Chapter 2:
Watershed Condition

2.1 General Watershed Information

The Little Hunting Creek Watershed is located in the Chesapeake Bay watershed in the southeastern part of Fairfax County, Virginia, as shown on Figure 2.1 and in greater detail on Map 2.1. It is bounded to the west by the Dogue Creek Watershed, to the south and east by the Potomac River, and to the north by the Belle Haven Watershed. The Little Hunting Creek Watershed encompasses 7,067 acres (11.042 square miles) and is located in the coastal plain physiographic province, a region characterized by sandy soil and low-gradient topography.

Figure 2.1 Location of the Little Hunting Creek Watershed

The headwaters of Little Hunting Creek are found in Huntley Meadows Park, located at the northwest border of the watershed. The creek flows in a southeasterly direction to its confluence with the Potomac River east of the historic Mount Vernon Estates. The Little Hunting Creek Watershed experiences tidal effects two to three miles upstream of its confluence with the Potomac River.

U.S. Route 1, also known as Richmond Highway, traverses the northwestern portion of the watershed and is the most heavily traveled roadway in the watershed. The George Washington Memorial Parkway is the second most heavily traveled roadway. It is located along the southeastern boundary of the watershed and runs parallel to the Potomac River. Mount Vernon Estates, the former home of General George Washington, is located at the southwestern tip of the watershed.

The Little Hunting Creek Watershed is part of the Chesapeake Bay Preservation Area (CBPA), and the entire main stream corridor of the Little Hunting Creek Watershed is located in the Resource Protection Area (RPA). The RPA is designated around all water bodies with perennial flows to protect the quality of water flowing to the Chesapeake Bay. The RPA totals approximately 858 acres in the watershed. The remainder of the watershed area is part of the Resource Management Area (RMA), and if improperly used or developed, could cause significant harm to water quality or diminish the functional value of the RPA.

2.2 History of the Watershed

Much of the land that is located in the Little Hunting Creek Watershed was once owned by General George Washington, as shown on the map in Figure 2.2. In fact, the original name for General Washington's Mount Vernon plantation was the Little Hunting Creek Plantation. The Little Hunting Creek Plantation's name was changed to Mount Vernon in the 1750s by General Washington's half-brother, Lawrence. One of General Washington's maps of his estate showed severe siltation near the mouth of Little Hunting Creek.

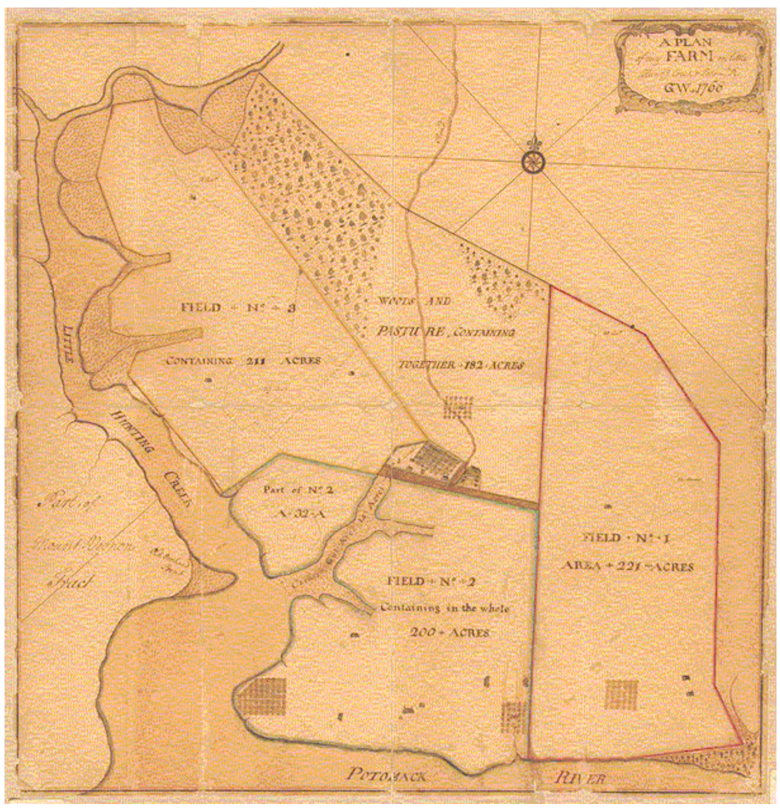


Figure 2.2 Map of Little Hunting Creek drawn by General George Washington

The original land grant from Lord Culpeper to George Washington's great-grandfather, John Washington, and Nicholas Spencer, was for 5,000 acres on or near Little Hunting Creek. That 5,000 acres was later evenly divided between the heirs of the two men in 1690, with the Little Hunting Creek property passing into the hands of George Washington's grandfather, Lawrence Washington. Through a series of deaths and remarriages, the land, by then known as Mount Vernon, became the property of George Washington, who spent a great deal of effort trying to acquire the lands that had been part of the original grant and reconstitute the original 5,000-acre parcel on Little Hunting Creek.

Fort Hunt Park is located along the Potomac River to the east of the mouth of Little Hunting Creek and is managed by the National Park Service. The land for Fort Hunt was purchased by the U.S. government in 1892 to establish a coastal defense fortification for the protection of the nation's capital. In 1930, the property was transferred from the War Department to the Office of Public Buildings and Public Parks of the National Capital for development as a recreational site along the newly established George Washington Memorial Parkway.

Huntley Meadows Park was once part of the plantation holdings of George Mason IV. It was acquired in the 1920s by Henry Woodhouse who planned to create the nation's greatest air center. The U.S. government purchased the land and used it as an asphalt road surface testing site in the 1940s. The Virginia National Guard provided anti-aircraft protection at this location for the capital in the 1950s. In addition, the Navy conducted highly classified radio communication research on the land before it was donated to Fairfax County in 1975 for use as a public park.

U.S. Route 1 passes through the Little Hunting Creek Watershed and was once known as Potomac Path. It is one of Fairfax County's oldest roads connecting the southeastern part of the county to Fredricksburg, Maryland. Potomac Path developed into an important colonial highway as a result of the 1662 Road Act of the Virginia Assembly.

2.3 Land Use and Impervious Cover

The residential, commercial, and industrial development in the Little Hunting Creek Watershed began in earnest in the late 1940s. Today, 82% of the developable land within the watershed has been developed, not including roadway right-of-way and wetlands. This watershed includes some of the oldest developed areas in Fairfax County. The total impervious area in the watershed is approximately 1,762 acres (25% of the total area). The percentage of each land use category that comprises the total impervious area is shown in Table 2.1. The impervious area was delineated by the county from the geographic information system (GIS) data showing the paved area and rooftops.

Table 2.1 Little Hunting Creek Watershed Imperviousness

Land Use	% of Total Impervious Area
Commercial/Industrial	18%
Residential	48%
Roads/Sidewalks	34%

The predominant existing land use in the watershed is medium-density, single-family residential, as shown in Table 2.2, with 33% of the watershed area consisting of a density of 0.5 to 1.0 acre per dwelling unit. The next major land use in the watershed is open space, parks, and recreational areas comprising 17% of the overall area. For ultimate future buildout of the watershed, medium-density, single-family residential land use may increase to 55% and the future watershed imperviousness may increase to 27%. The existing and future land use in the watershed is shown on Maps 2.2 and 2.3. The land use definitions are provided in Appendix A.

Table 2.2 - Existing and Future Land Use in the Little Hunting Creek Watershed

Land Use Description	Land Use			
	Existing Area (acres)	%	Future Area (acres)	%
Open space, parks, and recreational areas	1,200	17	1397	20
Estate residential	220	3	0	0
Low-density residential	851	12	0	0
Medium-density residential	2,316	33	3,860	55
High-density residential	580	8	391	5
Low-intensity commercial	335	5	289	4
High-intensity commercial	189	3	113	2
Industrial	36	1	4	0
Other	0	0	58	1
Unknown	14	0	15	0
Undeveloped	386	5	0	0
Road right-of-way (including shoulder areas)	855	12	855	12
Wetlands[1]	85	1	85	1
TOTAL	7,067	100	7,067	100

[1] This figure includes only delineated wetlands within the watershed and may not account for all existing wetlands.

The locations of vacant and underutilized parcels in the watershed are shown on Map 2.4. The vacant parcel data was obtained from the county's 2002 database and the underutilized parcel information was obtained from the county's 1999 database. Underutilized parcels with a comprehensive plan have a density greater than the existing land use on the parcel. Some of the vacant parcels are stream conservation areas located along the creek and creek tributaries. The majority of the planned land use for the underutilized parcels is medium-density residential. The Virginia Department of Transportation (VDOT) is currently performing a location study for Richmond Highway to determine the best design alternatives for widening and other future improvements.

2.4 Subwatersheds and Tributaries

For the purposes of this watershed plan, the Little Hunting Creek Watershed was divided into five subwatersheds, as shown on Map 2.1, to make it easier to evaluate the characteristics of the area draining to each of the major tributaries. The subwatersheds were delineated using the topographic data from the county's GIS and are described in Table 2.3.

Table 2.3 Subwatershed Area and Major Tributary Length

Subwatershed Name	Area (acres)	Tributary Name	Major Tributary Length (miles)
North Little Hunting Creek	1,384	Little Hunting Creek	2.23
South Little Hunting Creek (includes South Branch)	1,404	Little Hunting Creek South Branch	2.10 0.56
Paul Spring Branch	1,262	Paul Spring Branch	3.25
North Branch	1,760	North Branch	2.48
Potomac River (includes East and West Potomac)	1,257	N/A	N/A
TOTAL	**7,067**		

The tidally influenced Little Hunting Creek main stem is over 2.10 miles in length and lies mostly in the South Little Hunting Creek Subwatershed. For the purposes of this report, the northern portion of the Little Hunting Creek—from its headwaters to approximately 1,400 feet downstream of Richmond Highway—is called North Little Hunting Creek. The major tributaries of Little Hunting Creek include North Branch, Paul Spring Branch (a major tributary of North Branch), and South Branch. Table 2.3 also shows the length of the major tributaries in the Little Hunting Creek Watershed.

2.5 Summary of Existing Reports and Data

2.5.1 Stream Water Quality Report

The Fairfax County Health Department monitors stream water quality at 84 sampling sites throughout the county. Two water quality sampling sites are located in the Little Hunting Creek Watershed and are shown on Map 2.2. Site 14-02 is located on Little Hunting Creek and site 14-03 is located on North Branch. In 2001, 19 water samples were collected from each of these sites and evaluated for fecal coliform, dissolved oxygen, nitrate nitrogen, pH, phosphorous, temperature, and heavy metals. These parameters indicate the amount of pollution contributed from manmade sources and help to evaluate the quality of the aquatic environment. Information regarding the parameters and data collected for the Fairfax County 2001 Stream Water Quality Report can be found at http://www.co.fairfax.va.us/service/hd/strannualrpt.htm.

Fifteen percent of samples collected from site 14-03 on North Branch showed a dissolved oxygen concentration of less than 4.0 mg/l, which is the minimum standard considered suitable for aquatic life. The average dissolved oxygen concentration for site 14-02 was 7.2 mg/l and for site 14-03 was 7.0 mg/l, which is above the minimum standard. Low stream flows due to low rainfall can affect the dissolved oxygen levels.

As shown on Figure 2.2 for site 14-02, 42% of the samples had fecal coliform counts greater than 1,000/100 ml and for site 14-03, 37% of the samples had fecal coliform counts greater than 1,000/100 ml. Countywide, 30% of the samples exceeded fecal coliform counts of 1,000/100 ml. For fecal coliform, a count less than 200/100 ml is considered good water quality and a count of 250,000/100 ml can be considered a direct sewage discharge. From 2000 to 2001, Little Hunting Creek showed a 3% drop in the number of fecal coliform sample

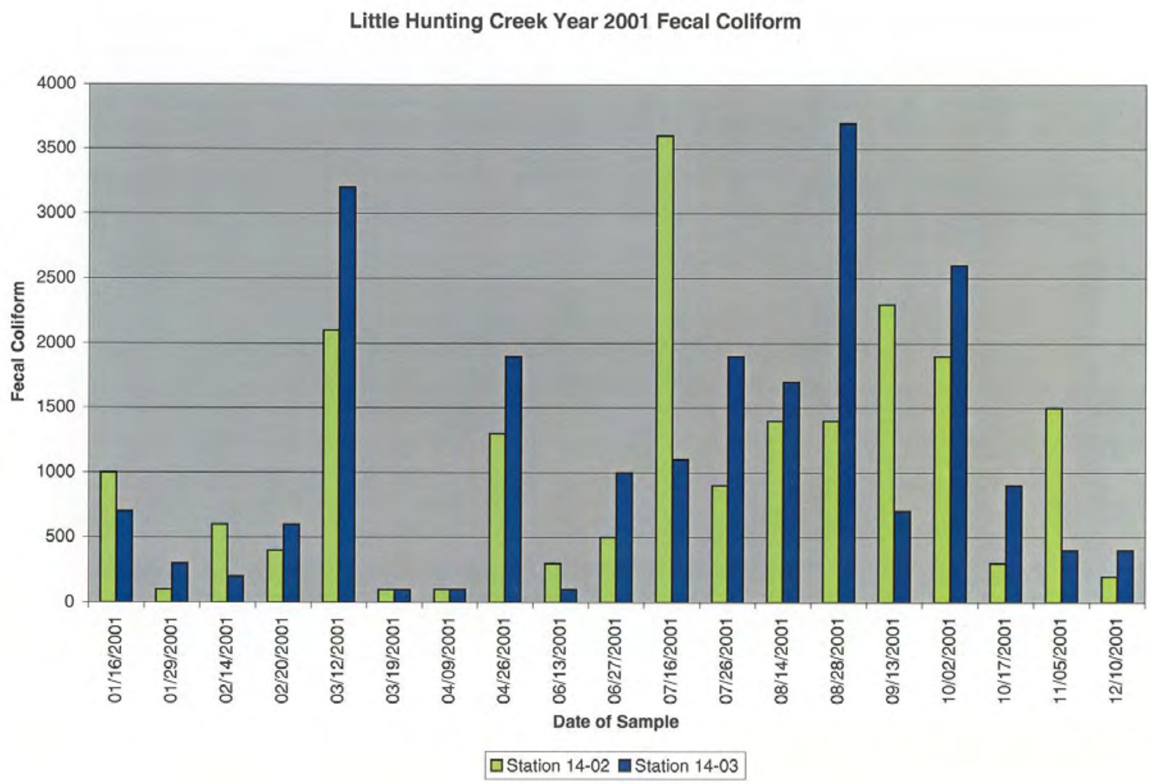


Figure 2.3 Year 2001 Fecal Coliform for Little Hunting Creek

results meeting the good water quality criteria. From 2000 to 2001, the geometric mean of fecal coliform rose from 426 to 625 for site 14-02 and from 574 to 672 for site 14-03. The geometric mean is used to measure the central tendency of the data. The geometric mean is calculated by multiplying a series of numbers and taking the nth root of the product where n is the number of items in the series.

The Fairfax County 2001 Stream Water Quality Report concluded that the overall water quality of Little Hunting Creek watershed is considered poor for fecal coliform and good for the chemical and physical parameters of the streams (except for the low dissolved oxygen level found in North Branch).

2.5.2 Volunteer Water Quality Monitoring

As part of the Northern Virginia Soil and Water Conservation District water quality monitoring program, sampling has been performed quarterly by a citizen volunteer at Paul Spring Branch since January 2002. The results show that 95% to 99% of the organisms found in the stream samples are pollution-tolerant species and that Paul Spring Branch has an unacceptable ecological condition as measured by the Virginia Save Our Streams Multimetric Index. The Multimetric Index is used to measure several biological attributes of a stream to calculate a score indicating the overall ecological condition of the stream. Information regarding the Northern Virginia Soil and Water Conservation District volunteer stream monitoring can be found at www.fairfax.va.us/nvswcd/monitoring.htm.

2.5.3 Wetland Data

The amount of existing tidal wetlands in the subwatersheds as measured from the county's GIS data is shown in Table 2.4. Wetlands account for approximately 2% of the total area in the Little Hunting Creek Watershed.

Table 2.4 Subwatershed Wetland Area

Subwatershed	Wetland Area (acres)
North Little Hunting Creek	0
South Little Hunting Creek	44
Paul Spring Branch	0
North Branch	23
Potomac River	18
Total	**85**

Wetlands provide habitat for wildlife and fish and act as natural filters for pollutants in stormwater runoff. They also slow and store stormwater, thus reducing downstream flooding and erosion. Wetland loss greatly affects the lower reaches of Little Hunting Creek with loss of water quality and habitat. A wetlands function and values survey has not been performed for the Little Hunting Creek Watershed.

From 1780 to 1980, there was a 42% loss in wetlands in Virginia as reported by the U.S. Fish and Wildlife Service. There is no specific data for the historic wetland loss in the Little Hunting Creek Watershed. More information is needed on the amount of wetland impacts, wetland mitigation, and restoration that have been performed in the Little Hunting Creek Watershed.

2.5.4 Environmental Baseline Report

The Dogue-Little Hunting-Belle Haven Environmental Baseline Report was written by Parsons, Brinkerhoff, Quade and Douglas in October 1976. The report presented a comprehensive view of the environmental baseline conditions for the three watersheds. The stream water quality and the majority of the habitat in the Little Hunting Creek Watershed was assessed in poor to fair condition. In the 2002 stream physical assessment, the majority of the stream water quality and habitat condition was found to be in poor condition.

Severe erosion was noted in North Branch at two locations and in Paul Spring Branch at two locations in the Environmental Baseline Report. North Branch appears to have slightly less erosion today. The stream physical assessment performed in 2002 showed that North Branch has minor to moderate erosion at all crossings and pipe outfalls and active widening of the majority of the stream channel. Paul Spring Branch has more erosion today with severe to extreme erosion at three pipe and crossing locations and severe to extreme bank erosion at seven locations.

In the 1976 study, severe sedimentation was noted at five locations in North Branch. The 2002 stream physical assessment results showed that 50% to 80% of the stream bottom is affected by sedimentation. In the 1976 study, six locations in Paul Spring Branch had severe sedimentation, and today, 50% to 70% of the stream bottom is affected by sedimentation in the upstream reaches. Debris accumulation was noted in both the North Branch and Paul Spring Branch in the 1976 study; it was also noted in the 2002 stream physical assessment.

The main stem of Little Hunting Creek did not have erosion, sedimentation, or debris noted in the 1976 study. The 2002 assessment showed that North Little Hunting Creek is in worse condition today with very poor to poor habitat condition, moderate to severe erosion at three crossings, and active widening of the stream channel. Sedimentation affects 40% to 60% of the stream bottom and debris was noted in several locations in the North Little Hunting Creek in 2002.

2.5.5 Immediate Action Plan Report

The Immediate Action Plan (IAP) Report for the Dogue Creek, Little Hunting Creek, and Belle Haven Watersheds was written by Parsons Brinckerhoff, Quade and Douglas in December 1978. The report identified 18 projects for the Little Hunting Creek Watershed at an estimated cost of $2,119,000. The various projects included piping, adding or replacing culverts, raising roads, and installing riprap bank protection. The purpose of these projects included protecting commercial facilities and residences from flooding, alleviating roadway flooding, and abating bank erosion. Eight of the projects have been constructed and one project is active with full funding. The remaining nine projects are inactive with no funding.

2.5.6 Future Basin Plan Report

The Future Basin Plan (FBP) Report for the Dogue Creek, Little Hunting Creek, and Belle Haven Watersheds was also written by Parsons, Brinckerhoff, Quade and Douglas in December 1978. This report, in conjunction with the IAP, specified the watershed's projected needs up to the year 2000. The report identified projects for constructing floodwalls at two locations in the watershed with an estimated cost of $83,000. These two projects are inactive with no funding.

2.5.7 Gum Springs Drainage Master Plan

The Gum Springs neighborhood is located east of Richmond Highway and includes the area surrounding Fordson Road, Sherwood Hall Lane, and Holland Road. The Gum Springs Drainage Master Plan Report was prepared in October 1981 to provide recommendations for drainage improvements to overcome flooding and ponding issues at low-lying areas in the neighborhood. The recommended Gum Springs drainage improvement projects have been completed in phases and the total estimated project costs were $1,707,000. The majority of the drainage improvement recommendations included constructing storm sewers to improve the efficiency of the storm drain system.

2.5.8 Fairfax County Master Plan Drainage Projects

Fairfax County has a list of 43 master plan drainage projects for the Little Hunting Creek Watershed dated February 2003. This list includes projects identified in the IAP, FBP, and Gum Springs Drainage Master Plan Reports. Twenty-three of the master plan drainage projects have been completed. The Little Hunting Creek Watershed study is one of the master plan drainage projects that is fully funded, active, and included in the pro rata share (PRS) program. Another active, fully funded project is a culvert replacement at Collingwood Road in the North Branch Subwatershed. Eighteen projects are inactive because of inadequate funds. The master plan drainage projects are described in more detail in the subwatershed descriptions provided in subsequent document sections.

2.5.9 Infill and Residential Development Study

The Fairfax County Infill and Residential Development Study, Draft Staff Recommendations Report was written by the county in July 2000. Any residential development that will occur proximate to or within already established neighborhoods is referred to as infill development. Infill development is expected to occur more frequently in the future in the Little Hunting Creek Watershed because the majority of the watershed is already developed. The recommendations from this study included policies for tree preservation, stormwater management, and erosion and sediment control. The recommended policies will be used to help make decisions regarding the watershed plan actions.

2.5.10 Fairfax County Virginia Pollutant Discharge Elimination System Permit Data

As part of its Virginia Pollutant Discharge Elimination System (VPDES) permit for a municipal separate storm sewer system, Fairfax County has initiated a program to monitor its streams on a routine basis and perform monitoring for illicit discharges. There have been 39 VPDES illicit discharge screening sites in the Little Hunting Creek Watershed since August 2002. The flow in the drainage system during dry weather conditions is monitored for pH, chlorine, copper, phenol, and detergents to determine if there is an illicit discharge. Illicit discharges could include sanitary, car wash, or laundry wastewater; radiator flushing; or improper disposal of oil and toxic materials. The monitoring parameters help to determine the possible occurrence and type of illicit discharge to the storm drain system. Based on the available data, there have been minimal illicit discharges in the Little Hunting Creek Watershed.

2.5.11 Virginia Department of Environmental Quality Water Quality Data Little Hunting Creek is included in a segment of the Potomac River listed as an impaired waterbody in the 2002 303(D) Priority List prepared by the Virginia Department of Environ- mental Quality (DEQ). The impairment classification is due to a health advisory issued by the Virginia Department of Health for fish consumption based on high levels of polychlorinated biphenyls (PCBs) found in fish tissue samples. Fish tissue analysis has revealed exceedances of the human health-risk based screening value of 54 parts per billion (ppb) of PCBs. Five differ- ent types of fish taken from Little Hunting Creek in 2000 had PCB concentrations between the range of 81 ppb and 682 ppb.

Sediment samples taken in 2000 from the tidal portion of Little Hunting Creek contained 7.57 ppb of chlordane, which is above the 6 ppb concentration that can threaten aquatic life. The five fish taken from Little Hunting Creek in 2000 were analyzed for chlordane in their tissue and had results below the DEQ screening value of 300 ppb. The sources of chlordane and PCBs are listed as unknown. Documentation for this information can be found in the Virginia 305(b) Water quality Assessment Report at www.deq.state.va.us/wqa/305b.html.

Algae blooms can be evidence of too much nitrogen and phosphorous in the water. The Virginia DEQ stated that aquatic life is threatened by the presence of excessive algae in the tidal waters of Little Hunting Creek. Little Hunting Creek has been designated by the Virginia DEQ as nutrient-enriched waters.

In addition to the causes of waterbody impairment described above, the Virginia DEQ Draft 2004 305(b)/303(d) Water Quality Assessment Integrated Report stated that there were enough samples that exceeded the fecal coliform bacteria criterion to cause the creek to not support the state’s recreational use goal.

2.5.12 Virginia Natural Heritage Resource

The Virginia Natural Heritage Resources Database describes the following status and rank of rare plant and animal species in the Little Hunting Creek and Dogue Creek Watersheds:

Table 2.5 Natural Heritage Resources in the Little Hunting Creek/Dogue Watersheds

Common Name	State Rank
Bird	
American Bittern	Extremely rare
Common Moorhen	Extremely rare
Bald Eagle	Very rare
Yellow-Crowned Night-Heron	Very rare
Pie-Billed Grebe	Very rare
King Rail	Very rare
Butterfly or Moth	
Hoary Elfin	Extremely rare
Dragonfly or Damselfly	
Midland Clubtail	Extremely rare
Reptile	
Wood Turtle	Very rare
Vascular Plant	
River Bulrush	Extremely rare
Carolina Fanwort	Extremely rare
Crested Sedge	Very rare
Epiphytic Sedge	Very rare
Lake-Bank Sedge	Extremely rare
Rough Avens	Very rare
Nuttal's Micranthemum	Historically known but not verified in 15 years
Hairy Beardtongue	Very rare
Heart-Leaved Plantain	Historically known but not verified in 15 years
Large-Leaf Pondweed	Extremely rare
Flatleaf Pondweed	Historically known but not verified in 15 years
Flatstem Pondweed	Extremely rare
Virginia Mallow	Extremely rare
Carolina Yellow-Eyed Grass	Extremely rare

2.5.13 Stream Protection Strategy

The Fairfax County Stream Protection Strategy (SPS) Baseline Study from January 2001 evaluated the quality of streams throughout the county. Little Hunting Creek and its tributaries, North Branch and Paul Spring Branch, received "very poor" composite site condition ratings. These ratings were based on environmental parameters such as an index of biotic integrity, stream physical assessment, habitat assessment, fish taxa richness, and percent imperviousness. Table 2.6 provides information regarding the macroinvertebrate and fish species in three of the streams located in the watershed. Map 2.2 shows the location of the three stream protection strategy sampling sites.

Table 2.6 Macroinvertebrate Assessment and Fish Species

Stream Name	Macroinvertebrate Assessment	No. of Fish Species
Little Hunting Creek	Very poor	Moderate
North Branch	Poor	Very low
Paul Spring Branch	Poor	Very low

Polluted stormwater runoff affects the number and diversity of macroinvertebrate and fish species. For the macroinvertebrate assessment, the number of unique species and the balance between pollution-tolerant and intolerant species were measured. The rankings ranged between excellent, good, fair, poor, and very poor. A poor rating indicates decreased diversity with intolerant species being rare or absent; a very poor rating indicates that the stream is degraded with a small number of tolerant species. For the number of unique fish species collected, the ratings were high, moderate, low, or very low. The amount of development in the watershed contributes to the poor water quality found in the waters of Little Hunting Creek.

In the SPS Baseline Study, the Little Hunting Creek Watershed was classified as a watershed restoration level II area with goals of maintaining areas to prevent further degradation and implementing measures to improve water quality and comply with Chesapeake Bay initiatives, total maximum daily load regulations, and other water quality initiatives and standards. The Little Hunting Creek Watershed Management Plan is a result of the county's stream protection strategy recommendations to help achieve the goal of preserving and restoring stream quality.

2.5.14 Stream Physical Assessment

The county initiated a stream physical assessment for all of its watersheds in August 2002. The stream physical assessment included a habitat assessment, infrastructure inventory, stream characterization, and stream geomorphologic assessment. The stream physical assessment data is described for each of the subwatersheds in the following sections.

As part of the stream physical assessment, the following items were identified and characterized:

- Deficient buffer vegetation
- Dumpsites
- Erosion locations
- Head cuts
- Obstructions
- Pipe and ditch outfalls
- Public utility lines
- Roads and other crossings

An impact score was assigned to those inventory items causing a negative impact to the stream. Based on the impact score, the degrees of impact were classified into three groups: minor to moderate, moderate to severe, and severe to extreme. Table 2.7 describes the impact ranges for each of the stream inventory items. Maps provided in the following subwatershed sections show the locations and severity of impact for the inventoried items.

Table 2.7 Description of Impacts

Deficient Buffer Vegetation (within 100 feet of stream bank)	
Extreme	Impervious/commercial area in close proximity to a stream. The stream banks may be modified or engineered. The stream character (bank/bed stability, sediment deposition, and/or light penetration) is obviously degraded by adjacent use.
Severe	Some impervious areas and/or turf located up to the bank and water. Very little vegetation aside from the turf exists within the 25-foot zone. Home sites may be located very close to the stream. The stream character is probably degraded by adjacent use.
Moderate	Encroachment mostly from residential uses and yards. There is some vegetation within the 25-foot zone, but very little aside from turf exists within the remainder of the 100-foot zone. The stream character may be changed slightly by adjacent use.
Minor	Vegetated buffer primarily consists of native meadow (not grazed).
Dumpsites	
Severe to Extreme	Active and/or threatening sites. The materials may be considered toxic or threatening to the environment (concrete, petroleum, empty 55-gallon drums, etc.) or the site is large (greater than 2,500 square feet) and appears active.
Moderate	Dumpsite less than 2,500 square feet with non-toxic material. It does not appear to be used often, but clean-up would definitely be a benefit.
Minor	Dumpsite appears small (less than 1,000 square feet) and the material stable (will not likely be transported downstream by high water). This site is not a high priority.
Erosion Locations	
Extreme	Impending threat to structures or infrastructure
Severe	Large area of erosion that is damaging property and causing obvious instream degradation. The eroding bank is generally five feet or greater in height.
Impact	Description
Moderate	A moderate area of erosion that may be damaging property and causing instream degradation. The eroding bank is generally two feet or greater in height.
Minor	A minor area of erosion that is a low threat to property and causes no noticeable instream degradation.
Head Cuts	
Severe to Extreme	Greater than two-foot head cut height
Moderate	One- to two-foot head cut height
Minor	One-half- to less than one-foot head cut height
Obstructions	
Severe to Extreme	The blockage is causing a significant erosion problem and/or the potential for flooding that can cause damage to infrastructure. The stream is usually almost totally blocked (more than 75% blocked).

Moderate to Severe	The blockage is causing moderate erosion and could cause flooding. The stream is partially blocked, but obstructions should probably be removed or the problem could worsen.
Minor to Moderate	The blockage is causing some erosion problems and has the potential to worsen. It should be looked at and/or monitored.
Pipes and Ditch Outfalls	
Severe to Extreme	Stormwater runoff from a ditch or pipe is causing a significant erosion problem to the stream bank or stream. Discharge that may not be stormwater is coming from the stormwater pipe.
Moderate	Stormwater runoff from a ditch or pipe is causing a moderate erosion problem and should be fixed; it may get worse if left unattended. Discharge is coming from the pipe. It is probably stormwater, but it will be uncertain without further investigation.
Minor	Stormwater runoff from a ditch or pipe is causing a minor erosion problem and some discharge is occurring.
Public Utility Lines	
Extreme	A utility line is leaking.
Severe	An exposed utility line is causing a significant erosion problem and/or obstruction (blockage). The potential for the sanitary line to burst or leak appears high.
Moderate	A partially exposed utility line is causing a moderate erosion problem. The line is partially visible (mostly buried in a stream bed with little if any erosion).
Minor	A utility line is exposed but stabilized with concrete lining and stable anchoring into the bank.
Road and Other Crossings	
Extreme	The condition of debris, sediment, or erosion poses an immediate threat to the structural stability of the road crossing or other structure. Major repairs will be needed if the problem is not addressed.
Severe	The condition probably poses a threat to a road crossing or other structure. The problem should be addressed to avoid larger problems in the future.
Moderate	The condition does not appear to pose a threat to a road crossing or other structure but should be addressed to enhance stream integrity and the future stability of the structures.
Minor	The condition is noticeable but may not warrant repair.

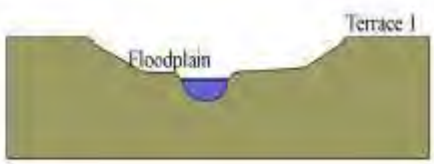
Source: Fairfax County Stream Physical Assessment Protocols, December 2002

The geomorphologic assessment of the stream channels in the Little Hunting Creek Watershed was based on the conceptual incised channel evolution model (CEM) developed by Schumm et al. (1984). Based on visual observation of the channel cross section and other morphological observations of the channel segment, the CEM type was assigned for the channel segment. The CEM types assigned to the Little Hunting Creek stream segments are summarized in Table 2.8. The five stages of the channel evolution process are shown in Figure 2.3. The CEM type for the stream segments is shown on the stream geomorphology maps provided for each of the subwatersheds.

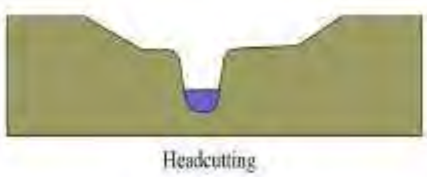
Table 2.8 Summary of CEM Types

CEM Type	Description
1	Stable stream banks and developed channel
2	Deep incised channel
3	Unstable stream banks and actively widening channel
4	Stream bank stabilizing and channel developing
5	Stable stream banks and widened channel

The scores assessed for the various physical parameters representing the stream habitat conditions were combined for each stream segment to obtain a total habitat score with the majority of the stream habitat assessed as poor. Table 2.9 describes the percentage of length for each habitat quality rating for the streams according to the total score. The habitat quality of each stream segment is shown on the stream habitat quality maps provided for each of the subwatersheds.



Type 1: Well-developed base flow and bankfull channel; consistent floodplain features easily identified; one terrace apparent above active floodplain; predictable channel morphology; floodplain covered by diverse vegetation; stream banks less than or equal to 45°



Type 2: Head cuts; exposed cultural features (along channel bottom); sediment deposits absent or sparse; exposed bedrock (parts of reach); stream bank slopes greater than 45°

Type 3: Stream bank sloughing, sloughed material eroding; stream bank slopes greater than 60° or vertical/undercut; erosion on inside of bends; accelerated bend migration; exposed cultural features (along channel banks); exposed bedrock (majority of reach)

Type 4: Stream bank aggrading; sloughed material not eroded; sloughed material colonized by vegetation; base flow, bankfull, and floodplain channel developing; predictable channel morphology developing; stream bank slopes less than or equal to 45°

Type 5: Well-developed base flow and bankfull channel; consistent floodplain features easily identified; two terraces apparent above active floodplain; predictable channel morphology; stream banks less than or equal to 45°

Figure 2.4 Incised Channel Evolution Model (Schumm, Harvey, and Watson, 1984)

Table 2.9 Summary of Stream Habitat Quality

Stream	Percent of Stream Length				
	Very Poor	Poor	Fair	Very Poor	Excellent
North Little Hunting Creek	33%	51%	16%	0%	0%
Paul Spring Branch	0%	47%	53%	0%	0%
North Branch	9%	82%	9%	0%	0%
Tributary to the Potomac River	0%	100%	0%	0%	0%
Total Watershed	**15%**	**58%**	**27%**	**0%**	**0%**

Riparian Buffer Loss

The majority of the nontidal streams in the watershed have an average buffer zone width of 25 to 50 feet. The total length of deficient buffer zone along the nontidal streams is 54,100 feet, 52% of the total assessed bank length. A deficient buffer does not have much vegetation such as trees, shrubs, or native ground cover in the 100-foot width adjacent to the stream. The vegetative cover in the deficient buffer areas typically consists of lawn. An average of 60% of the stream bank surface is covered by scattered shrubs, grasses, and thick non-woody vegetation with thin or bare spots or closely cropped vegetation. The average impact score for the deficient buffer areas is 4.5 out of a scale of 1 to 10 (10 is best). The buffer zone for the tidal portion of the creek and streams was not assessed. The riparian buffer assessment for the nontidal portions of the Little Hunting Creek watershed is summarized in Table 2.10.

Table 2.10 Riparian Buffer Assessment

Subwatershed	Description of Buffer Zone
North Little Hunting Creek	The majority of stream banks have thin vegetative cover—typically lawns with buffer widths of less than 25 feet. One stream tributary has 50 to 100-foot buffer widths.
South Little Hunting Creek (nontidal portion of South branch)	Some vegetation exists within the 25-foot buffer zone, but lawn typically makes up the rest of the 100-foot buffer zone.
Paul Spring Branch	The vegetation is primarily lawn, non-grass plants, and shrubs. The buffer width is between 25 and 50 feet.
North Branch	The buffer width is 25 to 50 feet with a majority of lawn, some shrubs, non-woody thick vegetation, grasses, and a few plant species. More than 25% the area beyond the buffer zone is impervious.
Potomac River (tributary located south of Eaglebrook Court)	The buffer zone width is 25 to 50 feet with a majority of lawn, isolated trees, and shrubs on the banks. More than 25% of the area beyond the buffer zone is impervious.

Deficient buffer zone width provides less filtering of pollutants in stormwater runoff. The stream banks are more likely to become unstable when they don't have any vegetation. Limited vegetation and non-native plant species do not offer sufficient habitat and food for birds and wildlife and may out-compete or replace native species. North Branch and Paul Spring Branch have conservation areas or parks adjacent to the stream. The county's comprehensive plan proposes placing park or conservation areas around most of the streams in the watershed.

Sedimentation

Streams, in their natural and stable condition, undergo some erosion and transport of sediments. This process is directly related to the stream's geometry, velocity, and amount of flow. Sediments will naturally deposit in areas of slower velocity, such as those typically seen at a stream's mouth, and erosion will occur where flow velocities are higher than the stream channel banks can withstand, typically at stream bends. Higher in-stream velocities and flows due to increased runoff result in larger amounts of sediment being transported with a greater weight and size. In-stream velocities and flows that are uncharacteristic and cannot be accommodated by a stream's natural geometry will result in a stream actively widening and transporting high amounts of sediment.

Approximately 50% to 60% of the bottom of nontidal streams in Little Hunting Creek is affected by sediment deposition, which contributes to a fair to poor habitat assessment throughout the watershed. Sediment deposition affecting less than 20% of the stream bottom is considered not to impact stream habitat.

The actively widening and unstable stream bed and banks found in Little Hunting Creek are the primary source of sediment in the watershed. Other sources may come from the stormwater runoff of unstabilized soil areas and from the sand placed on the roads for traction in the winter. Sedimentation causes the formation of instream islands, point bars, and shoals as well as the filling in of pools. High levels of sediment deposition create an unstable environment for aquatic organisms, and pollutants that attach to sediments are harmful to aquatic organisms. Table 2.11 summarizes the sedimentation assessment from the stream physical assessment for the nontidal portions of Little Hunting Creek. None of the assessed stream tributaries were unaffected by sediment deposition.

Table 2.11 Sedimentation Assessment

Subwatershed	Description of Sedimentation
North Little Hunting Creek	40% to 60% of the stream bottom is affected by sediment deposition of sand and/or silt
South Little Hunting Creek	No data
Paul Spring Branch	40% to 70% of the stream bottom is affected by sediment deposition of gravel, sand, and/or silt
North Branch	Pools are almost absent due to sedimentation for 5,000 feet in the stream tributary. The rest of the stream bottom has 50% to 80% sediment deposition of sand and/or silt.
Potomac River (tributary located south of Eaglebrook Court)	70% to 80% of the stream bottom is affected by sediment deposition of sand and/or silt

From visual observations by residents, and assuming that the sediment observed in the nontidal portions of Little Hunting Creek is carried downstream, the tidal areas have experienced significant sediment deposition. In order to determine the amount of sedimentation in the tidal areas of Little Hunting Creek, a hydrographic survey will need to be performed and compared to historical records.

Trash and Dumpsites

The county's stream physical assessment identified seven dumpsites in the nontidal stream segments. The dumpsites consisted of lawn waste such as leaves and grass, furniture, a camper shell, shopping carts, and trash. The dumpsites were located in the stream, on the bank, or in the floodplain. The volume of trash found in the stream was not measured.

2.5.15 Modeling Approach and Results

Hydrologic, hydraulic, and water quality models were created for the Little Hunting Creek Watershed to help identify flooding, channel erosion, and pollutant loads in the watershed. Current and anticipated ultimate development conditions (future) were modeled to evaluate the effects of development in the watershed and to allow formalization of cause and effect relationships. The modeling guidelines in the Technical Memorandum No. 3, Stormwater Model and GIS Interface Guidelines provided by the county were used in developing the models. The work to develop the models and analyze the results included the following steps:

- Selection of sub-basin scale and delineation of sub-basins
- Characterization of existing soils, land use, and impervious cover based on county GIS and other mapping sources
- Creation of stream channel and crossing data
- Prediction of ultimate land use conditions based on the county comprehensive plan and zoning
- Assessment of water quantity and quality impacts to identify existing and potential future problem areas

The 37 sub-basins are the smallest watershed area units delineated in the hydrologic model with an average size of approximately 191 acres. All of the watershed area was included in the hydrologic model. The majority of the soils data for infiltration was developed from the National Resource Conservation Service State Soil Geographic database and the remainder of the soil data was developed from the county soil GIS data which was unavailable for most of the watershed area.

The existing impervious cover for the model was developed from the county's GIS layers showing paved land cover for roads, buildings, and parking areas. The paved area of sidewalks and driveways was estimated and added to the total impervious land cover calculations. The ultimate build-out land use conditions were developed from the county's comprehensive plan for underutilized and vacant parcels. The existing residential land use conditions have an average of 19% imperviousness which is greater than the 18% imperviousness limit that requires implementation of water quality controls for development on non-bonded residential lots. No additional imperviousness was modeled for future residential development other than the predicted land use changes due to development of underutilized and vacant parcels.

The stream channel profiles and cross sections were developed from the county's topographical GIS data and stream culvert crossing data input from field survey data. The hydraulic model includes approximately eight miles of streams and 40 major road crossings over the various creeks and streams located within the Little Hunting Creek Watershed. The small streams, tributaries, and tidal portion of Little Hunting Creek were not included in the hydraulic model. The existing stormwater management and best management practice facilities were simulated in the model to estimate the peak flow control for parcels developed from 1972 to 1994 and the peak flow and quality treatment for parcels developed after 1994.

The hydrologic and hydraulic models were calibrated to validate the model results. No historical stream gage data was available for the Little Hunting Creek Watershed, so the calibration was based on historical flooding information at the Paul Spring Branch where it crosses Paul Spring Road. The model parameters were adjusted during the calibration process to replicate the historical road flooding condition for known storm events. The model parameter calibrations for the Paul Spring Branch Subwatershed were then applied to the rest of the watershed model. The calibrated hydrologic and hydraulic models were run for three rainfall events corresponding to the two-year return period and the 10-year return period for both existing and future build-out conditions and the 100-year return period for future build-out conditions. Peak discharges for each sub-basin were compared to evaluate any change in stormwater runoff as a result of the change in future land use, and the results are shown on the Map 2.5. No additional stormwater management facilities were included in the future development condition model in order to evaluate the change in peak flows from existing to future development conditions. The hydraulic model results were reviewed with respect to existing and future flow velocities in the streams, and the velocities for the two-year rainfall event for the existing conditions are shown on the Map 2.6. The model results for the flooding limits for the two- and 10-year peak rainfall events were evaluated, and the results for the future development conditions are shown on the Map 2.7. The difference in the flooding limits for the existing and future conditions was very minor. The results from the model were evaluated against observed or documented erosion and flooding conditions within each subwatershed to help further validate the hydraulic model. The model results for the 100-year peak rainfall event were used to determine the number of dwellings located in the flooding limits. The addresses of these properties are provided in Chapter 4.

The water quality model was used to evaluate the pollutant loading rates for the five-day biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), total suspended solids (TSS), total dissolved solids (TDS), dissolved phosphorous (DP), total phosphorous (TP), total Kjeldahl nitrogen (TKN), and total nitrogen (TN) for the entire watershed. The parameters used for the water quality model were developed by the county. The hydrologic model was run for a continuous 10-year time period from 1992 to 2002 to calculate the average annual contribution for each pollutant in units of pounds per acre per year for both existing and future land use conditions and existing and future land use conditions with proposed alternatives.

Though eight water quality parameters were modeled, only three, TSS, TP, and TN were evaluated in detail for the effect of development and BMP controls on the water quality of the watershed. Nitrogen, phosphorus, and sediment are considered the major pollutants that compromise the health of the Chesapeake Bay and its tributaries. The main source of nitrogen is the fertilizer used for lawns; it readily dissolves in surface runoff. Phosphorus also comes from lawn fertilizer and is found attached to sediment particles that wash off the ground surface as well as dissolved in the surface runoff. Nitrogen and phosphorus are typically the limiting nutrients in water for algal growth. Large amounts of algae in the water block sunlight from reaching submerged aquatic vegetation, an important part of the aquatic ecosystem. When algae dies and decays, it takes essential oxygen from the water, further affecting the health of the aquatic system. The sediment in the runoff comes mainly from erosion of the land and stream channels. Excess sediment in the stream destroys aquatic habitat, and when suspended in the water, it blocks sunlight from reaching the aquatic plants located at the bottom.

In order to evaluate the effects of the modeled sediment, phosphorus, and nitrogen loading rates, target loading rates were developed from the Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy for the Shenandoah and Potomac River Basins, Public Comment Draft, April 2004. The target rates for the watershed were developed from the target rates specific to the portion of Fairfax County located below the fall line, which includes the area of the Little Hunting Creek Watershed. The Tributary Strategy values are the target nutrient and sediment standards for the Potomac River that were established to meet the Chesapeake Bay Program cap or target loading values. The target loading values were established because of the Chesapeake 2000 Agreement, which calls for a reduction in nutrients and sediment to remove the Chesapeake Bay and its tributaries from the EPA's list of impaired waters by the year 2010.

The watershed sub-basin pollutant loading rates are categorized as good, fair, or poor. The good pollutant loading rates are equal to or less than the Tributary Strategy target rates. The fair pollutant loading rates are greater than the good rate but less than the poor rate. The poor pollutant loading rates are equal to or greater than nutrient and sediment pollutant loading rates predicted for the year 2010 if no BMPs were implemented. The numerical values used to evaluate the pollutant loading rates are provided in Table 2.12.

Table 2.12 Pollutant Loading Rates for Water Quality Evaluation

Pollutant	Loading Rate		
	Good	Fair	Poor
Sediment	≤ 78 lb/acre/yr	78 to 163 lb/acre/yr	≥ 78 lb/acre/yr
Total Phosphorous	≤ 0.67 lb/acre/yr	0.67 to 1.15 lb/acre/yr	≥ 1.15 lb/acre/yr
Total Nitrogen	≤ 6.5 lb/acre/yr	6.5 to 9.8 lb/acre/yr	≥ 9.8 lb/acre/yr

The model result summaries for each subwatershed are provided in Table 2.13 and described in the following sections. The evaluation of the pollutant loading rates for the future development conditions for each sub-basin is shown on Maps 2.8, 2.9, and 2.10. To help develop and evaluate the Little Hunting Creek Watershed Management Plan strategy, the hydrologic, hydraulic, and water quality models were used to determine the projected reduction in runoff and pollutants for the recommended actions.

Table 2.13 Water Quality Pollutant Loading Rates and Loads

Subwater-shed	Existing TSS Loading Rate, lb/ac/yr	Existing TSS Load, tons/year	Future TSS Loading Rate, lb/ac/yr	Future TSS Load, tons/year	% Increase TSS Load	Existing TSS Loading Rate, lb/ac/yr Existing TP Existing TP Loading Rate, lb/ac/yr	Existing TP Load, tons/year	Future TP Loading Rate, lb/ac/yr	Future TP Load, tons/year	% Increase TP Load	Existing TN Loading Rate, lb/ac/yr	Existing TN Load, tons/year	Future TN Loading Rate, lb/ac/yr	Future TN Load, tons/year	% Increase TN Load
North Little Hunting Creek	136	94	152	105	12	0.94	1307	1.21	1675	28	6.27	8680	7.32	10132	17
South Little Hunting Creek	75	53	87	61	16	0.68	957	0.90	1262	32	3.47	4874	4.35	6114	25
Paul Spring Branch	116	66	122	71	5	0.90	1164	1.08	1404	20	5.28	6273	5.88	7080	11
North Branch	49	102	56	108	15	0.47	1590	0.59	1902	27	2.16	9286	2.65	10346	22
Potomac River	105	31	112	35	7	0.92	585	1.11	742	21	4.97	2721	5.61	3328	13