kathy Joseph **–** Earth Sangha
Steven Lester – Poplar Heights Civic Association/Center for Health, Environment and Justice
Patrick Lucas **–** Tripps Run Resident/Fairfax County Police
Janice Martin – President, Poplar Heights Recreation Association
Jim McGlone – Department of Forestry
Liz McKeeby **–** Supervisor Gross/Mason District Office
Francoise B. Renard – Venice Street Homeowner
Russell Rosenberger – President of Madison Homes
Larry Sexton **–** President, Falls Hill Civic Association
Peter Silvia – Lake Barcroft Watershed Improvement District
Moe Wadda **–** City of Falls Church

PROJECT TEAM STAFF IN ATTENDANCE:

Dipmani Kumar **--** Fairfax County DPWES SWPD
Gayle England -- Fairfax County DPWES SWPD
Fred Rose – Fairfax County DPWES SWPD
Margaret Clark – Versar, Inc.
Jennifer Shore **–** Versar, Inc.
Mark Southerland **–** Versar, Inc.
Julie Tasillo -- Versar, Inc.
Amanda Peyton **–** Horne Engineering Services, Inc.

THE CAMERON RUN WATERSHED PLAN

The Cameron Run watershed has experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the creek and its watershed. The Cameron Run Advisory Committee advises the Cameron Run Watershed Plan project team. Versar, Inc., prepares watershed plan drafts and engineering studies. Versar, Inc., and Horne Engineering Services, Inc. serve as facilitators for the public meetings. For more information, contact cameronrun@versar.com or visit www.fairfaxcounty.gov/watersheds.

The opinions represented herein do not necessarily represent those of Fairfax County or its agents.

MEETING PURPOSE

Attendees of the advisory committee are individuals who represent diverse stakeholder groups that reside within the Cameron Run watershed community. The purpose of this meeting was to introduce the Committee to the Cameron Run Watershed Workbook, as a summary of work to date and a tool for new and continuing members to use for this project. In addition, the workbook was used to (1) identify and new or refined issues of concern in the watershed and (2) discuss possible solutions and how they would contribute to a vision for the watershed's future. The overall goal of the advisory committee is to help Fairfax County develop a watershed management plan for Cameron Run that incorporates community interests in the evaluation of problems and implementation of solutions for protecting and restoring the streams and other natural resources of the watershed.

KEY DECISIONS AND OUTCOMES

- The Cameron Run Advisory Committee added to and refined the list of issues of concern in the watershed.
- The Cameron Run Advisory Committee created a list of possible solutions to issues identified in the watershed workbook (see *Development of Vision for Cameron Run Watershed* below).
- The next meeting of the Cameron Run Advisory Committee will be held during the week of April 26, 2004 at 7:00 PM. The meeting location and agenda will be sent prior to the meeting.
- The advisory committee decided that conducting two public meetings by June 15 was too optimistic (especially holding the Public Scoping Meeting in early May). Therefore, the committee will decide on a public meeting schedule at the next (late April 2004) committee meeting.

ACTION ITEMS

- Project staff will update the advisory committee member contact list and distribute it to committee members via email and add it to the workbook.
- Project staff will research issues identified by committee members as concerns in the watershed, along with issues identified through other background research, and will present findings to the advisory committee.
- Project staff will contact committee members during the week of April 5, 2004 to confirm the date for the next committee meeting (week of April 26).
- Committee members will draft vision statements for the watershed for discussion at the April 2004 meeting.

MEETING DISCUSSION

Introduction, Agenda, and Overview of Ground Rules

Ms. Shore of Versar convened the advisory committee meeting by introducing the project team and advisory committee members. Following the introductory session, Ms. Shore and Dr. Southerland of Versar distributed a detailed agenda (similar time-structured agendas will be used at future committee meetings) and introduced Margaret Clark of Versar who will act as the advisory committee meeting facilitator at this and future meetings. The revised agenda included topics of discussion, timeframes, discussion leaders, preparation required by committee members, and projected outcomes of discussions. Ms. Shore and Dr. Southerland reintroduced the following ground rules that the advisory committee will operate under:

- One person represents each organization. If there are two people, one is designated as an alternate.
- Comments will be recorded but not attributed to particular individuals.
- The committee will operate through consensus. All views will be captured and recorded in the meeting minutes posted to the web.
- All meetings of the Cameron Run Watershed Advisory Committee are open to the public. The public may attend advisory committee meetings as 'observers' and public meetings as 'participants.'

Review the Roles of the Advisory Committee

Dr. Southerland reviewed the roles of the Advisory Committee for the benefit of those members who were attending their first advisory committee meeting. Committee roles are as follows:

- Advising the consultant team about community outreach including additions to the advisory committee, and groups and individuals to invite to public meetings and workshops.
- Helping to formulate agendas for public meetings to maximize relevance and applicability to the local watershed.
- Conducting outreach to their own constituency groups (e.g. neighborhood associations, civic and church groups, Chamber of Commerce).
- Advising the consultant team about key watershed issues on which to focus and additional sources of information.
- Providing suggestions on the topics and formats for public education materials and publicity.
- Reviewing and commenting on various initial and final drafts of the watershed management plan.

Discussion of the Draft Cameron Run Watershed Workbook

The Draft Cameron Run Watershed Workbook was sent to advisory committee members prior to this meeting. Dr. Southerland described the purpose of the workbook and gave a brief overview of its contents. The Cameron Run Watershed Workbook was created as a tool for the advisory committee to use during the watershed planning process. The workbook summarizes committee activities to date and includes an analysis of historical and County assessment data. Dr. Southerland encouraged committee members to use this workbook as a tool to help them dream, study, and plan for the future of the Cameron Run watershed. The Draft Cameron Run Watershed Workbook includes the following chapters:

- Chapter 1: Overview of the watershed
- Chapter 2: Our watershed plan – Introduction to watershed planning
- Chapter 3: Issues in the watershed – e.g. bank erosion and sedimentation
- Chapter 4: State of the watershed – Overall condition of the Cameron Run watershed and its subwatersheds
- Chapter 5: Vision for the watershed – Options to address issues and potential benefits to the watershed

- Glossary

During the discussion, one member suggested that the most recent committee member list and contact information be included in the workbook so that committee members can contact each other to discuss issues. This member also suggested that the committee member list be emailed to all committee members as well.

During the workbook discussion on Chapter 4, Dr. Southerland distributed a workbook insert with a GIS map depicting future imperviousness in the Cameron Run watershed based on the new Fairfax County calculations. The imperviousness numbers included on this insert supercede values included in the earlier Stream Protection Strategy report.

During the Chapter 5 discussion, one member stressed that the committee needs to develop a clear vision statement and map out overall goals for the watershed management plan so that everyone is in concurrence when the final product is distributed. A clear vision and goals will also indicate when the committee has completed its task.

Dr. Southerland briefly described how the watershed modeling component of this planning process will identify the flows and pollutant loadings occurring in small watersheds (ten or more within each of the eight subwatershed used for assessment) as a means of refining the identification and problems and solutions. One member was interested in finding out how the model will be calibrated and whether it will use field monitoring data. Mr. Kumar of DPWES addressed this member's concerns by explaining that the water quality component of the model uses established values for different County land use categories. When all is said and done, the model will correlate qualitatively with raw field data. There are six sites in Fairfax County used to determine water quality conditions in the model, two of the six are located within the Cameron Run watershed.

The workbook will be edited to address committee comments and will be posted on the County website.

Watershed Issues Identified in Draft Cameron Run Watershed Workbook

Margaret Clark of Versar introduced herself to the committee and explained how future advisory committee meetings would be held. Items discussed during a committee meeting that do not directly pertain to an agenda item will be noted and tracked in the 'parking lot' for discussion later during the meeting or at a future advisory committee meeting. In addition, all action items will be documented as they occur throughout the meeting. Ms. Clark proceeded to lead a group discussion concerning the watershed issues listed in Chapter 3 of the watershed workbook. Watershed issues were based on those identified by the advisory committee in earlier meetings.

10 Primary Issues	16 Component Issues Identified by Advisory Committee
Bank Erosion and Sedimentation	• Bank erosion including infrastructure impacts and channel instability • Sediment loading to watershed and accumulation in streams
Paved Surfaces	• Impervious surfaces and increased runoff
Loss of Stream Habitat and Stream Life	• Loss or degradation of habitats and biological communities
Irregular Stream Flows	• Higher peak flows • Lower low flows • Direct inflow from stormwater systems into streams

Loss of Riparian Buffer and Wetlands	• Loss or degradation of riparian buffers along streams and shorelines • Loss of wetlands in watershed
Pollution	• Discharge or runoff of toxic pollution into streams and lakes • Nutrients loading into watershed
Bacteria	• Bacteria and pathogens in streams and lakes
Flooding	• Flooding of property
Stream Channel Alteration	• Channel alteration of streams • Obstruction to flow and fish passage in streams
Trash	• Dumping and accumulation of trash in streams and lakes

Ms. Clark asked committee members to review the table above and identify issues of concern not captured in this list. Issues identified by committee members and the discussion of these issues were as follows:

- Development of new homes and commercial property. Tearing down smaller homes and building larger homes ("McMansion" analogy) or commercial property thus increasing imperviousness throughout the watershed.
- Flooding is an issue for all who reside in the watershed community, not just for those who reside in the floodplain. Responsibility for controlling flooding should be shared equally among watershed community residents. Several members felt that flooding should be ranked higher on the issue list.
- Include lawns as a contributor to flooding. Lawns are also relatively impervious and constitute a high percentage of non-pervious (80-95%) surfaces on residential properties. Forested yards absorb more rainwater and help reduce flooding.
- Control of Invasive (non-native) species. .
- Loss of terrestrial and aquatic species.
- Loss of tree cover resulting in an increase in imperviousness
- Impact of stormdrains as incubator for bacteria and as a habitat for rats, raccoons, feral cats and other animals that defecate in the stormdrains and pollute streams.
- Some of the issues listed above are causes and others are effects (e.g., bank erosion is a result of flashing flows caused by impervious surfaces). Members suggested identifying which issues are causes and which are effects and maybe separating the two categories in the final product.
- Improving quality of life by increasing recreational opportunities in the watershed. This can also be seen as a goal for the watershed management plan.
- Creating opportunities for retrofits on older communities that do not have latest stormwater management technology.
- Underutilization of stream valleys.

- Making monies available to finance development and implementation of watershed issue solutions.
- Educate those who reside upstream in the watershed about the effects that their actions have on the watershed and the impact on those who reside downstream in the watershed. Increase the involvement of the public in watershed management.
- Increase tree cover with species that are native to the watershed.
- Thermal impacts.
- Inherent conflict between improving water quality (e.g., increasing riparian buffers would slow runoff) and reducing flooding (e.g., riparian buffers could increase the width of the floodplain).
- Enforcement of current stormwater management policies (e.g., violations within Resource Protection Areas (RPAs)).

One member said that including the loss of tree and shrub cover throughout the watershed is important because it influences all the other issues with the exception of paved surfaces and possibly trash.

Members suggested changing the *Paved Surfaces* issue category to *Impervious Surfaces* with subsets of paved surfaces and infill.

Members ultimately decided that assigning priorities to the list of watershed is not as important as identifying solutions to these issues, and assigning priorities to these solutions.

Development of Vision for Cameron Run Watershed

Ms. Clark led a committee brainstorming session on developing a vision for the Cameron Run watershed. Committee members were asked to give their ideas of what they would like the Cameron Run watershed to look like after the management plan is implemented. Ms. Clark also asked committee members to discuss specific solutions to achieve their "vision."

Committee members discussed the differences between a vision for the watershed and more specific goals or objectives needed to achieve this vision. Members concluded that a discussion of goals and solutions to watershed problems would be more useful. Goals identified by the committee members included the following:

- Decrease flooding in the watershed, especially in homes.
- Reduce sediment loads to natural levels.
- Make the watershed swimmable and fishable by decreasing bacteria levels.
- Reduce the number of homes in the floodplain.
- Ensure that water quality downstream is comparable to water quality upstream.
- Provide Countywide street sweeping.
- Reduce silt from upstream areas of the watershed.
- Maximize green cover not only around streams but throughout the watershed.
- Ensure that watershed management is a priority with both policy makers and residents.
- Promote a healthy ecosystem through sound watershed management.

- Ensure solutions are equitable and that all watershed community members are held accountable for management implementation.
- Decrease impervious surfaces on both commercial and private property (e.g., by implementing Low Impact Development techniques to reduce stormwater runoff).

Based on the goals identified above, committee members have been asked to draft vision statements for discussion at the next committee meeting.

To meet the goals above, committee members identified the following solutions:

- Plant native vegetation around streams (not restricted to riparian buffer) and stop cutting down trees.
- Ensure there is enough County and city staff available to implement final watershed plan.
- Ensure that provisions in the management plan are implemented and enforced.
- Increase recycling awareness programs to encourage less littering in the watershed.
- Make responsible behaviors (e.g., recycling) easier for community members (i.e., eliminate counterproductive regulation).
- Update County building codes to include pervious driveways both for new development and replacement projects.
- Allow for hazardous waste material recycling through satellite collection areas.
- Limit development until impacts to the watershed are assessed (i.e., through a mini-NEPA assessment).
- Encourage public involvement and input for all publicly funded projects. All affected parties should be notified in writing prior to and well before extensive and/or expensive studies are conducted. Notification should be given to the entire community, not only to those property owners in the adjacent area.
- Provide equitable solutions that hold the watershed community equally accountable.
- Transparency of the true intent of publicly funded projects (i.e., community projects funded to address local issues, but that really address long-term future County or state development projects). Ensure that public can track project progress.
- Encourage Low Impact Development in management plan.
- Reduce geese population in the watershed community.
- Promote “friends of …groups” in the watershed.
- Address watershed issues as close to problem source as possible – encourage local solutions.
- Reduce pesticides through Integrated Pest Management practices.
- Encourage inter-jurisdictional coordination between watershed communities.
- Strengthen County policies and update land use, zoning, road development, waste disposal, stormwater, and building code policies as well as the County Master Plan.
- Coordinate with the State for regulating utilities in the watershed.

Mr. Kumar informed committee members that the public can track the progress of publicly funded projects through the LDS net tracking system. This system will allow community members to track projects in real time.

One member stated that in certain communities, developers do not have to notify adjacent residents of when a house will be demolished or the impact the demolition will have on them. When obtaining a wetland permit, developers have to notify the public 90 days in advance of any activities that could affect the wetland. This same policy should apply to demolition projects.

Another member addressed this concern by suggesting that the County use the Mount Vernon District Committee as a model for public notification by the County. The Mount Vernon District Committee informs community residents of projects before they are implemented. The committee acts as an education forum for community residents and as a catalyst for public involvement.

Schedule for Advisory Committee Activities

Ms. Shore presented the proposed schedule for future committee activities and encouraged committee feedback. The suggested committee schedule was as follows:

- Next advisory committee meeting: April 26 – 29 (date to be selected)
- Public Issues Scoping Forum: Either May 4 – 6 or May 11 – 13 (6 to 9 in the evening)
- May advisory committee meeting: May 26 – 27
- Public Community Watershed Forum: Saturday June 5 or 12 (full day)

Ms. Shore will send an email to all committee members to finalize meeting dates. Draft informational flyers publicizing the Public Issues Forum will be presented to committee members at the April meeting for approval and distribution.

Committee members were concerned that the timeframe for the public meetings was too short. Committee members were against the idea of having the Public Issues Scoping Forum in early May because they did not feel that they are ready to go to the public, nor did they feel that there is enough time to publicize the meeting. They argued that the earliest time the Public Issues Scoping Forum should be held is either the end of May or early June. Members reasoned that it is premature to conduct a public meeting before the committee has developed a clear vision statement, and concrete ideas about plan development and implementation. Members were also concerned because neither an advertising scheme nor an agenda have been developed in preparation for this first public meeting. In addition, members suggested that more than one Public Issues Scoping Forum meeting be held to increase the likelihood of a good turnout. They felt that a single meeting would not draw attendance from the other half of the watershed. Separate meetings in the northern and southern areas of the watershed, for example, would result in better public attendance. Committee members voiced concern about advertising the public meetings as the Cameron Run Watershed, as many citizens associate with other waterbodies located in the watershed (e.g., Holmes Run, Lake Barcroft).

Committee members agreed with project staff that conducting the Public Community Watershed Forum during the summer is unrealistic because it would be poorly attended. The committee members felt the process would not lose momentum by holding this meeting sometime during the fall.

A committee member also inquired about the watershed tour that was discussed at earlier committee meetings. This member also requested briefings on Low Impact Development and Best Management Practice techniques.

Meeting Adjournment

Dr. Southerland, Ms. Shore, and Ms. Clark closed the meeting by identifying agenda items for the April advisory committee meeting. Agenda items include setting a schedule to prepare for the Public Issues Scoping Forum and discussing a vision for the Cameron Run Watershed Management Plan. Project staff also asked committee members to draft vision statements for discussion at the April 2004 committee meeting. Content for the Public Issues Scoping Forum will be discussed in the committee meetings prior to the public meeting.

Information about Cameron Run and the Cameron Run Watershed Management Plan can be found on the Fairfax County watershed plans website at www.fairfaxcounty.gov/watersheds. Under pages specifically dedicated to the Cameron Run watershed plan, readers will be able to access other supporting documents. A meeting and events calendar and meeting minutes for the Cameron Run Advisory Committee are also located on the County website. The Cameron Run website contains a message board that community members can use to share ideas and also comment on plan drafts. Comments may be sent to the watershed email address at cameronrun@versar.com, or by calling the watershed hotline at (703) 642-6902 or toll free at (886) 341-4599.

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Cameron Run Watershed
Advisory Committee Meeting No. 6

Mason District Governmental Center, Annandale, Virginia
April 28, 2004

ADVISORY COMMITTEE MEMBERS IN ATTENDANCE:

Michael Aho – Providence District Board of Supervisors
Glenda Booth – Fairfax County Wetlands Board
Nick Byrne – Sleepy Hollow Homeowners Association (HOA)
Florence Cavazos – Tripps Run Resident
***Diane Davidson* –** Lake Barcroft Association
Richard Hartman – Berkshire HOA/Huntington Community Association
Sally Henley – Tripps Run Resident
Bob Jordan – Fairfax Trails and Streams/Potomac River Greenways Coalition
Ken Kopka – Lake Barcroft Watershed Improvement District
Patrick Lucas – Tripps Run Resident/Fairfax County Police
George Madill – Bren Mar Civic Association
***Jim McGlone* –** Department of Forestry
Liz McKeeby – Supervisor Gross/Mason District Office
Donald Peterson – Co-Chairman, Bren Mar Park-Lincolnia Park
Aaron Rodehorst – Citizen
F. Wyatt Shields – Assistant City Manager City of Falls Church
***Tom Wasaff* –** City of Alexandria

PROJECT TEAM STAFF IN ATTENDANCE:

***Dipmani Kumar* --** Fairfax County Department of Public Works and Environmental Services (DPWES)
Gayle England -- Fairfax County DPWES SWPD
***Margaret Clark* –** Versar, Inc.
Jennifer Shore – Versar, Inc.
Mark Southerland – Versar, Inc.
***Amanda Peyton* –** Horne Engineering Services, Inc.

THE CAMERON RUN WATERSHED PLAN

The Cameron Run watershed has experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the creek and its watershed. The Cameron Run Advisory Committee advises the Cameron Run Watershed Plan project team. Versar, Inc., prepares watershed plan drafts and engineering studies. Versar, Inc., and Horne Engineering Services, Inc. serve as facilitators for the public meetings. For more information, contact cameronrun@versar.com or visit www.fairfaxcounty.gov/watersheds.

The opinions represented herein do not necessarily represent those of Fairfax County or its agents.

MEETING PURPOSE

Attendees of the advisory committee are individuals who represent diverse stakeholder groups that reside within the Cameron Run watershed community. The purpose of this meeting was to begin coordinating the content, logistics, and public outreach strategy for the June Public Issues Scoping Forum. The overall goal of the advisory committee is to help Fairfax County develop a watershed management plan for Cameron Run that incorporates community interests in the evaluation of problems and implementation of solutions for protecting and restoring the streams and other natural resources of the watershed.

KEY DECISIONS AND OUTCOMES

- The next meeting of the Cameron Run Advisory Committee will be held on May 26, 2004 at 7:00 PM at the George Mason Regional Library (7001 Little River Turnpike, Annandale, VA 22003-5975).
- The Public Issues Scoping Forum will be held at the Mason District Governmental Center at 7:00 PM on June 17, 2004. The final agenda will be developed during the May meeting of the advisory committee.
- The advisory committee decided that it would be beneficial to meet over the summer months to plan for the September Community Issues Forum and conduct a watershed tour.

ACTION ITEMS

- Project staff will poll committee members to determine the next meeting date, proposed dates are May 24 - 27.
- Project staff will ensure that the Mason District Governmental Center is available for use on the evening of June 17, 2004 by the committee for the Public Issues Scoping Forum meeting.
- Project staff will develop a promotional flyer based on input from the committee and send to Fairfax County for review by May 5.
- Project staff will draft a public service announcement for local newspapers and submit to Fairfax County for approval.
- Project staff will send both 20 hard copies and an electronic copy of approved flyer and newspaper announcement text to committee members. These documents will also be placed on the Cameron Run Watershed web-page.
- Committee members will inform project staff if they need additional flyers for distribution within their communities.
- Project staff will produce the flyers requested by committee members in a timely manner.
- Project staff will develop a draft presentation to be presented at the Public Issues Scoping Forum for review by committee members during the May meeting.
- Project staff will propose dates for summer committee meetings and the watershed tour and then poll committee members for final dates.
- Project staff will contact committee members for a list of additional civic associations within the Cameron Run Watershed not represented on the proposed media strategy.

- Committee members are encouraged to contact civic associations they are associated with via phone to help publicize the June 17 Public Issues Scoping Forum.
- Project staff will place a complete list of home owner's associations and civic associations in the Cameron Run Watershed on the watershed web page.

MEETING DISCUSSION

Introductions and Overview

Ms. Shore of Versar convened the advisory committee meeting by introducing the project team and advisory committee members. Following the introductory session, Ms. Shore and Dr. Southerland of Versar, briefly reviewed the agenda, committee roles and ground rules. Dr. Southerland stressed that the focus of this meeting was to discuss how best to utilize resources to maximize public involvement in the watershed planning process. The committee will designate voting members for each stakeholder group represented at committee meetings during the May committee meeting. Dr. Southerland stressed that once the advisory committee structure is finalized

- Only the designated voting member can vote for that particular stakeholder group
- In the event the voting member is not present an alternate member may vote
- Anyone can attend and participate in advisory committee meetings
- Committee members and project staff will solicit input from the community for watershed planning purposes

Dr. Southerland reviewed the purpose, structure and content of the watershed workbook that was distributed to committee members prior to and discussed at the April 1, 2004 meeting. To reiterate, the watershed workbook is a tool to be used by committee members to plan the future of the Cameron Run Watershed through the watershed planning process. Project staff revised material contained within the workbook based on committee comments at the April 1, 2004 meeting, and added additional materials for the benefit of committee members. Dr. Southerland stressed the benefits of including a sources of assistance and Best Management Practices (BMPs) section in the workbook. The watershed workbook contains the following revisions and updates:

- Revised Table of Contents
- Chapter 1: Overview of the Watershed
    - Revised content in Chapter 1
    - Insert: Summary of Existing Reports and Data Sources (sources of assistance)
- Chapter 2: Our Watershed Plan
- Chapter 3: Issues in the Watershed
    - Revised content in Chapter 3
    - Insert: Preliminary Problem Areas in Watershed
- Chapter 4: State of the Watershed
    - Insert: Projected Future Imperviousness in Cameron Run Watershed
- Chapter 5: Vision of the Watershed
    - Insert: Data Sources on Options for Addressing Urban Watershed Problems (BMPs)

- Glossary

Discussion on Public Involvement and Public Meeting Schedule

Ms. Clark of Versar and Dr. Southerland led a committee discussion pertaining to the upcoming Public Issues Scoping Forum that will be held in June. The Public Issues Scoping Forum is an evening meeting with the purpose of introducing the public to the watershed planning process and to gather input from the public on specific issues facing the watershed community as they pertain to watershed management. Specifically, the meeting is used to explain to the public why a watershed management plan is being developed for the Cameron Run Watershed community, why public involvement is important to the planning process, what the end product will be, and to encourage public participants to discuss issues within the watershed. During this meeting it is the goal of Fairfax County and project staff to gather any additional watershed issues from the public not addressed by the advisory committee and to validate the watershed planning process by involving the public early in the watershed management plan development process. Public input is desired prior to development of the draft watershed management plan. It is important to have this first public meeting because it demonstrates to the public that

- A committee exists which represents community interests
- This committee is actively involved in the planning process
- Fairfax County and project staff are coordinating with the community to develop an implementable plan for the Cameron Run Watershed.

Demonstrating community involvement in the planning process will generate interest in plan development and members of the community will be more likely to attend public meetings. The goal of the public process is to educate the community about watershed issues and provide solutions to correct those issues.

Committee members had a variety of questions and comments concerning the content and purpose of the Public Issues Scoping Forum, as well as ideas on how to conduct the public meetings. Some felt it is important to watershed management plan development for members of the watershed community to attend all four public meetings. The following is a summary of the discussion between Fairfax County, project staff, and committee members concerning coordination of the Public Issues Scoping Forum and the remaining three public meetings (the Community Issues Forum, presentation of the draft watershed management plan, and presentation of the final watershed management plan). The discussion can be grouped into the following three topic areas of discussion:

- Conduct all public meetings in a centralized location
- Conduct multiple public meetings on the same topic in distinct geographical regions of the watershed community
- Conduct the Public Issues Scoping Forum at multiple locations and the other public meetings at a central location
- Not conduct the Public Issues Scoping forum

The arguments for conducting all public meetings at one central location focused on cataloguing public input and the ease of molding input into one plan. By having meetings in two geographical areas, there is the potential for groups to create two distinct watershed management plans. The groups would not interact with each other and the plan would reflect this lack of coordination and discussion. By having multiple meetings, the plan may go in various directions thus de-emphasizing the value of the public process. The goal of the public meetings is to capture public input for plan development, not create regional watershed management plans. The pros of having all public meetings in a central location is to decrease the cost to the county for conducting meetings and to encourage repeat participation by the public by having all meetings at the same location. The cons include a potential decrease in the level of public participation due to the large size of the Cameron Run Watershed. Members of one portion of the community may feel disconnected with those in another portion. To address this issue, some committee members suggested that the first half of the Public Issues Scoping Forum focus on issues in the different geographic regions of the watershed and that the second half of the meeting pull these geographic issues together and map out the overarching issues facing the watershed.

Arguments for conducting public meetings at multiple locations throughout the watershed focused on increasing public participation at public meetings by bringing meetings closer to the residents. For example, the issues facing residents in the Tripps Run portion of the watershed may differ from the issues facing residents who live near the Wilson Bridge region of the watershed. Areas of concern may differ due to geographic region. This group also warns that having one meeting in a central location might discourage public participation because of the potential, or fear, of attending a meeting with a very large, unmanageable group of people all trying to share their concerns in a short allocated amount of time. The watershed management plan should address issues from each region and stakeholder group within the watershed community. Therefore, public meetings would ideally include representatives from each region and stakeholder group within the watershed. The pros of having public meetings in multiple locations within the watershed are the potential for repeat participation by community members. Cons include an increase in the cost to the county and the potential for meeting participants to not interact with one another, thus causing the management plan to have multiple voices and focuses as opposed to a common focus and voice. This group suggests have meetings in the northern and southern regions of the watershed and by the Cameron Run tributary.

The third group agreed with the second group's arguments for conducting the Public Issues Scoping Forum at multiple locations within the watershed to encourage participation and spark community interest, but suggested conducting the other three public meetings at a central location to mold the management plan together. The pros of this option are that public participation will be encouraged at the Public Issues Scoping Forum and community members may have enough of an interest to attend the other public meetings. The con would be the increased cost to the county for conducting multiple Public Issues Scoping Forum meetings.

The last group of members questioned whether or not it is necessary for management plan development to conduct a Public Issues Scoping Forum. This group was concerned about the timeframe between the April meeting and the June Public Issues Scoping Forum meeting and whether committee members and project staff have enough time to publicize the meeting to the community. Dr. Southerland and Mr. Kumar of DPWES addressed this group's concerns by stating that the county developed a process for conducing public outreach which included four public meetings to discuss watershed issues and present the draft and final management plans. The county also encourages conducting the Public Issues Scoping Forum before the start of the summer season so that project staff can continue to move forward with the management plan development process.

Once all arguments were presented for the four groups discussed above, Ms. Clark initiated a vote to determine how public meetings will be conducted in the Cameron Run Watershed. Members voted to conduct all public meetings at a central location. Members further decided that the Public Issues Scoping Forum will be conducted on June 17, 2004 and the second public meeting, the Community Issues Forum, will be conducted in September. This will give community members enough time to become interested in the process, but not enough time to forget about the planning process. The committee decided that a good way to curtail forgetfulness in the planning process is to advertise the Community Issues Forum throughout the period between the Public Issues Scoping Forum and the Community Issues Forum using various media.

Public Outreach and Encouraging Public Involvement

Ms. Peyton of Horne Engineering initiated a discussion on public outreach and presented a draft media strategy for committee discussion. The media strategy included sending articles to local newspapers, to civic associations and homeowners associations for placement in their respective newsletters, and to non-profit organizations to be placed in newsletters and web pages. The strategy also suggests drafting public services announcements for local radio stations and cable channels, crafting flyers and brochures for distribution in local community centers and businesses. This strategy also encourages committee members to not segregate members of different ethnic groups, but rather to ensure that all messages can be easily translated and distributed to members of these communities. The proposed draft media strategy included a list of newspapers, home owner's associations and civic association groups to target. Ms. Peyton stressed that this was not an exhaustive list, but rather a starting point for groups to target and will be updated based on committee input.

Committee members suggested adding City of Alexandria and Mount Vernon newspapers to the list of papers to target. Upon further investigation, project staff discovered that the Mount Vernon area is out of the Cameron Run Watershed area and thus will not be targeted for public involvement. Another member suggested contacting the local farmer's market as another means for advertising public meetings.

One committee member emphasized that, on average, only four to six percent of targeted audience will come to a public meeting, regardless of the advertising strategy. Another member suggested adding local churches to the media strategy target list. This member also voiced a concern that articles submitted to local newspapers might reach readers outside of the watershed area. This member suggested relying more on flyer and brochure distribution as opposed to newspapers.

Another member suggested developing an advertising approach that focuses on issues that affect community members such as flooding. The flyers and brochures could have a catch phrases such as "do you have drainage problems?" The catch phrase should be tied to an issue that immediately impacts the community resident.

Committee members were concerned about the lead time for advertising to the public prior to the Public Issues Scoping Forum. Some civic and home owner's association newsletters are not distributed on a monthly basis, but rather on an every other month schedule. The lead time for advertising is six weeks and this may not be enough time to advertise the first public meeting. Dr. Southerland addressed this issue by committing project staff to developing and distributing flyers and newsletter advertisements to committee members via email within one week of this meeting. There will not be enough lead time to send material to every source listed in the strategy, but those sources will be targeted during summer months to advertise for the September Community Issues Forum. The flyer will include a map of the watershed area to give meeting attendees a reference point for discussion. It was also suggested that flyers be produced in a bright background color so that they catch the attention of the targeted audience.

Project staff will also draft an advertisement for distribution in local homeowners and civic associations.

One committee member suggested advisory committee members sit in on their local civic association meetings to discuss watershed management plan development for the Cameron Run Watershed community. This member suggested that the best way to speak at these meetings would be to come prepared with a presentation about the watershed planning process.

Advisory committee members are champions for advertising public meetings to the community. Outreach is not wholly dependent on community members for success, but members are encouraged to spread the word to their stakeholder groups. Committee members are also community members and thus will know how to communicate the watershed area and the issues facing the watershed in ways the Cameron Run Watershed community will understand. Community members may not realize they are part of the Cameron Run Watershed, but they will relate to issues that affect the tributary near to them (Tripps

Run, Holmes Run, etc.). It was noted that it would be more effective for committee members to call their local homeowner's and civic associations as opposed to sending an email to ensure contact. One member will provide a list of civic associations to project staff and committee members.

Advisory committee members are encouraged to attend the Public Issues Scoping Forum to show their support, but it is not essential that committee members be present. Dr. Southerland recommended that one or more committee members give a brief statement to the public on why they are interested in developing the plan. This will "bring home" the project by highlighting personal motivations. A few members of the committee volunteered to be present at the Public Issues Scoping Forum to perform this function. It will be essential for a number of committee members to be present at the September Community Issues Forum.

To prepare for the Public Issues Scoping Forum, project staff will develop a draft presentation to be presented at the public meeting. This presentation will include the purpose of public meetings and public involvement, the laws and regulations that are either being violated or could be violated, Chesapeake Bay initiatives, and some of the issues of concern within the watershed. The presentation will also highlight monitoring activities that will be conducted by project staff during the summer months. Committee members suggested using language from the watershed workbook for the presentation. This presentation will be presented at the May advisory committee meeting for committee review. Members also suggested distributing handouts of the presentation at the Public Issues Scoping Forum meeting so that meeting attendees can easily follow along with presentation content.

Watershed Vision

Dr. Southerland briefly reviewed primary goals identified by the committee when discussing a watershed vision at the April 1, 2004 meeting. The goals could be grouped into the following five groups:

- Increase natural cover
- Decrease imperviousness
- Decrease flooding
- Decrease sedimentation
- Achieve a fishable and swimmable watershed

Committee members noted that if natural cover is increased and imperviousness decreased, the other three goals can be achieved.

Members who crafted vision statements that could not be discussed at this meeting because of time constraints, should forward their statements to project staff for discussion via email or at the May committee meeting.

Schedule for Advisory Committee Activities

Ms. Shore reviewed the schedule for upcoming committee meetings as decided by the committee at this meeting. The upcoming schedule is as follows:

- Next advisory committee meeting: Sometime during the week of May 24, 2004 (now set for May 26). This meeting will focus on preparing for the June 17, 2004 Public Issues Scoping Forum
- Public Issues Forum: June 17, 2004 at the Mason District Governmental Center from 7:00 PM to 9:00 PM or longer.
- The advisory committee will convene at least once over the summer months and the watershed tour will be conducted during this time

- Community Watershed Forum: Tentatively scheduled for September 2004

Meeting Adjournment

Dr. Southerland, Ms. Shore, and Ms. Clark closed the meeting by identifying agenda items for the May advisory committee meeting. Agenda items include revising and approving the public meeting presentation, setting dates for the remainder of the public meetings, and developing a vision statement for the Cameron Run Watershed (if time permits).

Information about Cameron Run and the Cameron Run Watershed Management Plan can be found on the Fairfax County watershed plans website at www.fairfaxcounty.gov/watersheds. Under pages specifically dedicated to the Cameron Run watershed plan, readers will be able to access other supporting documents. A meeting and events calendar and meeting minutes for the Cameron Run Advisory Committee are also located on the county website. The Cameron Run website contains a message board that community members can use to share ideas and also comment on plan drafts. Comments may be sent to the watershed email address at cameronrun@versar.com, or by calling the watershed hotline toll free at (886) 341-4599.

Cameron Run Watershed
Advisory Committee Meeting No. 7

George Mason Regional Library, Annandale, Virginia
May 26, 2004

ADVISORY COMMITTEE MEMBERS IN ATTENDANCE:

***Michael Aho* –** Providence District Board of Supervisors
Stacey Sloan Blersch – USACE Baltimore District, Planning Division
Nick Byrne – Sleepy Hollow Homeowners Association (HOA)
***Diane Davidson* –** Lake Barcroft Association
Jonathan Daw – Poplar Heights Civic Association
Don Demetrius – Fairfax County DPW
Dave Eckert – Falls Church Stream Stewards
***Richard Hartman* –** Berkshire HOA/Huntington Community Association
Sally Henley – Tripps Run Resident
***Bob Jordan* –** Fairfax Trails and Streams/Potomac River Greenways Coalition
Patrick Lucas – Tripps Run Resident/Fairfax County Police
***Liz McKeeby* –** Supervisor Gross/Mason District Office
Heather Melchior – Fairfax County Park Authority
James Mottley – Falls Church Resident
Donald Peterson – Co-Chairman, Bren Mar Park-Lincolnia Park
Aaron Rodehorst – Citizen
Russell Rosenberger – President of Madison Homes
***Peter Silvia* –** Lake Barcroft Watershed Improvement District

PROJECT TEAM STAFF IN ATTENDANCE:

Dipmani Kumar -- Fairfax County Department of Public Works and Environmental Services (DPWES)
Gayle England -- Fairfax County DPWES
Fred Rose – Fairfax County DPWES
Clem Rastatter – Versar, Inc.
Jennifer Shore – Versar, Inc.
Mark Southerland – Versar, Inc.
***Amanda Peyton* –** Horne Engineering Services, Inc.
***Mark Mobius* –** Horne Engineering Services, Inc.

THE CAMERON RUN WATERSHED PLAN

The Cameron Run watershed has experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the creek and its watershed. The Cameron Run Advisory Committee advises the Cameron Run Watershed Plan project team. Versar, Inc., prepares watershed plan drafts and engineering studies. Versar, Inc., and Horne Engineering Services, Inc. serve as facilitators for the public meetings. For more information, contact cameronrun@versar.com or visit www.fairfaxcounty.gov/watersheds.

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MEETING PURPOSE

Attendees of the advisory committee are individuals who represent diverse stakeholder groups that reside within the Cameron Run watershed community. The purpose of this meeting was to prepare for the upcoming June Public Issues Scoping Forum. The overall goal of the advisory committee is to help Fairfax County develop a watershed management plan for Cameron Run that incorporates community interests in the evaluation of problems and implementation of solutions for protecting and restoring the streams and other natural resources of the watershed.

KEY DECISIONS AND OUTCOMES

- The Public Issues Scoping Forum will focus on obtaining input from attendees and avoid including too much technical and planning detail.
- The Cameron Run watershed tour will be held on July 24, 2004. A meeting location and time will be sent prior to the tour.
- Next advisory committee meeting will be held during the week of August 23, 2004. A meeting date, location and agenda will be sent prior to the meeting.
- The next public meeting, the Community Watershed Forum, will be held September 18, 2004. The agenda for this meeting will be discussed during the August advisory committee meeting.
- The third public meeting, the Draft Plan Review, is tentatively scheduled for January 12, 2005. An agenda for this meeting will be discussed during the fall.
- The fourth public meeting, the Final Plan Review, is tentatively scheduled for April 20, 2005. An agenda for this meeting will be discussed after the Draft Plan Review.

ACTION ITEMS

- Project staff will revise the draft presentation to focus on gathering public input on issues/problems faced by those in the watershed community and will describe how public input will steer management plan development (see *Public Meeting Presentation Discussion* below).
- Project staff will develop supplemental materials (e.g., handouts, power point slides) for distribution at the Public Issues Scoping Forum for those public attendees who might want more information.
- Project staff will send out a list via email to committee members of things that need to be done prior to the meeting.
- Project staff will contact those committee members who volunteered to contribute at the public meeting to verify that they are still willing and available.
- Project staff will provide meeting facilitators recognized facilitation methods and ground rules.
- Committee members will notify project staff if they are available to attend and/or help prepare for the public meeting.
- Committee members are encouraged to contact civic associations they are associated with via phone to help publicize the Public Issues Scoping Forum.

MEETING DISCUSSION

Introductions and Overview

Ms. Shore of Versar convened the advisory committee meeting by initiating an introductory session between project staff and advisory committee members. Ms. Shore also introduced Clem Rastatter as the new advisory committee meeting facilitator. Following the introductory session, Ms. Shore and Dr. Southerland of Versar briefly reviewed the agenda, as well as advisory committee roles and ground rules. Dr. Southerland stressed that the focus of this meeting was to prepare for the June 17 Public Issues Scoping Forum.

Public Meeting Presentation Discussion

Dr. Southerland briefly gave committee members an overview of the draft presentation that would be given during the first 45-minutes of the Public Issues Scoping Forum. The presentation would discuss watershed management planning goals, an overview of the watershed management planning process, and educate the public on some of the issues/problems facing the Cameron Run watershed community and overall watershed water quality. Dr. Southerland explained that through the presentation the public would gain an understanding of the watershed planning process. Specific presentation topics would include

- Fairfax County Watershed Planning
- Watershed Basics
- A "Virtual Tour" of the Cameron Run Watershed
- Steps in Developing a Watershed Management Plan
- Community Issues of Concern

At the conclusion of his overview, Dr. Southerland initiated a discussion to obtain committee member feedback on the presentation. While there were many thoughts and comments on the presentation, the following four main issues kept surfacing during this committee discussion:

- Purpose of Public Issues Scoping Forum
- Meeting Presentation Content
- Keeping Focus of Meeting on Public
- Public Meeting Structure

Purpose of Public Issues Scoping Forum

Committee members were concerned with clarifying not only the purpose of the public meetings in the watershed management planning process, but also the purpose of the Public Issues Scoping Forum. Project staff addressed committee member concerns by stating that the purpose of the public meetings is to educate the public on the state of the Cameron Run watershed, inform them of the issues and problems facing the watershed, and then to ask the public for input. Careful evaluation of public concern is key to developing an implementable plan. To obtain public buy-in it is imperative that the public understands that they are a vital part of the planning process.

Project staff also stressed that planning is an on-going process and the public should be aware of the role that the advisory committee plays in representing their interests in the process of management plan development. The issues identified by the advisory committee are good starting points for the public discussion of problems that concern the public in their subwatershed communities. While the Public

Issues Scoping Forum is the first step in the planning process, it should be realized that it is only one piece in a larger process. The public should know up-front what their role is in the planning process as well as the role of the advisory committee representing them. The focus of this first public meeting should be on letting the public know what their role is in the planning process and what the benefits and costs will be of developing and eventually implementing the plan.

Meeting Presentation Content

Since the Public Issues Scoping Forum will be a shorter meeting (two hours compared to the half day proposed for the Community Watershed Forum), committee members felt that the information presented at this meeting should be concise and only touch on a few points. For greater detail, the public should be directed to the project website where they can find more information. Project staff agreed with this suggestion and carried the recommendation a step further by suggesting that more detailed information be on hand in the event an attendee wants more information. Since not all community residents have access to the internet, this information can be in the form of handouts or fact sheets, overhead transparencies, or power point slides that include the project hot-line number in addition to the project website. Copies of the watershed workbook that was developed for advisory committee members will also be brought to the public meeting.

Committee members suggested that the draft presentation be revised because the current presentation is too long and far too technical for the purposes of this meeting. The focus of the presentation should be geared towards gathering public input on issues and describing how their input will steer management plan development. Committee members advise project staff to determine what three ideas they want the public to walk away with at the conclusion of this meeting. They suggest that three of these ideas be to obtain an understanding of where the Cameron Run Watershed is, who is included in the watershed community, a brief status of the state of the watershed, and a brief overview of the planning process. Technical detail should be limited because it can be overwhelming to meeting attendees. Committee members strongly encourage project staff to shorten the draft presentation because it is too technical and could give the impression that the public meeting is being held to tell the public about the status of the planning process rather than involving the public in the planning process. Another reason the presentation should rely less on presenting technical detail is because these details will be presented at the September Community Watershed Forum (the first half of this forum will be spent on presenting technical information to the public). The presentation portion of the Public Scoping meeting should be as short as possible, maybe only 15 minutes in length, and focus on the purpose of the public meetings. Otherwise, project staff may run the risk of intimidating the audience and thus receive no feedback from them. Also, if the presentation includes too much detail at this early stage in the public process, then there is a risk of shifting the focus of this meeting from an issues gathering and discussion meeting, to that of identifying solutions to issues already identified by project staff and committee members. Project staff agreed with committee members on these points, but stressed the importance of at least introducing the watershed modeling component of this project since most of the project funding is directed at modeling.

Committee members stressed the importance of grabbing the attention of public meeting attendees up front and capturing their interest in the watershed management planning process. It is very important to encourage public meeting attendees to talk about the issues and problems they are facing in their communities and the presentation should be tailored to encourage this dialogue. Committee members warned that subject experts sometimes tend to talk down to their audience when presenting ideas or data. To avoid alienating the audience, the material presented at this public meeting should be brief and concise and should be used to encourage a dialogue between project staff, committee members in attendance, and public attendees. The meeting facilitator should take care not to disregard or discard any of the issues brought up by meeting attendees. Each issue should be discussed to completion with other meeting attendees before the next point is discussed. This will let meeting attendees know they are being heard and that their input is valuable.

Focus on Public

Committee members stressed that the presentation needs to emphasize why the public should care about the watershed management planning process. Meeting attendees should leave the meeting with an understanding of their role in the planning process, and of how the Cameron Run Watershed Management Plan ties to both local and regional concerns (e.g., flooding basements and/or restoration of the Chesapeake Bay). Public attendees will be interested in learning what they can do to improve the watershed and help Fairfax County meet their planning goals, as well as what the county will do to improve the watershed. Ultimately, meeting attendees will be concerned with the quality of life in the watershed once the management plan is implemented.

Committee members also reminded project staff that the reason members of the public attend this type of meeting is because they have something to say and want to be heard by the county. These attendees have a desire to voice their opinions in order to influence policy changes that will improve their communities. Project staff and committee members agreed that they should encourage public attendees to talk about their issues, thus ensuring that the public knows they have a voice and a stake in the overall planning process. Committee members agreed that even if the public raises issues or problems that have been already recognized by project staff and committee members that this is okay because it reinforces the importance of these issues and problems. This will give the public a stake in the planning process by making the county and the public accountable for implementing solutions to those issues and problems. Project staff stressed the importance of community involvement in developing strategies for resolving watershed issues.

Public Meeting Structure

Project staff and committee members also discussed the structure of the first public meeting and whether or not the meeting should be driven by the discussion that follows the brief presentation. Project staff suggested structuring the meeting into two one-hour parts. The first hour of the meeting will begin with a few short remarks by Fairfax County followed by a 15-minute presentation introducing Cameron Run and the planning process and a 45-minute general discussion about the process and any overarching issues attendees might have. During the first 45 minutes of the second hour, public attendees will break into groups to discuss issues specific to their communities, after which project staff will bring all the groups together to discuss overarching issues.

The majority of committee members agreed that it would be a good idea to break into smaller groups as long as either a project staff member or a committee member were available to facilitate and keep groups on track. Committee members who did not agree with breaking into smaller groups warned that project staff and committee members may run the risk of public attendees losing sight of the meeting purpose and becoming confused about their role in the planning process.   They also noted that large, open forums generate more discussion because outspoken members of the group, or an outspoken group, will have less of a chance of forcing their agenda, thereby making other attendees feel either uninformed or intimidated. Facilitators should be able to keep groups on track and will dissuade the same individuals or groups from dominating a discussion. The committee meeting facilitator, Ms. Rastatter, advised that breakout groups should be no larger than 10 to 15 people. If groups are any larger, there is a risk that good discussion will not take place. Group facilitators will also have to be comfortable with keeping groups on track and addressing any questions or concerns they may have.

Public attendees can either be organized into smaller groups by subwatershed or issue, or randomly assigned to a group.   Breaking out groups by subwatershed could encourage the formation of community watershed groups and foster stewardship in those communities. However, it was noted that the same residents do not know which subwatershed they reside in and determining localities for a group breakout session could take away from group discussion. Likewise, public attendance might be strong in some subwatershed regions and weak or nonexistent in others. If public meeting attendance is low, there will be no need to break the attendees into discussion groups. Consequently, project staff and committee members agreed to keep the matter of format open until the meeting begins. Regardless if attendees are broken out into groups or discussion remains an open forum, each attendee should be provided a copy of the Cameron Run watershed map indicating where the subwatersheds and tributaries are located in relation to each other.

Committee members also suggested that project staff distribute 3”x5” index cards to attendees so they can record issues and problems. This would promote discussion within subgroups in an open format. Another value of the index cards is that project staff can see what issues are of most concern to the public. For example if 10 of 20 cards list flooding as a major issue in the watershed, then project staff can focus the plan on addressing flooding issues. The use of index cards to list issues may also obviate the need to break public attendees into groups.

Other Issues

Committee members stressed that project staff need to clearly show that Cameron Run is one of the many county watersheds developing a watershed management plan in Fairfax County. It should be made clear that Tripps Run is outside of the Fairfax County dataset for water quality monitoring, and also therefore water quality data is not available for this tributary. This does not mean that Tripps Run does not have water quality issues. Tripps Run lies within the city of Falls Church and has a great deal of issues facing it. Project staff also emphasized that many of the issues and problems that community residents and the county are combating today are due to current planning allowances and planning ordinances. This is very important because most community members do not make the connection between planning and water quality. If fact, most residents do not realize that stormwater from developed areas will eventually enter streams and tributaries and affects water quality in the watershed. Staff also stressed that the feedback obtained in this meeting will gauge activities during the summer months because this is the only public meeting where this type of on-the-ground input of specific issues and problem areas will be obtained.

One committee member expressed a dislike for rain barrels, noting that they are more trouble then they are worth. This same individual suggests that cisterns are a better option as a Best Management Practice. Ms. Rastatter suggested that including this as an example of a best management practice in the management plan can promote dialogue between project staff, committee members, and public meeting attendees.

Action Items

Project staff identified some of the key action items that will need to take place prior to the Public Issues Scoping Forum. These items included

- Revising the draft presentation to fit the focus and goals of the public meeting, but having additional materials available for public attendees who want more information. Committee members will trust project staff to revise the presentation based on the feedback received at this meeting.
- Committee members will inform project staff of availability to either attend or contribute at the public meeting.
- Project staff will send committee members a comprehensive list of actions that need to be completed in preparation for the public meeting.
- Project staff will send committee members who volunteered to facilitate at this public meeting a list of recognized facilitation methods and ground rules.

- Project staff will develop and distribute public meeting minutes to committee members.

Schedule of Advisory Committee Activities and Meeting Adjournment

Dr. Southerland, Ms. Shore, and Ms. Rastatter closed the meeting by reviewing the schedule of upcoming committee meetings as decided at this meeting. The schedule is as follows:

- Cameron Run watershed tour will be held on July 24, 2004. A meeting location and time will be sent prior to the tour.
- Next advisory committee meeting will be held during the week of August 23, 2004. Meeting date, location, and agenda will be sent prior to the meeting. The Cameron Run Watershed vision will be developed at this meeting, as well as a discussion of watershed modeling findings from activities conducted during the summer months.
- Community Watershed Issues Forum: September 18, 2004, meeting location and agenda will be discussed at August advisory committee meeting.
- Draft Plan Review: Tentatively scheduled for January 12, 2005.
- Final Plan Review: Tentatively scheduled for April 20, 2005.

One member announced that Yorktown Square in Cameron Run will be hosting a rain garden installation project. This member will send an email about the project for project staff to distribute to committee members.

Information about Cameron Run and the Cameron Run Watershed Management Plan can be found on the Fairfax County watershed plans website at www.fairfaxcounty.gov/watersheds. Under pages specifically dedicated to the Cameron Run watershed plan, readers will be able to access other supporting documents. A meeting and events calendar and meeting minutes for the Cameron Run Advisory Committee are also located on the county website. The Cameron Run website contains a message board that community members can use to share ideas and also comment on plan drafts. Comments may be sent to the watershed email address at cameronrun@versar.com, or by calling the watershed hotline toll free at (886) 341-4599.

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Cameron Run Watershed
Advisory Committee Meeting No. 8

Mason District Government Center, Annandale, Virginia
August 25, 2004

ADVISORY COMMITTEE MEMBERS IN ATTENDANCE:

Michael Aho **–** Providence District Board of Supervisors
Glenda Booth – Fairfax County Wetlands Board
Nick Byrne **–** Sleepy Hollow Homeowners Association (HOA)
Florence Cavazos – Tripps Run Resident
Diane Davidson **–** Lake Barcroft Association
Jonathan Daw – Poplar Heights Civic Association
Dave Eckert – Falls Church Stream Stewards
Davis Grant **–** Lake Barcroft Watershed Improvement District
Richard Hartman – Berkshire HOA/Huntington Community Association
Sally Henley – Tripps Run Resident
Bill Hicks **–** Northern Virginia Regional Commission
Bob Jordan **–** Fairfax Trails and Streams/Potomac River Greenways Coalition
Kathy Joseph – Earth Sangha
Patrick Lucas – Tripps Run Resident/Fairfax County Police
George Madill – Bren Mar Civic Association
Jim McGlone **–** Department of Forestry
Liz McKeeby –Mason District Board of Supervisors/Supervisor Gross
Donald Peterson **–** Co-Chairman, Bren Mar Park-Lincolnia Park Trails Association
Tom Wasaff – City of Alexandria
Bruce Williams -- Citizen

PROJECT TEAM STAFF IN ATTENDANCE:

Dipmani Kumar -- Fairfax County Department of Public Works and Environmental Services (DPWES)
Gayle England -- Fairfax County DPWES Ecologist/Public Involvement
Vishnu Seri – Fairfax County Stormwater Planning
Clem Rastatter **–** Versar, Inc.
Jennifer Shore **–** Versar, Inc.
Mark Southerland **–** Versar, Inc.
Amanda Peyton **–** Horne Engineering Services, Inc.

THE CAMERON RUN WATERSHED PLAN

The Cameron Run watershed has experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the stream and its watershed. The Cameron Run Advisory Committee advises the Cameron Run Watershed Plan project team. Versar, Inc., prepares watershed plan drafts and engineering studies. Versar, Inc., and Horne Engineering Services, Inc. serve as facilitators for the public meetings. For more information, contact cameronrun@versar.com or visit http://www.fairfaxCounty.gov/watersheds.

The opinions represented herein do not necessarily represent those of Fairfax County or its agents.

MEETING PURPOSE

Attendees of the advisory committee are individuals who represent diverse stakeholder groups that reside throughout the Cameron Run watershed. The purpose of this meeting was to finalize the advisory committee voting member list, discuss a vision for the Cameron Run Watershed, and begin preparations for the upcoming Community Watershed Forum. The overall goal of the advisory committee is to help Fairfax County develop a watershed management plan for Cameron Run that incorporates community interests in the evaluation of problems and implementation of solutions for protecting and restoring the streams and other natural resources of the watershed.

KEY DECISIONS AND OUTCOMES

- Advisory committee decisions will be made by consensus whenever possible. In the, hopefully rare, cases where a vote is required, only designated committee voting members (one from each organization) will vote. If a voting member is unable to attend a meeting, he or she will either (1) send an email to project staff designating who their alternate will be, or (2) send his or her vote to project staff prior to the meeting.
- The committee crafted a draft vision statement for the Cameron Run Watershed (See *Cameroon Run Watershed Project Approach and Vision and Goals* below).
- Next advisory committee meeting will be held either during the week of September 13th, or September 20th. A meeting date, location, and agenda will be sent prior to the meeting.
- The Community Watershed Forum is scheduled for Saturday, October 23, 2004. The agenda for the forum will be discussed during the September advisory committee meeting.

ACTION ITEMS

- Project staff will send committee members an email with the new flyers for distribution to their colleagues, once the site for the Community Watershed Forum is set. These documents will also be placed on the Cameron Run Watershed web-page.
- Committee members will request the number of hardcopy flyers that the project staff should mail them for distribution within their communities.
- Project staff will produce the requested flyers in a timely manner.
- Project staff will send flyers to Supervisors' staff.
- Project staff will poll committee members to determine the next meeting date. Proposed dates include September 13th, 14th, and the week of September 20th – 24th.
- Project staff will simplify issues identified by the committee and public at the Public Issues Scoping Forum (i.e., re-wording "dechannelization" to "restoring natural stream shape and flow") prior to next committee meeting.
- Project staff will develop a list of programmatic concerns to be discussed by the committee in September.
- Project staff will develop a draft presentation to be presented at the Community Watershed Forum for review by committee members during the September meeting.

MEETING DISCUSSION

Introductions and Overview

Ms. Shore of Versar convened the advisory committee meeting by introducing project staff and advisory committee members. Following the introduction, Ms. Shore briefly reviewed the agenda, advisory committee roles, and ground rules. Materials distributed to committee members included the following:

- Advisory Committee Meeting Agenda
- Approach to Solutions for Cameron Run Watershed Plan
- Vision Statement Options (including handouts distributed by committee members during discussion)
- Consolidated Issues of Concern for Cameron Run Watershed Plan
- Master Advisory Committee Member List (color coded to indicate group affiliation)
- Cameron Run Community Watershed Forum Strawman Agenda

Finalize Voting Members of the Advisory Committee

Prior to the advisory committee meeting, project staff sent committee members an email concerning designation of voting members for each group represented at advisory committee meetings. Committee members were asked to respond if they were willing to be the voting representative for their respective groups. By the time of the meeting, eight individuals had agreed to serve as voting representatives.

Dr. Southerland of Versar opened the discussion by asking members how voting should be structured for development of the Cameron Run Watershed Management Plan. During this discussion, Ms. Rastatter of Versar suggested that committee members decide whether the voting structure should be consensus-based or voting-based (majority rules). In a consensus-based structure, every member of the group must either agree with the decision or "live with" the decision by compromising. When agreement cannot be reached, the issue is either dismissed or the project manager makes the final decision. Consensus-based voting generally gives members a sense of ownership in decisions, and often produces better plans because members work as a team. A consensus-based structure can be time consuming because the group cannot move forward until a compromise is reached. In contrast, a voting-based structure requires less discussion prior to the vote, allowing decisions to be made more quickly.

During this discussion, committee members raised concerns about the voting process and the reasoning behind designating voting members. A few members pointed out that the advisory committee for the Little Hunting Creek Watershed Management Plan used consensus-based voting to develop 70% of the recommendations in their Plan, and relied on a voting-based structure for the remainder of the recommendations. Questions raised by various committee members included the following.

- Why are there voting and non-voting members when all members were selected and contacted by project staff to be a part of the advisory committee?
    - The reasoning behind designating voting members is to ensure that each group is equally represented during the decision making process. For example, when multiple members of a homeowners association attend a committee meeting, the group can cast only one vote, thereby ensuring that all groups have an equal say in management plan decisions. Designating voting members will also provide an incentive for attending future advisory committee meetings. Either the voting member or an alternate will be present at meetings ensuring that all watershed groups are equally represented.

- Why should I attend advisory committee meetings if I'm not a voting member?
  - ➢ All attendees, whether a voting member or not, are encouraged to speak up during discussion sessions. The committee will discuss an item prior to a voting session, and non-voting members can help to influence voting members by bringing up new ideas or points during the discussion of an item. Advisory committee meetings are open to the public and the public is encouraged to attend and serve as advisors to the voting members. Again the majority of decisions will be reached by consensus.
- Would Fairfax County have a vote?
  - ➢ The advisory committee was created to advise the County and project staff during the watershed management plan development process. Therefore, the County staff working on this project will not have a vote. On the other hand, a representative from the Board of Supervisors should be a voting member because the Board represents a broader constituency and will allocate funds to the County for plan implementation.

Committee members decided that the structure of voting by designated committee members should be voting/majority rules-based. More members had concerns about the consensus-based process than the voting/majority rules-based process. Members did specify that a vote will not be taken when an item is brought to the floor. Voting will only take place after an item has been discussed by the committee as a whole. The project staff facilitator will use a consensus-based approach as necessary during the discussion process before designated members can vote on any item. Project staff will also inform committee members (both voting and non-voting members) prior to a meeting if a voting decision will be made during the meeting. In turn, committee members will inform project staff if they are unable to attend a meeting and will either cast their vote at that time, or inform project staff that an alternate will be voting for them. If an alternate member will be voting, the designated voting member will inform project staff prior to the meeting that an alternate will be voting for them, and they will identify who the alternate will be.

The list of voting members (subject to new members being added) is as follows:

- Michael Aho -- Providence District Board of Supervisors
- Glenda Booth -- Fairfax County Wetlands Board
- Diane Davidson -- Lake Barcroft Association
- Jonathan Daw -- Poplar Heights Civic Association
- Dave Eckert -- Falls Church Stream Stewards
- Davis Grant – Lake Barcroft Watershed Improvement District
  - ➢ Alternate – Pete Silva
- Richard Hartman – Huntington Association
  - ➢ Alternate – Phyllis Evans
- Bob Jordan -- Fairfax Trails and Streams/Potomac River Greenways Coalition
- Kathy Joseph – Earth Sangha
- Patrick Lucas – Friends of Tripps Run
- George Madill – Bren Mar Park Civic Association
  - ➢ Alternate – Donald Peterson

- Liz McKeeby – Mason District Board of Supervisors
- Donald Peterson – Bren Mar Park-Lincolnia Park Trails Association
- Russ Rosenberger – Real Estate Developer
- Bruce Williams – Sleepy Hollow Citizen Association
    - Alternate – Nick Byrne

Cameron Run Watershed Project Approach, Vision, and Goals

Dr. Southerland presented a brief overview of the project approach and plans for future advisory committee activities (see Approach to Solutions for Cameron Run Watershed Plan handout). To date, most committee meetings have focused on identifying issues and problems within the watershed. Dr. Southerland encouraged the committee to change its focus from identifying problems to formulating the vision and goals for the watershed that would lead to identifying solutions. Ideally the advisory committee could present their vision and example solutions to the issues identified from the Public Issues Scoping Forum to the public at the Community Watershed Forum.

Ms. Rastatter began the discussion by defining a vision as a short, concise statement to lead committees or groups towards a goal. Committee members decided that the Cameron Run vision would be a vision for the watershed itself and not be a mission statement of vision for the watershed management plan. The committee developed a list of items that should be conveyed in the watershed vision statement. These items included ensuring that the watershed

- Is a valued community asset
- Supports a healthy ecosystem
- Supports recreational activities
- Meets water quality standards
- Supports improved habitat
- Supports a healthy Chesapeake Bay
- Is fishable and swimmable as defined in the Clean Water Act
- Supports biodiversity
- Is protected against pollution

Committee members also wanted watershed management plan implementation to encourage

- Early public involvement and awareness
- A multi-pronged strategy
- Transparency in County policy and programs
- Transparency of public actions
- Protection and restoration of resources
- Integration of environmental management, natural resources protection, and community goals
- A method for tracking chemical pollution and biological diversity (i.e., using chemical sensors that are strategically placed throughout the watershed)
- A method for rewarding those who report watershed polluters

- Integration of County policies (e.g., zoning, tax administration, permit code enforcement) with environmental sanitation and urban forestry for better coordination of environmental retrofitting activities

The overall goal of the watershed management plan is to help Fairfax County meet the requirements of the Clean Water Act, and the commitments that the State of Virginia made by signing the Chesapeake Bay Agreement. After detailed discussion, committee members crafted a consensus draft vision for the Cameron Run watershed. The following two options are edited versions of this draft for adoption as the next advisory committee meeting:

- Option 1: Revive Cameron Run and its tributaries to a fishable, swimmable, and biologically diverse condition, and then protect this community asset so that it supports a safe and vibrant environment for people and property.
- Option 2: A fishable, swimmable, and biologically diverse Cameron Run Watershed that supports a safe and enjoyable environment for people and property.

Upcoming Community Watershed Forum

The purpose of the Community Watershed Forum is to educate the public about Cameron Run Watershed issues and the watershed management planning process, and obtain their input on the best solutions to include in the plan. Based on this input, stream characterization, and modeling, the project staff and advisory committee will develop the draft watershed management plan. The advisory committee agree to moving the Community Watershed Forum to October 23, 2004 to allow for more discussion and additional advertising time. Project staff will begin advertising the Community Watershed Forum the week of August 30, 2004.

In preparation for the upcoming public meeting, committee members suggested project staff do the following:

- Simplify issues identified by the committee and from the public at the Public Issues Scoping Forum by rewording terms to make them understandable to the average person (i.e. re-wording "dechannelization" to "restoring natural stream shape and flow"). Use plain English.
- Clearly explain watershed issues of concern and identify corresponding County policies.
- Ensure that the watershed management planning process not only involves the development of a list of County public works projects, but provides recommendations for County programs as well.
- Present not only issues, but suggested solutions for those issues.

Committee members strongly recommended that project staff considers County policy and how current policy either causes or reduces current watershed problems. Project staff and committee members will identify current County policies and determine how they impact the watershed. Mr. Kumar of DPWES informed committee members that the County is analyzing current policies with the intent of updating and consolidating policy. The County is looking at policies County-wide, and not just policies that affect the Cameron Run watershed.

Dr. Southerland reminded committee members that other watershed groups (e.g., Little Hunting Creek Watershed) have analyzed County policy, so that our discussions should build on what they've learned. He suggested that the committee and project staff invite a County representative to a future advisory committee meeting to explain the rationale behind current policies and how those policies will be updated. This will allow the committee to focus on feasible solutions top the most important watershed issues.

Project staff will nail down a location for the Community Watershed Forum and email committee members the revised flyer for advertising the meeting. Committee members will tell project staff how many hardcopy flyers they need for distribution within their communities. Project staff will also send flyers to the County Supervisors' offices.

DISCUSSION OF PARKING LOT ITEMS AND MEETING ADJOURNMENT

Project staff suggested that the committee hold one more meeting before the upcoming Community Watershed Forum. Furthermore, it was suggested that the agenda for the next meeting consist of the following Parking Lot items from this meeting.

- Format and content of Community Watershed Forum
- Discussion of logistics and feedback from Public Issues Scoping Forum
- Role of dissenting views in the finalized watershed management plan
- Policies and procedures for developing the watershed management plan
- Determining what types of items committee voting members should seek consensus on and what items should be voted on
- Discussion of a conceptually different approach to stormwater management

Project staff will poll committee members regarding a date for the next meeting. Suggested dates include: September 13th, 14th, or during the week of September 20th. One committee member informed project staff that the National Low Impact Development Workshop will be conducted from September 21st – 23rd. Therefore, it may not be in the best interest of the committee to schedule a meeting during those dates.

Information about Cameron Run and the Cameron Run Watershed Management Plan can be found on the Fairfax County watershed plans website at www.fairfaxCounty.gov/watersheds. Under pages specifically dedicated to the Cameron Run watershed plan, readers will be able to access other supporting documents. A meeting and events calendar and meeting minutes for the Cameron Run Advisory Committee are also located on the County website. The Cameron Run website contains a message board that community members can use to share ideas and also comment on plan drafts. Comments may be sent to the watershed email address at cameronrun@versar.com, or by calling the watershed hotline toll free at (886) 341-4599.

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Cameron Run Watershed
Advisory Committee Meeting No. 9

Mason District Government Center, Annandale, Virginia

September 20, 2004

ADVISORY COMMITTEE MEMBERS IN ATTENDANCE:

Michael Aho – Providence District Board of Supervisors
Nick Byrne – Sleepy Hollow Homeowners Association (HOA)
Florence Cavazos – Tripps Run Resident
Diane Davidson **–** Lake Barcroft Association
Jonathan Daw – Poplar Heights Civic Association
Davis Grant – Lake Barcroft Watershed Improvement District
Richard Hartman **–** Berkshire HOA/Huntington Community Association
Sally Henley – Tripps Run Resident
Bill Hicks – Northern Virginia Regional Commission
Bob Jordan – Fairfax Trails and Streams/Potomac River Greenways Coalition
Kathy Joseph – Earth Sangha
Patrick Lucas – Tripps Run Resident/Fairfax County Police
Liz McKeeby – Supervisor Gross/Mason District Office
Donald Peterson – Co-Chairman, Bren Mar Park-Lincolnia Park Trails Association
Peter Silva -- Lake Barcroft Watershed Improvement District
Robert Taylor – Poplar Heights Recreation Association
Bruce Williams -- Citizen

PROJECT TEAM STAFF IN ATTENDANCE:

Fred Rose -- Fairfax County Department of Public Works and Environmental Services (DPWES)
Gayle England -- Fairfax County DPWES Ecologist/Public Involvement
Than Bawcomb – Fairfax County Stormwater Planning
Clem Rastatter **–** Versar, Inc.
Jennifer Shore – Versar, Inc.
Mark Southerland **–** Versar, Inc.
Julie Tasillo – Versar, Inc.
Amanda Peyton **–** Horne Engineering Services, Inc.

THE CAMERON RUN WATERSHED PLAN

The Cameron Run watershed has experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the creek and its watershed. The Cameron Run Advisory Committee advises the Cameron Run Watershed Plan project team. Versar, Inc., prepares watershed plan drafts and engineering studies. Versar, Inc., and Horne Engineering Services, Inc. serve as facilitators for the public meetings. For more information, contact cameronrun@versar.com or visit http://www.fairfaxCounty.gov/watersheds.

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MEETING PURPOSE

Attendees of the advisory committee are individuals who represent diverse stakeholder groups that reside throughout the Cameron Run watershed. The purpose of this meeting was to finalize a vision statement for the Cameron Run watershed and to prepare for the October Community Watershed Fforum. The overall goal of the advisory committee is to help Fairfax County develop a watershed management plan for Cameron Run that incorporates community interests in the evaluation of problems and implementation of solutions for protecting and restoring the streams and other natural resources of the watershed.

KEY DECISIONS AND OUTCOMES

- Committee members finalized a vision statement for the Cameron Run Watershed (See *Finalize Vision for Cameron Run and Voting Members for the Committee* below).
- Next advisory committee meeting will be held during the week of November 8th. A meeting date, location and agenda will be sent prior to the meeting.
- Project staff will send out a notice prior to each meeting to see which voting members will be in attendance and to determine if enough will be in attendance for an official committee vote.
- Email will be used prior to and between committee meetings to promote discussion between project staff and committee members and to ensure that plan development momentum is not lost.
- Project staff will present chapters for the management plan to committee members as they are developed for review and comment.

ACTION ITEMS

- Project staff will present a draft outline for the watershed management plan at the November advisory committee meeting.
- Project staff will poll committee members to determine the next meeting date. The proposed date is during the week of November 8th.
- Project staff will develop supplemental materials (i.e. handouts, power point slides, etc.) for distribution at the Community Watershed Forum to public attendees who might want more information.
- Project staff will revise the draft Community Watershed Forum presentation based on committee member feedback.
- Project staff will extract appropriate sections from the LHC plan for review by committee members.
- Project staff will develop a glossary and acronym list for public meeting attendees.
- Project staff will develop a "laundry list" that marries the list of watershed issues with proposed solutions. This list will also be included in the presentation and made into a poster.
- Committee members are encouraged to help publicize the Community Watershed Forum by contacting civic associations with which they are associated..

MEETING DISCUSSION

Introductions and Overview

Ms. Shore of Versar convened the advisory committee meeting with an introductory dialog between project staff and advisory committee members, followed by a review of the meeting agenda. Materials distributed to committee members included the following:

- Advisory Committee Meeting Agenda
- Revised Cameron Run Community Watershed Forum Strawman Agenda
- Proposed presentation for the Community Watershed Forum

Finalize Vision for Cameron Run and Voting Members for the Committee

Ms. Rastatter of Versar presented committee members with two versions of the vision statement developed by committee members at the August meeting. The two versions were:

1) *Revive Cameron Run and its tributaries to a fishable, swimmable, and biologically diverse condition, and then protect this community aspect so that it supports a safe and vibrant environment for people and property.* (draft statement from August committee meeting)
2) *A fishable, swimmable, and biologically diverse Cameron Run watershed that supports a safe and enjoyable environment for people and property.* (edited version of #1)

Ms. Rastatter opened a discussion of the two vision statements above, and then asked committee members to choose a final vision statement. Through the discussion, committee members clarified that the terms fishable and swimmable carry the same meaning as used in federal and state water quality standards. Members also discussed that the vision statement is a broad statement that conveys overarching goals for the Cameron Run Watershed. Committee members agreed that vision statement number two (2) would suffice as the vision statement for the development and implementation of the Cameron Run Watershed Management Plan.

At the conclusion of this discussion, Ms. Rastatter asked committee members if they agreed on the specified voting members and their alternates. Robert Taylor will be added as an official voting members and will represent the Poplar Heights Recreation Association.

Discussion of Parking Lot Items from August Advisory Committee Meeting

At the August advisory committee meeting, project staff and members decided that the parking lot items would help drive the agenda for this meeting. Parking lot items from the August meeting include:

- Format and content of Community Watershed Forum (see *Community Watershed Forum* below)
- Role of dissenting views in the finalized watershed management plan (discuss at future committee meeting)
- Policies and procedures for developing the watershed management plan
- Determining what types of items committee voting members should seek consensus on and what items should be voted on
- Discussion of a conceptually different approach to stormwater management (discuss at future committee meeting)

Ms. Rastatter began this discussion by recapping the committee decision made at the August meeting for appointed members to vote on issues raised by project staff. She also emphasized that project staff will seek consensus from the committee on items to be voted on by voting members.

Committee members and project staff had a long discussion on the policies and procedures that should be employed for developing the watershed management plan. Dr. Southerland suggested that committee involvement in plan development and implementation be more proactive as opposed to reactive. This could mean that the committee would either have to meet more than once per month, or communicate more via email. Committee members agreed that involvement in plan development should be more proactive, but that email should be used to generate discussion and to help the committee prepare for upcoming meetings. The committee also agreed that the County will use the watershed management plan as guidance for watershed management.

Mr. Rose of DPWES encouraged committee members to avoid creating unrealistic expectations for the management plan. He informed committee members of the status of the Little Hunting Creek (LHC) Watershed Management Plan. The final LHC plan has been presented to the County for review and approval. Currently, the County is consolidating comments for the project consultant, and reviewing the policy changes that were recommended by the LHC watershed committee. The County is in the process of trying to separate policy- and project-related solutions. The committee should use the LHC plan as a guideline for setting priorities. The County does not have the budget to fund all the projects in each of the watershed management plans under development, nor can the County afford to develop and implement all of the proposed policy changes. Changing County policy will involve an additional Countywide process, while funding can begin to be obtained for individual projects immediately. This is not to say that the committee should not address policy changes in the plan because the County will be basing policy decisions on the policy changes proposed in the 30 watershed plans. The LHC committee spent 60% of their efforts on evaluating current policy and making policy recommendations. Therefore, the committee should use the LHC plan as a guide for suggesting policy updates. This committee can build on the work of the LHC committee, thereby focusing its efforts on projects specific to Cameron Run. Mr. Rose suggested that this committee look at not only the policy recommendations made by the LHC committee, but the specific projects suggested in the plan as well. Project staff will extract the appropriate sections from the LHC plan for review by the Cameron Run Advisory Committee.

Ultimately, County policy makers are looking to each of the 30 watershed advisory committees in Fairfax County to help them prioritize projects and policy revisions. The Cameron Run Advisory Committee is tasked with helping the County focus on projects pertaining to the Cameron Run watershed, and to suggest those policies that will ensure the watershed continues to be a resource for the community. The committee, through project staff, will present solutions to the County that include both policy changes/updates and projects specific to the Cameron Run watershed. The committee has opportunities to improve the watershed by identifying projects to be implemented by individuals and by the County, and by updating and changing policy. The committee should prioritize projects such as (1) government capital projects, (2) activities by individuals, and (3) changes/updates in County policy. Examples of projects include stream restoration and the use of low impact development in new developments or as retrofits. Prioritizing projects in this manner will help the committee and the County achieve the vision developed by the committee. It was decided that the committee will continue to address procedures for developing the management plan at the November committee meeting. Project staff will send a proposed plan outline to committee members for review via email in preparation for the meeting. Once the outline is finalized, project staff will either send via email, or distribute at meetings, draft plan chapters for review by the committee as they are developed.

Community Watershed Forum

Dr. Southerland presented a strawman agenda and the proposed presentation for the October Community Watershed Forum. The purpose of this public meeting is to educate the public on the condition of the watershed and to gather ideas/solutions from the public. In addition to the presentation by project staff, two (2) watershed experts will be asked to speak at the meeting. The presentation will educate the public on the following:

- Overview of the watershed planning process
- The condition of the Cameron Run watershed
- What can be done to improve the watershed

After his brief overview, Dr. Southerland asked the committee for recommendations on the agenda and presentation. Committee members recommended that project staff clearly define what computer modeling means and how it is performed. . Members also suggested that project staff provide meeting attendees with presentation slide handouts, and make the background of the slides lighter to improve readability.. It was also suggested that the staff presentation had too many slides based on the time allotted on the strawman agenda. Committee members recommended that the number of slides be reduced to allow ample time for the public to ask questions before they are asked to break into groups and discuss ideas/solutions. Public meeting attendees will also be provided with a glossary of terms and acronyms. Finally, committee members suggested that project staff present the flow chart for management plan development at the beginning and end of the presentation as opposed to just the end of the presentation. Project staff will distribute their presentation along with those to be delivered by the invited experts.

Project staff and committee members agreed that it might not be realistic to ask the public for solutions to for the watershed's problems because the public they may not possess the required watershed knowledge. On the other hand, the public should be involved in the process and engaged in formulating solutions. Committee members suggested that the breakout session will provide opportunities for the public to identify opportunities for improving the watershed, and propose some solutions to the issues raised at the Public Issues Scoping Forum. Project staff will distribute a "laundry list" that marries the current list of watershed issues with some suggested solutions to meeting attendees. This same list will be included in the presentation and displayed on a poster. Mr. Rose reminded committee members that the ultimate goal of the public meeting is to query the public for ideas/issues that lead to solutions for the watershed.

Members of each breakout session group will be randomly selected as they were for the Public Issues Scoping Forum. Breakout session members will identify (1) specific places within the watershed and practices that may address issues, (2) projects within the Cameron Run watershed and throughout the County, and (3) criteria for evaluating solutions. Therefore, the public will help project staff and committee members develop a list of specific places with realistic solutions, thereby converting issues or problems into goals that correspond to the Cameron Run vision. Ultimately, the list of projects/solutions that will be recommended in the plan will be based on stream characterization data and computer modeling. The public meetings provide a venue for the public to identify additional opportunities beyond those identified in the computer modeling.

MEETING ADJOURNMENT

Dr. Southerland adjourned the meeting by asking committee members to advertise the public meeting to their colleagues. The next committee meeting will be held after the Community Watershed Forum during the week of November 8, 2004. Project staff will poll committee members regarding a date for the next meeting during the week of November 8^{th}.

Information about Cameron Run and the Cameron Run Watershed Management Plan can be found on the Fairfax County watershed plans website at www.fairfaxCounty.gov/watersheds. Under pages specifically dedicated to the Cameron Run watershed plan, readers will be able to access other supporting documents. A meeting and events calendar and meeting minutes for the Cameron Run Advisory Committee are also located on the County website. The Cameron Run website contains a message board that community members can use to share ideas and also comment on plan drafts. Comments may be sent to the watershed email address at cameronrun@versar.com, or by calling the watershed hotline toll free at (886) 341-4599.

Cameron Run Watershed
Advisory Committee Meeting No. 10

Versar Headquarters, Springfield, VA

November 10, 2004

ADVISORY COMMITTEE MEMBERS IN ATTENDANCE:

Michael Aho – Providence District Board of Supervisors
Nick Byrne – Sleepy Hollow Homeowners Association (HOA)
Jonathan Daw – Poplar Heights Civic Association
Richard Hartman – Berkshire HOA/Huntington Community Association
Kathy Joseph – Earth Sangha
Patrick Lucas – Tripps Run Resident/Fairfax County Police
***Jim McGlone* –** Department of Forestry
***Liz McKeeby* –** Supervisor Gross/Mason District Office

PROJECT TEAM STAFF IN ATTENDANCE:

***Dipmani Kumar* --** Fairfax County Department of Public Works and Environmental Services (DPWES)
***Clem Rastatter* –** Versar, Inc.
***Jennifer Shore* –** Versar, Inc.
Mark Southerland – Versar, Inc.
Mike Klevenz – Versar, Inc.
***Mark Mobius* –** Horne Engineering Services, Inc.

The Cameron Run Watershed Plan

The Cameron Run watershed has experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the creek and its watershed. The Cameron Run Advisory Committee advises the Cameron Run Watershed Plan project team. Versar, Inc., prepares watershed plan drafts and engineering studies. Versar, Inc., and Horne Engineering Services, Inc. serve as facilitators for the public meetings. For more information, contact cameronrun@versar.com or visit http://www.fairfaxCounty.gov/watersheds.

The opinions represented herein do not necessarily represent those of Fairfax County or its agents.

Meeting Purpose

Attendees of the advisory committee are individuals who represent diverse stakeholder groups that reside throughout the Cameron Run (CR) watershed. The purpose of this meeting was to establish a process for developing Cameron Run policy recommendations. The overall goal of the advisory committee is to help Fairfax County develop a watershed management plan for the Cameron Run watershed that incorporates community interests in the evaluation of problems and implementation of solutions for protecting and restoring the streams and other natural resources of the watershed.

Key Decisions and Outcomes

- The date of the next meeting will be determined via email exchanges.
- Committee members will review Little Hunting Creek (LHC) recommendations and respond off-line.
- CR policy recommendations will be finalized in a future meeting.

Action Items

- Project Staff will prepare map and tables of land use (including public lands) and areas with stormwater controls for the next meeting.
- Project staff will distribute an email asking committee members to vote on options for goals/strategies to help set plan priorities.

MEETING DISCUSSION

Ms. Jennifer Shore opened the meeting with an overview of the agenda, and she suggested that member introductions were not necessary since the committee members were already well familiar with each other. The committee agreed to move directly to the meeting material without introducing themselves.

Dr. Mark Southerland took the floor and stated that project staff would start drafting the draft plan shortly, and would try to have the draft available sometime in January 2005. Dr. Southerland proceeded to explain the handouts that had been provided to each committee member. Handouts distributed include:

- Meeting Agenda
- Advisory Committee Meeting 10 Presentation
- Summary of Policy Recommendations from Little Hunting Creek
- GIS Maps for Watershed Handbook
- Email Memo from Committee Member

Dr. Southerland reminded the committee of their Vision Statement for the Cameron Run Watershed:

"A fishable, swimmable, and biologically diverse Cameron Run watershed that supports a safe and enjoyable environment for people and property."

In discussing the tools that committee members will have to make the watershed vision a reality, Dr. Southerland referred members to the stream characterization maps on the walls around the room, and mentioned that modeling data would be ready for distribution soon.

Dr. Southerland continued by outlining general approaches to improving a watershed, such as preserving better areas, protecting vulnerable areas, restoring degraded areas, and reducing adverse impacts to the watershed as a whole. He then reviewed a list of Cameron Run watershed problems consolidated from previous advisory committee meetings, as well as from the categorized list developed by project staff that divides potential solutions between physical (local) and programmatic (regional) solutions.

Dr. Southerland then discussed the policy recommendations presented in the Little Hunting Creek (LHC) plan. He stressed that these recommendations were a very good collection of ideas and recommendations from which the committee members could draw suggestions. One committee member asked if, since time is critical, the group should use LHC recommendations as a base and build off of them. Along the same lines, another member asked if there were any items from the LHC document that would not apply to Cameron Run. Ms. Clem Rastatter responded by stating that some items in the LHC might need to be modified for direct application to Cameron Run. After some discussion concerning which of the LHC policy recommendations to adopt, the committee finally voted to review the recommendations off-line and respond with comments via email. Cameron Run recommendations will be finalized at a future meeting. The benefit of starting the process off-line, said Ms. Rastatter, is that non-critical items can be identified prior to committee meetings, thereby increasing the efficiency of in-person committee meetings.

While on the topic of future meetings, Dr. Southerland raised the question of how many additional committee meetings were required to complete the planning process. Mr. Kumar stated that one member thought that once a draft plan was in place, the group would need four meetings to solidify things. Dr. Southerland queried the group on whether or not some items could be addressed using email, or through web meetings,, or if the group should meet in-person to complete the planning process. There were mixed responses from the committee, with general agreement that some things could be done via email, but that others would require in-person committee meetings.

Dr. Southerland next queried committee members on whether to use the December meeting for programmatic or physical solutions. One committee member replied that the December meeting should focus on physical, site-specific, solutions so that project staff has time to incorporate them into the draft plan. This member pointed out that programmatic/policy solutions don’t require that kind of technical input.

Identifying Solutions:

Dr. Southerland proposed four steps for identifying solutions to watershed problems. The first step is to identify problem segments using stream characterization maps, modeling results, and local knowledge. The second step is to diagnose segment problems using individual stream characterization variables such as bank erosion or embeddedness. The third step is to look both at the site and upstream to identify specific causes. The final step is to identify opportunities to address these causes. Much of the meeting discussion revolved around these four steps.

Discussion turned to the identification of problem segments and areas where physical solutions would have the most impact. Dr. Southerland stated that the idea is to break the watershed into subwatersheds, and identify problems within each. When identifying problem areas, one has to look upstream. Aerial imagery can be viewed and a site visit performed. Next, identify opportunities for solutions. He used the example of Pike Branch, with a particular degraded stream segment. By looking at the aerial imagery upstream of the problem segment, it was possible to identify large areas of impervious surface at a shopping area. A visit to the site could reveal opportunities for managing water flowing off the site. Dr. Southerland also discussed the importance of assigning priorities to solutions based on a number of parameters such as contribution to regulatory compliance, ease of implementation, location, and public interest.

The committee asked a number of questions regarding the stream characterization maps. One committee member asked who had mapped the conditions. Dr. Southerland replied that the County had mapped a variety of different variables in an effort that was completed in the spring of 2002 or 2003, and acknowledged that stream condition assessments could change over time. Mr. Kumar, responding to a question about which streams were assessed, stated that streams with drainage areas of 50 acres or more were assessed. Another committee member asked about the gaps in stream characterization maps. Dr. Southerland answered that those gaps represent areas where the stream disappears (as into a culvert) or where a specific parameter wasn't measured for some reason. Mr. Kumar added that some rip-rapped areas weren't assessed.

Another committee member inquired about how riparian buffer were assessed in the study. Mr. Kumar stated that a stream segment was said to have a good riparian buffer if it had good quality cover extending outward by 100 ft. on both sides. This brought up the subject of improving stream buffers, and one member asked how adequate buffers could be added to those areas rated poorly, e.g., would land be "taken" from landowners? Mr. Kumar noted that all buffer deficiency recorded by the SPA occurred in a Resource Protection Area (RPA), so that planting would be enforceable even on private land. He added, however, that it would be easiest to start with buffer improvements on public lands.

Another committee member asked for a definition of embeddedness. Dr. Southerland explained that when silt fills in the spaces between rocks in a streambed, leaving no habitat for organisms, the stream is considered embedded. Mr. Kumar noted that concrete stream sections were not rated for embeddedness in the original assessment.

In discussions about where to implement potential solutions, one committee member expressed doubt about being able to contribute due to a limited geographic familiarity with the watershed. This member questioned the utility of piecemeal anecdotal information in formulating overarching watershed policy. It was suggested that perhaps people felt too much pressure about being experts, when they should be more concerned about expressing values. Dr. Southerland agreed, reassuring the committee that additional inputs would only improve the plan. Ms. Rastatter added that Versar staff would help match solutions to identified problems in order to meet the committee's watershed goals.

Mr. Kumar recognized the need to view problems from a watershed-wide perspective first. Land use information is important to determining the allocation of projects. This land use info, he continued, would be shared with all parties during plan development. Committee members agreed that land use information would enable them to make more informed project and policy recommendations. One member commented that both land use information, and traditional impervious surface management information is key to focusing plan development efforts. Another member thought that a map depicting land uses on public and private lands would enable the committee to view those areas where it would be easiest to implement solutions. Dr. Southerland offered to provide such a map for the next meeting.

One committee member asked about the main stem of Cameron Run, and expressed concern that if watershed management plan implementation efforts were not coordinated with watershed efforts taken by the City of Alexandria, there is a risk of wasting both County time and money. Mr. Kumar addressed this concern by stating that there is only so much that the committee can do for the main stem. The County has entered into an agreement with the U.S. Army Corp of Engineers, the City of Falls Church, and the City of Alexandria to improve the CR watershed. Dr. Southerland added that the committee could include recommendations for the main stem in the CR plan even though they couldn't enforce them on the other side of the stream.

Plan and Watershed Goals

Ms. Rastatter asked committee members each to come up with two goals, which she said should be specific, measurable, achievable, relevant, and time-bound. The following is a list of goals proposed by the committee:

- Keep the public involved at all levels, prior to planning, funding, etc.
- Maximize LID
- Educate Public on RPA
- Identify what solution will provide the greatest impact in different areas
- Assimilate all information. Establish methodology for determining where you get biggest bang for buck
- Identify low cost/convenient solutions
- Make Cameron Run boatable with trails
- Reduce imperviousness
- Increase forested buffers
- Address fish passage issues
- Incorporate a water-flow reduction plan in major transportation projects
- Control invasive species
- Reduce peak flow in upstream concrete channelizations to improve habitat downstream.
- Encourage private landowners to mitigate RPAs
- Educate realtors about RPAs
- Identify specific retrofit projects for older neighborhoods.
- Implement at least one LID project per subwatershed
- Choose projects that can be completed or have an impact within the next 5 years
- Create responsibility for runoff from new development

Ms. Rastatter asked committee members to distinguish between programmatic and project items within the goals discussed above. She then asked members whether each goal is specific for the CR watershed, or for the management plan. Ms. Rastatter stated that programmatic items would be addressed in the management plan after specific watershed projects were discussed. Following this informal categorization, some of the items were briefly discussed further. There was discussion about which neighborhoods needed retrofitting. The older ones would benefit most because they don't have any current management measures in place. Members also discussed the benefits of reducing peak flows and bank stabilization. Dr. Southerland noted that bank stabilization really only transports erosion problems downstream.

He asked the committee how they wanted to weight the proposed goals. One member asked how the committee could determine which goals/projects were more important. It was proposed that project staff present a general list of project solutions, with corresponding benefits, to demonstrate what types of projects/solutions address general issues found within the watershed. Another member disagreed, stating that the committee's job is to develop a list of problems or problem areas that they want to improve, and project staff would indicate what would work best for each item. The committee finally agreed to let project staff compile the list of goals, and to revisit the issue once everyone had had the chance to review the list off-line.

Meeting Adjournment

Dr. Southerland adjourned the meeting by asking committee members to rank or prioritize the broad list of goals/strategies discussed during this meeting. The list will be sent to committee members via email for review. Likewise, the date of the next committee meeting will be determined via email as well. Any questions or concerns about the goals discussed during this meeting will be addressed at the next committee meeting.

Information about Cameron Run and the Cameron Run Watershed Management Plan can be found on the Fairfax County watershed plans website at www.fairfaxCounty.gov/watersheds. Under pages specifically dedicated to the Cameron Run watershed plan, readers will be able to access other supporting documents. A meeting and events calendar and meeting minutes for the Cameron Run Advisory Committee are also located on the County website. The Cameron Run website contains a message board that community members can use to share ideas and also comment on plan drafts. Comments may be sent to the watershed email address at cameronrun@versar.com, or by calling the watershed hotline toll free at (886) 341-4599.

Cameron Run Watershed
Advisory Committee Meeting No. 11

Woodrow Wilson Public Library, Falls Church, Virginia

January 12, 2005

ADVISORY COMMITTEE MEMBERS IN ATTENDANCE:

Michael Aho – Providence District Board of Supervisors
Stacey Sloan-Blersch – U.S. Army Corps of Engineers Baltimore District Planning Division
Nick Byrne – Sleepy Hollow Homeowners Association (HOA)
Diane Davidson **–** Lake Barcroft Association
Chris and Tracey Eller -- Citizens
Davis Grant – Lake Barcroft Watershed Improvement District
Richard Hartman **–** Berkshire HOA/Huntington Community Association
Sally Henley – Tripps Run Resident
Kathy Joseph – Earth Sangha
Joan Maguire – Providence District Board of Supervisors
Robert Taylor – Poplar Heights Recreation Association
Tom Wasalf – City of Alexandria
Cynthia Wilson -- Poplar Heights Civic Association
Emael and Maura Yasin -- Citizens

PROJECT TEAM STAFF IN ATTENDANCE:

Dipmani Kumar -- Fairfax County Department of Public Works and Environmental Services (DPWES)
Gayle England -- Fairfax County DPWES Ecologist/Public Involvement
Fred Rose **–** Fairfax County DPWES
Mike Klevenz – Versar, Inc**.**
Mark Southerland – Versar, Inc.
Julie Tasillo – Versar, Inc.
Amanda Peyton **–** Horne Engineering Services, Inc.

The Cameron Run Watershed Plan

The Cameron Run watershed has experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the creek and its watershed. The Cameron Run Advisory Committee advises the Cameron Run Watershed Plan project team. Versar, Inc., prepares watershed plan drafts and engineering studies. Versar, Inc., and Horne Engineering Services, Inc. serve as facilitators for the public meetings. For more information, contact cameronrun@versar.com or visit http://www.fairfaxCounty.gov/watersheds.

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Meeting Purpose

Members of the Advisory Committee (AC) represent diverse stakeholder groups that reside throughout the Cameron Run watershed. The goal of the AC is to help Fairfax County develop a watershed management plan for Cameron Run that incorporates community interests in the evaluation of problems and implementation of solutions for protecting and restoring the streams and other natural resources within the watershed. The purpose of this meeting was to discuss and suggest potential solutions, or projects, for issues identified in Tripps Run, Upper Holmes Run, and Lower Holmes Run.

Key Decisions and Outcomes

- Notification of the next AC meeting will be sent via email once the date, location, and agenda have been set.

Action Items

- Project staff will poll committee members to determine a meeting date for March.
- Project staff will send out a notice prior to each meeting to see which voting members will be in attendance and to determine if enough voting members will be present.
- Project staff will complete maps of candidate solutions and make them available on the project web site. Individual hardcopy maps will be sent to AC members that request them.
- Project staff will draft chapters for the management plan and distribute them to committee members for review and comment.

Meeting Discussion

Introductions and Project Overview

Dr. Southerland of Versar convened the AC meeting with an introductory dialog between project staff and AC members, followed by a review of the committee ground rules and the meeting agenda. Materials distributed to committee members included:

- AC Meeting Agenda
- Consolidated List of Problems (to be placed in watershed handbook)
- Physical and Programmatic Solutions (to be placed in watershed handbook)
- Potential Projects (Management Alternatives) for Cameron Run Watershed (to be placed in watershed handbook)

Dr. Southerland then gave a brief overview of the project approach for watershed management plan development and reviewed the vision developed by the committee for the Cameron Run watershed.

Schedule for Plan Development

Dr. Southerland presented the following proposed schedule for final plan development:

- Committee review of candidate solutions for the subwatersheds of Turkeycock Run, Indian Run, Backlick Run, Pike Branch, and Cameron Run – February 2005 and via website

- Committee finalization of policy recommendations and public meeting preparations -- March 2005
- Public meeting to present Draft Cameron Run Watershed Management Plan – April 2005
- Committee review of final plan and public meeting preparations – May 2005
- Public meeting to present Final Cameron Run Watershed Management Plan – June 2005

PROCESS FOR IDENTIFYING CANDIDATE SOLUTIONS

Dr. Southerland gave a brief overview of the consolidated list of watershed problems as identified by committee members and the public. The consolidated list of problems includes:

- Loss of forest cover along streams in the watershed
- Increase of impervious surfaces
- Rapid stormwater delivery system
- Sources of point and non-point source pollution resulting from:
  - Lack of riparian buffers
  - Loss of instream habitat
  - Bank erosion and sedimentation
  - Irregular flows in streams
  - Channel alterations
  - Pollution
  - Bacteria
  - Flooding
  - Trash

Upon review of the above list, project staff divided the potential solutions into two categories, namely physical and programmatic solutions. A strawman list was developed based on recommendations presented in the Little Hunting Creek management plan. The list of solutions included:

- Physical solutions
  - Decrease impervious surfaces
  - Restore natural shape to culverts and eroded channels
  - Preserve or add trees and open spaces
  - Sweep streets and low cost solutions
  - Capture storm flows and sediments
- Programmatic solutions
  - Decrease trash and pollution
  - New regulations and policies
  - Tighter enforcement
  - Increase public awareness and transparency of government projects

In December 2004, project staff sent committee members an electronic poll to determine preferences for identifying solutions to watershed issues. Committee members were asked to vote on five items to determine what types of solutions or projects would be listed in the plan. Results of the poll are as follows:

- Protect most vulnerable places was first choice, but all four rated similarly
- Target solutions by site-specific and cumulative problems, rated nearly even
- Select solutions that provide greatest benefit regardless of time, rated slightly over projects within 5 years
- Riparian planting, LID, Stream restoration, Retrofits, Recreation, and New ponds, rated in that order
- 100% chose modifying allocation based on benefit

Based on these results, the project team decided to allocate projects among subwatersheds based on acres adjusted for uncontrolled imperviousness (see below).

Several committee members voiced concerns about implementation of the final watershed management plan and integration with other County plans and policies. Mr. Kumar of DPWES reassured committee members that the County already has regulations in place to address this issue. He reminded committee members that through the planning process, the public working through the committee will assist the County in directing stormwater management and identifying future stormwater projects. Mr. Kumar also informed committee members that the Fairfax Department of Public Works is working with the Board of Supervisors to ensure that new and upcoming policies are consistent with the other County regulations and with the recommendations provided by this committee.

REVIEW OF CANDIDATE SOLUTIONS/PROJECTS FOR TRIPPS RUN, UPPER HOLMES RUN, AND LOWER HOLMES RUN SUBWATERSHEDS

Based on the results of the poll discussed above (i.e., the AC desire to allocate projects among the 8 subwatershed based on level of water quantity/quality control and/or intensity of land use for each subwatershed) and on watershed modeling, project staff proposed a draft list of projects for each subwatershed. Projects included Low Impact Development (LID), stream and wetland restoration, retrofits to existing ponds, creation of additional small detention ponds, and watershed-wide riparian and reforestation plantings. The proposed breakdown of projects per watershed is as follows:

- Tripps Run – 16 %
- Upper Holmes Run – 19 %
- Lower Holmes Run – 14 %
- Turkeycock Run – 4 %
- Indian Run – 6 %
- Backlick Run – 28 %
- Tributaries to Cameron Run – 8 %
- Pike Branch – 5 %

Project staff generated a map of issues and corresponding solutions or projects for each subwatershed in Cameron Run. The maps reflect issues and solutions identified by committee members and the public, as well as those recommended by project staff through analysis of aerial photos and watershed conditions. Each map includes an aerial photo, land uses, and proposed projects within the subwatershed. The goal of each proposed project is to remove water as quickly as possible since 80% of the stormwater in the watershed is uncontrolled.

Each committee member was asked to review the proposed projects identified on the subwatershed maps for Tripps Run, Upper Holmes Run, and Lower Holmes Run. Project staff and committee members agreed that the particular projects identified in the management plan should provide the greatest benefit to the watershed. Mr. Kumar reminded committee members that the County will focus its efforts on County-owned or -operated lands and properties since the County does not have the authority to mandate stormwater best management practices (i.e., installation of raingardens) on private landowners. However, the management plan can still contain recommendations for educating and encouraging the public to voluntarily adopt these practices.

Maps detailing proposed projects for Turkeycock Run, Indian Run, Backlick Run, the tributaries to Cameron Run, and Pike Branch will be prepared and posted on the website of committee review. The project team will continue to identify solutions and solicit committee input throughout development of the draft plan.

Meeting Adjournment

Dr. Southerland adjourned the meeting by informing committee members that Ms. Shore of Versar will contact committee members via email to determine a date for the February meeting. Committee members inquired about the availability of the maps that were presented at this meeting and the maps that will be presented at the February meeting. Project staff informed committee members that the maps presented at this meeting will be available on the watershed website by mid-January and the maps for the remainder of the watershed will be available in February.

Information about Cameron Run and the Cameron Run Watershed Management Plan can be found on the Fairfax County watershed plans website at www.fairfaxCounty.gov/watersheds. Under pages specifically dedicated to the Cameron Run watershed plan, readers will be able to access other supporting documents. A meeting and events calendar and meeting minutes for the Cameron Run Advisory Committee (AC) are also located on the County website. The Cameron Run website contains a message board that community members can use to share ideas and also comment on plan drafts. Comments may be sent to the watershed email address at cameronrun@versar.com, or by calling the watershed hotline toll free at (886) 341-4599.

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Cameron Run Watershed
Advisory Committee Meeting No. 12

Woodrow Wilson Public Library, Falls Church, Virginia

April 7, 2005

ADVISORY COMMITTEE MEMBERS IN ATTENDANCE:

Glenda Booth – Fairfax County Wetlands Board
Nick Byrne – Sleepy Hollow Homeowners Association (HOA)
Florence Cavazos – Tripps Run Resident
Diane Davidson **–** Lake Barcroft Association
Jonathan Daw – Poplar Heights Civic Association
Chris and Tracey Eller – Citizens
Davis Grant **–** Lake Barcroft Watershed Improvement District
Richard Hartman – Berkshire HOA/Huntington Community Association
Sally Henley – Tripps Run Resident
Bill Hicks – Northern Virginia Regional Commission
Kathy Joseph – Earth Sangha
George Madill – Bren Mar Civic Association
Joan Maguire – Providence District Board of Supervisors
Jim McGlone – Department of Forestry
Liz McKeeby – Supervisor Gross/Mason District Office
Erin Stevens -- Citizen
Robert Taylor – Poplar Heights Recreation Association
Tom Wasalf – City of Alexandria
Bruce Williams – Citizen
Emael and Maura Yasin – Citizens

PROJECT TEAM STAFF IN ATTENDANCE:

Gayle England -- Fairfax County Department of Public Works and Environmental Services (DPWES) Ecologist/Public Involvement
Mike Klevenz **–** Versar, Inc**.**
Morris Perot – Versar, Inc.
Kris Sillett **–** Versar, Inc.
Jennifer Shore **–** Versar, Inc.
Mark Southerland – Versar, Inc.
Amanda Peyton **–** Horne Engineering Services, Inc.

The Cameron Run Watershed Plan

The Cameron Run watershed has experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the creek and its watershed. The Cameron Run Advisory Committee advises the Cameron Run Watershed Plan project team. Versar, Inc., prepares watershed plan drafts and engineering studies. Versar, Inc., and Horne Engineering Services, Inc. serve as facilitators for the public meetings. For more information, contact cameronrun@versar.com or visit http://www.fairfaxCounty.gov/watersheds.

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MEETING PURPOSE

Members of the advisory committee (AC) represent diverse stakeholder groups that reside throughout the Cameron Run watershed. The goal of the AC is to help Fairfax County develop a watershed management plan for Cameron Run that incorporates community interests in the evaluation of problems and implementation of solutions for protecting and restoring the streams and other natural resources within the watershed. The purpose of this meeting was to present the selected projects for publicly-owned lands (Tier 1) in the Cameron Run Watershed, review programmatic recommendations, and discuss the proposed agenda for the upcoming public meeting on the draft watershed management plan.

Key Decisions and Outcomes

- Notification of the next AC meeting will be sent via email once the date, location, and agenda have been set.
- Notification of the Draft Plan Review public meeting will be sent via email once a final date and location have been determined (the June 16 date has been confirmed).
- Only Tier 1 projects (those on public lands and non-public projects with the highest priority) will be described in detail at the public meeting and included in the body of the watershed management plan. Tier 2 projects (most non-public land projects) will be included in an appendix of the plan (see *Review of Candidate Solutions/Projects for Cameron Run Watershed*).

Action Items

- Project staff will poll committee members to determine a meeting date during summer 2005.
- Project staff will draft chapters for the management plan and distribute them to committee members for review and comment.
- Committee members will submit comments on proposed solutions/projects, draft programmatic recommendations, and the draft plan table of contents to project staff.

Meeting Discussion

INTRODUCTIONS AND PROJECT OVERVIEW

Dr. Southerland of Versar convened the AC meeting with an introductory dialog between project staff and AC members, followed by a review of the meeting agenda. Materials distributed to committee members included:

- AC Meeting Agenda
- Cameron Run Watershed Management Plan Table of Contents
- Example Template for Cameron Run Watershed Plan Selected Projects
- Programmatic Recommendations from Cameron Run
- Draft Agenda for Draft Plan Review Public Meeting

OVERVIEW ON PLAN DEVELOPMENT/CONTENT

Dr. Southerland gave a brief overview of the watershed management plan development process and presented a proposed table of contents (TOC) for the Draft Cameron Run Watershed Management Plan.

The proposed TOC presented at this meeting has been revised from the TOC presented in the Cameron Run Watershed Workbook based on County and AC member input. Chapters 1-5 of the watershed management plan will focus on background and management plan development methods, while Chapter 6 will contain the actual management plan. The Cameron Run Watershed Management Plan will include the following chapters:

- Chapter 1: Introduction
- Chapter 2: Overview of the Watershed
- Chapter 3: Assessing the Condition of Cameron Run Watershed
- Chapter 4: State of Cameron Run and Its Subwatersheds
- Chapter 5: Watershed Management Plan Development
- Chapter 6: Watershed Management Plan
    - Vision, Goals and Objectives
    - Policy, Land Use, and Programmatic Actions
    - Project Actions: *Location, Concept, Costs, Benefits, Priorities, and Monitoring*
    - Actions Summary
    - Implementation
    - Benefits Summary

Dr. Southerland explained to AC members that as a result of watershed management planning efforts thus far, Fairfax County has decided to review and update programmatic solutions for watershed management County-wide, rather than by watershed. At the conclusion of this discussion, Dr. Southerland reminded AC members that their input on the structure of the proposed plan is still welcome. All comments should be submitted to Ms. Jennifer Shore of Versar.

PROCESS FOR SELECTING PROJECT SITES

Dr. Southerland explained the process used for selecting projects to be included in the watershed management plan. Project selection was based on (1) the process described at the last AC meeting where staff conducted an exhaustive search for appropriate sites (based on stream characterization and landscape opportunities) and (2) the inclusion of sites identified by the AC and public. These approximately 600 sites were then grouped into land ownership categories (privately or public owned properties). Specifically, the staff identified candidate sites by reviewing stream condition and land use maps, and by relating proposed projects to AC and County management plan goals including:

- Reducing impervious areas in headwaters
- Identifying lots suitable for bioretention
- Identifying whether the topography and infrastructure are suitable for either a detention pond or retrofit to an existing pond
- Verifying available land (e.g., chapter 2 roads, schools, parks without trees)
- Identifying those streams that are degraded but stabilizing as restoration candidates

Dr. Southerland further explained that projects located on publicly owned lands will be identified as Tier 1 projects and a detailed analysis will be conducted on these projects to

- Examine the relative benefit for stormwater retrofit or LID project based on area to be treated and percent reduction in water quality pollution (watershed goal is a 10% reduction in pollution)

- Identify stream restoration sites based on the Stream Condition Index and projected stability after stormwater controls are implemented

Final selection of Tier 1 projects for inclusion in the watershed management plan will be based on each project's priority ranking. The priority ranking is obtained by applying the following formula to each project on the Tier 1 list:

Area	x	Relative Flow Reduction low = 1 moderate = 2 high = 3	x	Relative WQ Benefit low = 1 moderate = 2 high = 3	x	% Imperviousness - roads - roofs - sidewalks	=	Relative Project Priority

All other identified projects (i.e., those not on public lands and or with lower priorities) will be placed on the Tier 2 list and will be included in the watershed management plan as an appendix. A detailed analysis will not be conducted on Tier 2 projects by project staff unless requested by the County.

One AC member inquired about the method that will be used to determine whether the County is meeting their goal of a 10% reduction in water quality pollution. Versar will conduct modeling at the subwatershed level to determine the reduction in pollutant loading.

Review of Candidate Solutions/Projects for Cameron Run Watershed

Dr. Southerland clarified to AC members how each of the 247 Tier 1 projects was allocated in the Cameron Run watershed. The types of projects that will be included in the final watershed management plan are Low Impact Development (147 projects), stream and wetland restoration (34 projects), retrofits to existing ponds (42 projects), and creation of additional small detention ponds (24 projects). The allocation of projects per watershed would approximate the percentages in the goals (based on area of non-controlled impervious surface) as follows:

- Trips Run – 15.0
- Upper Holmes Run – 27.5
- Lower Holmes Run – 8.1
- Turkeycock Run – 11.3
- Indian Run – 6.1
- Backlick Run – 18.6
- Tributaries to Cameron Run – 6.1
- Pike Branch – 7.3

The watershed management plan will provide detailed descriptions of each proposed project that should be undertaken by the County. These descriptions will include a project type and concept, an aerial location map, a proposed cost estimate, benefits of the proposed project (e.g., reduction in stormwater flows), implementation schedule, and project prioritization. Not all projects will be initiated within the same year and the County has requested that project staff prioritize projects in five-year increments up to twenty years. Prioritization was based on how a particular project meets the following criteria:

- Direct contribution to regulatory obligations (i.e. Virginia tributary strategies, municipal separate storm sewer system (MS4) storm water permits, etc.)
- Public support from the AC and affected residents (i.e. projects identified by the AC)
- Location in headwaters and effectiveness in reducing stormwater runoff and improving water quality through habitat improvements
- Ease of implementation (e.g., project complexity, land acquisition)
- County board-adopted categories, including political interest

Project staff generated maps of issues and corresponding solutions or projects for each subwatershed within Cameron Run. The maps reflect issues and solutions identified by AC members and the public, as well as those recommended by project staff through analysis of aerial photos and watershed conditions. Each map includes an aerial photo, land uses, and proposed projects within the subwatershed. Upon review of the maps for each subwatershed, some AC members expressed concerns that there were no projects specified to address dams, weirs, or designated resource protection areas. Dr. Southerland encouraged all AC members to send all comments and concerns to Ms. Shore of Versar. Maps of the proposed projects in each subwatershed are available on the Cameron Run Watershed page on the Fairfax County watershed plans website. Alternatively, AC members can request a printed map of their subwatershed from project staff (requested maps have been mailed). The project team will continue to identify solutions and solicit committee input throughout draft plan development.

Draft Programmatic Recommendations

Ms. Shore of Versar emailed the draft programmatic recommendations for inclusion in the watershed management plan to AC members for review and comment. The draft recommendations included three main goals to direct policy within Cameron Run:

- Goal 1: Reduce storm water impacts from impervious areas to help restore and protect the streams in the Cameron Run watershed
- Goal 2: Preserve, maintain, and improve watershed habitats to support native flora and fauna
- Goal 3: Preserve, maintain, and improve stream water quality to benefit humans and aquatic life

Dr. Southerland and Ms. Shore initiated a discussion of proposed programs and policies to be included in the watershed management plan. AC members stressed that additional programmatic recommendations are needed to fully address managing stormwater, maintaining habitat, or for addressing funding and project implementation. AC members were also concerned that more time was not allocated to discussing programmatic recommendations in a group setting. AC members were encouraged to meet outside the AC meeting schedule to discuss and revise the proposed recommendations as necessary.

County Buffer Restoration Initiative

Ms. Gayle England of DPWES announced that Fairfax County has undertaken a buffer restoration initiative where forty sites within the County will be restored by spring 2006. All forty of the sites are located on public lands and residents are encouraged to participate in restoration efforts. The first buffer planting restoration project will be at Luria Park in Falls Church on April 9, 2005. For more information on volunteering to restore a buffer area or to find out where other restoration plantings will be conducted, contact Ms. England directly or visit the buffer restoration webpage at www.fairfaxcounty.gov/dpwes/stormwater/riparianbuffer/default.htm.

Project Schedule and Next Public Meeting

- Public meeting to present Draft Cameron Run Watershed Management Plan – June 16, 2005
  - Meeting will be conducted from 7 – 9 PM at Mason District Building
  - Project staff encourage AC members to attend and participate in meeting break-out sessions
  - Public attendees will review revised Tier 1 project maps and factsheets (revisions based on feedback obtained from County and AC members)

- Tier 2 projects will neither be illustrated in map format, nor discussed at the public meeting other than to inform attendees that a list of Tier 2 projects will be included in an appendix of the plan
- Public attendees will be introduced to programmatic recommendations that will be contained in the final watershed management plan

- Committee review of final plan and public meeting preparations – Summer or Fall 2005
- Public meeting to present Final Cameron Run Watershed Management Plan – Fall 2005

Meeting Adjournment

Dr. Southerland adjourned the meeting by informing committee members that Ms. Shore of Versar will contact committee members via email to inform them of the finalized date for the next public meeting and to determine a date for a summer 2005 AC meeting.

Information about Cameron Run and the Cameron Run Watershed Management Plan can be found on the Fairfax County watershed plans website at www.fairfaxCounty.gov/watersheds. Readers can access supporting documents from pages specifically dedicated to the Cameron Run watershed plan.. A meeting and events calendar and AC meeting minutes are also available on the County website. The Cameron Run website contains a message board that community members can use to share ideas and comment on plan drafts. Comments may be sent to the watershed email address at cameronrun@versar.com, or by calling the watershed hotline toll free at (886) 341-4599.

Cameron Run Watershed
Advisory Committee Meeting No. 13

Mason District Government Building, Annandale, Virginia
June 8, 2006

ADVISORY COMMITTEE MEMBERS IN ATTENDANCE:

Hunt Anderson- Citizen
Glenda Booth– Fairfax County Wetlands Board
Florence Cavazos – Tripps Run Resident
***Diane Davidson* –** Lake Barcroft Association
Jonathan Daw – Poplar Heights Civic Association
Pat Gushman- Barcroft Woods Citizens Association
Sally Henley- Citizen
Bill Herz- Lake Barcroft Environmental Board
George Madill – Bren Mar Civic Association
***Pat Sanders*-** Limcolnia Park Civic Association
Maura Yasin – Upper Holmes Run Resident

PROJECT TEAM STAFF IN ATTENDANCE:
Dipmani Kumar – Fairfax County Department of Public Works and Environmental Services (DPWES)
Mike Klevenz – Versar, Inc**.**
Morris Perot – Versar, Inc
Jennifer Shore – Versar, Inc.
***Kris Sillett* –** Versar, Inc
Mark Southerland – Versar, Inc.

THE CAMERON RUN WATERSHED PLAN

The Cameron Run watershed has experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the creek and its watershed. The Cameron Run Advisory Committee advises the Cameron Run Watershed Plan project team. Versar, Inc., prepares watershed plan drafts and engineering studies. For more information, contact cameronrun@versar.com or visit http://www.fairfaxcounty.gov/watersheds.

The opinions represented herein do not necessarily represent those of Fairfax County or its agents.

MEETING PURPOSE

Members of the advisory committee (AC) represent diverse stakeholder groups that reside throughout the Cameron Run watershed. The goal of the AC is to help Fairfax County develop a watershed management plan for Cameron Run that incorporates community interests in the evaluation of problems and implementation of solutions for protecting and restoring the streams and other natural resources within the watershed. The purpose of this meeting was to inform AC on status of plan development, present the final project selection process for 100 high-priority projects on public-owned lands (Tier 1) in the Cameron Run Watershed, and review changes made to the plans programmatic recommendations that reflect input from the public and the County.

KEY DECISIONS AND OUTCOMES

- Notification of the next public meeting will be sent via email once the date and location have been set. September 2006 is the projected time period.
- Only Tier 1 projects (those located on public land that met specific criteria) will be described in detail at the public meeting and in the body of the watershed management plan. Tier 2 and Tier 3 projects (most non-public land projects) will be described in an appendix of the plan.

ACTION ITEMS

- Project staff will poll committee members to determine a meeting date during September 2006.
- Project staff will send out the summary of methods and the scoring table used to rank each project, and an electronic version of the revised programmatic goals and actions.
- Committee members will submit comments on proposed high-priority Tier 1 projects, and revised programmatic recommendations to project staff.

MEETING DISCUSSION

Introduction and Project Overview

Dr. Southerland of Versar convened the AC meeting with an introductory dialog between project staff and AC members, followed by a review of the meeting agenda. Materials distributed to committee members included

- AC Meeting Agenda
- Revised Programmatic Recommendations from Cameron Run
- Maps and fact sheets of 100 selected high-priority Tier 1 projects for review at breakout session

Overview on Plan Development and Content

Dr. Southerland gave a brief overview of the watershed management plan development process and presented the table of contents (TOC) for the Draft Cameron Run Watershed Management Plan. Dr. Southerland explained that a year had passed since the last AC meeting due to administrative delays and project work. The Draft Cameron Run Watershed Management Plan is divided into six chapters. Chapters 1-5 of focus on background and management plan development methods, while Chapter 6 contains the actual management plan. The Cameron Run Watershed Management Plan will include the following chapters:

Executive Summary

- Chapter 1 Introduction
- Chapter 2 Overview of the Watershed
- Chapter 3 Assessing the Condition of Cameron Run Watershed
  - -Stream characterization methods
  - -Modeling methods
  - -Public involvement
- Chapter 4 State of Cameron Run and its Subwatersheds
  - -Individual watershed subchapters
- Chapter 5 Watershed Management Plan Development
  - \- Methods
- Chapter 6 Watershed Management Plan
  - -Vision, Goals and Objectives
  - -Policy, Land Use, and Programmatic Actions
  - -Project Actions
  - -Location, Concept, Costs, Benefits, Priorities, and Monitoring
  - -Actions summary
  - -Implementation tracks
  - -Benefits summary
  - -Length of stream improved
  - -Reduction in pollutants
  - -Reduction in flow velocities
  - -Extent to which plan meets Trib and TMDL goals
  - -Contributions to biodiversity and quality of life

Process for Selecting Projects

Dr. Southerland explained the process used for selecting projects to be included in the watershed management plan. Candidate sites were identified through the following: reviewing maps of stream condition and land use (in conjunction with aerial photographs); soliciting input from County staff, AC, and public stakeholders; and mapping and calculating area to be treated and percent reduction in water quality pollution. Through this process approximately 600 candidate projects were selected. Approximately 235 of the project sites are on public lands. Field visits were done at approximately 190 sites to develop site-specific restoration concept plans and identify site constraints.

Grouping of candidate projects into three rankings was described as follows:

- **Tier 1** – Best opportunities for County implementation, located on public land, and selected using SWMD prioritization framework and project distribution goals set by the AC (at present 100 sites)
- **Tier 2** – Other good opportunities either on public land that were beyond the distribution goals set by the AC, or on private lands that received support from AC or the larger public (at present 90 sites)
- **Tier 3** – Remainder of the approximately 600 sites that were identified a feasible through map analysis and initial public involvement (at present 407 sites)

Dr. Southerland gave a brief overview of how the projects would be laid out in the plan. Tier 1 projects have been described in full detail in project fact sheets; specific benefits and costs of each project will be included in the plan. Tier 2 and Tier 3 projects have been described in lesser detail but will be included an appendix; these projects may be implemented in the future by the County or the public as opportunities arise.

AC members had concerns over the project prioritization method for the Tier 1 projects and requested a summary of methods and the scoring table used to rank each project. Versar will send this information to the AC via email.

Dr. Southerland clarified to AC members that Tier 1 projects were chosen using the Fairfax County Project Prioritization Framework based on the following criteria:

- Direct contribution to regulatory obligations (VA Trib strategies, MS4 permits, TMDLs)
- Public support from advisory committee and affected residents
- Location in headwaters and effectiveness in reducing stormwater runoff and improving water quality through habitat improvements
- Ease of implementation based on project complexity, land acquisition, etc.
- Board adopted categories including political interest

Dr. Southerland presented the final allocation of Tier 1 projects (highest-priority) per subwatershed as follows:

Tripps Run	10
Upper Holmes Run	24
Lower Holmes Run	4
Turkeycock Run	13
Indian Run	10
Backlick Run	20
Tribs to Cameron Run	6
Pike Branch	10
Watershed-wide	3
	100%

The types of projects that will be included in the final watershed management plan are retrofitting existing SWM ponds, creating new SWM detention areas, low impact development (LID) projects, stream restoration, and drainage studies. Three of the Tier 1 projects are watershed-wide projects, and include instream debris jam evaluation and removal, community watershed restoration support, and a small watershed grant program.

Dr. Southerland emphasized that riparian planting and reforestation is a County-wide initiative. Dr. Southerland and Dipmani Kumar explained that the County would also incorporate approximately 25 drainage projects into the plan based on drainage complaints from the public.

Dr. Southerland presented the layout of the Tier 1 project fact sheets that would be in the plan prior to a breakout session for the committee to review the projects that was lead by Morris Perot and Mike Klevenz. Maps and binders with the Tier I projects were provided to the AC for review. Each of the 100 high-priority Tier 1 fact sheets contains the following information:

Project Type and Concept
Location (aerial map)
Cost Estimate
Benefits
Reduction in stormwater flows
Reduction in pollutant loads
Increase in healthy stream length
Timeline (sequence of implementation)

AC members that needed more time to review the Tier 1 projects were able to keep the fact sheet binders for further review and comment.

Revised Programmatic Goals and New Programmatic Actions

After the first breakout session, Dr. Southerland presented the following revised programmatic goals and actions from Chapter 6 of the watershed plan, which incorporated input received from the public and the County:

- **Goal A:** Reduce storm water impacts on the Cameron Run Watershed from impervious areas to help restore and protect the streams
- **Goal B:** Preserve, maintain, and improve watershed habitats to support desirable native flora and fauna
- **Goal C:** Preserve, maintain, and improve the water quality of the streams to benefit humans and aquatic life
- **Goal D:** Improve stream-based quality of life and recreational opportunities for residents of and visitors to Cameron Run Watershed

- **Action A1.7:** Fairfax County should coordinate stormwater management activities with those of neighboring jurisdictions.
- **Action A4.2:** Involve the public early in the planning of watershed projects and maintain transparency between the County and the public throughout the process. Improve coordination with and early notification of affected residents at both the study and implementation stages of proposed stormwater projects.
- **Action B1.5:** Amend the County tree-preservation ordinance to expand existing woodland habitat and prevent further deforestation.
- **Action B1.6**: Provide dedicated funding for inspectors that enforce the County's Chesapeake Bay Resource Protection Area Ordinance to improve enforcement, training, and supervision of builders and developers.
- **Action D2.2:** Install signage at public facilities to explain the reasons and benefits of rain gardens, green roofs, porous pavement, and other LID features.

Dr. Southerland initiated a discussion of the revised programmatic goals and actions to be included in the watershed management plan. There were concerns from some AC members that the revised actions lack specificity. AC members also recommended that the policies be strengthened in the areas of forest protection, recycling, and enforcement. It was agreed that the project staff would email the revised programmatic recommendations for inclusion in the watershed management plan to AC members for additional review and comment, and that the power point presentation from the meeting be posted on the website. AC members were also encouraged to fill out the comment cards that were available during the breakout session. Comments received included specific problems noted by some AC members (particularly erosion) and a commendation to the Cameron Run Plan development team for an excellent job.

Project Schedule and Next Public Meeting

Dr. Southerland reviewed a draft outline of the agenda for the next public meeting, which included the following:

Brief Introduction to the Watershed Planning Process
--Power point presentation by Versar and County
Summary of Draft Final Cameron Run Watershed Management Plan
--Power point presentation by Versar
Programmatic Recommendations in Draft Final Plan
--Posted on walls
Projects Selected in Draft Final Plan
--Breakout groups by subwatershed
--Each station with map, facilitator, recorder, and AC member

- Public meeting to present Draft Final Cameron Run Watershed Management Plan –September 2006

- Schedule for Plan Development
  AC review of revisions to Draft Final Plan (selected projects and programmatic recommendations) – TODAY
  Draft Final Plan Public Meeting – September 2006
  Final Plan Approved by County

MEETING ADJOURNMENT

Dr. Southerland adjourned the meeting by informing committee members that Versar will contact committee members via email to inform them of the date selected for the next public meeting. Versar will also email both policy recommendations handed out to AC and the project spreadsheet that shows project rankings.

Information about Cameron Run and the Cameron Run Watershed Management Plan can be found on the Fairfax County watershed plans website at www.fairfaxCounty.gov/watersheds. Readers can access supporting documents from pages specifically dedicated to the Cameron Run watershed plan. A meeting and events calendar and AC meeting minutes are also available on the County website. The Cameron Run website contains a message board that community members can use to share ideas and comment on plan drafts. Comments may be sent to the watershed email address at cameronrun@versar.com, or by calling the watershed hotline toll free at (886) 341-4599.

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C-2 Public Meetings

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Cameron Run Watershed
Public Issues Scoping Forum

George Mason Government Center, Annandale, Virginia
June 17, 2004

PROJECT TEAM STAFF IN ATTENDANCE:

Dipmani Kumar **–** Fairfax County Department of Public Works and Environmental Services (DPWES)
Gayle England – Fairfax County DPWES
Fred Rose **–** Fairfax County DPWES
Clem Rastatter – Versar, Inc.
Jennifer Shore – Versar, Inc.
Mark Southerland **–** Versar, Inc.
Julie Tasillo **–** Versar, Inc**.**
Amanda Peyton **–** Horne Engineering Services, Inc.
Mark Mobius **–** Horne Engineering Services, Inc.

PUBLIC IN ATTENDANCE:

In addition to the project team staff, the meeting was attended by 40 members of the public, representing each of the eight subwatersheds in the Cameron Run Watershed.

THE CAMERON RUN WATERSHED PLAN

The Cameron Run watershed has experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the creek and its watershed. The Cameron Run Advisory Committee advises the Cameron Run Watershed Plan project team. Versar, Inc., prepares watershed plan drafts and engineering studies. Versar, Inc., and Horne Engineering Services, Inc. serve as facilitators for the public meetings. For more information, contact cameronrun@versar.com or visit http://www.fairfaxcounty.gov/watersheds.

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MEETING PURPOSE

The purpose of this Public Issues Scoping Forum was to elicit and record input on the issues that most concern the citizens of the Cameron Run Watershed in Fairfax County, VA. The ultimate goal of the forum was to help Fairfax County develop a watershed management plan for Cameron Run that incorporates community interests in the evaluation of problems and the implementation of solutions for protecting and restoring the streams and other natural resources of the watershed.

Welcome and Introduction

Mr. Fred Rose of DPWES welcomed attendees and introduced Fairfax County Supervisor, Penny Gross. Supervisor Gross offered a brief introduction to the forum before introducing Carl Bouchard, Director of the Fairfax County Stormwater Planning Division, who reinforced the idea that the Cameron Run Watershed Management Plan belongs to the people and that it should reflect the needs of the people of Cameron Run.

Dr. Mark Southerland of Versar, after briefly reiterated the purpose and goals of the forum, introduced Dipmani Kumar of DPWES. Mr. Kumar described what Fairfax County is currently doing in terms of watershed management. He explained that the County is currently working on a comprehensive stormwater management program to cover the 30 designated watersheds in the County. The County has set a 5-year target for developing management plans for all 30 watersheds. These plans, he explained, will not only help protect the watersheds, they will also fulfill commitments made by the Commonwealth of Virginia in signing the Chesapeake 2000 agreement.

Dr. Southerland then delivered a brief presentation to provide background for the forum participants. First he defined the concept of a watershed; then he outlined what a watershed management plan is and what it can do for the residents of Cameron Run watershed. Fairfax County, Versar, Inc., Horne Engineering Services, Inc., the Advisory Committee, and the Public are all involved in developing Cameron Run Watershed's management plan. Dr. Southerland described the geography of Cameron Run Watershed, and detailed some of the watershed's problems including altered flow, physical impacts, and water quality issues. Dr. Southerland then introduced the concept of computer modeling, and explained how it will be an important tool in understanding the watershed. He continued by explaining where planners are in the process of developing the management plan, reinforcing the idea that the process is following a *public involvement* approach. To conclude, Dr. Southerland pointed out that there was a wealth of additional information (i.e., fact sheets) available on the tables; this information, as well as the Cameron Run Watershed workbook and all Advisory Committee meeting minutes, are also available on the website. At that point, he returned to the issue of "why we are here."

Why we are here – concerns and issues from the public

Two committee members spoke to the forum participants about why they were interested in watershed management and what brought them to the forum. One Advisory Committee member related that their interest is derived from, among other things, an interest in marine conservation and an understanding that what Fairfax County does ultimately affects the ocean. Another Committee member became interested in watershed management because how the plan is developed with entail fairness issues on how flooding and backyard floodplains are addressed. Clem Rastatter of Versar, asked attending Advisory Committee members to share their reasons for becoming involved in the process. Among the responses were the following: flooding; endangered species; quality of life; the County should do a better job protecting the watershed; need for more info on the watershed management process; improve water quality; and the connection between Cameron Run and the Chesapeake Bay program.

Questions & Answers

Dr. Southerland put the issue into a regional context, describing the plan's development as a political and societal process that will help to improve water quality in the Chesapeake Bay. The County is developing plans to meet goals and commitments that Virginia agreed to by signing the Chesapeake 2000 agreement, a multi-state reaffirmation of a commitment to clean up the bay.

One public meeting attendee inquired about management plan implementation funding. In response, Fred Rose explained that supervisors may dedicate funds to developing and implementing County watershed management plans, including Cameron Run. The County will also be looking for alternate funding sources for implementation. Another participant urged the County to pursue all sources of funding because there is a mandate to improve water quality in order to avoid future implementation of Total Maximum Daily Loads (under Clean Water Act).

Discussion also focused on the status of the plan. Ms. Rastatter explained that there is currently no Cameron Run Watershed Management Plan. Planners are currently soliciting feedback from the public and studying the watershed. Most streams in Fairfax County are rated poor to very poor, and it will be important to understand how watersheds within Fairfax County affect overall Chesapeake Bay water quality, and how development of this watershed management plan will affect Bay restoration efforts.

Brainstorming and Breakout Sessions

Meeting attendees were divided into three groups to participate in breakout brainstorming sessions. The purpose of the breakout sessions was to identify stakeholders' concerns with respect to the Cameron Run watershed rather than to discuss possible solutions to those concerns. At each session, a facilitator invited participants to relate what they felt were important issues in the watershed while another project staff member recorded items as they were put forth. Each group produced a long list of items that participants felt were *important to* or *of concern in* the Cameron Run Watershed.

Project staff facilitators encouraged participants to prioritize items of concern using a system called 10/4 voting. Each participant was allotted a total of 10 votes to cast for the items he or she felt were most important, and voters were allowed to cast from 0 – 4 votes for any single item. Those items receiving greater numbers of votes were assigned higher relative importance or priority than items receiving fewer votes. It was stressed to participants that this activity was not a final priority, nor was it intended to exclude any suggestions from an eventual plan. Rather it served to highlight items that each group felt were of greatest importance.

The following section details the five items that received the most votes from each group, and briefly summarizes other concerns identified in the breakout sessions.

Group 1:

Highest Priority Items	*Votes*
Quality of life improvements	13
Tighter enforcement by County government	7
Sedimentation	7
Imperviousness	6
Trash/Pollution	6

Many of the group's concerns were associated with policy and enforcement. Related items that didn't appear on the highest-priority list were transparency, reporting violations, down zoning, "enforcement funding" (fines, penalties, etc.) going toward restoration, decreasing urban sprawl/meeting increasing housing demands via infill of developed areas, and ensuring that the "rules" are followed by Federal, State, and local governments. Aesthetic stream design and shoreline restoration were discussed as well as Resource Protection Areas (RPAs), conservation easements, riparian buffers, and increasing vegetation in general. The group also thought that the engineers and planners should consider the overall watershed condition when designing transportation projects, and that seasonal snow removal methods play an important role in watershed health.

Group 2:

Highest Priority Items	*Votes*
Policy & Planning	5
Flooding	5
Recreation	4
Enforcement	4
Impervious surface	4

This group thought that Fairfax County's policies encouraged development without concern for how the development affects the environment. Waivers are granted too often for environmental regulations, and regulations between multiple agencies are not always consistent. For example, one regulation states that erosion controls should be placed in certain locations while another agency's regulation states that the erosion controls are not needed. Regulations that are in existence should be enforced and those developers that cause problems should be held accountable. This group recommends that impervious surfaces be retrofitted with Low Impact Development (LID) measures, that the County adopt an LID policy where County facilities use LID practices, and that incentives be given for the use of LID practices that preserve existing green space. In addition, areas should be set aside for recreational use, existing Trail systems should be interconnected to provide an alternative to vehicle transportation, and planting riparian buffers along streams should be encouraged.

Because there are numerous flooding problems throughout the County, Fairfax County should work with the City of Falls Church and the City of Alexandria to develop a monitoring program. This effort would provide useful data to identify where problems exist. Citizen participation and education should be encouraged.

Group 3:

Highest Priority Items *	*Votes*
Dechannelizing Tripps Run	16
Loss of open space and cutting down trees	10
Trail enhancement	8
Periodic street sweeping and other low cost alternatives	8
Concrete and asphalt	8
Low public awareness	8

* Top 6 listed to include 4-way tie with 8 votes each

Group 3 also identified many items relating to policy, planning, or enforcement. Participants felt that County regulations should be brought more in line with good stormwater management practices, that the County could serve as a better role model in developing its property, and that there should be more coordination between zoning, permitting, and planning processes. They felt that it is important to ensure better erosion control/storm water management at construction sites, and to catch "midnight dumpers" who illegally deposit trash and debris in the watershed. The group also questioned the adequacy of County resources and their authority to deal with such activities.

Numerous items pertained to stormwater management: storm drainage on main roads needs to be improved, retention ponds for flood/stormwater control and sediment control aren't working (what can be done with the dredge spoils?), and there is poor water management within developments. The group noted that in addition to soils/suspended solids this runoff carries trash, bacteria, pesticides, herbicides, and fertilizers, and they thought that, to the extent possible, decontamination of runoff should occur at the source. Participants also felt that small particulate matter and air pollutants could have significant impacts within the watershed.

Finally, the group felt that it would be important to identify potential terrestrial habitat for buffers and infiltration, identify soils amenable to recharge the water table, and restore streambeds to support aquatic life. Planners, they thought, should zone for open spaces. RPAs should be clearly designated and maximum flood depths should be marked along trails.

Forum Conclusion

The forum participants regrouped after the breakout sessions and the breakout session facilitators presented their groups' findings. Project staff thanked attendees for their participation and closed the meeting, remaining on-hand to answer additional questions.

Information about Cameron Run and the Cameron Run Watershed Management Plan can be found on the Fairfax County watershed plans website at www.fairfaxcounty.gov/watersheds. Under pages specifically dedicated to the Cameron Run watershed plan, readers will be able to access other supporting documents. A meeting and events calendar and meeting minutes for the Cameron Run Advisory Committee are also located on the County website. The Cameron Run website contains a message board that community members can use to share ideas and also comment on plan drafts. Comments may be sent to the watershed email address at cameronrun@versar.com, or by calling the watershed hotline toll free at (886) 341-4599.

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Cameron Run Watershed
Community Watershed Forum

Holmes Middle School, Alexandria, Virginia
October 23, 2004

PROJECT TEAM STAFF IN ATTENDANCE:

***Dipmani Kumar* --** Fairfax County Department of Public Works and Environmental Services (DPWES)
***Gayle England* --** Fairfax County DPWES, Ecologist/Public Involvement
Fred Rose – Fairfax County DPWES
Morris Perot – Versar, Inc.
Clem Rastatter – Versar, Inc.
Jennifer Shore – Versar, Inc.
Mark Southerland – Versar, Inc.
***Julie Tasillo* –** Versar, Inc.
***Amanda Peyton* –** Horne Engineering Services, Inc.

THE CAMERON RUN WATERSHED PLAN

The Cameron Run watershed has experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the creek and its watershed. The Cameron Run Advisory Committee advises the Cameron Run Watershed Plan project team. Versar, Inc. prepares watershed plan drafts and engineering studies. Versar, Inc., and Horne Engineering Services, Inc. serve as facilitators for the public meetings. For more information, contact cameronrun@versar.com or visit http://www.fairfaxcounty.gov/watersheds.

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MEETING PURPOSE

The purpose of this Community Watershed Forum was to educate the public on the current status of the Cameron Run Watershed, Fairfax County's planning and zoning process, benefits and application of Low Impact Development technology, and to elicit and record input from attendees of the issues that most concern them and proposed solutions for those issues. The ultimate goal of the forum was to help Fairfax County develop a watershed management plan for Cameron Run that incorporates community interests in the evaluation of problems and implementation of solutions for protecting and restoring the streams and other natural resources of the watershed.

Welcome and Introduction

Dr. Mark Southerland of Versar opened the Community Watershed Forum by introducing public attendees to the project team and the watershed vision developed by the advisory committee. Dr. Southerland then briefly reiterated the purpose and goals of the forum, and then turned the introduction over to Fred Rose of DPWES who discussed County goals and objectives for engaging the public throughout the watershed management plan process. Specifically, Mr. Rose stressed the importance of gathering public input to ensure that the finalized watershed management plan is not only compliant with current federal and state regulations, but that the plan addresses future impacts as well. Fairfax County has recognized that the Cameron Run Watershed is impaired, and with the assistance of the community, solutions will be found. Today's forum will help to raise community awareness and attendee input will help the County and project staff to understand all watershed impacts and will facilitate plan development.

Following Mr. Rose, an advisory committee member briefly discussed their interest in watershed management plan development. The agenda for this public meeting was to 1) go over basics of the Cameron Run Watershed, 2) review the development of the watershed management plan, and 3) to gather public input on issues and solutions. Dipmani Kumar, of DPWES, gave an overview of the Stormwater Business Area in Fairfax County and provided an update on the status of the Watershed Planning program countywide. Stacy Blersch of the United States Army Corps of Engineers (USACE) informed participants about a cost-sharing agreement between Fairfax County, the City of Alexandria, and the USACE to conduct a feasibility study for the Cameron Run watershed. The cost-sharing agreement will allow Fairfax County to participate in future cost-sharing arrangements with the Corps for implementing capital improvement projects that are identified by the final watershed plan for Cameron Run.

Materials distributed and made available to meeting attendees included:

- Community Watershed Forum Agenda
- Watershed Academy Presentations (including insert)
- Presentation of Fairfax County's Planning and Zoning Process
- The Countywide Policy Element of The Comprehensive Plan for Fairfax County
- Flyer concerning the benefits of Raingardens
- Example Problems and Potential Solutions spreadsheet

Watershed Academy

Dr. Southerland conducted the watershed academy by discussing the current condition of the Cameron Run Watershed, which included an in-depth discussion on the definition of a watershed, urban stream ecology, and the stresses impacting the Cameron Run Watershed. Overall, the Cameron Run watershed has poor stream quality based on the Stream Protection Strategy conducted by the County. Dr. Southerland; Noel Kaplan, of the Fairfax County Department of planning and Zoning; and Larry Coffman, of Prince Georges County Maryland, discussed possible solutions for improving the watershed. Topics discussed included:

- Fairfax County Zoning and Planning process
- Using Low Impact Development techniques to reduce development impacts
- Effects of the watershed Management Plan on water quality
- Public role in watershed management plan development

Community Watershed Plan Input

Meeting attendees were asked to identify specific areas within the watershed that are impaired, and then to suggest solutions for those impairments. Prior to breaking out into groups, Mr. Rose assured public attendees that Fairfax County has already been initiating projects to address major watershed problems. Some of these projects include buffer replanting along streams, and identifying and cleaning up dumpsites within the County. Full implementation of County watershed managements plans can take up to several years due to policy revision and obtaining project funding. Through developing a partnership with USACE and by assessing capital improvements and maintenance funding, the County will be better able to implement watershed management plans. The County also informed meeting attendees that the County Board of Supervisors adopted an environmental excellence plan in June that encourages a proactive approach to addressing future issues. This plan encourages identifying and taking advantage of environmental and technological opportunities.

The following tables depict specified areas of tributary impairment and suggested solutions for those areas.

Northern Region: Tripps Run, Holmes Run Upper, Holmes Run Lower		
Location	**Problem**	**Solution**
Tripps Run & Tributary stream north on Sleepy Hollow Rd.	Excessive Channelization Elevated Stream sewer runoff Frequent Pollution/dumping	Fairfax County educate residents on: a) Plantings b) Stormwater controls c) Pollution monitoring equipment d) Neighborhood watch and environmental groups e) Improving habitat conditions
Poplar Heights	Severe bank erosion Storm runoff	Provide additional stormwater controls in upland areas to reduce the magnitude and frequency of flows; apply bioengineering and natural stream channel design approaches to stabilize streambanks and bed, and improve habitat conditions. LID retrofits upstream.

Holmes Run Acres	High density housing on hill Erosion Habitat destruction Runoff Flooding	In new design, remove use of cul-de-sacs; make housing areas less dense, use swales, check dams, and increase riparian buffer along established trail.
Culmore Creek	High bacteria levels in stream	Find source
Jeb Stuart Stream Valley	Invasives	Remove invasives and re-establish riparian buffer
Marshall Property	Uncontrolled dumpsite	Clarification of zoning issues and inspection by the city of the dumpsite.
Fairfax County portion of Tripps Run	Stream channelization	Investigate retrofit opportunities and stream restoration
Custis Parkway	Stream erosion	Stream bank stabilization
Loeumans Plaza	Impervious surface Staging area for winter salting and de-icing	Require clean-up of salt and sand after release by dump trucks (street sweeping)
Valleycrest Drive	Stream bank erosion	Stream bank stabilization
"Barcroft Blight" Apartment Complex	Trash Undercut banks	Stream bank stabilization and remove trash
Tripps Run south of Holmes Run Road between Annandale and Sleepy Hollow	Abandoned sewer line that occasionally leaches out pollutants and other material	Clean-up old sewer line
Parcel A of Cloisters	Steep bank erosion	Stream bank stabilization
Shreve Road building site development	Erosion	Establish sedimentation controls during construction to minimize runoff from site
Glavis Property/Sleepy Hollow Rd.	Opportunity	Purchase Glavis property land for conservation easement. Opportunity to buy/save 10 acres of undeveloped woodland.
Opposite side of Tripps Run creek behind Bill Page Honda and US Post Office, Annandale Road and Route 50	Chemicals and trash in Tripps Run	Find chemical source and clean-up trash
Potters Drive	Sedimentation buildup	Stream bank stabilization and dredging of accumulated sediment.
Calvert Street	Severe erosion	Stream bank stabilization
JebStuart High School Parking Lot	Excessive runoff	Install pervious pavers and bioretention areas
Holmes Run Acres to Lake Barcroft	Lack of recreational opportunities	Extend bike trail
Broad street Multi-office building	Re-development of existing office building	Establish controls to minimize stream and habitat destruction

General Watershed-wide Issues
VDOT salt and sand removal procedures
Disconnect between city of Falls Church, City of Alexandria, and Fairfax County

General Watershed-wide Solutions
Integrate City of Falls Church into USACE agreement with City of Alexandria and Fairfax County
County-wide street sweeping program
Increase educational signage around county and make existing signage bigger and brighter (more noticeable)

Central Watershed: Backlick Run, Indian Run, Turkeycock Run Location	Problem	Solution	Contact Information
Lower reaches of Holmes- Van Dorn to Eisenhower Ave.	Cutting down all vegetation on stream bank. Mowing bottom 2/3 of berm. The berm is widened every few years. There is an agreement with the City of Alexandria and the ACOE.	Stop cutting vegetation/ plant riparian buffer	Gossett
Tributary off of Backlick Run (personal property)	Dump site, fenced off area, parked truck trailers (alleged group of people living in trailers)	Create a river edge park	Harry/Barbara Gossett
Predominantly industrial area/ boating companies	Collection of upstream trash	organize stream clean up	Harry/Barbara Gossett
Cameron Run mainstem	Channelized ditch	River edge park/ dechannelizing (ex. Four mile run is in the process of retrofits, contact Bill Hicks)	Harry/Barbara Gossett
Holmes Run Trail (below Barcroft Dam) Columbia Pike to Old Towne Alexandria to the Potomac River. ADC map 16/E13 is where the trail stops	The trail runs from below the Lake Barcroft Dam to the Potomac except where the trail ends around the private pool.	Extend the walking path	Harry/Barbara Gossett
Cameron Run mainstem	Non-operational weir. The sediment should settle out downstream of the weir. It was changed and now the water runs faster and sediment doesn't settle out.	Restore weir to original design	Ron Holder
Entrance of Tarrelton Park to end of asphalt	There are 14 tree stumps at the Western edge of the Resource protection area. He is unsure of why they were cut/who cut the trees. Are trees located in the resource protection area allowed to be cut?	punitive damages; 28 trees planted on the east side of the trail in the RPA	Ron Holder
S. Gordon St. Outfall (Mill Run)	Accumulation of trash (plastic netting buried in the 1950's or 60's for "erosion control" during building of warehouses)	Trash catcher/collector	Ron Holder
Canterbury Square Apts/Condos in flood zone A	Obstruction of flood channel	Take out bike underpass at Duke Street on the east side of Holmes Run. Move it to the West side of Holmes Run (make an extension of the overpass)	Ron Holder
Tributary to Cameron Run	No access to stream		
Wilburdale Park	Urbanized Stream	Earth Sangha - Stream planting project	Earth Sangha
Tarrelton Park	Runoff from park into neighborhood due to park being higher than properties. Rock/concrete outfall is 2ft too high. The outfall is not operating causing pooling of water and mosquito breeding.	8 inch high berm around park to slow runoff (put notches in berm for slow runoff)	Ron Holder

Turkeycock/Braddock Rd.	Dog walking. Look into golf course management. Lots of geese, bad water quality downstream of golf course	doggy mitts/cleanup	Harry/Barbara Gossett
Wooded lots below Holmes Middle School	Stream bank erosion and high flows within nice wooded areas south of Holmes Middle School	Stormwater control upstream to increase the good areas	Nick Byrne

South Watershed: Pike Branch, Tribs to Cameron Run			Contact Information
Location	**Problem**	**Solution**	
Pike Branch intersection with Cameron Run	Construction run off due to Wilson Bridge project		Meredith Upchurch
Jefferson Manor Neighborhood (and many others)	Trash, leaves, and runoff going down stormdrains (many times intentionally)	stormdrain stenciling	Meredith Upchurch
Jefferson Manor Park	Channelized stream	Dechannelizing/retrofit (ex. Four Mile Run is in the process of retrofits, contact Bill Hicks)	Meredith Upchurch
Telegraph Road	The proposed widening of Telegraph road will cause a major impact on Pike Branch		
Cameron Run between Holmes Run and Hunting Creek	Already identified as severe habitat	Add recreational remedies in addition to environmental. Light boating, kayaking could be readily accomplished in conjunction with the Northern Virginia Recreational Park	Richard Hartman
Cameron Run	Telegraph Road to Route 1 only access is by car	Create pedestrian walk along stream, across stream to Eisenhower Ave.	Meredith Upchurch

Forum Conclusion

Participants regrouped after the breakout sessions. Project staff thanked attendees for their participation and closed the meeting, but they remained on-hand to answer any lingering questions.

Information about Cameron Run and the Cameron Run Watershed Management Plan can be found on the Fairfax County watershed plans website at www.fairfaxcounty.gov/watersheds. Under pages specifically dedicated to the Cameron Run watershed plan, readers will be able to access other supporting documents. A meeting and events calendar and meeting minutes for the Cameron Run Advisory Committee are also located on the county website. The Cameron Run website contains a message board that community members can use to share ideas and also comment on plan drafts. Comments may be sent to the watershed email address at cameronrun@versar.com, or by calling the watershed hotline toll free at (886) 341-4599.

Cameron Run Watershed
Draft Plan Forum

George Mason Government Center, Annandale, Virginia
June 14, 2005

PROJECT TEAM STAFF IN ATTENDANCE:
***Gayle England* --** Fairfax County Department of Public Works and Environmental Services (DPWES), Ecologist/Public Involvement
***Dipmani Kumar* --** Fairfax County DPWES
Fred Rose – Fairfax County DPWES
Beth Franks – Versar, Inc.
Mike Klevenz – Versar, Inc**.**
Morris Perot – Versar, Inc
Jennifer Shore – Versar, Inc.
Kris Sillett – Versar, Inc
Deborah Slawson – Versar, Inc
Mark Southerland – Versar, Inc.
***Shana Bullock* –** Horne Engineering Services, Inc.

THE CAMERON RUN WATERSHED PLAN

The Cameron Run watershed has experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the creek and its watershed. The Cameron Run Advisory Committee advises the Cameron Run Watershed Plan project team. Versar, Inc., prepares watershed plan drafts and engineering studies. Versar, Inc., and Horne Engineering Services, Inc. serve as facilitators for the public meetings. For more information, contact cameronrun@versar.com or visit http://www.fairfaxcounty.gov/watersheds.

The opinions represented herein do not necessarily represent those of Fairfax County or its agents.

Meeting Purpose

The purpose of this Draft Plan Forum was to elicit and record comments from the citizens of the Cameron Run Watershed in Fairfax County, VA, on the policy recommendations and watershed management actions in the Draft Cameron Run Watershed Management Plan. The ultimate goal of the forum was to help Fairfax County refine the Draft Plan with input from the community.

Meeting Attendees

Name:	Organization:	Address:	PH:	Email:
Pete Walker	Lake Barcroft Assoc.	6404 Cavalier Coll Falls Church, VA 22044	703.354.9693	petewalker@cox.net
Jim McGlone		4534 Eaton Place Alexandria, VA 23210 **(NEW)**	703.822.9160	
A. Cambern		6364 Lakeview Drive Falls Church, VA		
George Madill	Bren Mark Park Civic Association	6322 Fenton Ct Alexandria, VA	703.354.4083	
Nick Byrne	Sleep Hollow Manor HOA	3109 Sleepy Holly Rd Seven Corners, VA	703.237.3055	Nicolaus.byrne@dhp.gov
Richard Hartman	Berkshire HOA Huntington HCA MUCCA	2109 Huntington Ave Alexandria, VA 22303	703.960.0296	Rs.hartman@verizon.net
Stacey Sloan Blersch	USACE, Baltimore	10 S. Howard Street Baltimore, MD 21211	410.962.5196	Stacey.s.blersch@usace.army.mil
Ronald Houder		238 South Jennings St. Alexandria, VA 22304	703.751.1272	
Diane Davidson	LBA	3538 Pinetree Terrace Falls Church, VA 22041	703.575.8187	DHD757@aol.com
David Grant	LBWID		703.820.1300	
Pete Silvia	LBWID		703.750.9440	
V. Moltheise			703.560.3704	
Bill Herz	Lake Barcroft	6538 Jay Miller Drive Falls Church, VA 22041	703.256.5533	billherz@gmail.com (Add to distribution list)
Nancy Goudreau	Huntington Com.	2325 Riverview Terrace Alexandria, VA 22303	713.329.2933	nagoudreau@yahoo.com
Florence Cavazos				

Welcome and Introduction

Mr. Fred Rose of DPWES welcomed the group to the forum. He said that the Cameron Run Watershed Plan, which has been in the works for a year, is at a critical stage in its development. The plan is 50 to 60 percent complete and that the next step is to zero in on specific projects for implementation. The County has elevated the stormwater program to a higher priority and allocated an additional $18 million in funding to Fairfax County Public Works to complete all of the watershed plans for the County and begin restoration projects. The County expects to have plans completed for all of its watersheds by 2009.

Dr. Mark Southerland of Versar reiterated the vision for the Cameron Run watershed, i.e., “A fishable, swimmable, and biologically diverse Cameron Run watershed that supports a safe and enjoyable environment for people and property.” He gave attendees instructions for filling out the comment cards that would be handed out during the second half of the meeting and went over the meeting agenda and handouts. Included in the handouts were the forum agenda, a CD containing the Draft Cameron Run Watershed Plan, a copy of the Executive Summary of the plan, a glossary of terms, the Cameron Run Watershed Plan Locator Map, the summary of projects from the plan, and the policy recommendations for the Cameron Run watershed.

Mr. Dipmani Kumar of DPWES presented an overview of the watershed planning process and discussed how the County proposes to implement the plans. As plans are being completed, the focus is shirting towards plan implementation. Two County-wide initiatives have been funded to support buffer restoration and dumpsite removal and a new County government branch has been created to oversee implementation of the watershed projects. Implementation projects to date have focused on parkland since access is not an issue. Mr. Kumar spoke about riparian buffer deficiencies throughout the County and highlighted a buffer restoration project initiated in March of 2005. The project used contractors and volunteers to remove invasive plants and install restoration plantings over about 20,000 square feet. The next steps in buffer restoration will include 12 volunteer plantings on parkland and up to 22 contracted plantings throughout the County. Dumpsite clean-up priority is given to high impact areas on parkland and on private lands where easements allow easy access. To date seven sites in Little Hunting Creek have been cleaned. Fourteen sites on parkland have been targeted for clean up in August of 2005. Regarding the Cameron Run watershed, $280,000 has been earmarked for watershed signage, buffer restoration, and scoping and design for low-impact development and best management practice (BMP) retrofit projects. In October 2004, Fairfax County entered into a cost-share agreement with the U.S. Army Corps of Engineers and the City of Alexandria to complete a comprehensive watershed study. The agreement will allow both jurisdictions to apply for federal cost-share funds for implementing watershed projects.

Dr. Southerland explained the characteristics of a watershed and discussed the condition of the Cameron Run watershed. He defined watersheds and differentiated them from subwatersheds, presented the common characteristics of a healthy stream, described good water quality indicators, described the types of degradation experienced by urban streams and discussed the effects of impervious surfaces on water flow. The Cameron Run watershed is 44 square miles and comprises eight major subwatersheds. The watershed is highly urbanized, with only 5 percent of the land vacant. Much of the land is impervious and the watershed is suffering the associated physical impacts including erosion, flooding, and channel alteration. Four reaches of the watershed are on the State 303d list of impaired waters requiring total maximum daily loads (TMDLs) for benthic impairment, fecal coliform, and Polychlorinated Biphenyls (PCBs). Overall, the Cameron Run watershed has very poor stream quality with few natural buffers, poor aquatic habitat, degraded fish and benthic communities, and significant erosion. More than half of the stream reaches in the watershed are considered moderately to severely degraded.

Mr. Mike Klevenz of Versar explained the purpose of the County’s watershed management plans to serve as a tool for evaluating, assessing, and managing a watershed. He explained how the County is working with Versar, the Advisory Committee, and the public to create the plan. He described the public involvement approach and said that the final public meeting will be held in September of 2005 to present the Final Cameron Run Watershed Plan. The plan will recommend actions and policy changes to address the problems identified during the stream characterization and by the public during the scooping meetings. Mr. Klevenz went over the watershed goals identified in the plan and the model that was used to evaluate potential solutions to the Cameron Run watershed’s issues. The model simulates runoff from land surfaces, stream water quality, and stream water quantity and identifies flooding and channel erosion problem areas, water quality problems, and other related factors affecting the watershed. The model takes into account current and future land uses and benefits from BMPs. The model was used as part of the planning process in conjunction with stream assessments, field studies, and analysis of aerial photographs to identify the actions recommended in the plan. The plan recommends 235 actions under four categories including low-impact development, new stormwater ponds, stormwater pond retrofit, and stream restoration. Mr. Klevenz concluded by providing detailed examples of the types of actions that fall within the four broad categories.

Mr. Southerland wrapped up the introductory segment of the forum by explaining how the 235 actions are prioritized in the plan, how the project website can be used to submit comments on the draft plan, and who to contact with questions and concerns.

PROJECT AND POLICY REVIEW

After the opening presentations, the attendees moved to a break-out room where they had the opportunity to review and comment on the Project Actions included in the Draft Cameron Run Watershed Plan. The watershed was divided into three geographic watershed groups (northern, central, and southern) and each group was provided with a map, project list, and comment cards. The following table provides a summary of the comments that were collected during the breakout sessions:

Project Number	Comment	Name and Contact Information
Policy	Would like to see policy that states county policy on transparency.	Jonathan Daw 703.573.6353 Jehosachicken@yahoo.com
Policy	Would like to see a stated county policy on early public awareness and involvement.	Jonathan Daw 703.573.6353 Jehosachicken@yahoo.com
Policy	Urge County to develop incentives for developers/owners to put in roof gardens, pervious paving, etc.	George Madill 703.354.4083
New Policy	Disclosure of RPA and other environmental easements when buying a home.	Jim McGlone 703.822.9160 Mccrumb1@msn.com
Objective B1	Require disclosure of RPAs in all real estate transactions.	Jim McGlone 703.822.9160 Mccrumb1@msn.com
No Number, Tripps Run	***Need stream stabilization, restore riparian buffer, remove tree canopy invasive vines from Sleepy Hollow Rd, North along sleepy Hollow Park, and opposite shore.*** Implement projects CA9126, 9221, 9886, 9887, 9893, 9894, 9896, 9222 in the Sleepy Hollow area, along with the suggestion above.	Nick Byrne O: 202.344.1924 H: 703.237.3055 Nicolaus.byrne@dhs.gov
No number Northern-most headwaters of Tripps Run near 66	Pond at headwaters of Tripps Run could use some improvement to help with flooding downstream. Retention pond or rain garden on south side of 66 to reduce runoff from 66.	Jonathan Daw 703.573.6353 Jehosachicken@yahoo.com
CA9882	Break this project up into smaller pieces.	Bill Herz 703.256.5533 billherz@gmail.com
CA219	Strongly Support	Bill Herz 703.256.5533
CA9882	Break this project down so that it can be implemented in stages.	P.R. Walker 703.354.9693

Project Number	Comment	Name and Contact Information
		petewalker@cox.net
CA9882	Break this project up into smaller chunks – the $5 million price is too high; no lump sum but separate out the green roof and the ball field.	Diane Davidson 703.575.8187 DHD757@aol.com
CA9882	Break up CA9882 into several sub-projects so the big price tag does not kill the whole project at JEB Stuart.	Peter A. Silvia 703.750.9440 PASilvia@aol.com
No Number See Map Holmes Run Upper (2)	Between Arlington Blvd. and New Providence Drive – degraded stream with trash. Developer planning to remove all vegetation and build around stream.	V. Mottleissser (?) 703.560.3704
No number	Address drainage/trash/pollution in feeder watercourse east of south end of Glen Carlyn Drive (from Culmore (See projects CA9880 and 9881 for top end of Glen Carlyn Dr.)	Peter A. Silvia LBWID 703.750.9440 PASilvia@aol.com
CA9882	Please add shoreline stabilization to tributary that is below the main parking lot of the JEB Stuart high School.	Davis Grant 703.820.1300 dgrantlbwid@vacoxmail.com
No number #1:	Restoration of concrete streambed should have velocity reducing techniques if no restoration done.	Florence Cavazos 703.532.2554 Florence.cavazos@fairfaxcounty.gov
CA95A (Circled in map – Holmes Run lower)	When the Potterton Bridge was replaced (DOT) it was opened up and much rip=rap was removed – allowing more sediment/nutrients into Lake Barcroft. Can this be a retrofit project to reduce flow?	Bill Herz 703.256.5533 billherz@gmail.com
4A – Homes Run Lower	This private land unbuildable and the owner has tried to get rid of it in a way that he wouldn't be taxed. Could the County work out an agreement to take the property into a conservation trust Lake Barcroft Watershed Improvement District could/would adopt it and maintain it.	Diane Davidson 703.575.8187 DHD757@aol.com Pete Silvia 703.750.9440 PASilvia@aol.com
CA9105	In addition to this specific project, there should be additional strainers and retention ponds to filter debris coming into Backlick Run from the Beltway/Springfield interchange construction and normal Beltway runoff.	George Madill 703.354.4083 g.madill@att.net
CA9200	VISION #1: The Huntington Community would like to see a demonstration project along the south side of Cameron Run between Telegraph Road and Rte. 1 of a porous pavement for the approved Huntington Stream Valley Trail. VISION #2: Huntington proposes the creation of "Lake Cameron" between the Lower Holmes Run junction and Hunting Creek.	Richard Hartman 703.960.0796 Rs.hartman@verizon.net
CA9200	The increasing population in the Huntington area would relish development along Cameron Run that would capitalize on this waterway. The old growth trees and the new SWPs and a new dock – the dock from which to fish and to launch non-motorized boats.	Nancy Goudreau 703.329.2933 nagoudreau@yahoo.com

Project Number	Comment	Name and Contact Information
CA9200	The Huntington Association is concerned how the interchange development project for the Telegraph Rd. exit off the Beltway will affect Cameron Run. Also, it sees an opportunity for the extension and improvement of a bike trail to run from Telegraph Rd. to Route 1.	Nancy Goudreau 703.329.2933 nagoudreau@yahoo.com
CA9200	The development of a "waterfront" along a bike trail next to Cameron Run would greatly enhance the recreational opportunities for residents who would NOT have to drive to a rec. area.	Nancy Goudreau 703.329.2933 nagoudreau@yahoo.com

MEETING CONCLUSION

Project staff will inform meeting attendees and other stakeholders of when the draft plan will be available for review and comment. Once the draft plan is posted on the Fairfax County watershed plans website at www.fairfaxcounty-watersheds.net, meeting attendees and the public will have thirty days to provide comments. (The public comment period closed July 28).

Information about Cameron Run and the Draft Cameron Run Watershed Management Plan can be found on the website. Under pages specifically dedicated to the Cameron Run watershed plan, readers will be able to access other supporting documents. A meeting and events calendar and meeting minutes for the Cameron Run Advisory Committee are also located on the county website. The Cameron Run website contains a message board that community members can use to share ideas and also comment on plan drafts. Comments may be sent to the watershed email address at cameronrun@versar.com, or by calling the watershed hotline at (703) 642-6902 or toll free at (886) 341-4599.

Cameron Run Watershed
Draft Final Plan Forum

Mason District Government Center, Annandale, Virginia
December 4, 2006

PROJECT TEAM STAFF IN ATTENDANCE:
Gayle England **-** Fairfax County Department of Public Works and Environmental Services (DPWES), Ecologist/Public Involvement
Dipmani Kumar **-** Fairfax County DPWES
Fred Rose **-** Fairfax County DPWES
Don Demetrius **-** Fairfax County DPWES
Mike Klevenz – Versar, Inc**.**
Morris Perot – Versar, Inc
Jennifer Shore – Versar, Inc.
Kris Sillett – Versar, Inc
Mark Southerland – Versar, Inc.

THE CAMERON RUN WATERSHED PLAN

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Meeting Purpose

The purpose of this Draft Final Plan Forum was to elicit and record comments from the citizens of the Cameron Run Watershed in Fairfax County, VA, on the Draft Final Cameron Run Watershed Management Plan. The ultimate goal of the forum was to help Fairfax County refine the Draft Final Plan with input from the community.

Meeting Attendees

Name	Organization	Address	Phone	Email
Hunt Anderson	Lincoln Park C/A	4827 Virginia St. Alexandra, VA 22312	(703) 941-8089	volstream@hotmail.com
Bob Beverly		7402 Beverly St. Annandale, VA 22003	(703) 256-6772	JillBob58@Juno.com
Mike Bienvenu	Poplar Heights Recreation Association	7301 Pinecastle Rd Falls Church, VA	(703) 645-9242	bienvenu@speakeasy.net
Stacey Blersch	USACE Baltimore District Planning Division	USACE Baltimore District CENAB-PL-CPD 10 S. Howard St. Baltimore, MD 21201	(410) 962-5196	stacey.s.blersch@usace.army.mil
Glenda Booth	Fairfax County Wetlands Board	7708 Tauxemont Rd. Alexandria, VA 22308	(703) 765-5233	gbooth123@aol.com
Sandra Brown		5408 Backlick Woods Ct. Springfield, VA 22151	(703) 345-6704	Sandra.brown@troutmansanders.com
Nick Byrne	Sleepy Hollow C/A	3109 Sleepy Hollow Rd. Falls Church, VA 22042	(703) 237-3055	niclaus.byrne@dhs.gov
Danell Castro		2233 Arlington Terrace	(703) 740-3620	danell.castro@gmail.com
Ken Clare		3102 Marl Pat Dr. Alexandria, VA 22310	(703) 460-4079	kenclare@bellatlantic.net
Bill Cleveland	MUCCA	902 Neal Dr. Alexandria, VA 22308	(703) 780-9151	wcleveland@pobox.com
Colleen Coughlin	Pinecrest C/A	4514 Shoal Creek Ct. Alexandria, VA 22312	(202) 874-4465	president@thepinecrest.org
Diane Davidson	LBA	3538 Pinetree Terrace Falls Church, VA 22041	(703) 575-8787	DHD757@aol.com

Name	Organization	Address	Phone	Email
Pat Gushman	Barcroft Woods C/A	3607 Bent Branch Ct. Falls Church, VA 22041	(703) 941-8382	patgushman@aol.com
Phil Hartenstein		2244 Arlington Terrace Alexandria VA 22303	(703) 960-1890	philbjhart@yahoo.com
Sally Henley	Fairfax County Resident	2836 Raymond Ct. Falls Church, VA 22042		
Bill Herz	LBA	6538 Jay Miller Dr. Falls Church, VA 22041	(202) 256-9986	billherz@gmail.com
David Jones		3664 Tallwood Terrace Falls Church, VA 22041	(703) 256-7525	djones121@cox.net
David Lewis		5408 Backlick Woods Springfield VA	(703) 354-6704	davidalewis@verizon.net
Robert Mankin		5825 Telegraph Rd Alexandria, VA22310	(703) 960-9210	
Richard Mendenhall	LPCA	7401 East Moreland Rd Annandale, VA 22003	(703) 333-6166	rmendenhall@mannagrp.com
Richard McCormack		4112 Sleepy Hollow Rd. Annandale, VA	(703) 354-7460	Richard@manufacturingnews.com
Bob Morsches	LPCA	5263 Navaho Dr Alexandria VA	(703) 256-2726	morsches@mac.com
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Douglas Olmsted		5510 Sheldon Drive Alexandria, VA 22312	(703) 642-8305	cadao@patriot.net
Karen Pal		5104 Redwing Dr. Alexandria, VA	(703) 914-1738	Karen.pal@verison.net
Paul Phelps		2212 Martha's Rd. Alexandria, VA 22307		pbphelps@cupg.org
Ingrid Phillips	Huntington	2231 Arlington Terrace Alexandria, VA 22303	(703) 960-4889	
Richard Record	Huntington	5643 Fenwick Dr. Alexandria, VA 22303	(571) 278-5141	Rarecord@yahoo.com
Marie Reinsdorf	Bel Air Civic Assoc.	6709 Kerns Rd. Falls Church, VA 22042	(703)534-3234	kreinsdorf@cox.net

Name	Organization	Address	Phone	Email
Pat Sanders	LPCA	4924 RidgeWood Rd. Alexandria, VA 22312	(703) 354-8651	safedak@yahoo.com
Larry Sexton	Falls Hill C/A	7205 Gordons Rd. Falls Church, VA 22043	(703) 552-5559	LKS.LJS@cox.com
Rob Taylor	Poplar Heights	121 S. Oat Falls Church, VA	(703) 574-3535	rjtaylor@starpower.net
Jim Turbett	LPCA	6501 Waverly St Alexandria, VA		
Peter Walker	LBA	6404 Cavalier Corridor Falls Church, VA 22041	(703) 254-9693	petewalker@cox.net
Clay Williams	Huntington	3424 Arnold Ave Falls Church, VA	(703) 573-6224	claywill@aol.com
Maura Yasin		3426 Annandale Rd. Falls Church, VA 22046	(703) 207-0520	myestimator@yahoo.com

WELCOME AND INTRODUCTION

Dr. Mark Southerland of Versar went over the forum agenda, which entailed how the Watershed Plan was developed, a review of what the Draft Final Watershed Plan includes, and the implementation plan. He reiterated the vision for the Cameron Run watershed, i.e., "A fishable, swimmable, and biologically diverse Cameron Run watershed that supports a safe and enjoyable environment for people and property." He gave attendees instructions for filling out the comment cards that would be handed out during the second half of the meeting and went over the handouts. Included in the handouts were the forum agenda, a summary of Tier 1 projects and Group 1 drainage projects, project maps, and the policy recommendations for the Draft Final Plan. There was also a sign-up sheet to request a CD of the Draft Final Plan.

Dr. Southerland explained the function of the watershed plan. He explained that it is a tool for evaluating, assessing, and managing a watershed. It provides goals and objectives for achieving management actions (e.g., to restore water quality, reduce flood frequency, or improve fish and wildlife habitats). He reviewed the groups involved in developing the plan, i.e., Fairfax County, Versar, Inc., the Advisory Committee, and the public. Overall, the Cameron Run watershed has very poor stream quality with few natural buffers, poor aquatic habitat, degraded fish and benthic communities, and significant erosion. More than half of the stream reaches in the watershed are considered moderately to severely degraded.

Dr. Southerland reviewed the steps involved in identifying project solutions, and the categories of projects included in the plan. He outlined the steps in selecting projects for the plan and how the projects are prioritized in the plan. Tier 1 project have been described in full detail (factsheets); specific benefits and costs of each project are included in the plan. Tier 2 and Tier 3 projects have been described in lesser detail and are included as an appendix (tables). Tier 1 projects include 100 stormwater pond retrofits, low impact development, and stream restoration projects recommended for County implementation, as well as 25 drainage complaint projects. The County will implement Tier 2 projects as opportunities arise. The community may choose to implement Tier 3 projects. Dr. Southerland discussed the implementation of the plan and the next steps for the Plan review.

Mr. Southerland wrapped up the introductory segment of the forum by explaining the next steps involved in finalizing the plan. The Draft Final Plan will be posted to the project website for the 30-day public comment period. After revision, the Draft Final Plan will go before County Board for approval. The Final Plan will be posted to project website.

PROJECT AND POLICY REVIEW

After the opening presentations, the attendees moved into break-outs where they had the opportunity to review and comment on Tier 1 Projects, Group 1 Drainage Complaint Projects, and Policy Recommendations included in the Draft Final Cameron Run Watershed Plan. The watershed was divided into three geographic groups (northern, central, and southern parts of the watershed) and each group was provided with a copy of the Draft Final plan, maps, project lists, and comment cards. The following table provides a summary of the comments that were collected during the breakout sessions:

Project Number	Comment	Name and Contact Information
Project CA9609	Wrong vicinity map shown on project data sheet. Extend study area to include entire stormwater pond.	Colleen Coughlin (202) 874-4465 president@thepinecrest.org
Policy	Request that the County provide information on outreach resources available to citizens and homeowner associations for consultation on different projects. Use the Board of Supervisors newsletter to raise awareness of available resources and programs.	Maura Yasin (703) 207-0520 myestimator@yahoo.com
Project CA9600	The County needs to get involved in all new construction of buildings and parking lots to implement improvements to drainage by reducing the amount of runoff from impervious surfaces entering the Cameron Run watershed area.	Ingrid Phillips (703) 960-4889

MEETING CONCLUSION

Project staff said they would inform meeting attendees and other stakeholders of when the draft final plan would be available for review and comment. The tentative date was December 11th. Once the draft plan is posted on the Fairfax County watershed plans website at www.fairfaxcounty-watersheds.net, meeting attendees and the public would have thirty days to provide comments.

Information about Cameron Run and the Draft Final Cameron Run Watershed Management Plan can be found on the website. Under pages specifically dedicated to the Cameron Run watershed plan, readers are be able to access other supporting documents. A meeting and events calendar and meeting minutes for the Cameron Run Advisory Committee are also located on the county website. The Cameron Run website contains a message board that community members can use to share ideas and also comment on plan drafts. Comments may be sent to the watershed email address at cameronrun@versar.com, or by calling the watershed hotline at (703) 642-6902 or toll free at (886) 341-4599.