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Stella Koch	*Audubon Naturalist Society*
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Robert McLaren	*Environmental Quality Advisory Council*
Douglas Moyer	*U.S. Geological Survey*
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Judy Okay, Ph.D.	*Virginia Department of Forestry*
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Jim Collins	*Tetra Tech, Inc.*
Deana Crumbling	*Northern Virginia Soil & Water Conservation District*
Kimberly Davis	*Parsons Engineering Science*
Cliff Fairweather	*Audubon Naturalist Society*
John Galli	*Washington Metropolitan Council of Governments*
Claudia Hamlin-Katnik, Ph.D.	*George Mason University*
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Mark Southerland	*Versar*
Wayne Teel	*Izaak Walton League, Virginia Division*

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Judy Okay, Ph.D.	*Virginia Department of Forestry*
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Others:

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Note: A downloadable form of this document (Adobe Acrobat .pdf file) and the appendices will be available on the SPS web page in Spring 2001. Use the address below and click on the link to the Stream Protection Strategy.

http://www.co.fairfax.va.us/dpwes/

ABOUT THIS DOCUMENT

The purpose of this report is to provide a baseline summary of general stream conditions across Fairfax County. This document does NOT contain any additions or amendments to County policy. Rather, it is intended for use as a planning tool by County policy makers and to serve as a reference point for future study. This report highlights the need for further investigation in many areas throughout the County.

If you encounter a problem pertaining to a County stream, please refer to the County's Environmental Services Directory at the following web address:

http://www.co.fairfax.va.us/gov/dpwes/environmental/environmental_concerns.htm

Alternatively, you can call the County Environmental Hotline at (703) 324-1937.

EXECUTIVE SUMMARY

Introduction

Prior to the 1940's, Fairfax County was largely rural and agricultural. Since that time, the landscape has been transformed into one dominated by suburban communities interspersed with highly developed urban centers. This shift from natural, vegetative ground cover to areas of impervious surface dramatically increases rainfall runoff and stream flow volumes during storm events. Rather than infiltrating the soil as it would under natural conditions, rainwater instead flows rapidly from rooftops, parking lots, and roadways, and is quickly directed toward streams via a conveyance system of roadside gutters, ditches, and storm sewer drains. The resulting high flows rapidly erode the channel of the receiving stream, leading to degradation of the entire downstream environment.

The need to protect the living environment while planning for orderly development and redevelopment of the County has long been recognized. There is a direct link between the vitality of ecological resources and the quality of life for citizens. Streams beginning in Fairfax County eventually flow into the Potomac River and then enter the Chesapeake Bay, and the measures taken by the County to improve stream quality within its boundaries have also been aimed at protecting the downstream environment.

However, despite the efforts taken over the years to mitigate the effects of increasing urbanization, stream degradation continues within the ecosystem. This degradation is evident through increasing stream channel erosion, loss of riparian buffers, decreased aquatic life and poor water quality in general within the County's streams. The purpose of the Stream Protection Strategy (SPS) program is to:

- Understand the degree of stream degradation.
- Formulate measures to effectively reverse the negative trends.
- Identify and prioritize 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.
- Encourage environmental stewardship by supporting established and new citizen stream monitoring programs and public education.

In general, objectives of the program focused on recommendations for protection and restoration activities on a subwatershed basis, prioritization of areas for allocation of limited resources, establishment of a framework for long-term stream quality monitoring, and support for overall watershed management. Although high counts of fecal coliform bacteria are recognized as a serious health risk in some County streams, the focus of this baseline study was on biological indicators of stream water quality. Fecal coliform bacteria counts are the subject of continual monitoring by the Fairfax County Health

Department. These results are published in a separate annual report (refer to the **1999 Stream Water Quality Report**), sections of which are described in Chapter 3, under Other Monitoring.

Fairfax County's SPS program currently supports several ongoing environmental initiatives at the County, State and Federal levels, all of which assist in achieving the goal of preservation and restoration of stream quality. Over time, SPS will become even more integrated with the following programs:

- Watershed management/master plans
- Chesapeake 2000 Agreement implementation
- National Pollutant Discharge Elimination Systems (NPDES)
- Total Maximum Daily Loads (TMDLs)
- Fairfax County's Policy Plan (Environmental Section)
- Citizens Volunteer Stream Monitoring
- Amendments to Public Facilities Manual (PFM), including the Infill and Residential Development Study recommendations
- Stormwater Environmental Utility implementation
- Virginia Riparian Buffer Initiative – Chesapeake Bay Program

  A detailed description of the above programs/initiatives and their linkage to SPS is outlined in Chapter 4 of this report.

The results of this SPS Baseline Study are not aimed at restricting new development but to provide the basis for more ecologically sensitive and sustainable new development and redevelopment countywide. Detailed goals and objectives are stated in Chapter 1 of this report.

Methods

The field component of this assessment involved the collection of detailed biological and habitat data from 138 stream sites/reaches, 13 of which were established as Quality Assurance/Quality Control (QA/QC) Sites. Of the 125 principal monitoring sites, 114 were reflective of conditions within Fairfax County and 11 were sampling locations in nearby Prince William Forest Park and used to aid in the development of "reference" conditions to which all sites were compared. This report presents the results of a comprehensive baseline study of conditions as they existed in 1999. These results can be utilized to formulate recommendations for strategies to consider in overall management of watersheds to preserve or restore stream quality to levels consistent with County environmental goals and applicable state and federal mandates.

With its emphasis on biological monitoring, the SPS program is an important first step toward improving environmental quality by viewing streams as more than mere conduits of stormwater flow. By tying together information on stream morphology, habitat condition, water chemistry, and current and projected land use patterns, it will provide an important base for the planning and decision-making framework that will be needed to protect and restore stream ecosystems within Fairfax County.

Research shows that at levels of 10-20% impervious surface cover, habitat quality and biological integrity in stream systems is significantly diminished (Klein, 1979, Booth, 1991, Schueler et al, 1992, Booth et al, 1993, Booth and Jackson, 1994 and Boward et al, 1999). Using modified versions of the U. S. Environmental Protection Agency's (U.S.EPA's) Rapid Bioassessment Protocols, the baseline study focused on assessments of channel morphology and the responses of living communities (aquatic insects and fish) to aspects of land use. Spatial analyses of development patterns and watershed imperviousness were conducted within a Geographic Information System (GIS) environment. Details of the methodology and protocols used for the study are outlined in Chapter 2 and Appendix A-H of this report.

A numeric ranking of overall quality was generated for each of the SPS monitoring sites within the County. Each of these ratings was based upon the numeric scores of the following four components of stream/watershed condition:

1) an Index of Biotic Integrity (IBI) incorporating 10 separate measures (each score on a 0 to 10 scale) of benthic macroinvertebrate (insect) community integrity (Figure I),

2) a general evaluation of the localized watershed features (including vegetation and instream features) as well as a more specific evaluation of 10 habitat parameters, each scored on a scale of 0 (worst condition) to 20 (optimal condition) of in-stream and riparian zone conditions (Figure II),

3) fish taxa richness (number of distinct species present) (Figure III), and

4) calculations of overall percent impervious cover within the contributing drainage area of each site based upon available Fairfax County GIS data layers (roads, parking lots, buildings, sidewalks) (Figure IV).

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**.

EXECUTIVE SUMMARY

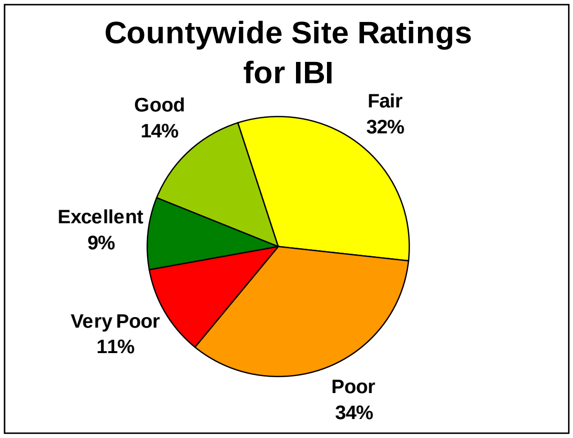


Figure I. Percentage of SPS monitoring sites scoring in each of the five IBI quality categories.

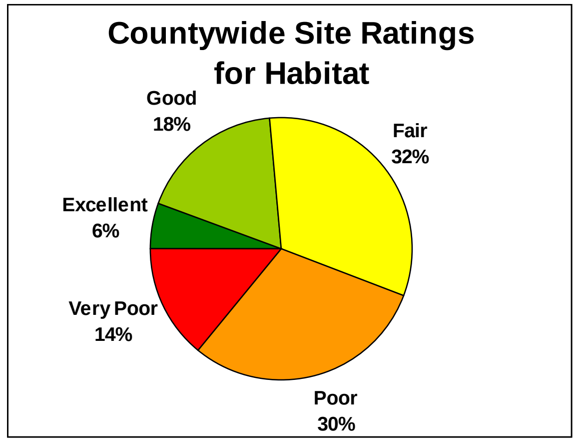


Figure II. Percentage of SPS monitoring sites scoring in each of the five Habitat quality categories.

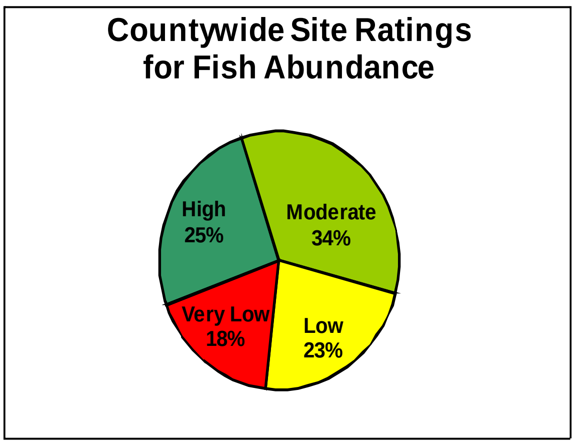


Figure III. Percentage of SPS monitoring sites scoring in each of the four Fish abundance categories.

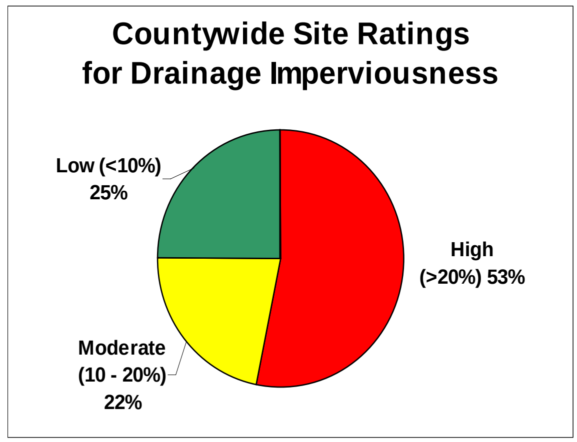


Figure IV. Distribution of Imperviousness at SPS monitoring sites.

RESULTS

Management category recommendations were made based upon both this overall ranking as well as *potential* levels of future development (based on current zoning information) within each respective subwatershed (Figure V). These categories are as follows (value in parenthesis is the percentage of the County falling within each grouping):

Watershed Protection (31.5% of County)

Primary goal: Preserve biological integrity by taking measures to identify and protect, to the extent possible, the conditions responsible for current high quality rating of these streams.

Example Key Management Strategies:

- Consider establishing a zoning overlay to clearly identify these areas as watershed protection areas.
- Evaluate and refine, as needed, existing County regulations and policies to assure continued protection of these watersheds.
- Assess current watershed conditions to identify characteristics and management practices that contribute to the high water quality rating.
- Expand stream valley park acquisition or dedication.
- Conduct public education programs on stream stewardship.

Watershed Restoration Level I (7.2% of County)

Primary Goal: Re-establish healthy biological communities, where feasible, by taking measures to identify and remedy the cause(s) of stream degradation both broad scale and site specific.

Example Key Management Strategies:

- Evaluate, prioritize and construct planned Capital Improvement Projects (CIP) for these watersheds including planned regional ponds and water quality BMP retrofits.
- Evaluate, prioritize and construct stream corridor restoration projects for these watersheds.
- Promote use of innovative BMPs and Low Impact Development Design (LID) techniques.
- Conduct public education programs on stream stewardship.

Watershed Restoration Level II (61.3% of County)

Primary Goal: Maintain areas to prevent further degradation and implement measures to improve water quality to comply with Chesapeake Bay Initiatives, Total Maximum Daily Load (TMDL) regulations and other water quality initiatives and standards.

Example Key Management Strategies:

- Implement a watershed approach to evaluate and prioritize restoration in these subwatersheds. Focus on restoring tributaries and headwaters prior to active restoration in mainstem segments.
- Select sites and implement monitoring of tributaries identified as “Assessment Priority Areas”.
- Identify, prioritize and implement projects to help stabilize critical areas with severe stream bank erosion.
- Identify and prioritize potential stormwater management retrofit opportunities.

- Promote use of innovative BMPs and reduction of imperviousness for infill and redevelopment.
- Conduct public education in stream stewardship.
- Promote programs like Adopt-A-Stream to increase public involvement.

Many of the key management strategies such as public outreach and promotion of low-impact development techniques have applications in all three watershed management categories. These management strategies will need to be integrated into a comprehensive watershed management approach on a countywide and subwatershed level. Countywide management strategies include prioritizing the 14 watershed groups, implementing watershed master planning, improving stream protection policies and promoting citizen involvement. Individual watershed management strategies include setting priorities for subwatersheds within a given watershed, defining additional stream monitoring needs and eventually implementing selected stream restoration projects. These strategies will need to be further developed into a comprehensive plan for stream protection and restoration.

These categories are intended for use only as planning level tools. Each category is characterized by a set of goals and strategy recommendations that best suit the respective stream environments given current subwatershed development patterns, likely future imperviousness and the assessments of biological condition detailed in this report. In addition, management categories are not intended to be a means of controlling development or to be confused with adopted land use categories contained within the County's Comprehensive Land Use Plan, or other land use documents currently guided by the County Ordinance. Rather, management categories propose a new technique to group targeted areas that might be recommended for similar treatment for more effective future watershed protection, preservation and restoration efforts. Actual implementation of the recommended treatment might entail more detailed study through watershed master plans and/or necessitate a re-examination of some existing policies and plans through a different process.

Chapter 3 contains detailed watershed by watershed descriptions, summary of conditions by both County staff's and volunteer groups' monitoring data and designated management category recommendations with watershed strategies. Some of these strategies, by themselves, represent established steps and initiatives currently being implemented in the County and neighboring jurisdictions. However, SPS attempts to organize these strategies in a more logical manner to foster a more effective watershed planning and management approach. The strategies outlined in this report by no means represent an all inclusive list; rather they will serve as the foundation of a process to identify potential strategies that may require further evaluation for applicability on a sub-watershed scale.

Countywide Management

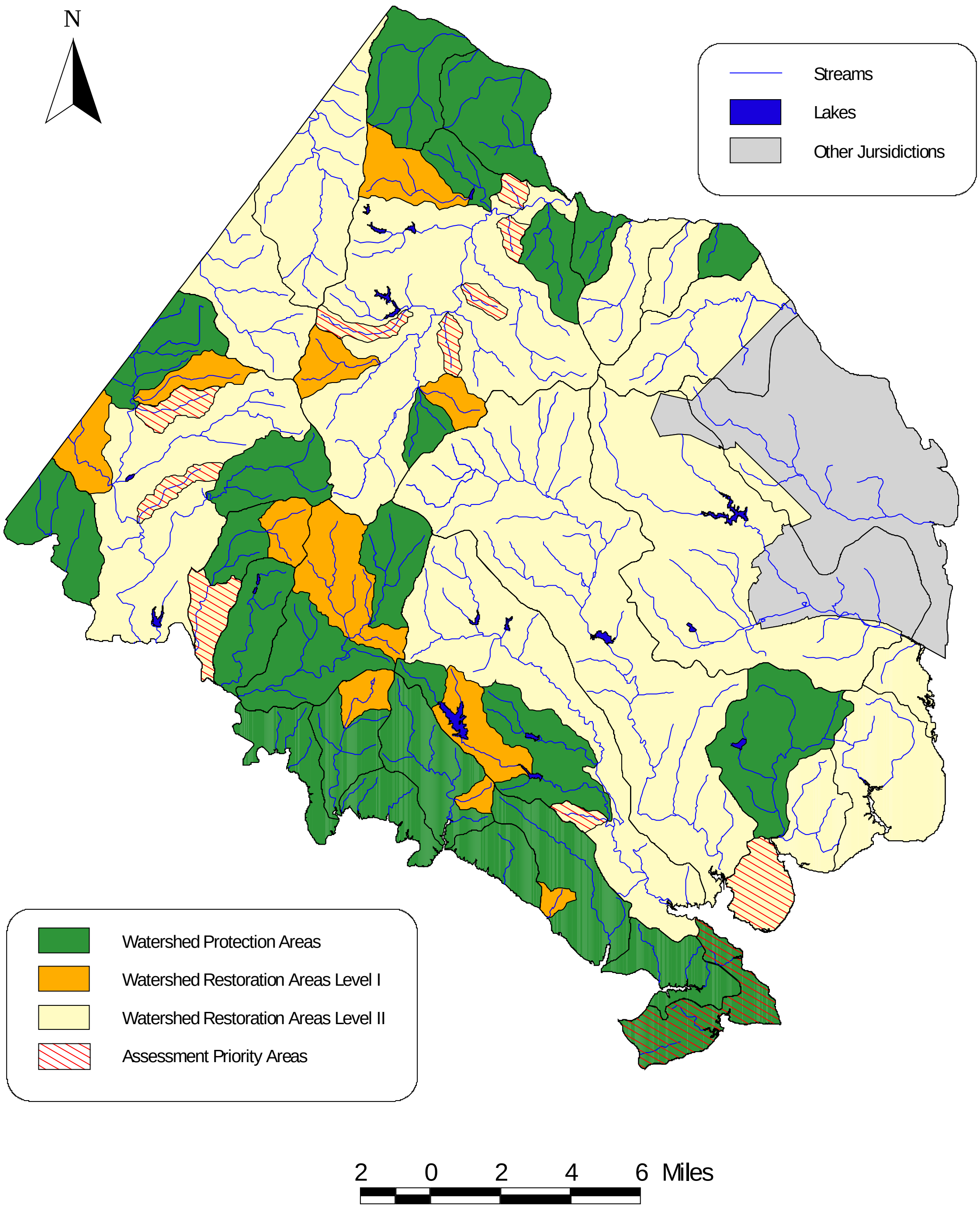


Figure V. Management recommendations for Fairfax County watersheds.

CONCLUSIONS AND RECOMMENDATIONS

Figure VI. Trend line indicating that Biological integrity, as measured by an Index of Biotic Intetrity (IBI) for benthic macroinvertebrates, generally decreases with increasing percent imperviousness. Appendix B includes information on the statistical significance of the data presented.

Consistent with what has been reported in the literature (Klein, 1979, Booth, 1991, Schueler et al, 1992, Booth et al, 1993, Booth and Jackson, 1994 and Boward et al, 1999) this study showed a statistically significant relationship between drainage area imperviousness and biological quality at a site (see Appendix B for details on the statistical analyses). Figure VI shows this relationship. The trend line shown in the figure is presented to highlight the fact that impervious area generated during development correlates with declining stream quality as measured by macroinvertebrate community health. However, the relationship in its current form (linear) should not be used for predictive purposes since that would require a more detailed statistical analysis.

The systems of high biological and habitat integrity that still exist within the County's boundaries are typically found only in largely undeveloped watersheds. Conversely, the most degraded streams are those that flow through areas of the most intense development (Figure VII). This pattern is even more pronounced in drainages containing older developments that often lack the more recently developed and sometimes more efficient stormwater controls.

Protecting and restoring stream quality within Fairfax will require a diverse management approach that includes an active and ongoing stream monitoring effort, targeted restoration activities, public education, enhanced stormwater controls, and enhanced channels of communication with the development community. Some of these steps have already commenced or are the subject of recommendations in the most recent draft of the Infill & Residential Development Study. This baseline study should be seen as only the beginning phase of a permanent monitoring effort that will be needed for effective management of aquatic resources within the County. If appropriate decisions are to be made, trends in stream conditions will need to be identified and assessed over the long term. This is absolutely essential in meeting the requirements and challenges of the new Chesapeake Bay 2000 Agreement and a potential bay-wide TMDL after 2010 (see Chapter 4 for details). This will require expanding our base of understanding of streams. Components of any future SPS program should involve:

- Monitoring of existing SPS sites on a rotating basis involving 20-25% of the County annually.
- Establishing a detailed visual assessment program at the subwatershed level.
- Assessing variables influencing fish community composition and distribution.
- Promoting the expansion of volunteer monitoring efforts.
- Defining and identifying perennial stream network within the County.
- Assessing relative contribution of various sources of instream sediment.
- Evaluating alternate site selection design to allow for more rigorous analyses.
- Assisting with assessments of effectiveness of various BMP technologies.
- Reassessing periodically imperviousness at the watershed and subwatershed levels.
- Improving inter-agency cooperation regarding sediment control implementation and maintenance.
- Promoting public education that fosters community interest in stream quality issues.

More detailed recommendations are discussed in Chapter 5 of this report.

Countywide Conditions

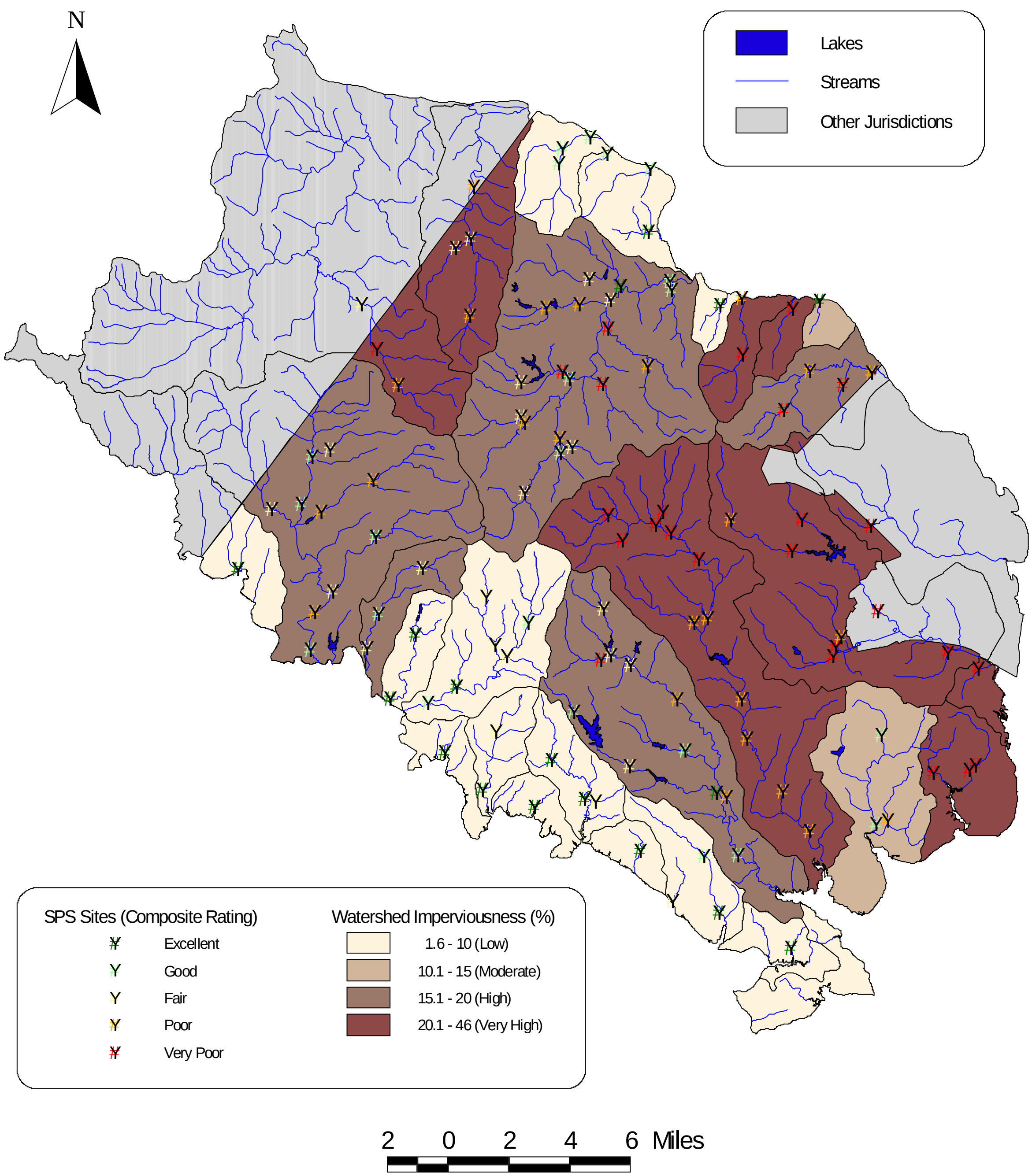


Figure VII. Relationship between imperviousness and overall stream condition.

CHAPTER 1

INTRODUCTION

Fairfax County is recognized as one of the world's premiere technology business centers. Its population, which has grown dramatically in the past fifty years, has expanded to almost one million residents. The landscape has been transformed from one of rural character, when the area led the entire state in dairy production, into an urban/suburban community of buildings, parking lots and roads which supports business and residential needs. Although the County does not have to contend with the more serious forms of pollution associated with heavy industry, the conversion of land to urban uses has impacted streams countywide. This, in turn, has contributed to degraded water quality in downstream environments, influencing conditions in the Potomac River and, ultimately, the Chesapeake Bay.

This shift from natural, vegetative ground cover to extensive areas of impervious surface dramatically increases rainfall runoff and stream flow volumes during storm events. Rather than infiltrating the soil as it would under natural conditions, rainwater instead flows rapidly from rooftops, parking lots and roadways, and is quickly directed toward streams via a conveyance system of roadside gutters, ditches and storm sewer drains. The resulting high flows rapidly erode the channel of the receiving stream, leading to degradation of the entire aquatic environment. At the same time, rainwater flowing over the urban/suburban environment picks up oil, grease and heavy metals from roads; trash and sediment from construction sites; and pesticides and fertilizers from lawns. The associated increase in the concentrations and volume of pollutants entering our waterways poses a threat to both humans and the environment as a whole.

Since the 1970's, the County has adopted ordinances to implement stormwater management and Best Management Practices (BMPs) to combat the problems associated with the quality of stormwater runoff and flooding. In the late 1970's Proposed Drainage Plans (Parsons, Brinckerhoff, Quade and Douglas), consisting of an "Immediate Action Plan" and a "Future Basin Plan," were prepared for all watersheds in the County. The establishment of the Water Supply Protection Overlay District (WSPOD) in the Occoquan watershed in the early 1980's required BMPs for all new developments in the southwest areas of the County draining into the Occoquan reservoir, one of the major sources of drinking water for the County. This was followed by the adoption of the Chesapeake Bay Preservation Ordinance in the early 1990's, which required BMPs for all other areas of the County outside the WSPOD. These are but a few examples of the many measures employed by the County in an attempt to mitigate the impacts of new development.

Purpose for a Stream Protection Strategy (SPS)

The need to protect the living environment while planning for orderly development and redevelopment of the County has long been recognized. There is a direct link between the vitality of ecological resources and the quality of life for citizens. Streams originating in Fairfax County flow into the Potomac River and eventually enter the Chesapeake

Bay, and the measures taken by the County to improve stream quality within its boundaries have also been aimed at protecting the downstream environment.

However, despite the efforts taken over the years to mitigate the harmful effects of increasing urbanization, stream degradation continues within the ecosystem. This degradation is evident through increasing stream channel erosion, loss of riparian buffers, decreased aquatic life, high fecal coliform counts and poor water quality in general within the County's streams. The purpose of the SPS program is to:

- Determine the extent and severity of stream degradation.
- Formulate measures to effectively reverse the negative trends.
- Identify and prioritize areas with the greatest needs.
- Recommend streams for preservation and restoration efforts where appropriate.
- Support detailed comprehensive watershed planning or stormwater master plans.
- Integrate applicable environmental policies, initiatives and regulatory requirements under one umbrella.
- Provide an additional information base to aid future planning efforts.
- Encourage environmental stewardship by supporting established and new citizen stream monitoring programs and public education.

The results of the SPS Baseline Study are not aimed at restricting new development but to provide the basis for more ecologically sensitive and sustainable developments.

The Background of SPS

The development of the SPS program was initiated in September 1997, when the Fairfax County Board of Supervisors (Board) requested that staff from the Department of Public Works and Environmental Services (DPWES) evaluate the need to implement a comprehensive assessment of County streams. At the time, Montgomery County, Maryland had completed a similar stream protection strategy study and provided some support and assistance to Fairfax County during the feasibility stage of this SPS baseline study. In September 1998, staff presented to the Board the results of a feasibility evaluation, a preliminary scope of work, and the associated costs to implement such a program. The Board approved a total funding allocation of $500,000 during the 1998 Fiscal Year Carryover Budget proceedings to implement the SPS Program. Work was initiated in September 1998 with several meetings involving representatives from stakeholder organizations and other interested individuals. DPWES sought their input in developing the study framework as well as coordinating citizen volunteer efforts, which are to become a key component of the SPS monitoring program. At present, a number of citizen volunteer organizations work closely with the County in recruiting and training volunteers and in developing the scope of citizen monitoring.

CHAPTER 1

The SPS baseline study entailed sampling of all major streams and tributaries throughout the County to assess overall environmental quality. Field monitoring focused on measuring various chemical parameters, visually assessing physical stream habitat characteristics and examining in detail the biological indicators of ecosystem health, including aquatic insects (benthic macroinvertebrates) and fish. This initial phase was designed to be a comprehensive baseline study (or a snapshot during 1999) of general County stream conditions, the results of which are outlined in this report. This study presents a ranking (**Excellent, Good, Fair, Poor and Very Poor**) of individual sites based on overall quality, recommends management categories and strategies to restore and preserve areas on a subwatershed basis, prioritizes areas for allocation of scarce resources and establishes the framework for long-term stream water quality assessment. This baseline study is regarded as the commencement of a dynamic stream assessment process that will be executed on a continual basis as conditions warrant and as more detailed results are desired in some targeted areas within the County.

STUDY GOALS

As directed by the Fairfax County Board of Supervisors, the countywide Stream Protection Strategy (SPS) Program does the following:

- Provides comprehensive baseline information on stream conditions through an assessment of biological, chemical, physical and habitat parameters within the County's watersheds.
- Provides a basis for continual/long term monitoring and assessment of water quality in County streams (i.e. 5-year rotating schedule of sampling).
- Evaluates the progress and effectiveness of implemented measures.
- Develops strategies for stream restoration and protection.
- Promotes inter-jurisdictional cooperation to restore and maintain the quality of shared watersheds.
- Recommends changes to County ordinances as necessary to achieve and enhance water quality goals.
- Conforms to past, present and future goals of the County.
- Develops a formal report outlining:

  a) stream assessment data and analysis;
  b) stream rankings based on stream assessment data;
  c) assignment of stream protection and stormwater management strategies for each watershed (i.e. methods of controlling stormwater);
  d) a classification system according to land use and biological quality in the watershed (i.e. protection area, restoration area, etc.);
  e) assignment of watershed priorities within the County; and
  f) the utilization of the County's Geographic Information System (GIS) to present results graphically in an easily understandable manner.

CHAPTER 1

STUDY OBJECTIVES

The assessment of stream quality within Fairfax County does the following:

- Identifies and confirms areas of seriously impaired water quality requiring immediate attention to reverse impairment to the maximum extent practicable.
- Provides a basis to identify priority areas for water quality/stream restoration programs and measures.
- Identifies and confirms areas of good water quality and develops strategies to continue or enhance preservation.
- Provides a basis for implementing strategies and techniques to bring all streams into compliance with prevailing State and Federal clean water standards, including Clean Water Act (CWA), potential requirements for Total Maximum Daily Load (TMDL) and the County's Chesapeake Bay Preservation Ordinance.
- Promotes and supports public outreach and education to provide greater citizen awareness and involvement.

Overall County Water Quality Goals

1. To comply with the Chesapeake Bay Preservation Ordinance (Section 118-1-5 of the Fairfax County Code): "The purpose and intent of this Chapter is to encourage and promote: (1) the protection of existing high-quality state waters; (2) the restoration of all other state waters to a condition or quality that will permit all reasonable public uses and will support the propagation and growth of all aquatic life, including game fish, which might reasonably be expected to inhabit them; (3) the safeguarding of the clean waters of the Commonwealth from pollution; (4) the prevention of any increase in pollution; (5) the reduction of existing pollution; and (6) water resource conservation in order to provide for the health, safety, and welfare of the present and future citizens of Fairfax County and the Commonwealth of Virginia." (16-93-118.)

2. Protect, maintain, and restore high quality chemical, physical and biological conditions in the waters of the County.

3. Other goals to be determined or adopted through a coordinated effort with other County and state agencies and stakeholder organizations for possible adoption in the County's ordinances.

CHAPTER 1

EVOLUTION OF STORMWATER MANAGEMENT

The Early Years: Pre 1941

In the early part of the last century, Fairfax County was still largely agricultural, with dairy farming being the most important single industry. In 1900, the population of the County was only slightly over 12,000; four decades later, it was still under 50,000. Throughout this entire period, development was essentially unregulated, and stormwater controls consisted mostly of ditching fields or pastures to prevent flooding. Several privately owned reservoirs, such as Lake Barcroft, served to control flooding as well as provide a municipal water supply.

The rural community of Centerville at Braddock Road in 1902.

As early as the 1920's, County planners realized the need for a comprehensive plan for the development of the County. In 1938, the first Planning Commission was formed to address these issues. The 1941 zoning ordinance, the first attempt at regulation of development within the County, defined categories of land use such as "rural-residential" or "urban-commercial." The basic goal of stormwater controls during this time period was to prevent expensive and catastrophic flooding in municipal areas.

Construction of Lake Barcroft dam 1913-1915.

The Suburban Explosion: 1941-1972

Beginning in the early 1940's, the County's economy shifted from agriculture to one that was largely commercial and based on providing services to an increasingly suburban population. After World War II, many people moved into Fairfax County from Washington, D.C., migrating into developed areas of Alexandria, Falls Church and Arlington. Subsequent expansion moved westward into Fairfax and Vienna. During this period the population of the County grew from roughly 50,000 to 500,000.

Under a Federal grant, a series of impoundments were built beginning in the late 1960's in the Pohick Creek Watershed as a part of a pilot program (Public Law 566) of the Soil Conservation Service. The purpose of these impoundments was to limit runoff volumes and allow suspended materials to settle out. Those six impoundments are known as

Lakes Woodglen, Royal, Braddock, Barton, Huntsman, and Mercer, all of which are currently operated and maintained by the County.

Lake Barton at Burke Centre, one of the six dams built as part of the Soil Conservation Service (PL566) pilot program.

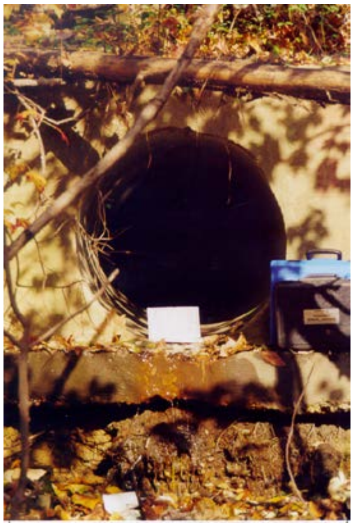
The year 1964 saw the adoption of the first Policy and Guidelines Manual, the forerunner of the current Public Facilities Manual (PFM) which established clear guidelines for construction of municipal infrastructure. Stormwater management at this time only meant adequate drainage, a modest goal that was usually achieved through simple curb-and-gutter construction leading to concrete pipes or channels, which emptied into the nearest stream. Flood prevention was the main focus of stormwater management at this time, and these systems were designed to quickly carry stormwater away from property. While this goal was largely achieved, intense peak flows in receiving streams also led to erosion problems, a situation that continues to this day. Several large floods, such as Hurricane Agnes, occurred during this period. Many homes that had been built on the floodplain required costly flood control structures, prompting the County to rigidly limit and control new construction within the 100-year floodplain of any waterway.

Sediment from a development site entering Sandy Run via a small tributary.

The Regulation Revolution: 1972-1993

Starting in the early 1970's, concerns began to rise nationwide about the health of our environment in general. The federal Clean Water Act, passed in 1972, required states and their municipalities to meet certain established water quality standards primarily based on chemical water quality. Regionally, nutrient and bacterial pollution, much of which was being carried into streams by stormwater runoff, was contributing to the decline of the Chesapeake Bay. This was compounded by heavy inputs of fine sediments from development in the surrounding watersheds.

During this period, the population of Fairfax County grew dramatically, reaching almost 900,000 residents. Much of the increase was driven by new technology-based businesses, which were less dependent upon urban centers than conventional industry, and migrated with the moving workforce. This new suburban expansion resulted in additional increases in impervious surfaces, which further contributed to bank erosion in



The NPDES program monitors water quality at stormwater outfalls within Fairfax County.

the receiving streams, and caused vast quantities of sediment to be carried into the Potomac from the County every year.

In 1982, Best Management Practices (BMPs) were adopted in the Occoquan watershed as part of an effort to reduce nutrient pollution and to preserve the Occoquan Reservoir, which supplies drinking water for many Fairfax County residents. Some of the BMPs were structural in nature, such as detention ponds, while others were land-use controls, such as the establishment of a special zoning district for roughly two-thirds of the Occoquan watershed in Fairfax County. This established a minimum residential lot size of five acres.

The BMP Era: 1993-Present

As a whole, the County is largely developed. The 1999 Demographic Reports document indicates that only 17.3% of the County's land area is considered to be underutilized residential land or vacant residential or nonresidential land (data are not available for underutilized nonresidential land). The County's population is expected to exceed one million people within the next three years.

In 1993, Fairfax County adopted BMPs countywide as a result of the Chesapeake Bay Ordinance, which established stream corridor areas as Resource Protection Areas (RPAs) and the remainder of the County as a Resource Management Area (RMA) in an effort to protect water resources. As a part of the National Pollutant Discharge Elimination System (NPDES), Fairfax County received a permit from the Virginia Department of Environmental Quality (DEQ) to discharge stormwater into State waters. To obtain this permit, Fairfax County was required to demonstrate that it had an effective stormwater management and monitoring program.

Many other measures at the local, state and federal levels have since been enacted to protect wetlands, stream valleys, the Chesapeake Bay and general water quality. The SPS program will have benefits that extend beyond the County's boundaries, and the ongoing effort will become an important and integral component of many of these initiatives. (For further discussion of these programs, see Chapter 4).

Today, assessments are being made countywide of the effectiveness of many old management measures as well as the suitability of new approaches and technologies aimed at further reducing stormwater runoff and associated pollution.

CHAPTER 1

EFFECTS OF URBANIZATION

When rainwater initially reaches the ground in a natural environment, it has four possible routes: evaporating into the air, filtering through the soil, running directly into a stream or being absorbed by plants. In an undeveloped watershed, only a small percentage of rainwater becomes surface runoff, the majority entering the soil where it is taken up by plants, evaporates, or infiltrates to the groundwater table. Abundant natural riparian vegetation helps retain precipitation, slows sheet flow, enables downward percolation through root systems and resists erosion by stabilizing the stream bank. This vegetative cover also recycles rainwater back into the atmosphere via evapo-transpiration.

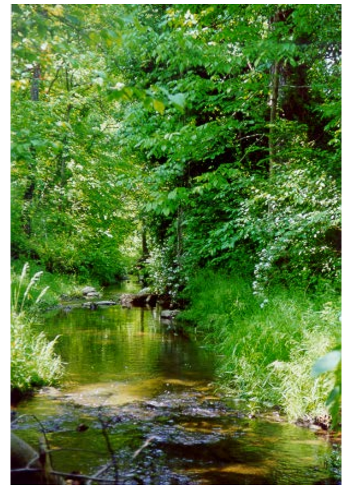
A headcut along Wolftrap Creek in the Difficult Run Watershed is indicative of erosive "downcutting."

When natural land is cleared to make way for commercial, residential, or other uses, vegetation is removed and bare soil is exposed. In this situation, rainwater is not absorbed, and the soil is substantially destabilized. More importantly, if proper controls are not in place during the construction process, there is great potential for sediment, one of the greatest threats to instream habitat quality, to run off directly into waterways.

Tree falls are indicative of stream channel widening along Pikes Branch in the Cameron Run Watershed.

Natural streams follow a predictable meandering pattern, which helps dissipate energy and minimize scouring of the streambed and banks. Increasing impervious surface area causes substantially higher peak flows during storm events. To compensate for the extra energy generated by the altered flow regime, streams undergo a predictable sequence of changes in channel morphology (Schumm, 1984).

Stream morphology will adjust over time to accommodate increased peak flows. Initial increases cause "downcutting," or incision of the channel bottom. Over time, stream banks begin to erode as well, resulting in an overall widening of the channel. This instability will persist until flow regimes within the drainage have become stable, a process that can only occur once increases in impervious cover have ceased. Once this takes place, a stream will establish a new equilibrium with the development of a new floodplain. However, the amount of time required to reach this stage is typically measured in decades.



Low gradient, vegetated stream banks indicate stabilization along Little Rocky Run.

Throughout this period of readjustment within streams, large volumes of sediment are eroded and transported into downstream receiving waters. This sediment smothers substrate particles and other forms of instream habitat, effectively denying many organisms access to shelter that is necessary for their survival. It may also deprive many fish species of suitable spawning habitat.

In addition to the physical damage done to streams by increased storm flows, urban/suburban runoff may bring with it many forms of pollution, any one of which has the potential to significantly impact biological communities. Types of pollution to streams can be lumped into two main categories: those that come from a distinct concentrated source (called point source pollution), and those that are diffuse, originating from large geographic areas (called nonpoint source). A pipe discharging untreated effluent would be an example of a point source of pollution, while fertilizer from an entire neighborhood washing off of the land during a storm event would be classified as coming from a nonpoint source. While each type may impact only a very specific element of a given biological community (Table 1), they all have the potential to impact the entire stream system, degrading conditions throughout its length.

Table 1. Major pollutants (stressors) in urban or suburban areas and their effect on streams.

Stressor	Source	Environmental Effect
Nutrients (Nitrogen and Phosphorous)	Improper use (over application) of lawn fertilizers.	Stimulate algae blooms. May reduce sunlight reaching stream bottom, limiting plant growth. Rapid accumulation of dead algae decomposes aerobically, robbing other stream animals of oxygen.
Toxics	Various. Underground storage tank leakage, surface spills, illegal discharges, chlorine from swimming pool drainage, etc.	Can have an immediate (acute) affect on stream biota if levels are high enough. May be chronic, eliminating the more sensitive species and disrupting ecosystem balance over time.
Sediment	Poorly managed construction areas, winter road sand, in-stream erosion, bare soils.	Clogs gills of fish and insects, embeds substrate, reducing available habitat and potential fish spawning areas.
Organic Loading	Sewage leaks, domestic and livestock wastes, yard wastes dumped into streams.	Human health hazard (pathogens), similar oxygen depletion situation as Nutrients. Causes benthic community shift to favor filter feeders as well as organisms with low oxygen requirements.
Exotic Species	Human transportation and release (intentional and unintentional).	Invade ecosystem and out compete native species for available resources (food and habitat). Some introduced intentionally to control other pests.
Thermal Loading	Water impoundments (lakes or ponds). Industrial discharges and power plants. Removal of riparian tree cover. Runoff from hot paved surfaces.	Biological community structure altered, shift to species tolerant of higher temperatures, sensitive species lost. Dissolved oxygen depletion.
Channel Alteration	In very urban areas, concrete, metal and rip-rap stabilization of stream banks. Stream channelization, flood erosion control.	Major habitat reduction/elimination, changes flow regime dramatically. Dramatic alteration of biological communities, can cause Thermal Loading and Sediment problems. Transfer erosion potential downstream.
Altered Hydrology	Conversion of forested/natural areas to impervious surfaces. Increases amount and rate of surface runoff and erosion.	Overall channel instability, habitat degradation or loss.
Riparian Loss	Development. Clearing or mowing of vegetation all the way up to stream banks.	Increase water temperature, greater pollutant input, less groundwater recharge, greater erosion potential from streambanks. Alters community composition.

CHAPTER 1

IMPORTANCE OF BIOLOGICAL MONITORING

Nationwide, there has been a shift in focus from chemical monitoring for point source pollution to a broader assessment of nonpoint source pollution. Urban/suburban runoff is now recognized as a significant cause of stream degradation, an issue that is especially relevant to the environment of Fairfax County. At levels of 10-20% imperviousness, stream quality becomes adversely impacted (Klein, 1979, Booth, 1991, Schueler et al, 1992, Booth et al, 1993, Booth and Jackson, 1994 and Boward et al, 1999 (Figure 1)). In recognition of this fact, current stream assessments rely heavily on methods of biological monitoring that highlight anthropogenic impacts of land use that most influence living stream communities.

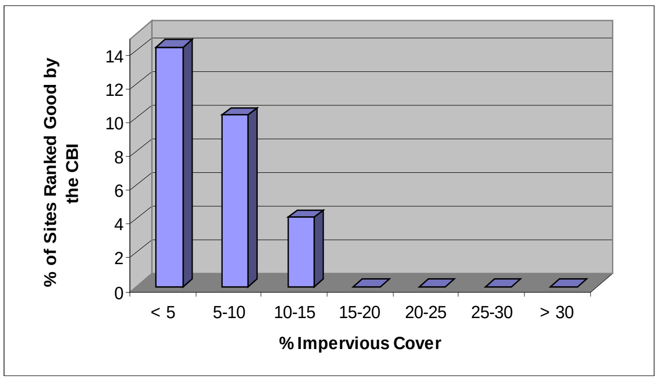


Figure 1: Stream health is directly related to the level of impervious cover in the surrounding watershed. Combined measures of biological integrity (in this case, a Combined Biotic Index (CBI) reflecting various components of living aquatic communities) are useful in highlighting potential threshold levels of development within stream drainages (ranking of sites from Maryland Biological Stream Survey (MBSS) (Boward et al, 1999)).

Fish and aquatic insect communities respond to the various forms of environmental degradation in a predictable manner, and aspects of their respective community structure can provide a useful measure of overall environmental quality within a given system. Such responses, often evident as changes in community composition and/or relative species abundance, can highlight single-source environmental stressors or the cumulative impact of multiple stressors.

Benthic macroinvertebrate communities are a major component of any healthy stream system. They are an important link in any aquatic food web, forming the core of the diet of many stream fishes. These organisms are useful indicators of water quality generally due to their varying tolerances to chemical, nutrient and sediment pollution. As a group, they integrate conditions in a watershed over time, yet are also useful in highlighting immediate problems due to their relatively quick responses to many environmental stressors.

Fish assemblages represent the apex of most stream communities. They are very sensitive to both natural and anthropogenic changes within a given system and are, therefore, useful indicators of stream health as well. Fish are also more readily understood and appreciated by the public than are other biological components of stream systems and can be useful tools for developing community interest in environmental and water management issues.

The chemical constituents of water are still recognized for their potential to influence stream biota and should be a component of any biological assessment. The impact of various chemical inputs on living organisms can be acute (immediate) or chronic (occurring over a long period) and may limit stream communities even when quality habitat is available. Measurement of a variety of basic chemical parameters is therefore useful in assessing areas of immediate concern and for highlighting situations where more detailed chemical analysis may be required.

With its emphasis on biological monitoring, the SPS program is an important first step toward improving environmental quality by viewing streams as more than mere conduits of stormwater flow. By tying together information on stream morphology, habitat condition, water chemistry, and current and projected land use patterns, it will provide an important base for the planning and decision-making framework that will be needed to protect and restore stream ecosystems within Fairfax County.

CHAPTER 2

METHODS

This section is intended to provide a brief summary of the protocols, techniques, and methodologies employed that are consistent with the goals and objectives for the SPS baseline study. More detailed information can be found in the Protocols sections of the Appendix (sections A-H).

Site Selection

Fairfax County extends across three physiographic provinces or distinct geologic regions, each containing stream systems with specific hydrologic regimes, substrate character, and aquatic communities. The Coastal Plain region lies in the eastern portion of the County and is generally characterized by sandy soils and low gradient topography. The Piedmont Upland region, consisting of rocky substrate and rolling hills, spans the central portion of the County. The Triassic Basin, a sub-region of the Piedmont Upland province, is characterized by areas of low relief and large expanses of shale and red sedimentary sandstone. For the purposes of this study, Piedmont and Triassic Basin regions were evaluated using the same protocols, and Coastal Plain areas were sampled and analyzed using a separate methodology.

The 114 monitoring locations (Figure 2) were selected to provide relatively even coverage of all subwatersheds throughout Fairfax County. The goal was to obtain information for small sub-drainages (typically 2 to 5 square miles in total area) both within tributary environments as well as along system mainstems of primarily second and third order streams (see Appendix A). Stream order was determined using USGS 1:24,000 scale maps. Logistical concerns (i.e., relative ease of accessibility, avoidance of private property, proximity to artificial structures) were taken into account in site placement. In some small watersheds with numerous independent stream systems — like those draining into the Occoquan Reservoir — sites were placed on single streams with conditions that reflected those of the drainage as a whole. No sites were established within the High Point watershed, as systems in the drainage are of a wetland character unsuited to sampling under the protocols established for streams countywide.

A similar approach was used in selecting 11 sites along reference streams within the Quantico Creek drainage in Prince William Forest Park, a largely undeveloped area in Prince William County, Virginia, with some of the highest quality stream systems available locally. The information obtained was used to develop a framework of optimal stream conditions, which ultimately allowed for the ranking of Fairfax County sites based upon their relative level of correspondence to a composite of “reference or benchmark” conditions (see discussion of Andrews Curves in this section or Appendix G).

Each of the individual sites consisted of a 100-meter stream reach that was representative of conditions in the surrounding drainage area.

Countywide Sampling

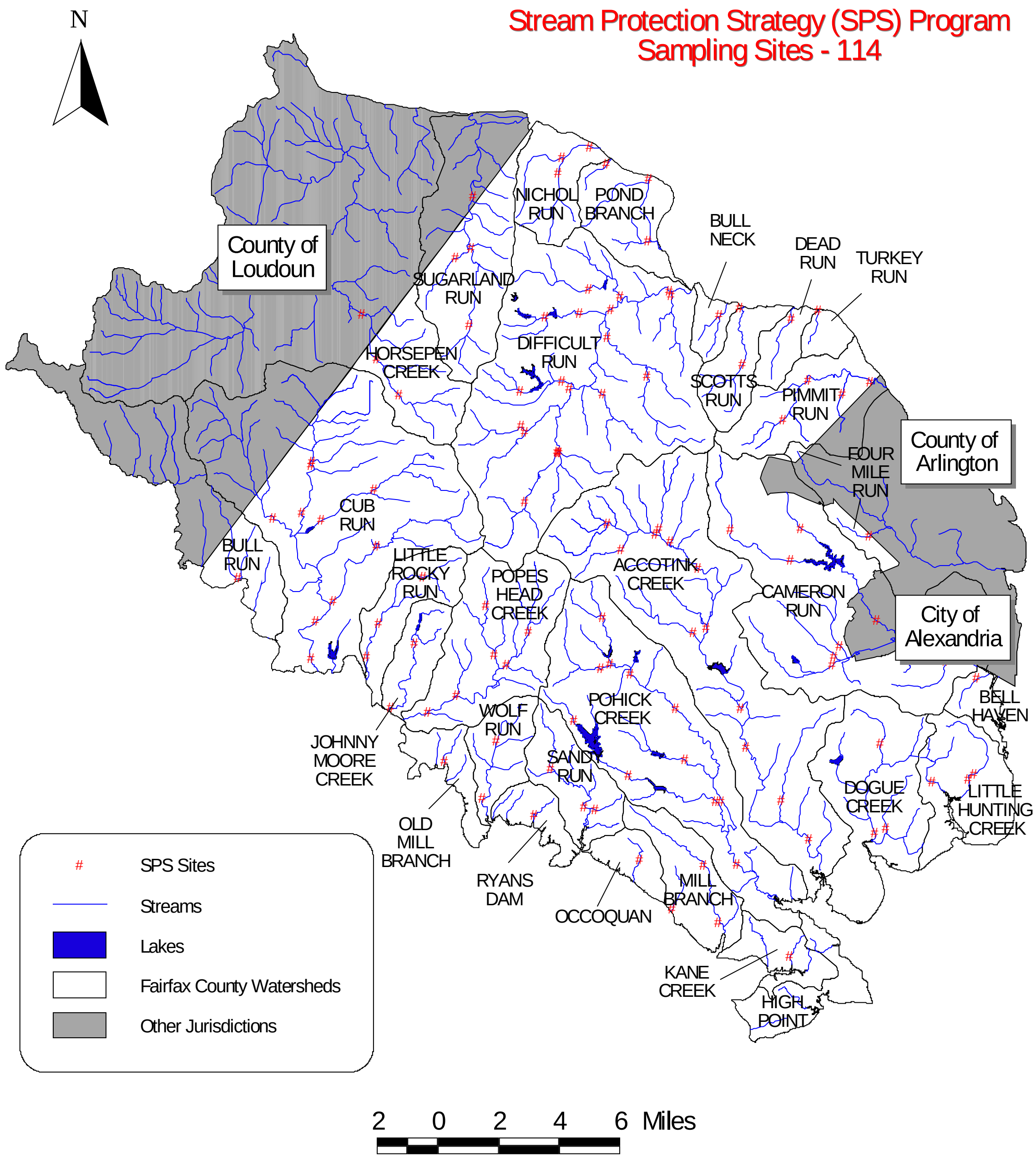


Figure 2. Countywide Stream Protection Strategy monitoring sites.

CHAPTER 2

Benthic Macroinvertebrate Sampling

Benthic macroinvertebrate samples are collected from riffles and shallow runs, the most productive areas in streams.

Benthic macroinvertebrate samples were collected at all sites in late winter/early spring of 1999, using the established protocols of the U.S. Environmental Protection Agency's (EPA) Rapid Bioassessment Protocol (RBP) for Use in Wadeable Streams and Rivers (Barbour et al. 1999, see Appendix B). Separate methodology was used in the two distinct physiographic regions. At sites within the Piedmont region, a kick sample was taken from one riffle and one run within each study reach, and the collections were combined into one sample. Within the Coastal Plain region, a combined sample was developed from 20 separate "jab" samples taken from representative habitat types in the reach including undercut banks, aquatic vegetation, riffles and snags.

The first 200 randomly selected individuals from each sample were identified to the genus level (Oligochaetes (aquatic worms) and Chironomidae (midges) were categorized at a higher taxonomic level due to time constraints). The resulting data were then used within a framework of a pre-established set of metrics, each a numerical valuation reflecting tolerance or trophic structure variables of each given macroinvertebrate community. An Index of MacroBenthic Integrity (IMBI) metric set developed for use in Northern Virginia Piedmont areas (Jones, 2000, personal communication) was used for sites within the Piedmont and Triassic physiographic regions (Table 2). Analysis of information from sites within the Coastal Plain region was based on a metric set (Table 3) created by Maxted et al. (1999).

For each individual metric, sites were scored on a scale of 0 (low correspondence) to 10 (high correspondence) relative to the reference condition. For Piedmont/Triassic sites, comparisons were made to a reference set developed by Jones et al. (2000, personal communication), while Coastal Plain sites where compared to Kane Creek in southeastern Fairfax County based on the use of least impaired sites approach recommended by Karr et al. (1986). Values from each suite of metrics (10 for the Piedmont/Triassic region and 5 for the Coastal Plain region) were then added together to develop a single Index of Biotic Integrity (IBI) measured on a 0 to 100 scale. In the Coastal Plain, values were doubled to produce a comparable 0 to 100 scale. Based on this value, individual sites were given a qualitative rating within one of the following five categories: **excellent, good, fair, poor and very poor** (Table 4).

CHAPTER 2

Table 2: Metrics for the Index of MacroBenthic Integrity (IMBI) (Jones personal communication 2000).

PIEDMONT AND TRIASSIC BASIN METRICS	
METRICS	**DESCRIPTIONS**
1. Taxa Richness	Number of different taxa in a sample.
2. EPT richness	Number of Mayfly, Stonefly and Caddisfly taxa at a site.
3. Percent EPT	Percent of Mayfly, Stonefly and Caddisfly taxa at a site excluding the tolerant Net-Spinning Caddisfly (Hydropsychidae).
4. Percent Trichoptera w/o Hydropsychidae	Percent of sample that are Caddisflies excluding the tolerant Net-Spinning Caddisflies (Hydropsychidae).
5. Percent Coleoptera	Percent of sample that are beetles.
6. Family Biotic Index (FBI)	General tolerance/intolerance of the sample.
7. Percent Dominance	Percent of the most abundant taxa.
8. Percent Clingers + Percent Plecoptera	Percent of individuals whose habitat type is clingers plus percent of sample that are stoneflies but are not clingers.
9. Percent Shredders	Percent of individuals that use shredding as its primary functional feeding group.
10. Percent Predators	Percent of individuals that use predation as its primary functional feeding group.

Table 3: Metrics for the Coastal Plain IBI (Maxted et al. 1999).

COASTAL PLAIN METRICS	
METRIC	**DESCRIPTION**
1. Taxa Richness	Number of different taxa at a site.
2. EPT Taxa	Number of Mayfly, Stonefly and Caddisfly taxa at a site.
3. Percent Ephemeroptera	Percent of sample that are Mayflies.
4. Hilsenhoff Biotic Index	Hilsenhoff Biotic Index - general tolerance/intolerance of the sample.
5. Percent Clingers	Percent of individuals whose habitat type is clingers.

Table 4: IBI scores and equivalent rating system.

IBI SCORE	SPS RATING	DESCRIPTION
80 to 100	Excellent	Equivalent to reference conditions; high biodiversity and balanced community.
60 to 80	Good	Slightly degraded site with intolerant species decreasing in numbers.
40 to 60	Fair	Marked decrease in intolerant species; shift to an unbalanced community.
20 to 40	Poor	Intolerant species rare or absent, decreased diversity.
0 to 20	Very Poor	Degraded site dominated by a small number of tolerant species.

Electrofishing with the use of battery-powered backpack generators allows for a quick assessment of fish community composition.

Fish Sampling

Fish sampling was based upon the techniques detailed in the EPA's Rapid Bioassessment Protocols (Barbour et al. 1999) and involved species-level identification of all fish captured within each reach (see Appendix C). Samples were collected in the field using electrofishing equipment that temporarily stuns fish, allowing them to be netted with relative ease. Individuals were then identified and released back into the stream. Representative specimens of each unique taxa (distinct species) found were preserved to establish a permanent reference collection of the fishes of Fairfax County. An extensive suite of candidate metrics was then developed based on trophic characteristics, tolerance, and community structure, and each was then assessed for its usefulness in developing an Index of Biotic Integrity for fish. Of these, only the species richness metric (total number of unique fish taxa collected at each site) was found to be useful in separating sites on a gradient of impairment. Measures of fish community richness typically increase with increasing stream discharge or order, and the values were adjusted accordingly to generate an ultimate rating of High, Moderate, Low, or Very Low. An IBI could not be developed for fish communities due to the poor performance of other candidate metrics.

During the summer of 1999, Fairfax County, like the entire surrounding region, experienced one of the most significant droughts on record. Because the unusual flow regime had the potential to influence fish samples obtained during that time period, 25%

of the sites were randomly selected from subgroups based on stream order and re-sampled in the summer of 2000. No significant difference between years was noted.

Habitat Assessment

The physical habitat of each SPS site was evaluated using two sets of protocols (see Appendix D). In the spring sampling period, a scored assessment that incorporated aspects of the Rapid Stream Assessment Technique (RSAT) (Galli, 1996) was used. During both spring and summer sampling periods, habitat conditions were examined using a modified version of the EPA's Rapid Bioassessment Protocols (Barbour et al., 1997). This method of habitat assessment consists of a general evaluation of the watershed features (including vegetation and instream features) as well as a more specific evaluation of 10 parameters, each scored on a scale of 0 (Worst Condition) to 20 (Optimal Condition). The scores were summed to obtain an overall rating of habitat quality, which was then used as the basis for countywide comparisons. To account for hydrologic and geographic differences between Piedmont/Triassic streams and those on the Coastal Plain, separate metrics for each were used (Table 5).

Increased storm discharges can have a measurable effect on stream habitat features.

Table 5. Habitat metrics for Piedmont/Triassic and Coastal Plain streams (metrics common to each group may be scored based upon different criteria).

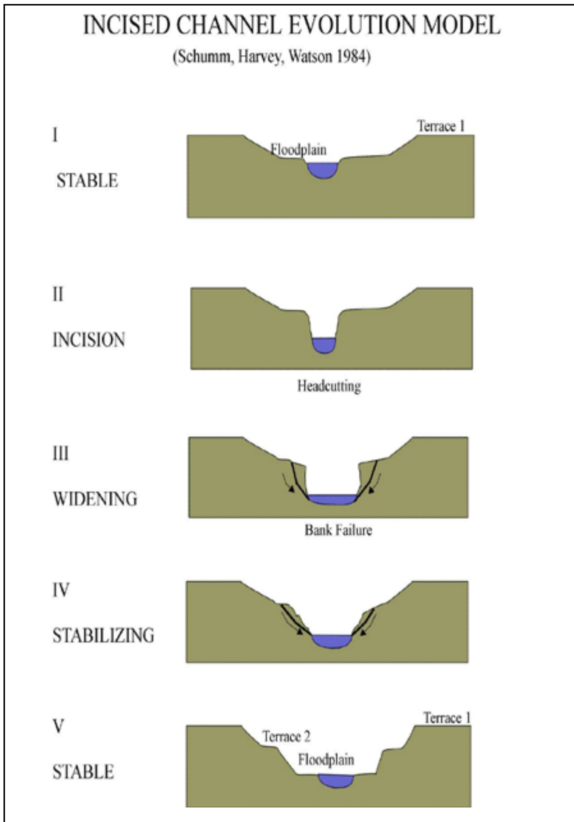
Piedmont/Triassic	Coastal Plain
Epifaunal Substrate/Available Cover	Epifaunal Substrate/Available Cover
Embeddedness	Pool Substrate Characterization
Velocity/Depth Regimes	Pool Variability
Channel Alteration	Channel Alteration
Sediment Deposition	Sediment Deposition
Frequency of Riffles/Bends	Channel Sinuosity
Channel Flow Status	Channel Flow Status
Bank Vegetative Protection	Bank Vegetative Protection
Bank Stability	Bank Stability
Riparian Vegetative Zone Width	Riparian Vegetative Zone Width

CHAPTER 2

Stream Morphology

During the summer sampling phase, a physical characterization of habitat was conducted using the Incised Channel Evolution Model (ICEM) (Schumm et al., 1984), a broad-scale assessment which involves examination of extensive sections of stream channel above and below each respective sample reach. The ICEM defines the stages through which stream channel morphology progresses after disturbance, and can act as a useful predictor of future conditions (Schumm et al., 1984, Harvey and Watson, 1986). A standardized field check sheet developed by Sewell (1999, personal communication) was used to aid County staff in identifying the respective stages at each site based upon key characteristics such as bank slope, headcutting, sediment deposition and/or erosion, and extent of vegetative colonization (Table 6). Visual assessments were conducted both upstream and downstream of study reaches (approximately a mile at each site) and extended to the nearest major tributary input, road crossing, or other significant feature that had the potential to influence local hydrology and/or morphology.

Table 6. Key characteristics of stream stages, as defined by the Incised Channel Evolution Model (ICEM).



Stage I: Well developed baseflow and bankfull change; consistent floodplain features easily identified; one terrace apparent above active floodplain; predictable pattern and steam bed morphology; floodplain covered by diverse vegetation; stream banks ≤ 45°.
Stage II: Headcuts; exposed cultural features; sediment deposits absent or sparse; exposed bedrock; streambank slopes > 45°.
Stage III: Stream bank sloughing, sloughed material eroding; streambank slopes 60° vertical/concave.
Stage IV: Streambank aggrading; sloughed material not eroded; sloughed material colonized by vegetation; baseflow, bankfull and floodplain channel developing; predictable sinuous pattern developing streambank slopes ≤ 45 °.
Stage V: Well developed baseflow and bankfull channel; consistent floodplain features easily identified; two terraces apparent above active floodplain; predictable pattern and streambed morphology; streambanks ≤ 45°.

CHAPTER 2

Other Field Sampling

Samples of stream water were tested twice at each site, once when collecting macroinvertebrate samples (spring) and once when sampling fish (summer). Dissolved oxygen (mg/L), pH, temperature (°C), conductivity (μS), % O_2 saturation and turbidity (NTUs) were recorded during both of these periods, while nitrate (mg/L) and fluoride (mg/L) measurements were recorded only once, during the summer sample period (see Appendix E).

Measurements were also made of tree canopy cover using a hand-held densiometer and of stream substrate condition using Pebble Count methodology (Wolman, 1954).

Spatial Analysis

Spatial information (latitude/longitude) on all SPS sites was collected using a portable, differential Global Positioning System (GPS) unit. The resulting data was incorporated into a Geographic Information System (GIS), which was used to assess existing and potential patterns in land use, both within the County as well as within neighboring jurisdictions, that potentially influenced stream quality. The contributing drainage area was delineated for all sites, and percent imperviousness within each of these respective areas was estimated using available Fairfax County data layers (roads, parking lots, buildings, sidewalks). These layers were reflective of conditions within the County in 1997.

Estimates of future imperviousness for these same areas were developed using County zoning information. Districts specified in the County Zoning Ordinance were assigned levels of imperviousness based upon values reported in the Fairfax County Zoning Ordinances for open space requirements, the County's Public Facilities Manual, and the Chesapeake Bay Local Assistance Department (CBLAD) Manual. The current zoning data layer was combined with the delineated drainage boundaries, and the predicted future imperviousness value for individual subwatersheds was obtained by area-weighting each zoning district contained within these subwatersheds. It is important to note that these values reflect future development *potential*, and are used here only as a general, conservative framework for guiding the prioritization of County watersheds. There are several factors that may contribute to over and under estimations of future imperviousness based on zoning information including:

- Site conditions (e.g. soils and slopes) may prevent a parcel from being fully developable resulting in less imperviousness.
- Protected resources such as parks, Resource Protection Areas, wetlands and floodplains may also reduce the developable area resulting in less imperviousness.
- Differences between zoning and the County's Comprehensive Plan will also result in differences in future imperviousness.

Information on all volunteer monitoring sites was also collected using a GPS unit and will be part of future spatial analyses related to stream monitoring.

See Appendix F for a detailed discussion of the methodology employed in generating measures of both current and future imperviousness.

Countywide Stream Ranking System: Multi-dimensional Curves

An overall ranking of stream conditions at sites countywide was developed using a procedure for plotting and analyzing multi-dimensional data suggested by Andrews (1972). A detailed explanation of the procedure can be found in Appendix G. The procedure entails generating a uniquely shaped curve for each set of multi-dimensional data. The procedure provides a consistent graphical means of recognizing and matching patterns across multiple dimensions. The components making up the dimensions of the curves for each site were the IBI score, percent imperviousness of the contributing drainage area, fish taxa richness, and physical habitat assessment scores (see Appendix G for an explanation of how these environmental variables were selected).

The basic approach employed in ranking was to evaluate the degree to which the curve for a site departed from the reference condition curve (Figure 3). The reference condition curve was determined from high quality sites within Fairfax County as well as the Quantico Creek watershed, a largely undeveloped region within Prince William Forest Park.

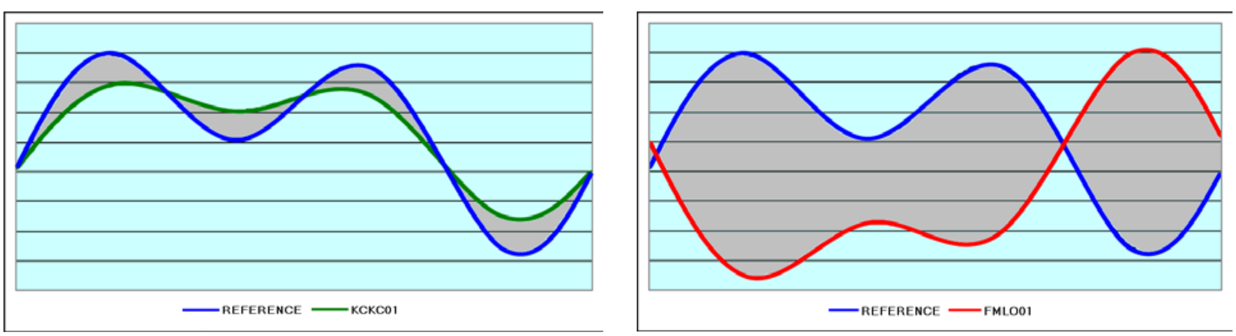


Figure 3: Example Curves. The blue curve on both graphs represents reference conditions. The green curve in the graph on the left represents one of the highest quality sites, and follows the reference curve closely. The red curve in the graph on the right clearly diverges from the reference curve and represents a site along one of the County's poorest quality streams. Numerical rankings were assigned to each site depending on the degree of divergence along the entire length of a given curve from the reference curve (i.e., shaded areas). The scale for the graph's axes are arbitrary and are intentionally excluded from presentation here. See Appendix G for a full discussion of these types of analyses.

CHAPTER 2

Management Categories

Three management categories were established to provide recommendations for future watershed management efforts based on overall stream ranking (composite score) and projected development within each respective subwatershed. These management categories are as follows:

- **Watershed Protection**
- **Watershed Restoration Level I**
- **Watershed Restoration Level II**

These categories are intended for use only as planning level tools. Each of these categories is characterized by a set of goals and strategy recommendations that best suit—in terms of cost-effectiveness, available resources and perceived efficacy of targeted actions—each respective stream environment given current subwatershed development patterns, likely future imperviousness and the current assessment of biological condition. In addition, management categories are not intended to be a means of controlling development or to be confused with adopted land use categories contained within the County's Comprehensive Land Use Plan, or other land use documents currently guided by the County Ordinance. Rather, management categories propose a new technique to group targeted areas that might be recommended for similar treatment for more effective future watershed protection, preservation and restoration efforts. Actual implementation of the recommended treatment might entail more detailed study through watershed master plans and/or necessitate a re-examination of some existing policies and plans through a different process. Some of these strategies, by themselves, represent established steps and initiatives currently being implemented in the County and neighboring jurisdictions. However, SPS attempts to organize these strategies in a more logical manner to foster a more effective watershed planning and management approach. The strategies outlined in this report by no means represent an all inclusive list; rather they will serve as the foundation of a process to identify potential strategies that may require further evaluation for applicability on a subwatershed scale.

The following information describes the criteria used for assigning subwatersheds to a specific management category. The assignment of individual subwatersheds to particular management categories is based on the best information currently available. As more information becomes available in the future, those subwatersheds may be reassigned. A detailed description of the potential strategies for each category, including existing County programs, is presented in Chapter 4 —Watershed Improvement Strategies.

CHAPTER 2

WATERSHED PROTECTION

Subwatersheds that fall into this category will likely be in areas with low development density and which currently possess biological communities that are relatively healthy. Such a ranking will be independent of the likelihood of future development. 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 current high-quality rating of these streams.

Some active measures may still be required to improve certain aspects of stream quality. These will be recommended on a subwatershed basis.

Criteria:
- Composite Rating is Good or Excellent.

WATERSHED RESTORATION LEVEL I

The primary goal of this 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. In general, these watersheds have fair biological conditions and are in areas where substantial development activity is ongoing, but which still hold potential for significant stream quality enhancement. The active approach warranted for subwatersheds in this category would also apply to all stream segments, no matter how degraded, that lie upstream of areas that fall within the WATERSHED PROTECTION category.

Criteria:
- Composite Rating is Fair or, rarely, Poor.
- Projected imperviousness of less than 20%.
- Areas classified as WATERSHED RESTORATON LEVEL II that are upstream of areas in the WATERSHED PROTECTION category.

WATERSHED RESTORATION LEVEL II

Subwatersheds in this category will likely be characterized by high development density, significantly degraded instream habitat conditions, and substantially impacted biological communities. 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 Chesapeake Bay Initiatives, Total Maximum Daily Load (TMDL) regulations and all other existing water quality standards. Some site-specific conditions may warrant further active measures to improve stream habitat or biological condition.

Subwatersheds within this category may also be further classified as Assessment Priority Areas, reflecting a current lack of site-specific information and/or their potential for a WATERSHED RESTORATION LEVEL I categorization.
Criteria:

- Composite rating is Poor, Very Poor or, rarely, Fair.
- Projected imperviousness greater than 20%.
- All watershed mainstems (see below).

Given the fact that the overall quality in the larger, higher order mainstem environments is largely a function of the conditions in their contributing subwatersheds, system-wide improvements will most likely be achieved through strategies that focus on and prioritize tributary and headwaters environments. In recognition of this, mainstem systems in every major watershed within the County are currently designated as WATERSHED RESTORATION LEVEL II, even though specific areas throughout their length may have achieved a high composite rating.

VOLUNTEER MONITORING

Northern Virginia Soil and Water Conservation District (NVSWCD)

The NVSWCD coordinates a Volunteer Stream Monitoring Program first established in 1997 that is open to all individuals or groups interested in water quality issues. The program currently sees the involvement of 50 volunteers assisting in all aspects of the program. Site monitors choose their own sites — or receive assistance in locating sites — and conduct sampling four times during the year.

NVSWCD uses the EPA-approved Izaak Walton League Save Our Streams (SOS) protocol for biological monitoring (see Appendix H). Monitors sample riffles by disturbing the stream bottom and collecting dislodged insects with the use of a 3 foot-square net. Visual assessments are made of community richness; a qualitative water quality rating (Excellent, Good, Fair, or Poor) is generated using pre-established scoring criteria.

Monitors may also make assessments of other site characteristics to include such parameters as basic water chemistry. NVSWCD provides all monitoring equipment and conducts a variety of training workshops in the field. Further information about the program can be found on the World Wide Web:

http://mason.gmu.edu/~jarcisze/StreamMonitoring/index.html

CHAPTER 2

Audubon Naturalist Society (ANS) Water Quality Monitoring Program

The ANS water quality monitoring program recruits, trains, equips, and organizes volunteers to assess the health of streams throughout the Washington, D.C., region. The program uses a modified version of the EPA's Rapid Bioassessment Protocols (RBP) to perform habitat assessments and benthic macroinvertebrate surveys (see Appendix H). All monitoring equipment is provided.

Volunteers assess habitat conditions and macroinvertebrates community composition at specific points throughout the year (May, July, September, with an optional winter sample). Macroinvertebrates are collected using a "kick" sampling technique, and collected individuals are visually identified to the family taxonomic level where possible. Multiple samples are collected from riffle areas.

Monitors gauge overall habitat condition by visually assessing parameters such as substrate composition, embeddedness, turbidity, bank cover and canopy cover. Four other components of the EPA's RBP habitat assessment — channel flow status, bank stability, sediment deposition and riparian zone width — are also scored. Readings of pH and water temperatures are taken concurrently.

More information about the Audubon Naturalist Society's water quality program is available through the Webb Sanctuary at (703) 803-8400 or through the website:

www.AudubonNaturalist.org

A variety of other citizen's group and organization are also involved in activities aimed at promoting stream awareness and clean water issues. Their programs, both individually and collectively, are important to the overall effort of improving conditions Countywide.

CHAPTER 3

WATERSHED SUMMARIES

The 30 watersheds in the County have been subdivided into 14 groups for reporting purposes. This was done based on characteristics of area, geography and, in most cases, physiographic province and proximity of watersheds to each other.

CHAPTER 3

Summaries for each watershed include a map of land cover and a brief description of generalized patterns in development. Also included are graphical depictions of primary land uses based upon 30 square-meter Landsat thematic mapper data collected in 1992. The National Land Cover Data Key (NLCD) was the basis for classifying the various land use categories (see Vogelmann et al., 1988). It should be noted that the two classes of residential development specified in the graphic, "High Intensity" versus "Low Intensity," are largely measures of communities with multi- versus single-family dwellings, respectively. These should not be confused with references in the text to low-, moderate-, and high-*density* development, terms frequently used to highlight current levels of imperviousness within subwatersheds. Definitions of land use categories are as follows:

Open Water – All areas of open water; typically 25 percent or greater cover of water (per $30m^2$ pixel).

Low Intensity Residential – Includes areas with a mixture of constructed materials and vegetation. Constructed materials account for 30 to 80 percent of the cover. Vegetation may account for 20 to 70 percent of the cover. These areas most commonly include single-family housing units. Population densities will be lower than in high intensity residential areas.

High Intensity Residential – Includes highly developed areas where people reside in large numbers. Examples include apartment complexes and row houses. Vegetation accounts for less than 20 percent of the cover. Constructed materials account for 80 to 100 percent of the cover.

Commercial/Industrial/Transportation – Includes infrastructure (e.g.) roads, railroads, ect.) and all highly developed areas not classified as High Intensity Residential.

Barren (exposed) – Areas characterized by bare rock, gravel, sand, silt, clay, or other earthen material, with little or no "green" vegetation present regardless of its inherent ability to support life. Vegetation, if present, is more widely spaced and scrubby than that in the "green" vegetated categories; lichen cover may be extensive.

Forested Upland – Areas characterized by tree cover (natural or semi-natural woody vegetation, generally greater than 6 meters tall); tree canopy accounts for 25 to 100 percent of the cover.

Pasture/Hay – Areas of grasses, legumes or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops.

Wetlands – Areas where the soil or substrate is periodically saturated with or covered with water as defined by Cowardin et al.

CHAPTER 3

The data tables for each watershed include rankings for the four major components of the overall composite site condition rating (IBI, Habitat Score, Fish Taxa Richness and Current % Impervious Surfaces) as well as Projected % Impervious Surfaces. Both Fish Taxa Richness rankings (High, Moderate, Low and Very Low) and Current % Impervious Surfaces were classified on a 5-category scale (Very Poor, Poor, Fair, Good and Excellent). A taxa table including all fish species found in the watershed groups and the number of sites where they were found is also included.

Where appropriate, a map of volunteer monitoring sites and data description has been included.

A map of the management category designations is included in each watershed group summary. The management groups are drawn from the individual composite ratings in the Data Summary Table and other factors discussed in the Management Categories of the Methods chapter.

Included in some Watershed Group Summaries are descriptions of other programs or initiatives that are currently going on in those watersheds.

The fish depicted throughout the chapter represent species found within Fairfax County. The color plates are courtesy of the New York State Department of Environmental Conservation. Biological profiles were compiled from Jenkins and Burkhead (1994). Insect color plates are courtesy of Dr. Reese Voshell.

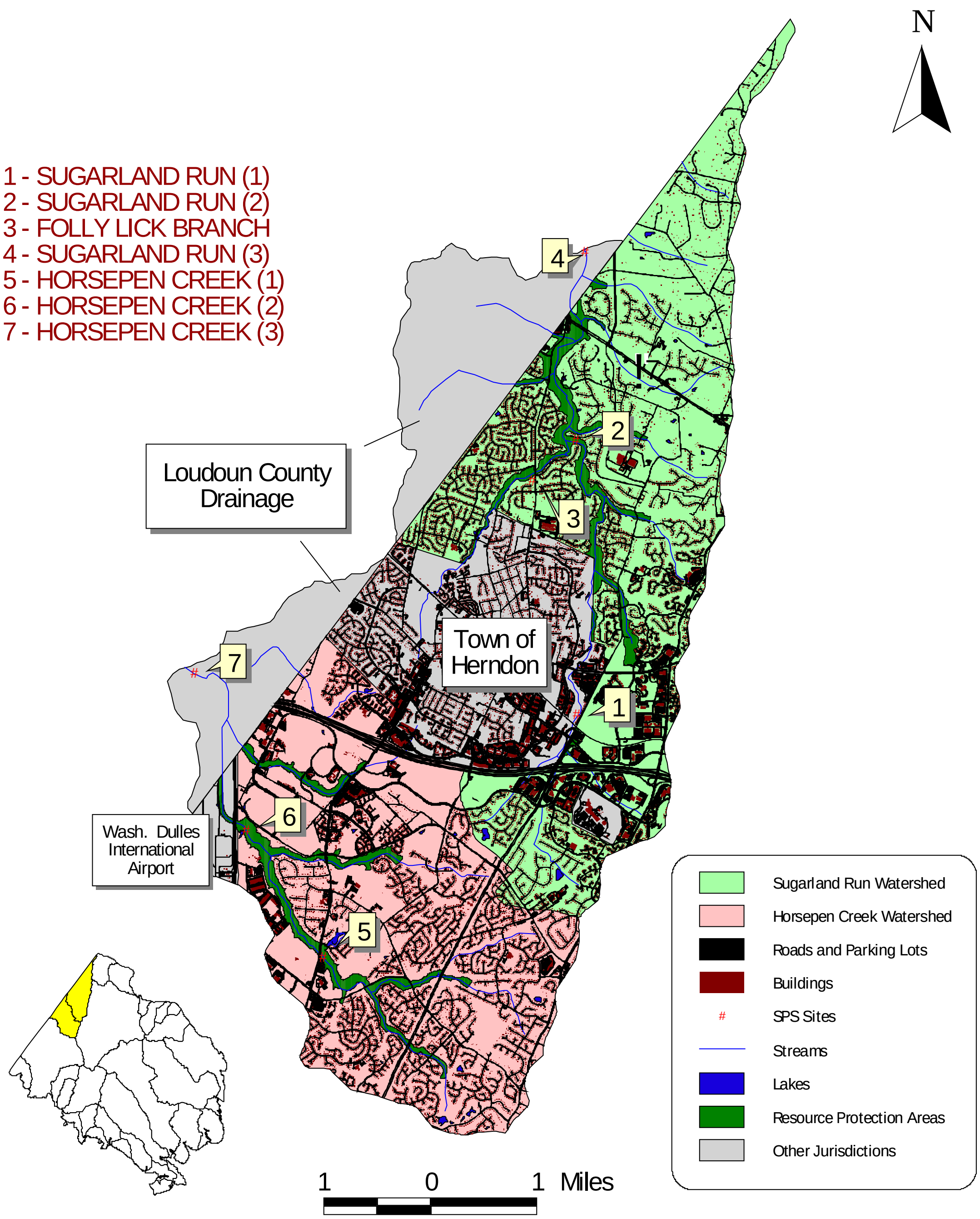
As described in Chapter 2, estimates of future imperviousness for the individual watersheds were developed using County zoning information. It is important to note that these values reflect future development *potential*, and are used here only as a general, conservative framework for guiding the prioritization of County watersheds. There are several factors that may contribute to over and under estimations of future imperviousness based on zoning information including:

- Site conditions (e.g. soils and slopes) which prevent a parcel from being fully developed.
- Protected resources such as parks, Resource Protection Areas, wetlands and floodplains that also reduce the developable area.
- Differences between zoning and the County's Comprehensive Plan.

CHAPTER 3

SUGARLAND RUN
AND HORSEPEN CREEK
WATERSHED SUMMARY

Land Cover

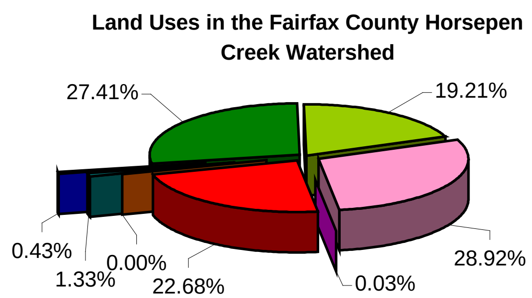


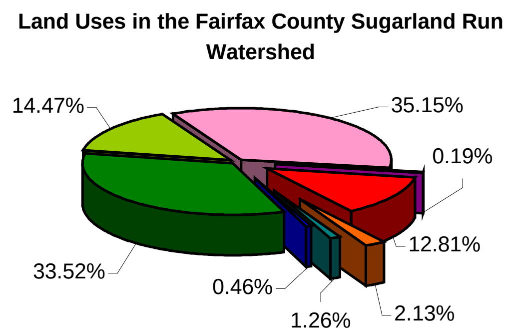
N
1 - SUGARLAND RUN (1)
2 - SUGARLAND RUN (2)
3 - FOLLY LICK BRANCH
4 - SUGARLAND RUN (3)
5 - HORSEPEN CREEK (1)
6 - HORSEPEN CREEK (2)
7 - HORSEPEN CREEK (3)
Loudoun County Drainage
Town of Herndon
Wash. Dulles International Airport
1 0 1 Miles
Sugarland Run Watershed
Horsepen Creek Watershed
Roads and Parking Lots
Buildings
SPS Sites
Streams
Lakes
Resource Protection Areas
Other Jurisdictions

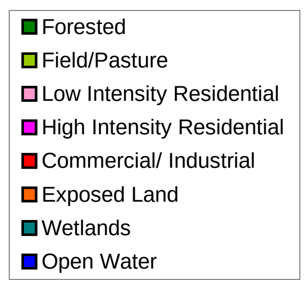
CHAPTER 3

Watershed Description

The Horsepen Creek and Sugarland Run watersheds are located in the northwestern portion of Fairfax County. Horsepen Creek, with an area of 9.6 square miles within Fairfax County, is part of the larger Goose Creek Watershed, which has an area of approximately 85.9 square miles. The majority lies within the jurisdiction of either Loudoun County or Washington Dulles International Airport. Sugarland Run is a smaller watershed, with an area of 22.9 square miles, roughly one-third of which lies outside the County's borders. Both drainages fall within the Triassic Basin physiographic province. No major impoundments occur in the Fairfax portions of the watersheds, and only two small regional ponds are contained within the combined area.







Although the Goose Creek watershed is dominated by forests, pastures and fields, the Fairfax County portion of the basin is heavily developed, with levels of imperviousness ranging between 20-25%. Horsepen Creek begins in Chantilly, crosses under Sully Road (Rte 28), and flows onto Dulles Airport property. From there it enters Loudoun County.


Eroded stream bank and undercut tree root systems are common along the Sugarland Run mainstem.

The Sugarland Run watershed shows a similar land use distribution on both sides of the Fairfax/Loudoun border, with almost 50% of the watershed consisting of low-density residential or commercial areas. The Sugarland Run mainstem begins in the heavily developed area of Reston, flows north under the Washington-Dulles Access and Toll Road (Rte 267), and continues on through the Town of Herndon. It then meets with Follylick Branch, a smaller system that also drains part of Herndon, and then leaves the County on its way to the Potomac River.

DATA SUMMARY

Stream Name and Site Code	Composite Site Condition Rating	Environmental Variables: Index of Biotic Integrity	Habitat Score	Fish Taxa Richness	Current Percent Impervious Surfaces	Projected Percent Impervious Surfaces
1 Sugarland Run 1 (SUSU01)	Poor	Fair	Fair	Low	33.5	52
2 Sugarland Run 2 (SUSU02)	Fair	Fair	Good	Moderate	29.8	48
3 Folly Lick Branch (SUFL01)	Fair	Fair	Fair	Low	26.1	42
4 Sugarland Run 3 (SUSU03)	Poor	Fair	Very Poor	Low	23.6	40
5 Horsepen Creek 1 (HCHC01)	Poor	Fair	Poor	Very Low	22.4	35
6 Horsepen Creek 2 (HCHC02)	Very Poor	Poor	Very Poor	Very Low	21.1	37
7 Horsepen Creek 3 (HCHC03)	Fair	Fair	Fair	Low	21.5	42

Sugarland Run and Horsepen Creek Fish Species List

Common Name	Number of Sites Where Species Occurred (7 Total Sites)
White Sucker	7
Green Sunfish	7
Bluntnose Minnow	7
Creek Chub	7
Blacknose Dace	6
Yellow Bullhead	6
Fantail Darter	5
Bluegill	5
Redbreast Sunfish	4
Pumpkinseed	4
Longnose Dace	4
Central Stoneroller	4
Rosyside Dace	3
Largemouth Bass	3
Greenside Darter	2
Tessellated Darter	2
Banded Killifish	2
Spottail Shiner	2
Satinfin Shiner	1
Creek Chubsucker	1
Eastern Silvery Minnow	1
Golden Shiner	1

Central Stoneroller

Campostoma anomalum

Size: to 7 inches
Habitat: riffles and runs in clear, moderate- to high-gradient streams
Feeding Group: herbivore
Tolerance: moderate
Known also as a "creek cow," the stoneroller is well suited to grazing. Its lower jaw has a hard ridge, which it uses to scrape algae from rocks. It also has the longest intestine of any American minnow, which allows better digestion of plant material. During the spring breeding season, males become covered in hard tubercles, which are used in courtship battles.

CHAPTER 3

Watershed Condition Summary

Measures of biological and habitat integrity throughout the Fairfax County portions of these two watersheds show each to be substantially degraded. This situation corresponds to the high levels of development seen in both areas.

Fish taxa richness was generally Fair and Poor for the Sugarland and Horsepen watersheds, respectively. The number of distinct species identified was relatively low throughout both drainages, and many of the species collected were classified as generalists and tolerant of degraded stream conditions.

A similar pattern is evident in measures of benthic macroinvertebrate community health. Aquatic worms and midges dominated samples throughout both drainages. Both groups are generally classified as being more tolerant of degraded stream conditions such as excessive sediment deposition, unstable habitat, and pollution. None of the samples collected in either drainage contained more than a few intolerant or “sensitive” organisms.

The overall instream habitat quality of these two watersheds is generally poor, and like the habitat scores countywide, sediment deposition and the related measure of embeddedness were consistently the lowest scoring components of the ranking. Active channel widening or downcutting, moderate to severe erosion, and unstable banks characterized most stream reaches throughout both regions. The one high habitat ranking seen along the Sugarland Run mainstem was likely a local occurrence and as such, was not representative of overall conditions. The rating in the Good category in this location was largely a function of the underlying substrate—bedrock and large boulders not found in other locations—that helped reduce the amount of channel erosion during the high discharge events that the entire area regularly experiences.

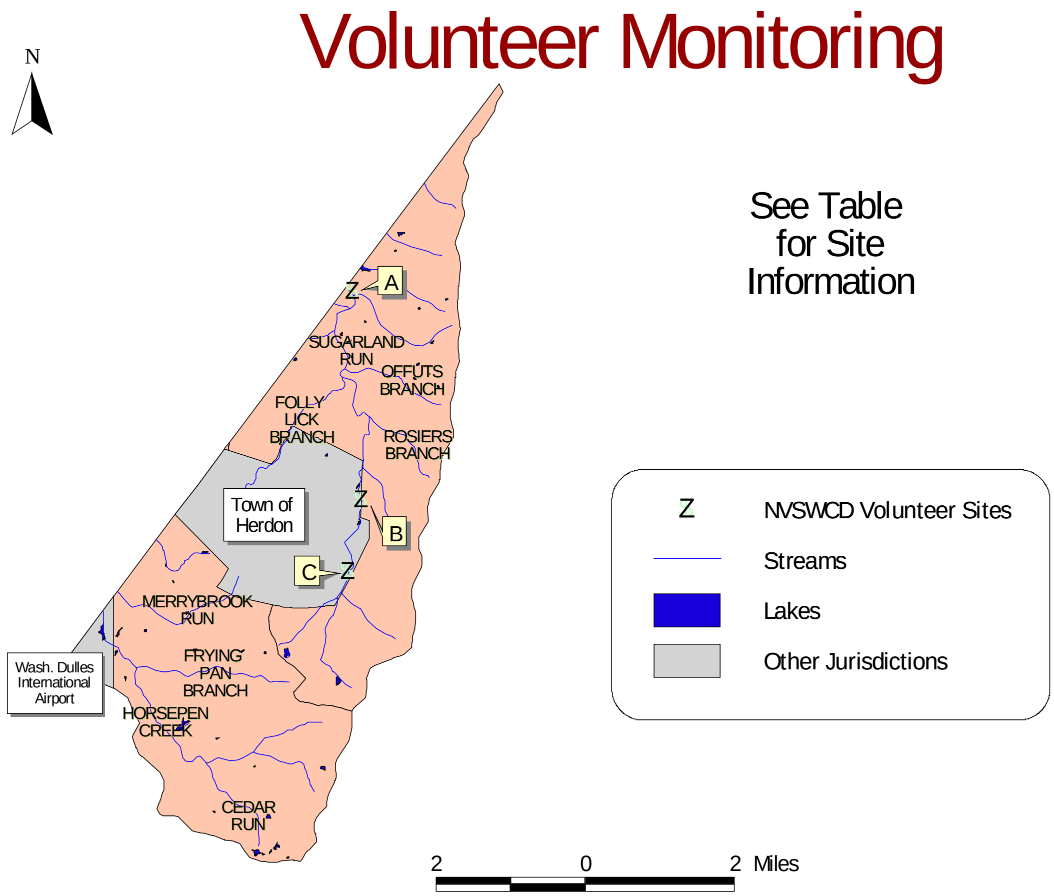
The portions of the Horsepen Creek and Sugarland Run watersheds that lie within Fairfax County are both intensely developed, and all systems in both basins drain areas with high levels (>20%) of impervious cover. This trend is seen almost uniformly in the assessments of biological and habitat integrity throughout the respective stream systems, and the ultimate composite rankings in both are correspondingly low.

As is the case in other watersheds, the highly degraded condition of the Horsepen Creek and Sugarland Run systems can be seen as a function of land use. While evidence from this and other assessments suggest that higher quality conditions may exist locally in relatively isolated stream reaches, the general pattern places both of the drainages among the most impacted in the County.

CHAPTER 3

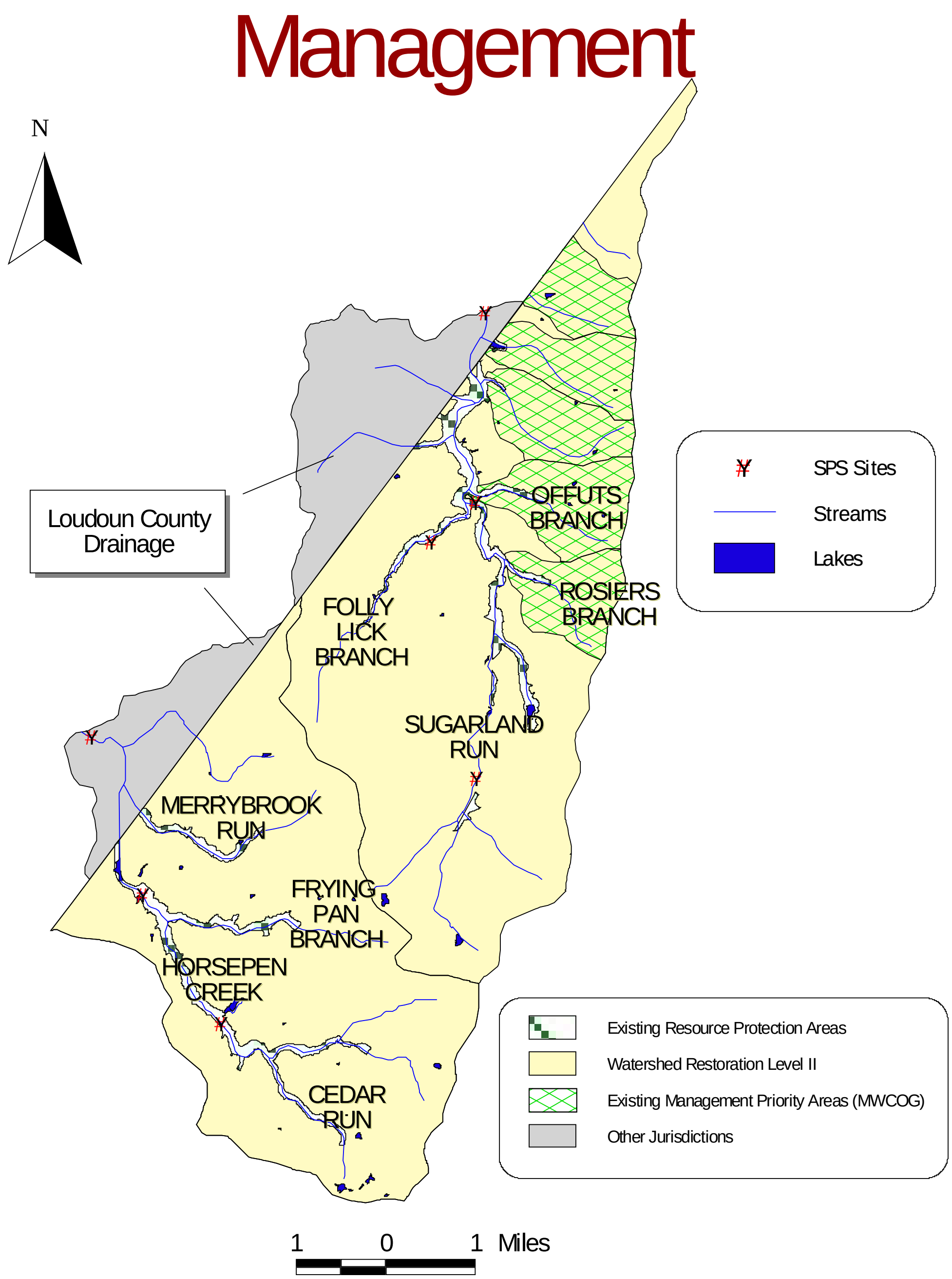
Volunteer Data Summary

There are currently three active volunteer monitoring sites in the Sugarland Run watershed, each of which is coordinated by the Northern Virginia Soil and Water Conservation District (NVSWCD). They are all located on the mainstem, one immediately downstream of Leesburg Pike (Rte 7) and the others just east of the Herndon Parkway.



Data from these sites correspond well with the findings of the SPS study. Although past monitoring has found unexpectedly good biological integrity in some localities, rankings of recent samples have generally ranged in the lower categories. The SPS study highlighted significant degradation in many of these areas.

Letter Code	Site Code	# times sampled	Last sampled	WQR (SOS only)	Trends noted
A	SLR3	9	####	Fair	Had Excellent ratings in '97, now varies from Poor - Good
B	SLR1	5	####	Fair	Varies from Poor - Fair
C	SLR2	2	####	Poor	Too few samples, but both were Poor



Management Category Description

Sugarland and Horsepen watersheds are highly impacted systems in terms of both biological and habitat quality. Intense development is ongoing in both areas, and there remains a great deal of potential for further degradation of stream quality. This entire area is classified as a Watershed Restoration Level II Area.

OTHER INITIATIVES

Metropolitan Washington Council of Governments Study

The study by the Metropolitan Washington Council of Governments (COG) used Rapid Stream Assessment Technique to evaluate physical, chemical and biological stream quality throughout the Sugarland Run watershed. The recommendations are as follows:

- Perform a comprehensive watershed-wide retrofit/stream restoration inventory. This work, together with results from both the two RSAT studies and Fairfax County's new biological monitoring program, would serve as the basis for a comprehensive Sugarland Run watershed restoration/protection plan. The plan should have a focus on identifying tributary areas that warrant maximum protection as well as reducing stormwater runoff impacts from existing uncontrolled developed areas.
- Perform annual water chemistry, macroinvertebrate, fisheries, physical habitat and channel morphology monitoring of Sugarland Run and its tributaries. Areas that should be given high priority include Rosiers Branch, Offuts Branch, Herndon Junction Branch, Seneca Road Tributary and Parrish Farm Tributary.
- Perform further analysis of fish barriers on Sugarland mainstem portions of the major tributaries. It is also recommended that one-pass electrofishing surveys of these streams be performed to assess existing fish communities.
- Perform riparian restoration of open canopied sections of the following streams: Stuart Road Tributary mainstem – below the Cameron stormwater management pond and Caris Glenne Drive Tributary (Offuts Branch) – upper and middle sections.
- Officially name all stream tributaries to promote citizen awareness.
- Consider incorporating vegetated riparian buffer strips specifically designed to help reduce nutrient and thermal loadings at both the Herndon Centennial and Algonkian Park Golf Course sites.
- Employ extraordinary erosion and sediment stormwater management controls for the construction of Wiehle Ave extended, especially thermally sensitive techniques.
- Implement further stormwater retrofit and/or stream bank stabilization analysis at Lowes Island Tributary, Rosiers Branch, Old Holly Drive Tributary, Offuts Branch and Muddy Branch.
- Removal of two large logjams in Folly Lick Branch is recommended.
- Further analyze a headcutting problem in the Seneca Road Tributary.
- Consider implementing environmental education/outreach programs in Fairfax and Loudoun counties.
- Utilize local volunteer and environmental groups in Fairfax and Loudoun Counties, such as Friends of Sugarland Run, Izaak Walton League, Save Our Streams and Fairfax County Park Authority's "Stream Valley Stewards – A Watershed Initiative" program in monitoring stream quality conditions.

CHAPTER 3

Friends of Sugarland Run

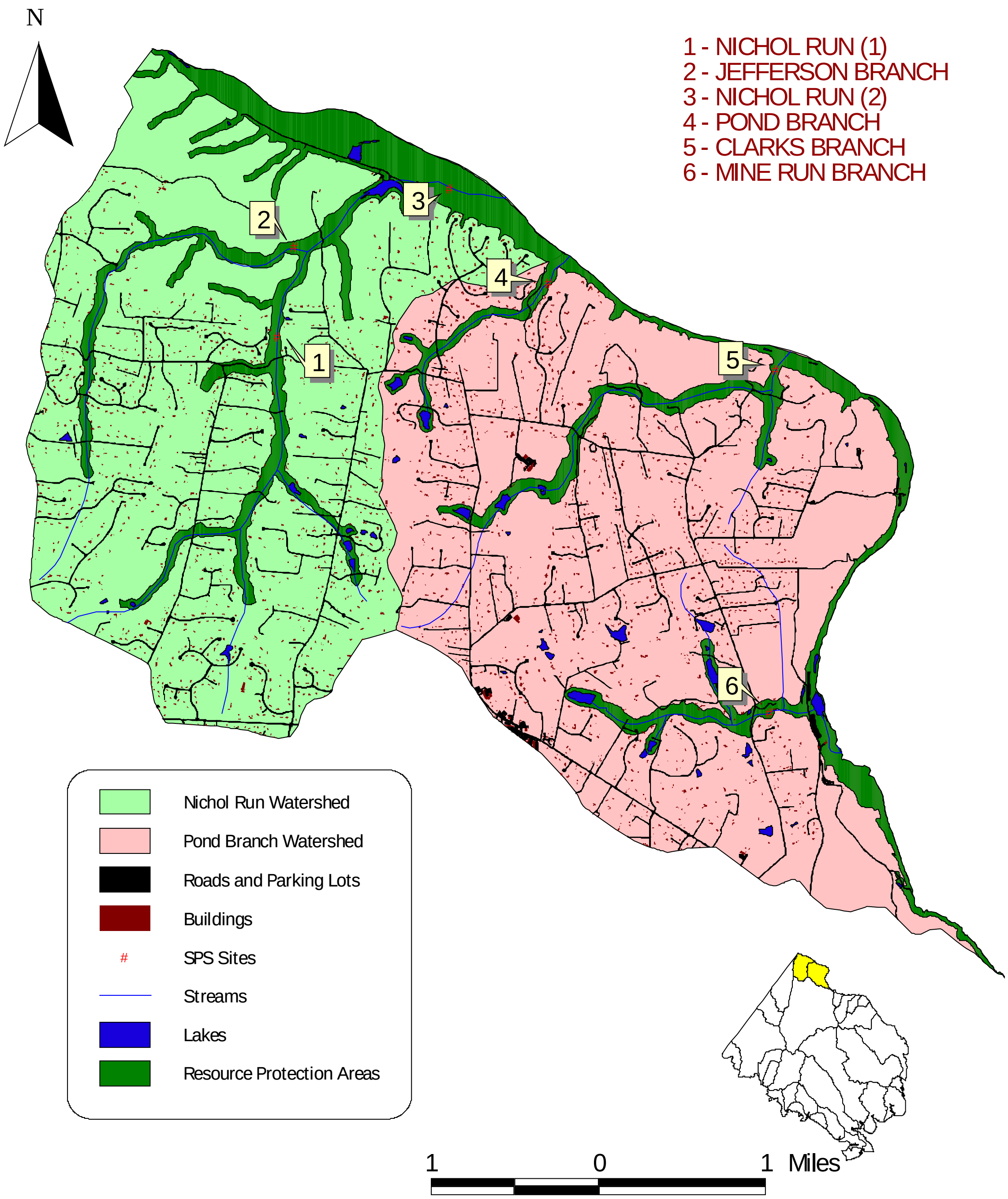
The Friends of Sugarland Run (FOSR) is a nonprofit citizens group that works on behalf of, and with the help of, the local community to protect, restore and enhance the natural, historical, educational, economic and recreational resource value of the entire Sugarland Run stream valley in Fairfax and Loudoun Counties. FOSR is working to make the Sugarland Run watershed a place where a diversity of animals and plants can thrive, a place for the community to enjoy as a piece of natural heritage of Northern Virginia for current and future generations. Some of the volunteer projects sponsored by the FOSR include stream clean-ups, water quality monitoring, construction site monitoring, tree planting, trail system planning and educational workshops. FOSR members attended public meetings and commented on development projects, road projects and the proposed mitigation projects as a result of an oil spill in 1993. FOSR hosted Project Clearwater to educate citizens about recognizing and reporting sediment problems to help construction site inspectors improve runoff controls. FOSR worked with local and state agencies to implement some of the recommendations from the COG study.

Greenside Darter
Etheostoma blenniodes
Size: to 4 inches
Habitat: rocky substrates in clear, fast-flowing streams of moderate gradient
Feeding Group: insectivore
Tolerance: moderate – intolerant
This small species feeds on insect larvae. It has a unique upper jaw that is believed to enable it to suck snails out of their shells. It cannot tolerate heavy erosion and sedimentation.

CHAPTER 3

POND BRANCH
AND NICHOL RUN
WATERSHED SUMMARY

Land Cover

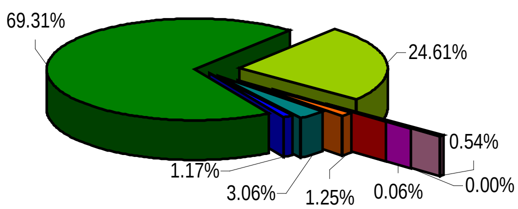

N
1 - NICHOL RUN (1)
2 - JEFFERSON BRANCH
3 - NICHOL RUN (2)
4 - POND BRANCH
5 - CLARKS BRANCH
6 - MINE RUN BRANCH
1
2
3
4
5
6
Nichol Run Watershed
Pond Branch Watershed
Roads and Parking Lots
Buildings
SPS Sites
Streams
Lakes
Resource Protection Areas
1
0
1
Miles

CHAPTER 3

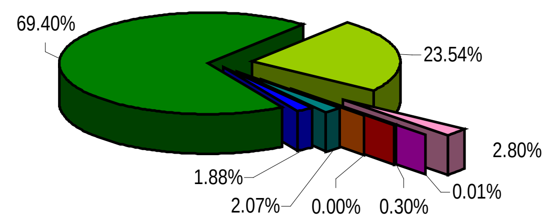
Watershed Description

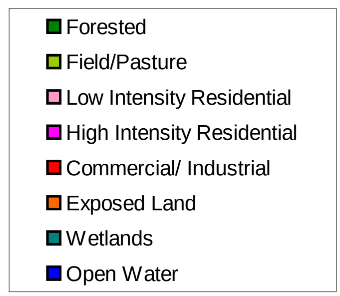
Nichol Run and Pond Branch watersheds are lightly developed areas at the northern extent of Fairfax County. Since the area is primarily forest and comprised of private residences on lots of two or more acres, these watersheds have impervious levels near 5%. There are no major lakes or impoundments in these watersheds, but numerous smaller, privately owned ponds occur.

Land Uses in the Nichol Run Watershed



Land Uses in the Pond Branch Watershed





The Nichol Run watershed consists of two main systems, Nichol's Run and Jefferson Branch, both of which flow through low-density residential areas. Jefferson Branch drains from the western portion of the watershed and travels through a protected area controlled by The Potomac River Nature Conservancy. Jefferson Branch empties into the Nichols Run mainstem, the combined flow hitting the Potomac River a mile farther downstream.

The Pond Branch watershed is actually a collection of several small independent tributaries that feed into the Potomac River. Pond Branch, Clark's Branch, and Mine Run all meander through low-density residential areas before meeting the Potomac. The lower reaches of Mine Run are contained within Great Falls National Park.

A section of Clarks Branch in the Pond Branch watershed showing signs of stream bank undercutting.

CHAPTER 3

DATA SUMMARY

Stream Name and Site Code	Composite Site Condition Rating	Environmental Variables: Index of Biotic Integrity	Habitat Score	Fish Taxa Richness	Current Percent Impervious Surfaces	Projected Percent Impervious Surfaces
Nichol Run 1 (NINI01)	Good	Excellent	Fair	Low	4.9	10
Jefferson Branch (NIJB01)	Good	Fair	Excellent	Low	3.8	10
Nichol Run 2 (NINI02)	Good	Poor	Fair	High	4.1	10
Pond Branch (PNPN01)	Good	Good	Poor	Moderate	5.2	9
Clarks Branch (PNCL01)	Good	Good	Fair	High	4.4	10
Mine Run Branch (PNMR01)	Excellent	Good	Good	Low	5.2	10

Pond Branch and Nichol Run Fish Species List

Common Name	**Number of Sites Where Species Occurred (6 Total Sites)**	**Common Name**	**Number of Sites Where Species Occurred (6 Total Sites)**
White Sucker	6	Bluegill	2
Longnose Dace	6	Longear Sunfish	2
Creek Chub	6	Common Shiner	2
Blacknose Dace	5	Smallmouth Bass	2
Rosyside Dace	4	Largemouth Bass	2
Central Stoneroller	4	Golden Shiner	2
Fantail Darter	4	Silverjaw Minnow	2
Yellow Bullhead	3	Margined Madtom	2
Greenside Darter	3	Bluntnose Minnow	2
Spotfin Shiner	2	Potomac Sculpin	1
Creek Chubsucker	2	Redear Sunfish	1
Tessellated Darter	2	Golden Redhorse	1
Eastern Mosquitofish	2	Spottail Shiner	1
Redbreast Sunfish	2	Black Crappie	1
Green Sunfish	2	Fallfish	1
Pumpkinseed	2	American Eel	1

CHAPTER 3

Watershed Condition Summary

Although exhibiting signs of impact locally, the subwatersheds within Pond Branch and Nichol Run represent some of the least degraded systems in Fairfax County.

Although this region as a whole maintained relatively rich fish communities (a total of 32 fish taxa were identified), scores for sites in individual subwatersheds varied widely. Values for sites on both Nichol's Run and Clark's Branch were exceptionally high, with taxa counts of 22 and 24, respectively. It should be noted, however, that both of these sites were placed near the mouth of each stream at the Potomac River, and proximity to this major system may have artificially inflated the richness measures. It is uncertain at this point whether or not these ratings are an accurate reflection of upstream conditions.

Measures of benthic macroinvertebrate community integrity generally contrasted with the fish rankings. With the exception of one site (NINI02), all of the subwatersheds were classified as Fair or better. Of special note are the results from the two sites in the Nichol Run drainage, which differed dramatically from one another and highlight the potential influence of some unknown stressor along the stream's length.

Although some areas received low scores for sediment deposition, embeddedness and bank stability, overall habitat quality at sites throughout the two drainages generally ranked in the highest categories. While active channel widening is taking place in many streams, there are also isolated areas that are beginning to develop a new equilibrium with their altered flow regimes.

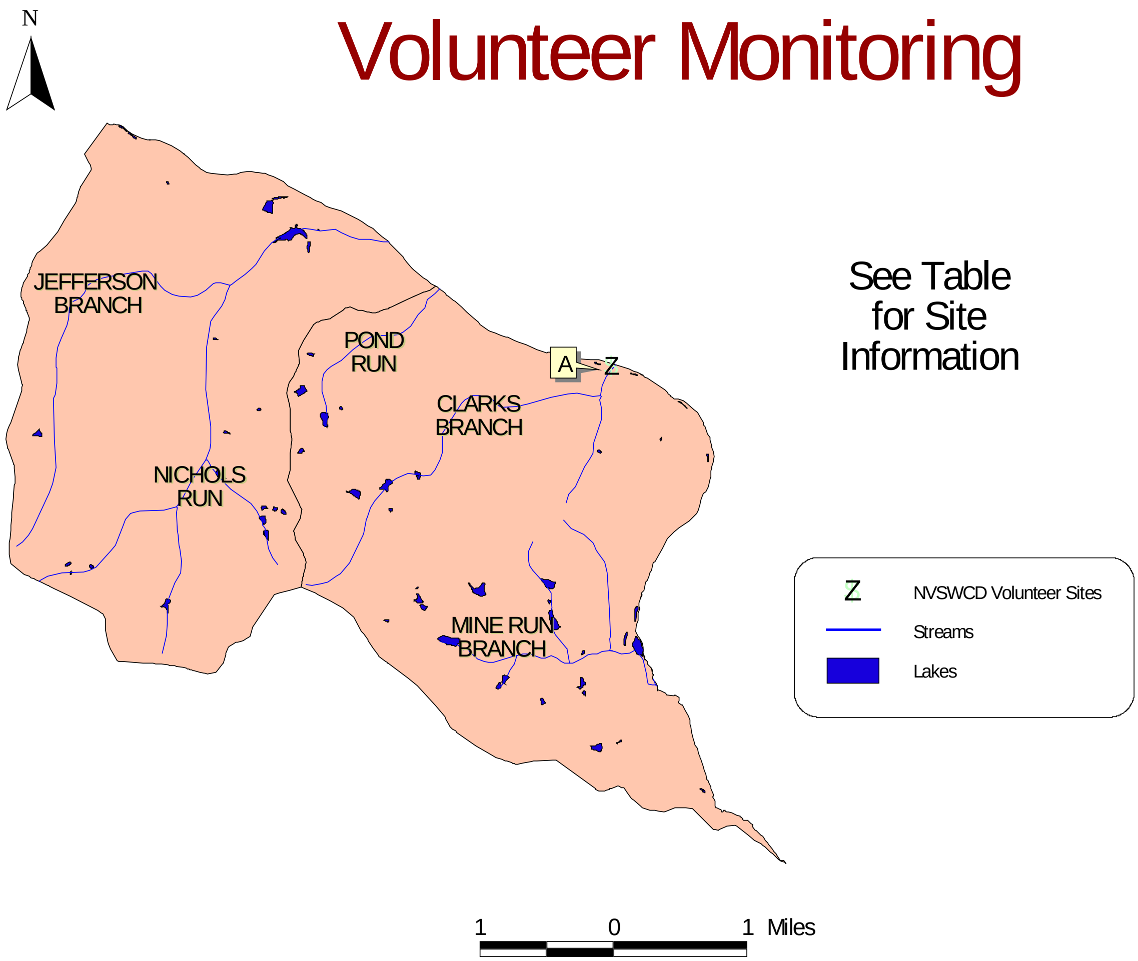
Nichol Run and Pond Branch exhibit some of the lowest levels of imperviousness of all the County's watersheds. The land within the Nichol Run basin is approximately 3.6% impervious, and the maximum level for any area within Pond Branch is 4.3%. Following this trend, the composite scores for all sites fell within the Good or Excellent categories.

Despite signs of significant degradation locally, both drainages contain relatively intact aquatic systems and, as such, represent some of the more valuable resources in the County. However, uncertainty still exists regarding conflicting measures of biological integrity at some sites, in particular those along the Nichol's Run mainstem. Also, the assessments made to date highlight the need to account for potential compounding factors influencing fish communities.

CHAPTER 3

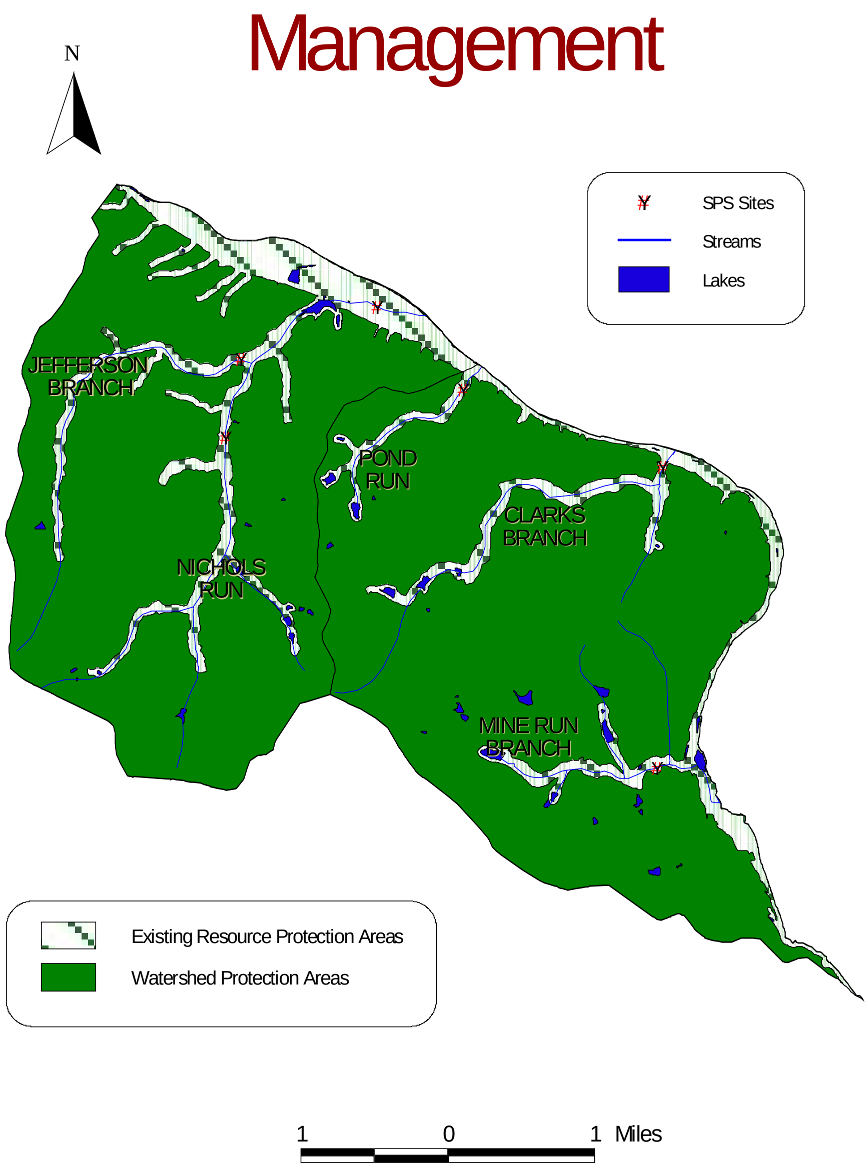
Volunteer Data Summary

There is only one volunteer monitoring site in this region. Located on Clarks Branch in the Pond Run watershed, the station is sampled by the staff from the Riverbend Park County Park under the coordination of the Northern Virginia Soil and Water Conservation District (NVSWCD). Although the site is a relatively recent addition to the program, the data collected to date correlate well with the findings of the SPS study. Sensitive taxa, indicative of higher quality conditions, were found on several occasions.



Letter Code	Site Code	# times sampled	Last sampled	WQR (SOS only)	Trends noted
A	PB1	3	####	Good	Generally Good - Excellent

CHAPTER 3

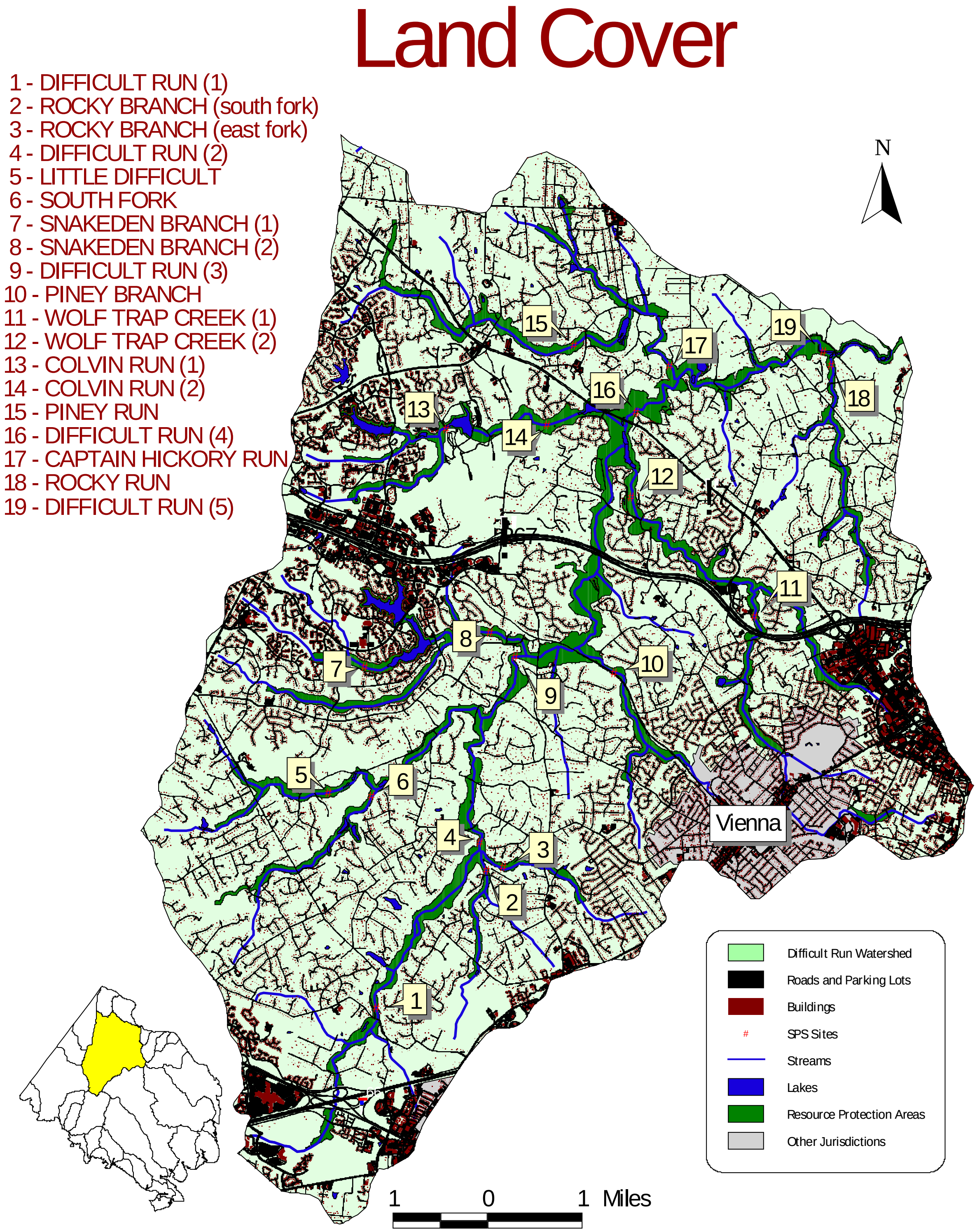


Management Category Description

The Nichol Run and Pond Branch watersheds are valuable resources in Fairfax County due to their high biological integrity and habitat quality. As such, both watersheds are classified as Watershed Protection Areas. Each should be monitored to ensure continuing high quality conditions and to look for specific factors causing lower scores in some categories. Specific assessments should focus on instream habitat degradation in both watersheds. The influence of the Potomac River on variations in fish communities throughout both drainages should also be examined. These watersheds might be good candidates to consider using innovative approaches to limit imperviousness or impacts of development.

CHAPTER 3

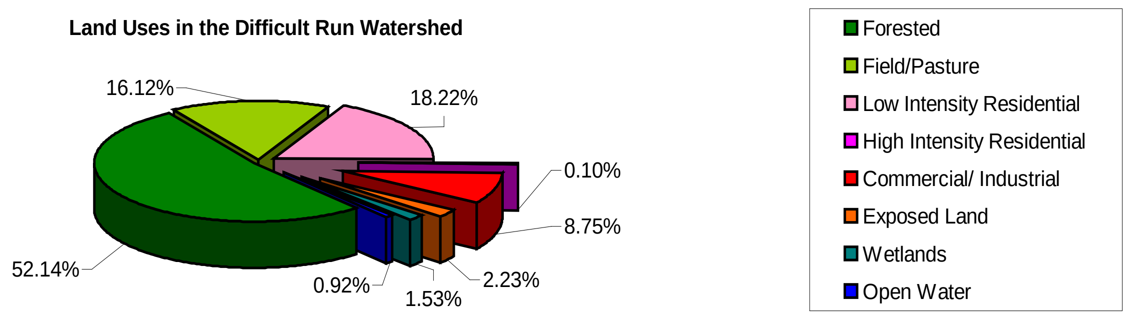
DIFFICULT RUN WATERSHED SUMMARY


Land Cover
1 - DIFFICULT RUN (1)
2 - ROCKY BRANCH (south fork)
3 - ROCKY BRANCH (east fork)
4 - DIFFICULT RUN (2)
5 - LITTLE DIFFICULT
6 - SOUTH FORK
7 - SNAKEDEN BRANCH (1)
8 - SNAKEDEN BRANCH (2)
9 - DIFFICULT RUN (3)
10 - PINEY BRANCH
11 - WOLF TRAP CREEK (1)
12 - WOLF TRAP CREEK (2)
13 - COLVIN RUN (1)
14 - COLVIN RUN (2)
15 - PINEY RUN
16 - DIFFICULT RUN (4)
17 - CAPTAIN HICKORY RUN
18 - ROCKY RUN
19 - DIFFICULT RUN (5)
N
Vienna
Difficult Run Watershed
Roads and Parking Lots
Buildings
SPS Sites
Streams
Lakes
Resource Protection Areas
Other Jurisdictions
1 0 1 Miles

CHAPTER 3

Watershed Description

Difficult Run is the largest watershed contained within the County, with an area of just over 58 square miles. The watershed lies entirely within the Piedmont physiographic province and is characterized by rolling hills and rough terrain, commonly with slopes of 10% or more. Slightly over 5% of the watershed area is not under County jurisdiction including the City of Fairfax, the Town of Vienna, and the U.S. Government lands within Great Falls Park and the Wolf Trap Farm Park for the Performing Arts. The watershed also contains several large impoundments including Lakes Audubon (33 acres), Thoreau (42 acres), Anne (28 acres) and Fairfax (21 acres). Other impoundments include Fox, Timber, Spring, Woodside and Newport lakes, and a variety of small regional ponds.



Development levels vary widely throughout the watershed. With the gathering of small headwater systems near the Fairfax County Government Center, the City of Fairfax, and the major interchange of Routes 50 and 66, Difficult Run begins its journey to the Potomac River. Over the next 17 miles of its length, the system is influenced by a diverse group of tributary systems that reflect a wide array of subwatershed conditions, ranging from forested basins to highly developed urban environments.

Streambank erosion was common at many locations in the Difficult Run watershed.

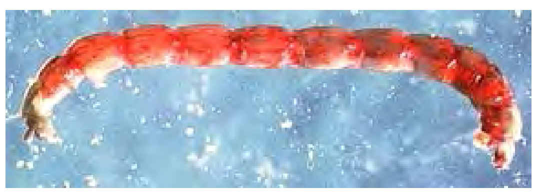
The system's first two major tributaries flow from areas where the intensity of development is moderate to low. The first of these, Rocky Branch, flows from the east and drains a region that includes Oakton, an area with levels of imperviousness ranging from 15 to 20%. In contrast, the Little Difficult Run drainage to the west includes many multi-acre residential lots spread throughout a subwatershed that, on the whole, has imperviousness levels that are still under 10%.

Further downstream, Difficult Run picks up tributary inputs from intensively developed regions with levels of imperviousness over 20%. Flowing from the west, Snakeden Branch and Colvin Run begin in the urbanized area of Reston and then meander through moderate-density residential communities. Similarly, Piney Branch and Wolf Trap Creek empty into Difficult Run in areas of low-intensity development but are generated from headwater systems that drain the highly developed urban/suburban expanse of Vienna and Tyson's Corner. The Dulles Toll Road (Route 267) bisects the watershed at this point, crossing over the mainstem on its way between major urban centers.

Before reaching its confluence with the Potomac River, Difficult Run receives the input of two other major tributary systems, Captain Hickory Run (and its own major tributary, Piney Run) and Rocky Run. Each of these drain moderately developed areas containing large expanses of forest cover interspersed with low-density communities comprised of multi-acre lots. Levels of imperviousness within these subwatersheds range between 10 and 15%.

Captain Hickory Run, one of the highest quality tributaries in the County.

The lowermost section of Difficult Run is sheltered within Difficult Run Stream Valley Park, a protected area adjacent to Great Falls National Park.



Midge Larvae
Family *Chironomidae*
Habitat Classification: burrowers
Feeding Group: collector-gatherers, predators
Tolerance: moderate - tolerant
The Midge larvae are some of the most resilient aquatic insects sampled. The chironomids were the second most common macroinvertebrate sampled, with the aquatic worms being the most common. The bright red chironomids are hemoglobin rich which allows them to thrive in systems with low dissolved oxygen.

Brown Bullhead
Ameiurus nebulosus
Size: to 12 inches
Habitat: ponds, impoundments, pools and sluggish streams
Feeding Group: omnivorous
Tolerance: tolerant
This hardy fish is able to breathe air by "gulping," using its swim bladder as a crude lung. It can thus tolerate high water temperatures, which deplete the oxygen. It uses its "whiskers" as taste organs to find food in dark, murky waters. Some live to be 9 years old.

Yellow Bullhead
Ameiurus natalis
Size: to 13 inches
Habitat: pools of streams and rivers, ponds and lakes
Feeding Group: omnivorous
Tolerance: tolerant
This species associates with cover, often dense vegetation. Spawning occurs in shallow circular nests excavated near cover or in open settings, in calm water. It is native to Virginia waters.

Longear Sunfish
Lepomis megalotis
Size: to 6 inches
Habitat: warmwater ponds, pools of streams and rivers
Feeding Group: invertivore
Tolerance: intolerant
The breeding male Longear is one of Virginia's most brilliantly colored sunfish. This sunfish feeds on aquatic and terrestrial insects. It is native to the Great Lakes and Mississippi Basin and has been introduced elsewhere.

DATA SUMMARY

Stream Name and Site Code	Composite: Site Condition Rating	Environmental Variables: Index of Biotic Integrity	Habitat Score	Fish Taxa Richness	Current Percent Impervious Surfaces	Projected Percent Impervious Surfaces
1 Difficult Run 1 (DFDF01)	Fair	Fair	Poor	High	21.9	46
2 Rocky Branch south (DFRB02)	Good	Excellent	Poor	High	12.2	20
3 Rocky Branch east (DFRB01)	Fair	Fair	Poor	High	16.0	18
4 Difficult Run 2 (DFDF02)	Poor	Poor	Poor	High	16.2	35
5 Little Difficult (DFLD01)	Fair	Good	Poor	Moderate	8.6	17
6 South Fork (DFSF01)	Poor	Poor	Poor	Moderate	8.9	15
7 Snakeden Branch 1 (DFSB01)	Very Poor	Very Poor	Very Poor	High	27.4	45
8 Snakedan Branch 2 (DFSB02)	Fair	Good	Good	Moderate	24.1	46
9 Difficult Run 3 (DFDF03)	Good	Fair	Fair	Moderate	12.4	23
10 Piney Branch (DFPB01)	Very Poor	Poor	Poor	Moderate	22.7	34
11 Wolftrap Creek 1 (DFWC01)	Poor	Poor	Fair	Low	24.8	41
12 Wolftrap Creek 2 (DFWC02)	Very Poor	Poor	Very Poor	Moderate	25.2	36
13 Colvin Run 1 (DFCR01)	Poor	Good	Very Poor	Moderate	27.0	48
14 Colvin Run 2 (DFCR02)	Poor	Poor	Poor	High	20.9	39
15 Piney Run (DFPR01)	Fair	Good	Poor	Low	13.3	22
16 Difficult Run 4 (DFDF04)	Fair	Good	Poor	Moderate	17.0	29
17 Captain Hickory (DFCH01)	Excellent	Good	Excellent	High	11.0	19
18 Rocky Run (DFRR01)	Good	Poor	Good	Moderate	14.7	21
19 Difficult Run 5 (DFDF05)	Good	Good	Fair	Moderate	15.7	27

Difficult Run Fish Species List

Common Name	Number of Sites Where Species Occurred (19 Total Sites)	Common Name	Number of Sites Where Species Occurred (19 Total Sites)
Blacknose Dace	19	Margined Madtom	8
Creek Chub	19	Yellow Bullhead	7
Tessellated Darter	18	Green Sunfish	6
White Sucker	18	Redbreast Sunfish	4
American Eel	17	Spottail Shiner	3
Rosyside dace	16	Fathead Minnow	2
Longnose Dace	14	Pumpkinseed	2
Central Stoneroller	13	Brown Bullhead	1
Common Shiner	13	Eastern Mudminnow	1
Bluegill	12	Fallfish	1
Cutlips Minnow	12	Fantail Darter	1
Satinfin Shiner	12	Golden Shiner	1
Swallowtail Shiner	10	Longear Sunfish	1
Largemouth Bass	9	Warmouth	1
Northern Hogsucker	9		

CHAPTER 3

Watershed Condition Summary

More so than perhaps any other watershed in the County, the Difficult Run drainage exhibits an extremely wide range of biological, habitat and land use conditions.

A total of 29 fish species were found within the watershed. Fish community assemblages at sampling locations generally exhibited taxa richness values in the moderate range, with only 2 of the 19 sampling sites scoring in the low category. On average, fish communities in the system were more diverse than many of the other County watersheds.

Overall rankings of benthic macroinvertebrate communities exhibited considerable variability throughout the watershed. Taxa richness, one component of the IBI, showed a similar pattern, with scores ranging from a low of 3 taxa in the upper Snakeden Branch (above Lake Audubon) to a high of 18 taxa in the south fork of Rocky Branch. Only 4 sample locations yielded diversity ratings that corresponded to those found at reference sites, and most communities were dominated by tolerant oligochaetes (aquatic worms), with tolerant individuals comprising 95% of the sample obtained from Piney Branch.

Habitat ratings were generally low throughout the watershed, with many systems ranking in the poor category. Two notable exceptions to this pattern were Captain Hickory Run and Rocky Run, both lightly developed drainages close to the mouth of Difficult Run. Of the 10 visually assessed components of the RBP score, sediment deposition and bank stability ratings were consistently low systemwide, reflecting the impact of stream flow volumes.

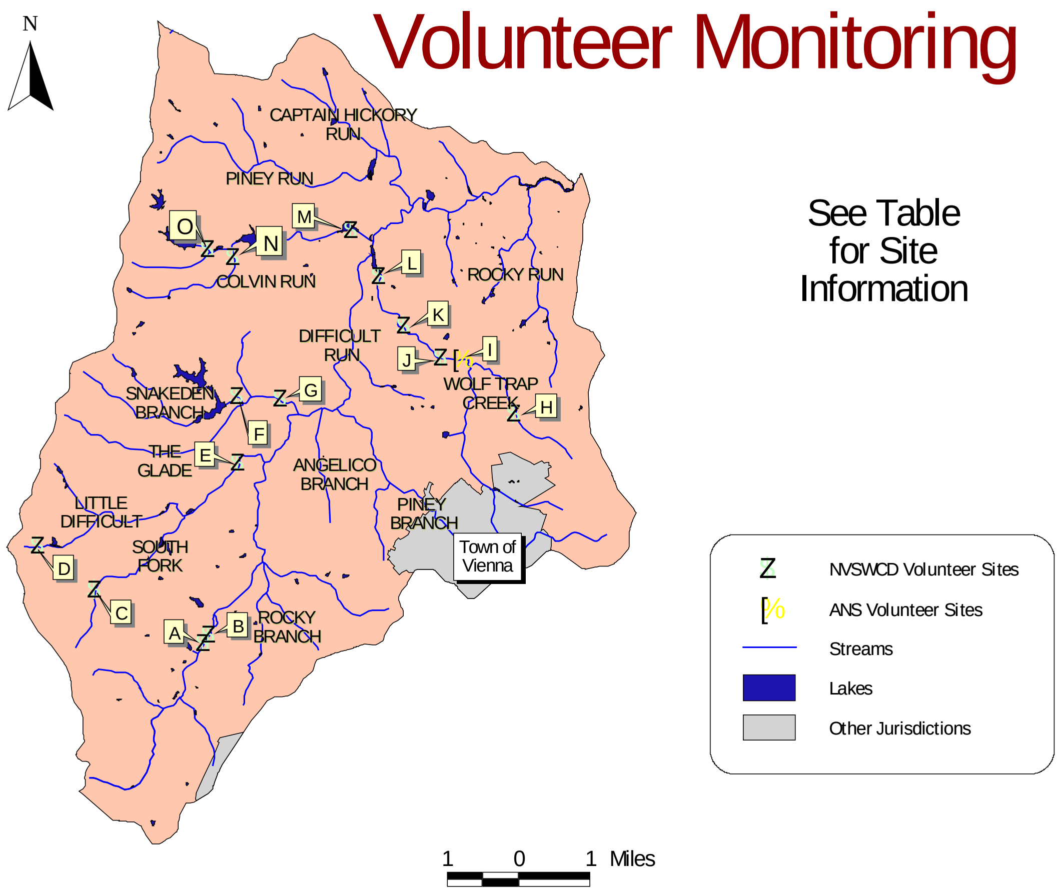
Development intensity throughout the watershed is highly variable as well, ranging from 8.2 to 27.4%, with the ultimate composite ratings reflecting this pattern. Several subwatersheds are in poor or very poor condition, with the lowest composite ratings seen in Snakeden Branch, Piney Branch and Wolftrap Creek, each a drainage with high impervious cover values and correspondingly low biological and habitat ratings. On the other end of the spectrum, Captain Hickory Run and Rocky Run drain regions of low- to moderate-intensity development and exhibit high levels of biological integrity. To a lesser extent, the same is true of Piney and Little Difficult Runs and of both the south and east forks of Rocky Branch.

These ratings seem to indicate that the watershed has been degraded, especially in localized areas, but overall still supports and maintains fairly healthy aquatic communities. More importantly, the watershed contains a variety of individual subwatersheds that remain of very high quality, a situation that is likely reflected in the mainstem environment itself, which still maintains some areas of high biological and habitat integrity, especially in its downstream reaches.

CHAPTER 3

Volunteer Data Summary

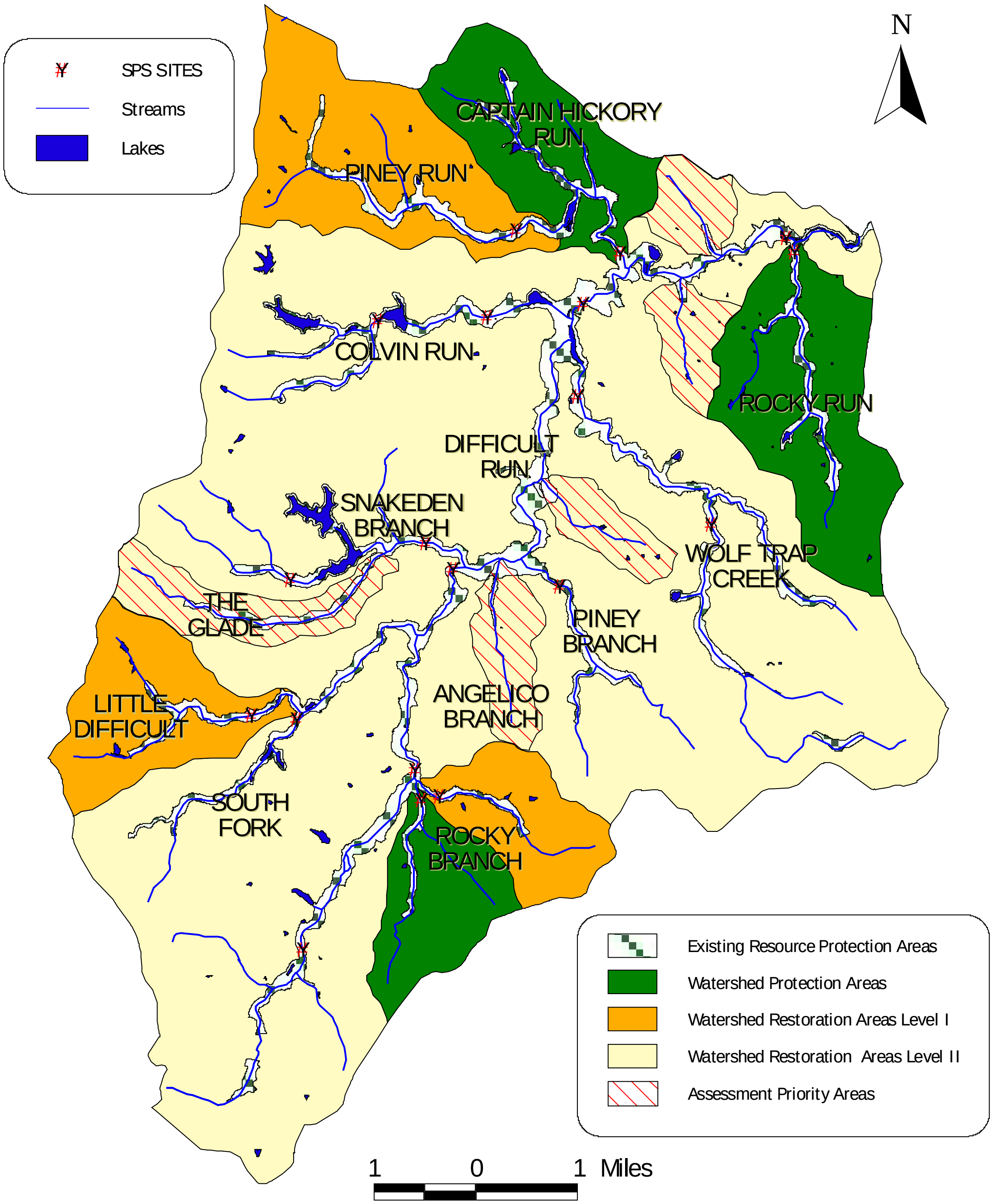
The Difficult Run Watershed currently has 15 active volunteer monitoring stations. The Northern Virginia Soil and Water Conservation District (NVSWCD) coordinates 14 of these, half of which are new additions to the program this year and have been sampled only once. The remaining site, located on Wolftrap Creek in Wolftrap Farm Park, is monitored by the Audubon Naturalist Society (ANS).



Results from the volunteer data show a wide range of water quality in the watershed as did the SPS study. The volunteer data generally supports the findings of SPS with most of the watershed in the “fair” category. Exceptions to this are the sites along Wolftrap Creek, which have shown repeated water quality ratings in the “good” range and the presence of such sensitive taxa as mayflies and stoneflies. Data from the ANS site on Wolftrap Creek also show the repeated presence of mayfly larvae. The repeated discovery of these sensitive taxa warrants future investigation of this tributary as part of an ongoing SPS program. If conditions of high biodiversity and a healthy benthic community are subsequently identified, alternative management strategies for that system may be recommended.

Letter Code	Site Code	# times sampled	Last sampled	WQR (SOS only)	Trends noted
A	DR26	1	####	Excellent	Too few samples
B	DR25	1	####	Fair	Too few samples
C	DR24	1	####	Fair	Too few samples
D	DR22	1	####	Poor	Too few samples
E	DR23	1	####	Good	Too few samples
F	DR11	2	####	Fair	Too few samples
G	DR03	8	####	Fair	Fair in early Spring, otherwise Good/Excellent
H	DR05	9	####	Fair	Poor in late Fall - Spring, otherwise Fair
I	012	4	####	N/A	Some mayfly larvae, otherwise moderately tolerant taxa
J	DR08	5	####	Excellent	Fair/Poor in late Fall - Winter, otherwise Good/Excellent
K	DR09	6	####	Good	generally Excellent
L	DR06	5	####	Fair	generally Fair
M	DR18	2	####	Good	Too few samples
N	DR27	1	####	Poor	Too few samples
O	DR20	2	####	Poor	Too few samples, but both were Poor

Management


SPS SITES
Streams
Lakes
N
CAPTAIN HICKORY RUN
PINEY RUN
COLVIN RUN
ROCKY RUN
DIFFICULT RUN
SNAKEDEN BRANCH
WOLF TRAP CREEK
THE GLADE
PINEY BRANCH
ANGELICO BRANCH
LITTLE DIFFICULT
SOUTH FORK
ROCKY BRANCH
Existing Resource Protection Areas
Watershed Protection Areas
Watershed Restoration Areas Level I
Watershed Restoration Areas Level II
Assessment Priority Areas
1 0 1 Miles

CHAPTER 3

Management Category Description

The Difficult Run watershed is highly diverse in land use and biological condition and, as such, requires an equally diverse approach in its management. Rocky Run and Captain Hickory Run are designated as protection areas due to their high biological and habitat quality. Although the south fork of Rocky Branch received a high rating overall and is similarly designated as a Watershed Protection Area, its poor habitat condition suggests the need for active management that focuses on restoration of instream habitat quality and the development of effective stormwater controls that minimize further degradation. Further study is also needed in the Rocky Run subwatershed to identify and mitigate the factors responsible for the poor condition of its benthic community.

Little Difficult Run and the east fork of Rocky Branch are categorized as priority Watershed Restoration Level I Areas. Piney Run falls into this category as well but is of special concern due to its potential influence on Captain Hickory Run, the system into which it flows. In all three watersheds, management should focus on the instream environment since all received poor scores in the habitat category. Such efforts should be monitored for their impact on the aquatic insect and fish communities of each respective system.

The remaining portions of the watershed are classified as Watershed Restoration Level II Areas. Issues of greatest concern include the system headwaters in the southern extent of the watershed and the urban centers of Reston, Vienna, and Tysons Corner. Stormwater management controls, through retrofitting, maintenance, or installation of new facilities, should be implemented where feasible. Such an approach would have the greatest potential for enhancement of conditions in downstream environments.

As is the case countywide, all five mainstem sites remain classified as Watershed Restoration Level II Areas due to the cumulative impacts of tributary conditions on these areas. However, the three lowermost mainstem sampling sites already rank as Good or Fair in overall site condition, a situation that should elevate the priority of the entire drainage relative to other watersheds in the County. Implementing strategies that focus on tributary systems first, an approach that is applicable countywide, becomes especially important. The first step in the process should be an expansion of the stream monitoring program to include those subwatersheds specified as Assessment Priority Areas. Due to the scale of this study, there were inevitable gaps in our coverage of the County's streams. Volunteer monitoring of headwater streams in these areas could aid in future assessments of the watershed.

CHAPTER 3

OTHER INITIATIVES

The Difficult Run Community Conservancy

The Difficult Run Community Conservancy is an organization of citizens interested in the Difficult Run stream and watershed with the following goals:

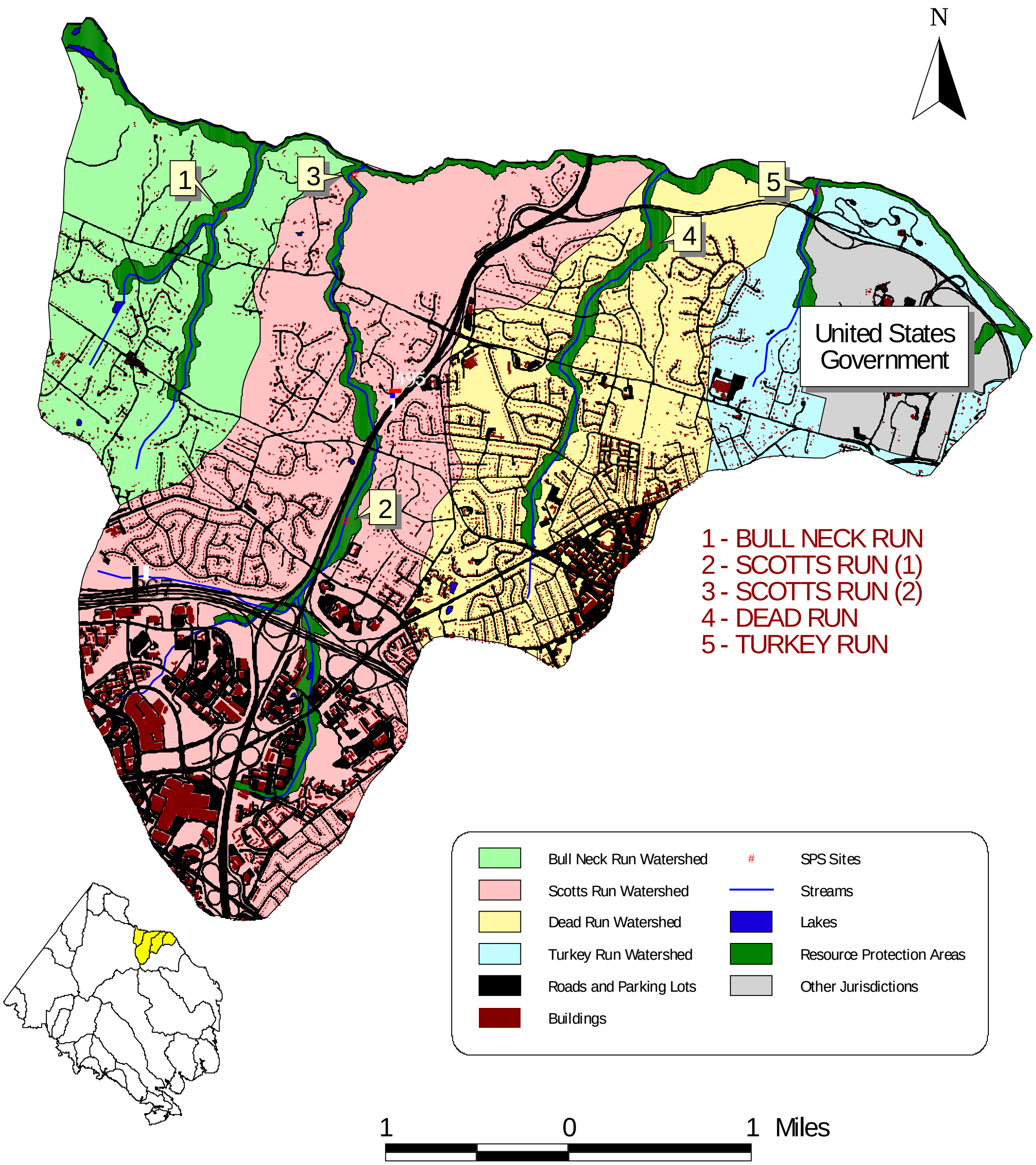
- Promote recognition of Difficult Run as a living system.
- Increase protection of, and public access to, Difficult Run Stream Valley corridor.
- Educate the public and members about issues in Difficult Run.
- Encourage and provide stewardship opportunities.
- Promote community involvement.
- Provide a communication network about issues concerning the watershed.

The Difficult Run Community Conservancy is a new organization that anticipates working with homeowners associations, other organizations and local government to improve, conserve and protect the natural resources of the Difficult Run watershed.

CHAPTER 3

BULL NECK RUN, SCOTTS RUN, DEAD RUN AND TURKEY RUN WATERSHED SUMMARY

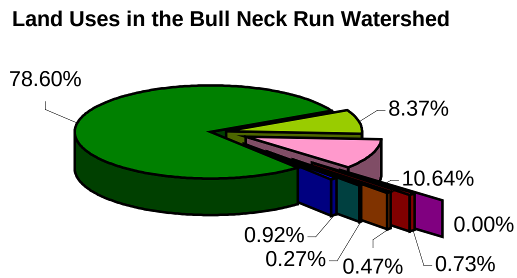
Land Cover

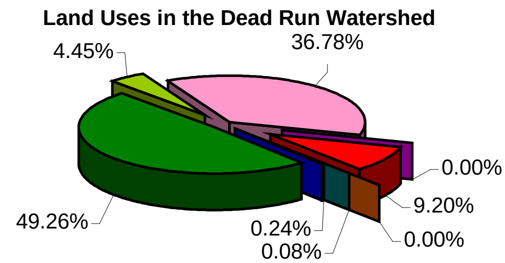

N
1
2
3
4
5
United States Government
1 - BULL NECK RUN
2 - SCOTTS RUN (1)
3 - SCOTTS RUN (2)
4 - DEAD RUN
5 - TURKEY RUN
Bull Neck Run Watershed
Scotts Run Watershed
Dead Run Watershed
Turkey Run Watershed
Roads and Parking Lots
Buildings
SPS Sites
Streams
Lakes
Resource Protection Areas
Other Jurisdictions
1 0 1 Miles

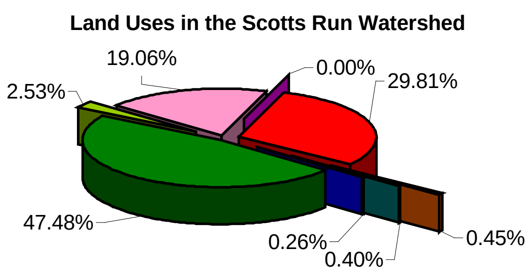
CHAPTER 3

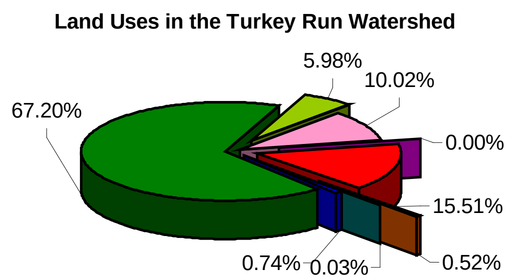
Watershed Descriptions

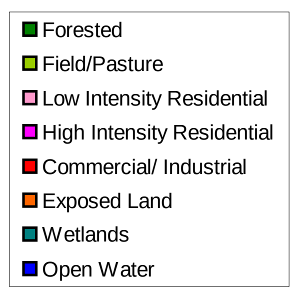
Rocky substrates and moderately high gradients characterize all four watersheds within this group. The respective drainages vary considerably in their level of imperviousness, with two of the watersheds draining highly urbanized areas and two remaining lightly developed. Each flows directly into the Potomac River.











Bull Neck Run and Turkey Run have low levels of imperviousness (less than 10% each) and are dominated by forestland. From its headwaters areas adjacent to Tyson's Corner, Bull Neck Run flows generally northward, passing through low-density residential areas. Turkey Run drains the lightly developed area surrounding a large parcel of U.S. Government property and then travels through Turkey Run Park before entering into the Potomac River.

Monitoring location on Scotts Run.

Both Dead and Scotts Runs flow from headwaters in or near the highly developed Tyson's Corner area, through moderate- and low-density residential communities, and into parkland along the Potomac.

DATA SUMMARY

Stream Name and Site Code	Composite Site Condition Rating	Environmental Variables Index of Biotic Integrity	Habitat Score	Fish Taxa Richness	Current Percent Impervious Surfaces	Projected Percent Impervious Surfaces
Bull Neck Run (BNBN01)	Excellent	Good	Excellent	Low	8.3	15
Scotts Run 1 (SCSC01)	Very Poor	Poor	Poor	Very Low	39.8	63
Scotts Run 2 (SCSC02)	Poor	Poor	Excellent	Very Low	28.6	46
Dead Run (DEDE01)	Very Poor	Poor	Poor	Very Low	21.9	25
Turkey Run (TUTU01)	Excellent	Excellent	Fair	High	8.0	15

Middle Potomac Fish Species List

Common Name	Number of Sites Where Species Occurred (5 Total Sites)
Creek Chub	5
Blacknose Dace	5
White Sucker	4
Longnose Dace	2
Largemouth Bass	2
Bluegill	2
American Eel	2
Yellow Bullhead	2
Bluntnose Minnow	1
Smallmouth Bass	1
Pumpkinseed	1
Green Sunfish	1
Redbreast Sunfish	1
Eastern Silvery Minnow	1
Mosquitofish	1
Fantail Darter	1

Longnose Dace
Rhinichthys cataractae
Size: to 4 inches
Habitat: small/medium fast moving streams
Feeding Group: insectivore
Tolerance: intolerant
The Longnose Dace's streamlined body and downturned mouth allow it to live in the swiftest of currents. Another adaptation for swift current is its rudimentary gas bladder that allows this minnow to maintain itself in areas with little current velocity. Males are very territorial and aggressive and will bite and chase off any other males.

CHAPTER 3

Watershed Condition Description

Although the small watersheds that make up this group possess similar physical and geologic characteristics, they reflect two extremes of stream quality within the County.

Within the group, only Turkey Run ranked as having High fish community richness (11 distinct taxa). It should be noted, however, that this site was located near the system's mouth at the Potomac River, and the ultimate values may have been influenced by proximity to this larger system. The remaining drainages all scored poorly, each containing 6 or fewer taxa. Sites on Scotts and Dead Runs ranked in the very lowest category.

Measures of benthic community integrity were similarly divergent. Sampling along Bull Neck Run highlighted the presence of a high-quality, well-balanced community, while the Turkey Run site ranked even higher, its conditions comparable to the reference level. The remaining drainages exhibited conditions on the other end of the spectrum, with all samples from both Scotts and Dead Runs being dominated by organisms highly tolerant of degradation.

Although a disparity in rankings across the 4 watersheds was again seen with the habitat scores, some values were inconsistent with the corresponding biological scores for the respective locations. The lowermost site on Scotts Run possessed high-quality habitat locally, yet its macroinvertebrate and fish communities were of very low integrity. Such a result may have been a function of the systems underlying geology, one that is highly resistant to erosion and which may have been masking the impact of the high flow volumes the stream is known to carry during storm events. While such substrate also typifies the lower portion of the Turkey Run drainage, substantial erosion was evident in its upstream reaches, and excessive sediment deposition in many areas led to a ranking in the Fair category. Habitat quality in the remaining drainages generally corresponded with overall biological condition, Excellent in Bull Neck, and Poor throughout Dead Run and the upper sections of Scotts Run.

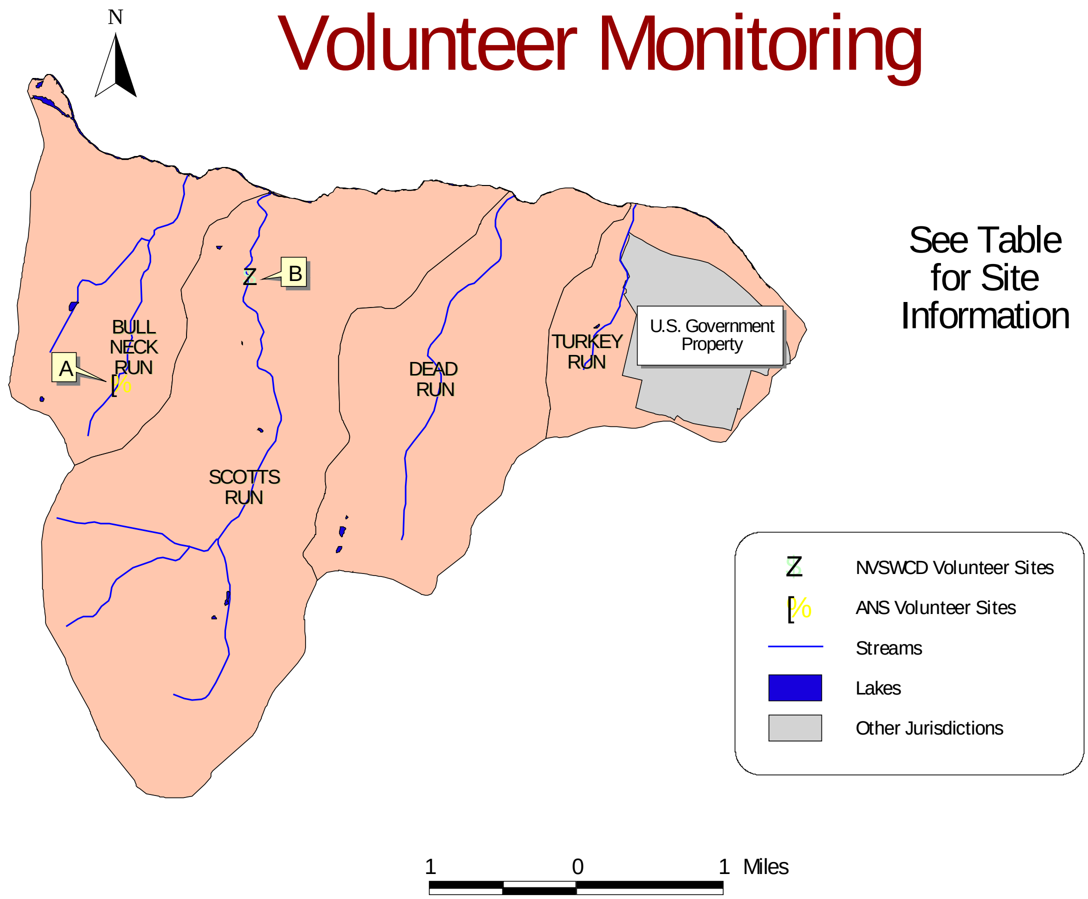
Nowhere was the difference in watershed condition more evident than with variations in the level of impervious cover. The drainage basins of Bull Neck Run and Turkey Run exhibit low-intensity land use patterns, are predominantly forested and have imperviousness values below 9%. Scotts Run and Dead Run, on the other hand, both drain major urban centers with levels of impervious cover ranging from 20 to 40%. This dramatic contrast in development intensity is reflected in the overall composite rankings.

Collectively, the watersheds in this group clearly highlight the impact that variations in land use can have on aquatic systems; those with the most development rank among the poorest quality streams in the County while those with the least, score among the best.

CHAPTER 3

Volunteer Data Summary

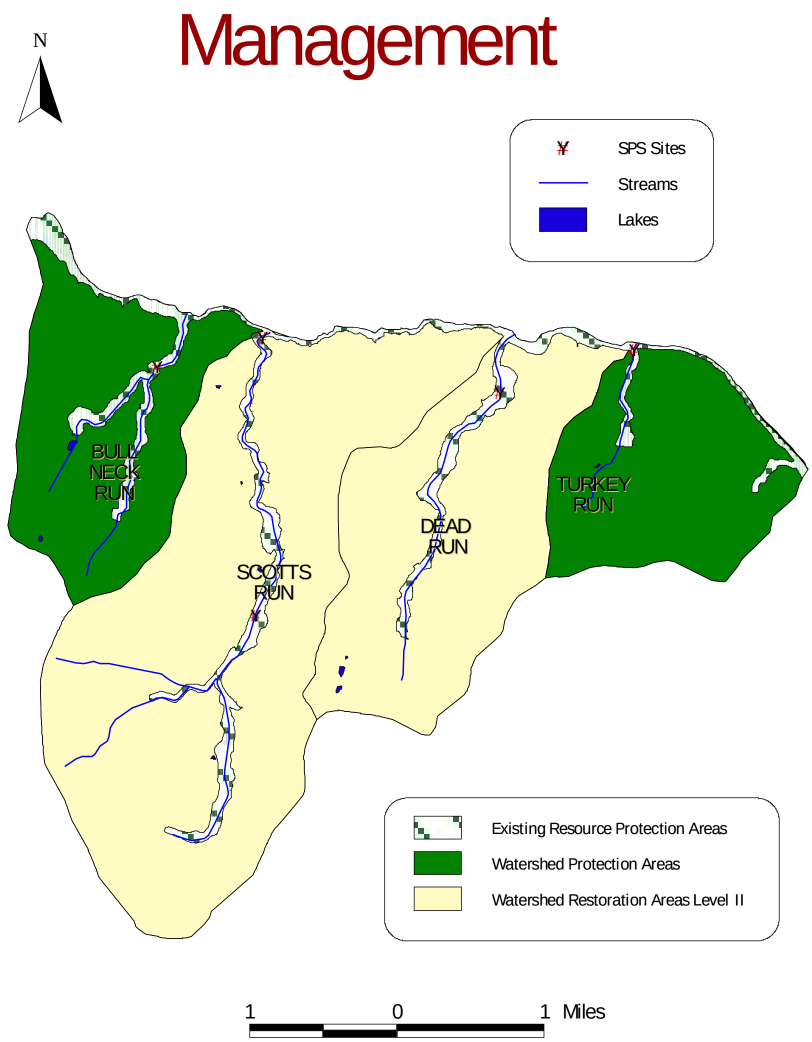
Within this group there are currently two active volunteer monitoring stations. One of these is located in Scotts Run and is coordinated by the Northern Virginia Soil and Water Conservation District (NVSWCD). The other site, located on Bull Neck Run, is coordinated by the Audubon Naturalist Society (ANS). Both monitoring locations are relatively recent additions to the volunteer site inventory.



Letter Code	Site Code	# times sampled	Last sampled	WQR (SOS only)	Trends noted
A	019	1	####	N/A	Sensitive taxa well represented in sample
B	SCOT1	3	####	Fair	Varies from Fair - Poor

The data collected from both sites generally support the findings of the SPS study. The site at Bull Neck Run indicated the presence of a more diverse benthic community, while the site on Scotts Run highlighted significant biological impairment.

CHAPTER 3



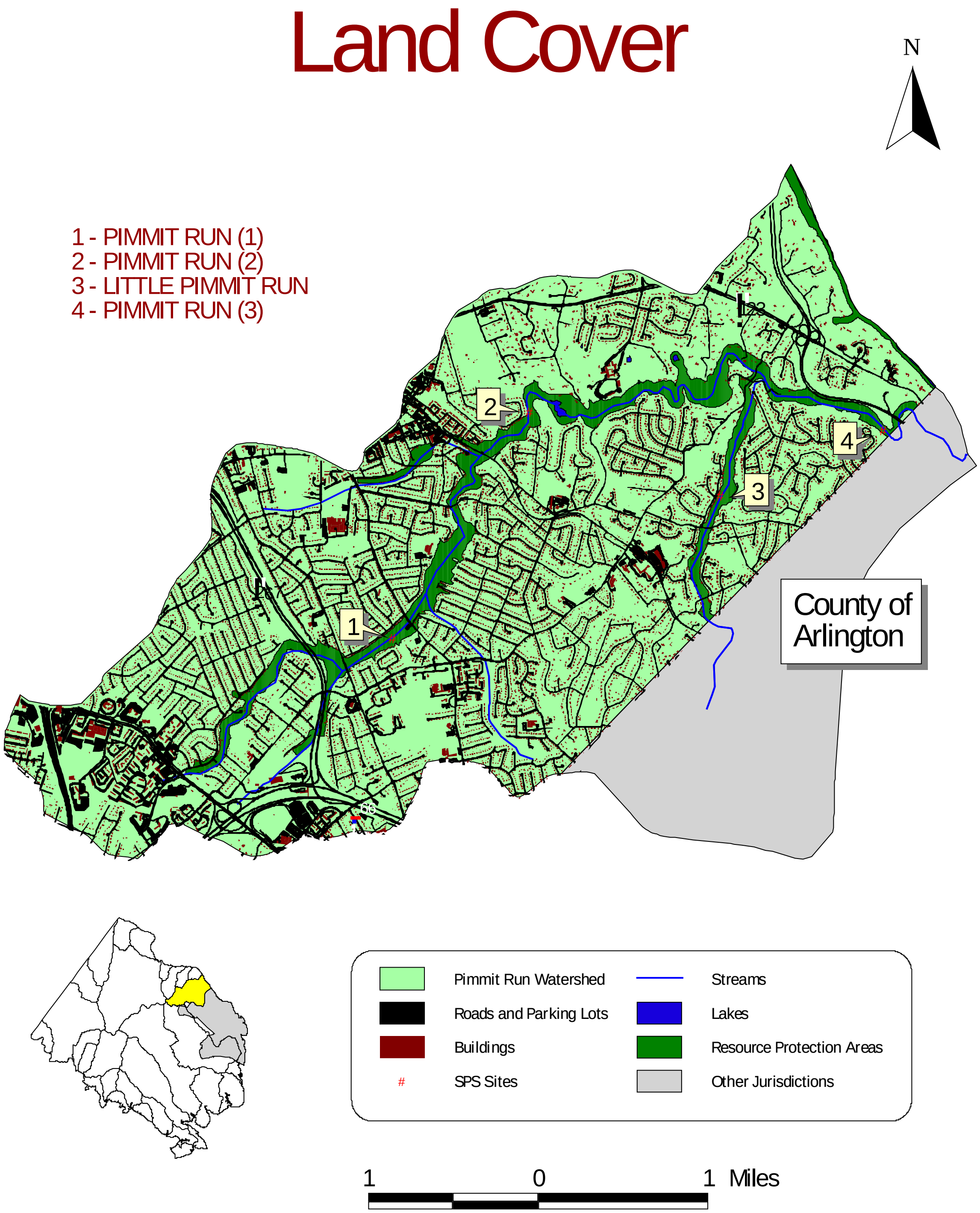
Management Category Description

The two extremes in biological integrity, habitat condition and land use translated into wide variations in the management category recommendations. Both Dead and Scotts Runs are currently classified as Watershed Restoration Level II Areas. Many opportunities for small-scale, localized improvements exist, and efforts should focus on minimizing, as much as possible, future degradation to instream habitat in the mainstem environments.

Although the two remaining watersheds are classified entirely as Watershed Protection Areas, regular monitoring within both should continue. This is especially true within Turkey Run, where instream erosion and high sediment deposition is occurring despite seemingly low levels of development within the watershed. Further assessment of fish communities within Bull Neck is also warranted.

CHAPTER 3

PIMMIT RUN WATERSHED SUMMARY


Land Cover
N
1 - PIMMIT RUN (1)
2 - PIMMIT RUN (2)
3 - LITTLE PIMMIT RUN
4 - PIMMIT RUN (3)
1
2
3
4
County of Arlington
Pimmit Run Watershed
Roads and Parking Lots
Buildings
SPS Sites
Streams
Lakes
Resource Protection Areas
Other Jurisdictions
1
0
1
Miles

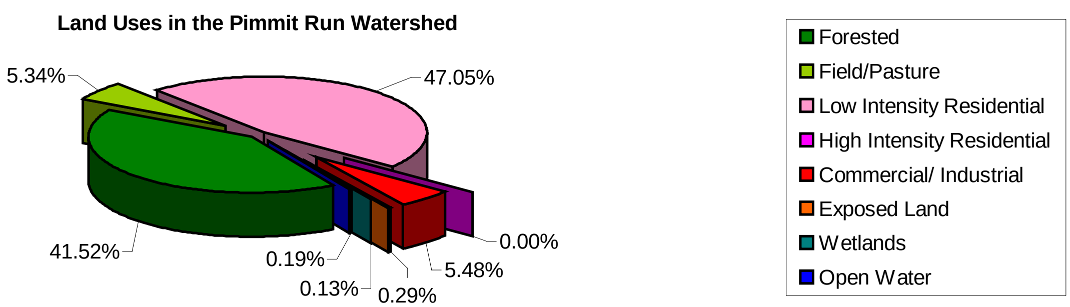
CHAPTER 3

Watershed Description

The lowermost site on the Pimmit Run mainstem.

The Pimmit Run Watershed, located in the northeastern portion of Fairfax County, has a total area of 12.6 square miles, nearly one-fifth of which is contained within the jurisdiction of Arlington County. Low- to moderate density residential communities, primarily comprised of single family houses, dominate the drainage, which exhibits overall levels of imperviousness in excess of 25%. No major impoundments or regional ponds occur within the watershed.

The headwaters of the Pimmit Run Watershed combine in the heavily developed area between Tyson's Corner and Falls Church. The mainstem then flows northeast, crossing under two large, heavily traveled road corridors. It continues through the town of McLean, joins with the Little Pimmit Run tributary, and enters Arlington County on its way to the Potomac River.



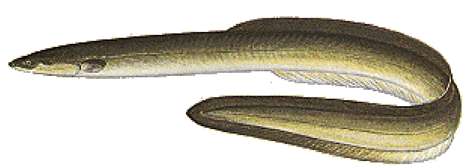
Net Spinning Caddisflies
Family *Hydropsychidae*
Habitat Classification: clingers
Feeding Group: collector-filterer
Tolerance: moderate to intolerant
These caddisflies build spider-like nets to filter material from the water column. The caddisfly then climbs out onto the net to collect any food present. These insects take up oxygen through the finger-like gills on their abdomens.

DATA SUMMARY

	Composite	Environmental Variables				
Stream Name and Site Code	Site Condition Rating	Index of Biotic Integrity	Habitat Score	Fish Taxa Richness	Current Percent Impervious Surfaces	Projected Percent Impervious Surfaces
Pimmit Run 1 (PMPM01)	Very Poor	Poor	Very Poor	Very Low	26.2	40
Pimmit Run 2 (PMPM02)	Poor	Fair	Poor	Low	26.8	36
Little Pimmit Run (PMLP01)	Very Poor	Poor	Fair	Very Low	20.9	22
Pimmit Run 3 (PMPM03)	Poor	Poor	Good	Very Low	24.2	30

Pimmit Run Fish Species List

Common Name	Number of Sites Where Species Occurred (4 Total Sites)
American Eel	4
White Sucker	4
Blacknose Dace	4
Creek Chub	4
Rosyside Dace	3
Redbreast Sunfish	3
Longnose Dace	3



American Eel
Anguilla rostrata

Size: to 39 inches
Habitat: medium/large streams, varied substrates
Feeding Group: generalist predator
Tolerance: tolerant
The American eel is one of the County's most remarkable fish. Beginning in the fall, adult eels travel from as far as the Appalachian Mountains downstream to the Atlantic Ocean. They spawn in the Sargasso Sea, between Bermuda and the Bahamas, then die. The eggs hatch into tiny, transparent larvae, which ride the tides back up the bays and rivers and into the creeks from which their

Rosyside Dace
Clinostomus funduloides

Size: to 4 inches
Habitat: pools of clear, moderate size streams with little silt
Feeding Group: insectivore
Tolerance: intolerant
This colorful minnow can be found hovering in small groups within pools. It has a blue-green dorsal color, yellow & black stripe and a characteristic red blaze behind the gills. It does not tolerate degraded stream conditions, particularly heavy siltation.

CHAPTER 3

Watershed Condition Summary

Pimmit Run is one of the more developed watersheds in Fairfax County and is characterized by low biological and habitat integrity.

Fish community richness was very low at all sampling locations. Only seven fish taxa were found throughout the drainage, and the majority of these species are classified as being highly tolerant of degraded conditions. However, some evidence suggests that instream barriers may also be playing a role in limiting the distribution of some species.

Measures of benthic macroinvertebrate community integrity were consistently low, with no site ranking above the Fair category. Highly tolerant midges and aquatic worms generally dominated communities at all monitoring locations.

Exposed sanitary pipe running across Little Pimmit Run indicates considerable erosion by the stream.

Channelized streams, unstable sediment bars and extensive areas of bank shoring typify the majority of this watershed. Exposed sewer lines were also evident in some locations, reflecting active channel incision and/or widening taking place in many stream segments. The habitat scores were generally Poor to Fair, with the only notable exception being the lowermost mainstem site which scored well largely as a result of the erosion-resistant substrate that dominates this portion of the watershed. Low ratings for sediment deposition, bank stability, and riparian zone quality were common in the upper reaches of the drainage.

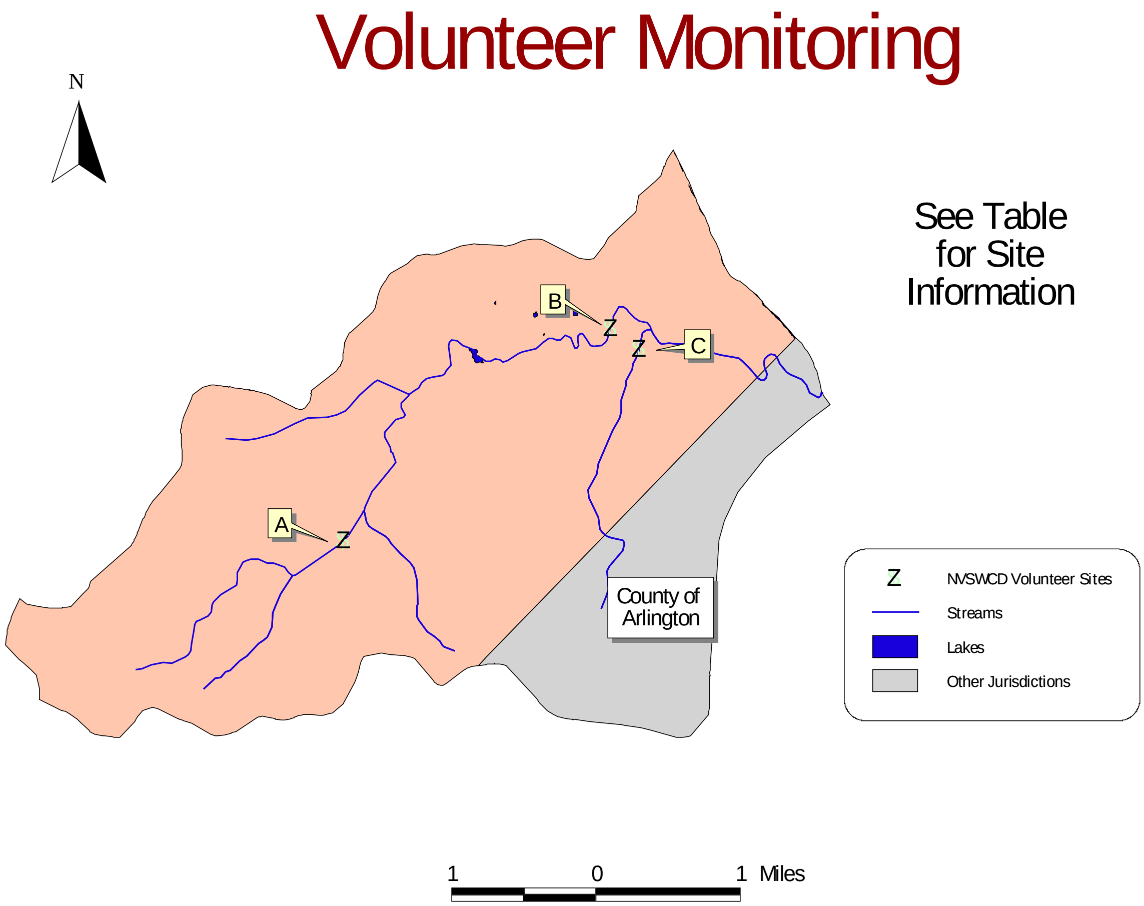
Development intensity is high throughout the Pimmit Run drainage, with all areas exhibiting levels of imperviousness in excess of 20%. This corresponds with the low rankings of biological and habitat quality, and this trend carries through to the overall composite ratings. All sites scored among the very lowest within Fairfax County.

As is the case in several of the more developed watersheds, conditions within Pimmit Run reflect the initial stormwater management approach of conveying runoff to streams as quickly as possible. Other factors may be at play in limiting some aspect of biological health within the basin—such as barriers to fish movement and ultimate distribution—but the widespread pattern of degradation seen suggests that the historic approach to stormwater management is most responsible for the substantial impacts seen systemwide.

CHAPTER 3

Volunteer Data Summary

There are currently three active volunteer monitoring sites in the Pimmit Run Watershed, all of which are coordinated by the Northern Virginia Soil and Water Conservation District. One site is on Little Pimmit Run tributary while the remaining two are located on the system's mainstem.

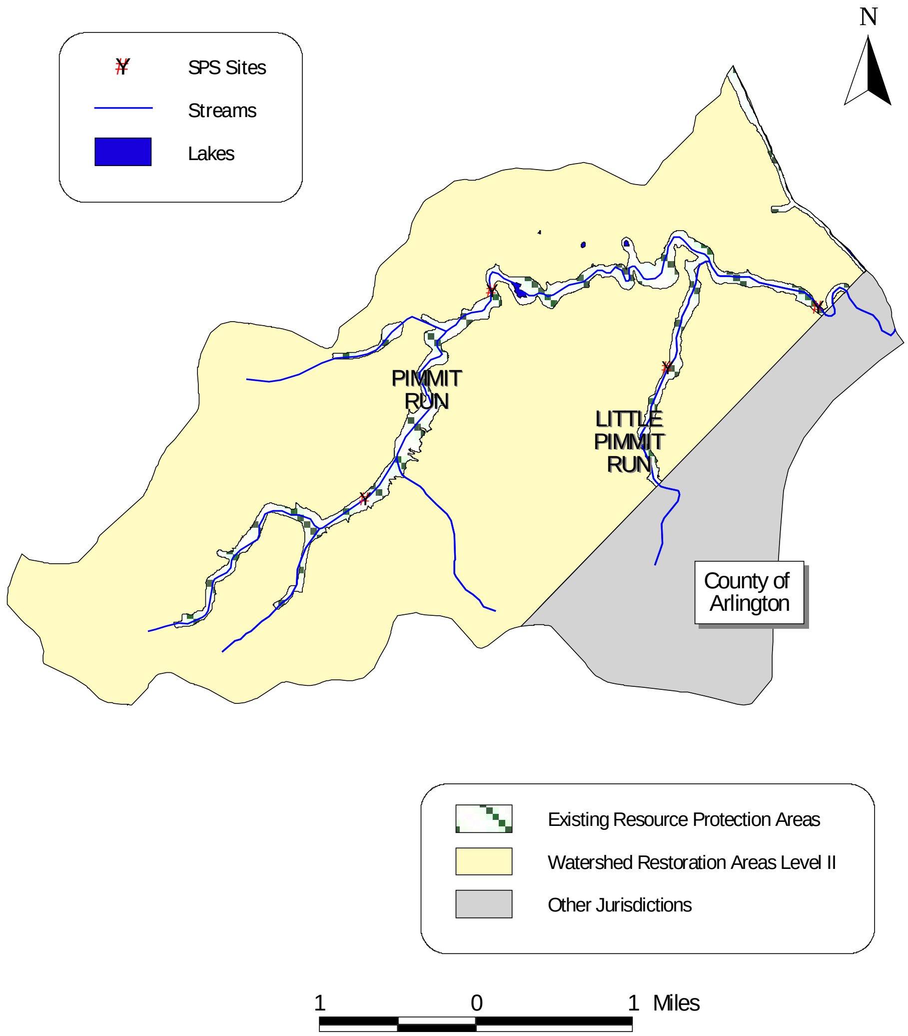


Results from volunteer monitoring support the findings of the SPS study, showing significant impairment at all three monitoring stations. Volunteer efforts generally highlighted low biological integrity throughout the drainage, with most locations being rated in the lower categories of their ranking system.

Letter Code	Site Code	# times sampled	Last sampled	WQR (SOS only)	Trends noted
A	PIM3	1	####	Fair	Too few samples
B	PIM2	2	####	Fair	Too few samples, but both were Fair
C	PIM1	4	####	Fair	Generally Poor

CHAPTER 3

Management



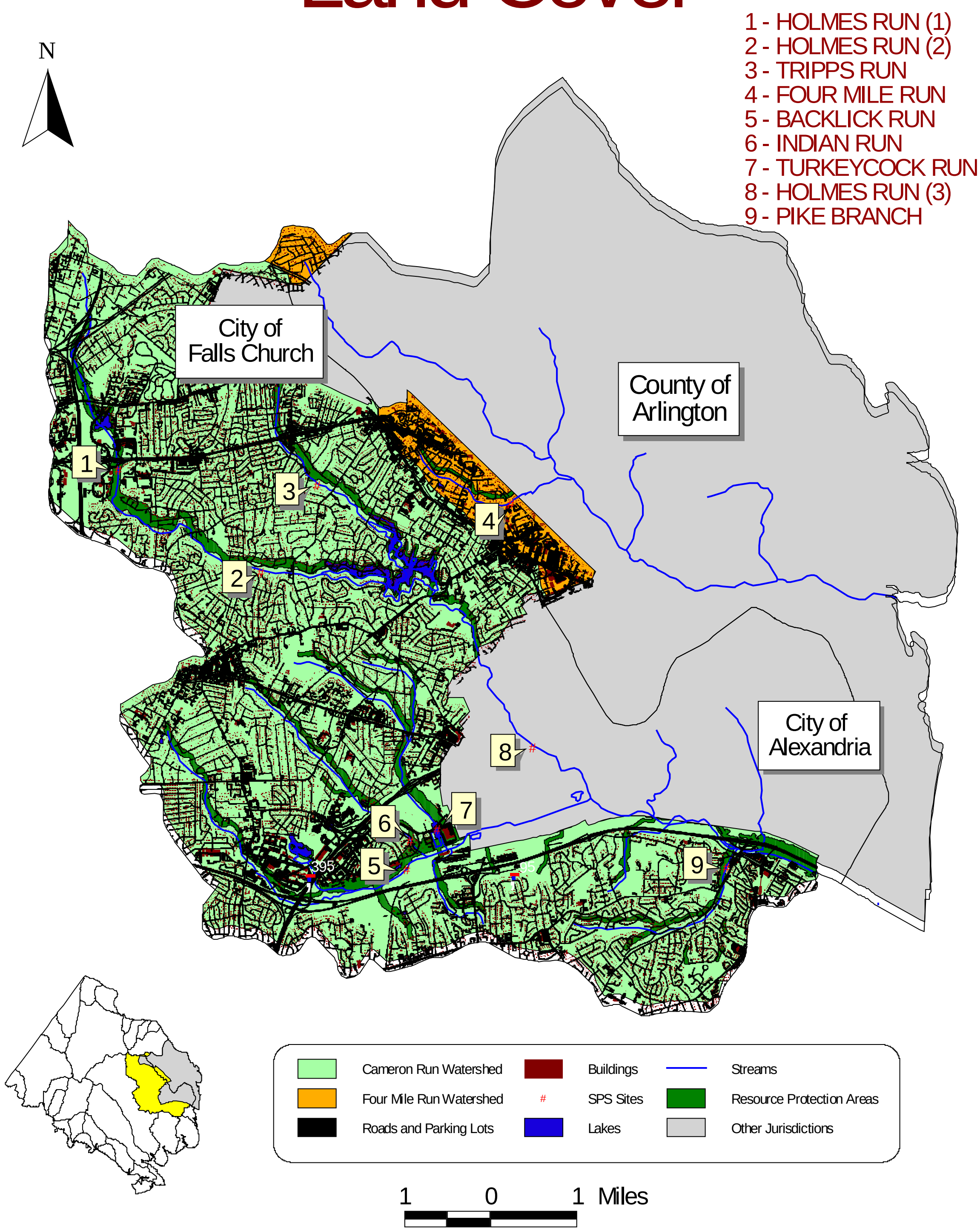
Management Category Description

Development within the watershed is extensive and has been occurring steadily for the last 50 years. Many communities in the area are quite old, as is the existing stormwater infrastructure draining them. And like many of the more impaired watersheds, the headwaters of the main stem originate within areas with the highest levels of imperviousness. The watershed as a whole is classified as a Watershed Restoration Level II Area and could benefit most from community education efforts and retrofitting of stormwater management facilities. Cooperation with Arlington County will likely be required to improve existing conditions especially in the headwaters of Little Pimmit Run.

CHAPTER 3

CAMERON RUN
AND
FOUR MILE RUN
WATERSHED SUMMARY

Land Cover


1 - HOLMES RUN (1)
2 - HOLMES RUN (2)
3 - TRIPPS RUN
4 - FOUR MILE RUN
5 - BACKLICK RUN
6 - INDIAN RUN
7 - TURKEYCOCK RUN
8 - HOLMES RUN (3)
9 - PIKE BRANCH
N
City of Falls Church
County of Arlington
City of Alexandria
1
2
3
4
5
6
7
8
9
395
Cameron Run Watershed
Four Mile Run Watershed
Roads and Parking Lots
Buildings
SPS Sites
Lakes
Streams
Resource Protection Areas
Other Jurisdictions
1 0 1 Miles

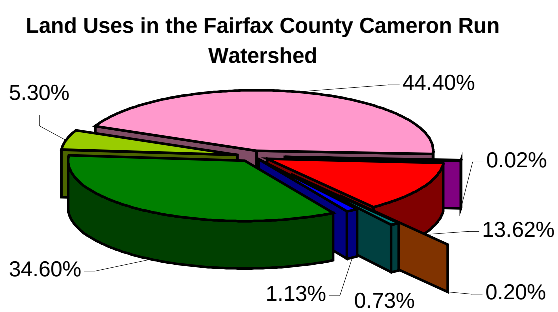
CHAPTER 3

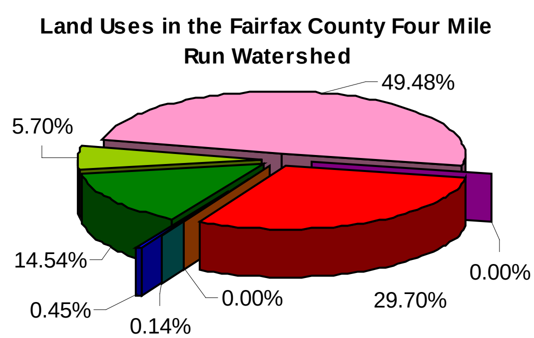
Watershed Description

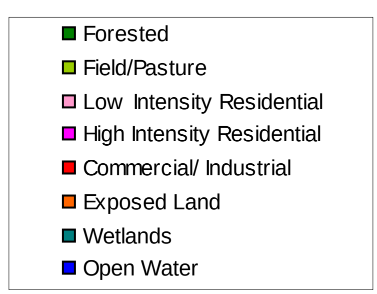
The Cameron and Four Mile Run watersheds, located in the eastern portion of Fairfax County, extend over both the Piedmont Upland and Coastal Plain physiographic provinces. Although Cameron Run has a total area of approximately 42 square miles, only 31.5 square miles are within Fairfax County jurisdiction; the remaining area lies within either the cities of Alexandria and Falls Church, or Arlington County. Similarly, only two small areas of the Four Mile Run watershed fall within the borders of Fairfax County. The only impoundments within the region are found in the Cameron Run watershed: Lake Barcroft (137 acres), Fairview Lake (15 acres) and four regional ponds.

Poor habitat quality characterizes much of Four Mile Run.

Both of these watersheds are highly urbanized. All sites sampled had subwatershed imperviousness values exceeding 20%, with several of these over 30%. The Long Branch tributary of Four Mile Run, which flows through the highly developed area of Seven Corners and Bailey's Crossroads, had an imperviousness value of over 40%, the highest sampled in this study. The major land use category throughout the watersheds is residential, consisting largely of older, single family homes.





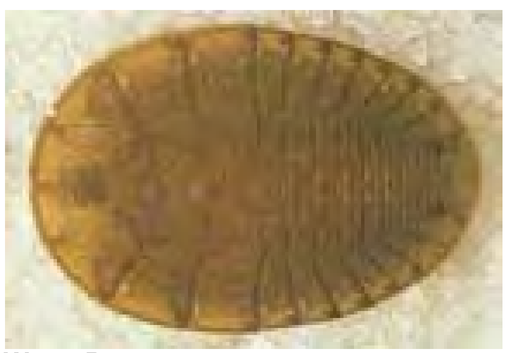


The Cameron Run watershed contains two large tributary systems that come together to form the Cameron Run mainstem. The northern part of the watershed is dominated by the first of these, Holmes Run, which drains the area between Tyson's Corner and the cities of Vienna and Falls Church. It flows south and east and crosses beneath four major road corridors before emptying into Lake Barcroft. There its flow is combined with Tripps Run, a smaller but still substantial tributary originating in the City of Falls Church.


Backlick Run in the Cameron Run watershed suffers from extreme levels of deposition.

The other major contributor of the Cameron Run system is Backlick Run, which begins in Annandale and closely parallels the Capital Beltway (I-495) for most of its length. Backlick Run increases with the addition of Indian Run and Turkeycock Run, both of which drain the high-density residential area around Annandale. After the confluence with Turkeycock Run, Backlick Run immediately enters the City of Alexandria and continues on to meet with Holmes Run.

With the merging of the two major systems, the Cameron Run mainstem begins its eastward flow, first traveling under I-495 and then picking up the input of Pike Branch and a variety of smaller tributaries before emptying into the Potomac River.


Water Penny
Family *Psephenidae*
Habitat Classification: clingers
Feeding Group: scrapers
Tolerance: moderate
These beetle larvae are very hard to spot. They tend to live on the underside of rocks in swiftly moving water. Their outer shell protects the larvae from predators and reduces the drag created by swiftly moving water. They will move slowly along the rocks in search of plant material to scrape off and eat.

Blacknose Dace
Rhinichthys atratulus
Size: to 3 inches
Habitat: small/medium streams, varied substrates
Feeding Group: omnivorous
Tolerance: tolerant
Omnivorous feeding and adaptability to many different habitats allow this fish to survive under degraded conditions. In severely impacted streams, the Blacknose Dace is often the dominant, if not only, fish present.

Creek Chub
Semotilus atromaculatus
Size: to 8 inches
Habitat: small/medium creeks, various substrates
Feeding Group: generalist omnivore/predator
Tolerance: tolerant
Like the Blacknose Dace this species is highly tolerant of degraded habitat conditions. Creek Chub breed in the spring and can live up to 7 years. This species constructs nests typically in gravel and/or sand along runs and at the tail end of pools.

Mummichog
Fundulus heteroclitus
Size: to 3 inches
Habitat: brackish, seasonally in tidal fresh creeks
Feeding Group: omnivorous
Tolerance: moderate
The Mummichog is generally associated with estuarine habitats but will sometimes venture into fresh water. Spawning occurs between April and the end of August, with eggs being laid at levels where only a spring high tide can reach them. Clutch sizes range from 10 to 300 eggs.

CHAPTER 3

DATA SUMMARY

Stream Name and Site Code	Composite Site Condition Rating	Environmental Variables: Index of Biotic Integrity	Habitat Score	Fish Taxa Richness	Current Percent Impervious Surfaces	Projected Percent Impervious Surfaces
1 Holmes Run 1 (CAHR01)	Poor	Poor	Poor	High	29.1	47
2 Holmes Run 2 (CAHR02)	Very Poor	Very Poor	Poor	Very Low	26.6	42
3 Tripps Run (CATR01)	Very Poor	Very Poor	Very Poor	Very Low	31.8	35
4 Four Mile Run (FMLO01)	Very Poor	Poor	Very Poor	Very Low	43.7	51
5 Backlick Run (CABA01)	Very Poor	Poor	Very Poor	Low	30.3	42
6 Indian Run (CAIR01)	Very Poor	Fair	Poor	Very Low	26.8	35
7 Turkeycock Run (CATK01)	Poor	Very Poor	Fair	Low	23.2	35
8 Holmes Run 3 (CAHR03)	Very Poor	Fair	Very Poor	Low	28.3	33
9 Pike Branch (CAPK01)	Very Poor	Fair	Very Poor	Very Low	25.0	32

Cameron Run and Four Mile Run Fish Species List

Common Name	Number of Sites Where Species Occurred (9 Total Sites)
Blacknose Dace	9
White Sucker	6
Creek Chub	5
Tessellated Darter	4
Bluegill	4
Yellow Bullhead	3
Satinfin Shiner	3
Swallowtail Shiner	3
Rosyside Dace	2
Redbreast Sunfish	2
Bluntnose Minnow	2
Largemouth Bass	2
Pumpkinseed	1
American Eel	1
Spotfin Shiner	1
Mummichog	1
Least Brook Lamprey	1
Green Sunfish	1
Golden Shiner	1
Black Crappie	1

CHAPTER 3

Watershed Condition Summary

The Cameron Run and Four Mile Run watersheds, both drainages containing some of the oldest and most highly developed areas in Fairfax County, have substantially degraded biological and habitat integrity.

Fish communities are of poor quality in both of these watersheds. The highest number of fish taxa found at any one site in the two watersheds was 13 with over half of the monitoring sites containing three or fewer taxa. Tolerant species dominated these communities.

Highly tolerant midges generally dominated benthic macroinvertebrate communities at all sites in both watersheds, and none contained a single representative of sensitive taxa indicative of higher quality conditions.

Many of the streams in this area are highly altered to accommodate large volumes of stormwater runoff. Examples of this include extensive areas of channelized or straightened stream reaches, many with banks stabilized by concrete, rip-rap, gabion baskets or a combination of all three. In some extreme cases, stream reaches were conveyed through a series of open cement channels and underground pipes. This high level of stream modification heavily influences the overall RBP habitat scores, which were poor to very poor throughout both watersheds.

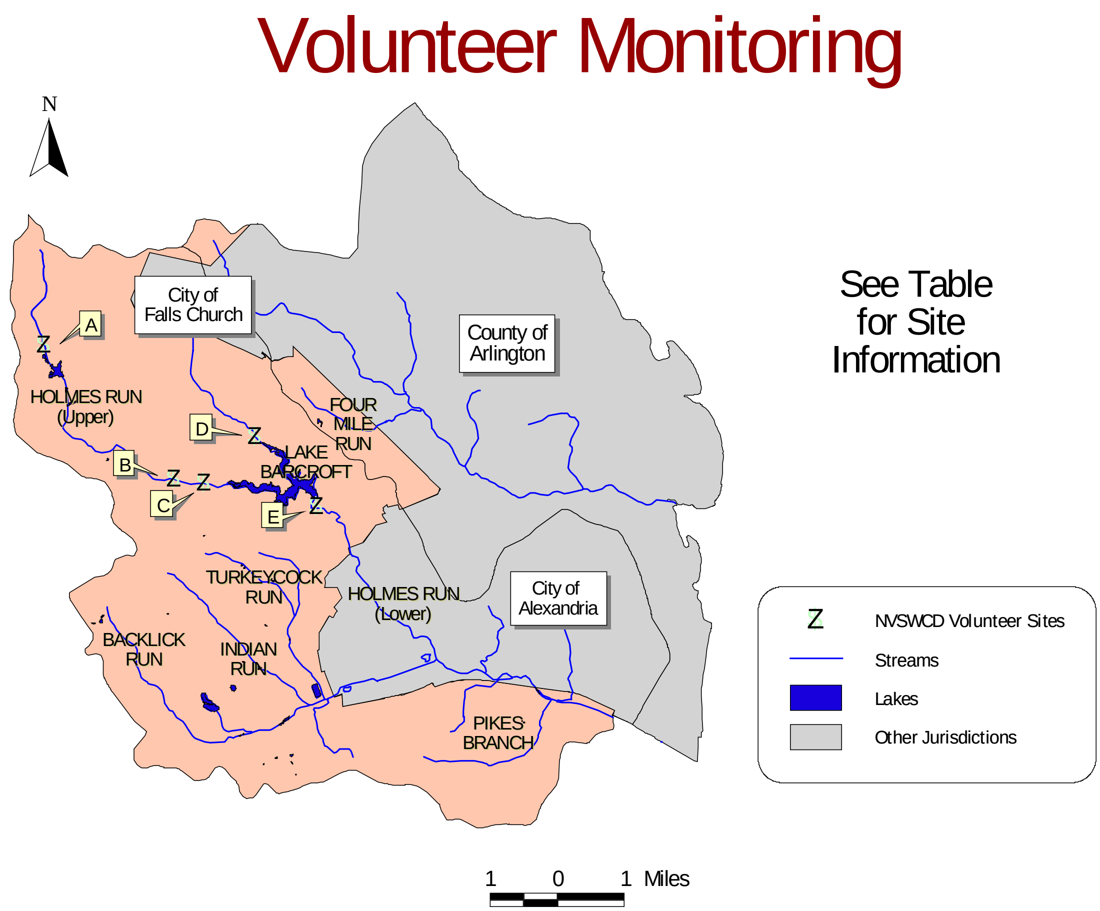
Levels of imperviousness are very high in each of the two drainages. Nearly 44% of the small section of the Four Mile Run watershed contained within the County border is comprised of impervious cover, while levels seen in the Cameron Run drainage exceed 23% in every subwatershed. The overall composite ratings for sites in both areas are similarly extreme, with all areas scoring among the very lowest within Fairfax County.

Conditions throughout both regions reflect the emphasis on treating streams solely as conveyances for stormwater discharge, an approach consistent with the period in which most of their communities were originally developed. In this light, the entire area can be viewed as being uniformly degraded from historic stormwater management approaches.

CHAPTER 3

Volunteer Data Summary

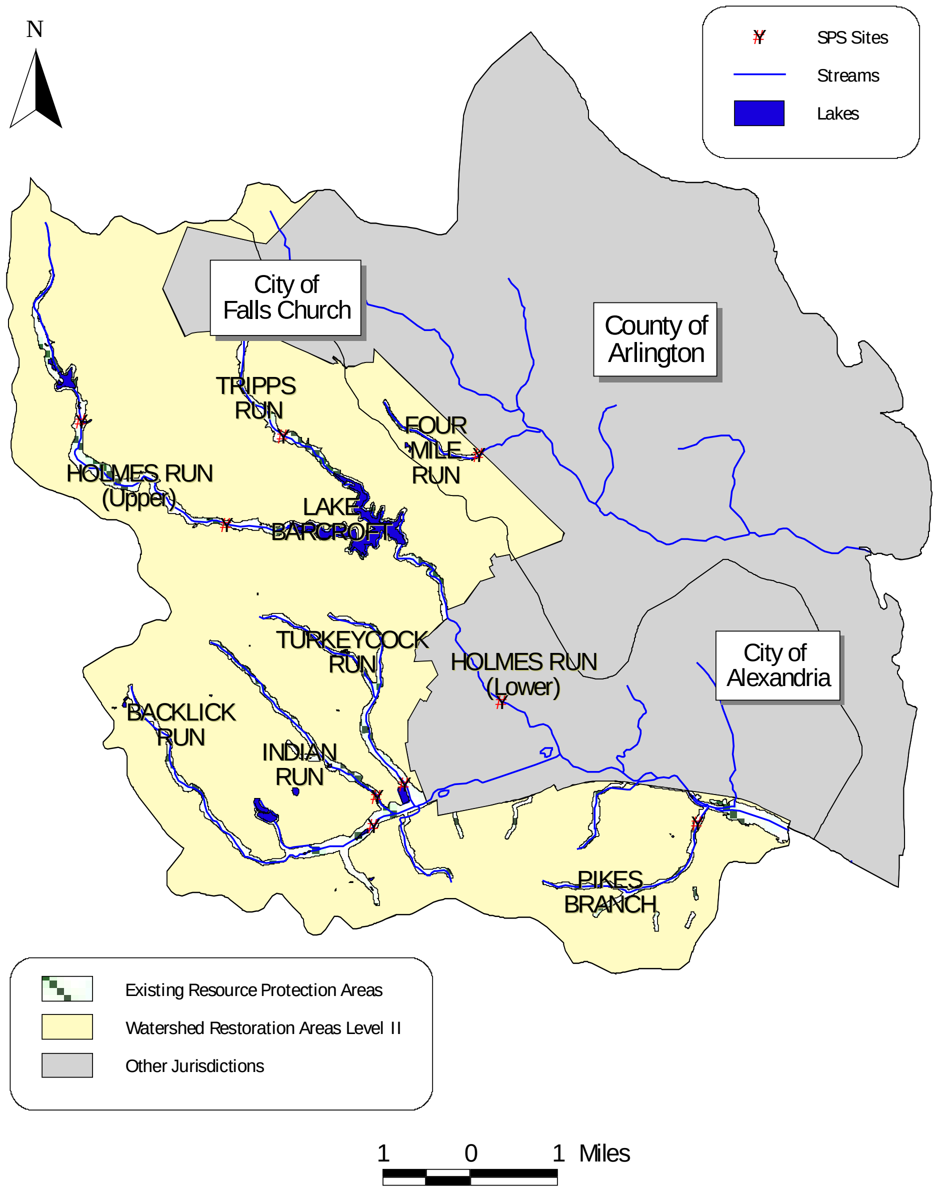
There are currently five active volunteer monitoring stations in the Cameron Run Watershed. The Northern Virginia Soil and Water Conservation District (NVSWCD) coordinates all of these sites. Three of these sites are sampled by the Lake Barcroft Watershed Improvement District (WID) as part of the agency's regular water quality monitoring activities.



Results from volunteer monitoring within the watersheds support those of the SPS Study. With few exceptions, ratings were generally in the lower categories.

Letter Code	Site Code	# times sampled	Last sampled	WQR (SOS only)	Trends noted
A	CAM1	4	#####	Poor	Varies from Fair - Poor
B	CAM2	4	#####	Fair	Generally Poor
C	CAM3	7	#####	Fair	Generally Fair - Good
D	CAM4	8	#####	Fair	Generally Fair - Good
E	CAM5	8	#####	Fair	Generally Poor

Management



Management Category Description

All of the Cameron Run and Four Mile Run watersheds are classified as Watershed Restoration Level II Areas, reflecting the uniformly degraded condition of streams throughout both drainages. Due to the age and pattern of development in these watersheds, this area may be well suited to pilot projects related to retrofitting stormwater management facilities, promoting of citizen stewardship and education, promoting Low Impact Development (LID) techniques at infill development sites and other innovative techniques. This is particularly true in the smaller order tributaries and headwater areas which could most benefit from enhancement efforts; restoring these areas would provide not only localized benefits, but should lead to improvements in the downstream environment as well. In many cases, inter-jurisdictional cooperation with the Cities of Falls Church and Alexandria, and Arlington County will be needed.

OTHER INITIATIVES

Lake Barcroft Watershed Improvement District

Founded in 1973, the fee-based Lake Barcroft Watershed Improvement District (WID) has implemented a variety of watershed improvement projects in the region surrounding the impoundment. Revenues collected from homeowners within the community provide the foundation for a variety of projects including sediment removal from the lake or contributing waterways, trash removal, algae and aquatic vegetation control, benthic macroinvertebrate and fecal coliform monitoring, street sweeping, dam maintenance and other stormwater management, water quality and health-related activities.

City of Falls Church Monitoring

The City of Falls Church received a grant from the Chesapeake Bay Local Assistance Department to monitor the effect of BMPs within city limits. The City and Fairfax County are currently sharing data and discussing areas of mutual concern with an eye toward developing beneficial strategies of stream improvement that cross jurisdictional boundaries.

Arlington County Watershed Management Plan

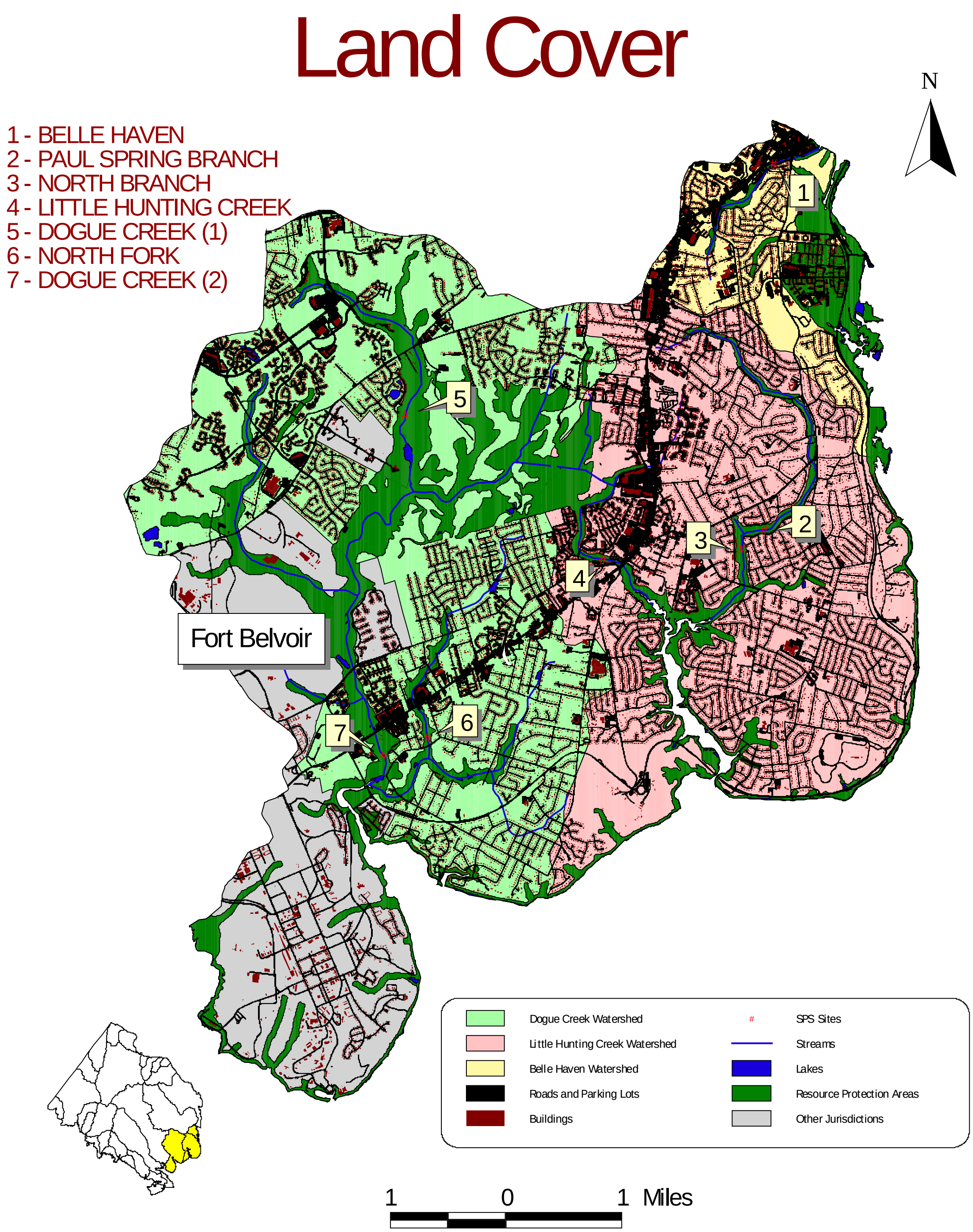
Arlington County, under a grant from Virginia Department of Environmental Quality (DEQ), developed a Watershed Management Plan for the County.
Examples of their recommendations include:

- Retrofitting BMPs
- Enforcing existing ordinances as strictly as possible for new developments
- Improving provisions of the Storm Water Detention Ordinance and Chesapeake Bay Preservation Ordinance
- Using NPDES to full extent
- Stabilizing badly eroded channels
- Restoring instream habitat
- Re-establishing riparian cover in accordance with the Chesapeake Bay Program
- Improving of stream aesthetics
- Restoring the most degraded stream reaches
- Continuing and improving public outreach programs

CHAPTER 3

DOGUE CREEK, LITTLE HUNTING CREEK

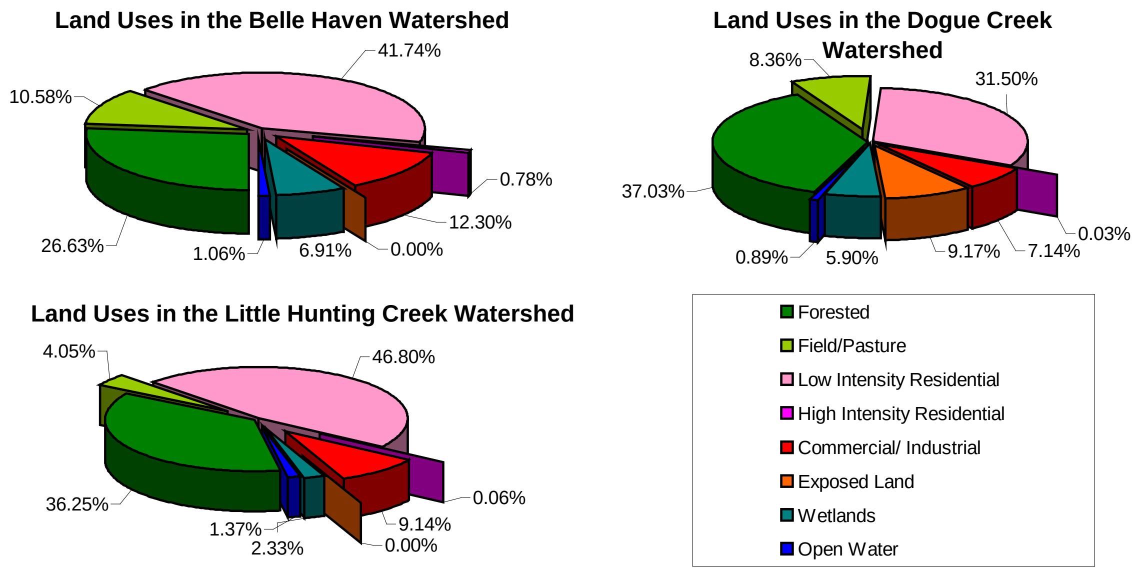
AND BELLE HAVEN WATERSHED SUMMARY


Land Cover
1 - BELLE HAVEN
2 - PAUL SPRING BRANCH
3 - NORTH BRANCH
4 - LITTLE HUNTING CREEK
5 - DOGUE CREEK (1)
6 - NORTH FORK
7 - DOGUE CREEK (2)
N
1
2
3
4
5
6
7
Fort Belvoir
Dogue Creek Watershed
Little Hunting Creek Watershed
Belle Haven Watershed
Roads and Parking Lots
Buildings
SPS Sites
Streams
Lakes
Resource Protection Areas
Other Jurisdictions
1 0 1 Miles

CHAPTER 3

Watershed Description

Dogue Creek, Little Hunting Creek and Belle Haven watersheds are located in southeastern Fairfax County. Out of the total drainage area of 28 square miles, 3.6 are not under County jurisdiction, lying within Fort Belvoir Military Reservation, the U.S. Coast Guard facility, Fort Hunt National Park and other federal parklands. These watersheds are located in the Coastal Plain physiographic province, a region containing significant areas of flat, often marshy terrain with slopes of less than 15%. Each system is tidally influenced at its confluence with the Potomac. Overall development is very high in most places, with many communities in the area dating back to the 1940’s. Impoundments within the watershed are limited to one small regional wet pond.



The North Fork of Dogue Creek shows the low-gradient character typical of Coastal Plain streams.

After its beginning as a collection of small streams within a moderate density residential/commercial area, Dogue Creek flows under Telegraph Road (Rt. 611) and into the protected area of Huntley Meadows Park, where it flattens into a wetland system with many stream channels. The stream then passes into the property of the Fort Belvoir Military Reservation, crosses Richmond Highway, and then meets with the North Fork of Dogue Creek. A mile further downstream, the combined system widens into a cove before emptying into the Potomac River.

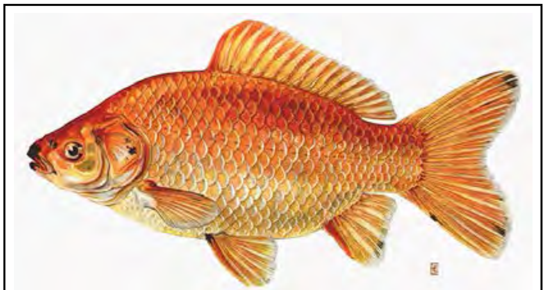
The Little Hunting Creek watershed consists of two main tributaries. The first of these, Little Hunting Creek itself, drains the commercial and high-density residential areas along the Richmond Highway corridor which have levels of imperviousness over 30%. The second tributary system, North Branch and its own tributary, Paul Springs Branch, drains part of the Richmond Highway corridor. These areas have imperviousness levels between 20-25%. After the confluence of the respective systems, the mainstem continues for a mile before flowing into the Potomac River.

Instream and riparian zone litter was common throughout many portions of Little Hunting Creek.

The Belle Haven watershed is an assortment of small tributaries flowing directly into the Potomac River. This watershed is highly urbanized, with streams flowing through pipes or culverts in many areas. Hunting Creek, the representative tributary monitored in this study, had levels of impervious cover in excess of 35%, one of the highest levels seen in the County.

Banded Killifish
Fundulus diaphanus
Size: approximately 3 inches
Habitat: tidal fresh/slightly brackish waters and upland streams
Feeding Group: insectivore/invertivore
Tolerance: tolerant
It is a hardy fish, able to survive a wide range of salinity, turbidity and temperature variations. They are known to breed throughout the summer. Few survive beyond 2 years.

Black Crappie
Pomoxis nigromaculatus
Size: to 18 inches
Habitat: lakes, swamps, slow moving creeks and rivers
Feeding Group: predator
Tolerance: moderate
The Black Crappie is one of the most popular panfishes in Virginia. They generally live about 6-7 years. They tend to spawn in April, and the females will lay between 11,000 to 188,000 eggs.



Goldfish
Carassius auritus
Size: to 18 inches
Habitat: vegetated areas of sluggish pools
Feeding group: omnivorous
Tolerance: tolerant
Even though it is mostly known as an aquarium fish, the Goldfish does occur in Virginia streams. This fish is able to survive in water temperatures up to 105°F. Not originally native to North America, the Goldfish was introduced from Asia in the late 1600's.

CHAPTER 3

DATA SUMMARY

Stream Name and Site Code	Composite Site Condition Rating	Environmental Variables Index of Biotic Integrity	Habitat Score	Fish Taxa Richness	Current Percent Impervious Surfaces	Projected Percent Impervious Surfaces
1 Belle Haven (BEBE01)	Very Poor	Very Poor	Very Poor	Very Low	36.4	50
2 Paul Spring Branch (LHPS01)	Very Poor	Poor	Very Poor	Very Low	24.4	29
3 North Branch (LHNB01)	Very Poor	Poor	Very Poor	Very Low	23.7	28
4 Little Hunting Creek (LHLH01)	Very Poor	Very Poor	Poor	Moderate	32.2	47
5 Dogue Creek 1 (DCDC01)	Good	Good	Fair	High	19.1	36
6 North Fork 1 (DCNF01)	Poor	Very Poor	Fair	Low	24.3	32
7 Dogue Creek 2 (DCDC04)	Good	Fair	Fair	Moderate	14.1	26

Lower Potomac Fish Species List

Common Name	**Number of Sites Where Species Occurred (6 Total Sites)**
White Sucker	5
Blacknose Dace	5
American Eel	4
Creek Chubsucker	4
Tessellated Darter	4
Eastern Mosquitofish	4
Creek Chub	4
Brown Bullhead	3
Goldfish	3
Pumpkinseed	3
Bluegill	3
Yellow Bullhead	2
Satinfin Shiner	2
Banded Killifish	2
Mummichog	2
Eastern Mudminnow	2
Least Brook Lamprey	1
Redbreast Sunfish	1
Green Sunfish	1
Warmouth	1
Largemouth Bass	1
Golden Shiner	1
Spottail Shiner	1
Swallowtail Shiner	1
Black Crappie	1

CHAPTER 3

Watershed Condition Summary

Although all three of the independent watersheds that comprise this group are similar in terms of relief and underlying geology, their respective systems represent wide variations in biological integrity among drainages within the Coastal Plain.

While a total of 25 individual fish taxa were collected across this entire region, values from the individual watersheds ranged considerably, with totals of three, twelve and fifteen unique taxa for Belle Haven, Little Hunting and Dogue Creek drainages, respectively. This same gradient is seen in the actual taxa richness scores for each site, with the mainstem of Dogue Creek ranking in the uppermost categories. Of special note is the presence of goldfish, an exotic species, throughout the Dogue Creek system; sampling highlighted the presence of a naturalized population of these fish in both its North Fork and mainstem environments.

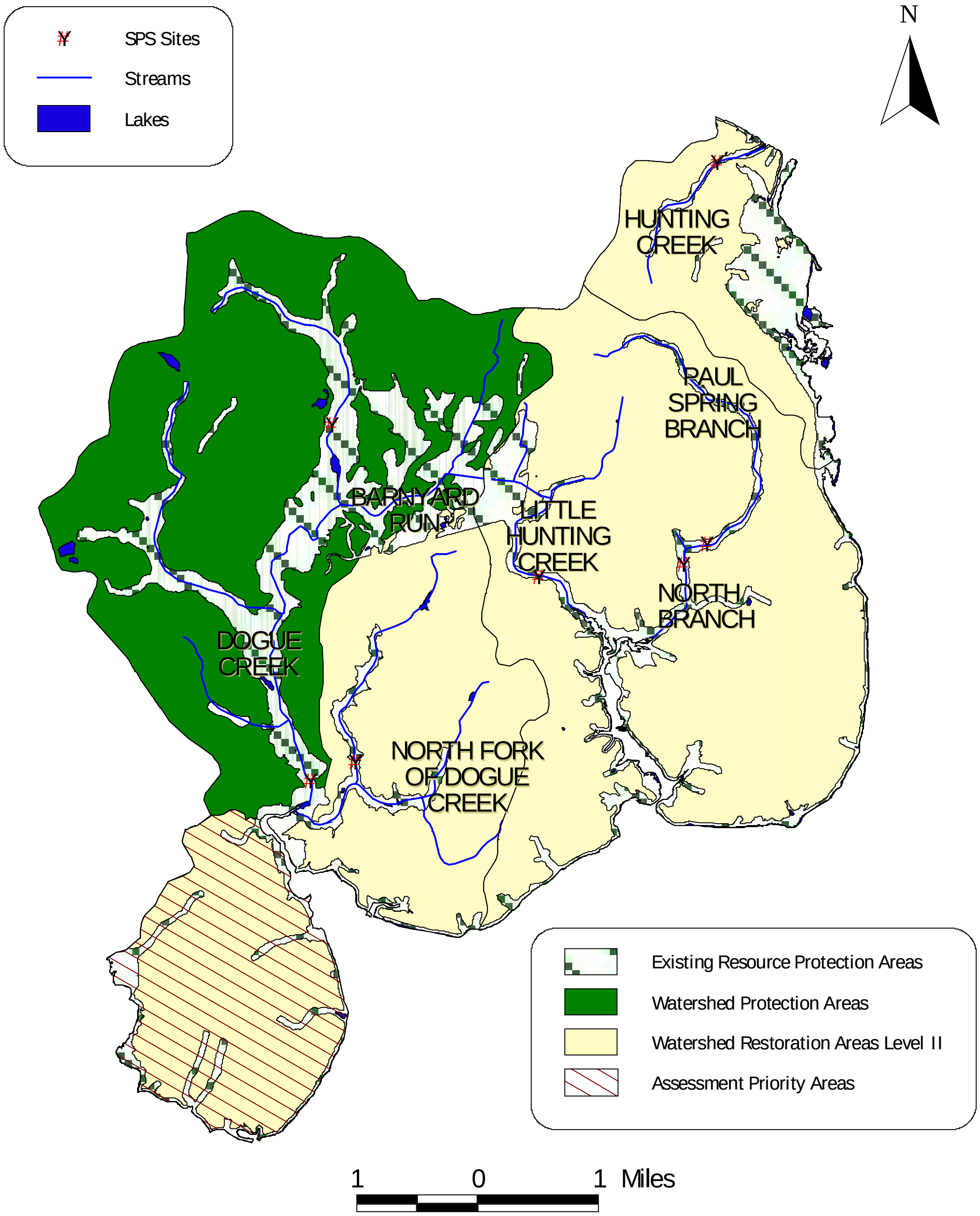
With the exception of the site on the Dogue Creek mainstem, all monitoring locations in the combined areas exhibited low quality benthic macroinvertebrate communities, with several subwatersheds in the Belle Haven and Little Hunting drainages ranking among the lowest of all Coastal Plain systems. Of the 1,618 benthic organisms identified within these watersheds, the overwhelming majority were representatives of taxa known to be tolerant of degraded conditions.

Although problems of sediment deposition limited habitat quality across this entire region, this same overall pattern between the separate watersheds was still evident. Measures of instream conditions were extremely poor throughout Little Hunting and Belle Haven (one site on the Little Hunting mainstem was also notable for an exceedingly high level of instream and riparian zone litter). Monitoring sites in Dogue Creek ranked consistently higher, each falling in the Fair category.

On average, the systems within this region drain areas with high levels of impervious cover, some even approaching the upper end of the range seen in the entire County. The Dogue Creek mainstem again remains as the only exception. Although it is exempt from the five-acre minimum lot size requirement, Ft. Belvoir Military Reservation contains some of the largest expanses of undeveloped land in the area. Together with Huntley Meadows, Fort Belvoir helps to protect Dogue Creek. Composite scores from all three of the watersheds corresponded to the trend seen in each category and highlighted the overall integrity of portions of the Dogue Creek watershed.

The highly altered nature of stream systems in Belle Haven and Little Hunting are a reflection of the limited levels and efficiency of stormwater controls implemented during the initial development of these areas. This is in stark contrast to large portions of the neighboring Dogue Creek watershed. As such, this relatively high-quality resource should be considered even more valuable given its isolation and uniqueness as one of the County’s few remaining higher quality Coastal Plain environments.

Management


SPS Sites
Streams
Lakes
N
HUNTING CREEK
PAUL SPRING BRANCH
BARNYARD RUN
LITTLE HUNTING CREEK
NORTH BRANCH
DOGUE CREEK
NORTH FORK OF DOGUE CREEK
Existing Resource Protection Areas
Watershed Protection Areas
Watershed Restoration Areas Level II
Assessment Priority Areas
1 0 1 Miles

CHAPTER 3

Management Category Description

The entire mainstem of Dogue Creek is classified as a Watershed Protection Area and should be monitored closely. Active measures are needed to improve instream habitat conditions at the small scale. Inter-jurisdictional cooperation between the County and Fort Belvoir will be required to ensure this area remains high quality.

The rest of this watershed group, Little Hunting, Belle Haven, and Dogue Creek North Fork, are classified as Watershed Restoration Level II Areas. Retrofitting of stormwater management facilities should be seen as a potential management focus in many areas. Of special note are the revitalization efforts potentially slated for the Richmond Highway corridor, which may present opportunities for improvement, at least locally, through the use of LID techniques at infill development sites. Community education efforts would be beneficial throughout the region.

OTHER INITIATIVES

Kingstowne Restoration

A section of Dogue Creek watershed was restored through a partnership between Fairfax County, Northern Virginia Soil and Water Conservation District, Natural Resources Conservation Service and two citizen groups. The project, initiated in 1998 and completed in 1999, used bioengineering techniques to restore a severely entrenched and eroded section of stream. To more efficiently dissipate flow energy during storm events, stream channel morphology was adjusted to reflect local conditions. Vegetation was added to stabilize streambanks. Monitoring of the site is ongoing, and the project remains a showcase for restoration approaches potentially applicable to many other County streams.

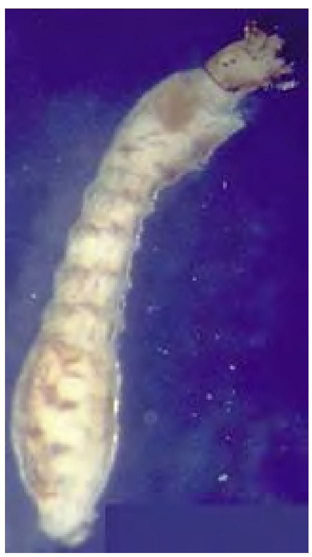
Kingstowne Environmental Monitoring

Residential and commercial development upstream of Telegraph Road has posed a threat to Huntley Meadows Park within the Dogue Creek drainage. The Kingstowne Environmental Monitoring Program, designed to detect and minimize runoff problems associated with development, is in its fourteenth year of sampling. Efforts at four sites in the Kingstowne area involve monitoring sediment levels, water chemistry and, as of 1999, benthic macroinvertebrate community integrity. To date, the results of the sampling show that despite controls achieving generally above 80% removal of sediment, benthic quality was fair to very poor, and current recommendations include controlling stormwater runoff and monitoring sources of habitat alteration and chemical inputs.

CHAPTER 3

Huntley Meadows Park Monitoring

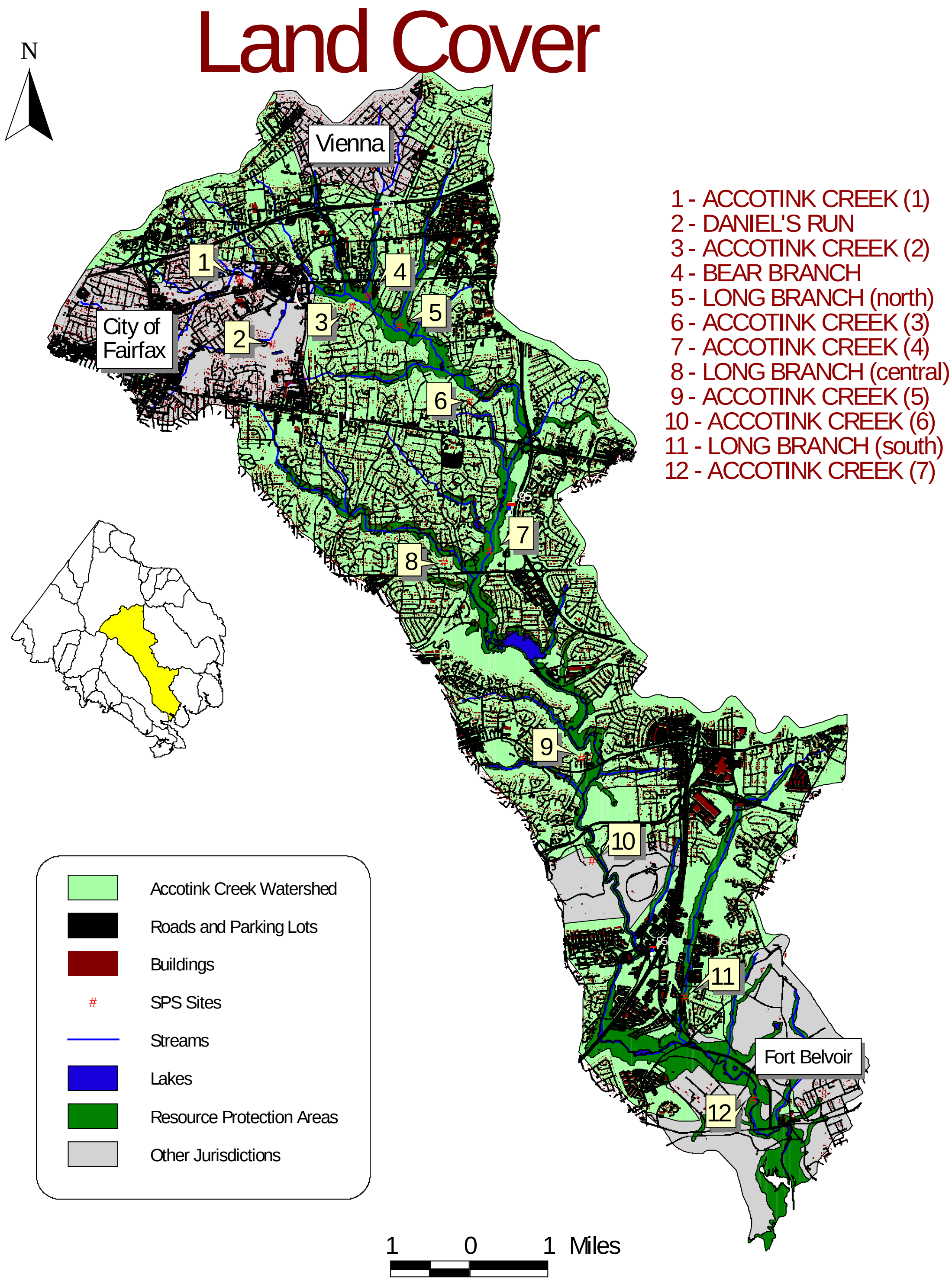
Huntley Meadows Park is a valuable natural resource, containing 1,425 acres of wildlife habitat. Approximately 800 acres of the park is classified as freshwater non-tidal emergent, scrub-shrub or forested wetlands. The park staff and citizen volunteers monitor benthic macroinvertebrates and habitat quality within the park at six sites, three along Dogue Creek and three in the Huntley Meadows Central Wetland. The wetland area contains greater diversity of aquatic insects than Dogue Creek, but tolerant organisms typically dominated communities in both sample areas. The habitat in Huntley Meadows is generally good with a few problem areas such as sediment deposition, embeddedness and high stream velocity. The dual purpose of its program is to evaluate aquatic macroinvertebrate communities and physical habitats in Dogue Creek watershed and to involve citizens in water quality monitoring issues through volunteer opportunities and community education efforts.



Blackfly Larvae
Family *Simuliidae*
Habitat Classification: clingers
Feeding Group: collector-filterer
Tolerance: moderate
Next to mosquitos, blackflies are some of the most well known insects to humans. The larval stage is very well adapted to living in fast moving currents. The larva will hold on to the bottom with "suction cups" located on its posterior end. It will then extend two fans from its head to filter any particulate matter out of the water column.

CHAPTER 3

ACCOTINK CREEK WATERSHED SUMMARY

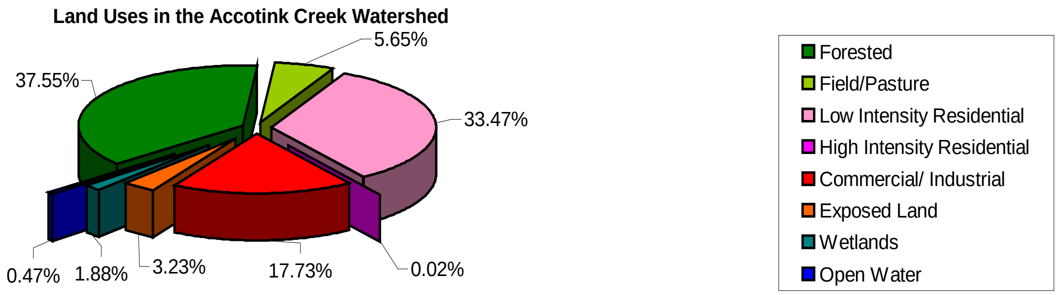

Land Cover
N
Vienna
City of Fairfax
Fort Belvoir
1
2
3
4
5
6
7
8
9
10
11
12
1 - ACCOTINK CREEK (1)
2 - DANIEL'S RUN
3 - ACCOTINK CREEK (2)
4 - BEAR BRANCH
5 - LONG BRANCH (north)
6 - ACCOTINK CREEK (3)
7 - ACCOTINK CREEK (4)
8 - LONG BRANCH (central)
9 - ACCOTINK CREEK (5)
10 - ACCOTINK CREEK (6)
11 - LONG BRANCH (south)
12 - ACCOTINK CREEK (7)
Accotink Creek Watershed
Roads and Parking Lots
Buildings
SPS Sites
Streams
Lakes
Resource Protection Areas
Other Jurisdictions
1 0 1 Miles

CHAPTER 3

Watershed Description

The Accotink Creek watershed has an area of 51.1 square miles, or 12.4% of the County. Approximately 13.4 square miles of this area are outside of County jurisdiction, located in the Town of Vienna, City of Fairfax, Fort Belvoir Military Reservation and other U.S. Government installations. The watershed includes areas of both Piedmont Uplands and Coastal Plain physiographic provinces. Only one major impoundment, Lake Accotink (68 acres), and six smaller regional ponds occur in the watershed.

Accotink Creek is characterized by heavy development throughout most of the watershed. Over half of the region is either commercial or low-density residential. Of all the major subwatersheds in the basin, only Long Branch (central) had an imperviousness value of less than 25%.



Highly eroded stream banks are common throughout the Accotink watershed.

The headwaters of Accotink Creek begin in the highly urbanized area of Fairfax City where it also joins with its first tributary, Daniel's Run. The mainstem soon increases in size with the addition of two large tributaries, Bear Branch and Long Branch (north), each draining the highly developed Vienna suburbs. Heading generally southeastward on a path to the Potomac River, the system runs under several major road corridors as it travels through a series of high-density residential areas. Along the way it receives input from the second Long Branch (central), itself a major system draining moderate density residential communities to the east. After passing through the protected area of the Lake Accotink reservoir system, it travels under the Franconia-Springfield Parkway and enters the Coastal Plain physiographic province. The mainstem then picks up additional input from Long Branch (south), which drains the eastern side of Springfield. On its final leg, Accotink Creek meanders slowly through the property of Fort Belvoir Military Reservation — the only large expanse of relatively undeveloped land in the entire watershed — and finally enters a freshwater tidal marsh at Accotink Bay, itself on the edge of the larger Gunston Cove.

DATA SUMMARY

Stream Name and Site Code	Composite Site Condition Rating	Environmental Variables: Index of Biotic Integrity	Habitat Score	Fish Taxa Richness	Current Percent Impervious Surfaces	Projected Percent Impervious Surfaces
1 Accotink Creek 1 (ACAC01)	Very Poor	Poor	Very Poor	Low	35.2	35
2 Daniel's Run (ACDR01)	Very Poor	Very Poor	Poor	Very Low	25.5	25
3 Accotink Creek 2 (ACAC02)	Very Poor	Fair	Very Poor	Moderate	31.3	37
4 Bear Branch (ACBB01)	Very Poor	Very Poor	Poor	Low	25.1	43
5 Long Branch North (ACLC01)	Very Poor	Very Poor	Poor	Low	37.6	44
6 Accotink Creek 3 (ACAC03)	Very Poor	Poor	Poor	Moderate	29.7	36
7 Accotink Creek 4 (ACAC04)	Poor	Poor	Poor	Moderate	28.6	35
8 Long Branch Central (ACLB01)	Poor	Poor	Fair	Moderate	23.6	24
9 Accotink Creek 5 (ACAC05)	Poor	Very Poor	Good	Moderate	27.4	34
# Accotink Creek 6 (ACAC06)	Poor	Poor	Good	Moderate	27.1	35
# Long Branch South (ACLA01)	Poor	Poor	Good	Low	30.3	49
# Accotink Creek 7 (ACAC07)	Poor	Poor	Poor	Moderate	26.3	36

Accotink Creek Fish Species List

Common Name	Number of Sites Where Species Occurred (12 Total Sites)	Common Name	Number of Sites Where Species Occurred (12 Total Sites)
White Sucker	12	**Northern Hogsucker**	3
Creek Chub	12	Common Shiner	3
Tessellated Darter	11	Largemouth Bass	3
Green Sunfish	10	Brown Bullhead	2
Swallowtail Shiner	10	Common Carp	2
Blacknose Dace	10	River Chub	2
Creek Chubsucker	9	Banded Killifish	1
Yellow Bullhead	8	Eastern Mosquitofish	1
American Eel	8	Eastern Silvery Minnow	1
Satinfin Shiner	7	Longear Sunfish	1
Bluegill	7	Spottail Shiner	1
Rosyside Dace	6	Yellow Perch	1
Pumpkinseed	6	Longnose Dace	1
Redbreast Sunfish	4	Fallfish	1
Golden Shiner	4	Eastern Mudminnow	1

CHAPTER 3

Watershed Condition Summary

Streams in the Accotink Creek watershed are substantially degraded, with the majority of tributary systems exhibiting poor habitat and biological conditions.

Thirty different fish taxa were collected from the12 SPS sampling sites in the watershed. While reasonably high species taxa counts were obtained from many locations along the length of the mainstem, most tributary systems generally lacked such diversity, even accounting for their smaller size.

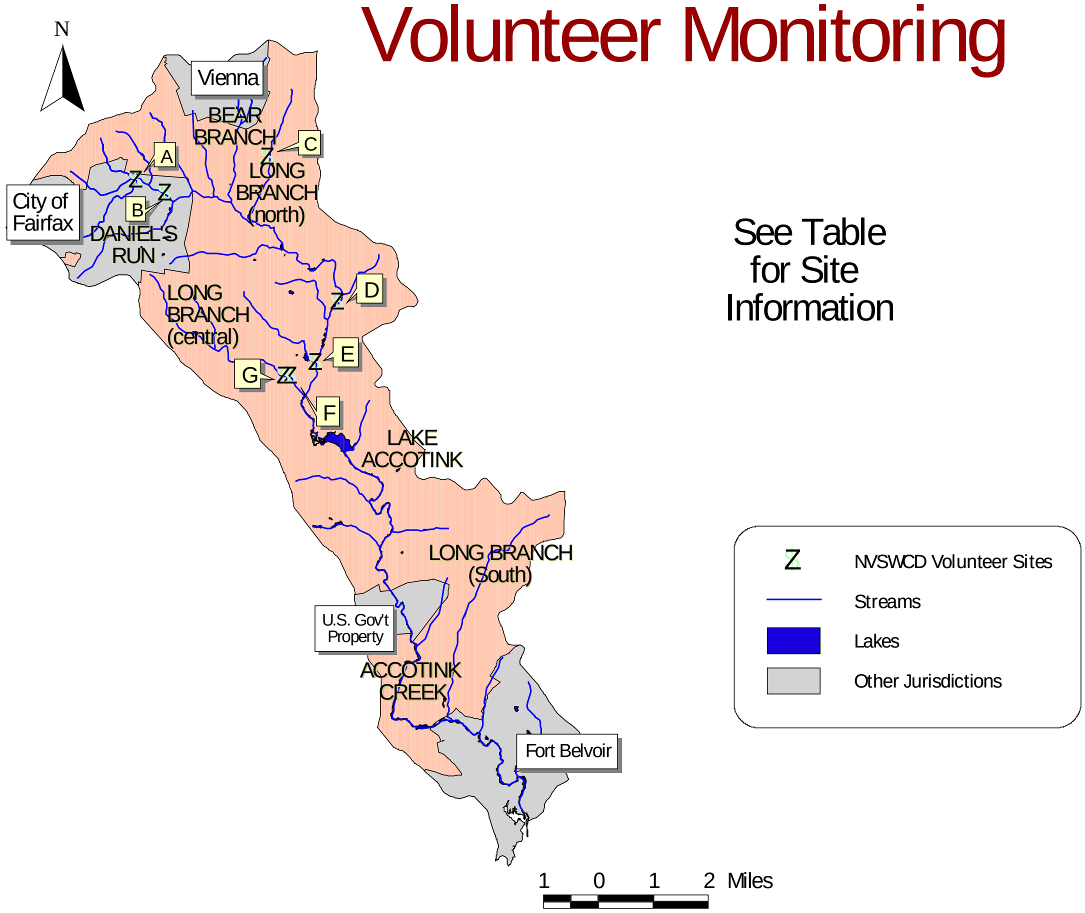
Measures of benthic macroinvertebrate community health were consistently low throughout the entire watershed. In fact, samples from three sites in the drainage, Daniel's Run in Fairfax City, Long Branch North and one site on the mainstem, yielded the lowest IBI scores seen in the entire county. For all watershed samples combined, nearly 100% of the 2,400 individual insects collected are categorized as being tolerant of degraded conditions.

With the exception of Long Branch Central and the lower mainstem of Accotink Creek itself, habitat conditions throughout the watershed were poor. Most of the small tributary systems were severely incised (entrenched), and an overall pattern of active stream widening was evident. The watershed contains extensive areas of unstable habitat, with sloughed and eroded banks, large unstable sediment bars and numerous tree falls and logjams.

The headwaters of Accotink Creek originate in the urbanized areas of Fairfax City and the Town of Vienna, and with the exception of the large parcel of Ft. Belvoir near its mouth, the system flows through areas with levels of imperviousness in excess of 25%. Rankings across the watershed are similarly consistent, with all sites being rated as poor or very poor overall.

The relatively good habitat ratings of the lowermost mainstem sites are the only contrast to the low ecological integrity seen in streams systemwide. While these results may simply reflect the ability of larger-order systems to better absorb and buffer the effects of high flow volumes (at least relative to smaller, lower-order tributaries), the impact may also be indicative of the influence of the upstream dam at Lake Accotink. Reservoir systems have been shown to trap sediments and reduce the intensity and erosive energy of storm flows, and such hydrologic control may be a component responsible for the increased stability in the downstream environment. However, these systems can limit the migration of aquatic species.

Volunteer Monitoring

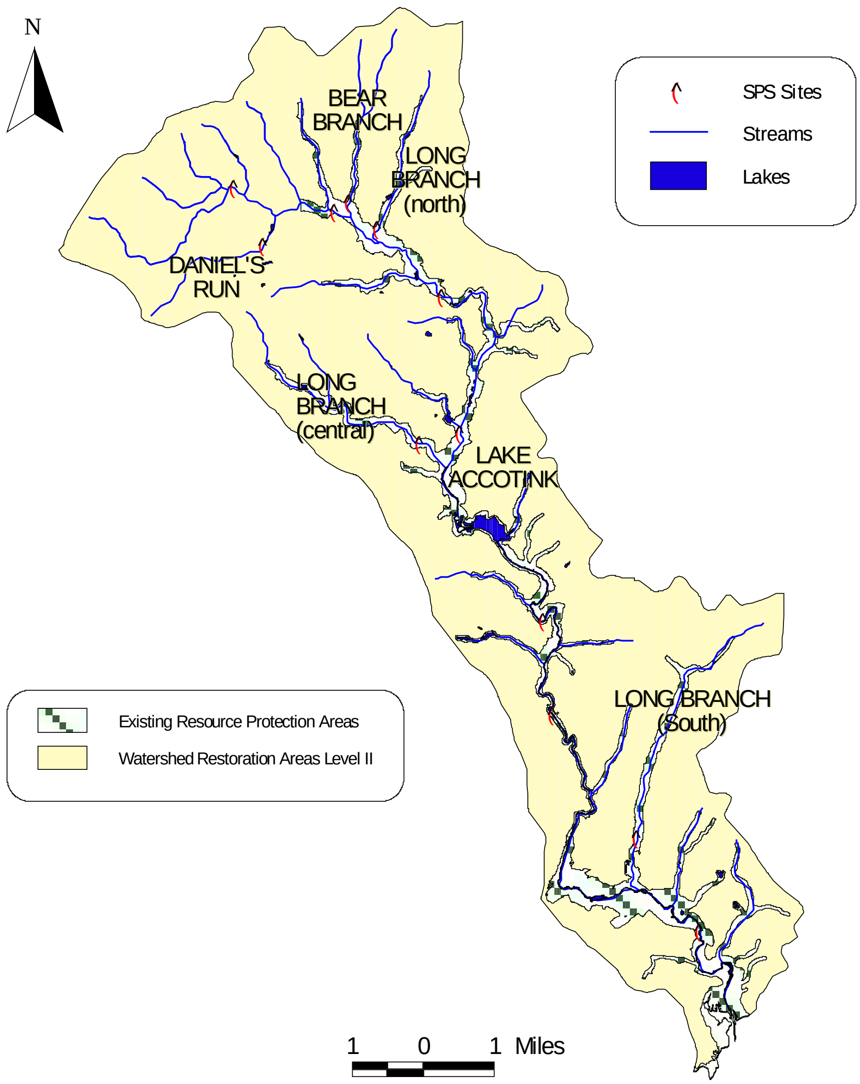


Volunteer Data Summary

There are seven active volunteer monitoring sites within the Accotink Creek Watershed, each of which is coordinated by the Northern Virginia Soil and Water Conservation District (NVSWCD). All but one of these sites are recent additions to the volunteer monitoring inventory. New volunteer monitoring efforts would be useful in many of the tributary environments, as well as locations on the mainstem downstream of Lake Accotink. To date, the volunteer data collected is consistent with the results of SPS monitoring; most of the sites sampled exhibited "Poor" water quality ratings, and none received a ranking higher than "Fair".

Letter Code	Site Code	# times sampled	Last sampled	WQR (SOS only)	Trends noted
A	ACC10	1	####	Fair	too few samples
B	ACC5	2	####	Poor	too few samples, although they were both Poor
C	ACC4	2	####	Poor	too few samples, although they were both Poor
D	ACC2	30	####	Poor	varies from Fair - Poor
E	ACC6	2	####	Fair	too few samples, although the previous one was Poor
F	ACC7	2	####	Fair	too few samples, although the previous one was Poor
G	ACC8	1	####	Fair	too few samples

Management



Management Category Description

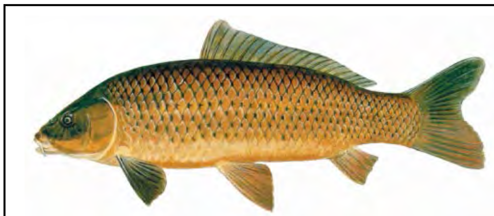
Accotink Creek presents a challenge in management. The entire watershed is classified as Watershed Restoration Level II Area, and many opportunities for localized improvements exist. In areas outside of County jurisdiction such as Fairfax City and Fort Belvoir, inter-agency cooperation will be required. The SPS Study shows that stream conditions improve slightly upstream and downstream of Lake Accotink, and more research is warranted to assess the impact of the reservoir system on the mainstem environment.

OTHER INITIATIVES

USGS Fecal Source Tracking

A 4.5 mile segment of Accotink Creek in Fairfax County, beginning at the confluence of Crook Branch and Accotink Creek to the start of Lake Accotink, was placed on the 1998 Virginia 303(d) Total Maximum Daily Load (TMDL) priority list for fecal coliform impairment. In December 1998, the United States Geological Survey (USGS), the Virginia Department of Conservation and Recreation (DCR), Virginia Department of Environmental Quality (DEQ) and Fairfax County entered into a partnership to pursue a bacteria source tracking study for Accotink Creek as part of a statewide study. Bacteria source tracking is a relatively new technique employed nationwide to positively identify the sources (e.g. human, waterfowl, deer, pets, and other warm-blooded animals) of fecal coliform in streams using genetic fingerprinting. Along with bacteria source tracking the USGS will also develop a fecal coliform TMDL for the Accotink Creek watershed. A TMDL is the loading capacity or greatest load a waterbody can receive without violating water quality standards. The TMDL calculation includes estimates of point source (e.g. municipal and industrial discharges) and nonpoint source (e.g. runoff from urban areas) loads. There are no permitted point source dischargers of fecal coliform bacteria in the Accotink Creek watershed study area. Therefore, the primary sources of fecal coliform bacteria are from nonpoint sources and may include direct runoff, stormwater outfalls, or failing septic systems. The TMDL development process will involve determining the primary sources of fecal pollution, evaluating load allocation scenarios to determine whether water quality standards in the impaired water body will be met, and implementing a plan to reverse the impairment over a certain timeframe.

White Sucker
Catostomus commersoni
Size: to 16 inches
Habitat: most freshwater habitats of at least moderate size
Feeding Group: generalist invertivore
Tolerance: tolerant
This widespread and common sucker is highly tolerant of degraded stream conditions. It uses sensitive "taste buds" in its lips to locate food. Large juveniles and adults occupy pools that are fairly deep or that have structural shelter.

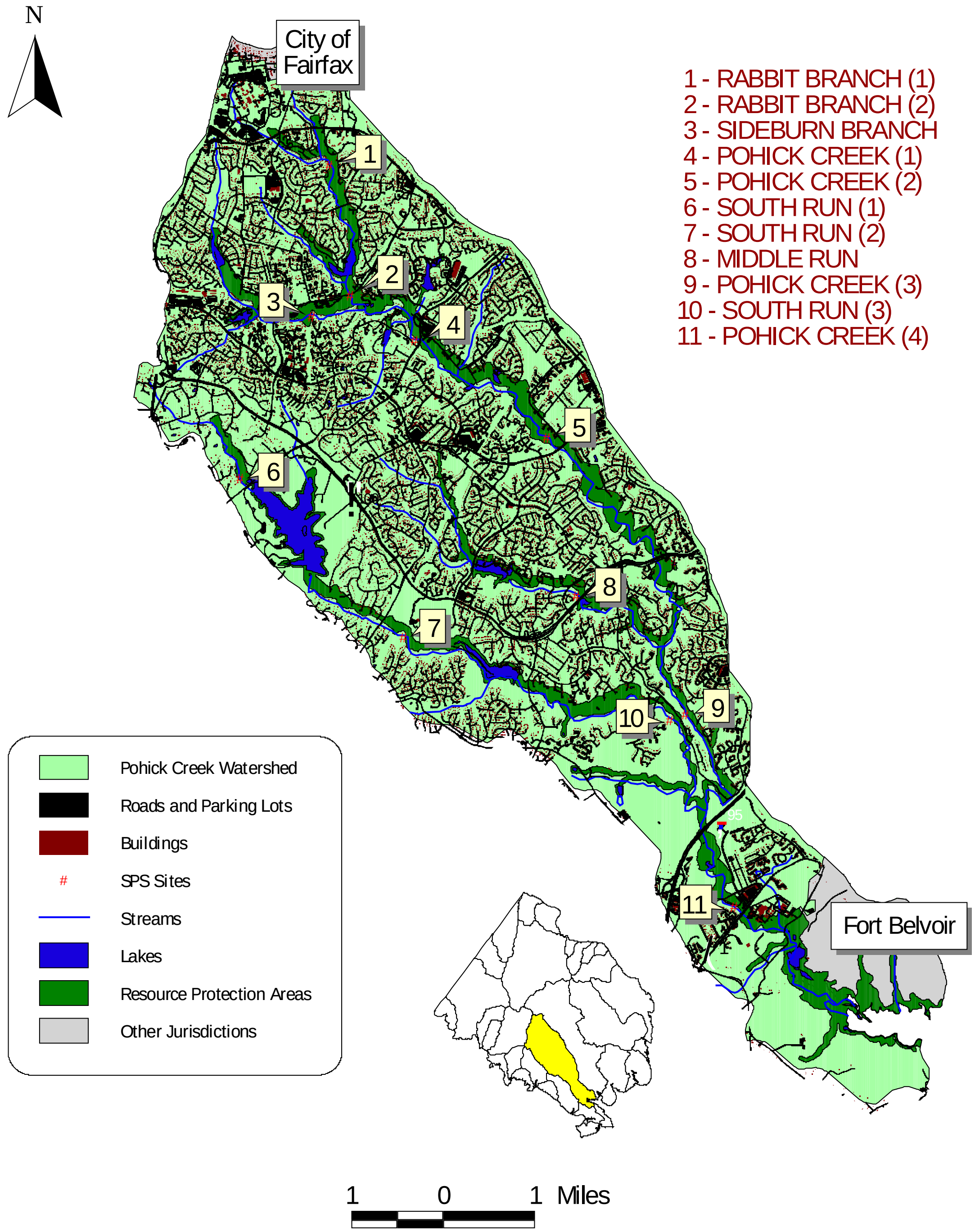


Common Carp
Cyprinus carpio
Size: to 28 inches or more, up to 60 pounds
Habitat: virtually any medium or large-sized, slow-moving freshwater habitat
Feeding Group: omnivore
Tolerance: tolerant
The common carp is an introduced species from Europe and Asia, where it has been cultivated for centuries. It is adaptable and hardy. They often feed by rooting in the mud for clams, worms, plants and whatever else they can find. It is a member of the minnow family.

CHAPTER 3

POHICK CREEK WATERSHED SUMMARY

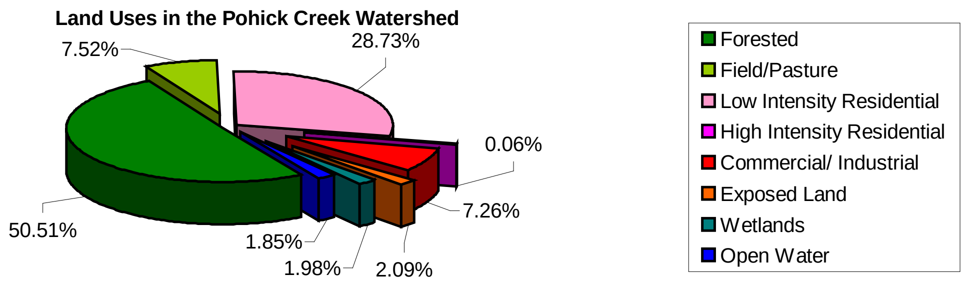
Land Cover


N
City of Fairfax
1 - RABBIT BRANCH (1)
2 - RABBIT BRANCH (2)
3 - SIDEBURN BRANCH
4 - POHICK CREEK (1)
5 - POHICK CREEK (2)
6 - SOUTH RUN (1)
7 - SOUTH RUN (2)
8 - MIDDLE RUN
9 - POHICK CREEK (3)
10 - SOUTH RUN (3)
11 - POHICK CREEK (4)
1
2
3
4
5
6
7
8
9
10
11
Fort Belvoir
Pohick Creek Watershed
Roads and Parking Lots
Buildings
SPS Sites
Streams
Lakes
Resource Protection Areas
Other Jurisdictions
1 0 1 Miles

CHAPTER 3

Watershed Description

The Pohick Creek watershed, with a drainage area of approximately 34 square miles, comprises eight percent of Fairfax County. Approximately 3.2 square miles of this area are outside of County jurisdiction, lying within Fairfax City or Fort Belvoir. Although the watershed is still predominantly forested, levels of impervious cover are generally very high throughout. There are several impoundments within the watershed including the County's largest, Burke Lake (213 acres), a community-owned park area and regional detention facility. Other impoundments include Barton, Braddock, Mercer, Royal, Huntsman and Woodglen Lakes, all of which were constructed in the late 1970's as part of a pilot, watershed-wide water quality management program known as Public Law 566 (PL566). There are also eight smaller regional stormwater facilities in the watershed.



The headwaters of the system consist of two main tributaries. The first of these, Sideburn Branch, had the highest imperviousness value in the entire watershed at 28.3%. The other tributary, Rabbit Branch, begins in the highly developed areas near George Mason University and Fairfax City. The two systems come together to form the Pohick Creek proper.

Some sections of South Run have exceptionally high quality habitat.

The mainstem travels for several miles through residential communities, collecting input from minor tributaries until it passes under the Fairfax County Parkway (Rte. 7100). Two large tributaries then add to its volume. Middle Run drains Huntsman Lake and a moderately developed residential area; South Run, the largest tributary system in the watershed, drains Burke Lake and Lake Mercer, as well as most of the low-density southwestern side of the watershed. Further downstream, below the Rte. 1 crossing, the Lower Potomac Pollution Control Plant discharges its effluent into the mainstem as it flows toward the Fort Belvoir Military Reservation. Toward its mouth, Pohick Creek is tidally influenced and gradually turns into a freshwater wetland before emptying into Pohick Bay.

DATA SUMMARY

Stream Name and Site Code	Composite Site Condition Rating	Environmental Variables: Index of Biotic Integrity	Habitat Score	Fish Taxa Richness	Current Percent Impervious Surfaces	Projected Percent Impervious Surfaces
1 Rabbit Branch 1 (PCRA01)	Fair	Fair	Fair	Low	24.4	31
Rabbit Branch 2 (PCRA02)	Fair	Fair	Poor	High	24.2	28
Sideburn Branch (PCSI01)	Very Poor	Very Poor	Poor	High	28.3	40
Pohick Creek 1 (PCPC01)	Fair	Fair	Fair	High	25.8	36
5 Pohick Creek 2 (PCPC02)	Poor	Poor	Fair	Low	25.5	36
South Run 1 (PCSR03)	Good	Fair	Good	Low	10.5	16
7 South Run 2 (PCSR02)	Fair	Poor	Poor	Moderate	9.0	18
Middle Run (PCMI01)	Good	Fair	Good	Moderate	25.5	30
Pohick Creek 3 (PCPC03)	Poor	Poor	Poor	Moderate	24.9	34
South Run 3 (PCSR01)	Excellent	Fair	Excellent	Moderate	12.1	33
Pohick Creek 4 (PCPC04)	Good	Poor	Good	High	20.3	35

Pohick Creek Fish Species List

Common Name	Number of Sites Where Species Occurred (11 Total Sites)	Common Name	Number of Sites Where Species Occurred (11 Total Sites)
Tessellated Darter	11	River Chub	5
Blacknose Dace	11	Margined Madtom	5
White Sucker	10	Creek Chubsucker	4
Swallowtail Shiner	10	Northern Hogsucker	3
Creek Chub	10	Largemouth Bass	3
Satinfin Shiner	8	Brown Bullhead	3
Cutlips Minnow	8	Banded Killifish	2
Common Shiner	8	Pumpkinseed	2
American Eel	8	Rosyside Dace	2
Yellow Bullhead	7	Eastern Mosquitofish	1
Longnose Dace	7	Golden Shiner	1
Redbreast Sunfish	6	Spottail Shiner	1
Green Sunfish	5	Bluntnose Minnow	1
Bluegill	5	Fantail Darter	1

CHAPTER 3

Watershed Condition Summary

Although heavily developed throughout most of its length, the Pohick Creek watershed holds stream systems ranging in quality from some of the worst to some of the best seen in the County.

With few exceptions, fish richness was relatively high throughout the drainage. Only three out of the 11 monitoring sites ranked below the Moderate level. At two separate sites on the Pohick Creek mainstem, a total of 20 or more distinct taxa were identified (a total of 28 were found throughout the entire watershed). Of special note are the two tributary sites in this watershed with the lowest fish taxa counts. Each of these, one on the upper sections of South Run and one on upper Rabbit Branch, was upstream of major impoundments which had the potential to influence the measure by acting as barriers to fish movement.

Measures of benthic macroinvertebrate community integrity were consistently low throughout the watershed, with no sites ranking above the Fair category. Assemblages at each monitoring site were generally dominated by midges and aquatic worms, organisms that are highly tolerant of disturbance. Representatives of the two respective groups accounted for 90% of all the individuals identified in the watershed.

Ratings of habitat integrity ranged widely throughout the drainage. Many of the tributaries and a major portion of the mainstem are experiencing moderate to severe erosion. Active channel widening and significant sediment deposition were common. Several sites on South Run exhibited good habitat condition, a situation that may have been influenced by the two major impoundments on the system. This is especially true of the lowermost site, immediately below Lake Mercer, which received the highest habitat score seen inside Fairfax County and showed signs of near full recovery. The lowermost reaches on Pohick Creek itself were found to be generally more stable.

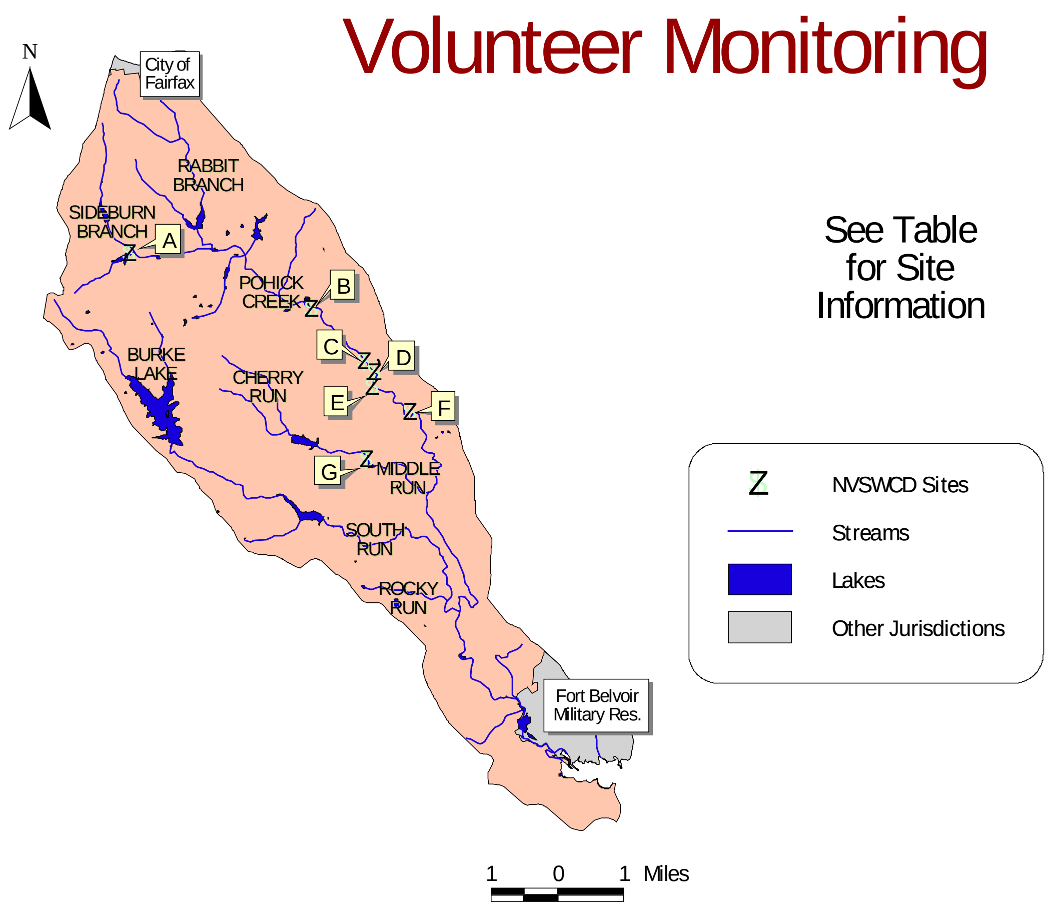
With the exception of the South Run subwatershed (9 to 12% impervious cover), all drainages exhibited levels of imperviousness in excess of 20%. While the sites with lower levels of development intensity were generally the highest in overall composite rating, not all sites fit this trend; several heavily developed areas scored well while other drainages received only modest ratings despite low land use. Middle Run was particularly anomalous in that it scored exceptionally well overall, yet it drained a region with more that 25% impervious cover.

The overall ratings suggest that while the watershed has been degraded throughout most of its length, it maintains relatively healthy aquatic communities in some localized areas, most especially portions of South and Middle Runs. In some other areas, factors independent of land use may be influencing stream quality. This includes the impact of in-line impoundments, which hold the potential to influence both biological and physical characteristics in both the upstream and downstream environments.

CHAPTER 3

Volunteer Data Summary

There are currently seven active volunteer monitoring stations in the Pohick Creek watershed, all of which are coordinated by the Northern Virginia Soil & Water Conservation District (NVSWCD). One is located immediately downstream of Lake Barton on the tributary of Sideburn Branch that drains the lake and another is on Sangster Branch, near the Fairfax County Parkway. The remaining five are clustered on the mainstem within approximately 2 ½ miles of each other. Given the scale of the watershed, expansion of the volunteer effort would be beneficial.



Data from the volunteer monitoring generally supports that of the SPS study, with five mainstem volunteer sites highlighting benthic communities that were generally of low integrity. With one exception, all of the volunteer sampling events have resulted in "Fair" or "Poor" ratings. Results from the site downstream of Lake Barton suggest a lesser degree of impairment, possibly due to the stabilizing influence of the impoundment itself. Further assessments are warranted in this area.

Letter Code	Site Code	# times sampled	Last sampled	WQR (SOS only)	Trends noted
A	POH1	11	#####	Fair	Varies from Poor - Good
B	POH5	8	#####	Poor	Usually Poor
C	POH8	2	#####	Poor	Varies from Poor - Fair
D	POH7	1	#####	Excellent	Too few samples
E	POH6	5	#####	Poor	Varies from Poor - Fair
F	POH3	14	#####	Fair	Varies from Poor - Fair
G	POH4	11	#####	Fair	Varies from Poor - Fair

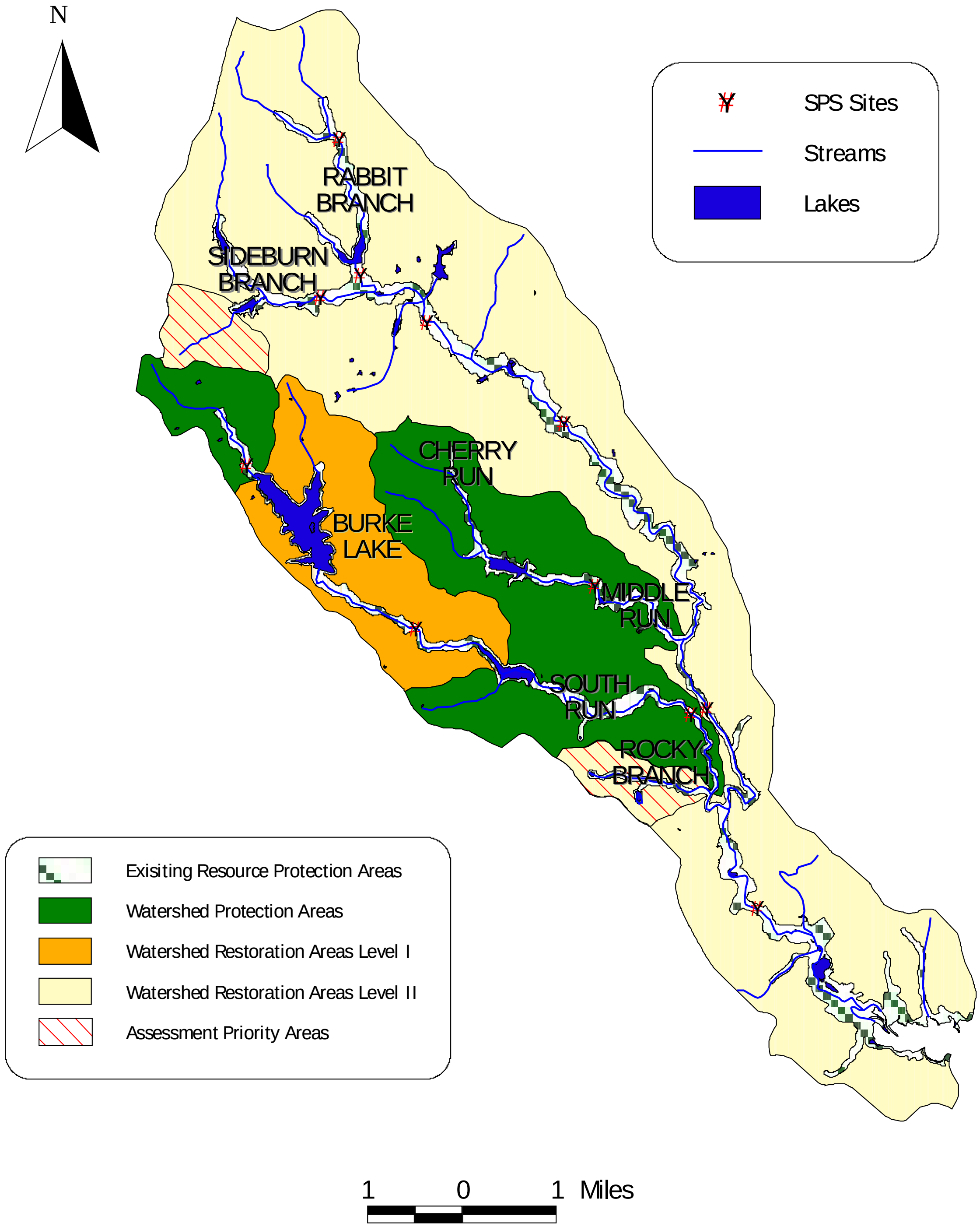
Satinfin Shiner
Cyprinella analostana
Size: to 3 inches
Habitat: runs and pools in warm streams
Feeding Group: insectivore, some algae eaten
Tolerance: intolerant
The male satinfin shiner develops an iridescent, greenish-purple colors and hard, white tubercles during the breeding season. Members of this species are also known to be very vocal, using their gas bladders to produce sounds.

Common Shiner
Luxilus cornutus
Size: to 5 inches
Habitat: clear streams of moderate gradient, often in pools
Feeding Group: insectivore
Tolerance: moderate
This widespread minnow can be recognized by its tall, crescent-shaped scales. It is primarily a pool dweller but is occasionally found in fast water. Few live beyond 5 years.

Northern Hogsucker
Hypentilium nigricans
Size: to 15 inches
Habitat: riffles and runs of cool, clear rocky streams
Feeding Group: invertivore
Tolerance: intolerant
The hogsucker is adapted to rapidly flowing waters. It has characteristic, saddle-shaped marks on its back and a concavity on the top of its head, which distinguishes it from other suckers. It feeds by actively disturbing the substrate with its snout and lips.

CHAPTER 3

Management



CHAPTER 3

Management Category Description

The Pohick watershed represents a range of biological and habitat conditions from high to low levels of degradation. The higher quality ratings at the lowermost site along Pohick Creek mainstem elevate the priority of the watershed as a whole. To preserve the quality of this site, each of the tributaries should be examined closely for restoration potential. The former D.C Department of Corrections facility in Lorton is currently being developed, and any future activities in the area should be monitored closely to assess their potential influence on stream quality.

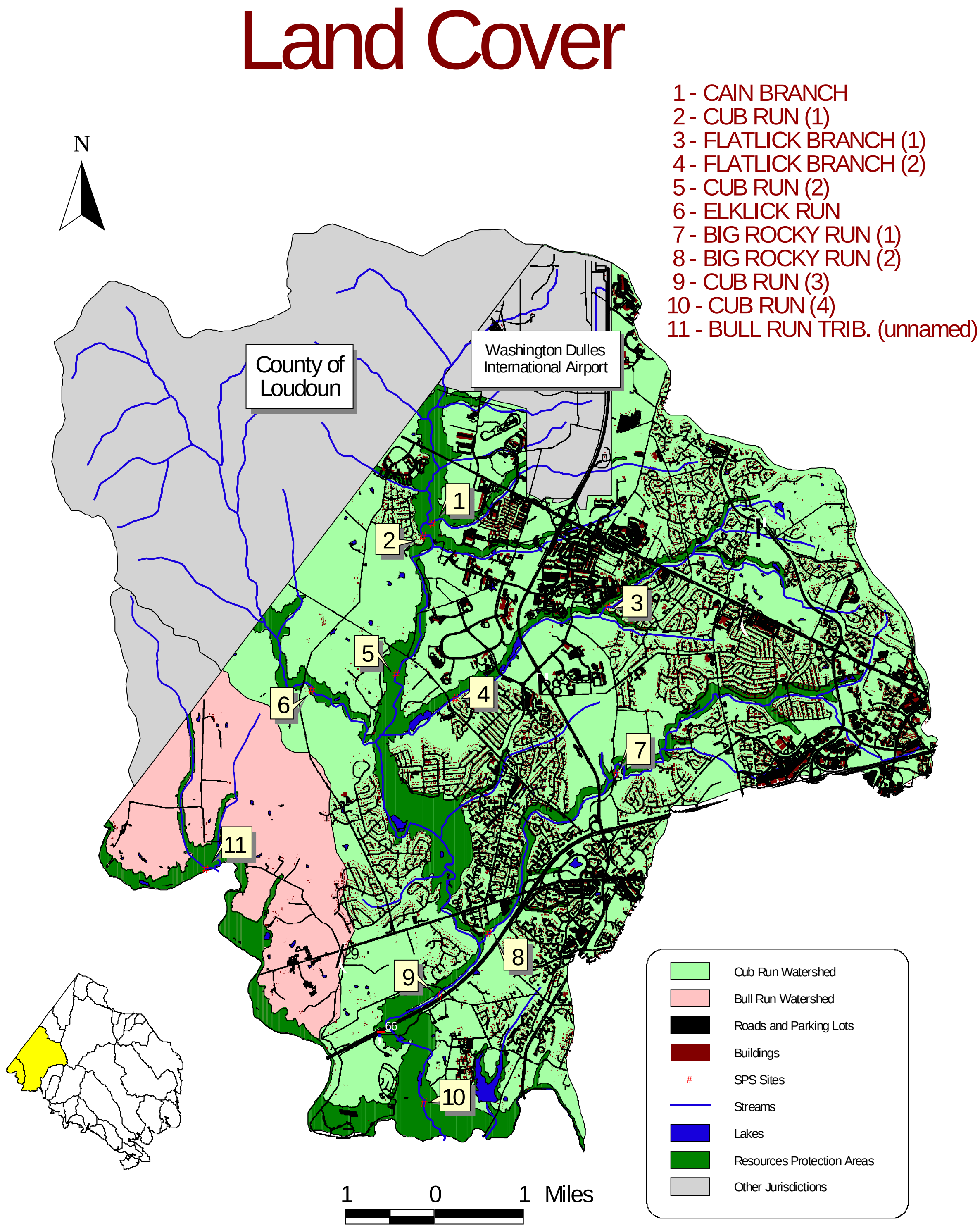
Middle Run and South Run represent the highest scoring areas in the watershed and are classified as Watershed Protection or Watershed Restoration Level I Areas. Every effort should be made to protect the high habitat quality in these tributaries, and further research is needed to determine causes of benthic impairment, especially in the stream reaches between the two major impoundments.

Efforts in the remainder of the watershed, all of which is currently classified as Watershed Restoration Level II Areas, should focus on mitigating erosion problems that are generating the excessive sediment deposition that is so widespread within the drainage. Inter-jurisdictional cooperation between the County, Fairfax City and Fort Belvoir will be needed.

Dobsonflies and Fishflies
Family *Corydalidae*
Habitat Classification: clingers
Feeding Group: predators
Tolerance: intolerant to moderate
The dobsonfly (Hellgrammite) has a very low tolerance to disturbance. They require very clean, high-oxygenated water to live. The Corydalids have been nicknamed “toe-biters” for their large jaws.

CHAPTER 3

CUB RUN AND BULL RUN WATERSHED SUMMARY


Land Cover
1 - CAIN BRANCH
2 - CUB RUN (1)
3 - FLATLICK BRANCH (1)
4 - FLATLICK BRANCH (2)
5 - CUB RUN (2)
6 - ELKLICK RUN
7 - BIG ROCKY RUN (1)
8 - BIG ROCKY RUN (2)
9 - CUB RUN (3)
10 - CUB RUN (4)
11 - BULL RUN TRIB. (unnamed)
N
County of Loudoun
Washington Dulles International Airport
Cub Run Watershed
Bull Run Watershed
Roads and Parking Lots
Buildings
SPS Sites
Streams
Lakes
Resources Protection Areas
Other Jurisdictions
1 0 1 Miles

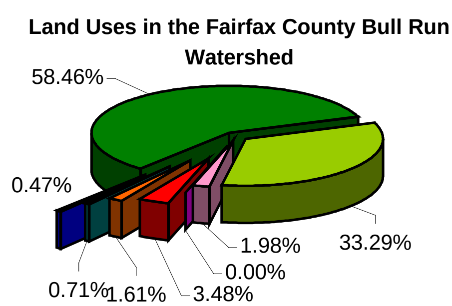
CHAPTER 3

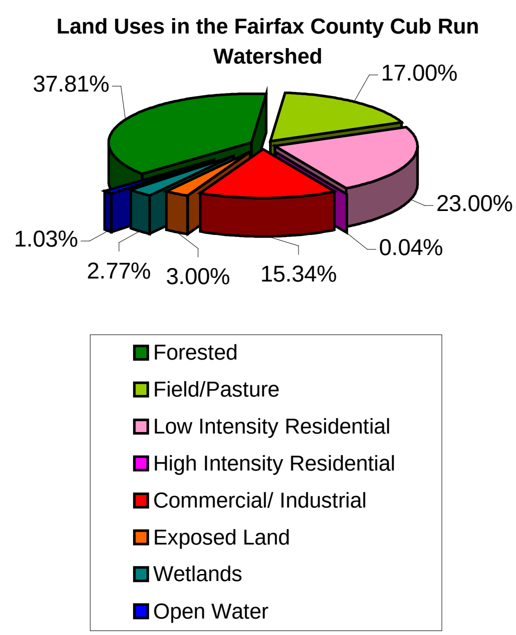
Watershed Description

The Bull Run watershed in Fairfax County is comprised of many small, independent tributaries draining directly into the Bull Run River system, the major source of the Occoquan Reservoir. Only a small portion of its total area is located within Fairfax County, with the remainder contained within the jurisdictions of Loudoun and Prince William Counties. The Fairfax portion of the watershed is mostly undeveloped with levels of imperviousness less than one percent, the lowest in the County.

Sections of streams in the Bull Run watershed have extensive riparian buffer zones.

The Cub Run watershed has an area of roughly 55 square miles, with approximately 17 square miles of this area lying outside of Fairfax in Loudoun County and Washington-Dulles International Airport. Like Bull Run, the watershed is located entirely in the Triassic Basin physiographic province. Eleven regional ponds are found within the drainage.





A variety of land uses are seen within Cub Run, ranging from highly developed urban centers to forest and pastureland. Cub Run has experienced recent growth in housing and commercial areas, mostly in the Centreville area, as suburban development continues to expand westward from Washington, D.C. The western side of the watershed consists of low-density residential communities mixed in with agriculture and forested land.

The Cub Run mainstem and its first tributary, Dead Run, begin as a wetland complex on the lightly developed property surrounding Washington-Dulles International Airport. After crossing the Dulles property line into Fairfax County, Cub Run flows for a short distance before increasing its discharge with the addition of Cain Branch, a system that drains part of Dulles and the residential/commercial area of Chantilly. Cub Run continues south to meet two very different tributaries. Flowing from the east, Flatlick Branch runs through much of the suburban region in and around Chantilly, areas with imperviousness of over 20%. The Elklick Run drainage lies to the west, the 6.5 miles of its mainstem length traveling through lightly developed pasture/agricultural land in Loudoun County, an area with levels of imperviousness averaging under 5%.

Areas of good habitat were common throughout Big Rocky Run in the Cub Run watershed.

Cub Run receives a final input from Big Rocky Run, a system which begins just west of Fair Oaks Mall and flows southwest through the heavily developed suburban areas of Fair Lakes and Centreville. After this confluence, the mainstem runs parallel to, and then crosses under, I-66. For the remainder of its course, Cub Run meanders south through the forested area of Bull Run Regional Park before joining the Bull Run River system on its way to the Occoquan Reservoir.

Largemouth Bass
Micropterus salmoides
Size: to 15 inches or more
Habitat: clear, warm water in ponds, lakes and pools medium/large streams and rivers.
Feeding Group: predator
Tolerance: moderate
This native North American fish has been introduced around the world due to its popularity as a game fish. During spawning, which usually occurs in late spring and early summer, males make and guard large nests. It is not uncommon for largemouth to live past 10 years.

Smallmouth Bass
Micropterus dolomieu
Size: to 20 inches
Habitat: medium/large rivers, gravelly and rocky substrates preferred
Feeding Group: predator
Tolerance: moderate
The Smallmouth Bass is one of the more popular freshwater sport fishes across its range. After spawning in early May, the males will vigorously defend the nests until after the eggs hatch. Larger juveniles and adults primarily feed on crayfishes and fishes but also insects.

Cutlips Minnow
Exoglossum maxillingua
Size: to 6 inches
Habitat: medium/large streams, gravelly and rocky bottoms preferred
Feeding Group: insectivore
Tolerance: intolerant
This minnow is named after the structure of its lower jaw, which is tri-lobed. The center portion is narrow and bony, and is thought that this adaptation might be used for scraping snails and insect larvae from the stream bottom and then crushing them against its upper jaw.

DATA SUMMARY

Stream Name and Site Code	Composite Site Condition Rating	Environmental Variables: Index of Biotic Integrity	Habitat Score	Fish Taxa Richness	Current Percent Impervious Surfaces	Projected Percent Impervious Surfaces
1 Cain Branch (CUCB01)	Fair	Fair	Poor	Moderate	16.8	51
2 Cub Run (CUCU02)	Good	Good	Fair	Low	8.4	43
3 Flatlick Branch 1 (CUFB01)	Poor	Poor	Poor	High	21.2	39
4 Flatlick Branch 2 (CUFB02)	Poor	Fair	Fair	Low	22.6	49
5 Cub Run 2 (CUCU03)	Good	Poor	Good	Moderate	10.4	46
6 Elklick Run (CUER02)	Fair	Fair	Fair	Very Low	2.2	5
7 Big Rocky Run 1 (CUBR01)	Good	Fair	Excellent	High	27.4	47
8 Big Rocky Run 2 (CUBR02)	Fair	Fair	Fair	Moderate	27.7	44
9 Cub Run 3 (CUCU04)	Poor	Fair	Very Poor	Moderate	12.2	32
Cub Run 4 (CUCU05)	Good	Fair	Fair	Moderate	12.0	31
Bull Run Tribitary (BLBT01)	Excellent	Excellent	Fair	High	0.8	5

Cub Run and Bull Run Fish Species List

Common Name	Number of Sites Where Species Occurred (11 Total Sites)	Common Name	Number of Sites Where Species Occurred (11 Total Sites)
Green Sunfish	11	Fallfish	5
Fantail Darter	10	Creek Chubsucker	4
Redbreast Sunfish	10	Cutlips Minnow	4
Bluegill	10	Common Shiner	4
Swallowtail Shiner	9	Smallmouth Bass	4
Bluntnose Minnow	9	Northern Hogsucker	3
Largemouth Bass	8	Comely Shiner	3
Longnose Dace	8	Blacknose Dace	3
Yellow Bullhead	6	River Chub	2
White Sucker	6	Golden Shiner	2
Tessellated Darter	6	Shield Darter	2
Eastern Mosquitofish	6	Rosyside Dace	1
Satinfin Shiner	6	Gizzard Shad	1
Pumpkinseed	5	Eastern Silvery Minnow	1
Spottail Shiner	5	Margined Madtom	1
Creek Chub	5		

CHAPTER 3

Watershed Condition Summary

In combination, the Cub Run and Bull Run watersheds exhibit a wide range of stream quality conditions, a reflection of the large variations in the intensity of land development seen across their respective drainages.

The fish richness in the two watersheds was relatively high compared to other watersheds in the County. Over 30 fish taxa were found throughout the two basins, with samples for the two lowermost sites on the Cub Run mainstem each yielding 22 distinct taxa. The most notable exception to this pattern was Elklick Run, a system with part of its drainage in Loudoun County, which scored in the very lowest category.

Within the Cub Run basin, many of the benthic macroinvertebrate samples collected were ranked as Fair, indicating a certain level of stream degradation systemwide. Conversely, the Bull Run monitoring site was ranked in the highest category, with almost 30% of the community being comprised of intolerant taxa.

Throughout both drainages, RBP values demonstrated an overall trend toward Fair habitat quality, with many sites showing the impact of substantial sediment deposition and the associated substrate embeddedness. An exception of note was Big Rocky Run in Cub Run, which received the highest ranking for overall quality of instream and riparian zone habitat. This high rating may be due to the fact that Big Rocky Run is protected within the Elanor C. Lawrence Park.

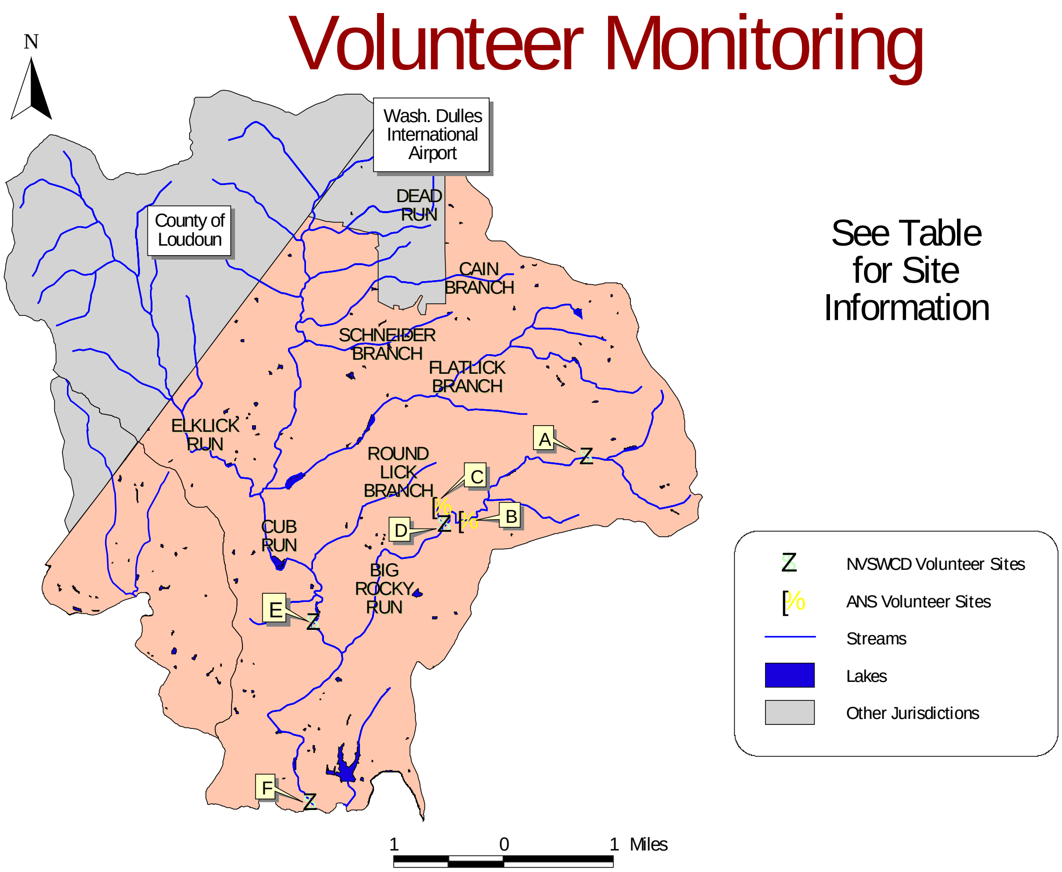
An extremely wide range of imperviousness values (2.2 to 27.7%) exists across the individual subwatersheds of the Cub Run drainage, reflecting both its recent past as farmland and the increasing level of development occurring in its eastern regions. In stark contrast, the Bull Run watershed is almost entirely undeveloped and still exhibits imperviousness values less than one percent. In both cases, the overall site rankings correspond to land use and their biological and habitat components generally decrease along a gradient of increasing development.

Given that the Bull Run basin is uniformly undeveloped in the County, these results serve to further highlight the area's value as a unique resource within Fairfax County. Although some subwatersheds within the Cub Run drainage have been significantly degraded, it also possesses many systems of high quality, including some within areas with high levels of imperviousness that may be just now approaching the threshold for impairment of biological integrity.

CHAPTER 3

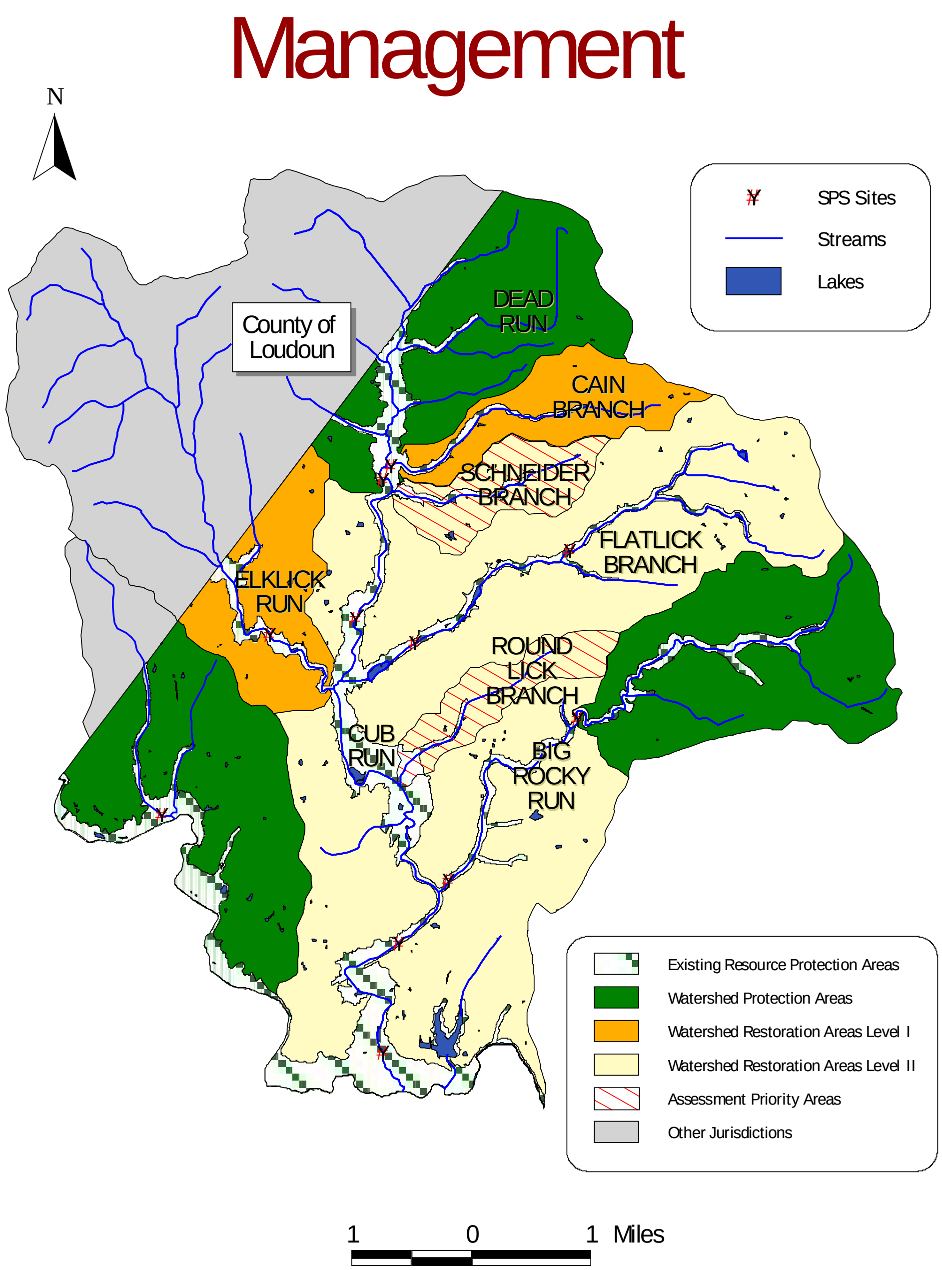
Volunteer Data Summary

There are currently six active volunteer monitoring stations in the Cub Run Watershed. The Northern Virginia Soil and Water Conservation District (NVSWCD) coordinates four, while the remaining two are operated by the Audubon Naturalist Society (ANS). The NVSWCD sites are recent additions to its countywide program.



Both volunteer efforts indicated the presence of relatively diverse communities within many sections of the mainstem, but they differed somewhat in their assessment of the Big Rocky Run tributary. Both NVSWCD sites on Big Rocky Run showed a high quality benthic community, but each has been sampled only once. The ANS site on Big Rocky Run has consistently shown dominance by tolerant taxa. This variation may be caused by local factors or be time-dependent. Continued sampling should resolve the issue.

Letter Code	Site Code	# times sampled	Last sampled	WQR (SOS only)	Trends noted
A	CR4	1	####	Excellent	Too few samples
B	010	3	####	N/A	Dominated by tolerant forms
C	009	3	####	N/A	Many sensitive taxa present, very diverse
D	CR5	1	####	Good	Too few samples
E	CR1	3	####	Good	All have been good
F	CR6	1	####	Good	Too few samples



Management Category Description

Cub Run and Bull Run watersheds represent a gradient of land use types and associated stream quality, which necessitates a range of management alternatives. Headwaters of Cub Run and Bull Run fall into the Watershed Protection category because of their high biological quality; however, both scored low in the habitat assessment, so a closer look at instream habitat restoration is warranted in these areas.

The upper portion of Big Rocky Run is also classified as Watershed Protection, but further research should focus on identifying the factors limiting the biological community.

Both Elklick Run and Cain Branch were classified in the higher priority Watershed Restoration Level I category. Elklick Run has some degree of biological impairment despite low levels of development, and the area warrants further study. Cain Branch received the same priority classification because it flows into the headwaters of Cub Run, a designated Protection Area. The level of imperviousness in the Cain Branch subwatershed is currently slightly above the generally accepted threshold of biological impairment, but this gives us an opportunity to take active measures now before degradation continues.

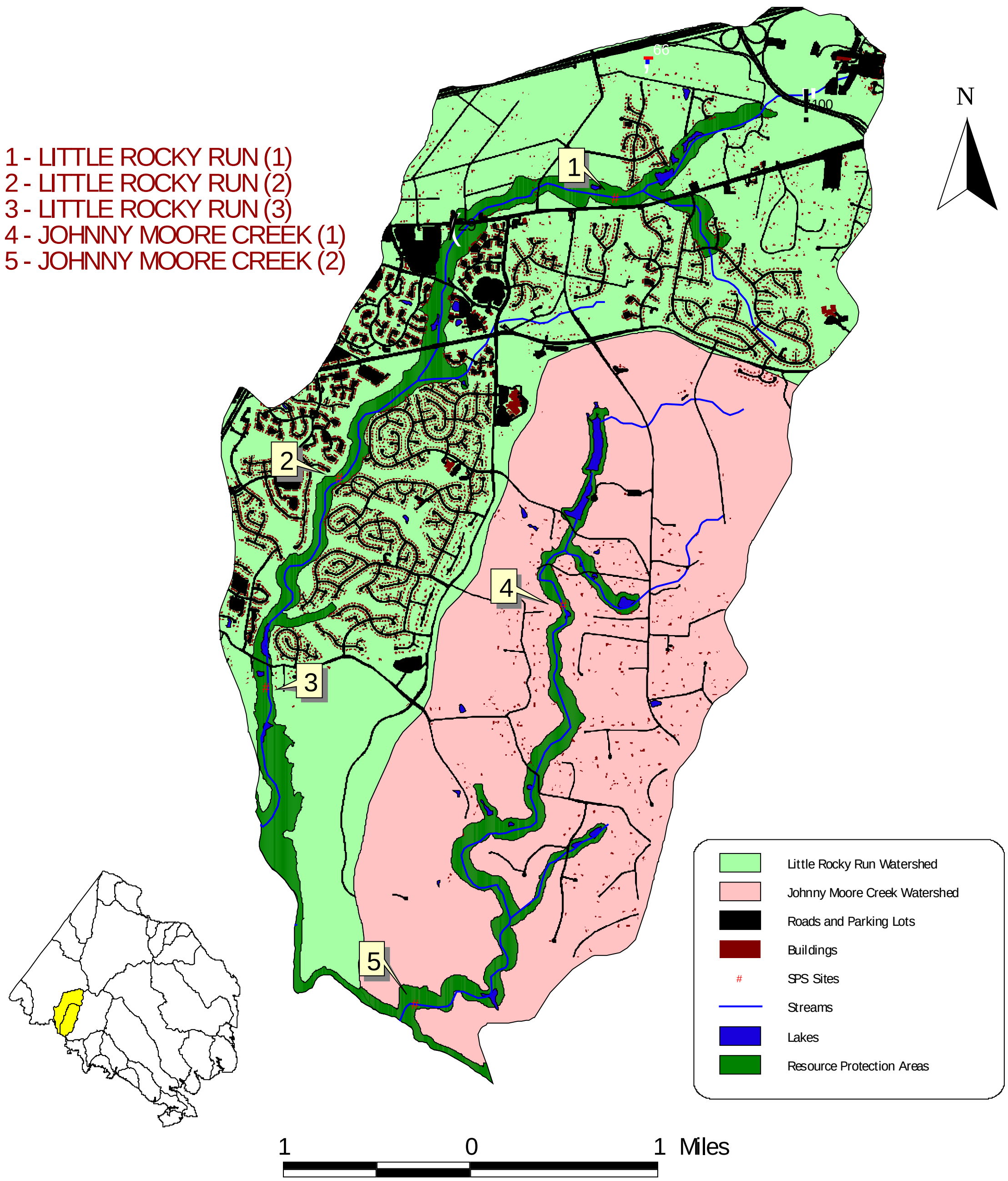
The remainder of the watershed, including the mainstem, are classified as Watershed Restoration Level II Areas. Some of the lower reaches of the mainstem received a Good ranking, raising the priority of the watershed relative to other drainages in the County. Two smaller tributaries, Schnieder Branch and Round Lick Branch, are highlighted as areas for further study due to lack of information about current conditions in these subwatersheds.

Common Stonefly
Family *Perlidae*
Habitat Classification: clingers
Feeding Group: predators
Tolerance: intolerant
Stoneflies require cool, well oxygenated water to survive, which leads them to be very susceptible to human disturbance. Their bodies are flattened to limit exposure to current flow.

CHAPTER 3

LITTLE ROCKY RUN AND JOHNNY MOORE CREEK WATERSHED SUMMARY

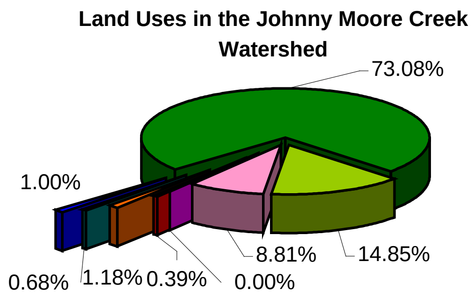
Land Cover

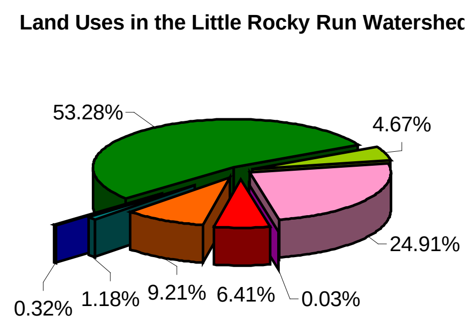

1 - LITTLE ROCKY RUN (1)
2 - LITTLE ROCKY RUN (2)
3 - LITTLE ROCKY RUN (3)
4 - JOHNNY MOORE CREEK (1)
5 - JOHNNY MOORE CREEK (2)
N
1
2
3
4
5
Little Rocky Run Watershed
Johnny Moore Creek Watershed
Roads and Parking Lots
Buildings
SPS Sites
Streams
Lakes
Resource Protection Areas
1
0
1
Miles

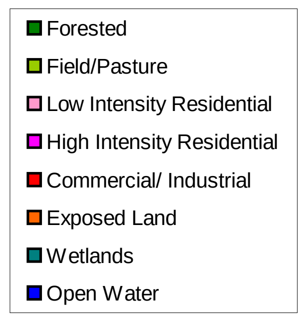
CHAPTER 3

Watershed Description

The two small watersheds that make up this group, Little Rocky Run and Johnny Moore Creek, lie predominately within the Triassic Basin and Piedmont Upland physiographic provinces, respectively. They are bordered on the west by Cub Run and to the east by the Pope's Head Creek drainage. The two systems are very different in terms of level of development. Their combined area contains six regional ponds.







The headwaters of Little Rocky Run begin near the interchange of I-66 and the Fairfax County Parkway (Rte. 7100). These small systems flow through low- to moderate-density residential communities. Once fully formed the mainstem heads south, crossing under Rte. 29, and continuing for nearly three miles through higher density residential areas of southeastern Centreville. After flowing under Compton Road, Little Rocky Run meanders almost a mile through a largely undeveloped area before emptying into the Bull Run River.

Sections of streams in Little Rocky had very stable banks indicative of high quality habitat.

The Johnny Moore watershed is relatively undeveloped with levels of imperviousness below five percent. The system begins at Twin Lakes Golf Course near the intersection of Braddock and Clifton Roads. It runs generally southward through low-density residential areas before flowing into Bull Run.

CHAPTER 3

DATA SUMMARY

	Composite	Environmental Variables				
Stream Name and Site Code	Site Condition Rating	Index of Biotic Integrity	Habitat Score	Fish Taxa Richness	Current Percent Impervious Surfaces	Projected Percent Impervious Surfaces
1 Little Rocky Run 1 (LRLR01)	Fair	Poor	Good	High	14.6	27
2 Little Rocky Run 2 (LRLR02)	Good	Fair	Good	High	17.7	32
3 Little Rocky Run 3 (LRLR03)	Fair	Poor	Good	Moderate	19.1	33
4 Johnny Moore Creek 1 (JMJM01)	Excellent	Good	Good	High	2.6	6
5 Johnny Moore Creek 2 (JMJM02)	Excellent	Poor	Good	High	2.4	5

Little Rocky Run and Johnny Moore Creek Fish Species List

Common Name	Number of Sites Where Species Occurred (5 Total Sites)	Common Name	Number of Sites Where Species Occurred (5 Total Sites)
Fantail Darter	5	Eastern Mosquitofish	2
Tessellated Darter	5	Northern Hogsucker	2
Green Sunfish	5	Redbreast Sunfish	2
Longnose Dace	5	White Sucker	2
Creek Chub	5	Largemouth Bass	2
Cutlips Minnow	4	Yellow Bullhead	1
Bluegill	4	Satinfin Shiner	1
Swallowtail Shiner	4	Eastern Silvery Minnow	1
Bluntnose Minnow	4	Pumpkinseed	1
Blacknose Dace	4	Warmouth	1
Smallmouth Bass	3	Common Shiner	1
Fallfish	3	River Chub	1
Rosyside dace	3	Golden Shiner	1
Creek Chubsucker	2	Spottail Shiner	1

CHAPTER 3

Watershed Condition Summary

Although the watersheds of Little Rocky Run and Johnny Moore Creek differ from one another in terms of intensity of land use and some aspects of overall biological integrity, their combined area still contains some of the higher quality stream systems found within the Piedmont Upland Region.

Fish taxa richness in the two watersheds was equal, with 21 individual species found in each. Sites in both systems were consistently rated in the upper categories, the region as a whole supporting some of the richest fish communities in the entire County.

With the exception of one site within the Johnny Moore basin, measures of benthic macroinvertebrate community integrity indicated a certain level of impairment across both watersheds, with sites ranging from Fair to Poor. Most communities were dominated by aquatic worms and/or midges, organisms generally considered tolerant of degraded conditions.

Although sediment deposition and bank stability ratings limited overall habitat rankings across the region, instream and riparian zone conditions were generally good throughout both watersheds. Some sample reaches within Little Rocky Run did show evidence of instability, most commonly in the form of active channel widening. Such conditions were less common in Johnny Moore, with areas of degradation often exhibiting early signs of recovery.

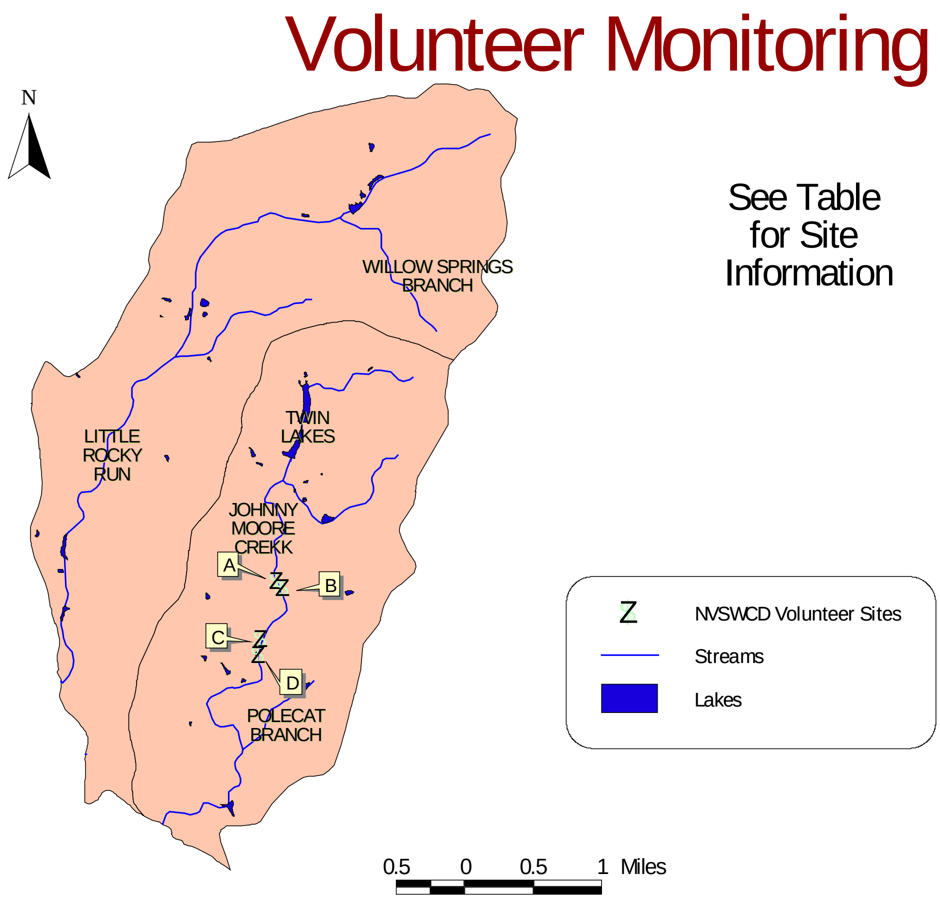
Levels of impervious cover differ dramatically between the two watersheds, with Johnny Moore exhibiting some of the lowest levels seen in the County (< three percent) and several areas of Little Rocky approaching 20%. These differences in land use reinforce the moderate trend in biological and habitat integrity seen across the region.

Despite considerable differences in development intensity, both drainages contain relatively intact aquatic systems. The largely undisturbed nature of the Johnny Moore watershed places it among the most valued and unique resources within Fairfax County. Holding elements of equal significance, Little Rocky Run is currently a semi-degraded system potentially approaching a threshold of biological integrity.

CHAPTER 3

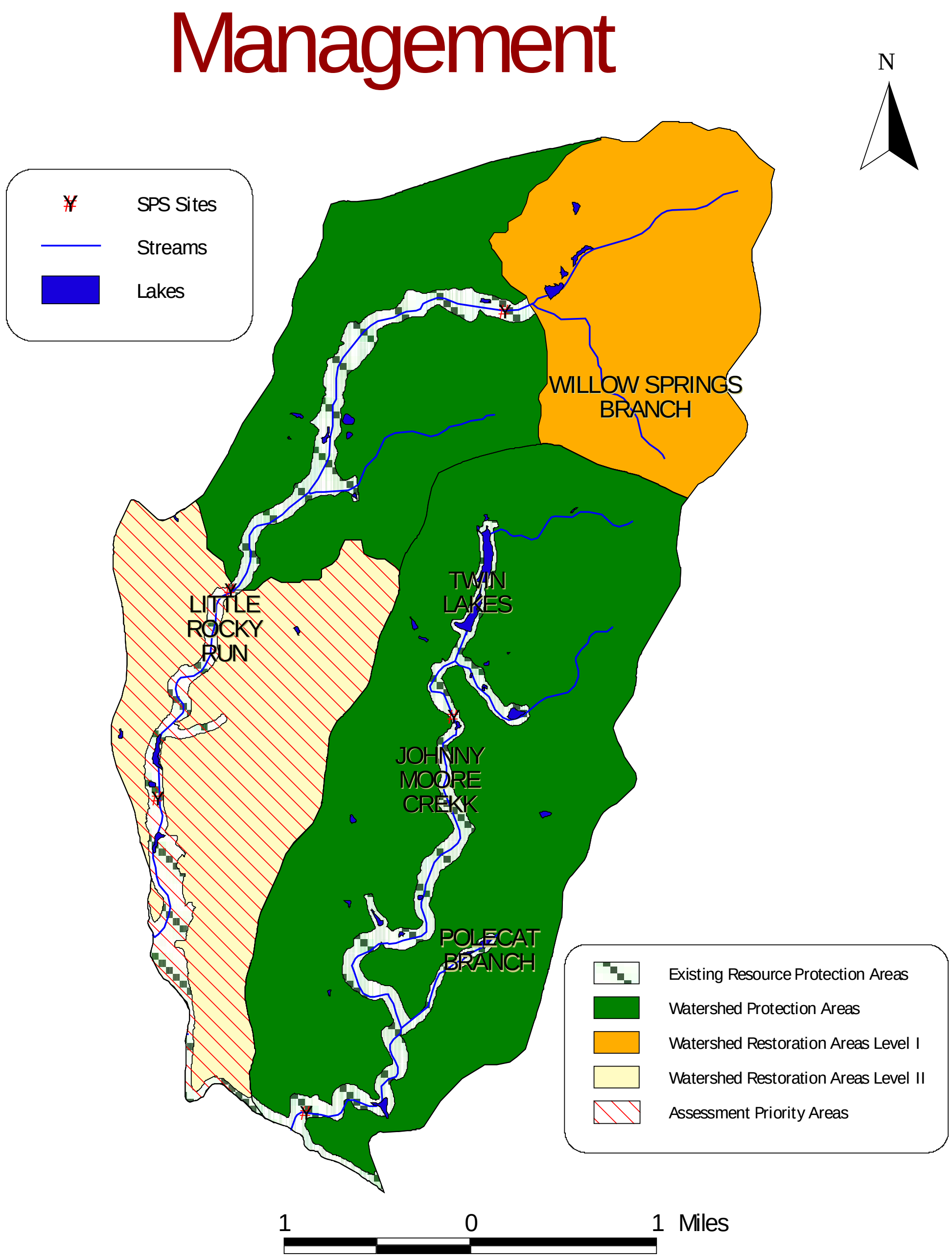
Volunteer Data Summary

The Northern Virginia Soil and Water Conservation District (NVSWCD) coordinates four volunteer monitoring sites in the Johnny Moore Creek Watershed. While monitoring in the watershed has been ongoing for several years, two of these sites are relatively recent additions. There are currently no volunteer efforts underway in the Little Rocky Run watershed, but given the dramatic change in the condition of the system's mainstem highlighted by SPS sampling, additional volunteer monitoring sites in this area would be an especially useful complement to the existing program.



All of the data collected is well correlated with the SPS findings of a largely healthy benthic community within the Johnny Moore Creek mainstem.

Letter Code	Site Code	# times sampled	Last sampled	WQR (SOS only)	Trends noted
A	JMC3	1	#####	Good	Too few samples
B	JMC1	11	#####	Excellent	Generally Good - Excellent
C	JMC2	8	#####	Good	Generally Good - Excellent
D	JMC4	1	#####	Good	Too few samples



Management Category Description

Many sections of both watersheds are under the zoning ordinance of the Water Supply Protection Overlay District (WSPOD) to protect the quality of water draining directly into the Occoquan reservoir. The Centerville area is exempt from this ordinance, a fact that explains the abrupt differences in land use and imperviousness between the two watersheds.

All of Johnny Moore and the middle portion of Little Rocky are classified as Watershed Protection Areas. Despite this overall ranking, benthic community integrity at many sites was still rated as Poor, and further research is needed to determine the specific factors influencing this measure of system health.

Because it drains into a designated Protection area, the upper portion of Little Rocky Run is classified as a Watershed Restoration Level I Area. This area deserves close attention due to the projected increase in imperviousness within this watershed.

The lower portion of Little Rocky Run is classified as a Watershed Restoration Level II Area. It is also designated as an Assessment Priority Area, reflecting the uncertainty over the dramatic change in condition seen between monitoring sites along the system's mainstem. Efforts should be made to identify the source(s) most responsible for the obvious degradation.

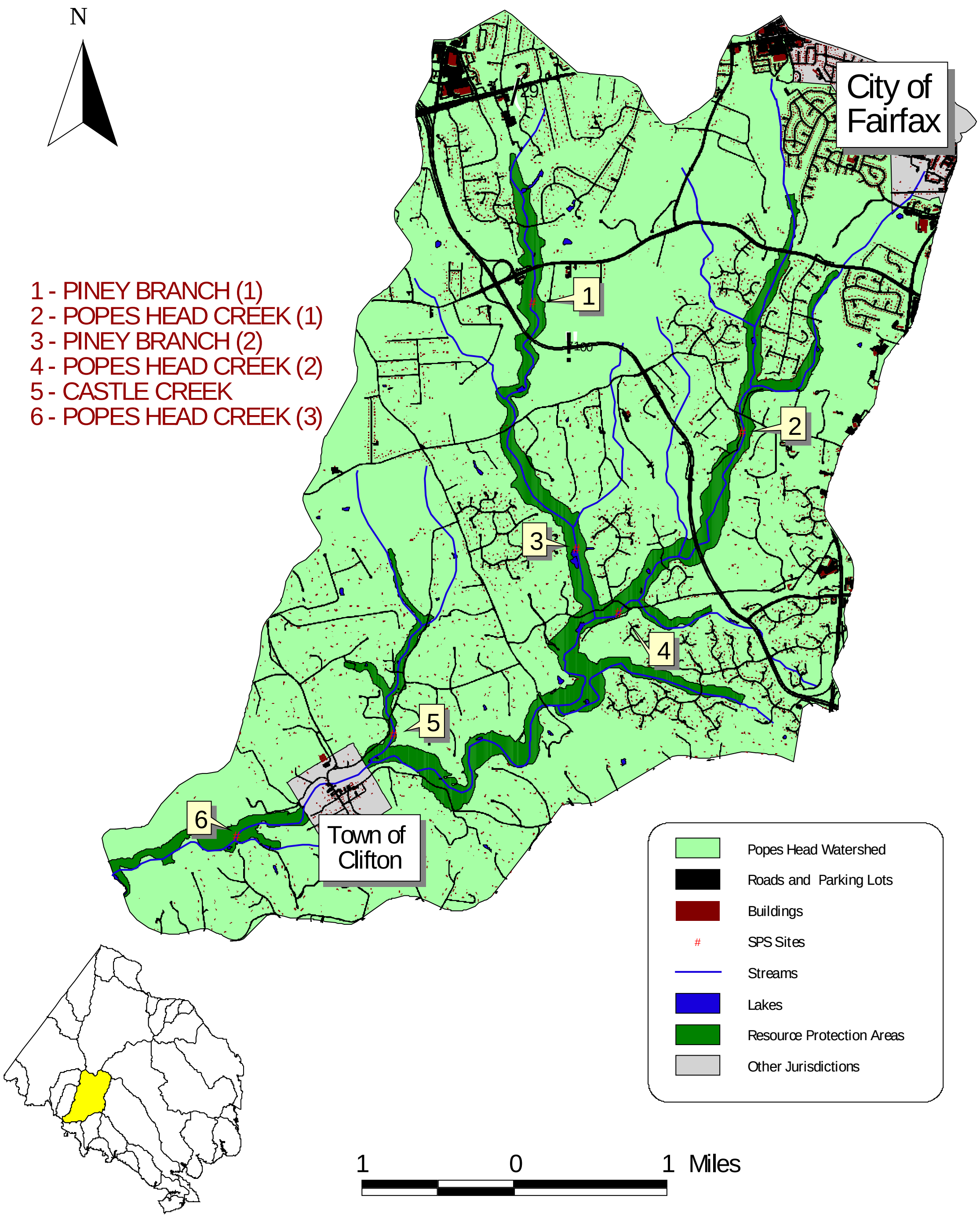
Swallowtail Shiner
Notropis procne
Size: to 2.5 inches
Habitat: in pools of warm, clear streams of moderate to low gradient
Feeding Group: invertivore
Tolerance: intolerant
This minnow feeds on worms, mites, microcrustaceans, aquatic and terrestrial insects, diatoms and algae. Spawning occurs from mid-May to late July by depositing their eggs on the nests of other fish.

Fantail Darter
Etheostoma flabellare
Size: to 3 inches
Habitat: typically in riffles and runs of gravelly or rocky, clear streams
Feeding Group: insectivore
Tolerance: moderate
The fantail darter breeds by depositing eggs in small crevices on the undersides of rocks. The male then aggressively defends the nest until the eggs hatch. While guarding the eggs the male's body secretes antifungal and antibiotic compounds to help protect the eggs.

CHAPTER 3

POPES HEAD WATERSHED SUMMARY

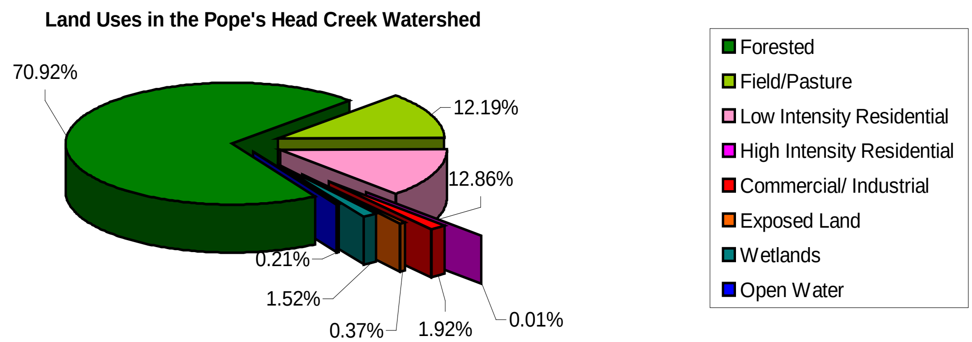
Land Cover


N
1 - PINEY BRANCH (1)
2 - POPES HEAD CREEK (1)
3 - PINEY BRANCH (2)
4 - POPES HEAD CREEK (2)
5 - CASTLE CREEK
6 - POPES HEAD CREEK (3)
City of Fairfax
Town of Clifton
1
2
3
4
5
6
Popes Head Watershed
Roads and Parking Lots
Buildings
SPS Sites
Streams
Lakes
Resource Protection Areas
Other Jurisdictions
1 0 1 Miles

CHAPTER 3

Watershed Description

The Pope's Head Creek watershed is located along the southwestern edge of Fairfax County. The watershed lies entirely within the Piedmont Uplands physiographic province and is characterized by rocky substrates and forestland throughout. The entire watershed is under County jurisdiction with the exception of the Town of Clifton and a small portion of Fairfax City. Development within the watershed consists of low-density residential communities, and levels of imperviousness across the drainage are correspondingly low.



Severe stream bank erosion is common throughout much of the Popes Head drainage.

Both Pope's Head Creek and its primary tributary, Piney Branch, begin in highly impervious areas surrounding the City of Fairfax. Each system flows south under Braddock Rd. and the Fairfax County Parkway (Rte. 7100) and then through low-density residential communities. After their confluence, the mainstem meanders toward Clifton, where it receives the input of Castle Creek, a smaller system draining a lightly developed area along the western side of the watershed. A little over a mile below this point, the creek empties into the Bull Run River.

DATA SUMMARY

Stream Name and Site Code	Composite Site Condition Rating	Environmental Variables: Index of Biotic Integrity	Habitat Score	Fish Taxa Richness	Current Percent Impervious Surfaces	Projected Percent Impervious Surfaces
Piney Branch 1 (PHPI01)	Fair	Poor	Fair	High	12.8	14
Popes Head Creek 1 (PHPH01)	Good	Poor	Fair	High	13.1	20
Piney Branch 2 (PHPI02)	Fair	Poor	Poor	High	8.3	9
Popes Head Creek 2 (PHPH02)	Fair	Fair	Poor	Moderate	11.4	14
Castle Creek (PHCC01)	Excellent	Fair	Good	High	3.9	5
Popes Head Creek 3 (PHPH03)	Good	Poor	Fair	Moderate	8.0	10

Popes Head Creek Fish Species List

Common Name	Number of Sites Where Species Occurred (6 Total Sites)
White Sucker	6
Tessellated Darter	6
Green Sunfish	6
Bluegill	6
Swallowtail Shiner	6
Creek Chub	6
Rosyside Dace	5
Fantail Darter	5
Cutlips Minnow	5
Redbreast Sunfish	5
Common Shiner	5
Bluntnose Minnow	5
Blacknose Dace	5
Fallfish	5
Longnose Dace	4
Northern Hogsucker	3
Largemouth Bass	3
Yellow Bullhead	2
Pumpkinseed	1
Smallmouth Bass	1
River Chub	1
Golden Shiner	1
Margined Madtom	1

Fallfish
Semotilus corporalis
Size: to 12 inches
Habitat: clear, sandy- or rocky-bottom streams and rivers of moderate to low gradient
Feeding Group: planktivore (juvenile), generalist predator (adult)
Tolerance: moderate
The fallfish is the largest native minnow east of the Rockies. It is less tolerant of degraded stream conditions than its smaller cousin, the creek chub. Adults have mirrorlike, silver scales. During the breeding season, they build large nest mounds with stones of up to a pound. They may live up to 9 years.

CHAPTER 3

Watershed Condition Summary

While overall site rankings throughout this watershed were generally above average for the County, low scores for some biological measures—even in the presence of better quality habitat—may indicate that the levels of land development in the drainage (currently low to moderate) may be approaching a threshold of ecological integrity.

Fish communities in this watershed appear to be among the richest within Fairfax County. This was true even in the smaller, lower order tributaries which are most susceptible to disturbance. Nineteen distinct taxa were identified at one site on Piney Branch alone, and no site in the entire drainage, regardless of stream order, had less than 14 individual species of fish. These levels were similar to those found under reference conditions.

Measures of benthic macroinvertebrate community integrity were in significant contrast to the fish community rankings. Scores across the eight monitoring sites were generally below average, with the highest rankings falling only in the Fair category. Tolerant midges dominated most samples.

The overall habitat conditions throughout the drainage ranged from Poor to Good, indicating substantial localized disturbance and an overall pattern of moderate degradation. The bank stability and sediment deposition measures were consistently the lowest scoring aspect of the habitat assessment. Many stream reaches throughout the watershed are actively widening.

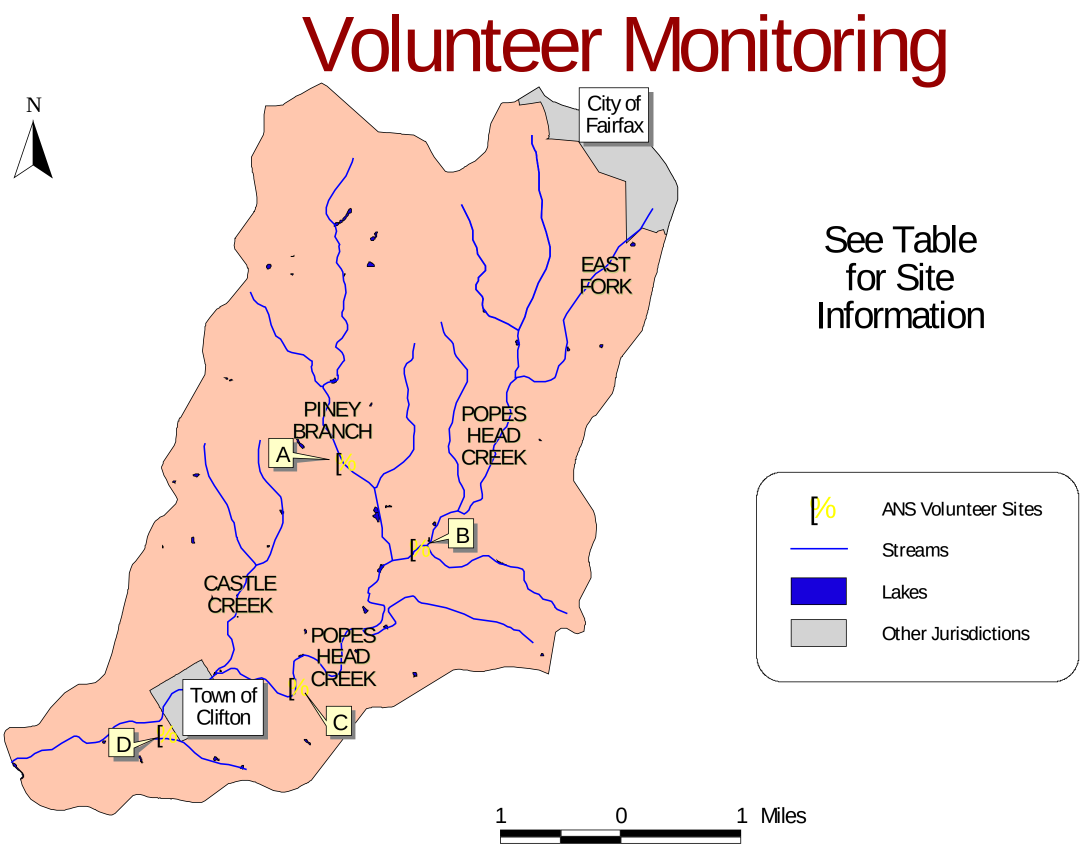
Levels of imperviousness ranged from low to moderate (3.9 to 12.8%). With the exception of the upper regions of the watershed, including the southwestern portion of Fairfax City, the area as a whole contains some of the least developed drainages in the County. However, the ultimate composite ratings did not reflect this overall trend; their respective biological components often contradicted one another. This may reflect either a decline in system integrity that has just recently begun or the presence of other undetected environmental stressors.

Because much of the watershed falls within the Water Supply Protection Overlay District (WSPOD), which requires five acres per residence, the area should be recognized for its significant potential to maintain higher quality aquatic systems. However, while the inconsistencies in the various ranking categories may in fact be a function of localized land use that is approaching some threshold value and is beginning to influence the downstream environment generally, other factors may be involved warranting further investigation.

CHAPTER 3

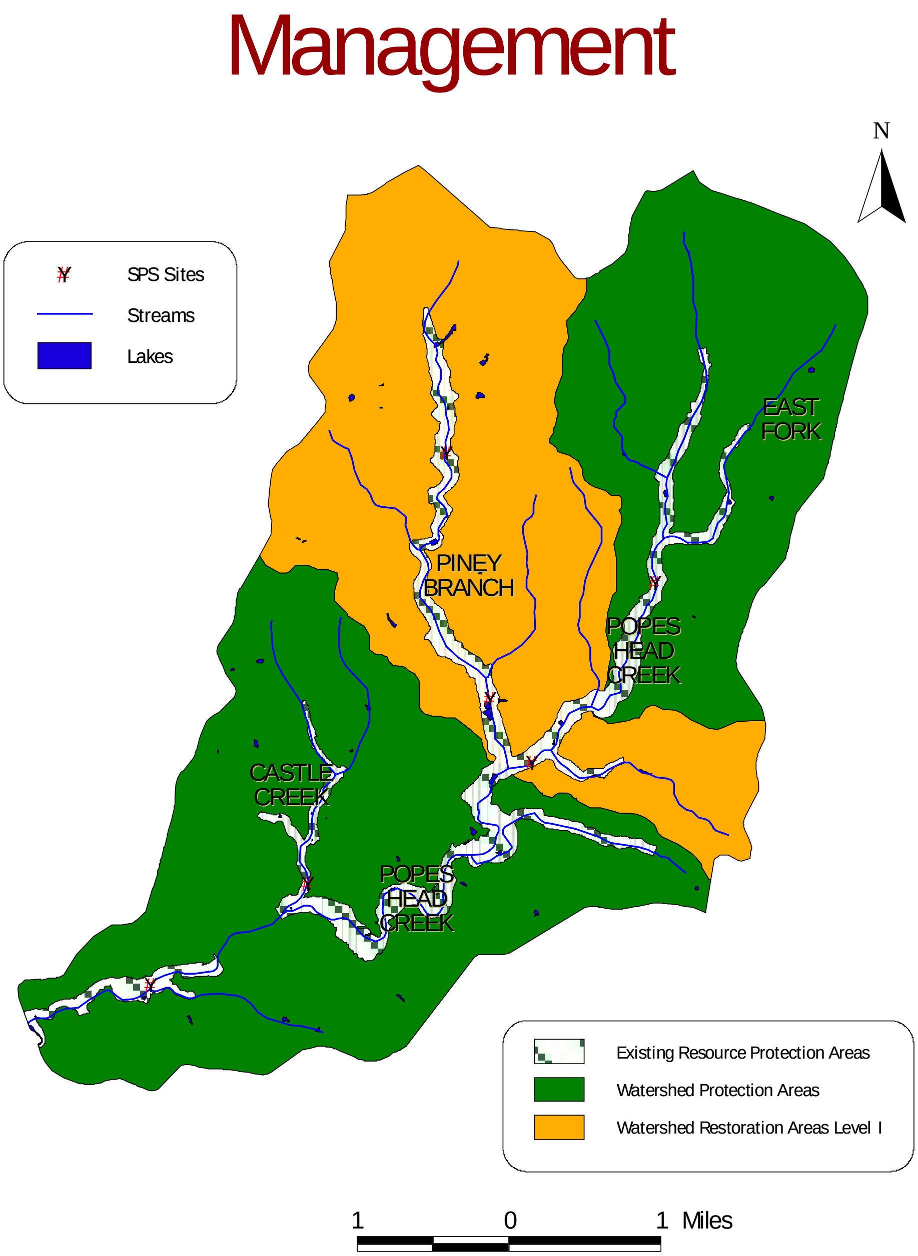
Volunteer Data Summary

The Audubon Naturalist Society coordinates all four of the active volunteer monitoring stations in the Pope's Head Creek watershed. Two of these are located on the mainstem; one is on Piney Branch, and the other is on a small unnamed tributary of the mainstem, just below the Town of Clifton.



Letter Code	Site Code	# times sampled	Last sampled	WQR (SOS only)	Trends noted
A	017	2	#####	N/A	Several sensitive taxa, but stoneflies absent
B	018	1	#####	N/A	Good species richness, but dominated by tolerant forms
C	014	3	#####	N/A	Dominated by tolerant forms
D	008	8	#####	N/A	Generally high number of sensitive taxa, some abundant

The volunteer data generally supports the findings of the SPS study, similarly highlighting several communities dominated by individuals with high tolerance to many forms of degradation. It is worth noting, however, volunteer efforts on Piney Branch found considerably higher diversity than did the SPS monitoring, and further sampling is needed to determine which results are most reflective of overall conditions within the tributary.



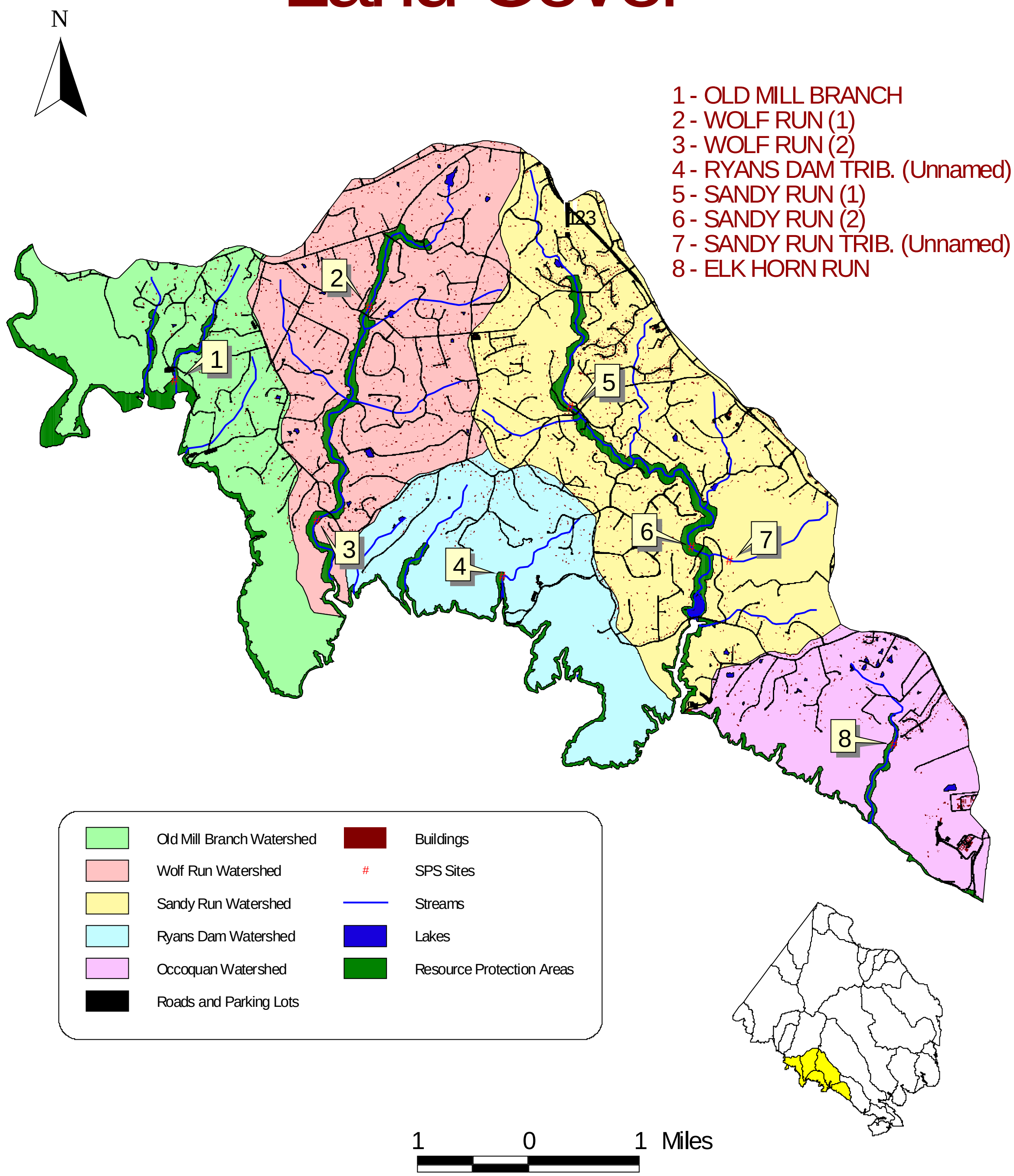
Management Category Description

The Pope's Head watershed is of relatively high quality in general, and as such, the majority of the drainage is classified as a Watershed Protection Area. However, some regions are showing signs of approaching a threshold of biological integrity. Degradation, especially in terms of habitat quality, is evident in some localized areas on both Piney Branch and the mainstem, and each of these areas is designated as Watershed Restoration Level I Areas, warranting a priority assessment focus.

CHAPTER 3

OLD MILL BRANCH, WOLF RUN, RYANS DAM, SANDY RUN AND OCCOQUAN WATERSHED SUMMARY

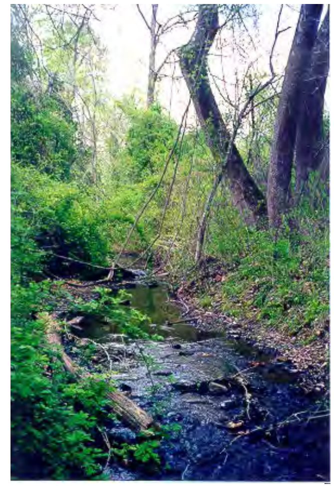
Land Cover


N
1 - OLD MILL BRANCH
2 - WOLF RUN (1)
3 - WOLF RUN (2)
4 - RYANS DAM TRIB. (Unnamed)
5 - SANDY RUN (1)
6 - SANDY RUN (2)
7 - SANDY RUN TRIB. (Unnamed)
8 - ELK HORN RUN
123
1
2
3
4
5
6
7
8
Old Mill Branch Watershed
Wolf Run Watershed
Sandy Run Watershed
Ryans Dam Watershed
Occoquan Watershed
Roads and Parking Lots
Buildings
SPS Sites
Streams
Lakes
Resource Protection Areas
1
0
1
Miles

CHAPTER 3

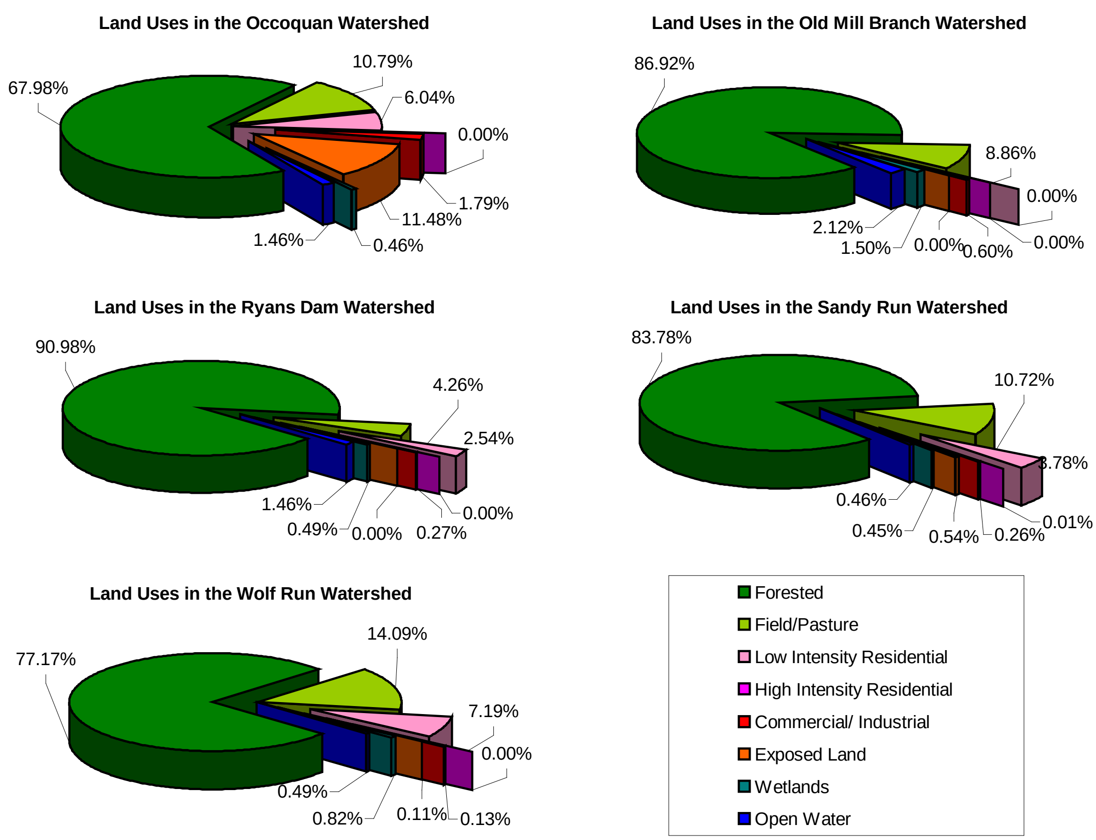
Watershed Description

The Upper Occoquan watersheds, a group of five watersheds in the southwestern corner of Fairfax County, drain an area of approximately 25.4 square miles, or about 6.4 percent of the County's total area. The watersheds are bounded by Mill Branch to the east, the Pope's Head Creek and Pohick Creek watersheds to the north and Prince William County to the south. All five watersheds lie within the Piedmont Uplands physiographic province.



Old Mill Branch exhibited many areas of high stream integrity.

The dominant land use category in these watersheds is forestland. Fountainhead Regional Park runs along the southern edge of this group of watersheds and serves as a forested buffer zone for the Occoquan River and Reservoir. The low degree of development in these watersheds is a direct result of the implementation of the Water Supply Protection Overlay District, a special zoning amendment that required a minimum lot size of five acres for homes in these watersheds. This "downzoning" was intended to protect the water quality in the Occoquan Reservoir.



Sections of Ryans Dam scored for macroinvertebrate integrity.

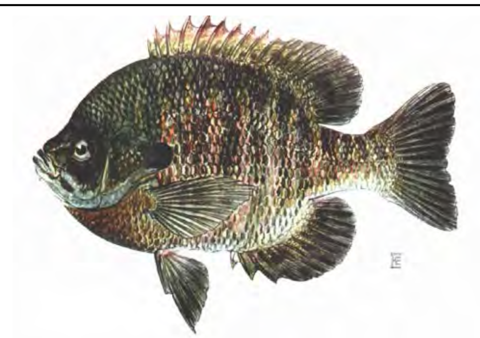
Three of the five watersheds in this group, Old Mill Branch, Ryans Dam and Occoquan, are comprised of many small independent tributaries of the Occoquan River. All of the representative tributaries chosen for monitoring were less than two miles in length. Each watershed has low-density development, less than five percent imperviousness, and parkland bordering the Occoquan River. Approximately 11.5% of the Occoquan watershed area was classified as "exposed land" by the USGS National Land Use coverage maps, based on aerial photography from 1992, and was associated with a quarry operated in this area.

The two other watersheds in this group have larger drainage areas and a single mainstem of over five miles in length. Wolf Run and Sandy Run begin in the same area but one flows southwest and the other flows southeast. Like the other watersheds in this group, both Sandy Run and Wolf Run have levels of imperviousness below five percent.

Spiny Crawler Mayflies
Family *Ephemerellidae*
Habitat Classification: clingers
Feeding Group: collector-gatherers
Tolerance: intolerant
Representatives of this family are some of the more intolerant macroinvertebrates and are indicative of healthy aquatic systems. It lives most of its life in the nymphal stage. The adult stage may only last about 1 day.

Redbreast Sunfish
Lepomis auritis
Size: to 8 inches
Habitat: pools and slow runs of warm streams and rivers
Feeding Group: generalist predator
Tolerance: moderate
The redbreast is another vividly colored sunfish native to our area. Like most sunfish, it will eat almost any animal small enough for it to swallow. This includes insects, crayfish, mollusks and the occasional small fish. Maximum life span is about 8 years.

Pumpkinseed
Lepomis gibbosus
Size: to 12 inches
Habitat: pools and other calm areas of streams and rivers, often over soft bottoms
Feeding Group: invertivore
Tolerance: moderate
The pumpkinseed is a common and beautiful fish native to Virginia. Like most sunfish, it is territorial and aggressive. Special molar-like teeth in its throat allow the pumpkinseed to crack the shells of small snails and clams, which they often eat.



Bluegill
Lepomis macrochirus
Size: to 8 inches
Habitat: ponds, lakes and pools of moderate gradient creeks
Feeding Group: planktivore (juvenile), insectivore (adult)
Tolerance: moderate
This adaptable sunfish is native to the Mississippi River basin, Great Lakes and Gulf coast but has been introduced across the country as well as other continents. It breeds throughout the summer and can tolerate high temperatures. Some live for 6 years or more.

DATA SUMMARY

Stream Name and Site Code	Composite Site Condition Rating	Environmental Variables: Index of Biotic Integrity	Habitat Score	Fish Taxa Richness	Current Percent Impervious Surfaces	Projected Percent Impervious Surfaces
1 Old Mill Branch (OMOM01)	Excellent	Excellent	Fair	Low	3.5	5
Wolf Run 1 (WRWR01)	Fair	Excellent	Fair	Very Low	3.3	5
Wolf Run 2 (WRWR02)	Excellent	Excellent	Good	Moderate	3.9	5
Ryans Dam Unnamed Trib. (RDRT01)	Excellent	Excellent	Fair	Moderate	3.3	5
5 Sandy Run 1 (SASA01)	Excellent	Good	Good	High	6.1	6
Sandy Run 2 (SASA03)	Excellent	Good	Good	Moderate	4.4	5
7 Sandy Run Unnamed Trib. (SASA02)	Fair	Good	Fair	Very Low	1.0	8
Elk Horn Run (OCEH01)	Excellent	Excellent	Excellent	Low	3.6	14

Upper Occoquan Fish Species List

Common Name	**Number of Sites Where Species Occurred (8 Total Sites)**
Blacknose Dace	8
Creek Chub	8
Bluegill	6
Fantail Darter	5
Green Sunfish	5
Tessellated Darter	4
Largemouth Bass	4
Yellow Bullhead	3
White Sucker	3
Rosyside Dace	3
Pumpkinseed	3
Swallowtail Shiner	3
Fallfish	3
Creek Chubsucker	2
Eastern Mosquitofish	2
Northern Hogsucker	2
Margined Madtom	2
American Eel	1
Cutlips Minnow	1
Redbreast Sunfish	1
Golden Shiner	1
Longnose Dace	1

CHAPTER 3

Watershed Condition Summary

All watersheds within this group are protected by zoning restrictions under the Water Supply Protection Overlay District (WSPOD) specifications which were implemented to improve the quality of surface water entering the Occoquan reservoir. The region as a whole exhibits some of the lowest levels of impervious surface seen in the County, and with only a few exceptions, overall site rankings were high.

Fish taxa richness was the most variable biological measure found across the five distinct watersheds. Several factors independent of historic condition may have been responsible for some of the lower values. The site on the unnamed Sandy Run tributary began receiving heavy loads of fine sediment prior to the summer sample, and unlike the High and Moderate diversity ratings at sites along the mainstem environment, the system ranked at the very lowest level (only three taxa). Unknown factors may have also played a role at the upper site on Wolf Run mainstem (only four taxa identified), which exhibited extremely low water levels throughout most of the 1999 fish sampling season.

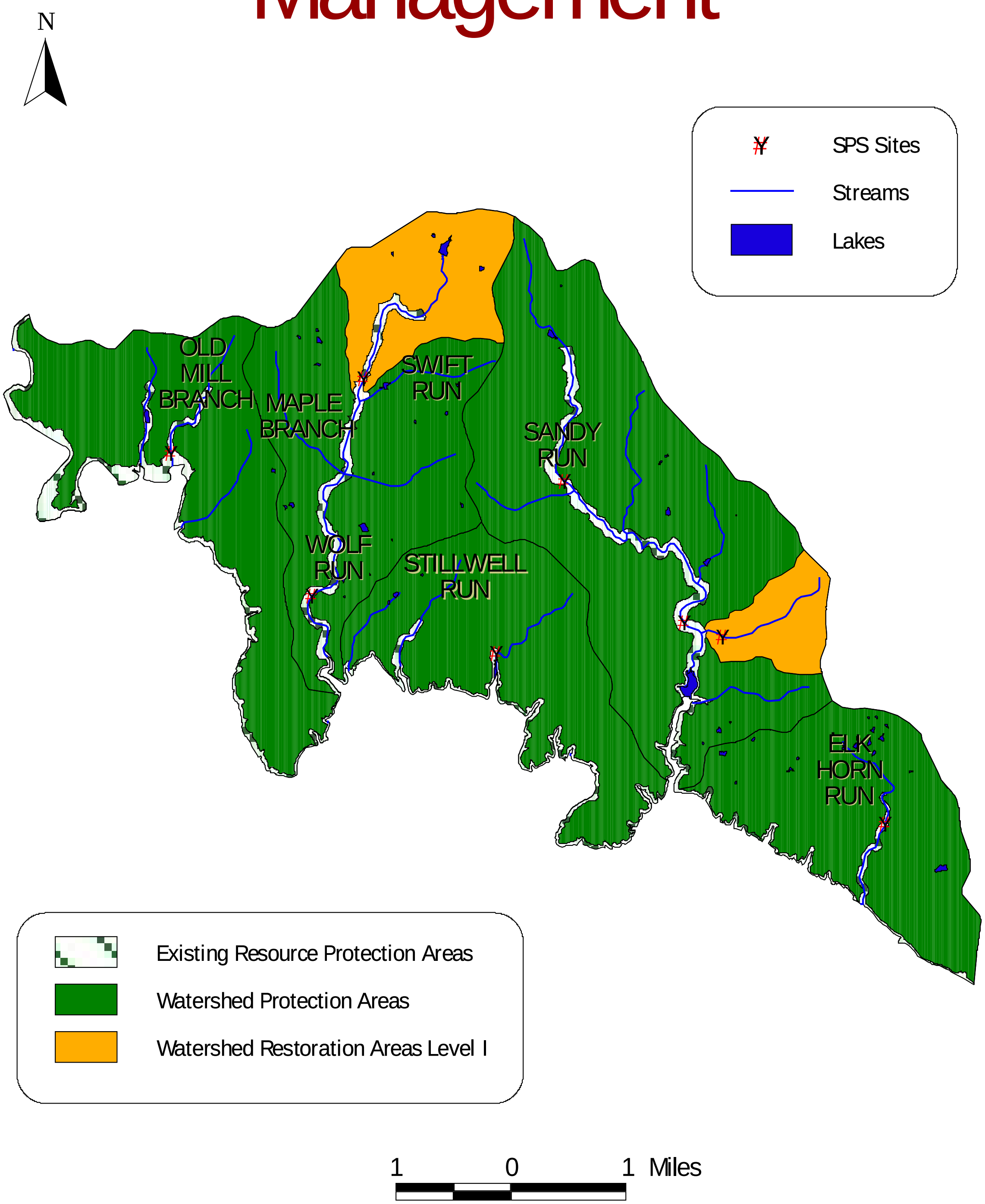
The IBI measures from sites within these five watersheds represent some of the highest scores seen in the County. All sites in the region rated in the highest categories, and five of the eight were ranked as excellent overall, indicating correspondence to the reference level conditions for benthic macroinvertebrate community integrity.

The habitat scores of the group ranged from Fair to Excellent, and although the sediment deposition and bank stability subcategories scores were somewhat low at many sites, these systems are generally more stable relative to the rest of the County's watersheds. One of the highlights in this region was Elk Horn Run, a small stream in the Occoquan watershed that is exhibiting some early signs of reaching a true equilibrium with its new flow regime. An exception to the overall trend was the previously mentioned Sandy Run tributary, which received a rating in the Fair category due largely to the low scores for both sediment levels and the related embeddedness measures.

This group of watersheds collectively has one of the lowest levels of land disturbance in the County, with no watershed exceeding six percent impervious cover. Measures of stream conditions generally corresponded with these values (high biological and habitat ratings versus low imperviousness values), and beyond the two sites experiencing anomalous conditions already noted, rankings throughout the region were Excellent.

Although the many watersheds that make up this region are individually small, their combined area represents one of the largest continuous expanses of undeveloped land in the County. It also holds some of its best, most intact aquatic systems. However, results from monitoring on the Sandy Run tributary serve as a useful reminder of the overall susceptibility of such unique, high quality systems. In this case, the sediment input was directly attributable to inadequate maintenance of control structures at an upstream development site, and though the stream maintained overall biological and habitat integrity prior to this release—IBI score previously ranked among the best of any monitoring site—it is now one of the more degraded systems in the County, and the impacts are being carried to downstream environments.

Management



Management Category Description

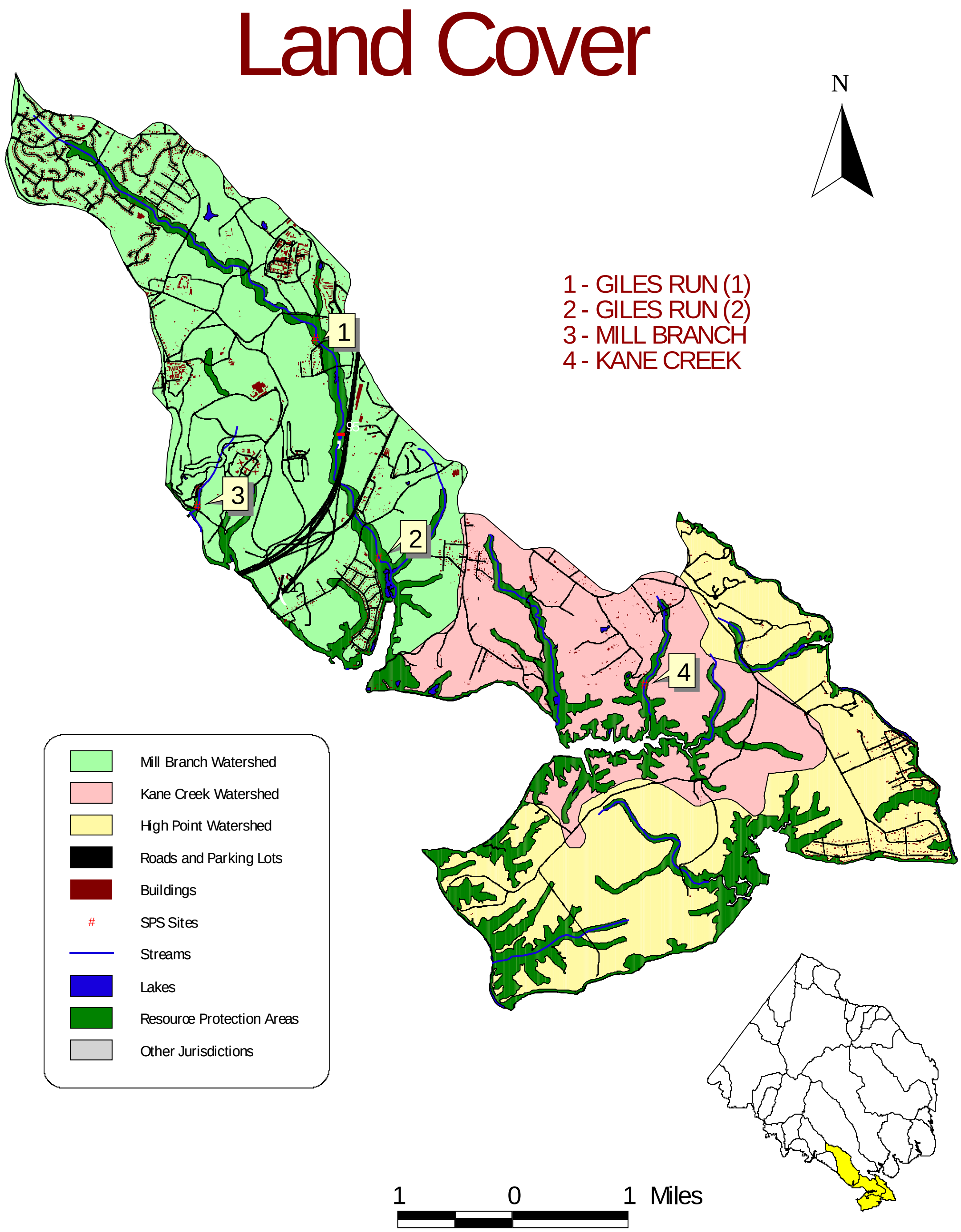
With the exception of upper Wolf Run and the unnamed tributary to Sandy Run, all of the subwatersheds are classified as Watershed Protection Areas. Each of these drainages has already been protected by the WSOPD, and this study highlights the value of the zoning district overlay in preserving stream quality.

The two exceptions mentioned above are classified as high priority Watershed Restoration Level I Areas. Further research is needed in Upper Wolf Run due to low fish and habitat scores; the compounding factors in this area need to be identified, if possible, and then mitigated. Unlike this situation — and most similar cases countywide — the causes of stream degradation within the unnamed tributary of Sandy Run were clear, being directly attributable to exceedingly high levels of sediment entering the system from an upstream development with improperly maintained erosion and sediment controls. This case exemplifies the importance of such measures in the development process. Maintenance of these controls is critical if aquatic environments are to be protected.

Darner Dragonfly Larvae
Family *Aeshnidae*
Habitat Classification: climbers
Feeding Group: predators
Tolerance: intolerant
Relatives of the dragonflies and damselflies are some of the most ancient of the flying insects. Fossils have been found of giant dragonflies with wingspans up to 28 inches that lived long before the dinosaurs. Dragonfly nymphs are some of the most aggressive predators in aquatic systems. They have extendable mouthparts that they can shoot out at high speeds to grasp their prey. Dragonflies' nymphs also have a unique method of locomotion. If they need to move in a hurry, they have the ability to expel water from their posterior and "jet-propel" themselves forward.

CHAPTER 3

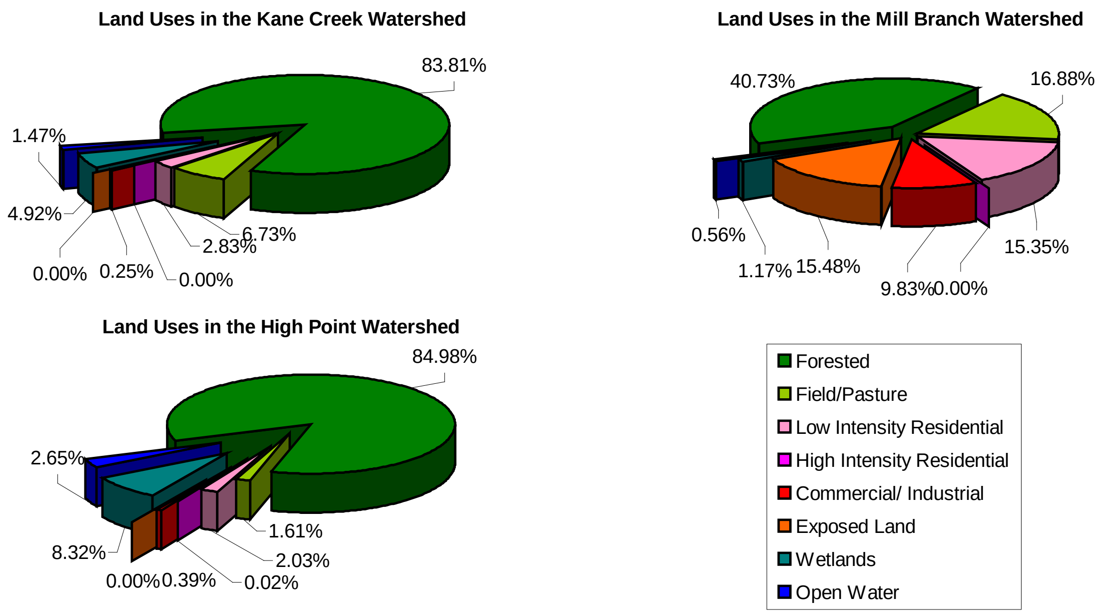
MILL BRANCH, KANE CREEK AND HIGH POINT WATERSHED SUMMARY


Land Cover
N
1 - GILES RUN (1)
2 - GILES RUN (2)
3 - MILL BRANCH
4 - KANE CREEK
1
2
3
4
Mill Branch Watershed
Kane Creek Watershed
High Point Watershed
Roads and Parking Lots
Buildings
SPS Sites
Streams
Lakes
Resource Protection Areas
Other Jurisdictions
1
0
1
Miles

CHAPTER 3

Watershed Description

The three watersheds in this group are located at the southeastern tip of Fairfax County, near the confluence of the Occoquan and Potomac Rivers. With the exception of the northwestern tip of Mill Branch, these watersheds lie within the Coastal Plain physiographic province and are characterized by very low development and associated imperviousness levels. Much of this area, particularly in the High Point watershed, is protected as part of the Mason Neck State Park and the U.S. Mason Neck Wildlife Refuge.



The Mill Branch Watershed consists of two independent systems, Mills Branch and Giles Run, which flow separately into the Occoquan River. Mills Branch is a small stream approximately two miles in length that drains a region containing a sanitary landfill, a sewage treatment plant, and a large parcel of relatively undisturbed land previously controlled by the D.C. Department of Corrections. Giles Run drains the majority of the watershed, with its headwaters beginning in the only residential area in the watershed (10-15% imperviousness). The stream flows southeast, meandering first through the property of the former Lorton Correctional Facility, and then crossing under the major highways I-95 and Rte. 1, before emptying into the Occoquan River.

Giles Run in the Mills Branch watershed.

CHAPTER 3

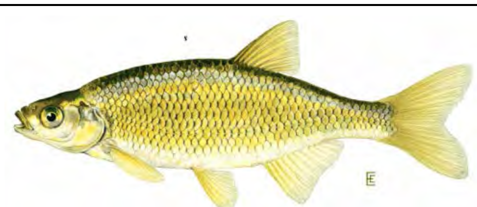
The monitoring location on Kane Creek was used as the reference or standard to which all other Coastal Plain streams were compared.

Kane Creek Watershed includes a number of small independent streams. SPS monitoring was conducted on the drainage's largest tributary, which begins near Gunston Hall, George Mason's historic estate, and flows south for roughly two miles before entering Belmont Bay along the Potomac River. There is very little development within the watershed, and the area as a whole exhibits levels of imperviousness below five percent.

The High Point watershed is actually a wetland-dominated region with many small, marshy tributaries that flow independently into the Potomac River. A few small developments exist along the eastern edge of the watershed, but the majority of the area is well protected by the Mason Neck National Wildlife Refuge.

White Perch
Morone americana
Size: to 10 inches
Habitat: tidal fresh or brackish waters
Feeding Group: generalist predator
Tolerance: moderate
The white perch is an anadromous fish migrating to freshwater from salt water to spawn. It spawns in the spring over sand or gravel. It is especially common in the tidal Potomac River seasonally.

Tessellated Darter
Etheostoma olmstedi
Size: to 2.5 inches
Habitat: typically in pools and slow runs, sandy, gravelly or rocky substrates of clear streams
Feeding Group: insectivore
Tolerance: moderate
This fish usually 2 to 3 years. During spawning, subordinate males may defend nests that are first fertilized by a dominant male. These Darters may lay eggs 2 – 8 times a season.



Golden Shiner
Notemigonus chrysoleucas
Size: to 7 inches
Habitat: Slow waters in ponds, lakes, swamps, and pools in medium/large streams.
Feeding Group: planktivore
Tolerance: tolerant
The adult golden shiner has a characteristic deep body profile. It is a hardy minnow, able to survive in turbid conditions. It also has one of the highest thermal tolerances among our native fish, enduring temperatures up to 110 F. Individuals may live as long as 9 years.

CHAPTER 3

DATA SUMMARY

Stream Name and Site Code	Composite Site Condition Rating	Environmental Variables: Index of Biotic Integrity	Habitat Score	Fish Taxa Richness	Current Percent Impervious Surfaces	Projected Percent Impervious Surfaces
1 Giles Run 1 (MBGR01)	Good	Fair	Fair	Moderate	11.4	33
2 Giles Run 2 (MBGR02)	Excellent	Fair	Good	Moderate	10.5	30
3 Mill Branch (MBMB01)	Fair	Fair	Poor	Moderate	8.0	10
4 Kane Creek (KCKC01)	Excellent	Excellent	Good	High	2.2	10

Mill Branch and Kane Creek Fish Species List

Common Name	Number of Sites Where Species Occurred (4 Total Sites)
American Eel	4
Bluegill	4
Creek Chubsucker	3
Blacknose Dace	3
White Sucker	2
Rosyside Dace	2
Tessellated Darter	2
Eastern Mosquitofish	2
Pumpkinseed	2
Spottail Shiner	2
Swallowtail Shiner	2
Creek Chub	2
Eastern Mudminnow	2
Brown Bullhead	2
Banded Killifish	1
Mummichog	1
Least Brook Lamprey	1
Largemouth Bass	1
White Perch	1
Golden Shiner	1
Bluntnose Minnow	1

CHAPTER 3

Watershed Condition Summary

The Mill Branch and Kane Creek watersheds stand out as the highest quality Coastal Plain basins within Fairfax County. High Point, the remaining drainage in this group, is a largely undeveloped region containing extensive areas of wetland communities that is already protected as a component of the National Wildlife Refuge System (the watershed was excluded from monitoring in this program).

Measures of fish community richness were in the moderate and high categories for sites in Mill Branch and Kane Creek, respectively. A total of 21 different fish taxa were collected in sampling across both areas.

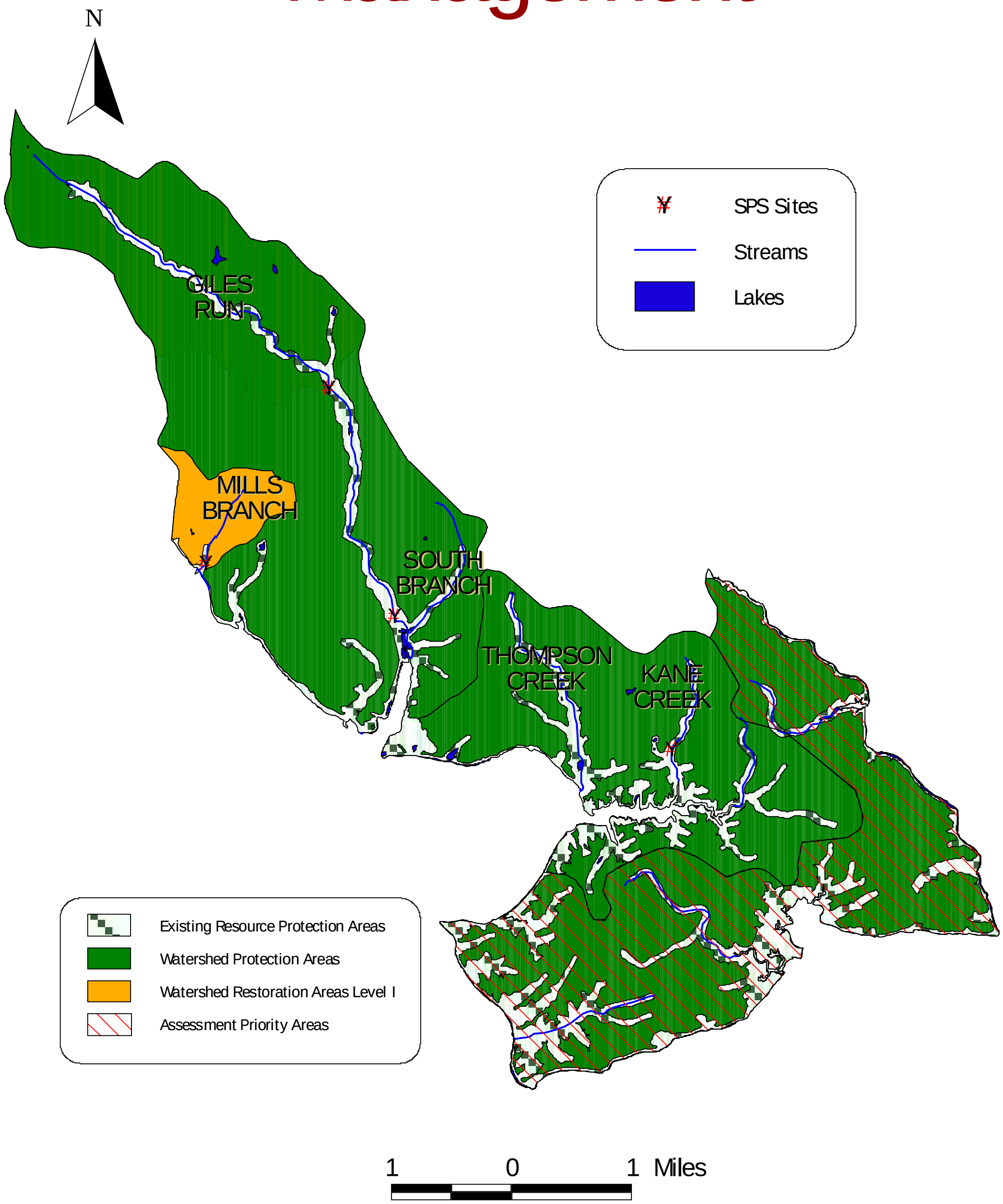
Kane Creek represents the highest level of biological integrity to be found within any Coastal Plain system in the County, and the measures of its benthic community were used as the reference to which all other sites within the physiographic province were compared. Each site in the Mill Branch watershed was rated as fair based on this standard, with the two sites on Giles Run actually scoring higher for the individual IBI component of taxa richness. The lowermost site on this system produced the most diverse sample in the entire Coastal Plain group (22 distinct taxa).

Habitat conditions at monitoring sites ranged from poor to good. The Mills Branch subwatershed received the lowest rating, a situation that may be influenced both currently and historically by characteristics of the upstream basin, an environment that includes an inactive landfill and a sewage treatment facility. Overall quality of instream and riparian habitat was higher in the Giles Run tributary, especially in the lower reaches where the stream is contained within a wide, marshy, undeveloped floodplain. Kane Creek exhibited fairly stable conditions and was similarly ranked in the Good category. Sediment deposition was consistently the lowest scoring component of the rating of each site.

While existing zoning regulations specify minimum lot sizes of one-acre and two-acres for many sections of the Mill Branch and Kane Creek watersheds, respectively, levels of imperviousness are low throughout the entire region. With the exception of the Mills Branch site below the landfill and treatment plant, composite rankings were consistently high.

The combined area of the three watersheds contains some of the highest quality systems found not only in the Coastal Plain province, but in the County as a whole. Kane Creek is partially contained within either Mason Neck State Park or Mason Neck Wildlife Refuge, and its usefulness as a reference of minimally impacted invertebrate communities makes it even more valuable. This is equally true of the protected areas within the High Point drainage, an area that may hold its own potential as a source of small stream reference conditions within the Coastal Plain.

Management


N
SPS Sites
Streams
Lakes
GILES RUN
MILLS BRANCH
SOUTH BRANCH
THOMPSON CREEK
KANE CREEK
Existing Resource Protection Areas
Watershed Protection Areas
Watershed Restoration Areas Level I
Assessment Priority Areas
1 0 1 Miles

CHAPTER 3

Management Category Description

Kane Creek, High Point and Giles Run are all classified as Watershed Protection Areas. Most of the High Point watershed is already protected by parkland, and further study is needed to assess the usefulness of the region as a source of potential reference streams. Kane Creek represents the best available regional conditions and was used as a source of reference characteristics for all Coastal Plain sites; as such, the watershed deserves the highest level of protection. Many portions of the Giles Run subwatershed are just now being opened up for development — the area was previously held by the D.C. Department of Corrections — and extensive stream monitoring should coincide with any subsequent alterations to the land. If widespread development is to occur on this property, care will be needed in zoning, site planning, and construction to protect the existing stream conditions.

Mill Branch was ranked lower than the other subwatersheds in the area due to modifications from the inactive landfill and Sewage Treatment Plant, which altered the stream channel and, potentially, its water quality. The primary strategy for this area would be to coordinate with landfill and sewage treatment plant personnel to improve conditions in this area.

These watersheds have no volunteer sites and are sensitive areas that warrant further attention, especially with the projected development of the former Lorton Correctional Facility property.

Flat Headed Mayflies
Family *Heptageniidae*
Habitat Classification: clinger
Feeding Group: scraper, collector gatherer
Tolerance: moderate – intolerant
The low profile of the Flat Headed Mayfly allows them to move freely along the bottom of fast moving streams and not be swept away. They are indicator organisms of higher quality stream conditions.

CHAPTER 3

OTHER MONITORING

Fairfax County Health Department
1999 Stream Water Quality Report

Even though the SPS Study did not conduct any monitoring for Fecal Coliform, it is still an important issue pertaining to Fairfax County streams. Fecal Coliform are bacteria found in the intestinal tracts of warm-blooded animals and are useful indicators of fecal contamination within aquatic systems. While they may not be harmful in themselves, the presence of fecal coliform may indicate possible fecal contamination. The Fairfax County Health Department annually conducts a Stream Water Quality Report on 24 watersheds within Fairfax County (Figure 3), the major component of the program being an assessment of fecal coliform content in streams.

Standards set by the Virginia Department of Environmental Quality – Water (DEQW) specify that all surface waters, excluding shell-fish waters, "shall not exceed a geometric mean of 200 fecal coliform bacteria per 100 ml of water for two or more samples over a 30 day period, or a fecal coliform (f.c.) bacteria level of 1,000 per 100 ml at any time." According to the Health Department's 1999 Stream Water Quality Report, samples collected within the County failed to meet both of these criteria, with no site averaging under the 200 f.c. limit in the past five years, and over 41% of the 1999 samples exceeding the 1000 f.c. maximum level (Table 7). The highest counts were seen within Long Branch in the Four Mile Run watershed, with samples averaging 1605 f.c.

Table 7: Fecal Coliform levels by watershed. Watersheds not included are Belle Haven, High Point, Horsepen Creek, Kane Creek, Occoquan and Ryans Dam.

Watershed	Percentage of Samples Below 200 f.c. per 100 ml	Percentage of Samples Above 1000 f.c per 100 ml	Watershed	Percentage of Samples Below 200 f.c. per 100 ml	Percentage of Samples Above 1000 f.c per 100 ml
Sugarland	14.6	26.2	Dogue Creek	4.7	57.1
Nichol	0	33.3	Accotink Creek	5.9	55.4
Pond Branch	9.6	37.1	Pohick Creek	11.5	49
Difficult Run	6.1	53.4	Mill Branch	30.2	36.5
Bullneck Run	23.8	38.1	Sandy Run	19	45.2
Scotts Run	14.3	42.9	Wolf Run	12.8	33.3
Dead Run	4.7	57.1	Old Mill Branch	16.7	44.4
Turkey Run	28.6	23.8	Popes Head Creek	12.5	33.9
Pimmit Run	9.5	44	Johnny Moore Creek	15.8	26.3
Four Mile Run	5	65	Little Rocky Run	7.9	42.1
Cameron Run	14.8	46.7	Cub Run	13.1	29.2
Little Hunting Creek	17.1	41.5	Bull Run	9.1	36.4

Samples not in the following two categories have values between 200 and 1000 f.c.

Rainfall and water temperature are suggested as responsible for the increase or decrease of fecal coliform in stream water. Of these two factors, temperature has the more direct influence, with warmer water during the summer providing optimal conditions for bacterial growth. This relationship is seen in the data from the 1999 report, with higher counts occurring during the summer period.

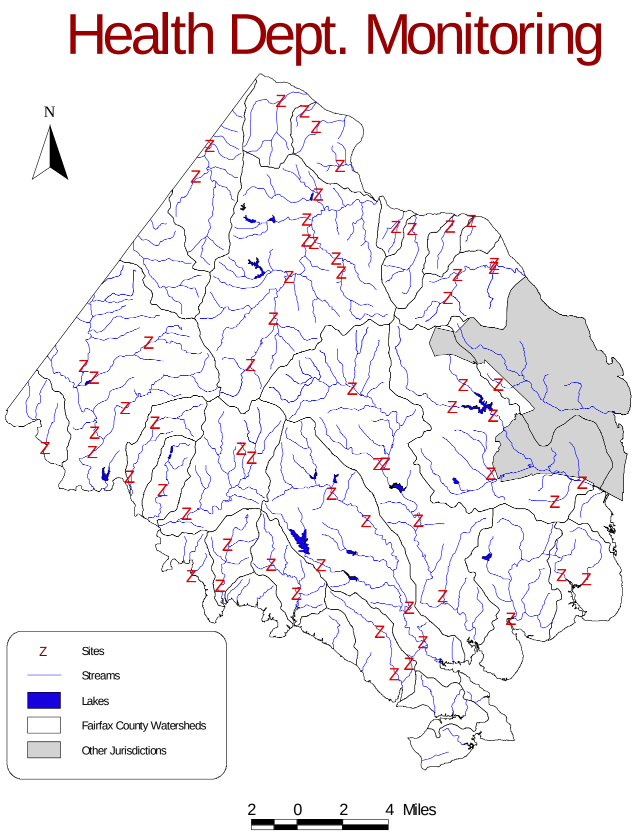


Figure 3: Fairfax County Health Department monitoring sites.

In addition to water temperature, the report also looked at several other parameters including dissolved oxygen, nitrate-nitrogen (N-NO_3^-), pH, total phosphorous, and heavy metals. With the exception of a few measurements of pH and N-NO_3^- at a handful of sites, values for most of these parameters were within normal ranges.

"Therefore, the use of streams for contact recreational purposes, such as swimming, wading, etc, which could cause ingestion of stream water or possible contamination of an open wound by stream water, should be avoided." (Fairfax County Health Department, 2000).

A copy of the 1999 Stream Water Quality Report can be obtained by calling 703-246-2341 or found on-line at the following address on the World Wide Web:

http://www.co.fairfax.va.us/service/hd/strannualrpt.htm

CHAPTER 4

WATERSHED IMPROVEMENT STRATEGIES

Chapter 4

WATERSHED MANAGEMENT CATEGORIES

The Stream Protection Strategy baseline study establishes a current picture of stream conditions throughout the County that provides a foundation for prioritizing and implementing sound watershed management strategies. All drainage areas have been classified into one of three management categories: **Watershed Protection**, **Watershed Restoration Level I** and **Watershed Restoration Level II**, as described in Chapter 2, Methods. Each of these categories is characterized by a set of goals and strategies that best suit each respective stream environment given current subwatershed development patterns, potential future imperviousness and the current assessment of biological condition. The overall objective is to recommend measures to protect the highest quality streams and actively restore degraded streams to the most practical extent possible to meet the County's water quality goals.

The primary goals and proposed key management strategies to be considered for each watershed management category are discussed below. The key management strategies are examples of tools that can be used for future stream restoration and protection. These strategies will need to be further developed and integrated into a comprehensive watershed management plan to adequately address the stream protection and restoration needs throughout the County. The watershed management plans will need to be implemented in a phased approach at watershed and subwatershed scales to effectively manage available resources. In addition, significant interagency cooperation, stakeholder involvement and public outreach will be required to develop and implement a successful watershed management program that achieves the desired stream protection objectives.

Watershed Protection Area

Primary goal: Preserve biological integrity by taking measures to identify and protect, to the extent possible, the conditions responsible for current high quality rating of these streams.

Example Key Management Strategies:

- Consider establishing a zoning overlay to clearly identify these areas as watershed protection areas.
- Evaluate and refine, as needed, existing County regulations and policies to assure continued protection of these watersheds.
- Assess current watershed conditions to identify characteristics and management practices that contribute to the high water quality rating.

Countywide Management

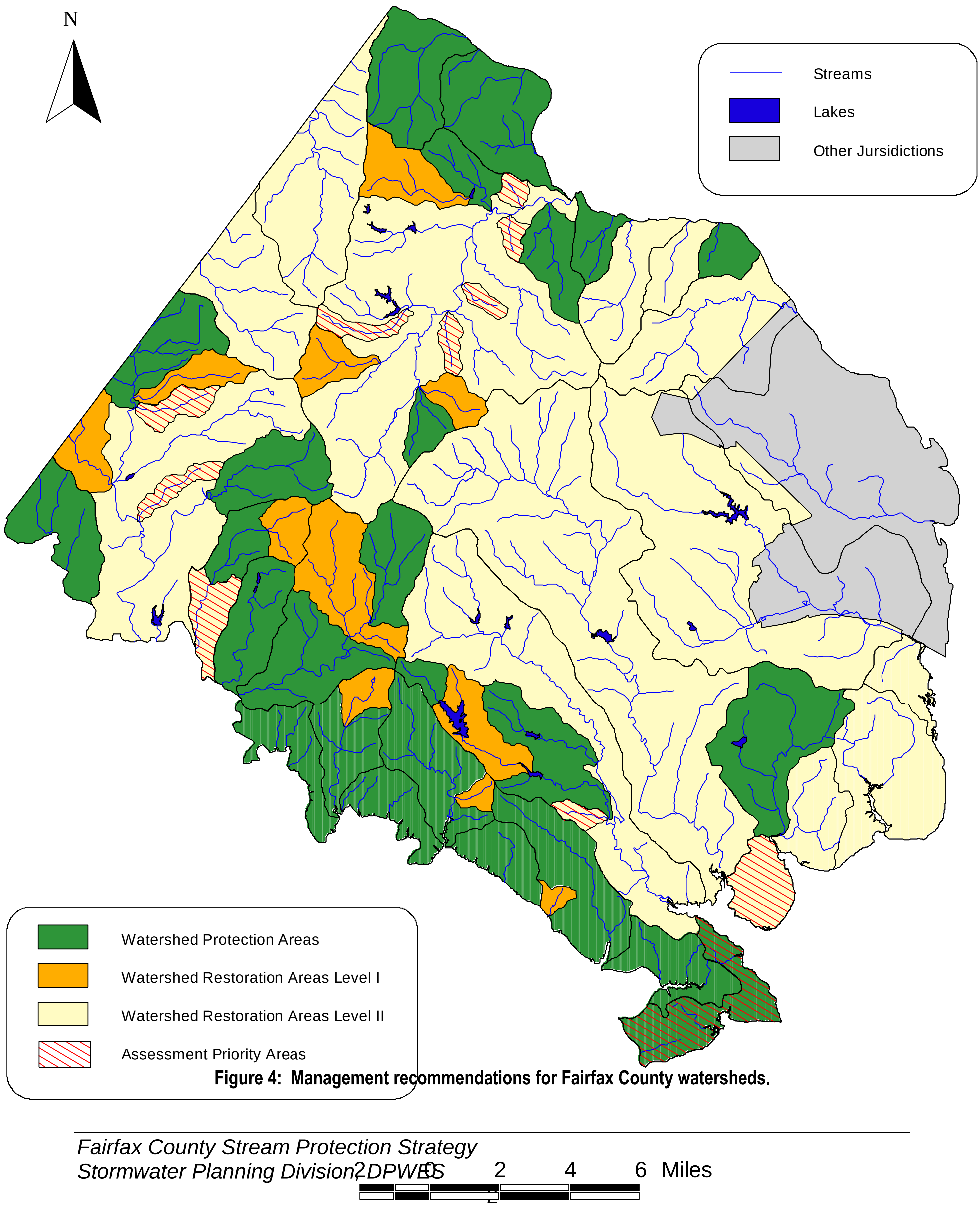


Figure 4: Management recommendations for Fairfax County watersheds.

- Expand stream valley park acquisition or dedication.
- Conduct public education programs on stream stewardship.

Watershed Protection Areas:

Watershed	Subwatershed
Bull Neck Run	Entire watershed
Bull Run	Entire watershed
Cub Run	Mainstem, above confluence with Schneider Branch
	Big Rocky Run above Walney Rd.
	Dead Run
Difficult Run	Captain Hickory Run
	Rocky Run
	Southern limb of Rocky Branch
Dogue Creek	Mainstem, above confluence with North Fork
	Barnyard Run
High Point	Entire watershed
Kane Creek	Entire watershed
Little Rocky Run	Mainstem, between SPS sites LRLR01 & LRLR02
Mill Branch	Giles Run
Nichol Run	Entire watershed
Occoquan	Entire watershed
Old Mill Branch	Entire watershed
Pohick Creek	South Run above Burke Lake (PCSR03) and below Lake Mercer
	Middle Run
Pond Branch	Entire watershed
Popes Head Creek	Mainstem, above Rte 7100 and below confluence with Piney Branch
Ryan's Dam	Entire watershed
Turkey Run	Entire watershed
Wolf Run	Mainstem below Clifton Road

Watershed Restoration Level I

Primary Goal: Re-establish healthy biological communities, where feasible, by taking measures to identify and remedy the cause(s) of stream degradation both broad scale and site specific.

Example Key Management Strategies:

- Evaluate, prioritize and construct planned Capital Improvement Projects (CIPs) for these watersheds including planned regional ponds and water quality BMP retrofits.
- Evaluate, prioritize and construct stream corridor restoration projects for these watersheds to re-establish habitat and biological communities.
- Promote use of innovative BMPs and Low-Impact Development (LID) techniques.
- Conduct public education programs on stream stewardship.

Watershed Restoration Level I Areas:

Watershed	Subwatershed
Cub Run	Cain Branch
	Elklick Run
Difficult Run	Little Difficult
	Piney Run
	East limb of Rocky Branch
Little Rocky Run	Mainstem above site LRLR01
Mill Branch	Mill Branch
Pohick Creek	South Run between site PCSR03 to Lake Mercer
Popes Head Creek	Piney Branch
	Mainstem between Piney Branch and the Fairfax County Parkway
Sandy Run	Unnamed tributary of Sandy Run (SASA02)
Wolf Run	Wolf Run above Clifton Rd.

Watershed Restoration Level II

Primary Goal:

Maintain areas to prevent further degradation and implement measures to improve water quality to support or comply with Chesapeake Bay Initiatives, Total Maximum Daily Load (TMDL) regulations and other water quality initiatives and standards.

Example Key Management Strategies:

- Implement a watershed approach to evaluate and prioritize restoration in these subwatersheds. One element to consider is the stabilization and restoration of tributaries and headwaters prior to active restoration in mainstem segments.
- Select sites and implement monitoring of tributaries identified as “Assessment Priority Areas.”

- Identify, prioritize and implement projects to help stabilize critical areas with severe stream bank erosion.
- Identify and prioritize potential opportunities for stormwater management/BMP retrofits, especially in redeveloping areas.
- Promote use of innovative BMPs and reduction of imperviousness for infill and redevelopment.
- Conduct public education on stream stewardship.
- Promote programs like Adopt-A-Stream to increase public involvement.

Watershed Restoration Level II Areas:

Watershed	Subwatershed
Accotink Creek	Entire watershed
Belle Haven	Entire watershed
Cameron Run	Entire watershed
Cub Run	Entire watershed, except where noted
Dead Run	Entire watershed
Difficult Run	Entire watershed, except where noted
Dogue Creek	North Fork and mainstem downstream of North Fork
Horsepen Creek	Entire watershed
Little Hunting	Entire watershed
Little Rocky Run	Mainstem below SPS site LRLR02
Pimmit	Entire watershed
Pohick Creek	Entire watershed, except where noted
Scotts Run	Entire watershed
Sugarland Run	Entire watershed

CHAPTER 4

COMPREHENSIVE WATERSHED MANAGEMENT APPROACH

Many of the key management strategies such as public outreach and promotion of low-impact development techniques have applications in all three watershed management categories. These management strategies will need to be integrated into a comprehensive watershed management approach on a countywide and subwatershed level. Countywide management strategies include prioritizing the 14 watershed groups, implementing watershed master planning, improving stream protection policies and promoting citizen involvement. Individual watershed management strategies include setting priorities for subwatersheds within a given watershed, defining additional stream monitoring needs, and eventually implementing selected stream restoration projects. The main components and examples of these recommended management strategies are listed below. These strategies will need to be further developed into a comprehensive plan for stream protection and restoration.

As discussed in the next section, many of the ideas presented below are being considered or implemented in current County initiatives.

Watershed Prioritization

- Prioritization of watershed planning and restoration projects within the 14 watershed groups will need to be based on many factors including the results of this initial SPS baseline study, existing and proposed development, existing improvement project needs and available resources.
- Watershed Protection Areas have the highest priority and require immediate attention to assure their current biological integrity is maintained.
- Watershed Restoration Level I Areas have the greatest opportunity for improvement based on current conditions and proposed development. Watershed restoration plans should be developed and implemented for these watersheds first.
- Subwatersheds identified as Watershed Restoration Level II will need to be prioritized based on stream order (headwater vs. mainstem), current and potential development, existing improvement projects, regulatory requirements and other initiatives.

Watershed Master Planning

- Develop watershed and subwatershed prioritization.
- Develop and implement watershed monitoring plans.
- Conduct comprehensive field reconnaissance.
- Select and plan restoration projects.

CHAPTER 4

Programmatic Changes

- Implement the recent Policy Plan amendment for countywide stream protection.
- Implement the stormwater management and erosion and sedimentation (E&S) control recommendations presented in the "Infill & Residential Development Study" report. A few of these recommendations are included below. A complete list of recommendations presented in this study is available on the Department of Planning & Zoning web page at:

  http://www.co.fairfax.va.us/gov/ocp/homepage.htm

  - Improve, in the E&S control review 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 E&S control inspection and enforcement process, the enforcement of violations including, in certain egregious instances, revoking of land disturbing permits.
  - Enhance, through educational programs, the knowledge and awareness of staff, the development industry, and citizens regarding the importance and capabilities of an E&S control program as well as create an E&S Hotline to improve program responsiveness.
  - Improve the design and installation of E&S control silt fences and super silt fences by improving the design standards in the County's regulations.

- Implement recommendations to enhance and promote best management practices (BMPs) as presented in the Infill & Residential Development Study. These recommendations include:

  - Provide additional guidance on BMP selection.
  - Enhanced BMP design standards in the Public Facilities Manual.
  - Establish a Countywide monitoring program to assess BMP performance.
  - Allow BMP credit for contributions to a "land trust fund".
  - Facilitate the implementation of bioretention/biofiltration facilities ("rain gardens"), underground sand filters in residential areas, and manufactured or ultra urban BMP systems in Fairfax as acceptable privately maintained BMPs.
  - Develop enhanced design features for extended detention and retention pond BMPs to increased pollutant removal efficiencies.
  - Encourage the retrofitting of existing stormwater detention-only ponds for water pollution treatment.

- Integrate Floodplain Management and Chesapeake Bay ordinances in future watershed master plans.

Citizen Involvement and Education

- Educate citizens about specific problems in their watershed (i.e. sediment, nutrients, trash, etc.).
- Promote riparian revegetation and tree planting.
- Educate Homeowner's Associations about tree planting and open space preservation.
- Partner with citizen groups where possible to achieve goals.
- Promote citizen volunteer monitoring.
- Promote storm drain stenciling.
- Promote watershed/stream naming and signs.
- Evaluate the effectiveness of different public involvement and education programs and implement the most effective one.

Stream Monitoring Plans

- Evaluate merits of current SPS site placement.
- Utilize and promote volunteer monitoring programs.
- Select sites and implement monitoring of tributaries identified as "Assessment Priority Areas."
- Establish reference conditions within the County for both established and developing urban watersheds, particularly in the Coastal Plain region.
- Use measurable goals to assess long-term improvements and success of the SPS program.

Stream Assessment

- Conduct a comprehensive field reconnaissance of streams to inventory resources and identify potential project areas.
- Conduct stream assessments to obtain physical and habitat information.
- Establish design criteria such as bankfull conditions for selected project areas.

Site Development Practices

- Use low-impact development and "ecological friendly design" techniques.
- Implement recommendations by the Tree Preservation Task Force which include:
  - Minimize grading to increase tree preservation.
  - Include tree buffer protection and restoration.
  - Request conservation easements where appropriate.
- Implement stormwater management, E&S controls and BMP recommendations as discussed above.

CHAPTER 4

"Ecological Friendly Design" (EFD) Practices

Over the last few years, several efforts have been focused on the application of new approaches to conventional stormwater management practices. These practices acknowledge the link between sound water resource management and effective ecosystem management, which maintains or improves the integrity of the aquatic living resources, the physical attributes of receiving streams and the quality of life for citizens.

EFD promotes the concept of a holistic approach to sound ecosystem management. EFD practices feature integrated watershed management strategies that encompass planning, monitoring, maintenance, capital improvements and public education as primary components. In Fairfax County, in addition to the SPS program, the EFD approach would include the application of the following:

- ***Innovative BMPs***
  These include an array of fairly new techniques that utilize such practices as manufactured or proprietary devices to remove pollutants from stormwater runoff on a small scale through chemical or physical methods, bioretention/biofiltration or "rain gardens," sand filters, bioengineering and constructed wetland systems.

- ***Low-impact Development Design (LID)***
  This approach enhances our ability to protect surface and groundwater quality and maintains the integrity of streams and living aquatic resources through the creation of a hydrologically functional landscape that mimics the natural hydrologic regime *(Prince George's County, MD, June 1999)*. LID accomplishes its objective by reducing imperviousness, conserving natural resources and ecosystems, maintaining natural drainage courses, reducing storm sewer pipes, minimizing clearing and grading, using a variety of detention and retention practices, maintaining predevelopment times of concentration and implementing effective public education programs.

- ***Ecosystem-based Process***
  This approach establishes a framework for planning or restoring communities by linking the social, economic and ecological dimensions of a particular geographic area and using the natural environment as its foundation. The goal of this process is to conserve, maintain, restore or develop a vibrant community, viable economy and a healthy environment over the long term. The process also recognizes that ecosystems change over time and are affected by human influences; however, these changes need to be monitored and balanced. The ecosystem-based process emulates natural processes to use natural resources in a sustainable way so that valuable resources are not depleted or degraded. This process strongly advocates the involvement of all stakeholders in the planning process to achieve understanding, buy-in and balance among the three dimensions (social-economic-ecological).

- ***Other stormwater management strategies***
  It is recognized that there is often spatial, regional and national variability in the selection of appropriate practices, as well as in the design constraints and pollution control effectiveness of practices. It is widely believed that the cumulative effect of onsite controls influence regional conditions which in turn influence conditions nationally. On the national scale, recent efforts have been concentrated on the development and implementation of TMDLs to reverse impairments in water bodies due to one or more pollutants exceeding applicable water quality standards. On the regional level, efforts are being concentrated on reversing water quality degradation within the Chesapeake Bay ecosystem through implementation of a multi-state agreement. The new Chesapeake 2000 Agreement was executed in June 2000 by the Governors of Virginia, Maryland and Pennsylvania, the mayor of Washington, D.C., the U.S. Environmental Protection Agency (EPA) and the Chesapeake Bay Commission. Implementation of the Chesapeake 2000 Agreement is expected to include an enhanced Tributary Strategy for major watersheds feeding into the Chesapeake Bay. Each contributory state is expected to develop and implement, on a locally collaborative and voluntary basis, its own Tributary Strategy. The main goals of the Tributary Strategy are to achieve improved water quality, effectively control pollutants causing impairment to the Chesapeake Bay and to avoid the requirement by EPA for a bay-wide TMDL by year 2011. Previous Chesapeake Bay Agreements led to the adoption of a Chesapeake Bay Preservation Ordinance in Fairfax County which established Resource Protection Areas (RPAs) along stream corridors and Resource Management Areas (RMAs) elsewhere in the County. Therefore, EFD practices would also include these and any other global methods advocated by local, state or regional bodies to achieve mutually desirable outcomes in terms of measurable water quality enhancements. EFD practices definitely include stream preservation and restoration of local streams guided by the designation of Management Categories being recommended for watersheds in this report.

CHAPTER 4

OTHER ENVIRONMENTAL INITIATIVES

Fairfax County's SPS program currently supports several ongoing environmental initiatives at the County, State and Federal levels all of which assist in achieving the goal of preservation and restoration of stream quality. Over time, SPS will become even more integrated with the following programs:

- Watershed management/master plans
- Chesapeake 2000 Agreement implementation
- National Pollutant Discharge Elimination Systems (NPDES)
- Total Maximum Daily Loads (TMDLs)
- Fairfax County's Policy Plan (Environmental Section)
- Citizen Volunteer Stream Monitoring
- Amendments to Public Facilities Manual (PFM), including the Infill and Residential Development Study recommendations
- Stormwater Environmental Utility implementation
- Virginia Riparian Buffer Initiative – Chesapeake Bay Program

Watershed Management/Master Plans

The most recent Countywide Master Plan for Flood Control and Drainage was developed during the 1970's and, as such, does not address fully the issues of either increasing urbanization or changes in federal and/or state water quality requirements that have taken place in the last 30 years.

To complete new comprehensive watershed master plans for the entire County within five to seven years, the current approach is to prioritize watersheds based on characteristics such as stream water quality ranking, development potential, existing improvement project needs and potential development impacts. In the first year, the master planning process will focus on the highest priority watersheds.

A comprehensive Stormwater Control Master Plan will include several components such as:

- Comprehensive field reconnaissance, compilation of reports, and use of GIS to map stream conditions, storm drainage systems and stormwater control facilities, including privately maintained facilities.
- Development of watershed management goals to achieve improvements in flood and water quality control, restoration of stream habitat and implementation of strategies to protect stream ecosystems.
- Review of monitoring results from water quality sampling and stream evaluation efforts such as the Stream Protection Strategy (SPS) program.
- Review of infrastructure deficiencies and maintenance needs to develop effective plans for achieving desired levels of service.

- Development of alternatives to address identified deficiencies; to meet federal, state and County water quality improvement requirements; and to accomplish the watershed management goals of the County.
- Evaluation of alternatives with cost estimates.
- A schedule of improvements for implementation as part of the overall Plan.
- Evaluation of the capabilities of available watershed modeling tools, selection of the most appropriate one(s) and development of watershed models of all County watersheds to analyze impacts of stream quality and stormflow quantity on present and future conditions.
- General scope and cost of improvement projects.
- A formalized public education/information program.

Chesapeake 2000 Agreement

The Chesapeake Bay is worthy of the highest levels of protection and restoration because it is North America's largest, most biologically diverse estuary, home to more than 3,600 species of plants, fish and animals. On June 28, 2000 representatives of Virginia, Maryland, Pennsylvania, Washington, D.C., U.S. Environmental Protection Agency and the Chesapeake Bay Commission signed a new Chesapeake Bay Agreement to reaffirm their commitment to the protection and restoration of ecological integrity, productivity and beneficial uses of the Chesapeake Bay system (Chesapeake 2000 Agreement).

Fairfax County lies within the Chesapeake Bay watershed and therefore shares the responsibilities of maintaining a cleaner, healthier Chesapeake Bay system. The new Chesapeake 2000 Agreement includes several commitments that will impact local government programs, organized in the following general categories:

- ✓ Stormwater Management and Sediment Control
- ✓ Stream Restoration
- ✓ Watershed Planning
- ✓ Land, Forest and Wetland Conservation
- ✓ Land Use and Development

As part of the Chesapeake Bay Initiatives, Fairfax County will be expected to develop and implement individual, locally supported watershed management plans for each of its watersheds by the year 2010. The County has commenced with the development of new watershed management plans with the support of the results from the SPS baseline study. The SPS program will continue to fulfill an important role in monitoring the progress of watershed management plan improvements and assessing the County's contribution to reversing impairment of the Chesapeake Bay.

CHAPTER 4

National Pollutant Discharge Elimination Systems (NPDES)

The federal Clean Water Act enables the U.S. Environmental Protection Agency (EPA) to authorize the states to carry out certain EPA responsibilities, such as issuing National Pollutant Discharge Elimination System (NPDES) permits. EPA has authorized Virginia, under the Virginia Department of Environmental Quality (DEQ), to issue NPDES permits, called Virginia Pollutant Discharge Elimination System (VPDES) permits, which are enforceable under both federal and state laws. Individual VPDES permits are issued by DEQ to localities and also to entities, such as wastewater treatment facilities and some industrial plants, which discharge directly into the streams from a distinct point.

In January 1997 Fairfax County was issued its first general VPDES permit, which requires conducting countywide monitoring, reporting annually to DEQ and managing stormwater to reduce nonpoint source pollution to the 'maximum extent practicable' (DPWES 1999). Designed to detect illicit discharges, countywide chemical monitoring during both storm events and dry-weather flow conditions is the cornerstone of the VPDES program in Fairfax. The County, with the assistance of several instrumental organizations within Fairfax, administers the VDPES program with the goal of attaining good water quality throughout the County. These organizations work together to promote improved stream quality and a higher level of public awareness with programs including BMP research projects, stream monitoring, stream clean up, training, and information dissemination by citizen volunteers.

As federal and state emphasis on water quality issues increases, localities are likely to be required to increase the scope of their NPDES/VPDES programs. Several other localities have incorporated biological monitoring, in addition to the traditional chemical monitoring, into their NPDES programs. Fairfax County's SPS program has established a framework that could likewise be used to support these additional requirements.

Total Maximum Daily Loads (TMDLs)

The Total Maximum Daily Load (TMDL) program of the U.S. Environmental Protection Agency (EPA) provides a national framework for identifying impaired waters, determining pollution sources, and developing restoration strategies. Authority for the TMDL program is vested in Section 303(d) of the Clean Water Act (CWA), which requires each state to identify surface waters not meeting water quality standards. As with the VPDES permits, DEQ has the responsibility to oversee or implement the development of TMDLs for impaired water bodies throughout Virginia. Impaired water bodies are placed on the 303(d) list for a specific pollutant (i.e.: NH_3-N, or ammonia bound nitrogen) and may be listed multiple times for different pollutants.

In Fairfax County the following stream segments are on the 303(d) impaired list:

Stream	Impairment
Difficult Run	Benthic and Fecal Coliform
Four Mile Run	NH_3-N and Fecal Coliform
Hunting Creek	NH_3-N
Accotink Creek	Benthic and Fecal Coliform
Daniel's Run	Benzene and Toluene
Pohick Creek	NH_3-N

The development of a TMDL for an impaired waterbody includes the following steps:

- Identification of pollutant sources
- Determination of allowable pollutant amount
- Required load reduction to meet water quality standards
- Pollutant load allocation among point and nonpoint sources
- An implementation plan to reverse the impairment within a certain timeframe

In December 1998, as part of a statewide study, the United States Geological Survey (USGS), Virginia Department of Conservation and Recreation (DCR), DEQ and Fairfax County entered into a partnership to pursue a bacteria source tracking study and TMDL development for Accotink Creek (See Accotink Watershed Summary). DCR has suggested that the implementation of proposed SPS baseline study management strategies for Accotink Creek could be an acceptable component of a TMDL implementation plan. SPS could provide the framework to assist in the implementation plan for other TMDLs countywide.

Fairfax County's Policy Plan (Environmental Section)

In June 1998, the Planning Commission's Environment Committee, in coordination with members of the Fairfax County Environmental Quality Advisory Council (EQAC), began a review of the County's Policy Plan as it relates to stream protection issues. The purpose of this review was twofold: first, to determine if stream protection issues are addressed adequately by the *Policy Plan* and second, to consider a *Policy Plan* amendment incorporating more explicit language regarding stream protection. The focus of this review was limited to stream protection issues affected by review of development applications that come before the Planning Commission, the Board of Zoning Appeals and the Board of Supervisors.

At the request of the Planning Commission's Environment Committee, staff of the Fairfax County Department of Planning and Zoning (DPZ) prepared a background paper identifying current *Policy Plan* sections related to stream protection and suggesting consideration of a new stream protection Objective within the *Policy Plan*. The background paper also identified design techniques to reduce the impact of development on stream systems and recommended incorporating guidance regarding such techniques into the amendment.

CHAPTER 4

On October 30, 2000 the Board of Supervisors adopted the *Policy Plan* amendment for Fairfax County that further defines practices regarding the County's stream resources and provides design guidance to be applied during the development review process. The implementation of SPS clearly provides support for the revised *Policy Plan*, which also heightens the priority of stream protection.

Citizens Volunteer Stream Monitoring

Data collected by citizens has been shown to be useful in assessing water quality and is becoming more widely used at the state and federal level. The citizen monitoring programs in Fairfax County generate information about stream quality and foster environmental stewardship. Three main programs exist within the County: the Northern Virginia Soil and Water Conservation District's Save Our Streams Program, the Audubon Naturalist Society Water Quality Monitoring Program and the Adopt-A-Stream Program. The SPS program works closely with these volunteer groups to incorporate their data into overall County water quality assessment. Volunteer groups will be of even greater importance as the Stream Protection Strategy program grows and examines each watershed more closely.

Amendments to Public Facilities Manual (PFM)

Since its establishment in 1963, the Fairfax County PFM has undergone several revisions and amendments, which have led to the current edition adopted by the Board of Supervisors in August 1997. The current PFM sets forth the guidelines governing the design of all public facilities and contains a section specifically addressing storm drainage by requiring that public facilities meet or exceed all applicable drainage laws. Several policies regarding stormwater are outlined in the PFM including:

- Erosion and sediment control practices
- Stormwater detention
- Stormwater quality control practices
- Floodplain management
- Design criteria for stormwater control structures, appurtenances and conveyance systems

During the last decade in the County, stormwater management has experienced increased attention relating to water quality issues. This attention, coupled with development patterns, has generated significant challenges to the County's ability to deal effectively with stormwater. An effort to address these challenges was the "Infill and Residential Development Study" requested by the Board of Supervisors in May 1999. This study is ongoing but a "Draft Staff Recommendations Report" was published in July 2000.

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The infill study provides a framework for discussion of issues concerning residential development in the County, some of which could apply to other types of development. The trend of development in Fairfax County is future residential development occurring with increasing frequency in areas adjacent to or within established neighborhoods. The most commonly cited problems with infill development are:

- Compatibility of the new development with the existing neighborhood/area, including lot size, house size, house orientation, setbacks, topography, etc.
- Additional traffic congestion and cut-through traffic.
- Loss of trees/tree preservation and the loss of open space in the neighborhood.
- Storm drainage and erosion control.

Staff have reviewed the effectiveness of current policies regarding erosion control and storm drainage with the dual goal of minimizing any impacts of stormwater from a proposed development on downstream property and limiting the impacts of stormwater management facilities on a neighborhood. Some of the recommendations presented include:

- An enhanced erosion and sediment control program.
- Adoption of innovative BMPs.
- Improved requirements for early review of stormwater management facilities as part of the rezoning process.
- Improved requirements for evaluating the adequacy of stream channels for increased runoffs due to new developments.
- Adoption of a water quality control retrofit program.
- Development of a BMP monitoring program.

The component of the infill study relating to storm drainage and erosion impacts is closely linked to SPS program objectives, and SPS will have a significant role in supporting the implementation of these recommendations, which could lead to PFM amendments.

Stormwater Environmental Utility Implementation

Between summer 1999 and March 2000, DPWES staff, with assistance from a consultant, developed a concept paper expressing the “vision” for a comprehensive stormwater management (SWM) program for Fairfax County. The report describes a compelling need for, and expected benefits of, a proactive, comprehensive stormwater management program to replace the current, limited program. The paper also recommends that the County undertake an extensive public education and outreach effort enabling staff to: raise awareness of problems with continuing the current, piecemeal program; provide a vision of a potential, comprehensive program; and assess the public’s interest in funding mechanisms to make the vision a reality.

The current SWM program is inadequate due to increased emphasis in recent years on stormwater quality and pollution control, annual funding limitations, the growing inventory of stormwater facilities, continuing degradation of streams, increased citizen complaints and expectations, greater ecological awareness and regulatory pressures. To foster a more proactive approach to SWM, the consultant's report recommended three major components of master plans — Watershed Improvement Plans, Stream Protection Master Plan and a Maintenance Program Master Plan. The SPS program has already established the framework necessary to support all three components of a master plan to achieve a more comprehensive SWM program.

One approach for achieving a dedicated and reliable funding source for a comprehensive SWM program would be to establish a Stormwater Environmental Utility. Many communities across the United States are searching for workable ways to fund stormwater management and water quality programs. The first few stormwater utilities were started in the early 1970's and, despite some initial acceptance problems, the number of stormwater utilities has increased rapidly (Kaspersen, 2000). A 1994 EPA report estimated the total in the United States at just over 100, and today there are more than 500 nationwide. By one estimate, the country will have 2,500 stormwater utilities within the next 10 years.

Virginia Riparian Buffer Initiative

As part of the implementation of the Chesapeake Bay Agreement, a policy was developed in 1994 by the Chesapeake Executive Council to recognize the value of riparian forest buffers as a mechanism to enhance stream water quality. The policy was adopted by the Chesapeake Executive Council in October 1996. The policy outlined the support of an integrated and comprehensive approach to the conservation of riparian areas. Some of the key goals adopted were as follows:

- To assure, to the extent feasible, that all streams and shorelines will be protected by a forested or other riparian buffer.
- To conserve existing forests along all streams and shorelines.
- To increase the use of all riparian buffers and restore riparian forests on 2,010 miles of streams and shoreline in the Chesapeake Bay watershed by 2010, targeting efforts where they will be of greatest value to water quality and living resources.

The Virginia Department of Forestry, with assistance from local volunteer groups and organizations, has been actively implementing a riparian buffer restoration program in Fairfax County since adoption of the policy. This effort resulted in over six thousand tree seedlings being planted in riparian zones throughout the County during 1999 alone. SPS also recognizes the value and benefit of maintaining a healthy stream riparian buffer system as one strategy towards improving overall stream habitat and water quality.

CHAPTER 5

SUMMARY & RECOMMENDATIONS

The overall goal of the SPS study was to provide comprehensive baseline information on stream conditions in Fairfax County through biological and physical habitat assessments, and based on these results, assign priorities for watershed management. This overall goal and the purpose for the study were achieved.

In summary, this SPS Baseline Study achieved the following:

- Enabled Fairfax County staff and the public to have a better understanding of the degree of stream degradation in the County.
- Established Watershed Management Categories that outlined strategies and measures that, if implemented, could be effective in reversing the negative trends of stream degradation and the protection of stream resources.
- Identified areas to be treated on a priority basis for the allocation of resources toward development of comprehensive watershed master plans.
- Demonstrated how SPS supports and integrates with other ongoing and future environmental policies, initiatives and regulations.
- Provided a basis for moving ahead with implementation of stream restoration and preservation efforts and assessing future conditions of County streams.
- Established working partnerships with citizens and provided the basis for continual environmental stewardship by supporting other monitoring efforts.

The methods and detailed results of the study were presented in Chapters 2 and 3. Priorities and recommendations for watershed management were presented in Chapter 4. This chapter provides a summary of the results and presents recommendations for future work to achieve and enhance water quality goals.

Streams within Fairfax County exhibit a diverse range of conditions. While field monitoring isolated numerous systems with high biological and habitat quality, it also highlighted many areas where substantial degradation has taken place (Figures 5, 6, and 7). Levels of drainage imperviousness are known to influence stream condition, and spatial analyses of land cover characteristics indicate that a large percentage of County watersheds currently have imperviousness levels that are within or above the range (10 – 20%) at which biological impairment is generally accepted to occur. (Figure 8).

The systems of high integrity that still exist within the County's boundaries are typically found only in largely undeveloped watersheds. Conversely, the most degraded streams are those that flow through areas of the most intensive development (Figure 10). This pattern is even more pronounced in drainages containing older developments that often lack the more recently developed and more efficient stormwater controls.

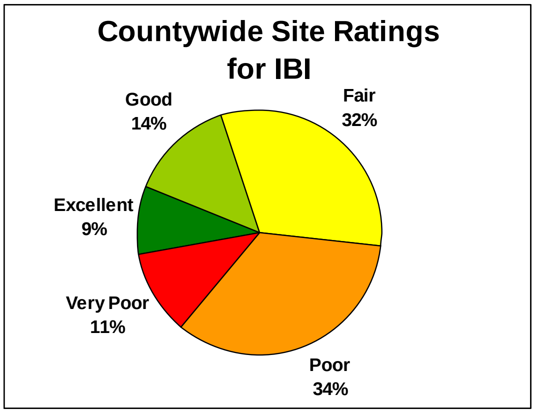

Figure 5. Percentage of SPS monitoring sites scoring in each of the five IBI quality categories.

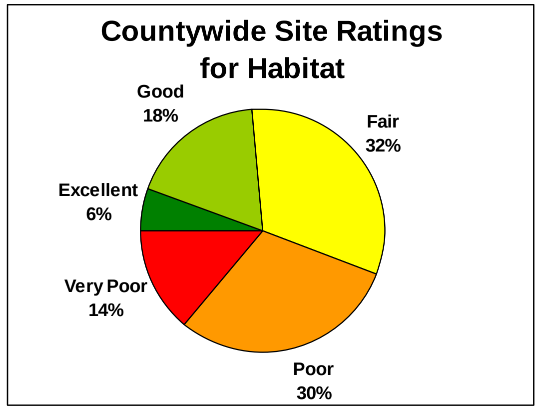

Figure 6. Percentage of SPS monitoring sites scoring in each of the five Habitat quality categories.

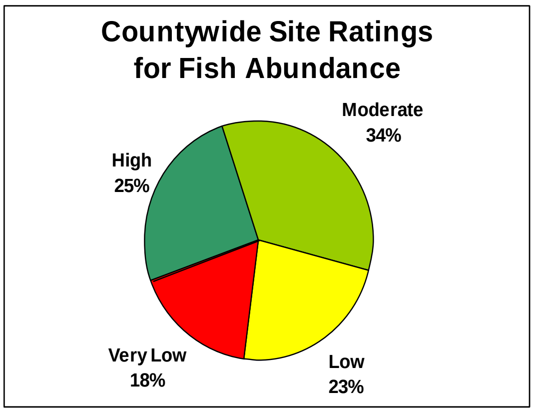

Figure 7. Percentage of SPS monitoring sites scoring in each of the four Fish abundance categories.

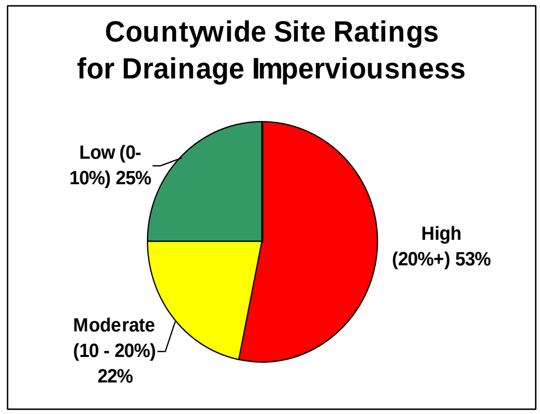

Figure 8. Distribution of Imperviousness at SPS monitoring sites.

The impact of land alteration on aquatic systems within the County is twofold: (1) widespread instream habitat degradation from channel incision and widening caused by high storm flows and (2) excessive sediment loading (with the associated high levels of deposition) from instream erosion and sometimes poorly installed and/or maintained controls at construction sites.

Consistent with what has been reported in the literature (Klein, 1979, Booth, 1991, Schueler et al, 1992, Booth et al, 1993, Booth and Jackson, 1994 and Boward et al, 1999) this study showed a statistically significant relationship between drainage area, imperviousness and biological quality at a site (see Appendix B for details on the statistical analyses). Figure 9 shows the relationship between biological integrity and drainage area imperviousness. The trend line shown in the figure is presented to highlight the fact that impervious area generated during development is correlated with declining stream quality as measured by macroinvertebrate community health. However, the relationship in its current form (linear) should not be used for predictive purposes since that would require a more detailed statistical analysis.

CHAPTER 5

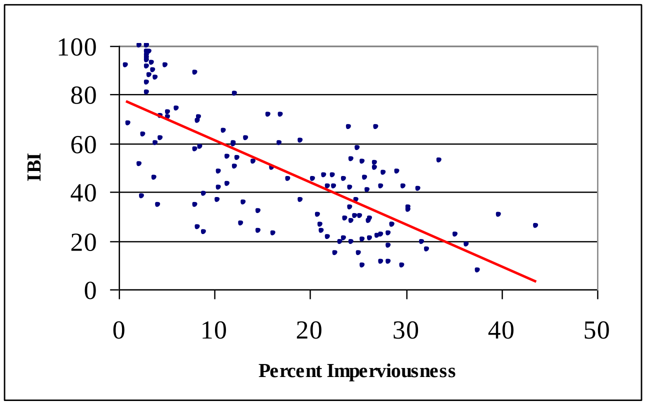

Figure 9. Trend line indicating that Biological integrity, as measured by an Index of Biotic Intetrity (IBI) for benthic macroinvertebrates, generally decreases with increasing percent imperviousness. Appendix B includes information on the statistical significance of the data presented.

To address the many issues of stream quality, an innovative approach will be needed, with the SPS program as the cornerstone. The County has already begun the process by improving the existing erosion and sediment inspection program, updating and enhancing the EQC policy and enforcing existing environmental regulations. These changes must continue with an attitude shift toward viewing streams as important natural resources and functioning ecosystems. Many new technologies are available in the field of stormwater management and bioengineering, which can be used to eliminate or substantially limit the impact of development on adjacent aquatic systems.

The goal of protecting and restoring stream quality is an achievable one, but the key to success will be found only in a diverse approach which includes an active and ongoing stream monitoring effort, community education, improving stormwater controls, and enhanced channels of communication with site developers. The SPS program is but one component of the larger effort that will be needed, but its initial creation and subsequent integration with many other existing programs is a vital first step.

Countywide Conditions

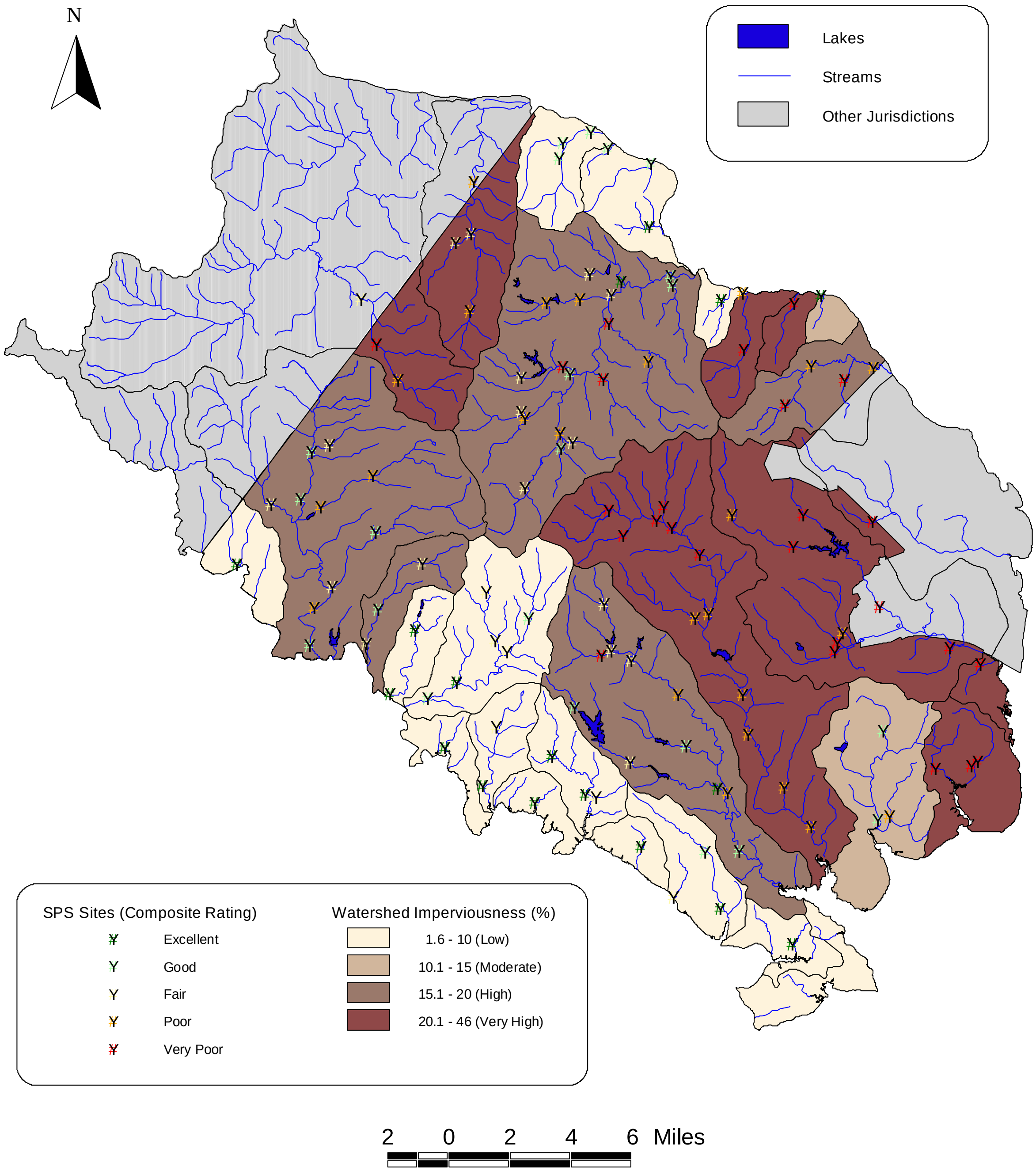

Figure 10. Relationship between imperviousness and overall stream condition.

CHAPTER 5

This baseline study identifies and prioritizes areas with the greatest needs, and creates a foundation for implementing targeted monitoring and remediation efforts in the future. The recommended management classifications are each characterized by a set of goals and strategies that best suits each respective environment given our current level of understanding. The overall objective is to recommend measures to protect the highest quality streams and actively restore degraded streams to the most practical extent possible. The management categories are as follows:

Watershed Protection (31.5% of County)
Primary goal: Preserve biological integrity by taking measures to identify and protect, to the extent possible, the conditions responsible for current high quality rating of these streams. Watershed Protection Areas have the highest priority and require immediate attention to assure their current biological integrity is maintained.

Watershed Restoration Level I (7.2% of County)
Primary Goal: Re-establish healthy biological communities, where feasible, by taking measures to identify and remedy the cause(s) of stream degradation both broad scale and site specific. Watershed Restoration Level I Areas have the greatest opportunity for improvement based on current conditions and proposed development. Restoration plans should be developed and implemented for these watersheds first.

Watershed Restoration Level II (61.3% of County)
Primary Goal: Maintain areas to prevent further degradation and implement measures to improve water quality to comply with Chesapeake Bay Initiatives, Total Maximum Daily Load (TMDL) regulations and other water quality initiatives and standards. Areas designated as Watershed Restoration Level II will need to be prioritized based on stream order (headwater vs. mainstem), current and potential development, existing improvement projects, regulatory requirements and other initiatives.

CHAPTER 5

FUTURE ASSESSMENT

The results in this report are only intended to provide a snapshot of stream quality conditions as they exist today. As such, this baseline study should be seen only as the beginning phase of the permanent monitoring effort that will be needed for effective management of aquatic resources within the County. If appropriate decisions are to be made, trends in stream conditions will need to be identified and assessed over the long term. This will require expanding our base of understanding of streams, and components of any future SPS program should involve:

- Expanding analyses of existing spatial data sets
- Continuing to monitor existing SPS sites on a rotating basis
- Establishing a detailed visual assessment program at the subwatershed level
- Assessing variables influencing fish community composition and distribution
- Promoting the expansion of volunteer monitoring efforts
- Defining and identifying perennial stream networks within the County
- Assessing relative contribution of various sources of instream sediment
- Evaluating alternate site selection design to allow for more rigorous analyses
- Assisting with assessments of effectiveness of various BMP technologies
- Monitoring changes in imperviousness at the watershed and subwatershed levels
- Improving inter-agency cooperation regarding sediment control implementation and maintenance
- Fostering community interest in stream quality issues.

Spatial Analysis

Assessments of the relationship between land use and stream condition should be expanded to include other variables. Specifically, comparisons should be made between current site composite ratings and percent forest cover, proximity to upstream impoundments, extent of parkland and Resource Protection Areas, and age of development. Each of these examinations should be made with respect to the contributing drainage area of each SPS monitoring location.

Long Term Monitoring

All environmental monitoring relies on repeated observation to provide the most complete picture of environmental processes. In this vein, all County watersheds should be re-sampled in coming years to both highlight changes in conditions as well as develop a broader information base. Identification of ongoing trends, both on a large- and small-scale, will provide a basis for targeting management activities in the future. Annual re-sampling should include at least 20 – 25% of SPS sites each year. Areas of priority concern (i.e., those potentially reaching a threshold for integrity) should be reassessed first and more frequently, potentially with an expansion of monitoring efforts within the respective subwatersheds.

Visual Assessments

Given the limited scope of this initial baseline study, many questions remain as to the actual extent of degradation within many watersheds. As a first step, County streams should be walked in full to identify areas of both large- and small-scale concern and to better understand factors influencing basin-wide patterns in stream condition. Such efforts would also be useful in highlighting otherwise undiscovered problems where property or other infrastructure requires maintenance or repair. Site-specific information should be collected using a GPS unit for use within a GIS environment. Given the amount of time required to complete such a task within all of the County's watersheds, areas of priority concern should be targeted first. This effort could be integrated with a comprehensive watershed master planning effort.

Fish Community Metrics

Many questions remain regarding fish communities in many County watersheds. Specifically, further study is needed of the factors influencing measures of relative abundance, composition, and distribution, with an eye toward developing a useful suite of metrics for broad-scale comparisons. Of specific concern are the compounding effects of instream fish barriers, stocking efforts, and the relative proximity of large rivers systems. Impoundments should also be assessed with regard to their impact on fish movement as well as their influence on stream temperature, sediment load, and nutrient content.

Volunteer Monitoring Efforts

Subwatersheds designated within this report as Assessment Priority Areas should be a primary focus of future biological sampling efforts. The expansion of the volunteer monitoring program, with the help of the NVSWCD and ANS, would be of great benefit in this regard. Reliable volunteer data could be used to help develop a broader information base, particularly in areas of priority concern where more detailed examinations are warranted. It is also recommended that volunteers receive training in identifying possible violations of County E&S regulations. Broader involvement of citizen volunteer monitors could promote greater environmental stewardship, heighten public awareness and provide support for public education.

CHAPTER 5

Stream Network Assessment

Perennial or "permanent" streams within the County were identified based upon the USGS 1:24,000 topographic maps, a standard source used by many resource management agencies at the federal, state, and local levels. It has been argued, however, that the resulting coverage is incomplete and inaccurate and that a more rigorous definition needs to be developed. Once this criteria is established, perennial streams within the County could be identified and inventoried as part of the ongoing visual assessment efforts detailed above. This would again require the use of GPS units so that the resulting information could be incorporated as part of land use analyses within a GIS environment. In this process, it is also recommended that the many unnamed tributary systems found in all watersheds be given title designations, a process that would allow for better referencing and serve to enhance citizen identification and ownership of streams.

Instream Sediment Studies

Since sediment is a serious pollutant in County streams, pilot studies should be undertaken to determine the relative contribution of specific sources (i.e., instream erosion versus site development) and to look at ways to mitigate the associated degradation. As an important step toward better voluntary compliance with the Chesapeake 2000 Agreement, attempts should also be made to quantify sediment loads leaving County streams. Any stream restoration activities will also require better estimates of current rates of erosion and bend migration to ensure viability. Controlling the amount of stream sediment loading must be a major priority for the SPS as well as other County environmental programs, particularly in light of recent issues surrounding the intake system for the Potomac River water supply. Additional training in stream classification and morphological assessment methodology is recommended for all County personnel with a stake in affecting stream restoration.

Study Designs Modifications

A re-evaluation of current SPS study site placement is recommended. Other, more statistically rigorous alternatives may be useful in allowing for more detailed analysis of data collected in the future. Specifically, the use of a more randomized sampling design would allow for more direct comparison of site characteristics both within stream orders and between subwatersheds and physiographic regions.

Stormwater Control Effectiveness

Assessments of new BMP technologies should be an ongoing process as recommended by the recent draft of the Infill and Residential Development Study. Detailed cost-benefit analyses and a better overall understanding of their applicability within Fairfax County is needed. Both pre- and post-implementation monitoring should be conducted to determine overall effectiveness of various designs.

Impervious Cover Estimation

As a primary component of the overall ranking system detailed in this report, levels of imperviousness within all County watersheds will need to be regularly reassessed and compared with the results of subsequent biological habitat monitoring. Efforts should also be made to develop applications within a GIS environment to automate, as much as possible, the detailed, multi-step processes (point delineation, clipping of land use coverages, tabulation of areas) that are necessary to develop impervious cover estimates. This could be used to further refine the relationship of imperviousness to biological integrity of County watersheds. GIS will likely play an increasingly significant role in the future.

Wetland Monitoring

Methods for monitoring coastal wetland areas with variable drainages, such as the entire High Point Watershed, will need to be developed. These areas cannot currently be sampled under the RBP protocol, which requires clearly defined stream systems. The value of various indicators, such as macroinvertebrates, amphibians, and even plants, will need to be assessed with regard to their utility in highlighting degradation in wetland environments.

SPS monitoring can be incorporated into the new countywide wetland delineation and evaluation study currently being undertaken jointly with George Mason University personnel.

Inter-Agency Cooperation

With regard to monitoring for and responding to violations of E&S regulations at sites under development, SPS should work to strengthen its relationship with the Office of Site Inspection. Cross training of staff from both agencies should be encouraged.

Promoting Public Awareness

A major goal of the SPS program has been and will continue to be increasing community involvement and awareness in water resource issues. To this end, further developments of the SPS site on the World Wide Web are needed. This should include adding summaries of the information detailed in this current report, as well as periodic updates on monitoring efforts and management activities aimed at restoration and overall stream quality improvement. It is also recommended to develop an online GIS server, which would enable County residents to obtain information on stream health in their own neighborhoods on a continual basis.

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GLOSSARY

A

Andrews Curve - A graphical approach to viewing patterns of similarity or dissimilarity based on multi-dimensional data.

Anthropogenic - Effects or processes that are derived from human activity.

B

Base Flow - The sustained portion of stream discharge that is drawn from natural storage sources and not affected by human activity or regulation.

Baseline Monitoring - Data collection intended to define existing biological conditions and to set up a framework for long-term study.

Benthic - That portion of the aquatic environment inhabited by organisms which live permanently in or on the bottom.

Benthic Macroinvertebrate - An aquatic animal lacking a backbone and generally visible to the unaided eye.

Best Management Practice (BMP) - Structural or nonstructural practice that is designed to minimize the impacts of change in land use on surface and groundwater systems.

Biomonitoring - The use of living organisms to assess environmental conditions.

Bioretention Basin - Water quality BMP engineered to filter the water quality volume through an engineered planting bed, consisting of a vegetated surface layer (vegetation, mulch, and ground cover), planting soil, and sand bed (optional), and into the in-situ material. Also called a Rain Garden.

C

Channelization - Strengthening, widening, deepening, clearing, or lining of existing stream channels.

Clean Water Act - A law enacted by the United States Congress in 1972 and enforced by the Environmental Protection Agency on the national level and the Georgia Environmental Protection Division on the local level. The Clean Water Act established three main goals: "zero discharge" or the elimination of polluting discharges to the nation's waters by 1985; "fishable and swimmable waters" or the restoration and protection of water quality and wildlife habitat; and "no toxins in toxic amounts" or the prohibition of the discharge of toxic pollutants in amounts that are toxic to the environment or life.

Clingers - An aquatic macroinvertebrate that is able to cling to substrates and maintain itself in fast flowing water.

Coastal Plain - The physiographic province that lies along the Atlantic coast and extends inland to the Piedmont physiographic province. This area is generally characterized by low gradient, meandering streams with mobile sand/silt or gravel substrates.

Confluence - A flowing together of two or more streams.

D

Dissolved Oxygen - The amount of oxygen freely available in water and necessary for aquatic life and the oxidation of organic materials.

GLOSSARY

E

Ecoregion - A physical area that is defined by ecological factors such as meteorology, elevation, plant and animal speciation, landscape aspect, and soils.

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

Electrofishing - Fish sampling method using electrical currents to temporarily stun fish to facilitate capture.

Embeddedness - Refers to the extent to which stream substrate (gravel, cobble, boulders and snags) is filled and/or covered with silt, sand, or mud.

Epifaunal Substrate - The variety of natural structures in the stream, such as cobble (riffles), large rocks, fallen trees, logs and branches, and undercut banks, available as refugia, feeding, or sites for spawning and nursery functions of aquatic macrofauna.

EPT - A group of three orders of insects: mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) which are used to determine stream health based on their sensitivity to pollution.

F

Family Biotic Index (FBI) - The general tolerance/intolerance of an assemblage that considers the numbers of individuals in each tolerance class at the family level taxonomic resolution.

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

Fish Barrier - An obstacle in a stream or river, such as a dam or elevated culvert, that prevents the up and downstream movement of fish and other aquatic species.

Flood Plain - For a given flood event, that area of land adjoining a continuous water course which has been covered temporarily by water.

Functional Feeding Group (FFG) - A categorization of a biological community based on its trophic or feeding level within its environment (shredder, predator, scraper…).

G

Gabion - A wire basket or cage that is filled with gravel and generally used to stabilize stream banks and improve degraded aquatic habitat.

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.

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

Global Positional System (GPS) - Network of satellites that emit continuous location-finding radio signals; GPS receivers use the signals from multiple satellites to determine their exact three-dimensional coordinates (latitude, longitude, and height).

GLOSSARY

H

Habitat - The environment in which an organism lives.

Headcut - A place with an abrupt change in a stream profile, generally formed by the presence of a rock layer resistant to erosive force of the stream flow.

Hilsenhoff Biotic Index (HBI) - The general tolerance/intolerance of the assemblage which considers the number of individuals in each tolerance class.

I

Impaired Stream - An aquatic system in which the water quality is degraded to an extent such that resident biological communities lack the diversity and/or abundance that would otherwise be present.

Impervious Cover - A surface composed of any material that significantly impedes or prevents natural infiltration of water into soil (i.e. sidewalks, houses, parking lots...).

Imperviousness - The percentage of impervious cover within a defined area.

Impoundment - A body of water contained by a barrier, such as a dam.

Instream Erosion - Erosion of stream banks caused by high flow rates.

Incised Channel Evolution Model (ICEM) - ICEM defines the stages through which stream channel morphology progresses after disturbance and can act as a useful predictor of future conditions.

Index of Biotic Integrity (IBI) - A stream assessment tool that evaluates biological integrity based on characteristics of the fish and benthic assemblage at a site.

Infiltration - The portion of rainfall or surface runoff that moves downward into the subsurface rock and soil.

Insectivore - An animal that feeds primarily on insects.

Intermittent Streams - Streams flowing temporarily or periodically rather than continuously throughout the year.

Intolerant Species - Populations of animals and/or plants that are adversely affected even at low levels of degradation.

Invertivore - An animal that primarily feeds on invertebrates.

L

Lentic - A non-flowing or standing body of fresh water, such as a lake or pond.

M

Metric - A characteristic of a habitat or biological community structure that changes in some predictable way with increased disturbance or divergence from normal, natural conditions.

N

National Pollutant Discharge Elimination System (NPDES) - Mandated by Congress under the Clean Water Act, a two-phased national program to address nonagricultural sources of stormwater discharge and prevent harmful pollutants from being washed into local water bodies by stormwater runoff.

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

Nutrients - Chemicals that are needed by plants and animals for growth (e.g., nitrogen, phosphorus). In water resources, if other physical and chemical conditions are optimal, excessive amounts of nutrients can lead to degradation of water quality by promoting excessive growth, accumulation, and subsequent decay of plants, especially algae. Some nutrients can be toxic to animals at high concentrations.

O

Outfall – Site of discrete water and/or effluent discharge.

P

Peak Flow - Refers to a specific period of time when the discharge of a stream or river is at its highest point.

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

Physiographic Provinces - A region whose pattern of relief features or landforms differs significantly from that of adjacent regions.

Piedmont Upland - This physiographic province bordered by the Atlantic Coastal Plain to the east and the Appalachian Mountains to the west and is generally characterized by rolling terrain with streams of moderate gradient and cobble/gravel substrates.

Q

Quality Assurance/Quality Control (QA/QC) - A system of procedures, checks, audits, and corrective actions to ensure that research design and performance, environmental monitoring and sampling, and other technical and reporting activities are of the highest achievable quality.

R

Rain Gardens - See Bioretention Basin.

Rapid Bioassessment Protocol (RBP) - A synthesis of techniques and methodologies for quickly assessing habitat and biological conditions in stream systems.

Rapid Stream Assessment Technique (RSAT) - A stream monitoring protocol for visually assessing instream and localized watershed conditions.

Reference Conditions - Conditions (i.e. habitat, chemical, biological) that reflect least impaired or best attainable conditions in a given area.

Reference Streams - Streams which exhibit highest quality or least impaired habitat conditions that are used as a standard to which all other streams are compared.

Resource Management Area (RMA) - That component of the Chesapeake Bay Preservation Area that is not classified as the Resource Protection Area. RMAs include land types that, if improperly used or developed, have the potential for causing significant water quality degradation or for diminishing the functional value of the Resource Protection Area.

Resource Protection Area (RPA) - That component of the Chesapeake Bay Preservation Area comprised of lands at or near the shoreline of water bodies that have an intrinsic value due to the ecological and biological processes they perform or are sensitive to impacts which may result in significant degradation to the quality of state waters. All other land outside RPAs within Fairfax County is considered RMAs.

Restoration - Improving conditions within a natural system so that its functional characteristics are comparable to its original, unaltered state.

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

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

Riparian Buffer - A transitional area around a stream, lake, or wetland left in a natural state to protect the waterbody from runoff pollution. Development is often restricted within such zones.

S

Shannon-Wiener Index - A measure of general richness and composition of a biological community.

Shredder - Macroinvertebrate functional feeding group in which the individuals feed off of large pieces of plant material (i.e. leaves, twigs and bark) that have fallen into the stream.

Silt Fence - Temporary sediment barrier consisting of filter fabric, sometimes backed with wire mesh, attached to supporting posts and partially buried.

Stormwater Runoff - That portion of precipitation that is discharged across the land surface or through conveyances to one or more waterways.

Subwatershed - A defined land area within a watershed drained by a river, stream or drainage way, or system of connecting rivers, streams, or drainage ways such that all surface water within the area flows through a specific point.

T

Taxon (plural - Taxa) - A taxonomic category or group, such as a phylum, order, family, genus, or species.

Tolerant Species - Animals and/or plants that can withstand high levels of degradation.

Total Maximum Daily Load (TMDL) - The maximum levels of a particular pollutant water body can receive in a given day without violating pre-established water quality standards. Total Maximum Daily Loads are the sum of point and nonpoint source loads.

Triassic Basin - This physiographic province is a subprovince of the Piedmont Upland. The geology consists largely of red sedimentary (sandstone, siltstone, shale, and conglomerate) rocks characterized by wide and gently rolling hilltops, with long gently sloping sideslopes and nearly level areas.

Turbidity - A measure of the suspended solids in a liquid.

U

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

W

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

Watershed Restoration - Improving current conditions of watersheds to restore degraded fish habitat and provide long-term protection to aquatic and riparian resources.

Wetland - Land that is saturated with water and which contains plants and animals that are adapted to living on, near, or in water. Wetlands have hydric soils and are usually located between a body of water and land.