BEAVERDAM CREEK WATERSHED

2005 PROFILE

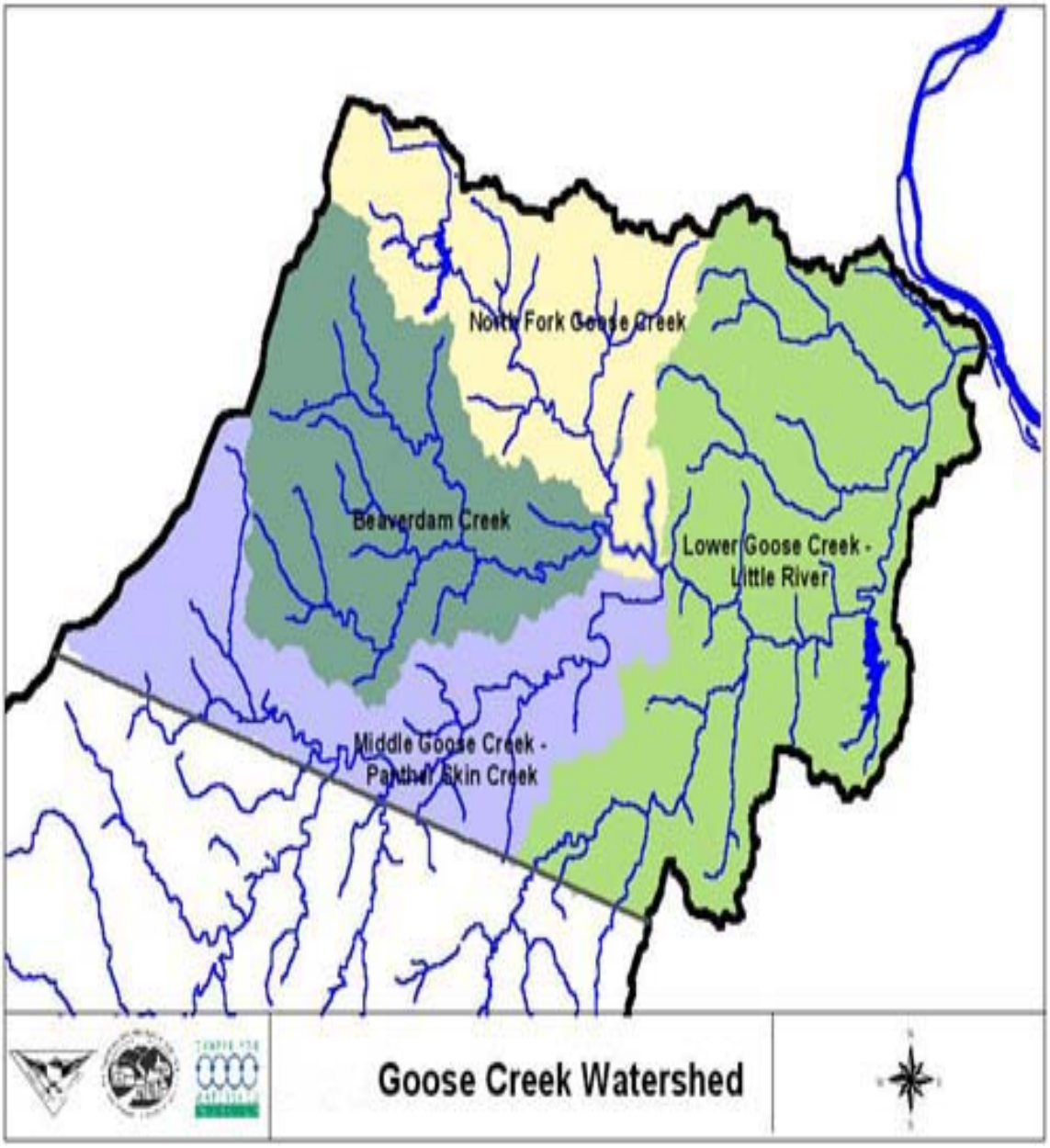


Table of Contents Page

Watershed Description

The Beaverdam Creek watershed is part of the larger North Fork Goose Creek Watershed, and drains 34,000 acres or 10% of the southwestern portion of Loudoun County. Major tributaries are the North Fork Beaverdam Creek, Butchers Branch, and Dog Branch.

Beaverdam Creek is located in the Blue Ridge and Piedmont geographic regions. The watershed has moderately well-drained silt and clay loam soils, and bedrock geology.

North Fork Beaverdam Creek -- LWC Monitoring Site

Rainfall and Streamflow -- Rainfall in the watershed is monitored at Lincoln, VA. A summary of average monthly and annual precipitation is provided in **Table 1**. The rainfall is fairly evenly distributed throughout the year, although it tends to be lower between December and February.

Table 1. Summary of Average Monthly and Annual Rainfall Data (inches) at Lincoln, VA. in the North Fork Goose Creek Watershed.

J	F	M	A	M	J	J	A	S	O	N	D	Annual
3.02	2.63	3.63	3.40	4.09	3.84	3.87	4.11	3.56	3.16	3.17	3.12	41.59

There is little stream flow data for the Beaverdam Creek watershed. The Virginia Department of Environmental Quality (DEQ) discontinued collecting stream flow data in the early 1990's. The Loudoun Soil and Water Conservation District (LSWCD) take sporadic stream flow readings at their monitoring stations. The US Geological Survey established a new stream flow gauge in 2001 on Beaverdam Creek at Rt. 734. Data from the USGS station is shown on **Table 2**. There are insufficient data to establish any

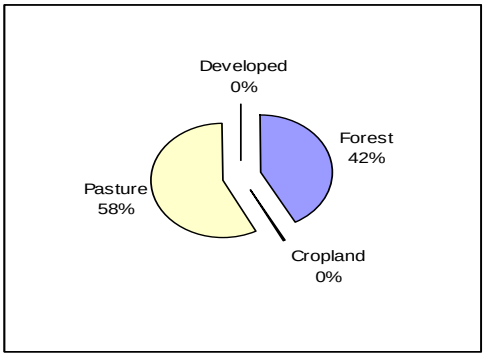
patterns for Beaverdam Creek. However, long term stream flow data for Goose Creek at Middleburg show that lowest flows usually occur between July and November.

Table 2. USGS Stream Flow Data for Beaverdam Creek Watershed.

YEAR	Monthly Mean Stream Flow, in ft^3/s											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2001										6.1	7.22	9.04
2002	9	8	26	24	43	26	11	3	10	25	53	73
2003	113	91	180	83	237	197	69	28	181			
Mean of Monthly Stream Flows	61	50	103	53	140	111	40	15	96	15	30	41

Land Use -- Land use is predominately agricultural and forested lots. Riparian buffer zones are poor to marginal in several segments of the streams where the land is in agricultural use. Runoff of sediments into the stream is a problem in some of these segments.

Figure 1. Land Use in Beaverdam Creek Watershed Based on 1997 Data.



Impervious Surfaces -- Impervious surfaces include the roadways, driveways, rooftops and parking lots that do not allow infiltration of water from rainstorms and runoff into the ground. The Loudoun County Environmental Indicators Project (LEIP) included mapping impervious surfaces in the county using Lansat Imagery. They report that the amount of impervious surface over the entire Goose Creek watershed is **1.37%**. Impervius surface coverage in the Beaverdam Creek subwatershed portion is likely similar. As a general rule, a watershed with less than 10% of its area in impervious surfaces **will not experience a noticeable impact** on the hydrological characterisitics of the watershed.

Water Quality Studies

Water Quality Standards – DEQ is required under the Federal Clean Water Act and Virginia statutes to publish an assessment of the quality of state waters. This assessment includes a list of waters that do not meet state and federal water quality standards. These waters are designated as "impaired waters." The DEQ list of impaired waters includes a 6.32 mile segment of Beaverdam Creek that extends from its confluence with the North Fork Goose Creek upstream to the confluence with the North Fork Beaverdam Creek. A summary of the information published by DEQ in their assessment report on North Fork Goose Creek is provided in **Table 3.** These data show that 75% of the watershed has not been monitored and assessed by DEQ because there is no data.

Table 3. Assessment of Beaverdam Creek by DEQ in the 2004 303(d)/305(b) Integrated Report to EPA (data in river miles).

Watershed Monitoring Station	Meet Stnds	No Data	Insufficient Data	Citizen Data Show Problems	Citizen Data Show No Problems	Impaired
Beaverdam Creek/ Upper Beaverdam Creek	3.62	54.54	0	4.00	0	6.32

Water Quality Studies – Stream waters listed by DEQ that do not meet water quality standards are required to be studied. The purpose of the study is to identify the source(s) of the pollution and quantify the pollution load(s) to the stream. In addition, the Federal Safe Drinking Water Act requires states to assess the health of streams and watersheds that are used as a drinking water supply. Water from Goose Creek is used as a public drinking water supply. Two studies have been conducted in recent years because of these requirements, and they provide good information about the water quality and sources of pollution that degrade the North Fork Goose Creek.

- **TMDL Report** – DEQ published a report, " *Bacterial TMDL for the Goose Creek Watershed*," in February 2003 that included water quality information on the Beaverdam Creek subwatershed. The lower mainstem of Goose Creek and six tributary streams have elevated fecal coliform bacteria levels that exceed state water quality standards for the safe use for recreation. The TMDL (Total Maximum Daily Load) study identified the sources of pollution affecting the Goose Creek watershed.
- **Goose Creek Source Water Protection Study** – The Loudoun County Sanitation Authority (LCSA) published a report, " Goose Creek Source Water Protection Program," in December 2003 that included water quality information on the North Fork Goose Creek. The purpose of the report was to provide a plan to protect drinking water supplies in the Goose Creek from pollution and stream habitat degradation that will affect the safety of drinking water supplies.

Findings – Fecal coliform bacteria pollution originates from a variety of sources in Beaverdam Creek. DEQ did special bacteria source tracking or BST studies to determine the type of warm-blooded animals that are contributing the fecal bacteria to the stream waters. They also used a Hydrological Simulation Program, Fortran (HSPF) to develop a model to simulate the fate and transport of fecal bacteria in the stream.

- **Point Sources of Pollution** – Point sources of fecal bacteria include the municipal and industrial plants that treat human wastes, and private residences that have non-septic tank systems that have a discharge requiring a permit. These permitted sources are listed in **Table 4.**

Table 4. Permitted Point Sources of Fecal Bacteria in the Beaverdam Creek Watershed.

Facility	City	Receiving Stream
St. Louis Community	St. Louis	Beaverdam Creek
US FEMA	Bluemont	Jeffries Branch
Bluemont Post Office	Bluemont	Butcher's Branch
Residence A	Round Hill	Jeffries Branch
Residence B	Middleburg	Dog Branch
Residence C	Bluemont	Butcher's Branch
Residence D	Bluemont	Butcher's Branch
Residence E	Bluemont	Butcher's Branch

- **Human Sources – Septic Systems** – Properly functioning septic systems allow treated human waste effluent to filter into the soil so it does not reach surface water. However, failing septic tank systems can allow bacteria to reach the surface and flow directly into a nearby stream, especially in runoff during a rainfall. Failing systems can also allow the effluent to seep into the ground water if the system is located too close to a stream or pond.

  The special BST study conducted by DEQ showed that fecal bacteria from human sources are widespread in the Goose Creek watershed including Beaverdam Creek. Human sources can be the dominant source for some rainfall events. They estimate that there is a 5% failure rate of septic systems in the watershed, and that fecal bacteria from these systems are entering streams as stormwater runoff. Any system located within 50 feet of surface water is assumed to be directly discharging fecal bacteria to the stream.

  These estimates are based on surveys that have been conducted. For example, in 1992 the Loudoun County Health Department conducted a septic system survey of Bluemont in the North Fork Beaverdam Creek watershed and found 22 failing systems out of 52 systems surveyed. In 2002 the Health Department estimated there are 97 failing septic systems in the Beaverdam Creek watershed. A breakdown of the estimated failing systems is provided in **Table 5.**

Table 5. 2002 Estimate of Failing Septic Systems in the Beaverdam Creek Watershed.

Stream Segment	# Septic Systems	# Failing Systems	# Systems <50' from Stream
Beaverdam Creek	141	29	0
Upper Beaverdam Creek	1,188	59	9

- **Biosolids** – Class B biosolids (liquid or dewatered sludge from a sewage treatment plant) are applied on occasion to both cropland and pasture in the North Fork Beaverdam Creek watershed. Record keeping of applications is poor, and DEQ had to estimate application amounts. Application varies considerably by year and even

more so by month. The only application recorded in the Beaverdam Creek watershed was in 1999 when 620 dry tons were applied.

- **Dairy and Beef Cattle** – In 2003 DEQ reported there are large numbers of dairy cattle and beef cattle pasturing in the Beaverdam Creek watershed. The number of beef cattle varies seasonally in the watershed, with the highest numbers in the summer and lowest in the winter (October to April). Cattle are generally pastured and have access to streams. Beef cattle normally spend a portion of each day in the streams, especially in the summer. Most farmers in the watershed do not use stream bank fencing. The estimated number of dairy and beef cattle are provided in **Table 7.**

- **Horses** – Loudoun County has the largest horse population in Virginia, and many are located in the Beaverdam Creek watershed. However, most horses do not have access to streams, and horse manure is typically deposited on pasture land. Therefore, horses were not identified as a major source of pollution by DEQ. The estimated number of horses is also listed on **Table 7.**

Table 7. Estimated Livestock Populations in the Beaverdam Creek Watershed in 2002.

Stream Segment	Dairy Cattle	Beef Cattle	Horses
Beaverdam Creek		**500**	**400**
Upper Beaverdam Creek	**650**	**3,000**	**2,500**

- **Wildlife** – There are a wide variety and large number of wildlife in the watershed that contribute some fecal bacteria to the streams. It is estimated, for example, that there are 2,900 deer and 1,300 raccoon. However, there have been no wildlife surveys conducted in Loudoun County, and the Virginia Department of Game and Inland Fisheries (VDGIF) uses a model to estimate wildlife populations based on the various habitat types found in the watershed.

  The study found that most wildlife are not a significant source of pollution to the streams because they spend little time in stream waters, and their wastes impact stream water quality only as part of stormwater runoff. Of all the wildlife species, DEQ estimates that deer and raccoon are the only wildlife species that impact water quality in Beaverdam Creek.

- **Average Daily Fecal Bacteria Load By Source** – DEQ combined the information from the various sources of fecal wastes to estimate the average daily fecal bacteria load to the streams in the watershed. These percent average daily loads are listed in **Table 8**. This list shows that 92% of the fecal coliform bacteria in Beaverdam Creek come from the manure of cattle and other livestock.

Table 8. Percent Average Daily Loads of Fecal Bacteria by Source in the Beaverdam Creek Watershed.

Source	Beaverdam Creek	Upper Beaverdam Creek
Livestock	92%	92%
Human	1%	1%
Wildlife	1%	1%
Other	6%	7%
Total All Sources	**100%**	**101%**

Water Quality Restoration – DCR and DEQ will use the TMDL study to develop an implementation plan for the voluntary reduction of pollution loads by riparian property owners. The needed pollution load reductions are substantial, and are shown in **Table 9**. DCR has not scheduled a TMDL Implementation Plan for Goose Creek as of 6/1/2005.

Table 9. TMDL Implementation Needs for Beaverdam Creek Watershed.

Level of Reduction	Source of Nonpoint Pollution
98%	Reduction in loads from pasture runoff
100%	Reduction in direct deposition from cattle in streams
100%	Reduction in loads from failing septic systems

Watershed Monitoring

Stream Monitoring – DEQ has documented the chemical and bacteriological quality of Beaverdam Creek dating back to 1976. DEQ added two new stations in Beaverdam Creek and the North Fork Beaverdam Creek in 2001. The Loudoun Soil and Water Conservation District (LSWCD) has chemical, bacteriological, and aquatic insect data from 1999 to 2001 at one station in Beaverdam Creek. The Loudoun Wildlife Conservancy has a monitoring station on Butchers Branch with data from 1997-2002. The North Fork Goose Creek Association began monitoring the Butcher's Branch station again in 2004. A summary of the available data is provided in **Table 10**.

Table 10. Stream Monitoring Data for the Beaverdam Creek Watershed.

Monitoring Sites	Water Flow	Chemical	Bacterial	Habitat	Aquatic Insects
Beaverdam Creek					
Rt. 734, Snickersville Rd.	USGS (new)	DEQ 1976-2001	DEQ 1976-2001		
Rt. 731, Watermill Rd.		LSWCD 1999-2001	LSWCD 1999-2001		LSWCD 1999-2001
Rt. 626, Foxcroft Rd		DEQ 2001-2004	DEQ 2001-2004		
North Fork Beaverdam Creek					

Monitoring Sites	Water Flow	Chemical	Bacterial	Habitat	Aquatic Insects
Rt. 630, Jeb Steuart Rd				LWC 1997- 1998 NFGCA 2004	LWC 1997-1998 NFGCA 2004
Rt. 719, Airmont Rd		DEQ 2001-2004	DEQ 2001-2004		
Butchers Branch					
Rt. 831				LWC 1997-2002	LWC 997-2002

Water Chemistry Conditions

The chemical quality of Beaverdam Creek is an important indicator used by DEQ to determine whether streams in the watershed are fit for aquatic life and recreational use. DEQ has collected chemical water quality data at one stations in Beaverdam Creek at Rt. 734, Snickersville Turnpike, since the 1970's. These data show that chemical parameters meet state standards and national guidelines. The key chemical parameters are summarized in **Table 11**.

LSWCD has also collected chemical data at their station at Rt. 731 begining in 1997. These data are consistent with DEQ's data, and support DEQ's finding that the chemical quality of the water in Beaverdam Creek is good.

Table 11. Summary of Key Chemical Parameters Based Upon DEQ Data from the Beaverdam Creek Watershed Between 1996 and 2001.

Parameter	Criteria	Observation	Condition
pH	DEQ sets a range of 6-9 for pH levels	Mean pH level is 7.2 and the range is 5.7 to 7.8. Levels are consistently between 6.5 and 7.5 which is good for aquatic life.	Criteria consistently met
DO (Dissolved Oxygen)	DEQ sets a minimum of 4 mg/l	Mean DO level is 9.4 with a range of 3.9 to 13.5 mg/l. Levels flucuate inversely with temperature and are consistently between 8 and 12 mg/l which is good for aquatic life.	Criteria consistently met
BOD (Biological Oxygen Demand)	No DEQ standard. EPA guildline is a maximum of 7 mg/L	Mean BOD level is 2 with a range of 0.7 to 4 mg/l. Levels are consistently about 2 mg/l suggesting low organic loads in stream water.	Criteria consistently met
Phosphorus	No DEQ standard. EPA set a guide of 1.0 mg/L for non-impaired waters	Mean level of 0.1 mg/l suggests there is no excessive run-off of fertilizers from agricultural and other operations affecting the watershed.	Criteria consistently met
	There are no state or	Mean level is 0.5 with a range of 0.2 to 1.2 mg/l. These low levels of	

Nitrogen (as Nitrate)	EPA guide for nitrogen.	nitrogen in combination with low levels of phosphorus keep growth of aquatic plants and algae in check.	Low levels

Water Bacteriology Conditions

DEQ Data –DEQ's most recent 1996-2004 fecal coliform data at their three stations in the Beaverdam Creek watershed are shown in **Figure 2**. The data are plotted as cumulative percentages and are compared with the DEQ water quality standard. The water quality at these stations do not meet state standards in that approximately 20-30 % of the samples are above 400 fecal coliform. **Figure 3** shows the same data plotted over time to illustrate the characteristic spikes of pollution that occur. The trend line for these data suggest that fecal coliform levels are decreasing.

Figure 2. DEQ Fecal Coliform Bacteria Data for Beaverdam Run 1996-2004

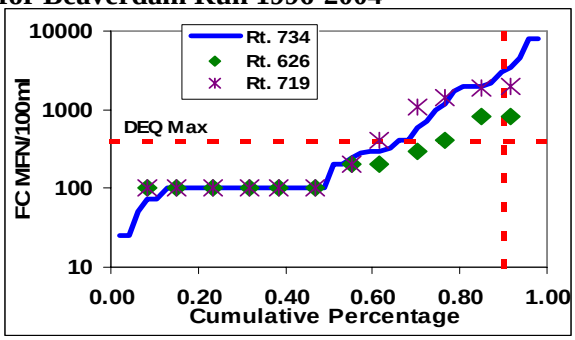
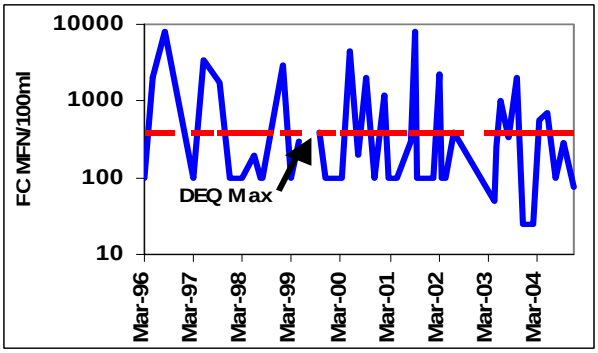


Figure 3. DEQ Fecal Coliform Bacteria Data for Beaverdam Run 1996-2004.



Loudoun Soil and Water Conservation District –LSWCD has also collected fecal coliform data at a site since 1999. These data also show that approximately 30 % of the samples exceed 400 and that water quality standards are not met. These data also show the same trend as the DEQ data.

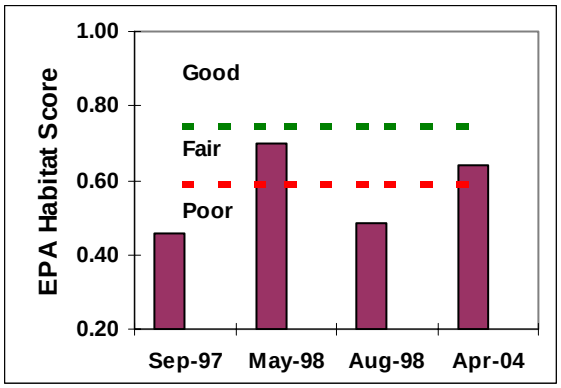
Future Fecal Impairments – DEQ's fecal coliform data from their two new stations at Rt. 626 on the main stem of Beaverdam Creek and Rt. 719 on the North Fork Beaverdam Creek support the TMDL findings that fecal coliform bacteria contamination is wide spread in the watershed. The existing 6-mile fecal impairment on the main stem should be extended to include all of Beaverdam Creek and the North Fork Beaverdam Creek.

Stream Habitat Quality

Loudoun Wildlife Conservancy – LWC has collect stream habitat data at one station in the North Fork Beaverdam Creek since 1997 using the Audubon Naturalist Society

protocol. LWC also collected stream habitat data at a station in Butcher's Branch, but discontinued this in 2003. The quality of the stream habitat is summarized in **Figure 4**. These data show that the stream habitat is generally "poor" to "fair." The data indicates there has been a substantial loss of natural riparian stream buffer, and that streambank erosion is a major problem. Stream habitat is a limiting factor to supporting a health biological community.

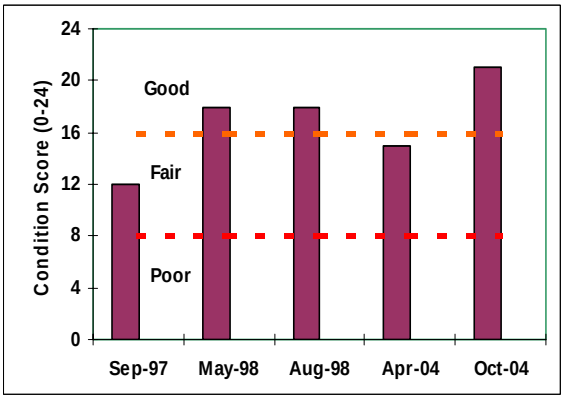
Figure 4. Stream Habitat Conditions for Beaverdam Creek at Rt. 630, 1997-2004.



Aquatic Insect Populations

Loudoun Wildlife Conservancy – LWC has collected aquatic insect data in North Fork Beaverdam Creek and Butchers Branch since 1997. The Butchers Branch station was discontinued in 2003. The results showed "poor" to "fair" conditions using EPA metrics. The LWC aquatic life condition data for the North Fork Beaverdam Creek station at Rt. 630 are provided in **Figure 5**. These data show that the insect community conditions at this site are "fair to "good." This indicates that the composition and diversity of the aquatic insects are sometimes less than expected for a healthy stream in this ecological region.

Figure 5. Aquatic Insect Condition Scores for Beaverdam Creek at Rt. 630 from 1997-2004.



Loudoun Soil and Water Conservation District and North Fork Goose Creek Association – LSWCD has also monitored aquatic insect conditions in the Beaverdam Creek watershed since 1999 using the original SOS protocol. Results show fair to good conditions at their station on Rt. 731.

Overall Assessment of Stream Health

The water quality problems in the Beaverdam Creek watershed are well documented now that DEQ has completed their TMDL study, and two new stations are being monitored. The fecal coliform bacteria monitoring and the TMDL study show that there is fecal contamination from nonpoint sources of pollution throughout the watershed. DEQ has designated a six-mile segment of Beaverdam Creek as impaired because it does not meet DEQ's standards for recreational use. This impairment should be extended to include the entire main stem and the North Fork Beaverdam Creek. DCR also needs to schedule a

TMDL Implementation Plan for this watershed so efforts to restore the water quality to meet standards can begin.

The stream habitat and aquatic insect communities are less well documented. The stream habitat conditions have been assessed by LWC in Butchers Branch and the North Fork Beaverdam Creek. Conditions are "poor" to "fair" at both sites using the EPA criteria. This indicates there has been a moderate loss of good stream habitat, and that it is a limiting factor that impacts on the biological community. The assessment of the aquatic insect conditions at the two stations range from "fair" to "good" depending upon the monitoring site.

Overall, the assessments indicate that the Beaverdam Creek watershed is impacted by human activities and the health of the stream is stressed as a result. The results of various measurements of stream health are summarized on **Table 12**.

Table 12. Summary of North Fork Goose Creek Assessments.

Monitoring Site	Environmental Parameters					
	Water Flow	**Chemical Quality**	**Bacteria Quality**	**Habitat Assessment**	**Aquatic Insect Score**	**Impervious Surfaces**
Beaverdam Creek		Good	Impaired			Good
NF Beaverdam Creek					Fair-Good	Good
Butchers Branch		Good		Fair-Good	Fair	Good

References

George Washington University. 2000. "Loudoun County Environmental Indicators Project (LEIP). Annual Report 2000. Ashburn, VA.

Interstate Commission on the Potomac River Basin. 2003. *Bacteria TMDLs for the Goose Creek Watershed*. Virginia Department of Environmental Quality and Virginia Department of Conservation and Recreation. February 2003.

Loudoun County Sanitation Authority. 2003. *Goose Creek Source Water Protection Program.* December 2003.