# A Multi-Year Update (2011 – 2014) to Maryland Biological Stream Survey's Sentinel Site Network

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December 31, 2014

This study was funded in part by State Wildlife Grant funds provided to State wildlife agencies by the U.S. Congress, and administered through the Maryland Department of Natural Resources' Natural Heritage Program

**ABSTRACT**

Each year since 2000, the Maryland Biological Stream Survey, led by the Maryland Department of Natural Resources (MDDNR), Monitoring and Non-tidal Assessment Division, monitors several high quality reference streams in the Sentinel Site Network (SSN) to assess annual variability in stream conditions associated with natural factors. Data are collected on the biology, chemistry, physical habitat, water and air temperature, and land cover/use at each Sentinel Site.

The major goal of this report is to describe the temporal variability in conditions at 29 SSN streams based on 15 years of annual sampling, 2000 through 2014. The secondary goals of this report are to present biological indicators as assessment parameters that could be used to track climate change effects on Maryland's non-tidal streams, and to conduct exploratory analyses of SSN data from the 15-year baseline of stream conditions against which future climate influences can be assessed.

Between 2000 and 2014, drought conditions occurred in Maryland during 2001, 2002, and 2007. Conversely, years 2003 and 2011 were wetter than normal. Precipitation amounts and stream flows were near normal in the other ten years. Biological indicator scores for benthic macroinvertebrates and fish responded to the 2001 and 2002 drought conditions at Sentinel Sites in only one of the four geographic regions: The Coastal Plain – western shore. Macroinvertebrate Index of Biotic Integrity (IBI) scores, fish IBI scores, and total numbers of individual fish collected decreased at Sentinel Sites in this region during 2003, following two years of drought, but returned to normal numbers in 2004. The aquatic biota at Sentinel Sites in this region also decreased slightly in 2008, a year after the 2007 drought. Stream biota did not appear to respond negatively to the relatively wet years, 2003 and 2011, in any region, based on the parameters measured by the SSN. Neither the macroinvertebrate nor fish IBI scores varied significantly across years at Sentinel Sites in all regions.

Water temperatures collected by in-situ data loggers at all Sentinel Sites did not vary significantly between 2000 and 2014, at any spatial scale (site, region, or statewide).

Temporal trends in coldwater taxa richness and abundances could serve as an indication of potential climate change impacts to Maryland streams. Analysis of coldwater benthic macroinvertebrate taxa in Highland region sentinel sites showed no significant temporal trends. Percent Brook Trout at Highland and Eastern Piedmont sentinel sites did show a significant negative trend over the past 15 year period. It appears that the decline in Brook Trout numbers is not due to changes in stream temperature, but may be due to flow events or abiotic parameters not being measured.

Land cover/ land use (i.e., forest loss or urban increase) changed between 2001 and 2011 in the catchments of 22 of the 29 Sentinel Sites, potentially confounding the interpretation of SSN changes due to natural variability over time. The Leonard Pond Run catchment had the largest amount of forest loss (1646.5 acres; 12.0%). The Mattawoman Creek SSN site catchment had the largest increase of urbanization (4,762.7 acres; 11.8%).

None of the 29 Sentinel Sites drain catchments that are located entirely on protected lands. Therefore, all are vulnerable to urban/suburban development and other anthropogenic impacts in the future. It is critically important that every effort be made to protect the current 29 Sentinel Sites and their catchments from further development impacts. It is also desirable that the SSN be expanded, that the SSN data be used by a diverse array of interested parties, and that we find ways to extend the current 15-year baseline period of record and continue monitoring the SSN for many decades. Implementation of recommendations that emerged from a workshop sponsored by the Maryland Water Monitoring Council in November 2009 (www.marylandwatermonitoring.org) could help achieve the goal of SSN expansion and persistence over the long run. In the coming months, MD DNR will seek funding and partners who can contribute resources and/or monitoring sites to an expanded SSN that will provide the framework for a long-term network, implemented statewide, to track climate change effects on Maryland's non-tidal waters.

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## INTRODUCTION

The Maryland Biological Stream Survey (MBSS), started in 1995 by the Maryland Department of Natural Resources (MD DNR), assesses the ecological condition of 1st through 4th order, non-tidal streams at statewide, basin, and watershed scales, by measuring key chemical, physical, and biological parameters. Spanning 15 years, the MBSS also provides an opportunity to document changes in stream condition over time and elucidate discernable trends. Each year since 2000, the MBSS has monitored several high quality, reference streams in the Sentinel Site Network (SSN), to assess natural annual variability in stream conditions (Prochaska 2005, Becker et al. 2007, Becker et al. 2008, Becker et al. 2010).

In streams relatively uninfluenced by anthropogenic disturbance, temporal trends in ecological condition should be attributed primarily to seasonal and annual variations in precipitation (and resultant droughts or floods) and temperature/dissolved oxygen regimes, as well as biotic interactions. Stress caused by these natural changes can effect stream biota (e.g., benthic macroinvertebrates and fish), effects that should be detected by the biological indicators and ancillary chemical/physical measurements from the SSN. Therefore, monitoring a set of minimally-disturbed streams in places not likely to experience major anthropogenic impacts (i.e., the SSN) offers the best means of discerning changes in biological indicator scores across years at stream sites sampled along the entire gradient of disturbance that are also being influenced by natural variability.

Although pristine streams no longer exist in Maryland, monitoring several of the best remaining streams, or those perhaps "mostly recovered" from past degradation (personal communication with R.P. Morgan II), is a useful approach for evaluating variability in stream conditions associated with natural influences. The SSN includes some of the best remaining non-tidal streams in Maryland, based on chemical, physical, and biological parameters measured by the MBSS.

***The major goal of this report is to describe the temporal variability in conditions at 29 SSN streams based on fifteen years of annual sampling from 2000 through 2014.***

The abundance and species composition of stream fish and invertebrate communities respond to seasonal and annual changes in biotic and abiotic conditions (McElravy et al. 1989, Grossman et al. 1990, Boulton et al. 1992, Poff and Allan 1995). Understanding natural variability is critical to the interpretation and application of stream assessments, including the designation of impaired waters and also documenting then adjusting stream assessment results to account for natural variability influences on stream condition, particularly the biota. Natural variability in lotic environments can be manifested in floods and droughts that, in turn, influence water quality and quantity, channel morphology, substrate composition, and habitat availability.

A multi-decadal time series of monitoring data, coupled with focused research and data-rich models, will be needed to detect and track climate change effects on Maryland streams. Long-term monitoring programs are key components of environmental science and natural

resource management (Lovett et al. 2007). Palmer et al. (2009) recommended that populations at high risk from climate change effects or of special value should be monitored so appropriate management actions can be taken. DNR's SSN has an 15-year data base that could serve as the core monitoring program or framework for an expanded network of headwater stream sites established and regularly monitored to track the effects of climate change in Maryland. A recent study (Brooks 2009) and others (Poff et al. 2002, Grubin et al. 2009) concluded that headwater streams and ephemeral aquatic habitats (e.g., vernal pools) are especially sensitive to changes in precipitation patterns. Therefore, these places may be the first non-tidal ecosystems to respond to climate change.

***The secondary goals of this report are to present biological indicators and species composition information that could be used to track climate change effects on Maryland's streams and to present exploratory analyses of SSN data from an 15-year baseline of stream conditions against which future climate change influences can be assessed.***

## METHODS

To track natural variability in stream chemical, physical, and biological conditions, the Maryland Biological Stream Survey (MBSS) established a long-term monitoring component, the Sentinel Site Network (SSN) in 2000. The Network consists of 29 of the highest quality, minimally-disturbed freshwater streams in the State. These streams represent all regions and stream sizes ranging from 1$^{st}$ through 3$^{rd}$ order. To minimize the potential for human-related impacts to the Sentinel Sites, they are located in catchments that would be least likely to experience future anthropogenic disturbances. Since 2000, the MBSS has collected chemical, physical, and biological data at all Sentinel Sites each year. This annual monitoring effort documents natural annual changes in water chemistry, physical habitat quality, and biological communities that occur in these minimally-disturbed streams. The SSN also provides data that can be used to detect and track subtle changes to stream conditions over time that may be associated with climate change.

The methods and criteria used to select stream sites for inclusion in the SSN are described in detail in Prochaska (2005). The criteria were used to identify streams with minimal human alterations, thus limiting the potential for anthropogenic factors to confound attempts to document the effects of natural annual variability and climate change. The basic criteria used to select Sentinel Sites were:

- no evidence of acid mine drainage (AMD) in the site catchment;
- sulfate concentrations < 50 mg/l;
- pH > 6.0 or dissolved organic carbon concentrations (DOC) > 8.0 mg/l (i.e., pH could be < 6 if the stream is naturally acidic blackwater);
- nitrate nitrogen concentrations < 4.0 mg/l;
- forested land use > 50% of catchment area; and
- mean of the fish (FIBI) and benthic macroinvertebrate (BIBI) indices of biotic integrity > 3.0 (or a blackwater stream site).

Maps with the locations of MBSS Sentinel Sites in each of four geographic regions are shown in Figures 1-4.

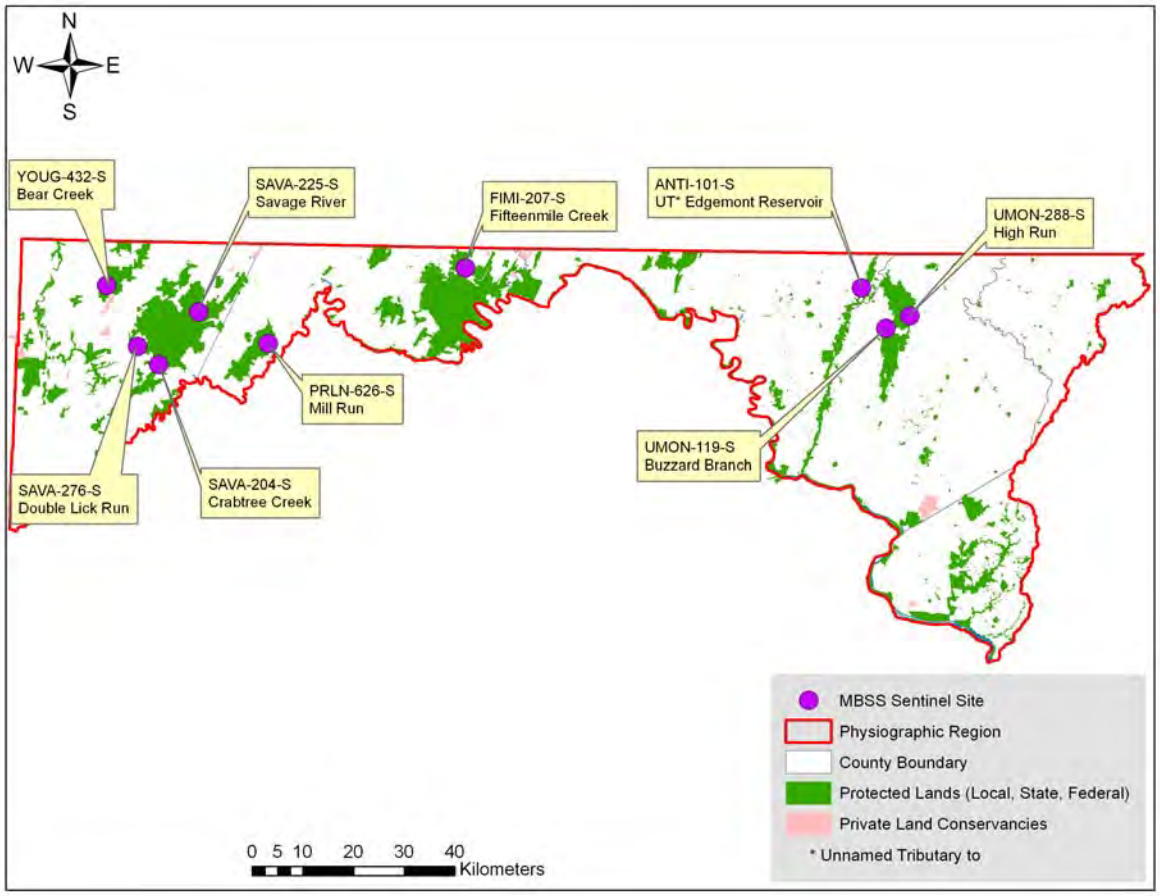



**Figure 1 - Sentinel Sites in the Highlands Region.**

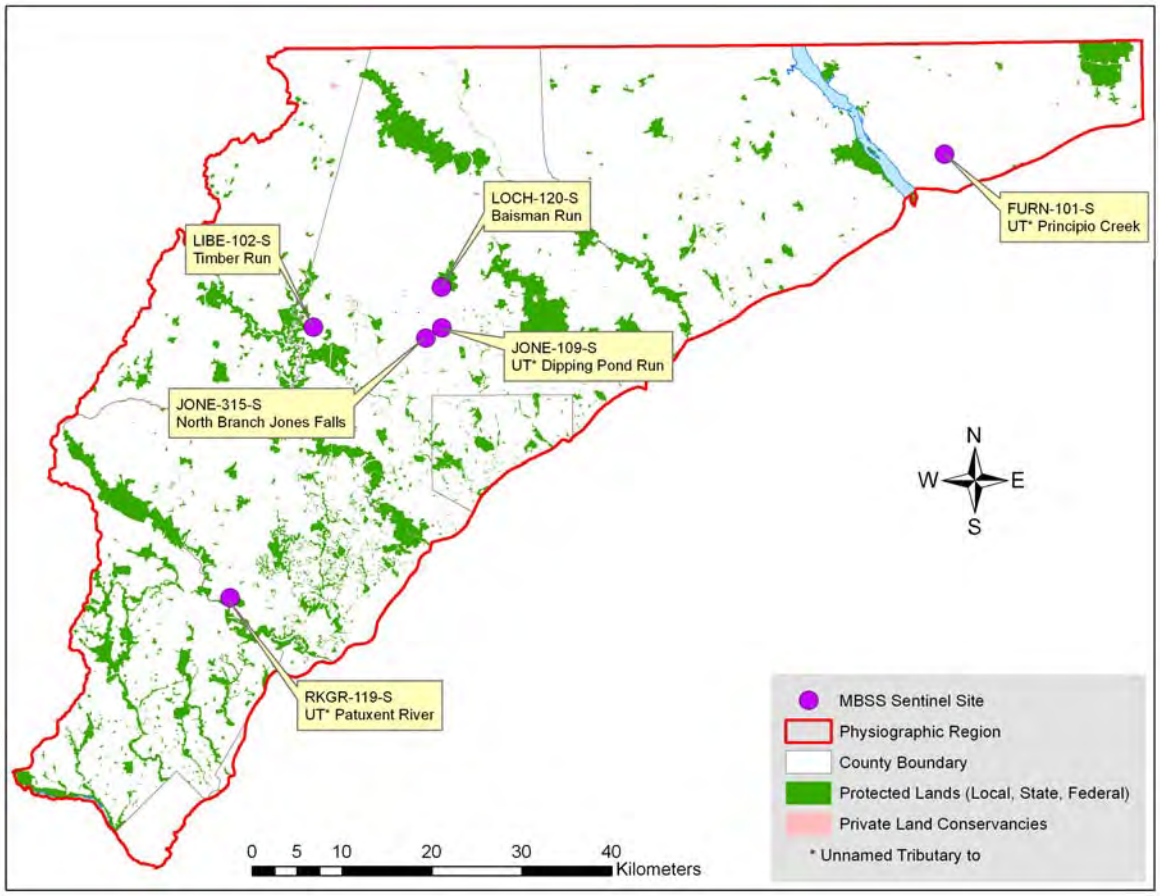



**Figure 2 - Sentinel Sites in the Eastern Piedmont Region.**

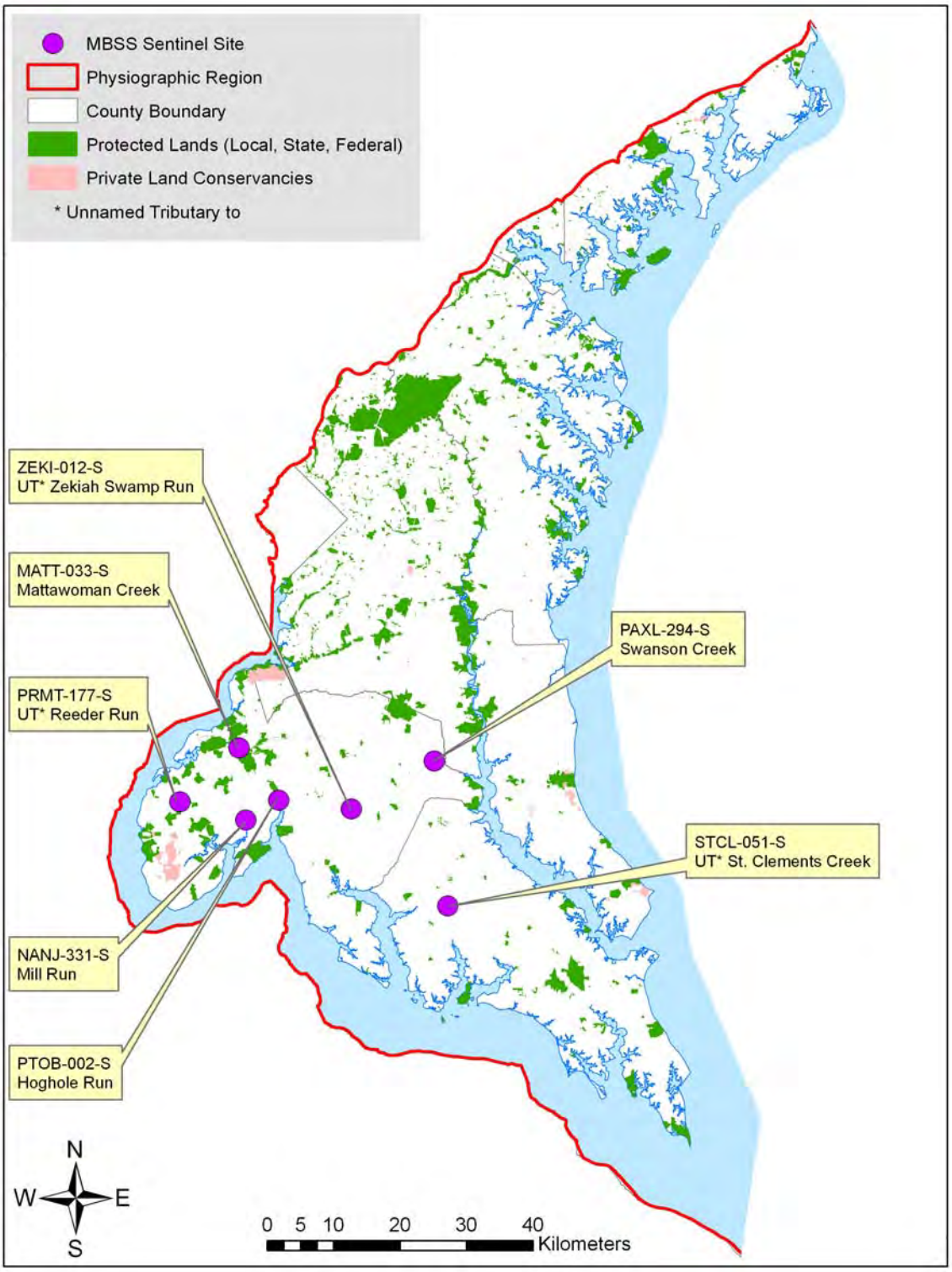



**Figure 3 - Sentinel Sites in the Coastal Plain – Western Shore Region.**

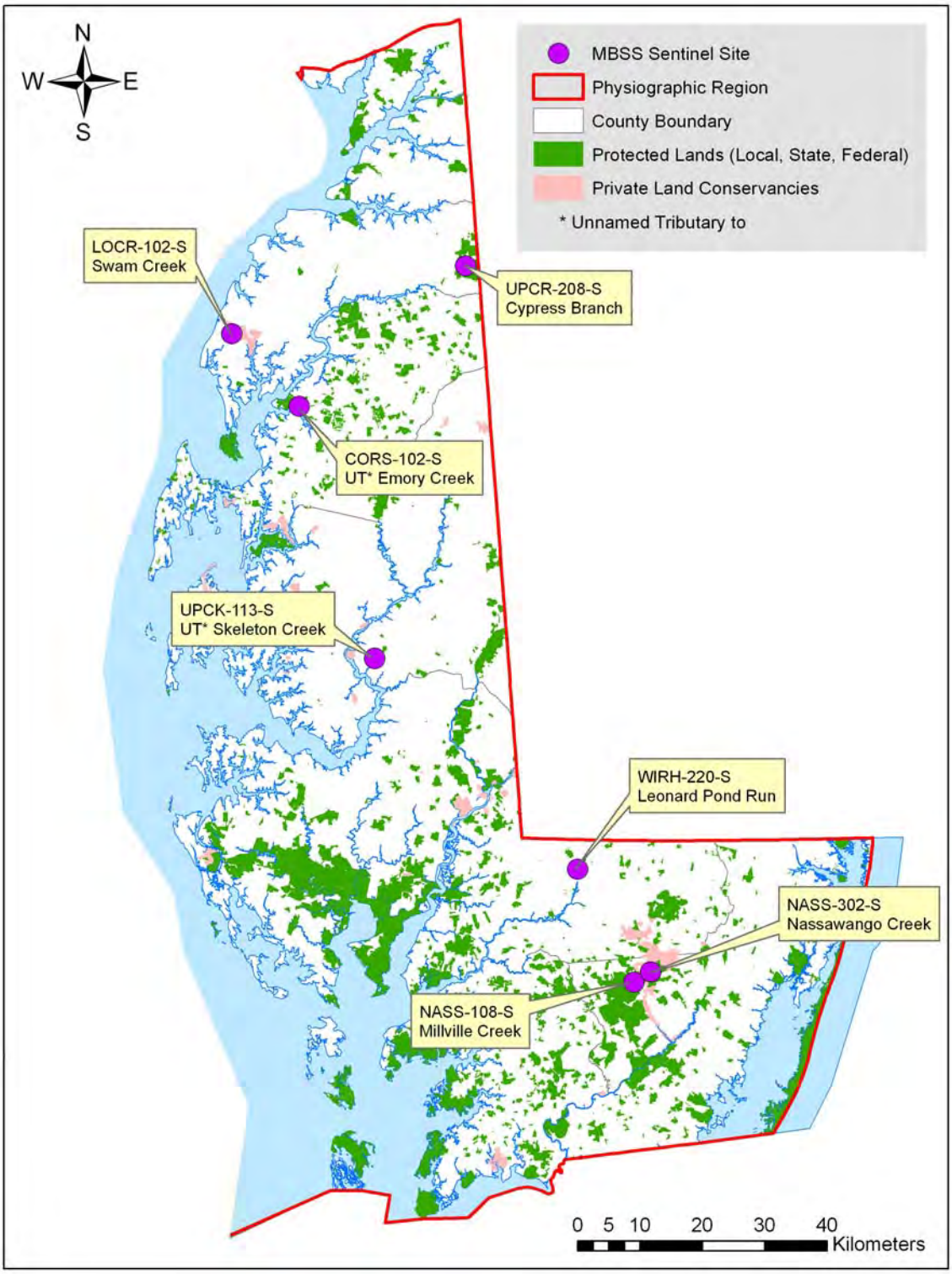



**Figure 4 - Sentinel Sites in the Coastal Plain - Eastern Shore Region.**

Biological, temperature, and catchment land use/ land cover data were collected annually at 22 Sentinel Sites from 2000 to 2014. Site access for sampling was not provided for at least one year during the 15-year period at the other seven Sentinel Sites (Table 1). A detailed explanation of sampling protocols used at these stream sites can be found in Stranko et al. 2009. A shortened version of the protocols used to collect site-specific biological, temperature, and land use/cover data follows.

*Biological Parameters*

During spring (March-April) of each year, benthic macroinvertebrates were collected using 20, 0.093 $M^2$ samples of the best available invertebrate habitats found within each 75 M-long sites using a 500 micron mesh D-net. Backpack electrofishing with two passes and block nets in each 75 M-long site was used to collect fishes during summer months (June-August).

Indices of biotic integrity developed specifically for the MBSS (Roth et al. 1998, Southerland et al. 2005, Southerland et al. 2007) were calculated using the benthic macroinvertebrate (BIBI) and fish (FIBI) data. Analysis of variance (ANOVA) was used to test IBI scores for significant differences among years ($p<0.01$), by geographic region.

A general linear model (GLM) was developed to calculate estimates of the deviation of the annual average IBI scores from the overall average IBI score by region most likely due to natural variability. The model identifies years where the IBI scores at SSN sites were significantly lower than the long-term average. It then calculates an adjustment that can be applied toSSN sites, as well as other sites sampled during those years. This could be used to raise that region's IBI score(s) and make those data comparable to other years in the time series. The GLM code was modified slightly to incorporate new data and run with sentinel site IBI scores for the years 2000-2014.

Trends in coldwater-obligate stream fishes were examined using Brook Trout, a native species found in suitable habitats throughout much of Maryland. Percent Brook Trout abundances at the 15 Sentinel Sites located in the Eastern Piedmont and Highlands regions were calculated over the 15 year sampling period. Spearman correlation analysis (with Bon Ferroni
correction) was used to test for significant temporal trends ($p<0.05$) in the proportion of coldwater-preference benthic macroinvertebrate taxa collected at the eight Sentinel Sites located in the Highlands region over the over the 15-year period.

*Temperature*

Air and water temperatures were recorded every 20 minutes at each Sentinel Site during June – August (2000-2007) using Onset$^{TM}$ temperature loggers. Beginning in March 2008, air and water temperatures were recorded year round at all Sentinel Sites. For each site, there may be a missing year (or multiple years) of temperature data during the period of record. Missing data could be caused by a temperature logger becoming dewatered in low water events and thus recording air temperature instead of water temperature, or the logger being

**Table 1: Years in which the Sentinel Sites were sampled in each geographic region.**

| SITE | STREAM NAME | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Coastal Plain- eastern shore* | | | | | | | | | | | | | | | | |
| CORS-102-S | UT to Emory Creek | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| LOCR-102-S | Swan Creek | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| NASS-108-S | Millville Creek | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| NASS-302-S | Nassawango Creek | | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| UPCK-113-S | UT to Skeleton Creek | X | X | X | X | X | X[2] | X | X | X | X | X | X | X | X | X |
| UPCR-208-S | Cypress Branch | | | | | | | | | X | X | X | X | X | X | X |
| WIRH-220-S | Leonard Pond Run | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| *Coastal Plain- western shore* | | | | | | | | | | | | | | | | |
| MATT-033-S | Mattawoman Creek | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| NANJ-331-S | Mill Run (Nanjemoy Creek) | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| PAXL-294-S | Swanson Creek | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| PRMT-177-S | UT to Reeder Run | | | | | | | | | | | | | X | X | X |
| PTOB-002-S | Hoghole Run | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| STCL-051-S | UT to St. Clements Creek | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| ZEKI-012-S | UT to Zekiah Swamp Run | X | X | X | X | X | X | X | X | X | [3] | X | X | X | X[2] | [3] |
| *Eastern Piedmont* | | | | | | | | | | | | | | | | |
| FURN-101-S | UT to Principio Creek | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| JONE-109-S | UT to Dipping Pond Run | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| JONE-315-S | North Branch Jones Falls | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| LIBE-102-S | Timber Run | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| LOCH-120-S | Baisman Run | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| RKGR-119-S | UT to Patuxent River | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| *Highlands* | | | | | | | | | | | | | | | | |
| ANTI-101-S | UT to Edgemont Reservoir | X | X | | | | | | | | | X | X | X | X | X |
| FIMI-207-S | Fifteenmile Creek | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| PRLN-626-S | Mill Run | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| SAVA-204-S | Crabtree Creek | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| SAVA-225-S | Savage River | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| SAVA-276-S | Double Lick Run | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| UMON-119-S | Buzzard Branch | X | | X | X | X | X | X | X | X | X | X | X | X | X | X |
| UMON-288-S | High Run | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| YOUG-432-S | Bear Creek | X | X | X | X | X | X[1] | X[1] | X | X | X | X | X | X | X | X |

[1] site not sampled in summer 2005 and 2006 due to contamination concerns at Bear Creek Hatchery
[2] site not sampled in summer due to landowner permission issues
[3] site not sampled due to landowner permission issues

physically lost when field crews attempted retrieval. All available years of data at each site were used in our analyses.

Mean, maximum, proportion of readings greater than 20 $^{o}$C, and proportion of readings greater than 24 $^{o}$C taken from summer temperatures by site were graphed. A Spearman correlation analysis (with Bon Ferroni correction) was used to test for significant ($p<0.05$) temporal trends.

*Precipitation*

Monthly rainfall data were acquired from NOAA for the period 1999 through 2009 (NOAA 1999; NOAA 2000; NOAA 2001; NOAA 2002; NOAA 2003; NOAA 2004; NOAA 2005; NOAA 2006; NOAA 2007; NOAA 2008; NOAA 2009; NOAA 2010; NOAA 2011; NOAA 2012; NOAA 2013; NOAA 2014) for each geographic region in Maryland. Only the first few months of data for 2014 were available at the time of analysis. We used average annual deviations from normal rainfall amounts, as defined by NOAA (www7.ncdc.noaa.gov/IPS/cd/cd.html).

*Land Use/Land Cover*

Although Sentinel Sites were chosen in areas with minimal human impacts, none have upstream catchments that are completely protected from land alterations (i.e., the entire catchments are not contained within county, state, or federal park land, or on private land conservancies). The percentages of forest, agriculture, and urban land use/cover from the 2001, 2006, and 2011 National Land Cover Database (NLCD; Homer et al. 2007, Fry et al. 2011, Jin et al. 2013) were extracted for the catchment upstream of each Sentinel Site. Catchment boundaries were drawn by hand using digital USGS 7.5 minute topographic quadrangle maps. Since even minor changes in land use/ land cover could affect Sentinel Site quality and confound our attempts to evaluate the effects of short-term, natural variability and also longer-term, climate change influences, it was important to understand land use/ land cover changes that occurred in Sentinel Site catchments since sampling began. To accomplish this task, we compared 2001, 2006, and 2011 NLCD land use/ land cover for each site.

Measures of climate, weather, and land use/cover change over time were acquired from appropriate sources. These data were used to help explain temporal variability in Sentinel Site-specific data. Since these are some of the factors likely to change as Maryland's climate continues to change, correlations between them and Sentinel Site-specific variables may be useful in predicting and documenting future changes to stream biology, physical habitat, and chemical conditions.

*Sampling Candidate Sentinel Sites – Expanding the Network*

In order to supplement the current SSN and increase the number of sites available to analyze for the potential effects of global climate change, an effort was made to identify sites for potential inclusion in the SSN. The entire Maryland Biological Stream Survey (MBSS) data set, 1995-2008 (n=3642), was analyzed using the initial SSN selection criteria (Prochaska, 2005).

Landscape scale data were gathered for the resulting subset of candidate sites. The upstream catchment for each of the potential new Sentinel Sites was analyzed in a GIS to calculate the area of the catchment in protected lands, targeted for development, and whether or not the catchment and/or site is located within a Stronghold Watershed. The protected lands area was calculated using County-owned lands, DNR-owned lands, non-Military Federally-owned lands, and lands associated with private land conservancies. The acreage targeted for development was calculated using Maryland's Priority Funding Areas (PFA) areas identified by the State to receive infrastructure assistance as a way to limit development and suburban sprawl. Each candidate Sentinel Site was examined to determine whether or not the site or a portion of its upstream catchment was located within a Stronghold Watershed.

The landscape-scale data were used to rank the candidate Sentinel Sites. A composite score was developed using all three of the landscape-scale data sources. The percentage of the upstream catchment in protected land was scored as follows: 100% of the catchment in protected land was given a score of 100 points, 99% protected equaled a score of 99 points, etc. The percentage of the upstream catchment in PFA was converted to a negative number: 100% in a PFA equaled a score of -100 points, 99% equaled a score of -99 points, etc. If a candidate site or its catchment was located in a Stronghold Watershed, a score of 100 points was added. No points were added to sites (and/or catchments) not located within a Stronghold Watershed. The maximum potential site score was 200 points (for a site with 100% of its catchment in protected land and located within a Stronghold Watershed) and the minimum site score was -100 points (for a site with 100% of its catchment in a PFA and not being located within a Stronghold Watershed). The candidate sites were then grouped by the four geographical areas used to organize the SSN and the ranking criteria were applied to each area. This exercise selected 515 (14.1%) of 3642 possible sites as candidates for new Sentinel Sites.

From the list of 515 potential Sentinel Sites, one site was selected for resampling in 2013. The selected site was the highest ranked potential Sentinel Site from the Coastal Plain - Western Shore region. Permission to revisit the original site location could not be obtained. The site was moved upstream onto Doncaster State Forest property. This site (PRMT-177-S) is in the Lower Potomac watershed in Charles County.

## RESULTS

The array of biological, chemical, and physical habitat-related information collected at each of the 29 Sentinel Sites (plus site photos) is presented in Appendices A through D.

### *Biological Parameters*

Results of an analysis of variance (ANOVA) show that the region by year effect was not statistically significant for either BIBI scores ($p$=0.1685) or FIBI scores ($p$=0.9759). Year effect among region was also not statistically significant for either BIBI scores (p=0.2263) or FIBI scores (p=0.6678). Significant differences among regions were observed for both BIBI and FIBI scores (p<0.0001) (Table 2). Graphical analysis shows that while rare, there are

occasional years where the annual mean BIBI or FIBI score in one region deviates substantially but not significantly from the overall mean (Figure 5, Figure 6).

**Table 2: Analysis of variance (ANOVA) results for testing temporal trends in IBI scores among regions.**

| Source | DF | Type III SS | Mean Squares | F Value | Pr > F |
|---|---|---|---|---|---|
| **BIBI** | | | | | |
| Region | 3 | 93.67 | 31.22 | 71.33 | <0.0001 |
| Year | 14 | 7.76 | 0.55 | 1.27 | 0.2263 |
| Region*Year | 42 | 22.53 | 0.54 | 1.23 | 0.1685 |
| | | | | | |
| **FIBI** | | | | | |
| Region | 3 | 78.28 | 26.09 | 31.94 | <0.0001 |
| Year | 14 | 9.16 | 0.65 | 0.8 | 0.6678 |
| Region*Year | 42 | 20.73 | 0.49 | 0.6 | 0.9759 |

When examined at a region scale, significant differences in IBI scores across years were observed in the Coastal Plain – western shore region (BIBI $p<0.0001$, FIBI $p = 0.001$). The lowest annual mean Sentinel Site IBI scores in this region were recorded during 2003: 2.39 (FIBI) and 3.67 (BIBI), lower than the mean annual IBI scores for this region during any other year from 2000-2014. (Table 3, Figure 7). The IBI scores are based on a condition scale that ranges from 1 (very poor) to 5 (good), with scores below 3.0 indicating poor/very poor biological condition (Southerland et al. 2005). The 2003 and 2008 were the only years when the FIBI score was less than 3.0. The only time the BIBI score was less than 4.0 (the threshold for Tier 2, high quality waters) in this region was 2003. No BIBI or FIBI scores were significantly different ($p<0.01$) at the Sentinel Sites across years in the Piedmont ($p=0.19$ for BIBI, $p=0.99$ for FIBI), the Coastal Plain - eastern shore ($p=0.78$ for BIBI, $p=0.98$ for FIBI), or the Highlands regions ($p=0.05$ for BIBI, $p=0.65$ for FIBI).

**Table 3: Mean annual IBIs for MBSS Round 2 and 3 Sentinel Sites by region.**

| Region | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | Greatest difference (highest year and lowest year) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FIBI** | | | | | | | | | | | | | | | | |
| Coastal Plain- eastern shore | 2.40 (n=5) | 2.83 (n=6) | 3.07 (n=5) | 2.67 (n=6) | 2.83 (n=6) | 2.87 (n=5) | 3.00 (n=6) | 3.00 (n=6) | 2.86 (n=7) | 3.05 (n=7) | 3.22 (n=6) | 3.39 (n=6) | 2.76 (n=7) | 3.29 (n=7) | 3.10 (n=7) | 0.99 (2011 and 2001) |
| Coastal Plain- western shore | 3.67 (n=6) | 3.78 (n=6) | 3.78 (n=6) | 2.39 (n=6) | 3.83 (n=6) | 3.78 (n=6) | 3.61 (n=6) | 3.61 (n=6) | 2.94 (n=6) | 3.87 (n=5) | 3.67 (n=6) | 3.56 (n=6) | 4.00 (n=7) | 4.17 (n=6) | 3.89 (n=6) | 1.78 (2013 and 2003) |
| Eastern Piedmont | 3.50 (n=6) | 3.56 (n=6) | 3.67 (n=6) | 2.94 (n=6) | 3.33 (n=6) | 3.44 (n=6) | 3.67 (n=6) | 3.44 (n=6) | 3.06 (n=6) | 3.11 (n=6) | 3.72 (n=6) | 3.33 (n=6) | 3.50 (n=6) | 3.50 (n=6) | 3.33 (n=6) | 0.78 (2010 and 2003) |
| Highlands | 4.07 (n=9) | 4.23 (n=8) | 4.25 (n=8) | 4.33 (n=8) | 4.08 (n=8) | 4.17 (n=7) | 4.45 (n=7) | 4.08 (n=8) | 4.33 (n=8) | 4.33 (n=8) | 4.04 (n=9) | 3.78 (n=9) | 3.94 (n=9) | 3.89 (n=9) | 4.00 (n=9) | 0.67 (2006 and 2011) |
| **BIBI** | | | | | | | | | | | | | | | | |
| Coastal Plain- eastern shore | 3.06 (n=5) | 3.62 (n=6) | 3.33 (n=6) | 3.33 (n=6) | 3.41 (n=7) | 3.62 (n=6) | 3.38 (n=6) | 3.57 (n=6) | 2.55 (n=7) | 2.84 (n=7) | 2.95 (n=6) | 2.63 (n=7) | 3.04 (n=7) | 3.20 (n=7) | 3.33 (n=7) | 1.07 (2001, 2005 and 2008) |
| Coastal Plain- western shore | 4.29 (n=6) | 4.52 (n=6) | 4.43 (n=6) | 3.67 (n=6) | 4.81 (n=6) | 4.62 (n=6) | 4.67 (n=6) | 4.81 (n=6) | 4.43 (n=6) | 4.43 (n=5) | 4.76 (n=6) | 4.52 (n=6) | 4.47 (n=7) | 4.14 (n=7) | 4.57 (n=6) | 1.14 (2004, 2007 and 2003) |
| Eastern Piedmont | 4.67 (n=6) | 4.78 (n=6) | 4.39 (n=6) | 4.28 (n=6) | 4.22 (n=6) | 4.72 (n=6) | 4.00 (n=6) | 3.94 (n=6) | 4.22 (n=6) | 4.22 (n=6) | 4.28 (n=6) | 4.33 (n=6) | 4.22 (n=6) | 4.06 (n=6) | 3.94 (n=6) | 0.83 (2001 and 2007) |
| Highlands | 4.36 (n=9) | 4.23 (n=8) | 4.47 (n=8) | 4.31 (n=8) | 3.81 (n=8) | 4.28 (n=8) | 4.00 (n=8) | 4.31 (n=8) | 4.34 (n=8) | 4.41 (n=8) | 4.33 (n=9) | 4.22 (n=9) | 4.14 (n=9) | 4.06 (n=9) | 3.78 (n=9) | 0.69 (2002 and 2014) |
| **CBI** | | | | | | | | | | | | | | | | |
| Coastal Plain- eastern shore | 2.73 (n=5) | 3.23 (n=6) | 3.29 (n=5) | 3.00 (n=6) | 3.11 (n=6) | 3.22 (n=5) | 3.19 (n=6) | 3.29 (n=6) | 2.70 (n=7) | 2.94 (n=7) | 3.14 (n=5) | 3.05 (n=6) | 2.90 (n=7) | 3.24 (n=7) | 3.21 (n=7) | 0.59 (2002 and 2008) |
| Coastal Plain- western shore | 3.98 (n=6) | 4.15 (n=6) | 4.10 (n=6) | 3.03 (n=6) | 4.32 (n=6) | 4.20 (n=6) | 4.14 (n=6) | 4.21 (n=6) | 3.69 (n=6) | 4.15 (n=5) | 4.21 (n=6) | 4.04 (n=6) | 4.23 (n=7) | 4.11 (n=6) | 4.23 (n=6) | 1.29 (2004 and 2003) |
| Eastern Piedmont | 4.08 (n=6) | 4.17 (n=6) | 4.03 (n=6) | 3.61 (n=6) | 3.78 (n=6) | 4.08 (n=6) | 3.83 (n=6) | 3.69 (n=6) | 3.64 (n=6) | 3.67 (n=6) | 4.00 (n=6) | 3.83 (n=6) | 3.86 (n=6) | 3.78 (n=6) | 3.64 (n=6) | 0.56 (2001 and 2003) |
| Highlands | 4.22 (n=9) | 4.22 (n=8) | 4.36 (n=8) | 4.32 (n=8) | 3.95 (n=8) | 4.26 (n=7) | 4.21 (n=7) | 4.20 (n=8) | 4.34 (n=8) | 4.37 (n=8) | 4.19 (n=9) | 4.00 (n=9) | 4.04 (n=9) | 3.97 (n=9) | 3.89 (n=9) | 0.48 (2009 and 2014) |

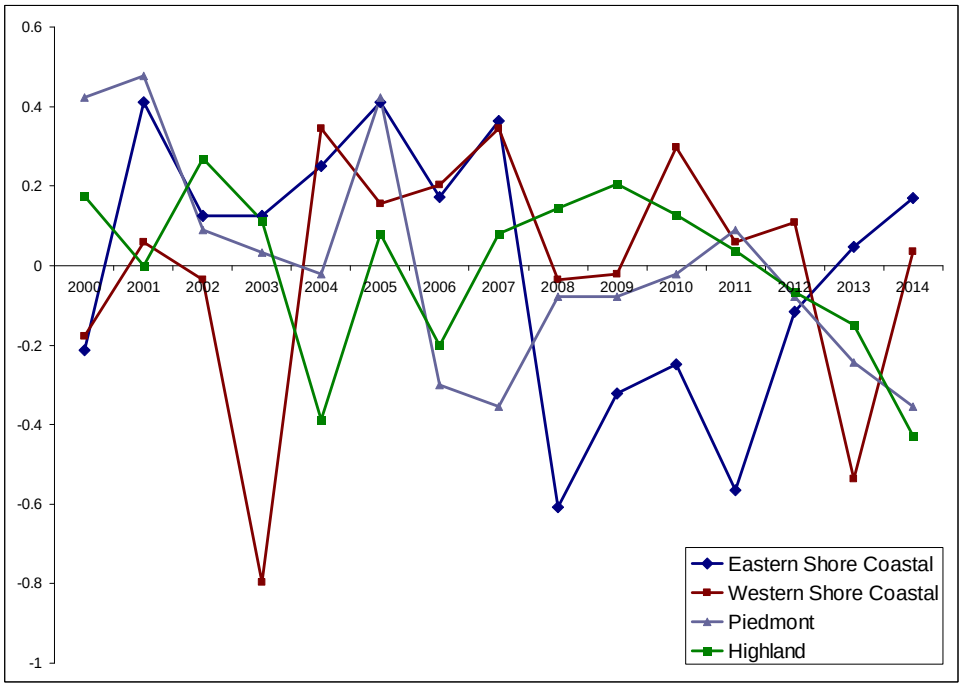



**Figure 5: Annual deviations in the BIBI scores for sentinel sites by region during the years 2000-2014.**

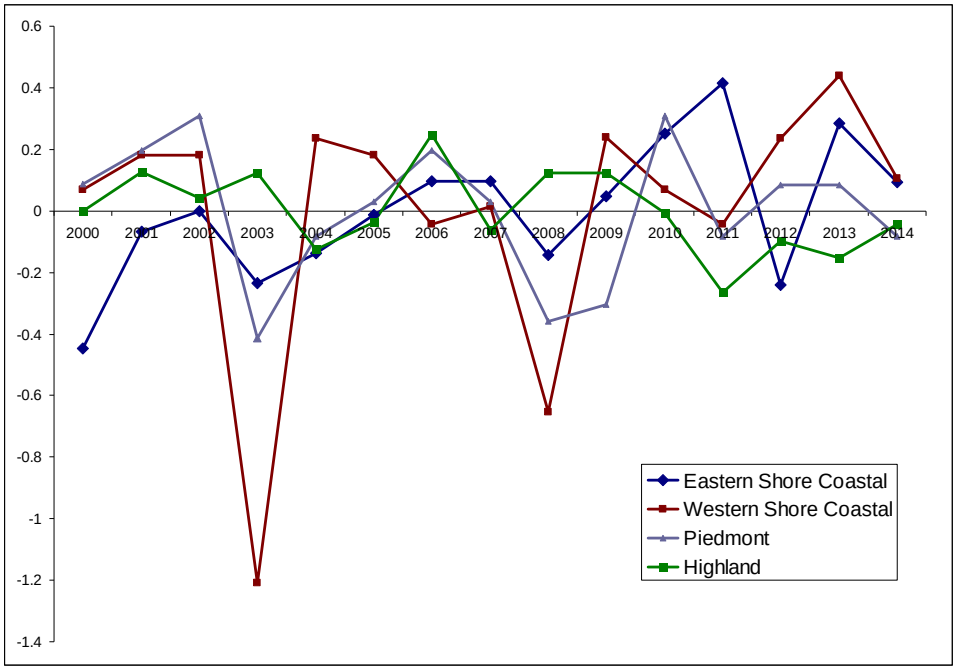



**Figure 6: Annual deviations in the FIBI scores for sentinel sites by region during the years 2000-2014.**

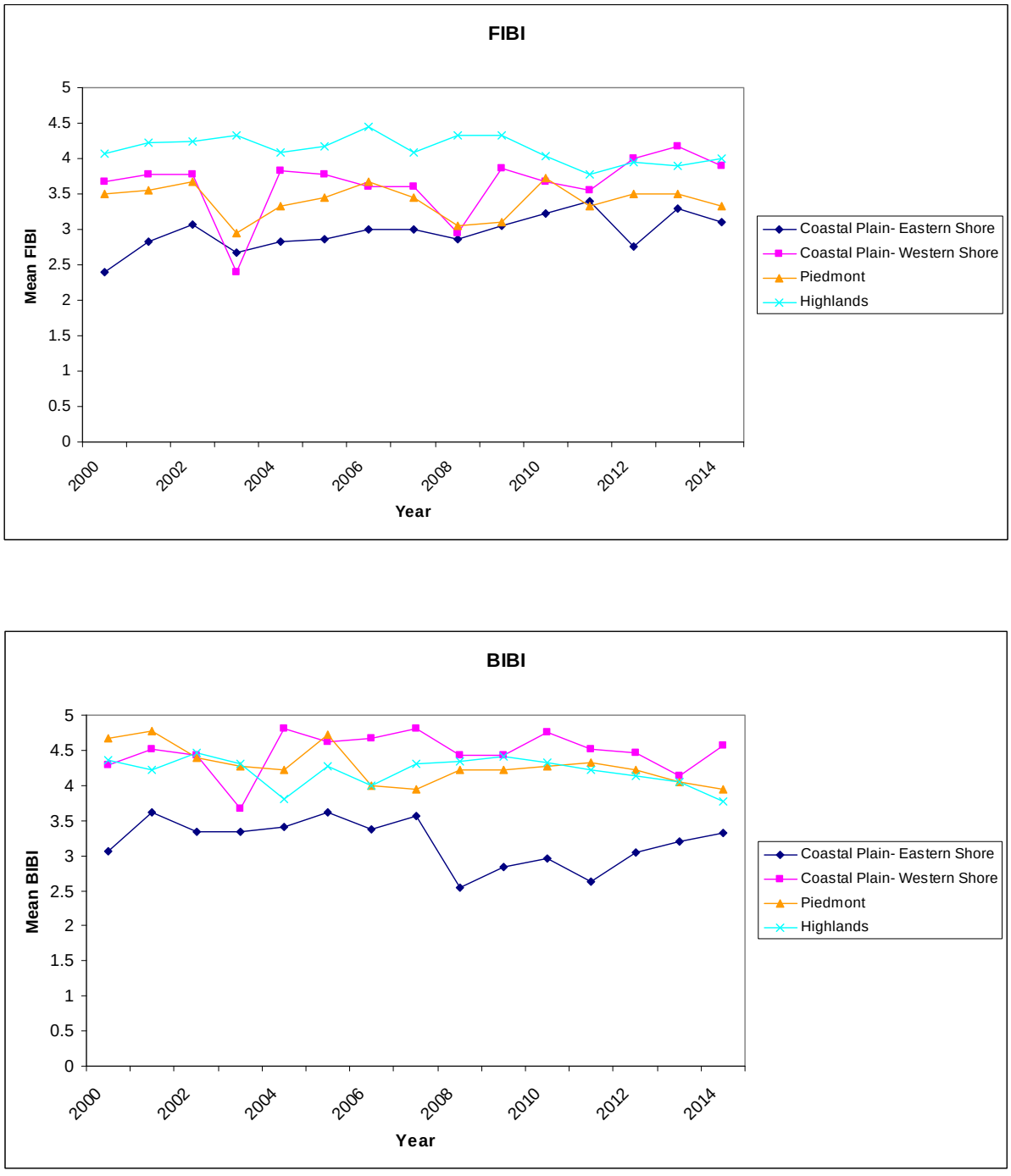



**Figure 7 - Mean annual FIBI and BIBI scores for the Sentinel Sites by geographic region.**

Using the general linear model (GLM) to identify and adjust for natural variability, annual adjustments to Coastal Plain-eastern shore Sentinel Sites were minimal with no statistically significant IBI adjustment values (Table 4). Coastal Plain-western shore Sentinel Sites had six years (2003, 2004, 2007, 2008, 2010, 2013) when either annual BIBI and/or FIBI adjustment values were significant. For 2003, Sentinel Sites in this region had the largest level of score adjustment with a positive increase of 1.21 for FIBI scores and 0.80 for BIBI scores. Eastern Piedmont Sentinel Sites had one year (2011) with statistically significant BIBI adjustment values. Highland Sentinel Sites had three years (2004, 2011, 2014) of statistically significant IBI adjustment values for BIBI and/or FIBI scores. The plots for annual BIBI and FIBI adjustments inversely match the plots of annual deviations to BIBI and FIBI scores (Figure 8, Figure 9).

**Table 4: Annual adjustments to BIBI and FIBI scores for sentinel sites listed by region. Annual adjustment values in bold indicate statistically significant (p<0.05) values.**

*Coastal Plain- eastern shore*

| Year | FIBI | BIBI |
|---|---|---|
| 2000 | 0.446 | 0.213 |
| 2001 | 0.069 | -0.41 |
| 2002 | 0.002 | -0.125 |
| 2003 | 0.236 | -0.125 |
| 2004 | 0.138 | -0.25 |
| 2005 | 0.012 | -0.41 |
| 2006 | -0.098 | -0.172 |
| 2007 | -0.098 | -0.363 |
| 2008 | 0.144 | 0.607 |
| 2009 | -0.046 | 0.321 |
| 2010 | -0.251 | 0.248 |
| 2011 | -0.416 | 0.565 |
| 2012 | 0.239 | 0.117 |
| 2013 | -0.284 | -0.046 |
| 2014 | -0.093 | -0.169 |

*Coastal Plain- western shore*

| Year | FIBI | BIBI |
|---|---|---|
| 2000 | -0.069 | 0.178 |
| 2001 | -0.18 | -0.06 |
| 2002 | -0.18 | 0.035 |
| 2003 | **1.209** | **0.797** |
| 2004 | -0.235 | **-0.346** |
| 2005 | -0.18 | -0.155 |
| 2006 | 0.042 | -0.203 |
| 2007 | -0.013 | **-0.346** |
| 2008 | **0.653** | 0.035 |
| 2009 | -0.24 | 0.023 |
| 2010 | -0.069 | **-0.298** |
| 2011 | 0.043 | -0.058 |
| 2012 | -0.235 | -0.107 |
| 2013 | -0.44 | **0.537** |
| 2014 | -0.107 | -0.034 |

*Eastern Piedmont*

| Year | FIBI | BIBI |
|---|---|---|
| 2000 | -0.086 | 0.001 |
| 2001 | -0.196 | -0.127 |
| 2002 | -0.307 | -0.041 |
| 2003 | 0.415 | -0.124 |
| 2004 | 0.081 | 0.126 |
| 2005 | -0.03 | 0.037 |
| 2006 | -0.196 | -0.249 |
| 2007 | -0.03 | 0.063 |
| 2008 | 0.359 | -0.124 |
| 2009 | 0.304 | -0.124 |
| 2010 | -0.307 | 0.006 |
| 2011 | 0.083 | **0.265** |
| 2012 | -0.085 | 0.098 |
| 2013 | -0.085 | 0.154 |
| 2014 | 0.081 | 0.043 |

*Highlands*

| Year | FIBI | BIBI |
|---|---|---|
| 2000 | 0.001 | -0.175 |
| 2001 | -0.127 | 0 |
| 2002 | -0.041 | -0.268 |
| 2003 | -0.124 | -0.112 |
| 2004 | 0.126 | **0.388** |
| 2005 | 0.037 | -0.081 |
| 2006 | -0.249 | 0.2 |
| 2007 | 0.063 | -0.081 |
| 2008 | -0.124 | -0.143 |
| 2009 | -0.124 | -0.206 |
| 2010 | 0.006 | -0.128 |
| 2011 | **0.265** | -0.037 |
| 2012 | 0.098 | 0.066 |
| 2013 | 0.154 | 0.15 |
| 2014 | 0.043 | **0.428** |

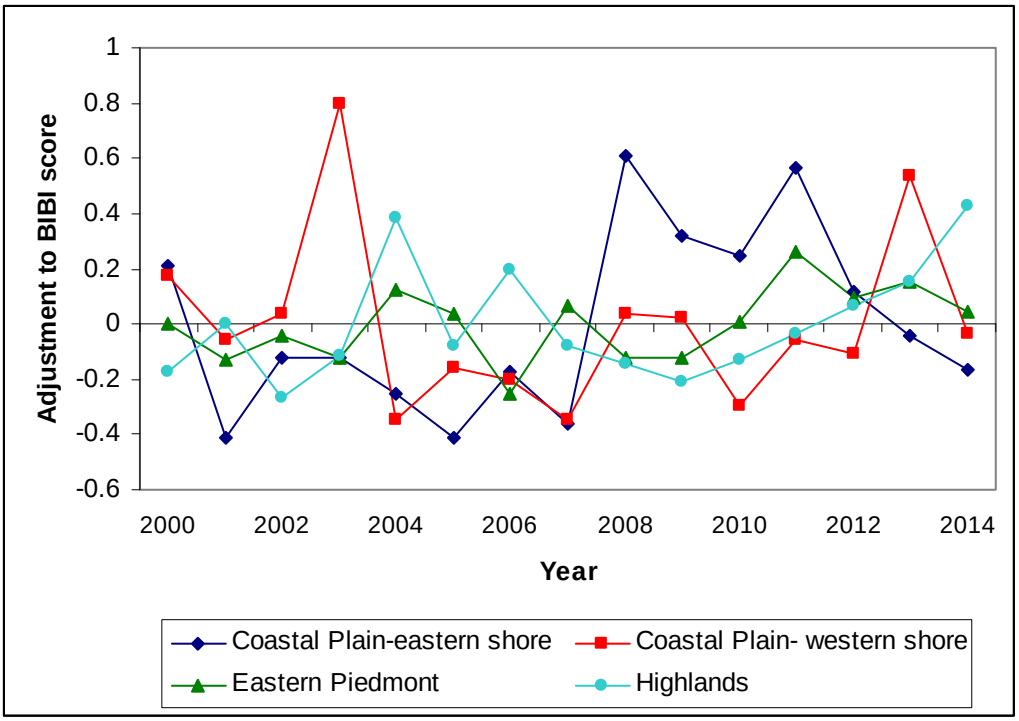



**Figure 8: Annual adjustments to the BIBI scores for Sentinel Sites by region, 2000-2014.**

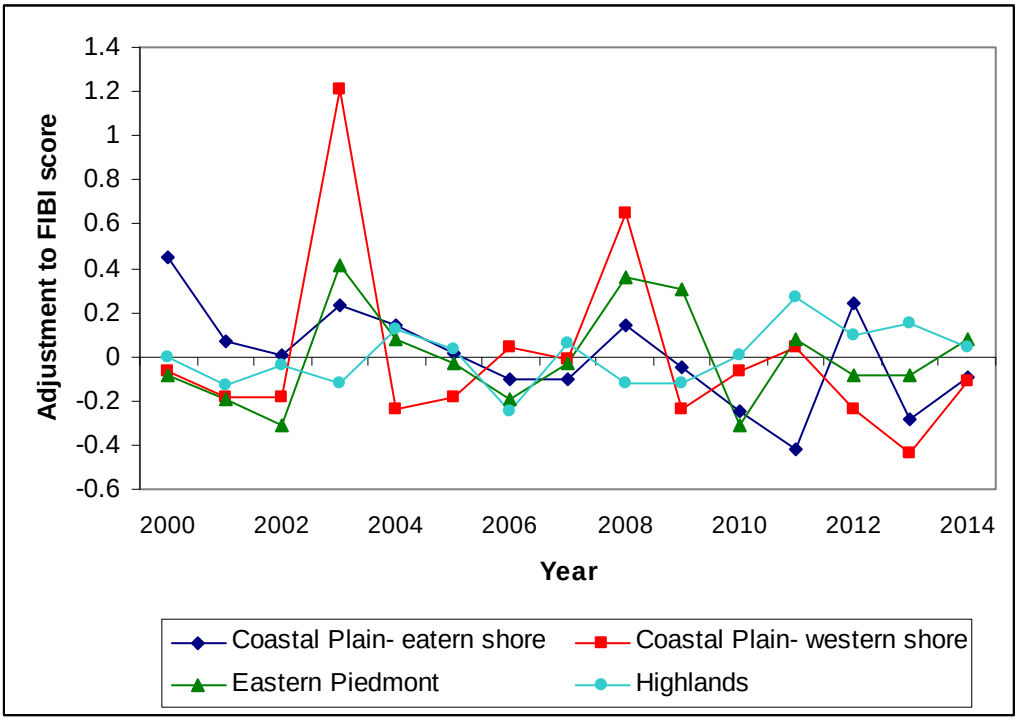



**Figure 9: Annual adjustments to the FIBI scores for Sentinel Sites by region, 2000-2014.**

This site adjustment analysis is an attempt to account for years when MBSS site IBI scores could be too low due to large natural annual variations in precipitation. Therefore, we would not adjust IBI scores down, only up. An upward adjustment to MBSS sites could be applied in a region that is identified as having Sentinel Site IBI scores significantly lower than the long-term mean. This adjustment reduces the chance that a watershed is listed as impaired on the 305(b) inventory of waters of the State when IBI scores are depressed due to natural variability (Becker et al. 2010). In 2014, Sentinel Sites in the Highlands region were identified as having BIBI scores lower than the long term mean (Table 4). The GLM computed an adjustment value for BIBI scores in that region for that year (Table 4). This adjustment value could be applied to the watersheds sampled using randomly-selected MBSS sites during that year.

A total of 16 benthic macroinvertebrate taxa were designated as coldwater-preference and one fish species (Brook Trout) was designated as a coldwater-obligate (Becker et al. 2010). Two stonefly genera (*Tallaperla* and *Sweltsa*) are coldwater-obligate species. These taxa require streams with cold water temperatures to survive. Based on examining data from those Sentinel Sites in the Highlands region with average maximum daily water temperatures below 20.5 $^{o}$C (8 of 9 sites), the richness and abundances of coldwater-preference benthic macroinvertebrate taxa in the community at these 8 Sentinel Sites were not significantly, but positively correlated ($r = 0.24$, $p = 0.40$; $r = 0.11$, $p = 0.69$) with year between 2000 and 2014. Percent richness of coldwater-preference macroinvertebrates varied from about 12.9% (2003) to 21.3% (2010) across this 15-year period of record (Figure 10). Percent abundance of coldwater-preference macroinvertebrates ranged from a low of 17.9% in 2014 to a high of 35.0% in 2012 (Figure 11). Spearman correlation analysis showed a negative and significant temporal trend in Brook Trout abundances at the fifteen Sentinel Sites in the Highlands and Eastern Piedmont regions ($r = -0.78$, $p = 0.0006$). Combined percent Brook Trout abundance in the Highlands and Eastern Piedmont regions ranged from a low of 2.8% (2012) to a high of 11.1% (2004) (Figure 12). Maximum percent abundance of Brook Trout in the Highlands region was observed in 2004 (18.4 %) while the minimum percent abundance was observed in 2013 (4.0%) (Figure 13). Eastern Piedmont region percent Brook Trout abundance ranged from a minimum of 0.2% (2005) to a maximum of 2.2% in 2006 (Figure 13). Data collected in the SSN from 2000 through 2014 have established a 15-year baseline for 16 coldwater-preference benthic macroinvertebrate genera and one coldwater-obligate fish species (Brook Trout) that can be used to look for shifts in these biological taxa in future years that may reflect climate change influences.

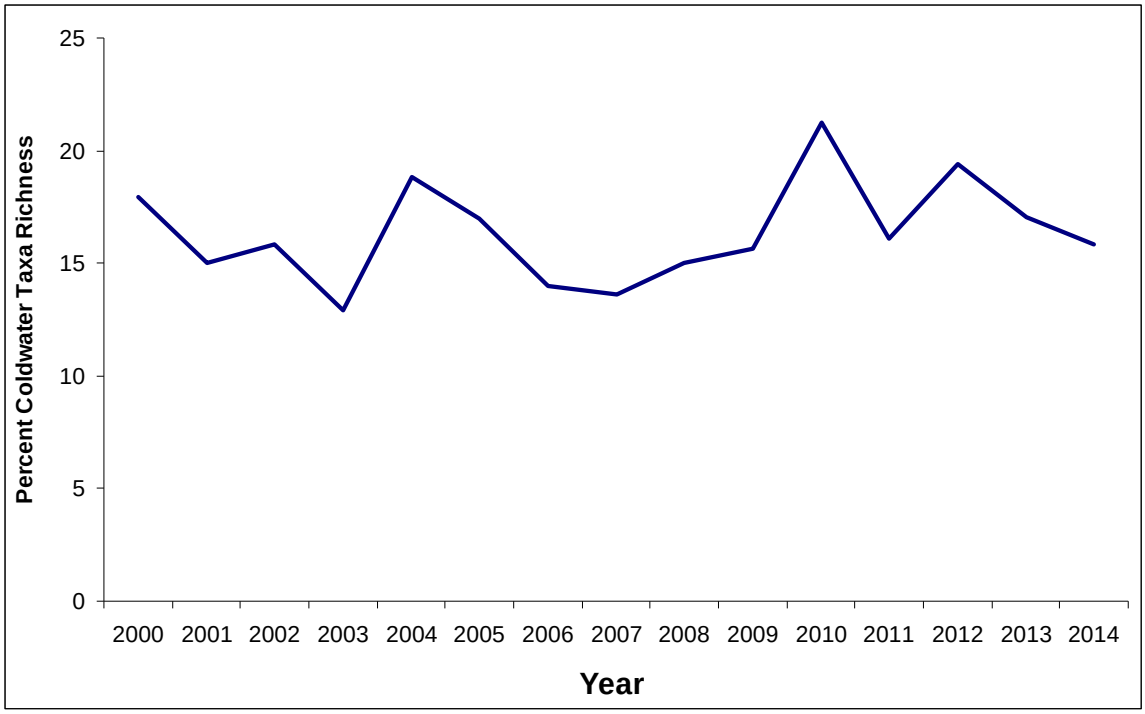



**Figure 10: Percent coldwater benthic taxa richness at 8 highland MBSS Sentinel Sites between 2000 and 2014.**

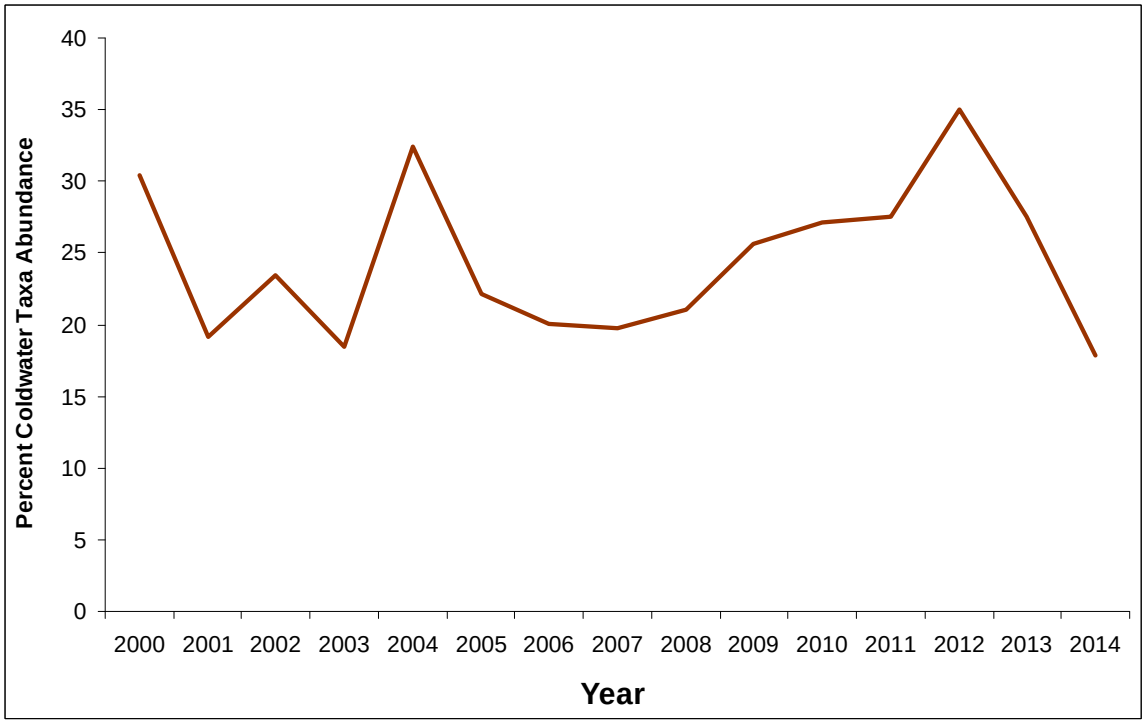



**Figure 11: Percent coldwater benthic taxa abundance at 8 highland MBSS Sentinel Sites between 2000 and 2014.**

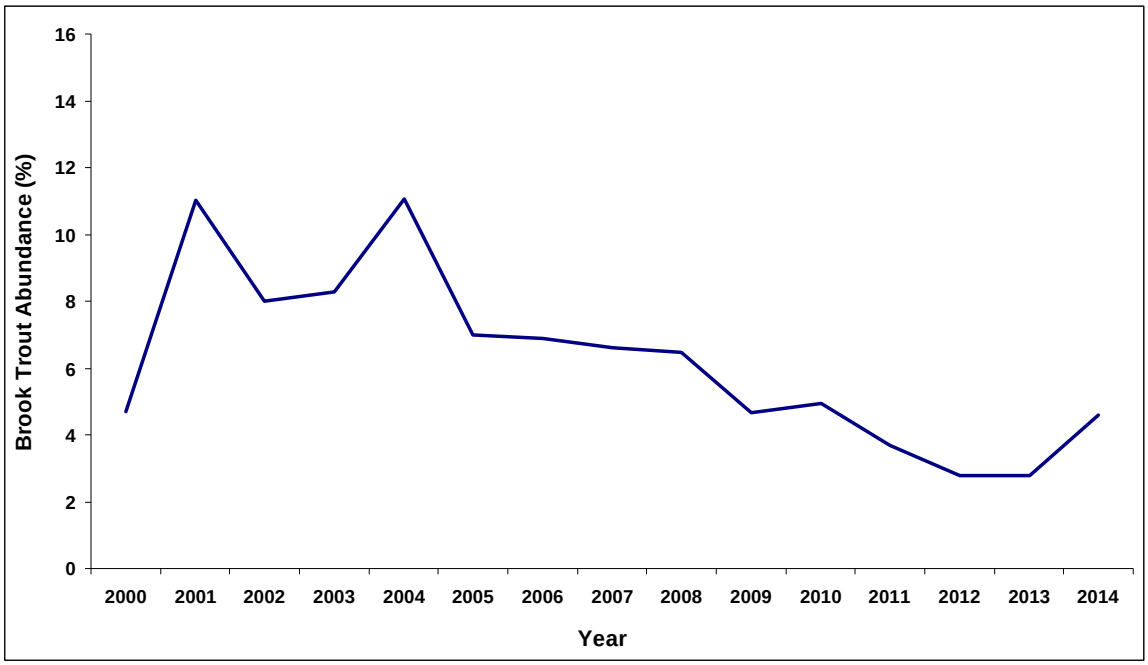



**Figure 12: Brook Trout percent abundance at 15 Highland and Eastern Piedmont MBSS Sentinel Sites sampled between 2000 and 2014.**

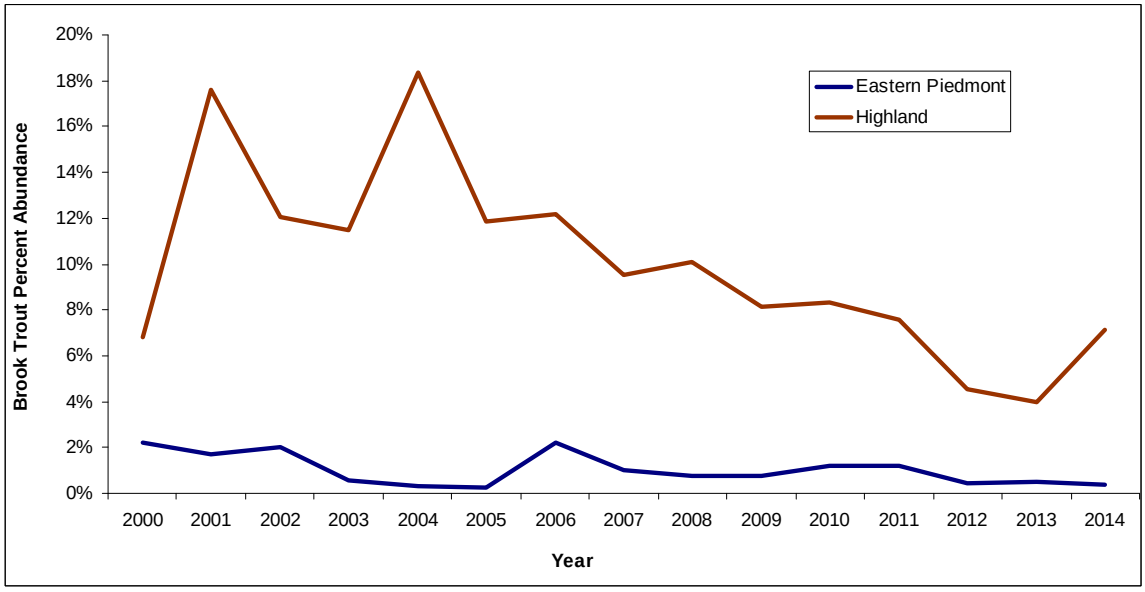



**Figure 13: Brook Trout percent abundance at Highland and Eastern Piedmont MBSS Sentinel Sites sampled between 2000 and 2014.**

*Water Temperature*

Water temperature data (mean, maximum, proportion of readings greater than 20 $^{o}$C, proportion of readings greater than 24 $^{o}$C) collected by in-situ, automated temperature loggers located at all Sentinel Sites did not show any significant differences across years ($p>0.05$) during the 15-year period of record (2000-2014) at the site, region, or statewide scale.

*Precipitation*

In all regions, mean annual precipitation amounts were more than two inches below normal during 2001 and 2007 (Figure 14). During 2003 and 2011, mean annual precipitation amounts were more than five inches above normal in all regions. Mean annual precipitation amounts were near the long-term normal in 2000, 2004-2006, 2008-2010, and 2013.

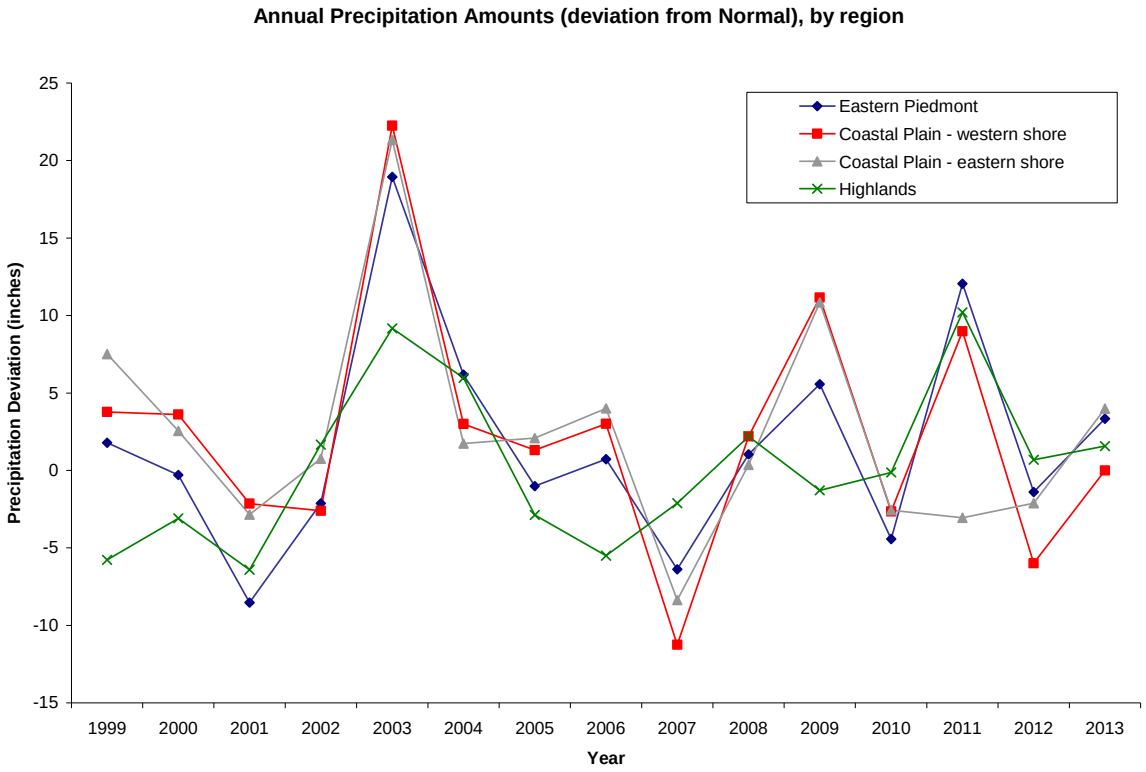



**Figure 14: Graph of annual precipitation amounts (deviation from normal), by region, in Maryland from 1999-2013.**

*Land Use/Cover*

We observed differences in land use/cover at 21 of the 29 Sentinel Sites between 2001 and 2011 (Table 5). The largest amount of forest cover loss was observed in Leonard Pond Run (1646.5 acres; 12.0 % of the watershed area) while the largest percent of forest cover loss occurred in Millville Creek (713.4 acres; 25.1 %). Two other Sentinel Sites lost more than 15 % forest land cover between 2001 and 2011. The largest increase in urban land use/cover

area was observed in Mattawoman Creek (4762.7 acres; 11.8 % of the watershed area). Baisman Run had the largest percent increase of urban land use (154.08 acres; 37.0 %). Two other Sentinel Sites gained urban land use/land cover of more than 20 %.

**Table 5: Forest land cover loss and urban land use/ land cover increase from 2001 to 2011 at the Sentinel Sites from NLCD.**

| Site | Forest loss (acres) | Forest loss (%) | Urban increase (acres) | Urban increase (%) |
|---|---|---|---|---|
| ANTI-101-S | 0.00 | 0.00 | 0.00 | 0.00 |
| CORS-102-S | 0.00 | 0.00 | 24.94 | 3.90 |
| FIMI-207-S | 0.00 | 0.00 | 0.00 | 0.00 |
| FURN-101-S | 70.11 | 9.60 | 42.04 | 5.76 |
| JONE-109-S | 0.00 | 0.00 | 39.44 | 24.27 |
| JONE-315-S | 0.00 | 0.00 | 762.65 | 20.04 |
| LIBE-102-S | 0.00 | 0.00 | 35.13 | 6.02 |
| LOCH-120-S | 0.00 | 0.00 | 154.08 | 36.95 |
| LOCR-102-S | 28.81 | 6.68 | 0.00 | 0.00 |
| MATT-033-S | 0.00 | 0.00 | 4762.69 | 11.76 |
| NANJ-331-S | 0.00 | 0.00 | 77.69 | 1.24 |
| NASS-108-S | 713.42 | 25.05 | 65.20 | 2.29 |
| NASS-302-S | 0.00 | 0.00 | 759.51 | 3.87 |
| PAXL-294-S | 0.00 | 0.00 | 222.65 | 5.98 |
| PRLN-626-S | 0.00 | 0.00 | 0.00 | 0.00 |
| PRMT-177-S | 48.50 | 17.84 | 32.82 | 12.07 |
| PTOB-002-S | 0.00 | 0.00 | 69.32 | 2.98 |
| RKGR-119-S | 0.00 | 0.00 | 32.98 | 4.90 |
| SAVA-204-S | 0.00 | 0.00 | 0.00 | 0.00 |
| SAVA-225-S | 0.00 | 0.00 | 0.00 | 0.00 |
| SAVA-276-S | 44.50 | 1.64 | 0.00 | 0.00 |
| STCL-051-S | 0.00 | 0.00 | 12.97 | 5.15 |
| UMON-119-S | 0.62 | 0.06 | 0.62 | 0.06 |
| UMON-288-S | 0.00 | 0.00 | 0.00 | 0.00 |
| UPCK-113-S | 77.00 | 16.35 | 17.47 | 3.71 |
| UPCR-208-S | 0.00 | 0.00 | 389.52 | 3.66 |
| WIRH-220-S | 1646.48 | 12.04 | 0.00 | 0.00 |
| YOUG-432-S | 0.00 | 0.00 | 0.00 | 0.00 |
| ZEKI-012-S | 0.00 | 0.00 | 8.25 | 2.68 |

*Relating Sentinel Site-Specific Data to Climate Variables*

Total fish numbers collected at Sentinel Sites in the Coastal Plain – western shore region showed the same pattern as the BIBI and FIBI scores, with the fewest total individuals collected during 2003, the year after the lowest recorded precipitation and stream flows. The proportion of coldwater-preference benthic macroinvertebrates decreased slightly

(but not significantly) between 2000 and 2014 in the Highlands region. Brook Trout abundance decreased significantly between 200 and 2014, in the Highlands and Eastern Piedmont regions.

*Sampling Candidate Sentinel Sites – Expanding the Network*
Sampling in 2013 demonstrated that this candidate Sentinel Site still met the criteria. The candidate Sentinel Site was again resampled in 2014. The candidate site continues to meet Sentinel Site selection criteria. The site PRMT-177-S is now an official part of the SSN. The array of biological, chemical, and physical habitat-related information collected at the candidate Sentinel Site (plus site photos) is presented in Appendix B.

## DISCUSSION

The MBSS Sentinel Site Network (SSN) is a valuable monitoring tool for interpreting stream conditions in a given year, for evaluating the causes of stream condition changes observed over time, and for making informed decisions on water resource management issues. Throughout the 15-year period of record for the SSN (2000-2014), precipitation patterns varied from drought conditions (2001, 2002, 2007) to two extremely wet years (2003 and 2011). Stream fish and benthic macroinvertebrate communities were influenced by natural variations in precipitation and flows more in some regions of Maryland than in others. Regional differences in geology and ground water availability may explain the dramatic responses of fish and benthic macroinvertebrates in the Coastal Plain-western shore region to the 2001-2002 drought, as discussed previously by Prochaska (2005). By comparison, stream biota in other Maryland regions responded much less dramatically to these drought conditions. Although the biotic response to the 2001-2002 drought was relatively severe, especially in the Coastal Plain – western shore regions, it was also temporary and the biotic communities appeared to recover quickly.

If droughts occur more frequently and with greater magnitude in response to climate change, fauna in Coastal Plain-western shore region streams may be the first to be affected. The influence of climate change on streams in this region that are also suffering from other stresses (e.g., urbanization, sand and gravel mining) could be much more severe than in other areas of Maryland.

The general linear model (GLM) is effective in statistically identifying years when IBI scores differ from the overall regional mean and calculating an adjustment value to compensate for annual natural variability. The years identified by the GLM as being significantly lower match very well with the IBI response to drought years. These results suggest that precipitation patterns greatly influence IBI scores in a region. This model may also prove useful when applied to the entire MBSS dataset. With more analysis we may be able to apply the adjustment values developed for the Sentinel Sites to entire regions. This would help to reduce the risk of erroneously assessing watersheds as impaired if the low scores were caused by natural variability or influenced by extreme precipitation patterns. As precipitation patterns change due to climate change, this model may prove important in analyzing the effects on Maryland's streams.

Even small changes in land use/cover (like those documented in this report) may be sufficient to substantially change the biological quality of the State's streams and could confound our attempts to detect and track the effects of annual natural variability and also longer term global climate change. The loss of Brook Trout at the Timber Run Sentinel Site was documented by Stranko et al. (2008), who showed that the last collection of Brook Trout from this stream occurred in 2003, after the start and just prior to the completion of residential development in the watershed in 2004. Based on observations like these, supported by empirical evidence, we will examine land use/cover changes at finer temporal scales in future reports, as we continue to collect biological data at the Sentinel Sites, to determine more precisely when landscape changes occurred. By tracking such alterations, we may be better able to document land use/cover changes that are coincident with ecological variability at these sites.

The decline of coldwater species has been widely forecast to result from global climate change predictions (e.g., Meisner 1990, Eaton and Scheller 1996, Mohseni 2003). The results of our study show no significant negative declines in coldwater-preference benthic macroinvertebrate genera over the 15-year period of record for the SSN (2000-2014). There have been statistically significant declines in Brook Trout abundance over the 15-year period, particularly at Highland Sentinel Sites. The fact that Brook Trout abundances have declined, yet stream water temperatures and coldwater benthic macroinvertebrate taxa richness and abundances have remained steady suggest that temperature is not the factor impacting Brook Trout. Without a significant correlation with air or water temperatures or any other climate related variable, inferring climate change as the potential cause of this decline is not possible. Stochastic flow events or other abiotic parameters that are not measured may be the driving force behind this decline in Brook Trout numbers at sentinel sites. Coldwater-preference and obligate stream biota may be responding to climate change influences that are as yet too subtle to measure directly or that are related to changes in the timing of climatic events. Streams that warm more quickly than normal or experience base-flow conditions earlier in the year could become inhospitable to certain coldwater stream taxa. MDDNR will continue to carefully track taxa composition and abundance at the Sentinel Sites.

As the population of Maryland continues to grow and development converts more forests and farm land to houses, roadways, shopping centers, and other impervious surfaces, many Sentinel Sites and/or their catchments may be altered. Since climate change will add to and magnify stressors already present (Palmer et al., 2009), any disturbances caused by land use/ land cover changes in Sentinel Site catchments will make it difficult to quantify either short-term natural variability or the longer-term effects of climate change. Land use/ land cover changes that occurred at some Sentinel Sites between 2001 and 2011, as described in this report, emphasize the need to protect Sentinel Site watersheds. To continue to build a longer and more robust time series, the SSN should be protected, expanded and also continued into the foreseeable future.

**REFERENCES**


Allan, J.D. 1995. Stream Ecology: Structure and Function of Running Waters. Chapman and Hall, London, UK.

Becker, A., A. Prochaska, M. Depew, and J. Kilian. 2007. A Report on the Long-term Monitoring Site Network from the Maryland Biological Stream Survey. Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division, Annapolis, MD.

Becker, A., A. Prochaska, G. Graves, and J. Schuster. 2008. An Update on the Long-term Monitoring Site Network from the Maryland Biological Stream Survey, 2008. Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division, Annapolis, MD.

Becker, A. 2009. A Technical Memorandum – Expanding the Maryland Biological Stream Survey Sentinel Site Network. Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division, Annapolis, MD.

Becker, A.J., Stranko, S.A., Klauda, R.J., Prochaska, A.P., Schuster, J.D., Kashiwagi, M.T. and P.H. Graves. 2010. Maryland Biological Stream Survey's Sentinel Site Network: A Multi-purpose Monitoring Program. Prepared by the Maryland Department of Natural Resources Monitoring and Non-tidal Assessment Division. Prepared for the Maryland Department of Natural Resources Natural Heritage Program.

Brooks, R.T. 2009. Potential impacts of global climate change on the hydrology and ecology of ephemeral freshwater systems of the forests of the northeastern United States. Climate Change 95:469-483.

Boulton, A.J., C.G. Peterson, N.B. Grimm and S.G. Fisher. 1992. Stability of an aquatic macroinvertebrate community in a multiyear hydrologic disturbance regime. Ecology 73: 2192-2207.

Eaton, J.G. and R.M. Scheller. 1996. Effects of climate warming on fish thermal habitat in streams of the United States. Limnology and Oceanography 41:1109-1115.

Flebbe, P.A., L.D. Roghair, and J.L. Bruggink. 2006. Spatial modeling to project Southern Appalachian trout distribution in a warmer climate. Transactions of the American Fisheries Society 135:1371-1382.

Fry, J., G. Xian, S. Jin, J. Dewitz, C. Homer, L. Yang, C. Barnes, N. Herold, and J. Wickham. 2011. Completion of the 2006 National Land Cover Database for the Conterminous United States. Photogrammetric Engineering and Remote Sensing **77**(9):858-864.

Grafe, C.S., C.A. Mebane, M.J. McIntyre, D.A. Essig, D.H. Brandht, and D.T. Mosier. 2002. The Idaho Department of Environmental Quality Water Body Assessment Guidance, Second Edition-Final. Idaho Department of Environmental Quality, Boise, ID.

Grossman, G.D., J.F. Dowd, and M. Crawford. 1990. Assemblage stability in stream fishes: A review. Environmental Management 14(5):661-671.

Grubin, E., A. Hardy, R. Lyons, A. Schmale, and T. Sugii. 2009. Conserving Freshwater and Coastal Resources in a Changing Climate. Report prepared for The Nature Conservancy. 58 pp.

Hayhoe, K., C. Wake, B. Anderson, X-Z. Liang, E. Maurer, J. Zhu, J. Bradbury, A. DeGaetana, A. M. Stoner, and D. Wuebbles. 2008. Regional climate change projections for the Northeast USA. Mitig. Adapt. Strat. Glob. Change 13:425-436.

Homer, C. C. Dewitz, J. Fry, J. Coan, M. Hossain, N. Larson, C. Herold, N. McKerrow, A. VanDriel, J. N. and Wickham, J. 2007. Completion of the 2001 National Landcover Database for the conterminous United States. Photogrammetric Engineering and Remote Sensing 73(4):337-341.

IPCC (Intergovernmental Panel on Climate Change). 2007. Climate change 2007: the physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Quin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor, and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Jin, S., L. Yang, P. Danielson, C. Homer, J. Fry, and G. Xian. 2013. A comprehensive change detection method for updating the National Land Cover Database to circa 2011. Remote Sensing of Environment **132**:159-175.

Kaushal, S.S., P.M. Groffman, L.E. Band, C.A. Shields, R. P. Morgan, M.A. Palmer, K.T. Belt, C.M. Swan, S.E.G. Findlay, and G.T. Fisher. 2008. Interaction between urbanization and climate variability amplifies watershed nitrate export in Maryland. Environmental Science & Technology 42(16):5873-5878.

Lovett, G.M., D.A. Burns, C.T. Driscoll, J.D. Jenkins, M.J. Mitchell, L. Rustad, J. B. Shanley, G.E. Likens, and R. Haeuber. 2007. Who needs environmental monitoring? Frontiers in Ecology and the Environment 5(5):253-260.

MacCrimmon, H.R. and J.S. Campbell. 1969. World distribution of Brook Trout (*Salvelinus fontinalis*). Journal of the Fisheries Research Board of Canada 26:1699-1725.

Maryland Commission on Climate Change (MCCC). 2008a (July). Global Warming and the Free State: Comprehensive Assessment of Climate Change Impacts in Maryland. Report of the Scientific and Technical Working Group.

Maryland Commission on Climate Change (MCCC). 2008b (August). Climate Action Plan: Final Report to the Governor and the Maryland General Assembly.

McElravy, E.P. G.A. Lamberti, and V.H. Resh, 1989. Year-to-year variation in the aquatic macroinvertebrate fauna of a northern California stream. Journal of the North American Benthological Society 8:51-63.

Meisner, J.D. 1990. Effect of climatic warming on the southern margins of the native range of Brook Trout, *Salvelinus fontinalis*. Canadian Journal of Fisheries and Aquatic Sciences 47:1065-1070.

Mohseni, O., H.G. Stefan, and J.G. Eaton. 2003. Global warming and potential changes in fish habitat in US streams. Climate Change 59:389-409.

Najar, R.G., C.R. Pyke, M.B Adams, D. Breitburg, C. Hershner, M. Kemp, R. Howarth, M.R. Mulholland, M. Paolisso, D. Secor, K. Sellner, D. Wardrop, and R. Wood. 2009. Potential climate-change impacts on the Chesapeake Bay. Estuarine, Coastal and Shelf Science xxx:1-20.

NOAA. (National Oceanic and Atmospheric Administration). 1999. Climatological data annual summary, Maryland and Delaware, 1999. National Environmental Satellite, Data and Information Service, National Climatic Data Center, Asheville, NC. Volume 123, Number 13.

NOAA. (National Oceanic and Atmospheric Administration). 2000. Climatological data annual summary, Maryland and Delaware, 2000. National Environmental Satellite, Data and Information Service, National Climatic Data Center, Asheville, NC. Volume 124, Number 13.

NOAA. (National Oceanic and Atmospheric Administration). 2001. Climatological data annual summary, Maryland and Delaware, 2001. National Environmental Satellite, Data and Information Service, National Climatic Data Center, Asheville, NC. Volume 125, Number 13.

NOAA. (National Oceanic and Atmospheric Administration). 2002. Climatological data annual summary, Maryland and Delaware, 2002. National Environmental Satellite, Data and Information Service, National Climatic Data Center, Asheville, NC. Volume 126, Number 13.

NOAA. (National Oceanic and Atmospheric Administration). 2003. Climatological data annual summary, Maryland and Delaware, 2003. National Environmental Satellite, Data and Information Service, National Climatic Data Center, Asheville, NC. Volume 127, Number 13.

NOAA. (National Oceanic and Atmospheric Administration). 2004. Climatological data annual summary, Maryland and Delaware, 2004. National Environmental Satellite,

Data and Information Service, National Climatic Data Center, Asheville, NC. Volume 128, Number 13.

NOAA. (National Oceanic and Atmospheric Administration). 2005. Climatological data annual summary, Maryland and Delaware, 2005. National Environmental Satellite, Data and Information Service, National Climatic Data Center, Asheville, NC. Volume 129, Number 13.

NOAA. (National Oceanic and Atmospheric Administration). 2006. Climatological data annual summary, Maryland and Delaware, 2006. National Environmental Satellite, Data and Information Service, National Climatic Data Center, Asheville, NC. Volume 130, Number 13.

NOAA. (National Oceanic and Atmospheric Administration). 2007. Climatological data annual summary, Maryland and Delaware, 2007. National Environmental Satellite, Data and Information Service, National Climatic Data Center, Asheville, NC. Volume 131, Number 13.

NOAA. (National Oceanic and Atmospheric Administration). 2008. Climatological data annual summary, Maryland and Delaware, 2008. National Environmental Satellite, Data and Information Service, National Climatic Data Center, Asheville, NC. Volume 132, Number 13.

NOAA. (National Oceanic and Atmospheric Administration). 2009. Climatological data annual summary, Maryland and Delaware, 2009. National Environmental Satellite, Data and Information Service, National Climatic Data Center, Asheville, NC. Volume 133, Number 13.

NOAA. (National Oceanic and Atmospheric Administration). 2010. Climatological data annual summary, Maryland and Delaware, 2010. National Environmental Satellite, Data and Information Service, National Climatic Data Center, Asheville, NC. Volume 134, Number 13.

NOAA. (National Oceanic and Atmospheric Administration). 2011. Climatological data annual summary, Maryland and Delaware, 2011. National Environmental Satellite, Data and Information Service, National Climatic Data Center, Asheville, NC. Volume 115, Number 13.

NOAA. (National Oceanic and Atmospheric Administration). 2012. Climatological data annual summary, Maryland and Delaware, 2012. National Environmental Satellite, Data and Information Service, National Climatic Data Center, Asheville, NC. Volume 116, Number 13.

NOAA. (National Oceanic and Atmospheric Administration). 2013. Climatological data annual summary, Maryland and Delaware, 2013. National Environmental Satellite,

Data and Information Service, National Climatic Data Center, Asheville, NC. Volume 117, Number 13.

NOAA. (National Oceanic and Atmospheric Administration). 2014. Climatological data annual summary, Maryland and Delaware, 2014. National Environmental Satellite, Data and Information Service, National Climatic Data Center, Asheville, NC. Volume 118, Number 1-6.

Palmer, M.A., D.P. Lettenmaier, N.L. Poff, S.L. Postel, B. Richter, and R. Warner. 2009. Climate Change and River Ecosystems: Protection and Adaptation Options. Environmental Management 44:1053-1068.

Poff, N.L. and J.D. Allan. 1995. Functional organization of stream fish assemblages in relation to hydrological variability. Ecology 76(2):606-627.

Poff, N.L., M.M. Brinson, and J.W. Day. 2002. Aquatic ecosystems and global climate change: Potential impacts on inland freshwater and coastal wetland ecosystems in the United States. Pew Center on Global Climate Change. *http://www.pewclimate.org/docUploads/aquatic%2Epdf*

Prochaska, T. 2005. Maryland Biological Stream Survey 2000-2004. Volumn XI: Sentinel Site Network. Maryland Department of Natural Resources, Monitoring and Non-Tidal Assessment Division, Annapolis, Maryland.

Pyke, C., R. Najjar, M.B. Adams, D. Breitburg, M. Kemp, C. Heershner, R. Howarth, M. Mulholland, M. Paolisso, D. Secor, K. Sellner, D. Wardrop, and R. Wood. 2008. Climate Change and the Chesapeake Bay: State-of-the-Science Review and Recommendations. A Report from the Chesapeake Bay Program Science and Technical Advisory Committee (STAC). Annapolis, MD. 59 pp.

Roth, N., M. Southerland, J. Chaillou, R. Klauda, P. Kazyak, S. Stranko, S. Weisberg, L. Hall, Jr., and R. Morgan II. 1998. Maryland Biological Stream Survey: Development of an Index of Biotic Integrity for fishes in Maryland streams. Third EMAP Symposium, Albany, NY. Environmental Monitoring and Assessment 51:89-106.

Southerland, M., G. Rogers, M. Kline, R. Morgan, D. Boward, P. Kazyak, and S. Stranko. 2005. Development of New Fish and Benthic Macroinvertebrate Indices of Biotic Integrity for Maryland Streams. Report to Monitoring and Non-Tidal Assessment Division, Maryland Department of Natural Resources, Annapolis, MD.

Southerland, M.T., G.M. Rogers, M.J. Kline, R.P. Morgan, D.M. Boward, P.F. Kazyak, R.J. Klauda, and S.A. Stranko. 2007. Improving biological indicators to better assess the condition of streams. Ecological Indicators 7:751-767.

Stranko, S.A., R.H. Hilderbrand, R.P. Morgan II, M.W. Staley, A.J. Becker, and

A. Roseberry-Lincoln. 2008. Brook Trout declines with land cover and temperature changes in Maryland. North American Journal of Fisheries Management 28:1223-1232.

Stranko, S., D. Boward, J. Kilian, A. Becker, R. Gauza, A. Schenk, A. Roseberry-Lincoln, M. Ashton, and P. Kazyak. 2009. Maryland Biological Stream Survey, Round Three Field Sampling Manual. Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division, Annapolis, MD.

# *Appendix A*
# *Sentinel Sites in the Coastal Plain – Eastern Shore Region*

Cypress Branch (UPCR-208-S)
Unnamed Tributary to Emory Creek (CORS-102-S)
Leonard Pond Run (WIRH-220-S)
Millville Creek (NASS-108-S)
Nassawango Creek (NASS-302-S)
Unnamed Tributary to Skeleton Creek (UPCK-113-S)
Swan Creek (LOCR-102-S)

# *Cypress Branch (UPCR-208-S)*

Site UPCR-208-S is located on Cypress Branch in the Coastal Plain – eastern shore region of Maryland. It is in the upper Chester River watershed in Kent County. This site was sampled in 2004 and 2008 to 2014.


*Cypress Branch in spring 2013.*

## ***Land Use/ Land Cover***

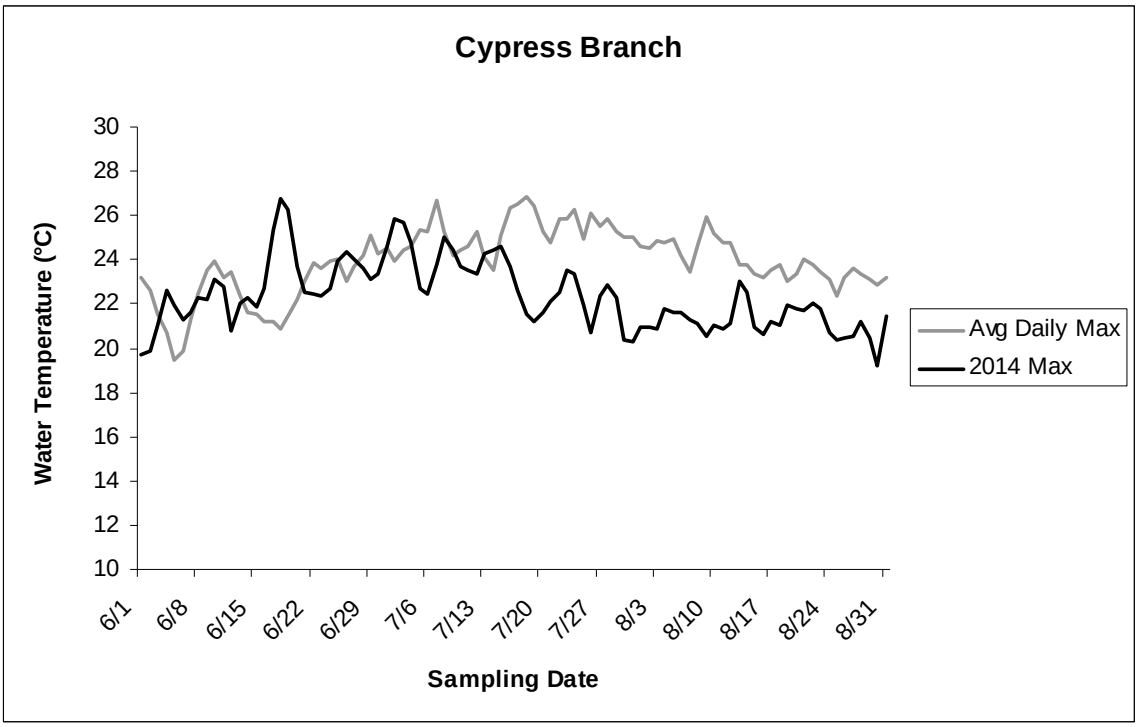
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 0.64 | 40.29 | 21.03 |
| Agriculture | 32.18 | 30.75 | 30.80 |
| Urban | 0.33 | 3.78 | 4.00 |
| Other | 66.84 | 25.18 | 44.17 |

## ***Physical Habitat***

Physical habitat measurements collected at Cypress Branch (2004 and 2008 to 2014). Scored parameters are on a 0 (worst) to 20 (best) scale. There was not discharge information available for 2012 due to a dry stream channel with some standing pools.

| *Parameter* | *2004* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 13 | 12 | 18 | 16 | 17 | 1 | 17 | 12 |
| Epifaunal substrate (0-20) | 11 | 13 | 17 | 14 | 18 | 6 | 13 | 15 |
| Velocity/Depth Diversity (0-20) | 14 | 6 | 9 | 8 | 7 | 1 | 9 | 8 |
| Pool Quality (0-20) | 15 | 13 | 17 | 16 | 11 | 3 | 15 | 12 |
| Riffle Quality (0-20) | 16 | 0 | 16 | 4 | 8 | 0 | 11 | 2 |
| Shading (%) | 90 | 95 | 80 | 80 | 75 | 85 | 95 | 90 |
| Embeddedness (%) | 100 | 85 | 100 | 100 | 30 | 85 | 100 | 90 |
| Discharge (cfs) | 2.35 | 0.00 | 1.53 | 0.19 | 0.42 | na | 0.73 | 0.00 |




The graph above displays the average daily maximum temperatures recorded at Cypress Branch. The average temperature was calculated from four years of data.

## ***Biology***

### *Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2004* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|
| BIBI | 4.14 | 2.14 | 1.86 | 3.57 | 1.86 | 2.71 | 2.14 | 3.00 |
| FIBI | 4.00 | 3.00 | 4.00 | 4.00 | 3.33 | 3.33 | 4.33 | 3.33 |

### *Fish*

Cumulative list of fish species (with abundance) collected in Cypress Branch by sampling year.

| *Species* | *2004* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|
| American eel | 13 | - | 2 | 1 | - | 5 | 15 | 4 |
| Bluegill | 1 | - | 7 | - | 13 | 1 | 20 | - |
| Bluespotted sunfish | 4 | - | 2 | 2 | 1 | 1 | 1 | 2 |
| Brown bullhead | - | 2 | - | - | - | - | - | - |
| Chain pickerel | - | 1 | - | - | - | - | 1 | - |
| Creek chubsucker | 2 | - | 5 | 1 | 1 | - | 1 | - |
| Eastern mudminnow | 38 | 15 | 18 | 12 | 10 | 22 | 4 | 14 |
| Golden shiner | 11 | - | 8 | 3 | 1 | 6 | 2 | 4 |
| Green sunfish | 21 | - | 3 | 8 | 12 | 53 | 23 | 9 |
| Largemouth Bass | - | - | 3 | - | - | - | 4 | 3 |
| Margined madtom | 5 | - | 1 | - | - | - | - | - |
| Mud sunfish | 3 | 2 | 3 | - | - | - | - | - |
| Pirate perch | 18 | 10 | 5 | 5 | 9 | 5 | 19 | 7 |
| Pumpkinseed | 6 | - | 4 | 1 | 7 | 2 | 13 | - |
| Redbreast sunfish | 4 | - | 1 | 1 | 1 | 2 | 2 | - |
| Redfin pickerel | 16 | 28 | 26 | 6 | 4 | 2 | 15 | 10 |
| Swamp Darter | - | - | - | - | - | - | 1 | - |
| Tadpole madtom | 39 | 1 | 3 | - | 1 | 4 | 34 | 25 |
| Tessellated darter | 33 | - | - | 1 | 9 | 4 | 25 | 44 |
| Yellow bullhead | 10 | 1 | 1 | - | 2 | 2 | 6 | 7 |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

*Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in Cypress Branch by sampling year.

| *Species* | *2004* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|
| Devil crawfish (*Cambarus diogenes*) | A | A | A | P | P | A | A | A |
| Spinycheek crayfish *(Orconectes limosus*) | A | P | A | A | A | A | A | A |
| (*Procambarus sp*.) | A | P | P | P | P | A | P | P |

*Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in Cypress Branch by sampling year.

| *Species* | *2012* | *2013* | *2014* |
|---|---|---|---|
| Elliptio Complanata | P | A | A |
| Elliptio Fisheriana | P | A | A |

*Herpetofauna*

Cumulative list of herpetofauna species collected in or near Cypress Branch.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | American bullfrog, Cope's gray treefrog, Eastern cricket frog, Fowler's toad, Gray treefrog, New Jersey chorus frog, Northern green frog, Northern spring peeper, Pickerel frog, Southern leopard Frog, Wood frog |
| Caudata (Salamanders and Newts) | Marbled salamander |
| Squamata (Snakes and Lizards) | Eastern ratsnake, Northern watersnake |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in the Cypress Branch by sampling year, RA = %Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *2004 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|
| | | PHYLUM ANNELIDA | | | | | | | | |
| Haplotaxida | Tubificidae | na | - | - | - | - | - | *0.9 | - | - |
| | | Limnodrilus | - | - | - | 1.7 | - | - | - | - |
| Lumbriculida | Lumbriculidae | na | - | - | - | *3.4 | - | - | - | *0.9 |
| | | PHYLUM ARTHROPODA | | | | | | | | |
| Amphipoda | Crangonyctidae | *Crangonyx* | 0.9 | - | - | - | - | - | - | - |
| (Scud) | | *Synurella* | 0.9 | 1 | 0.9 | - | 0.9 | - | 0.8 | - |
| Coleoptera | Dytiscidae | *Neoporus* | - | - | - | 0.8 | - | - | - | - |
| (Beetle) | Elmidae | *Dubiraphia* | - | - | - | 0.8 | - | - | - | - |
| | Gyrinidae | *Dineutus* | 2.7 | - | - | - | - | - | - | - |
| Collembola | Isotomidae | *Isotomurus* | - | - | - | 0.8 | - | - | - | - |
| (Springtail) | | | - | - | - | - | - | - | - | - |
| Diptera | Chironomidae | *Ablabesmyia* | - | - | - | 0.8 | - | - | - | - |
| (True fly) | | *Conchapelopia* | 2.7 | - | - | - | - | - | - | - |
| | | *Dicrotendipes* | - | - | - | 0.8 | - | - | - | - |
| | | *Diplocladius* | - | - | 3.6 | - | - | 0.9 | - | 2.6 |
| | | *Heterotrissocladius* | - | - | - | - | - | - | 0.8 | - |
| | | *Hydrobaenus* | - | 1 | 8.1 | - | - | - | 7.2 | 7.8 |
| | | *Kiefferulus* | - | 1 | - | - | - | - | - | - |
| | | *Limnophyes* | - | - | - | - | - | - | 0.8 | 0.9 |
| | | Orthocladiinae | *0.9 | *1 | *2.7 | *2.5 | *0.9 | *2.7 | *2.4 | *2.6 |
| | | *Orthocladius* | 1.8 | - | 3.6 | 4.2 | 2.7 | 6.2 | 6.4 | 7.8 |
| | | *Paraphaenocladius* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.5 |
| | | *Paratanytarsus* | - | - | - | 0.8 | - | - | - | - |
| | | *Phaenospectra* | - | - | - | - | - | 0.9 | - | 0.9 |
| | | *Polypedilum* | 3.6 | - | - | 0.8 | - | 22.1 | - | - |
| | | *Pseudorthocladius* | - | - | - | 0.8 | - | - | - | - |
| | | *Rheosmittia* | 4.5 | - | - | - | - | - | - | - |
| | | *Rheotanytarus* | - | - | - | - | - | 0.9 | - | - |
| | | *Stenochironomus* | 1.8 | - | - | - | - | - | - | 0.9 |
| | | *Symposiocladius* | 1.8 | - | - | - | - | - | - | - |
| | | Tanypodinae | *0.9 | - | - | *3.4 | - | - | - | *1.7 |
| | | *Tanytarsus* | 2.7 | - | - | 1.7 | - | 2.7 | - | - |
| | | *Thienemanniella* | - | - | - | - | - | 0.9 | - | - |
| | | Thienmannimyia Group | *10.8 | - | - | *8.4 | - | *2.7 | - | *3.5 |
| | | *Tribelos* | 0.9 | - | - | - | - | - | - | - |
| | | *Tvetenia* | - | 4.8 | 23.4 | 3.4 | 17 | 16.8 | - | - |
| | Simuliidae | na | - | *22.9 | - | *1.7 | - | - | - | - |

| ORDER | FAMILY | GENUS | 2004 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Cnephia* | - | 2.9 | 2.7 | - | 8 | 6.2 | 31.2 | 16.5 |
| | | *Prosimulium* | 9 | 13.3 | 37.8 | 8.4 | 33 | 17.7 | 33.6 | 27 |
| | | *Simulium* | 20.7 | 1.9 | - | 17.6 | - | 8 | - | 2.6 |
| | | *Stegopterna* | 3.6 | 32.4 | 10.8 | 14.3 | 33.9 | - | 11.2 | 3.5 |
| | Tipulidae | *Erioptera* | - | - | - | - | - | - | 0.8 | - |
| | | *Hexatoma* | - | - | - | - | - | 0.9 | - | - |
| | | *Ormosia* | - | - | 0.9 | 0.8 | - | - | - | - |
| | | *Tipula* | - | - | - | - | - | - | - | 0.9 |
| Ephemeroptera | Caenidae | *Caenis* | - | - | - | 0.8 | - | - | - | - |
| (Mayfly) | Heptageniidae | *Stenonema* | 0.9 | - | - | - | - | - | - | - |
| | Leptophlebiidae | na | *0.9 | - | - | - | - | - | - | - |
| | | | | | | | | | - | - |
| Isopoda | Asellidae | *Caecidotea* | 0.9 | - | - | 8.4 | - | - | - | 3.5 |
| (Aquatic Sow Bug) | Crangonyctidae | *Synurella* | - | - | - | - | - | - | - | 3.5 |
| | Hyalellidae | *Hyalella* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.7 |
| Lepidoptera | na | na | *0.9 | - | - | - | - | - | - | - |
| (Moth) | | | - | - | - | - | - | - | - | - |
| Megaloptera | Corydalidae | *Sialis* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.9 |
| Odonata | Aeshnidae | *Boyeria* | 0.9 | - | - | - | - | - | - | - |
| | Coenagrionidae | na | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *0.9 |
| | Corduliidae | *Somatochlora* | - | - | - | 0.8 | | - | - | - |
| Plecoptera | Nemouridae | na | *5.4 | - | *5.4 | *2.5 | *1.8 | *5.3 | *0.8 | - |
| (Stonefly) | | *Prostoia* | 5.4 | 11.4 | - | - | - | - | 0.8 | - |
| | Perlodidae | na | - | *1 | - | - | - | - | - | - |
| | | *Isoperla* | - | - | - | - | 0.9 | - | - | - |
| | Taeniopterygidae | *Taeniopteryx* | - | 1 | - | - | - | - | 2.4 | 0.9 |
| Trichoptera | Hydropsychidae | *Cheumatopsyche* | 10.8 | - | - | 1.7 | - | 1.8 | - | 1.7 |
| (Caddisfly) | Limnephilidae | na | - | - | - | - | *0.9 | - | - | *0.9 |
| | | *Ironoquia* | 1.8 | 2.9 | - | 6.7 | - | 2.7 | 0.8 | - |
| | Phryganeidae | *Ptilostomis* | 0.9 | - | - | - | - | | - | - |
| PHYLUM MOLLUSCA | | | | | | | | | | |
| Veneroida | Pisidiidae | na | - | *1.9 | - | - | - | - | - | - |
| (Bivalve) | | *Musculium* | 0.9 | - | - | 0.8 | - | - | - | 0.9 |
| | | *Pisidium* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.7 |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).
* Taxa not identified to genus.

# *Unnamed Tributary to Emory Creek (CORS-102-S)*

Site CORS-102-S is located on an unnamed tributary to Emory Creek in the Coastal Plain – eastern shore region of Maryland. It is in the Corsica River watershed in Queen Anne's County. This site was sampled from 2000 to 2014.

*Unnamed tributary to Emory Creek in spring 2013.*

## ***Land Use/ Land Cover***

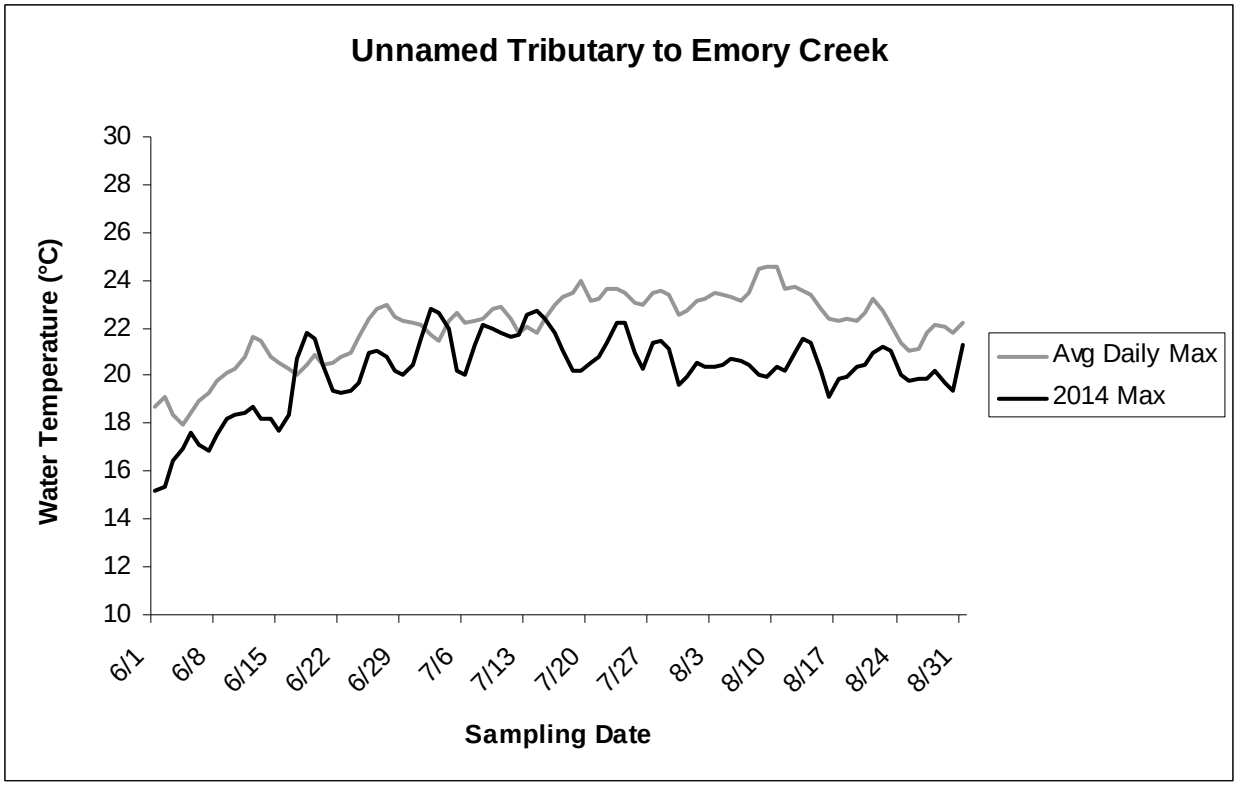
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 69.78 | 71.59 | 69.86 |
| Agriculture | 6.27 | 11.77 | 11.08 |
| Urban | 0.00 | 2.82 | 3.90 |
| Other | 23.95 | 13.82 | 15.16 |

## ***Physical Habitat***

Physical habitat measurements collected at the unnamed tributary to Emory Creek (2000 to 2014). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 10 | 8 | | 14 | 8 | 7 | 12 | 10 | 6 | 14 | 10 | 9 | 15 | 16 | 8 |
| Epifaunal substrate (0-20) | 8 | 9 | | 12 | 9 | 8 | 10 | 8 | 6 | 14 | 9 | 9 | 11 | 18 | 10 |
| Velocity/Depth Diversity (0-20) | 8 | 9 | Not sampled in summer (dry) | 16 | 8 | 7 | 5 | 2 | 2 | 12 | 8 | 7 | 10 | 9 | 9 |
| Pool Quality (0-20) | 9 | 13 | | 16 | 11 | 11 | 10 | 6 | 8 | 12 | 8 | 11 | 15 | 12 | 14 |
| Riffle Quality (0-20) | 12 | 8 | | 16 | 6 | 0 | 0 | 0 | 0 | 15 | 0 | 0 | 6 | 8 | 4 |
| Shading (%) | 80 | 92 | | 95 | 93 | 95 | 95 | 70 | 80 | 70 | 90 | 75 | 75 | 55 | 55 |
| Embeddedness (%) | 40 | 60 | | 20 | 20 | 25 | 70 | 100 | 100 | 100 | 45 | 20 | 95 | 75 | 85 |
| Discharge (cfs) | 0.58 | 0.02 | | 4.13 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.88 | 0.00 | 0.00 | 0.02 | 0.26 | 0.15 |




The graph above displays the average daily maximum temperatures recorded at the unnamed tributary to Emory Creek. No data was available for 2012. The average was calculated from eight years of data.

## ***Biology***

### *Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 4.14 | 4.14 | 2.43 | 3.29 | 3.86 | 4.43 | 3.86 | 4.43 | 3.29 | 3.00 | 4.14 | 3.29 | 3.57 | 2.43 | 3.86 |
| FIBI | 2.00 | 2.00 | Not Sampled (dry) | 2.00 | 1.67 | 2.00 | 1.67 | 2.67 | 2.00 | 2.33 | 1.67 | 2.00 | 2.33 | 2.33 | 2.33 |

### *Fish*

Cumulative list of fish species (with abundance) collected in the unnamed tributary to Emory Creek by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| American eel | 3 | - | Not sampled in summer (dry) | 1 | - | - | - | - | - | 4 | - | - | 2 | 14 | 10 |
| Black Crappie | - | - | | - | - | - | - | - | - | - | - | - | - | 1 | - |
| Bluegill | - | - | | - | - | 1 | - | 11 | - | 1 | - | 5 | - | - | - |
| Eastern mosquitofish | - | - | | - | - | - | - | - | - | - | - | - | - | 7 | - |
| Eastern mudminnow | 37 | 168 | | 23 | 33 | 227 | 7 | 66 | 7 | 8 | 3 | 11 | 40 | 265 | 133 |
| Golden shiner | - | - | | 1 | - | 3 | 2 | 5 | 2 | - | 1 | - | 1 | - | - |
| Green sunfish | - | - | | - | - | - | 2 | 2 | - | - | - | 6 | 10 | - | 3 |
| Eastern mosquitofish | - | - | | - | 6 | 6 | - | - | - | - | 13 | - | - | - | - |
| Largemouth bass | - | - | | - | - | - | - | - | - | - | - | - | - | 7 | - |
| Pumpkinseed | - | - | | - | - | - | - | 2 | - | - | - | - | 3 | - | - |
| Redfin pickerel | 6 | 5 | | 3 | 8 | 7 | 26 | 14 | 2 | 18 | - | 5 | 2 | 1 | 11 |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant

*Crayfish:*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to Emory Creek by sampling year.

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Devil crawfish (*Cambarus diogenes*) | A | P | P | A | A | A | A | P | P |
| Red Swamp Crawfish *(Procambarus clarkii)* | A | A | A | A | A | A | A | P | A |

*Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to Emory Creek by sampling year.

| *Species* |
|---|
| None Observed |

*Herpetofauna*

Cumulative list of herpetofauna collected in or near the unnamed tributary to Emory Creek.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | American bullfrog, Fowler's toad, Gray Treefrog, New Jersey chorus frog, Northern green frog, Northern spring peeper, Pickerel frog, Southern leopard frog, Wood frog |
| Squamata (Snakes and Lizards) | Common five-lined skink, Eastern garter snake |
| Testudines (Turtles) | Eastern snapping turtle |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in the unnamed tributary to Emory Creek by sampling year, RA = % Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | |
| Haplotaxida | Enchytraeidae | na | *0.9 | - | - | *1.6 | - | - | - | - | *0.9 | - | - | - | - | - | - |
| | Naididae | na | *7.7 | - | - | - | - | *0.9 | - | - | - | - | - | *0.8 | - | - | - |
| | Tubificidae | na | *3.4 | *0.9 | *5.1 | *1.6 | - | - | - | - | *0.9 | - | *3.6 | - | - | 6.8 | - |
| | | *Limnodrilus* | - | - | - | - | - | 0.9 | - | - | - | - | 0.9 | - | - | - | - |
| | | *Spirosperma* | - | - | - | - | - | 0 | 0.7 | - | 0.9 | - | - | - | - | - | - |
| Lumbriculida | Lumbriculidae | na | - | *0.9 | - | - | *1 | *2.6 | *1.4 | - | *0.9 | *1.7 | *0.9 | *0.8 | - | *0.9 | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | |
| Amphipoda | na | na | - | - | - | - | - | *10.3 | - | - | - | - | *9.9 | - | - | - | - |
| (Scud) | Crangonyctidae | na | *10.3 | - | - | - | *1.9 | - | - | - | - | - | - | - | - | - | - |
| | | *Crangonyx* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | 0.9 |
| | | *Synurella* | - | 0.9 | - | 2.3 | 14.4 | 0.9 | 29.5 | 3.6 | 2.8 | - | 3.6 | - | - | - | - |
| | Gammaridae | *Gammarus* | - | 1.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Coleoptera | Dryopidae | *Helichus* | - | - | - | - | - | 0.9 | - | - | 0.9 | - | - | - | - | - | - |
| (Beetle) | Dytiscidae | na | *1.7 | - | - | - | - | *0.9 | *9.6 | - | - | - | - | - | - | - | - |
| | | *Acilius* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | | *Neoporus* | - | - | - | 0.8 | - | 1.7 | - | 2.7 | - | - | - | - | - | - | - |
| | Elmidae | *Stenelmis* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | Haliplidae | *Peltodytes* | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - |
| | Hydrophilidae | *Hydrobius* | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - |
| | Scirtidae | na | - | *0.9 | - | *0.8 | - | - | - | - | - | - | 0.9 | - | - | - | - |
| Diptera | na | na | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - |
| (True Fly) | Ceratopogonidae | na | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - | *0.9 |
| | | *Culicoides* | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - |
| | | *Probezzia* | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - |
| | Chironomidae | na | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Ablabesmyia* | - | - | - | - | - | 6.9 | - | - | - | - | - | - | - | - | - |
| | | *Chaetocladius* | - | - | - | - | - | - | 2.1 | - | - | - | - | - | - | - | - |
| | | Chironomini | - | *0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Chironomus* | 1.7 | - | - | - | - | - | 1.4 | - | - | - | - | - | - | - | - |
| | | *Conchapelopia* | 0.9 | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Corynoneura* | 10.3 | - | - | - | - | - | - | - | 0.9 | - | - | - | 0.8 | 0.9 | - |
| | | *Cricotopus* | 1.7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Cryptochironomus* | - | - | - | - | - | 1.7 | - | - | - | - | - | - | - | 0.9 | - |
| | | *Dicrotendipes* | 0.9 | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - |
| | | *Diplocladius* | - | - | - | 0.8 | - | - | - | 4.5 | - | - | - | - | 1.6 | - | - |
| | | *Eukiefferiella* | - | 0.9 | - | - | - | 0.9 | - | - | 3.7 | 0.9 | - | 4.2 | - | 2.6 | - |
| | | ***Heleniella*** [+] | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Heterotrissocladius* | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - |
| | | *Hydrobaenus* | - | 0.9 | 52.5 | 3.1 | 2.9 | 2.6 | - | - | 26.6 | 11.3 | 2.7 | 6.7 | 6.5 | 14.53 | 3.4 |
| | | *Micropsectra* | - | 1.8 | - | - | - | - | 3.4 | - | - | - | - | - | - | - | - |
| | | *Microtendipes* | - | 1.8 | - | - | - | 0.9 | - | - | - | - | - | - | - | 0.9 | - |
| | | *Odontomesa* | - | - | - | - | - | - | 0.7 | - | - | - | - | - | - | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Orthocladiinae | - | *3.7 | - | - | - | - | - | - | - | - | *3.6 | - | - | - | *1.7 |
| | | *Orthocladius* | - | - | 22 | 3.1 | 10.6 | 2.6 | 4.1 | 0.9 | 7.3 | 5.2 | 0.9 | 4.2 | 1.6 | - | 3.4 |
| | | *Paramerina* | - | - | - | - | - | - | - | - | - | - | 2.7 | - | - | - | - |
| | | *Parachaetocladius* | - | - | - | - | - | - | - | - | - | - | - | 0.8 | 0.8 | - | - |
| | | *Parametriocnemus* | - | 5.5 | - | - | 1.9 | 0.9 | - | - | - | 0.9 | 1.8 | 26.1 | 1.6 | - | - |
| | | *Paraphaenocladius* | - | - | - | - | - | - | - | - | 0.9 | - | 1.8 | - | - | - | 0.9 |
| | | *Phaenopsectra* | - | - | - | - | - | - | - | - | - | - | - | - | 1.6 | - | - |
| | | *Polypedilum* | 0.9 | - | - | - | 1 | - | - | - | - | - | - | - | 0.8 | - | 1.7 |
| | | *Procladius* | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Rheocricotopus* | 9.4 | 1.8 | 1.7 | - | - | 1.7 | - | 1.8 | - | - | 1.8 | 0.8 | 3.3 | - | - |
| | | *Rheosmittia* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | | *Sympotthastia* | - | 4.6 | 1.7 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | Tanypodinae | - | *2.8 | - | - | - | - | *0.7 | - | - | - | - | - | - | - | - |
| | | *Tanytarsus* | 3.4 | 1.8 | - | - | - | - | 4.1 | - | - | - | - | - | - | - | - |
| | | *Thienemanniella* | 13.7 | - | - | - | - | - | - | - | - | - | - | - | 4.9 | - | - |
| | | Thienemannimyia Group | - | - | - | - | *4.8 | *6.9 | - | *1.8 | - | *0.9 | *0.9 | - | - | - | *0.9 |
| | | *Tribelos* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | | *Tvetenia* | - | - | 0.8 | - | - | - | - | 1.8 | - | 0.9 | - | - | 0.8 | - | 0.9 |
| | | *Zavrelimyia* | 2.6 | 6.4 | - | 2.3 | - | 3.4 | 26 | 0.9 | 0.9 | 0.9 | - | - | - | - | 0.9 |
| | Simuliidae | na | *1.7 | *1.8 | - | - | - | *0.9 | - | - | - | - | - | - | - | - | - |
| | | *Prosimulium* | 1.7 | 29.4 | 0.8 | 13.3 | 1.9 | - | - | 1.8 | - | 17.4 | - | 29.4 | 39.8 | 34.2 | 44 |
| | | *Simulium* | 1.7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Stegopterna* | 5.1 | 13.8 | - | 46.1 | 5.8 | 1.7 | - | 2.7 | 10.1 | 3.5 | 0.9 | 9.2 | 19.5 | 31.6 | 21.6 |
| | Tabanidae | *Chrysops* | - | - | 0.8 | - | - | - | - | - | - | - | 0.9 | 0.8 | - | - | - |
| | | *Tabanus* | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Tipulidae | na | - | - | - | - | - | *0.9 | - | - | - | - | *0.9 | - | *0.8 | *0.9 | *0.9 |
| | | *Erioptera* | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - |
| | | *Pilaria* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - |
| | | *Pseudolimnophila* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 |
| | | *Tipula* | - | 0.9 | - | - | 1 | 1.7 | - | 1.8 | 0 | - | - | - | - | - | 0.9 |
| Ephemeroptera | Ameletidae | *Ameletus* | 2.6 | - | - | - | - | - | - | 0.9 | - | - | 0.9 | - | - | - | 0.9 |
| (Mayfly) | Baetidae | *Acerpenna* | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - |
| | Leptophlebiidae | na | - | - | - | *0.8 | - | - | - | - | - | - | - | *0.8 | *0.8 | - | - |
| | | *Leptophlebia* | - | 1.8 | - | 0.8 | 4.8 | 20.7 | 1.4 | 46.4 | - | - | 5.4 | - | - | - | 4.3 |
| Hemiptera | Corixidae | na | - | - | - | - | - | *0.9 | - | - | - | - | - | - | - | - | - |
| (True Bug) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Isopoda | Asellidae | *Caecidotea* | 5.1 | - | - | 0.8 | 1.9 | 3.4 | 2.7 | - | 0.9 | - | 1.8 | - | - | - | - |
| (Aquatic Sow Bug) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Odonata | Aeshnidae | *Aeshna* | - | - | - | - | - | - | 0.7 | - | - | - | - | - | - | - | - |
| (Dragonfly/ | Cordulegastridae | *Cordulegaster* | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - |
| Damselfly) | Corduliidae | *Neurocordulia* | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - |
| | | *Somatochlora* | - | - | - | - | - | 1.7 | 2.1 | - | - | - | - | - | - | - | - |
| Plecoptera | Capniidae | na | - | - | - | - | - | *0.9 | - | *0.9 | *3.7 | - | - | - | *1.6 | - | *4.3 |
| (Stonefly) | | *Allocapnia* | - | - | - | - | - | - | - | - | - | 8.7 | - | - | - | - | - |
| | | *Paracapnia* | - | - | - | - | - | - | - | *1.8 | 17.4 | - | - | - | - | - | - |
| | Nemouridae | na | - | *0.9 | - | *3.9 | *8.7 | - | - | *12.5 | *6.4 | *40.9 | - | *9.2 | *7.3 | *1.7 | *4.3 |
| | | *Amphinemura* | 5.1 | - | - | - | - | 2.6 | 1.4 | 0.9 | 3.7 | - | 29.7 | 0.8 | - | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Ostrocerca* | - | - | - | 10.2 | - | - | - | - | - | - | - | - | 1.6 | - | - |
| | | *Prostoia* | - | 0.9 | - | 2.3 | 28.8 | 5.2 | - | 6.3 | - | - | 9.9 | - | - | - | - |
| | Perlidae | na | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - |
| | | *Perlesta* | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - |
| | Perlodidae | na | *0.9 | - | - | - | - | - | - | - | *4.6 | *1.7 | *0.9 | - | - | 0.9 | - |
| | | *Isoperla* | - | - | - | - | - | - | - | - | - | - | 4.5 | - | - | - | - |
| Trichoptera | Hydropsychidae | *Cheumatopsyche* | - | 1.8 | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 |
| (Caddisfly) | | *Diplectrona*+ | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 33.3 |
| | Limnephilidae | na | *0.9 | - | *0.8 | - | *6.7 | - | - | *0.9 | - | *1.7 | *0.9 | *0.8 | *0.8 | - | - |
| | | *Ironoquia* | 0.9 | - | - | - | - | - | 0.7 | 0.9 | - | - | - | - | 0.8 | 0.9 | - |
| | | *Pycnopsyche* | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Philopotamidae | ***Wormaldia***+ | - | - | - | - | - | - | - | 0.9 | - | - | - | 0.8 | - | - | - |
| | Phryganeidae | *Ptilostomis* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 |
| | Rhyacophilidae | *Rhyacophila* | - | - | - | - | - | - | - | - | - | 1.7 | 0.9 | 0.8 | 0.8 | 0.9 | - |
| | Polycentropodidae | *Polycentropus* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| PHYLUM MOLLUSCA | | | | | | | | | | | | | | | | | |
| Basommatophora | Physidae | *Physa* | 1.7 | 3.7 | 2.5 | - | - | 0.9 | 2.1 | 1.8 | 0.9 | - | - | - | - | - | - |
| (Snail) | Planorbidae | *Menetus* | - | - | 5.9 | - | - | 1.7 | 0.7 | - | - | - | - | - | - | - | - |
| | | *Planorbella* | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Veneroida | Pisidiidae | na | *0.9 | - | - | - | - | - | - | - | - | *0.9 | - | - | *0.8 | - | - |
| (Bivalve) | | *Musculium* | - | - | - | - | - | 6 | 4.8 | - | - | - | 1.8 | 0.8 | - | - | - |
| | | *Pisidium* | - | - | 2.5 | 1.6 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Sphaerium* | - | 1.8 | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - |
| PHYLUM NEMATOMORPHA | | | | | | | | | | | | | | | | | |
| Gordioidea | Gordiidae | na | - | - | - | - | - | - | - | - | - | - | *1.8 | - | - | - | - |
| PHYLUM NEMERTEA | | | | | | | | | | | | | | | | | |
| Hoplonemertea | Tetrastemmatidae | *Prostoma* | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - |

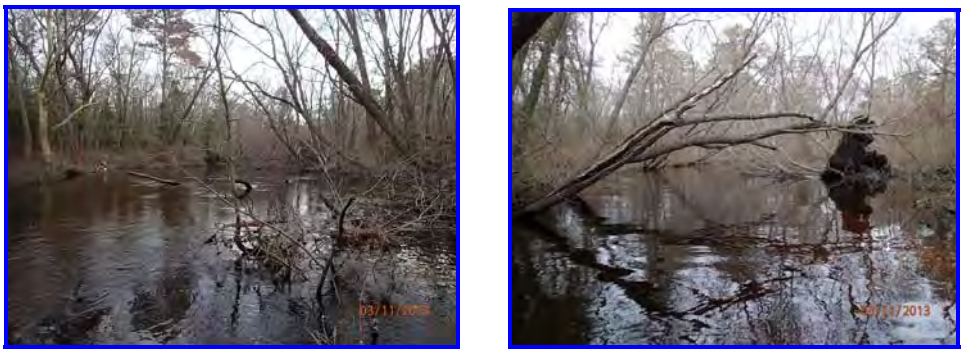
Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

+ Coldwater-preference genera

# *Leonard Pond Run (WIRH-220-S)*

Site WIRH-220-S is located on Leonard Pond Run in the Coastal Plain – eastern shore region of Maryland. It is in the Wicomico River Head watershed in Wicomico County. This site was sampled in 1995 and 2000 to 2014.



Leonard Pond Run in spring 2013.

## ***Land Use/ Land Cover***

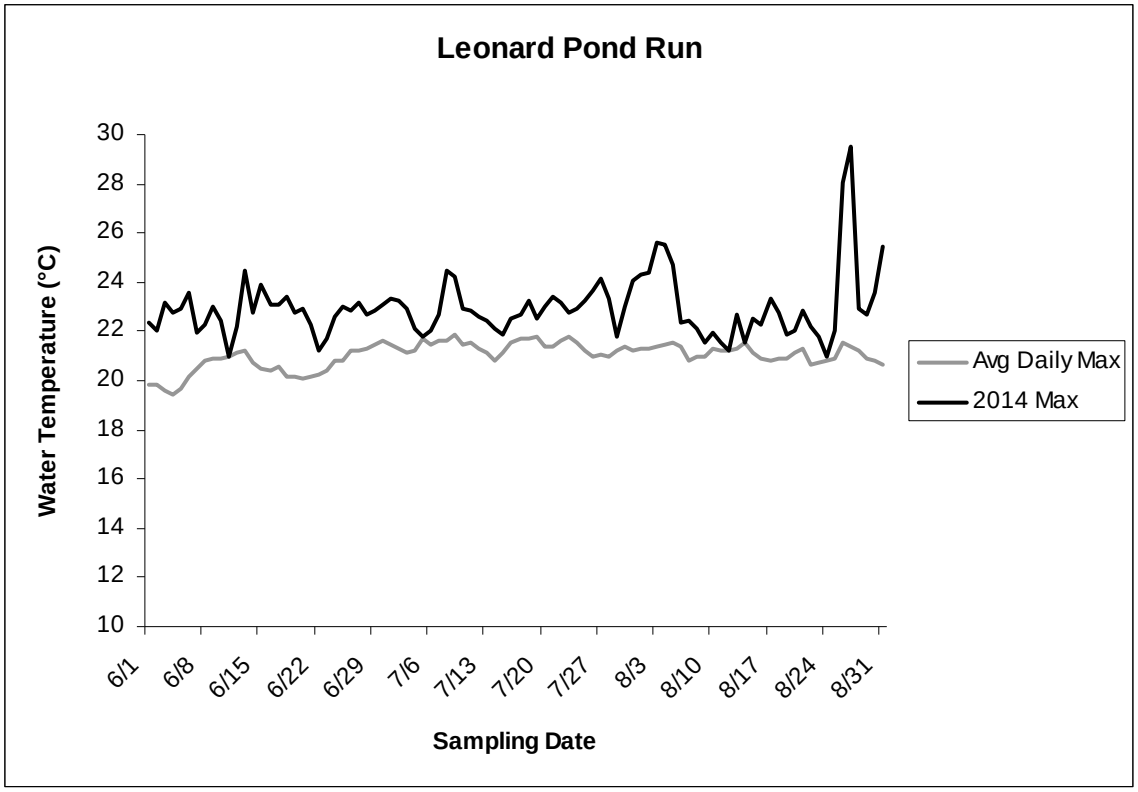
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 34.69 | 26.70 | 22.65 |
| Agriculture | 4.38 | 36.59 | 34.89 |
| Urban | 22.38 | 15.04 | 16.86 |
| Other | 38.54 | 21.67 | 25.60 |

## ***Physical Habitat***

Physical habitat measurements collected at Leonard Pond Run (2000 to 2014). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 19 | 18 | 17 | 16 | 15 | 17 | 18 | 18 | 17 | 17 | 16 | 13 | 17 | 18 | 16 |
| Epifaunal substrate (0-20) | 16 | 16 | 13 | 16 | 13 | 12 | 16 | 14 | 14 | 17 | 15 | 15 | 16 | 16 | 16 |
| Velocity/Depth Diversity (0-20) | 18 | 19 | 15 | 17 | 13 | 14 | 11 | 8 | 9 | 9 | 10 | 6 | 8 | 10 | 10 |
| Pool Quality (0-20) | 17 | 17 | 17 | 16 | 16 | 16 | 17 | 19 | 18 | 17 | 18 | 16 | 15 | 18 | 19 |
| Riffle Quality (0-20) | 15 | 0 | 13 | 16 | 16 | 13 | 12 | 0 | 0 | 6 | 0 | 0 | 9 | 12 | 0 |
| Shading (%) | 87 | 85 | 60 | 80 | 78 | 80 | 85 | 85 | 85 | 80 | 80 | 65 | 75 | 85 | 55 |
| Embeddedness (%) | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 95 | 100 | 100 | 100 | 100 |
| Discharge (cfs) | 39.23 | 20.77 | 13.82 | 31.74 | 18.07 | 39.53 | 12.66 | 12.45 | 9.14 | 11.59 | 7.05 | 5.73 | 6.9 | 20.35 | 13.08 |




The above graph displays the average daily maximum temperatures recorded at Leonard Pond Run. The average was calculated from ten years of data.

***Biology***

*Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 4.14 | 4.71 | 4.43 | 4.14 | 4.43 | 4.71 | 4.43 | 4.71 | 3.86 | 2.43 | 3.57 | 3.57 | 3.86 | 5.00 | 4.71 |
| FIBI | 4.00 | 3.67 | 3.67 | 3.33 | 3.33 | 3.33 | 3.67 | 4.00 | 3.00 | 3.67 | 3.67 | 4.33 | 4.33 | 3.67 | 3.67 |

## *Fish*

Cumulative list of fish species (with abundance) collected in Leonard Pond Run by year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| American eel | 5 | 7 | 15 | 3 | 10 | 1 | 8 | 15 | 17 | 19 | 20 | 25 | 38 | 41 | 41 |
| Black crappie | 1 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bluegill | 27 | 37 | 9 | 31 | 32 | 16 | 9 | 23 | 9 | 52 | 21 | 26 | 9 | 74 | 31 |
| Bluespotted sunfish | - | - | - | - | - | 1 | - | 4 | 2 | - | - | - | - | - | 1 |
| Brown bullhead | - | - | 2 | - | 1 | 1 | - | - | - | 3 | - | 1 | 1 | 2 | - |
| Chain pickerel | 26 | 26 | 17 | 11 | 16 | 4 | 23 | 19 | 18 | 12 | 36 | 18 | 56 | 38 | 38 |
| Creek chubsucker | 12 | 6 | 1 | - | 2 | - | - | 1 | - | - | 1 | 2 | 2 | - | - |
| Eastern mosquitofish | - | - | 1 | - | - | - | - | 1 | - | - | 5 | - | - | - | 3 |
| Eastern mudminnow | 6 | 6 | 19 | 4 | 9 | - | 15 | 5 | 25 | 14 | 6 | 15 | 28 | 4 | 25 |
| Golden shiner | - | - | - | - | 4 | - | - | - | - | - | - | - | - | - | - |
| Largemouth bass | 2 | 6 | 1 | 2 | 8 | 3 | - | 2 | 5 | - | 2 | - | - | 3 | 2 |
| Least brook lamprey | 5 | 2 | 18 | 3 | 19 | 3 | 40 | 28 | 36 | 78 | 5 | 29 | 35 | 42 | 16 |
| Margined madtom | 1 | 1 | 4 | 4 | 5 | 1 | 4 | 1 | 3 | 3 | 5 | 3 | 2 | 3 | 2 |
| Pirate perch | 7 | 16 | 42 | 10 | 17 | 3 | 24 | 17 | 12 | 19 | 14 | 17 | 58 | 20 | 32 |
| Pumpkinseed | 1 | - | - | 17 | 5 | 6 | 14 | 8 | 5 | 2 | 15 | 3 | 6 | 4 | 2 |
| Redbreast sunfish | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| Redfin pickerel | - | - | 2 | - | 1 | 6 | - | - | - | - | - | - | 1 | - | 1 |
| Tadpole madtom | 1 | 4 | 8 | 1 | 3 | - | 1 | - | 1 | - | - | - | - | - | 2 |
| Tessellated darter | 70 | 93 | 220 | 47 | 119 | 21 | 87 | 78 | 128 | 49 | 214 | 78 | 66 | 32 | 85 |
| White perch | 2 | 2 | - | 2 | - | 1 | - | - | - | - | - | - | 8 | - | - |
| Yellow bullhead | 1 | - | 1 | - | 1 | - | - | - | - | - | - | - | 2 | - | 1 |
| Yellow perch | 1 | - | 2 | 9 | 8 | 12 | 5 | 9 | 4 | 1 | 2 | 3 | 3 | 4 | - |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

## *Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in Leonard Pond Run by sampling year.

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Devil crawfish (*Cambarus diogenes*) | A | P | A | A | A | A | P | A | A |
| (*Procambarus sp.*) | P | P | A | P | A | P | P | P | P |
| Spinycheek crayfish (*Orconectes limosus*) | P | P | P | P | P | P | P | P | P |

## *Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in Leonard Pond Run by sampling year.

| *Species* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|
| Eastern elliptio (*Elliptio complanata*) | P | P | P | P | P | A | P | P |
| Northern lance (Elliptio fisheriana) | A | P | A | A | P | P | P | A |

## *Herpetofauna*

Cumulative list of herpetofauna species collected in or near Leonard Pond Run.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | American bullfrog, Cope's gray treefrog, Eastern American toad, Fowler's toad, Gray treefrog, Green treefrog, Northern green frog, Northern spring peeper, Pickerel frog, Southern leopard frog |
| Caudata (Salamanders and Newts) | Eastern red-backed salamander |
| Squamata (Snakes and Lizards) | Common five-linked skink, Northern ring-necked snake, Southern ring-necked snake |
| Testudines (Turtles) | Eastern box turtle, Eastern snapping turtle |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in Leonard Pond Run by sampling year, RA = % Relative Abundance.

| *ORDER* | *FAMILY* | Genus | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | |
| Haplotaxida | Enchytraeidae | na | - | - | - | *1.7 | - | - | - | - | - | - | - | - | - | - | - |
| | Naididae | na | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - |
| Lumbriculida | Lumbriculidae | na | - | *0.9 | - | - | - | - | - | - | *1 | - | - | - | - | - | - |
| Tubificida | Tubificidae | na | - | *0.9 | *1.1 | - | - | - | - | - | *4 | - | - | - | - | - | - |
| | | *Limnodrilus* | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | |
| Amphipoda | na | na | *6.1 | - | - | - | - | - | - | - | - | - | *10.8 | - | - | - | - |
| (Scud) | Crangonyctidae | na | - | - | - | - | - | - | - | - | *2 | - | - | - | - | - | - |
| | | *Crangonyx* | - | 0.9 | - | - | 3 | - | - | 0.8 | 1 | 2.8 | 1 | - | 0.9 | 2.6 | - |
| | | *Synurella* | - | - | - | - | - | - | - | 0.8 | - | - | 2 | - | - | - | 1.8 |
| | Gammaridae | *Gammarus* | 0.9 | 2.6 | 3.2 | 1.7 | 10.9 | 7.1 | 1.8 | 4.2 | 1 | 7.5 | 21.6 | - | 11.9 | 13.9 | 5.5 |
| | Hyalellidae | *Hyalella* | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - |
| Coleoptera | Dytiscidae | na | - | - | - | *0.9 | - | - | - | - | - | - | - | - | - | - | - |
| (Beetle) | | *Neoporus* | 0.9 | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - |
| | Elmidae | *Ancyronyx* | - | - | - | - | - | 0.9 | 1.8 | 0.8 | - | - | - | - | - | 0.9 | 0.9 |
| | | *Dubiraphia* | - | - | - | - | - | - | 1.8 | - | - | - | - | - | 0.9 | - | - |
| | | *Macronychus* | - | 0.9 | - | - | - | - | 2.7 | 0.8 | - | - | - | - | - | - | - |
| | | *Microcylloepus* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 |
| | Gyrinidae | *Dineutus* | - | - | - | 1.7 | 1 | - | - | - | - | - | - | - | - | - | - |
| | | *Gyrinus* | - | - | - | 1.7 | - | - | - | - | - | - | - | - | - | - | - |
| Decapoda | Cambaridae | *Procambarus* | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - |
| Diptera | na | na | - | - | - | *1.7 | - | - | - | - | - | - | - | - | - | - | - |
| (True Fly) | Ceratopogonidae | na | - | - | *1.1 | - | - | - | - | - | *5 | - | - | - | - | - | - |
| | | *Probezzia* | - | - | - | - | - | - | 3.6 | - | 1 | - | - | - | - | - | - |
| | Chironomidae | na | - | - | - | *2.6 | - | - | - | - | *2 | - | - | - | - | - | - |
| | | *Ablabesmyia* | - | - | - | - | - | 0.9 | 3.6 | - | - | 0.9 | - | - | 2.8 | - | - |
| | | *Apsectrotanypus* | - | - | - | - | - | - | 0.9 | - | - | 0.9 | - | - | - | - | - |
| | | *Brillia* | 0.9 | - | - | 1.7 | - | 1.8 | - | 3.3 | 4 | - | 1 | 0.8 | - | 2.6 | 0.9 |
| | | *Chaetocladius* | - | - | - | - | - | - | - | 1.7 | 1 | - | - | - | - | - | - |
| | | Chironomini | - | - | - | - | - | - | - | - | - | - | *1 | - | - | - | *0.9 |
| | | *Cladopelma* | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - |
| | | *Cladotanytarsus* | - | - | 3.2 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Clinotanypus* | - | - | - | - | - | - | 3.6 | - | 1 | - | - | - | - | - | - |
| | | *Conchapelopia* | 2.6 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Corynoneura* | - | - | 1.1 | - | - | - | 0.9 | - | 2 | - | - | 1.6 | - | - | - |
| | | *Cricotopus* | - | - | 6.3 | - | - | - | - | 3.3 | 3 | 0.9 | - | - | 1.8 | - | 0.9 |
| | | *Cryptochironomus* | - | - | 1.1 | - | 1 | - | - | - | - | - | - | - | - | - | 1.8 |
| | | *Diplocladius* | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Endochironomus* | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Eukiefferiella* | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - |

| ORDER | FAMILY | Genus | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Heterotrissocladius* | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - |
| | | *Hydrobaenus* | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Labrundinia* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| | | *Micropsectra* | - | - | - | - | - | - | - | - | 1 | - | - | - | 3.7 | - | - |
| | | *Microtendipes* | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - |
| | | *Natarsia* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| | | Orthocladiinae | *8.7 | *5.1 | *1.1 | *0.9 | - | *1.8 | - | - | - | *0.9 | *1 | - | 0.9 | 2.6 | - |
| | | *Orthocladius* | - | 0.9 | 2.1 | 9.5 | 13.9 | 1.8 | 4.5 | 5.8 | 4 | 2.8 | 2 | 1.6 | - | 0.9 | 4.6 |
| | | *Paracladopelma* | - | - | - | - | - | - | 1.8 | - | - | - | - | - | - | - | 0.9 |
| | | *Parakiefferiella* | - | - | 1.1 | - | 5 | - | - | - | - | - | - | - | 0.9 | - | 0.9 |
| | | *Parametriocnemus* | 0.9 | 0.9 | - | - | - | 0.9 | - | 1.7 | - | 4.7 | - | - | - | - | - |
| | | *Paraphaenocladius* | - | - | - | 27.6 | - | - | - | - | 16.8 | - | - | - | - | - | - |
| | | *Paratanytarsus* | 13 | 12 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Paratendipes* | - | - | - | 0.9 | - | - | - | - | 3 | 0.9 | - | - | 0.9 | - | - |
| | | *Phaenopsectra* | - | - | - | - | - | - | - | - | 2 | 0.9 | - | - | - | - | - |
| | | *Polypedilum* | 15.7 | 5.1 | 18.9 | 6.9 | 18.8 | 6.2 | 2.7 | 5.8 | 1 | 43 | 16.7 | 3.9 | 4.6 | 5.2 | 7.3 |
| | | *Potthastia* | - | - | - | - | - | - | - | - | - | 1.9 | - | - | - | - | - |
| | | *Procladius* | - | - | - | - | - | - | 2.7 | - | 1 | - | - | - | - | - | - |
| | | *Pseudorthocladius* | - | - | - | 3.4 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Rheocricotopus* | 0.9 | 1.7 | 8.4 | 4.3 | 1 | 1.8 | 4.5 | - | 4 | 14 | 2 | 4.7 | 6.4 | 1.7 | 18.3 |
| | | *Rheosmittia* | - | - | 7.4 | 3.4 | 3 | 19.5 | 4.5 | 5 | - | - | - | - | - | - | - |
| | | *Rheotanytarsus* | - | - | - | - | - | - | - | - | - | 3.7 | 2.9 | 67.2 | 7.3 | 1.7 | 5.5 |
| | | *Stempellinella* | - | - | - | - | 1 | - | 3.6 | 1.7 | - | - | 1 | - | - | 13 | 6.4 |
| | | *Symposiocladius* | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - |
| | | Tanypodinae | - | - | - | - | - | - | - | *0.8 | - | - | *2 | - | - | - | *0.9 |
| | | *Tanytarsus* | - | 3.4 | 7.4 | 1.7 | - | - | 0.9 | - | - | - | - | 11.7 | 7.3 | 0.9 | 3.7 |
| | | *Thienemanniella* | - | 2.6 | - | 6 | - | - | 2.7 | 0.8 | 1 | - | - | 0.8 | - | - | 1.8 |
| | | Thienemannimyia Group | - | *0.9 | - | *1.7 | *7.9 | *4.4 | *12.7 | *3.3 | *5.9 | *1.9 | *2 | *3.9 | *8.3 | - | - |
| | | *Tribelos* | - | - | - | - | 1 | - | 4.5 | - | 1 | - | - | - | 1.8 | - | - |
| | | *Tvetenia* | 0.9 | 3.4 | 6.3 | 3.4 | 2 | 5.3 | 3.6 | 7.5 | 1 | - | - | - | 0.9 | 0.9 | - |
| | Empididae | *Chelifera* | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Hemerodromia* | - | - | 1.1 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Neoplasta* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | 0.9 |
| | Ephydridae | na | *0.9 | - | - | - | - | - | - | - | - | - | - | - | - | *0.9 | - |
| | Sciomyzidae | na | - | - | - | *0.9 | - | - | - | - | - | - | - | - | - | - | - |
| | Simuliidae | na | - | *0.1 | *1.1 | - | - | - | - | - | *8.9 | - | - | - | - | - | - |
| | | *Simulium* | 17.4 | - | - | - | - | 3.5 | - | 5.8 | - | 1.9 | 1 | 0.8 | 14.7 | 2.6 | 1.8 |
| | | *Stegopterna* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 |
| | Tabanidae | na | - | - | *1.1 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Chrysops* | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - |
| | Tipulidae | na | - | - | - | - | - | - | - | - | *1 | - | - | - | - | - | - |
| | | *Erioptera* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - |
| | | *Hexatoma* | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Tipula* | - | - | - | 0.9 | - | - | - | - | - | - | - | - | 0.9 | - | - |
| Ephemeroptera (Mayfly) | Baetidae | na | - | - | *1.1 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Acentrella* | 2.6 | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | | *Plauditus* | - | - | - | - | - | - | - | 10 | - | - | - | - | - | - | - |

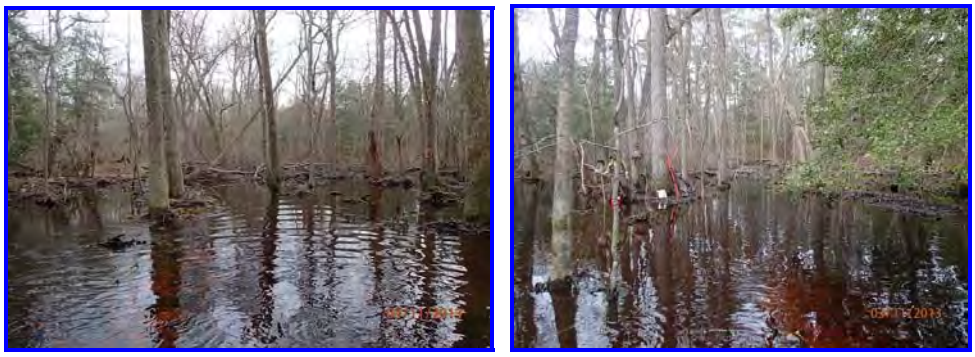
| ORDER | FAMILY | Genus | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ephemerellidae | *Eurylophella* | 15.7 | 24.8 | 12.6 | 2.6 | 1 | 1.8 | 1.8 | 9.2 | 6.9 | - | - | 0.8 | - | 2.6 | 1.8 |
| | Heptageniidae | na | - | *10.3 | - | *0.9 | - | - | *4.5 | - | - | - | - | - | - | - | - |
| | | *Maccaffertium* | - | - | - | - | - | - | - | - | 1 | - | 15.7 | 0.8 | 8.3 | 13.9 | 11 |
| | | *Stenonema* | 4.3 | - | 7.4 | - | 8.9 | 12.4 | - | 10.8 | - | - | - | - | - | - | - |
| | Leptophlebiidae | na | *0.9 | *0.9 | - | - | - | - | *2.7 | - | - | - | - | - | - | - | - |
| | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Isopoda | Asellidae | *Caecidotea* | 1.7 | 0.9 | - | - | - | 4.4 | 1.8 | 0.8 | - | - | - | - | 0.9 | 1.7 | - |
| (Aquatic Sow Bug) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Megaloptera | Corydalidae | *Nigronia* | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Dobsonfly/ | Sialidae | *Sialis* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| Fishfly) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Odonata | Aeshnidae | *Boyeria* | - | - | - | - | 1 | - | - | 1.7 | - | - | - | - | - | - | - |
| (Dragonfly / | Calopterygidae | *Calopteryx* | - | - | - | 1.7 | 1 | - | 1.8 | - | - | 0.9 | - | - | - | - | - |
| Damselfly) | Coenagrionidae | *Argia* | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - |
| | Gomphidae | *Hagenius* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| Plecoptera | Leuctridae | na | - | - | - | - | - | *0.9 | - | - | - | - | - | - | - | - | - |
| (Stonefly) | Perlidae | na | - | - | - | *1.7 | - | *0.9 | - | - | - | - | - | - | *0.9 | - | - |
| | | *Perlesta* | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - | 0.9 | - |
| | Perlodidae | na | - | *3.4 | - | - | *1 | *0.9 | - | - | - | - | - | - | *0.9 | - | - |
| | | *Isoperla* | 2.6 | 4.3 | 4.2 | 3.4 | 9.9 | 2.7 | 0.9 | 1.7 | 1 | - | - | - | 5.5 | 13.9 | 1.8 |
| | Pteronarcyidae | *Pteronarcys* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | Taeniopterygidae | *Taeniopteryx* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Trichoptera | Brachycentridae | *Brachycentrus* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | 0.9 |
| (Caddisfly) | Calamoceratidae | *Heteroplectron* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - |
| | Hydropsychidae | *Cheumatopsyche* | - | 2.6 | 1.1 | 0.9 | 3 | 10.6 | 2.7 | 2.5 | 1 | 0.9 | 10.8 | - | 6.4 | 7.8 | 11.9 |
| | | ***Diplectrona*** + | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - |
| | Lepidostomatidae | *Lepidostoma* | - | 0.9 | - | - | - | 1.8 | - | 6.7 | - | - | 2.9 | - | - | 2.6 | - |
| | Leptoceridae | na | - | - | *1.1 | - | - | *0.9 | - | - | - | - | - | - | - | - | - |
| | | *Ceraclea* | - | - | - | - | - | - | - | - | 1 | 1.9 | - | - | - | - | - |
| | | *Mystacides* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2.8 |
| | | *Oecetis* | - | - | - | - | - | - | 5.5 | - | - | - | 2.9 | - | - | 0.9 | - |
| | | *Triaenodes* | 0.9 | - | - | - | - | - | 0.9 | 0.8 | - | - | - | - | - | - | - |
| | Limnephilidae | na | - | - | - | *0.9 | - | *0.9 | - | - | - | - | - | - | - | - | - |
| | | *Hydatophylax* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | | *Pycnopsyche* | - | - | - | - | 1 | - | - | - | - | - | - | - | - | 1.7 | - |
| | Polycentropodidae | *Polycentropus* | - | - | - | - | 1 | - | 0.9 | - | - | - | - | - | - | - | - |
| | Psychomyiidae | *Lype* | - | - | - | - | 1 | 1.8 | 0.9 | - | 2 | - | - | - | - | 0.9 | 1.8 |
| PHYLUM MOLLUSCA | | | | | | | | | | | | | | | | | |
| Basommatophora | Lymnaeidae | *Pseudosuccinea* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| (Snail) | Physidae | *Physa* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Veneroida | Pisidiidae | na | - | - | - | - | - | - | *0.9 | - | - | *0.9 | - | - | - | - | - |
| (Bivalve) | | *Musculium* | - | - | - | - | 1 | - | 0.9 | - | - | - | - | - | - | - | - |
| PHYLUM PLATYHELMINTHES | | | | | | | | | | | | | | | | | |
| Tricladida | Planariidae | *Girardia* | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus.

# *Millville Creek (NASS-108-S)*

Site NASS-108-S is located on Millville Creek in the Coastal Plain – eastern shore region of Maryland. It is in the Nassawango Creek watershed in Worcester County. This site was sampled in 1997 and 2000 to 2009, 2013 and 2014. The site was not sampled in summer 2010 to 2012.



*Millville Creek in spring 2013.*

## ***Land Use/ Land Cover***

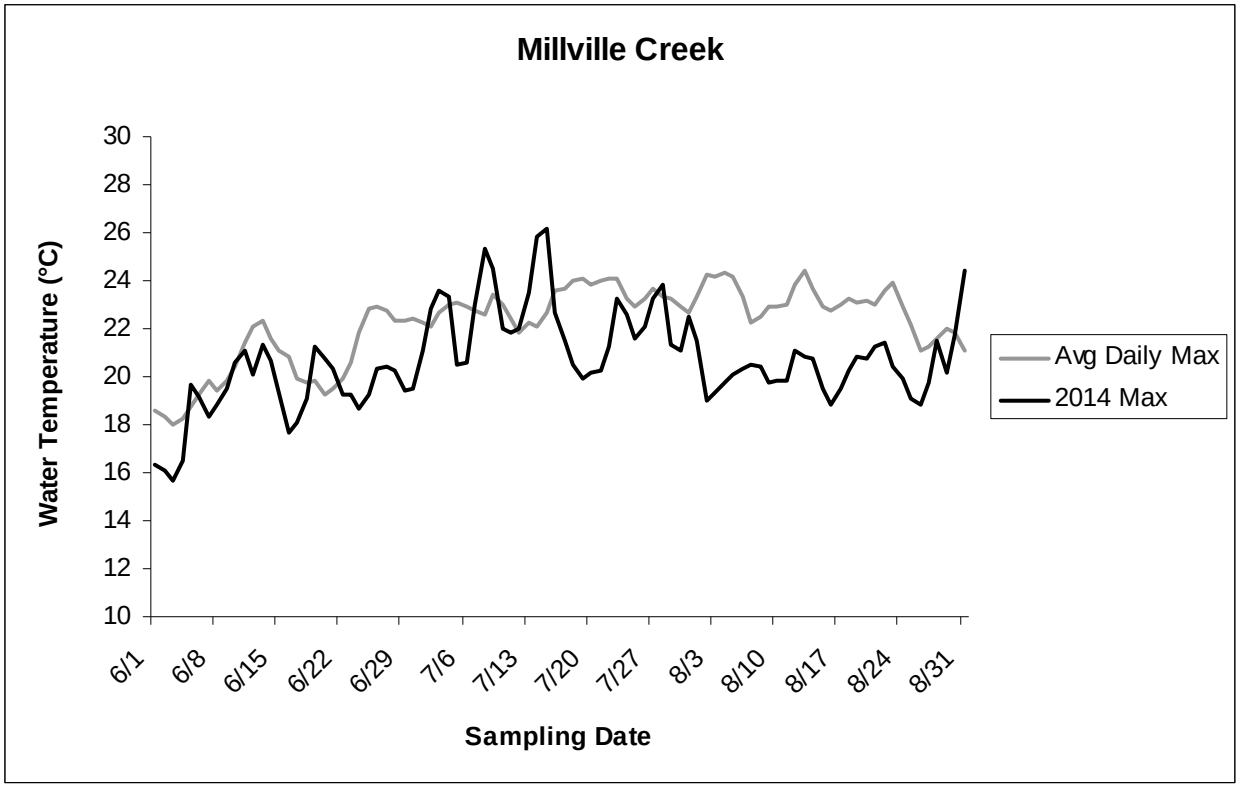
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 31.60 | 8.89 | 6.55 |
| Agriculture | 12.24 | 8.65 | 8.53 |
| Urban | 0.63 | 2.60 | 2.92 |
| Other | 55.53 | 79.86 | 82.00 |

## ***Physical Habitat***

Physical habitat measurements collected at Millville Creek (2000 to 2009, 2013, and 2014). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 17 | 6 | 12 | 11 | 12 | 7 | 15 | 1 | 11 | 14 | | | | 16 | 10 |
| Epifaunal substrate (0-20) | 16 | 6 | 7 | 10 | 13 | 9 | 11 | 2 | 12 | 17 | | | | 16 | 13 |
| Velocity/Depth Diversity (0-20) | 14 | 3 | 7 | 7 | 8 | 5 | 6 | 1 | 6 | 9 | | | | 7 | 8 |
| Pool Quality (0-20) | 14 | 7 | 11 | 15 | 13 | 7 | 15 | 2 | 13 | 15 | | | | 12 | 11 |
| Riffle Quality (0-20) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Not Sampled (dry) | | | 6 | 0 |
| Shading (%) | 99 | 93 | 92 | 90 | 90 | 95 | 98 | 95 | 98 | 90 | | | | 95 | 90 |
| Embeddedness (%) | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | | | | 100 | 100 |
| Discharge (cfs) | 0.92 | 0.00 | 0.00 | 0.57 | 0.71 | 0.00 | 0.17 | 0.00 | 0.05 | 0.07 | | | | 0.24 | 0.06 |




The graph above displays the average daily maximum temperatures recorded at Millville Creek. No data was available for 2012. The average was calculated from five years of data.

## ***Biology***

### *Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 2.14 | 2.43 | 1.00 | 1.57 | 1.86 | 2.43 | 1.57 | 1.86 | 2.14 | 1.57 | 1.29 | 2.14 | 2.71 | 2.43 | 2.14 |
| FIBI | 2.00 | 2.00 | 2.00 | 1.67 | 2.00 | 2.00 | 2.00 | 1.00 | 1.67 | 1.67 | Not Sampled (dry) | Not Sampled (dry) | Not sampled (dry) | 2.33 | 2.67 |

### *Fish*

Cumulative list of fish species (with abundance) collected in Millville Creek by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| American eel | 1 | - | - | - | - | - | - | - | - | - | | | | - | - |
| Banded sunfish | 6 | - | - | 1 | 10 | 30 | 2 | - | - | - | | | | 6 | 1 |
| Bluespotted sunfish | - | - | - | - | - | - | - | - | 1 | - | | Not Sampled (dry) | | - | - |
| Eastern mudminnow | 136 | 1005 | 181 | 165 | 194 | 2184 | 55 | - | 41 | 25 | Not Sampled (dry) | | Not Sampled (dry) | 204 | 94 |
| Mud sunfish | - | 1 | - | 4 | - | 3 | 1 | - | 1 | - | | | | 1 | 9 |
| Pirate perch | 9 | 10 | 5 | 7 | 12 | 79 | - | - | 3 | 3 | | | | 11 | 9 |
| Redfin pickerel | 45 | 8 | 16 | 41 | 8 | 42 | 10 | - | 1 | 8 | | | | 22 | 24 |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant

*Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in Millville Creek by sampling year.

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Devil crawfish (*Cambarus diogenes*) | A | A | A | P | A | A | A | P | A |
| Digger crayfish (*Fallicambarus fodiens*) | A | A | A | P | A | P | A | A | A |
| (*Procambarus sp.*) | P | A | A | P | A | A | A | P | P |

*Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in Millville Creek by sampling year.

| *Species* |
|---|
| None Observed |

*Herpetofauna*

Cumulative list of herpetofauna species collected in or near Millville Creek.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | American bullfrog, Fowler's toad, Gray treefrog, Northern green frog, Northern spring peeper, Pickerel frog, Southern leopard frog, Wood frog |
| Squamata (Snakes and Lizards) | Eastern fence lizard, Eastern wormsnake |
| Testudines (Turtles) | Eastern snapping turtle |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in Millville Creek by sampling year,

RA = % Relative Abundance.

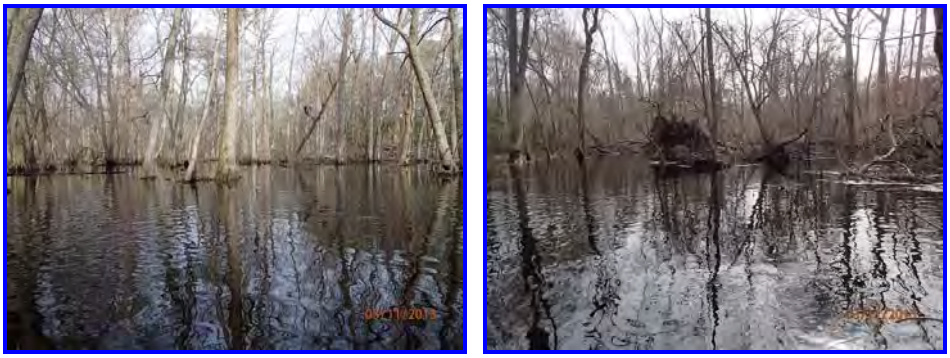
| | | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ORDER | FAMILY | GENUS | RA | RA | RA | RA | RA | RA | RA | RA | RA | RA | RA | RA | RA | RA | RA |
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | |
| Lumbriculida | Lumbriculidae | na | - | *1 | *1.8 | *1 | - | *0.9 | *0.9 | *0.8 | - | - | *3.8 | - | - | *0.9 | *0.9 |
| Haplotaxida | Enchytraeidae | na | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - |
| Tubificida | Tubificidae | na | - | - | - | - | - | *0.9 | - | - | - | *0.9 | - | *1 | - | *0.9 | - |
| | | *Spirosperma* | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | |
| Amphipoda | na | na | - | - | - | - | - | - | - | *4.2 | - | - | - | - | - | - | - |
| (Scud) | Crangonyctidae | na | - | - | - | - | - | *3.5 | - | - | - | - | - | - | - | - | - |
| | | *Crangonyx* | 17.9 | 2.9 | - | - | 28.3 | - | 0.9 | 1.7 | 1 | 10.1 | 11.3 | 5.2 | 3.3 | 13.9 | 2.7 |
| | | *Synurella* | - | 3.9 | - | 1.9 | 6.2 | 1.8 | 2.8 | - | - | 2.8 | - | 1 | 1.7 | 0.9 | 3.5 |
| Coleoptera | Dytiscidae | na | - | - | - | - | - | - | - | - | *1 | - | - | - | - | - | - |
| (Beetle) | | *Neoporus* | - | - | - | - | 2.7 | - | 2.8 | - | - | - | - | - | 2.5 | - | - |
| | Hydrophilidae | *Berosus* | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - |
| | | *Hydrobius* | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | 0.9 |
| Collembola | Isotomidae | *Isotomurus* | - | - | - | - | - | 0.9 | - | - | 1 | - | - | - | - | - | - |
| (Springtail) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Diptera | Ceratopogonidae | na | - | - | - | - | - | *1.8 | - | - | *3 | - | - | - | - | - | - |
| (True Fly) | | *Bezzia* | - | - | - | - | - | - | - | - | - | - | 1.9 | - | 2.5 | 1.9 | - |
| | Chironomidae | *Cantopelopia* | - | - | - | - | - | - | - | - | - | - | 1.9 | - | - | - | - |
| | | *Chironomus* | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Conchapelopia* | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - |
| | | *Corynoneura* | - | 1 | - | 17.1 | - | - | - | - | - | 1.8 | - | 9.4 | 0.8 | 1.9 | 0.9 |
| | | *Cricotopus* | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - |
| | | *Dicrotendipes* | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - |
| | | *Heterotrissocladius* | - | - | 2.7 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Orthocladius* | - | - | - | - | 1.8 | - | 4.6 | - | 10.9 | - | - | - | - | - | - |
| | | Orthocladiinae | *14.2 | *3.9 | - | *4.8 | - | *0.9 | - | - | - | *1.8 | *1.9 | - | *1.7 | - | - |
| | | *Parachaetocladius* | - | - | - | - | - | - | - | - | - | - | - | - | - | 8.3 | - |
| | | *Parachironomus* | - | 5.9 | - | - | - | 1.8 | - | - | - | - | 0.9 | - | - | - | 0.9 |
| | | *Parakiefferiella* | - | - | - | 2.9 | - | 17.5 | - | - | - | - | - | - | - | 2.8 | - |
| | | *Phaenopsectra* | - | - | - | - | - | - | - | 2.5 | - | - | - | - | 2.5 | - | - |
| | | *Polypedilum* | 1.9 | - | - | - | - | 1.8 | - | 0.8 | - | 0.9 | 6.6 | - | 8.3 | 2.8 | - |
| | | *Psectrocladius* | 9.4 | - | - | - | - | - | - | 1.7 | - | - | - | - | - | 15.7 | - |
| | | *Stenochironomus* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | | *Tanytarsus* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | | *Thienemanniella* | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - |
| | | Thienemannimyia Group | - | - | - | - | *0.9 | - | - | - | - | - | - | - | *0.8 | - | - |
| | | *Tribelos* | - | 1 | 2.7 | - | 7.1 | 3.5 | - | - | - | 0.9 | - | 2.1 | - | 0.9 | - |
| | | *Tvetenia* | 0.9 | 5.9 | 9.8 | 2.9 | - | - | 9.3 | - | 42.6 | 2.8 | - | 6.3 | 17.4 | 1.9 | - |
| | | *Zalutschia* | - | 43.1 | 82.1 | 22.9 | 15.9 | 12.3 | 62 | 2.5 | - | 12.8 | 65.1 | 51 | 9.1 | 1.9 | 24.8 |

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Zavrelmyia* | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Simuliidae | na | *2.8 | - | - | - | - | - | - | - | - | - | - | *1 | - | - | - |
| | | *Simulium* | - | 2 | - | 7.6 | - | 36.8 | - | 0.8 | - | - | - | - | - | - | - |
| | | *Stegopterna* | - | 20.6 | - | - | 0.9 | - | 5.6 | 1.7 | 3 | 5.5 | - | 3.1 | 2.5 | 11.1 | 27.4 |
| | Tabanidae | *Chrysops* | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - |
| | Tipulidae | na | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - |
| | | *Erioptera* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - |
| | | *Hexatoma* | 0.9 | - | - | - | - | - | - | - | 2 | - | - | - | - | 3.7 | - |
| | | *Ormosia* | - | - | - | - | - | - | - | - | - | 0.9 | - | 1 | - | - | - |
| Isopoda | Asellidae | *Caecidotea* | 47.2 | 2 | - | 1 | 30.1 | 12.3 | 8.3 | 79 | 17.8 | 16.5 | 2.8 | - | 36.4 | 24.1 | 12.4 |
| (Aquatic Sow Bug) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Odonata | Aeshnidae | *Aeshna* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| (Dragonfly/Damselfly) | | | | | | | | | | | | | | - | - | - | - |
| Plecoptera | Nemouridae | na | - | *2 | - | *18.1 | *4.4 | - | *2.8 | - | *16.8 | - | *0.9 | *15.6 | *7.4 | *1.9 | *11.5 |
| (Stonefly) | | *Amphinemura* | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - |
| | | *Ostrocerca* | - | - | - | - | - | - | - | - | - | - | - | - | 1.7 | 1.9 | 8 |
| | | *Prostoia* | 3.8 | - | - | 18.1 | - | 1.8 | - | - | - | 41.3 | - | - | - | - | - |
| Trichoptera | Limnephilidae | na | - | *2.9 | *0.9 | - | - | - | - | - | *1 | - | - | - | - | - | *2.7 |
| (Caddisfly) | | *Ironoquia* | - | - | - | 1 | - | 0.9 | - | 0.8 | - | - | - | - | - | 1.9 | 3.5 |
| | Polycentropodidae | *Polycentropus* | 0.9 | - | - | 1 | - | - | - | - | - | - | - | 1 | - | - | - |
| | Uenoidae | *Neophylax* | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - |
| PHYLUM PLATYHELMINTHES | | | | | | | | | | | | | | | | | |
| Tricladida | Dugesiidae | *Cura* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Flatworm) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).
* Taxa not identified to genus.

# *Nassawango Creek (NASS-302-S)*

Site NASS-302-S is located on Nassawango Creek in the Coastal Plain – eastern shore region of Maryland. It is in the Nassawango Creek watershed in Worcester County. This site was sampled in 2001 to 2014.



*Nassawango Creek in spring 2013.*

## ***Land Use/ Land Cover***

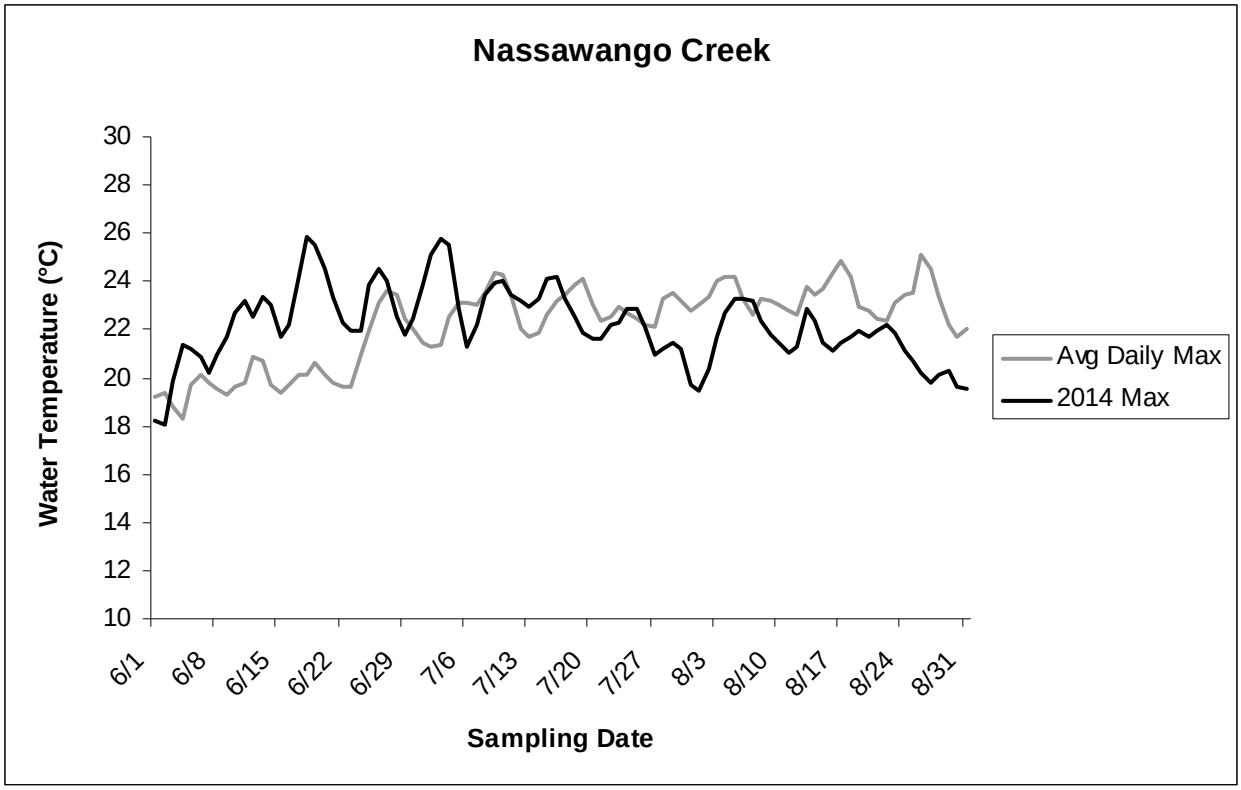
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 7.81 | 18.77 | 16.46 |
| Agriculture | 11.76 | 21.38 | 21.91 |
| Urban | 1.04 | 4.82 | 4.92 |
| Other | 79.38 | 55.02 | 56.71 |

## ***Physical Habitat***

Physical habitat measurements collected at Nassawango Creek (2001 to 2014). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 19 | 16 | 16 | Not Sampled (high flow conditions) | 17 | 18 | 17 | 14 | 14 | 14 | 12 | 18 | 18 | 15 |
| Epifaunal substrate (0-20) | 18 | 14 | 13 | | 12 | 12 | 16 | 15 | 14 | 16 | 12 | 15 | 17 | 14 |
| Velocity/Depth Diversity (0-20) | 8 | 10 | 8 | | 9 | 10 | 6 | 8 | 7 | 9 | 6 | 6 | 9 | 9 |
| Pool Quality (0-20) | 19 | 17 | 17 | | 18 | 19 | 17 | 17 | 18 | 18 | 16 | 19 | 18 | 19 |
| Riffle Quality (0-20) | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Shading (%) | 80 | 89 | 85 | | 80 | 75 | 80 | 65 | 70 | 75 | 80 | 70 | 75 | 50 |
| Embeddedness (%) | 100 | 100 | 100 | | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Discharge (cfs) | 8.91 | 0.87 | 12.88 | | 23.94 | 2.74 | 0.31 | 0.00 | 1.01 | 0.11 | 0.00 | 0.00 | 1.35 | 0.45 |




The graph above displays the average daily maximum temperatures recorded at Nassawango Creek. No data was available for 2013. The average was calculated from three years of data.

***Biology***

*Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 3.57 | 5.00 | 4.43 | 3.57 | 4.14 | 5.00 | 4.43 | 1.86 | 4.43 | Not Sampled (high flow) | 3.29 | 3.86 | 4.14 | 4.71 |
| FIBI | 4.67 | 4.67 | 4.67 | Not Sampled (high flow) | 4.33 | 4.33 | 4.67 | 4.67 | 4.67 | 4.33 | 4.33 | 3.33 | 5 | 5.00 |

## *Fish*

Cumulative list of fish species (with abundance) collected in Nassawango Creek by sampling year. Fish were not sampled during 2004 due to high flow conditions.

| *Species* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| American eel | 31 | 58 | 52 | | 18 | 37 | 102 | 41 | 27 | 25 | 39 | 17 | 86 | 44 |
| Banded sunfish | 11 | 7 | 35 | | 34 | 35 | 21 | 2 | 1 | 15 | 3 | 1 | 11 | 9 |
| Black crappie | - | - | 1 | | - | - | - | - | - | - | - | 3 | - | - |
| Bluegill | 1 | 8 | 3 | | - | - | - | 5 | 1 | 3 | 20 | 3 | 16 | 4 |
| Bluespotted sunfish | 17 | 12 | 4 | | 3 | 25 | 17 | 6 | 9 | 3 | 5 | 9 | 3 | 17 |
| Brown bullhead | - | 2 | 1 | | 4 | 12 | 11 | 8 | 7 | 16 | 3 | 4 | 15 | 9 |
| Chain pickerel | 17 | 6 | 10 | | 1 | 9 | 5 | 5 | 4 | 5 | 11 | 1 | 16 | 4 |
| Creek chubsucker | 16 | 18 | 35 | | 19 | 24 | 23 | 23 | 39 | 100 | 17 | - | 71 | 54 |
| Eastern mudminnow | 25 | 60 | 9 | | 18 | 8 | 10 | 9 | 29 | 7 | 17 | 36 | 93 | 20 |
| Golden shiner | 117 | 88 | 96 | | 69 | 67 | 132 | 51 | 60 | 208 | 9 | 5 | 98 | 59 |
| Largemouth bass | - | - | 1 | Not sampled (high flow conditions) | - | - | - | - | 1 | - | - | - | - | - |
| Longnose Gar | - | - | - | | - | - | - | 1 | - | - | - | - | - | - |
| Least brook lamprey | - | 1 | 5 | | - | - | - | - | - | - | - | - | - | - |
| Margined madtom | - | 1 | 1 | | 1 | 1 | 20 | 5 | 6 | - | - | - | - | - |
| Mud Sunfish | - | - | - | | - | - | - | - | - | 1 | - | - | - | - |
| Pirate perch | 35 | 68 | 35 | | 9 | 46 | 59 | 49 | 90 | 33 | 11 | 18 | 140 | 113 |
| Pumpkinseed | 7 | 14 | 9 | | 9 | 12 | 18 | 3 | 12 | 29 | 7 | 1 | 27 | 4 |
| Redbreast sunfish | 1 | 1 | 6 | | 1 | - | - | - | 3 | - | - | - | 2 | - |
| Redfin pickerel | 17 | 12 | 34 | | 32 | 5 | 18 | 20 | 51 | 23 | 6 | 2 | 56 | 71 |
| Swamp darter | - | - | - | | - | 1 | 19 | 11 | 11 | 5 | 1 | 2 | 2 | 4 |
| Tadpole madtom | 7 | 9 | - | | - | 17 | 24 | 8 | 2 | 8 | 10 | 3 | 19 | 51 |
| Tessellated darter | 1 | 4 | - | | - | 1 | 5 | 4 | 2 | - | - | 1 | - | 9 |
| White crappie | - | - | - | | - | - | 1 | - | - | - | - | - | - | - |
| Yellow bullhead | 1 | 1 | - | | 1 | 5 | 7 | 4 | 3 | 6 | 1 | 6 | - | 6 |
| Yellow perch | 15 | 33 | 7 | | 4 | 9 | 36 | 17 | 8 | - | - | - | 4 | - |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

## *Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in Nassawango Creek by sampling year.

| *Parameter* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Spinycheek crayfish (*Orconectes limosus*) | P | P | A | P | P | A | A | A | A |
| (*Procambarus sp.*) | P | P | A | P | P | P | P | P | P |

## *Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in Nassawango Creek by sampling year.

| *Species* |
|---|
| None Observed |

## *Herpetofauna*

Cumulative list of herpetofauna species collected in or near Nassawango Creek.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | American bullfrog, Eastern American toad, Fowler's toad, Gray treefrog, New Jersey chorus frog, Northern green frog, Northern spring peeper, Pickerel frog, Southern leopard frog |
| Squamata (Snakes and Lizards) | Common five-lined skink, Northern black racer, Northern watersnake |
| Testudines (Turtles) | Eastern box turtle, Eastern snapping turtle, Stinkpot |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in Nassawango Creek by sampling year, RA = % Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | |
| Haplotaxida | Enchytraeidae | na | *3.8 | - | - | - | - | - | - | *9.8 | - | na | - | - | *3.8 | - |
| Lumbriculida | Lumbriculidae | na | *12.3 | - | - | - | *1.1 | - | *2.8 | - | - | na | - | - | *7 | - |
| Tubificida | Tubificidae | na | *7.5 | - | *0.8 | - | - | - | - | - | - | na | - | - | - | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | |
| Amphipoda | Crangonyctidae | *Crangonyx* | 6.6 | 1 | - | 3.6 | - | 2.8 | - | 3.9 | 3.9 | na | - | 2.8 | 9.5 | 0.9 |
| (Scud) | | *Stygobromus* | - | - | - | - | - | - | - | 1 | - | na | - | - | - | - |
| | | *Synurella* | - | - | - | 2.4 | - | - | - | - | - | na | - | - | - | - |
| | Gammaridae | *Gammarus* | - | - | - | - | - | - | - | - | - | na | 2.9 | - | - | - |
| | Hyallelidae | *Hyalella* | - | - | - | - | - | 1.9 | 5.7 | - | - | na | - | 3.7 | 1 | 0.9 |
| Coleoptera | Dytiscidae | *na* | - | - | - | - | - | - | - | - | *1.9 | na | - | - | - | - |
| (Beetle) | | *Neoporus* | - | 1 | - | 6 | 1.1 | 10.2 | 0.9 | - | - | na | 14.4 | 3.7 | 4.8 | - |
| | Elmidae | *Ancyronyx* | - | - | - | - | - | 0.9 | - | - | - | na | - | - | - | - |
| | | *Dubiraphia* | - | 3.8 | - | - | - | 2.8 | - | - | - | na | 1 | - | 1 | - |
| | | *Stenelmis* | - | - | - | - | - | - | - | - | - | na | 1 | - | - | - |
| | Gyrinidae | *Dineutus* | - | - | - | - | - | - | - | - | - | na | - | 0.9 | - | - |
| | Hydrophilidae | *Tropisternus* | - | - | - | - | - | - | - | - | - | na | - | 1.8 | - | - |
| | Scirtidae | na | - | - | - | - | - | - | - | - | - | na | - | - | 1.9 | - |
| Decapoda | Cambaridae | na | - | - | - | - | - | *0.9 | - | - | - | na | - | - | - | - |
| | (Crayfish) | | - | - | - | - | - | - | - | - | - | na | - | - | - | - |
| | Palaemonidae | *Palaemonetes* | - | - | - | 1.2 | - | 6.5 | - | - | 1 | na | - | - | - | - |
| | (Shrimp) | | - | - | - | - | - | - | - | - | - | na | - | - | - | - |
| Diptera | Ceratopogonidae | na | - | - | *0.8 | - | - | - | - | *33.3 | - | na | - | - | - | - |
| (True Fly) | | *Bezzia* | - | - | - | - | - | 0.9 | - | - | - | na | 2.9 | - | - | - |
| | Chironomidae | *Ablabesmyia* | - | 5.7 | 1.6 | - | 10.1 | 0.9 | 32.1 | - | - | na | 1.9 | 0.9 | - | 1.8 |
| | | Chironomini | - | - | - | - | *1.1 | - | - | - | - | na | *1.9 | - | - | - |
| | | *Chironomus* | - | - | - | 2.4 | - | - | - | - | - | na | - | - | - | - |
| | | *Corynoneura* | - | - | - | - | - | - | - | 2 | - | na | - | - | 1 | - |
| | | *Dicrotendipes* | - | - | - | - | - | - | - | - | 5.8 | na | 1.9 | 6.4 | 2.9 | - |
| | | *Hydrobaenus* | - | - | - | - | - | - | - | - | - | na | - | - | 1.0 | - |
| | | *Larsia* | - | 5.7 | - | - | - | - | - | - | - | na | 2.9 | - | - | - |
| | | *Limnophyes* | 0.9 | - | - | - | - | - | - | - | 2.9 | na | - | 0.9 | - | - |
| | | *Micropsectra* | - | - | - | - | 13.5 | 0.9 | - | - | - | na | - | - | 1 | - |
| | | *Microtendipes* | - | 1 | - | - | - | - | - | - | - | na | - | - | - | - |
| | | *Natarsia* | - | 8.6 | - | - | - | - | - | - | - | na | - | - | 1 | - |
| | | Orthocladiinae | - | - | *1.6 | - | *2.2 | - | - | *2.9 | - | na | *2.9 | - | - | - |
| | | *Orthocladius* | - | - | 7.4 | 4.8 | - | 8.3 | 1.9 | - | 4.9 | na | 51 | 12.8 | 1 | - |
| | | *Parakiefferiella* | - | - | - | - | - | - | - | - | - | na | 1 | - | - | - |
| | | *Parametriocnemus* | - | - | - | - | - | 4.6 | - | - | 1 | na | - | - | 1 | 1.8 |
| | | *Paraphaenocladius* | - | - | 2.5 | - | - | 0.9 | - | 2 | - | na | 1 | - | 1.9 | - |
| | | *Paratanytarsus* | - | - | - | 1.2 | - | - | - | - | - | na | - | 0.9 | - | - |
| | | *Phaenopsectra* | - | 1 | 0.8 | 1.2 | - | - | - | - | 5.8 | na | - | - | - | - |
| | | *Polypedilum* | - | - | 0.8 | - | - | - | 0.9 | - | 1 | na | - | 5.5 | - | - |

| ORDER | FAMILY | GENUS | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Potthastia* | - | - | - | - | - | - | - | - | - | na | 1 | - | - | - |
| | | *Procladius* | 0.9 | - | - | - | - | - | - | - | 2.9 | na | - | - | - | - |
| | | *Psectrocladius* | - | - | - | - | - | - | - | - | - | na | 1 | - | - | - |
| | | *Pseudosmittia* | - | - | - | - | - | - | 2.8 | - | - | na | - | - | - | - |
| | | *Rheocricotopus* | - | - | 4.1 | - | - | - | - | - | - | na | - | - | - | - |
| | | *Rheosmittia* | - | 1.9 | - | - | 7.9 | - | - | - | - | na | - | - | - | - |
| | | *Rheotanytarsus* | - | - | - | - | - | - | - | - | 1.9 | na | - | - | - | 0.9 |
| | | *Stempellinella* | - | 1 | - | - | - | - | - | - | - | na | 1 | - | 1 | - |
| | | *Stenochironomus* | - | 1 | - | - | - | - | - | - | - | na | - | - | - | 2.7 |
| | | Tanypodinae | - | *12.4 | *1.6 | - | - | - | - | - | *22.3 | na | *1 | *0.9 | *1.9 | - |
| | | Tanytarsini | - | - | - | - | *1.1 | *0.9 | - | - | - | na | - | - | - | - |
| | | *Tanytarsus* | - | 4.8 | 13.9 | - | 10.1 | - | 3.8 | - | 6.8 | na | 1 | - | - | 0.9 |
| | | *Thienemanniella* | - | - | - | - | - | - | 0.9 | - | - | na | - | 1.8 | - | - |
| | | Thienemannimyia Group | - | - | *4.9 | *13.1 | *11.2 | - | *3.8 | - | *5.8 | na | - | - | *1 | *1.8 |
| | | *Tribelos* | - | 1 | - | 1.2 | - | 1.9 | 3.8 | - | - | na | - | - | 1.9 | 6.3 |
| | | *Tvetenia* | - | - | - | - | - | - | - | - | - | na | - | 11.9 | 5.7 | - |
| | | *Unniella* | - | 6.7 | - | - | - | 13.9 | - | - | 5.8 | na | 1 | - | - | - |
| | | *Zalutschia* | - | - | - | 1.2 | - | 1.9 | - | - | - | na | - | 0.9 | - | - |
| | | *Zavrelimyia* | 1.9 | - | - | 3.6 | - | 0.9 | - | - | - | na | - | - | - | 0.9 |
| | Dolichopodidae | na | - | - | - | - | - | - | - | *1 | - | na | - | - | - | - |
| | Empididae | *Hemerodromia* | - | - | - | - | 1.1 | - | - | - | - | na | - | - | - | - |
| | Ephydridae | na | - | - | - | - | - | - | - | *1 | - | na | - | - | - | - |
| | | *Pseudolimnophila* | - | - | - | - | - | - | - | - | - | na | - | - | 1.0 | - |
| | Simuliidae | na | - | - | - | - | - | - | - | *1 | - | na | - | - | - | - |
| | | *Cnephia* | - | - | - | - | - | - | - | 1 | - | na | - | 1.8 | - | - |
| | | *Prosimulium* | - | - | - | - | - | - | - | 5.9 | - | na | - | 1.8 | 3.8 | - |
| | | *Simulium* | - | - | 28.7 | - | - | - | - | - | - | na | - | 10.1 | 3.8 | - |
| | | *Stegopterna* | - | - | - | - | - | - | - | 2 | 1.9 | na | - | 9.2 | 7.6 | 20.5 |
| | Tabaninae | *Tabanus* | - | - | - | - | - | - | - | - | - | na | - | - | 1.0 | - |
| | Tipulidae | na | - | - | - | *1.2 | - | *0.9 | - | - | - | na | - | - | - | - |
| | | *Hexatoma* | - | - | - | - | - | - | - | - | - | na | - | - | 1.0 | - |
| | | *Limonia* | - | - | - | - | 1.1 | - | - | - | - | na | - | - | - | - |
| | | *Ormosia* | - | - | - | - | - | - | - | 1 | - | na | - | - | - | - |
| Ephemeroptera | Ephemerellidae | na | - | - | - | - | - | *0.9 | - | - | *1 | na | - | - | - | - |
| (Mayfly) | | *Eurylophella* | 3.8 | 6.7 | 0.8 | - | 2.2 | - | 2.8 | - | - | na | - | - | - | - |
| | Heptageniidae | *Maccaffertium* | - | - | - | - | - | - | - | - | - | - | - | - | - | 2.7 |
| | | *Stenacron* | - | - | - | - | - | - | - | - | 1 | na | - | - | - | - |
| | | *Stenonema* | - | - | 4.1 | - | 3.4 | - | 6.6 | - | - | na | - | - | - | - |
| | Leptophlebiidae | na | - | *29.5 | *13.1 | - | - | *0.9 | *0.9 | - | *4.9 | na | *1 | *12.8 | - | *0.9 |
| | | *Leptophlebia* | 47.2 | - | 1.6 | 38.1 | - | 22.2 | - | - | - | na | - | - | 4.8 | 43.8 |
| Hemiptera | Nepidae | na | - | - | - | - | - | - | *0.9 | - | - | na | - | - | - | - |
| (True Bug) | Notonectidae | *Notonecta* | - | - | - | - | - | 0.9 | - | - | - | na | - | - | - | - |
| Isopoda | Asellidae | *Caecidotea* | 8.5 | - | 4.9 | 4.8 | 28.1 | 1.9 | 7.5 | 31.4 | 2.9 | na | - | 4.6 | 26.7 | 2.7 |
| (Aquatic Sow Bug) | | *Lirceus* | - | 1 | - | - | - | - | - | - | - | na | - | - | - | - |
| Odonata | Aeshnidae | *Boyeria* | | 1 | - | - | - | - | - | - | - | na | - | - | - | - |
| (Dragonfly/Damselfly) | | *Nasiaeschna* | - | - | - | 1.2 | - | - | - | - | - | na | - | 0.9 | - | - |
| | Corduliidae | *Somatochlora* | - | - | - | - | - | - | - | - | 1 | na | - | - | - | - |

| ORDER | FAMILY | GENUS | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coenagrionidae | na | - | *1.9 | - | - | - | - | - | - | - | na | - | - | - | - |
| | | *Argia* | - | - | - | - | - | - | - | - | - | na | 1 | - | - | - |
| | | *Ischnura* | - | - | - | - | - | - | - | - | - | na | - | 1.8 | - | - |
| | Gomphidae | *Gomphus* | - | - | - | - | - | - | 1.9 | - | - | na | - | - | - | - |
| | Libellulidae | na | - | - | - | - | - | - | - | *1 | - | na | - | - | - | - |
| Plecoptera | Perlidae | na | - | - | - | - | - | - | - | - | - | na | - | - | 2.9 | - |
| (Stonefly) | Taeniopterygidae | *Taeniopteryx* | - | - | - | 4.8 | - | - | - | - | 6.8 | na | - | 0.9 | - | 1.8 |
| Trichoptera | Hydropsychidae | *Cheumatopsyche* | - | - | 0.8 | - | - | - | - | - | - | na | - | - | - | 0.9 |
| (Caddisfly) | Leptoceridae | *Oecetis* | - | 1 | - | - | - | - | - | - | - | na | - | - | - | - |
| | | *Triaenodes* | - | 1 | - | - | - | 4.6 | 1.9 | - | - | na | - | - | - | 3.6 |
| | Limnephilidae | na | - | *1 | - | - | - | *1.9 | - | - | *1.9 | na | - | - | - | - |
| | | *Ironoquia* | - | - | 2.5 | - | - | - | - | - | 1.9 | na | - | - | - | - |
| | | *Limnephilus* | - | - | - | 1.2 | - | - | - | - | - | na | 1 | - | 1 | - |
| | | *Platycentropus* | - | - | - | - | - | - | 0.9 | - | - | na | - | - | - | - |
| | | *Pycnopsyche* | 5.7 | - | 1.6 | 2.4 | - | - | 0.9 | - | 1 | na | - | - | - | 1.8 |
| | Phryganeidae | *Ptilstomis* | 0.9 | - | - | - | 1.1 | - | - | - | - | na | - | - | - | - |
| | Polycentropodidae | *Nyctiophylax* | - | - | - | - | - | 0.9 | - | - | - | na | - | - | - | - |
| | | *Polycentropus* | - | 1 | - | - | - | 0.9 | - | - | - | na | 1 | - | - | - |
| PHYLUM MOLLUSCA | | | | | | | | | | | | | | | | |
| Basommatophora | Physidae | *Physa* | - | - | - | - | - | 0.9 | - | - | - | na | - | - | - | - |
| (Snail) | Planorbidae | *Menetus* | - | - | - | - | - | - | - | - | 1 | na | - | - | 1.9 | 0.9 |
| Neotaenioglossa | Hydrobiidae | na | - | - | - | - | - | - | *6.6 | - | - | na | *1 | - | - | - |
| (Snail) | | | - | - | - | - | - | - | - | - | - | na | - | - | - | - |
| Architaenioglossa | Viviparidae | *Campeloma* | - | - | - | - | - | - | 7.5 | - | 1 | na | - | - | - | - |
| (Snail) | | | - | - | - | - | - | - | - | - | - | na | - | - | - | - |
| Veneroida | Pisidiidae | na | - | - | - | - | - | *0.9 | - | - | - | na | - | - | - | - |
| (Bivalve) | | *Musculium* | - | - | - | 4.8 | 3.4 | - | 1.9 | - | - | na | - | - | - | 0.9 |
| PHYLUM NEMERTEA | | | | | | | | | | | | | | | | |
| Hoplonemertea | Tetrastemmatidae | *Prostoma* | - | - | - | - | - | - | - | - | - | na | 2.9 | - | - | - |
| PHYLUM PLATYHELMINTHES | | | | | | | | | | | | | | | | |
| Tricladida | Dugesiidae | *Cura* | - | - | 0.8 | - | - | - | - | - | - | na | - | - | - | - |
| (Flatworm) | | | - | - | - | - | - | - | - | - | - | na | - | - | - | - |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).
* Taxa not identified to genus.

# *Unnamed Tributary to Skeleton Creek (UPCK-113-S)*

Site UPCK-113-S is located on an unnamed tributary to Skeleton Creek in the Coastal Plain – eastern shore region of Maryland. It is in the Upper Choptank River watershed in Caroline County. This site was sampled in 1996 and 2000 to 2014. The site was not sampled in summer 2005 due to landowner permission issues.


*Skeleton Creek in the spring 2013.*

## ***Land Use/ Land Cover***

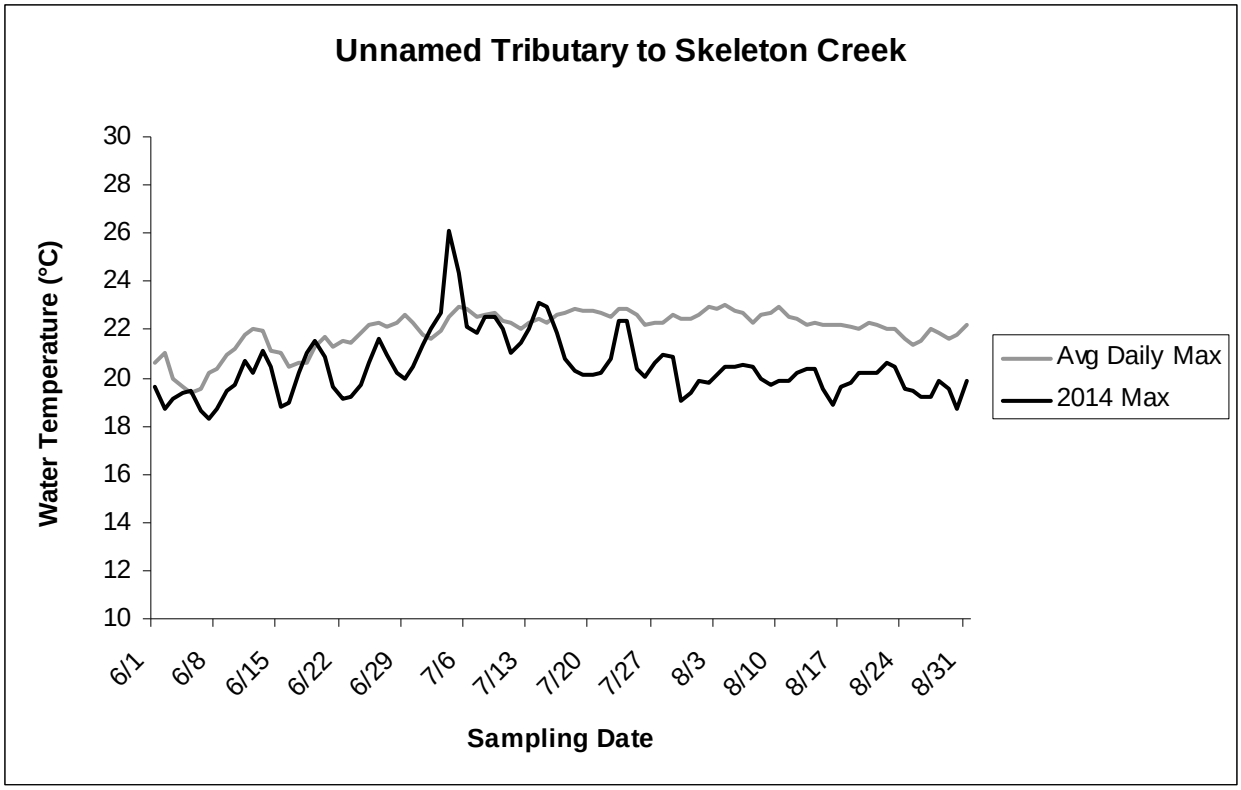
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 38.31 | 23.90 | 21.96 |
| Agriculture | 2.93 | 40.08 | 40.53 |
| Urban | 0.11 | 3.77 | 3.82 |
| Other | 58.66 | 32.25 | 33.69 |

## ***Physical Habitat***

Physical habitat measurements collected at the unnamed tributary to Skeleton Creek (2000 to 2004, 2006 to 2014). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 17 | 11 | 13 | 11 | 12 | | 16 | 14 | 8 | 11 | 17 | 10 | 17 | 16 | 16 |
| Epifaunal substrate (0-20) | 17 | 9 | 13 | 11 | 11 | | 11 | 10 | 10 | 13 | 14 | 10 | 15 | 15 | 14 |
| Velocity/Depth Diversity (0-20) | 14 | 10 | 8 | 13 | 10 | | 10 | 7 | 7 | 8 | 13 | 7 | 6 | 9 | 9 |
| Pool Quality (0-20) | 14 | 12 | 12 | 14 | 13 | Not Sampled | 14 | 12 | 12 | 13 | 17 | 11 | 10 | 18 | 16 |
| Riffle Quality (0-20) | 7 | 8 | 7 | 8 | 9 | | 3 | 6 | 6 | 7 | 10 | 3 | 6 | 8 | 3 |
| Shading (%) | 96 | 97 | 96 | 95 | 95 | | 98 | 85 | 95 | 85 | 90 | 85 | 90 | 90 | 75 |
| Embeddedness (%) | 40 | 40 | 15 | 50 | 65 | | 40 | 30 | 70 | 45 | 75 | 30 | 80 | 75 | 70 |
| Discharge (cfs) | 1.00 | 0.04 | 0.02 | 0.04 | 0.04 | | 0.06 | 0.00 | 0.03 | 0.05 | 0.03 | 0.02 | 0.02 | 0.17 | 0.07 |




The above graph displays the average daily maximum temperatures recorded at the unnamed tributary to Skeleton Creek. The average was calculated from eleven years of data.

***Biology***

*Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 3.00 | 4.43 | 3.86 | 4.14 | 4.14 | 3.86 | 3.00 | 3.86 | 2.43 | 3.29 | 3.29 | 2.14 | 3.00 | 3.29 | 2.43 |
| FIBI | 2.00 | 2.67 | 3.33 | 2.33 | 4.00 | Not Sampled | 3.67 | 3.00 | 3.33 | 3.00 | 3.00 | 4.00 | 2.67 | 2.67 | 2.67 |

*Fish*

Cumulative list of fish species (with abundance) collected in the unnamed tributary to Skeleton Creek by sampling year.

| *Species* | *1996* | *2000* | *2001* | *2002* | *2003* | *2004* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| American eel | 10 | 13 | 11 | 8 | 4 | 6 | 4 | 3 | 8 | 3 | 4 | 3 | 12 | 10 | 11 |
| Bluegill | - | 4 | - | - | 5 | 2 | 1 | 3 | 12 | 9 | 2 | 2 | 6 | 4 | 3 |
| Brown bullhead | - | - | - | - | 3 | 7 | 1 | 3 | 12 | - | 4 | 9 | 10 | 4 | - |
| Creek chubsucker | 2 | - | 1 | 2 | - | 9 | 2 | 9 | 4 | 4 | 6 | 3 | - | - | - |
| Eastern mosquitofish | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - |
| Eastern mudminnow | 51 | 25 | 30 | 55 | 95 | 53 | 35 | 26 | 33 | 17 | 37 | 17 | 24 | 15 | 31 |
| Golden shiner | - | - | - | - | 3 | 2 | 3 | 1 | 21 | 2 | 4 | 15 | 5 | 2 | 5 |
| Green sunfish | - | - | - | - | - | - | - | 3 | - | 6 | 13 | 34 | 100 | 87 | 96 |
| Lepomis hybrid | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 | 4 |
| Pirate perch | 34 | 95 | 39 | 6 | 8 | 10 | 40 | 19 | 59 | 26 | 29 | 32 | 27 | 8 | 14 |
| Pumpkinseed | 5 | - | - | - | 1 | 3 | 7 | 16 | 35 | 9 | 7 | 1 | 14 | 9 | 2 |
| Redfin pickerel | 7 | - | 2 | 25 | 11 | 52 | 12 | 1 | 9 | 2 | - | 23 | 2 | - | - |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

*Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to Skeleton Creek by sampling year.

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| (*Procambarus sp.*) | P | P | A | P | A | P | P | A | P |

*Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to Skeleton Creek by sampling year.

| *Species* |
|---|
| None Observed |

*Herpetofauna*

Cumulative list of herpetofauna species collected in or near the unnamed tributary to Skeleton Creek.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | American bullfrog, Cope's gray treefrog, Eastern American toad, Eastern spadefoot, Fowler's toad, Gray treefrog, New Jersey chorus frog, Northern green frog, Northern spring peeper, Pickerel frog, Southern leopard frog |
| Squamata (Snakes) | Common five-lined skink, Eastern wormsnake, Northern black racer, Northern watersnake, Southern ring-necked snake |
| Testudines (Turtles) | Eastern box turtle, Eastern snapping turtle |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in the unnamed tributary to Skeleton Creek by sampling year, RA = % Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *1996 RA* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | | |
| Haplotaxida | Enchytraeidae | na | - | - | - | - | *0.9 | - | - | - | - | - | - | - | - | *0.9 | - | - |
| Lumbriculida | Lumbriculidae | na | *0.9 | - | - | - | *3.7 | - | *0.9 | - | - | - | - | - | - | - | - | - |
| Rhynchobdellida | Glossiphoniidae | na | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - |
| Tubificida | Tubificidae | na | *0.9 | *2.5 | - | - | *3.7 | - | *2.8 | *3 | - | - | - | *2 | *1.4 | - | - | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | | |
| Amphipoda | na | na | - | - | - | - | - | - | *1.8 | - | *1.9 | - | - | *5 | - | - | - | - |
| (Scud) | Crangonyctidae | na | - | - | - | - | - | - | - | *6.1 | - | - | - | - | - | - | - | - |
| | | *Crangonyx* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - |
| | | *Synurella* | - | - | - | - | - | 1.8 | - | - | 3.8 | - | - | 2 | - | - | - | 1.6 |
| | Gammaridae | *Gammarus* | - | 2.5 | 1.6 | - | 16.5 | 4.5 | - | 24.2 | 12.4 | 2.5 | - | 9 | - | 4.3 | 1.6 | 3.2 |
| Coleoptera | Curculionidae | na | - | - | - | - | - | - | - | - | - | - | - | *1 | - | - | - | - |
| (Beetle) | Dytiscidae | na | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Neoporus* | - | - | - | 0.8 | 3.7 | - | - | 7.1 | 6.7 | 3.4 | 0.9 | - | - | - | - | - |
| | Elmidae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Ancyronyx* | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| | | *Dubiraphia* | - | 4.2 | 4.1 | 0.8 | 2.8 | - | 0.9 | 6.1 | 2.9 | 0.8 | - | - | - | - | 0.8 | - |
| | | *Stenelmis* | 0.9 | 3.4 | - | - | 0.9 | - | 9.2 | 7.1 | 1 | - | 1.7 | 11 | - | 3.5 | 1.6 | - |
| | Gyrinidae | *Dineutus* | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - |
| | Hydrophilidae | *Tropisternus* | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - |
| | Ptilodactylidae | *Anchytarsus* | - | 0.8 | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - |
| Collembola | Isotomidae | *Isotomurus* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| Decapoda | Cambaridae | *Procambarus* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - |
| (Crayfish) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Diptera | Ceratopogonidae | na | - | - | - | - | - | - | *0.9 | - | - | - | - | - | - | - | - | - |
| (True Fly) | | *Bezzia* | - | - | - | - | - | - | - | 1 | - | - | 0.9 | - | - | - | - | - |
| | | *Ceratopogon* | - | - | - | - | - | - | - | - | 2.9 | - | - | - | - | - | - | - |
| | | *Probezzia* | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - |
| | | *Stilobezzia* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - |
| | Chironomidae | *Ablabesmyia* | - | - | - | - | - | - | 1.8 | - | - | - | 0.9 | - | - | - | - | - |
| | | *Brilla* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| | | *Chaetocladius* | - | - | - | - | - | - | - | 5.1 | - | - | - | - | - | - | - | - |
| | | *Clinotanypus* | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Conchapelopia* | 0.9 | 0.8 | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Cricotopus* | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| | | *Cryptochironomus* | - | 2.5 | - | - | 0.9 | - | 0.9 | - | - | - | - | 2 | - | - | 0.8 | - |
| | | *Dicrotendipes* | 0.9 | - | - | 0.8 | 2.8 | - | 0.9 | - | 1.9 | 0.8 | 1.7 | 1 | - | - | 0.8 | 0.8 |
| | | *Diplocladius* | - | - | - | - | - | - | - | - | 8.6 | 25.4 | - | 1 | - | - | 1.6 | - |
| | | *Endochironomus* | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | 0.8 | - |
| | | *Hydrobaenus* | - | - | - | - | 2.8 | 1.8 | - | - | - | - | - | 1 | 2.7 | 0.9 | 2.4 | - |
| | | *Kiefferulus* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - |
| | | *Labrundinia* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | | *Microtendipes* | 0.9 | 0.8 | - | - | 2.8 | - | - | 1 | 1 | 0.8 | 0.9 | - | 0.7 | 0.9 | 0.8 | 2.4 |

| ORDER | FAMILY | GENUS | 1996 RA | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Natarsia* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | | Orthocladiinae | *27.2 | - | *2.4 | - | *1.8 | - | - | - | - | - | - | - | *1.4 | - | *0.8 | - |
| | | *Orthocladius* | 0.9 | - | - | 6.6 | 1.8 | 5.4 | 0.9 | - | - | - | 2.6 | - | 4.1 | 2.6 | 3.2 | 4 |
| | | *Paramerina* | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Paraphaenocladius* | - | - | - | - | - | - | - | - | - | - | 2.6 | - | - | - | - | - |
| | | *Parametriocnemus* | - | - | - | - | 0.9 | - | - | 3 | - | - | - | - | - | 0.9 | - | 0.8 |
| | | *Paratendipes* | - | - | - | 0.8 | - | - | - | - | - | - | 1.7 | - | - | - | - | - |
| | | *Phaenopsectra* | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Polypedilum* | 0.9 | - | - | - | - | 0.9 | 3.7 | 1 | 2.9 | - | - | - | - | 0.9 | 0.8 | - |
| | | *Procladius* | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| | | *Rheocricotopus* | 17.3 | 14.3 | 50.8 | 37.2 | 2.8 | 4.5 | 47.7 | - | 10.5 | - | 28.4 | 9 | - | 3.5 | 8 | - |
| | | *Stictochironomus* | - | 1.7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | Tanypodinae | - | - | *3.3 | - | - | - | *0.9 | - | - | - | - | - | - | - | - | - |
| | | *Thienemannimyia* | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | Thienemannimyia Group | - | - | *0.8 | - | *1.8 | *1.8 | *0.9 | *2 | *7.6 | - | *3.4 | - | - | *0.9 | - | *0.8 |
| | | *Tribelos* | - | 0.8 | - | - | 3.7 | - | 0.9 | - | 1.9 | - | 1.7 | - | - | - | 0.8 | - |
| | | *Zavrelimyia* | 1.8 | - | 0.8 | - | 4.6 | - | 0.9 | 1 | - | - | - | - | - | - | - | - |
| | Simuliidae | na | - | *4.2 | - | - | - | - | *0.9 | - | *0.9 | - | - | *1 | *13 | - | - | - |
| | | *Cnephia* | - | - | 0.8 | - | - | 1.8 | - | - | - | - | - | - | - | 0.9 | - | - |
| | | *Prosimilium* | 21.8 | 9.2 | 5.7 | 19 | 7.3 | 57.7 | 3.7 | - | - | 31.4 | 7.8 | - | 21.2 | 39.1 | 36.8 | 69.6 |
| | | *Simulium* | - | 19.3 | 0.8 | - | - | - | 1.8 | - | - | - | - | - | 1.4 | 0.9 | 0.8 | - |
| | | *Stegopterna* | 14.5 | 16 | 4.9 | 14 | 2.8 | 0.9 | 1.8 | - | 1 | 22 | 37.9 | 4 | 50.7 | 29.6 | 26.4 | 12.8 |
| | Tabanidae | *Chrysops* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - |
| | | *Tabanus* | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - |
| | Tipulidae | *Hexatoma* | - | 1.7 | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - |
| | | *Pseudolimnophila* | - | - | - | - | - | 0.9 | - | - | - | 0.8 | - | - | - | - | - | - |
| Ephemeroptera | Caenidae | *Caenis* | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Mayfly) | Leptophlebiidae | na | *0.9 | - | *1.6 | - | *3.7 | *0.9 | - | - | *1 | - | *0.9 | - | - | - | - | - |
| | | *Leptophlebia* | - | - | 0.8 | 11.6 | 0.9 | - | 1.8 | - | - | - | - | - | - | - | - | - |
| | | ***Paraleptophlebia*** [+] | - | - | 1.6 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hemiptera | Belostomatidae | *Belostoma* | - | - | - | 0.8 | - | - | - | - | 1 | - | - | - | - | - | - | - |
| (True Bug) | Corixidae | na | - | - | *0.8 | - | - | - | - | - | - | - | - | - | *0.7 | - | - | - |
| | Nepidae | *Ranatra* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - |
| Isopoda | Asellidae | *Caecidotea* | - | - | 4.1 | 4.1 | 16.5 | 5.4 | 2.8 | 13.1 | 14.3 | 1.7 | 1.7 | 4 | - | 1.7 | - | - |
| (Aquatic Sow Bug) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Lepidoptera | | na | - | - | - | - | - | - | - | - | - | - | - | - | - | *1.7 | - | - |
| Megaloptera | Corydalidae | *Chauliodes* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| (Dobsonfly/Fishfly) | | *Nigronia* | - | - | 0.8 | - | - | - | - | 1 | - | - | - | - | 0.7 | - | - | - |
| Odonata | Calopterygidae | *Calopteryx* | - | - | 0.8 | - | 0.9 | - | 2.8 | - | 4.8 | - | - | - | - | - | - | - |
| (Dragonfly/ Damselfly) | Coenagrionidae | na | - | - | *0.8 | - | - | - | - | - | *2.9 | - | - | - | - | - | - | - |
| | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Plecoptera | Capniidae | na | - | - | - | *0.8 | - | *0.9 | - | - | - | - | - | - | - | - | - | - |
| (Stonefly) | | *Allocapnia* | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Nemouridae | na | - | - | *1.6 | - | - | *1.8 | - | - | - | - | - | *4 | - | - | *0.8 | - |
| | | *Prostoia* | 5.5 | 5.9 | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - |
| Trichoptera | Hydropsychidae | na | - | - | - | - | - | - | - | - | - | - | - | *1 | - | - | - | - |
| (Caddisfly) | | *Cheumatopsyche* | - | - | - | - | - | 0.9 | - | - | - | - | - | 1 | - | 0.9 | 0.8 | - |

| *ORDER* | *FAMILY* | *GENUS* | *1996 RA* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Limnephilidae | na | - | - | - | - | - | *0.9 | - | - | *1 | - | - | - | - | - | - | - |
| | | *Ironoquia* | - | 2.5 | 0.8 | - | - | 0.9 | 0.9 | - | 1.9 | - | - | 1 | - | 0.9 | - | - |
| | Phryganeidae | *Ptilstomis* | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - |
| | Psychomyiidae | *Lype* | - | - | 1.6 | - | - | 1.8 | - | - | - | - | - | - | - | - | - | - |
| | Uenoidae | *Neophylax* | - | - | - | - | - | - | 0.9 | - | - | - | - | 10 | 0.7 | - | - | - |
| PHYLUM MOLLUSCA | | | | | | | | | | | | | | | | | | |
| Basommatophora | Lymnaeidae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | *0.8 |
| (Snail) | Physidae | *Physa* | - | - | 1.6 | - | - | - | - | 1 | - | - | - | - | - | - | 0.8 | - |
| | Planorbidae | *Menetus* | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | 0.8 |
| Architaenioglossa | Bithyniidae | *Bithynia* | - | - | - | - | - | - | 1.8 | 2 | - | - | 0.9 | - | - | - | - | - |
| (Snail) | Viviparidae | na | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | *0.9 | *1.6 | - |
| | | *Campeloma* | - | 0.8 | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | 1.6 |
| | | *Viviparus* | 0.9 | - | - | - | - | - | - | - | - | - | - | 3 | - | - | - | - |
| Neotaenioglossa | Hydrobiidae | na | - | *0.8 | - | - | - | - | - | - | - | *0.8 | - | *1 | - | - | - | - |
| Veneroida | Pisidiidae | na | - | - | - | - | *2.8 | *0.9 | *1.8 | *4 | - | *0.8 | - | - | - | - | - | - |
| (Bivalve) | | *Musculium* | - | - | - | - | - | - | - | 4 | 3.8 | - | - | 2 | 1.4 | 2.6 | - | - |
| | | *Pisidium* | 0.9 | 3.4 | - | 0.8 | - | - | - | - | - | - | - | - | - | - | 5.6 | - |
| | | *Sphaerium* | - | - | 3.3 | - | - | - | - | - | - | 8.5 | - | - | - | - | - | 0.8 |
| PHYLUM NEMATOMORPHA | | | | | | | | | | | | | | | | | | |
| Gordioidea | Gordiidae | na | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| PHYLUM NEMERTEA | | | | | | | | | | | | | | | | | | |
| Tricladida | na | na | - | - | - | - | *4.6 | - | - | - | - | - | - | - | - | - | - | - |
| (Flatworm) | Dugesiidae | *Cura* | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).
* Taxa not identified to genus.
+ Coldwater-preference genera

# *Swan Creek (LOCR-102-S)*

Site LOCR-102-S is located on Swan Creek in the Coastal Plain – eastern shore region of Maryland. It is in the Lower Chester River watershed in Kent County. This site was sampled in 1995 and 2000 to 2014.

*Swan Creek in spring 2013.*

## ***Land Use/ Land Cover***

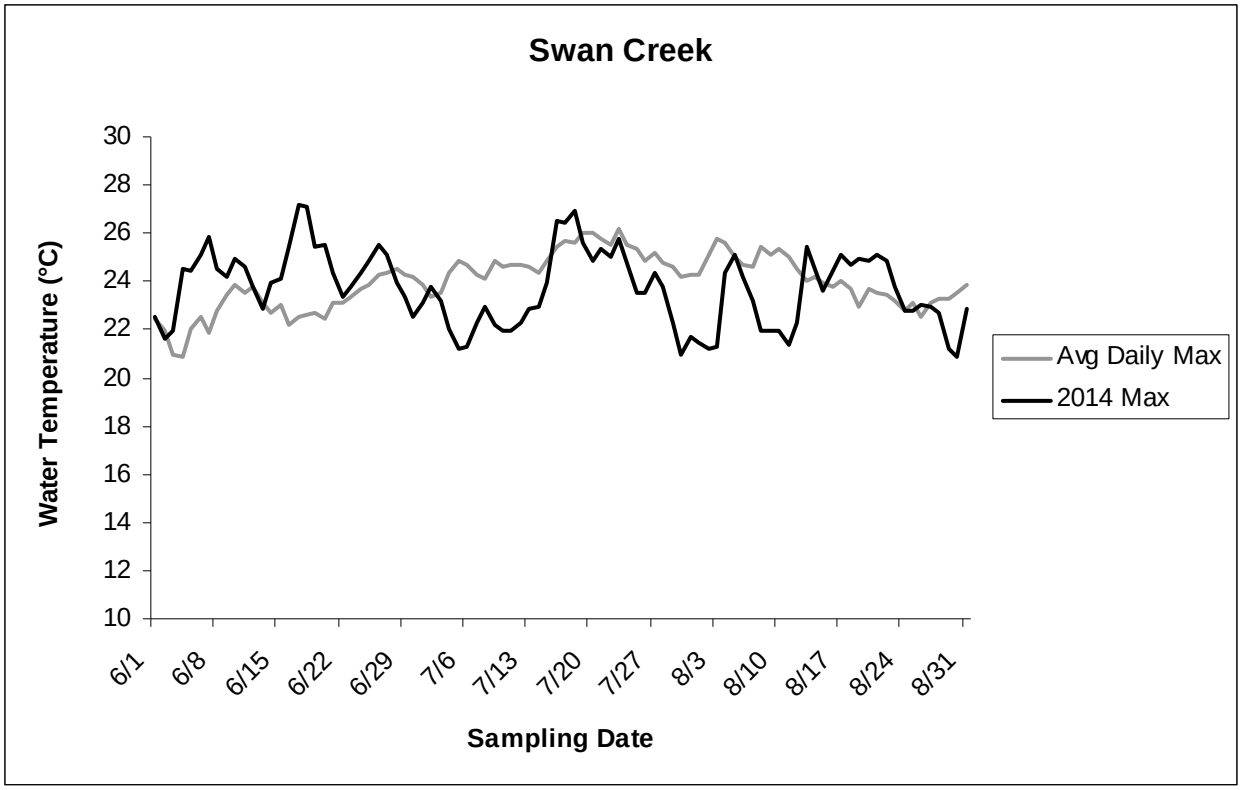
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 27.17 | 20.79 | 20.49 |
| Agriculture | 23.94 | 17.68 | 17.38 |
| Urban | 0.00 | 0.00 | 0.00 |
| Other | 48.89 | 61.53 | 62.13 |

## ***Physical Habitat***

Physical habitat measurements collected at Swan Creek (2000 to 2014). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 16 | 8 | 11 | 13 | 13 | 9 | 17 | 8 | 14 | 14 | 16 | 12 | 17 | 16 | 13 |
| Epifaunal substrate (0-20) | 17 | 8 | 11 | 14 | 11 | 9 | 16 | 8 | 13 | 15 | 16 | 8 | 12 | 13 | 16 |
| Velocity/Depth Diversity (0-20) | 8 | 4 | 5 | 12 | 9 | 4 | 10 | 2 | 3 | 6 | 3 | 3 | 5 | 4 | 9 |
| Pool Quality (0-20) | 11 | 7 | 5 | 13 | 12 | 8 | 10 | 7 | 8 | 9 | 10 | 8 | 10 | 9 | 10 |
| Riffle Quality (0-20) | 10 | 8 | 0 | 11 | 11 | 8 | 13 | 1 | 6 | 12 | 0 | 7 | 6 | 11 | 6 |
| Shading (%) | 40 | 20 | 65 | 65 | 40 | 45 | 40 | 80 | 70 | 60 | 40 | 60 | 80 | 65 | 45 |
| Embeddedness (%) | 30 | 99 | 100 | 30 | 100 | 100 | 30 | 95 | 100 | 100 | 100 | 70 | 85 | 100 | 90 |
| Discharge (cfs) | 0.29 | 0.05 | 0.00 | 0.22 | 0.21 | 0.02 | 0.02 | 0.00 | 0.02 | 0.33 | 0.00 | 0.05 | 0.02 | 0.36 | 0.41 |




The graph above displays the average daily maximum temperatures recorded at Swan Creek. The average was calculated from twelve years of data.

## ***Biology***

### *Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 1.86 | 2.43 | 3.29 | 2.43 | 1.86 | 2.14 | 2.43 | 2.14 | 2.14 | 3.29 | 1.86 | 1.86 | 1.57 | 3.00 | 2.43 |
| FIBI | 2.00 | 2.00 | 1.67 | 2.00 | 2.00 | 2.67 | 2.67 | 2.67 | 2.33 | 2.00 | 2.67 | 2.33 | 2.33 | 2.67 | 2.00 |

### *Fish*

Cumulative list of fish species (with abundance) collected in Swan Creek by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| American eel | 9 | 6 | 10 | 4 | 6 | 11 | 12 | 4 | 4 | - | 6 | 3 | 1 | 3 | 3 |
| Black crappie | - | - | - | - | 1 | - | 6 | - | - | - | - | - | - | 3 | - |
| Bluegill | 27 | - | - | - | 9 | 2 | 2 | 17 | 1 | 6 | 11 | 1 | 6 | 7 | 21 |
| Brown bullhead | - | 22 | 8 | 2 | 26 | 12 | 7 | - | 8 | 1 | 2 | 7 | - | 4 | 1 |
| Eastern mosquitofish | - | - | - | 1 | - | 643 | 92 | 15 | 7 | 4 | 19 | - | 21 | 19 | - |
| Eastern mudminnow | 513 | 1603 | 515 | 1768 | 786 | 743 | 310 | 118 | 255 | 375 | 149 | 218 | 86 | 259 | 512 |
| Golden shiner | 86 | 97 | 42 | 2 | 39 | 57 | 26 | 34 | 28 | 20 | 20 | 15 | 27 | 18 | 19 |
| Largemouth bass | - | - | - | - | - | - | - | - | - | 1 | - | - | - | 2 | 1 |
| Pumpkinseed | 528 | 213 | 42 | 21 | 51 | 162 | 54 | 49 | 71 | 68 | 24 | 135 | 20 | 79 | 55 |
| Redfin pickerel | - | 2 | - | 7 | 4 | - | 5 | 6 | 12 | 4 | 1 | 3 | - | 2 | 1 |
| Warmouth | 16 | 4 | 1 | - | 1 | 5 | 4 | 1 | - | 1 | - | 2 | 1 | 8 | 4 |
| Yellow bullhead | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Yellow perch | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

*Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in Swan Creek by sampling year.

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Red swamp crawfish *(Procambarus clarkii*) | P | A | A | P | P | P | P | P | P |
| Devil crayfish (Cambarus diogenes) | A | A | P | P | A | P | A | P | P |
| (*Procambarus sp*.) | A | A | A | P | A | A | A | A | A |

*Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in Swan Creek by sampling year.

| *Species* |
|---|
| None Observed |

*Herpetofauna*

Cumulative list of herpetofauna species collected in or near Swan Creek.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | American bullfrog, Fowler's toad, Gray treefrog, Green tree frog, Northern cricket frog, Northern green frog, Northern spring peeper, Pickerel frog, Southern leopard frog |
| Squamata (Snakes and Lizards) | Common five-lined skink, Eastern rat snake, Northern watersnake, Ringneck snake |
| Testudines (Turtles) | Eastern painted turtle, Eastern snapping turtle, Red bellied turtle |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in the Swan Creek by sampling year,

RA = % Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *1995 RA* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | | |
| Haplotaxida | Enchytraeidae | na | - | - | *0.8 | *1 | - | - | - | - | - | - | - | - | - | *1.8 | - | - |
| | Naididae | na | - | - | - | *2 | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| Hirudinea | Glossiphoniidae | *Placobdella* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| Lumbriculida | Lumbriculidae | na | *1 | *10.4 | *5.9 | *4 | *1.6 | - | - | - | *0.9 | *1 | - | *1.7 | - | - | *2.8 | - |
| Arhynchobdellida | Erpobdellidae | na | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - | - | - | *0.8 |
| Tubificida | Tubificidae | na | - | *5.7 | *1.7 | *4 | *0.8 | - | - | *1.7 | - | - | *0.9 | *0.9 | *1.7 | *6.1 | *1.9 | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | | |
| Amphipoda | na | na | - | *1.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Scud) | Crangonyctidae | na | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - | - | - |
| | | *Crangonyx* | 4.1 | - | - | - | 1.6 | - | - | 1.7 | 3.6 | - | 3.5 | - | - | 0.9 | - | - |
| | | *Synurella* | - | - | - | - | - | 0.7 | - | 10.4 | 2.7 | 1 | 2.6 | - | 1.7 | 0.9 | - | - |
| Coleoptera | Dytiscidae | *Deronectes* | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Beetle) | | *Neoporus* | - | - | - | - | 0.8 | - | - | 2.6 | - | - | 0.9 | - | - | 0.9 | - | - |
| | Haliplidae | *Peltodytes* | - | - | - | 3 | - | - | - | - | - | 1 | 0.9 | - | - | - | - | - |
| | Scirtidae | na | *2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Decapoda (Crayfish) | Cambaridae | na | - | - | - | - | - | - | - | - | - | *1 | - | - | - | - | - | - |
| Diptera | na | na | - | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| (True Fly) | Ceratopogonidae | na | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - |
| | | *Bezzia* | - | 1.9 | - | - | - | - | - | 0.9 | - | - | 1.7 | - | - | - | - | - |
| | | *Ceratopogon* | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Mallochohelea* | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - |
| | | *Probezzia* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| | Chironomidae | *Alotanypus* | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | Chironomini | - | - | *0.8 | - | - | - | - | - | - | - | *0.9 | *0.9 | - | - | - | - |
| | | *Chironomus* | 1 | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Clinotanypus* | - | - | 0.8 | - | - | 0.7 | - | - | - | - | 0.9 | - | - | - | - | - |
| | | *Conchapelopia* | 9.2 | 3.8 | - | 10.1 | - | 0.7 | - | - | 1.8 | - | - | - | - | - | - | - |
| | | *Cryptochironomus* | - | - | - | - | - | - | - | - | 1.8 | - | 0.9 | 0.9 | - | - | - | - |
| | | *Diamesinae* | - | - | - | - | - | - | - | - | - | - | - | - | - | *1.6 | - | - |
| | | *Dicrotendipes* | 8.2 | - | 0.8 | 9.1 | 3.2 | 0.7 | 0.9 | 0.9 | - | - | 2.6 | - | - | - | 0.9 | - |
| | | *Diplocladius* | - | 0.9 | - | 2 | - | - | 1.8 | - | 18.9 | 2 | - | 0.9 | - | 0.9 | - | - |
| | | *Endochironomus* | - | 3.8 | 0.8 | - | - | 0.7 | - | - | 0.9 | - | - | - | - | - | - | - |
| | | *Glyptotendipes* | 2 | - | - | - | - | 0.7 | - | - | - | - | - | - | - | - | - | - |
| | | *Hydrobaenus* | 6.1 | - | - | - | - | - | - | - | - | - | 2.6 | - | 0.9 | - | 0.9 | 2.5 |
| | | *Kiefferulus* | - | - | - | - | - | - | - | - | 0.9 | - | 2.6 | - | - | - | - | 1.7 |
| | | *Krenopelopia* | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Labrundinia* | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| | | *Limnophyes* | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | 1.9 | - |
| | | *Mesosmittia* | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| | | *Microtendipes* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - |

| ORDER | FAMILY | GENUS | 1995 RA | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Nanocladius* | - | - | 1.7 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | Orthocladiinae | *11.2 | *2.8 | *11 | - | *3.2 | - | - | - | *0.9 | *4.9 | - | - | - | - | - | - |
| | | *Orthocladius* | 8.2 | - | - | 13.1 | 19.8 | 13.1 | 2.8 | - | - | 22.5 | 20 | 5.2 | 4.3 | 0.9 | 7.5 | 2.5 |
| | | *Parachironomus* | - | - | - | - | 3.2 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Paramerina* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - |
| | | *Parametriocnemus* | - | 0.9 | 0.8 | 4 | - | 1.5 | - | - | - | - | 4.3 | - | - | - | - | 5.1 |
| | | *Paraphaenocladius* | - | - | - | 14.1 | 2.4 | - | - | - | 1.8 | - | 5.2 | - | - | - | 0.9 | 3.4 |
| | | *Paratanytarsus* | - | - | - | 2 | - | - | - | - | 0.9 | - | 1.7 | 0.9 | - | - | - | - |
| | | *Paratendipes* | 2 | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - |
| | | *Polypedilum* | 1 | - | 0.8 | - | 11.9 | - | 0.9 | 6.1 | 1.8 | 2 | 3.5 | 1.7 | - | 0.9 | 0.9 | 5.9 |
| | | *Procladius* | - | - | - | 5.1 | 15.9 | - | 0.9 | 3.5 | - | 1 | - | - | - | 0.9 | - | 1.7 |
| | | *Rheocricotopus* | - | 1.9 | 1.7 | - | 1.6 | - | - | - | - | - | - | - | 0.9 | - | 3.7 | 1.7 |
| | | Tanypodinae | - | *0.9 | *1.7 | - | - | *1.5 | *0.9 | - | *0.9 | - | - | - | - | - | - | *0.8 |
| | | *Tanypus* | - | - | - | 1 | - | - | - | - | - | - | 1.7 | - | - | - | - | - |
| | | Tanytarsini | - | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | Thienemannimyia Group | - | - | *5.1 | - | - | *10.9 | *0.9 | - | *6.3 | - | *5.2 | - | *0.9 | *0.9 | - | *0.8 |
| | | *Tribelos* | 1 | - | - | - | - | - | - | - | - | - | - | - | - | 1.8 | - | - |
| | | *Trissopelopia* | - | - | - | - | 1.6 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Tvetenia* | - | - | - | - | - | - | - | - | - | - | - | 1.7 | - | - | - | - |
| | | *Zavrelimyia* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | 0.9 | - | - | - |
| | Simuliidae | na | - | - | - | - | *0.8 | - | *1.8 | *1.7 | - | *5.9 | - | *1.7 | - | *0.9 | *1.9 | - |
| | | *Cnephia* | - | - | - | - | 1.6 | - | - | - | 15.3 | 11.8 | - | - | - | - | - | 10.2 |
| | | *Prosimulium* | - | - | 1.7 | - | - | - | - | - | 0.9 | 1 | - | - | - | - | 5.6 | 2.5 |
| | | *Simulium* | - | 2.8 | 4.2 | - | 7.9 | 46 | 77.1 | - | - | - | - | 64.7 | 5.2 | 64.0 | 3.7 | - |
| | | *Stegopterna* | - | - | 47.5 | - | 12.7 | 16.8 | 2.8 | - | 14.4 | 34.3 | 4.3 | 4.3 | 80 | 9.6 | 57 | 58.5 |
| | Tabanidae | na | - | - | - | *1 | - | - | - | - | *0.9 | *1 | - | - | - | - | - | - |
| | | *Chrysops* | - | 1.9 | - | - | - | - | 0.9 | - | - | - | 0.9 | - | - | - | 0.9 | - |
| | | *Tabanus* | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Tipulidae | na | - | - | - | - | *0.8 | - | *0.9 | *0.9 | - | *1 | - | - | - | *0.9 | *0.9 | - |
| | | *Hexatoma* | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Ormosia* | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| | | *Pedicia* | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Pilaria* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | 0.9 | - |
| | | *Pseudolimnophila* | - | - | - | - | - | 1.5 | - | - | 0.9 | - | - | - | - | - | - | - |
| | | *Tipula* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| Ephemeroptera | Caenidae | *Caenis* | - | - | - | 1 | - | - | 2.8 | - | - | - | - | - | - | - | - | - |
| (Mayfly) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hemiptera | Corixidae | na | *1 | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - |
| (True Bug) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Isopoda | Asellidae | *Caecidotea* | 6.1 | 36.8 | 4.2 | 2 | 3.2 | 2.9 | 2.8 | 57.4 | 19.8 | 1 | 13 | - | 1.7 | 0.9 | 0.9 | 0.8 |
| (Aquatic Sow Bug) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Lepidoptera (Moth) | Tortricidae | na | *3.1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Megaloptera | Corydalidae | *Chauliodes* | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| (Dobsonfly/Fishfly) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Odonata | Calopterygidae | *Calopteryx* | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - |
| (Dragonfly/ | Coenagrionidae | na | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Damselfly) | Libellulidae | na | - | - | - | - | - | - | - | - | - | - | *1.7 | - | - | - | - | - |

| *ORDER* | *FAMILY* | *GENUS* | *1995* *RA* | *2000* *RA* | *2001* *RA* | *2002* *RA* | *2003* *RA* | *2004* *RA* | *2005* *RA* | *2006* *RA* | *2007* *RA* | *2008* *RA* | *2009* *RA* | *2010* *RA* | *2011* *RA* | *2012* *RA* | *2013* *RA* | *2014* *RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plecoptera | Nemouridae | na | - | - | *1.7 | - | *0.8 | - | - | - | - | *5.9 | *2.6 | - | - | *1.8 | - | *0.8 |
| (Stonefly) | | *Ostrocerca* | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Prostoia* | 3.1 | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | 0.9 | - |
| Trichoptera | Hydropsychidae | *Cheumatopsyche* | - | - | - | - | - | 0.7 | - | - | - | - | - | - | - | - | - | - |
| (Caddisfly) | Limnephilidae | na | - | - | - | *3 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Ironoquia* | - | - | - | - | - | 0.7 | - | - | - | - | 4.3 | - | - | - | 0.9 | - |
| | Phryganeidae | *Ptilostomis* | - | - | - | - | - | - | - | - | - | - | 1.7 | - | - | - | - | - |
| PHYLUM MOLLUSCA | | | | | | | | | | | | | | | | | | |
| Basommatophora | Lymnaeidae | *Pseudosuccinea* | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Snail) | Physidae | *Physa* | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Planorbidae | *Menetus* | 4.1 | - | 0.8 | 3 | - | - | - | - | - | - | 2.6 | - | - | - | - | - |
| Veneroida | Pisidiidae | na | - | - | - | - | *0.8 | - | - | - | - | - | - | *4.3 | - | *1.8 | - | - |
| (Bivalve) | | *Musculium* | - | - | - | 12.1 | - | - | 0.9 | 7.8 | 1.8 | 1 | 0.9 | 2.6 | 1.7 | - | 2.8 | - |
| | | *Pisidium* | 18.4 | 21.7 | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Sphaerium* | - | - | 3.4 | - | - | - | - | - | - | - | - | - | - | - | - | - |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).
* Taxa not identified to genus.

## *Appendix B*
## *Sentinel Sites in the Coastal Plain – Western Shore Region*

Hoghole Run (PTOB-002-S)
Mattawoman Creek (MATT-033-S)
Mill Run (Nanjemoy Creek, NANJ-331-S)
Unnamed Tributary to Reeder Run (PRMT-177-S)
Unnamed Tributary to St. Clements Creek (STCL-051-S)
Swanson Creek (PAXL-294-S)
Unnamed Tributary to Zekiah Swamp Run (ZEKI-012-S)

# *Hoghole Run (PTOB-002-S)*

Site PTOB-002-S is located on Hoghole Run in the Coastal Plain – western shore region of Maryland. It is in the Port Tobacco River watershed in Charles County. This site was sampled in 1995 and 2000 to 2014.

*Hoghole Run in spring 2013.*

## ***Land Use/ Land Cover***

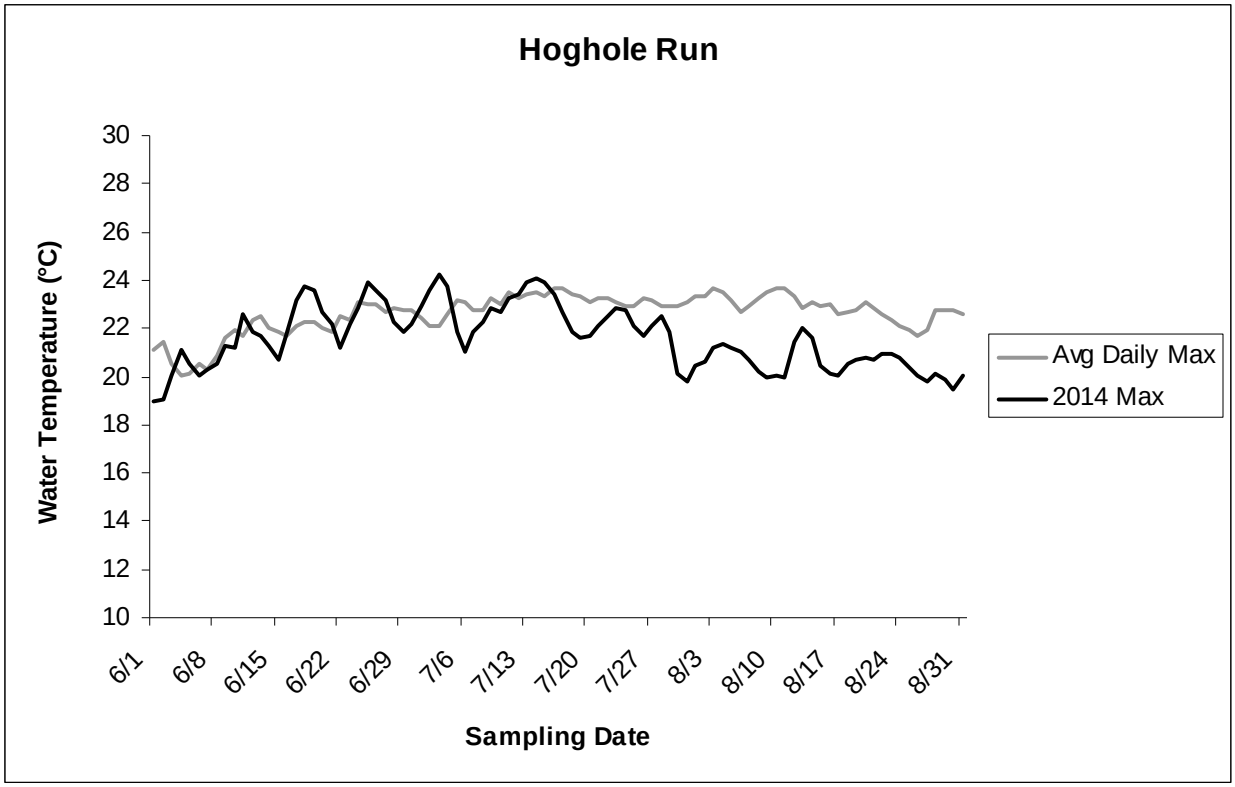
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 68.32 | 74.12 | 73.11 |
| Agriculture | 0.22 | 12.84 | 13.66 |
| Urban | 3.30 | 6.14 | 6.28 |
| Other | 28.16 | 6.80 | 6.95 |

## ***Physical Habitat***

Physical habitat measurements collected at Hoghole Run (2000 to 2014). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 17 | 18 | 10 | 13 | 16 | 16 | 16 | 15 | 18 | 18 | 17 | 18 | 16 | 17 | 13 |
| Epifaunal substrate (0-20) | 15 | 18 | 9 | 17 | 15 | 14 | 14 | 16 | 16 | 16 | 16 | 16 | 17 | 16 | 14 |
| Velocity/Depth Diversity (0-20) | 14 | 14 | 2 | 12 | 13 | 14 | 13 | 14 | 15 | 13 | 15 | 10 | 13 | 13 | 14 |
| Pool Quality (0-20) | 16 | 15 | 9 | 14 | 14 | 15 | 14 | 14 | 16 | 14 | 13 | 18 | 16 | 17 | 15 |
| Riffle Quality (0-20) | 12 | 14 | 0 | 15 | 14 | 16 | 14 | 15 | 16 | 13 | 13 | 7 | 11 | 14 | 12 |
| Shading (%) | 80 | 90 | 96 | 93 | 85 | 90 | 90 | 96 | 75 | 85 | 90 | 80 | 80 | 90 | 45 |
| Embeddedness (%) | 40 | 15 | 21 | 35 | 40 | 60 | 45 | 40 | 25 | 20 | 70 | 15 | 20 | 35 | 35 |
| Discharge (cfs) | 0.38 | 0.36 | 0.00 | 3.89 | 0.28 | 1.18 | 0.91 | 0.69 | 2.70 | 2.41 | 0.25 | 0.1 | 0.53 | 0.37 | 0.39 |




The graph above displays the average daily maximum temperatures recorded at Hoghole Run. No temperature data was available for 2012. The average was calculated from eleven years of data.

## ***Biology***

### *Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 4.71 | 4.14 | 4.71 | 3.29 | 4.71 | 4.71 | 4.43 | 4.71 | 4.14 | 4.43 | 4.71 | 4.43 | 4.43 | 3.29 | 4.14 |
| FIBI | 4.33 | 4.00 | 4.00 | 1.00 | 3.67 | 4.33 | 3.67 | 4.33 | 3.00 | 4.00 | 4.00 | 4.33 | 3.67 | 4 | 3.67 |

### *Fish*

Cumulative list of fish species (with abundance) collected in Hoghole Run by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| American eel | 2 | 4 | - | 2 | - | - | 1 | 1 | 1 | 2 | - | - | 1 | 1 | 1 |
| Bluegill | 2 | - | - | - | - | 1 | - | - | - | - | - | - | - | 1 | - |
| Creek chub | 71 | 60 | 121 | 1 | 78 | 56 | 18 | 34 | 7 | 6 | 41 | 44 | 9 | 49 | 22 |
| Creek chubsucker | 3 | 3 | 4 | - | 3 | 7 | 1 | 5 | - | 4 | 5 | 6 | 4 | 24 | 9 |
| Eastern blacknose dace | 58 | 101 | 13 | 17 | 175 | 89 | 32 | 67 | 53 | 72 | 47 | 55 | 8 | 47 | 84 |
| Eastern mudminnow | 61 | 11 | 142 | 54 | 260 | 63 | 122 | 113 | 28 | 40 | 76 | 90 | 20 | 122 | 32 |
| Fallfish | 7 | 3 | 3 | - | - | 1 | 2 | - | 1 | - | - | - | - | - | - |
| Flier | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Green Sunfish | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| Golden shiner | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Largemouth Bass | - | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - |
| Least brook lamprey | 9 | 10 | 11 | - | 1 | 3 | 3 | - | 1 | 2 | 4 | 6 | - | 2 | 1 |
| Pumpkinseed | - | - | 2 | - | - | - | - | - | - | - | - | 6 | 1 | - | - |
| Rosyside dace | 82 | 210 | 92 | - | 39 | 85 | 36 | 110 | 33 | 22 | 140 | 45 | 17 | 28 | 41 |
| Sea lamprey | - | - | - | - | - | - | - | 1 | - | - | 3 | - | - | - | - |
| Spottail shiner | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Tadpole madtom | 5 | 4 | 1 | - | - | - | - | - | - | 1 | - | - | - | - | - |
| Tessellated darter | 5 | 19 | 1 | - | - | - | - | - | - | - | 2 | 1 | 1 | - | 9 |
| White sucker | 27 | 17 | 7 | - | - | - | - | - | - | - | - | - | - | - | - |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

## *Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to Hoghole Run by sampling year.

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Common crayfish (*Cambarus bartonii bartonii*) | P | P | A | P | P | P | P | P | P |
| Devil crawfish (*Cambarus diogenes*) | A | A | A | A | P | A | A | P | P |
| Spinycheek crayfish (*Orconectes limosus*) | P | P | A | P | P | P | P | P | P |

## *Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in Hoghole Run by sampling year.

| *Species* |
|---|
| None Observed |

## *Herpetofauna*

Cumulative list of herpetofauna species collected in or near Hoghole Run.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | American bullfrog, Eastern American toad, Fowler's toad, Northern cricket frog, Northern green frog, Northern spring peeper, Pickerel frog, Wood frog |
| Caudata (Salamanders and Newts) | Northern dusky salamander, Northern two-lined salamander |
| Squamata (Snakes and Lizards) | Eastern wormsnake, Northern watersnake |
| Testudines (Turtles) | Eastern box turtle |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in Hoghole Run by sampling year, RA = % Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | |
| Haplotaxida | Enchytraeidae | na | - | - | - | *0.9 | - | - | - | - | - | - | - | - | - | - | - |
| | Naididae | na | - | - | - | - | - | - | - | *1 | *1.7 | - | - | - | - | - | - |
| Lumbriculida | Lumbriculidae | na | - | *0.9 | - | *0.9 | *0.8 | - | *2.5 | - | *1.7 | *0.8 | - | - | - | *0.8 | *0.9 |
| Tubificida | Tubificidae | na | - | - | - | - | - | *1 | - | - | - | - | - | - | - | - | - |
| | | *Spirosperma* | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | |
| Amphipoda (Scud) | Crangonyctidae | na | *6.1 | - | - | - | - | - | - | *1.9 | - | *0.8 | - | - | - | - | - |
| | | *Crangonyx* | - | - | - | - | - | - | - | - | - | 0.8 | - | - | 0.9 | - | 0.9 |
| | | *Synurella* | - | - | - | - | 1.7 | - | 1.7 | 5.8 | 3.4 | 10.5 | - | - | - | - | - |
| Coleoptera (Beetle) | Elmidae | *Ancyronyx* | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - |
| | | *Dubiraphia* | - | - | - | - | - | - | 1.7 | - | - | - | - | - | - | - | - |
| | | *Macronychus* | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - |
| | | *Optioservus* | - | - | - | - | - | - | 2.5 | 1 | - | 0.8 | 0.9 | - | - | - | - |
| | | *Oulimnius* | 7.1 | 6.6 | 1.9 | 3.7 | - | 12.1 | 4.2 | 1.9 | - | - | 1.9 | 2.5 | - | - | - |
| | | *Stenelmis* | 1 | - | - | 0.9 | - | 1 | - | 2.9 | - | - | 1.9 | - | - | - | - |
| | Dryopidae | *Helichus* | - | - | - | - | - | - | - | - | - | 2.4 | - | - | - | - | - |
| | Psephenidae | *Psephenus* | - | 1.9 | 0.9 | - | - | - | - | 1.9 | 0.9 | - | - | - | - | - | - |
| Collembola (Springtail) | na | na | - | - | - | *0.9 | - | - | - | - | - | - | - | - | - | - | - |
| | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Decapoda (Crayfish) | Cambaridae | na | *1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Diptera (True Fly) | Ceratopogonidae | na | - | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - |
| | | *Bezzia* | - | - | - | 0.9 | - | - | - | - | 1.7 | - | - | - | - | - | 0.9 |
| | | *Ceratopogon* | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| | | *Probezzia* | - | - | - | 0.9 | - | - | 0.8 | - | - | 0.8 | - | - | - | - | - |
| | Chironomidae | *Ablabesmyia* | - | - | - | - | 1.7 | - | - | - | - | - | - | - | - | - | - |
| | | *Conchapelopia* | - | - | 1.9 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Corynoneura* | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Cricotopus* | 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Cryptochironomus* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Demicryptochironomus* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | | *Dicrotendipes* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | | *Diplocladius* | - | - | - | - | - | - | - | - | 1.7 | 0.8 | 3.8 | - | - | - | - |
| | | *Eukiefferiella* | 3 | 0.9 | - | 1.8 | - | 1 | 7.5 | 1 | 2.6 | 0.8 | - | 1.7 | 1.8 | - | - |
| | | *Heterotrissocladius* | - | - | - | - | - | - | - | - | 1.7 | - | - | - | - | - | - |
| | | *Hydrobaenus* | - | - | - | 2.8 | - | - | 3.3 | 5.8 | 5.1 | 6.5 | - | - | 1.8 | - | 0.9 |
| | | *Micropsectra* | - | 1.9 | - | - | - | - | 0.8 | - | - | 0.8 | - | 0.8 | 0.9 | - | - |
| | | *Microtendipes* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Nanocladius* | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - |
| | | Orthocladiinae | *2 | *1.9 | *1.9 | - | - | *3 | *0.8 | *1 | - | *0.8 | - | - | - | - | - |
| | | *Orthocladius* | - | - | 4.7 | 0.9 | 2.5 | - | 5 | 3.8 | 10.3 | 33.9 | 3.8 | 0.8 | 9.2 | 0.8 | 1.7 |
| | | *Parakiefferiella* | - | - | - | - | - | - | - | - | 1.7 | - | - | - | - | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Parametriocnemus* | - | - | 5.7 | - | 13.2 | 3 | 0.8 | 17.3 | - | - | - | 0.8 | 0.9 | - | 0.9 |
| | | *Paraphaenocladius* | - | - | - | - | - | - | - | - | - | 1.6 | - | - | - | - | - |
| | | *Paratanytarsus* | - | - | - | - | - | - | - | - | - | - | - | - | 1.8 | - | - |
| | | *Polypedilum* | - | - | - | - | 2.5 | - | - | 7.7 | - | - | 6.6 | 0.8 | 5.5 | - | 0.9 |
| | | *Rheocricoptous* | - | 0.9 | - | - | 8.3 | 1 | - | 1.9 | - | - | - | - | 6.4 | - | - |
| | | *Rheosmittia* | - | 0.9 | - | - | 3.3 | - | - | 1 | - | - | - | - | - | - | - |
| | | *Rheotanystarsus* | - | - | - | - | - | - | - | - | - | - | 0.9 | 1.7 | - | - | - |
| | | *Stempellinella* | 2 | 0.9 | 0.9 | - | - | 1 | - | - | - | - | 0.9 | - | - | - | - |
| | | *Stenochironomus* | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Stilocladius* | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - |
| | | *Sympotthastia* | - | - | - | 0.9 | - | - | - | - | 0.9 | 5.6 | - | - | - | - | - |
| | | *Synorthocladius* | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - |
| | | *Tanytarsus* | - | - | 0.9 | - | 13.2 | 1 | 0.8 | 1 | - | - | - | - | - | - | - |
| | | *Thienemannimyia* | 1 | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - |
| | | Thienemannimyia Group | - | - | - | - | *11.6 | *2 | - | *2.9 | *0.9 | *0.8 | - | - | - | *0.8 | - |
| | | *Tribelos* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Trissopelopia* | - | - | - | - | 1.7 | - | - | - | - | - | - | - | 0.9 | - | - |
| | | *Tvetenia* | - | - | 0.9 | - | - | - | - | 1.9 | - | - | - | - | - | - | - |
| | Dolichopodidae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | *0.8 | - |
| | Empididae | *Chelifera* | - | - | - | - | - | - | - | 1 | - | - | - | - | - | 1.6 | - |
| | | *Clinocera* | - | - | 3.8 | - | - | - | - | - | - | - | - | - | - | - | 0.9 |
| | | *Hemerodromia* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | | *Neoplasta* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | Simuliidae | na | *2 | - | - | - | - | - | *4.5 | - | - | - | - | *0.8 | *0.9 | - | - |
| | | *Prosimulium* | - | 56.6 | 2.8 | 30.3 | - | | 1.7 | 1 | 17.1 | - | - | 16.5 | - | 55.3 | 29.6 |
| | | *Simulium* | 16.2 | 1.9 | 3.8 | - | 3.3 | 4 | 1.7 | 6.7 | 0.9 | - | 23.6 | - | 9.2 | 6.5 | 1.7 |
| | | *Stegopterna* | - | 1.9 | - | 7.3 | - | - | - | - | 0.9 | 0.8 | - | 0.8 | - | - | - |
| | Tabanidae | na | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - | - |
| | | *Chrysops* | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - |
| | Tipulidae | *Antocha* | - | - | 0.9 | - | - | 1 | - | - | - | - | - | - | - | - | - |
| | | *Dicranota* | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Hexatoma* | 1 | - | - | - | 2.5 | - | 0.8 | - | - | 0.8 | 1.9 | - | - | - | - |
| | | *Pseudolimnophila* | - | - | - | 0.9 | - | - | - | 1 | - | - | - | - | - | - | - |
| | | *Tipula* | 1 | - | - | 0.9 | - | - | - | - | 1.7 | - | 2.8 | - | - | 1.6 | - |
| Ephemeroptera | Ameletidae | *Ameletus* | - | - | - | - | - | - | - | - | 3.4 | 0.8 | - | - | - | - | 0.9 |
| (Mayfly) | Baetidae | *Acentrella* | 12.1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Acerpenna* | 1 | 2.8 | 22.6 | - | - | 21.2 | 2.5 | - | - | - | 4.7 | - | 6.4 | - | - |
| | | *Centroptilum* | - | - | - | - | - | - | - | 1 | - | - | - | 1.7 | - | - | - |
| | Ephemerellidae | na | - | - | - | - | - | - | - | - | - | - | *2.8 | - | - | - | - |
| | | *Ephemerella* | 13.1 | 2.8 | 6.6 | - | 0.8 | 1 | - | 1.9 | - | - | 2.8 | - | 0.9 | 0.8 | 6.1 |
| | | *Eurylophella* | - | - | 1.9 | - | 0.8 | - | - | 1.9 | - | - | - | - | 3.7 | 0.8 | - |
| | Heptageniidae | *Maccaffertium* | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - |
| | | *Stenonema* | - | - | 7.5 | - | - | 8.1 | - | - | - | - | - | - | - | - | - |
| | Leptophlebiidae | na | - | - | *0.9 | - | - | - | - | - | - | - | *1.9 | *0.8 | - | - | - |
| | Siphlonuridae | *Siphlonurus* | - | - | - | - | - | - | 1.7 | - | - | - | - | - | - | - | - |
| Isopoda | Asellidae | *Caecidotea* | - | - | - | - | 0.8 | - | - | 1.9 | 1.7 | 1.6 | 0.9 | 0.8 | 6.4 | - | 0.9 |
| (Aquatic Sow Bug) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Megaloptera | Corydalidae | *Nigronia* | - | - | - | - | - | 2 | - | 1 | - | 0.8 | - | - | - | - | - |
| (Dobsonfly/Fishfly) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Odonata | Aeshnidae | *Boyeria* | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Dragonfly/ | Gomphidae | na | - | - | *0.9 | - | - | - | - | - | - | - | - | - | - | - | - |
| Damselfly) | | *Gomphus* | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| Plecoptera | Capniidae | na | - | - | - | *0.9 | - | - | - | - | *2.6 | *2.4 | - | - | - | - | - |
| (Stonefly) | | *Allocapnia* | - | - | - | 5.5 | - | - | - | - | - | - | - | 0.8 | - | - | - |
| | Chloroperlidae | na | *4 | *1.9 | *13.2 | *0.9 | *10.7 | *2 | *2.5 | - | - | *0.8 | - | *5.8 | - | *1.6 | - |
| | | *Haploperla* | - | - | - | - | - | 5.1 | - | - | - | - | - | - | 0.9 | - | - |
| | Leuctridae | na | - | *0.9 | - | *0.9 | - | - | - | - | - | - | - | *0.8 | - | - | - |
| | | ***Leuctra***[+] | 9.1 | - | 0.9 | - | 9.9 | 4 | - | 1 | 3.4 | - | 3.8 | - | 1.8 | - | 2.6 |
| | Nemouridae | na | - | *6.6 | - | *5.5 | - | - | - | - | *2.6 | *4 | - | *4.1 | - | - | *0.9 |
| | | *Amphinemura* | 6.1 | 4.7 | 3.8 | 4.6 | - | 12.1 | 35 | 14.4 | 17.1 | 7.3 | 19.8 | 14.9 | 28.4 | 17.1 | 36.5 |
| | | *Ostrocerca* | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Prostoia* | - | - | 4.7 | 14.7 | - | - | 5 | - | 3.4 | 4 | - | 15.7 | - | - | - |
| | Perlidae | na | *1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Eccoptura* | - | - | - | - | 5 | - | - | - | - | - | - | - | - | - | - |
| | Perlodidae | na | - | *0.9 | - | *1.8 | - | - | *1.7 | - | *0.9 | *0.8 | - | *1.7 | - | *0.8 | - |
| | | *Clioperla* | - | - | 0.9 | 0.9 | - | - | - | - | 3.4 | - | - | 1.7 | - | - | - |
| | | *Isoperla* | 2 | - | 1.9 | 0.9 | - | 1 | 4.2 | 3.8 | - | - | 8.5 | 6.6 | 4.6 | 1.6 | - |
| | Taeniopterygidae | *Oemopteryx* | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Strophopteryx* | - | - | - | 5.5 | - | - | 0.8 | - | 0.9 | 1.6 | - | 1.7 | | 2.4 | 2.6 |
| Trichoptera | Hydropsychidae | *Cheumatopsyche* | - | - | - | - | - | 3 | - | - | - | - | - | - | 1.8 | - | - |
| (Caddisfly) | | *Diplectrona*[+] | - | - | - | - | - | - | - | - | - | - | - | 1.7 | 0.9 | - | - |
| | | *Hydropsyche* | - | 0.9 | - | - | - | 2 | - | - | - | - | 0.9 | - | - | - | - |
| | Lepidostomatidae | *Lepidostoma* | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - |
| | Limnephilidae | na | - | - | - | - | - | *1 | - | - | - | - | - | *0.8 | - | - | *4.3 |
| | | *Ironoquia* | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - |
| | | *Pyncopsyche* | - | - | - | - | 0.8 | 1 | - | - | - | - | - | - | - | - | - |
| | Philopotamidae | ***Wormaldia***[+] | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Odontoceridae | *Psilotreta* | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | 2.6 |
| | Rhyacophilidae | *Rhyacophila* | - | - | - | 0.9 | - | - | 0.8 | - | - | - | - | - | - | 4.9 | - |
| | Uenoidae | *Neophylax* | - | - | 0.9 | - | 1.7 | 2 | 3.3 | - | 2.6 | 2.4 | 0.9 | 12.4 | 0.9 | 1.6 | 3.5 |
| PHYLUM MOLLUSCA | | | | | | | | | | | | | | | | | |
| Veneroida | Pisidiidae | na | - | - | - | - | - | - | - | *1 | - | - | - | - | - | - | - |
| (Bivalve) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| PHYLUM NEMATOMORPHA | | | | | | | | | | | | | | | | | |
| Gordioidea | Gordiidae | na | - | - | *0.9 | - | *0.8 | - | - | - | - | - | - | - | - | - | - |
| (Worm) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| PHYLUM NEMERTEA | | | | | | | | | | | | | | | | | |
| Hoplonemertea | Tetrastemmatidae | *Prostoma* | - | - | - | - | - | 1 | - | - | - | 0.8 | - | - | - | - | - |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).
* Taxa not identified to genus
[+] Coldwater-preference genera

# *Mattawoman Creek (MATT-033-S)*

Site MATT-033-S is located on Mattawoman Creek in the Coastal Plain – western shore region of Maryland. It is in the Mattawoman Creek watershed in Charles County. This site was sampled in 1995 and 2000 to 2014.

*Mattawoman Creek in spring 2013.*

## ***Land Use/ Land Cover***

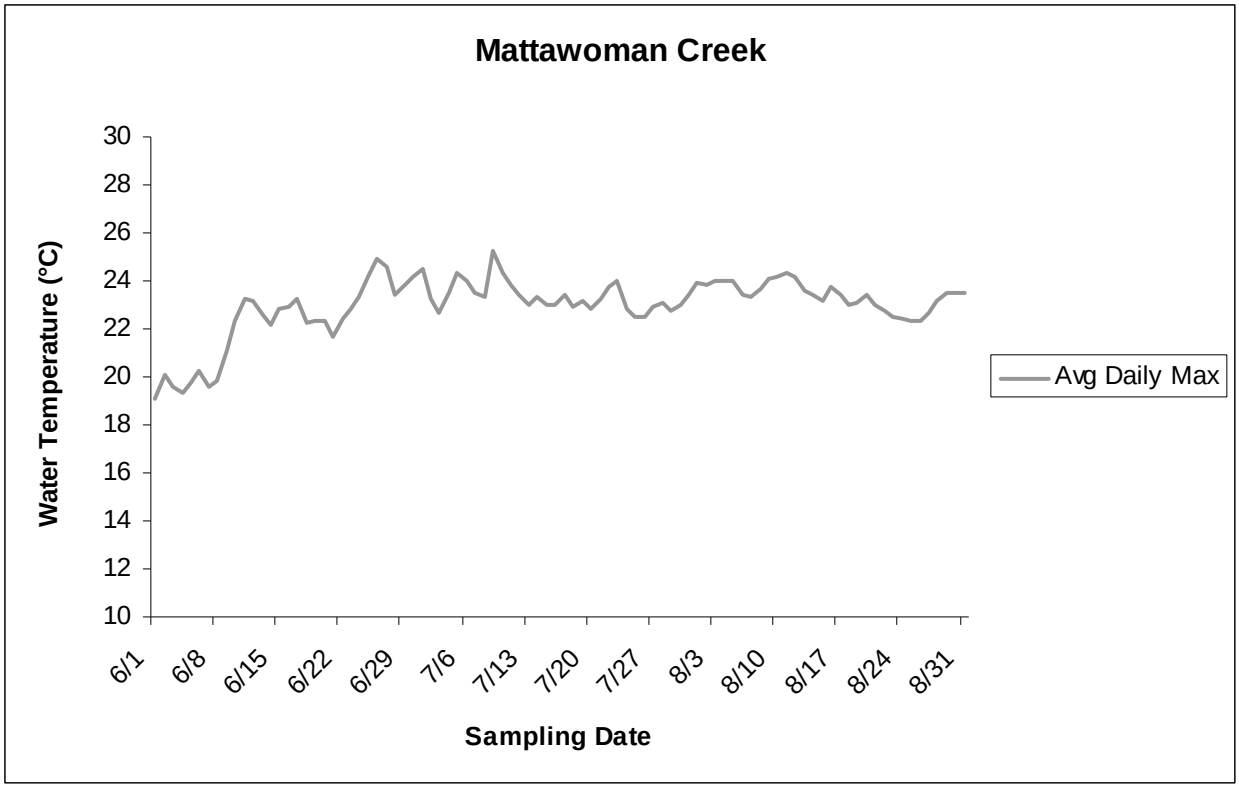
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 2.16 | 48.27 | 42.97 |
| Agriculture | 10.21 | 9.28 | 8.41 |
| Urban | 17.75 | 25.61 | 29.51 |
| Other | 69.87 | 16.85 | 19.11 |

## ***Physical Habitat***

Physical habitat measurements collected at Mattawoman Creek (2000 to 2014). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 19 | 13 | 13 | 18 | 16 | 13 | 16 | 16 | 15 | 16 | 14 | 16 | 12 | 17 | 15 |
| Epifaunal substrate (0-20) | 18 | 3 | 11 | 17 | 16 | 6 | 13 | 14 | 13 | 14 | 14 | 15 | 13 | 15 | 11 |
| Velocity/Depth Diversity (0-20) | 17 | 8 | 6 | 15 | 15 | 10 | 10 | 10 | 13 | 11 | 13 | 5 | 6 | 7 | 9 |
| Pool Quality (0-20) | 12 | 14 | 12 | 19 | 16 | 16 | 17 | 17 | 18 | 14 | 17 | 17 | 16 | 18 | 18 |
| Riffle Quality (0-20) | 13 | 0 | 0 | 14 | 15 | 0 | 0 | 0 | 12 | 6 | 12 | 0 | 0 | 0 | 0 |
| Shading (%) | 85 | 90 | 91 | 90 | 85 | 90 | 85 | 88 | 80 | 80 | 85 | 85 | 80 | 65 | 65 |
| Embeddedness (%) | 35 | 40 | 35 | 5 | 15 | 30 | 40 | 40 | 35 | 15 | 40 | 35 | 40 | 70 | 75 |
| Discharge (cfs) | 5.51 | 0.00 | 0.00 | 18.89 | 9.19 | 0.00 | 0.00 | 0.00 | 3.27 | 0.47 | 12.67 | 0.00 | 0.00 | No flow, standing pools | 0.02 |




The graph above displays the average daily maximum temperatures recorded at Mattawoman Creek. No data was available for 2012 to 2014. The average was calculated from five years of data.

***Biology***

*Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 3.86 | 3.86 | 4.14 | 3.00 | 4.43 | 4.14 | 4.71 | 5.00 | 4.43 | 4.71 | 5.00 | 4.71 | 4.71 | 3.57 | 4.43 |
| FIBI | 3.33 | 3.67 | 3.67 | 3.67 | 4.67 | 3.00 | 2.33 | 2.67 | 3.00 | 3.33 | 3.67 | 3.00 | 4.00 | 3.67 | 3.67 |

## *Fish*

Cumulative list of fish species (with abundance) collected in Mattawoman Creek by year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alewife | - | - | - | - | 39 | - | - | - | - | - | - | - | - | - | - |
| American eel | 26 | 5 | 2 | 20 | 18 | 5 | 1 | 3 | 23 | 19 | 10 | 3 | 27 | 12 | 20 |
| American shad | - | - | - | - | - | - | - | - | - | - | - | - | - | 6 | - |
| Black crappie | - | - | - | - | - | - | - | - | - | - | - | - | - | 20 | 3 |
| Bluegill | 25 | 56 | 5 | 31 | 27 | 15 | 13 | 7 | 42 | 59 | 361 | 52 | 109 | 101 | 313 |
| Bluespotted sunfish | 8 | 8 | - | - | 10 | 3 | 1 | - | 1 | 1 | 9 | - | 16 | - | 2 |
| Brown bullhead | 18 | 3 | 2 | 13 | 36 | 12 | 1 | 5 | 5 | - | 5 | 21 | 30 | 1 | 4 |
| Chain pickerel | 3 | 7 | 4 | 6 | 6 | 3 | - | 4 | 4 | 4 | 1 | 3 | 9 | 3 | 25 |
| Creek chub | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Creek chubsucker | - | 2 | 4 | - | 2 | - | - | - | - | 1 | 1 | 1 | 1 | 3 | 9 |
| Eastern blacknose dace | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Eastern mosquitofish | 16 | - | 1 | - | 3 | - | 10 | - | - | - | 4 | - | 9 | 3 | 15 |
| Eastern mudminnow | 20 | 49 | 16 | 67 | 11 | 3 | 2 | 12 | 55 | 19 | 14 | 2 | 8 | 41 | 75 |
| Eastern silvery minnow | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Gizzard Shad | - | - | - | - | - | - | - | - | - | 6 | 8 | - | - | - | - |
| Golden shiner | - | - | - | - | - | - | - | - | - | - | 5 | - | - | 4 | - |
| Green sunfish | 1 | - | - | 2 | 1 | - | - | - | 5 | 9 | 1 | - | - | - | 29 |
| Largemouth bass | - | 9 | - | 51 | - | - | - | - | 2 | 2 | 22 | - | 10 | 11 | 11 |
| Least brook lamprey | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | 1 |
| Lepomis hybrid | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| Longnose gar | - | - | - | 1 | - | - | - | - | - | - | - | - | 1 | - | - |
| Pirate perch | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Pumpkinseed | 443 | 49 | 8 | 41 | 58 | 17 | 18 | 3 | 21 | 5 | 57 | 13 | 12 | 42 | 49 |
| Redbreast sunfish | - | - | - | - | - | - | - | - | - | - | - | - | 3 | - | 4 |
| Redfin pickerel | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| Rosyside dace | - | - | - | - | - | - | - | - | - | - | - | - | - | 4 | - |
| Sea lamprey | 5 | 5 | - | - | 2 | 7 | - | - | - | - | 3 | 3 | 1 | - | 1 |
| Spotfin shiner | - | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - |
| Spottail shiner | 2 | - | 3 | 84 | 54 | - | - | - | - | - | 15 | - | 13 | 2 | - |
| Striped bass | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - |
| Tadpole madtom | 5 | 2 | - | 1 | 24 | 9 | 3 | 1 | 2 | - | 3 | 2 | 14 | 1 | 2 |
| Tessellated darter | 116 | 105 | 15 | 69 | 125 | 78 | 55 | 48 | 105 | 72 | 47 | 23 | 51 | 204 | 87 |
| Warmouth | - | 4 | - | 1 | 1 | - | - | - | - | - | 2 | - | 4 | 2 | 10 |
| White catfish | - | - | - | 4 | - | - | - | - | 1 | 7 | 3 | - | - | 2 | 2 |
| White perch | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| White sucker | 2 | 6 | - | - | 5 | - | - | - | - | - | - | - | - | 38 | 5 |
| Yellow bullhead | 1 | 1 | - | 1 | 3 | - | - | 3 | 1 | 2 | - | - | 1 | 6 | 8 |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

## *Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to Mattawoman Creek by sampling year.

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Spinycheek crayfish (*Orconectes limosus*) | A | P | A | P | P | P | P | A | P |
| Red swamp crawfish (*Procambarus clarkii*) | A | P | A | P | P | P | P | P | P |
| Devil Crawfish (*Cambarus diogenes*) | A | A | A | P | A | A | A | P | A |
| *Procambarus sp.* | A | A | A | A | P | A | P | A | A |

## *Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to Mattawoman Creek by sampling year.

| *Species* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|
| Eastern elliptio (*Elliptio complanata*) | P | P | P | P | P | P | P | P |

*Herpetofauna*

Cumulative list of herpetofauna species collected in or near the Mattawoman Creek.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | American bullfrog, Cope's gray treefrog, Eastern American toad, Eastern cricket frog, Fowler's toad, Gray treefrog, Northern green frog, Northern spring peeper, Pickerel frog, Southern leopard frog, Upland chorus frog |
| Caudata (Salamanders and Newts) | Marbled salamander, Northern two-lined salamander, Spotted Salamander |
| Squamata (Snakes and Lizards) | Common five-linked skink, Eastern garter snake, Eastern rat snake, Hog-nosed snake, Northern black racer, Plestiodon sp. |
| Testudines (Turtles) | Eastern box turtle, Eastern painted turtle, Eastern snapping turtle, Stinkpot |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in Mattawoman Creek by sampling year, RA = %Relative Abundance

| *ORDER* | *FAMILY* | *GENUS* | *2000* *RA* | *2001* *RA* | *2002* *RA* | *2003* *RA* | *2004* *RA* | *2005* *RA* | *2006* *RA* | *2007* *RA* | *2008* *RA* | *2009* *RA* | *2010* *RA* | *2011* *RA* | *2012* *RA* | *2013* *RA* | *2014* *RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | |
| Haplotaxida | Enchytraeidae | na | *0.9 | - | *1.6 | - | - | *0.9 | - | - | - | - | - | - | - | - | - |
| Lumbriculida | Lumbriculidae | na | *1.8 | - | *7.8 | *0.9 | *1.6 | - | - | *2.6 | *12 | *1 | - | - | - | - | - |
| Tubificida | Tubificidae | na | - | - | *3.1 | - | - | *0.9 | - | - | *0.9 | - | - | - | - | - | - |
| | | *Spirosperma* | - | - | 7 | - | - | - | - | - | - | 1 | - | - | - | - | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | |
| Amphipoda | na | na | - | - | - | - | - | - | - | - | - | - | *5 | - | - | - | - |
| (Scud) | Crangonyctidae | na | *4.4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Crangonyx* | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - |
| | Hyalellidae | *Hyalella* | - | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - |
| Coleoptera | Dryopidae | *Helichus* | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Beetle) | Elmidae | *Ancyronyx* | - | - | - | - | - | - | - | - | - | - | 3 | - | - | - | - |
| | | *Optioservus* | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Oulimnius* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| | | *Stenelmis* | 1.8 | 10.1 | 2.3 | 9.7 | 7.8 | 46.2 | 20.9 | 28.9 | - | 5 | 1 | 1.8 | 0.9 | - | 1.7 |
| | Hydrophilidae | *Sperchopsis* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Collembola | Isotomidae | *Isotomurus* | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - |
| (Springtail) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Decapoda | Cambaridae | *Orconectes* | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - |
| (Crayfish) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Diptera | na | na | - | - | *3.1 | - | - | - | - | - | - | - | - | - | - | - | - |
| (True Fly) | Ceratopogonidae | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Probezzia* | - | - | 1.6 | - | - | - | - | - | - | - | - | - | - | - | - |
| | Chironomidae | na | - | - | - | *1.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Ablabesmyia* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | 0.9 | - | - |
| | | *Brillia* | - | 2.5 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | Chironomini | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Cladotanytarsus* | - | - | - | - | - | - | - | - | - | - | 1 | - | 0.9 | - | - |
| | | *Conchapelopia* | 1.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Corynoneura* | - | - | - | - | - | - | - | - | - | - | - | - | 2.7 | - | - |
| | | *Cricotopus* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | | *Eukiefferiella* | 1.8 | 5 | 0.8 | - | - | - | 0.9 | - | - | 7 | - | - | 0.9 | - | - |
| | | *Heterotrissocladius* | - | - | 1.6 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Hydrobaenus* | - | - | 21.1 | - | - | - | 7 | - | 8.3 | 13 | - | 4.4 | 0.9 | - | - |
| | | *Labrundinia* | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - |
| | | *Microtendipes* | - | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - |
| | | *Nanocladius* | - | - | - | - | 0.8 | - | - | 0.9 | - | - | - | - | 1.8 | - | - |
| | | *Natarsia* | - | - | 0.8 | - | - | - | - | - | 0.9 | - | - | - | - | - | - |
| | | Orthocladiinae | *0.9 | *0.8 | *1.6 | *1.8 | - | - | *0.9 | - | *0.9 | *6 | - | *2.7 | - | 6.5 | - |
| | | *Orthocladius* | - | - | 10.9 | - | - | - | 1.7 | 2.6 | 1.9 | 8 | 1 | 0.9 | 8.9 | - | - |
| | | *Paralauterborniella* | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| | | *Paramerina* | - | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - |
| | | *Parametriocnemus* | - | - | 0.8 | - | 0.8 | - | - | - | - | - | - | - | - | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Polypedilum* | - | - | - | - | 1.6 | - | - | - | - | - | 2 | - | 0.9 | - | 0.9 |
| | | *Potthastia* | - | 0.8 | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| | | *Rheosmittia* | - | 0.8 | - | - | - | 0.9 | - | 1.8 | - | - | - | - | - | - | - |
| | | *Rheotanytarsus* | - | - | - | - | - | - | - | - | 0.9 | 1 | - | 0.9 | 6.3 | - | - |
| | | Smittia | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - |
| | | *Stempellinella* | - | - | - | - | - | 0.9 | 1.7 | 1.8 | - | 1 | 2 | 2.7 | - | - | - |
| | | *Stenochironomus* | - | - | 0.8 | - | - | - | - | - | - | - | 2 | - | - | - | - |
| | | *Sympotthastia* | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - |
| | | Tanypodinae | - | - | *0.8 | - | - | - | - | - | - | *1 | *2 | *0.9 | - | - | - |
| | | Tanytarsini | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Tanytarsus* | 0.9 | - | - | - | - | 1.9 | 0.9 | 3.5 | - | - | 1 | - | 1.8 | - | - |
| | | *Thienemanniella* | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| | | Thienemannimyia Group | - | - | - | - | - | *1.9 | - | - | - | - | *2 | - | - | - | - |
| | | *Trissopelopia* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | | *Tvetenia* | - | 1.7 | - | - | - | - | 2.6 | - | 11.1 | 2 | - | 8 | - | 4.8 | - |
| | | *Zarvelimyia* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | Empididae | *Clinocera* | - | - | 0.8 | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| | | *Hemerodromia* | - | 0.8 | 0.8 | - | 2.3 | - | - | - | - | - | - | - | - | - | - |
| | Simuliidae | *Prosimulium* | - | 31.9 | 4.7 | 63.7 | - | - | 11.3 | - | 4.6 | - | - | - | - | 0.8 | - |
| | | *Simulium* | 10.5 | - | - | 0.9 | 22.5 | 1.9 | - | - | - | - | - | - | - | - | 7.8 |
| | | *Stegopterna* | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - |
| | Tabanidae | *Chrysops* | - | - | 1.6 | - | - | - | - | - | - | - | - | - | - | - | - |
| | Tipulidae | na | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - | - |
| | | *Ormosia* | - | - | 1.6 | 0.9 | - | - | - | - | - | 1 | - | - | - | - | - |
| | | *Tipula* | - | 0.8 | - | - | - | - | - | - | 0.9 | - | - | 0.9 | - | - | 0.9 |
| Ephemeroptera | Ameletidae | *Ameletus* | - | - | 0.8 | - | - | - | 3.5 | 0.9 | 0.9 | - | - | 5.3 | - | 0.8 | - |
| (Mayfly) | Baetidae | na | - | *1.7 | - | - | - | - | *0.9 | - | - | *1 | *3 | *0.9 | - | - | - |
| | | *Acentrella* | 36.8 | - | - | - | 6.2 | - | - | - | - | - | 19 | - | - | - | - |
| | | *Acerpenna* | - | - | - | - | 1.6 | 3.8 | - | 2.6 | - | - | - | 1.8 | 5.4 | - | - |
| | | *Centroptilum* | - | - | - | - | - | - | - | 0.9 | - | - | 1 | 0.9 | 2.7 | - | - |
| | | *Plauditus* | - | - | - | - | - | - | - | - | - | - | 15 | - | - | - | 24.1 |
| | Caenidae | *Caenis* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| | Ephemerellidae | *Attenella* | 14.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | 7.8 |
| | | *Dannella* | - | - | - | - | - | - | - | - | - | - | 6 | - | - | - | - |
| | | *Ephemerella* | 0.9 | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - |
| | | *Eurylophella* | - | - | 0.8 | - | - | - | 1.7 | 4.4 | - | 3 | - | - | - | - | - |
| | | *Timpanoga* | - | - | - | - | 12.4 | - | - | - | - | - | - | - | - | - | - |
| | Heptageniidae | *Leucrocuta* | - | - | - | - | 0.8 | - | - | 0.9 | - | - | - | - | 0.9 | - | - |
| | | *Maccaffertium* | - | - | - | - | - | - | - | - | - | - | - | - | 2.7 | - | - |
| | | *Stenonema* | - | - | - | - | 0.8 | 6.6 | - | 1.8 | - | - | - | - | - | - | - |
| | Leptophlebiidae | na | - | - | - | - | - | - | *1.7 | - | - | - | *1 | - | - | - | - |
| | | ***Paraleptophlebia***[+] | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| | Siphlonuridae | *Siphlonurus* | - | - | - | - | - | 2.8 | 1.7 | - | 7.4 | 11 | - | 3.5 | 0.9 | 2.4 | - |
| Isopoda | Asellidae | *Caecidotea* | 8.8 | - | 1.6 | 1.8 | 1.6 | - | - | - | - | - | 21 | - | 0.9 | 3.2 | 0.9 |
| (Aquatic Sow Bug) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Lepidoptera | Noctuidae | na | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (Moth) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Odonata | Aeshnidae | *Basiaeschna* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| (Dragonfly/ | Calopterygidae | *Calopteryx* | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - |
| Damselfly) | Corduliidae | na | - | - | - | - | - | - | - | *0.9 | - | - | *2 | - | - | - | - |
| | | *Somatochlora* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| Plecoptera | Capniidae | na | - | - | - | *0.9 | - | - | - | - | - | - | - | - | *0.9 | - | - |
| (Stonefly) | | *Allocapnia* | - | 1.7 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Paracapnia* | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - |
| | Chloroperlidae | ***Haploperla*** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 |
| | Leuctridae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | - | *0.9 |
| | | ***Leuctra***[+] | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | 0.8 | 0.9 |
| | Nemouridae | na | - | *1.7 | - | - | - | - | - | - | - | - | - | *2.7 | - | *0.8 | - |
| | | *Amphinemura* | 7.9 | 0.8 | - | - | - | - | 0.9 | 1.8 | 4.6 | 1 | - | 1.8 | 8.0 | 30.6 | 40.5 |
| | | *Prostoia* | - | - | - | 1.8 | - | - | 3.5 | - | 5.6 | - | - | 4.4 | 3.6 | - | - |
| | Perlidae | na | - | - | *0.8 | - | - | *0.9 | *1.7 | - | - | *1 | - | *4.4 | - | - | *0.9 |
| | | *Perlesta* | 5.3 | - | 5.5 | - | 10.9 | - | - | - | - | - | - | 4.4 | - | 3.2 | - |
| | Perlodidae | na | - | - | *3.1 | *0.9 | - | *3.8 | - | - | - | - | - | - | *0.9 | - | - |
| | | *Clioperla* | - | - | - | 3.5 | - | - | 0.9 | - | - | - | - | - | - | - | - |
| | | *Isoperla* | 0.9 | 1.7 | 1.6 | 3.5 | 10.9 | 8.5 | 24.3 | 38.6 | 15.7 | 8 | - | 26.5 | 31.3 | 33.9 | 6.9 |
| | Taeniopterygidae | *Oemopteryx* | - | 2.5 | 3.1 | 0.9 | - | - | - | 0.9 | - | 3 | - | - | - | - | - |
| | | *Taeniopteryx* | - | - | 0.8 | 0.9 | - | - | - | - | 0.9 | - | - | 2.7 | 1.8 | 0.8 | 0.9 |
| | | *Strophopteryx* | - | 7.6 | - | 5.3 | - | - | 4.3 | - | 14.8 | 7 | - | 8.8 | 8.0 | 8.9 | - |
| Trichoptera | Glossosomatidae | *Agapetus* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Caddisfly) | | *Protoptila* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 |
| | Hydropsychidae | *Cheumatopsyche* | - | 17.6 | - | - | 11.6 | 11.3 | - | - | - | - | - | - | - | - | - |
| | | *Hydropsyche* | - | 5.9 | - | - | 3.9 | - | - | - | - | - | - | - | - | - | - |
| | Lepidostomatidae | *Lepidostoma* | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| | Leptoceridae | *Ceraclea* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 |
| | | *Triaenodes* | - | - | - | - | 0.8 | 0.9 | - | - | - | - | - | - | - | - | - |
| | Limnephilidae | na | - | *0.8 | - | *2.7 | - | - | - | - | *0.9 | - | - | *8 | - | *0.8 | - |
| | | *Ironoquia* | - | - | 0.8 | - | - | 0.9 | - | - | - | 13 | 1 | - | - | - | 0.9 |
| | Philopotamidae | *Chimarra* | - | - | - | - | 1.6 | - | - | - | - | - | - | - | - | - | - |
| | Rhyacophilidae | *Rhyacophila* | - | - | - | - | - | - | 0.9 | 0.9 | - | - | - | - | - | 0.8 | 0.9 |
| | Uenoidae | *Neophylax* | - | 0.8 | - | - | - | 0.9 | - | - | - | 1 | - | - | - | - | - |
| PHYLUM MOLLUSCA | | | | | | | | | | | | | | | | | |
| Architaenioglossa | Viviparidae | *Campeloma* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | 0.9 | - | - |
| Basommatophora | Physidae | *Physa* | - | - | - | - | - | - | - | - | 0.9 | 3 | - | - | 0.9 | - | - |
| (Snail) | Planorbidae | *Menetus* | - | - | 0.8 | - | - | - | 0.9 | - | - | 1 | - | - | - | - | - |
| Veneroida | Pisidiidae | *Sphaerium* | - | - | 0.8 | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| (Bivalve) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| PHYLUM NEMERTEA | | | | | | | | | | | | | | | | | |
| Hoplonemertea | Tetrastemmatidae | *Prostoma* | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | 0.9 |
| (Roundworm) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus [+] Coldwater-preference genera

# *Mill Run (Nanjemoy Creek, NANJ-331-S)*

Site NANJ-331-S is located on Mill Run in the Coastal Plain – western shore region of Maryland. It is in the Nanjemoy Creek watershed in Charles County. This site was sampled in 1995 and 2000 to 2014.

***Mill Run in spring 2013.***

## ***Land Use/ Land Cover***

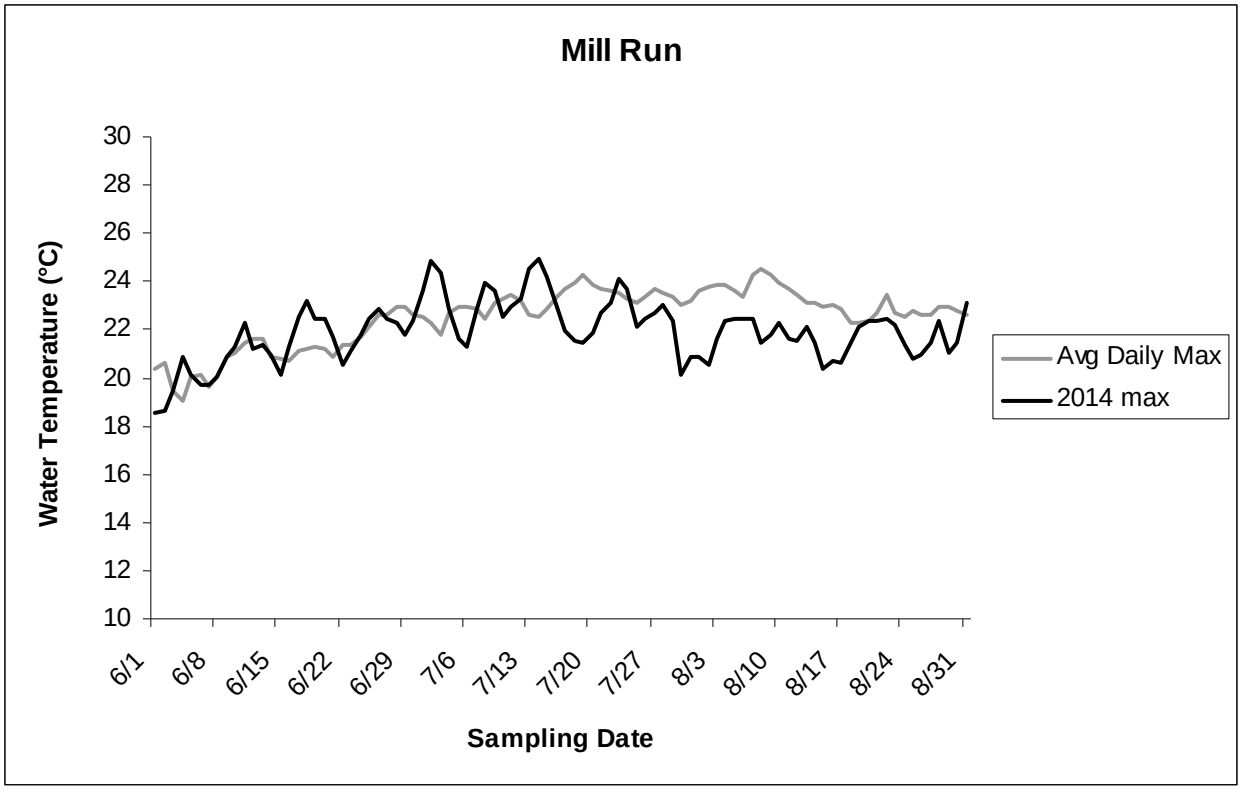
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 20.24 | 72.52 | 70.08 |
| Agriculture | 0.73 | 11.61 | 11.46 |
| Urban | 7.02 | 7.18 | 8.26 |
| Other | 72.00 | 8.69 | 10.19 |

## ***Physical Habitat***

Physical habitat measurements collected at Mill Run (2000 to 2014). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 13 | 15 | 7 | 13 | 11 | 15 | 12 | 14 | 10 | 14 | 14 | 15 | 15 | 14 | 16 |
| Epifaunal substrate (0-20) | 11 | 10 | 7 | 14 | 13 | 10 | 9 | 8 | 7 | 9 | 12 | 12 | 16 | 17 | 14 |
| Velocity/Depth Diversity (0-20) | 15 | 13 | 2 | 14 | 12 | 7 | 11 | 11 | 11 | 12 | 14 | 14 | 14 | 13 | 15 |
| Pool Quality (0-20) | 16 | 15 | 6 | 15 | 16 | 16 | 11 | 14 | 12 | 14 | 15 | 16 | 17 | 17 | 16 |
| Riffle Quality (0-20) | 7 | 8 | 0 | 12 | 12 | 0 | 6 | 8 | 11 | 7 | 12 | 13 | 8 | 10 | 8 |
| Shading (%) | 94 | 95 | 95 | 92 | 85 | 93 | 90 | 95 | 85 | 85 | 95 | 90 | 90 | 80 | 75 |
| Embeddedness (%) | 80 | 40 | 100 | 40 | 30 | 40 | 80 | 60 | 40 | 45 | 75 | 20 | 40 | 85 | 85 |
| Discharge (cfs) | 1.32 | 0.74 | 0.00 | 12.07 | 1.40 | 0.00 | 3.10 | 1.34 | 1.75 | 1.06 | 2.11 | 0.47 | 0.92 | 0.73 | 0.65 |




The above graph displays the average daily maximum temperatures recorded at Mill Run. No data was available for 2012. The average was calculated from nine years of data.

***Biology***

*Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 3.86 | 4.71 | 4.71 | 3.29 | 5.00 | 5.00 | 4.71 | 4.71 | 4.71 | 4.43 | 4.71 | 5.00 | 4.71 | 4.14 | 4.14 |
| FIBI | 4.00 | 3.67 | 3.67 | 2.33 | 4.00 | 4.67 | 4.00 | 3.67 | 2.67 | 4.00 | 3.33 | 3.00 | 4.00 | 4.00 | 3.67 |

## *Fish*

Cumulative list of fish species (with abundance) collected in Mill Run by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| American eel | 4 | - | 1 | - | 3 | 2 | 1 | 4 | 5 | 5 | - | 8 | 4 | 6 | 16 |
| Bluegill | 3 | 3 | 5 | 3 | 8 | 5 | 13 | 1 | 2 | 53 | 8 | 8 | 8 | 10 | 9 |
| Bluespotted sunfish | - | - | 3 | - | - | - | 1 | - | - | - | - | - | - | - | - |
| Brown bullhead | 2 | 2 | 72 | 3 | 4 | 2 | - | 1 | - | - | - | 2 | - | 2 | - |
| Chain pickerel | 1 | 1 | - | 1 | - | - | - | - | - | - | - | - | - | - | - |
| Creek chub | 3 | 4 | 23 | - | - | 5 | 4 | - | 2 | 2 | 2 | 4 | 3 | 46 | 4 |
| Creek chubsucker | 3 | 7 | 5 | - | 1 | 1 | 1 | - | - | 7 | 4 | 32 | 5 | 9 | 7 |
| Eastern blacknose dace | - | 4 | - | - | 31 | - | - | 2 | - | 23 | 3 | 7 | 1 | 7 | 20 |
| Eastern mosquitofish | 42 | 1 | 55 | - | - | 8 | 38 | - | - | - | 2 | - | - | 4 | - |
| Eastern mudminnow | 2 | 14 | 142 | 9 | 24 | 19 | 4 | 15 | 27 | 12 | 32 | 13 | 11 | 64 | 50 |
| Eastern silvery minnow | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| Flier | - | - | - | - | - | - | - | - | 1 | 4 | 1 | 1 | - | - | - |
| Golden shiner | - | - | 1 | 1 | 31 | 28 | - | - | - | - | - | 2 | - | 19 | 1 |
| Green Sunfish | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 8 | 9 |
| Largemouth bass | 7 | - | - | - | 4 | 2 | - | - | 2 | 1 | - | - | - | 4 | 8 |
| Least brook lamprey | - | - | 3 | - | 1 | 1 | 2 | - | - | 1 | 3 | - | 1 | 1 | 3 |
| Margined madtom | 2 | - | 6 | - | - | - | - | - | - | - | - | - | - | - | - |
| Pirate perch | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| Pumpkinseed | 4 | 5 | 2 | - | 17 | 4 | 1 | 5 | - | 8 | 6 | 4 | 1 | - | - |
| Redbreast sunfish | 1 | 2 | - | - | - | - | 1 | - | - | 2 | - | 1 | - | - | 1 |
| Rosyside dace | - | 2 | 4 | - | 2 | - | - | - | - | - | - | - | - | 5 | 1 |
| Satinfin shiner | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - |
| Sea lamprey | - | - | - | - | 3 | 36 | 7 | 11 | 3 | - | 2 | - | - | - | 1 |
| Spottail shiner | - | - | - | 5 | 3 | 23 | - | - | - | - | - | - | 10 | - | 8 |
| Swallowtail shiner | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - |
| Tessellated darter | 24 | 13 | 1 | - | 38 | 12 | 9 | 5 | 21 | 16 | 4 | - | 8 | 72 | 29 |
| White sucker | 17 | 4 | 9 | 7 | 13 | 9 | 2 | - | 2 | 10 | - | 4 | 10 | 38 | 22 |
| Yellow bullhead | 1 | - | 3 | 2 | 4 | 2 | 9 | - | 1 | 7 | - | 1 | 1 | 9 | 8 |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

## *Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to Mill Run by sampling year.

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Common Crayfish (*Cambarus bartonii bartonii*) | A | A | A | P | A | A | P | P | P |
| Devil crayfish (*Cambarus diogenes*) | A | A | P | A | P | A | A | P | A |
| Spinycheek crayfish (*Orconectes limosus*) | P | P | A | P | P | P | P | P | P |
| Red swamp crawfish (*Procambarus clarkii*) | P | P | A | P | P | P | P | P | P |
| Digger crayfish (*Falicambarus fodiens*) | A | A | A | A | A | A | P | A | A |

## *Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in Mill Run by sampling year.

| *Species* |
|---|
| None Observed |

*Herpetofauna*

Cumulative list of herpetofauna species collected in or near Mill Run.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | American bullfrog, Eastern American toad, Eastern cricket frog, Fowler's toad, Northern green frog, Northern spring peeper, Pickerel frog, Southern leopard frog, Upland chorus frog, Wood frog |
| Caudata (Salamanders and Newts) | Northern two-lined salamander, Spotted salamander |
| Squamata (Snakes and Lizards) | Common five-linked skink, Eastern rat snake, Northern ring-necked snake, Northern watersnake |
| Testudines (Turtles) | Eastern snapping turtle |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in Mill Run by sampling year, RA = %Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | |
| Haplotaxida | Naididae | na | - | - | - | - | - | - | - | - | *1 | - | - | - | - | - | - |
| Lumbriculida | Lumbriculidae | na | - | - | - | - | *1.9 | - | - | *1 | *1 | *0.8 | - | *2.6 | - | *0.9 | *0.9 |
| Tubificida | Tubificidae | na | - | - | - | *0.8 | - | *1.9 | - | - | *1 | - | - | - | - | *1.8 | - |
| | | *Limnodrilus* | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | |
| Amphipoda | Crangonyctidae | na | *1.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Scud) | | *Crangonyx* | - | - | | - | 0.9 | - | | - | - | - | - | - | 0.9 | - | - |
| | | *Synurella* | - | - | 0.9 | 0.8 | 0.9 | - | 0.9 | 1.9 | 1 | 1.6 | 0.8 | 0.9 | 1.7 | - | 1.8 |
| Coleoptera | Dryopidae | *Helichus* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| (Beetle) | Dytiscidae | *Neoporus* | - | - | - | - | - | 0.9 | - | - | 1 | - | - | 0.9 | - | - | - |
| | Elmidae | *Ancyronyx* | - | - | - | - | - | 1.9 | 3.5 | 6.8 | - | - | 3.4 | - | - | - | - |
| | | *Dubiraphia* | - | - | - | - | - | - | 0.9 | 1 | - | - | - | - | - | - | - |
| | | *Macronychus* | - | - | - | - | - | 0.9 | - | 4.9 | - | - | - | 1.7 | - | - | - |
| | | *Optioservus* | - | 4.2 | 8.8 | 0.8 | - | - | 0.9 | - | - | - | - | 2.6 | - | - | 0.9 |
| | | *Oulimnius* | 2.8 | 16.7 | 9.6 | 5.5 | - | - | - | - | - | - | - | - | 0.9 | - | 0.9 |
| | | *Stenelmis* | - | 1 | - | - | - | 0.9 | - | 1 | - | - | 0.8 | 0.9 | - | 0.9 | 0.9 |
| | Gyrinidae | *Dineutus* | - | - | - | - | 1.9 | - | - | - | - | - | - | - | - | - | - |
| | | *Gyrinus* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 |
| | Psephenidae | *Psephenus* | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - |
| Decapoda | Palaemonidae | *Palaemonetes* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| (Shrimp) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Diptera | Ceratopogonidae | na | - | - | *0.9 | - | *1.9 | - | - | - | - | - | - | - | - | - | - |
| (True fly) | | *Bezzia* | - | - | - | - | - | - | - | - | 1 | - | - | - | - | 0.9 | - |
| | | *Probezzia* | - | - | - | - | - | - | - | 3.9 | 3.8 | - | - | - | - | - | - |
| | Chironomidae | *Ablabesmyia* | - | - | - | - | 2.8 | 0.9 | 1.7 | 1 | 1.9 | 0.8 | - | 0.9 | - | - | - |
| | | Chironomini | - | *1 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Chironomus* | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - |
| | | *Cladotanytarsus* | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Conchapelopia* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Cricotopus* | - | - | 5..3 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Dicrotendipes* | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - |
| | | *Diplocladius* | - | - | - | - | - | - | 0.9 | 1 | 5.7 | 0.8 | - | 0.9 | - | - | - |
| | | *Eukiefferiella* | - | 3.1 | - | 0.8 | - | 0.9 | - | - | - | - | - | - | 0.9 | 1.8 | - |
| | | *Heterotrissocladius* | - | - | - | - | - | 0.9 | - | 1 | - | - | - | - | - | - | - |
| | | *Hydrobaenus* | - | - | 0.9 | - | 0.9 | 0.9 | 22.6 | 6.8 | 26.7 | 0.8 | - | 8.5 | 1.7 | 4.5 | - |
| | | *Limnophyes* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 |
| | | *Micropsectra* | - | - | 3.5 | - | - | 0.9 | - | - | - | 0.8 | - | - | - | - | - |
| | | *Microtendipes* | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Nanocladius* | - | - | 1.8 | - | - | - | 1.7 | - | - | - | 0.8 | 1.7 | - | - | - |
| | | Orthocladiinae | - | *5.1 | *2.6 | *0.8 | - | - | - | *1.9 | - | *0.8 | - | - | - | - | - |
| | | *Orthocladius* | - | - | 5.3 | - | 1.9 | - | 12.2 | 4.9 | 5.7 | 2.4 | - | 2.6 | 0.9 | 5.4 | 0.9 |
| | | *Paracladopelma* | - | - | - | - | 0.9 | - | - | - | - | 0.8 | - | - | - | - | - |
| | | *Parakiefferiella* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Paralauterborniella* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | | *Paramerina* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| | | *Parametriocnemus* | - | - | 7 | - | 1.9 | - | 3.5 | 1.9 | - | - | - | 0.9 | - | 1.8 | - |
| | | *Paraphaenocladius* | - | - | - | - | 0.9 | - | 1.7 | 1 | - | - | - | - | - | - | - |
| | | *Paratanytarsus* | - | - | 0.9 | - | - | - | - | 1 | 1 | 0.8 | - | - | - | - | - |
| | | *Phaenopsectra* | - | - | - | - | - | - | - | 1.9 | 1 | - | - | - | - | - | - |
| | | *Polypedilum* | - | 1 | - | - | 0.9 | - | - | 1.9 | - | - | 2.5 | - | 0.9 | - | - |
| | | *Potthastia* | - | 1 | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| | | *Procladius* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| | | *Psectrocladius* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Pseudorthocladius* | - | - | - | - | - | 1.9 | - | - | - | - | - | - | - | - | - |
| | | *Rheocricotopus* | - | - | 0.9 | - | 2.8 | 1.9 | 2.6 | 5.8 | - | - | - | - | 0.9 | - | - |
| | | *Rheosmittia* | - | 8.3 | - | - | 1.9 | 7.5 | - | - | - | - | - | - | - | - | - |
| | | *Rheotanytarsus* | - | - | - | - | - | - | - | - | - | - | 0.8 | 1.7 | 1.7 | 0.9 | 0.9 |
| | | *Stempellinella* | - | - | - | - | 0.9 | - | - | - | 1.9 | - | - | 0.9 | - | - | - |
| | | *Stenochironomus* | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - |
| | | *Symposiocladius* | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - |
| | | *Sympotthastia* | - | - | - | - | - | - | - | - | - | - | - | 1.7 | - | - | - |
| | | Tanypodinae | - | - | - | - | - | *2.8 | - | - | *1 | - | - | *6 | - | - | - |
| | | *Tanytarsus* | - | - | 3.5 | - | 7.5 | 1.9 | 0.9 | - | 1.9 | - | 2.5 | 0.9 | - | - | - |
| | | Tanytarsini | - | - | - | - | - | - | - | - | *1 | - | - | - | - | - | - |
| | | Thienemannimyia Group | - | - | - | *0.8 | *7.5 | *1.9 | *1.7 | *1.9 | *1 | - | - | *6.8 | - | *1.8 | - |
| | | *Tribelos* | - | 1 | 0.9 | - | 0.9 | - | - | - | - | - | - | - | 0.9 | - | - |
| | | *Trissopelopia* | - | - | - | - | 0.9 | 0.9 | 0.9 | 3.9 | - | - | 1.7 | - | 0.9 | - | - |
| | | *Tvetenia* | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Unniella* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | | *Xylotopus* | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| | | *Zavrelia* | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| | | *Zavrelimyia* | - | - | - | - | - | - | 0.9 | - | 1.9 | - | - | - | 0.9 | - | - |
| | Empididae | *Clinocera* | - | - | - | - | - | - | - | - | - | - | - | - | - | 2.7 | - |
| | Simuliidae | *Prosimulium* | - | 5.2 | - | 9.4 | - | - | - | 1 | - | - | - | 2.6 | - | - | - |
| | | *Simulium* | 12 | - | - | - | - | 0.9 | - | - | - | - | 7.6 | - | - | - | - |
| | | *Stegopterna* | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | Tabanidae | na | - | - | - | - | - | - | - | - | *1.9 | - | - | - | - | - | - |
| | | *Chrysops* | - | - | - | - | - | - | - | - | 1.9 | - | 0.8 | - | - | - | - |
| | Tipulidae | na | - | - | - | - | *0.9 | - | - | - | - | - | - | - | - | - | - |
| | | *Hexatoma* | - | 2.1 | 0.9 | - | - | - | - | - | 1 | - | - | - | - | - | - |
| | | *Ormosia* | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - |
| | | *Pilaria* | - | - | - | - | - | - | - | - | 1.9 | - | - | - | - | - | - |
| | | *Pseudolimnophila* | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - |
| | | *Tipula* | - | 1 | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| Ephemeroptera (Mayfly) | Ameletidae | *Ameletus* | - | - | - | 0.8 | - | - | - | 1 | 1.9 | 0.8 | - | - | 0.9 | - | - |
| | Baetidae | na | - | - | - | - | - | - | *3.5 | - | *1 | - | - | - | - | - | - |
| | | *Acentrella* | 10.2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Acerpenna* | - | 11.5 | 26.3 | - | 11.3 | 7.5 | - | 8.7 | - | 1.6 | - | - | 4.3 | - | 1.8 |
| | | *Centroptilum* | - | - | - | - | - | - | - | - | - | 1.6 | - | - | 2.6 | - | - |
| | Ephemerellidae | na | - | - | - | - | - | - | *0.9 | - | - | - | *0.8 | *1.7 | - | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Ephemerella* | 66.7 | 13.5 | 0.9 | - | 6.6 | 5.7 | - | 2.9 | 3.8 | - | 14.4 | 1.7 | 23.3 | 52.3 | 66.7 |
| | | *Eurylophella* | 1.9 | - | 0.9 | - | 4.7 | 7.5 | 0.9 | 11.7 | 1.9 | 12.2 | 1.7 | - | - | - | 1.8 |
| | Heptageniidae | na | - | *2.1 | - | - | - | *6.6 | - | - | - | - | - | - | - | - | - |
| | | *Maccaffertium* | - | - | - | - | - | - | - | - | - | - | 5.1 | - | 0.9 | - | 0.9 |
| | | *Stenonema* | 0.9 | - | 5.3 | - | 8.5 | 7.5 | - | 1 | - | - | - | - | - | - | - |
| | Leptophlebiidae | na | - | - | - | - | - | - | *7.8 | - | *1.9 | - | - | *1.7 | - | - | - |
| | | *Leptophlebia* | - | - | - | - | 0.9 | - | - | - | - | 8.1 | - | - | 0.9 | - | - |
| | | ***Paraleptophlebia*** [+] | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| | Metretopodidae | *Siphloplecton* | - | - | - | - | - | - | - | 1.9 | - | - | - | - | - | - | - |
| | Siphlonuridae | *Siphlonurus* | - | - | - | - | - | - | 7.8 | - | 7.6 | 52.8 | - | 7.7 | 1.7 | - | - |
| Hemiptera | Corixidae | na | - | - | - | - | - | - | - | - | *1 | - | - | - | - | - | - |
| (True bug) | Nepidae | *Ranatra* | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Isopoda | Asellidae | *Caecidotea* | - | 1 | - | 0.8 | - | 2.8 | - | 1 | - | 3.3 | 0.8 | 6 | - | - | 0.9 |
| (Aquatic Sow Bug) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Lepidoptera | na | na | - | - | - | - | - | - | - | *1 | - | - | - | - | - | - | - |
| (Moth) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Megaloptera | Corydalidae | *Nigronia* | - | - | - | - | - | 0.9 | - | - | - | - | - | 0.9 | - | - | - |
| (Dobsonfly/Fishfly) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Odonata | Aeshnidae | *Boyeria* | - | - | - | - | - | - | - | - | - | 0.8 | 0.8 | - | - | - | - |
| (Dragonfly/ | Calopterygidae | *Calopteryx* | - | - | - | - | 1.9 | 0.9 | - | - | - | - | - | - | - | - | - |
| Damselfly ) | Gomphidae | na | - | - | *0.9 | - | - | - | - | *1 | - | - | - | - | - | - | - |
| | | *Dromogomphus* | - | - | - | - | - | 1.9 | - | - | - | - | - | - | - | - | - |
| Plecoptera | Capniidae | na | - | - | - | *2.3 | - | - | - | - | - | - | - | - | - | - | - |
| (Stonefly) | | *Allocapnia* | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - |
| | Chloroperlidae | na | - | *2.1 | *2.6 | - | *1.9 | *0.9 | - | - | - | - | - | - | *2.6 | - | - |
| | Leuctridae | ***Leuctra*** [+] | - | 1 | - | - | - | - | 0.9 | 1 | - | - | 2.5 | - | - | - | - |
| | Nemouridae | na | - | *4.2 | - | *25.8 | - | - | - | - | *1 | - | - | - | *1.7 | - | - |
| | | *Amphinemura* | 1.9 | - | 1.8 | 0.8 | 1.9 | 3.8 | 3.5 | - | - | - | 33.1 | 0.9 | 8.6 | 1.8 | 1.8 |
| | | *Ostrocerca* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| | | *Prostoia* | - | - | 1.8 | 39.1 | - | - | 3.5 | 1 | - | - | - | 6 | - | 15.3 | - |
| | Perlidae | na | - | *1 | - | - | *0.9 | - | *0.9 | - | - | - | *0.8 | - | - | - | - |
| | | *Eccoptura* | - | 2.1 | - | - | 10.4 | - | - | - | - | - | - | - | - | - | - |
| | Perlodidae | na | - | *1 | - | *4.7 | *0.9 | - | - | - | - | - | - | - | - | - | - |
| | | *Clioperla* | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| | | *Diploperla* | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - |
| | | *Isoperla* | - | 4.2 | - | - | 0.9 | - | 2.6 | 1 | 2.9 | - | 11 | 17.1 | 30.2 | 15.3 | 4.4 |
| | Taeniopterygidae | na | - | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - |
| | | *Oemopteryx* | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Strophopteryx* | - | - | 0.9 | 2.3 | - | - | - | - | - | - | - | 0.9 | 1.7 | 0.9 | - |
| Trichoptera | Hydropsychidae | na | - | - | - | - | - | *0.9 | - | - | - | - | - | - | - | - | - |
| (Caddisfly) | | *Cheumatopsyche* | - | 2.1 | 4.4 | - | - | 12.3 | - | 1.9 | - | - | 0.8 | - | 1.7 | - | 0.9 |
| | | *Diplectrona* [+] | - | - | - | - | 0.9 | - | 0.9 | 1 | - | - | 0.8 | - | - | - | - |
| | | *Hydropsyche* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | 1.7 | - | - |
| | Lepidostomatidae | *Lepidostoma* | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - |
| | Leptoceridae | na | - | - | - | - | - | - | - | - | - | *5.7 | - | - | - | - | - |
| | | *Triaenodes* | - | - | - | - | - | 1.9 | 0.9 | 1 | - | - | - | 5.1 | 1.7 | - | - |
| | Limnephilidae | na | - | - | - | - | - | - | *0.9 | - | *4.8 | - | - | - | - | *0.9 | - |

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Ironoquia* | - | - | - | - | 2.8 | 0.9 | 0.9 | - | - | - | 0.8 | - | - | 1.8 | 0.9 |
| | | *Pycnopsyche* | - | - | - | - | 1.9 | 0.9 | - | 1.9 | - | - | 0.8 | - | - | - | - |
| | Odontoceridae | *Psilotreta* | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| | Phryganeidae | *Ptilostomis* | - | - | - | - | - | 0.9 | 0.9 | - | - | - | - | - | - | - | - |
| | Polycentropodidae | *Polycentropus* | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - |
| | Psychomyiidae | *Lype* | - | - | - | - | 0.9 | 0.9 | - | - | - | - | - | - | 0.9 | - | - |
| | Uenoidae | *Neophylax* | - | 2.1 | - | 1.6 | - | - | - | 1 | - | - | - | 0.9 | - | 1.8 | 7 |
| PHYLUM MOLLUSCA | | | | | | | | | | | | | | | | | |
| Bassommatiphora (Snail) | Physidae | *Physa* | - | - | - | - | - | - | - | - | - | 1 | 0.8 | - | - | - | - |
| | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Veneroida (Bivalve) | Pisidiidae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | - | *4.4 |
| | | *Musculium* | - | - | - | - | - | - | 0.9 | 1 | - | - | - | - | - | - | - |
| Gordioidea (Worm) | Gordiidae | na | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hoplonemertea (Roundworm) | Tetrastemmatidae | *Prostoma* | - | - | - | - | - | 0.9 | 0.9 | - | - | - | - | 0.9 | - | 0.9 | - |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).
* Taxa not identified to genus
+ Coldwater-preference genera

## *(PRMT-177-S)*

Site PRMT-177-S is located on an unnamed tributary to Red Run in the Eastern Piedmont region of Maryland. It is in the Gywnns falls watershed in Baltimore County. This site was first sampled in 2013.


*Reeder Run in spring 2013.*

### ***Land Use/ Land Cover***

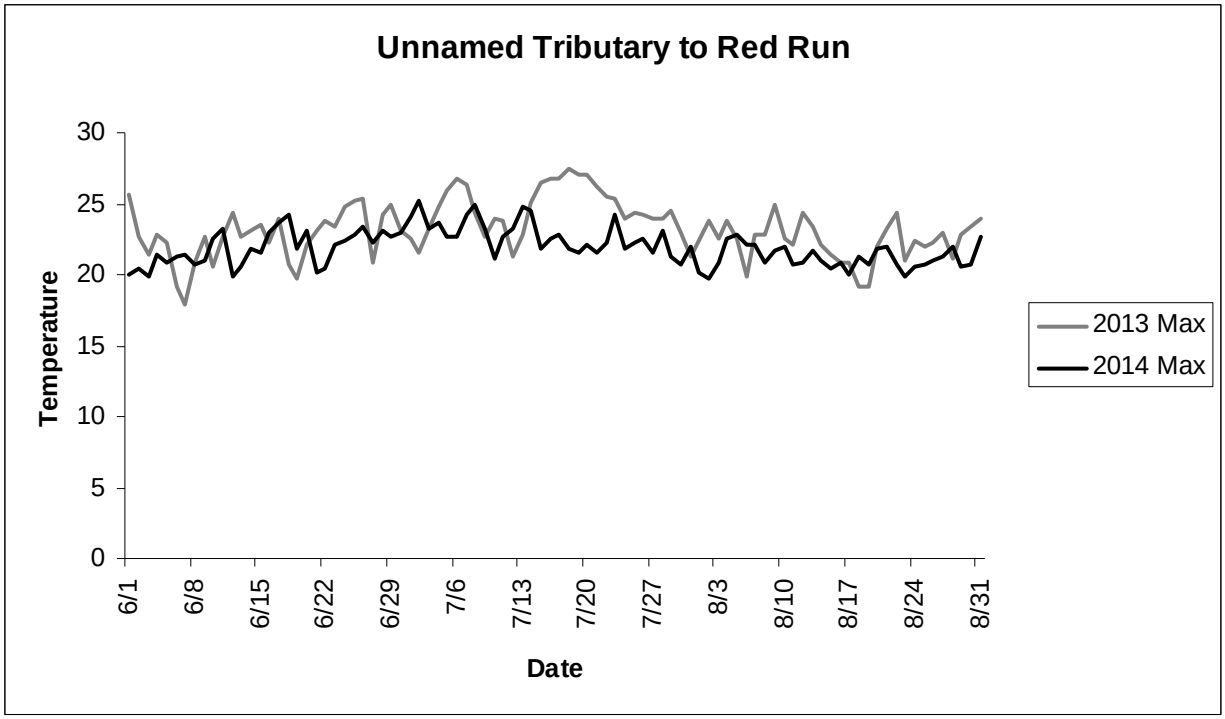
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 90.79 | 82.80 | 72.95 |
| Agriculture | 0.00 | 2.85 | 2.87 |
| Urban | 1.62 | 12.55 | 13.69 |
| Other | 7.59 | 1.79 | 10.49 |

### ***Physical Habitat***

Physical habitat measurements collected at Reeder Run. Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2013* | *2014* |
|---|---|---|
| Instream habitat (0-20) | 18 | 13 |
| Epifaunal substrate (0-20) | 17 | 14 |
| Velocity/Depth Diversity (0-20) | 12 | 13 |
| Pool Quality (0-20) | 17 | 11 |
| Riffle Quality (0-20) | 11 | 8 |
| Shading (%) | 50 | 70 |
| Embeddedness (%) | 40 | 80 |
| Discharge (cfs) | 0.11 | 0.20 |




The graph above displays the average daily maximum temperatures recorded at Reeder Run for 2013 and 2014.

## ***Biology***

*Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2013* | *2014* |
|---|---|---|
| BIBI | 4.71 | 5.00 |
| FIBI | 4.67 | 4.67 |

*Fish*

Cumulative list of fish species (with abundance) collected in the unnamed tributary to Red Run by sampling year.

| *Species* | *2013* | *2014* |
|---|---|---|
| American eel | *8* | *17* |
| Chain pickerel | 1 | - |
| Creek chub | 2 | 1 |
| Creek chubsucker | 15 | 14 |
| Eastern blacknose dace | 6 | 12 |
| Eastern mudminnow | 17 | 30 |
| Golden shiner | 8 | 1 |
| Least brook lamprey | 17 | 3 |
| Lepomis hybrid | 3 | 1 |
| Margined madtom | - | 1 |
| Pumpkinseed | 2 | - |
| Redbreast sunfish | 96 | 43 |
| Rosyside dace | 1 | 8 |
| Tessellated darter | 4 | 2 |
| Yellow bullhead | - | 1 |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

## *Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to Red Run by sampling year

| *Species* | *2013* | *2014* |
|---|---|---|
| Common crayfish (*Orconectes limosus*) | P | P |
| (Procambarus clarkia) | P | A |

## *Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in Reeder Run by sampling year.

| *Species* |
|---|
| None Observed |

## *Herpetofauna*

Cumulative list of herpetofauna species collected in or near Reeder Run.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | Pickerel frog, Eastern American toad, Northern green frog, Northern spring peeper, Gray treefrog or Cope's gray treefrog, |
| Caudata (Salamanders and Newts) | Northern two-lined salamander |
| Squamata (Snakes and Lizards) | Eastern wormsnake, Plestrodon sp. |
| Testudines (Turtles) | Stinkpot turtle, Red-eared slider |

## *Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in Reeder Run by sampling year, RA = %Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|
| PHYLUM ARTHROPODA | | | | |
| Coleoptera | Dryopidae | *Helichus* | - | 0.8 |
| | Dytiscidae | na | - | *0.8 |
| | Ptilodactylidae | *Anchytarsus* | - | 0.8 |
| Diptera (True Fly) | Ceratopogonidae | na | - | *0.8 |
| | | *Bezzia* | 4.5 | - |
| | | *Ceratopogon* | 1.8 | - |
| | Chironomidae | *Cricotopus* | 0.9 | 0.8 |
| | | *Micropsectra* | 0.9 | - |
| | | *Microtendipes* | 0.9 | - |
| | | *Orthocladius* | 0.9 | - |
| | | *Parametriocnemus* | 4.5 | 5.7 |
| | | *Polypedilum* | 2.7 | 0.8 |
| | | *Stempellina* | 2.7 | - |
| | | *Stempellinella* | - | 4.1 |
| | | *Tanypodinae* | 0.9 | - |
| | | *Tanytarsus* | 0.9 | 4.9 |
| | | *Thienemanniella* | - | 0.8 |
| | | Thienemannimyia Group | *0.9 | - |
| | | *Tribelos* | 0.9 | - |
| | | *Trissopelopia* | 0.9 | 0.8 |
| | | *Unniella* | - | 0.8 |
| | Simuliidae | *Prosimulium* | 2.7 | 1.6 |
| | | *Simulium* | 2.7 | 6.5 |
| | | *Stegopterna* | 29.5 | 1.6 |
| | Tabanidae | *Chrysops* | 0.9 | - |
| | Tipulidae | *Hexatoma* | - | 0.8 |
| | | *Pseudolimnophila* | - | 4.1 |

| *ORDER* | *FAMILY* | *GENUS* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|
| Ephemeroptera | Baetidae | *Acerpenna* | 8.0 | 7.3 |
| (Mayfly) | | *Centroptilum* | - | 1.6 |
| | Ephemerellidae | *Eurylophella* | - | 0.8 |
| | Heptageniidae | *Maccaffertium* | 2.7 | 3.3 |
| Megaloptera | Corydalidae | *Nigronia* | 2.7 | 0.8 |
| (Dobsonfly/Fishfly) | | | - | - |
| Odonata | Aeshnidae | *Boyeria* | - | 1.6 |
| | Gomphidae | na | - | *1.6 |
| Plecoptera | Leuctridae | na | - | *3.3 |
| (Stonefly) | Nemouridae | *Amphinemura* | - | 3.3 |
| | Perlodidae | *Isoperla* | 0.9 | - |
| Trichoptera | Hydropsychidae | *Cheumatopysche* | 13.4 | 8.1 |
| (Caddisfly) | | ***Diplectrona***[+] | 2.7 | 4.1 |
| | | *Hydropsyche* | 8.0 | 26 |
| | Hydroptilidae | *Oxyethira* | - | 0.8 |
| | Odontoceridae | *Psilotreta* | 0.9 | - |
| | Philopotamidae | *Chimarra* | 0.9 | - |
| PHYLUM NEMERTEA | | | | |
| Hoplonemertea | Tetrastemmatidae | *Prostoma* | - | 0.8 |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus

[+] Cold-preference genera

## *Unnamed Tributary to St. Clements Creek (STCL-051-S)*

Site STCL-051-S is located on an unnamed tributary to St. Clements Creek in the Coastal Plain – western shore region of Maryland. It is in the St. Clements Bay watershed in St. Mary's County. This site was sampled in 1995 and 2000 to 2014.


***Unnamed tributary to St. Clements Creek in spring 2013.***

### ***Land Use/ Land Cover***

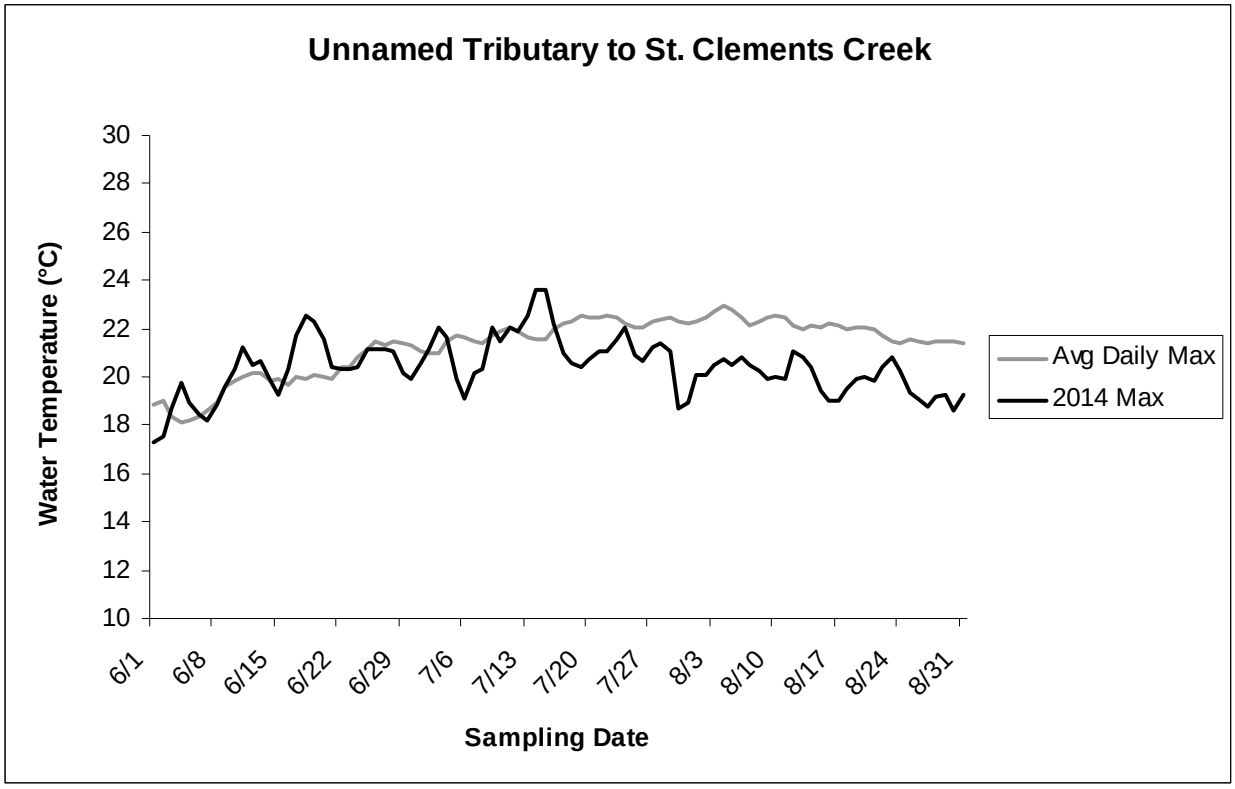
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 64.44 | 69.81 | 67.34 |
| Agriculture | 0.00 | 18.05 | 17.61 |
| Urban | 1.46 | 6.07 | 6.60 |
| Other | 34.10 | 6.07 | 8.45 |

### ***Physical Habitat***

Physical habitat measurements collected at the unnamed tributary to St. Clements Creek (2000 to 2013). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 14 | 18 | 14 | 14 | 11 | 14 | 14 | 13 | 17 | 15 | 12 | 13 | 13 | 17 | 15 |
| Epifaunal substrate (0-20) | 13 | 16 | 15 | 14 | 13 | 14 | 15 | 16 | 14 | 9 | 12 | 12 | 15 | 17 | 17 |
| Velocity/Depth Diversity (0-20) | 5 | 13 | 8 | 12 | 11 | 8 | 6 | 4 | 7 | 6 | 10 | 10 | 5 | 11 | 12 |
| Pool Quality (0-20) | 10 | 15 | 7 | 15 | 12 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 15 | 12 |
| Riffle Quality (0-20) | 6 | 11 | 7 | 14 | 11 | 8 | 7 | 6 | 7 | 7 | 10 | 10 | 7 | 10 | 8 |
| Shading (%) | 95 | 95 | 95 | 95 | 92 | 91 | 92 | 95 | 75 | 80 | 90 | 90 | 90 | 90 | 60 |
| Embeddedness (%) | 40 | 25 | 30 | 40 | 20 | 30 | 40 | 15 | 40 | 45 | 85 | 20 | 20 | 55 | 50 |
| Discharge (cfs) | 0.11 | 0.16 | 0.01 | 0.40 | 0.12 | 0.17 | 0.09 | 0.02 | 0.10 | 0.02 | 0.02 | 0.03 | 0.04 | 0.08 | 0.08 |




The above graph displays the average daily maximum temperatures recorded at the unnamed tributary to St. Clements Creek. The average was calculated from fourteen years of data.

## ***Biology***

### *Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 4.43 | 5.00 | 4.14 | 4.43 | 5.00 | 4.71 | 4.71 | 5.00 | 4.14 | 4.43 | 4.71 | 3.29 | 4.71 | 4.14 | 5.00 |
| FIBI | 3.33 | 3.67 | 3.33 | 3.67 | 3.67 | 3.67 | 3.33 | 4.00 | 1.67 | 3.67 | 3.00 | 3.67 | 4.00 | 4.00 | 4.00 |

### *Fish*

Cumulative list of fish species (with abundance) collected in the unnamed tributary to St. Clements Creek by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| American eel | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Creek chubsucker | - | 2 | - | 2 | 2 | 4 | - | 2 | - | 2 | - | 4 | 4 | 37 | 8 |
| Eastern blacknose dace | 26 | 95 | 34 | 13 | 179 | 143 | 59 | 118 | 41 | 82 | 131 | 31 | 60 | 98 | 63 |
| Eastern mudminnow | 51 | 80 | 54 | 42 | 73 | 59 | 42 | 37 | 12 | 11 | 35 | 36 | 49 | 202 | 120 |
| Fallfish | 2 | 8 | - | - | - | - | - | 2 | - | - | 15 | 2 | 1 | 2 | 8 |
| Least brook lamprey | 5 | 2 | 3 | 7 | 20 | 11 | 7 | 28 | - | 1 | - | 5 | 3 | 12 | 7 |
| Pirate perch | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Redbreast sunfish | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 3 | 2 |
| Sea lamprey | - | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - |
| Tessellated darter | - | 3 | - | - | 1 | 2 | - | 2 | 4 | - | 3 | - | 1 | 6 | 5 |

Green indicates in tolerant fish; blue are moderately tolerant; and red are tolerant.

*Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to St. Clements Creek by sampling year.

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Spinycheek crayfish (*Orconectes limosus*) | P | P | A | A | P | P | P | P | P |
| Devil crawfish (*Cambarus diogenes*) | A | P | A | P | A | A | A | P | A |

*Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to St. Clements Creek by sampling year.

| *Species* |
|---|
| None Observed |

*Herpetofauna*

Cumulative list of herpetofauna species collected in or near the unnamed tributary to St. Clements Creek.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | American bullfrog, Eastern American toad, Fowler's toad, Northern green frog, Northern spring peeper, Pickerel frog, Southern leopard frog, Wood frog |
| Caudata (Salamanders and Newts) | Northern red salamander, Northern two-lined salamander, Spotted salamander |
| Squamata (Snakes and Lizards) | Northern black racer, Northern watersnake |
| Testudines (Turtles) | Eastern box turtle |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in the unnamed tributary to St. Clements Creek by sampling year, RA = %Relative Abundance

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | |
| Haplotaxida | Naididae | na | *6 | - | - | - | - | - | - | - | *1.1 | - | - | - | - | - | - |
| Lumbriculida | Lumbriculidae | na | *2.6 | *0.9 | - | - | *0.9 | - | - | - | - | - | *0.9 | - | - | - | *0.8 |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | |
| Amphipoda | na | na | - | - | - | - | - | - | - | - | - | - | *4.4 | - | - | - | - |
| (Scud) | Crangonyctidae | na | *4.3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Crangonyx* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | 0.8 | - |
| | | *Synurella* | - | 1.8 | - | 6 | 5.7 | 0.9 | - | 1.8 | - | - | 0.9 | - | 1.7 | - | - |
| | Gammaridae | *Gammarus* | - | 0.9 | - | - | 4.7 | 2.8 | - | 4.5 | - | - | - | - | - | - | 0.8 |
| Coleoptera | Dryopidae | *Helichus* | - | - | - | - | - | - | 0.8 | 0.9 | - | - | - | - | - | - | - |
| (Beetle) | Dytiscidae | na | - | - | - | - | - | - | - | - | *1.1 | - | - | - | - | - | - |
| | Elmidae | na | - | - | - | *0.9 | - | - | *1.7 | - | - | - | - | - | - | - | - |
| | | *Ancyronyx* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 |
| | | *Dubiraphia* | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - |
| | | *Microcylloepus* | - | - | - | - | - | 2.8 | - | - | - | - | - | - | - | - | - |
| | | *Oulimnius* | 8.5 | 5.3 | 17.2 | 6.8 | - | 4.6 | 1.7 | 0.9 | - | 10.9 | 2.7 | - | 2.6 | 0.8 | 4.8 |
| | | *Stenelmis* | 1.7 | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | Gerridae | *Trepobates* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Gyrinidae | *Dineutus* | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - |
| | Hydrochidae | *Hydrochus* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | Hydrophilidae | *Helochares* | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - |
| | | *Hydrobius* | - | - | - | - | - | - | - | - | 1.1 | - | - | - | - | - | - |
| | Psephenidae | *Psephenus* | 0.9 | - | 1.6 | 1.7 | - | - | 0.8 | 1.8 | - | 0.8 | 1.8 | 0.8 | - | - | 1.6 |
| | Ptilodactylidae | *Anchytarsus* | 1.7 | 1.8 | 8.2 | - | 1.9 | 7.4 | 5.9 | 3.6 | 4.2 | 4.2 | 0.9 | - | - | 0.8 | - |
| Collembola | Isotomidae | *Isotomurus* | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| Diptera | Ceratopogonidae | na | - | - | - | *1.7 | - | - | - | - | *2.1 | - | - | - | - | - | - |
| (True fly) | | *Bezzia* | - | - | - | - | - | - | - | - | 1.1 | - | - | - | - | 0.8 | - |
| | | *Ceratopogon* | - | - | - | - | 0.9 | - | - | - | - | 0.8 | - | - | - | - | - |
| | | *Culicoides* | - | - | - | - | - | - | - | - | 2.1 | - | - | - | - | - | - |
| | | *Probezzia* | 0.9 | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - |
| | | *Stilobezzia* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | Chironomidae | *Ablabesmyia* | - | - | - | - | 1.9 | - | - | 0.9 | - | - | - | - | - | - | - |
| | | *Brillia* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - |
| | | *Conchapelopia* | 4.3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Corynoneura* | - | 1.8 | - | - | - | - | - | 1.8 | 5.3 | - | - | - | - | - | - |
| | | *Diplocladius* | - | - | - | - | - | - | - | - | - | - | - | 0.8 | 0.9 | - | - |
| | | *Eukiefferiella* | 0.9 | 2.7 | - | 1.7 | - | - | - | - | 1.1 | - | 0.9 | - | - | - | - |
| | | ***Heleniella***$^{+}$ | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | | *Hydrobaenus* | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | 2.4 |
| | | *Labrundinia* | - | - | - | - | - | 0.9 | 0.8 | - | - | - | - | - | - | - | - |
| | | *Micropsectra* | - | 10.6 | - | - | - | 0.9 | 0.8 | 1.8 | - | 2.5 | 0.9 | - | 0.9 | 4.9 | 14.4 |
| | | *Microtendipes* | - | - | - | - | 2.8 | - | - | - | - | - | - | - | 0.9 | 0.8 | - |
| | | *Monodiamesa* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Nanocladius* | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - |
| | | Orthocladiinae | - | *1.8 | - | *2.6 | - | - | *0.8 | *2.7 | - | - | - | - | - | - | 0.8 |
| | | *Orthocladius* | - | - | - | - | 2.8 | - | 0.8 | 1.8 | - | - | 3.5 | - | 2.6 | - | 2.4 |
| | | *Parametriocnemus* | 6.8 | 1.8 | - | - | 0.9 | - | 1.7 | 0.9 | - | 0.8 | - | - | - | 1.6 | 3.2 |
| | | *Paraphaenocladius* | - | - | - | - | - | - | - | - | 3.2 | - | - | - | - | - | - |
| | | *Polypedilum* | 0.9 | 0.9 | - | - | 2.8 | - | - | - | - | - | 1.8 | - | - | - | 0.8 |
| | | *Potthastia* | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Procladius* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | | *Rheocricotopus* | - | - | - | - | 4.7 | - | - | - | - | - | 1.8 | - | 0.9 | 0.8 | 2.4 |
| | | *Rheotanytarsus* | - | - | - | - | - | - | - | - | - | 1.7 | - | - | - | 1.6 | - |
| | | *Stempellinella* | - | - | - | - | - | - | 1.7 | - | - | 0.8 | 1.8 | - | - | 0.8 | - |
| | | *Symposiocladius* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | | *Sympotthastia* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - |
| | | Tanypodinae | *4.3 | - | - | - | - | *0.9 | *1.7 | *1.8 | *3.2 | - | - | - | - | *0.8 | - |
| | | Tanytarsini | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Tanytarsus* | - | - | - | - | 6.6 | - | - | 0.9 | - | - | - | - | - | 2.5 | - |
| | | *Thienemanniella* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | 0.9 | - | - |
| | | Thienemannimyia Group | - | - | - | *0.9 | *7.5 | *4.6 | *0.8 | *1.8 | - | - | - | - | - | - | - |
| | | *Trissopelopia* | - | - | 0.8 | - | 9.4 | 1.9 | 0.8 | 0.9 | - | - | - | - | 1.7 | 0.8 | 1.6 |
| | | *Tvetenia* | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | 1.6 | 0.8 |
| | | *Zavrelimyia* | 5.1 | - | - | - | - | - | 0.8 | 0.9 | 9.5 | - | - | 1.6 | 0.9 | - | - |
| | Dixidae | ***Dixa***[+] | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Dixella* | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - |
| | Simuliidae | *Prosimulium* | - | 24.8 | - | 9.4 | - | - | 1.7 | 0.9 | 24.2 | - | - | 72.6 | 52.6 | 13.9 | 6.4 |
| | | *Simulium* | 12.8 | - | - | - | 2.8 | - | - | 0.9 | - | - | 15.9 | - | - | - | - |
| | | *Stegopterna* | - | 7.1 | 0.8 | 17.9 | - | - | 1.7 | 0.9 | 2.1 | - | - | 16.9 | 2.6 | - | - |
| | Tabanidae | na | - | - | - | - | - | - | - | - | *2.1 | - | - | - | - | - | - |
| | Tipulidae | na | - | - | - | - | *0.9 | - | - | - | - | - | - | - | - | - | - |
| | | *Dicranota* | - | - | 2.5 | - | - | - | - | - | 1.1 | - | - | - | - | - | - |
| | | *Hexatoma* | - | - | 0.8 | - | 0.9 | - | 0.8 | 2.7 | - | - | 3.5 | - | 0.9 | - | 0.8 |
| | | *Pilaria* | - | - | - | - | - | - | - | - | 2.1 | - | - | - | - | - | - |
| | | *Pseudolimnophila* | 0.9 | - | - | - | 0.9 | 2.8 | - | - | - | 1.7 | - | - | - | - | - |
| | | *Tipula* | 1.7 | 0.9 | - | 7.7 | 0.9 | 0.9 | 0.8 | - | - | - | 0.9 | 0.8 | - | - | - |
| Ephemeroptera (Mayfly) | Ameletidae | *Ameletus* | - | - | - | - | - | - | - | 0.9 | 2.1 | - | - | - | 0.9 | - | - |
| | Baetidae | na | *0.9 | - | - | - | - | - | *2.5 | - | - | - | - | - | - | - | - |
| | | *Acentrella* | 1.7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Acerpenna* | - | 8 | 8.2 | - | 4.7 | 8.3 | 1.7 | 2.7 | - | 16.8 | - | - | 5.2 | 31.1 | 1.6 |
| | Ephemerellidae | na | - | - | - | - | - | - | - | - | *1.1 | - | - | - | - | - | - |
| | | *Ephemerella* | 4.3 | 8 | 32.8 | 6 | 3.8 | 13 | 29.4 | 4.5 | 1.1 | 27.7 | 6.2 | - | 6.0 | 5.7 | 14.4 |
| | | *Eurylophella* | 0.9 | - | 1.6 | - | 0.9 | 0.9 | 2.5 | - | - | - | - | - | 0.9 | - | - |
| | Heptageniidae | *Maccaffertium* | - | - | - | - | - | - | - | - | - | 1.7 | 1.8 | - | 0.9 | - | 1.6 |
| | | *Stenonema* | - | 0.9 | 1.6 | - | 1.9 | 5.6 | 0.8 | 0.9 | - | - | - | - | - | - | - |
| | Leptophlebiidae | na | - | - | - | *0.9 | *0.9 | - | - | *1.8 | - | - | *2.7 | - | *0.9 | - | *1.6 |
| | | ***Habrophlebia***[+] | - | - | 2.5 | - | - | 1.9 | - | - | - | - | 0.9 | - | - | - | - |
| | | *Leptophlebia* | - | 0.9 | - | 0.9 | 0.9 | - | 0.8 | - | 5.3 | - | - | - | - | - | - |
| | | ***Paraleptophlebia***[+] | 14.5 | 4.4 | - | - | - | 2.8 | - | 3.6 | - | - | - | 0.8 | - | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Siphlonuridae | *Siphlonurus* | - | - | - | - | - | - | - | - | 1.1 | - | - | - | - | - | - |
| Isopoda | Asellidae | *Caecidotea* | 2.6 | - | - | 1.7 | - | 0.9 | - | 2.7 | - | - | 0.9 | - | 0.9 | - | 0.8 |
| (Aquatic Sow bug) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Megaloptera | Corydalidae | *Nigronia* | - | - | - | - | 1.9 | - | 0.8 | 0.9 | - | 0.8 | - | - | 0.9 | - | - |
| (Dobsonfly/Fishfly) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Odonata | Aeshnidae | *Boyeria* | - | - | - | - | - | 0.9 | - | 1.8 | - | - | - | - | - | - | - |
| (Dragonfly/ | Calopterygidae | *Calopteryx* | - | - | - | - | 1.9 | 0.9 | - | - | - | - | - | - | - | - | - |
| Damselfly) | Cordulegastridae | *Cordulegaster* | - | - | - | - | - | 1.9 | - | - | 1.1 | - | - | 0.8 | - | - | - |
| | Gomphidae | na | *0.9 | - | *2.5 | - | - | - | - | - | - | *1.7 | - | - | - | - | *0.8 |
| | | *Arigomphus* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Lanthus* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 |
| | | *Stylogomphus* | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| Plecoptera | Capniidae | na | - | - | - | - | - | - | *0.8 | - | *2.1 | - | - | - | - | - | - |
| (Stonefly) | | *Allocapnia* | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| | | *Paracapnia* | - | - | - | 17.1 | - | - | - | - | - | - | - | - | - | - | - |
| | Chloroperlidae | na | *0.9 | *5.3 | *6.6 | *0.9 | *1.9 | - | - | - | - | - | - | - | - | - | - |
| | | *Haploperla* | - | - | - | - | - | 10.2 | 7.6 | 20.7 | - | 7.6 | 22.1 | - | 6.0 | 10.7 | 5.6 |
| | Leuctridae | ***Leuctra***[+] | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Nemouridae | na | - | - | - | *4.3 | - | - | *1.7 | - | - | - | - | *0.8 | - | - | - |
| | | *Amphinemura* | 1.7 | - | 1.6 | 0.9 | 4.7 | 1.9 | 5.9 | 2.7 | - | 10.1 | 4.4 | - | 1.7 | 17.2 | 9.6 |
| | | *Ostrocerca* | - | - | - | 4.3 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Prostoia* | - | - | - | - | - | - | 5 | - | - | - | - | - | - | - | - |
| | Perlidae | na | - | - | *0.8 | - | *0.9 | - | - | *0.9 | - | - | - | - | - | - | - |
| | | *Eccoptura* | - | 2.7 | - | - | 3.8 | - | - | - | - | - | 1.8 | - | - | - | 0.8 |
| | Perlodidae | na | *5.1 | - | - | *0.9 | *0.9 | - | - | - | *13.7 | - | - | - | - | - | - |
| | | *Clioperla* | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Isoperla* | - | 0.9 | - | 0.9 | - | - | - | 2.7 | - | 0.8 | - | - | 0.9 | - | - |
| Trichoptera | Brachycentridae | *Brachycentrus* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Caddisfly) | Calamoceratidae | *Anisocentropus* | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - |
| | Goeridae | *Goera* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 |
| | Hydropsychidae | na | - | - | - | - | - | *0.9 | - | - | - | - | - | - | - | - | - |
| | | *Cheumatopsyche* | - | - | 6.6 | - | - | 1.9 | - | 0.9 | - | 1.7 | 0.9 | - | - | - | 4 |
| | | *Diplectrona*[+] | - | 2.7 | 0.8 | - | 1.9 | 1.9 | - | - | - | 5 | 5.3 | - | 0.9 | - | - |
| | | *Hydropsyche* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 |
| | Lepidostomatidae | *Lepidostoma* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | Leptoceridae | na | - | - | - | - | - | - | *0.8 | - | - | - | - | - | *0.9 | - | - |
| | | *Triaenodes* | - | - | - | - | - | - | 0.8 | 0.9 | - | - | - | - | - | - | - |
| | Limnephilidae | na | - | *1.8 | - | *1.7 | - | - | - | *0.9 | *1.1 | - | *0.9 | *0.8 | - | - | - |
| | | *Ironoquia* | - | - | - | - | 2.8 | 2.8 | - | 1.8 | - | - | - | - | - | - | 0.8 |
| | | *Pycnopsyche* | - | - | - | - | 1.9 | 2.8 | - | 5.4 | - | 0.8 | - | - | - | - | - |
| | Philopotamidae | *Dolophilodes* | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| | | ***Wormaldia***[+] | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - |
| | Phryganeidae | *Ptilostomis* | - | - | - | 0.9 | - | - | 1.7 | - | 1.1 | - | - | - | - | - | - |
| | Polycentropodidae | *Polycentropus* | - | - | - | - | 0.9 | 0.9 | - | - | - | - | - | - | - | - | - |
| | Psychomyiidae | *Lype* | - | - | 0.8 | - | - | 0.9 | - | 0.9 | - | - | - | 1.6 | - | - | 0.8 |
| | Odontoceridae | *Psilotreta* | - | - | - | - | 0.9 | - | - | 3.6 | - | - | 2.7 | - | - | - | 0.8 |
| | Rhyacophilidae | *Rhyacophila* | - | - | - | 0.9 | - | - | 1.7 | - | - | - | - | - | - | - | - |

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sericostomatidae | *Agarodes* | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - |
| | Uenoidae | *Neophylax* | - | 0.9 | - | - | - | 3.7 | 1.7 | 1.8 | 1.1 | 0.8 | 1.8 | 0.8 | - | - | 9.6 |
| PHYLUM MOLLUSCA | | | | | | | | | | | | | | | | | |
| Veneroida | Pisidiidae | na | - | - | - | - | - | - | *0.8 | - | - | - | - | - | - | - | - |
| (Bivalve) | | *Musculium* | - | - | - | - | - | - | - | - | 3.2 | - | - | - | - | - | - |
| PHYLUM NEMERTEA | | | | | | | | | | | | | | | | | |
| Hoplonemertea | Tetrastemmatidae | *Prostoma* | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - |
| PHYLUM PLATYHELMINTHES | | | | | | | | | | | | | | | | | |
| Tricladida | Planariidae | *Phagocata* | 1.7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Flatworm) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus

+ Coldwater-preference genera

# *Swanson Creek (PAXL-294-S)*

Site PAXL-294-S is located on Swanson Creek in the Coastal Plain – western shore region of Maryland. It is in the Lower Patuxent River watershed in Charles County. This site was sampled in 1997 and 2000 to 2014.



*Swanson Creek in spring 2013.*

## ***Land Use/ Land Cover***

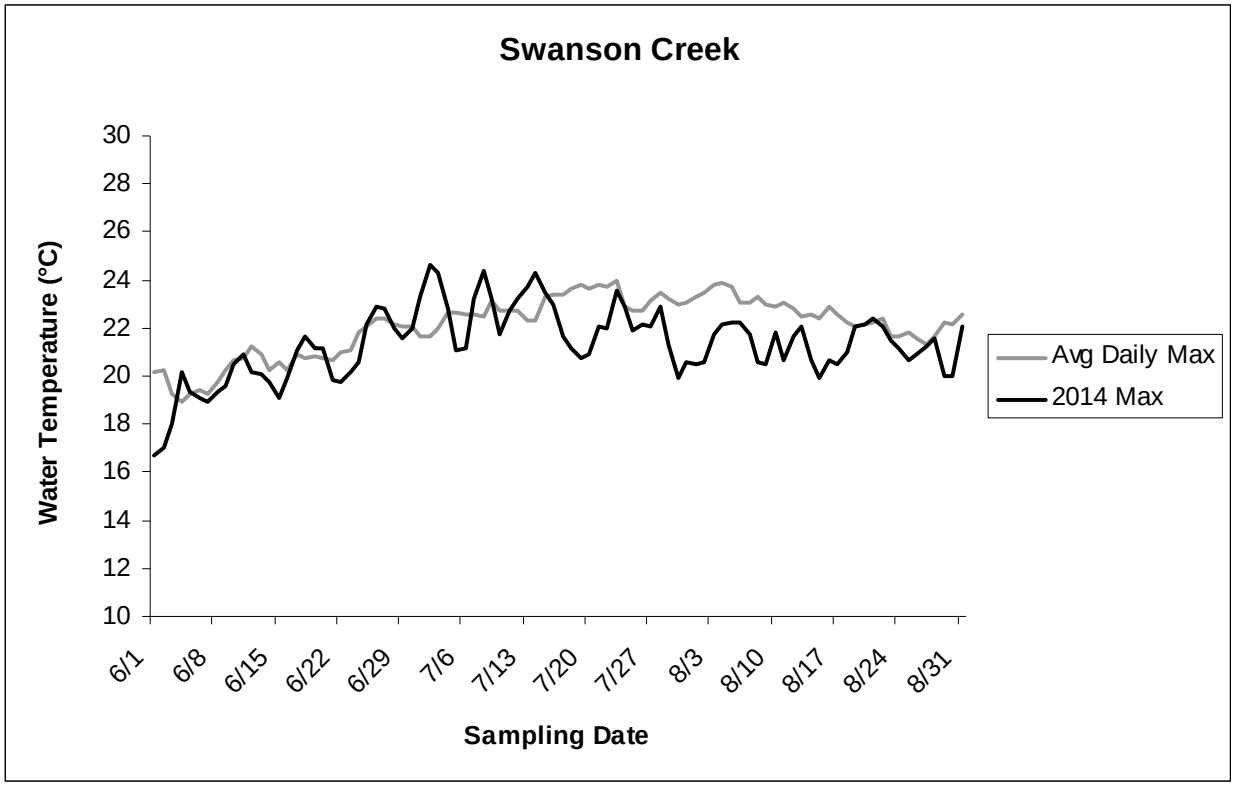
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 61.68 | 67.31 | 66.06 |
| Agriculture | 0.21 | 17.75 | 19.14 |
| Urban | 3.68 | 10.54 | 9.66 |
| Other | 34.43 | 4.40 | 5.14 |

## ***Physical Habitat***

Physical habitat measurements collected at Swanson Creek (2000 to 2013). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 18 | 15 | 6 | 14 | 12 | 16 | 16 | 16 | 17 | 17 | 15 | 18 | 16 | 13 | 11 |
| Epifaunal substrate (0-20) | 16 | 13 | 4 | 16 | 15 | 13 | 12 | 15 | 14 | 15 | 13 | 15 | 16 | 12 | 10 |
| Velocity/Depth Diversity (0-20) | 15 | 15 | 6 | 17 | 12 | 13 | 12 | 12 | 16 | 16 | 14 | 16 | 14 | 15 | 12 |
| Pool Quality (0-20) | 17 | 15 | 11 | 15 | 12 | 16 | 16 | 15 | 16 | 17 | 15 | 17 | 15 | 17 | 14 |
| Riffle Quality (0-20) | 14 | 15 | 0 | 16 | 15 | 13 | 16 | 16 | 17 | 17 | 12 | 15 | 17 | 12 | 13 |
| Shading (%) | 70 | 92 | 91 | 90 | 90 | 90 | 90 | 89 | 80 | 80 | 90 | 85 | 80 | 70 | 60 |
| Embeddedness (%) | 35 | 30 | 50 | 20 | 25 | 35 | 65 | 50 | 75 | 75 | 75 | 40 | 70 | 80 | 80 |
| Discharge (cfs) | 3.86 | 7.01 | 0.00 | 14.04 | 2.62 | 2.59 | 2.84 | 2.53 | 6.25 | 6.74 | 2.83 | 1.38 | 4.05 | 2.53 | 3.33 |




The above graph displays the average daily maximum temperatures recorded at Swanson Creek. The average was calculated from eleven years of data.

## ***Biology***

### *Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 4.14 | 4.71 | 4.43 | 4.43 | 5.00 | 4.71 | 4.71 | 4.71 | 4.14 | 4.14 | 5.00 | 5.00 | 4.14 | 4.43 | 4.71 |
| FIBI | 3.33 | 3.33 | 4.33 | 2.33 | 3.67 | 3.33 | 4.33 | 3.67 | 4.00 | 4.33 | 4.67 | 4.33 | 3.33 | 4.67 | 3.67 |

### *Fish*

Cumulative list of fish species (with abundance) collected in Swanson Creek by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| American eel | 5 | - | - | 1 | 3 | 6 | 11 | 9 | 14 | 7 | 4 | 6 | 4 | 9 | 5 |
| Bluegill | 1 | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - |
| Creek chubsucker | 2 | 2 | 1 | 1 | 4 | - | 5 | - | 6 | 12 | 10 | 4 | 2 | 7 | - |
| Eastern blacknose dace | 16 | 97 | 62 | - | 93 | 26 | 34 | 28 | 34 | 56 | 44 | 119 | 31 | 47 | 67 |
| Eastern mudminnow | 21 | 15 | 3 | 2 | 29 | 10 | 8 | 3 | 6 | 4 | 8 | 15 | 17 | 16 | 7 |
| Fallfish | 3 | 2 | 4 | - | 1 | - | 1 | 7 | 23 | 41 | 65 | 116 | 16 | 26 | 16 |
| Golden shiner | - | 2 | - | 1 | - | 1 | - | - | - | - | - | - | - | - | - |
| Largemouth bass | - | - | 8 | - | - | - | 3 | - | - | - | - | - | - | - | - |
| Least brook lamprey | - | 2 | 7 | - | 6 | 9 | 2 | - | - | 2 | 1 | 7 | - | 2 | 3 |
| Pumpkinseed | 3 | 3 | 4 | 1 | 7 | 2 | 2 | - | - | - | - | - | - | - | - |
| Redbreast sunfish | - | - | - | - | 1 | - | - | - | - | - | - | 2 | - | - | 2 |
| Redfin pickerel | - | 1 | - | - | - | 2 | 1 | - | - | - | - | - | - | - | - |
| Rosyside dace | 40 | 25 | 26 | 17 | 1 | 1 | 5 | - | 4 | 26 | 36 | 86 | 45 | 90 | 45 |
| Sea lamprey | - | - | 26 | - | - | - | 22 | 27 | 5 | 9 | 5 | 7 | - | 6 | 3 |
| Tadpole madtom | - | - | - | - | 2 | 3 | 2 | 3 | 2 | 1 | 2 | 3 | 1 | 2 | 2 |
| Tessellated darter | 1 | 30 | 35 | - | 16 | 11 | 12 | 8 | 14 | 11 | 6 | 35 | 13 | 86 | 27 |
| White sucker | 1 | - | 33 | - | - | - | 1 | - | - | - | 4 | 11 | - | 1 | 2 |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

## *Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to Swanson Creek by sampling year.

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Spinycheek crayfish (*Orconectes limosus*) | P | P | A | P | P | P | P | P | P |
| Devil crayfish (*Cambarus diogenes*) | A | A | A | A | A | A | A | P | A |
| Common crayfish (*Cambarus bartonii bartonii*) | A | A | A | A | A | A | A | P | A |

## *Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in Swanson Creek by sampling year.

| *Species* |
|---|
| None Observed |

## *Herpetofauna*

Cumulative list of herpetofauna species collected in or near Swanson Creek.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | American bullfrog, Cope's gray treefrog, Eastern cricket frog, Fowler's toad, Gray treefrog, Northern green frog, Northern spring peeper, Pickerel frog, Wood frog |
| Caudata (Salamanders and Newts) | Northern two-lined salamander |
| Squamata (Snakes and Lizards) | Eastern worm snake, Northern watersnake |
| Testudines (Turtles) | Eastern box turtle |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in Swanson Creek by sampling year, RA = %Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | |
| Haplotaxida | Enchytraeidae | na | - | - | - | *1.8 | - | - | - | - | - | - | - | - | - | - | - |
| | Naididae | na | *0.7 | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - |
| | Tubificidae | na | - | - | - | - | - | - | - | - | - | - | - | *0.9 | - | *0.9 | - |
| Lumbriculida | Lumbriculidae | na | - | - | - | *2.7 | - | *0.8 | - | - | - | *1.8 | - | | - | *0.9 | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | |
| Amphipoda | na | na | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - |
| (Scud) | Crangonyctidae | na | *3.4 | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - |
| | Gammaridae | *Gammarus* | - | - | - | 0.9 | 1.9 | 4.1 | 0.9 | 1.7 | - | - | - | - | - | - | - |
| Decapoda | Cambaridae | *Orconectes* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| (Crayfish) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Coleoptera | Dryopidae | *Helichus* | 0.7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Beetle) | Elmidae | na | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - |
| | | *Ancyronyx* | - | - | - | - | - | - | - | 1.7 | - | - | - | - | - | - | 1 |
| | | *Dubiraphia* | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - |
| | | *Macronychus* | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - |
| | | *Optioservus* | 0.7 | 0.7 | - | - | - | - | 3.5 | - | - | - | - | 0.9 | - | - | 1 |
| | | *Oulimnius* | - | 9.7 | 3.2 | - | - | 16.5 | 17.5 | 6 | 0.9 | 3.5 | 1.9 | 2.6 | 0.8 | 1.8 | 1.9 |
| | | *Stenelmis* | - | - | - | - | - | 0.8 | 0.9 | 1.7 | - | - | 0.9 | 0.9 | - | - | - |
| | Ptilodactylidae | *Anchytarsus* | 0.7 | - | - | - | - | 1.7 | - | 0.9 | - | - | - | 0.9 | - | - | - |
| Diptera | Ceratopogonidae | na | - | - | - | - | - | - | - | *1.7 | - | *0.9 | - | *2.6 | - | - | - |
| (True Fly) | | *Bezzia* | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Probezzia* | - | - | - | 0.9 | - | - | - | 0.9 | 1.9 | - | 0.9 | - | - | - | - |
| | Chironomidae | *Ablabesmyia* | - | - | - | - | - | - | - | 0.9 | - | - | - | 1.7 | - | - | - |
| | | *Brillia* | - | - | - | - | 0.9 | - | - | 0.9 | - | 0.9 | - | - | - | - | - |
| | | *Corynoneura* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| | | *Cricotopus* | - | - | - | - | - | - | - | - | - | 20.2 | - | - | - | - | - |
| | | *Diamesa* | - | - | - | - | 2.8 | - | - | - | - | - | - | - | - | - | - |
| | | *Eukiefferiella* | - | - | - | - | - | - | - | 0.9 | 0.9 | - | - | 0.9 | 0.8 | 0.9 | 1.9 |
| | | ***Heleniella***[+] | - | - | 0.8 | - | - | 0.8 | - | 0.9 | - | - | - | - | - | - | - |
| | | *Hydrobaenus* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| | | *Micropsectra* | - | - | - | - | - | - | - | - | - | - | 0.9 | 12 | - | 0.9 | - |
| | | *Microtendipes* | - | 0.7 | - | 0.9 | - | - | 0.9 | - | - | - | - | 1.7 | - | - | 1.9 |
| | | *Nanocladius* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| | | Orthocladiinae | - | - | - | - | - | *0.8 | - | *0.9 | - | - | - | - | - | - | - |
| | | *Orthocladius* | - | - | 1.6 | - | 16 | - | - | 0.9 | 2.8 | 8.8 | 5.6 | - | 0.8 | 1.8 | 5.7 |
| | | *Parachaetocladius* | - | - | - | 1.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Parakiefferiella* | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - |
| | | *Parametriocnemus* | 1.4 | 1.5 | - | 1.8 | 3.8 | - | - | 0.9 | 2.8 | 2.6 | - | 2.6 | - | - | 1 |
| | | *Paraphaenocladius* | - | - | 0.8 | - | - | - | - | 0.9 | 0.9 | - | - | 0.9 | - | - | 1 |
| | | *Paratanytarsus* | - | - | - | - | - | - | - | - | 1.9 | - | - | - | - | - | - |
| | | *Polypedilum* | - | 0.7 | - | - | 10.4 | - | 0.9 | - | - | - | 7.4 | - | - | 0.9 | - |
| | | *Pseudorthocladius* | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Rheocricotopus* | - | - | - | - | - | - | 1.8 | 2.6 | - | - | - | 2.6 | - | - | 1.9 |
| | | *Rheosmittia* | - | 3 | - | - | 2.8 | 0.8 | 1.8 | 12 | - | - | - | - | - | - | - |
| | | *Rheotanytarsus* | - | - | - | - | - | - | - | - | - | - | - | 1.7 | - | - | 1 |
| | | *Stempellinella* | - | - | - | - | - | - | - | - | 0.9 | - | - | 1.7 | - | - | - |
| | | *Stenochironomus* | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - |
| | | *Symposiocladius* | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - |
| | | Tanypodinae | - | - | - | *0.9 | - | - | - | *0.9 | - | - | - | *0.9 | - | - | - |
| | | Tanytarsini | - | - | - | - | - | - | - | - | - | *1.8 | - | - | - | - | - |
| | | *Tanytarsus* | - | 0.7 | 5.6 | - | - | - | 0.9 | - | 0.9 | - | - | - | - | - | - |
| | | Thienemannimyia Group | - | - | - | *1.8 | *4.7 | *0.8 | - | *1.7 | *1.9 | - | *0.9 | *1.7 | - | - | - |
| | | *Tribelos* | - | - | - | - | - | - | - | - | 3.7 | - | - | - | - | - | - |
| | | *Trissopelopia* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | 1 |
| | | *Tvetenia* | - | 0.7 | - | - | - | - | - | - | 0.9 | 2.6 | - | - | - | - | 2.9 |
| | | *Xylotopus* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - |
| | | *Zavrelimyia* | - | - | - | - | - | - | - | - | 0.9 | - | 0.9 | 1.7 | - | - | - |
| | Dolichopodidae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | - | *1 |
| | Empididae | *Hemerodromia* | - | - | 1.6 | - | 1.9 | - | - | - | - | 1.8 | - | - | - | - | - |
| | Simuliidae | na | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - | - |
| | | *Prosimulium* | - | 1.5 | - | 1.8 | 0.9 | - | 6.1 | - | 9.3 | - | - | - | - | - | 19 |
| | | *Simulium* | 3.4 | - | - | 0.9 | 0.9 | - | 0.9 | - | - | - | 4.6 | 1.7 | - | - | 3.8 |
| | | *Stegopterna* | - | 0.7 | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - |
| | Tabanidae | *Chrysops* | - | - | 0.8 | 0.9 | - | - | - | - | - | - | - | - | - | - | - |
| | Tipulidae | na | - | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - |
| | | *Antocha* | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - |
| | | *Hexatoma* | - | - | 4 | - | 2.8 | 1.7 | 2.6 | 0.9 | - | 1.8 | 1.9 | - | - | 1.8 | 1 |
| | | *Ormosia* | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - |
| | | *Pseudolimnophila* | - | - | - | - | 0.9 | - | - | 0.9 | - | - | - | - | - | - | - |
| | | *Tipula* | 0.7 | - | 0.8 | 1.8 | - | - | - | - | 0.9 | - | - | 0.9 | - | 0.9 | - |
| Ephemeroptera (Mayfly) | Baetidae | na | - | - | - | *0.9 | - | - | - | - | - | *3.5 | *3.7 | - | - | - | - |
| | | *Acentrella* | 42.1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Acerpenna* | 9 | 6.7 | 12.1 | 3.6 | 0.9 | 33.9 | 6.1 | 6.8 | - | 14.9 | 10.2 | 14.5 | 11.5 | 11.9 | 5.7 |
| | Ephemerellidae | na | - | - | - | - | - | - | - | - | - | *4.4 | *0.9 | - | - | - | - |
| | | *Ephemerella* | 24.8 | 57.5 | 43.5 | 36.9 | 14.2 | 11.6 | 18.4 | 22.2 | 0.9 | 10.5 | 20.4 | 6 | 41.0 | 34.9 | 15.2 |
| | | *Eurylophella* | 0.7 | - | - | - | - | 0.8 | - | - | - | - | - | 0.9 | - | - | - |
| | Heptageniidae | na | - | - | - | - | *0.9 | - | - | - | - | - | - | - | - | - | - |
| | | *Maccaffertium* | - | - | - | - | - | - | - | - | - | 0.9 | - | 0.9 | 0.8 | - | 1.9 |
| | | *Stenonema* | 0.7 | 2.2 | 0.8 | - | - | - | 1.8 | 1.7 | - | - | - | - | - | - | - |
| | Leptophlebiidae | na | - | - | - | - | - | *0.8 | - | - | - | - | - | - | *1.6 | - | - |
| | | ***Paraleptophlebia***[+] | - | 0.7 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Isopoda | Asellidae | *Caecidotea* | 2.8 | 0.7 | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - |
| Lepidoptera (Moth) | na | na | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - | - | - |
| | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Megaloptera (Dobsonfly/ Fishfly) | Corydalidae | *Nigronia* | - | - | - | 0.9 | - | - | 0.9 | 1.7 | 0.9 | - | - | 0.9 | - | - | 1 |
| | Sialidae | *Sialis* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Odonata (Dragonfly/ | Aeshnidae | *Boyeria* | - | 0.7 | 0.8 | - | - | 0.8 | - | - | - | - | - | - | - | - | - |
| | Calopterygidae | *Calopteryx* | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - |

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Damselfly) | Cordulegastridae | *Cordulegaster* | 0.7 | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - |
| | Gomphidae | na | - | - | - | - | - | - | *0.9 | - | - | - | - | - | - | - | - |
| Plecoptera | Capniidae | na | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - | - |
| (Stonefly) | Chloroperlidae | na | *2.8 | *5.2 | - | *1.8 | *12.3 | *9.1 | - | *8.5 | - | - | - | *8.5 | - | - | - |
| | | *Haploperla* | - | - | 12.9 | - | - | 4.1 | 11.4 | - | - | 11.4 | 23.1 | - | 6.6 | 8.3 | 1 |
| | Leuctridae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | - | *2.9 |
| | | ***Leuctra***[+] | 0.7 | - | - | 0.9 | 0.9 | - | - | 2.6 | 0.9 | - | - | - | 1.6 | - | - |
| | Nemouridae | na | - | - | - | - | - | - | - | - | *12.1 | *0.9 | - | - | - | - | - |
| | | *Amphinemura* | 0.7 | - | - | 0.9 | 2.8 | 2.5 | 3.5 | 6 | - | 1.8 | 7.4 | - | 4.9 | 4.6 | - |
| | | *Ostrocerca* | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Prostoia* | - | 0.7 | - | 4.5 | - | - | 4.4 | - | 13.1 | - | - | - | - | 1.8 | 4.8 |
| | Perlidae | na | *1.4 | *0.7 | *0.8 | *0.9 | *3.8 | *0.8 | - | *0.9 | - | - | - | *4.3 | *2.5 | - | - |
| | | *Eccoptura* | - | - | - | - | 2.8 | - | - | - | - | - | - | - | - | - | 1 |
| | | *Perlesta* | 0.7 | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - |
| | Perlodidae | na | - | *0.7 | *1.6 | - | - | - | *2.6 | - | - | - | - | - | *0.8 | - | *1 |
| | | *Cultus* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Isoperla* | 0.7 | - | 2.4 | 20.7 | - | - | 5.3 | - | 7.5 | - | - | 2.6 | 5.7 | 1.8 | 5.7 |
| | Simulidae | *Prosimulium* | - | - | - | - | - | - | - | - | - | - | - | - | 13.9 | 17.4 | - |
| | Taeniopterygidae | *Strophopteryx* | - | - | - | 0.9 | - | - | - | - | 27.1 | - | - | 3.4 | 1.6 | 0.9 | 2.9 |
| Trichoptera | Hydropsychidae | na | - | - | - | - | - | *0.8 | - | - | - | *0.9 | - | - | - | - | - |
| (Caddisfly) | | *Cheumatopsyche* | - | 1.5 | 4 | - | - | - | 2.6 | 4.3 | - | 1.8 | 0.9 | 7.7 | 1.6 | 3.7 | 2.9 |
| | | *Diplectrona*[+] | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| | | *Hydropsyche* | - | 1.5 | - | - | - | 0.8 | - | 1.7 | - | 0.9 | 0.9 | - | - | - | 1 |
| | Lepidostomatidae | *Lepidostoma* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | Leptoceridae | na | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| | Limnephilidae | na | *0.7 | - | - | - | *0.9 | - | - | - | *1.9 | - | - | - | - | *0.9 | - |
| | | *Hydatophylax* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| | | *Ironoquia* | - | - | - | - | - | - | - | - | - | - | 1.9 | - | - | - | - |
| | | *Limnephilus* | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - |
| | | *Pycnopsyche* | - | - | 0.8 | 0.9 | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | Phryganeidae | *Ptilostomis* | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - |
| | Uenoidae | *Neophylax* | - | 0.7 | 0.8 | 3.6 | 7.5 | 2.5 | 2.6 | - | 0.9 | - | 0.9 | 4.3 | - | 1.8 | 1 |
| PHYLUM NEMERTEA | | | | | | | | | | | | | | | | | |
| Hoplonemertea | Tetrastemmatidae | *Prostoma* | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - |
| (Worm) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| PHYLUM MOLLUSCA | | | | | | | | | | | | | | | | | |
| Gastropoda | Physidae | *Physa* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.9 |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).
* Taxa not identified to genus
[+] Coldwater-preference genera

# *Unnamed Tributary to Zekiah Swamp Run (ZEKI-012-S)*

Site ZEKI-012-S is located on an unnamed tributary to Zekiah Swamp Run in the Coastal Plain – western shore region of Maryland. It is in the Zekiah Swamp watershed in Charles County. This site was sampled in 1995, 2000 to 2008 and 2010 to 2014. Permission to sample in 2009, the summer of 2013, and 2014 could not be obtained.


***Unnamed tributary to Zekiah Swamp Run in spring 2013.***

## ***Land Use/ Land Cover***

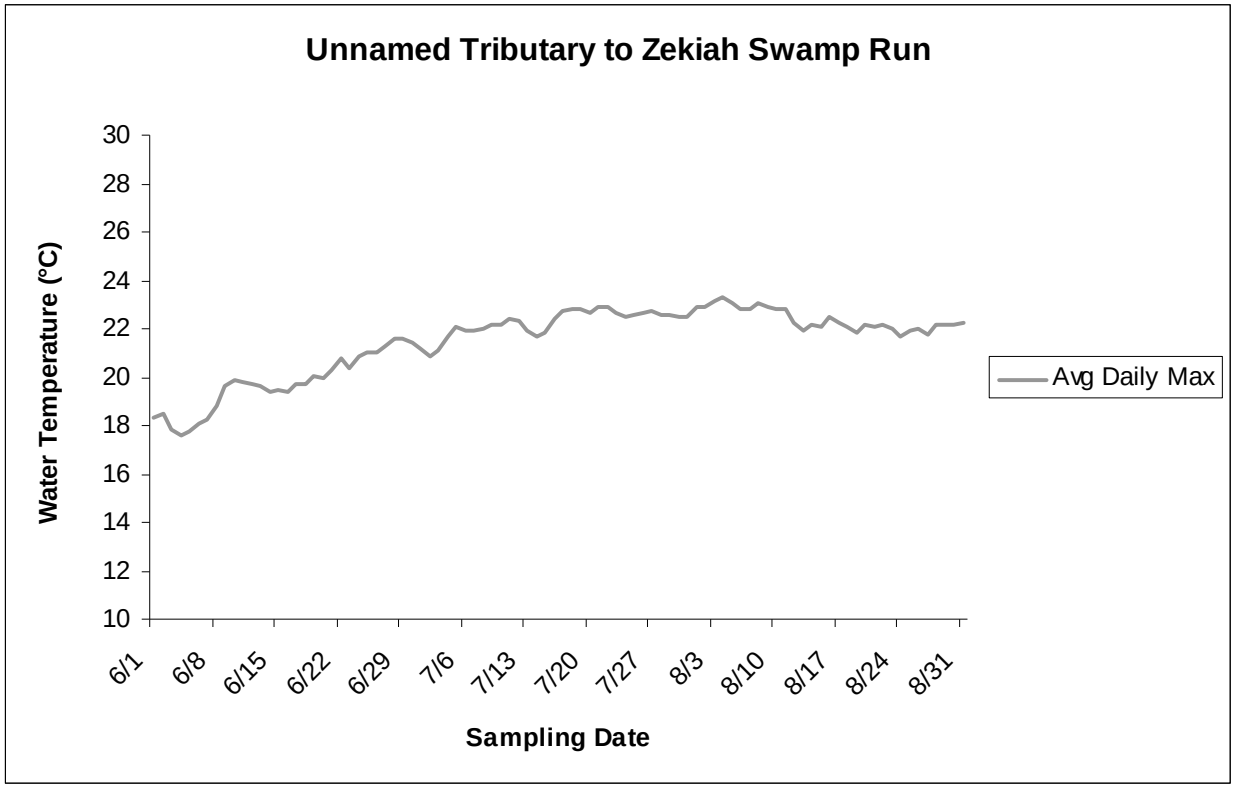
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 80.03 | 89.83 | 85.95 |
| Agriculture | 1.51 | 5.98 | 6.95 |
| Urban | 0.00 | 2.38 | 2.68 |
| Other | 18.46 | 1.80 | 4.42 |

## ***Physical Habitat***

Physical habitat measurements collected at the unnamed tributary to Zekiah Swamp Run (2000 to 2008, and 2010 to 2012). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 15 | 17 | 4 | 15 | 13 | 12 | 12 | 15 | 12 | | 8 | 16 | 12 | | |
| Epifaunal substrate (0-20) | 11 | 17 | 1 | 12 | 14 | 12 | 12 | 14 | 11 | | 13 | 16 | 14 | | |
| Velocity/Depth Diversity (0-20) | 10 | 10 | 2 | 8 | 11 | 9 | 6 | 9 | 7 | | 5 | 10 | 8 | | |
| Pool Quality (0-20) | 10 | 10 | 5 | 8 | 7 | 8 | 8 | 10 | 10 | Not | 5 | 10 | 12 | Not Sampled | |
| Riffle Quality (0-20) | 6 | 14 | 0 | 13 | 12 | 14 | 9 | 12 | 10 | Sampled | 10 | 15 | 13 | | |
| Shading (%) | 95 | 94 | 95 | 94 | 94 | 92 | 95 | 94 | 80 | | 80 | 90 | 90 | | |
| Embeddedness (%) | 45 | 16 | 100 | 40 | 15 | 40 | 45 | 40 | 40 | | 15 | 25 | 20 | | |
| Discharge (cfs) | 0.33 | 0.69 | 0.00 | 1.11 | 0.30 | 0.56 | 0.15 | 0.22 | 0.58 | | 0.20 | 0.2 | 0.35 | | |




The above graph displays the average daily maximum temperatures recorded at the unnamed tributary to Zekiah Swamp Run. The average was calculated from eleven years of data. No data is available for 2013 and 2014

***Biology***

*Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 4.71 | 4.71 | 4.43 | 3.57 | 4.71 | 4.43 | 4.71 | 4.71 | 5.00 | Not Sampled | 4.43 | 4.71 | 4.71 | 4.71 | Not Sampled |
| FIBI | 3.67 | 4.33 | 3.67 | 1.33 | 3.33 | 3.67 | 3.67 | 3.33 | 3.33 | | 3.33 | 3 | 4 | Not Sampled | |

*Fish*

Cumulative list of fish species (with abundance) collected at the unnamed tributary to Zekiah Swamp Run by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| American eel | - | 2 | - | - | - | - | - | 1 | 1 | | 5 | 1 | 1 | | |
| Eastern blacknose dace | 23 | 21 | - | 11 | 20 | 31 | 12 | 34 | 12 | | 184 | 77 | 81 | | |
| Eastern mudminnow | 15 | 49 | 57 | 9 | 234 | 29 | 15 | 5 | 1 | | - | - | 6 | | |
| Fallfish | - | - | 2 | - | - | - | - | - | - | | - | - | - | | |
| Least brook lamprey | 43 | 45 | 21 | - | 26 | 8 | 28 | 17 | 26 | Not Sampled | 47 | 16 | 71 | Not Sampled | |
| Pirate perch | - | 7 | 5 | - | 5 | - | - | - | - | | - | - | - | | |
| Pumpkinseed | - | - | - | - | 1 | - | - | - | - | | - | - | - | | |
| Redfin pickerel | 10 | - | 2 | - | 7 | 10 | 4 | 15 | 1 | | 1 | 1 | 2 | | |
| Tessellated darter | - | - | 2 | - | - | 1 | 2 | - | - | | - | - | - | | |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

## *Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to Zekiah Swamp Run by sampling year.

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Devil crawfish (*Cambarus diogenes*) | A | P | P | Not | P | A | A | A | Not |
| Common crayfish (*Cambarus bartonii bartonii*) | P | P | A | Sampled | A | P | P | P | Sampled |

## *Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to Zekiah Swamp Run by sampling year.

| *Species* |
|---|
| None Observed |

## *Herpetofauna*

Cumulative list of herpetofauna species collected at or near the unnamed tributary to Zekiah Swamp Run.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | Eastern American toad, Gray tree frog, Northern green frog, Pickerel frog, Southern leopard frog, Wood frog |
| Caudata (Salamanders and Newts) | Northern dusky salamander, Northern red salamander, Northern two-lined salamander |
| Squamata (Snakes and Lizards) | Northern watersnake |
| Testudines (Turtles) | Eastern box turtle, Spotted turtle |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected at the unnamed tributary to Zekiah Swamp Run by sampling year, RA = %Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | |
| Haplotaxida | Naididae | na | *5.8 | - | - | - | - | - | - | - | - | na | *1.8 | - | - | - | na |
| Lumbriculida | Lumbriculidae | na | - | - | *0.9 | - | *0.8 | *1 | - | - | *1.8 | na | *0.9 | - | - | - | na |
| Tubificida | Tubificidae | na | - | - | - | - | - | - | - | - | *0.9 | na | *1.8 | - | - | - | na |
| | | *Limnodrilus* | - | - | - | - | - | - | 0.9 | - | 0.9 | na | - | - | - | - | na |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | |
| Amphipoda | Crangonyctidae | *Crangonyx* | - | - | - | - | - | - | - | 0.9 | - | na | - | 0.9 | - | - | na |
| (Scud) | | | - | - | - | - | - | - | - | - | - | na | - | - | - | - | na |
| Coleoptera | Dytiscidae | *Neoporus* | 1.7 | - | - | - | - | - | - | - | - | na | - | - | - | - | na |
| (Beetle) | Elmidae | na | - | - | - | - | *0.8 | - | - | - | *0.9 | na | - | - | - | - | na |
| | | *Macronychus* | - | - | - | - | - | - | - | 3.5 | - | na | - | - | - | - | na |
| | | *Optioservus* | 5.8 | 2.3 | 8.6 | 4.3 | - | - | 7.8 | 1.8 | - | na | - | 1.8 | - | 0.9 | na |
| | | *Oulimnius* | 34.2 | 2.3 | 16.4 | 6.1 | - | 2.9 | 4.3 | 0.9 | - | na | - | - | - | 2.6 | na |
| | | *Stenelmis* | - | - | - | 0.9 | - | - | - | - | 0.9 | na | 0.9 | 0.9 | - | - | na |
| | Hydrophilidae | *Hydrobius* | 0.8 | - | - | - | - | - | - | - | - | na | - | 0.9 | - | - | na |
| | | *Tropisternus* | - | - | - | - | - | - | - | 0.9 | - | na | - | - | - | - | na |
| | Ptilodactylidae | *Anchytarsus* | - | - | 0.9 | - | - | - | 0.9 | 2.7 | - | na | 0.9 | - | - | 2.6 | na |
| Collembola | na | na | *0.8 | - | - | - | - | - | - | - | - | na | - | - | - | - | na |
| (Springtail) | Isotomidae | *na* | - | - | - | - | - | - | - | - | - | na | - | - | - | 0.9 | na |
| Decapoda | Cambaridae | na | - | - | *0.9 | - | - | - | - | - | - | na | - | - | - | - | na |
| (Crayfish) | | | - | - | - | - | - | - | - | - | - | na | - | - | - | - | na |
| Diptera | Ceratopogonidae | na | *0.8 | - | - | - | - | - | - | *0.9 | *1.8 | na | - | *2.6 | - | - | na |
| (True Fly) | | *Bezzia* | - | - | - | - | - | - | - | 4.4 | 0.9 | na | 0.9 | - | - | 0.9 | na |
| | | *Ceratopogon* | 0.8 | - | - | - | - | - | - | 0.9 | 0.9 | na | 0.9 | - | - | - | na |
| | | *Probezzia* | - | 0.8 | 5.2 | - | - | - | - | - | - | na | - | - | - | - | na |
| | | *Stilobezzia* | - | - | - | - | - | - | - | - | - | na | 2.7 | - | - | - | na |
| | Chironomidae | na | - | - | - | - | - | *1 | - | - | - | na | - | - | - | - | na |
| | | *Apsectrotanypus* | - | - | - | - | - | - | - | - | - | na | 0.9 | - | - | - | na |
| | | *Brillia* | - | - | - | - | - | - | - | - | - | na | - | - | 0.9 | - | na |
| | | *Conchapelopia* | 0.8 | - | 0.9 | - | - | - | - | - | - | na | - | - | - | - | na |
| | | *Corynoneura* | 1.7 | - | - | - | - | 1 | - | 0.9 | 2.6 | na | - | 0.9 | 0.9 | 0.9 | na |
| | | *Cricotopus* | - | - | - | 0.9 | - | - | - | - | - | na | - | - | - | - | na |
| | | *Cryptochironomus* | - | - | - | - | 0.8 | - | - | - | - | na | 0.9 | - | - | - | na |
| | | *Diamesa* | - | - | - | - | - | - | - | - | - | na | - | - | 7 | - | na |
| | | *Eukiefferiella* | 1.7 | - | - | 0.9 | - | 1 | 0.9 | 12.4 | 0.9 | na | - | - | 3.5 | 1.8 | na |
| | | ***Heleniella***$^{+}$ | - | - | - | - | - | - | - | - | - | na | - | - | - | - | na |
| | | *Heterotrissocladius* | - | - | - | - | - | 1.9 | - | - | 0.9 | na | - | - | - | - | na |
| | | *Hydrobaenus* | - | - | - | - | - | - | - | - | - | na | - | - | 1.7 | - | na |
| | | *Micropsectra* | - | 0.8 | 0.9 | - | - | 1 | - | - | - | na | - | 1.8 | - | - | na |
| | | *Nanocladius* | - | 0.8 | - | - | - | - | - | - | - | na | - | - | - | - | na |
| | | *Odontomesa* | - | - | - | - | - | - | - | - | - | na | - | - | 0.9 | - | na |
| | | Orthocladiinae | *4.2 | *7.7 | - | - | - | - | - | - | - | na | - | *0.9 | *2.6 | - | na |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Orthocladius* | - | - | - | - | - | - | - | - | - | na | - | 0.9 | 7.0 | - | na |
| | | *Parachaetocladius* | - | - | - | - | - | - | - | 1.8 | - | na | - | - | 0.9 | - | na |
| | | *Paralauterborniella* | - | - | - | - | - | 1 | - | - | - | na | 2.7 | - | - | - | na |
| | | *Paramerina* | - | - | - | - | - | - | - | - | - | na | 0.9 | 0.9 | - | - | na |
| | | *Parametriocnemus* | 3.3 | 3.8 | 0.9 | - | 1.6 | 3.8 | - | 1.8 | 1.8 | na | - | 2.6 | 0.9 | - | na |
| | | *Paraphaenocladius* | - | - | - | - | - | - | - | - | 1.8 | na | - | - | - | - | na |
| | | *Paratanytarsus* | - | 0.8 | - | - | - | - | - | - | - | na | - | - | - | - | na |
| | | *Paratendipes* | - | - | - | - | - | - | - | - | - | na | 0.9 | - | - | - | na |
| | | *Polypedilum* | 2.5 | - | - | - | 0.8 | - | - | - | - | na | 0.9 | 2.6 | - | - | na |
| | | *Potthastia* | 1.7 | - | - | - | - | - | - | - | - | na | - | - | - | - | na |
| | | *Rheocricotopus* | - | - | - | - | - | 1 | 3.4 | 1.8 | - | na | - | 6.1 | 0.9 | - | na |
| | | *Rheosmittia* | - | - | - | - | 1.6 | - | - | - | - | na | - | - | - | - | na |
| | | *Rheotanytarsus* | - | - | - | - | - | - | - | - | - | na | - | 0.9 | - | - | na |
| | | *Stempellinella* | - | - | - | - | - | - | - | 0.9 | 1.8 | na | - | 0.9 | - | - | na |
| | | *Stilocladius* | - | - | - | - | - | - | - | - | - | na | - | 1.8 | - | - | na |
| | | *Symposiocladius* | - | - | - | - | - | - | - | - | 0.9 | na | - | - | - | - | na |
| | | *Sympotthastia* | - | - | - | - | - | - | - | - | - | na | - | - | 1.7 | - | na |
| | | Tanypodinae | - | - | - | - | - | - | - | *0.9 | *0.9 | na | - | - | - | - | na |
| | | Tanytarsini | - | - | - | - | - | - | - | - | *0.9 | na | - | - | - | - | na |
| | | *Tanytarsus* | 0.8 | - | - | - | 1.6 | - | - | - | 0.9 | na | 1.8 | 8.8 | - | - | na |
| | | *Thienemanniella* | 0.8 | - | - | - | - | - | - | - | 0.9 | na | - | - | 0.9 | - | na |
| | | Thienemannimyia Group | - | - | - | - | - | - | - | - | *2.6 | na | - | *0.9 | *1.7 | - | na |
| | | *Trissopelopia* | - | - | 0.9 | - | 0.8 | - | - | - | 2.6 | na | - | 0.9 | - | - | na |
| | | *Zavrelimyia* | - | - | - | - | 0.8 | - | - | - | - | na | - | - | - | - | na |
| | Dixidae | ***Dixa***[+] | - | 0.8 | - | - | - | - | - | - | - | na | - | - | - | - | na |
| | Empididae | *Chelifera* | - | - | - | - | 0.8 | - | - | - | - | na | - | - | - | - | na |
| | | *Hemerodromia* | - | 0.8 | - | - | - | - | - | - | - | na | - | - | - | - | na |
| | Simuliidae | na | - | - | - | - | - | - | *2.6 | - | - | na | - | *0.9 | - | - | na |
| | | *Prosimulium* | - | 42.7 | 3.4 | 67 | - | - | 21.6 | 1.8 | 22.8 | na | - | - | 5.2 | 3.5 | na |
| | | *Simulium* | 2.5 | - | 0.9 | - | 0.8 | 1 | - | 1.8 | - | na | 6.3 | - | - | - | na |
| | | *Stegopterna* | 0.8 | 5.3 | 0.9 | 9.6 | - | - | 3.4 | - | 1.8 | na | - | - | - | - | na |
| | Tabanidae | *Chrysops* | - | - | - | - | - | - | - | - | - | na | - | - | 0.9 | - | na |
| | | *Tabanus* | - | - | - | - | - | - | - | - | - | na | - | - | - | 0.9 | na |
| | Tipulidae | na | - | - | - | - | - | - | - | - | - | na | - | - | - | - | na |
| | | *Antocha* | - | - | - | - | - | - | 0.9 | - | - | na | - | - | - | - | na |
| | | *Dicranota* | 0.8 | - | - | - | - | - | - | - | - | na | - | - | - | - | na |
| | | *Hexatoma* | 0.8 | - | - | - | - | - | 0.9 | - | - | na | 5.4 | 2.6 | - | 5.3 | na |
| | | *Pseudolimnophila* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | na |
| | | *Tipula* | 0.8 | - | - | - | 0.8 | - | - | - | - | na | 1.8 | - | 0.9 | 0.9 | na |
| Ephemeroptera (Mayfly) | Ameletidae | *Ameletus* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | 0.9 | - | na |
| | Baetidae | na | - | - | - | - | - | - | *1.7 | - | - | na | - | *1.8 | - | - | na |
| | | *Acentrella* | 0.8 | - | - | - | - | - | - | - | - | na | - | - | - | - | na |
| | | *Acerpenna* | - | 6.9 | 14.7 | - | 1.6 | 22.9 | - | 8.8 | 9.6 | na | 3.6 | 1.8 | 4.3 | 6.1 | na |
| | Ephemerellidae | na | - | - | - | - | - | - | - | - | *1.8 | na | - | - | - | - | na |
| | | *Ephemerella* | 11.7 | 13.7 | 15.5 | 0.9 | 19.5 | 34.3 | 25 | 9.7 | 4.4 | na | 5.4 | 1.8 | 14.8 | 18.42 | na |
| | Heptageniidae | na | *0.8 | *0.8 | - | - | - | - | *0.9 | - | - | na | - | - | - | - | na |
| | | *Maccaffertium* | - | - | - | - | - | - | - | - | 0.9 | na | 0.9 | - | 0.9 | - | na |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Stenonema* | - | - | 1.7 | - | - | 1 | - | 2.7 | - | na | - | - | - | - | na |
| | Leptophlebiidae | na | *0.8 | *0.8 | - | - | - | - | - | - | - | na | - | - | - | - | na |
| Hemiptera | Veliidae | *Microvelia* | - | - | - | - | - | - | - | 1.8 | - | na | - | - | - | - | na |
| (True Bug) | | | - | - | - | - | - | - | - | - | - | na | - | - | - | - | na |
| Isopoda | Asellidae | *Caecidotea* | - | - | - | - | 0.8 | - | - | - | - | na | 1.8 | 1.8 | 0.9 | - | na |
| (Aquatic Sow Bug) | | | - | - | - | - | | - | - | - | - | na | - | - | - | - | na |
| Megaloptera | Corydalidae | *Nigronia* | - | - | - | - | 0.8 | - | - | - | 0.9 | na | - | - | - | - | na |
| (Dobsonfly/Fishfly) | | | - | - | - | - | - | - | - | - | - | na | - | - | - | - | na |
| Odonata | Aeshnidae | *Boyeria* | 0.8 | - | - | - | 1.6 | - | 0.9 | 0.9 | - | na | - | - | - | - | na |
| (Dragonfly/ | Calopterygidae | *Calopteryx* | - | - | - | - | 1.6 | - | - | - | 0.9 | na | - | - | - | - | na |
| Damselfly) | Cordulegastridae | *Cordulegaster* | 0.8 | - | - | - | 0.8 | - | - | - | - | na | 1.8 | - | 0.9 | - | na |
| | Gomphidae | na | - | - | - | - | - | - | - | - | - | - | - | *1.8 | - | - | na |
| Plecoptera | Capniidae | na | - | - | - | - | - | - | - | - | *0.9 | na | - | - | *0.9 | - | na |
| (Stonefly) | Chloroperlidae | na | *5.8 | *2.3 | - | - | *3.3 | *6.7 | - | *2.7 | *1.8 | na | - | *6.1 | *16.5 | - | na |
| | | *Haploperla* | - | - | 19.8 | - | - | 3.8 | 0.9 | 3.5 | - | na | 16.1 | - | - | 13.2 | na |
| | Leuctridae | ***Leuctra***[+] | - | - | - | - | 16.3 | 1.9 | - | - | - | na | - | 11.4 | 1.7 | 1.8 | na |
| | Nemouridae | na | - | - | - | *0.9 | - | - | *3.4 | - | *4.4 | na | - | - | *1.7 | - | na |
| | | *Amphinemura* | 3.3 | 0.8 | 0.9 | 0.9 | 10.6 | 8.6 | 10.3 | 25.7 | 0.9 | na | 24.1 | 19.3 | 5.2 | 15.8 | na |
| | | *Clioperla* | - | - | - | - | - | - | - | - | - | na | - | - | - | - | na |
| | | *Prostoia* | - | - | - | 4.3 | - | - | 0.9 | - | 3.5 | na | - | - | 0.9 | 5.3 | na |
| | Perlidae | na | - | - | - | - | *0.8 | - | - | - | - | na | - | - | - | - | na |
| | | *Eccoptura* | - | - | 1.7 | - | 8.9 | - | 1.7 | - | 0.9 | na | - | - | 0.9 | 1.8 | na |
| | Perlodidae | na | *0.8 | - | - | - | *0.8 | - | *0.9 | - | - | na | - | - | *0.9 | - | na |
| | | *Isoperla* | - | - | - | - | - | 1.9 | 1.7 | - | 0.9 | na | 2.7 | - | - | 1.8 | na |
| Trichoptera | Hydropsychidae | *Cheumatopsyche* | - | 0.8 | 2.6 | - | - | - | - | 0.9 | 0.9 | na | 0.9 | - | 0.9 | - | na |
| (Caddisfly) | | ***Diplectrona***[+] | - | 1.5 | - | 0.9 | 5.7 | - | 1.7 | 0.9 | 0.9 | na | - | 2.6 | 2.6 | 2.6 | na |
| | | *Hydropsyche* | - | 1.5 | 0.9 | - | - | - | - | - | - | na | - | - | - | - | na |
| | Lepidostomatidae | *Lepidostoma* | - | - | - | - | 8.1 | 1.9 | 0.9 | - | - | na | 4.5 | 0.9 | 0.9 | 0.9 | na |
| | Leptoceridae | na | - | - | - | - | - | - | - | - | *0.9 | na | - | *0.9 | - | - | na |
| | Limnephilidae | na | - | *0.8 | - | *1.7 | *0.8 | - | - | *0.9 | *6.1 | na | - | - | - | - | na |
| | | *Ironoquia* | - | - | - | - | - | - | 0.9 | - | - | na | 0.9 | - | - | - | na |
| | | *Pycnopsyche* | - | - | - | - | - | 1 | - | - | - | na | - | - | 0.9 | 1.8 | na |
| | Odontoceridae | *Psilotreta* | - | - | - | - | - | - | 0.9 | - | - | na | - | 2.6 | - | - | na |
| | Philopotamidae | na | - | - | - | - | *1.6 | - | - | - | *0.9 | na | - | - | - | - | na |
| | | ***Wormaldia***[+] | - | - | - | - | 1.6 | - | - | - | - | na | - | - | - | - | na |
| | Polycentropodidae | *Polycentropus* | - | - | - | - | - | - | - | - | 1.8 | na | - | - | 0.9 | - | na |
| | Psychomiidae | *Lype* | - | - | - | - | - | - | - | - | 0.9 | na | - | - | - | - | na |
| | Uenoidae | *Neophylax* | - | 0.8 | 0.9 | 0.9 | 4.1 | - | - | - | 3.5 | na | 4.5 | 3.5 | - | 8.8 | na |
| PHYLUM MOLLUSCA | | | | | | | | | | | | | | | | | |
| Veneroida | Pisidiidae | na | - | - | - | - | - | - | - | *0.9 | - | na | - | *0.9 | - | - | na |
| (Bivalve) | | *Sphaerium* | - | 0.8 | - | - | - | - | - | - | - | na | - | - | - | - | na |
| PHYLUM NEMERTEA | | | | | | | | | | | | | | | | | |
| Hoplonemertea (Round worm) | Tetrastemmatidae | *Prostoma* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | na |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus [+] Coldwater-preference genera

# *Appendix C*
# *Sentinel Sites in the Eastern Piedmont Region*

Baisman Run (LOCH-120-S)
Unnamed Tributary to Dipping Pond Run (JONE-109-S)
North Branch Jones Falls (JONE-315-S)
Unnamed Tributary to the Patuxent River (RKGR-119-S)
Unnamed Tributary to Principio Creek (FURN-101-S)
Timber Run (LIBE-102-S)

# *Baisman Run (LOCH-120-S)*

Site LOCH-120-S is located on Baisman Run in the Eastern Piedmont region of Maryland. It is in the Loch Raven Reservoir watershed in Baltimore County. This site was sampled in 1996 and 2000 to 2014.

*Baisman Run in spring 2013.*

## ***Land Use/ Land Cover***

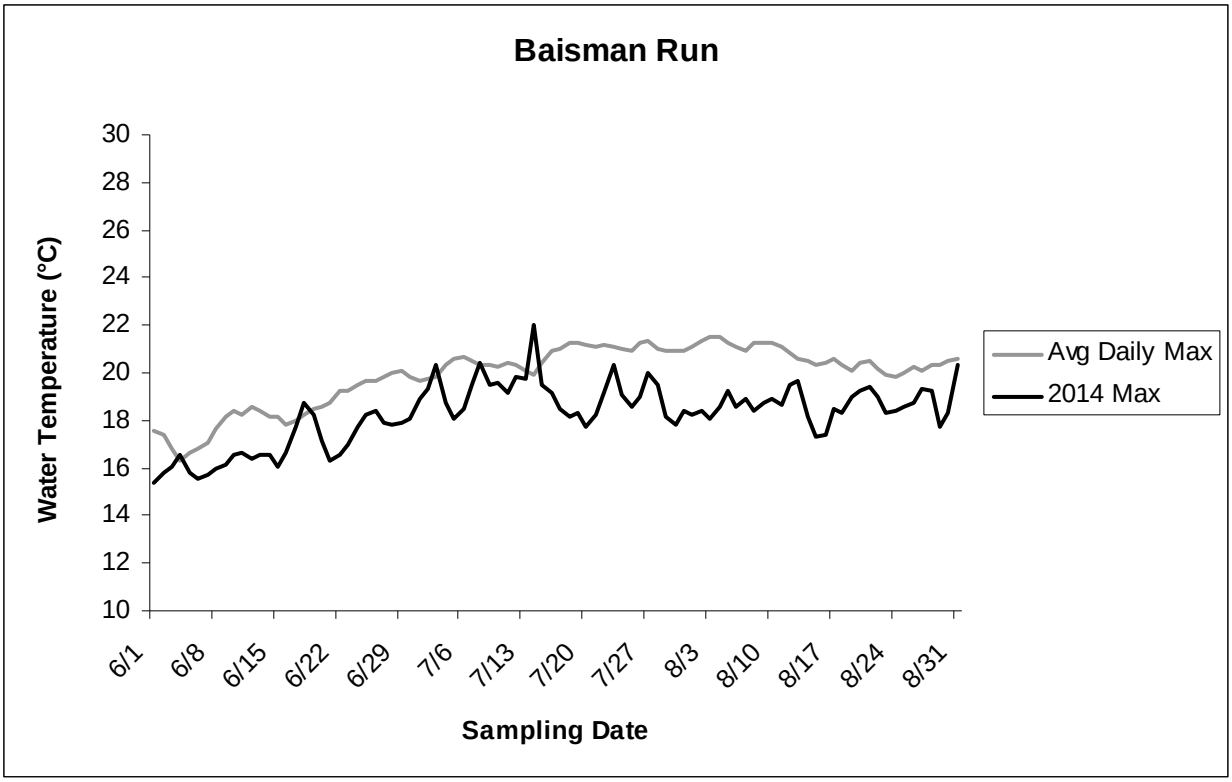
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 55.54 | 58.43 | 59.09 |
| Agriculture | 0.11 | 0.27 | 0.21 |
| Urban | 2.19 | 40.02 | 39.14 |
| Other | 42.16 | 1.28 | 1.55 |

## ***Physical Habitat***

Physical habitat measurements collected at Baisman Run (2000 to 2014). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 16 | 16 | 16 | 16 | 18 | 16 | 16 | 16 | 17 | 17 | 15 | 14 | 17 | 15 | 16 |
| Epifaunal substrate (0-20) | 16 | 17 | 17 | 17 | 18 | 15 | 17 | 18 | 16 | 18 | 14 | 16 | 16 | 17 | 17 |
| Velocity/Depth Diversity (0-20) | 8 | 10 | 9 | 10 | 10 | 13 | 10 | 11 | 9 | 12 | 10 | 8 | 9 | 12 | 13 |
| Pool Quality (0-20) | 9 | 10 | 9 | 10 | 10 | 13 | 10 | 11 | 10 | 14 | 9 | 9 | 10 | 12 | 11 |
| Riffle Quality (0-20) | 17 | 15 | 15 | 14 | 15 | 15 | 16 | 15 | 15 | 18 | 17 | 15 | 13 | 16 | 14 |
| Shading (%) | 95 | 95 | 98 | 95 | 95 | 94 | 90 | 90 | 90 | 90 | 90 | 90 | 75 | 85 | 55 |
| Embeddedness (%) | 20 | 20 | 35 | 35 | 25 | 35 | 40 | 25 | 40 | 40 | 60 | 15 | 45 | 25 | 70 |
| Discharge (cfs) | 1.29 | 0.80 | 0.37 | 5.91 | 1.15 | 2.16 | 0.86 | 0.96 | 0.75 | 1.49 | 1.13 | 1.01 | 0.78 | 1.93 | 1.79 |




The graph above displays the average daily maximum temperatures recorded at Baisman Run. The average was calculated from twelve years of data.

## ***Biology***

### *Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 4.67 | 5.00 | 4.33 | 4.00 | 4.33 | 4.67 | 4.67 | 4.00 | 4.33 | 5.00 | 4.67 | 4.67 | 4.33 | 5.00 | 4.67 |
| FIBI | 2.67 | 2.67 | 2.33 | 2.33 | 2.00 | 1.67 | 2.67 | 1.67 | 2.00 | 2.00 | 3.00 | 2.33 | 2.67 | 2.67 | 3.00 |

### *Fish*

Cumulative list of fish species (with abundance) collected in Baisman Run by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bluegill | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - |
| Brook trout | 19 | 31 | 17 | 2 | 5 | 4 | 33 | 11 | 10 | 10 | 17 | 18 | 8 | 9 | 6 |
| Brown trout | 1 | - | - | 1 | 1 | - | 2 | - | - | - | 1 | 1 | 2 | 10 | 5 |
| Creek chub | 41 | 80 | 95 | 13 | 34 | 41 | 50 | 22 | 94 | 87 | 82 | 91 | 55 | 44 | 32 |
| Eastern blacknose dace | 45 | 58 | 51 | 11 | 22 | 28 | 43 | 17 | 81 | 87 | 86 | 72 | 56 | 50 | 43 |
| Longnose dace | 20 | 20 | 20 | 1 | 3 | 5 | 5 | 3 | 9 | 4 | 5 | 4 | 8 | 10 | 7 |
| Largemouth bass | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - |
| River chub | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| Rosyside dace | 8 | 14 | 25 | 10 | 5 | 6 | 21 | - | 58 | 42 | 80 | 38 | 35 | 28 | 35 |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

### *Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to Baisman Run by sampling year.

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Virile crayfish (*Orconectes virilis*) | P | P | A | P | P | P | P | P | P |
| Common crayfish (*Cambarus bartonii bartonii*) | P | P | A | P | P | P | P | P | P |

*Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in Baisman Run by sampling year.

| *Species* |
|---|
| None Observed |

*Herpetofauna*

Cumulative list of herpetofauna species collected in or near Baisman Run.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | Eastern American toad, Northern green frog, Pickerel frog, Wood frog |
| Caudata (Salamanders and Newts) | Eastern red-backed salamander, Long-tailed salamander, Northern dusky salamander, Northern red salamander, Northern two-lined salamander, Spotted salamander |
| Squamata (Snakes and Lizards) | Eastern garter snake, Northern ring-necked snake, Northern watersnake |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in Baisman Run by sampling year,

RA = %Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *1996 RA* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | | |
| Haplotaxida | Enchytraeidae | na | - | - | - | - | *0.7 | - | - | - | - | - | - | - | - | - | - | - |
| | Naididae | na | - | *2.4 | - | *1.8 | - | - | - | - | - | *1 | - | - | - | - | *1.4 | - |
| Lumbriculida | Lumbriculidae | na | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | | |
| Coleoptera (Beetle) | Dryopidae | *Helichus* | 0.9 | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - |
| | Dytiscidae | *Neoporus* | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - |
| | Elmidae | na | - | - | - | - | - | - | *1.6 | - | *2 | *1 | *0.9 | - | - | - | - | - |
| | | *Optioservus* | 2.8 | 3.2 | 3.2 | 3.6 | - | - | 4 | - | - | 1 | 0.9 | - | 3.8 | 1 | - | - |
| | | *Oulimnius* | 0.9 | 0.8 | - | 4.5 | - | - | 5.6 | - | 1 | - | 0.9 | 1.7 | 1 | 1.9 | - | - |
| | | *Promoresia* | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Stenelmis* | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Psehenidae | *Ectopria* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.7 | - |
| | Ptilodactylidae | *Anchytarsus* | - | - | - | - | - | - | - | - | - | - | 6.4 | - | 1 | - | - | 0.9 |
| Diptera (True Fly) | Ceratopogonidae | na | - | - | - | - | - | - | - | - | - | - | - | *0.8 | *1 | - | - | - |
| | | *Bezzia* | - | - | - | - | - | - | - | - | - | 1 | - | - | - | 1 | - | - |
| | | *Ceratopogon* | - | - | 0.8 | - | - | - | 0.8 | - | 1 | - | - | - | - | - | - | - |
| | | *Probezzia* | - | - | - | - | - | - | 0.8 | - | 1 | - | - | 0.8 | - | - | - | - |
| | Chironomidae | *Corynoneura* | 0.9 | 0.8 | 0.8 | - | 1.4 | 0.8 | - | - | 2.9 | - | 1.8 | - | 4.8 | 1.9 | 2.9 | - |
| | | *Diamesa* | 0.9 | - | 0.8 | - | - | - | - | - | - | - | - | - | - | 1.9 | - | 0.9 |
| | | Diamesinae | - | - | - | - | - | - | - | - | - | - | - | - | - | *0.7 | - | - |
| | | *Eukiefferiella* | 0.9 | 0.8 | 1.6 | 0.9 | - | - | 0.8 | 5.7 | - | - | 6.4 | 8.3 | 7.7 | 2.9 | 1.4 | 12.1 |
| | | *Heterotrissocladius* | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Micropsectra* | - | - | - | 0.9 | - | - | - | - | 5.9 | - | 0.9 | - | - | - | - | - |
| | | *Microtendipes* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 |
| | | Orthocladiinae | *1.9 | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - | *0.9 |
| | | *Orthocladius* | - | - | - | - | 0.7 | - | - | - | 1 | - | - | 0.8 | - | 2.9 | 2.2 | 0.9 |
| | | *Parachaetocladius* | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | 2.2 | 0.9 |
| | | *Parametriocnemus* | - | - | - | 1.8 | 0.7 | 1.6 | 2.4 | 0.8 | 2.9 | 2 | 0.9 | - | 2.9 | 1.9 | - | 0.9 |
| | | *Paraphaenocladius* | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| | | *Polypedilum* | - | - | - | 0.9 | - | - | - | - | 2 | - | - | - | 1 | 1 | - | - |
| | | *Procladius* | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Rheosmittia* | - | - | - | - | - | - | 0.8 | - | 1 | - | - | - | - | - | - | - |
| | | *Rheotanytarsus* | 1.9 | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 0.7 | 1.9 |
| | | *Stempellinella* | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - |
| | | *Stilocladius* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | 1 | 1 | - | - |
| | | *Symposiocladius* | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - |
| | | *Sympotthastia* | - | - | 3.2 | - | 1.4 | - | 0.8 | - | - | - | 0.9 | - | 1 | - | - | 2.8 |
| | | Tanypodinae | - | - | - | - | - | - | - | - | - | *1 | - | *1.7 | *1 | - | - | *1.9 |
| | | Tanytarsini | - | - | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - |
| | | *Tanytarsus* | - | - | 0.8 | - | - | - | - | - | - | - | 0.9 | - | 1 | - | - | - |

| ORDER | FAMILY | GENUS | 1996 RA | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Thienemanniella* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | 1 | 0.7 | - |
| | | *Trissopelopia* | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - |
| | | *Tvetenia* | - | - | 0.8 | 0.9 | 5 | - | 0.8 | 0.8 | 2.9 | 2 | - | - | 1 | 9.6 | - | - |
| | | *Zavrelimyia* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.4 | - |
| | Dixidae | ***Dixa***[+] | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - |
| | Empididae | na | - | - | - | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - |
| | | *Chelifera* | - | - | 0.8 | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - |
| | | *Clinocera* | - | - | - | - | - | - | - | 1.6 | - | - | 0.9 | 2.5 | 1.9 | 1 | 2.9 | - |
| | Orthocladiinae | *Hydrobaenus* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.4 | - |
| | Simuliidae | *Prosimulium* | 12.3 | 18.5 | 13.6 | 6.3 | 62.4 | 40.5 | 5.6 | 34.1 | 37.3 | 43.1 | 32.7 | 27.5 | 20.2 | 8.7 | 1.4 | 37.4 |
| | | *Simulium* | - | - | - | 1.8 | - | 0.8 | - | - | - | - | - | - | - | - | - | - |
| | | *Stegopterna* | - | - | 0.8 | - | 2.1 | - | - | - | - | 1 | - | 0.8 | 1 | - | - | 0.9 |
| | Tipulidae | *Antocha* | - | - | 0.8 | - | - | - | - | - | - | - | - | - | 1.9 | - | - | - |
| | | *Dicranota* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 |
| | | *Hexatoma* | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - |
| | | *Pseudolimnophila* | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - |
| | | *Tipula* | 0.9 | 0.8 | 1.6 | - | 0.7 | 0.8 | - | - | 4.9 | 1 | 2.7 | 7.5 | 1 | - | - | - |
| Ephemeroptera | Ameletidae | *Ameletus* | 2.8 | - | 1.6 | 1.8 | 7.8 | 2.4 | - | 1.6 | - | - | 8.2 | 0.8 | - | 1.9 | 4.3 | 0.9 |
| (Mayfly) | Baetidae | *Acerpenna* | 1.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Plauditus* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.9 |
| | Ephemerellidae | na | - | - | - | - | - | - | - | - | - | *11.8 | *1.8 | *9.2 | - | - | - | - |
| | | *Ephemerella* | 37.7 | 55.6 | 28 | 54.1 | 5 | 31.7 | 38.7 | 13.8 | 18.6 | - | - | - | 1.9 | 24 | 43.5 | 2.8 |
| | | *Eurylophella* | - | - | 1.6 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Serratella* | - | - | 1.6 | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - |
| | Heptageniidae | na | - | - | - | *1.8 | - | - | *1.6 | *0.8 | *1 | *2 | - | - | *1 | - | *0.7 | - |
| | | ***Epeorus***[+] | - | 8.1 | 13.6 | 0.9 | - | - | 4 | 17.9 | 1 | 8.8 | 4.5 | 0.8 | 1.9 | - | 5.8 | 12.1 |
| | | *Maccaffertium* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | 1 | - | - | - |
| | | *Stenonema* | 0.9 | 0.8 | 1.6 | - | - | 1.6 | - | - | 2 | - | - | - | - | - | - | - |
| | Leptophlebiidae | ***Paraleptophlebia***[+] | 0.9 | 0.8 | - | - | - | - | - | - | - | - | - | - | - | 1.0 | 0.7 | - |
| Odonata | Aeshnidae | *Boyeria* | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - |
| (Dragonfly/ | Cordulegastridae | *Cordulegaster* | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - |
| Damselfly) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Plecoptera | na | na | - | - | - | *0.9 | - | - | - | - | - | - | - | - | - | - | - | - |
| (Stonefly) | Capniidae | na | - | - | *0.8 | - | *5.7 | - | - | *0.8 | - | - | - | *0.8 | - | - | - | - |
| | | *Allocapnia* | - | - | - | - | - | - | - | - | - | - | - | - | 2.9 | - | - | - |
| | Chloroperlidae | *Haploperla* | - | - | - | - | - | - | - | - | - | - | - | 2.5 | - | - | - | - |
| | Leuctridae | na | - | - | - | - | - | *1.6 | *6.5 | - | *1 | *1 | *0.9 | *1.7 | - | *1 | *1.4 | - |
| | | *Leuctra*[+] | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.9 | - | - |
| | Nemouridae | na | - | - | *8 | - | - | *3.2 | - | *1.6 | *1 | - | - | *1.7 | *12.5 | *1 | - | *1.9 |
| | | *Amphinemura* | 14.2 | - | - | 1.8 | - | 0.8 | 3.2 | - | - | - | - | - | - | - | - | - |
| | | *Prostoia* | - | - | - | - | 4.3 | 3.2 | 0.8 | 8.9 | - | 4.9 | 2.7 | 2.5 | - | - | - | 3.7 |
| | Peltoperlidae | ***Tallaperla***[+] | 1.9 | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Perlidae | na | - | - | *5.6 | - | - | - | - | *1.6 | *1 | *1 | *0.9 | *1.7 | *1.9 | - | *3.6 | - |
| | | *Acroneuria* | 1.9 | 0.8 | 1.6 | 0.9 | - | - | 0.8 | 2.4 | 1 | 3.9 | 2.7 | 4.2 | 1 | 1.9 | - | 2.8 |
| | Perlodidae | na | - | *3.2 | - | *1.8 | - | *2.4 | *1.6 | - | - | - | *0.9 | 3.3 | - | *4.8 | *2.9 | - |
| | | *Isoperla* | 3.8 | - | - | 3.6 | - | - | 0.8 | - | - | - | - | - | - | 5.8 | 7.2 | 0.9 |
| | Pteronarcyidae | *Pteronarcys* | 1.9 | - | 2.4 | 3.6 | - | 1.6 | 3.2 | 0.8 | 1 | 2 | - | 2.5 | - | - | 0.7 | 0.9 |

| ORDER | FAMILY | GENUS | 1996 RA | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Taeniopterygidae | *Oemopteryx* | - | - | 0.8 | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - |
| | | *Strophopteryx* | - | - | - | - | - | 0.8 | - | - | - | 1 | - | - | - | 1 | 0.7 | - |
| | | *Taeniopteryx* | - | 1.6 | - | - | - | - | - | - | - | - | 0.9 | - | - | 1 | - | - |
| Trichoptera | Glossosomatidae | na | - | - | - | *0.9 | - | - | - | - | - | - | - | - | - | - | - | - |
| (Caddisfly) | | *Glossosoma* | - | - | - | 0.9 | - | - | 0.8 | - | - | - | 0.9 | 0.8 | - | - | 0.7 | - |
| | Hydropsychidae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | *1 | - | - |
| | | *Ceratopsyche* | - | - | - | - | - | - | - | - | - | - | - | 1.7 | - | - | - | - |
| | | *Cheumatopsyche* | - | - | - | 1.8 | - | - | 0.8 | 0.8 | 1 | 2 | 3.6 | 1.7 | 2.9 | - | 1.4 | 0.9 |
| | | ***Diplectrona***[+] | 0.9 | - | - | - | - | - | 4 | 1.6 | 2.9 | 1 | 4.5 | 3.3 | 5.8 | 6.7 | - | - |
| | | *Hydropsyche* | - | - | 0.8 | - | - | 2.4 | 4 | 1.6 | - | 2 | 2.7 | 0.8 | 1.9 | 1 | - | 3.7 |
| | Lepidostomatidae | *Lepidostoma* | - | - | - | - | 0.7 | 3.2 | - | - | - | - | - | 0.8 | - | - | - | - |
| | Limnephilidae | na | - | - | - | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - |
| | | *Hydatophylax* | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - |
| | | *Pycnopsyche* | - | - | 1.6 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Philopotamidae | *Dolophilodes* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | 2.9 | - | 0.7 | 0.9 |
| | Polycentropodidae | *Polycentropus* | - | - | - | - | 0.7 | - | - | - | - | - | - | - | - | - | 0.7 | - |
| | Rhyacophilidae | *Rhyacophila* | 0.9 | 0.8 | - | - | - | - | - | - | 1 | 1 | - | - | - | 1 | 2.2 | 0.9 |
| | Uenoidae | *Neophylax* | 2.8 | - | - | - | 0.7 | - | 0.8 | 0.8 | - | 2 | 1.8 | 2.5 | 6.7 | - | 1.4 | 0.9 |
| PHYLUM PLATYHELMINTHES | | | | | | | | | | | | | | | | | | |
| Tricladida | Dugesiidae | *Cura* | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | |
| (Flatworm) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).
* Taxa not identified to genus
[+] Cold-preference genera

## *Unnamed Tributary to Dipping Pond Run (JONE-109-S)*

Site JONE-109-S is located on an unnamed tributary to Dipping Pond Run in the Eastern Piedmont region of Maryland. It is in the Jones Falls watershed in Baltimore County. This site was sampled in 1995 and 2000 to 2014.


*Unnamed tributary to Dipping Pond Run in spring 2013.*

### ***Land Use/ Land Cover***

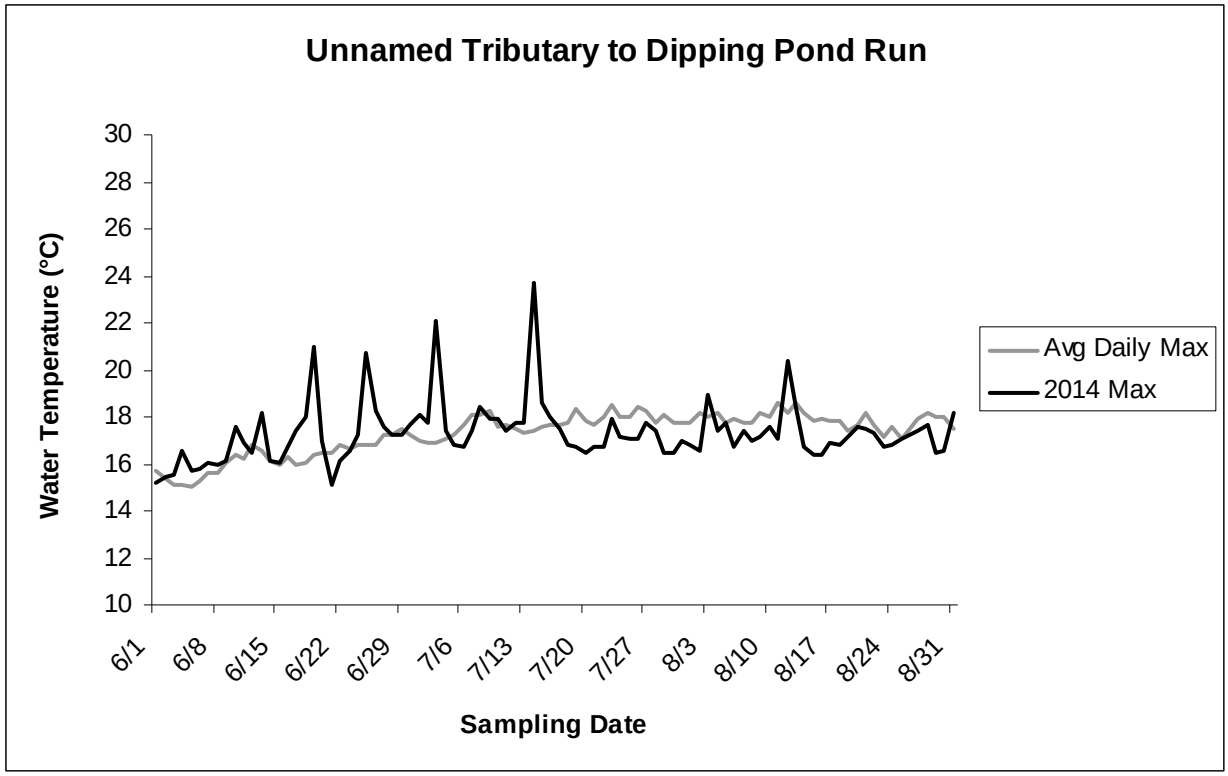
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 59.67 | 67.98 | 62.79 |
| Agriculture | 0.00 | 1.09 | 0.00 |
| Urban | 12.94 | 30.93 | 37.21 |
| Other | 27.38 | 0.00 | 0.00 |

### ***Physical Habitat***

Physical habitat measurements collected at the unnamed tributary to Dipping Pond Run (2000 to 2014). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 12 | 11 | 16 | 16 | 15 | 8 | 13 | 12 | 13 | 15 | 15 | 9 | 12 | 14 | 15 |
| Epifaunal substrate (0-20) | 11 | 13 | 16 | 18 | 17 | 9 | 13 | 12 | 12 | 15 | 14 | 12 | 15 | 14 | 16 |
| Velocity/Depth Diversity (0-20) | 8 | 7 | 11 | 11 | 9 | 7 | 7 | 9 | 7 | 8 | 11 | 6 | 9 | 9 | 9 |
| Pool Quality (0-20) | 6 | 7 | 11 | 11 | 8 | 6 | 6 | 8 | 6 | 10 | 11 | 7 | 7 | 9 | 9 |
| Riffle Quality (0-20) | 9 | 11 | 10 | 14 | 11 | 11 | 12 | 8 | 9 | 9 | 10 | 9 | 8 | 10 | 10 |
| Shading (%) | 90 | 95 | 95 | 97 | 95 | 90 | 95 | 90 | 95 | 85 | 90 | 85 | 70 | 75 | 65 |
| Embeddedness (%) | 25 | 40 | 35 | 15 | 23 | 40 | 40 | 30 | 40 | 50 | 40 | 30 | 35 | 35 | 25 |
| Discharge (cfs) | 0.12 | 0.08 | 0.06 | 0.26 | 0.10 | 0.16 | 0.13 | 0.04 | 0.08 | 0.10 | 0.41 | 0.09 | 0.06 | 0.15 | 0.20 |




The above graph displays the average daily maximum temperatures recorded at the unnamed tributary to Dipping Pond Run. The average was calculated from twelve years of data.

***Biology***

*Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 4.67 | 5.00 | 4.00 | 4.67 | 4.00 | 4.67 | 3.67 | 3.67 | 3.67 | 4.00 | 4.33 | 4.00 | 4.67 | 3.33 | 3.67 |
| FIBI | 1.33 | 1.33 | 1.33 | 1.33 | 1.67 | 1.33 | 1.67 | 1.67 | 1.33 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 |

*Fish*

Cumulative list of fish species (with abundance) collected in the unnamed tributary to Dipping Pond Run by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brook trout | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Brown trout | - | - | - | - | 2 | - | 2 | 1 | - | 1 | 2 | - | 1 | 4 | 1 |
| Eastern blacknose dace | 41 | 93 | 49 | 28 | 52 | 64 | 42 | 60 | 59 | 78 | 44 | 120 | 96 | 67 | 108 |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

*Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to Dipping Pond Run by sampling year.

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Common crayfish (*Cambarus bartonii bartonii*) | P | P | A | A | P | A | P | P | P |
| Virile Crayfish (*Orconectes virilis*) | A | A | A | P | A | P | A | P | A |

*Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in Dipping Pond Run by sampling year.

| *Species* |
|---|
| None Observed |

*Herpetofauna*

Cumulative list of herpetofauna species collected in or near the unnamed tributary to Dipping Pond Run.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | American bullfrog, Eastern American toad, Gray tree frog, Northern green frog, Pickerel frog, Wood frog |
| Caudata (Salamanders and Newts) | Eastern red-backed salamander, Northern dusky salamander, Northern red salamander, Northern two-lined salamander |
| Squamata (Snakes and Lizards) | Northern ring-necked snake, Northern watersnake |
| Testudines (Turtles) | Eastern box turtle |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in the unnamed tributary to Dipping Pond Run by sampling year, RA = %Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *1995 RA* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | | |
| Haplotaxida | Enchytraeidae | na | - | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | Naididae | na | - | *5.9 | *5.5 | *20.1 | - | - | - | *5.3 | *1.8 | *1.7 | *1.5 | - | - | - | *0.8 | *0.8 |
| Lumbriculida | Lumbriculidae | na | - | - | - | - | - | *1 | - | - | - | - | - | *3 | - | - | - | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | | |
| Coleoptera (Beetle) | Elmidae | na | - | - | *3.9 | - | - | - | *1.7 | *1.5 | - | - | - | - | - | - | - | - |
| | | *Optioservus* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.6 | - | - |
| | | *Oulimnius* | 5.5 | 1.7 | 2.4 | - | - | - | 2.6 | 7.5 | 0.9 | - | - | - | 1.5 | 1.3 | 1.6 | - |
| | Hydrophilidae | *Tropisternus* | - | - | - | 0.7 | - | - | - | - | - | - | - | - | - | - | - | - |
| | Psephenidae | *Ectopria* | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - |
| | Ptilodactylidae | *Anchytarsus* | - | - | - | 0.7 | - | - | - | - | - | 1.7 | - | - | 0.8 | 0.6 | - | - |
| Collembola (Springtail) | na | na | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Isotomidae | *Isotomurus* | - | - | - | 0.8 | - | - | - | 0.8 | 0.9 | - | - | - | 0.8 | - | - | - |
| Diptera (True Fly) | Ceratopogonidae | na | - | - | *1.6 | - | - | - | - | - | - | - | - | *0.7 | - | - | - | - |
| | | *Ceratopogon* | - | - | - | - | 4.1 | - | 0.9 | 1.5 | - | - | 0.7 | 0.7 | 0.8 | - | - | - |
| | Chironomidae | *Brillia* | - | - | - | - | - | 1 | - | - | 0.9 | - | - | 0.7 | - | 0.6 | - | - |
| | | *Chaetocladius* | - | - | - | - | - | - | - | 0.8 | - | - | 2.2 | - | 1.5 | - | 0.8 | - |
| | | *Corynoneura* | - | - | - | 1.5 | 0.8 | 1 | - | - | 3.5 | 1.7 | 7.4 | 9 | 4.6 | 3.9 | 8 | 0.8 |
| | | *Diamesa* | - | - | 0.8 | - | - | - | - | - | 1.8 | - | - | - | - | 0.6 | 0.8 | - |
| | | *Eukiefferiella* | 0.8 | 1.7 | - | - | 8.2 | 2 | - | 9.8 | 6.1 | - | 5.1 | 3.7 | 14.5 | 5.2 | 12.7 | 16.4 |
| | | ***Heleniella***[+] | - | - | - | - | 2.5 | - | - | - | - | - | - | - | - | - | - | - |
| | | ***Heterotrissocladius*** | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.6 | - | - |
| | | ***Limnophyes*** | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.3 | 0.8 | - |
| | | *Micropsectra* | - | - | 3.1 | - | - | 2.9 | 0.9 | - | - | - | - | - | 0.8 | - | - | - |
| | | Orthocladiinae | - | *9.2 | *1.6 | - | - | - | - | - | - | *0.8 | *0.7 | *2.2 | - | - | 1.6 | - |
| | | *Orthocladius* | - | - | - | - | - | - | - | - | 0.9 | 0.8 | 2.2 | 0.7 | 1.5 | - | 2.4 | - |
| | | *Paracladopelma* | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | 0.8 |
| | | *Parametriocnemus* | - | - | 3.1 | 1.5 | 2.5 | 6.9 | 4.3 | 6.8 | 9.6 | 6.8 | 9.6 | 8.2 | 4.6 | 0.6 | 7.1 | - |
| | | *Paraphaenocladius* | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - |
| | | *Phaenopsectra* | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - |
| | | *Polypedilum* | - | 1.7 | 1.6 | - | - | 2 | - | 0.8 | 4.4 | - | 2.2 | 0.7 | - | 0.6 | - | 1.6 |
| | | *Pseudorthocladius* | - | - | - | - | - | - | - | 1.5 | - | - | - | - | - | - | - | - |
| | | *Stempellinella* | - | - | - | - | - | - | - | - | 2.6 | - | 0.7 | - | - | - | - | - |
| | | *Stilocladius* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.6 |
| | | *Sympotthastia* | - | - | - | - | 9.8 | - | - | - | 0.9 | 11 | 1.5 | 2.2 | 0.8 | 1.3 | 0.8 | - |
| | | Tanypodinae | - | - | - | - | - | *2 | *0.9 | - | - | *2.5 | - | *3.7 | *0.8 | - | - | - |
| | | Tanytarsini | - | - | - | - | - | - | - | - | - | *0.8 | - | - | - | - | - | *0.8 |
| | | *Tanytarsus* | - | - | - | - | - | - | - | - | 1.8 | - | | - | - | - | 0.8 | 3.3 |
| | | *Thienemanniella* | - | - | - | - | - | 1 | - | 0.8 | - | - | 0.7 | 2.2 | 1.5 | 4.5 | 0.8 | - |
| | | Thienemannimyia Group | - | - | - | - | - | *1 | - | - | - | *0.8 | *0.7 | - | *0.8 | - | - | *0.8 |
| | | *Trissopelopia* | - | - | 1.6 | 0.7 | - | 5.9 | - | 1.5 | - | - | - | 0.7 | 0.8 | - | - | - |
| | | *Tvetenia* | - | - | 2.4 | - | 0.8 | 5.9 | - | - | 0.9 | 1.7 | 2.2 | 2.2 | 1.5 | 1.3 | 0.8 | 1.6 |

| ORDER | FAMILY | GENUS | 1995 RA | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Zavrelimyia* | - | - | - | - | - | - | - | 0.8 | - | - | - | 0.7 | - | - | 0.8 | - |
| | Dixidae | ***Dixa***[+] | - | - | - | - | - | - | - | - | - | - | 2.2 | 0.7 | - | - | - | - |
| | Empididae | na | - | - | - | - | - | - | - | - | - | *1.7 | - | - | - | - | - | - |
| | | *Chelifera* | 3.1 | - | 0.8 | 0.7 | - | 1 | - | - | - | - | - | - | - | 0.6 | - | - |
| | | *Clinocera* | - | - | - | - | - | 1 | - | - | - | - | - | - | 1.5 | - | 3.2 | 0.8 |
| | Orthocladiinae | *Stilocladius* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - |
| | Simuliidae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | *0.8 |
| | | *Prosimulium* | - | - | - | - | 3.3 | 2.9 | - | 8.3 | 0.9 | 1.7 | 0.7 | 1.5 | 3.1 | - | 0.8 | - |
| | | *Simulium* | - | - | - | - | - | 1 | - | - | 0.9 | - | 2.9 | - | - | 1.9 | 1.6 | - |
| | | *Stegopterna* | 1.6 | - | - | - | 0.8 | - | - | - | 0.9 | 1.7 | - | - | - | 0.6 | - | - |
| | Tabanidae | *Chrysops* | - | - | - | - | 0.8 | - | - | - | - | - | 0.7 | - | 0.8 | - | - | - |
| | Tipulidae | na | - | - | - | - | - | - | - | *0.8 | - | - | - | *1.5 | - | - | - | - |
| | | *Antocha* | - | - | 0.8 | 0.7 | - | 3.9 | - | - | 0.9 | - | - | 1.5 | 0.8 | 0.6 | 0.8 | 1.6 |
| | | *Dicranota* | - | - | - | - | 0.8 | 1 | - | - | - | - | - | - | - | - | - | - |
| | | *Hexatoma* | - | - | - | - | 1.6 | - | 1.7 | - | - | - | - | - | - | - | - | - |
| | | *Pseudolimnophila* | - | 0.8 | - | 1.5 | - | - | 0.9 | 2.3 | - | 1.7 | - | - | - | - | - | - |
| | | *Tipula* | - | 0.8 | - | - | 0.8 | 2.9 | 0.9 | 3.8 | 3.5 | - | 1.5 | 1.5 | - | 1.3 | 2.4 | 1.6 |
| Ephemeroptera | Ameletidae | *Ameletus* | 0.8 | 5 | - | - | - | 1 | 1.7 | - | - | - | 0.7 | 1.5 | - | 1.3 | - | - |
| (Mayfly) | Baetidae | na | - | *0.8 | - | *1.5 | *0.8 | - | - | *0.8 | - | - | *0.7 | *0.7 | - | - | - | - |
| | | *Acerpenna* | 20.5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Baetis* | - | - | 1.6 | - | - | 5.9 | - | - | - | - | - | - | - | 2.6 | 10.3 | 5.7 |
| | | *Diphetor*[+] | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - |
| | Ephemerellidae | na | - | - | - | - | - | - | - | *2.3 | - | - | - | - | - | - | - | - |
| | | *Ephemerella* | 36.2 | 23.5 | 27.6 | 18.7 | 16.4 | - | 11.1 | 1.5 | 4.4 | 17.8 | 0.7 | 0.7 | - | - | - | - |
| | | *Eurylophella* | - | 0.8 | - | - | 0.8 | - | - | - | - | 2.5 | 0.7 | - | - | - | 0.8 | - |
| | Heptageniidae | na | - | - | *0.8 | - | - | - | - | - | *0.9 | - | - | - | - | - | - | - |
| | | ***Epeorus***[+] | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Maccaffertium* | - | - | - | - | - | - | - | - | - | 4.2 | - | - | 1.5 | 0.6 | - | 0.8 |
| | | *Stenonema* | - | 0.8 | 2.4 | 0.7 | 6.6 | 2.9 | 8.5 | 9.8 | 0.9 | - | - | - | - | - | - | - |
| | Leptophlebiidae | na | - | - | - | - | - | - | - | - | - | - | - | *0.7 | - | - | - | - |
| | | ***Paraleptophlebia***[+] | 0.8 | 1.7 | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| Megaloptera | Corydalidae | *Nigronia* | 0.8 | 0.8 | 0.8 | - | 0.8 | - | - | 1.5 | 2.6 | - | - | - | - | - | - | - |
| (Dobsonfly/ | Sialidae | *Sialis* | - | - | - | - | 0.8 | - | 0.9 | - | - | - | - | - | - | - | - | - |
| Fishfly) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Odonata | Calopterygidae | *Calopteryx* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 |
| | Cordulegastridae | *Cordulegaster* | - | - | - | 0.7 | 0.8 | - | - | - | 1.8 | - | - | - | - | - | - | 0.8 |
| (Dragonfly/Damselfly) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Gomphidae | na | - | - | - | - | - | - | - | - | - | - | *0.7 | - | - | - | - | - |
| Plecoptera | na | na | - | - | - | *0.7 | - | - | - | - | - | - | - | - | - | - | - | - |
| (Stonefly) | Chloroperlidae | na | - | - | - | - | - | *1 | - | - | - | - | - | - | - | - | - | - |
| | | ***Alloperla***[+] | - | - | - | 0.7 | - | - | - | - | - | - | - | - | - | - | - | - |
| | Leuctridae | na | - | *5 | *3.1 | *6.7 | - | *2 | *8.5 | - | *1.8 | *6.8 | *16.2 | *27.6 | *8.4 | *38.3 | - | *3.3 |
| | | ***Leuctra***[+] | 12.6 | - | - | 3 | 3.3 | 1 | - | - | - | - | - | - | 2.3 | - | 5.6 | - |
| | Nemouridae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | *0.6 | - | - |
| | | *Amphinemura* | 7.1 | 22.7 | 17.3 | 11.9 | 1.6 | 5.9 | 17.9 | 8.3 | 15.8 | 12.7 | 27.9 | 2.2 | 25.2 | 5.8 | 18.3 | 7.4 |
| | | *Prostoia* | - | - | - | - | - | - | 1.7 | 6.8 | 1.8 | 0.8 | - | - | 1.5 | - | 4 | 4.9 |

| ORDER | FAMILY | GENUS | 1995 RA | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Soyedina* | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - |
| | Peltoperlidae | *Peltoperla* | - | - | - | 0.7 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | ***Tallaperla***[+] | - | 0.8 | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | Perlidae | na | - | - | - | - | *1.6 | *2 | - | - | - | - | - | - | - | - | - | *0.8 |
| | | *Eccoptura* | 0.8 | - | - | - | 1.6 | 1 | 0.9 | - | 0.9 | 0.8 | - | 0.7 | 0.8 | 0.6 | - | - |
| | Perlodidae | na | - | *5.9 | *3.1 | *6 | *2.5 | *4.9 | *3.4 | - | - | - | - | *3 | *3.1 | *0.6 | - | *0.8 |
| | | *Diploperla* | - | 2.5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Isoperla* | 3.9 | - | - | - | - | 2 | - | - | 0.9 | - | - | - | - | - | - | - |
| | Taeniopterygidae | na | - | - | - | - | - | - | - | - | - | - | - | - | *0.8 | - | - | - |
| | | *Taeniopteryx* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - |
| Trichoptera | Glossosomatidae | *Glossosoma* | - | - | - | 0.7 | - | 1 | - | - | - | - | - | - | - | - | - | 0.8 |
| (Caddisfly) | Hydropsychidae | *Cheumatopsyche* | - | - | - | - | 0.8 | 1 | 5.1 | 0.8 | 2.6 | 0.8 | 0.7 | - | - | 1.9 | 0.8 | 4.9 |
| | | ***Diplectrona***[+] | 0.8 | 5 | 9.4 | 7.5 | 16.4 | 14.7 | 23.9 | 12 | 21.9 | 12.7 | 5.1 | 9 | 8.4 | 8.4 | 5.6 | 12.3 |
| | | *Hydropsyche* | - | - | - | - | - | - | 0.9 | - | - | - | - | 0.7 | 0.8 | 0.6 | - | 1.6 |
| | Limnephilidae | na | - | - | - | - | - | - | - | - | - | - | - | *0.7 | - | - | - | - |
| | | *Pycnopsyche* | - | - | 1.6 | - | - | 2.9 | - | - | - | - | 0.7 | 0.7 | 0.8 | - | - | - |
| | Molannidae | *Molanna* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 |
| | Philopotamidae | na | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | *6.5 | - | - |
| | | *Chimarra* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.6 | - | 0.8 |
| | | *Dolophiloides* | - | 0.8 | - | - | - | - | - | - | - | - | - | 0.7 | - | - | 0.8 | 2.5 |
| | | *Wormaldia*[+] | - | - | - | 6 | - | - | - | - | - | - | - | - | - | - | - | - |
| | Polycentropodidae | *Polycentropus* | - | - | - | - | - | - | - | - | - | - | - | 0.7 | - | - | - | - |
| | Rhyacophilidae | *Rhyacophila* | 2.4 | - | 0.8 | 1.5 | 1.6 | - | - | - | - | - | - | - | 0.8 | - | - | - |
| | Uenoidae | *Neophylax* | - | 0.8 | 1.6 | 3.7 | 3.3 | 3.9 | - | - | - | 0.8 | - | 1.5 | - | 1.3 | 3.2 | 16.4 |
| PHYLUM MOLLUSCA | | | | | | | | | | | | | | | | | | |
| Veneroida | Pisidiidae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | *0.8 |
| (Bivalve) | | *Pisidium* | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| PHYLUM NEMATOMORPHA | | | | | | | | | | | | | | | | | | |
| Gordioidea | Gordiidae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | *0.7 | - | - |
| (Worm) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| PHYLUM PLATYHELMINTHES | | | | | | | | | | | | | | | | | | |
| Tricladida | Dugesiidae | na | - | - | - | - | - | - | - | - | - | *0.8 | - | - | *1.5 | - | - | - |
| (Flatworm) | Planariidae | na | - | - | - | - | *1.6 | *1 | - | - | - | - | - | - | - | - | - | - |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).
* Taxa not identified to genus
[+] Cold-preference genera

# *North Branch of Jones Falls (JONE-315-S)*

Site JONE-315-S is located on the North Branch of Jones Falls in the Eastern Piedmont region of Maryland. It is in the Jones Falls watershed in Baltimore County. This site was sampled in 1996 and 2000 to 2014.

*North Branch of Jones Falls in spring 2013.*

## ***Land Use/ Land Cover***

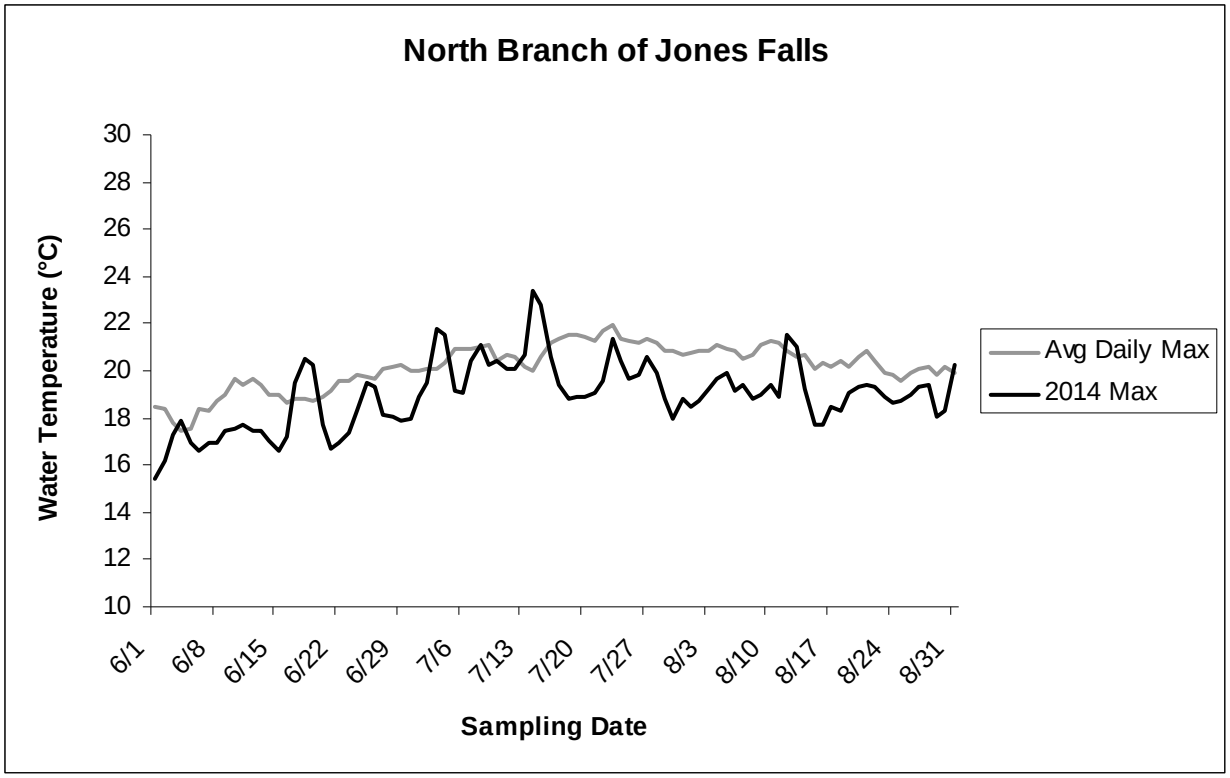
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 53.16 | 57.60 | 56.45 |
| Agriculture | 1.52 | 15.74 | 15.55 |
| Urban | 4.50 | 23.30 | 24.54 |
| Other | 40.82 | 3.35 | 3.46 |

## ***Physical Habitat***

Physical habitat measurements collected at the North Branch of Jones Falls (2000 to 2014). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 17 | 17 | 19 | 19 | 18 | 17 | 18 | 17 | 17 | 17 | 17 | 17 | 17 | 14 | 15 |
| Epifaunal substrate (0-20) | 17 | 18 | 19 | 18 | 16 | 17 | 17 | 16 | 14 | 17 | 17 | 17 | 15 | 13 | 14 |
| Velocity/Depth Diversity (0-20) | 15 | 15 | 15 | 17 | 16 | 15 | 16 | 14 | 13 | 13 | 13 | 15 | 12 | 12 | 8 |
| Pool Quality (0-20) | 16 | 16 | 19 | 17 | 17 | 17 | 17 | 16 | 17 | 15 | 16 | 16 | 12 | 13 | 16 |
| Riffle Quality (0-20) | 17 | 17 | 17 | 17 | 17 | 16 | 16 | 13 | 13 | 17 | 16 | 16 | 15 | 14 | 14 |
| Shading (%) | 95 | 83 | 96 | 98 | 80 | 90 | 90 | 85 | 80 | 80 | 85 | 65 | 40 | 70 | 60 |
| Embeddedness (%) | 15 | 20 | 16 | 20 | 15 | 30 | 35 | 20 | 25 | 20 | 30 | 30 | 65 | 20 | 20 |
| Discharge (cfs) | 2.77 | 3.05 | 0.59 | 8.44 | 4.73 | 1.25 | 2.62 | 0.99 | 2.59 | 3.06 | 4.74 | 3.28 | 4.84 | 1.77 | 3.72 |




The graph above displays the average daily maximum temperatures recorded at the North Branch of Jones Falls. The average was calculated from ten years of data.

***Biology***

*Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 5.00 | 4.00 | 4.67 | 4.67 | 4.00 | 5.00 | 4.00 | 3.33 | 3.33 | 2.33 | 2.67 | 3.33 | 3.67 | 3.00 | 3.00 |
| FIBI | 4.00 | 4.00 | 4.33 | 3.33 | 3.67 | 4.33 | 4.00 | 4.00 | 3.33 | 3.33 | 4.33 | 3.00 | 3.00 | 3.33 | 3.67 |

## *Fish*

Cumulative list of fish species (with abundance) collected in the North Branch of Jones Falls by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| American eel | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| Bluegill | - | 5 | 4 | 6 | 4 | 77 | 43 | 8 | 34 | 13 | 22 | 44 | 103 | 27 | 21 |
| Brown trout | 94 | 111 | 81 | 24 | 57 | 131 | 134 | 86 | 55 | 48 | 60 | 16 | 36 | 40 | 59 |
| Creek chub | 26 | 23 | 9 | 13 | 32 | 21 | 5 | 12 | 29 | 29 | 27 | 20 | 64 | 56 | 41 |
| Cutlips minnow | 13 | 7 | 6 | 11 | 27 | 18 | 7 | 10 | 1 | 27 | 34 | 8 | 18 | 10 | 13 |
| Eastern blacknose dace | 162 | 105 | 35 | 39 | 101 | 57 | 39 | 69 | 87 | 73 | 43 | 67 | 152 | 96 | 111 |
| Green sunfish | 16 | 9 | 2 | 8 | 108 | 162 | 63 | 58 | 26 | 6 | 11 | 40 | 55 | 23 | 14 |
| Golden shiner | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - |
| Largemouth bass | - | 7 | 4 | - | 1 | 4 | - | 3 | 2 | 6 | - | - | 9 | 6 | 1 |
| Lepomis hybrid | - | - | - | - | - | - | 4 | - | - | - | - | - | - | - | - |
| Longnose dace | 128 | 109 | 62 | 34 | 81 | 52 | 17 | 57 | 36 | 31 | 23 | 16 | 57 | 65 | 69 |
| Northern hogsucker | - | - | - | - | - | - | - | - | - | - | - | 3 | - | - | - |
| Pumpkinseed | - | - | - | - | - | - | 4 | 5 | - | - | - | - | - | - | - |
| Redbreast Sunfish | - | - | - | - | - | - | - | - | - | 1 | - | 2 | - | - | - |
| Rock bass | 5 | - | 1 | - | - | 1 | - | - | - | - | - | - | - | - | - |
| Rosyside dace | 15 | 11 | 9 | 10 | 4 | 5 | - | 1 | - | 1 | - | - | 1 | - | - |
| Smallmouth bass | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Sunfish (unknown) | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - |
| Tessellated darter | 20 | 17 | 7 | 13 | 12 | 8 | 6 | 7 | 19 | 32 | 1 | 8 | 15 | 29 | 33 |
| White sucker | 49 | 29 | 33 | 23 | 39 | 30 | 37 | 50 | 14 | 46 | 39 | 42 | 44 | 72 | 40 |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

## *Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to North Branch of Jones Falls by sampling year.

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Virile crayfish (*Orconectes virilis*) | P | P | A | P | P | P | P | P | P |
| Common crayfish (*Cambarus bartonii bartonii*) | P | P | A | P | P | P | P | A | P |

## *Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in the North Branch of Jones Falls by sampling year.

| *Species* |
|---|
| None Observed |

## *Herpetofauna*

Cumulative list of herpetofauna species collected in or near the North Branch of Jones Falls.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | American bullfrog, Eastern American toad, Gray treefrog, Northern green frog, Pickerel frog, Wood frog |
| Caudata (Salamanders and Newts) | Eastern red-backed salamander, Long-tailed salamander, Northern dusky salamander, Northern two-lined salamander, *Pseudotriton sp.* |
| Squamata (Snakes and Lizards) | Northern ring-necked snake, Northern watersnake, Queen snake |
| Testudines (Turtles) | Eastern box turtle, Eastern snapping turtle |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in the North Branch of Jones Falls by sampling year, RA = %Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *1996 RA* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | | |
| Haplotaxida | Enchytraeidae | na | - | - | - | - | - | - | - | - | - | - | - | *1 | - | - | - | - |
| | Naididae | na | - | - | - | - | *0.9 | - | - | - | - | *0.9 | - | *1 | - | - | *0.9 | *1 |
| Lumbriculida | Lumbriculidae | na | *1.1 | - | - | - | - | *0.9 | - | - | - | - | - | - | - | - | *0.9 | - |
| Tubificida | Tubificidae | na | - | - | *1.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Limnodrilus* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | | |
| Amphipoda (Scud) | Crangonyctidae | na | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - |
| | | *Crangonyx* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| Coleoptera (Beetle) | Elmidae | na | - | - | - | - | - | - | *0.9 | - | - | - | - | - | - | - | - | - |
| | | *Dubiraphia* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - |
| | | *Macronychus* | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| | | *Optioservus* | 6.3 | - | - | 0.8 | 0.9 | - | 0.9 | 3.1 | - | - | 0.9 | - | 0.9 | - | 0.9 | - |
| | | *Oulimnius* | - | - | 0.9 | 0.8 | - | - | 5.5 | 3.9 | 2.9 | 0.9 | - | - | - | - | - | - |
| | | *Promoresia* | - | - | - | - | 0.9 | - | - | 1.6 | - | - | - | - | - | - | - | - |
| | | *Stenelmis* | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| | Psephenidae | *Ectopria* | - | - | - | - | - | - | 1.8 | - | - | - | - | - | - | - | - | - |
| | | *Psephenus* | - | - | - | 0.8 | - | - | - | 0.8 | 1.9 | - | - | - | - | - | - | - |
| Diptera (True Fly) | Ceratopogonidae | na | - | - | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - |
| | Chironomidae | *Brillia* | - | - | - | - | - | - | - | - | 1 | - | - | - | - | 0.9 | - | - |
| | | *Conchapelopia* | 1.1 | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Corynoneura* | - | - | - | - | 1.7 | - | - | - | - | 0.9 | - | - | - | 0.9 | - | 1 |
| | | *Diamesa* | - | - | 0.9 | - | - | - | - | - | 3.8 | 0.9 | 2.8 | 6 | - | 6.3 | 1.8 | - |
| | | *Eukiefferiella* | 1.1 | 1.6 | 1.8 | 0.8 | - | - | - | 0.8 | - | 0.9 | - | 1 | - | 4.4 | 0.9 | - |
| | | *Hydrobaenus* | - | - | - | - | - | - | - | - | - | - | 3.7 | - | - | - | - | - |
| | | *Nanocladius* | 1.1 | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - |
| | | *Micropsectra* | - | - | - | - | - | - | - | - | 1 | 0.9 | - | - | - | - | - | 1 |
| | | Orthocladiinae | *2.1 | *9.7 | *9.8 | - | - | - | *2.8 | *0.8 | - | *0.9 | *5.6 | *3 | - | *0.9 | - | *4.8 |
| | | *Orthocladius* | 1.1 | - | - | - | 9.5 | 1.8 | 1.8 | 14.1 | 16.3 | 6.2 | 38.9 | 37 | 2.7 | 25.7 | 11.4 | 23.1 |
| | | *Parakiefferiella* | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - |
| | | *Parametriocnemus* | 2.1 | 1.6 | 1.8 | 0.8 | - | 2.6 | 2.8 | 1.6 | 6.7 | 6.2 | 4.6 | 2 | 10.6 | 8 | 3.5 | 3.8 |
| | | *Phaenopsectra* | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | 0.9 | - |
| | | *Polypedilum* | - | - | - | - | - | - | 1.8 | - | 1.9 | 1.8 | 0.9 | - | - | 4.4 | - | 1 |
| | | *Potthastia* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - |
| | | *Pseudorthocladius* | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Rheocricotopus* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | | *Rheosmittia* | - | - | - | - | - | 1.8 | - | - | - | - | - | - | - | - | - | - |
| | | *Rheotanytarsus* | - | - | - | - | - | - | - | - | - | 2.7 | - | 1 | 1.8 | 1.8 | 0.9 | 1 |
| | | *Stempellinella* | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - |
| | | *Sympotthastia* | - | 1.6 | - | - | 5.2 | - | - | 0.8 | 1.9 | 2.7 | - | 6 | 2.7 | 0.9 | 0.9 | 8.7 |
| | | *Thienemanniella* | - | 0.8 | - | - | - | - | - | - | - | 1.8 | 0.9 | 1 | 0.9 | 6.2 | - | - |
| | | Thienemannimyia Group | - | - | - | - | - | *1.8 | - | - | *1 | *0.9 | - | - | - | - | - | - |

| ORDER | FAMILY | GENUS | 1996 RA | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Tvetenia* | - | - | - | - | - | 4.4 | - | 1.6 | 1 | 0.9 | 0.9 | 4 | 1.8 | 3.5 | 4.4 | 5.8 |
| | | *Zavrelimyia* | 1.1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Empididae | na | - | - | - | - | - | - | - | - | - | *1.8 | - | - | - | - | - | - |
| | | *Chelifera* | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| | | *Clinocera* | - | 1.6 | - | - | - | - | 3.7 | 1.6 | 5.8 | - | 8.3 | 3 | 0.9 | 0.9 | 8.8 | - |
| | | *Hemerodromia* | 1.1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Neoplasta* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| | Psychodidae | *Psychoda* | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| | Simuliidae | *Prosimulium* | 24.2 | 12.2 | 33 | 26.3 | 61.2 | 10.5 | 3.7 | 29.7 | 8.7 | 3.5 | 0.9 | - | 1.8 | 1.8 | 7 | - |
| | | *Simulium* | - | 0.8 | - | 0.8 | - | - | - | - | - | - | 0.9 | - | - | 3.5 | 0.9 | - |
| | | *Stegopterna* | - | - | - | - | - | 1.8 | - | - | 1 | - | - | - | - | - | - | - |
| | Tipulidae | *Antocha* | - | - | - | - | - | - | 3.7 | 0.8 | 1 | - | - | 2 | - | 0.9 | 1.8 | 1 |
| | | *Dicranota* | - | - | - | - | - | 2.6 | - | 0.8 | 1.9 | 2.7 | - | - | - | - | - | - |
| | | *Pseudolimnophila* | 1.1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Tipula* | - | 0.8 | - | - | - | 3.5 | 1.8 | - | 3.8 | - | 0.9 | 1 | 2.7 | - | 0.9 | 2.9 |
| Ephemeroptera | Ameletidae | *Ameletus* | - | 3.3 | - | - | - | - | - | - | - | - | - | 1 | - | 0.9 | - | - |
| (Mayfly) | Baetidae | na | - | *0.8 | *0.9 | *0.8 | - | - | *1.8 | - | - | - | - | - | - | - | - | - |
| | | *Acentrella* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | | *Baetis* | 5.3 | - | - | - | - | 21.9 | 5.5 | - | - | - | - | 1 | - | 0.9 | 9.6 | 2.9 |
| | Ephemerellidae | *Drunella* | - | 0.8 | - | 2.5 | - | - | 0.9 | 1.6 | - | - | - | - | - | - | - | - |
| | | *Ephemerella* | 16.8 | 39 | 34.8 | 44.9 | 6.9 | 16.7 | 34.9 | 18.8 | 4.8 | 2.7 | - | - | - | 0.9 | - | - |
| | | *Eurylophella* | 1.1 | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Serratella* | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - |
| | Heptageniidae | na | - | - | - | - | *0.9 | - | *0.9 | - | - | *0.9 | - | - | - | - | - | *1.9 |
| | | ***Epeorus***[+] | 4.2 | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Leucrocuta* | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| | | *Maccaffertium* | - | - | - | - | - | - | - | - | - | - | 3.7 | 1 | - | 0.9 | 0.9 | 2.9 |
| | | *Stenonema* | 2.1 | 1.6 | 1.8 | 2.5 | 0.9 | - | 4.6 | - | - | - | - | - | - | - | - | - |
| | Isonychiidae | *Isonychia* | 5.3 | 0.8 | - | - | 0.9 | - | 0.9 | - | - | - | - | 1 | 6.2 | 1.8 | - | 3.8 |
| Megaloptera | Corydalidae | *Chauliodes* | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - |
| (Dobsonfly/Fishfly) | | *Nigronia* | - | - | - | 3.4 | 0.9 | 0.9 | 0.9 | - | 1 | - | - | - | 1.8 | - | - | - |
| Odonata | Aeshnidae | *Boyeria* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - |
| (Dragonfly) | Gomphidae | *Lanthus* | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - |
| Plecoptera | Capniidae | *Allocapnia* | - | - | 0.9 | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - |
| (Stonefly) | Leuctridae | na | - | *1.6 | *1.8 | - | - | - | *0.9 | - | - | - | - | - | - | - | - | - |
| | | *Leuctra* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| | Nemouridae | na | - | - | - | - | - | - | - | *2.3 | - | *0.9 | - | - | *15.9 | - | - | - |
| | | *Amphinemura* | - | 2.4 | - | - | - | - | 4.6 | - | 1 | - | - | - | - | - | - | - |
| | | *Prostoia* | 15.8 | - | 4.5 | - | 1.7 | 4.4 | - | 1.6 | - | 0.9 | 0.9 | - | 23.9 | 7.1 | 8.8 | - |
| | Perlidae | na | *2.1 | - | - | - | - | - | - | *0.8 | *1 | - | - | - | *1.8 | - | - | - |
| | | *Acroneuria* | - | 1.6 | - | - | - | - | - | - | - | 0.9 | 1.9 | - | - | - | - | - |
| | Perlodidae | na | *1.1 | *4.9 | *1.8 | *0.8 | - | - | *0.9 | - | - | - | - | - | - | *0.9 | - | - |
| | Taeniopterygidae | *Oemopteryx* | - | - | 0.9 | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - |
| | | *Strophopteryx* | - | - | 2.7 | - | 0.9 | 5.3 | - | - | - | - | - | - | - | - | - | - |
| Trichoptera | Hydropsychidae | *Ceratopsyche* | - | - | - | - | - | - | - | - | - | - | - | 4 | - | - | - | - |
| (Caddisfly) | | *Cheumatopsyche* | - | 2.4 | - | 5.1 | - | 2.6 | 2.8 | 2.3 | 3.8 | 16.8 | 7.4 | 11 | 4.4 | 1.8 | 14 | 2.9 |
| | | ***Diplectrona***[+] | - | 6.5 | - | 1.7 | 1.7 | 1.8 | 0.9 | 0.8 | - | 1.8 | 2.8 | 3 | 0.9 | 0.9 | 0.9 | 1 |

| ORDER | FAMILY | GENUS | 1996 RA | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Hydropsyche* | 1.1 | - | - | 2.5 | 0.9 | 3.5 | - | 3.9 | 14.4 | 8 | 7.4 | 4 | 6.2 | 8.8 | 13.2 | 11.5 |
| | Limnephilidae | na | - | - | - | - | - | - | - | - | - | - | - | *1 | - | - | - | - |
| | | *Pycnopsyche* | - | - | - | - | - | - | 0.9 | - | - | - | - | 1 | - | - | - | - |
| | Philopotamidae | na | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Chimarra* | - | - | - | - | - | 3.5 | 0.9 | 3.9 | 8.7 | 25.7 | 1.9 | - | 8.8 | 2.7 | 2.6 | 16.3 |
| | | *Dolophilodes* | - | - | - | 0.8 | 0.9 | 0.9 | - | - | 1 | - | - | - | - | 0.9 | - | - |
| | Polycentropodidae | *Polycentropus* | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| | Psychomyiidae | *Lype* | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| | | *Psychomyia* | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - |
| | Rhyacophilidae | *Rhyacophila* | 2.1 | 0.8 | - | 1.7 | - | 6.1 | 2.8 | - | - | 0.9 | - | - | - | - | 0.9 | 1 |
| | Uenoidae | *Neophylax* | - | - | - | - | - | 0.9 | - | 0.8 | - | - | - | - | - | - | 0.9 | 1 |
| PHYLUM PLATYHELMINTHES | | | | | | | | | | | | | | | | | | |
| Tricladida (Flatworm) | Dugesiidae | na | - | - | - | - | - | - | - | - | - | *1.8 | - | - | - | - | - | - |
| | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus

+ Cold-preference genera

## *Unnamed Tributary to the Patuxent River (RKGR-119-S)*

Site RKGR-119-S is located on an unnamed tributary to the Patuxent River in the Eastern Piedmont region of Maryland. It is in the Rocky Gorge Dam watershed in Howard County. This site was sampled in 1997 and 2000 to 2014.


*Unnamed tributary to the Patuxent River in spring 2013.*

### ***Land Use/ Land Cover***

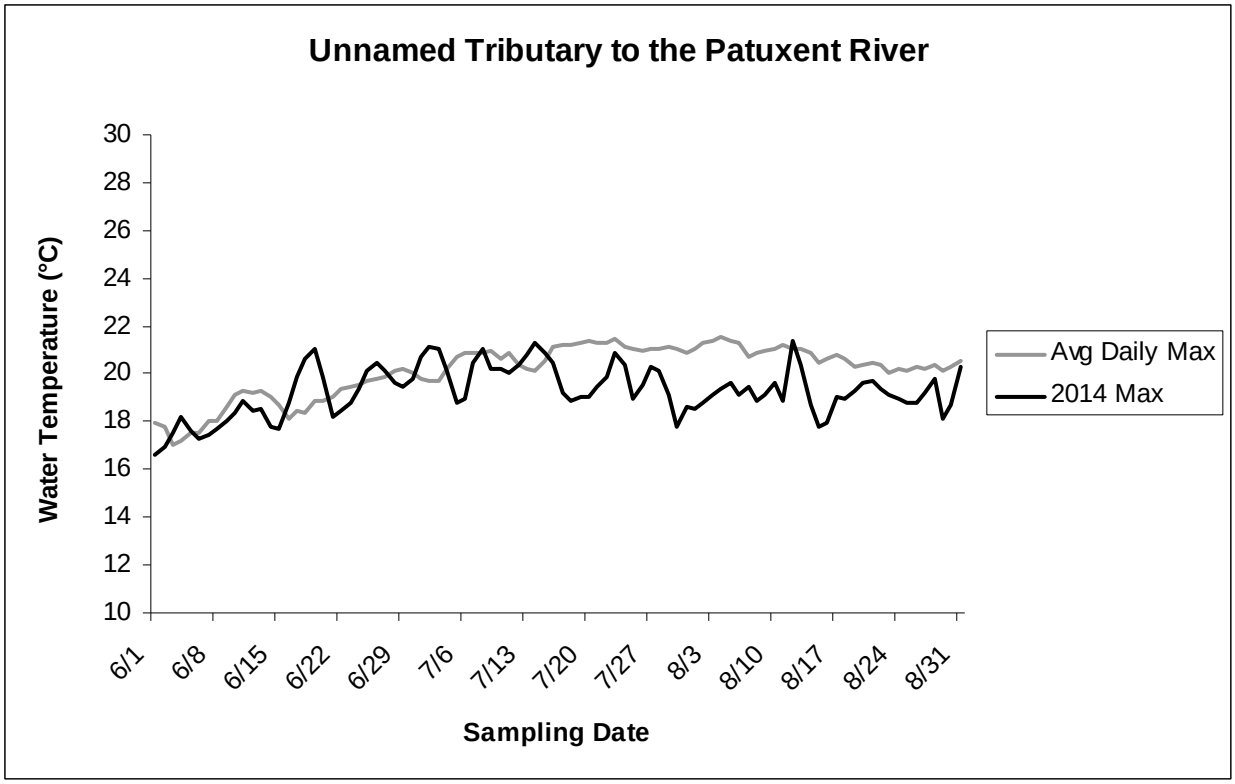
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 31.84 | 52.77 | 52.56 |
| Agriculture | 3.07 | 34.38 | 33.43 |
| Urban | 4.61 | 8.47 | 9.51 |
| Other | 60.48 | 4.38 | 4.49 |

### ***Physical Habitat***

Physical habitat measurements collected at the unnamed tributary to the Patuxent River (2000 to 2014). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 16 | 16 | 16 | 18 | 18 | 16 | 15 | 17 | 15 | 13 | 16 | 17 | 13 | 15 | 14 |
| Epifaunal substrate (0-20) | 17 | 17 | 16 | 18 | 19 | 13 | 16 | 17 | 16 | 15 | 17 | 16 | 15 | 12 | 15 |
| Velocity/Depth Diversity (0-20) | 14 | 14 | 13 | 14 | 14 | 14 | 12 | 14 | 11 | 13 | 12 | 14 | 11 | 14 | 11 |
| Pool Quality (0-20) | 12 | 11 | 13 | 14 | 14 | 15 | 14 | 13 | 13 | 13 | 12 | 16 | 16 | 16 | 13 |
| Riffle Quality (0-20) | 16 | 14 | 12 | 16 | 14 | 15 | 16 | 15 | 14 | 12 | 14 | 13 | 11 | 13 | 14 |
| Shading (%) | 90 | 95 | 95 | 93 | 95 | 96 | 95 | 95 | 90 | 90 | 80 | 95 | 90 | 70 | 75 |
| Embeddedness (%) | 35 | 25 | 18 | 10 | 15 | 35 | 35 | 35 | 20 | 20 | 30 | 25 | 15 | 55 | 35 |
| Discharge (cfs) | 1.35 | 0.97 | 0.17 | 1.58 | 0.85 | 0.54 | 0.62 | 0.23 | 0.43 | 0.65 | 1.06 | 0.55 | 0.6 | 0.8 | 0.80 |




The graph above displays the average daily maximum temperatures recorded at the unnamed tributary to the Patuxent River. The average was calculated from eleven years of data.

## ***Biology***

### *Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 4.33 | 5.00 | 4.00 | 4.33 | 4.67 | 4.67 | 4.00 | 3.67 | 5.00 | 4.33 | 4.67 | 5.00 | 5.00 | 4.00 | 4.00 |
| FIBI | 4.00 | 4.67 | 4.67 | 4.00 | 4.00 | 4.67 | 4.33 | 4.33 | 3.33 | 4.00 | 4.00 | 4.33 | 4.33 | 4.67 | 3.67 |

### *Fish*

Cumulative list of fish species (with abundance) collected in the unnamed tributary to the Patuxent River by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Blue Ridge sculpin | 111 | 283 | 233 | 87 | 121 | 192 | 154 | 67 | 92 | 140 | 128 | 96 | 92 | 198 | 84 |
| Bluegill | 9 | 10 | - | 5 | - | 1 | 2 | - | 2 | 4 | - | 10 | 4 | 7 | - |
| Brown bullhead | - | 1 | - | - | - | - | - | - | - | - | - | 2 | - | - | 1 |
| Central stoneroller | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - |
| Creek chub | 16 | 5 | 56 | 9 | - | 18 | - | - | 9 | 7 | 5 | 9 | 11 | 6 | 22 |
| Cottus sp. | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | |
| Eastern blacknose dace | 82 | 56 | 178 | 160 | 111 | 28 | 16 | 42 | 99 | 53 | 45 | 53 | 23 | 29 | 49 |
| Fallfish | 7 | 1 | 1 | 1 | - | 8 | 3 | 1 | 1 | - | - | 9 | 10 | 5 | 3 |
| Green sunfish | - | - | - | 2 | - | - | - | - | 2 | 8 | 5 | 1 | 1 | 8 | 5 |
| Largemouth bass | 1 | - | - | 1 | - | 2 | - | - | 17 | 5 | - | 8 | 23 | 66 | 6 |
| Longnose dace | 11 | 9 | 9 | 3 | 6 | 2 | 7 | 5 | 9 | 2 | 4 | - | 6 | 6 | - |
| Rosyside dace | 16 | 5 | 28 | 40 | 25 | 12 | 8 | 14 | 11 | 11 | 4 | 12 | 7 | 2 | 6 |
| Tessellated darter | 3 | 2 | - | - | - | 8 | 2 | 2 | 4 | 2 | - | 9 | 2 | 4 | - |
| White sucker | 2 | 2 | 1 | 2 | - | 1 | 1 | - | 3 | - | 1 | 16 | 2 | 10 | 2 |
| Yellow bullhead | - | - | - | - | 2 | - | - | 3 | - | 1 | - | 2 | 1 | 3 | - |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

*Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to the Patuxent River by sampling year

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Virile crayfish (*Orconectes virilis*) | P | P | A | P | P | P | P | P | P |
| Common crayfish (*Cambarus bartonii bartonii*) | P | P | A | P | P | P | P | P | P |

*Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to the Patuxent River by sampling year.

| *Species* |
|---|
| None Observed |

*Herpetofauna*

Cumulative list of herpetofauna collected in or near the unnamed tributary to the Patuxent River.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | American bullfrog, Bufo sp., Cope's gray tree frog, Eastern American toad, Fowler's toad, Gray tree frog, Northern green frog, Pickerel frog, Southern leopard frog, Wood frog, |
| Caudata (Salamanders and Newts) | Northern red salamander, Northern two-lined salamander, Spotted salamander |
| Testudines (Turtles) | Eastern box turtle |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in the unnamed tributary to the Patuxent River by sampling year, RA = %Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *1997 RA* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | | |
| Haplotaxida | Naididae | na | - | - | - | *1 | *2.4 | - | - | - | - | - | *0.9 | - | - | *0.8 | - | - |
| Lumbriculida | Lumbriculidae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | *0.8 |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | | |
| Coleoptera (Beetle) | Dryopidae | *Helichus* | - | - | 0.7 | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - |
| | Elmidae | na | - | - | - | - | - | - | - | - | - | *1.6 | - | - | - | - | - | - |
| | | *Ancyronyx* | - | - | - | - | - | - | - | 1.6 | - | - | - | - | - | - | - | - |
| | | *Dubiraphia* | 1.1 | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - |
| | | *Optioservus* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | 1.6 | - | - |
| | | *Oulimnius* | - | - | - | - | - | - | 1.9 | 2.4 | 1.8 | 1.6 | - | 0.9 | 1.6 | - | 2.7 | 0.8 |
| | | *Stenelmis* | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | Ptilodactylidae | *Anchytarsus* | - | - | 0.7 | - | - | 1.1 | - | - | - | - | - | 0.9 | - | - | - | 0.8 |
| Diptera (True Fly) | Ceratopogonidae | na | - | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - |
| | | *Probezzia* | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| | Chironomidae | *Brillia* | - | - | - | - | 0.8 | - | - | - | - | - | - | - | 0.8 | - | - | - |
| | | *Chaetocladius* | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Cladotanytarsus* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | *0.8 |
| | | *Conchapelopia* | - | 0.9 | 1.4 | 7.6 | - | - | 1 | - | - | - | - | - | - | - | - | - |
| | | *Corynoneura* | - | - | 0.7 | - | - | - | - | - | - | - | - | - | 1.6 | - | - | - |
| | | *Cricotopus* | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.6 | - | - |
| | | *Demicryptochironomus* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | | *Diamesa* | - | - | - | 1 | 0.8 | 1.1 | 1.9 | 0.8 | 0.9 | - | - | 0.9 | - | 0.8 | - | - |
| | | *Dicrotendipes* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - |
| | | *Eukiefferiella* | - | 1.8 | - | 1 | 0.8 | 2.2 | - | - | - | 0.8 | - | 1.8 | 0.8 | - | 1.8 | - |
| | | *Hydrobaenus* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | 0.9 | - |
| | | *Micropsectra* | - | - | - | 1 | - | - | - | - | - | - | - | 1.8 | - | - | - | - |
| | | *Microtendipes* | - | - | 0.7 | 2.9 | - | - | - | - | - | - | - | - | 0.8 | - | - | - |
| | | *Nilotanypus* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 |
| | | Orthocladiinae | *5.7 | - | *0.7 | - | - | - | *1.9 | - | *1.8 | - | - | - | - | 2.3 | - | - |
| | | *Orthocladius* | - | - | 0.7 | - | 0.8 | - | - | 8.7 | 9.1 | 0.8 | 4.5 | 3.5 | - | 7 | 2.7 | 0.8 |
| | | *Parakiefferiella* | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - |
| | | *Parametriocnemus* | 2.3 | - | 2.1 | 2.9 | 0.8 | 3.3 | 1 | 13.5 | 1.8 | 1.6 | 1.8 | - | 8.1 | - | - | 1.7 |
| | | *Paraphaenocladius* | - | - | - | - | - | 1.1 | - | - | 4.5 | 0.8 | - | - | - | - | - | - |
| | | *Paratendipes* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 |
| | | *Polypedilum* | - | - | - | 1.9 | - | - | - | 6.3 | - | - | - | 2.7 | - | 1.6 | - | 0.8 |
| | | *Potthastia* | - | - | - | - | 0.8 | 1.1 | - | - | - | - | - | - | - | - | - | - |
| | | *Pseudorthocladius* | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - |
| | | *Rheocricotopus* | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Rheosmittia* | - | - | 0.7 | - | - | 3.3 | - | - | - | - | - | - | - | - | - | - |
| | | *Rheotanytarsus* | - | - | - | - | - | - | - | - | - | 0.8 | - | - | 1.6 | - | 0.9 | 1.7 |
| | | *Stempellinella* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 |
| | | *Symposiocladius* | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Sympotthastia* | - | - | - | - | - | - | - | - | 0.9 | - | - | - | 0.8 | - | - | - |

| ORDER | FAMILY | GENUS | 1997 RA | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Tanypodinae | - | - | - | - | - | - | - | *0.8 | - | - | - | - | - | - | - | - |
| | | Tanytarsini | - | - | - | - | *0.8 | - | *2.9 | - | - | - | - | - | - | - | - | *0.8 |
| | | *Tanytarsus* | 1.1 | - | - | - | - | - | - | - | 1.8 | - | - | - | - | 0.8 | - | 3.3 |
| | | *Thienemanniella* | - | 0.9 | - | 1 | - | 1.1 | - | 2.4 | - | 3.1 | - | 1.8 | 1.6 | - | - | - |
| | | *Thienemannimyia* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - |
| | | Thienemannimyia Group | - | - | - | - | - | *1.1 | *1 | - | - | *1.6 | - | *5.3 | - | *0.8 | - | - |
| | | *Trissopelopia* | - | - | - | - | - | 1.1 | - | - | - | - | - | - | - | - | - | - |
| | | *Tvetenia* | - | - | 3.5 | 1 | - | 1.1 | 1 | 1.6 | - | 0.8 | 2.7 | - | - | - | - | - |
| | | *Zavrelimyia* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - |
| | Dixidae | ***Dixa***[+] | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | Empididae | na | - | - | - | - | - | - | - | - | *0.9 | - | *0.9 | - | - | *1.6 | - | - |
| | | *Chelifera* | 2.3 | - | - | - | 0.8 | 1.1 | 1 | 0.8 | - | - | - | 0.9 | - | - | - | - |
| | | *Clinocera* | 1.1 | 0.9 | - | - | - | - | - | - | - | 0.8 | - | - | 1.6 | - | - | - |
| | | *Hemerodromia* | - | - | - | - | - | - | - | - | - | - | - | 1.8 | - | - | - | - |
| | Simuliidae | na | - | - | - | - | *1.6 | - | - | - | *2.7 | *0.8 | - | - | *0.8 | *1.6 | - | - |
| | | *Prosimulium* | 2.3 | 7.3 | 34 | 21.9 | 41.7 | 27.5 | 1 | 4 | 1.8 | 10.9 | 31.3 | - | 16.3 | 3.1 | 27.9 | 10.8 |
| | | *Simulium* | 2.3 | 3.6 | - | - | 0.8 | - | 2.9 | 2.4 | 1.8 | 1.6 | - | 1.8 | - | 14.1 | 0.9 | 17.5 |
| | | *Stegopterna* | - | - | - | - | - | - | - | - | - | - | 1.8 | - | - | - | - | - |
| | Tipulidae | na | - | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - |
| | | *Antocha* | - | - | - | 1 | 0.8 | 1.1 | 1 | - | - | - | - | - | - | - | - | 0.8 |
| | | *Dicranota* | - | - | - | - | - | - | - | 1.6 | - | - | - | - | - | - | - | - |
| | | *Hexatoma* | - | - | - | - | - | 1.1 | 1 | 3.2 | - | 1.6 | - | 0.9 | - | - | - | - |
| | | *Pseudolimnophila* | - | - | - | - | 0.8 | - | - | - | - | - | - | 0.9 | 0.8 | - | - | - |
| | | *Tipula* | 1.1 | - | 1.4 | - | - | 2.2 | - | - | 0.9 | - | - | 0.9 | - | - | - | - |
| Ephemeroptera | Ameletidae | *Ameletus* | 3.4 | 2.7 | 0.7 | - | - | - | - | - | - | 1.6 | - | - | 3.3 | 0.8 | - | - |
| (Mayfly) | Baetidae | na | - | *1.8 | *0.7 | - | - | *2.2 | - | - | - | - | - | - | - | - | - | - |
| | | *Acentrella* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - |
| | | *Acerpenna* | 2.3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Baetis* | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - |
| | Ephemerellidae | na | - | - | - | - | - | - | - | - | - | | *40.2 | - | *14.6 | *10.2 | - | - |
| | | *Ephemerella* | 52.3 | 59.1 | 31.3 | 28.6 | 26 | 15.4 | 50.5 | 36.5 | 31.8 | 38.3 | - | 6.2 | - | 18.8 | 31.5 | 20.8 |
| | | *Eurylophella* | - | - | - | - | - | - | - | - | - | 0.8 | - | 0.9 | 0.8 | - | - | - |
| | | *Serratella* | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - |
| | Heptageniidae | na | - | *2.7 | *3.5 | - | - | - | - | *0.8 | - | *0.8 | *0.9 | - | - | - | - | - |
| | | *Maccaffertium* | - | - | - | - | - | - | - | - | - | 0.8 | - | 0.9 | 0.8 | 0.8 | 1.8 | - |
| | | *Stenonema* | - | - | - | - | 0.8 | 1.1 | 2.9 | 1.6 | - | - | - | - | - | - | - | - |
| | Leptophlebiidae | na | - | - | - | - | - | - | - | - | - | - | - | - | *0.8 | - | - | - |
| Lepidoptera | na | na | - | - | - | - | - | - | *1 | - | - | - | - | - | - | - | - | - |
| Megaloptera | Corydalidae | *Nigronia* | - | - | - | - | 0.8 | 2.2 | 2.9 | 0.8 | 0.9 | - | - | 0.9 | 0.8 | 3.9 | - | - |
| (Dobsonfly/Fishfly) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Odonata | Gomphidae | na | - | *0.9 | *0.7 | *1 | - | - | *1.9 | - | - | *0.8 | - | - | - | - | - | - |
| | | *Lanthus* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - |
| Plecoptera | Capniidae | na | - | - | - | - | - | - | - | - | - | - | - | - | *1.6 | - | - | - |
| (Stonefly) | Chloroperlidae | na | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - | - | - |
| | Leuctridae | na | - | - | - | - | - | *1.1 | *1 | - | - | *0.8 | *0.9 | - | - | - | - | *0.8 |
| | | ***Leuctra***[+] | 1.1 | - | - | - | - | - | - | - | 4.5 | - | - | 8 | - | 0.8 | - | - |

| *ORDER* | *FAMILY* | *GENUS* | *1997 RA* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nemouridae | na | - | - | *1.4 | - | - | - | - | - | - | - | - | - | *4.9 | - | *0.9 | - |
| | | *Amphinemura* | 6.8 | 12.7 | 3.5 | 11.4 | 4.7 | 2.2 | 7.8 | 1.6 | 20.9 | 14.1 | 1.8 | 33.6 | 1.6 | 15.6 | 11.7 | 11.7 |
| | | *Ostrocerca* | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Prostoia* | 2.3 | - | - | - | - | - | - | - | - | 0.8 | - | - | 8.1 | - | 2.7 | - |
| | Perlidae | na | - | - | *1.4 | - | - | - | - | - | - | *3.1 | - | - | - | - | - | - |
| | | *Acroneuria* | 1.1 | - | - | - | - | 3.3 | 1 | 1.6 | - | 0.8 | 0.9 | - | - | 0.8 | 0.9 | - |
| | Perlodidae | na | - | *1.8 | - | *1 | - | *3.3 | *2.9 | *0.8 | *3.6 | *6.3 | - | *0.9 | - | - | *0.9 | - |
| | | *Diploperla* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | 3.3 | - | - | 0.8 |
| | | *Isoperla* | 2.3 | - | - | - | - | - | - | 0.8 | - | - | - | - | - | 2.3 | - | - |
| | Taeniopterygidae | *Strophopteryx* | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - |
| Trichoptera | Glossosomatidae | na | - | - | - | - | - | - | - | *0.8 | - | *0.8 | - | - | - | - | - | - |
| (Caddisfly) | | *Agapetus* | 2.3 | - | - | - | - | - | - | - | - | - | - | 1.8 | - | - | - | 5 |
| | | *Glossosoma* | - | - | - | - | - | - | - | - | - | - | 0.9 | 0.9 | - | - | - | - |
| | Hydropsychidae | *Cheumatopsyche* | 2.3 | 0.9 | 4.2 | 1 | 1.6 | 3.3 | 1 | 0.8 | - | - | 1.8 | - | 3.3 | - | 1.8 | 0.8 |
| | | ***Diplectrona***[+] | 1.1 | 0.9 | 0.7 | - | 0.8 | 2.2 | - | 0.8 | 0.9 | - | 0.9 | - | 0.8 | 0.8 | - | 0.8 |
| | | *Hydropsyche* | - | - | 0.7 | 1 | - | 5.5 | 1 | 0.8 | 0.9 | - | 0.9 | - | 0.8 | 2.3 | - | 5 |
| | Limnephilidae | na | - | - | - | - | - | - | - | - | - | - | - | - | *0.8 | - | - | - |
| | Philopotamidae | na | - | - | - | - | - | - | - | - | *1.8 | - | - | - | - | - | - | *4.2 |
| | | *Chimarra* | 2.3 | - | - | - | - | 2.2 | - | - | - | 0.8 | - | - | - | - | 0.9 | - |
| | | *Dolophilodes* | - | - | 0.7 | 1.9 | - | 2.2 | - | - | - | - | - | 9.7 | - | 3.1 | - | - |
| | Polycentropodidae | na | - | - | - | - | - | *1.1 | - | - | - | - | - | - | - | - | - | - |
| | | *Polycentropus* | - | - | - | - | - | - | 2.9 | - | - | - | - | - | 0.8 | - | - | - |
| | Psychomyiidae | *Lype* | - | - | 0.7 | - | - | - | - | - | - | - | 1.8 | - | - | - | - | - |
| | Rhyacophilidae | *Rhyacophila* | - | - | 0.7 | 3.8 | 0.8 | - | 1 | 0.8 | 1.8 | - | - | 0.9 | 0.8 | 0.8 | - | - |
| | Uenoidae | *Neophylax* | 1.1 | 0.9 | 2.1 | 1.9 | 7.1 | 2.2 | 1 | 0.8 | - | 0.8 | 2.7 | 2.7 | 12.2 | - | 7.2 | 3.3 |
| PHYLUM MOLLUSCA | | | | | | | | | | | | | | | | | | |
| Veneroida | Pisidiidae | na | - | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - |
| PHYLUM NEMATOMORPHA | | | | | | | | | | | | | | | | | | |
| Gordioidea | Gordiidae | na | - | - | - | *1 | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| PHYLUM PLATYHELMINTHES | | | | | | | | | | | | | | | | | | |
| Tricladida | Planariidae | *Girardia* | - | - | - | - | 0.8 | - | - | - | 0.9 | - | - | - | - | - | - | - |
| (Flatworm) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus

[+] Cold-preference genera

## *Unnamed Tributary to Principio Creek (FURN-101-S)*

Site FURN-101-S is located on an unnamed tributary to Principio Creek in the Eastern Piedmont region of Maryland. It is in the Furnace Bay watershed in Cecil County. This site was sampled in 2000 to 2014.

*Unnamed tributary to Principio Creek in spring 2013.*

### ***Land Use/ Land Cover***

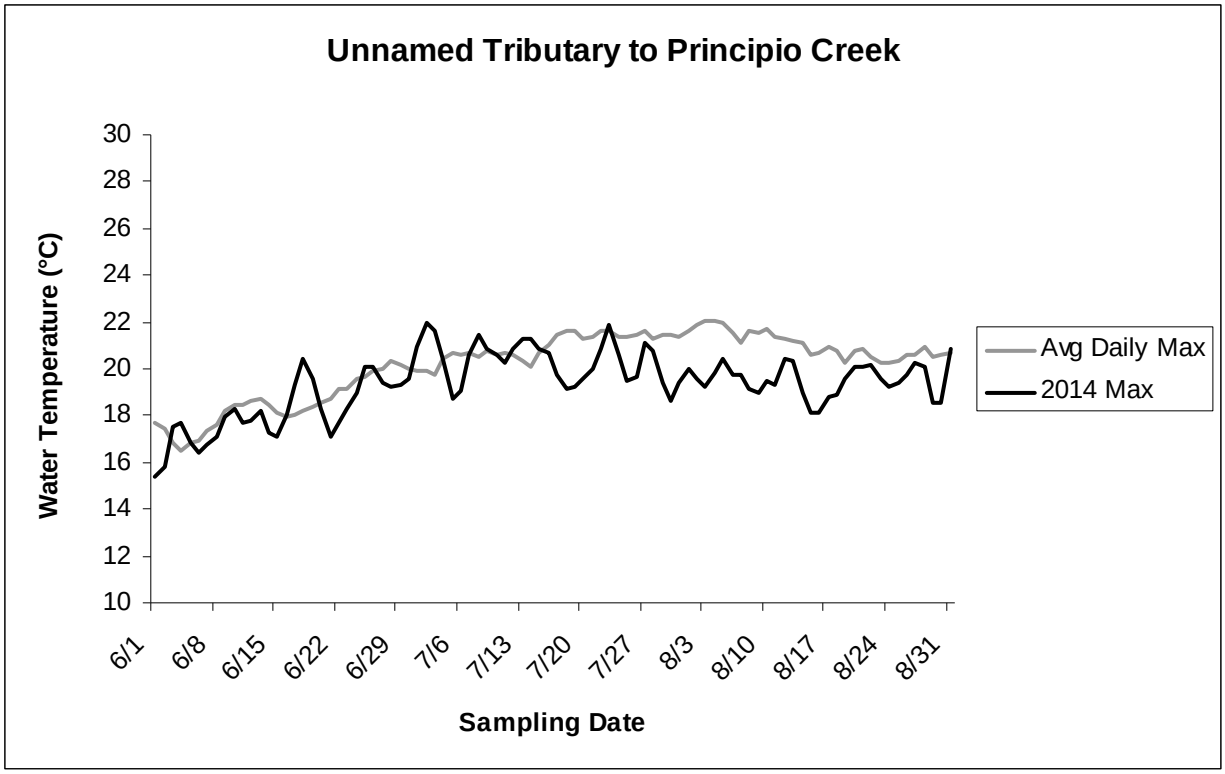
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 79.84 | 74.44 | 70.23 |
| Agriculture | 0.03 | 10.48 | 9.93 |
| Urban | 0.82 | 6.85 | 6.58 |
| Other | 19.31 | 8.22 | 13.25 |

### ***Physical Habitat***

Physical habitat measurements collected at the unnamed tributary to Principio Creek (2000 to 2014). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 16 | 16 | 16 | 15 | 16 | 14 | 16 | 16 | 16 | 16 | 14 | 17 | 15 | 14 | 13 |
| Epifaunal substrate (0-20) | 16 | 16 | 16 | 16 | 16 | 14 | 16 | 17 | 17 | 17 | 17 | 15 | 15 | 16 | 12 |
| Velocity/Depth Diversity (0-20) | 14 | 13 | 14 | 13 | 13 | 12 | 13 | 12 | 11 | 13 | 12 | 12 | 12 | 13 | 11 |
| Pool Quality (0-20) | 14 | 12 | 15 | 14 | 14 | 14 | 10 | 12 | 12 | 13 | 12 | 14 | 11 | 13 | 12 |
| Riffle Quality (0-20) | 15 | 14 | 14 | 15 | 15 | 11 | 15 | 13 | 12 | 13 | 13 | 13 | 14 | 14 | 12 |
| Shading (%) | 92 | 95 | 96 | 95 | 90 | 93 | 90 | 90 | 95 | 90 | 85 | 80 | 80 | 80 | 60 |
| Embeddedness (%) | 10 | 25 | 10 | 15 | 5 | 30 | 35 | 15 | 15 | 10 | 20 | 15 | 25 | 15 | 50 |
| Discharge (cfs) | 0.84 | 0.47 | 0.12 | 0.77 | 2.28 | 0.38 | 0.81 | 0.40 | 0.93 | 0.91 | 1.51 | 1.04 | 0.57 | 1.93 | 0.90 |




The graph above displays the average daily maximum temperatures recorded at the unnamed tributary to Principio Creek. The average was calculated from thirteen years of data.

## ***Biology***

### *Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 5.00 | 4.67 | 5.00 | 4.33 | 4.00 | 5.00 | 3.67 | 4.33 | 4.00 | 4.67 | 5.00 | 4.67 | 4.00 | 4.33 | 4.33 |
| FIBI | 4.00 | 4.00 | 4.67 | 3.33 | 4.00 | 3.67 | 4.33 | 4.67 | 4.00 | 3.67 | 4.67 | 4.33 | 4.67 | 4.00 | 3.67 |

### *Fish*

Cumulative list of fish species (with abundance) collected in the unnamed tributary to Principio Creek by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| American eel | 22 | 25 | 26 | 16 | 33 | 13 | 18 | 21 | 13 | 9 | 19 | 11 | 17 | 12 | 11 |
| Blue Ridge sculpin | 40 | 73 | 49 | 2 | 3 | 16 | 32 | 34 | 20 | 14 | 42 | 31 | 40 | 24 | 18 |
| Common shiner | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |
| Creek chub | 49 | 60 | 56 | 29 | 58 | - | 56 | 32 | 29 | 15 | 57 | 67 | 37 | 16 | 9 |
| Creek chubsucker | - | - | - | - | - | 26 | - | - | - | - | - | - | - | - | - |
| Cutlip minnow | 3 | - | - | 4 | 7 | 9 | 5 | 2 | 3 | 1 | 13 | 4 | 4 | 5 | 4 |
| Eastern blacknose dace | 83 | 99 | 71 | 58 | 159 | 302 | 106 | 62 | 36 | 44 | 88 | 72 | 85 | 53 | 31 |
| Margined madtom | 4 | 1 | 3 | 1 | - | 2 | 2 | 2 | - | 1 | 3 | 5 | 10 | 14 | 10 |
| Rosyside dace | 107 | 125 | 168 | 80 | 199 | 125 | 239 | 95 | 56 | 62 | 124 | 173 | 151 | 129 | 87 |
| Tessellated darter | - | 1 | 4 | - | 3 | 6 | 6 | 2 | 2 | - | 5 | 6 | 5 | 3 | - |
| White sucker | 1 | 2 | 4 | - | 3 | 5 | 7 | - | 4 | - | 1 | 16 | 3 | 1 | - |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

*Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to Principio Creek by sampling year

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Common crayfish (*Cambarus bartonii bartonii*) | P | P | A | P | P | P | P | A | A |

*Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to Principio Creek by sampling year.

| *Species* |
|---|
| None Observed |

*Herpetofauna*

Cumulative list of herpetofauna species collected in or near the unnamed tributary to Principio Creek.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | American bullfrog, Eastern American toad, Fowler's toad, Gray treefrog, Northern green frog, Pickerel frog |
| Caudata (Salamanders and Newts) | Eastern red-backed salamander, Northern dusky salamander, Northern red salamander, Northern two-lined salamander |
| Squamata (Snakes and Lizards) | Northern ring-necked snake, Northern watersnake |
| Testudines (Turtles) | Common snapping turtle, Eastern box turtle |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in the Unnamed Tributary to Principio Creek by sampling year, RA = %Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | |
| Haplotaxida | Enchytraeidae | na | - | - | *0.7 | - | - | - | - | - | - | - | - | *0.8 | - | - | - |
| | Naididae | na | *4 | - | - | - | - | - | - | *0.7 | - | - | - | - | - | - | - |
| Lumbriculida | Lumbriculidae | na | - | - | - | *2.3 | *1.6 | - | - | - | - | - | - | - | - | - | - |
| Tubificida | Tubificidae | na | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | |
| Coleoptera (Beetle) | Elmidae | na | - | - | - | - | - | *3 | - | - | - | - | - | - | - | - | - |
| | | *Macronychus* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - |
| | | *Optioservus* | 1.6 | - | 0.7 | - | - | - | - | - | 1.8 | 1.8 | - | 1.7 | - | - | 0.8 |
| | | *Oulimnius* | - | 5.9 | 1.5 | - | - | 3 | 0.9 | 1.5 | 1.8 | 9.6 | 2.4 | 0.8 | 1.5 | 1.6 | 0.8 |
| | | *Promoresia* | - | 0.8 | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Stenelmis* | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | 0.8 | - |
| | Psephenidae | *Psephenus* | 3.2 | - | - | - | - | - | - | 0.7 | - | - | - | 2.5 | - | 0.8 | - |
| Diptera (True fly) | Ceratopogonidae | *Bezzia* | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | 0.8 | - |
| | | *Probezzia* | - | - | - | - | - | - | - | 0.7 | - | - | - | - | - | - | - |
| | Chironomidae | na | - | - | - | - | - | - | - | - | - | - | *0.8 | - | - | - | - |
| | | *Brillia* | - | - | 0.7 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Conchapelopia* | 3.2 | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Constempellina* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - |
| | | *Corynoneura* | - | - | - | - | - | - | 0.9 | - | - | - | 1.6 | - | - | - | - |
| | | Diamsinae | - | - | - | - | - | - | - | - | - | - | - | - | *0.7 | - | - |
| | | *Eukiefferiella* | 5.6 | - | 0.7 | - | - | - | 0.9 | - | - | - | 4.8 | - | 0.7 | - | - |
| | | *Lopescladius* | - | - | - | - | - | - | - | 0.7 | - | - | - | - | - | - | - |
| | | *Micropsectra* | - | 0.8 | 4.9 | - | - | - | - | 9.6 | 0.9 | - | - | - | - | - | - |
| | | *Microtendipes* | - | - | - | - | - | - | - | 14 | - | - | 0.8 | - | - | - | 1.6 |
| | | *Nanocladius* | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Natarsia* | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Nilotanypus* | - | - | - | - | - | - | - | 0.7 | - | - | - | - | - | - | - |
| | | Orthocladiinae | - | - | - | - | - | *2 | - | - | - | *0.9 | - | - | - | 0.8 | - |
| | | *Orthocladius* | - | - | 0.7 | 3.9 | - | - | 0.9 | 0.7 | - | - | - | - | 0.7 | 0.8 | 1.6 |
| | | *Parachaetocladius* | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | 0.8 | - |
| | | *Parametriocnemus* | - | - | 0.7 | 0.8 | 2.4 | 1 | - | 0.7 | - | - | 0.8 | 0.8 | - | - | - |
| | | *Paraphaenocladius* | - | - | - | - | - | 3 | - | - | - | 0.9 | 0.8 | - | - | - | - |
| | | *Phaenopsectra* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 |
| | | *Polypedilum* | 2.4 | - | - | - | - | - | - | 2.9 | - | - | 0.8 | 0.8 | - | 0.6 | - |
| | | *Rheotanytarsus* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - |
| | | *Stempellinella* | - | 0.8 | 0.7 | - | - | - | - | 5.1 | - | - | 0.8 | 0.8 | - | - | - |
| | | *Sympotthastia* | - | - | - | - | - | - | - | - | - | - | - | - | 0.7 | - | - |
| | | Tanypodinae | *0.8 | - | *1.5 | *2.3 | - | - | - | - | - | - | - | - | - | - | - |
| | | Tanytarsini | *0.8 | - | *1.5 | *1.6 | - | - | - | - | - | - | - | *0.8 | - | - | - |
| | | *Tanytarsus* | - | - | - | - | - | - | - | - | - | 0.9 | 3.2 | 0.8 | - | 6.6 | 0.8 |
| | | *Thienemanniella* | - | - | - | - | - | - | - | - | - | - | - | 2.5 | 0.7 | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Thienemannimyia Group | - | - | - | - | *2.4 | *1 | - | *0.7 | - | - | *2.4 | *0.8 | *0.7 | *0.8 | *1.6 |
| | | *Trissopelopia* | - | 0.8 | - | - | - | - | - | 0.7 | - | - | - | - | - | 0.8 | - |
| | | *Tvetenia* | - | 0.8 | - | - | - | - | - | - | - | - | 1.6 | - | 1.5 | - | - |
| | | *Zavrelimyia* | 3.2 | 1.7 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Empididae | *Clinocera* | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - |
| | Simuliidae | na | - | - | - | *0.8 | - | - | *0.9 | - | - | - | - | - | - | *0.8 | - |
| | | *Prosimulium* | 4 | 31.1 | 18.4 | 25 | 25.6 | 9.9 | 70.2 | 8.8 | 73.5 | 9.6 | 39.7 | 53.4 | 53.7 | 9.8 | 39.3 |
| | | *Simulium* | 5.6 | - | 0.7 | 3.1 | - | 1 | - | 1.5 | - | - | - | 0.8 | 0.7 | 6.6 | - |
| | | *Stegopterna* | - | - | - | - | - | 1 | 0.9 | - | - | 0.9 | 0.8 | 0.8 | - | - | - |
| | Tipulidae | *Antocha* | 0.8 | - | - | - | - | - | - | 0.7 | - | - | - | - | - | 1.6 | - |
| | | *Dicranota* | 0.8 | 0.8 | 0.7 | 2.3 | 1.6 | 1 | - | - | 0.9 | 0.9 | 0.8 | 1.7 | 1.5 | - | 1.6 |
| | | *Erioptera* | - | - | - | - | - | - | - | 0.7 | - | - | - | - | - | - | - |
| | | *Hexatoma* | - | - | 0.7 | - | 2.4 | - | 1.8 | - | 0.9 | 2.6 | 1.6 | 1.7 | 0.7 | 1.6 | - |
| | | *Tipula* | - | 0.8 | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| Ephemeroptera | Ameletidae | *Ameletus* | - | - | - | 7.8 | 0.8 | - | - | - | - | - | 0.8 | 0.8 | - | - | - |
| (Mayfly) | Baetidae | na | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Acentrella* | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Acerpenna* | - | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - |
| | | *Baetis* | - | - | 2.2 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | ***Diphetor***[+] | - | - | - | - | - | - | - | 0.7 | - | - | - | - | - | 0.8 | - |
| | Ephemerellidae | na | - | - | - | - | - | - | - | - | *2.7 | - | - | *12.7 | - | - | - |
| | | *Ephemerella* | 35.2 | 34.5 | 29.4 | 9.4 | 13.6 | 27.7 | 7 | 16.9 | - | 39.5 | 7.9 | - | 15.4 | 26.2 | 21.3 |
| | | *Eurylophella* | 0.8 | 4.2 | 0.7 | - | - | - | 0.9 | - | 0.9 | 3.5 | 0.8 | 0.8 | - | - | - |
| | Heptageniidae | na | - | *0.8 | *0.7 | - | - | - | - | - | - | *0.9 | - | - | - | - | - |
| | | ***Epeorus***[+] | 0.8 | 1.7 | 5.1 | 0.8 | 9.6 | 7.9 | 5.3 | 1.5 | 3.5 | 12.3 | 4 | - | 0.7 | - | 12.3 |
| | | *Maccaffertium* | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - |
| | | *Stenonema* | 0.8 | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - |
| | Leptophlebiidae | na | - | *0.8 | *4.4 | *0.8 | - | *2 | - | - | - | - | - | *2.5 | - | - | *4.9 |
| | | ***Paraleptophlebia***[+] | - | - | 6.6 | - | - | - | - | - | - | 0.9 | - | - | - | - | - |
| Megaloptera | Corydalidae | *Nigronia* | - | - | - | - | - | 3 | - | - | - | - | - | 0.8 | - | 0.8 | 0.8 |
| (Dobsonfly/Fishfly) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Odonata | Gomphidae | na | *1.6 | - | *2.2 | - | - | - | - | *1.5 | *0.9 | *0.9 | - | - | *0.7 | - | - |
| (Dragonfly/Damselfly) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Plecoptera | Capniidae | na | - | - | - | - | - | - | - | - | - | - | *1.6 | - | - | - | *0.8 |
| (Stonefly) | Chloroperlidae | na | - | - | - | - | *0.8 | *1 | - | *0.7 | - | - | - | - | *1.5 | - | - |
| | | *Sweltsa*[+] | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - |
| | Leuctridae | na | - | - | *0.7 | *8.6 | - | - | - | - | - | *0.9 | *6.3 | - | *8.1 | - | - |
| | | *Leuctra*[+] | 9.6 | 0.8 | - | 10.2 | 26.4 | 7.9 | 0.9 | 17.6 | - | - | - | - | 1.5 | 12.3 | - |
| | Nemouridae | na | - | *2.5 | *1.5 | *2.3 | - | - | - | - | - | *1.8 | *3.2 | *2.5 | - | - | - |
| | | *Amphinemura* | 2.4 | 0.8 | 2.9 | 7 | 1.6 | 7.9 | - | 2.2 | - | 4.4 | 1.6 | - | 2.9 | 6.6 | - |
| | | *Ostrocerca* | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Prostoia* | - | - | 2.9 | - | - | - | 6.1 | - | 7.1 | - | 2.4 | 0.8 | 3.7 | - | 4.9 |
| | Perlidae | na | - | *1.7 | *0.7 | - | - | - | - | - | *2.7 | - | *0.8 | - | - | *0.8 | *0.8 |
| | | *Acroneuria* | - | - | - | - | 0.8 | 1 | - | - | - | - | - | - | - | 1.6 | - |
| | | *Eccoptura* | - | 0.8 | - | - | 1.6 | - | - | - | - | - | - | - | - | - | - |
| | Perlodidae | na | - | *4.2 | *2.2 | *1.6 | *8 | *5 | *1.8 | - | *0.9 | *1.8 | - | *0.8 | *0.7 | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Cultus* | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - |
| | | *Diploperla* | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | 0.8 |
| | | *Isoperla* | 4 | - | - | - | - | - | - | - | - | - | 0.8 | 0.8 | - | 0.8 | 0.8 |
| Trichoptera | Brachycentridae | na | *0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Caddisfly) | Glossosomatidae | *Agapetus* | - | - | 0.7 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Glossosoma* | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Hydropsychidae | *Cheumatopsyche* | - | 0.8 | - | - | - | - | - | - | 0.9 | - | 0.8 | - | - | - | 0.8 |
| | | ***Diplectrona***[+] | - | - | - | 0.8 | - | 1 | - | - | - | - | 0.8 | - | - | - | 0.8 |
| | Lepidostomatidae | *Lepidostoma* | 0.8 | - | - | - | - | 2 | - | 1.5 | - | - | 2.4 | - | - | 3.3 | - |
| | Limnephilidae | *Pycnopsyche* | - | - | - | - | - | - | - | 0.7 | - | - | - | - | - | - | - |
| | Odontoceridae | *Psilotreta* | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Philopotamidae | na | *2.4 | - | - | - | *0.8 | - | - | *1.5 | - | - | - | - | - | - | - |
| | | *Dolophilodes* | - | - | - | - | - | - | - | - | - | - | - | - | - | 3.3 | - |
| | | ***Wormaldia***[+] | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | Polycentropodidae | na | - | - | - | - | - | *1 | - | - | - | - | - | - | - | - | - |
| | | *Polycentropus* | 0.8 | - | - | - | - | - | - | 2.9 | 0.9 | 1.8 | - | 0.8 | - | 3.3 | - |
| | Psychomyiidae | *Lype* | - | - | - | - | - | - | - | 0.7 | - | - | - | - | - | - | - |
| | Rhyacophilidae | *Rhyacophila* | - | - | 0.7 | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| | Uenoidae | *Neophylax* | - | - | 2.9 | - | - | 2 | - | - | - | 1.8 | 0.8 | 3.4 | - | - | 0.8 |
| PHYLUM MOLLUSCA | | | | | | | | | | | | | | | | | |
| Basommatophora | Ancylidae | *Ferrissia* | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| (Snail) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| PHYLUM PLATYHELMINTHES | | | | | | | | | | | | | | | | | |
| Tricladida | Planariidae | *Girardia* | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| (Flatworm) | Dugesiidae | *Cura* | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus

[+] Cold-preference genera

# *Timber Run (LIBE-102-S)*

Site LIBE-102-S is located on Timber Run in the Eastern Piedmont region of Maryland. It is in the Liberty Reservoir watershed in Baltimore County. This site was sampled in 2000 to 2014.

*Timber Run in spring 2013.*

## ***Land Use/ Land Cover***

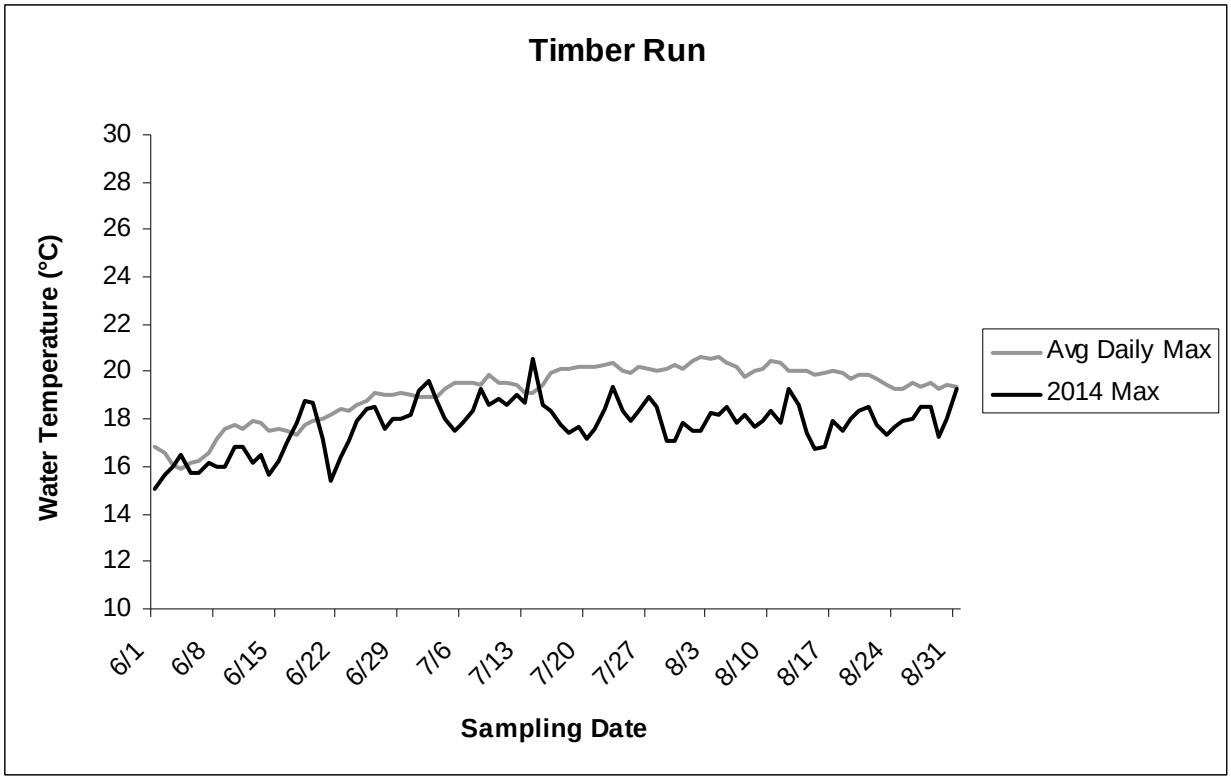
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 70.07 | 77.35 | 77.08 |
| Agriculture | 0.38 | 10.94 | 10.81 |
| Urban | 0.95 | 6.25 | 6.97 |
| Other | 28.59 | 5.45 | 5.14 |

## ***Physical Habitat***

Physical habitat measurements collected at Timber Run (2000 to 2014). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 18 | 17 | 16 | 17 | 16 | 16 | 16 | 14 | 17 | 16 | 17 | 16 | 15 | 16 | 16 |
| Epifaunal substrate (0-20) | 18 | 17 | 17 | 16 | 15 | 14 | 16 | 16 | 16 | 17 | 16 | 15 | 16 | 14 | 17 |
| Velocity/Depth Diversity (0-20) | 12 | 15 | 10 | 10 | 12 | 10 | 12 | 12 | 12 | 11 | 10 | 11 | 12 | 12 | 11 |
| Pool Quality (0-20) | 15 | 16 | 10 | 10 | 13 | 10 | 13 | 11 | 12 | 13 | 11 | 11 | 14 | 13 | 16 |
| Riffle Quality (0-20) | 15 | 13 | 14 | 15 | 14 | 15 | 14 | 12 | 16 | 14 | 15 | 8 | 14 | 16 | 14 |
| Shading (%) | 95 | 88 | 95 | 96 | 95 | 95 | 95 | 95 | 95 | 90 | 80 | 90 | 80 | 80 | 85 |
| Embeddedness (%) | 12 | 25 | 35 | 20 | 30 | 40 | 40 | 30 | 35 | 20 | 30 | 30 | 35 | 25 | 30 |
| Discharge (cfs) | 0.63 | 0.52 | 0.34 | 1.93 | 0.79 | 1.62 | 0.49 | 0.84 | 0.73 | 0.48 | 1.12 | 0.51 | 0.89 | 0.97 | 2.26 |




The graph above displays the average daily maximum temperatures recorded at Timber Run. The average was calculated from thirteen years of data.

## ***Biology***

### *Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 4.67 | 5.00 | 4.33 | 4.00 | 4.67 | 4.33 | 4.00 | 4.67 | 5.00 | 5.00 | 4.33 | 4.33 | 3.67 | 4.67 | 4.00 |
| FIBI | 5.00 | 5.00 | 5.00 | 3.67 | 4.67 | 5.00 | 4.67 | 4.33 | 4.33 | 4.00 | 4.67 | 4.33 | 4.67 | 4.67 | 4.33 |

### *Fish*

Cumulative list of fish species (with abundance) collected in Timber Run by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Blue Ridge sculpin | 180 | 250 | 162 | 51 | 157 | 147 | 168 | 113 | 116 | 128 | 114 | 165 | 297 | 229 | 167 |
| Brook trout | 18 | 2 | 17 | 3 | - | - | 1 | - | - | - | - | - | - | - | - |
| Creek chub | 53 | 52 | 29 | 16 | 61 | 39 | 25 | 18 | 21 | 30 | 20 | 15 | 21 | 43 | 26 |
| Eastern blacknose dace | 120 | 128 | 77 | 35 | 72 | 72 | 95 | 77 | 94 | 155 | 100 | 96 | 66 | 148 | 83 |
| River chub | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - |
| Rosyside dace | 34 | 45 | 18 | 8 | 29 | 21 | 19 | 22 | 25 | 45 | 34 | 22 | 28 | 117 | 120 |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

### *Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in Timber Run by sampling year

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Virile crayfish (*Orconectes virilis*) | A | P | P | P | A | P | P | P | P |
| Common crayfish (*Cambarus bartonii bartonii*) | P | P | A | P | P | P | P | A | P |

*Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in Timber Run by sampling year.

| *Species* |
|---|
| None Observed |

*Herpetofauna*

Cumulative list of herpetofauna species collected in or near Timber Run.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | Eastern American toad, Fowler's toad, Northern green frog, Pickerel frog, Southern leopard frog, Wood frog |
| Caudata (Salamanders and Newts) | Eastern red-backed salamander, Northern dusky salamander, Northern red salamander, Northern two-lined salamander |
| Squamata (Snakes and Lizards) | Eastern garter snake, Northern ring-necked snake |
| Testudines (Turtles) | Eastern box turtle |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in Timber Run by sampling year, RA = %Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | |
| Haplotaxida | Enchytraeidae | na | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | Naididae | na | *0.8 | - | *0.9 | - | - | - | - | - | - | - | - | - | - | - | - |
| Lumbriculida | Lumbriculidae | na | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | |
| Coleoptera | Dryopidae | *Helichus* | 0.8 | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| (Beetle) | Elmidae | na | - | *1.5 | *4.3 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Ancyronyx* | - | - | - | - | - | - | 1.8 | - | - | - | - | - | - | - | - |
| | | *Optioservus* | 0.8 | 1.5 | 0.9 | 0.8 | - | - | 7.1 | 2 | 6.8 | 2.3 | - | 1.9 | 0.8 | 2.5 | 1.7 |
| | | *Oulimnius* | 1.6 | - | 3.4 | - | - | 3.6 | 2.7 | - | 0.8 | 0.8 | - | 1.9 | 3.3 | 4.2 | 0.8 |
| | Hydrophilidae | *Hydrobius* | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| | Psephenidae | *Ectopria* | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | 0.8 | 0.8 |
| | Ptilodactylidae | *Anchytarsus* | - | - | 0.9 | 0.8 | 0.7 | 2.7 | - | - | - | - | - | - | 1.7 | 4.2 | - |
| | Ceratopogonidae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | *0.8 | - |
| | | *Bezzia* | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - |
| Diptera | | *Ceratopogon* | - | - | - | 0.8 | - | - | - | - | - | - | 1 | - | 0.8 | 0.8 | - |
| (True Fly) | | *Probezzia* | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | Chironomidae | *Apsectrotanypus* | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Brillia* | - | 0.8 | - | - | - | - | - | - | - | - | 1.9 | - | - | - | - |
| | | *Chaetocladius* | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | Chironominae | - | - | - | - | - | - | - | *1 | - | - | - | - | - | - | - |
| | | *Conchapelopia* | 1.6 | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Corynoneura* | - | - | - | 0.8 | 0.7 | - | - | 1 | 0.8 | 1.6 | 1.9 | 0.9 | 5 | - | - |
| | | *Diamesa* | - | 2.3 | - | 2.5 | - | - | - | - | - | - | - | - | 2.5 | - | - |
| | | Diamesinae | - | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - |
| | | *Eukiefferiella* | - | - | - | 1.7 | - | - | 5.4 | 2 | 2.5 | 3.1 | 4.8 | 5.6 | 0.8 | 3.4 | 3.3 |
| | | ***Heleniella*** [+] | - | - | - | 0.8 | - | - | 0.9 | 3 | 0.8 | 0.8 | 1 | 1.9 | - | 0.8 | - |
| | | ***Hydrobaenus*** | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - |
| | | *Micropsectra* | - | 1.5 | 18.8 | - | - | 2.7 | 0.9 | 1 | - | - | - | - | 0.8 | - | 0.8 |
| | | *Microtendipes* | - | 0.8 | - | - | - | - | - | - | - | - | - | 1.9 | - | 1.7 | - |
| | | *Nanocladius* | - | - | 0.9 | 0.8 | - | - | - | - | 0.8 | - | - | - | - | - | - |
| | | Orthocladiinae | *0.8 | *2.3 | *0.9 | - | *0.7 | - | *1.8 | - | - | - | - | - | *2.5 | - | *0.8 |
| | | *Orthocladius* | - | 1.5 | 2.6 | 0.8 | - | - | 0.9 | 3 | 0.8 | 1.6 | - | - | 6.6 | - | 0.8 |
| | | *Parametriocnemus* | - | - | 1.7 | 4.2 | 2.8 | - | - | 1 | - | - | 4.8 | 1.9 | 2.5 | 3.4 | 0.8 |
| | | *Paraphaenocladius* | - | - | - | 0.8 | - | 0.9 | - | - | - | 2.3 | - | 0.9 | 1.7 | 1.7 | - |
| | | *Paratanytarsus* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - |
| | | *Platysmittia* | - | - | 1.7 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Polypedilum* | - | - | 1.7 | - | - | - | - | - | - | 0.8 | - | - | - | - | - |
| | | *Pseudorthocladius* | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - |
| | | *Rheosmittia* | - | - | - | - | 2.8 | 3.6 | - | 1 | - | - | - | - | - | - | - |
| | | *Rheotanytarsus* | - | - | - | - | - | - | - | - | - | - | - | 1.9 | - | - | 6.6 |
| | | *Stempellina* | - | - | - | - | - | - | - | - | - | 0.8 | 1 | - | - | - | - |
| | | *Stilcladius* | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Sympotthastia* | - | 0.8 | - | 10.9 | - | - | - | 1 | 2.5 | - | - | - | 0.8 | - | - |
| | | Tanypodinae | - | - | - | - | *1.4 | - | - | - | - | *2.3 | - | - | *0.8 | 1.7 | - |
| | | Tanytarsini | - | - | *8.5 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Tanytarsus* | - | - | 2.6 | 0.8 | - | - | 2.7 | - | - | 1.6 | - | - | - | - | - |
| | | *Thienemanniella* | - | 0.8 | 2.6 | - | 1.4 | - | - | - | - | 0.8 | - | 0.9 | 9.9 | - | - |
| | | Thienemannimyia Group | - | - | - | - | *0.7 | *0.9 | - | *1 | *0.8 | - | - | *0.9 | - | - | *1.7 |
| | | *Trissopelopia* | - | 0.8 | - | - | 2.1 | - | 0.9 | - | - | - | - | - | - | - | - |
| | | *Tvetenia* | - | - | - | - | - | - | - | - | - | 0.8 | 1.9 | - | 1.7 | 1.7 | - |
| | | *Zavrelimyia* | 0.8 | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - |
| | Dixidae | ***Dixa***[+] | - | 1.5 | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - |
| | Empididae | *Chelifera* | - | - | - | - | 0.7 | - | - | - | - | - | 1.9 | - | - | - | - |
| | | *Clinocera* | - | - | - | - | - | - | - | - | - | - | 1 | - | - | 0.8 | - |
| | | *Hemerodromia* | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | 0.8 | - |
| | Sciomyzidae | *na* | - | - | - | - | - | - | - | - | - | - | - | - | - | *0.8 | - |
| | Simuliidae | *Prosimulium* | 3.2 | 48.9 | 1.7 | 23.5 | 35.7 | 13.4 | 24.1 | 41.6 | 11 | 10.9 | 39.4 | 36.4 | 5.8 | 12.6 | 28.1 |
| | | *Simulium* | 14.3 | - | 1.7 | - | - | - | - | 1 | 0.8 | - | - | - | 5.8 | - | - |
| | | *Stegopterna* | - | - | - | - | - | - | - | - | - | - | 1 | 0.9 | 0.8 | 0.8 | - |
| | Tabanidae | *Chrysops* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - |
| | Tipulidae | *Antocha* | - | - | - | 1.7 | 1.4 | 0.9 | - | - | - | - | 1.9 | - | - | 1.6 | - |
| | | *Dicranota* | - | 2.3 | 1.7 | 0.8 | 1.4 | 3.6 | 0.9 | 3 | 4.2 | 3.9 | 1.9 | - | - | 0.8 | - |
| | | *Hexatoma* | - | - | - | - | - | - | 1.8 | - | 0.8 | 0.8 | 1.9 | 0.9 | - | - | 0.8 |
| | | *Limonia* | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Ormosia* | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| | | *Pedicia* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| | | *Pseudolimnophila* | - | - | - | - | - | - | - | - | - | - | 1.9 | - | 0.8 | - | - |
| | | *Tipula* | 0.8 | - | - | 2.5 | 1.4 | - | 0.9 | 2 | 0.8 | 0.8 | 1 | - | - | 0.8 | 0.8 |
| Ephemeroptera | Baetidae | na | - | - | *1.7 | - | - | - | - | *1 | - | - | *1 | - | - | - | - |
| (Mayfly) | | *Acentrella* | 2.4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Baetis* | - | - | - | - | 7.7 | - | - | - | - | - | - | - | - | - | - |
| | Ephemerellidae | na | - | - | - | - | - | - | - | *11.9 | *11 | *3.9 | *2.9 | - | - | - | - |
| | | *Ephemerella* | 35.7 | 5.3 | 12.8 | 11.8 | 6.3 | 41.1 | 35.7 | 6.9 | 29.7 | 27.3 | 1 | 15.9 | 13.2 | 18.5 | 19.8 |
| | | *Eurylophella* | - | - | - | - | - | - | - | - | - | - | - | - | 2.5 | 1.7 | - |
| | | *Serratella* | 2.4 | 0.8 | 13.7 | - | - | 2.7 | 5.4 | - | 6.8 | 2.3 | - | 4.7 | 1.7 | - | - |
| | Heptageniidae | na | *0.8 | - | *0.9 | - | - | *0.9 | - | *2 | - | *0.8 | - | - | - | - | - |
| | | ***Epeorus***[+] | 0.8 | 1.5 | - | - | - | - | 1.8 | 2 | 2.5 | 1.6 | - | - | - | - | - |
| | | *Maccaffertium* | - | - | - | - | - | - | - | - | 1.7 | - | - | - | - | - | 0.8 |
| | | *Stenacron* | - | - | - | 1.7 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Stenonema* | 0.8 | 0.8 | - | 5 | 4.9 | 0.9 | - | - | - | - | - | - | - | - | - |
| | Leptophlebiidae | na | - | - | - | *0.8 | - | - | - | - | - | *0.8 | *1.9 | - | - | - | - |
| | | *Leptophlebia* | - | 1.5 | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - |
| | | ***Paraleptophlebia***[+] | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Megaloptera | Corydalidae | *Nigronia* | - | 0.8 | - | 1.7 | 0.7 | - | - | 1 | 2.5 | 0.8 | - | - | - | - | 0.8 |
| Odonata | Aeshnidae | *Boyeria* | - | - | - | - | 0.7 | - | - | - | - | - | - | - | - | - | - |
| (Dragonfly) | Gomphidae | na | - | - | - | *0.8 | - | - | - | *1 | - | - | - | - | - | 1.7 | - |
| Plecoptera | Chloroperlidae | na | - | - | - | - | - | - | - | - | - | *0.8 | - | *0.9 | - | *2.5 | - |
| (Stonefly) | | *Haploperla* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Leuctridae | na | *4.8 | - | *0.9 | - | *2.8 | *6.3 | - | - | - | *2.3 | - | *0.9 | *12.4 | *1.7 | - |
| | | ***Leuctra***[+] | - | - | - | - | - | - | - | - | - | - | 2.9 | - | - | - | - |
| | Nemouridae | na | - | - | - | *2.5 | *2.8 | - | - | - | - | - | - | *3.7 | - | *0.8 | - |
| | | *Amphinemura* | 13.5 | - | 1.7 | - | 2.8 | 7.1 | - | - | 1.7 | 10.9 | 1.9 | - | - | 1.7 | - |
| | | *Prostoia* | - | 13.7 | - | 5 | - | - | 0.9 | - | - | 0.8 | 1 | - | 6.6 | 3.4 | 1.7 |
| | Peltoperlidae | ***Tallaperla***[+] | - | - | - | - | 0.7 | - | - | - | - | - | - | - | - | - | - |
| | Perlidae | na | - | - | - | - | *0.7 | - | - | - | - | - | *1 | *1.9 | - | - | *0.8 |
| | | *Acroneuria* | - | - | - | - | 0.7 | - | - | - | 0.8 | - | 1 | - | 1.7 | 0.8 | - |
| | | *Eccoptura* | - | - | - | - | 0.7 | - | - | - | 0.8 | - | - | - | - | - | - |
| | Perlodidae | na | *3.2 | - | - | - | *2.8 | *0.9 | - | - | - | *0.8 | *1.9 | - | *0.8 | - | *0.8 |
| | | *Diploperla* | - | - | - | - | 1.4 | - | - | - | - | - | - | - | - | - | - |
| | | *Isoperla* | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - |
| | Pteronarcyidae | *Pteronarcys* | - | - | 0.9 | - | - | - | - | - | - | - | - | - | 0.8 | - | - |
| Trichoptera | na | na | - | - | *0.9 | - | - | - | - | - | - | - | - | - | - | - | - |
| (Caddisfly) | Glossosomatidae | *Glossosoma* | - | - | - | - | - | 0.9 | - | 1 | - | - | - | - | - | 0.8 | - |
| | Hydropsychidae | *Ceratopsyche* | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - |
| | | *Cheumatopsyche* | 0.8 | - | - | - | 2.8 | 0.9 | - | 2 | 0.8 | 0.8 | 3.8 | 4.7 | 2.5 | 5.9 | 5 |
| | | *Diplectrona*[+] | 1.6 | - | - | 2.5 | 0.7 | 1.8 | - | - | 0.8 | 0.8 | 1.9 | 1.9 | - | 1.7 | - |
| | | *Hydropsyche* | - | - | - | - | 2.8 | 2.7 | - | 2 | - | - | - | - | - | 2.5 | 3.3 |
| | Lepidostomatidae | *Lepidostoma* | - | - | 0.9 | - | - | 0.9 | - | 1 | - | - | 1.9 | - | 0.8 | - | - |
| | Limnephilidae | *Hydatophylax* | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Pycnopsyche* | - | 0.8 | - | - | 2.1 | - | - | - | - | 0.8 | - | - | - | - | - |
| | Philopotamidae | na | - | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - |
| | | *Dolophilodes* | 4 | - | - | - | - | - | 0.9 | - | - | - | 1 | - | - | - | - |
| | Polycentropodidae | na | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Polycentropus* | - | - | 0.9 | 0.8 | - | - | - | 1 | - | 0.8 | - | - | - | - | - |
| | Psychomyiidae | *Lype* | - | - | - | 0.8 | 0.7 | - | - | - | - | - | - | - | - | - | - |
| | Rhyacophilidae | *Rhyacophila* | 0.8 | - | 0.9 | 1.7 | - | - | 0.9 | - | 0.8 | 0.8 | 1 | - | - | 2.5 | - |
| | Uenoidae | *Neophylax* | 2.4 | 3.8 | 3.4 | 4.2 | 1.4 | 0.9 | 0.9 | 2 | 4.2 | 4.7 | 1 | 3.7 | 0.8 | 5.0 | 19 |
| PHYLUM PLATYHELMINTHES | | | | | | | | | | | | | | | | | |
| Tricladida | Planariidae | na | - | - | - | *1.7 | - | - | - | - | - | - | - | - | - | - | - |
| (Flatworm) | | *Girardia* | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).
* Taxa not identified to genus

[+] Cold-preference genera

## *Appendix D*
## *Sentinel Sites in the Highlands Region*

Bear Creek (YOUG-432-S)
Buzzard Branch (UMON-119-S)
Crabtree Creek (SAVA-204-S)
Double Lick Run (SAVA-276-S)
Unnamed Tributary to Edgemont Reservoir (ANTI-101-S)
Fifteenmile Creek (FIMI-207-S)
High Run (UMON-288-S)
Mill Run (PRLN-626-S)
Savage River (SAVA-225-S)

# *Bear Creek (YOUG-432-S)*

Site YOUG-432-S is located on Bear Creek in the Highlands region of Maryland. It is in the Youghiogheny River watershed in Garrett County. This site was sampled in 1995 and 2000 to 2014 Summer sampling was not performed in 2005 and 2006 due to contamination concerns at the Bear Creek Hatchery.


*Bear Creek in spring 2013.*

## ***Land Use/ Land Cover***

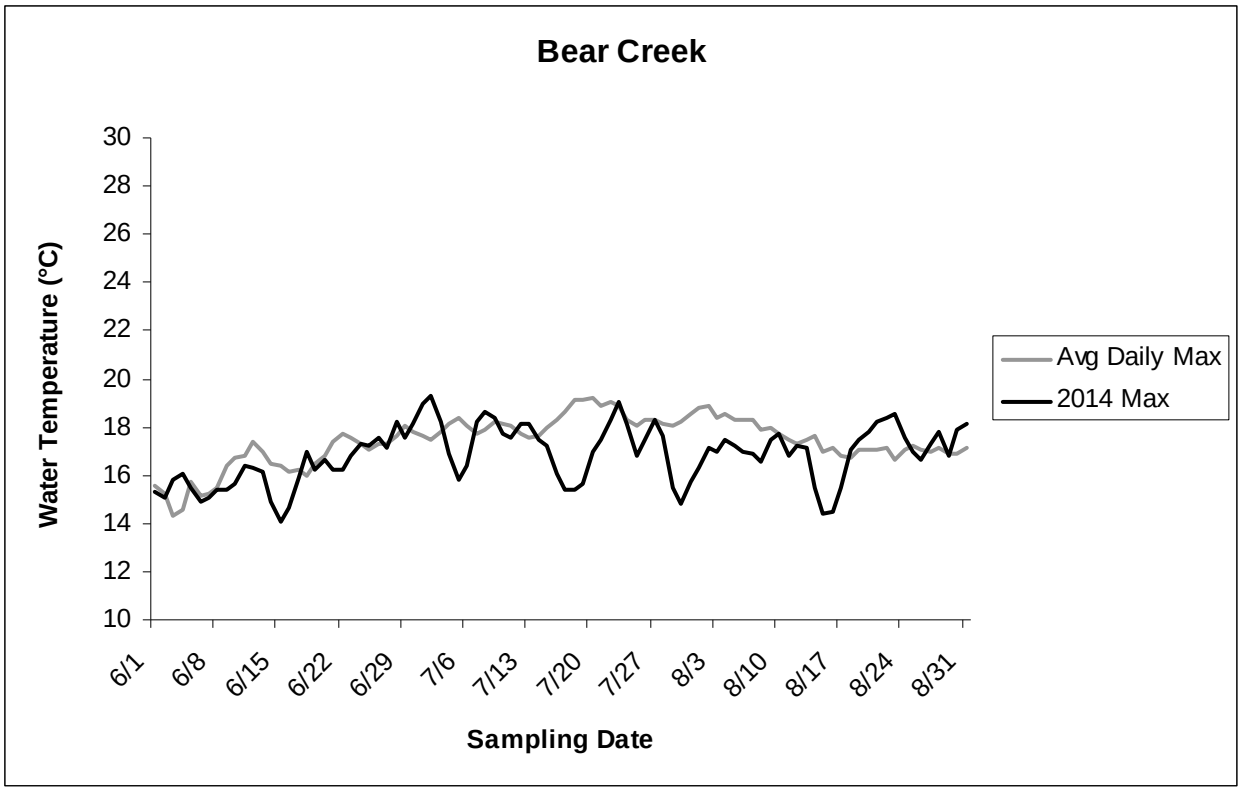
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 14.80 | 65.74 | 65.36 |
| Agriculture | 1.51 | 27.22 | 27.55 |
| Urban | 10.17 | 4.08 | 2.68 |
| Other | 73.51 | 2.95 | 2.94 |

## ***Physical Habitat***

Physical habitat measurements collected at Bear Creek (2000 to 2004, and 2007 to 2014. Scored parameters are on a 0 (worst) to 20 (best) scale. The site was not sampled in the summer of 2005 or 2006.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 18 | 18 | 18 | 16 | 16 | Not Sampled | | 17 | 17 | 17 | 17 | 19 | 15 | 19 | 18 |
| Epifaunal substrate (0-20) | 18 | 17 | 15 | 14 | 14 | | | 17 | 19 | 19 | 18 | 19 | 16 | 18 | 19 |
| Velocity/Depth Diversity (0-20) | 12 | 17 | 10 | 9 | 15 | | | 10 | 14 | 16 | 18 | 17 | 14 | 19 | 15 |
| Pool Quality (0-20) | 13 | 16 | 17 | 9 | 14 | | | 10 | 12 | 14 | 16 | 17 | 16 | 18 | 17 |
| Riffle Quality (0-20) | 18 | 17 | 17 | 16 | 11 | | | 17 | 17 | 18 | 19 | 18 | 17 | 15 | 18 |
| Shading (%) | 85 | 85 | 92 | 93 | 88 | | | 97 | 85 | 85 | 80 | 85 | 90 | 85 | 80 |
| Embeddedness (%) | 10 | 20 | 35 | 35 | 35 | | | 35 | 20 | 35 | 20 | 5 | 20 | 10 | 10 |
| Discharge (cfs) | 2.55 | 2.86 | 1.33 | 1.16 | 2.00 | | | 1.19 | 5.84 | 2.22 | 9.33 | 6.25 | 5.39 | 4.47 | 2.11 |




The graph above displays the average daily maximum temperatures recorded at Bear Creek. No data was available for 2010. The average was calculated from eight years of data.

## ***Biology***

### *Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 4.75 | 4.50 | 4.75 | 4.00 | 4.50 | 3.75 | 4.25 | 4.25 | 4.25 | 4.75 | 4.25 | 4.25 | 4.25 | 4.00 | 3.00 |
| FIBI | 4.00 | 4.33 | 4.00 | 4.67 | 4.67 | Not Sampled | | 4.00 | 4.00 | 4.00 | 5.00 | 4.00 | 4.33 | 4.33 | 4.67 |

### *Fish*

Cumulative list of fish species (with abundance) collected in Bear Creek by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brook trout | 12 | 29 | 20 | 8 | 32 | 8 | 8 | 9 | 7 | 9 | 22 | 32 | 40 |
| Brown Trout | - | - | - | - | - | - | 1 | 5 | - | - | - | - | 1 |
| Creek chub | - | - | - | 10 | 8 | - | - | - | - | 1 | - | - | 3 |
| Eastern blacknose dace | 4 | 29 | 11 | 10 | 60 | 2 | - | - | - | 1 | - | - | 12 |
| Longnose dace | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| Mottled sculpin | 190 | 279 | 265 | 287 | 239 | 203 | 117 | 75 | 19 | 41 | 132 | 210 | 281 |
| Rainbow trout | - | - | - | - | - | - | - | - | - | - | - | 1 | 1 |
| White sucker | 1 | - | 1 | 24 | 28 | 1 | 2 | 3 | 3 | 3 | 6 | 4 | 6 |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant. Site not sampled in summer 2006 and 2007.

### *Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in Bear Creek by sampling year

| *Species* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|
| Rock crayfish (Cambarus carinirostris) | P | P | P | P | P | P | P | P |
| Upland burrowing crayfish (Cambarus dubius) | A | A | A | A | A | P | P | A |

*Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in Bear Creek by sampling year.

| *Species* |
|---|
| None Observed |

*Herpetofauna*

Cumulative list of herpetofauna species collected in or near Bear Creek.

| *Order (Common)* | *Species* |
|---|---|
| Caudata (Salamanders and Newts) | Allegheny mountain dusky salamander, Eastern red-backed salamander, Northern dusky salamander, Northern red salamander, Northern slimy salamander, Northern spring salamander, Northern two-lined salamander, Seal salamander |
| Anura (Frogs and Toads) | Eastern American toad |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in Bear Creek by sampling year, RA = %Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | |
| Lumbriculida | Lumbriculidae | na | - | - | *1.7 | - | - | - | - | *0.9 | - | - | *1.7 | - | - | - | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | |
| Amphipoda | Gammaridae | *Gammarus* | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Scud) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Coleoptera | Elmidae | na | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Beetle) | | *Optioservus* | - | - | 2.5 | - | 2.8 | 10.3 | 3.1 | 11.2 | 7.9 | 1.9 | 3.4 | 0.9 | 2.7 | - | - |
| | | *Oulimnius* | 2.4 | 3.4 | 9.2 | 10.8 | - | 8.4 | 2.3 | 8.6 | 15.9 | 2.9 | 2.6 | - | 2.7 | - | - |
| | | *Promoresia* | - | 0.9 | - | - | - | - | - | 1.7 | - | 1 | 1.7 | - | - | - | - |
| | Psephenidae | *Ectopria* | 0.8 | - | - | - | - | - | - | 0.9 | - | - | - | - | 1.8 | - | - |
| Collembola | Isotomidae | *Isotomurus* | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| Decapoda | Cambaridae | na | - | - | - | - | - | - | - | - | - | *1 | - | - | - | - | - |
| (Crayfish) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Diptera | Athericidae | *Atherix* | - | - | - | - | - | 0.9 | - | - | - | 1 | - | 0.9 | 0.9 | - | - |
| (True Fly) | Blephariceridae | *Blepharicera* | 4 | - | - | - | 1.9 | - | 1.5 | 0.9 | - | - | - | 0.9 | 1.8 | - | - |
| | Ceratopogonidae | *Bezzia* | - | - | - | - | - | - | 1.5 | - | - | - | - | - | - | - | - |
| | | *Probezzia* | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Chironomidae | na | - | - | - | - | - | - | - | - | - | - | - | *3.6 | - | - | - |
| | | *Brillia* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| | | *Chaetocladius* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | 0.9 | - | - |
| | | Chironominae | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Diamesa* | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Eukiefferiella* | - | 0.9 | - | - | - | - | 0.8 | - | - | - | - | - | - | - | 1.8 |
| | | ***Heleniella***[+] | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - |
| | | *Micropsectra* | - | 0.9 | 3.3 | - | - | - | - | - | - | - | - | - | - | 1.8 | 1.8 |
| | | *Microtendipes* | - | - | - | - | - | - | 0.8 | - | - | - | - | - | 0.9 | - | - |
| | | *Nanocladius* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | Orthocladiinae | - | *3.5 | *1.7 | *0.8 | - | - | - | - | *0.8 | - | - | *0.9 | - | - | - |
| | | *Orthocladius* | - | - | - | - | - | - | 0.8 | - | 2.4 | 1 | - | - | - | 0.9 | 0.9 |
| | | *Parachaetocladius* | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - |
| | | *Parametriocnemus* | 3.2 | 2.6 | - | 3.1 | - | 4.7 | 0.8 | - | 2.4 | - | - | - | 0.9 | - | - |
| | | *Paraphaenocladius* | - | - | - | - | - | - | - | - | 1.6 | - | - | 0.9 | - | - | - |
| | | *Polypedilum* | - | - | - | - | - | - | - | - | - | - | 0.9 | 1.8 | - | - | - |
| | | *Pseudorthocladius* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - |
| | | *Rheocricotopus* | 1.6 | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Rheopelopia* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Stempellinella* | 5.6 | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 |
| | | *Sublettea* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Symposiocladius* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | Tanypodinae | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | Tanytarsini | - | *1.7 | 10 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Tanytarsus* | - | - | - | - | - | - | - | - | - | 1.9 | - | - | - | - | - |
| | | *Thienemanniella* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | Thienemannimyia Group | - | - | - | - | - | - | - | - | *1.6 | - | - | - | - | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Tvetenia* | - | - | - | - | - | 0.9 | - | - | 0.8 | 1 | - | 4.5 | 0.9 | - | 3.5 |
| | Empididae | *Chelifera* | - | - | - | 0.8 | - | 0.9 | - | 2.6 | - | - | 0.9 | - | - | - | - |
| | | *Clinocera* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Hemerodromia* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Simuliidae | na | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - |
| | | *Prosimulium* | 3.2 | 21.4 | 5.8 | 20 | 0.9 | 9.3 | 30.8 | 8.6 | - | 1 | 2.6 | 19.6 | 4.5 | 35.4 | 72.6 |
| | | *Simulium* | - | - | - | - | - | - | - | - | - | - | 7.7 | - | - | - | - |
| | Tipulidae | *Antocha* | 0.8 | 0.9 | 0.8 | - | 0.9 | 0.9 | 0.8 | 1.7 | 1.6 | 1 | - | - | - | 0.9 | - |
| | | *Dicranota* | - | 0.9 | - | 1.5 | - | - | - | 0.9 | 3.2 | - | - | 0.9 | 1.8 | - | - |
| | | *Hexatoma* | 1.6 | - | 0.8 | 0.8 | 0.9 | 1.9 | - | - | 0.8 | 1 | 0.9 | - | - | 0.9 | - |
| | | *Tipula* | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| Ephemeroptera (Mayfly) | Baetidae | na | *0.8 | *0.9 | - | *1.5 | - | - | - | - | - | - | - | - | - | - | *0.9 |
| | | *Acentrella* | 6.3 | - | - | 3.1 | 2.8 | 0.9 | - | - | - | - | 26.5 | - | - | - | - |
| | | *Acerpenna* | 0.8 | - | 0.8 | - | - | - | - | 0.9 | - | - | - | - | - | - | - |
| | | *Baetis* | - | 3.4 | 0.8 | 4.6 | 8.5 | 19.6 | 4.6 | 3.4 | 6.3 | 4.8 | 9.4 | - | 11.6 | - | - |
| | | ***Diphetor***[+] | - | - | - | - | - | - | - | - | 2.4 | - | 0.9 | 0.9 | 1.8 | 3.5 | - |
| | | ***Plauditus*** | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - |
| | Ephemerellidae | na | - | - | - | - | - | - | *2.3 | - | - | - | *5.1 | *9.8 | - | - | *3.5 |
| | | *Drunella* | 0.8 | - | - | 1.5 | 4.7 | - | - | 0.9 | - | - | - | - | 0.9 | - | - |
| | | *Ephemerella* | 13.5 | 6 | 5 | 15.4 | 19.8 | 7.5 | 2.3 | 23.3 | 8.7 | 21.9 | 6 | 3.6 | 8 | 2.7 | - |
| | | *Serratella* | - | - | - | 1.5 | - | - | 2.3 | 1.7 | 0.8 | - | - | - | - | - | - |
| | | ***Teloganopsis*** | - | - | - | - | - | - | - | - | - | - | - | 1.8 | 0.9 | - | - |
| | Ephemeridae | ***Ephemera***[+] | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - | 0.9 | - |
| | Heptageniidae | na | *2.4 | *0.9 | *1.7 | *1.5 | - | - | - | - | *2.4 | - | *1.7 | - | - | - | - |
| | | ***Cinygmula***[+] | 1.6 | 2.6 | 1.7 | - | 5.7 | - | 0.8 | - | 3.2 | 1 | 0.9 | 2.7 | 4.5 | - | - |
| | | ***Epeorus***[+] | 11.9 | 6 | 10.8 | 5.4 | 15.1 | 4.7 | 13.8 | 2.6 | 8.7 | 9.5 | 12 | 15.2 | 16.1 | 19.5 | 0.9 |
| | | *Heptagenia* | 0.8 | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - |
| | | *Leucrocuta* | - | - | - | - | 0.9 | - | - | - | 0.8 | - | - | - | - | - | - |
| | | *Rhithrogena* | - | - | - | - | - | - | 1.5 | - | - | - | - | - | 1.8 | - | - |
| | | *Stenacron* | - | 0.9 | - | 0.8 | - | - | - | 0.9 | - | 2.9 | - | - | - | 0.9 | - |
| | | *Maccaffertium* | - | - | - | - | - | - | - | - | 0.8 | 1 | - | 0.9 | - | 1.8 | - |
| | | *Stenonema* | - | 0.9 | 3.3 | - | 0.9 | - | - | 2.6 | - | - | - | - | - | - | - |
| | Isonychiidae | *Isonychia* | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Leptophlebiidae | na | - | *1.7 | *2.5 | *9.2 | - | *2.8 | *7.7 | *3.4 | *8.7 | - | *2.6 | *1.8 | *7.1 | *7.1 | *3.5 |
| | | ***Paraleptophlebia***[+] | 15.9 | 11.1 | 10.8 | 3.8 | 13.2 | 7.5 | 1.5 | - | - | 14.3 | 0.9 | 9.8 | - | 0.9 | - |
| Megaloptera (Dobsonfly/Fishfly) | Corydalidae | *Nigronia* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Plecoptera (Stonefly) | Chloroperlidae | na | *2.4 | *2.6 | *1.7 | - | *3.8 | *0.9 | - | *4.3 | *0.8 | - | - | - | *1.8 | - | - |
| | | *Haploperla* | - | - | - | - | - | - | 1.5 | - | - | - | - | - | - | - | - |
| | | ***Sweltsa***[+] | - | - | 0.8 | - | - | 1.9 | - | - | - | 1 | - | - | 2.7 | - | - |
| | Leuctridae | na | - | *1.7 | - | *2.3 | - | *2.8 | - | - | *4 | *1 | - | *1.8 | *0.9 | - | - |
| | | ***Leuctra***[+] | 2.4 | 0.9 | 5 | 0.8 | - | - | 2.3 | - | - | - | - | 0.9 | - | - | - |
| | Nemouridae | na | - | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - |
| | | *Amphinemura* | 2.4 | 7.7 | 1.7 | 1.5 | 1.9 | - | 0.8 | 1.7 | - | - | 1.7 | - | - | - | - |
| | Peltoperlidae | na | *0.8 | - | - | - | *0.9 | - | - | - | - | - | - | - | - | - | - |
| | | ***Tallaperla***[+] | - | - | 0.8 | - | 1.9 | 0.9 | - | 1.7 | - | 2.9 | - | - | 1.8 | - | 0.9 |
| | Perlidae | na | - | - | - | - | *1.9 | - | *0.8 | *0.9 | - | - | - | - | - | *0.9 | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Acroneuria* | - | - | 0.8 | - | - | - | - | 0.9 | - | - | - | - | - | 1.8 | - |
| | Perlodidae | na | - | *0.9 | *0.8 | *2.3 | *1.9 | *1.9 | *2.3 | *1.7 | - | - | *2.6 | *5.4 | *2.7 | - | *0.9 |
| | | *Cultus* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | 1.8 | - |
| | | *Diploperla* | - | - | - | - | - | - | - | - | - | - | - | 1.8 | - | - | - |
| | | *Isoperla* | 4 | 1.7 | 1.7 | 0.8 | - | 0.9 | 4.6 | - | 4 | 7.6 | 1.7 | 0.9 | 2.7 | 4.4 | 2.7 |
| | | *Yugus* | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| | Pteronarcyidae | *Pteronarcys* | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - |
| | Taeniopterygidae | *Oemopteryx* | - | - | - | - | - | - | - | - | - | - | - | - | - | 2.7 | - |
| | | *Taenionema* | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - | 0.9 |
| Trichoptera | na | na | - | *0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Caddisfly) | Brachycentridae | *Micrasema* | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - |
| | Glossosomatidae | *Agapetus* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | | *Glossosoma* | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| | | *Goera* | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| | Hydropsychidae | na | - | - | - | *0.8 | - | - | - | - | - | - | - | - | *1.8 | - | - |
| | | *Cheumatopsyche* | - | - | 0.8 | - | 1.9 | - | 0.8 | 0.9 | 2.4 | 1 | - | - | - | - | - |
| | | ***Diplectrona***[+] | 2.4 | 3.4 | 8.3 | 1.5 | 3.8 | 6.5 | 3.8 | 4.3 | 0.8 | 5.7 | 1.7 | 1.8 | 2.7 | - | 0.9 |
| | | *Hydropsyche* | - | 0.9 | - | 1.5 | - | - | - | - | - | 1 | - | - | 1.8 | 0.9 | - |
| | Lepidostomatidae | *Lepidostoma* | 3.2 | - | 0.8 | - | - | - | - | 0.9 | 0.8 | - | - | - | - | - | - |
| | Limnephilidae | na | - | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - |
| | | *Pycnopsyche* | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Philopotamidae | na | - | - | - | - | *0.9 | - | - | - | - | - | *0.9 | - | - | - | - |
| | | *Dolophilodes* | - | 0.9 | - | - | - | 0.9 | - | - | 0.8 | 1.9 | - | 0.9 | - | 2.7 | - |
| | Polycentropodidae | na | - | - | - | - | - | - | - | - | *0.8 | - | - | - | - | - | - |
| | | *Nyctiophylax* | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - |
| | | *Polycentropus* | - | - | 0.8 | - | - | - | 0.8 | - | - | - | - | 2.7 | 0.9 | - | - |
| | Psychomyiidae | *Lype* | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - |
| | | *Psychomyia* | - | - | - | - | - | - | - | 2.6 | - | - | - | - | - | - | - |
| | Rhyacophilidae | *Rhyacophila* | 0.8 | 1.7 | 0.8 | - | - | 0.9 | 1.5 | - | 0.8 | 1.9 | - | - | 2.7 | 3.5 | 0.9 |
| | Uenoidae | *Neophylax* | 0.8 | 3.4 | 1.7 | 0.8 | 0.9 | 0.9 | - | 1.7 | - | 2.9 | - | - | 1.8 | 2.7 | 2.7 |

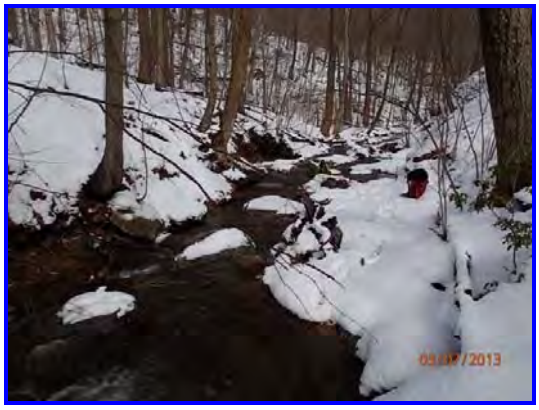
Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).

* Taxa not identified to genus

[+] Coldwater-preference genera

# *Buzzard Branch (UMON-119-S)*

Site UMON-119-S is located on Buzzard Branch in the Highlands region of Maryland. It is in the Upper Monocacy River watershed in Frederick County. This site was sampled in 2000 and 2002 to 2014




*Buzzard Branch in the spring of 2013.*

## ***Land Use/ Land Cover***

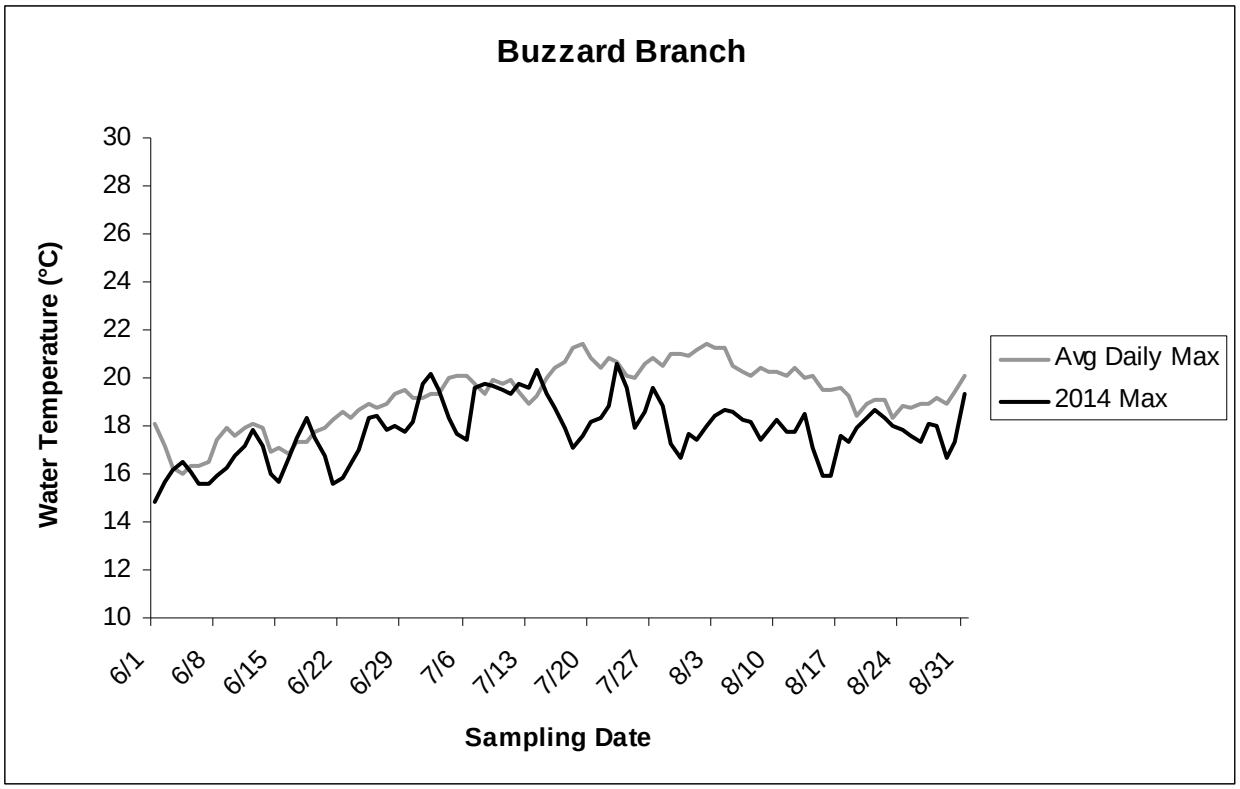
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 96.67 | 96.67 | 96.61 |
| Agriculture | 0.00 | 0.06 | 0.06 |
| Urban | 3.27 | 3.27 | 3.33 |
| Other | 0.06 | 0.00 | 0.00 |

## ***Physical Habitat***

Physical habitat measurements collected at Buzzard Branch (2000 and 2002 to 2014. Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 17 | 17 | 16 | 16 | 17 | 18 | 18 | 17 | 17 | 18 | 18 | 18 | 14 | 14 |
| Epifaunal substrate (0-20) | 18 | 17 | 17 | 17 | 17 | 19 | 18 | 16 | 17 | 19 | 19 | 17 | 13 | 17 |
| Velocity/Depth Diversity (0-20) | 15 | 9 | 10 | 12 | 10 | 10 | 10 | 10 | 10 | 10 | 9 | 15 | 15 | 11 |
| Pool Quality (0-20) | 16 | 9 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 16 | 9 | 11 |
| Riffle Quality (0-20) | 15 | 14 | 15 | 16 | 16 | 19 | 17 | 13 | 14 | 14 | 15 | 19 | 14 | 13 |
| Shading (%) | 90 | 86 | 98 | 90 | 90 | 90 | 90 | 80 | 80 | 95 | 95 | 95 | 85 | 85 |
| Embeddedness (%) | 25 | 20 | 20 | 20 | 20 | 20 | 50 | 35 | 35 | 10 | 10 | 5 | 5 | 5 |
| Discharge (cfs) | 0.54 | 0.09 | 0.38 | 1.39 | 0.99 | 2.17 | 0.89 | 0.16 | 1.02 | 1.46 | 0.32 | 2.95 | 0.51 | 3.15 |




The graph above displays the average daily maximum temperatures recorded at Buzzard Branch. No data was available for 2010. The average was calculated from seven years of data.

## ***Biology***

### *Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 3.50 | Not | 5.00 | 4.25 | 3.00 | 4.25 | 3.50 | 3.50 | 4.25 | 3.75 | 4.25 | 4.25 | 3.00 | 2.50 | 2.75 |
| FIBI | 3.50 | Sampled | 3.50 | 3.50 | 3.50 | 3.50 | 4.00 | 3.50 | 3.50 | 3.50 | 1.67 | 3.50 | 3.50 | 3.00 | 2.50 |

### *Fish*

Cumulative list of fish species (with abundance) collected in Buzzard Branch by sampling year.

| *Species* | *2000* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Eastern blacknose dace | 24 | 33 | 17 | 37 | 22 | 7 | 30 | 43 | 41 | 30 | 43 | 56 | 95 | 68 |
| Brook trout | 19 | 57 | 25 | 43 | 43 | 31 | 43 | 55 | 21 | 16 | 11 | 24 | 20 | 8 |
| Brown trout | 30 | 10 | 2 | 5 | 4 | 6 | 9 | 9 | - | - | - | - | - | - |
| Largemouth Bass | - | - | - | - | - | - | - | 1 | - | - | - | 1 | - | - |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

### *Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in Buzzard Branch by sampling year

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Common crayfish (*Cambarus bartonii bartonii)* | P | P | P | P | P | P | P | P | P |

*Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in Buzzard Branch by sampling year.

| *Species* |
|---|
| None Observed |

*Herpetofauna*

Cumulative list of herpetofauna species collected in or near Buzzard Branch.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | American bullfrog, Eastern American toad, Pickerel frog, Northern green frog, Northern spring peeper |
| Caudata (Salamanders and Newts) | Eastern red-backed salamander, Eastern red-spotted newt, Northern dusky salamander, Northern red salamander, Northern slimy salamander, Northern two-lined salamander |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in Buzzard Branch by sampling year, RA = %Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | |
| Haplotaxida | Enchytraeidae | na | - | - | *1.6 | - | - | - | - | - | - | - | - | - | - | - |
| Lumbriculida | Lumbriculidae | na | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | |
| Coleoptera (Beetle) | Elmidae | na | - | - | - | - | - | *0.8 | - | - | - | - | - | - | - | - |
| | | *Oulimnius* | 6.6 | 27.2 | 0.8 | 2.2 | 8 | 12.7 | 0.9 | 2.8 | 8 | 7.9 | 8 | 0.8 | 0.9 | 1.7 |
| | Psephenidae | *Psephenus* | - | 1.6 | 0.8 | - | 1.8 | 0.8 | - | 0.9 | - | - | - | - | - | - |
| | | *Ectopria* | - | - | - | - | 0.9 | 1.7 | 0.9 | - | - | - | - | - | - | - |
| Decapoda (Crayfish) | Cambaridae | na | - | - | - | - | *0.9 | *0.8 | - | - | - | - | - | - | - | - |
| | | *Cambarus* | - | - | - | - | - | - | - | - | - | 1.8 | - | - | - | 0.8 |
| Diptera (True Fly) | Blephariceridae | *Blepharicera* | - | - | - | - | 0.9 | - | - | 1.9 | - | - | - | 0.8 | - | - |
| | Ceratopogonidae | na | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Bezzia* | - | - | 0.8 | - | - | - | - | - | - | - | - | 0.8 | - | - |
| | | *Ceratopogon* | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | Chironomidae | *Brillia* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| | | *Chaetocladius* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 |
| | | *Conchapelopia* | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Corynoneura* | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - |
| | | *Diamesa* | - | - | 1.6 | - | - | 4.2 | - | - | 0.9 | - | - | 1.7 | - | 0.8 |
| | | Diamesinae | *0.8 | - | - | *2.2 | - | *1.7 | - | - | - | - | - | - | - | - |
| | | *Eukiefferiella* | 5 | - | 0.8 | 1.1 | - | 7.6 | 0.9 | - | 6.2 | 1.8 | 0.9 | 0.8 | - | - |
| | | ***Heleniella***[+] | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - |
| | | *Parachaetocladius* | - | 0.8 | - | - | - | - | - | - | - | 0.9 | 3.6 | 0.8 | - | 1.7 |
| | | *Parametriocnemus* | 0.8 | 0.8 | 0.8 | 2.2 | - | 0.8 | 7.5 | 2.8 | - | 0.9 | 3.6 | - | 0.9 | - |
| | | *Paraphaenocladius* | - | - | - | - | - | 0.8 | - | - | 0.9 | - | - | - | - | - |
| | | Podonominae | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - | - |
| | | *Polypedilum* | - | - | 0.8 | 2.2 | - | 0.8 | 4.7 | 11.3 | - | 0.9 | 5.4 | 0.8 | - | 5.9 |
| | | *Pseudorthocladius* | - | - | - | 1.1 | - | - | - | - | - | - | - | - | - | - |
| | | *Micropsectra* | - | 10.4 | 3.9 | - | - | 2.5 | 0.9 | - | - | 0.9 | - | - | - | 1.7 |
| | | *Microtendipes* | - | - | 2.4 | - | - | - | - | - | 0.9 | - | 4.5 | - | - | 0.8 |
| | | Orthocladiinae | - | - | *3.1 | - | *0.9 | - | - | - | - | *2.6 | *0.9 | - | *1.7 | - |
| | | *Orthocladius* | - | - | - | - | - | - | - | 0.9 | 1.8 | - | 0.9 | - | 0.9 | - |
| | | *Stenochironomus* | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | | *Stempellina* | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Stempellinella* | - | - | 3.9 | 1.1 | - | - | - | 0.9 | 3.5 | 3.5 | 10.7 | - | - | 6.7 |
| | | *Sympotthastia* | - | 0.8 | - | 1.1 | - | - | - | - | 0.9 | 0.9 | - | - | 0.9 | 21.8 |
| | | Tanytarsini | - | - | *2.4 | - | - | - | *0.9 | - | - | - | - | - | - | - |
| | | *Tanytarsus* | 1.7 | - | - | - | - | - | - | 5.7 | - | - | - | - | - | 1.7 |
| | | *Thienemanniella* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | 0.8 |
| | | Thienemannimyia Group | - | - | - | *1.1 | - | - | - | *3.8 | - | - | - | - | - | - |
| | | *Tvetenia* | - | - | 0.8 | - | - | - | 0.9 | 0.9 | - | 4.4 | 0.9 | - | - | 0.8 |
| | | *Zavrelimyia* | 0.8 | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | Empididae | *Chelifera* | - | 1.6 | - | - | - | - | 0.9 | 0.9 | - | - | - | - | - | - |
| | | *Clinocera* | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Simuliidae | *Prosimulium* | 52.9 | 1.6 | 8.7 | 10 | 3.6 | 25.4 | 16.8 | 9.4 | 32.7 | 15.8 | 5.4 | 64.5 | 76.7 | 32.8 |
| | | *Simulium* | 0.8 | - | - | - | - | - | - | 2.8 | - | - | - | - | - | - |
| | | *Stegopterna* | 1.7 | - | - | - | - | - | - | - | - | - | - | 2.6 | - | 0.8 |
| | Tipulidae | na | - | - | - | - | *0.9 | - | - | *0.9 | - | - | - | - | - | - |
| | | *Dicranota* | - | 1.6 | - | 1.1 | - | 1.7 | - | 0.9 | - | - | - | - | - | - |
| | | *Hexatoma* | - | 1.6 | 6.3 | 7.8 | 1.8 | - | 4.7 | 0.9 | 0.9 | - | 1.8 | 0.9 | 0.9 | 0.8 |
| | | *Tipula* | - | - | 0.8 | - | - | - | 2.8 | 0.9 | - | - | 0.9 | - | 0.9 | 0.8 |
| Ephemeroptera | Ameletidae | *Ameletus* | - | - | - | - | - | - | - | - | - | 1.8 | 3.6 | - | - | - |
| (Mayfly) | Baetidae | na | *2.5 | *3.2 | *0.8 | - | *3.6 | - | - | *0.9 | *2.7 | - | *0.9 | - | - | - |
| | | *Acentrella* | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Baetis* | - | - | - | 27.8 | 6.3 | 2.5 | - | 0.9 | - | - | - | - | - | - |
| | | ***Diphetor***[+] | - | - | - | - | - | - | - | 1.9 | - | 2.6 | - | - | - | - |
| | | *Plauditus* | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | Ephemerellidae | na | - | *5.6 | - | - | *6.3 | - | - | - | *3.5 | *6.1 | *0.9 | - | - | - |
| | | *Drunella* | - | - | - | - | 1.8 | - | - | - | - | - | - | - | - | - |
| | | *Ephemerella* | 7.4 | 3.2 | 8.7 | 6.7 | 5.4 | 6.8 | 1.9 | 2.8 | - | - | 1.8 | 0.8 | 0.9 | 0.8 |
| | | *Eurylophella* | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - |
| | | *Serratella* | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | Ephemeridae | *Ephemera*[+] | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| | Heptageniidae | na | - | *2.4 | - | - | *4.5 | - | *0.9 | *1.9 | *1.8 | *3.5 | - | - | - | - |
| | | ***Cinygmula***[+] | - | - | - | - | - | - | - | - | 3.5 | - | - | - | - | - |
| | | ***Epeorus***[+] | 1.7 | 9.6 | 6.3 | - | 18.8 | 11.9 | 24.3 | 6.6 | 10.6 | 13.2 | 6.3 | 13.2 | 6.9 | - |
| | | *Leucrocuta* | - | 0.8 | - | - | - | - | - | 0.9 | - | 1.8 | 2.7 | - | - | - |
| | | *Maccaffertium* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | 1.7 | - |
| | | *Stenacron* | - | - | 0.8 | - | - | - | - | - | 1.8 | 0.9 | - | - | - | - |
| | | *Stenonema* | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - |
| | Isonychiidae | *Isonychia* | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | Leptophlebiidae | na | - | - | *10.2 | - | *1.8 | *4.2 | *5.6 | *1.9 | *0.9 | *4.4 | *8 | *2.5 | - | *0.8 |
| | | ***Paraleptophlebia***[+] | 3.3 | 6.4 | - | 13.3 | - | - | - | - | 5.3 | 0.9 | 1.8 | - | - | - |
| Megaloptera | Corydalidae | *Nigronia* | 0.8 | 1.6 | 1.6 | - | - | - | - | - | - | - | - | - | - | - |
| (Dobsonfly/Fishfly) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Odonata | Gomphidae | na | *0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Dragonfly/Damselfly) | | *Lanthus* | - | - | 1.6 | - | - | - | - | - | - | - | - | - | - | - |
| Plecoptera | na | na | - | - | *1.6 | - | - | - | - | - | - | - | - | - | - | - |
| (Stonefly) | Capniidae | *Paracapnia* | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | Chloroperlidae | na | *0.8 | - | *0.8 | *2.2 | *3.6 | - | *6.5 | *0.9 | - | *0.9 | - | *0.8 | - | - |
| | | ***Sweltsa***[+] | 0.8 | 0.8 | 6.3 | 4.4 | 2.7 | 0.8 | 12.1 | 4.7 | 2.7 | 2.6 | 2.7 | 0.8 | 2.6 | 4.2 |
| | Leuctridae | na | - | *1.6 | - | - | - | - | - | *14.2 | - | - | - | - | - | - |
| | | ***Leuctra***[+] | 1.7 | - | 1.6 | 3.3 | 6.3 | 0.8 | - | - | - | 0.9 | 1.8 | - | - | - |
| | Nemouridae | na | *0.8 | - | - | - | - | - | - | - | - | *0.9 | *0.9 | *1.7 | - | *0.8 |
| | | *Amphinemura* | 3.3 | 1.6 | 0.8 | - | 6.3 | - | - | - | 4.4 | 2.6 | - | 1.7 | - | - |
| | | *Prostoia* | - | - | - | - | - | - | - | - | - | - | - | 0.8 | 0.9 | - |
| | Peltoperlidae | ***Tallaperla***[+] | - | - | 1.6 | - | - | - | - | - | - | - | - | - | - | - |
| | Perlidae | na | - | - | *0.8 | - | *0.9 | *0.8 | - | *2.8 | *1.8 | - | *1.8 | *0.8 | - | *1.7 |
| | | *Acroneuria* | - | - | 3.1 | 1.1 | - | 0.8 | 0.9 | 1.9 | - | 2.6 | 2.7 | - | - | 0.8 |
| | Perlodidae | na | - | *1.6 | *0.8 | - | *2.7 | *0.8 | - | *0.9 | - | - | - | - | *0.9 | - |
| | | *Isoperla* | 1.7 | 0.8 | - | 3.3 | - | 0.8 | 2.8 | - | 0.9 | 1.8 | 2.7 | - | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pteronarcyidae | *Pteronarcys* | - | 2.4 | - | - | 2.7 | 1.7 | - | - | 1.8 | 0.9 | 0.9 | 0.8 | - | 1.7 |
| | Taeniopterygidae | na | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - |
| | | *Oemopteryx* | - | - | 0.8 | 1.1 | - | 0.8 | - | - | - | - | - | - | - | - |
| | | *Taenionema* | - | - | - | - | - | - | - | - | 0.9 | - | 0.9 | 1.7 | - | 3.4 |
| | | *Taeniopteryx* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 |
| Trichoptera (Caddisfly) | Hydropsychidae | *Cheumatopsyche* | - | - | - | - | 0.9 | - | - | - | - | 0.9 | - | - | - | - |
| | | ***Diplectrona***[+] | 0.8 | 4 | 3.1 | 1.1 | 3.6 | 3.4 | 0.9 | 1.9 | - | 0.9 | 5.4 | 0.8 | 0.9 | 3.4 |
| | | *Hydropsyche* | - | - | 0.8 | 1.1 | - | 0.8 | - | - | 0.9 | - | - | - | 1.7 | - |
| | Limnephilidae | *Pycnopsyche* | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | Philopotamidae | *Dolophilodes* | 0.8 | 1.6 | 0.8 | - | - | - | 0.9 | - | - | - | 0.9 | - | - | - |
| | | ***Wormaldia***[+] | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | Polycentropodidae | *Polycentropus* | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | Rhyacophilidae | *Rhyacophila* | 0.8 | 0.8 | 3.1 | 1.1 | 1.8 | - | - | - | - | 0.9 | 0.9 | - | - | - |
| | Uenoidae | *Neophylax* | - | 1.6 | 0.8 | - | - | - | - | 0.9 | - | - | 0.9 | 1.7 | - | - |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).
* Taxa not identified to genus
[+] Coldwater-preference genera

# *Crabtree Creek (SAVA-204-S)*

Site SAVA-204-S is located on Crabtree Creek in the Highlands region of Maryland. It is in the Savage River watershed in Garrett County. This site was sampled in 2000 to 2014.

*Crabtree Creek in spring 2013.*

## ***Land Use/ Land Cover***

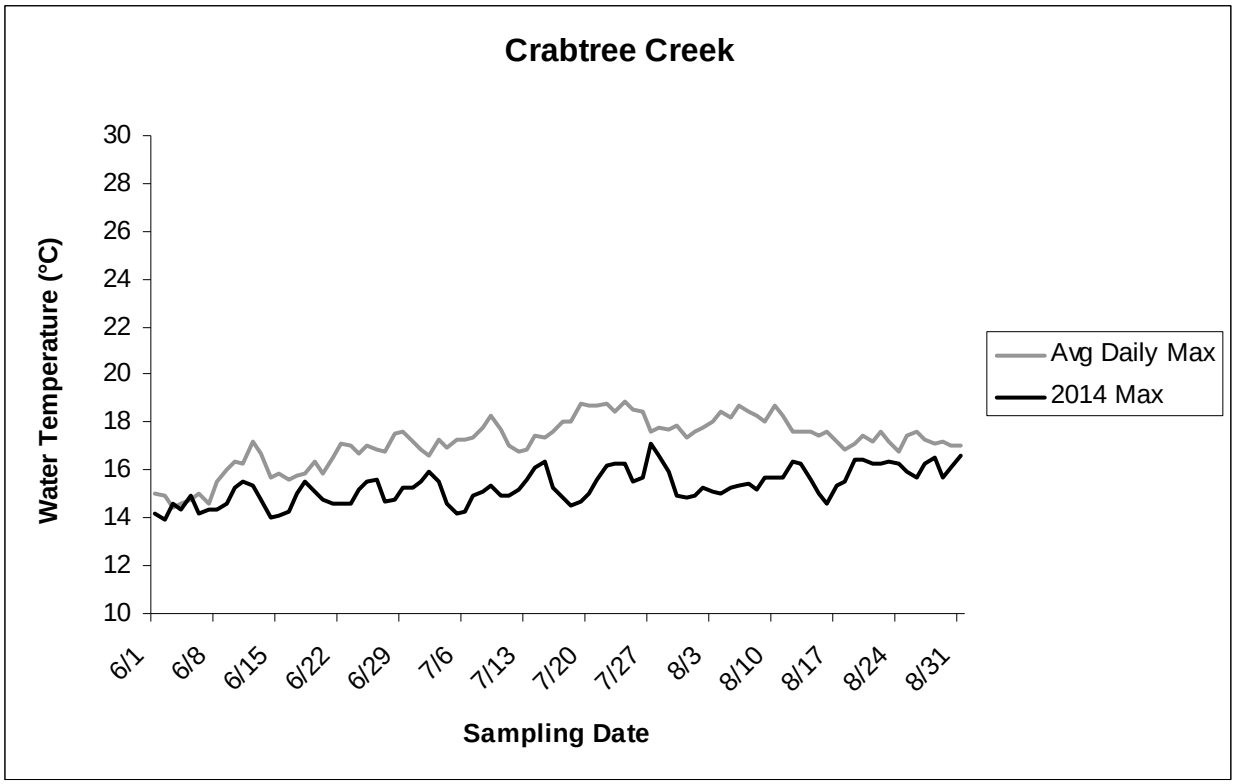
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 22.83 | 84.19 | 84.23 |
| Agriculture | 0.37 | 9.36 | 9.33 |
| Urban | 29.10 | 6.07 | 6.05 |
| Other | 47.70 | 0.38 | 0.38 |

## ***Physical Habitat***

Physical habitat measurements collected at Crabtree Creek (2000 to 2014). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 20 | 19 | 19 | 20 | 18 | 17 | 18 | 19 | 18 | 18 | 19 | 20 | 15 | 18 | 19 |
| Epifaunal substrate (0-20) | 19 | 18 | 16 | 20 | 17 | 17 | 18 | 18 | 18 | 18 | 19 | 19 | 18 | 19 | 19 |
| Velocity/Depth Diversity (0-20) | 15 | 17 | 15 | 17 | 16 | 15 | 17 | 20 | 17 | 17 | 20 | 20 | 14 | 19 | 17 |
| Pool Quality (0-20) | 17 | 18 | 18 | 18 | 18 | 16 | 16 | 18 | 17 | 15 | 17 | 18 | 15 | 18 | 17 |
| Riffle Quality (0-20) | 17 | 18 | 18 | 19 | 18 | 16 | 19 | 20 | 19 | 19 | 20 | 19 | 15 | 19 | 17 |
| Shading (%) | 75 | 85 | 85 | 75 | 91 | 90 | 92 | 92 | 80 | 85 | 90 | 85 | 65 | 65 | 75 |
| Embeddedness (%) | 15 | 15 | 20 | 10 | 30 | 20 | 20 | 20 | 15 | 0 | 5 | 5 | 15 | 5 | 5 |
| Discharge (cfs) | 3.74 | 5.38 | 3.15 | 8.22 | 3.80 | 2.04 | 7.16 | 7.96 | 7.38 | 3.80 | 4.17 | 4.35 | 2.68 | 5.73 | 5.08 |




The above graph displays the average daily maximum temperatures recorded at Crabtree Creek. The average was calculated from six years of data.

***Biology***

*Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 4.25 | 4.75 | 4.50 | 4.25 | 3.00 | 4.25 | 4.25 | 4.75 | 4.75 | 4.00 | 4.25 | 4.25 | 4.00 | 4.50 | 4.00 |
| FIBI | 4.50 | 4.50 | 4.50 | 4.00 | 4.00 | 4.00 | 4.50 | 4.00 | 4.50 | 4.50 | 4.33 | 4.00 | 4.00 | 4.00 | 4.50 |

## *Fish*

Cumulative list of fish species (with abundance) collected in Crabtree Creek by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Blue Ridge sculpin | 108 | 169 | 112 | 59 | 44 | 167 | 87 | 97 | 188 | 141 | 70 | 121 | 51 | 69 | 78 |
| Bluntnose minnow | - | - | - | - | 3 | 1 | - | - | - | - | - | - | - | - | - |
| Brook trout | 11 | 170 | 95 | 29 | 22 | 51 | 34 | 36 | 25 | 27 | 27 | 17 | 14 | 30 | - |
| Brown trout | 1 | 2 | 1 | - | 1 | 1 | - | - | - | - | - | - | - | - | - |
| Central stoneroller | - | - | - | - | 1 | 1 | - | - | - | 17 | - | 3 | - | - | - |
| Common shiner | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - |
| Creek chub | - | - | 2 | - | - | 1 | 3 | - | - | 5 | 2 | 5 | 6 | 12 | 3 |
| Cutlips minnow | - | - | - | - | - | - | 1 | - | - | - | - | 1 | 3 | - | - |
| Eastern blacknose dace | 18 | 44 | 44 | 53 | 32 | 33 | 10 | 15 | 28 | 19 | 56 | 34 | 47 | 47 | 15 |
| Fantail darter | 37 | 31 | 13 | 51 | 14 | 24 | 16 | 44 | 57 | 24 | 21 | 51 | 100 | 92 | 43 |
| Golden shiner | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - |
| Longnose dace | 41 | 18 | 30 | 43 | 48 | 58 | 25 | 48 | 72 | 51 | 64 | 61 | 60 | 47 | 15 |
| Potomac sculpin | - | - | - | 1 | 1 | 1 | 2 | 6 | 2 | - | - | 1 | - | 1 | - |
| Pumpkinseed | - | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - |
| Rainbow trout | - | - | - | - | 1 | - | - | - | - | - | - | - | - | 1 | 4 |
| Rock bass | - | - | - | 37 | 36 | 55 | 27 | 26 | 21 | 4 | 12 | 10 | 21 | 28 | 13 |
| Rosyside dace | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| Smallmouth bass | - | - | - | - | - | - | - | - | - | - | - | 3 | - | 2 | 1 |
| Tessellated darter | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - |
| White sucker | 12 | - | 2 | 7 | 1 | 3 | 3 | 1 | 2 | 8 | 6 | 7 | 4 | 11 | 3 |
| Yellow perch | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

## *Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in Crabtree Creek by sampling year

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Common crayfish (*Cambarus bartonii bartonii*) | P | P | P | P | P | P | P | P | P |

## *Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in Crabtree Creek by sampling year.

| *Species* |
|---|
| None Observed |

## *Herpetofauna*

Cumulative list of herpetofauna species collected in or near Crabtree Creek.

| *Order (Common)* | *Species* |
|---|---|
| Caudata (Salamanders and Newts) | Allegheny mountain dusky salamander, Eastern red-spotted newt, Northern dusky salamander, Northern spring salamander, Northern two-lined salamander, Long-tailed salamander, Seal salamander |
| Squamata (Snakes and Lizards) | Northern ring-necked snake, Northern watersnake |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in Crabtree Creek by sampling year, RA = %Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | |
| Haplotaxida | Naididae | na | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| Lumbriculida | Lumbriculidae | na | - | - | *1.8 | - | - | - | *0.9 | *0.9 | - | *0.8 | - | *0.9 | - | - | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | |
| Coleoptera (Beetle) | Elmidae | na | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Oulimnius* | 1.6 | 0.9 | 15.2 | 1.6 | - | 3.5 | - | 2.8 | 3.8 | 6.3 | 4.5 | - | 1.9 | 1.7 | 1.4 |
| | Psephenidae | *Psephenus* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | 0.9 | 0.9 | - |
| Decapoda (Crayfish) | Cambaridae | na | - | - | - | - | - | *0.9 | - | - | - | *0.8 | - | - | - | - | - |
| | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Diptera (True Fly) | Blephariceridae | *Blepharicera* | - | - | - | 1.6 | - | - | 0.9 | 1.9 | - | - | - | - | 1.9 | - | - |
| | Ceratopogonidae | *Ceratopogon* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.7 |
| | | *Probezzia* | 0.8 | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - |
| | Chironomidae | *Brillia* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.7 |
| | | *Corynoneura* | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - |
| | | *Cryptochironomus* | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Diamesa* | 8.1 | - | - | 0.8 | 29.7 | - | 3.4 | - | 1.5 | 7.9 | - | 5.2 | - | - | - |
| | | Diamesinae | - | - | - | - | *3.4 | - | - | - | *0.8 | - | - | - | - | - | - |
| | | *Eukiefferiella* | - | 1.8 | - | 2.4 | 2.5 | - | - | - | 2.3 | 1.3 | - | 0.9 | - | - | - |
| | | *Heterotrissocladius* | - | - | 1.8 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Micropsectra* | 3.2 | - | 17.9 | - | - | - | 7.8 | 25.5 | 3.8 | 1.6 | - | - | - | 3.4 | 45.5 |
| | | *Microtendipes* | - | - | - | - | 1.7 | - | - | - | - | 0.8 | - | 2.6 | - | - | - |
| | | Orthocladiinae | *1.6 | - | - | *1.6 | *0.8 | - | *3.4 | - | *1.5 | - | - | - | - | - | - |
| | | *Orthocladius* | 1.6 | - | - | - | - | - | 0.9 | 0.9 | 1.5 | 3.2 | - | 1.7 | - | 3.4 | 0.7 |
| | | *Parachaetocladius* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.7 |
| | | *Parametriocnemus* | 4.8 | 0.9 | 2.7 | - | 2.5 | 1.7 | 4.3 | - | 0.8 | 3.2 | - | 7.8 | - | 3.4 | 1.4 |
| | | *Paraphaenocladius* | - | - | - | - | - | - | - | - | - | 5.6 | - | 1.7 | - | - | 0.7 |
| | | *Polypedilum* | 0.8 | - | - | 2.4 | 0.8 | - | 5.2 | - | 3.8 | 0.8 | 0.9 | 3.4 | - | - | - |
| | | *Rheocricotopus* | - | - | - | - | - | - | - | - | 0.8 | 0.8 | - | - | - | - | - |
| | | *Stempellinella* | - | - | - | - | - | - | 1.7 | - | - | - | - | - | - | - | - |
| | | *Stilocladius* | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - |
| | | *Sympotthastia* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| | | Tanytarsini | *1.6 | *4.5 | - | - | - | - | - | - | *0.8 | - | - | - | - | - | - |
| | | *Tanytarsus* | - | - | - | - | - | - | 0.9 | - | - | 0.8 | - | 0.9 | - | - | - |
| | | *Thienemanniella* | - | - | - | 0.8 | - | - | - | - | 0.8 | - | - | 0.9 | - | - | - |
| | | Thienemannimyia Group | - | - | - | *2.4 | - | - | *6 | *0.9 | *0.8 | - | - | *0.9 | - | - | *0.7 |
| | | *Tvetenia* | - | - | 0.9 | - | - | - | 0.9 | 0.9 | - | 3.2 | 0.9 | 6.9 | - | 0.9 | 3.4 |
| | | *Zavrelimyia* | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - |
| | Dixidae | ***Dixa***[+] | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Empididae | na | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Chelifera* | - | 0.9 | 0.9 | - | - | - | 1.7 | - | - | - | - | - | - | - | - |
| | | *Clinocera* | - | 0.9 | - | - | - | - | 0.9 | - | 1.5 | - | - | - | - | - | - |
| | Simuliidae | na | - | - | - | *0.8 | - | - | *0.9 | - | - | - | - | - | - | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Prosimulium* | 1.6 | 0.9 | - | - | - | 0.9 | 0.9 | 1.9 | 1.5 | 0.8 | - | 0.9 | 0.9 | 2.6 | - |
| | | *Simulium* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| | Tipulidae | *Antocha* | - | 0.9 | - | - | - | - | 0.9 | 0.9 | - | - | - | - | - | 1.7 | - |
| | | *Dicranota* | 0.8 | - | - | 0.8 | - | - | 1.7 | - | - | - | - | - | - | - | - |
| | | *Hexatoma* | 0.8 | - | - | - | - | 1.7 | - | - | - | - | - | 1.7 | - | 0.9 | - |
| | | *Ormosia* | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Tipula* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| Ephemeroptera | Ameletidae | *Ameletus* | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Mayfly) | Baetidae | na | *4 | *0.9 | *0.9 | *15.1 | - | - | - | *2.8 | - | *1.6 | - | - | - | - | *0.7 |
| | | *Acentrella* | 1.6 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Baetis* | 2.4 | 0.9 | 0.9 | - | 6.8 | 3.5 | 1.7 | - | 5.4 | - | 9.9 | 0.9 | 24.1 | - | - |
| | | ***Diphetor***[+] | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | 0.9 | - |
| | | *Fallceon* | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - |
| | Ephemerellidae | na | - | *2.7 | *1.8 | 20.6 | - | - | *4.3 | *0.9 | *1.5 | *4 | *9.9 | *3.4 | *1.9 | *0.9 | *0.7 |
| | | *Drunella* | - | - | - | - | - | - | - | 1.9 | - | - | - | - | - | - | - |
| | | *Ephemerella* | 21 | 7.1 | 9.8 | 7.1 | 8.5 | 13.9 | - | 4.7 | 10.8 | 3.2 | 16.2 | 5.2 | 10.2 | - | 7.6 |
| | Heptageniidae | na | - | *9.8 | *1.8 | *2.4 | - | - | - | - | - | - | - | - | - | - | - |
| | | ***Cinygmula***[+] | 5.6 | - | - | - | - | 6.1 | - | - | 3.1 | 2.4 | 2.7 | - | 5.6 | - | 0.7 |
| | | ***Epeorus***[+] | 4.8 | 18.8 | 13.4 | 13.5 | 10.2 | 18.3 | 14.7 | 12.3 | 10.8 | 11.9 | 26.1 | 14.7 | 21.3 | 34.2 | 7.6 |
| | | *Leucrocuta* | - | - | - | - | - | - | - | 0.9 | 2.3 | - | - | - | - | - | - |
| | | *Maccaffertium* | - | - | - | - | - | - | - | - | 0.8 | 1.6 | - | 1.7 | 0.9 | - | - |
| | | *Rhithrogena* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| | | *Stenonema* | - | 0.9 | 0.9 | 0.8 | - | - | - | 1.9 | - | - | - | - | - | - | - |
| | Isonychiidae | *Isonychia* | 0.8 | - | - | 0.8 | - | 0.9 | 0.9 | - | - | - | - | - | 1.9 | 1.7 | - |
| | Leptophlebiidae | na | - | *2.7 | *3.6 | *2.4 | *5.9 | *9.6 | *6 | *9.4 | *6.9 | *4.8 | *3.6 | *4.3 | *2.8 | *4.3 | *4.8 |
| | | ***Habrophlebia***[+] | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | | ***Paraleptophlebia***[+] | 4 | 1.8 | 3.6 | 1.6 | 0.8 | 3.5 | 1.7 | 1.9 | 3.1 | 3.2 | 3.6 | 5.2 | 0.9 | - | - |
| Megaloptera | Corydalidae | *Nigronia* | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| (Dobsonfly/Fishfly) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Odonata | Gomphidae | na | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - | - | - |
| (Dragonfly/Damselfly) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Plecoptera | Capniidae | *Paracapnia* | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Stonefly) | Chloroperlidae | na | *4 | *6.3 | *0.9 | *1.6 | *10.2 | *15.7 | - | *0.9 | *0.8 | *0.8 | *2.7 | *1.7 | *5.6 | - | *1.4 |
| | | ***Alloperla***[+] | - | - | 0.9 | - | - | - | - | 0.9 | - | - | - | - | - | - | - |
| | | *Haploperla* | - | - | - | - | - | - | 3.4 | - | 2.3 | - | - | 0.9 | - | - | - |
| | | ***Sweltsa***[+] | - | - | - | 0.8 | - | 0.9 | 0.9 | - | - | 1.6 | 1.8 | 0.9 | - | 0.9 | 0.7 |
| | Leuctridae | na | - | *5.4 | *4.5 | *4 | *5.9 | - | - | *10.4 | *13.1 | *5.6 | - | *0.9 | - | - | *3.4 |
| | | ***Leuctra***[+] | 1.6 | - | 1.8 | - | - | - | 0.9 | - | 0.8 | - | - | - | 0.9 | - | - |
| | Nemouridae | *Amphinemura* | 2.4 | 1.8 | - | 3.2 | 1.7 | - | 0.9 | 4.7 | 0.8 | 0.8 | 1.8 | 0.9 | 0.9 | 0.9 | - |
| | | *Prostoia* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - |
| | Perlidae | na | - | - | - | - | - | - | *1.7 | *0.9 | - | *0.8 | *0.9 | - | - | *2.6 | *0.7 |
| | | *Acroneuria* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | Perlodidae | na | *3.2 | *9.8 | *0.9 | *0.8 | - | *0.9 | - | - | *0.8 | *0.8 | *1.8 | - | *1.9 | - | - |
| | | *Isoperla* | - | 5.4 | 1.8 | - | 2.5 | 7 | 6 | - | 1.5 | 6.3 | 2.7 | - | 1.9 | 5.1 | 2.1 |
| | Pteronarcyidae | *Pteronarcys* | 2.4 | 1.8 | - | 0.8 | - | - | 0.9 | - | - | 0.8 | 0.9 | - | - | 0.9 | - |
| | Taeniopterygidae | na | - | - | - | - | - | - | - | - | - | - | - | - | *0.9 | - | *4.1 |
| | | *Oemopteryx* | 0.8 | 7.1 | 6.3 | - | - | 0.9 | 6.9 | 1.9 | - | - | - | - | - | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Taenionema* | - | - | - | - | - | - | - | - | 0.8 | 2.4 | 0.9 | 10.3 | - | 17.9 | 0.7 |
| | | *Taeniopteryx* | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | 0.7 |
| Trichoptera | Glossomatidae | *Glossosoma* | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.7 | - |
| (Caddisfly) | Hydropsychidae | na | - | - | *0.9 | - | - | *0.9 | - | - | - | - | - | *0.9 | - | - | - |
| | | *Ceratopsyche* | - | - | - | - | - | - | - | - | - | 3.2 | 3.6 | - | - | - | - |
| | | *Cheumatopsyche* | 2.4 | - | - | - | - | - | - | 0.9 | 2.3 | 2.4 | - | 3.4 | 4.6 | 0.9 | 0.7 |
| | | ***Diplectrona***[+] | - | - | - | - | 0.8 | - | - | - | - | - | 0.9 | 0.9 | - | 0.9 | 0.7 |
| | | *Hydropsyche* | 8.9 | 1.8 | 0.9 | 1.6 | 2.5 | 7.8 | 3.4 | 2.8 | 3.1 | - | 0.9 | 4.3 | 6.5 | 2.6 | 3.4 |
| | Philopotamidae | *Dolophilodes* | - | - | 1.8 | - | - | - | - | - | - | - | - | 0.9 | - | 0.9 | 2.1 |
| | | ***Wormaldia***[+] | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Polycentropodidae | na | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - | - | - |
| | | *Polycentropus* | | | | | | | | 0.9 | - | - | - | - | - | - | - |
| | Rhyacophilidae | *Rhyacophila* | - | 0.9 | 0.9 | 4 | 0.8 | 0.9 | - | - | - | - | 0.9 | - | 0.9 | 3.4 | 0.7 |
| | Uenoidae | *Neophylax* | - | - | - | - | - | - | 0.9 | - | 0.8 | 1.6 | - | - | 0.9 | - | 0.7 |
| PHYLUM NEMERTEA | | | | | | | | | | | | | | | | | |
| Hoplonemertea | Tetrastemmatidae | *Prostoma* | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| (Worm) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).
* Taxa not identified to genus
[+] Coldwater-preference genera

# *Double Lick Run (SAVA-276-S)*

Site SAVA-276-S is located on Double Lick Run in the Highlands region of Maryland. It is in the Savage River watershed in Garrett County. This site was sampled in 1996 and 2000 to 2014..



*Double Lick Run in the spring 2013.*

## ***Land Use/ Land Cover***

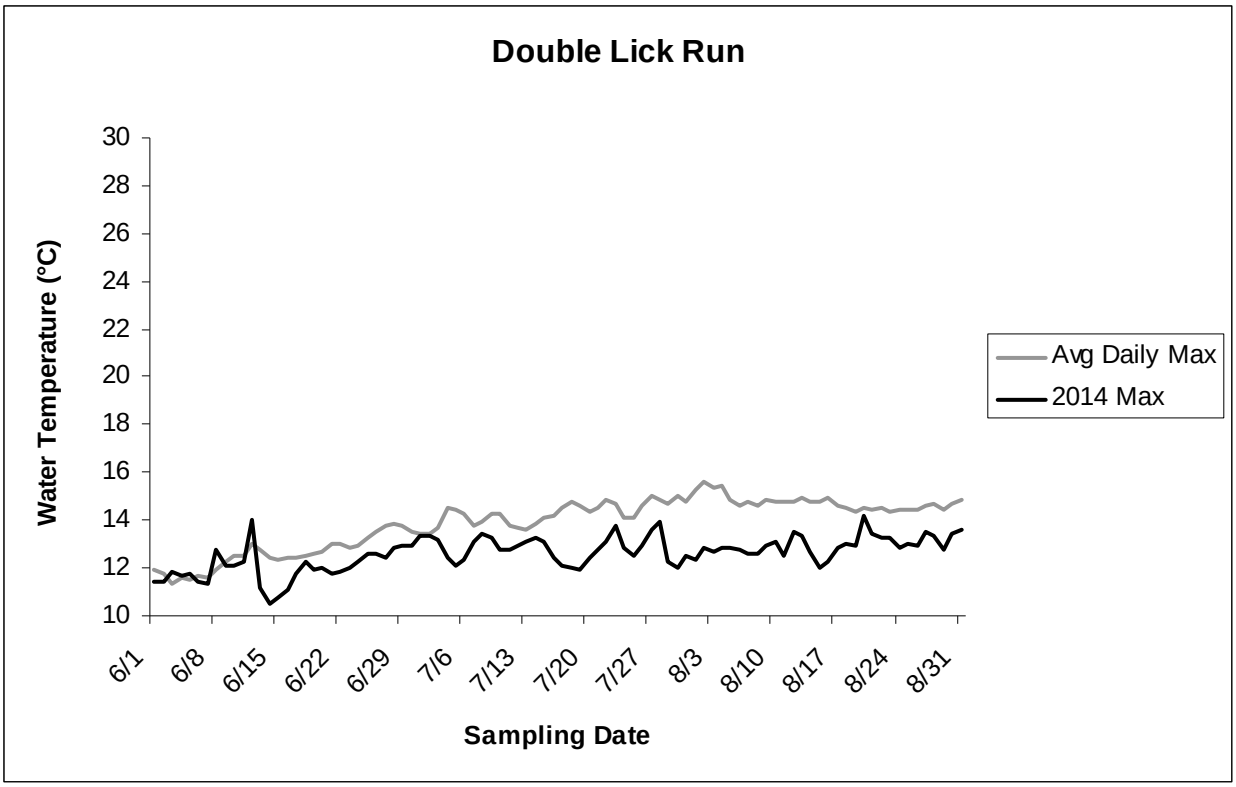
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 91.40 | 91.59 | 89.76 |
| Agriculture | 0.00 | 7.17 | 6.94 |
| Urban | 1.18 | 1.18 | 0.86 |
| Other | 7.43 | 0.06 | 2.45 |

## ***Physical Habitat***

Physical habitat measurements collected at Double Lick Run (2000 to 2014). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 16 | 16 | 14 | 17 | 12 | 12 | 11 | 18 | 17 | 16 | 18 | 18 | 14 | 9 | 9 |
| Epifaunal substrate (0-20) | 18 | 19 | 18 | 19 | 15 | 15 | 16 | 17 | 18 | 18 | 19 | 19 | 18 | 17 | 17 |
| Velocity/Depth Diversity (0-20) | 10 | 13 | 10 | 15 | 10 | 7 | 8 | 10 | 10 | 10 | 10 | 10 | 10 | 7 | 9 |
| Pool Quality (0-20) | 10 | 15 | 10 | 16 | 10 | 9 | 7 | 10 | 10 | 10 | 10 | 10 | 9 | 7 | 7 |
| Riffle Quality (0-20) | 9 | 15 | 10 | 17 | 13 | 10 | 11 | 16 | 15 | 14 | 15 | 15 | 15 | 11 | 8 |
| Shading (%) | 98 | 93 | 95 | 98 | 96 | 95 | 95 | 95 | 90 | 85 | 90 | 85 | 85 | 95 | 95 |
| Embeddedness (%) | 10 | 15 | 20 | 15 | 30 | 25 | 20 | 40 | 25 | 15 | 5 | 5 | 10 | 25 | 10 |
| Discharge (cfs) | 0.36 | 0.20 | 0.07 | 0.64 | 1.12 | 0.16 | 0.10 | 0.15 | 0.36 | 0.20 | 0.16 | 0.6 | 0.31 | 0.46 | 0.17 |




The graph above displays the average daily maximum temperatures recorded at Double Lick Run. The average was calculated from nine years of data.

## ***Biology***

*Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 4.50 | 4.25 | 4.50 | 3.75 | 3.75 | 4.00 | 4.25 | 4.25 | 4.25 | 4.50 | 4.50 | 4.00 | 4.25 | 4.00 | 4.00 |
| FIBI | 4.50 | 4.50 | 4.50 | 4.50 | 4.00 | 4.50 | 5.00 | 4.50 | 5.00 | 5.00 | 4.50 | 4.50 | 4.5 | 4.00 | 5.00 |

*Fish*

Cumulative list of fish species (with abundance) collected in Double Lick Run by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Blue Ridge sculpin | 16 | 19 | 16 | 19 | 19 | 9 | 18 | 13 | 20 | 17 | 6 | 23 | 17 | 29 | 5 |
| Brook trout | 32 | 59 | 44 | 67 | 152 | 53 | 7 | 19 | 9 | 11 | 8 | 3 | 22 | - | 5 |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

*Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in Double Lick Run by sampling year

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Common crayfish (*Cambarus bartonii bartonii*) | P | P | P | P | P | P | P | P | P |

*Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in Double Lick Run by sampling year.

| *Species* |
|---|
| None Observed |

*Herpetofauna*

Cumulative list of herpetofauna species collected in or near Double Lick Run.

| *Order (Common)* | *Species* |
|---|---|
| Caudata (Salamanders and Newts) | Allegheny mountain dusky salamander, Northern dusky salamander, Northern slimy salamander, Northern spring salamander, Northern two-lined salamander, Eastern red-spotted newt, Seal salamander |
| Squamata (Snakes and Lizards) | Eastern gartersnake, Northern red-bellied snake |
| Testudines (Turtles) | Eastern snapping turtle |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in Double Lick Run by sampling year, RA = %Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | |
| Lumbriculida | Lumbriculidae | na | - | *0.8 | *0.9 | *0.8 | *1.7 | - | - | - | *0.5 | *0.7 | - | - | *0.8 | - | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | |
| Amphipoda | na | na | - | - | - | - | - | - | - | - | *41.3 | - | *10.2 | - | - | - | - |
| (Scud) | Gammaridae | na | - | - | - | - | - | - | - | - | - | *1.5 | - | - | - | - | - |
| | | *Gammarus* | 5.2 | 10.1 | 27.5 | 16.7 | 21.5 | 19.8 | 6.7 | 6.1 | 5.3 | 8.2 | 5.6 | 28.9 | 14.4 | 17.4 | 26.4 |
| | Crangonyctidae | *Synurella* | - | - | - | - | - | 1.7 | - | - | - | - | - | - | - | - | - |
| Coleoptera | Elmidae | na | *0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Beetle) | | *Oulimnius* | - | - | - | - | 0.8 | - | 0.8 | - | - | - | - | - | - | - | - |
| Collembola | Isotomidae | *Isotomurus* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| (Springtail) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Decapoda | Cambaridae | na | - | - | - | - | - | - | - | *1 | - | - | - | - | - | - | - |
| (Crayfish) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Diptera | Ceratopogonidae | *Bezzia* | - | - | - | - | - | - | - | - | 0.5 | - | - | - | - | - | - |
| (True Fly) | | *Probezzia* | - | 0.8 | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| | Chironomidae | *Cladotanytarsus* | - | - | 0.9 | - | - | - | - | - | 0.5 | - | - | - | 0.8 | - | - |
| | | *Diamesa* | - | - | 0.9 | 4 | 1.7 | 6 | 1.7 | 2 | 0.5 | 1.5 | - | 0.8 | 0.8 | 0.9 | - |
| | | *Eukiefferiella* | 2.6 | - | - | - | 0.8 | - | 1.7 | - | 0.5 | - | 2.8 | 0.8 | - | - | - |
| | | *Micropsectra* | 0.9 | 3.4 | 3.7 | 2.4 | - | - | - | 1 | 0.5 | 1.5 | 2.8 | 2.5 | 1.7 | 4.3 | 0.8 |
| | | Orthocladiinae | *1.7 | - | - | - | - | - | - | - | - | - | - | - | - | *0.9 | *0.8 |
| | | *Orthocladius* | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - |
| | | *Parametriocnemus* | 0.9 | 1.7 | 0.9 | - | 0.8 | - | - | 1 | 0.5 | 1.5 | - | - | - | - | - |
| | | *Paraphaenocladius* | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - |
| | | *Paratanytarsus* | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - |
| | | *Polypedilum* | 5.2 | - | - | - | - | - | - | - | 0.5 | 0.7 | - | - | - | - | - |
| | | *Pseudorthocladius* | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Rheocricotopus* | - | - | - | - | - | - | 0.8 | - | - | 0.7 | - | - | - | - | - |
| | | *Stempellinella* | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Symposiocladius* | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | Tanypodinae | - | - | - | - | - | - | *0.8 | - | - | - | - | - | - | - | - |
| | | Tanytarsini | - | - | *1.8 | - | *0.8 | - | - | - | - | - | - | - | *0.8 | - | - |
| | | *Tanytarsus* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Thienemanniella* | - | - | - | - | - | - | - | - | 0.5 | 0.7 | - | - | - | - | - |
| | | Thienemannimyia Group | - | - | - | - | - | - | - | - | *0.5 | - | - | - | - | - | - |
| | | *Tvetenia* | - | - | - | 1.6 | - | - | - | - | - | - | 0.9 | - | - | 2.6 | - |
| | Empididae | *Chelifera* | 0.9 | - | - | - | - | 0.9 | - | 1 | - | - | - | 0.8 | - | - | - |
| | | *Neoplasta* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 |
| | Simuliidae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | - | *0.8 |
| | | *Prosimulium* | 0.9 | 0.8 | 1.8 | - | - | - | - | - | - | - | 1.9 | - | 0.8 | 2.6 | *0.8 |
| | | *Smulium* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - |
| | Tipulidae | na | - | - | *0.9 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Dicranota* | - | - | 1.8 | 1.6 | 0.8 | 2.6 | - | 1 | 0.5 | 2.2 | - | 1.7 | - | - | - |
| | | *Hexatoma* | 0.9 | - | 0.9 | 0.8 | - | - | - | 1 | 1.1 | - | - | - | - | 0.9 | 0.8 |
| Ephemeroptera | Ameletidae | *Ameletus* | - | 2.5 | 1.8 | 0.8 | - | - | 0.8 | 1 | 0.5 | - | 0.9 | - | - | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (Mayfly) | Baetidae | na | *0.9 | - | - | - | - | - | - | - | - | *1.5 | - | - | - | - | - |
| | | *Baetis* | - | - | 0.9 | - | 2.5 | 0.9 | - | - | 0.5 | - | - | - | - | - | 0.8 |
| | Ephemerellidae | na | - | - | - | - | - | - | *13.3 | *6.1 | - | - | *3.7 | - | - | - | - |
| | | *Ephemerella* | 5.2 | 19.3 | 1.8 | 24.6 | 34.7 | 25.9 | 5.8 | 12.2 | 3.7 | 6.7 | 13.9 | 7.4 | 22.9 | 22.6 | 13.2 |
| | | *Drunella* | 0.9 | - | - | - | 0.8 | 0.9 | 2.5 | 3.1 | - | 1.5 | 0.9 | - | 1.7 | - | 0.8 |
| | Heptageniidae | na | - | *8.4 | *0.9 | - | *0.8 | - | *3.3 | *1 | - | - | *0.9 | - | *0.8 | - | *0.8 |
| | | ***Cinygmula***[+] | 13.9 | - | 6.4 | - | - | 5.2 | 19.2 | 2 | 1.6 | 2.2 | 2.8 | 2.5 | 11.0 | 8.7 | 9.9 |
| | | ***Epeorus***[+] | 14.8 | 31.1 | 17.4 | 17.5 | 3.3 | 11.2 | 17.5 | 31.6 | 12.7 | 17.2 | 25 | 17.4 | 25.4 | 18.3 | 22.3 |
| | | *Heptagenia* | - | - | - | - | - | 0.9 | - | - | - | - | - | 0.8 | - | - | - |
| | | *Leucrocuta* | 2.6 | - | - | - | - | - | - | - | 1.1 | - | 0.9 | - | - | - | - |
| | | *Stenacron* | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - |
| | | *Stenonema* | - | - | 3.7 | - | - | - | - | - | - | - | - | - | - | - | - |
| | Leptophlebiidae | na | - | - | *4.6 | *0.8 | - | *1.7 | *3.3 | - | *4.8 | *6 | *3.7 | *5 | *1.7 | *3.5 | *2.5 |
| | | ***Paraleptophlebia***[+] | 8.7 | 3.4 | - | 0.8 | - | 1.7 | 2.5 | - | 1.1 | 0.7 | - | 6.6 | 2.5 | - | - |
| Isopoda | Asselidae | ***Caecidotea*** | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - |
| (Aquatic Sow Bug) | | | - | - | - | - | - | | - | - | - | - | - | - | - | - | - |
| Odonata | Gomphidae | na | - | - | - | - | - | - | - | - | - | - | - | - | *0.8 | - | - |
| Plecoptera | Chloroperlidae | na | - | - | - | *2.4 | *3.3 | *2.6 | - | *6.1 | *1.1 | - | *0.9 | *2.5 | *2.5 | *0.9 | *1.7 |
| (Stonefly) | | ***Alloperla***[+] | - | - | 3.7 | - | 0.8 | - | - | - | - | - | - | - | - | - | - |
| | | *Haploperla* | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - |
| | | ***Sweltsa***[+] | 2.6 | - | 1.8 | - | - | - | - | - | - | - | 0.9 | - | 0.8 | - | - |
| | Leuctridae | na | - | *4.2 | *0.9 | - | - | - | - | - | *5.8 | - | - | - | - | - | *0.8 |
| | | ***Leuctra***[+] | 14.8 | - | 1.8 | 9.5 | 9.9 | 4.3 | 10.8 | 6.1 | 7.4 | 26.1 | 1.9 | 9.1 | - | 3.5 | 5 |
| | | *Paraleuctra* | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - |
| | Nemouridae | na | - | - | - | *0.8 | - | - | - | - | - | - | - | - | *0.8 | *0.9 | - |
| | | *Amphinemura* | 7.8 | 6.7 | 0.9 | 4.8 | 1.7 | 1.7 | 0.8 | 5.1 | 1.1 | 6 | 5.6 | 4.1 | 5.9 | - | 0.8 |
| | | *Ostrocerca* | - | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - |
| | Peltoperlidae | na | - | - | - | - | - | - | - | - | *0.5 | *0.7 | - | - | - | - | - |
| | | ***Tallaperla***[+] | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Perlodidae | na | *1.7 | *1.7 | *0.9 | *3.2 | *2.5 | *6 | *0.8 | *1 | - | *1.5 | - | *0.8 | *0.8 | *1.7 | *2.5 |
| | | *Isoperla* | - | - | - | - | - | - | - | 1 | - | - | - | - | - | 0.9 | - |
| | | *Malirekus* | - | - | - | - | 5 | 0.9 | - | - | - | - | - | - | - | 0.9 | 4.1 |
| | | *Yugus* | - | - | - | - | - | - | - | - | 1.6 | 2.2 | 3.7 | - | - | - | - |
| | Pteronarcyidae | *Pteronarcys* | 1.7 | 1.7 | 0.9 | - | 0.8 | 0.9 | 2.5 | 5.1 | - | 3.7 | 5.6 | 3.3 | 0.8 | 3.5 | 1.7 |
| Trichoptera | Calamoceratidae | *Heteroplectron* | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - |
| (Caddisfly) | Hydropsychidae | na | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Cheumatopsyche* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | ***Diplectrona***[+] | 0.9 | - | 0.9 | 1.6 | - | - | - | - | 1.1 | 0.7 | 0.9 | 2.5 | - | 0.9 | - |
| | | *Hydropsyche* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Parapsyche* | - | - | - | - | 0.8 | - | - | 1 | - | - | - | - | 0.8 | - | - |
| | Lepidostomatidae | *Lepidostoma* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | 0.8 |
| | Limnephilidae | *Pycnopsyche* | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Philopotamidae | na | - | - | - | *0.8 | - | - | - | - | *0.5 | - | - | - | - | - | - |
| | | *Dolophilodes* | - | - | 0.9 | - | - | 0.9 | - | - | - | 0.7 | - | - | - | - | - |
| | | ***Wormaldia***[+] | - | - | 0.9 | - | 0.8 | - | - | 1 | - | - | 0.9 | - | - | - | - |
| | Psychomyiidae | *Lype* | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - |
| | Rhyacophilidae | *Rhyacophila* | 0.9 | 0.8 | 0.9 | 2.4 | 2.5 | 2.6 | 0.8 | 1 | 1.6 | 2.2 | 1.9 | - | - | 0.9 | 1.7 |

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Uenoidae | *Neophylax* | - | 0.8 | 1.8 | 2.4 | - | - | 0.8 | - | - | 0.7 | - | - | - | 1.7 | - |
| PHYLUM NEMATOMORPHA | | | | | | | | | | | | | | | | | |
| Gordioidea (Worm) | Gordiidae | na | - | - | *0.9 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).
* Taxa not identified to genus
+ Coldwater-preference genera

## *Unnamed Tributary to Edgemont Reservoir (ANTI-101-S)*

Site ANTI-101-S is located on an unnamed tributary to Edgemont Reservoir in the Highlands region of Maryland. It is in the Antietam Creek watershed in Washington County. This site was sampled from 2010 to 2014.


*Unnamed tributary to Edgemont Reservoir in spring 2013.*

### ***Land Use/ Land Cover***

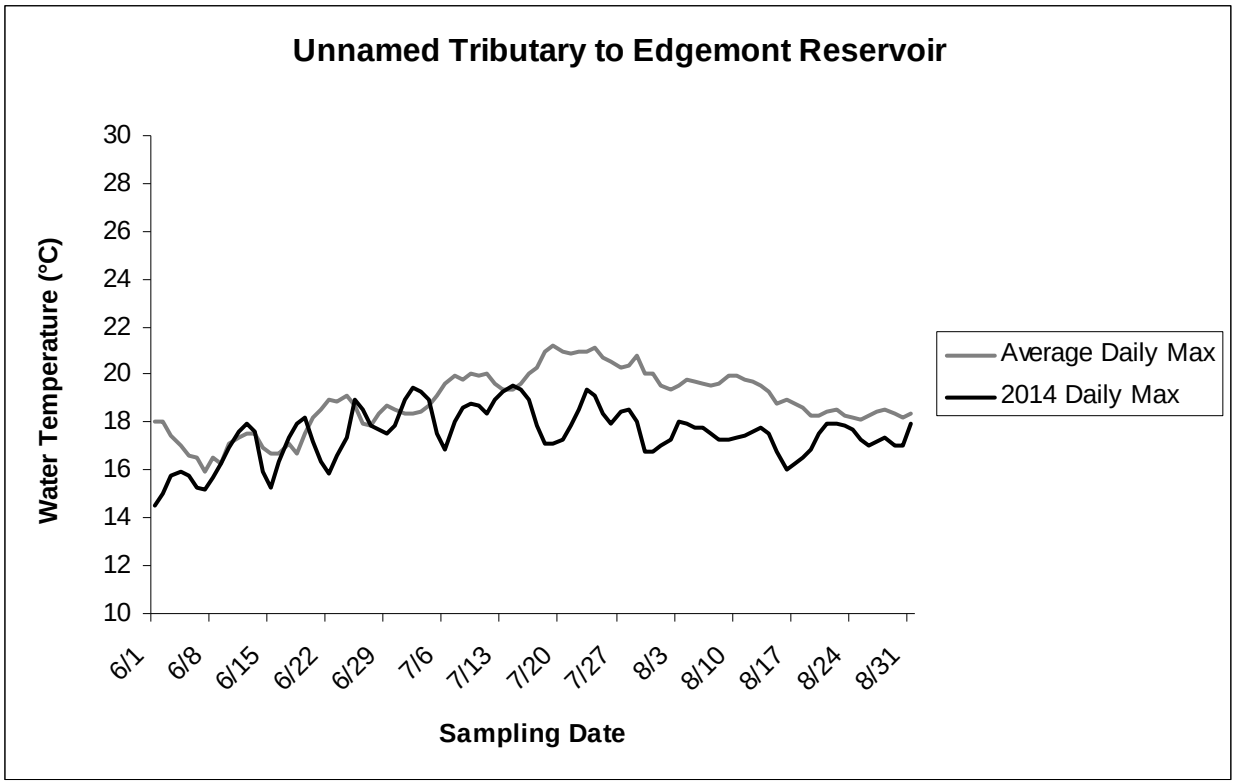
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 89.90 | 90.35 | 90.38 |
| Agriculture | 0.08 | 5.20 | 5.27 |
| Urban | 4.37 | 4.37 | 4.27 |
| Other | 5.65 | 0.08 | 0.08 |

### ***Physical Habitat***

Physical habitat measurements collected at the unnamed tributary to Edgemont Reservoir. Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|
| Instream habitat (0-20) | 18 | 18 | 15 | 16 | 16 |
| Epifaunal substrate (0-20) | 15 | 14 | 18 | 16 | 17 |
| Velocity/Depth Diversity (0-20) | 17 | 15 | 15 | 15 | 12 |
| Pool Quality (0-20) | 15 | 15 | 15 | 14 | 12 |
| Riffle Quality (0-20) | 18 | 17 | 15 | 14 | 14 |
| Shading (%) | 85 | 90 | 85 | 80 | 60 |
| Embeddedness (%) | 35 | 20 | 15 | 10 | 5 |
| Discharge (cfs) | 3.34 | 0.16 | 0.84 | 0.66 | 1.90 |




The graph above displays the average daily maximum temperatures recorded at the unnamed tributary to Edgemont Reservoir. The average was calculated from four years of data.

***Biology***

*Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|
| BIBI | 4.25 | 4.00 | 4.50 | 4.00 | 4.00 |
| FIBI | 3.50 | 2.00 | 2.50 | 2.50 | 2.50 |

*Fish*

Cumulative list of fish species (with abundance) collected in the unnamed tributary to Edgemont Reservoir by sampling year.

| *Species* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|
| Brook trout | 30 | 10 | 11 | 5 | 14 |
| Brown trout | - | - | - | - | 1 |
| Creek chub | - | 2 | 2 | 9 | 13 |
| Eastern blacknose dace | 83 | 182 | 146 | 238 | 102 |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

*Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to Edgemont Reservoir by sampling year

| *Species* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|
| Common crayfish (*Cambarus bartonii bartonii*) | P | P | P | P | P |

*Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in the unnamed tributary to Edgemont Reservoir by sampling year.

| *Species* |
|---|
| None Observed |

## *Herpetofauna*

Cumulative list of herpetofauna species collected in or near the unnamed tributary to Edgemont Reservoir.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | Eastern American toad, Northern green frog |
| Caudata (Salamanders and Newts) | Eastern red-backed salamander, Long-tailed salamander, Northern dusky salamander, Northern red salamander, Northern slimy salamander, Northern spring salamander, Northern two-lined salamander |
| Squamata (Snakes and Lizards) | Northern watersnake |

## *Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in the unnamed tributary to Edgemont Reservoir by sampling year, RA = %Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|
| | | PHYLUM ANNELIDA | | | | | |
| Haplotaxida | Enchytraeidae | na | 0.9 | - | - | - | - |
| Lumbriculida | Lumbriculidae | na | - | - | - | - | *0.8 |
| | | PHYLUM ARTHROPODA | | | | | |
| Coleoptera | Elmidae | *Oulimnius* | 1.9 | 2.8 | 0.9 | - | 1.5 |
| (Beetle) | Psephenidae | *Psephenus* | - | 0.9 | - | - | - |
| Diptera | Chironomidae | *Diamesa* | - | 2.8 | - | 0.8 | 0.8 |
| (True Fly) | | *Eukiefferiella* | - | 0.9 | - | - | 3.8 |
| | | *Micropsectra* | - | 1.8 | 0.9 | - | 8.4 |
| | | *Microtendipes* | - | 2.8 | - | - | - |
| | | *Nanocladius* | - | 0.9 | - | - | - |
| | | *Parakiefferiella* | - | - | - | - | 0.8 |
| | | *Sympotthastia* | 1.9 | 3.7 | - | 12.5 | 11.5 |
| | | *Tanytarsus* | 0.9 | - | - | - | 10.7 |
| | | *Tvetenia* | - | 0.9 | - | - | - |
| | Simuliidae | na | - | *0.9 | - | - | - |
| | | *Prosimulium* | 12.3 | 10.1 | 6.0 | 9.2 | 9.9 |
| | Tipulidae | *Hexatoma* | - | 2.8 | - | - | 0.8 |
| | | *Tipula* | - | 0.9 | - | - | - |
| Ephemeroptera | Ameletidae | *Ameletus* | 5.7 | 12.8 | 5.2 | 1.2 | 3.8 |
| (Mayfly) | Baetidae | na | *0.9 | - | - | - | *0.8 |
| | | ***Baetis*** | - | 0.9 | 4.3 | 5.0 | - |
| | | ***Diphetor***[+] | 0.9 | - | - | - | - |
| | | ***Heterocloeon*** | - | - | 0.9 | 4.2 | - |
| | Ephemerellidae | na | *4.7 | *1.8 | *3.4 | - | - |
| | | *Ephemerella* | - | - | 3.4 | 5.0 | - |
| | Heptageniidae | na | *1.9 | *0.9 | *1.7 | - | - |
| | | ***Epeorus***[+] | 25.5 | 8.3 | 53.4 | 21.7 | 8.4 |
| | | *Maccaffertium* | 1.9 | 1.8 | - | - | - |
| | Leptophlebiidae | na | *4.7 | *1.8 | *0.9 | - | *1.5 |
| | | ***Paraleptophlebia***[+] | 0.9 | 0.9 | - | 0.8 | - |
| Plecoptera | Chloroperlidae | *Sweltsa*[+] | 7.5 | 15.6 | 2.6 | 7.5 | 4.6 |
| (Stonefly) | Leuctridae | na | - | - | - | - | *1.5 |
| | | *Leuctra*[+] | 0.9 | - | - | 0.8 | - |
| | Nemouridae | na | *3.8 | *0.9 | - | - | *1.5 |
| | | *Amphinemura* | 4.7 | 0.9 | 10.3 | 0.8 | 8.4 |
| | | *Prostoia* | 3.8 | 6.4 | 0.9 | 15.0 | 10.7 |
| | Perlidae | na | - | *1.8 | - | - | - |
| | | *Acroneuria* | 0.9 | 1.8 | 0.9 | - | 1.5 |
| | Perlodidae | na | - | - | - | 0.8 | - |
| | Pteronarcyidae | ***Pteronarcys*** | - | 0.9 | 0.9 | - | - |
| Trichoptera | Hydropsychidae | ***Diplectrona***[+] | 5.7 | 1.8 | - | 1.7 | 1.5 |
| (Caddisfly) | | *Hydropsyche* | - | - | - | 0.8 | - |
| | Philopotamidae | ***Wormaldia***[+] | 0.9 | - | - | - | 1.5 |
| | Polycentropodidae | *Polycentropus* | - | - | - | - | 0.8 |
| | Rhyacophilidae | *Rhyacophila* | 2.8 | - | 1.7 | 4.2 | 0.8 |
| | Uenoidae | *Neophylax* | 3.8 | 8.3 | 1.7 | 4.2 | 3.8 |

# *Fifteenmile Creek (FIMI-207-S)*

Site FIMI-207-S is located on Fifteenmile Creek in the Highlands region of Maryland. It is in the Fifteen Mile Creek watershed in Allegany County. This site was sampled in 1995 and 2000 to 2014.


*Fifteenmile Creek in spring 2013.*

## ***Land Use/ Land Cover***

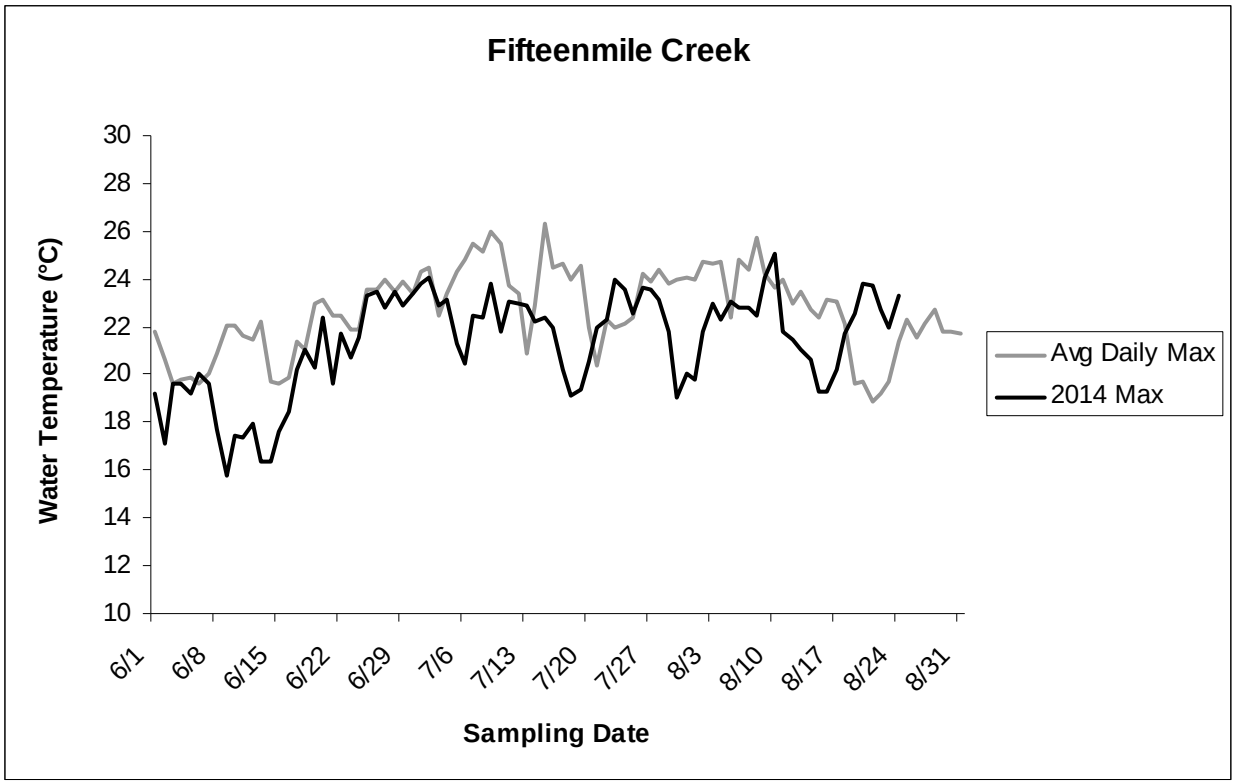
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 46.91 | 88.83 | 87.59 |
| Agriculture | 0.00 | 6.41 | 6.44 |
| Urban | 21.99 | 4.76 | 4.85 |
| Other | 31.10 | 0.00 | 1.11 |

## ***Physical Habitat***

Physical habitat measurements collected at Fifteenmile Creek (2000 to 2014). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 15 | 11 | 11 | 11 | 13 | 10 | 10 | 9 | 8 | 10 | 10 | 15 | 12 | 17 | 11 |
| Epifaunal substrate (0-20) | 10 | 11 | 11 | 10 | 16 | 10 | 13 | 8 | 9 | 11 | 10 | 17 | 11 | 12 | 8 |
| Velocity/Depth Diversity (0-20) | 9 | 5 | 5 | 8 | 10 | 8 | 11 | 9 | 9 | 10 | 6 | 15 | 10 | 15 | 9 |
| Pool Quality (0-20) | 8 | 6 | 10 | 9 | 10 | 7 | 11 | 9 | 8 | 8 | 6 | 15 | 8 | 15 | 9 |
| Riffle Quality (0-20) | 11 | 5 | 11 | 8 | 15 | 9 | 12 | 12 | 12 | 13 | 8 | 20 | 8 | 16 | 8 |
| Shading (%) | 50 | 50 | 65 | 60 | 60 | 76 | 65 | 60 | 65 | 70 | 40 | 55 | 65 | 60 | 40 |
| Embeddedness (%) | 5 | 10 | 15 | 20 | 20 | 30 | 30 | 0 | 0 | 0 | 10 | 5 | 30 | 15 | 0 |
| Discharge (cfs) | 0.55 | 0.10 | 0.09 | 0.22 | 3.05 | 0.42 | 1.60 | 2.47 | 5.06 | 2.09 | 0.13 | 8.72 | 0.79 | 2.56 | 0.13 |




The graph above displays the average daily maximum temperatures recorded at Fifteenmile Creek. The average was calculated from three years of data.

***Biology***

*Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 3.75 | 3.75 | 3.75 | 4.25 | 4.00 | 4.00 | 3.75 | 4.25 | 4.00 | 4.50 | 3.75 | 3.50 | 4.00 | 4.00 | 3.75 |
| FIBI | 5.00 | 5.00 | 5.00 | 5.00 | 4.67 | 4.67 | 4.67 | 4.67 | 4.67 | 4.67 | 5.00 | 3.67 | 4.67 | 4.67 | 4.67 |

## *Fish*

Cumulative list of fish species (with abundance) collected in Fifteenmile Creek by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Blue Ridge sculpin | - | - | 1 | - | - | - | 31 | 1 | - | 1 | - | - | 6 | - | - |
| Bluntnose minnow | 23 | 5 | 28 | 26 | 43 | 85 | 63 | 40 | 19 | 29 | 32 | 10 | 66 | 225 | 72 |
| Central stoneroller | 208 | 125 | 30 | 79 | 182 | 111 | 33 | 75 | 19 | 40 | 29 | - | 25 | 9 | 27 |
| Chain pickerel | - | 2 | - | - | - | 2 | - | - | - | - | - | - | - | - | - |
| Creek chub | 28 | 85 | 43 | 5 | 24 | 82 | 5 | 21 | 21 | 34 | 26 | 1 | 32 | 59 | 64 |
| Creek chubsucker | - | - | - | 2 | - | - | - | - | - | 1 | - | - | 1 | - | - |
| Eastern blacknose dace | 215 | 211 | 83 | 34 | 17 | 50 | 29 | 67 | 91 | 75 | 79 | 4 | 52 | 38 | 137 |
| Fallfish | - | - | - | 3 | - | 1 | - | - | - | - | - | - | - | 1 | - |
| Fantail darter | 56 | 164 | 92 | 68 | 106 | 52 | 59 | 62 | 39 | 52 | 40 | 5 | 77 | 106 | 61 |
| Green sunfish | 1 | - | - | 3 | - | 1 | - | 1 | - | - | - | - | - | 1 | 2 |
| Greenside darter | 48 | 32 | 17 | 5 | 25 | 19 | 8 | 16 | 3 | 15 | 16 | - | 10 | 10 | 5 |
| Largemouth bass | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Longnose dace | 29 | 35 | 1- | 2 | 15 | 14 | 4 | 3 | 5 | 2 | 5 | - | 2 | 4 | 4 |
| Northern hogsucker | - | 4 | - | - | 2 | - | - | - | - | 1 | - | - | - | 1 | - |
| Potomac sculpin | 165 | 217 | 239 | 122 | 345 | 283 | 159 | 234 | 276 | 285 | 132 | 14 | 241 | 628 | 179 |
| Rainbow darter | - | - | - | - | - | - | - | 1 | 17 | 46 | 26 | 1 | 13 | 3 | 3 |
| Redbreast sunfish | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - |
| Rock bass | - | 3 | 6 | - | 7 | 6 | 1 | - | - | - | 1 | - | 30 | 14 | 15 |
| Smallmouth bass | 8 | - | 2 | - | 4 | - | 2 | - | 3 | - | 1 | - | - | - | 1 |
| Tessellated darter | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - |
| White sucker | 9 | 22 | 10 | 3 | 5 | 9 | - | 7 | 10 | 7 | 16 | 1 | 11 | 3 | 1 |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

## *Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in Fifteenmile Creek by sampling year

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Common crayfish (*Cambarus bartonii bartonii*) | P | P | P | P | P | P | P | P | P |
| Allegheny crayfish (*Orconectes obscurus*) | A | P | A | P | P | P | P | P | P |
| (*Orconectes* sp.) | P | A | A | A | A | A | A | A | A |

## *Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in Fifteenmile Creek by sampling year.

| *Species* |
|---|
| None Observed |

## *Herpetofauna*

Cumulative list of herpetofauna species collected in or near Fifteenmile Creek.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | American bullfrog, Eastern American toad, Northern green frog, Pickerel frog |
| Caudata (Salamanders and Newts) | Northern dusky salamander, Northern green frog, Northern red salamander, Northern spring salamander, Northern two-lined salamander, Red-spotted newt |
| Squamata (Snakes and Lizards) | Northern ring-necked snake, Northern watersnake |
| Testudines (Turtles) | Wood turtle |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in Fifteenmile Creek by sampling year, RA = %Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | |
| Branchiobdellida | na | na | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - |
| Haplotaxida | Naididae | na | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| Lumbriculida | Lumbriculidae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | |
| Coleoptera (Beetle) | Elmidae | *Optioservus* | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Stenelmis* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | Psephenidae | *Psephenus* | - | - | 2.9 | - | - | - | - | - | - | - | 0.9 | - | 1.8 | - | 0.8 |
| Decapoda (Crayfish) | Cambaridae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Diptera (True Fly) | Athericidae | *Atherix* | - | - | 3.9 | - | - | - | 6 | - | - | - | - | - | - | - | - |
| | Ceratopogonidae | *Probezzia* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| | Chironomidae | *Conchapelopia* | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Corynoneura* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Diplocladius* | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Eukiefferiella* | - | - | - | 0.8 | - | - | - | - | 1 | - | - | - | - | 0.9 | - |
| | | *Micropsectra* | 3.4 | 3.6 | - | 11.2 | 3.4 | - | 0.9 | 7.1 | 2.9 | 0.9 | 11.5 | 14.5 | 0.9 | - | 3.4 |
| | | *Microtendipes* | - | 0.9 | 2.9 | - | - | - | - | - | 1.9 | - | - | - | - | - | - |
| | | *Parakiefferiella* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - |
| | | *Parametriocnemus* | - | 2.7 | 3.9 | 0.8 | 0.8 | 2.7 | 2.6 | - | - | - | 0.9 | 0.9 | - | - | 0.8 |
| | | *Paraphaenocladius* | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Polypedilum* | - | - | - | - | 1.7 | 13..5 | - | 0.9 | 8.7 | - | - | - | - | - | 4.2 |
| | | *Potthastia* | - | 1.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | Orthocladiinae | - | - | - | *4 | - | - | - | - | - | - | - | *0.9 | - | - | - |
| | | *Orthocladius* | - | - | 1 | - | 0.8 | - | - | - | - | - | - | - | - | - | 0.8 |
| | | *Sympotthastia* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | Tanytarsini | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Tanytarsus* | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | Thienemannimyia Group | - | - | - | - | - | - | *0.9 | *1.8 | - | *0.9 | - | - | - | - | *0.8 |
| | | *Tvetenia* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| | Empididae | *Clinocera* | - | - | - | - | - | - | - | 0.9 | 1.9 | - | - | - | - | - | - |
| | Simuliidae | na | - | - | - | *0.8 | - | - | *0.9 | - | - | - | - | - | - | - | - |
| | | *Prosimulium* | 13.6 | 20 | 7.8 | 8 | - | 11.7 | 25.6 | 9.8 | 16.5 | 21.3 | - | 12.7 | 21.9 | 25.2 | 55.9 |
| | | *Simulium* | 9.3 | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - |
| | | *Stegopterna* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Tipulidae | *Antocha* | - | - | - | - | 1.7 | - | - | - | - | - | - | - | - | - | - |
| | | *Dicranota* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| | | *Hexatoma* | - | - | - | - | - | 0.9 | 0.9 | - | - | - | - | - | - | - | - |
| | | *Tipula* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 |
| Ephemeroptera (Mayfly) | Ameletidae | *Ameletus* | - | - | - | 1.6 | - | - | - | - | - | 0.9 | 1.8 | 0.9 | 0.9 | 2.6 | - |
| | Baetidae | na | - | - | - | - | *0.8 | *1.8 | - | - | - | - | - | - | - | - | - |
| | | *Acentrella* | 2.5 | - | - | - | - | 2.7 | 1.7 | - | - | - | - | - | - | - | - |
| | | *Acerpenna* | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.7 | 2.5 |
| | | *Diphetor* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Heterocloeon* | - | - | - | - | - | - | - | - | 1 | - | - | - | - | 0.9 | - |
| | Caenidae | *Caenis* | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | Ephemerellidae | na | - | - | *1 | - | - | *10.8 | - | - | *8.7 | *25.9 | - | *3.6 | *0.9 | *1.7 | - |
| | | *Ephemerella* | 8.5 | 12.7 | - | 23.2 | 16.9 | 10.8 | 3.4 | 13.4 | 9.7 | - | - | 1.8 | 7.0 | 17.4 | - |
| | | *Eurylophella* | - | - | 1 | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Drunella* | 1.7 | 4.5 | - | 2.4 | 0.8 | 1.8 | 1.7 | - | - | - | 0.9 | - | 0.9 | 0.9 | - |
| | | *Serratella* | - | - | - | - | 1.7 | - | - | - | - | - | - | - | - | - | - |
| | Ephemeridae | ***Ephemera***[+] | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Heptageniidae | na | - | *7.3 | - | *5.6 | - | - | *0.9 | - | *9.7 | *11.1 | *12.4 | - | - | *1.7 | - |
| | | ***Cinygmula***[+] | 3.4 | - | - | - | 43.2 | 9 | - | 10.7 | 1 | - | 8 | 4.5 | 36 | 4.3 | - |
| | | ***Epeorus***[+] | 0.8 | 3.6 | - | 1.6 | 7.6 | 6.3 | 4.3 | 3.6 | 5.8 | 8.3 | 0.9 | 1.8 | 7.9 | 13.9 | 5.1 |
| | | *Leucrocuta* | - | - | - | - | 0.8 | - | - | - | - | 0.9 | - | - | - | - | 0.8 |
| | | *Maccaffertium* | - | - | - | - | - | - | - | - | 1 | 0.9 | - | - | - | 0.9 | 2.5 |
| | | *Stenacron* | - | - | 1 | - | - | 0.9 | - | - | - | - | 0.9 | - | - | 0.9 | 0.8 |
| | | *Stenonema* | - | - | 9.8 | 0.8 | - | - | 0.9 | 1.8 | - | - | 0.9 | - | - | - | - |
| | Isonychiidae | *Isonychia* | - | 0.9 | 3.9 | - | - | 0.9 | - | - | - | 0.9 | - | - | - | - | 0.8 |
| | Leptophlebiidae | na | *7.6 | - | - | *1.6 | - | *1.8 | *0.9 | *1.8 | - | - | - | - | - | - | - |
| | | ***Paraleptophlebia***[+] | - | - | - | 1.6 | - | - | - | - | - | - | - | - | - | - | - |
| Isopoda | Asellidae | *Caecidotea* | - | 0.9 | - | - | 1.7 | - | - | - | - | - | - | - | - | - | - |
| (Aquatic Sow Bug) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Megaloptera | Corydalidae | *Nigronia* | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| (Dobsonfly/Fishfly) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Odonata | Gomphidae | na | - | - | *6.9 | - | - | - | - | - | - | - | - | - | - | - | *0.8 |
| (Dragonfly/Damselfly) | | *Stylogomphus* | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Plecoptera | Capniidae | na | - | - | *2 | - | - | - | - | - | - | - | - | - | - | - | - |
| (Stonefly) | Chloroperlidae | na | *5.9 | *0.9 | - | - | - | - | - | *8 | *2.9 | - | *0.9 | *1.8 | - | - | *0.8 |
| | | *Haploperla* | - | - | - | - | - | 13.5 | - | - | - | 0.9 | - | - | - | - | - |
| | | ***Sweltsa***[+] | - | - | - | - | 5.9 | 1.8 | 0.9 | 0.9 | 1.9 | 0.9 | - | - | - | - | 0.8 |
| | Leuctridae | na | - | *0.9 | - | *0.8 | *2.5 | - | - | - | *1 | - | *2.7 | *2.7 | *0.9 | - | - |
| | Nemouridae | na | - | - | *6.9 | - | - | - | *2.6 | - | - | *4.6 | *3.5 | *0.9 | - | *1.7 | *0.8 |
| | | *Amphinemura* | 32.2 | 20.9 | 2.9 | 18.4 | 4.2 | 4.5 | 5.1 | 23.2 | 12.6 | 0.9 | 17.7 | 20.9 | 7 | - | 1.7 |
| | | *Ostrocerca* | - | - | - | 3.2 | - | - | 0.9 | - | - | - | - | 0.9 | 0.9 | - | - |
| | | *Prostoia* | - | - | - | 0.8 | - | - | 2.6 | - | 1 | - | 0.9 | - | - | 0.9 | - |
| | Perlidae | na | - | - | *2 | - | - | - | - | *0.9 | - | - | - | - | - | - | - |
| | | *Acroneuria* | - | 0.9 | - | - | - | - | 0.9 | - | - | 0.9 | - | - | - | - | - |
| | Perlodidae | na | *1.7 | *4.5 | - | *3.2 | - | - | - | *0.9 | *1 | *0.9 | *3.5 | *3.6 | - | - | - |
| | | *Clioperla* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| | | *Isoperla* | 0.8 | - | - | 1.6 | 4.2 | 1.8 | 20.5 | 11.6 | 6.8 | 10.2 | 0.9 | 12.7 | 10.5 | 12.2 | 4.2 |
| | Taeniopterygidae | *Oemopteryx* | - | 8.2 | 4.9 | 0.8 | - | - | 13.7 | - | - | - | - | - | - | - | - |
| | | *Strophopteryx* | - | - | - | - | - | - | - | - | - | - | - | - | - | 3.5 | 0.8 |
| | | *Taenionema* | - | - | - | - | - | - | - | - | 1 | 4.6 | 7.1 | 3.6 | 0.9 | 2.6 | - |
| Trichoptera | Glossosomatidae | *Glossosoma* | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - | - |
| (Caddisfly) | Hydropsychidae | *Cheumatopsyche* | 0.8 | 2.7 | 20.6 | - | - | 0.9 | - | - | - | - | - | - | - | - | 0.8 |
| | Lepidostomatidae | *Lepidostoma* | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | 0.9 | 2.5 |
| | Philopotamidae | na | *5.9 | *1.8 | - | *3.2 | - | - | *0.9 | *0.9 | - | - | - | *6.4 | - | - | - |
| | | *Chimarra* | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | 5.1 |
| | Polycentropodidae | na | - | - | - | - | - | *0.9 | - | *0.9 | - | - | - | - | - | - | - |

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Polycentropus* | - | - | - | - | - | - | 0.9 | 0.9 | - | 0.9 | 0.9 | - | - | - | - |
| | Rhyacophilidae | *Rhyacophila* | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - |
| | Uenoidae | *Neophylax* | - | - | 3.9 | 0.8 | 0.8 | - | - | - | 1 | 1.9 | - | 0.9 | - | 3.5 | 0.8 |
| PHYLUM PLATYHELMINTHES | | | | | | | | | | | | | | | | | |
| Tricladida | Dugesiidae | *Cura* | 0.8 | - | - | - | - | - | | - | - | - | *0.9 | - | - | - | - |
| (Flat Worm) | Planariidae | na | - | - | *1 | - | - | - | - | - | - | - | - | - | - | - | - |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).
* Taxa not identified to genus
+ Coldwater-preference genera

# *High Run (UMON-288-S)*

Site UMON-288-S is located on High Run in the Highlands region of Maryland. It is in the Upper Monocacy River watershed in Frederick County. This site was sampled from 2000 to 2014.

*High Run in spring 2013.*

## ***Land Use/ Land Cover***

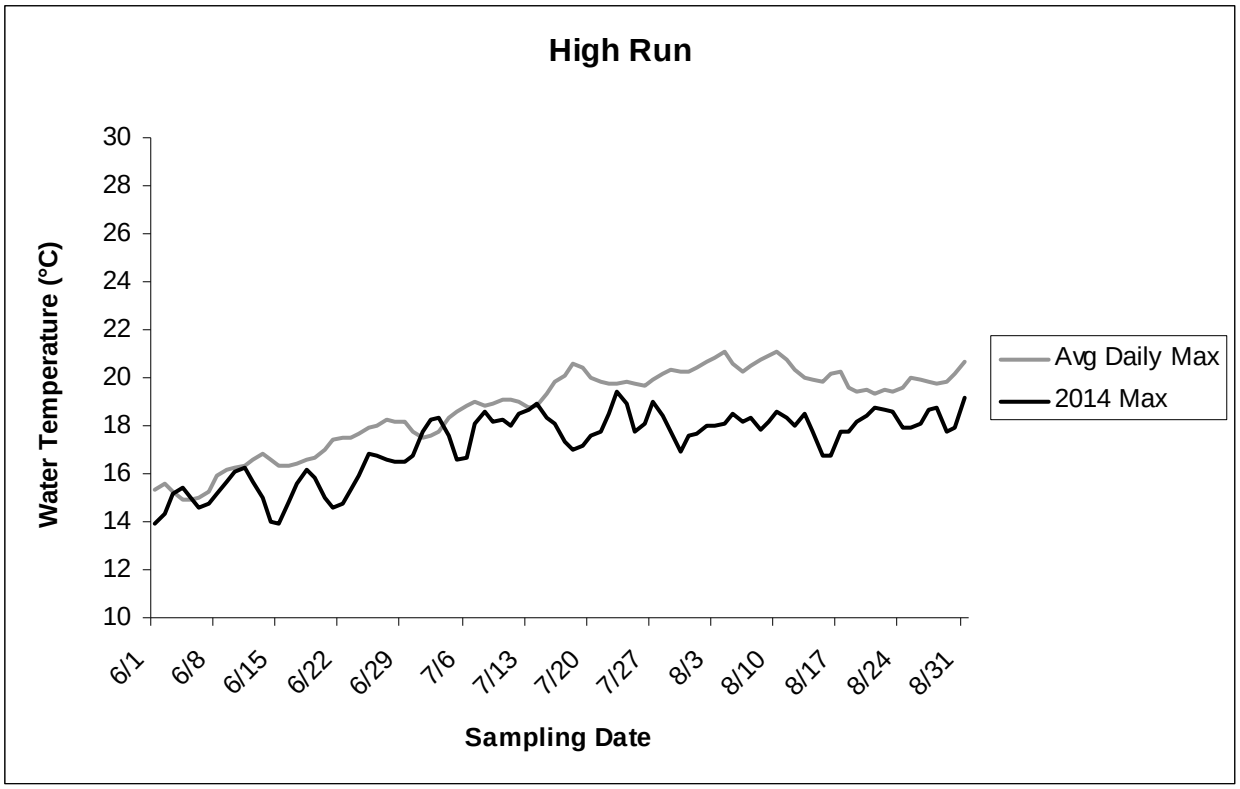
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 100.00 | 100.00 | 100.00 |
| Agriculture | 0.00 | 0.00 | 0.00 |
| Urban | 0.00 | 0.00 | 0.00 |
| Other | 0.00 | 0.00 | 0.00 |

## ***Physical Habitat***

Physical habitat measurements collected at High Run (2000 to 2014). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 17 | 18 | 18 | 17 | 17 | 17 | 18 | 18 | 18 | 18 | 19 | 19 | 15 | 16 | 17 |
| Epifaunal substrate (0-20) | 18 | 16 | 18 | 16 | 19 | 18 | 18 | 18 | 18 | 18 | 15 | 16 | 18 | 18 | 19 |
| Velocity/Depth Diversity (0-20) | 14 | 10 | 10 | 11 | 16 | 15 | 15 | 10 | 10 | 10 | 15 | 15 | 15 | 10 | 14 |
| Pool Quality (0-20) | 17 | 15 | 13 | 14 | 16 | 16 | 18 | 10 | 10 | 10 | 12 | 15 | 15 | 10 | 13 |
| Riffle Quality (0-20) | 17 | 15 | 17 | 16 | 17 | 16 | 19 | 18 | 15 | 14 | 16 | 16 | 15 | 15 | 14 |
| Shading (%) | 95 | 85 | 92 | 95 | 95 | 98 | 95 | 90 | 85 | 85 | 70 | 75 | 95 | 95 | 80 |
| Embeddedness (%) | 20 | 20 | 20 | 35 | 20 | 25 | 35 | 25 | 25 | 25 | 15 | 15 | 10 | 5 | 5 |
| Discharge (cfs) | 1.11 | 0.28 | 0.46 | 0.84 | 1.48 | 1.03 | 1.44 | 0.58 | 0.39 | 1.60 | 1.85 | 1.05 | 1.71 | 0.82 | 2.21 |




The graph above displays the average daily maximum temperatures recorded at High Run. The average was calculated from nine years of data.

***Biology***

*Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 4.50 | 4.50 | 4.50 | 4.75 | 4.00 | 4.75 | 3.50 | 4.75 | 4.50 | 4.75 | 4.50 | 4.75 | 4.50 | 4.50 | 4.25 |
| FIBI | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 1.67 | 4.00 | 4.00 | 4.00 | 4.00 |

*Fish*

Cumulative list of fish species (with abundance) collected in High Run by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brook trout | 41 | 167 | 30 | 23 | 67 | 51 | 36 | 54 | 39 | 19 | 12 | 5 | 3 | 5 | 23 |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

*Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in High Run by sampling year

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Common crayfish (*Cambarus bartonii bartonii*) | P | P | P | P | P | P | P | P | P |

*Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in High Run by sampling year.

| *Species* |
|---|
| None Observed |

*Herpetofauna*

Cumulative list of herpetofauna species collected in or near High Run.

| *Order(Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | Eastern American toad, Gray tree frog, Northern green frog, Northern spring peeper, Pickerel frog |
| Caudata (Salamanders and Newts) | Eastern red-backed salamander, Jefferson salamander, Marbled salamander, Northern dusky salamander, Northern red salamander, Northern spring salamander, Northern slimy salamander, Northern two-lined salamander, Red-spotted newt, Spotted salamander |
| Squamata (Snakes and Lizards) | Northern ring-necked snake, Plestrodon sp. |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in High Run by sampling year, RA = %Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | |
| Branchiobdellida | na | na | *1.6 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Haplotaxida | Naididae | na | *0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | |
| Coleoptera | Elmidae | *Oulimnius* | 7.4 | 2.8 | 17.9 | 6.8 | - | 10.6 | 10.3 | 6 | 1.9 | 0.8 | - | 2.6 | 2.7 | 0.9 | 2.6 |
| (Beetle) | | *Promoresia* | - | - | 7.7 | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | Psephenidae | *Ectopria* | - | - | - | 0.8 | - | 0.8 | - | 0.9 | 0.9 | - | - | - | - | - | - |
| | | *Psephenus* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| Decapoda | Cambaridae | na | - | - | - | - | - | - | - | - | - | *0.8 | - | - | - | - | - |
| (Crayfish) | | *Cambarus* | 0.8 | - | - | - | - | - | 1.7 | - | - | - | - | - | - | - | - |
| Diptera | Ceratopogonidae | *Bezzia* | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - |
| (True Fly) | Chironomidae | na | - | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - |
| | | *Brillia* | - | - | - | - | - | - | - | - | 0.9 | - | 1 | - | - | - | - |
| | | *Chaetocladius* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 |
| | | *Cladotanytarsus* | - | - | - | - | - | - | - | 0.9 | - | 1.7 | - | - | - | - | - |
| | | *Diamesa* | - | - | - | 1.7 | - | 0.8 | 2.6 | 2.6 | - | 0.8 | 2.9 | - | - | - | - |
| | | *Eukiefferiella* | 0.8 | - | 2.6 | 1.7 | 2.4 | - | 0.9 | 3.4 | - | 2.5 | 6.8 | 2.6 | - | 3.3 | 7 |
| | | *Limnophyes* | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| | | *Micropsectra* | 0.8 | 6.5 | 4.3 | 4.2 | 4 | 16.3 | - | 0.9 | - | - | 1 | 10.5 | 0.9 | 1.7 | 1.7 |
| | | *Microtendipes* | - | - | - | - | - | - | - | - | 1.9 | - | - | - | - | - | 1.7 |
| | | Orthocladiinae | - | - | - | *0.8 | - | - | *0.9 | - | *0.9 | - | *1 | - | - | - | *0.9 |
| | | *Orthocladius* | - | - | - | - | - | - | - | - | - | 1.7 | - | - | - | - | 0.9 |
| | | *Parakiefferiella* | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |
| | | *Parametriocnemus* | 0.8 | - | - | 0.8 | - | 3.3 | 0.9 | 1.7 | 3.7 | - | 1 | - | 1.8 | 0.9 | 0.9 |
| | | *Paraphaenocladius* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | 0.9 | - |
| | | *Rheocricotopus* | 0.8 | - | - | - | - | - | - | - | 0.9 | - | - | - | 0.9 | - | - |
| | | *Stempellinella* | - | - | 0.9 | 1.7 | - | - | - | - | - | 8.4 | - | - | - | - | - |
| | | *Sympotthastia* | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - | - |
| | | Tanypodinae | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - | - |
| | | Tanytarsini | - | - | *0.9 | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Tanytarsus* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 |
| | | *Thienemanniella* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 |
| | | *Tvetenia* | - | - | - | 1.7 | 0.8 | - | - | 0.9 | - | - | 1 | 0.9 | - | 1.7 | 0.9 |
| | Dixidae | ***Dixa***$^{+}$ | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - | 0.9 |
| | Empididae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | *0.8 | - |
| | Simuliidae | na | - | - | - | - | - | - | *0.9 | *0.9 | - | - | - | - | - | - | - |
| | | *Prosimulium* | - | 3.7 | - | 2.5 | - | - | 22.2 | 2.6 | 0.9 | 6.7 | 4.9 | 5.3 | 6.3 | 2.5 | 19.1 |
| | | *Stegopterna* | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Tipulidae | *Antocha* | - | - | 0.9 | | - | 1.6 | - | - | - | 0.8 | - | - | - | 1.7 | - |
| | | *Dicranota* | - | - | 0.9 | 0.8 | 2.4 | 0.8 | - | - | 2.8 | - | - | 3.5 | - | - | 1.7 |
| | | *Hexatoma* | - | - | 1.7 | 0.8 | 2.4 | - | 0.9 | 3.4 | - | - | - | 0.9 | - | 0.9 | - |
| | | *Tipula* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Ephemeroptera | Ameletidae | *Ameletus* | - | - | - | - | - | - | - | - | - | 4.2 | - | 0.9 | 2.7 | - | - |
| (Mayfly) | Baetidae | na | - | *4.6 | *1.7 | - | - | - | - | - | - | *0.8 | - | - | - | *2.5 | - |

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Acentrella* | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Baetis* | 6.6 | - | - | - | 13.5 | 7.3 | - | 1.7 | - | 1.7 | 1.9 | 1.8 | 11.7 | 13.2 | 0.9 |
| | | ***Diphetor***$^{+}$ | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - |
| | Ephemerellidae | na | - | - | - | - | - | - | - | *19.8 | - | *16.8 | - | *6.1 | - | - | - |
| | | *Drunella* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - |
| | | *Ephemerella* | 36.9 | 41.7 | 22.2 | 20.3 | 17.5 | 23.6 | 24.8 | 12.1 | 18.5 | - | 17.5 | - | 15.3 | 12.4 | 8.7 |
| | | *Eurylophella* | - | - | - | - | - | - | - | - | - | 0.8 | 1 | - | - | - | - |
| | Heptageniidae | na | - | *13 | *8.5 | *9.3 | - | - | - | *4.3 | - | *11.8 | - | - | *0.9 | - | - |
| | | ***Cinygmula***$^{+}$ | 4.1 | - | - | - | - | 4.9 | 6 | 3.4 | 5.6 | 2.5 | - | - | 2.7 | 8.3 | 3.5 |
| | | ***Epeorus***$^{+}$ | 3.3 | 7.4 | 5.1 | 2.5 | 15.1 | 1.6 | 6 | 5.2 | 5.6 | 14.3 | 2.9 | 17.5 | 27.9 | 18.2 | 20 |
| | | *Leucrocuta* | 2.5 | - | - | - | - | - | - | - | 2.8 | - | - | - | - | - | 0.9 |
| | | *Maccaffertium* | - | - | - | - | - | - | - | - | 0.9 | - | 1 | - | 0.9 | - | - |
| | | *Stenacron* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Stenonema* | - | - | - | - | 0.8 | - | - | 0.9 | - | - | - | - | - | - | - |
| | Isonychiidae | *Isonychia* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Leptophlebiidae | na | - | *4.6 | - | *5.9 | *6.3 | - | *6 | *6 | *2.8 | *2.5 | *5.8 | *6.1 | *6.3 | *2.5 | *0.9 |
| | | ***Paraleptophlebia***$^{+}$ | 11.5 | - | 9.4 | 5.1 | 0.8 | 1.6 | - | - | 0.9 | 4.2 | 2.9 | - | 0.9 | 0.9 | - |
| Megaloptera | Corydalidae | *Nigronia* | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - |
| (Dobsonfly/Fishfly) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Plecoptera | Capniidae | na | - | - | - | - | - | - | - | - | - | - | - | *7 | - | - | - |
| (Stonefly) | | *Paracapnia* | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| | Chloroperlidae | na | *0.8 | - | - | - | *1.6 | *2.4 | *1.7 | - | *0.9 | *0.8 | - | - | - | *0.9 | - |
| | | ***Sweltsa***$^{+}$ | 0.8 | - | - | 0.8 | 2.4 | 1.6 | 0.9 | 0.9 | - | 3.4 | 1 | 4.4 | - | - | 1.7 |
| | Leuctridae | na | - | - | - | - | - | - | - | - | *6.5 | *0.8 | - | *0.9 | *0.9 | - | - |
| | | ***Leuctra***$^{+}$ | 2.5 | 3.7 | 1.7 | 2.5 | 4.8 | 6.5 | - | 1.7 | 7.4 | - | 2.9 | - | 1.8 | 3.3 | 7 |
| | Nemouridae | na | - | - | - | - | - | - | - | - | - | - | *2.9 | - | - | - | - |
| | | *Amphinemura* | 2.5 | - | - | - | - | - | 0.9 | 3.4 | 4.6 | 0.8 | 4.9 | - | 0.9 | - | - |
| | | *Prostoia* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Peltoperlidae | ***Tallaperla***$^{+}$ | - | - | - | 2.5 | - | - | - | 2.6 | - | - | 2.9 | 1.8 | - | 0.9 | - |
| | Perlidae | na | - | - | - | *0.8 | *0.8 | *0.8 | *0.9 | *0.9 | - | - | *1.9 | *0.9 | - | *0.9 | *0.9 |
| | | *Acroneuria* | - | 0.9 | - | - | - | - | 0.9 | - | - | 0.8 | 1 | 0.9 | - | - | - |
| | Perlodidae | na | *4.1 | *1.9 | *4.3 | *4.2 | *2.4 | *4.1 | *1.7 | *2.6 | *2.8 | *3.4 | *3.9 | - | *1.8 | *0.9 | - |
| | | *Isoperla* | - | - | - | - | - | - | - | - | - | - | 2.9 | 1.8 | 4.5 | 3.3 | - |
| | Pteronarcyidae | *Pteronarcys* | - | - | 0.9 | - | - | 2.4 | - | - | - | - | 1 | 1.8 | - | - | *0.9 |
| | Taeniopterygidae | *Oemopteryx* | - | - | - | - | - | - | - | - | - | - | - | 4.4 | - | - | - |
| Trichoptera | Hydropsychidae | na | - | *2.8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Caddisfly) | | *Cheumatopsyche* | - | 0.9 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | ***Diplectrona***$^{+}$ | 6.6 | 1.9 | 5.1 | 13.6 | 11.1 | 5.7 | 4.3 | 7.8 | 16.7 | 2.5 | 9.7 | 8.8 | 2.7 | 9.1 | 8.7 |
| | | *Hydropsyche* | - | - | - | - | 7.1 | 0.8 | - | - | - | - | - | - | - | 2.5 | 0.9 |
| | Lepidostomatidae | *Lepidostoma* | 2.5 | 0.9 | 3.4 | 0.8 | - | 0.8 | 0.9 | - | 3.7 | 0.8 | 8.7 | 0.9 | 1.8 | 1.7 | - |
| | Limnephilidae | na | - | - | - | - | - | - | - | - | - | - | - | *0.9 | - | - | - |
| | | *Pycnopsyche* | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| | Philopotamidae | *Chimarra* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Dolophilodes* | - | - | - | 0.8 | - | - | - | - | 1.9 | - | - | - | - | - | - |
| | | ***Wormaldia***$^{+}$ | - | - | - | - | - | - | - | - | - | - | 1 | - | - | 0.9 | 0.9 |
| | Polycentropodidae | *Polycentropus* | - | - | - | 0.8 | - | 0.8 | - | - | - | - | - | 1.8 | - | 0.9 | - |
| | Psychomyiidae | *Lype* | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - |

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rhyacophilidae | *Rhyacophila* | - | 0.9 | - | 0.8 | 3.2 | - | 0.9 | 0.9 | 0.9 | - | - | - | 1.8 | - | 0.9 |
| | Uenoidae | *Neophylax* | - | 0.9 | - | 0.8 | - | - | 1.7 | 0.9 | - | 2.5 | 1 | 3.5 | - | 1.7 | 2.6 |
| PHYLUM NEMATOMORPHA | | | | | | | | | | | | | | | | | |
| Gordioidea | Gordiidae | na | - | *0.9 | - | *1.7 | - | - | - | - | - | - | - | - | - | - | - |
| (Worm) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).
* Taxa not identified to genus
+ Coldwater-preference genera

# *Mill Run (PRLN-626-S)*

Site PRLN-626-S is located on Mill Run in the Highlands region of Maryland. It is in the Lower North Branch Potomac River watershed in Allegany County. This site was sampled in 1996 and 2000 to 2014.

*Mill Run in spring 2013.*

## ***Land Use/ Land Cover***

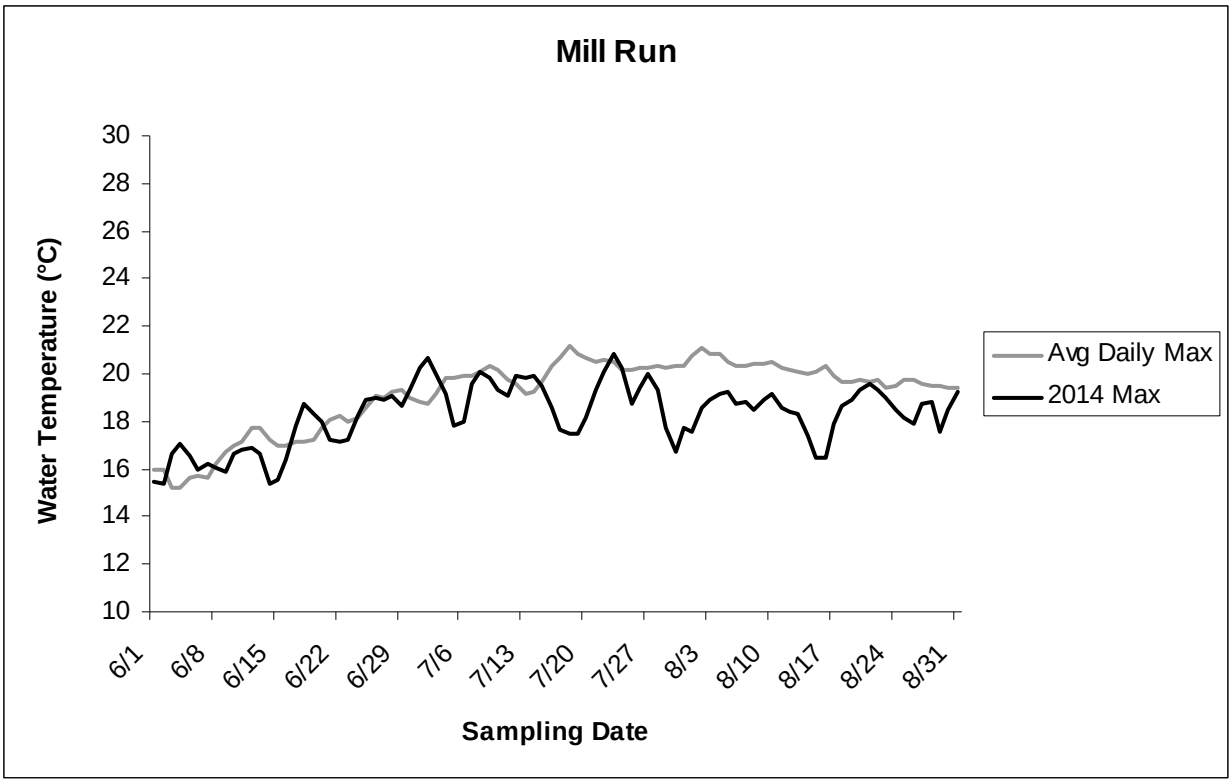
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 100.00 | 100.00 | 100.00 |
| Agriculture | 0.00 | 0.00 | 0.00 |
| Urban | 0.00 | 0.00 | 0.00 |
| Other | 0.00 | 0.00 | 0.00 |

## ***Physical Habitat***

Physical habitat measurements collected at Mill Run (2000 to 2014). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 17 | 18 | 16 | 18 | 16 | 16 | 15 | 18 | 18 | 18 | 12 | 13 | 18 | 14 | 17 |
| Epifaunal substrate (0-20) | 17 | 18 | 16 | 14 | 16 | 16 | 12 | 18 | 19 | 19 | 14 | 14 | 19 | 16 | 16 |
| Velocity/Depth Diversity (0-20) | 16 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 11 | 12 | 13 | 10 | 10 | 10 |
| Pool Quality (0-20) | 16 | 15 | 10 | 12 | 14 | 10 | 10 | 11 | 10 | 13 | 10 | 10 | 10 | 10 | 10 |
| Riffle Quality (0-20) | 17 | 16 | 14 | 16 | 15 | 15 | 15 | 17 | 13 | 15 | 13 | 13 | 15 | 15 | 9 |
| Shading (%) | 90 | 85 | 94 | 95 | 90 | 95 | 98 | 95 | 90 | 90 | 85 | 80 | 85 | 55 | 75 |
| Embeddedness (%) | 0 | 15 | 20 | 35 | 35 | 35 | 30 | 20 | 0 | 0 | 0 | 0 | 15 | 25 | 10 |
| Discharge (cfs) | 1.47 | 0.29 | 0.26 | 0.73 | 0.50 | 0.21 | 0.23 | 0.24 | 0.47 | 0.89 | 0.47 | 0.37 | 0.42 | 0.91 | 0.85 |




The above graph displays the average daily maximum temperatures recorded at Mill Run. The average was calculated from thirteen years of data.

***Biology***

*Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 5.00 | 4.25 | 4.50 | 5.00 | 4.00 | 4.50 | 4.00 | 3.75 | 4.25 | 5.00 | 5.00 | 4.50 | 4.75 | 4.75 | 4.00 |
| FIBI | 3.50 | 3.50 | 3.50 | 4.00 | 3.50 | 3.50 | 4.00 | 3.50 | 4.00 | 4.00 | 3.33 | 4.00 | 3.00 | 3.50 | 3.50 |

*Fish*

Cumulative list of fish species (with abundance) collected in Mill Run by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Blue Ridge sculpin | 54 | 137 | 120 | 40 | 40 | 24 | 23 | 28 | 20 | 16 | 17 | 23 | 35 | 44 | 43 |
| Brook trout | 28 | 36 | 16 | 61 | 96 | 52 | 30 | 13 | 47 | 22 | 16 | 14 | 2 | 2 | 1 |
| Eastern blacknose dace | 100 | 124 | 134 | 108 | 79 | 53 | 51 | 90 | 68 | 42 | 47 | 60 | 152 | 145 | 118 |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

*Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in Mill Run by sampling year

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Common crayfish (*Cambarus bartonii bartonii*) | P | P | P | P | P | P | P | P | P |

*Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in Mill Run by sampling year.

| *Species* |
|---|
| None Observed |

*Herpetofauna*

Cumulative list of herpetofauna species collected in or near Mill Run.

| *Order (Common)* | *Species* |
|---|---|
| Anura (Frogs and Toads) | Eastern American toad, Northern green frog , Northern spring peeper, Pickerel frog |
| Caudata (Salamanders and Newts) | Allegheny mountain dusky, Eastern red-spotted newt, Long-tailed salamander, Northern dusky salamander, Northern red salamander, Northern spring salamander, Northern slimy salamander, Northern two-lined salamander, Seal salamander |
| Squamata (Snakes and Lizards) | Eastern gartersnake, Northern fence lizard, Northern ring-necked snake, Northern watersnake |
| Testudines (Turtles) | Box turtle |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in Mill Run by sampling year, RA = %Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | |
| Haplotaxida | Enchytraeidae | na | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| Lumbriculida | Lumbriculidae | na | - | - | - | *0.8 | - | *0.8 | - | - | - | - | *2.2 | - | - | - | *0.8 |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | |
| Amphipoda (Scud) | Gammaridae | *Gammarus* | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - |
| | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Coleoptera (Beetle) | Elmidae | *Optioservus* | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - |
| | | *Oulimnius* | 0.8 | - | 1.9 | 0.8 | - | 0.8 | - | 1.9 | - | - | - | - | - | - | - |
| | | *Promoresia* | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Psephenidae | *Ectopria* | 0.8 | - | - | - | - | - | 1.1 | 1.9 | 0.9 | - | - | - | - | - | - |
| | | *Psephenus* | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - |
| Decapoda (Crayfish) | Cambaridae | *Cambarus* | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Diptera (True Fly) | Ceratopogonidae | na | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Bezzia* | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - | - | - |
| | | *Ceratopogon* | - | - | - | - | 0.8 | - | - | - | - | - | - | 0.9 | - | - | - |
| | | *Probezzia* | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - |
| | Chironomidae | *Brillia* | - | - | - | - | - | - | - | - | - | - | 1.5 | - | - | 0.9 | - |
| | | Chironominae | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Corynoneura* | - | - | 1 | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Diamesa* | 2.5 | 0.8 | - | - | - | - | 4.4 | - | - | - | - | - | - | - | - |
| | | *Eukiefferiella* | - | - | 1 | 0.8 | - | 2.4 | - | - | 2.6 | 0.8 | 1.5 | 0.9 | - | 0.9 | 2.3 |
| | | ***Heleniella*** [+] | - | - | - | - | - | - | 2.2 | 0.9 | - | - | 0.7 | - | - | - | 0.8 |
| | | *Micropsectra* | 8.5 | 6.8 | 21 | 0.8 | 2.5 | 9.6 | 22.2 | - | - | 1.6 | 2.2 | 1.7 | 0.9 | 2.7 | 6.1 |
| | | *Microtendipes* | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - |
| | | Orthocladiinae | - | - | *1.9 | *0.8 | - | *2.4 | *1.1 | - | - | - | *3 | - | - | - | - |
| | | *Parametriocnemus* | - | - | 1 | - | 1.7 | 3.2 | 4.4 | - | 6.1 | 0.8 | - | - | - | 0.9 | - |
| | | *Paraphaenocladius* | - | - | - | - | - | - | - | - | - | 2.5 | - | - | - | - | 0.8 |
| | | *Platysmittia* | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Polypedilum* | - | - | - | - | - | 0.8 | - | - | 0.9 | - | 0.7 | - | - | 0.9 | - |
| | | *Stempellina* | - | - | - | - | - | - | - | - | - | 2.5 | - | - | - | - | - |
| | | *Stempellinella* | - | - | 2.9 | - | - | - | - | - | 5.3 | - | 0.7 | - | - | - | 2.3 |
| | | Tanytarsini | - | - | - | *3.4 | - | - | *3.3 | - | - | *1.6 | - | - | - | - | - |
| | | *Tanytarsus* | - | - | - | - | - | - | - | - | 1.8 | 2.5 | 1.5 | 0.9 | 0.9 | - | - |
| | | Thienemannimyia Group | - | *0.8 | - | - | - | - | - | - | - | - | *0.7 | - | - | - | - |
| | | *Trissopelopia* | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Tvetenia* | - | 2.5 | 1 | 0.8 | - | - | - | - | 1.8 | 0.8 | - | - | - | - | - |
| | Empididae | *Chelifera* | - | 3.4 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Clinocera* | - | - | - | - | - | - | 4.4 | - | - | - | - | - | - | 0.9 | - |
| | Simuliidae | *Prosimulium* | 3.4 | 31.4 | 3.8 | 13.4 | 11.9 | 0.8 | 3.3 | 23.6 | 7.9 | 0.8 | - | 11.2 | 0.9 | 11.6 | 19.1 |
| | | *Simulium* | 0.8 | - | - | - | - | - | 1.1 | - | - | 0.8 | - | - | 0.9 | - | - |
| | | *Stegopterna* | - | - | - | - | - | - | - | - | - | - | 0.7 | - | - | - | - |
| | Tipulidae | *Dicranota* | 0.8 | - | - | - | - | - | - | 0.9 | 0.9 | 0.8 | - | - | 1.9 | 0.9 | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Hexatoma* | - | - | 1 | - | - | 0.8 | 1.1 | 4.7 | - | - | - | - | - | 1.8 | - |
| | | *Pseudolimnophila* | 0.8 | - | - | - | - | - | - | 0.9 | - | - | 1.5 | - | 0.9 | - | - |
| | | *Tipula* | - | - | - | - | - | - | - | - | - | - | 0.7 | - | - | - | - |
| Ephemeroptera | Ameletidae | *Ameletus* | - | - | - | 0.8 | - | - | - | 0.9 | 0.9 | 1.6 | - | - | - | - | - |
| (Mayfly) | Baetidae | na | *13.6 | *5.9 | - | *3.4 | - | *0.8 | *1.1 | *4.7 | - | *2.5 | *2.2 | - | - | - | - |
| | | *Acentrella* | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Baetis* | 1.7 | - | - | 1.7 | 12.7 | 18.4 | 4.4 | - | - | 4.1 | 1.5 | 8.6 | 1.9 | 8 | - |
| | | ***Diphetor***$^{+}$ | - | - | 11.4 | - | - | - | - | - | 9.6 | 1.6 | 5.2 | 1.7 | 5.6. | - | - |
| | | ***Heterocleon*** | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| | Ephemerellidae | na | - | - | - | - | - | *1.6 | - | - | - | - | - | *5.2 | *5.6 | *0.9 | - |
| | | *Drunella* | - | - | - | 0.8 | - | - | - | - | 0.9 | 3.3 | - | - | 1.9 | 0.9 | - |
| | | *Ephemerella* | 2.5 | 4.2 | 2.9 | 5 | 1.7 | 1.6 | 3.3 | 4.7 | 3.5 | 4.9 | 8.9 | 3.4 | 5.6 | 8.9 | 2.3 |
| | | *Eurylophella* | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - |
| | | *Serratella* | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - |
| | Ephemeridae | ***Ephemera***$^{+}$ | - | - | - | - | - | - | - | - | - | - | 0.7 | - | - | - | - |
| | Heptageniidae | na | - | *1.7 | - | *4.2 | - | *5.6 | *1.1 | *4.7 | - | *0.8 | - | *2.6 | - | - | *0.8 |
| | | ***Cinygmula***$^{+}$ | 11 | - | 2.9 | 5 | - | - | 11.1 | - | 2.6 | 4.1 | 3 | 1.7 | 7.5 | - | - |
| | | ***Epeorus***$^{+}$ | 5.9 | 9.3 | 3.8 | 7.6 | 32.2 | 2.4 | 4.4 | 8.5 | 2.6 | 6.6 | 9.6 | 17.2 | 27.1 | 16.1 | 13 |
| | | *Leucrocuta* | 0.8 | - | - | - | - | - | - | - | - | - | 1.5 | - | - | - | - |
| | | *Maccaffertium* | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - |
| | | *Stenacron* | - | - | - | 2.5 | - | - | - | - | - | 0.8 | - | - | - | - | - |
| | | *Stenonema* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Isonychiidae | *Isonychia* | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| | Leptophlebiidae | na | - | - | *10.5 | *6.7 | - | *12.8 | *3.3 | *6.6 | *6.1 | *1.6 | *7.4 | *9.5 | *11.2 | *3.6 | *6.9 |
| | | ***Habrophlebia***$^{+}$ | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - |
| Megaloptera | | ***Paraleptophlebia***$^{+}$ | 13.6 | 8.5 | 9.5 | 3.4 | 6.8 | 0.8 | - | - | 8.8 | 3.3 | 3.7 | 4.3 | - | - | - |
| (Dobsonfly/Fishfly) | | ***Nigronia*** | - | - | - | - | - | - | - | - | - | - | - | - | 3.7 | - | - |
| | Sialidae | *Sialis* | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Odonata | Gomphidae | na | - | - | - | - | - | - | - | - | *0.9 | *0.8 | - | - | - | - | - |
| (Dragonfly/Damselfly) | | *Stylogomphus* | | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| Plecoptera | na | na | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| (Stonefly) | Capniidae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | - | *3.1 |
| | | *Allocapnia* | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| | Chloroperlidae | na | *0.8 | *0.8 | - | - | *1.7 | *0.8 | *1.1 | *0.9 | *1.8 | *2.5 | *2.2 | *0.9 | *2.8 | - | *0.8 |
| | | ***Alloperla***$^{+}$ | - | - | - | - | - | - | 2.2 | - | - | - | - | - | - | - | - |
| | | *Haploperla* | - | - | - | - | - | 4.8 | 1.1 | - | - | - | - | 0.9 | - | - | - |
| | Leuctridae | na | *1.7 | - | - | - | - | *11.2 | - | - | *6.1 | *4.9 | *9.6 | - | - | - | - |
| | | ***Leuctra***$^{+}$ | - | 3.4 | - | 1.7 | 3.4 | 3.2 | 1.1 | - | - | 0.8 | - | 0.9 | - | 1.8 | - |
| | Nemouridae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Amphinemura* | 11 | 5.9 | 6.7 | 11.8 | - | 1.6 | 4.4 | 16 | 14 | 18 | 8.1 | 6.9 | 4.7 | 11.6 | 6.9 |
| | Peltoperlidae | na | - | - | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - |
| | | *Peltoperla* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | ***Tallaperla***$^{+}$ | - | 0.8 | - | - | - | - | - | - | - | - | - | - | 1.9 | - | - |
| | Perlidae | na | *0.8 | - | *1.9 | *0.8 | *1.7 | *0.8 | *1.1 | *4.7 | *1.8 | *2.5 | *2.2 | *0.9 | - | *0.9 | *0.8 |
| | | *Acroneuria* | - | 2.5 | - | - | - | - | - | 0.9 | - | - | 0.7 | 0.9 | - | 1.8 | 1.5 |
| | | *Eccoptura* | - | - | - | - | - | - | - | - | - | - | 0.7 | - | - | - | - |

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Perlodidae | na | - | *1.7 | - | - | - | - | - | - | *0.9 | - | *1.5 | - | - | - | *1.5 |
| | | *Isoperla* | 5.1 | 1.7 | 1.9 | 1.7 | 5.9 | 0.8 | 4.4 | 0.9 | 1.8 | - | 0.7 | 0.9 | 1.9 | 3.6 | - |
| | Pteronarcyidae | *Pteronarcys* | 4.2 | 0.8 | 1 | 2.5 | 1.7 | 1.6 | - | 3.8 | 2.6 | 1.6 | - | 1.7 | - | 3.6 | 3.8 |
| Trichoptera | Glossosomatidae | *Agapetus* | - | - | - | - | - | - | - | - | - | 1.6 | 0.7 | - | - | - | - |
| (Caddisfly) | Hydropsychidae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | *0.9 | - |
| | | *Cheumatopsyche* | - | - | 1 | - | - | - | - | - | - | - | - | 0.9 | - | - | - |
| | | ***Diplectrona***[+] | 5.9 | 3.4 | 1.9 | 8.4 | 6.8 | 4.8 | 5.6 | 2.8 | 3.5 | 9.8 | 9.6 | 7.8 | 6.5 | 8.9 | 16 |
| | | *Hydropsyche* | - | - | 1 | 1.7 | 2.5 | - | 1.1 | - | - | - | - | 3.4 | - | 0.9 | 2.3 |
| | Lepidostomatidae | na | - | - | - | - | - | - | - | - | - | - | *0.7 | - | - | - | - |
| | | *Lepidostoma* | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - | - |
| | Limnephilidae | na | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - | - |
| | | *Pycnopsyche* | - | - | - | 0.8 | - | - | - | - | - | - | 0.7 | - | - | 1.8 | - |
| | Philopotamidae | na | - | - | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - |
| | | *Dolophilodes* | 0.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.5 |
| | | ***Wormaldia***[+] | - | - | - | - | - | - | - | - | - | - | 0.7 | - | 0.9 | 2.7 | - |
| | Polycentropodidae | na | - | - | - | - | - | - | - | - | *0.9 | - | - | - | - | - | - |
| | | *Polycentropus* | - | - | 1 | - | - | - | - | - | - | 0.8 | - | - | - | - | - |
| | Rhyacophilidae | *Rhyacophila* | - | 1.7 | - | - | 1.7 | - | - | 0.9 | - | - | - | 1.7 | - | 0.9 | 1.5 |
| | Uenoidae | *Neophylax* | - | 1.7 | 1.9 | 1.7 | 3.4 | 1.6 | - | 1.9 | - | 3.3 | - | 2.6 | 2.8 | 0.9 | 5.3 |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).
* Taxa not identified to genus
[+] Coldwater-preference genera

# *Savage River (SAVA-225-S)*

Site SAVA-225-S is located on the Savage River in the Highlands region of Maryland. It is in the Savage River watershed in Garrett County. This site was sampled in 1996 and 2000 to 2014.

*Savage River in spring 2013.*

## ***Land Use/ Land Cover***

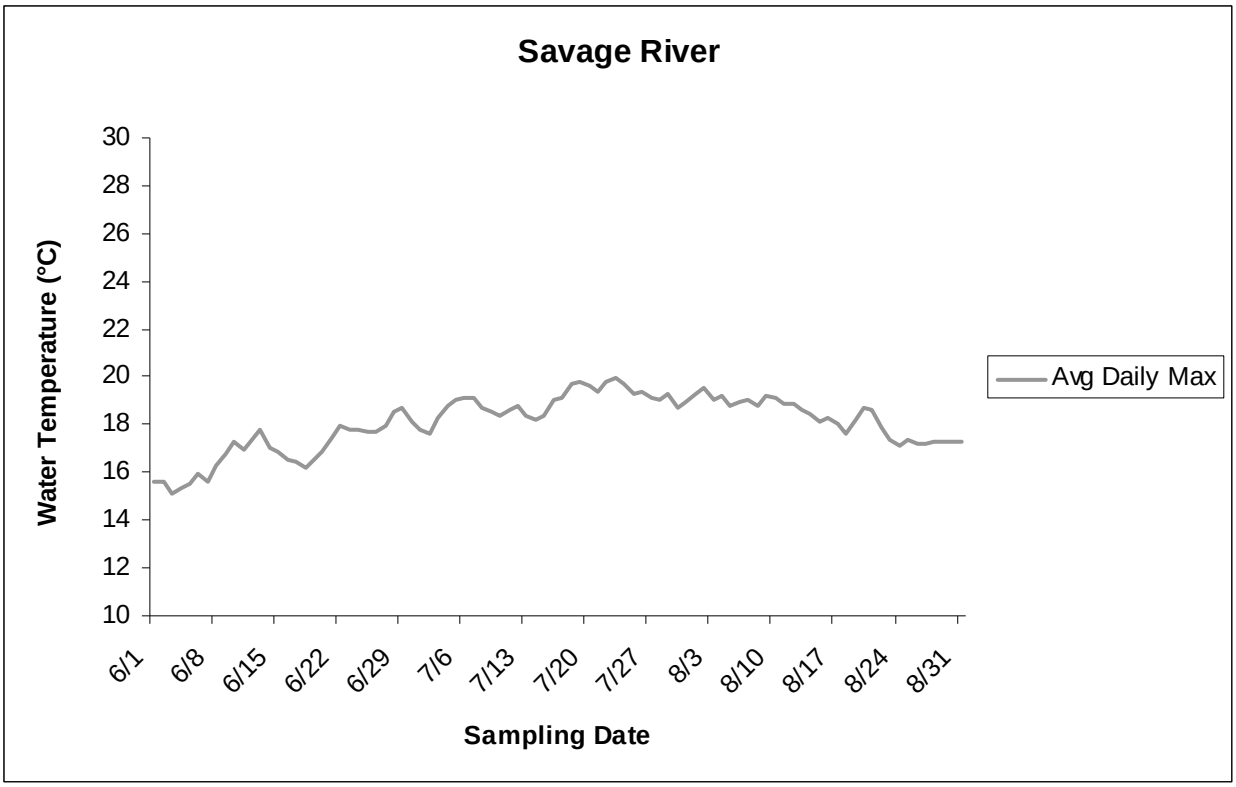
Percent land use/ land cover data (from NLCD 2001, 2006, and 2011) calculated for upstream catchment draining to this site.

| *Percent Land Type* | *2001* | *2006* | *2011* |
|---|---|---|---|
| Forest | 39.95 | 77.04 | 76.98 |
| Agriculture | 0.35 | 16.37 | 16.31 |
| Urban | 13.67 | 5.30 | 5.18 |
| Other | 46.03 | 1.28 | 1.53 |

## ***Physical Habitat***

Physical habitat measurements collected at the Savage River (1996 and 2000 to 2013). Scored parameters are on a 0 (worst) to 20 (best) scale.

| *Parameter* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Instream habitat (0-20) | 19 | 18 | 19 | 19 | 17 | 17 | 19 | 18 | 17 | 17 | 17 | 18 | 16 | 17 | 18 |
| Epifaunal substrate (0-20) | 18 | 16 | 17 | 19 | 17 | 17 | 19 | 18 | 18 | 18 | 19 | 19 | 17 | 19 | 17 |
| Velocity/Depth Diversity (0-20) | 18 | 16 | 16 | 17 | 15 | 15 | 17 | 16 | 18 | 16 | 16 | 17 | 15 | 15 | 14 |
| Pool Quality (0-20) | 19 | 17 | 17 | 18 | 18 | 17 | 18 | 17 | 16 | 15 | 15 | 15 | 17 | 17 | 15 |
| Riffle Quality (0-20) | 18 | 18 | 20 | 18 | 17 | 18 | 18 | 18 | 17 | 16 | 17 | 17 | 17 | 17 | 18 |
| Shading (%) | 75 | 75 | 65 | 90 | 85 | 85 | 80 | 91 | 75 | 70 | 75 | 75 | 75 | 50 | 35 |
| Embeddedness (%) | 15 | 10 | 20 | 25 | 30 | 25 | 25 | 15 | 15 | 15 | 10 | 5 | 15 | 5 | 5 |
| Discharge (cfs) | 4.91 | 4.84 | 3.45 | 4.60 | 4.95 | 1.87 | 7.17 | 0.18 | 11.48 | 3.05 | 3.10 | 14.25 | 3.53 | 7.18 | 5.42 |




The graph above displays the average daily maximum temperatures recorded at Savage River. The average was calculated from seven years of data. No temperature data is available for 2014.

## ***Biology***

### *Indexes of Biotic Integrity*

Metrics are scored on a 1 (very poor) to 5 (good) scale.

| *Metric* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIBI | 4.75 | 3.50 | 4.25 | 4.25 | 4.25 | 4.75 | 4.50 | 4.75 | 4.50 | 4.00 | 4.25 | 4.50 | 4.00 | 4.25 | 4.25 |
| FIBI | 4.67 | 5.00 | 5.00 | 5.00 | 4.33 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 4.33 | 4.33 | 5.00 | 5.00 | 4.67 |

### *Fish*

Cumulative list of fish species (with abundance) collected in the Savage River by sampling year.

| *Species* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Blue Ridge sculpin | 161 | 213 | 225 | 213 | 127 | 331 | 195 | 235 | 225 | 115 | 139 | 67 | 264 | 356 | 167 |
| Brook trout | 10 | 30 | 42 | 24 | 33 | 41 | 26 | 28 | 19 | 15 | 11 | 5 | 4 | 41 | 34 |
| Brown trout | 3 | - | - | 1 | 1 | - | - | 1 | 1 | - | - | - | - | - | 1 |
| Central stoneroller | - | - | - | - | - | - | - | 2 | - | 4 | - | - | - | - | - |
| Common shiner | - | 1 | - | - | 1 | 4 | 5 | 11 | - | - | - | - | - | 5 | 2 |
| Creek chub | 2 | 4 | 11 | 3 | 1 | - | 2 | - | 1 | 3 | 1 | 1 | 4 | 23 | 26 |
| Cutlip minnow | 24 | 33 | 58 | 61 | 55 | 46 | 24 | 36 | 24 | 14 | 26 | 3 | 11 | 30 | 29 |
| Eastern blacknose dace | 89 | 88 | 134 | 99 | 130 | 160 | 71 | 163 | 165 | 74 | 148 | 40 | 152 | 239 | 169 |
| Fantail darter | 34 | 56 | 27 | 41 | 24 | 54 | 32 | 68 | 45 | 14 | 18 | 7 | 86 | 85 | 29 |
| Longnose dace | 107 | 82 | 90 | 142 | 128 | 347 | 157 | 190 | 141 | 94 | 166 | 60 | 223 | 209 | 158 |
| Margined madtom | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Northern hogsucker | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - |
| Potomac sculpin | 23 | 30 | 23 | 28 | 24 | 25 | 8 | 14 | 15 | 8 | 18 | 7 | 32 | 31 | - |
| Rainbow trout | - | - | 1 | 1 | - | - | 2 | 2 | 1 | - | 2 | - | - | 2 | - |
| River chub | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| Rock bass | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Rosyside dace | 3 | 12 | 18 | 3 | 6 | 6 | 2 | 19 | 14 | 4 | 12 | 2 | 28 | 65 | 38 |
| Smallmouth bass | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| White sucker | 7 | 18 | 11 | 19 | 1 | 1 | 12 | 15 | 10 | 11 | 24 | 3 | 8 | 16 | 24 |
| Yellow perch | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - |

Green indicates intolerant fish; blue are moderately tolerant; and red are tolerant.

## *Crayfish*

Cumulative list of crayfish species (with abundance or presence {P}/absence {A} data) collected in the Savage River by sampling year

| *Species* | *2006* | *2007* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|---|---|---|
| Common crayfish (*Cambarus bartonii bartonii*) | P | P | A | P | P | P | P | P | P |
| Allegheny crayfish (*Orconectes obscurus*) | A | P | A | A | P | A | P | P | P |

## *Mussels*

Cumulative list of mussel species (with abundance or presence {P}/absence {A} data) collected in Savage River by sampling year.

| *Species* |
|---|
| None Observed |

## *Herpetofauna*

Cumulative list of herpetofauna species collected in or near the Savage River.

| *Order (Common)* | *Species* |
|---|---|
| Caudata (Salamanders and Newts) | Allegheny mountain dusky salamander, Eastern red-backed salamander, Eastern red-spotted newt, Jefferson salamander, Long-tailed salamander, Northern dusky salamander, Northern spring salamander, Northern two-lined salamander, , Seal salamander, Spotted salamander |
| Squamata (Snakes and Lizards) | Eastern, gartersnake, Eastern rat snake, Northern watersnake |
| Anura (Frogs and Toads) | American toad, Fowler's toad, Northern green frog, Pickerel frog |

*Benthic Macroinvertebrates*

Cumulative list of benthic macroinvertebrates collected in the Savage River by sampling year, RA = %Relative Abundance.

| *ORDER* | *FAMILY* | *GENUS* | *2000 RA* | *2001 RA* | *2002 RA* | *2003 RA* | *2004 RA* | *2005 RA* | *2006 RA* | *2007 RA* | *2008 RA* | *2009 RA* | *2010 RA* | *2011 RA* | *2012 RA* | *2013 RA* | *2014 RA* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PHYLUM ANNELIDA | | | | | | | | | | | | | | | | | |
| Haplotaxida | Enchytraeidae | na | - | - | - | *0.8 | - | - | - | *1 | - | - | - | - | - | - | - |
| Lumbriculida | Lumbriculidae | na | *1 | *0.8 | - | - | - | - | - | *1 | - | - | - | - | - | - | - |
| PHYLUM ARTHROPODA | | | | | | | | | | | | | | | | | |
| Coleoptera (Beetle) | Elmidae | *Oulimnius* | 1 | - | 1 | - | - | - | - | - | 1.8 | - | - | - | - | 0.8 | - |
| | | *Promoresia* | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - |
| | Psephenidae | *Psephenus* | - | - | - | - | 1 | - | - | - | - | 1 | - | - | 0.8 | 0.8 | - |
| Diptera (True Fly) | Athericidae | *Atherix* | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - |
| | Blepharicerida | *Blepharicera* | - | - | - | - | 1 | - | - | - | - | - | - | - | 3.9 | - | - |
| | Ceratopogonidae | na | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Bezzia* | - | - | - | - | - | - | - | - | - | 1 | - | 0.8 | - | - | - |
| | Chironomidae | na | - | - | - | - | - | - | - | - | - | - | - | *0.8 | - | - | - |
| | | *Brillia* | - | - | - | 0.8 | - | - | - | - | - | 1 | - | - | - | - | - |
| | | *Conchapelopia* | 1 | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Corynoneura* | - | 0.8 | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Cricotopus* | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - |
| | | *Diamesa* | - | - | - | 0.8 | 4 | 0.8 | - | 1 | - | - | - | - | 0.8 | - | - |
| | | *Eukiefferiella* | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| | | ***Heleniella*** [+] | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - |
| | | *Nanocladius* | - | 1.7 | - | 1.7 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Micropsectra* | 2 | - | 10.7 | 0.8 | 2 | 1.7 | - | 1 | 1.8 | - | - | - | 2.3 | 0.8 | 2.6 |
| | | *Microtendipes* | 2.9 | - | - | - | - | 1.7 | - | 1 | - | - | - | 0.8 | - | - | 0.9 |
| | | Orthocladiinae | *1 | *1.7 | - | *1.7 | - | - | - | *1 | - | - | - | - | - | 0.8 | - |
| | | *Orthocladius* | - | - | - | - | 1 | - | 0.8 | 1 | 2.7 | 3 | - | 0.8 | 2.3 | 6.8 | - |
| | | *Parametriocnemus* | 3.9 | 1.7 | - | 3.4 | 2 | - | - | 1 | 1.8 | 2 | 0.9 | 0.8 | - | 0.8 | - |
| | | *Paraphaenocladius* | - | - | - | 3.4 | - | - | - | - | - | - | - | 0.8 | - | - | - |
| | | *Polypedilum* | 2 | 5.8 | 1 | 3.4 | 5 | 3.3 | 0.8 | - | 7.3 | 2 | - | 0.8 | - | - | - |
| | | *Rheocricotopus* | - | 0.8 | - | 1.7 | - | - | - | - | - | 1 | - | - | - | - | - |
| | | *Rheosmittia* | - | - | - | - | - | - | 0.8 | - | - | - | - | - | - | - | - |
| | | *Rheotanytarsus* | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - | - | - |
| | | *Stempellinella* | 1 | - | - | - | - | - | - | 1 | 2.7 | - | - | 0.8 | - | 1.7 | - |
| | | *Stilocladius* | - | - | - | - | - | - | - | - | 0.9 | 2 | - | 0.8 | - | - | - |
| | | Tanypodinae | - | - | - | - | - | - | - | *1 | *0.9 | *2 | - | - | - | - | - |
| | | Tanytarsini | - | *6.6 | - | - | - | - | - | - | *1.8 | - | - | - | - | - | - |
| | | *Tanytarsus* | 1 | - | - | - | - | - | - | - | 0.9 | - | - | 2.5 | - | 0.8 | - |
| | | *Thienemanniella* | - | - | - | - | - | - | 0.8 | - | 0.9 | - | - | - | - | - | - |
| | | Thienemannimyia Group | - | - | - | - | - | *0.8 | *0.8 | - | *0.9 | - | - | *1.6 | - | - | - |
| | | *Trissopelopia* | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - |
| | | *Tvetenia* | - | 4.1 | 2.9 | - | - | 0.8 | - | 1.9 | 3.6 | 1 | - | 2.5 | - | 1.7 | 2.6 |
| | Empididae | *Clinocera* | - | - | - | - | - | 0.8 | 0.8 | 1 | 0.9 | - | - | - | - | - | - |
| | Simuliidae | *Prosimulium* | 1 | 23.1 | - | 3.4 | 4 | - | 15.3 | 1 | - | - | 4.4 | - | 17.8 | 13.6 | 13 |
| | | *Simulium* | - | - | - | - | - | - | - | - | - | - | 0.9 | - | - | - | - |
| | Tipulidae | *Antocha* | - | - | - | - | - | 0.8 | - | - | 0.9 | 2 | - | 0.8 | 3.1 | - | 1.7 |
| | | *Dicranota* | 1 | - | - | 0.8 | - | - | - | - | - | - | - | 0.8 | - | - | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Hexatoma* | 1 | - | - | - | - | - | - | - | 0.9 | - | - | 1.6 | - | - | - |
| | | *Tipula* | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| Ephemeroptera | Ameletidae | *Ameletus* | - | - | - | 0.8 | - | - | 0.8 | - | - | - | - | 0.8 | - | - | - |
| (Mayfly) | Baetidae | na | - | - | *5.8 | *1.7 | - | *1.7 | - | - | - | - | - | - | - | - | - |
| | | *Acentrella* | - | - | - | 1.7 | - | - | - | - | - | - | - | - | - | - | - |
| | | *Acerpenna* | 2 | - | - | - | - | - | - | 1 | 7.3 | 1 | - | - | - | 0.9 | - |
| | | *Baetis* | 2 | 4.1 | - | - | 6 | 5.8 | 4.2 | 1 | 1.8 | - | 7.1 | - | 0.8 | 1.7 | 8.7 |
| | | ***Diphetor***$^{+}$ | - | - | - | - | - | - | - | - | 0.9 | - | 1.8 | - | 0.8 | - | - |
| | | *Fallceon* | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | Ephemerellidae | na | - | - | - | *1.7 | - | - | - | - | - | *4 | *7.1 | *5.7 | - | *1.7 | - |
| | | *Drunella* | 1 | - | 1.9 | 2.5 | 1 | 5.8 | 5.1 | 7.6 | - | - | 5.3 | - | 3.1 | - | - |
| | | *Ephemerella* | 33.3 | 31.4 | 28.2 | 19.3 | 23 | 24.2 | 39 | 21.9 | 8.2 | 30.7 | 14.2 | 10.7 | 21.7 | 15.6 | 33 |
| | | *Eurylophella* | - | - | 1 | - | - | - | - | - | - | - | - | - | - | 0.9 | - |
| | | *Serratella* | 1 | - | - | 7.6 | - | 2.5 | 3.4 | 2.9 | 0.9 | 3 | 4.4 | - | - | - | - |
| | | ***Teloganopsis*** | - | - | - | - | - | - | - | - | - | - | - | 3.3 | 0.8 | 0.9 | - |
| | Ephemeridae | ***Ephemera***$^{+}$ | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | 0.9 |
| | Heptageniidae | na | - | - | *1 | - | - | - | *5.1 | - | - | *1 | *0.9 | - | - | - | - |
| | | ***Cinygmula***$^{+}$ | 7.8 | - | - | - | 1 | 9.2 | - | 5.7 | 8.2 | 4 | 18.6 | 17.2 | 10.9 | 7.6 | 2.6 |
| | | ***Epeorus***$^{+}$ | 2.9 | 7.4 | 1.9 | 3.4 | 8 | 4.2 | 3.4 | - | 2.7 | 3 | 6.2 | 9.8 | 7 | 5.1 | 1.7 |
| | | *Heptagenia* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | *Leucrocuta* | - | - | - | - | - | 0.8 | - | - | 0.9 | - | 3.5 | - | 0.8 | - | - |
| | | *Maccaffertium* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 |
| | | *Stenacron* | - | - | - | - | - | - | - | - | - | - | - | 3.3 | - | - | - |
| | | *Stenonema* | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Isonychiidae | *Isonychia* | 3.9 | - | 3.9 | 0.8 | 2 | 3.3 | - | 1.9 | 1.8 | - | - | 2.5 | 1.6 | - | 3.5 |
| | Leptophlebiidae | na | - | - | - | *7.6 | - | *0.8 | *3.4 | *8.6 | *10.9 | *4 | *2.7 | *2.5 | *3.1 | *6.8 | *9.6 |
| | | ***Paraleptophlebia***$^{+}$ | 9.8 | 3.3 | 18.4 | 11.8 | 10 | 10 | 1.7 | - | 7.3 | 5.9 | 1.8 | 8.2 | 0.8 | 6.8 | 3.5 |
| Megaloptera | Corydalidae | *Nigronia* | - | - | - | - | 1 | - | - | - | 0.9 | - | - | - | 0.8 | - | - |
| (Dobsonfly/Fishfly) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Odonata | Aeshnidae | *Boyeria* | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| (Dragonfly/Damselfly) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Plecoptera | Capniidae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | *0.8 | - |
| (Stonefly) | | *Paracapnia* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | 0.9 |
| | Chloroperlidae | na | *1 | - | - | - | *1 | *0.8 | - | *5.7 | - | - | *2.7 | - | - | - | - |
| | | *Haploperla* | - | - | - | - | - | - | 0.8 | - | 0.9 | - | - | - | - | - | - |
| | | ***Sweltsa***$^{+}$ | 1 | - | - | 0.8 | - | - | - | 1.9 | - | 2 | 0.9 | - | - | - | 0.9 |
| | Leuctridae | na | - | - | - | *0.8 | - | *2.5 | - | *12.4 | *1.8 | - | - | *0.8 | - | - | - |
| | | ***Leuctra***$^{+}$ | - | 1.7 | 1 | - | 8 | - | - | - | 0.9 | - | - | - | - | 0.8 | - |
| | Nemouridae | na | - | - | - | - | - | - | - | - | - | - | - | - | - | *0.8 | - |
| | | *Amphinemura* | 2.9 | - | - | 1.7 | 1 | 1.7 | 0.8 | 4.8 | - | - | 1.8 | 3.3 | - | - | - |
| | Peltoperlidae | *Tallaperla*$^{+}$ | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - | - | - |
| | Perlidae | na | *1 | - | - | - | - | - | - | - | *0.9 | *1 | *0.9 | - | - | *1.7 | - |
| | | *Acroneuria* | 2 | - | - | - | 4 | - | 3.4 | - | 0.9 | - | 0.9 | 1.6 | - | 1.7 | 0.9 |
| | Perlodidae | na | - | - | *2.9 | *3.4 | - | - | *0.8 | *1 | - | - | - | - | *0.8 | - | - |
| | | *Isoperla* | 3.9 | 1.7 | - | 0.8 | 6 | 7.5 | 0.8 | 1.9 | 3.6 | 5.9 | - | 4.9 | 0.8 | 4.2 | 7 |
| | Pteronarcyidae | *Pteronarcys* | - | - | - | - | - | 0.8 | - | - | - | - | 0.9 | 0.8 | - | - | - |
| | Taeniopterygidae | *Strophopteryx* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | - |

| ORDER | FAMILY | GENUS | 2000 RA | 2001 RA | 2002 RA | 2003 RA | 2004 RA | 2005 RA | 2006 RA | 2007 RA | 2008 RA | 2009 RA | 2010 RA | 2011 RA | 2012 RA | 2013 RA | 2014 RA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Taenionema* | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.8 | 0.9 |
| Trichoptera | Brachycentridae | *Brachycentrus* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| (Caddisfly) | Hydropsychidae | *Ceratopsyche* | - | - | - | - | - | - | - | - | - | 3 | 4.4 | - | - | - | - |
| | | *Cheumatopsyche* | - | - | 1.9 | - | 4 | 0.8 | 0.8 | 2.9 | 3.6 | 1 | 5.3 | 3.3 | 6.2 | 5.9 | 1.7 |
| | | ***Diplectrona***[+] | - | 0.8 | - | 0.8 | 2 | - | - | - | - | 1 | 0.9 | - | - | - | - |
| | | *Hydropsyche* | 2 | 0.8 | 2.9 | - | 1 | 4.2 | 1.7 | - | 0.9 | 1 | - | - | 5.4 | - | 0.9 |
| | Lepidostomatidae | *Lepidostoma* | - | 1.7 | 11.7 | 2.5 | - | - | 0.8 | 1 | 0.9 | 1 | - | 2.5 | - | 0.8 | 0.9 |
| | Limnephilidae | *Pycnopsyche* | - | - | - | 0.8 | - | - | - | - | - | - | - | - | - | - | - |
| | Odontoceridae | *Psilotreta* | - | - | - | - | - | - | - | 1 | - | - | 0.9 | 0.8 | - | 0.8 | - |
| | Philopotamidae | *Dolophilodes* | - | - | - | - | - | - | 0.8 | 1 | - | - | - | - | 1.6 | 0.8 | 0.9 |
| | Polycentropodidae | na | - | - | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - |
| | | *Polycentropus* | - | - | - | - | - | - | - | - | 0.9 | - | 0.9 | - | - | - | - |
| | Rhyacophilidae | *Rhyacophila* | 1 | - | - | 1.7 | - | 0.8 | 0.8 | 1 | - | - | - | - | 0.8 | 0.8 | - |
| | Uenoidae | *Neophylax* | 1 | - | - | - | - | 0.8 | - | - | - | - | - | - | - | 1.7 | - |
| PHYLUM MOLLUSCA | | | | | | | | | | | | | | | | | |
| Gastropoda | na | na | - | - | - | *0.8 | - | - | - | - | - | - | - | - | - | - | - |
| (Snail) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

Green families are intolerant (family tolerance values from 0 to 3); blue are moderately tolerant (family tolerance values from 3.1 to 6.9); and red are tolerant (family tolerance values from 7 to 10).
* Taxa not identified to genus
[+] Coldwater-preference genera