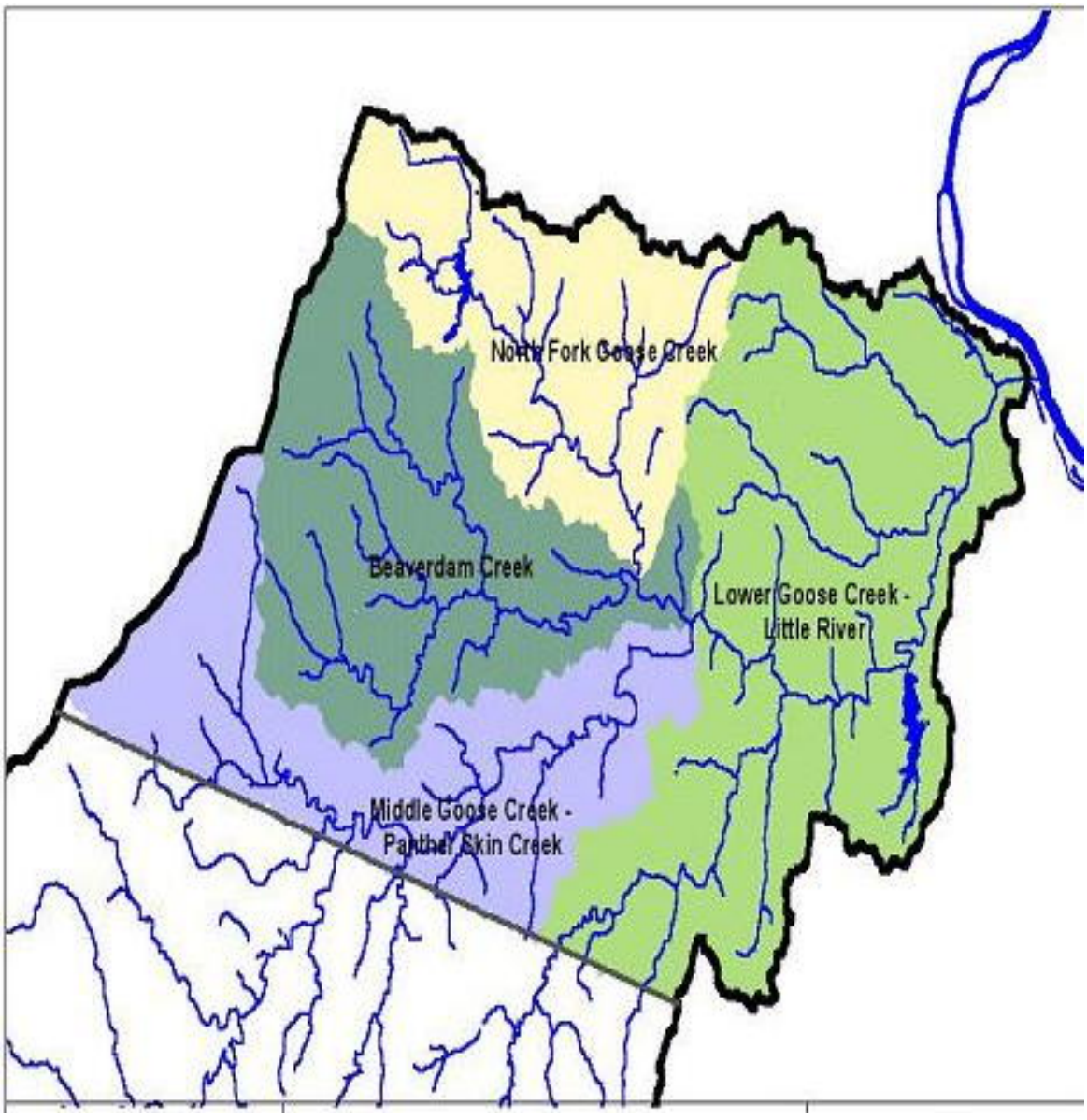
LOWER GOOSE CREEK/ LITTLE RIVER WATERSHED – 2005



Goose Creek Watershed

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Watershed Description

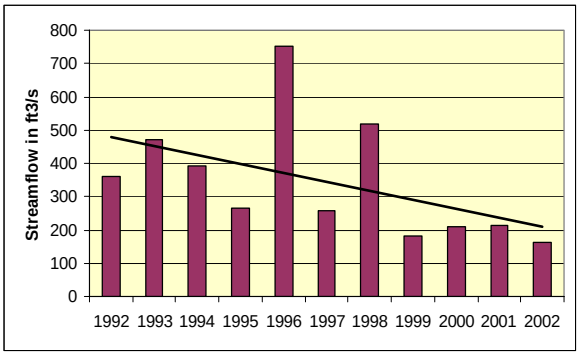
Goose Creek and its tributaries are part of the Potomac River Basin that flows into the Chesapeake Bay. The headwaters of Goose Creek begin near the Blue Ridge Mountains in northwestern Fauquier county and flow east and slightly north for approximately 53 miles toward its confluence with the Potomac River. The Lower Goose Creek subwatershed drains 57,000 acres in the middle portion of Loudoun County. Major tributaries are Little River, Tuscarora Creek, and Sycolin Creek. Tuscarora Creek flows through Leesburg and drains large urban residential and commercial areas.

The watershed is characterized by silt and clay loam soils derived from metamorphic and igneous bedrock. A large percentage of the soils in the lower portion of the watershed east of Leesburg are poorly-drained soils.

The entire portion of the mainstem of Goose Creek in Loudoun County have been designated a scenic river under Virginia's Scenic River Act. The City of Fairfax operates a water supply reservoir and intake on Goose Creek and maintains a second water supply reservoir on a small tributary.

Stream Flow Rates – There are limited data on stream flow in the Lower Goose Creek watershed. DEQ discontinued collecting stream flow data in the early 1990's. US Geological Survey has stream flow data at Rt. 7 dating from 1910. The USGS data are shown in **Figure 1**. These data show a declining trend of stream flow since 1992.

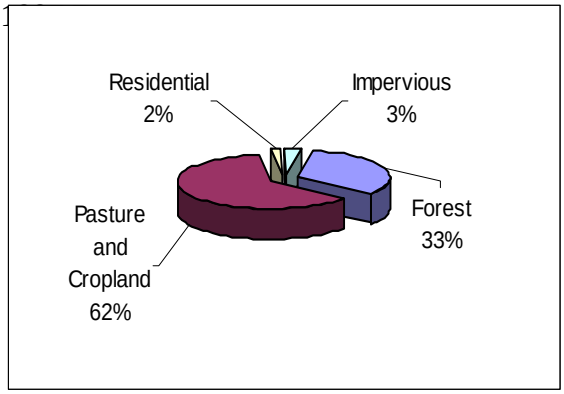
Figure 1. USGS Annual Mean Streamflow for Goose Creek, 1992-2002.



Land Use – The Goose Creek watershed lies on the edge of the Washington, D.C. metropolitan area. The watershed includes

the towns of Leesburg and Middleburg. Much of the watershed remains rural, although large portions around Leesburg and Beaverdam Creek and Resevoir are rapidely being developed. These areas are in the high density and moderate density development sections of the Loudoun County Comprehensive Plan. A breakdown of land uses in the watershed is shown in **Figure 2**.

Figure 2. Land Use in Lower Goose Creek Watershed Based on



Impervious Surfaces -- Impervious surfaces include the roadways, driveways, rooftops and parking lots that do not allow infiltration of water from rainstorms and runoff. DEQ used a 1997 EPA study to determine that the amount of impervious surface in the Lower Goose Creek and Little River subwatershed is **3%**. As a general rule, a watershed with less than 10% of its area in impervious surfaces will **not** experience a noticeable impact on its hydrological characterisitics.

However, these same data shown that the **Tuscarora Creek** subwatershed has an imperviousness of **10%.** Further, the lower **Sycolin Creek** subwatershed has an imperviousness of **17%.** These streams drain large residential and comercial areas in Leesburg, and have poor riparian buffers along many segments. Streams having 10% or greater imperviousness will exhibit characteristics such as eroding banks, poor biological diversity, and high bacterial levels. In addition, the DEQ reports that the population of Loudoun County is expected to increase by 75% over the next 10 years, and a large portion of this growth will be in the Goose Creek watershed. Imperviousness can be expected to increase substantially.

Water Quality Studies

Water Quality Standards – Stream waters that are fit for recreational use must have low levels of fecal contamination. Virginia streams also need to be fit to support aquatic life. DEQ has collected fecal coliform data at five stations in the Lower Goose Creek and Little River watersheds since the 1970's to determine whether these water quality standards are being met. DEQ also monitors aquatic life (benthic macroinvertebrates) in the Lower Goose Creek at Rt. 7 and in Little River.

The fecal coliform bacteria samples indicate that water quality at these stations do not meet the state fecal coliform bacteria standard of 400 fecal coliform. The 1995-2004 data on fecal coliform bacteria levels, plotted as cumulative percentages to show the level at which the water quality standard is exceeded, are shown in **Figure 3**. The percent violations at the different stations range from 20 to 55%.

The trend line for these data, when plotted by sampling date, suggest that fecal coliform concentrations have gradually decreased over time. The two exceptions are in Sycolin Creek and Tuscarora Creek where fecal concentrations have increased over the period of sampling. The Sycolin Creek data are shown in **Figure 4.**

Figure 3. Fecal Coliform Concentrations in Goose Creek and Little River Showing Level of Violations, 1995-2004.

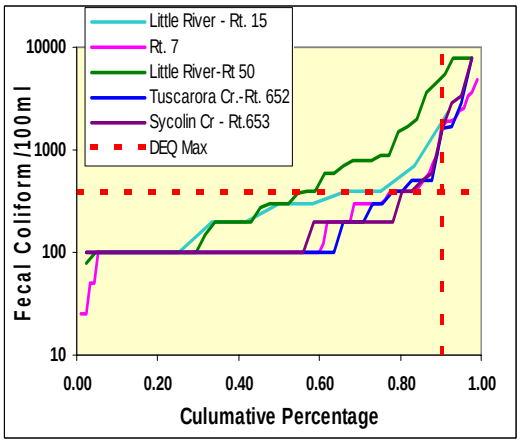
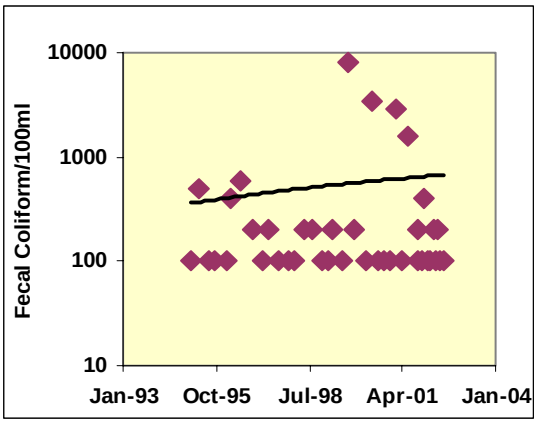
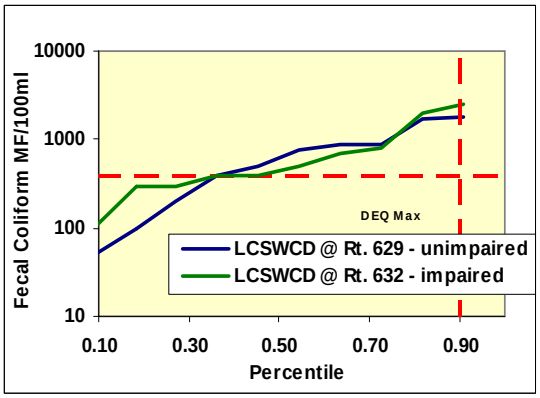


Figure 4. Fecal Coliform Concentrations for Sycolin Creek Showing an Increasing Trend for 1995-2004.



Loudoun Soil and Water Conservation District –LSWCD has also collected fecal coliform data in Little River at two sites since 1999. These data support the DEQ data that over 10 % of the samples exceed 400 and that water quality standards are not being met, as shown in **Figure 5**. These data also reveal that intermittent spikes of high concentrations of pollution occur, and that fecal coliform concentrations in the lower Goose Creek and Little River are either remaining constant or gradually decreasing over time.

Figure 5. Fecal Coliform Concentrations for Little River at Rt. 629 and Rt. 632 Showing level of Violations, 1999-2004.



Impaired Waters – Lower Goose Creek and little River are listed by DEQ as impaired for recreational use due to the violations of the Virginia water quality standards for fecal coliform bacteria. The impaired portions in Goose Creek extend from the Potomac River to Goose Creek Dam, all of Tuscarora Creek and Sycolin Creek, and most of Little River. "Impaired" means the water quality in these portion do not support the stream's intended use for recreation including swimming, wading, and fishing.

DEQ has also designated portions of the mainstem of Goose Creek from the Potomac River upstream to the Goose Creek Dam and Little River as being impaired for violating this state water quality standards for the support of aquatic life. Further, in 2004 DEQ identified Tuscarora Creek as having a benthic macroinvertebrate community that is threatened (has "observed effects") based on citizen stream monitoring data.

TMDL Reports – DEQ is required to conduct studies of all waters that do not meet state water quality standards. The purpose of the study is to identify the sources of pollution and quantify the pollution loads to the stream. DEQ has published two reports on water

quality in the Goose Creek watershed. The first report, "*Bacteria TMDLs for the Goose Creek Watershed*," was published in February 2003. The second report, "*Benthic TMDLs for the Goose Creek and Little River Watersheds*," was published in March 2004.

Sources of Pollution – There are two types of pollution impacting the Lower Goose Creek watershed. Point sources of fecal bacteria include municipal and industrial waste water treatment plants (WWTP) and private residences that have an above ground treatment system. Nonpoint sources of fecal bacteria include human sources, agricultural souces, and wildlife sources. In addition, the mainstem of Goose Creek is potentially impacted by nonpoint pollution loads delivered from the whole upstream watershed making nonpoint pollution a watershed wide problem.

- **Point Sources** -- There are four wastewater treatment facilities that discharge in the watershed: Aldie WWTP, Goose Creek Industrial Park WWTP; Rehau Plastics, Inc., and St. Louis Community treatment facility. These sourcs are permitted by the state and provide a high level of treatment. There is no evidence that they are contibuting any significant amounts of fecal bacteria pollution to Goose Creek.
- **Human Sources** – The most significant source of fecal pollution from humans is from failing septic systems that allow waste water to flow on the surface and into streams or ponds. Water quality samples showed that fecal coliforms from human sources are widespread in the watershed, and that human sources could even be the dominant source after storm events. Extensive field work shows septic systems that are more than 40 years old have an average failure rate of 40%, 20–40 year old systems have a 20% failure rate, and less than 20 years old systems have a 5% failure rate. Based on these studies, DEQ estimates there are 78 failing septic systems in the Lower Goose Creek and Little River subwatersheds.
- **Liverstock Sources** – Beef cattle and horses are the predominant livestock in the Goose Creek watershed. The DEQ study found that fecal coliform loads come from both pasture runoff and from direct deposites of manure by cattle in streams. Over 95% of the fecal contamination to the streams comes from cattle. In most impaired stream segments, contamination from runoff from pastures is greater than contamination from direct deposites in the stream by cattle. This occurs despite the fact that most of the bacteria die off on the land surface and only a small portion are transported to the stream in runoff.
- **Wildlife** – There are no wildlife population surveys available for the Goose Creek watershed. DEQ estimated the number of wildlife of different species based on the available habitat types. Beaver and muskrat are the most important species from a water quality aspect because 80-100% of their wastes are deposited directly into streams. However, wildlife populations and their fecal contributions are relatively small, and reductions are not necessary to meet water quality standards.

Wildlife in Goose Creek.

Cattle in Sycolin Creek

- **Average Daily Fecal Bacteria Load By Source** – DEQ combined the information on point sources, nonpoint sources, and direct disposition of fecal wastes and estimated the average daily fecal bacteria load in the watershed. The percent of the average daily load from different sources are shown in **Table 1**. The fecal coliform bacteria in the North Fork Goose Creek that comes from pasture runoff or direct disposition by cattle range from 68% to 99%.

Table 1. Percent of Average Daily Loads of Fecal Bacteria by Source in the Lower Goose Creek Watershed.

Source	Lower Goose Creek	Tuscarora Creek	Sycolin Creek	Little River
Direct Sources:				
• Point Sources	---	---	---	---
• Septic Systems	---	---	---	---
• Wildlife in Stream	0.8%	0.3%	0.3%	0.1%
• **Cattle in Stream**	**30.4%**	**25.3%**	**37.6%**	**23.3%**
Runoff Sources:				
• Forest - Wildlife	8.2%	1%	0.9%	0.3%
• Crop	12.4%	3.3%	0.5%	0.1%
• **Pasture - Livestock**	**37.2%**	**66%**	**60.1%**	**76%**
• Developed	11%	4%	0.7%	0.3%
Total All Sources	**100%**	**100%**	**100%**	**100%**

Stream Monitoring

Stream water quality and habitat conditions are monitored in the Lower Goose Creek watershed by DEQ, LSWCD, and LWC. DEQ has chemical, nutrient, sediment, and bacterial data at stations in Goose Creek, Little River, Sycolin Creek, and Tuscarora Creek that date back to 1973. DEQ also has habitat and aquatic insect data for Goose Creek at Rt. 7 and Little River at Rt. 50. LSWCD has nutrient, bacterial, and aquatic insect data at two stations on Little River from 1999 to 2004. LWC has habitat and aquatic insect data from one station on Tuscarora Creek since 1997, and a station in Sycolin Creek starting in 2004. A summary of the available data is provided in **Table 2**.

Table 2. Stream Monitoring Stations and Data Type for the Lower Goose Creek and Little River Watersheds.

Monitoring Sites	Water Flow	Chemical & Physical	Bacterial	Stream Habitat	Aquatic Insects
Main Stem					
– Rt. 7	USGS 1910 -1999	DEQ 1973-2004	DEQ 1973-2004	DEQ 1996- 2004	DEQ 1996-2004
-- Rt. 621	USGSS	DEQ 2001-2004	DEQ 2001-2004		
Little River					
-- Rt. 15		DEQ 2001- 2002	DEQ 2001-2002		
– Rt. 50		DEQ 1973-2002	DEQ 1973-2002	DEQ 1997-2004	DEQ 1997-2004
-- Rt. 629	LSWCD 1999-2001	DEQ 2003-2004 LSWCD 1999-2001	DEQ 2003-2004 LSWCD 1999-2001		LSWCD 1999-2001
-- Rt. 632	LSWCD 1999-2001	LSWCD 1999-2001	LSWCD 1999-2001		LSWCD 1999-2001
Sycolin Creek					
– Rt. 15		DEQ 1973-2000	DEQ 1973-2000		
– Rt. 652		DEQ 1973-2002	DEQ 1973-2001	LWC 2004	LWC 2004
– Rt. 621		DEQ 1973-2000	DEQ 1973-2000		
– Rt. 797		DEQ 1973-2000	DEQ 1973-2000		
Tuscarora Creek					
-- Golf Course		DEQ 2003-2004	DEQ 2003-2004		
– Rt. 653		DEQ 1973-2002	DEQ 1973-2002		
-- Lawson Rd.				LWC 1997-2004	LWC 1997-2004

Chemical, Nutrient, and Physical Water Quality Studies

DEQ studied the chemical, nutrient, and physical conditions in the mainstem of Goose Creek and Little River in 2003 that impact on aquatic life. Earlier DEQ stream monitoring data indicated that aquatic life in the streams were slightly impaired. The study was conducted to identify the stress factors in the stream environment what were degrading aquatic life. Four potential stress factors were examined: (1) heavy metals and toxic chemicals; (2) alteration of water flow; (3) nutrients and excess algae; and (4)

sediment. DEQ published their findings in their 2004 report, "*Benthic TMDLs for the Goose Creek and Little River Watersheds*."

Heavy Metals and Toxic Chemicals – DEQ did not identify any heavy metals or toxic chemicals in the water samples, the sediment samples, or fish tissue samples that are likely to cause the aquatic life impairment. Toxicity studies were conducted on the growth and survival of fathead minnows and the survival and reproduction of water fleas in an EPA laboratory to make this determination.

Altered Water Flow – Both Goose Creek and Little River have dams that can affect aquatic life downstream if sufficient stream flows are not maintained. Habitat assessments conducted by DEQ under low flow conditions indicate there is sufficient flow in both Goose Creek and Little River to support aquatic life. Water temperatures were also normal under low flow conditions.

Nutrients – Nitrogen and phosphorus concerntrations in samples collected by DEQ were compared to concerntrations in healthy streams. DEQ data from 1992 to 2002 show that nitrogen concentrations in the lower Goose Creek are considerably higher than those in healthy streams. Nitrogen levels in Little River, and phosphorus levels in both Goose Creek and Little River were comparable to levels in healthy streams. There are no water quality standards for nitrogen.

Government and citizen groups have worked together since 1987 to reduce the amount of nutrients flowing into the Chesapeake Bay from tributaries of the Potomac River including Goose Creek. High nutrient levels threaten the delicate balance of the Bay ecosystem by causing rapid growth of unhealthy algae and prohibiting light from reaching underwater grasses critical to the Bay's fish and shellfish.

DEQ data for Goose Creek at Rt. 7 and Little River at Rt. 50 also show that total nitrogen and total phosphorus concentrations have remained relatively constant over the last 5-10 years. It is critical to reduce nitrogen levels in order to raise the dissolved oxgyen levels in Chesapeake Bay and eliminate the "dead zones" in the Bay where the lack of oxygen is killing fish, crabs, and shellfish.

Sediment Loads – DEQ found that sediment loads in excess of those found in healthy streams are the likely cause of the aquatic life impairments in Goose Creek and Little River. This is based on direct evidence from an examination of the aquatic insects and other macroinvertebrates found in Goose Creek and Little River compared to those found in healthy streams. Information on these findings are reported in the section on "Aquatic Life Conditions."

- **Sources of Sediment in Goose Creek** – The major source of sediment in Goose Creek is streambank erosion. It accounts for almost 70% of the total sediment load. Erosion from pasture is the second largest source, accounting for about 25% of the total load. Erosion from crops and construction sites are the next largest sources, but neither accounts for more than 3% of the total sediment load.
- **Sediment Trapping in the Goose Creek Reservoir and Beaverdam Reservoir** – The Goose Creek Reservoir is a major sink for sediment generated in the Goose Creek watershed. The reservoir, created in 1961, had to be dredged in 1998 because it

had lost almost half its storage capacity. Studies estimate that sediment was deposited in the reservoir at a rate of approximately 10,000 tons/year.

- **Little River** – Erosion from pasture is the largest source of sediment load to Little River, accounting for 60%. Streambank erosion is not as dominant, and accounts for 30% of the sediment load.
- **Sediment Loads –** The sediment loading to Goose Creek and Little River from different sources are shown in **Table 3**. The total for Goose Creek is 76,000 tons per year of which 7,600 tons is trapped in the Goose Creek reservoir. The total for Little River is 8,900 tons per year.

Table 3. Average Annual Sediment Loads From Goose Creek and Little River By Source (tons/year).

Source	Goose Creek (tons/year)	Little River (tons/year)
Construction	1,542	268
Crops	1,843	**1,335**
Forest	998	290
Pasture	**15,481**	**3,213**
Developed Land	447	16
Streambank Erosion	**55,502**	**3,728**
Reservoir Trapping	-7,592	---
Total	**68,250 tons/yr**	**8,851 tons/yr**

- **Impact of Development** – The impact of development is an important factor to consider in the Goose Creek watershed. The population in the Town of Leesburg doubled between 1990 and 2000, and the area surrounding Leesburg continues to grow at a rapid rate. This growth will especially impact the Tuscarora and Sycolin Creeks.

  As development in the watershed increases, the total sediment load changes. Increased development leads to an increase in sediment loads primarily through an increase in streambank erosion. **Table 4** shows the projected impact of development on sediment loads in Goose Creek. The data show that an increase in developed land from 4% to 8% (projected by DEQ for 2015) increases the overall sediment load in Goose Creek by 36%.
- **Meeting Water Quality Standards** -- The annual sediment load that needs to be reduced to meet water quality standards is shown in **Table 4**. The percentage changes from 38% under current conditions to 63% under full build-out conditions.
- **Chesapeake Bay Sediment Reduction Goals** – The high levels of sediment in Goose Creek impact the Chesapeake Bay Sediment Reduction Goals agreed to by Virginia in 2003. Reductions in sediment loading are needed to provide clarity in the Chesapeake Bay necessary for underwater grasses to thrive. Virginia has agreed to reduce sediment loads in the Potomac River watershed by 617,000 tons/year.

Table 4. Average Annual Sediment Loads to Goose Creek (tons/yr) Under Different Development Conditions.

Source	Current Load (tons/yr)	2015 Load (tons/yr)	Full Build-out Load (tons/yr)
Forest	1,000	1,000	1,000
Cropland	1,800	1,700	1,600
Pasture	15,500	14,200	13,300
Developed Land	500	1,000	1,400
Construction	1,000	800	500
Streambank Erosion	55,500	83,800	110,300
Other Sources	200	200	200
Reservoir Trapping	-7,500	-10,300	-12,900
Percent Developed	**4%**	**8%**	**12%**
Total Sediment Load	**68,000**	**92,400**	**115,400**
Required Reduction	**38%**	**54%**	**63%**

Stream Habitat Conditions

The quality of stream habitats is assessed using ten parameters that are combine into a "habitat quality score." EPA provide criteria to use the habitat score to characterize stream habitat conditions as "poor," "fair," "good," or "excellent." DEQ, LCSA, and LWC use EPA's parameters and habitat score to assess stream habitats at their stream monitoring sites.

DEQ – DEQ has monitored stream habitat conditions on Goose Creek at Rt. 7 and Little River at Rt. 50 for several years. The habitat condition scores are shown in **Figures 6 & 7**. The habitat conditions at the Goose Creek station appear to have a downward trend and are currently in the "fair" condition category. The scores show that habitat conditions at the Little River station are consistently "good" and will support healthy biological communities. These healthy conditions have existed steady for several years.

Figure 6. DEQ Habitat Scores for Goose Creek at Rt. 7, 1997-2000.

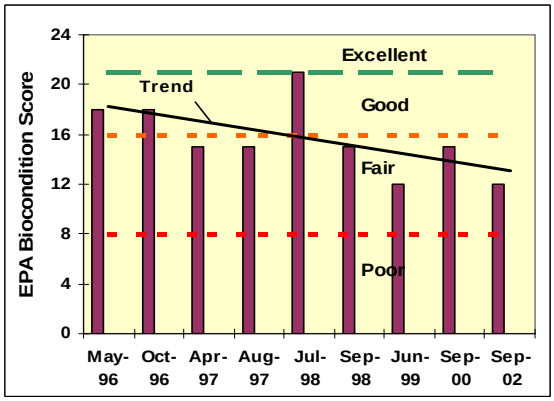
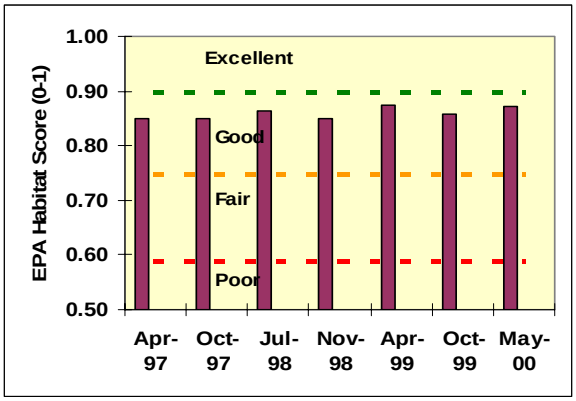


Figure 7. DEQ Habitat Scores for Little River at Rt. 50, 1997-2000.



LCSA – LCSA has assessed stream habitats throughout the Goose Creek watershed as part of their "Goose Creek Source Water Protection Program" study. The stream habitats were assessed to determine whether they provided the necessary elements of a healthy

aquatic system. Ten reaches in both the Lower Goose Creek watershed and the Little River watershed were assessed using the EPA RBP II protocol. These assessments provide the most extensive data on stream habitats in the Lower Goose Creek/Little River watershed.

The LCSA assessment scores, based on the same EPA criteria as used for the DEQ data, are shown in **Figures 8 and 9**. The stations progress from the mouth of each watershed to upstream reaches. These data show generally "poor to fair" conditions in each watershed. The lack of riparian buffers and active bank erosion contribute to these lower scores. The scores suggest that habitat is a limiting factor for healthy aquatic insect communities.

Figure 8. LCSA Stream Habitat Scores, Lower Goose Creek Watershed, 2003.

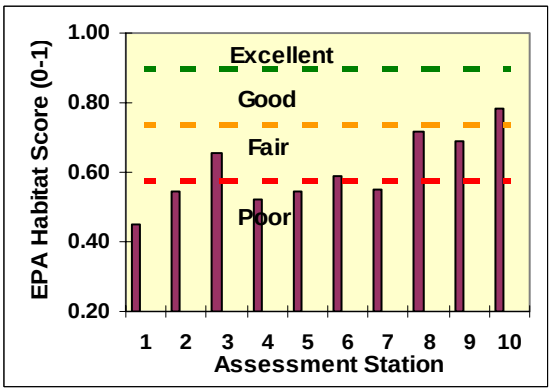
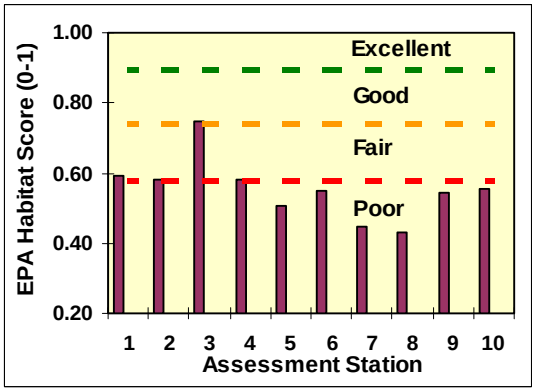
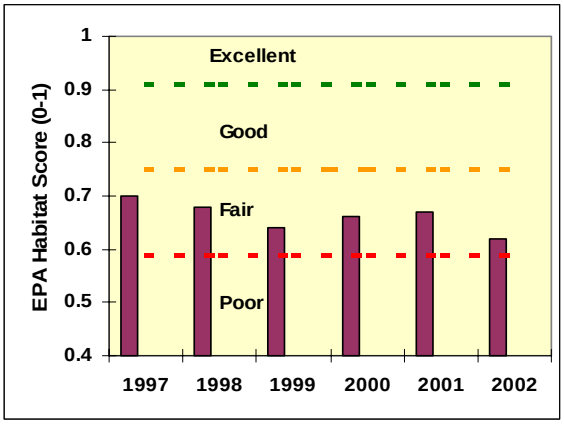


Figure 9. LCSA Stream Habitat Scores for Little River Watershed, 2003.



LWC – LWC has monitored Tuscarora Creek since 1997, and began monitoring Sycolin Creek in 2004. The monitoring results for Tuscarora Creek are shown in **Figure 10**. The results show that stream habitat conditions are characterized as being "fair." The factors stressing the habitat are increased sediment deposits that reduce living spaces for aquatic life, reduced canopy cover, and stream channel alterations. Habitat conditions at the Sycolin Creek monitoring site are characterized as "good."

Figure 10. Habitat Conditions in Tuscarora Creek, 1997-2002.

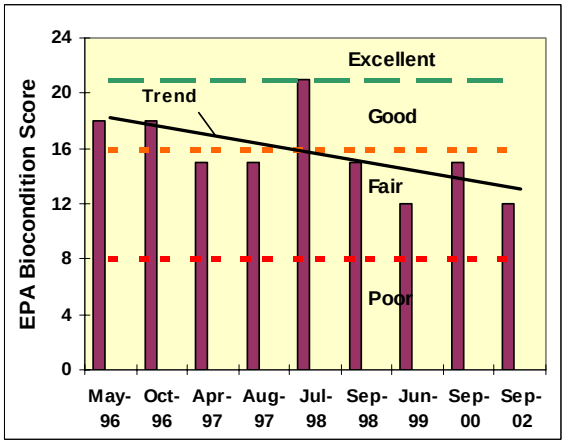


Aquatic Life Conditions

DEQ – DEQ has monitored aquatic insects at stations in Goose Creek and Little River for several years. They use EPA's RBP II protocol to assess whether there are healthy aquatic life communities, and to determine whether streams meet aquatic life water quality standards. The aquatic life conditions at DEQ stations in Goose Creek and Little River are shown in **Figures 11 & 12**.

Goose Creek – The results for Goose Creek at Rt. 7 show that there are some insects such as mayflies and free living caddisflies that are commonly found in good water quality conditions. Goose Creek also does not have unusually high numbers of insects found in poor water quality conditions such as worms, clams, and midge fly larvae. However, overall there is a reduced number of insect species, particularly insects found in good quality water quality and good stream habitat conditions.

Figure 11. Aquatic Insect Conditions in Goose Creek at Rt. 7, 1996-2002.

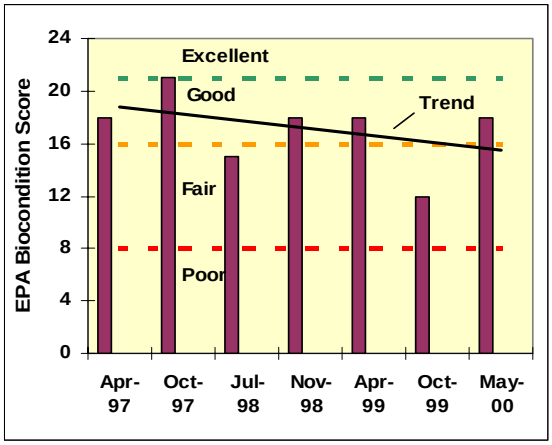


DEQ concludes that:

- Goose Creek has more crayfish, which are sediment toleratant, than healthy streams;
- Goose Creek shows consistently higher numbers of water striders and whirligig beetles, and low numbers of riffle beetles, which taken together suggest slow moving water and less coarse substrate;
- Goose Creek has more narrow-winged damselflies, which may suggest some sediment desposition; and
- Goose Creek lacks some sediment intolerant aquatic insects including stoneflies and water pennies.

DEQ designated Goose Creek as **slightly impaired** based upon human impacts that are harmful to aquatic life. The aquatic insect community is stressed because of high sediment levels in the stream caused by streambank erosion as discussed in the section on "Physical, Chemical, and Nutrient Water Quality Studies."

Figure 12. Aquatic Insect Conditions in Little River at Rt. 50, 1997-2002.



Little River – The results of DEQ monitoring of aquatic insects in Little River show slightly better conditions than found in Goose Creek. Little River does contain a good abundance of riffle beettles, and does not contain a high abundance of

poor water quality insects such as worm, midge fly lavae, and narrow-winged damselflies. However, monitoring also show higher numbers of sediment tolerant insects than normally found in good water quality streams.

DEQ concludes that:

- Little River has high numbers of burrowing and sprawling mayflies, and increasing abundance of crayfish, and many Asian clams, which suggest sediment desposition; and
- Little River has few water pennies and almost no stoneflies.

DEQ's assessments of these data have changed over the years. Prior to 1998, Little River was classified as being moderately impaired for aquatic life. DEQ reported that "rural development and an upstream impoundment impact the water quality." In November 1998, DEQ changed their assessment of the aquatic insect population from "moderately impaired" to "non-impaired." In the August 2000, the aquatic life designation for Little River was changed again to "slightly impaired."

Tuscarora Creek –LWC has monitored Tuscarora Creek since 1997 using the same EPA protocol as DEQ. The aquatic insect scores for Tuscarora Creek are shown in **Figure 13**. The graph shows dramatic fluctuations in the condition of the aquatic insect community with scores ranging from a low of 3 to a high of 21. Low aquatic insect scores are correlated with low species diversity and high numbers of insects tolerant to pollution. Impact from urban runoff is most likely causing these conditions. The high insect population scores demonstrates the potential that can be achieved if human impact can be better controlled and stream conditions stabilized.

Sycolin Creek – LWC began monitoring Sycolin Creek in 2004. The results, shown in **Figure 14**, indicate that aquatic life conditions are in the "good" range. LWC has used Sycolin Creek for a training site because of the good diversity of aquatic insects. However, increased streambank erosion, shifting sand and gravel bars in the stream channel, and increased sediments in the substrate indicate that agricultural activities and increased development upstream are having a negative impact on the stream.

Figure 13. LWC Aquatic Insect Conditions for Tuscarora Creek, 1997-2004.

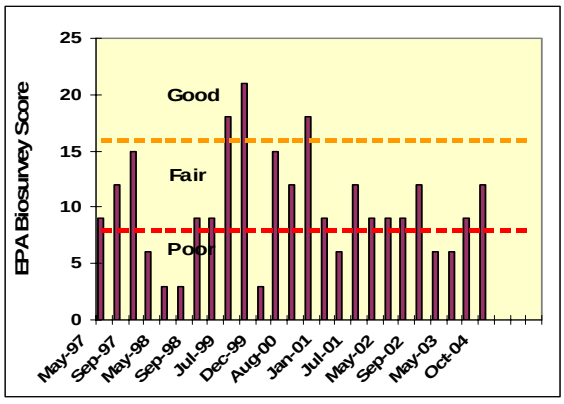
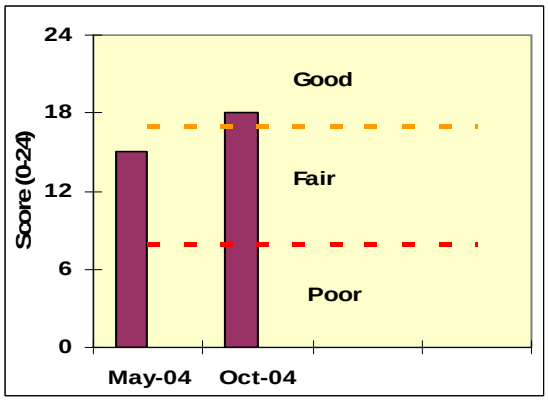


Figure 14. LWC Aquatic Insect Conditions for Lower Sycolin Creek, 2004.



LWC monitoring site in Sycolin Creek showing good habitat conditions.

A Sycolin Creek section with severe streambank erosion and gravel bar in stream channel.

Overall Assessment of Stream Health

The water quality and stream habitat conditions are well documented in the Lower Goose Creek and Little River watersheds. The data show that water quality is impacted by human activities, and the overall health of streams in the watershed is marginal. Stream waters throughout the watershed are impaired for recreational use due to high fecal coliform levels. On the positive side, stream flows are adequate, and the chemical quality of stream waters is good. There are no point sources of pollution that are degrading the water quality.

A Total Maximum Daily Load (TMDL) study has been conducted by DEQ that identifies livestock, failing septic tank systems, and wildlife as the major sources of pollution impacting on water quality. The report includes recommendations regarding the level of reductions in nonpoint pollution needed to restore water quality.

In addition, aquatic insect monitoring data show only "fair" aquatic life conditions because of a reduced number of insect species than would be expected without human stresses. DEQ has identified portions of Goose Creek and Little River that are slightly impaired for aquatic life, and portions of Turcarora Creek where aquatic life conditions are "threatened." DEQ conducted a study in 2003 and identified sediment from active streambank erosion as being the primary cause of stress on aquatic life. These finding were supported by stream habitat assessments conducted by Loudoun County Sanitation Authority as part of a source water protection study. They found problems with active streambank erosion at several stations in the Lower Goose Creek and Little River watersheds.

The assessments of various environmental parameters that show the impacts on water quality and stream health are summarized on **Table 5**.

Table 5. Summary of Lower Goose Creek / Little River Water Quality and Stream Health Assessments.

Monitoring Site	Environmental Parameters					
	Chemical Quality	Nutrients/ Sediments	Bacteriological Quality	Habitat Assessment	Aquatic Insect Score	Impervious Surfaces
Main Stem	**Good**	**Marginal-Poor**	**Impaired**	**Fair-Poor**	**Fair**	**Good**
Little River	**Good**	**Marginal-Poor**	**Impaired**	**Fair-Poor**	**Fair - Good**	**Good**
Sycolin Creek	**Good**		**Impaired**		**Fair-Good**	**Good**
Tuscarora Creek	**Good**		**Impaired**	**Fair**	**Fair-Poor**	**Poor**

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