3. Results

In general, bacteria levels found in a majority of streams make them unsafe for recreational contact (swimming and wading). The benthic macroinvertebrate community lacks sensitive species that are indictors of good water quality and is dominated by tolerant species that are characteristic of degraded streams. The fish community is dominated by habitat generalists, omnivores, and non-native species.

3.1 Bacteria Monitoring Data

In 2003, the Department of Environmental Quality adopted a more stringent bacteria standard for primary contact recreation to all surface water of the state. This action was taken as part of Virginia's commitment to attain the national goal of water quality of surface water for all types of recreation. According to these standards, the following standards now apply:

- Fecal coliform bacteria shall not exceed a geometric mean of 200 fecal coliform bacteria per 100 ml of water for two or more samples over a calendar month
- No more than 10 percent of the total samples taken during any calendar month can exceed 400 fecal coliform bacteria per 100 ml of water
- *E. coli* shall not exceed a geometric mean of 126 bacteria per 100 ml of water or exceed an instantaneous value of 235 bacteria per 100 ml of water.

Since bacteria sampling in the county is only conducted on a quarterly basis, the geometric mean standard cannot really be applied to the data. Comparisons with the 400 f.c./100 ml standard are more meaningful. In 2004, the percentage of samples with fecal concentration less than 400 f.c./100ml decreased to 28 percent from 32 percent in 2002 (Figure 6). However, since the Health Department has historically used 200 f.c./100ml as the cutoff for "good" water quality, the percentage of samples with fecal concentrations less than 200 f.c./100ml are also shown in Figure 6. This percentage, actually showed an increase from 17 percent to 24 percent.

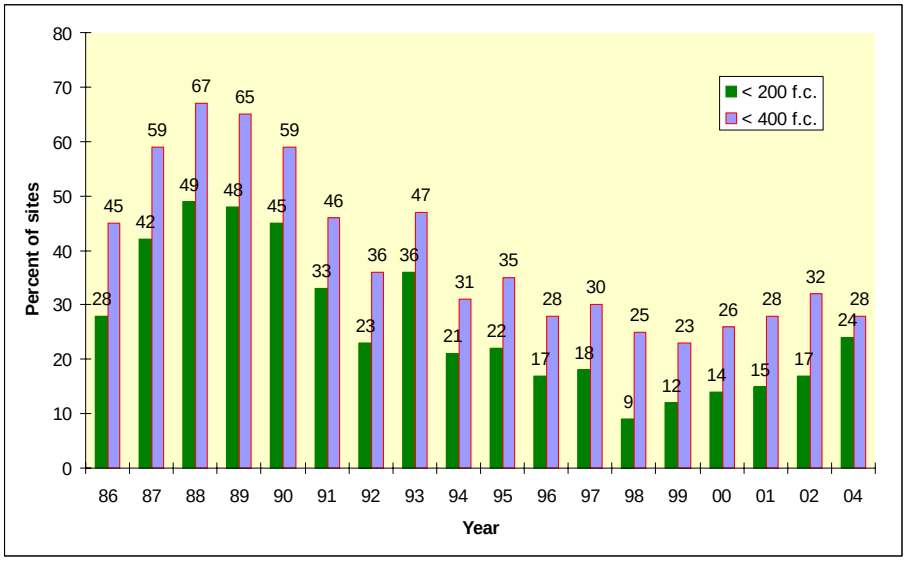

Figure 6: Percent of sites with less than 200 and 400 fecal coliform bacteria per 100ml.

Factors affecting the increase or decrease in the amount of fecal coliform in stream waters include, rainfall and the sample water temperature. Both of these factors are noted in past Health Department stream water quality reports as environmental conditions affecting the fecal coliform results. Plots of fecal concentration counts versus temperature (Figure 7) and fecal concentration geometric means versus 5-day antecedent rainfall (Figure 8) suggests a closer association to temperature.

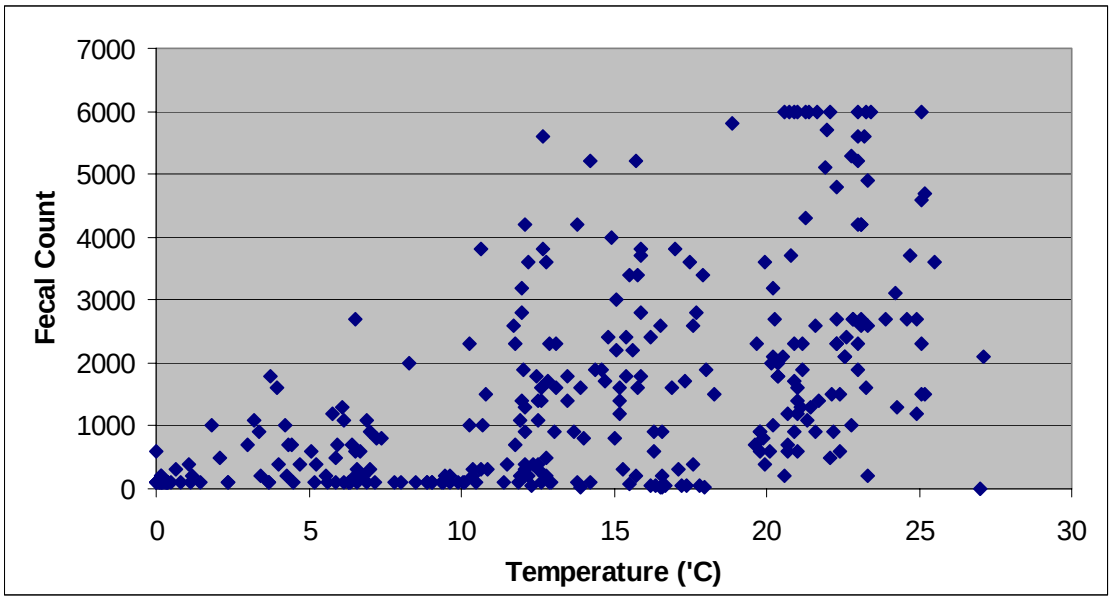

Figure 7: Fecal coliform concentrations versus water temperature.

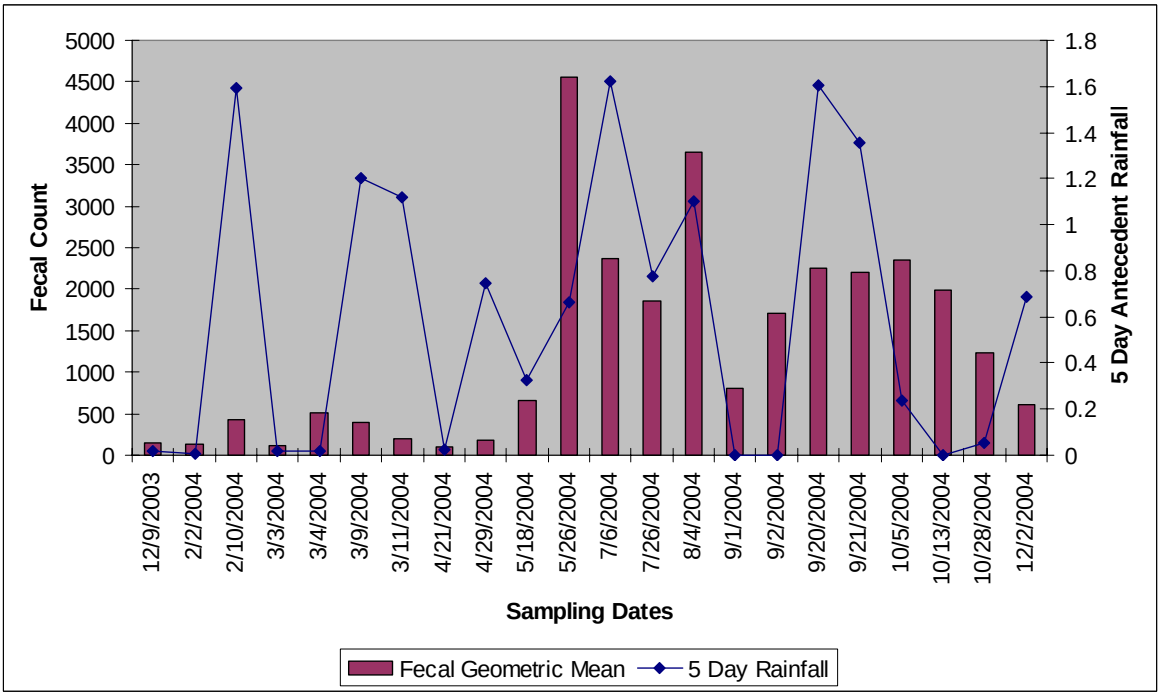

Figure 8: Geometric mean of fecal coliform concentrations versus 5-day antecedent rainfall.

All sites in Fairfax County where at least 4 samples were taken exceeded concentrations of 400 f.c./100ml at least once. The distribution of the number of exceedences in shown in Figure 9, it can be seen that the vast majority of sites (97%) exceeded 400 f.c./100ml two or more times. This would imply that in all areas of the county whether intensely developed or sparsely developed are experiencing a problem with fecal coliform contamination in our waterways. *At any time, any stream in Fairfax County may exceed the level of fecal coliform that the Department of Environmental Quality deems appropriate for recreational contact.*

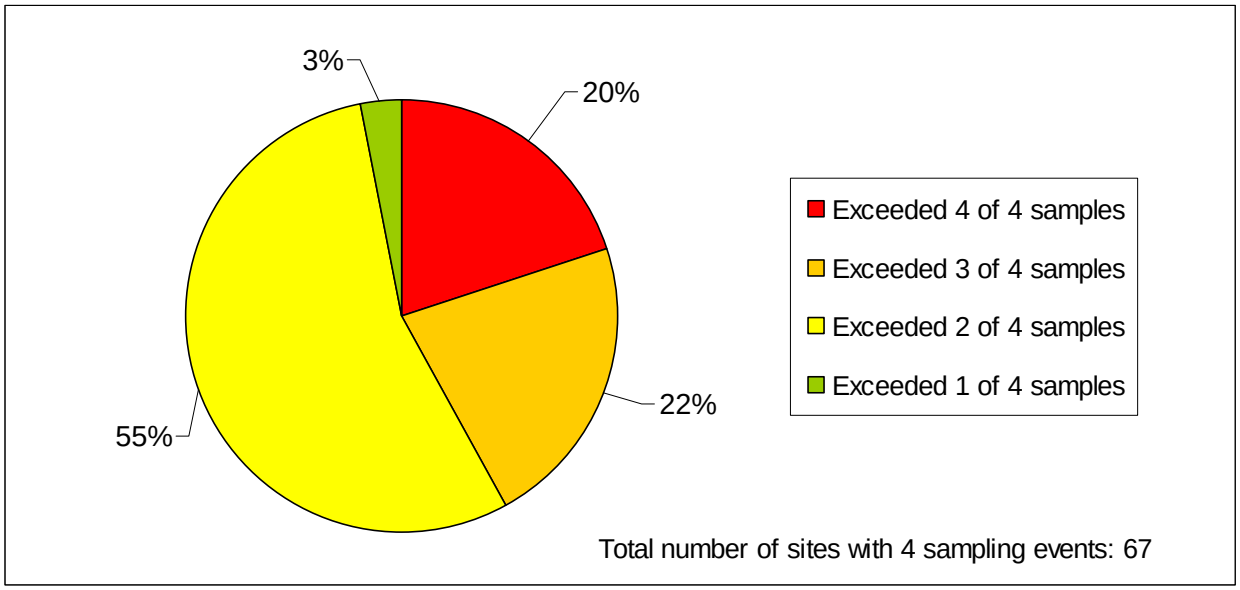

Figure 9: Percentage of sites with exceedences of the state's water quality standard (400 f.c./100ml) for fecal coliform bacteria.

Eighty sites were sampled four times throughout 2004 for a total of 320 samples. The original Health Department sample sites are located on major streams and their tributaries and were picked on ease of access. Only 25 of the 30 watersheds were sampled using the original Health Department bacteria monitoring program locations (Figure 9). Four of these five watersheds are located in downzoned areas of Fairfax County. By disregarding these watersheds, the percent of sites within the acceptable fecal coliform range may be skewed. Future bacteria monitoring efforts will utilize sites selected using stratified random sampling and will provide more representative data.

3.2 Fish Sampling Data

A total of 14 streams within the county were sampled for fish during 2004. All sites were rated in the "fair" to "very poor" range according to the fish community (Figure 10) meaning most streams were dominated by habitat generalists, omnivores, and species that are tolerant of poor water quality. Sixty-four percent of all streams assessed for fish received a "poor" or "very poor" rating and the remaining 36 percent fell into the "fair" rating.

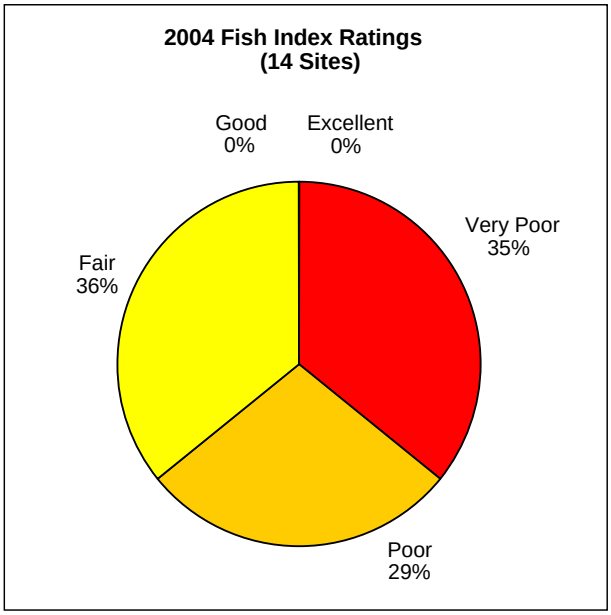

Figure 10: Ratings of 2004 biomonitoring sites based on the Fish Index of Biotic Integrity.

The Blacknose dace, Rhinichthys atratulus, is tolerant of poor water quality. The Blacknose dace is common in streams throughout Fairfax County.

The White Sucker, Catostomus commersoni, is an omnivore. This species is also found throughout Fairfax County.

Larger streams (3, 4, and 5 order) had a higher rating ("fair" to "poor") compared with second order streams based on the mean (Table 8). Second order streams have a higher standard deviation compared with the larger streams meaning there was high variability in the rating scores of second order streams.

Table 8: Fish Index of Biotic Integrity statistics by stream order.

Stream Order	Number of samples	Mean Fish Index	Rating	Standard Deviation
2	7	14.5	Very Poor	9.8
3, 4, and 5	7	24.9	Fair to Poor	5.4

3.3 Benthic Macroinvertebrates

A total of 30 sites within the county were sampled for benthic macroinvertebrates. Consistent with what was reported in the baseline study, a majority of streams within the county are in "fair" to "very poor" condition (80 percent) based on the Benthic Index of Biotic Integrity (Figure 11). For the 2004 sampling season, 6 sites were rated in the "excellent" to "good" range while 24 sites were rated in the "fair" to "very poor" range. Volunteer sampling data from the Northern Virginia Soil and Water Conservation District also shows that 81 percent of the sites that they sampled were rated as "unacceptable" (Figure 12).

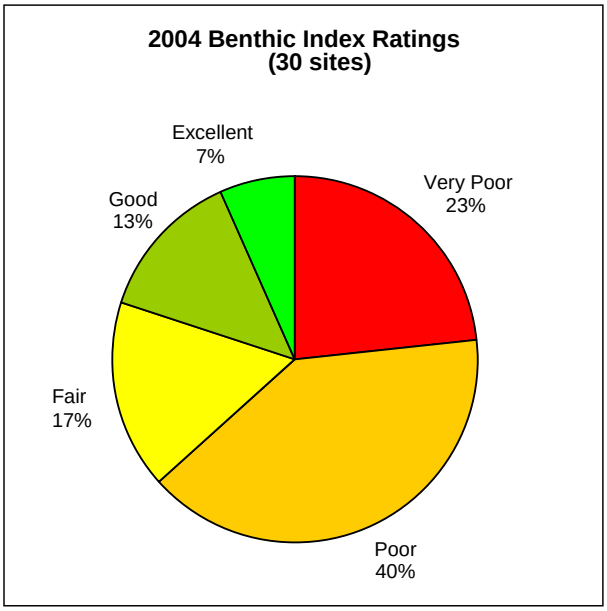

Figure 11: Ratings of 2004 biomonitoring sites based on the Benthic Index of Biotic Integrity.

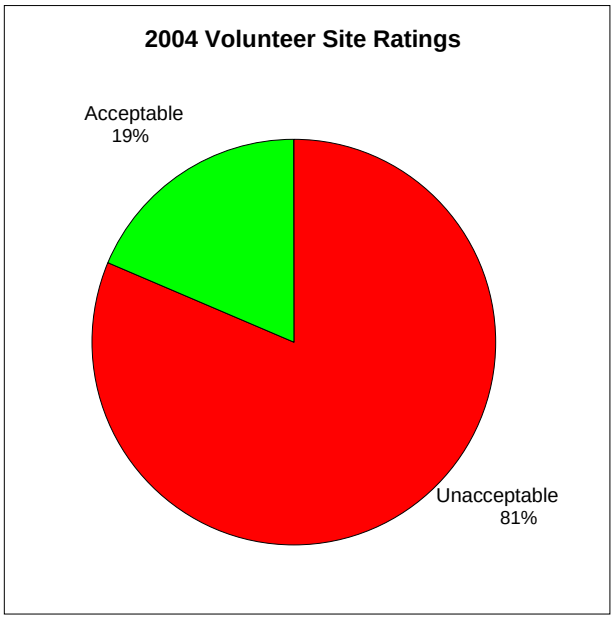

Figure 12: Results from the 48 Northern Virginia Soil and Water Conservation District volunteer monitoring sites.

First order streams and large streams (3, 4, and 5 order) have similar means corresponding to a rating of "fair" (Figure 12). First order streams have a higher standard deviation compared with the other sized streams meaning there was high variability in the rating scores of second order streams, with one stream rated "excellent" and four rated "good".

Table 9: Benthic Index of Biotic Integrity statistics by stream order.

Stream Order	Number of samples	Mean Benthic Index	Rating	Standard Deviation
1	16	40.8	Fair	19.1
2	7	27.3	Poor	11.8
3, 4, and 5	7	40.1	Fair	5.1

3.4 Stream Quality Index

Fairfax County's vision is to protect and enrich the quality of life for the people, neighborhoods, and diverse communities of Fairfax County. An important aspect of achieving this vision is through the practice of environmental stewardship. This includes the wise use of resources, and the protection and enhancement of the county's natural environment and open space.

A number of key indicators have been developed to support the environmental component of Fairfax County's vision. Indicators include one related to watersheds/stream quality. Benthic macroinvertebrate data from the biological monitoring program was used to develop a watersheds/stream quality indicator.

A segment of stream in Accotink Creek Watershed shows eroding banks and inadequate riparian buffer. This segment of stream is rated "poor" and is representative of streams in Fairfax County.

The number of sites placed in each of the five rating categories (excellent; good; fair; poor; and very poor based on the benthic macroinvertebrate monitoring data) was used to develop a stream quality index of overall watershed/stream conditions countywide. The index is computed by multiplying the fraction of total sites rated "excellent" by 5, those rated "good" by 4, those rated "fair" by 3, those rated "poor" by 2, and those rated "very poor" by 1. These values are then summed, resulting in an index ranging from 1 to 5, with a higher value indicating better stream biological conditions. Thus, an index value of 5 would correspond to "excellent", 2.5 would indicate conditions intermediate between "fair" and "poor", and an index of 1 corresponds to "poor". This watershed/stream quality indicator meets a number of criteria including:

- A measurable index, data for which can be collected annually.
- Derived primarily from direct measurement of a key natural resource, the county's receiving waters, which is visible and of great interest to the public.
- Supports the long-term trend analysis of stream conditions.

The stream quality index values for the baseline study and the 2004 stratified random sampling is shown in Table 10. The stream quality index suggests a small decline in overall stream quality from in 2004 compared to 1999. However, it is difficult to make any broad statements about trends based on data from two sampling years. This index will be reported annually to evaluate trends in the overall health of streams countywide.

Table 10: Stream quality index values for sampling completed in 1999 and 2004.

Sampling Year	Fraction of total sites					Index Value
	Very Poor	Poor	Fair	Good	Excellent	
1999	0.11	0.34	0.32	0.14	0.09	2.76
2004	0.23	0.40	0.17	0.13	0.07	2.41