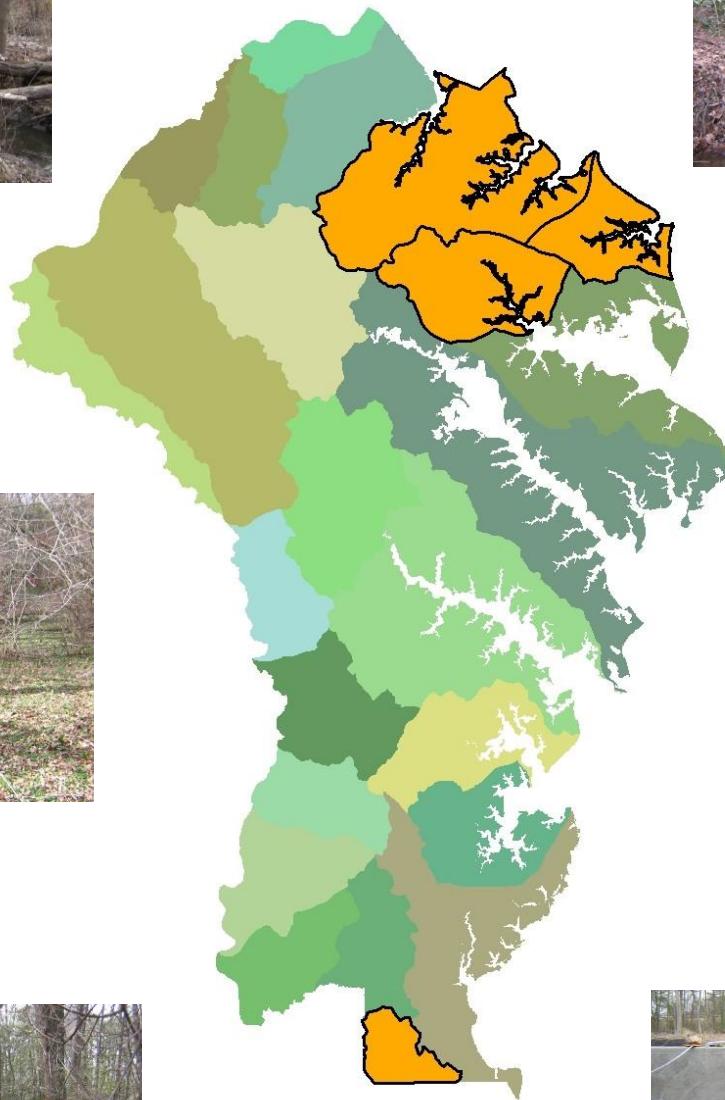


## Aquatic Biological Assessment of the Watersheds of Anne Arundel County, Maryland: 2006



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County, Maryland: 2006**

**Prepared by:**

Tetra Tech, Inc.  
400 Red Brook Blvd., Suite 200  
Owings Mills, MD 21117-5159

**Prepared for:**

Anne Arundel County  
Department of Public Works  
Watershed, Ecosystem, and Restoration Services  
2662 Riva Road  
Annapolis, MD 21401

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## **Abstract**

The Anne Arundel County Department of Public Works' Watershed and Ecosystem Services Program assesses water resource quality as it relates to the intended uses of the waterbodies and State regulations. One intended use of all waterbodies is the support of aquatic life. Assessment of the ability of a stream to support aquatic life can be accomplished for the entire County through probabilistic (random) site selection, sampling of biological specimens, and observations of the physical habitat and water quality. Sampling in four subwatershed-based primary sampling units in 2006 partially fulfills the DPW goal of County-wide stream assessment. The primary sampling units include Marley Creek, Bodkin Creek, Upper Magothy River, and Hall Creek. The indicators used to assess the support of aquatic life in streams include the Benthic Index of Biological Integrity (BIBI), the Rapid Bioassessment Protocol (RBP) physical habitat assessment, the Maryland Biological Stream Survey Physical Habitat Index (PHI), geomorphic conditions in the context of the Rosgen Classification of Natural Rivers, and four water quality measures (temperature, dissolved oxygen, specific conductance, and acidity). Excluding stream classification, each of these indicators was compared to established thresholds. The percentage of samples on the acceptable side of each threshold was tallied to arrive at estimates of water resource quality in the subwatersheds. Each of the four subwatersheds rated as poor for biological condition (using the Maryland Benthic-IBI), along with different levels of physical degradation (using USEPA RBP habitat assessment and the Maryland DNR Physical Habitat Index [PHI]).



## Acknowledgements

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For more information about this report, please contact:

Christopher Victoria  
Watershed, Ecosystem, and Restoration Services  
Department of Public Works  
Anne Arundel County  
2662 Riva Road / MS 7301  
Annapolis, Maryland 21401  
410.222.4240  
pwvict16@aacounty.org

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## Introduction

Anne Arundel County is bordered on the north by the Patapsco River, to the west by the Patuxent River and to the east by the Chesapeake Bay. All streams within the County, whether directly or indirectly, eventually discharge into the Chesapeake Bay. The Chesapeake Bay is the largest estuary in the United States (USEPA 2004) with a drainage area of over 64,000 square miles. It provides ideal habitat for a broad diversity of plant and animal species, and is also an important economic and recreational resource for the more than 15 million people who live in its basin. However, rapidly expanding human activity and population in the basin is leading to increasing rates of landscape conversion, new and intensifying point and nonpoint sources of pollutants, and multiple other sources of stressors to environmental conditions.

Because resource constraints prevent evaluation of every reach in every subwatershed, and it is impossible to know all stressor sources, it is important to monitor in such a way as to allow broad spatial coverage, to minimize bias in the site selection process, and to structure assessments at multiple spatial scales. This is imperative because habitat fragmentation caused by development or other stressors can often be underestimated at smaller spatial scales (Robinson et al. 1992, Suter 1993). Further, traditional regulatory approaches do not adequately address the effects of non-point source pollution, such as runoff or nutrient enrichment (USEPA 1996).

In 2004, the Anne Arundel County Office of Environmental and Cultural Resources (now the Watershed and Ecosystem Services Group of the Department of Public Works) began a five-year, rotating basin sampling effort to assess the ecological condition of streams and watersheds throughout the County (Hill and Stribling 2004). The primary goals of the biomonitoring program are to assess the current ecological status of

streams and watersheds of the County and to establish baseline conditions to which future assessments can be compared; to assess the status and trends of the biological stream resources, and to relate them to specific programmatic activities, such as BMP siting, installation, and evaluation (Stribling et al. 2001); stormwater discharge permits; contributing to restorations initiatives (such as DNR's Watershed Restoration Action Strategy [WRAS]); and guidelines for Low Impact Development [LID] (PG County 2000).

In the first year of the monitoring program (2004), the Severn River (Severn Run and Lower Severn River), Lower Patapsco River, Middle Patuxent River, and Ferry Branch sampling units were assessed (Victoria and Markusic 2007). In 2005, Herring Bay, South River (Upper and Lower), Lyons Creek and Stocketts Run sampling units were assessed (Roberts et al. 2006). The purpose of this report is to present the third year results of the sampling, analysis, and assessment results for Marley Creek, Bodkin Creek, Upper Magothy River and Hall Creek sampling units.

## *Purpose of Biological and Physical Habitat Assessment*

The use of benthic macroinvertebrates as the basis of biological assessments offers a number of considerable advantages such as 1) they are ubiquitous and often occur in large numbers; 2) they respond to cumulative effects of physical habitat alteration, point source pollution, non-point source contaminants; 3) they are relatively sedentary; and 4) different aspects of the benthic assemblage change in response to degraded conditions (Barbour et al. 1999).

To supplement biological sample collection, physical habitat quality was also visually assessed at each sampling location (Barbour et al. 1999, Kazyak 2001), which reflects physical complexity of the stream channel, the capacity of the stream to support a "healthy" biota, and potential of the channel to maintain normal rates

of erosion and other hydrogeomorphic functions. Moreover, impacts on physical habitat through sustained farming operations, increased housing density, and other urban-suburban developments (highways, schools, shopping centers) cause sedimentation, degradation of riparian vegetation, and bank instability, leading to reduced overall habitat quality (Richards et al. 1996).

Further factors such as interruption of natural hydrologic regimes, alterations in food/energy sources and water quality, and nonnative invasive species cause the biological condition of a stream to deteriorate (Karr et al. 1986). Potential stressors that cause this type of degradation include nutrient enrichment, toxic spills, flood control engineering, temperature extremes due to depletion of riparian zones or effluent discharge, and elevated levels of suspended sediment due to livestock access, clearing of riparian areas, and/or construction runoff. Sources of these stressors exist throughout Anne Arundel County. However, although biological monitoring is a critical tool for detecting impairment, it cannot identify specific causal relationships between stressors and stressor sources (Norton et al. 2000, USEPA 2000). Combining results from both biological and physical habitat assessments can provide insight into the potential types of stressors and stressor sources causing observed biological impairment. This allows prioritization of more detailed, diagnostic investigations based on the severity of observed biological responses. This report reflects the current biological, physical, and geomorphological conditions of the Marley Creek, Bodkin Creek, Hall Creek and Upper Magothy River watersheds (**Figure 1**), and provides potential reasons for those conditions.

## Methods

### *Network Design*

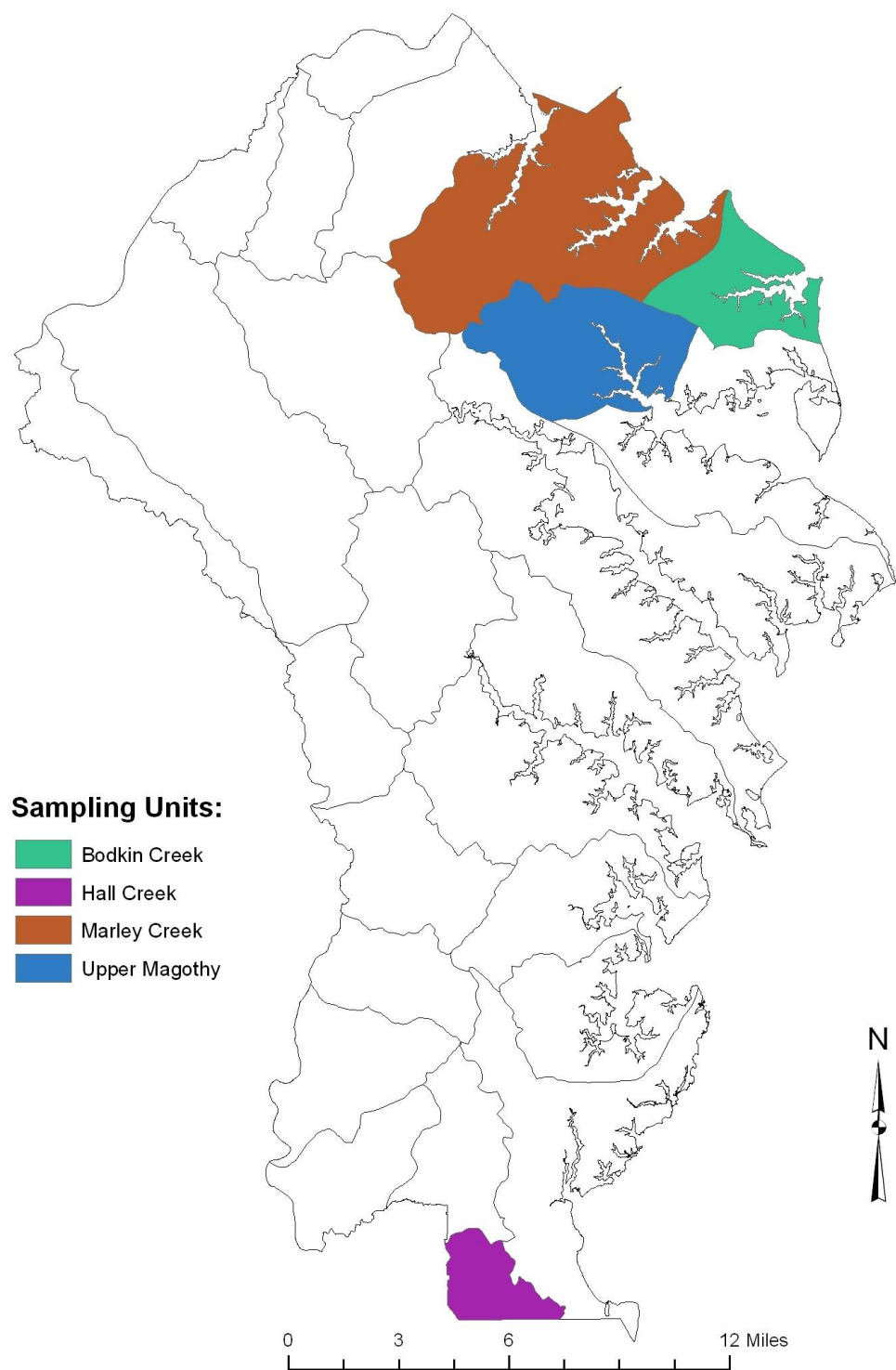
#### *Summary of Sampling Design*

Measurement and data quality objectives (MQOs and DQOs) for the Anne Arundel County biological monitoring program, including the approach for selection of sampling locations and documentation of data quality and performance characteristics, is presented in Hill and Stribling (2004) and Hill et al. (2005).

#### *Site Selection*

The program is designed so that 10 sites in each of four or five primary sampling units (PSU) are sampled per year, thus totaling 40-50 sites per year. A total of 24 PSUs will be sampled over a five-year period. Spatial allocation of the sampling segments was based on random selection within Strahler (1957) stream orders. The number of sampling segments within each of the first through third order channel distances was proportional to total stream length (meters). Thus, final selection and placement of sampling segments was random, and stratified by subwatershed and stream order at 1:100,000 scale.

For 2006, 10 randomly selected sites were chosen from each PSU (Marley Creek [5], Bodkin Creek [6], Upper Magothy River [7], and Hall Creek [24]) for a total of 40 sites. A single site within each PSU was randomly-selected for purposes of quality control (QC) sites to address issues of measurement error (= systematic error). The number of repeat samples collected was 10 percent of the total for this sampling event (4 sites); thus, there were a total of 44 samples collected at 40 sites. Only biology, chemistry, and physical habitat data were repeated. Geomorphologic work was not repeated at the QA/QC sites.



**Figure 1 - 2006 Sampling Units.**



### *Alternate Sites*

In addition to the primary sites, ten secondary (alternate) sites were randomly chosen for each subwatershed to provide backup locations in the event that the primary sampling site was deemed unsampleable (i.e., landowner denied access, no channel remaining [filled in] or, channel too deep). During this sampling period, it was necessary to sample a total of 10 alternate sites (**Table 1**).

*Table 1–Field Sampling- Alternate Sites Chosen*

<b>Original Site</b>	<b>Alternate Site</b>	<b>Reason</b>
05-01	05-11A	Dry swale
05-03	05-13A	Tidal/unwadeable segment
05-05	05-15A	Dry swale
06-01	06-11A	Dry channel
06-06	06-12A	Dry channel
06-07	06-13A	Dry channel
07-01	07-11A	Wetland, no defined channel
07-06	07-14A	Ponded by impoundment
24-01	24-11A	Permission denied
24-03	24-13A	Backwatered by beaver

### *Field Sampling and Laboratory Processing*

Sites were located in the field using topographic maps and handheld GPS units for navigation to pre-selected coordinates, which mark the mid-point of each site. A 75-meter segment of stream was measured following the thalweg, and both upstream and downstream ends were flagged and labeled. Field data collection was conducted in accordance with the methods described in the *Sampling and Analysis Plan (SAP) for Anne Arundel County Biological Monitoring and Assessment Program* (Tetra Tech 2005), which are summarized below. Field data collection forms are included in **Appendix A**.

#### *Benthic Sampling and Processing*

At each site, benthic macroinvertebrates were collected from a 75-meter reach by sampling approximately 20 ft<sup>2</sup> of surface area with a D-frame net (595 µm mesh), with an emphasis on the most productive habitat types (e.g., riffles,

snags, vegetated banks, sandy bottom) found within the reach. The most productive habitat types, in order of sampling preference include riffles, gravel/broken peat and/or clay lumps in a run area, snags/logs that create a partial dam or are in a run area, undercut banks and associated root mats in moving water, and detrital/sand areas in moving water. Kazyak (2001) also states that it is appropriate to move outside of the 75m reach if necessary to locate riffle habitat. Samples are primarily collected by jabbing the net into a habitat type (snags, root wads) to dislodge organisms or by disturbing the bottom substrate just upstream of the net allowing organisms to wash into the net. Larger surfaces such as logs or cobbles are often scrubbed by hand to further dislodge organisms. All sampled material (including leaf litter, small woody debris, and sediment) was composited in a 595 µm sieve bucket, placed in one or more one-liter sample containers and preserved in 70 - 80% ethanol. Internal and external labels were completed for each container. Samples were tracked on chain-of-custody forms and transported to the laboratory for sorting.

All sorting of the samples and taxonomic identifications were completed by the Aquatic Resources Center (ARC), Nashville, TN. The subsampling method involved spreading the entire sample on a Caton gridded tray (Caton 1991, Flotemersch et al. 2006) with 30 square grids (6-cm each), which allows isolation of physically defined amounts of sample material (leaf litter detritus, sticks, substrate particles) from the total sample and the separation/removal of the organisms from that material. A minimum of four grids were selected at random and sorted to completion until the target number of organisms ( $100 \pm 20\%$ ) was reached. If more than 40 organisms are found in the first grid, the original four grids are re-spread on a separate Caton tray and another four grids are then randomly selected for sorting, and consecutive grids are selected until the target number is reached.

### *Benthic Taxonomy*

Primary taxonomy (Boward and Friedman 2000) was performed by ARC and were identified primarily to genus level. In some cases, e.g., when individuals were early instars or had damaged or missing diagnostic morphological features, identification was left at genus-group, subfamily, or family level. Taxonomic data were received in Excel spreadsheets and loaded into the Ecological Data Application System, Version 3.2 (EDAS, TetraTech 1999). Functional feeding group, habit, and tolerance value designations were assigned to each taxon according to Merritt and Cummins (1996), Barbour et al. (1999), and Stribling et al. (1998). The tolerance value assigned to each taxon is based on its ability to survive and reproduce in the presence of chemical pollution, hydrologic alteration, or habitat degradation (Stribling et al. 1998, Bressler et al. 2005, 2006, Flotemersch et al. 2006).

### *Stream Physical Habitat Assessments Methods*

Physical habitat quality was visually assessed at each site using two procedures, the USEPA Rapid Bioassessment Protocol (RBP; Barbour and Stribling 1994; Barbour et al. 1999) and MBSS Physical Habitat Index (PHI; Paul et al. 2003). The RBPs evaluate 10 parameters that describe instream physical characteristics, channel morphology, and riparian vegetation and stream bank structure. Each parameter was scored as either optimal, suboptimal, marginal, or poor and given a corresponding score based on a 20-point scale (20 = best, 0 = worst), or 10-point scale for individual bank parameters. The following 10 parameters were evaluated:

- epifaunal substrate/available cover
- pool substrate characterization
- pool variability
- sediment deposition
- channel flow status
- channel alteration
- channel sinuosity
- bank stability

- vegetative protection
- riparian vegetative zone width

The MBSS PHI is based on the RBP method but has been revised to incorporate parameters that better characterize the physical complexity of Maryland Coastal Plain streams. The PHI evaluates physical habitat quality based on the following metrics: bank stability, instream woody debris and rootwads, instream habitat quality, epibenthic substrate, shading, and remoteness.

### *Water Quality*

Conductivity, dissolved oxygen, pH, and temperature were measured at each site using a YSI 600QS sonde and 650 MDS display unit. This instrument was calibrated according to the specifications provided by the manufacturer, and the readings were recorded on a calibration log sheet.

### *Geomorphic Assessment*

Geomorphic surveys were conducted within the 75-meter segments at each site identified in the four sampling units. Geomorphic assessment measurements included a simplified longitudinal profile survey, a cross section survey, and pebble counts following methods described in Harrelson et al. (1994). Data from these measurements were recorded on field forms and used to determine the stream type of each reach as categorized by the Rosgen Stream Classification (Rosgen 1994). Using basic geomorphic parameters described in greater detail below, stream reaches were classified into one of 42 basic stream types. Details on each of the types can be found in Rosgen (1996) and briefly in the Data Analysis section of this report.

The simplified longitudinal profile was performed throughout the 75-meter reach length of each site. The purpose of the longitudinal profile was to identify indicators and elevations of the bankfull discharge (bankfull indicators) and to determine the bankfull water surface slope throughout the reach. Once the bankfull

indicators were identified, elevation data on the channel thalweg, water surface, and bankfull indicator were collected, at a minimum, at the upstream and downstream ends of the representative reach on the same bed feature.

The cross section surveys were performed at channel transects that were installed in riffles as close to the midpoint of the 75-meter reach as possible. If no riffles existed within the reach, cross sections were installed in a nearby run or glide within a straight transitional reach (i.e., not in a meander bend pool). Cross section monuments, placed on each bank, consisted of iron reinforcement bars hammered to within six inches of the ground surface and topped with yellow caps. The monuments were field identified with orange flagging labeled with the site name and wrapped around the rebar and on nearby trees. The photos at each cross section and each cross section monument were located using the GPS.

Each cross section survey consisted of measuring the topographic variability of the associated stream bed, floodplains, and terraces, including:

- monument elevations,
- changes in topography,
- top of each channel bank,
- elevations of bankfull indicators,
- edge of water during time of survey,
- thalweg or deepest elevation along active channel, and
- depositional and erosional features within the channel.

During the cross section survey, the following measurements and calculations of the bankfull channel that are critical for determining the stream type of each reach also were collected:

- Bankfull Width (Wbkf): the width of the channel at the elevation of bankfull discharge or at the stage that defines the bankfull channel.

- Mean Depth (dbkf): the mean depth of the bankfull channel.
- Bankfull Cross Sectional Area (Abkf): the area of the bankfull channel, estimated as the product of bankfull width and mean depth.
- Width Depth Ratio (Wbkf/dbkf): the ratio of the bankfull width divided by the mean depth.
- Maximum Depth (dmbkf): the maximum depth of the bankfull channel, or the difference between the thalweg elevation and the bankfull discharge elevation.
- Width of Floodprone Area (Wfpa): the width of the channel at a stage of twice the maximum depth. If the width of the floodprone area was far outside of the channel, its value was visually estimated or paced off.
- Entrenchment Ratio (ER): the ratio of the width of the floodprone area divided by bankfull width.
- Sinuosity (K): ratio of the stream length divided by the valley length or the valley slope divided by the channel slope. Sinuosity was visually estimated or the valley length was paced off so that an estimate could be calculated.

To determine the size of channel substrate within the 75-meter reach segments, a Wolman Pebble Count (Wolman 1954) was performed, which consists of stratifying the reach based on its frequency of pools, riffles, runs, and glides. The goal of the pebble count is to measure the intermediate axis of 100 particles across ten transects, or ten particles in each of ten transects across the bankfull width and calculate the median particle size, the D50, of the reach. This value was then used for the Rosgen system to classify the sites. The number of transects performed in each bed feature was determined by measuring or visually estimating the percentage of reach length for each type of bed feature. For example, if riffles covered 20 percent of the reach length, then 20 percent of the pebble count, or two transects, were performed in riffles. If a

channel was clearly a sand or silt bed channel with no distinct variation in material size, the pebble count was not performed, and the D50 was visually estimated. However, if the channel did have changes in bed material size from feature to feature, a full pebble count was performed.

## Data Analysis

### Land Use and Impervious Surface Evaluation

The County has an extensive collection of spatial data which was used to characterize land use and impervious surface distributions and the age of development occurrence for the areas evaluated during this assessment. All geoprocessing work was done using ArcGIS 9.1. Individual land use coverages were developed for each sampling unit and for the drainage upstream of each sampling point from a countywide coverage. Additionally, shapefiles of impervious surfaces were also created for each sampling unit and for the land area draining to each sampling point from a countywide coverage of impervious surfaces. This information is summarized for each sample station in **Appendix A: Individual Site Summaries**.

Both the impervious coverage and the land use coverage were developed from aerial photography collected in 2004. Both of these coverages are vector type data and were developed at a map scale of 1:2400.

### Data Structure

Benthic macroinvertebrate, physical habitat, and water quality data were entered into EDAS, Version 3.2 (Tetra Tech 1999). This relational database allows for the management of location and other metadata, taxonomic and count data, raw physical habitat scores, the calculation of metric values, physical habitat and water quality rankings, and BIBI values.

### Physical Habitat

The 10 RBP metric scores are summed to obtain a final habitat score, which is then compared to a

reference condition score. However, since there was no RBP data for reference sites within Anne Arundel, a reference condition based on similar studies from Prince George's County, Maryland (Stribling et al. 1999) was used. The values were compared to the maximum possible score (168) for overall percent comparability for each site.

**Table 2** provides narrative ratings that correspond to physical habitat quality scores. These scores express the potential of a stream or watershed to support a healthy biological community. Percentages and their narrative ratings were adapted from Plafkin et al. (1989).

Table 2– EPA RBP Scoring

Score	Narrative
151 +	Comparable
126 – 150	Supporting
101 – 125	Partially Supporting
0 – 100	Non-supporting

Source: Stribling et al. 1999

For the PHI, the metric values scored in the field are adjusted for watershed size and scored on a 100-point scale. The scores are then summed and divided by the total number of metrics (six) to a yield final score. **Table 3** provides the narrative ratings that correspond to PHI scores. Composite scores or values for individual sampling units are presented as means plus/minus a single standard

Table 3–MPHI Scoring

Score	Narrative
81-100	Minimally Degraded
66-80.9	Partially Degraded
51-65.9	Degraded
0-50.9	Severely Degraded

Source: Paul et al. (2002), Boward (2006)

deviation ( $\bar{x} \pm 1$  s.d.).

### Biological Index Rating

The biological indicator is based on the Index of Biological Integrity (IBI; Karr et al. 1986), which uses characteristics of the benthic macroinvertebrate assemblage structure and function to assess the overall water resource condition. Benthic IBI (BIBI) were developed by

the MBSS and calibrated for different geographic areas of Maryland (Stribling et al. 1998). In 2005, MBSS revised the BIBI (Southerland et al. 2005). The revised benthic metrics calculated in this report were those selected and calibrated specifically for Maryland Coastal Plain streams. The seven metrics calculated for each of the benthic macroinvertebrate samples were:

1. *Total number of taxa.* The taxa richness of a community is commonly used as a qualitative measure of stream water and habitat quality. Stream degradation generally causes a decrease in the total number of taxa.
2. *Number of EPT taxa.* Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) are generally sensitive to degraded stream conditions. A low number of taxa representing these orders are indicative of stream degradation.
3. *Number of Ephemeroptera.* Mayflies are generally sensitive to pollution and the number of mayfly genera represented by individuals in a sample can be an indicator of stream conditions, generally decreasing with increasing stress.
4. *Percent Intolerant to Urban.* This is the percentage of the benthic sample that is intolerant to urban stressors. This metric decreases with increased stream degradation.
5. *Percent Ephemeroptera.* The degree to which mayflies dominate the community can indicate the relative success of these generally pollution intolerant individuals in sustaining reproduction. The presence of stresses will reduce the abundance of mayflies relative to other, more tolerant individuals; although, some mayfly groups, such as several genera of the family *Baetidae*, are known to increase in numbers in cases of nutrient enrichment.
6. *Number of Scrapers.* Specialized feeders such as scrapers tend to be more sensitive species and are thought to be well represented in healthy streams, and tend to decrease with increasing stressors.
7. *Percent Climbers.* This is the percentage of the benthic sample living primarily on stem

type surfaces. Climbers tend to decrease with increasing stressors.

Each metric was scored on a 5, 3, 1 basis (5 being the best, 1 being the worst) according to stream health. Metric scoring criteria are listed in **Table 4**. Overall biological index scores are obtained by summing of the seven metric scores for each

Table 4—MBSS BIBI Metrics

Metric	Threshold		
	1	3	5
Number of Taxa	< 14	14-21	>= 22
Number of EPT Taxa	< 2	2-4	>= 5
Number of Ephemeroptera Taxa	< 1	1	>= 2
Percent Intolerant to Urban	<10	10-27	>= 28
Percent Ephemeroptera	< 0.8	0.8-10.9	>= 11
Number of Scraper Taxa	< 1	1	>= 2
Percent Climbers	< 0.9	0.9-7.9	>= 8

Source: Southerland et al. (2005)

site, and dividing by the number of metrics (7). Using the format established by MBSS, the resulting value is then compared to the index scoring criteria for translation into narrative categories (**Table 5**). Again, using the MBSS protocol, if the total number of organisms in a sample was less than 60, metrics were not calculated (D. Boward, personal communication). Sites with < 60 organisms were rated as “Very Poor” unless there was evidence that this represented a natural condition. Each of the metric scores are added together and the resulting average is the BIBI score, which is converted to narrative ratings by comparison to criteria (**Table 5**). Composite scores for individual sampling units are presented as means plus/minus a single standard deviation ( $\bar{x} \pm 1$  s.d.).

Table 5–MBSS BIBI Scoring

BIBI Score	Narrative Ranking	Characteristics
4.0 – 5.0	Good	Comparable to reference streams considered to be minimally impacted, biological metrics fall within the upper 50 % of reference site conditions.
3.0 – 3.9	Fair	Comparable to reference conditions, but some aspects of biological integrity may not resemble the qualities of minimally impacted streams.
2.0 – 2.9	Poor	Significant deviation from reference conditions, indicating some degradation. On average, biological metrics fall below the 10 <sup>th</sup> percentile of reference site values.
1.0 - 1.9	Very Poor	Strong deviation from reference conditions, with most aspects of biological integrity not resembling the qualities of minimally impacted streams, indicating severe degradation. On average, most or all metrics fall below the 10 <sup>th</sup> percentile of reference site values.

### Water Quality

Water quality data were compared to Maryland water quality standards for Use I streams. Use I streams have designated uses for water contact recreation and protection of nontidal warm water aquatic life. **Table 6** lists the water quality standards for these streams. Composite values for individual sampling units are means plus/minus a single standard deviation ( $\bar{x} \pm 1$  s.d.).

Table 6–Maryland COMAR Standards

Parameter	Standard
pH	6.5 to 8.5
Dissolved Oxygen (mg/L)	Minimum of 5 mg/L
Conductivity (µmhos/cm)	No state standard
Turbidity (NTU)	Maximum of 150 NTU and maximum monthly average of 50 NTU
Temperature (°C)	Maximum of 32°C (90°F) or ambient temperature, whichever is greater

Source: COMAR 26.08.02.03-3

### Geomorphic Assessment

Geomorphic field data were compared to regional relationships of bankfull channel geometry developed by the USFWS for streams in the Maryland Coastal Plain (McCandless 2003). This comparison is a crucial step in verifying whether field determined bankfull estimates are appropriate or within a range of known values for drainage basins of similar size. Determination of bankfull indicators is difficult in the urbanized sampling units like the ones assessed for this report. To be cautious, field staff would typically identify two or more possible topographic features within the cross section as possible bankfull indicators. Occasionally, changes to the field-called bankfull indicator were made in the office if, based upon an inspection of the plotted cross section and photographs, another identified indicator or obvious slope break or other observable feature gave better agreement with the regional relationships that have been well established in this physiographic region. However, no changes to the field-derived call were made if there was no obvious other potential indicator observable in the cross section and only one bankfull indicator was called in the field or if there was reasonable ( $\pm 15\%$  of the expected value for the drainage area upstream of the sample point) agreement between the original call and the Coastal Plain regional relationships.

After field data were compared to the regional relationships and determined to be accurate estimates of the bankfull channel parameters, the longitudinal profile survey, the cross section survey, and the pebble count data were analyzed for each assessment site. These data were then used to identify each stream reach as one of the stream types categorized by the Rosgen Stream Classification (Rosgen 1996). In this classification methodology, streams are categorized based on their measured field values of entrenchment ratio, width/depth ratio, sinuosity, water surface slope, and channel materials according to the table in **Appendix B**:



**Rosgen Stream Classification.** As shown in Appendix D, the Rosgen Stream Classification categorizes streams into broad stream types, which are identified by the letters, A, G, F, B, E, C, D, and DA. Additionally, when a numeric code for dominant bed material is added, a total of 41 unique types exist in this scheme.

The most entrenched streams are the A, G, and F channels. In these streams, flood flows are confined to their channels with little relief provided by a floodplain. Type A streams generally occur in narrow high relief valleys and are generally narrow, deep, confined, and entrenched streams with cascading step-pools and low sinuosity. These streams can be very stable if the bed material consists mainly of bedrock or boulders. Type G streams occur in moderate gradient valleys and also are generally narrow and deep. These streams also have step-pool systems, but are generally more sinuous and gully-like than A streams. G streams are considered unstable and commonly have grade control problems and high bank erosion rates. Type F streams occur in more gentle gradients and have higher width/depth ratios than A and G streams. F streams are generally entrenched in highly weathered materials that make these streams laterally unstable. These streams usually have riffle-pool morphologies, greater sinuosity than A and G streams, and high bank erosion rates (Rosgen 1994; Rosgen 1996).

Type B streams are moderately entrenched. These streams have better floodplain connectivity than the entrenched A, G, and F streams. B streams are found in narrow valleys of moderate relief and generally have very stable planforms, profiles, and banks. Riffles and rapids dominate these channels with intermittent pools (Rosgen 1994; Rosgen 1996).

The least entrenched single thread channels are the type E and C streams. Type E streams are commonly narrow and deep but have very wide and well-developed floodplains. These streams are highly sinuous with well-vegetated banks, a

riffle-pool morphology, and low gradients; occurring in broad valleys and meadows. E streams are generally very stable, efficiently conveying flood flows and transporting sediment. Type C streams have wider and shallower channels with well-developed floodplains and very broad valleys. These streams have riffle-pool morphology, point bar depositional features, and well-defined meandering channels (Rosgen 1994; Rosgen 1996).

Type D and DA streams are multi-thread streams (Rosgen 1994; Rosgen 1996). These stream types are very uncommon in the mid-Atlantic and are very rare in Anne Arundel County. None were observed during this assessment and so are not discussed further.

To facilitate the data analysis and classification work, an Excel spreadsheet developed by the Ohio Department of Fish and Game's Division of Soil and Water Conservation specifically designed for Rosgen stream classification was used to analyze the channel data collected and help classify the stream reaches.

For the E type channels observed during this assessment, it was possible to compare the values of the various parameters measured to the values obtained by Secrist et al. (2006) for E type reference reaches in the Western Coastal Plain. A statistical comparison was made using a t-Test procedure to compare the mean values of width to depth, entrenchment, and sinuosity of the study group to the reference group.

Because the goal of the geomorphic assessment component of this study is to support the biological assessments, a full set of geomorphic parameters was not collected. Therefore, the data have certain limitations that should be noted:

- An assessment reach length of between 10 and 20 bankfull channel widths is typically required for classification purposes. Depending upon the location of random biological site, some reaches met

this criterion while others did not. Consequently, while it is unlikely that a change in stream type would occur using a properly sized assessment reach, any classifications reported here should be considered subject to refinement during future reassessment work.

- Typically, stream classification using the Rosgen methodology (Rosgen 1996) is best performed on riffle or step cross sections. Many of the 75-meter reaches assessed in this study did not contain riffles, although transition reaches between meanders were frequently identified and used for cross section placement.
- Pebble count data were collected for stream classification purposes only and are not appropriate for use in hydraulic calculations of bankfull velocity and discharge. This is particularly the case for the many sand bed channels in the study area, where data on the dune height would be used instead of the 84<sup>th</sup> percentile particle size, or  $D_{84}$ , in hydraulic calculations. Dune height data were not collected for this study.
- No detailed analyses of stream stability were performed for this study. Statements referring to stream stability are based on observations and assumptions, which were founded on fundamental geomorphic principles. Conclusive evidence of the stability of the sampling units assessed could only be obtained after detailed watershed and stream stability assessments were performed.

A summary of the stream types identified for the streams in this study is included in **Appendix C: Geomorphic Assessment Results**.

## Results and Discussion

This section first makes brief comparisons about conditions across all sampling units. Then, each sampling unit is discussed individually. A

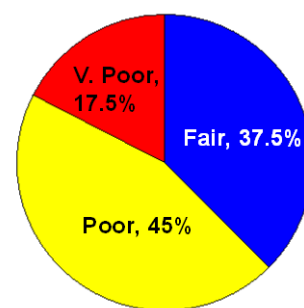
thorough discussion of data quality pertaining to biological results is included in **Appendix D**. A listing of taxa sampled and their characteristics are in **Appendix E**.

### *Comparisons Among Sampling Units*

Biological conditions, habitat quality, and geomorphologic results are discussed for selected subwatersheds. However, because of the random nature of the site selection process (Hill and Stribling 2004), it should be noted that average results for each sampling unit describe typical conditions, even for where no data were directly collected. Individual streams could almost always be found that would assess as either better or worse than the typical conditions. **Table 7** summarizes overall biological and habitat conditions for each sampling unit.

### *Biological and Habitat Assessment Summary*

Overall, the BIBI scores throughout the sampling units were variable, with the largest portion of the sites (45 percent) falling within the “Poor” range (**Figure 2**). Thirty-eight percent of the sites fell into the “Fair” range, and 18 percent were “Very Poor”. All four sampling units had composite BIBI values ( $\bar{x}$  and s.d.) that put them in the overall “Poor” category (**Table 7**).



**Figure 2 - Proportional distribution of BIBI assessment results for Year 3 (n=40 sites).**

Across the four sampling units, physical habitat quality generally assessed as impaired, with RBP narratives for mean scores as “Partially Supporting” for 3 of the 4 units and “Supporting” only for Bodkin Creek. For the MPHI, 2 of the 4 units assessed as “Partially Degraded” while Marley Creek and the Upper Magothy were classified as “Degraded” (**Table 7**). Only 5% of the individual sites were assessed as having minimal physical habitat disturbance (**Figure 3**)

### Water Quality Assessment Summary

There were a number of sites that exceeded the standards listed in **Table 6**. For pH, all 10 Bodkin Creek sites were more acidic than the standards, ranging from 5.16-6.29; 9 out of 10 sites for the Magothy River PSU were below the pH standard ranging from 5.89-6.43. For Marley Creek and Hall Creek, there were four and two sites, respectively, that exceeded the pH standard, exhibiting greater acidity than the standard. For dissolved oxygen, a single Marley Creek site (05-

Table 7—Summary of BIBI and habitat scores across sampling units.

Sampling Unit	Average BIBI Score $\pm$ SD / Condition Narrative	Average MBSS PHI Score $\pm$ SD / Condition Narrative	Average EPA RBP Habitat Score $\pm$ SD / Condition Narrative
Marley Creek	2.57 $\pm$ 0.54 Poor	63.9 $\pm$ 7.5 Degraded	107.0 $\pm$ 18.4 Partially Supporting
Bodkin Creek	2.43 $\pm$ 0.60 Poor	72.8 $\pm$ 12.1 Partially Degraded	128.8 $\pm$ 26.0 Supporting
Upper Magothy	2.86 $\pm$ 0.65 Poor	65.2 $\pm$ 8.0 Degraded	113.3 $\pm$ 16.8 Partially Supporting
Hall Creek	2.77 $\pm$ 0.75 Poor	67.3 $\pm$ 9.1 Partially Degraded	106.0 $\pm$ 16.1 Partially Supporting

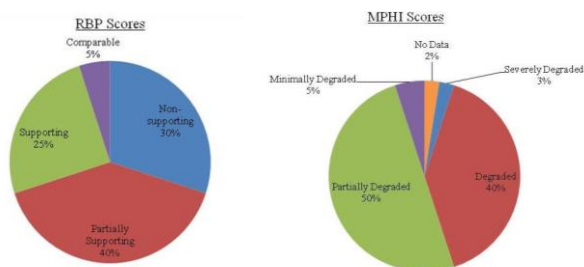


Figure 3 - Summary of Year 3 Habitat Scores

05, unnamed tributary to Furnace Creek) and two sites in the Hall Creek PSU (Sites 24-08 and 24-13A, which are both unnamed tributaries to Hall Creek) had DO readings below COMAR standards. There were no exceedences of the COMAR temperature standards.

### Geomorphic Assessment Summary

The E type stream channel was the dominant stream type found within the sampling units. As shown in **Figure 4**, 56% of all sites assessed were classified as E channels. G and C channel types both occurred in 19% of sites while B channels

made up 6% of sites assessed. While comprising 19% of observed types overall, G channels were predominantly concentrated in the Hall Creek sampling unit, with 86% of all observed (6 of 7) found here. The C channel type was found in all sampling units with the largest occurrence in the Bodkin Creek sampling unit. The B channel type

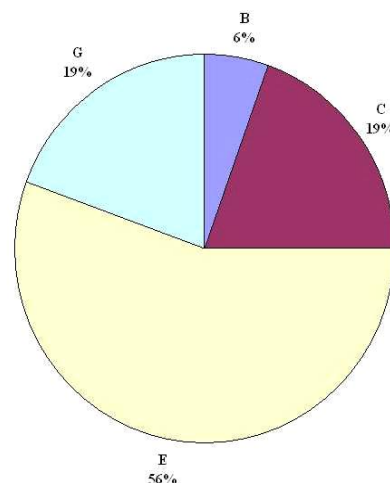


Figure 4 - Distribution of Rosgen stream types within the 2006 sampling units.

was only found in the Hall Creek and Marley Creek sampling units. The majority of channels had sand substrates. Approximately 89% of assessed reaches were found to have sand bottoms. The remainder had clay substrate. No gravel-dominated channels were observed in these sampling units. The clay dominated channel reaches were confined to the E and C types. No B or G types with clay bottoms were identified. Within sand bottom channels, the average D50 observed was 0.294 mm.

Stream slope was very low in the assessment reaches. The average slopes for all reaches assessed were approximately 0.6%. Slopes were lowest in the Bodkin (0.516%) and highest in the Hall Creek (0.738%) sampling units. The B types observed were all in the Bc category, meaning that slopes of less than 2 percent were measured at these two reaches. Additionally, all but one of the G types observed was in the Gc category.

### ***Individual Sampling Unit Discussions***

This section summarizes conditions found within each sampling unit. Discussions of potential impacts to observed habitat and biological conditions are discussed here. For site-specific data and assessment results see **Appendix F**.

When appropriate, conditions within individual subwatershed are discussed. However, it should be noted that even when site-specific data are not available for a particular subwatershed within a unit, the unit wide results characterize basic conditions of streams throughout the unit.

### ***Marley Creek***

The Marley Creek sampling unit is located in the northeastern part of the County (**Figure 1**), with site drainage areas ranging from 180 to 2,742 acres. The ten sample locations (**Figure 5**) are on the Marley Creek mainstem (one site), and unnamed tributaries to Furnace, Stony, and Marley Creeks (sites 2, 1, and 6, respectively).

### ***Aquatic Habitat***

Half of the Marley Creek streams were rated as “Partially Supporting” by the RBP method, 30% “Non supporting”, and 20% “Supporting” (**Figure 6**); the MBSS PHI results showed 60% of the streams being “Partially Degraded” and 40% as “Partially Supporting”. The mean RBP habitat score was  $107 \pm 18$  (**Table 7**), with individual sites ranging from 79 to 138. Streams with the worst RBP scores had very unstable banks (usually indicating active erosion and mass-wasting), simplified instream habitat, and disturbed riparian zone; all of these streams were unnamed tributaries to Marley Creek. The mean PHI score was  $63.9 \pm 7.5$ , with individual sites ranging from 54-74. The sites scoring lowest on the PHI were all unnamed tributaries to Marley Creek, on the mainstem of Marley Creek, and an unnamed tributary to Furnace Creek.

### ***Benthic Macroinvertebrates***

Ten percent of the streams rated as in “Very Poor” biological condition, 30% as “Fair”, and the majority 60% as “Poor” (**Figure 7**). The mean BIBI score for the Marley Creek PSU was  $2.57 \pm 0.54$ , with individual sites ranging from 1.57 (very poor) - 3.29 (fair). The unnamed tributary to Furnace Creek (05-02) was the site with the greatest degree of biological impairment (BIBI = 1.57), and was dominated with stressor tolerant organisms, almost 80% of the sample was worms (Oligochaeta: *Limnodrilus*, *Specaria*, enchytraeids, and other unnamed Tubificinae). The two sites with the highest biological scores (05-06 and 05-15A), although both dominated by Chironomidae, had two caddisfly genera (Trichoptera: *Ptilostomis*, *Ironoquia*) and four genera of beetles (Coleoptera: Elmidae: *Ancyronyx*, *Stenelmis*, and *Oulimnius*; Dryopidae: *Helichus*). In general, caddisflies and beetles are considered to be more stressor-tolerant than midges and worms. For site-specific data and assessment results see **Appendix F**.

### ***Water Quality***

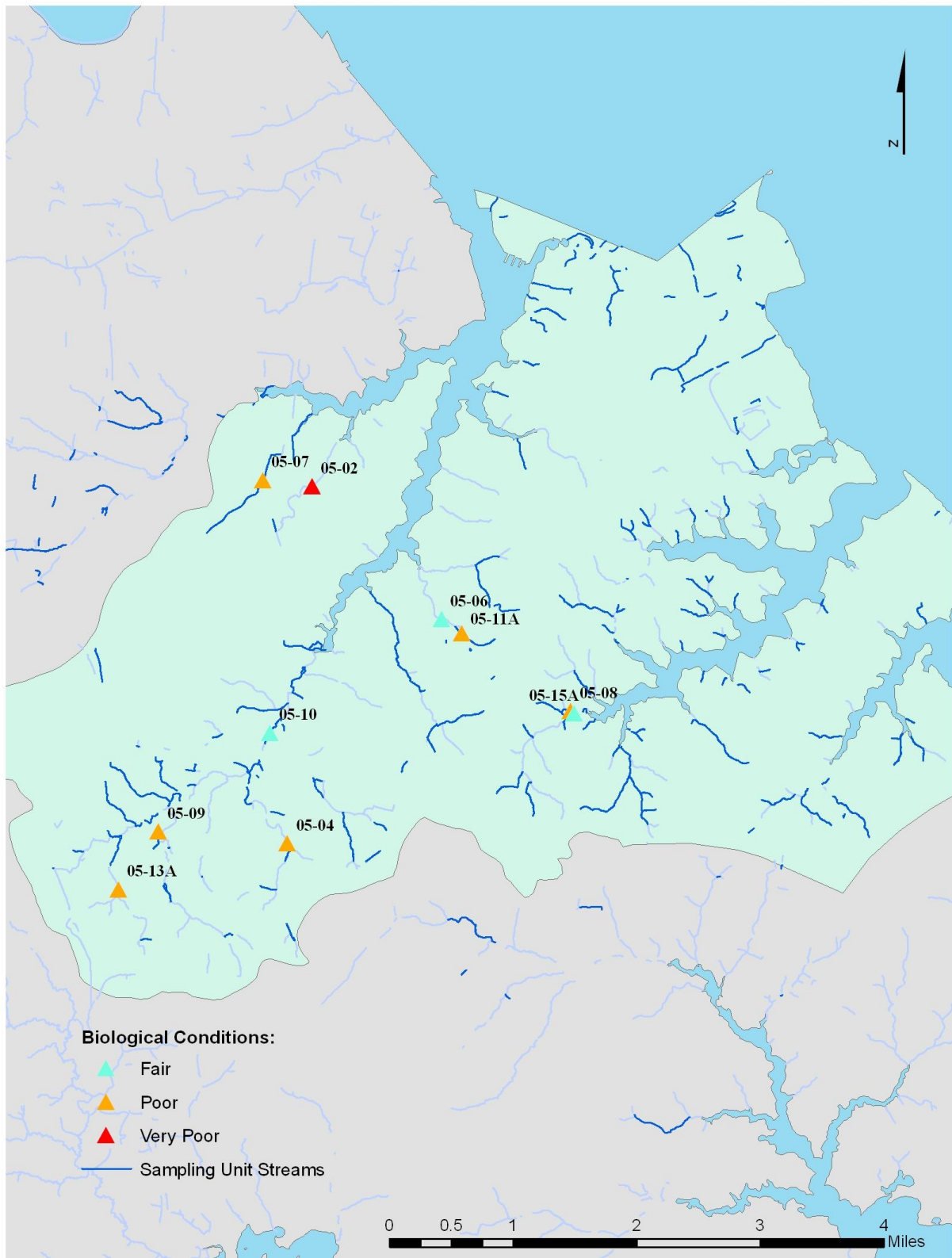


Figure 5 - Location of Marley Creek sample stations.

The only water quality values of the Marley Creek sites that exceeded state standards (**Table 6**) were 3.43 mg/L DO for the unnamed tributary to Furnace Creek (Site 05-02); and four sites for pH<6.5 (05-09, 05-10, 05-11A, and 05-13A), all unnamed tributaries to Marley Creek. Mean values for streams in this PSU are provided in **Table 8**. Water temperature ranged from 4.9-10.8°C; conductivity from 105-561 µmhos/cm; pH from 5.64-6.08; DO from 3.4-15.2 mg/L (an outlier value of 112 mg/L in site 05-04 was removed from analysis as a suspected error.).

Table 8–Average water quality values – Marley Creek

Value ± Standard Deviation			
Temperature*	D.O.*	pH	Conductivity*
8.0 ± 2.1	10.7 ± 3.4	6.5 ± 0.4	299.4 ± 133.3

\*Units: Temp. (°C), D.O. (mg/L), Cond. ( µmhos/cm ), pH (units)

### Geomorphic Assessment

A total of four different Rosgen stream types were observed in this sampling unit, the greatest number observed among all the units assessed.

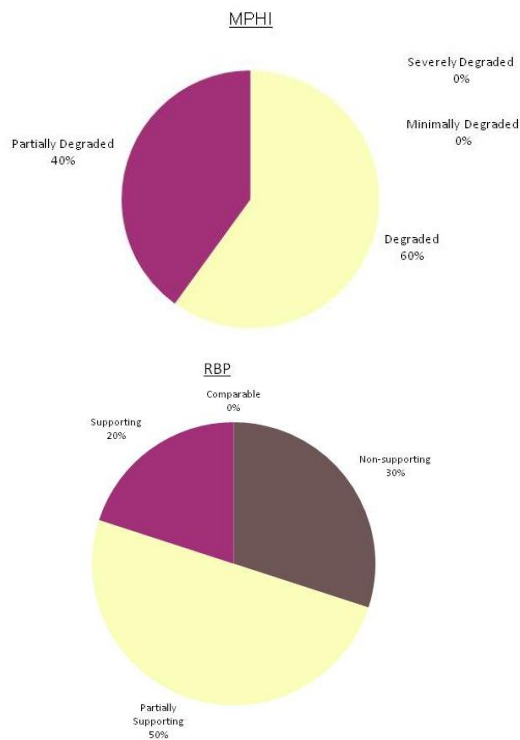


Figure 6 - Marley Creek Habitat Scores

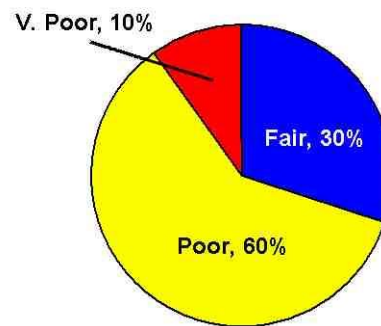


Figure 7 - Marley Creek BIBI Scores

Due to high levels of disturbance observed at one site (05-13A), only nine sites were included in this evaluation. The E type channel was the most frequently observed, comprising 67% (6 of 9) of the types observed while the G, B and C types were found in equal frequency (11%) (**Figure 8**). All sites had less sinuosity that expected for a given type. Additionally, for site 05-11A the entrenchment ratio was in the B range at 1.9.

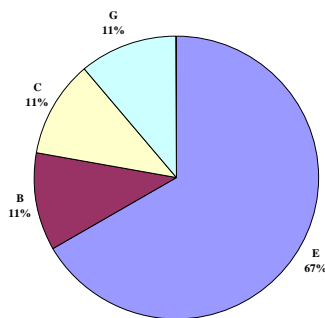
Streams in this sampling unit had predominately sand bottoms (8 of 10) while silt and clay materials dominated the remaining systems. The average D50 observed was 0.14 mm. Slopes were fairly gradual, ranging from around 1.1% to around 0.03 %, with an average of 0.50% across all sites.

The average W:D ratio observed for the E types found in this sampling unit was 5.9, somewhat narrower than that associated with stable E type channels (see **Table 15**) while the average Entrenchment Ratio around 18.8, a value much lower than that associated with stable E types in the Western Coastal Plain (Secrist et al. 2006).

Sinuosity in these systems was low and was the only classification parameter frequently outside of the allowed range of values. Average sinuosity for all the types observed in this sampling unit was around 1.12, which means that these streams are much straighter than the typical



E, B, or C type, which typically have sinuosity values of 1.4 or greater in the Western Coastal Plain.



**Figure 8 - Rosgen stream types observed in Marley Creek**

### ***Bodkin Creek***

The Bodkin Creek sampling unit is located in the northeastern part of the County (**Figure 1**), with site drainage areas ranging from 127-806 acres. Of the ten sample locations in the watershed (**Figure 9**), two are unnamed tributaries to Bodkin Creek, and eight are unnamed tributaries to Main Creek.

### ***Aquatic Habitat***

Approximately one-fifth (20%) of the streams in the watershed have physical habitat quality in conditions comparable to reference (RBP), while the PHI two sites were rated as “Minimally Degraded” (**Figure 10**). For the RBP assessment, another 40% of the streams were rated as “Supporting” and 20% each “Partially Supporting” and “Non-supporting”. The PHI further rated 50% “Partially Degraded” and 20% as “Degraded.” MPHI parameters were not completed scored at one site, which prevented its evaluation. The mean RBP habitat score was  $128.8 \pm 26$ , with individual sites ranging from 86 (Non-supporting) - 164 (Comparable). The two streams rated as “Non-supporting” are both unnamed tributaries to Main Creek (Sites 06-03 and 06-04). Physical habitat features that most

affected overall condition in them were instability of banks, some apparent channel straightening or other human alteration, very little bank protection or buffered riparian zone, and loss of instream physical complexity. Those sites scoring highest on the RBP assessments (comparable to reference) were also unnamed tributaries to Main Creek (Site 06-09 and 06-13A). The mean PHI rating was  $72.8 \pm 12.1$ , with individual sites ranging from 52 (Partially Degraded) to 92 (Minimally Degraded). This PSU rated highest, both on average and by individual stream site, the best of the other three PSU for the year 3 assessments.

### ***Benthic Macroinvertebrates***

The MBSS BIBI resulted in half (50%) of the streams as being rated as “Poor”. Another 30% were “Very Poor” and 20% “Fair” (**Figure 11**). The lowest BIBI scores (06-03, 06-09, and 06-11A) were on an unnamed tributary to Main Creek; the two sites that rated as “Fair” (Sites 06-05, 06-08) were unnamed tributaries to Main and Bodkin Creek, respectively. Site 06-05 exhibited six different genera of caddisflies (Insecta: Trichoptera) and 11 genera of midges (Chironomidae); and it also had six specimens of *Anchytarsus* (Coleoptera: Ptilodactylidae). Most of the caddisflies and the *Anchytarsus* are considered relatively stressor-sensitive. Site 06-08 was dominated by midges (Diptera: Chironomidae), which are considered to be generally stressor tolerant. Two-thirds of the organisms found in the sample from Site 06-03 were the clam *Pisidium* (Mollusca: Pelecypoda: Sphaeriidae); similarly for the Site 06-04, there were 68 specimens of the biting midge *Culicoides* (Diptera: Ceratopogonidae). Both of these samples are dominated by stressor tolerant taxa. Interestingly, the latter sample also produced single individuals of the mayfly *Eurylophella* (Ephemeroptera: Ephemerellidae) and the marsh beetle *Prionocyphon* (Coleoptera: Scirtidae), both considered relatively stressor-sensitive. For site-specific data and assessment results see **Appendix F**.

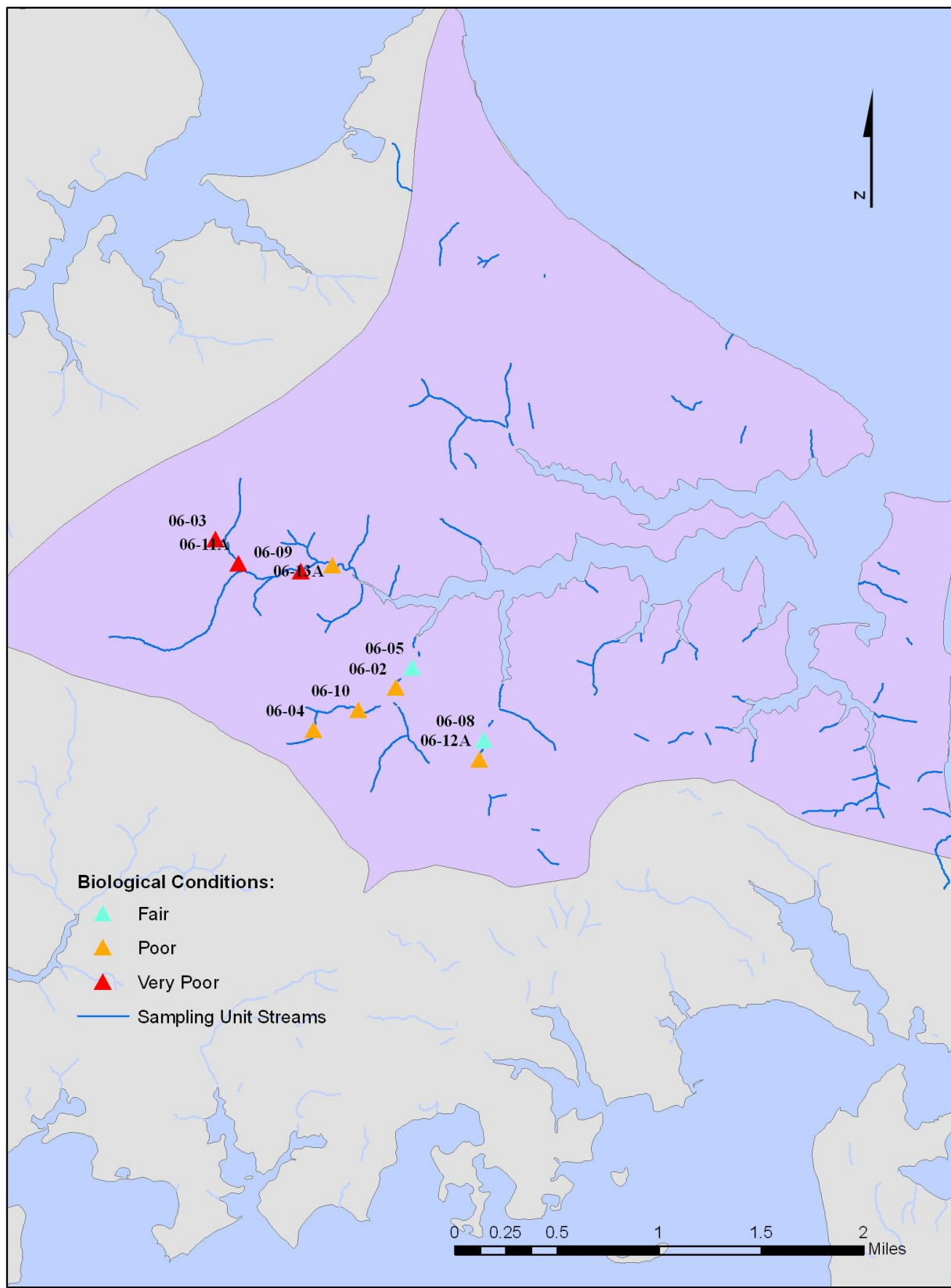


Figure 9 - Location of Bodkin Creek sample stations.

### Water Quality (WQ)

There are several parameters that exceed the COMAR standards (**Table 6**). Dissolved O<sub>2</sub> standards were exceeded for two sites (130 mg/L in site 06-11A and 0.74 mg/L in site 06-4). However these values were removed from analysis as outliers and suspected errors, average values for water quality variables in Bodkin Creek sampling unit (excluding outliers) are presented in **Table 9**. The pH exceeded COMAR on the low end for all sites, ranging from 5.12-6.29. Water temperature ranged from 10.7-17.6°C; and conductivity ranged from 79-290 µmhos/cm.

Table 9–Average water quality values – Bodkin Creek

Value ± Standard Deviation			
Temperature*	D.O.*	pH	Conductivity*
13.4 ± 2.3	9.4 ± 0.5	5.7 ± 0.3	165.9 ± 55.8

\*Units: Temp. (°C), D.O. (mg/L), Cond. ( µmhos/cm ), pH (units)

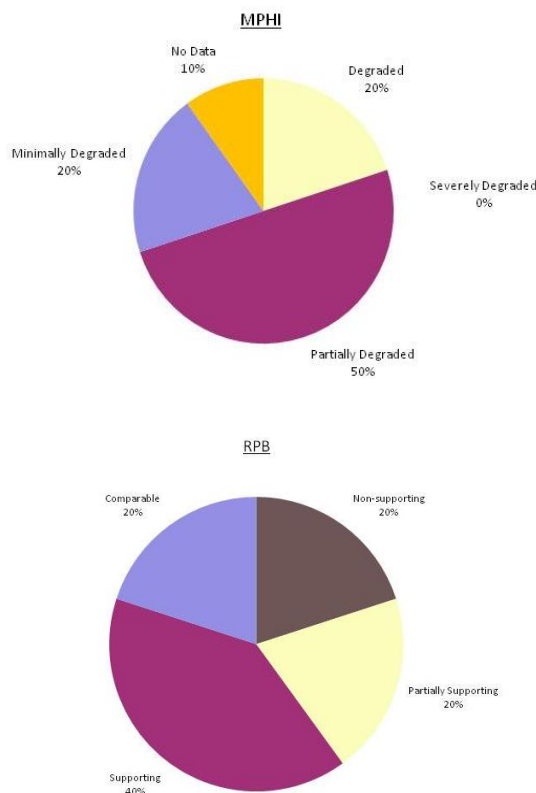


Figure 10 - Bodkin Creek Habitat Scores

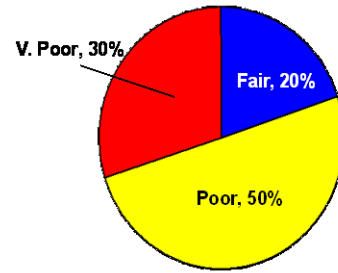


Figure 11 - Bodkin Creek BIBI Scores

### Geomorphic Assessment

The stream type observed most frequently in this sampling unit was the E type channel, with 70% of all streams assessed falling into this classification (**Figure 12**). The remaining three sites were C type channels. Regarding the various classification criteria for the Rosgen method, all reaches were within the allowed variation associated with the classification process, excluding sinuosity.

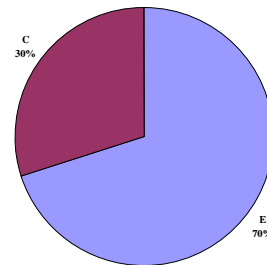


Figure 12 - Rosgen stream types observed in Bodkin Creek

Streams in this sampling unit had predominately sand bottoms (8 of 10) while silt and clay materials dominated the remaining systems. The average D50 observed was 0.14 mm. Slopes were fairly gradual, ranging from around 1% to around 0.1 %, with an average of 0.51% across all sites.

The average width to depth ratio for the E types was 6.53, somewhat narrower than that associated with stable E type channels (see **Table 15**) while the average Entrenchment Ratio around 17.2. For the C type channels, the average width to depth ratio observed was 16.2 and the average similar to the E types here at 15.6.

Sinuosity in these systems was low and was the only classification parameter frequently outside of the allowed range of values. Average sinuosity for both the C and E types observed in this sampling unit was around 1.13, which means that these examples are much straighter than typical E or C types, which usually have sinuosity values of around 1.4 in the Western Coastal Plain.

### ***Upper Magothy River***

The Upper Magothy River sampling unit is located in the northeastern part of the County (**Figure 1**), with site drainage areas ranging from 143-2,977 acres. Of the ten sample locations in the watershed (**Figure 13**), one is in each of the mainstems of Cattail Creek and the Magothy River, and eight are unnamed tributaries to Cattail Creek (2), Lake Waterford (5), and the Magothy River (1).

#### ***Aquatic Habitat***

The RBP physical habitat assessments showed that half of the Upper Magothy River streams are “Partially Supporting”, 20 percent are “Non supporting”, and 30 percent are “Supporting” (**Figure 14**). The mean RBP score was  $113.3 \pm 16.8$  (**Table 7**), with site-specific scores ranging from 87 (non-supporting) to 137 (supporting). The site that rated lowest with the most degraded habitat, was an unnamed tributary to Cattail Creek (07-02), and was rated low for bank stability, channel alteration, bank protection, and width of undisturbed riparian vegetative buffer. All of the tributaries to Lake Waterford rated as either “Partially Supporting” or “Supporting”, with Site 07-09 having the highest score for the Upper Magothy River streams. That stream,

although with some indication of bank instability, had apparently natural sinuosity and an abundance of undisturbed riparian vegetation.

The MBSS PHI rated half of the streams as “Partially Degraded” and half as “Degraded” (**Figure 14**). The mean PHI score was  $65.2 \pm 8.0$ , but there was not a large range of PHI scores for this sampling unit (53-76). The highest PHI score was for an unnamed tributary to Lake Waterford (07-04), the lowest an unnamed tributary to Cattail Creek (07-08). (Trichoptera). The lowest rated stream was an unnamed tributary to the Magothy River (Site 07-14A), for (unnamed tributary to Cattail Creek) had 23 genera of midges (Chironomidae); it also had 4 genera of elmids and 1 genus of dryopid beetle (*Helichus*: Dryopidae). Some of the elmids and *Helichus* are considered to be somewhat tolerant

#### ***Benthic Macroinvertebrates***

The BIBI rated 60 percent of the streams as being in “Fair” condition, 30 percent as “Poor”, and 10 percent as “Very Poor” (**Figure 15**). The mean score was  $2.86 \pm 0.65$  (**Table 7**), with streams ranging from 1.86 to 3.86. The highest rated stream, an unnamed tributary to Lake Waterford (Site 07-09) received a 3.86 (Fair). Although the sample for this site was approximately two-thirds midges (65 specimens in 10 genera), there were also four genera each of beetles (Coleoptera) and caddisflies to different kinds of stressors, and thus, are often which the sample was almost completely midges (112 out of 118). The sample from Site 07-02 had 57 midge specimens (Chironomidae) among 15 genera; otherwise, there were 25 elmids (beetles (*Dubiraphia* and *Stenelmis* [Coleoptera: Elmidae) and 18 blackflies (*Simulium* and *Stegopterna* [Diptera: Simuliidae]). The sample for Site 07-08 seen in degraded conditions. For site-specific data and assessment results see **Appendix F**.

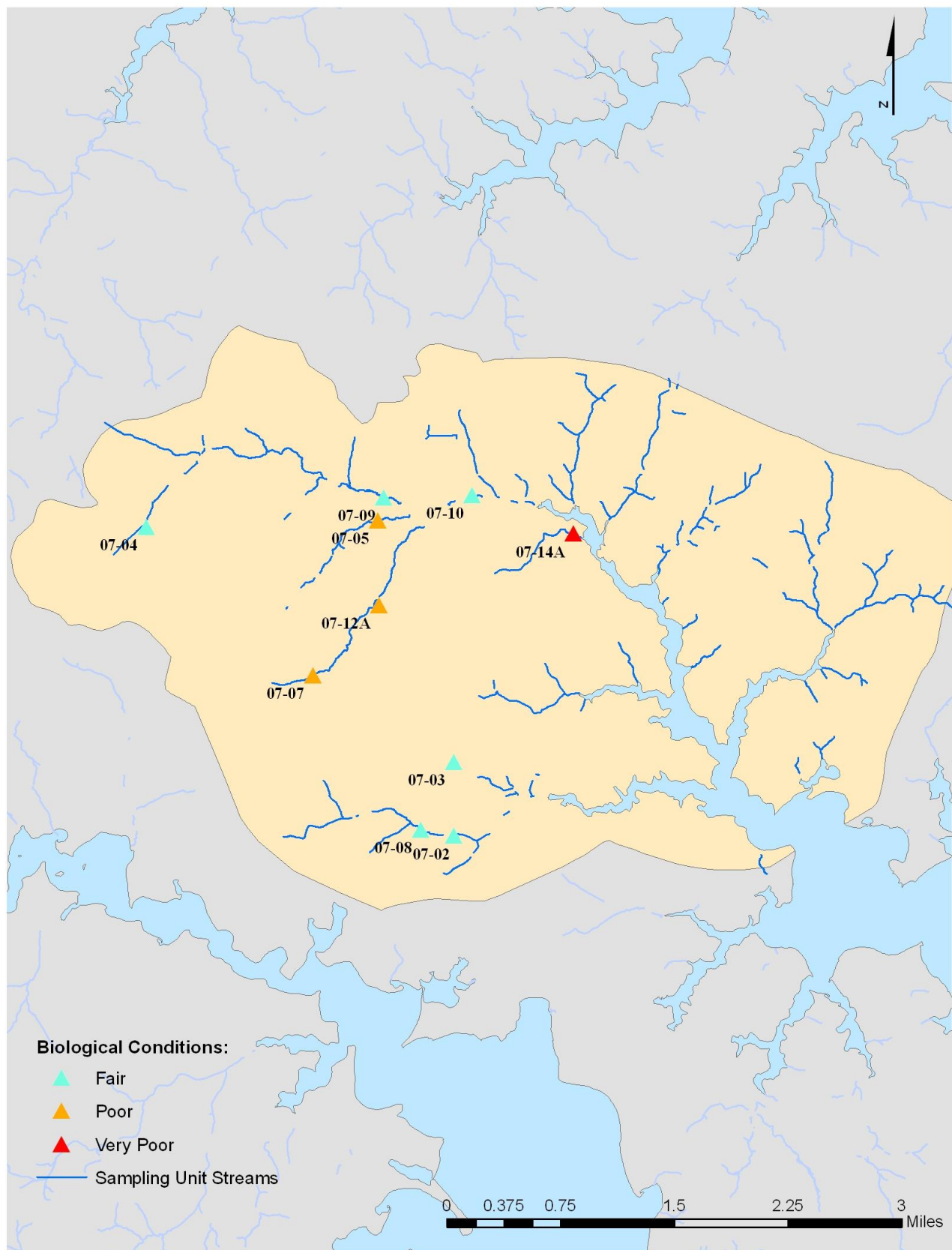


Figure 13 - Location of Upper Magothy sample stations.



## Water Quality

Observations are summarized in **Table 10**. The COMAR standard (**Table 6**) was met for D.O., but not for pH. Most values (9 of 10) for pH at exceeded COMAR on the low end of the range

Table 10–Average water quality values – Upper Magothy			
Value ± Standard Deviation			
Temperature*	D.O.*	pH	Conductivity*
7.3 ± 2.4	8.1 ± 1.5	6.2 ± 0.2	231.0 ± 110.7
*Units: Temp. (°C), D.O. (mg/L), Cond. ( μmhos/cm ), pH (units)			

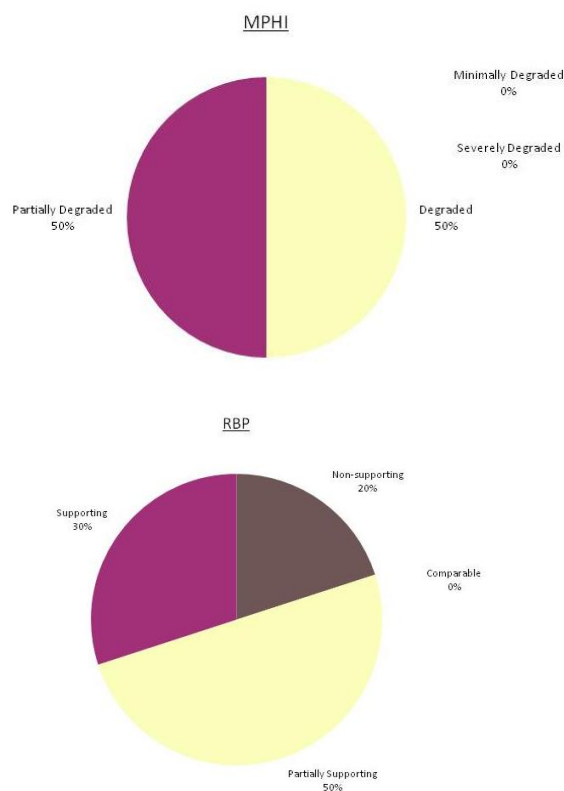


Figure 14 - Upper Magothy Habitat Scores

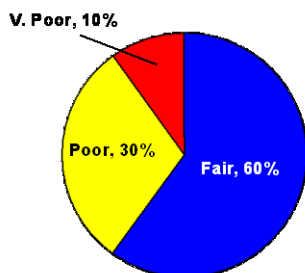


Figure 15 - Upper Magothy BIBI Scores

varied from 5.89 to 6.43. There were no atypical values observed for conductivity or temperature.

## Geomorphic Assessment

The E type and the C type were observed in this sampling unit, with the E type being the dominant type observed (8 of 9 sites) (**Figure 16**). One site, 07-02, was excluded from analysis because over half the site consisted of a culvert and a stormwater pond upstream of the culvert.

The E channels observed during this assessment were different from reference E types found in the Western Coastal Plain (see **Table 15**). The E types within the Upper Magothy appear to be narrower and deeper (W/D = 6.99), occupy more of the stream valley (Entrenchment Ratio = 12.2), and are straighter (sinuosity = 1.15) than expected under stable conditions.

Streams in this sampling unit were exclusively sand bottom channels. The average D50 observed was 0.22 mm. Slopes ranged from a high of just over 1% to a low of 0.17%, with an average of 0.620% across all sites.

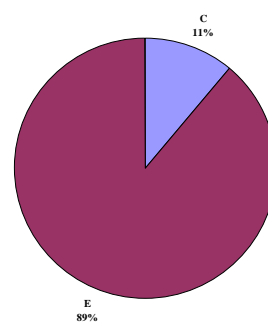


Figure 16 - Rosgen stream types observed in the Upper Magothy



## Hall Creek

The Hall Creek sampling unit is the southernmost in the County (**Figure 1**). Sampling sites in Hall Creek have individual drainage areas ranging from 75-3,845 acres. Of the ten sample locations in the watershed (**Figure 17**), three are in the Hall Creek mainstem and seven are unnamed tributaries to Hall Creek.

### Aquatic Habitat

The RBP physical habitat quality assessments show half (50 percent) of the streams in Hall Creek as “Non-supporting”, 40 percent as “Partially Supporting”, and 10 percent as “Supporting” (**Figure 18**). The mean RBP value is  $106 \pm 16.1$  (**Table 7**) with values ranging from 80-128. The site with the lowest score, 24-13A (unnamed tributary to Hall Creek), is experiencing severe bank instability, almost no bank vegetation to help with stabilization, the riparian zone protection is limited one side, and instream habitat structure has lost much of its complexity. The stream scoring highest (24-10, Hall Creek) had good riparian zone (undisturbed vegetated buffer), largely natural channel form, and relatively complex instream structure. The PHI returned assessments of “Degraded” for 30 percent of the streams, “Partially Degraded” for 60 percent, and “Severely Degraded” for 10 percent. Although it scored highest in this PSU for PHI, Site 24-10 had a score of 79, earning the site a rating of “Partially Degraded”.

### Benthic Macroinvertebrates

The BIBI rated no sites as “Very Good”, 40 percent as “Fair” and “Poor”, and 20 percent as “Very Poor” (**Figure 19**). Mean value for the PSU is  $2.77 \pm 0.75$  (**Table 7**), with streams ranging from 1.86 to 3.57.

There were two streams with the low score of 1.86, one on the Hall Creek mainstem (24-04) and the other on an unnamed tributary to Hall Creek (24-13A). For 24-04, there were 91 midges (Chironomidae) distributed among 10 genera. Generally, taxa belonging to that family are considered stressor tolerant; however some

individual genera are sensitive. Interestingly, in this sample there were 11 stoneflies in two genera (*Nemoura*, *Amphinemura*: Nemouridae: Plecoptera). Stoneflies are typically considered to be some of the more stressor-sensitive freshwater insects; stressors mostly affecting them are physical habitat degradation and low DO, and often tend to be somewhat tolerant to chemical degradation. On the unnamed tributary, the sample was similarly dominated by midges (97 specimens in 13 genera, out of 114 specimens in 20 genera). The highest-scoring stream was 24-07 (unnamed tributary to Hall Creek) that received a “Fair” rating for a BIBI score of 3.86. It had 116 specimens, which included 84 midges in 11 genera, as well as representatives of mayflies (*Stenonema* [prob. *Maccaffertium*]: Heptageniidae: Ephemeroptera), stoneflies (*Isoperla*: Perlodidae: Plecoptera), and caddisflies (Trichoptera: Limnephilidae: *Pycnopsyche*; Psychomyiidae: *Lype*). For site-specific data and assessment results see **Appendix F**.

### Water Quality

The COMAR standard (**Table 6**) for DO was not met for two sites (24-08 and 24-13A); pH was exceeded on the low end by sites 24-02 and 24-08; there were no anomalies for conductivity, with values ranging from 73-258  $\mu\text{mhos}$ ; and there were also no exceedences for water temperature (range 3.9-11.3°C). Means and s.d. for these parameters are presented in **Table 11**.

Table 11—Average water quality values – Hall Creek

Value $\pm$ Standard Deviation			
Temperature*	D.O.*	pH	Conductivity*
$8.1 \pm 2.2$	$6.4 \pm 2.5$	$6.6 \pm 0.2$	$183.2 \pm 63.3$

\*Units: Temp. (°C), D.O. (mg/L), Cond. (  $\mu\text{mhos/cm}$  ), pH (units)

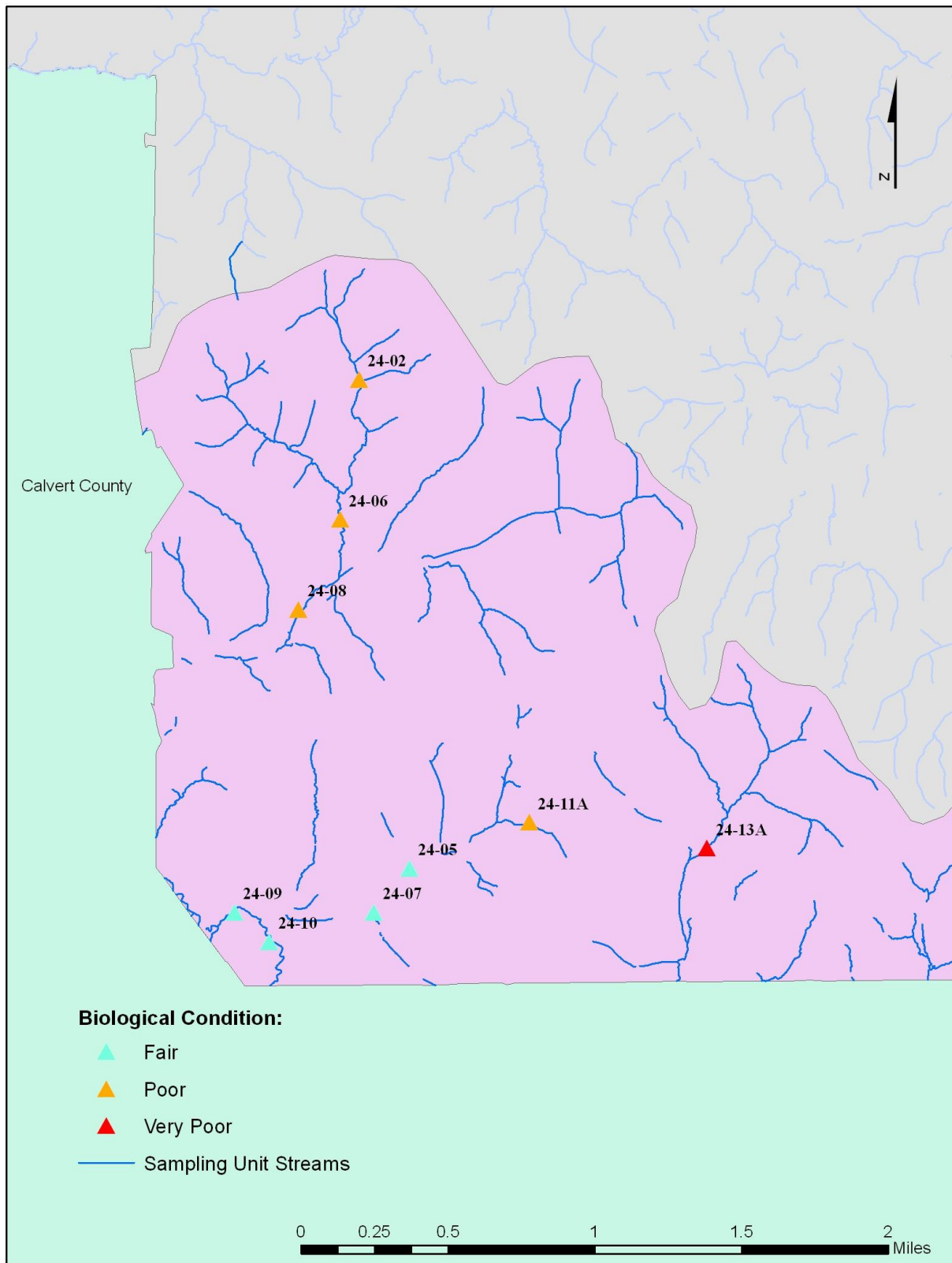
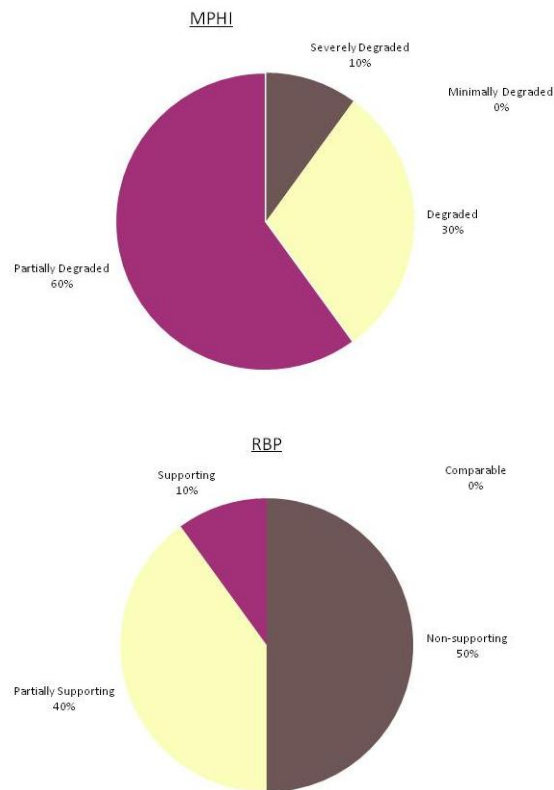
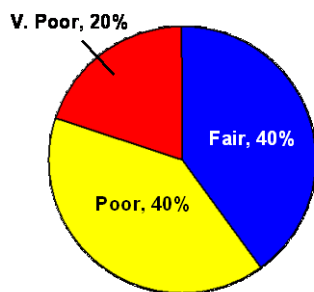


Figure 17 - Location of Hall Creek sample stations.



**Figure 18 - Hall Creek Habitat Scores**

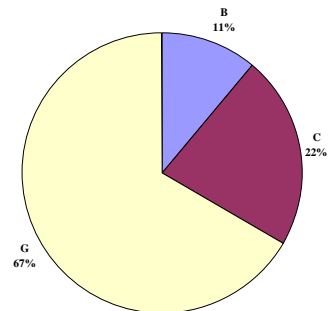


**Figure 19 - Hall Creek BIBI Scores**

### *Geomorphic Assessment*

Three different Rosgen stream types were observed in this sampling unit among nine sites. Site 24-08 was excluded from analysis because the majority of the assessment reach consisted of a beaver impoundment. The unstable G type

channel was the most frequently observed (**Figure 20**), comprising 67% (6 of 9) of the types observed. The C type, at 22% was the second most frequently observed stream type. The only B type observed was found at site 24-07.



**Figure 20 - Rosgen stream types observed in the Hall Creek**

The C type reaches had much less sinuosity than expected for this type, averaging around 1.1. An appropriate average sinuosity value of 1.33 was observed for all the G types. Measured at 1.5, the single B channel also showed sinuosity typical for its type.

Streams in this sampling unit had predominately sand bottoms (8 of 9) while silt and clay materials dominated within one of the C type reaches. The average D50 observed was 0.12 mm. Slopes ranged from a high of almost 4% to a low of 0.139%, with an average of 0.738% across all sites.

The average width to depth ratio observed for the G types found in this sampling unit was 9.57, somewhat wider than that the average for G type systems (Rosgen 2004). The C types in the Hall Creek sampling unit were much narrower and deeper than typical (Rosgen 2004), with average C5 having a W/D of 27 compared to the observed average of 14.1. This condition could be indicative of adjustment towards an unstable type like the G type predominant within the sampling unit. It is possible that the relatively recent spike

in development within this sampling unit has perturbed stream reaches such that basinwide adjustments are now underway (see additional discussion in the next section). The trajectory of any adjustment will require conformation with additional assessment data collected regularly over time.

## Conclusions and Recommendations

Biological conditions are impaired for all four sampling units. Although physical habitat quality is also degraded for the sampling units and for individual streams, the specific stressors causing biological impairment are not necessarily easy to isolate. To more effectively identify the stressors and their sources, it is important to use a more deliberate stressor identification technique (USEPA 2000, Suter et al. 2002, Cormier et al. 2002). There are almost never situations where single, isolated stressors cause biological impairment, most often stressors are multiple and cumulative, both short-term (acute) and long-term (chronic), and they may result from legacy disturbances, such as is the case with many sediment and physical habitat stressors. Further, as our knowledge about the specific modes of action of most stressors is somewhat limited, there could be either synergistic effects (two or more stressors amplifying the effects of others) or antagonistic effects (two or more stressors buffering or reducing the effects of others) at work in a reach of interest, or both, impacting the biological community. The most defensible approach to specifying those stressors that should be reduced or eliminated and their sources that need to be corrected (retrofit, restoration) is a strength of evidence process. Data quantity and quality being collected by DPW as part of this program would be sufficient to begin isolating stressor sources, which could then be targeted for correction.

### *Habitat Assessment and Biological Conditions*

As there are typically multiple stressors affecting stream biota, it is often difficult if not impossible to isolate single stressors that are the direct cause of biological impairment (Norton et al. 2000, USEPA 2000). As such, we should not expect strong correlations of biological condition with any composite measure of physical habitat quality (such as the RBP or the PHI), or individual physical or water chemistry characteristics (such as median substrate particle size, width of undisturbed riparian vegetation, or dissolved oxygen). There are both synergistic and antagonistic relationships among stressors that are not fully understood (Miller et al. 2004, Poulton et al. 1995, Harding et al. 1998) For example, of the six sites that rated as “Poor” or “Very Poor” for biology (BIBI) with simultaneous high RBP habitat ratings (comparable or supporting) (**Table 12**), four of them were from the Bodkin Creek sampling unit (PSU 6). This is an indication that additional, potentially unknown stressors are causing biological degradation in this sampling unit. **Table 13** similarly arranges biological assessment narratives against those for PHI, but readily recognizable patterns do not emerge. This observation of the relationship between the results of the RBP habitat and the PHI was similar to that observed by Roberts et al. (2006). Stability and complexity of physical habitat is necessary for a healthy biota, though it is not sufficient. As mentioned, other factors such as insults to water chemistry, availability of food energy materials, and invasive species can impair the ability of stream biota to survive and reproduce. Using physical habitat quality as a principal factor in defining the biological potential of a stream, the biota “outperforming” that potential is possibly enhanced by something like nutrient enrichment; a biota “underperforming” the potential is being depressed by stressors such as water chemistry contaminants. **Table 14** shows those sites for which the BIBI is indicating higher or lower than expected; only sites for which that situation was true for both habitat quality indicators are shown.

Table 12—Comparison of sample site biological scores to EPA RBP habitat condition.

EPA RBP Habitat Scores	BIBI Score			
	Good	Fair	Poor	Very Poor
Comparable			<b>06-13A</b>	<b>06-09</b>
Supporting		05-10 06-05 06-08 07-09 07-10 24-10	05-08 06-02 06-12A 07-07	
Partially Supporting		05-06 05-15A 07-03 07-04 24-05 24-07 24-09	05-04 05-07 06-10 07-05 07-12A	05-02 06-11A 07-14A 24-04
Non-Supporting		<b>07-02</b> <b>07-08</b>	05-09 05-11A 05-13A 06-04 24-02 24-06 24-08 24-11A	06-03 24-13A

**Green** cells contain stations where the biological community was less impaired than the habitat scores would predict.

**Orange** cells contain stations where biological community matched available habitat.

**Pink** cells contain stations where the biological community was more impaired than the habitat scores would predict.

**Stations in bold type** have biological conditions that differ by at least two qualitative habitat categories in both methods.

### Geomorphic Conditions

Channel instability and excessive erosion are likely significant stressors impacting stream insect communities in these sampling units. While a large fraction of reaches assessed consisted of G-type reaches typically considered unstable, most of these occurred within the Hall Creek sampling unit. While additional

Table 13—Comparison of sample site biological scores to MBSS PHI habitat condition.

MBSS PHI Score	BIBI Score			
	Good	Fair	Poor	Very Poor
Minimally Degraded		06-08		<b>06-09</b>
Partially Degraded		05-15A 06-05 07-03 07-04 07-09 07-10 24-05 24-07 24-10	05-04 05-07 05-08 06-02 06-10 06-12A 07-07 24-06 24-11A	<b>06-03</b> <b>06-11A</b> <b>24-04</b>
Degraded		05-10 05-06 07-02 07-08 24-09	05-09 05-11A 05-13A 06-03 06-04 07-05 07-12A 24-02	05-02 07-14A 24-13A
Severely Degraded			24-08	

**Green** cells contain stations where the biological community was less impaired than the habitat scores would predict.

**Orange** cells contain stations where biological community matched available habitat.

**Pink** cells contain stations where the biological community was more impaired than the habitat scores would predict

**Stations in bold type** have biological conditions that differ by at least two qualitative habitat categories in both methods.

Site 06-13A not scored with this method.

assessment information is necessary in order to understand the ultimate or optimal of channel form, these baseline results indicate that significant channel erosion will occur in this sampling unit.

*Table 14—Reaches in which habitat and biological conditions are somewhat mismatched, as similarly characterized by both habitat assessment methods.*

Possible Water Quality Impairment	Possible Enrichment
05-02, 05-08	05-06
06-02, 06-09, 06-11A,	07-02
06-12A, 07-07, 07-14A	07-08
24-04	24-09

As noted by Roberts et al. (2006), continued monitoring of channel cross-sectional areas in the County is advisable to help develop an objective understanding of the rates and directions of physical changes in the channels. This would also potentially help better understand if geomorphic processes are resulting from recent or legacy disturbances in the watershed, and would have implications for decision-making in stream and watershed restoration and protection initiatives.

As illustrated in **Table 15**, E channels in the sampling units are significantly different from Western Coastal Plain reference conditions (Secrist et al. 2006). In general, E channels in the sampling units are narrower and deeper, straighter, and occupy more of the stream valley than predicted from stable reference conditions. These differences from the reference condition are likely indicative of either recovery from

*Table 15—Comparison of average E channel dimensionless ratios found in this study to other sources.*

Data Sources	Sinuosity	ER	W/D	Ref.
General E5 stream type	2.35	39.5	5.78	Rosgen (1998)
E channel Western Coastal Plain (WCP) reference reaches	1.42	26.4	9.2	Secrist et al. (2006)
Field data from this assessment	1.14*	15.8*	6.4*	—
* = Significant difference from E channel WCP reference reaches (p< 0.05)				

instability associated with past development and/or agricultural activities or are associated with on-going adjustment as the reaches evolve toward unstable stream types. The current trajectory for these reaches is unknown at the present time.

In Anne Arundel County and the Maryland Coastal Plain, historical human activities are assumed to have occurred in a similar manner and timeframe as those documented in the Maryland Piedmont physiographic province (Jacobson and Coleman 1986). Jacobson and Coleman cite that human disturbances to land use in the Maryland Piedmont have occurred since approximately 1730, when European settlement of the area initiated a >200-year period of forest clearing and agricultural activities. Since approximately 1930, much of the acreage of land used for farming has been converted to urban, suburban, commercial, and industrial development. Consequently, streams in the Maryland Piedmont have adjusted to the increased flow and sediment supply by overwidening, deepening, and reworking aggraded floodplain materials in an effort to transition toward a sustainable stable form (Jacobson and Coleman 1986). Similar processes also are assumed to have occurred in the Anne Arundel County area of the Maryland Coastal Plain, and the responses of the County's streams are likely still occurring today.

Stable stream types dominated the Upper Magothy, Bodkin Creek, and Marley Creek sampling units (Northern Units). The C, E and B types found in these units are considered evolutionary end points in the Rosgen classification system, which perturbed systems tend to adjust toward over time (Rosgen 1996). Conversely, unstable G types dominate the Hall Creek sampling unit.

While stable stream types predominate, the levels of imperviousness and high intensity land uses found in the Northern Units—discussed in subsequent sections—are quite high. The pace

and age of development might influence channel evolution and the types of stream channels found in these sampling units. As shown in **Figure 24**, development in the Northern Units occurred mostly between the 1950s and the 1970s. Consequently, given the thirty years since near full build out of these areas, it is possible that the streams in these units have evolved into stable types after undergoing a period of adjustment associated with the highly altered discharge regime that results from such development, reworking any excess sediment deposited in the stream valleys and reworking it as described by Jacobson and Coleman (1986) for the Maryland Piedmont. It should be noted that this proposed pattern of adjustment is speculative, as no historic geomorphic data exist for these sites.

For Hall Creek, **Figure 21** shows that most development occurred within this sampling unit during the 1980s and 1990s. It is possible that within this unit, the process of sediment reworking has not progressed as far as in the Northern Units. G channel formation would be consistent with downcutting through deposited sediment as channels resize themselves in response to alterations in discharge associated with development activities. Severe headcuts have been observed in Hall Creek (**Figure 22**). Again, this is speculation, as no historical channel stability data exist for the streams in this sampling unit. It should be noted that the data presented in Figure 21 is not complete as development age data were not all structures built within these PSUs.

More detailed watershed assessments would be necessary to determine with greater certainty where these drainage networks are in the evolutionary sequence of adjustment and would be essential for a better understanding of their existing conditions. However, this report provides valuable baseline data that can be compared to data collected in subsequent years and used to generate trend analyses of channel adjustment.

In the meantime, these baseline geomorphic assessment field data can be compared to the Maryland Coastal Plain regional relationships of bankfull channel geometry developed for relatively rural channels (McCandless 2003) and for urbanized watersheds (AAC 2002) in order to determine whether bankfull characteristics observed in the field at sites where the discharge is unknown depart from USGS gages where bankfull conditions are known. This comparison is shown in **Figure 23**. While there is moderate scatter ( $r^2$  values ranged from ~0.50 to 0.65) in these relationships, many of the values cluster somewhere between the rural and urban bankfull channel regional curves with an apparent bias toward the McCandless curve. The implications of this observation on stream channel evolution in these sampling units is unclear, but it likely means that these reaches are in some state of transition where the dominant process is floodplain incision due to a disturbance in the discharge regime associated with impervious surface occurrence. Typically, lateral adjustment follows such incision as the stream resets itself into an equilibrium condition at a different, lower elevation than it was in the pre-disturbance phase.

Based upon the discussion above, the following recommendations are made for these sampling units:

**Investigate potential for retrofitting existing development with stormwater Best Management Practices.** Three of four sampling units have extensive amounts of developed land area. To the extent feasible, BMPs should be installed to improve water quality, particular in the areas upstream of the sites listed in **Table 14** as potentially have a water quality impairment of unknown type.

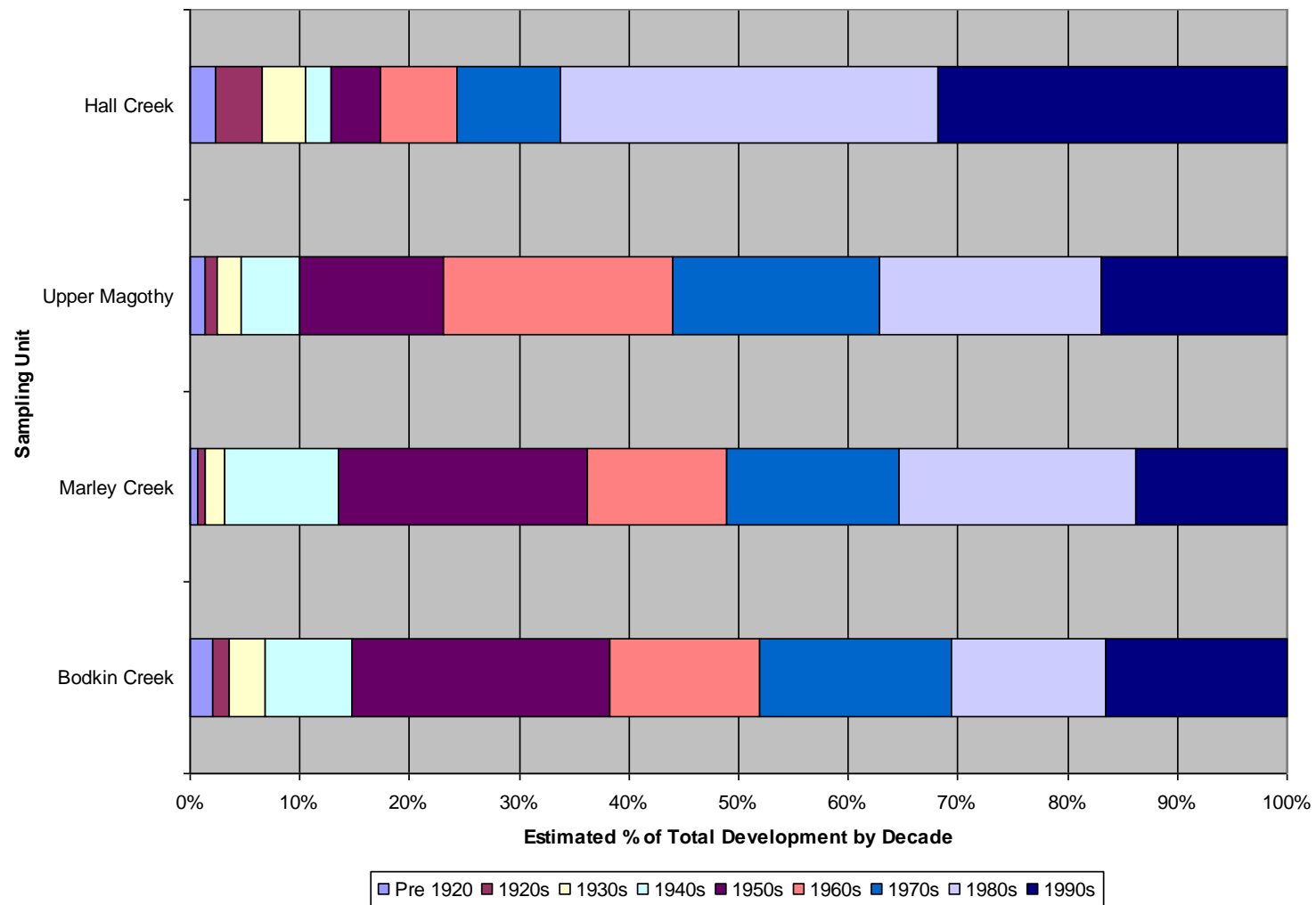


Figure 21 - Estimated distribution of development activities in the sampling units by decade.

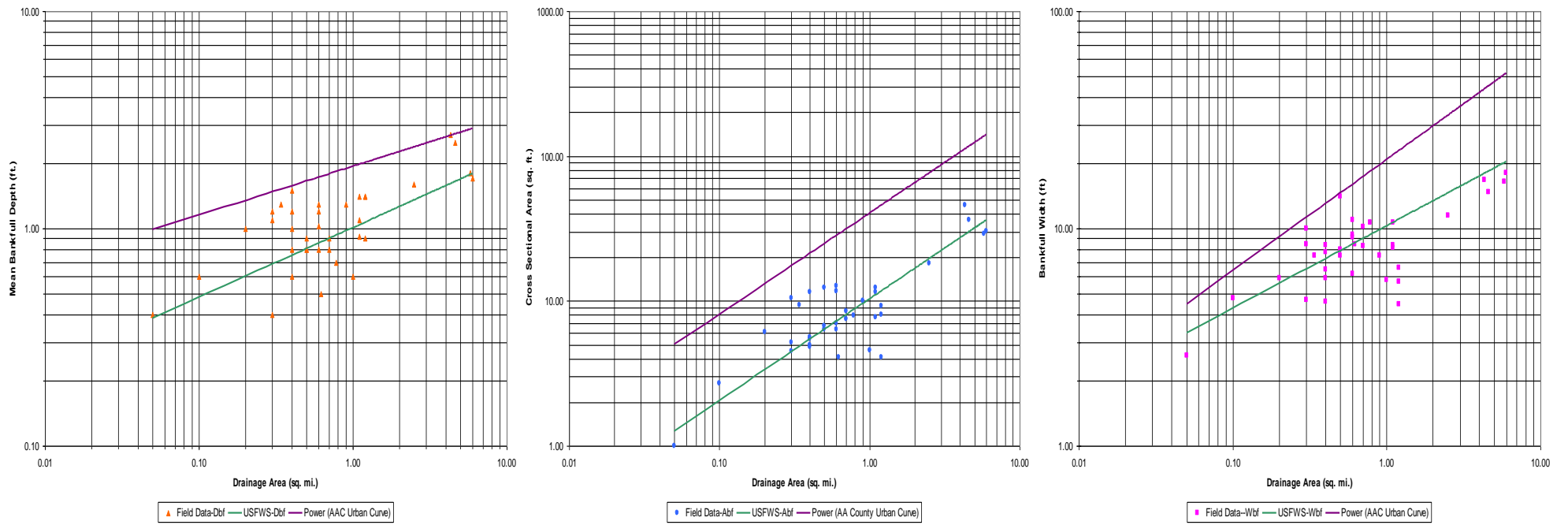


**Perform study to identify specific stressors in County watersheds.** As described above, a deliberate stressor identification technique (USEPA 2000, Suter et al. 2002, Cormier et al. 2002) is needed to correctly associate biological stresses with their most probable causes. The stressor identification process can encompass multiple watersheds simultaneously, and the compilation of similar environmental scenarios will strengthen the study. However, individual watershed studies will also be required because each disturbed watershed and stream has unique circumstances.

**Track stream channel evolution and trajectory predictions in subsequent sampling rounds.** Stability assumptions made about particular sites should be validated with repeated measurements and additional assessment work. By verifying these predictions, the County will have a better understanding of how land use changes impact streams over time, which may eventually allow for fine tuning zoning and development regulations toward maximum protection of stream channel stability.



**Figure 22 - Active headcut in Hall Creek sampling unit.**



**Figure 23 - Comparison of field collected A) bankfull channel depth, B) bankfull channel area, and C) bankfull channel width with Coastal Plain regional relationships.**

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# **APPENDIX A: SAMPLE FIELD SHEETS**

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# Stream Channel Classification and Assessment Form

## Rosgen Classification System

### Level II



Watershed Name: \_\_\_\_\_ Stream/ReachID: \_\_\_\_\_

Drainage Area: \_\_\_\_\_ mi<sup>2</sup>/acres/ha

Observers: \_\_\_\_\_ Date/Time: \_\_\_\_\_/\_\_\_\_\_/\_\_\_\_\_

Lat: \_\_\_\_\_

GPS [ ] Y [ ] N Differential Correction? [ ] Y [ ] N Positional Error: \_\_\_\_\_ ft.

Lon: \_\_\_\_\_

Location Description: \_\_\_\_\_

Camera/Film No. \_\_\_\_\_

Weather: \_\_\_\_\_ Rain in last 24 hrs? [ ] Y [ ] N

Photo Nos: US \_\_\_\_\_ DS \_\_\_\_\_ LB \_\_\_\_\_ RB \_\_\_\_\_

Bankfull Width (W): \_\_\_\_\_ ft.

Bankfull Mean Depth (D) : \_\_\_\_\_ ft.

W/D Ratio: \_\_\_\_\_

W and D checked on Regional Curve?

[ ] Y [ ] N

Describe feature(s) used:

Thalweg elv.(TE): \_\_\_\_\_ ft.

Bankfull elv.(BFE): \_\_\_\_\_ ft.

Max Bankfull Depth (TE-BFE): \_\_\_\_\_ ft.

2X Max Bankfull Depth (2XMBD): \_\_\_\_\_ ft.

Floodprone Area Elevation (TE-

2XMBD): \_\_\_\_\_ ft.

Floodprone Area Width (FPW): \_\_\_\_\_ ft.

Entrenchment Ratio(FPW/W): \_\_\_\_\_

	us elv	ds elv	elv. diff.
--	-----------	-----------	---------------

WS Elv.(WSE)	_____ ft.	_____ ft.	_____ ft.
--------------	-----------	-----------	-----------

Thalweg Elv.(TE)	_____ ft.	_____ ft.	_____ ft.
------------------	-----------	-----------	-----------

Valley Elv.(VE)	_____ ft.	_____ ft.	_____ ft.
-----------------	-----------	-----------	-----------

Assessment Reach Length (ARL): \_\_\_\_\_ ft.

Valley Distance (VD): \_\_\_\_\_ ft.

WS Slope (WSE/ARL): \_\_\_\_\_ ft./ft.

Valley Slope (VE/VD): \_\_\_\_\_ ft./ft.

Sinuosity (ARD/VD): \_\_\_\_\_

Meander Length: \_\_\_\_\_ ft.

Belt Width: \_\_\_\_\_ ft.

#### CLASSIFICATION (USE ROSGEN KEY OF NATURAL RIVERS):

**Channel Type:**

**Single Thread [ ]**

**Multiple Channels [ ]**

**Entrenchment Ratio:**

<1.4 [ ]

1.4-2.2 [ ]

>2.2 [ ]

**Width/Depth Ratio:**

<12 [ ]

12-40 [ ]

>40 [ ]

**Sinuosity:**

<1.2 [ ]

1.2-1.5 [ ]

>1.5 [ ]

**D50:** \_\_\_\_\_

**Adjustments?** \_\_\_\_\_

**Rosgen  
Stream  
Type:** \_\_\_\_\_



Habitat Parameter	Optimal 16-20	Sub-Optimal 11-15	Marginal 6-10	Poor 0-5
Instream Habitat	Greater than 50% of a variety of cobble, boulder, submerged logs, undercut banks, snags rootwads, aquatic plants or other stable habitat.	30-50% of stable habitat. Adequate habitat.	10-30% mix of stable habitat. Habitat availability less than desirable.	Less than 10% of stable habitat. Lack of habitat is obvious.
Epifaunal Substrate	Preferred substrate abundant, stable, and at full colonization potential (riffles well developed and dominated by cobble; and/or woody debris prevalent, no new, and not transient)	Abundance of cobble with gravel &/or boulders common; or woody debris, aquatic veg., undercut banks, or other productive common but not prevalent/suited for full colonization.	Large boulders and/or bedrock prevalent; cobble, woody debris, or other preferred surfaces uncommon.	Stable substrates lacking; or particles are over 75% surrounded by fine sediment or flocculent material.
Velocity/Depth Diversity	Slow (<0.3 m/s), deep (>0.5m); slow, shallow (<0.5m); fast (>0.3m/s), deep; fast, shallow habitats all present.	Only 3 of the 4 habitat categories present.	Only 2 of the 4 habitat categories present.	Dominated by 1 velocity/depth category (usually pools).
Pool/Glide/Eddy Quality	Complex cover/&/or depth > 1.5m; both deep (>0.5m)/shallows (<0.2m) present.	Deep (>0.5m) areas present; but only moderate cover.	Shallows (<0.2m) prevalent in pool/glide/eddy habitat; little cover.	Max depth <0.2m in pool/glide/eddy habitat; or absent completely.
Riffle/Run Quality	Riffle/run depth generally >10 cm, with maximum depth greater than 50 cm (maximum score); substrate stable (e.g. cobble, boulder) & variety of current velocities.	Riffle/run depth generally 5-10 cm, variety of current velocities.	Riffle/run depth generally 1-5 cm; primarily a single current velocity.	Riffle/run depth <1 cm; or riffle/run substrates concreted.
Embeddedness	Percentage that gravel, cobble, and boulder particles are surrounded by line sediment or flocculent material.			
Shading	Percentage of segment that is shaded (duration is considered in scoring). 0%= fully exposed to sunlight all day in summer; 100% fully and densely shaded in summer.			
Trash Rating	Little or no human refuse visible from stream channel or riparian zone.	Refuse present in minor amounts.	Refuse present in moderate amounts.	Refuse abundant and unsightly.
Bank Stability	Upper banks stable, 0-10% of banks with erosional scars and little potential for future problems.	Moderately stable. 10-30% of banks with erosional scars, mostly healed over. Slight potential in extreme floods.	Moderately unstable. 30-60% of banks with erosional scars and high erosion potential during extreme high flow.	Unstable. Many eroded areas. "Raw" areas frequent along straight sections and bends. Side slopes >60 common.
Remoteness	Stream segment more than ¼ mile from nearest road; access difficult and little or no evidence of human activity.	Stream segment within ¼ mile of but not immediately accessible to roadside access by trail; site with moderately wild character.	Stream within ¼ mile of roadside and accessible by trail; anthropogenic activities readily evident.	Segment immediately adjacent to roadside access; visual, olfactory, and/or auditory displeasure experienced.

#### **Vegetation Types**

G- Grasses/Forbes  
R- Regen Deciduous/Shrubs (<4"DBH)  
Y- Young Deciduous (4-12" DBH)  
M- Mature Deciduous (12-24" DBH)  
O- Old Deciduous (>24" DBH)  
A- Regen Coniferous (<4" DBH)  
B- Young Coniferous (4-12" DBH)  
C- Mature Coniferous (12-24" DBH)  
D- Old Coniferous (>24" DBH)  
L- Lawn

#### **Riparian Buffer Zone/ Adjacent Land Cover Types**

FR- Forest  
OF- Old Field  
EM- Emergent Vegetation  
LN- Mowed Lawn  
TG- Tall Grass  
LO- Logged Area  
SL- Bare Soil  
RR- Railroad  
PV- Paved Road  
PK- Parking Lot/Industrial/Commercial  
GR- Gravel Road  
DI- Dirt Road  
PA- Pasture  
OR- Orchard  
CP- Cropland  
HO- Housing

#### **Sampleability Codes**

s- Sampleable  
1- Dry Stream Bed  
2- Too Deep  
3- Marsh, no defined channel  
4- Excessive Riparian Vegetation  
5- Impoundment  
6- Tidally Influenced  
7- Permissions Denied  
8- Unsafe (Describe in Comments)  
9- Beaver  
10- Other \_\_\_\_\_

#### **Instream Blockage Codes**

DM- Dam  
PC- Pipe Culvert  
F- Fishway  
GW- Guaging Station Weir  
G- Gabion  
PX- Pipeline Crossing  
AC- Arch Culvert  
BC- Box Culvert  
TG- Tide Gauge

(Note: Height is measured in meters from stream surface to water surface above structure)

#### **Other Notes:**

## HABITAT ASSESSMENT FIELD DATA SHEET-LOW GRADIENT STREAMS (FRONT)

STREAM NAME _____	LOCATION _____	
STATION # _____	STREAM CLASS _____	
LAT _____	RIVER BASIN _____	
STORET # _____	AGENCY _____	
INVESTIGATORS _____		
FORM COMPLETED BY _____	DATE _____ TIME _____	REASON FOR SURVEY _____

Parameters to be evaluated in sampling reach	Habitat Parameter	Condition Category																				
		Optimal					Suboptimal					Marginal					Poor					
	1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).					30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).					10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.					Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.					
	SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.					Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.					All mud or clay or sand bottom; little or no root mat; no submerged vegetation.					Hard-pan clay or bedrock; no root mat or vegetation.					
	SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.					Majority of pools large-deep; very few shallow.					Shallow pools much more prevalent than deep pools.					Majority of pools small-shallow or pools absent.					
	SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.					Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.					Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.					Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.					
	SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.					Water fills >75% of the available channel; or <25% of channel substrate is exposed.					Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.					Very little water in channel and mostly present as standing pools.					
	SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

## HABITAT ASSESSMENT FIELD DATA SHEET-LOW GRADIENT STREAMS (BACK)

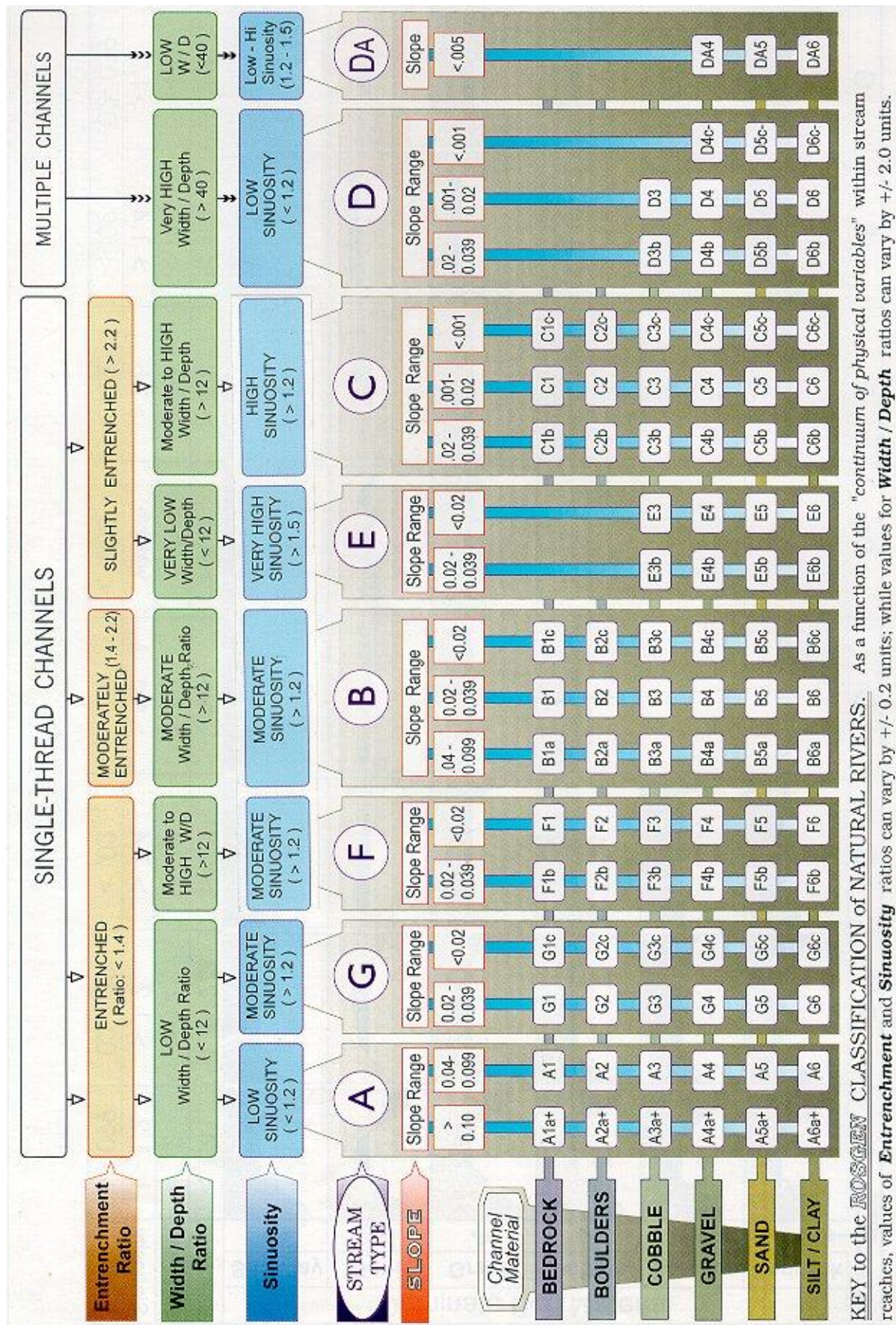
Habitat Parameter	Condition Category																				
	Optimal					Suboptimal					Marginal					Poor					
<b>6. Channel Alteration</b>	Channelization or dredging absent or minimal; stream with normal pattern.					Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.					Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.					Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.					
<b>SCORE</b>	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
<b>7. Channel Sinuosity</b>	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)					The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.					The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.					Channel straight; waterway has been channelized for a long distance.					
<b>SCORE</b>	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
<b>8. Bank Stability (score each bank)</b>	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.					Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.					
SCORE ____ (LB)	Left Bank      10    9					8      7      6					5      4      3					2      1      0					
SCORE ____ (RB)	Right Bank    10    9					8      7      6					5      4      3					2      1      0					
<b>9. Vegetative Protection (score each bank)</b>  Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.					Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.					
SCORE ____ (LB)	Left Bank      10    9    9					8      7      6					5      4      3					2      1      0					
SCORE ____ (RB)	Right Bank    10    9    9					8      7      6					5      4      3					2      1      0					
<b>10. Riparian Vegetative Zone Width (score each bank riparian zone)</b>	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.					Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.					Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.					Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.					
SCORE ____ (LB)	Left Bank      10    9					8      7      6					5      4      3					2      1      0					
SCORE ____ (RB)	Right Bank    10    9					8      7      6					5      4      3					2      1      0					

**Total Score** \_\_\_\_\_

Benthic Spring Sampling Data Sheet													
Watershed Code		Segment		Type		Year							
SITE						2005		Reviewed By: _____					
BASIN				Sample Label Verified By: _____				2nd Reviewer: _____					
DATE		Year		Month		Day		Crew: _____					
TIME				(Military)		Project: _____							
Distance from Nearest Road to Site (m)				RIPARIAN VEGETATION (facing upstream)						WATER QUALITY PARAMETERS			
Remoteness				Left Bank		Right Bank		Temperature ©					
Bank Erosion		Left Bank		Right Bank		Width (50m max)		DO (mg/L)					
Extent						Adjacent Land Cover		pH					
Severity		1=min		2=mod		Vegetation Type (see back)		Cond (ms/cm)					
3=severe						Buffer Breaks (Y/N)		Turbidity (NTU)					
Eroded Area (m2 X 10)						Buffer Break Types (M=minor; S=severe)		Meter Calibrations by: _____		Sampleability			
Bank Stability						Storm Drain				<input type="checkbox"/> Benthos			
						Tile Drain				<input type="checkbox"/> Habitat Assessment			
						Impervious Drainage				<input type="checkbox"/> Water Quality			
						Gully				Road Culvert			
						Orchard				<input type="checkbox"/> Culvert in Segment? (y/n)			
						Crop				<input type="checkbox"/> Sampleable? (y/n)			
						Pasture				<input type="checkbox"/> Length of Culvert (m)			
						New Construction				<input type="checkbox"/> Width of Culvert (m)			
						Dirt Road				Maximum Depth (cm)			
						Gravel Road							
						Raw Sewage				No. Instream Woody Debris			
						Railroad				No. of Dewatered			
Benthic Habitat Sampled		(Square feet; Total = 20 square feet)				CHANNELIZATION		Evidence of Channel Straightening or Dredging (Y/N)		<input type="checkbox"/>			
Riffle						TYPE		EXTENT (m)		Woody Debris			
Rootwad/Woody Debris						Concrete		Left Bank		Bottom		Right Bank	
Leaf Pack						Gabion							
Macrophytes						Rip-rap							
Undercut Banks						Earthen Berm							
Other						Drege Spoil off Channel							
(Specify)						Pipe Culvert							
Stream Width (m)		0 m		75 m		HABITAT ASSESSMENT		Instream Habitat (0-20)		Picture Number		Subject	
LANDUSE (Y/N)		Old Field		Deciduous Forest				Epifaunal Substrate (0-20)		Picture Number		Subject	
		Coniferous Forest		Wetland				Velocity/Depth Diversity (0-20)		Picture Number		Subject	
		Surface Mine		Landfill				Pool/Glide/Eddy Quality (0-20)		Picture Number		Subject	
		Residential		Commercial/Industrial				Extent (0-20)		Picture Number		Subject	
		Cropland		Pasture				Riffle/Run Quality (0-20)		Picture Number		Subject	
		Orchard/Vineyard/Nursery		Golf Course				Extent (0-20)		Picture Number		Subject	
								Embeddedness (%)		Picture Number		Subject	
								Shading (%)		Picture Number		Subject	
								Trash Rating		Picture Number		Subject	
Site Access Route										_____			
Sampling Consd ( _____ num. Anodes)										_____			
Comments										_____			

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Source: Rosgen, D.L. 1996. *Applied River Morphology*. Wildland Hydrology, Pagosa Springs, CO.

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	Drainage Area (mi <sup>2</sup> )	Bankfull Width (ft)	Mean Bankfull Depth (ft)	Floodprone Width (ft)	Entrenchment Ratio	Width to Depth Ratio	Cross Sectional Area (ft <sup>2</sup> )	Slope (%)	Sinuosity	D50 (mm)	Rosgen Stream Type
05-02	0.34	7.5	1.3	225	30.1	6	9.4	0.37	1.1	0.19	E5
05-04	0.5	8	0.8	11.2	1.4	9.5	6.7	1.13	1.14	2.82	G5c
05-06	0.4	7.8	1.5	207	26.5	5.3	11.6	0.279	1.2	1.51	E5
05-07	1	20.4	2.2	300	14.7	9.2	45.5	0.31	1.04	0.17	E5
05-08	1.2	6.6	1.4	121	18.4	4.7	9.2	0.985	1.1	0.081	E5
05-09	0.78	10.7	0.7	15	1.4	14.5	7.9	0.263	1.2	0.18	B5c
05-10	4.3	16.7	2.7	102	6.1	6.1	45.8	0.029	1.1	0.078	E5
05-11A	0.3	8.5	1.2	16	1.9	6.8	10.5	0.245	1.1	0.062	C6
05-13A	–	–	–	–	–	–	–	–	–	–	–
05-15A	1.2	5.7	1.41	95.1	16.7	4.1	8	0.84	1.1	0.25	E5
06-02	1	5.8	0.6	95	16.5	7.1	4.6	0.22	1.2	0.15	E5
06-03	0.3	10	0.4	115	11.5	22	4.5	0.83	1	0.062	C6
06-04	0.05	2.6	0.4	17	6.5	6.6	1	0.3	1.1	0.062	E6
06-05	1.1	8.2	1.4	98	11.9	5.8	11.6	0.29	1.2	0.13	E5
06-08	0.6	6.2	1.03	131	21	6	6.4	0.19	1.1	0.16	E5
06-09	1.1	8.4	0.92	98	11.6	9.2	7.7	0.91	1.1	0.25	E5
06-10	0.4	8.4	0.6	69	8.2	14.7	4.8	0.67	1.3	0.13	C5
06-11A	0.6	9.1	0.8	>246	27	11.9	7	0.37	1.1	0.12	C5
06-12A	0.4	5.9	1	148	25.1	6.2	5.6	1.1	1.2	0.13	E5
06-13A	1.2	4.5	0.9	141	31.6	4.8	4.1	0.28	1.1	0.21	E5
07-02	1.2	7.9	1.9	–	–	4.2	14.9	–	–	–	–
07-03	0.4	4.6	1.2	115	25	3.8	5.5	1.04	1.2	0.13	E5
07-04	0.7	8.3	0.9	85	10.2	9.2	7.5	0.54	1.1	0.25	E5
07-05	0.9	7.5	1.3	59	7.8	5.7	10	0.69	1	0.34	E5
07-07	0.2	5.9	1	75	12.7	5.7	6.1	0.7	1.2	0.19	E5
07-08	1.1	10.7	1.1	121	11.3	9.4	12.3	0.17	1.2	0.094	E5
07-09	2.5	11.5	1.6	144.4	12.6	7.3	18.2	0.46	1.3	0.14	E5
07-10	4.6	14.7	2.48	190	13	5.9	36.3	0.43	1.1	0.71	E5
07-12A	0.621	8.5	0.5	92	10.8	17.7	4.1	0.78	1	0.16	C5
07-14A	0.5	7.5	0.8	36.1	4.8	8.9	6.4	0.77	1.1	0.01	E5
24-02	0.3	4.7	1.1	4.6	1.7	4.1	5.3	3.28	<1.2	0.13	B5
24-04	0.5	14.1	0.9	131	9.3	16.1	12.4	0.927	1.1	0.062	C6
24-05	0.6	11	1.2	15.7	1.4	9.5	12.7	0.35	1.2	0.18	G5c
24-06	0.7	10.2	0.84	25.3	2.5	12.1	8.5	0.23	1.1	0.094	C5
24-07	0.6	9.4	1.3	17.4	1.9	0.6	11.7	0.413	1.5	0.25	B5c
24-08	–	–	–	–	–	–	–	–	–	–	–
24-09	1.32	18	1.7	21.4	1.2	10.7	30.2	0.193	1.2	0.09	G5c
24-10	5.8	16.4	1.8	17.8	1.1	9.2	29.1	0.139	2.4	0.11	G5c
24-11A	0.1	4.8	0.6	6.9	1.5	8.4	2.7	0.76	1.1	0.077	G5c
24-13A	0.4	6.5	0.8	9.1	1.4	8.5	5	0.347	1.2	0.071	G5c



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## QUALITY CONTROL

Three aspects of data quality were addressed for the biological components of this dataset, and include field sampling precision (repeatability), laboratory sorting and subsampling bias, and taxonomic precision (consistency) (Flotemersch et al. 2006, Stribling et al. 2008). Field sampling precision was calculated using results from 4 sample pairs for both the original and revised B-IBI (Stribling et al. 1998, Southerland et al. 2005), including individual metrics (**Table D-1**). Several of the values for field sampling precision exceeded MQO presented by Hill et al. (2005); for example, the MQO for the B-IBI is 15%, 10%, and  $\pm 0.5$  for median relative percent difference (RPD), coefficient of variability (CV), and 90 percent confidence interval, respectively. Results for this dataset were 17.7, 18.5, and  $\pm 0.76$  for the 1998 index. Although somewhat less variable with the 2005 index at 10.1, 17.1, and  $\pm 0.70$ , the MQO for field precision are still exceeded for two of the three. This is most likely due to the fact that most of the samples completely lacked mayflies (Ephemeroptera) and/or taxa representing the scraper functional feeding group, which led to aberrant index values some metrics and increased index variability. The small number of samples that went into the calculations (n=8 sample pairs) also contributed to elevated variability.

**Table D-1.** Precision statistics for field sampling.

1998 Index	mean	avgRPD	medRPD	MSE	RMSE	CV	CI90
B-IBI	2.5	20.6	17.7	0.214	0.46	18.5	0.76
Total Taxa	25.3	19.4	17.1	15.750	3.97	15.7	6.51
EPT Taxa	4.4	16.5	18.8	0.375	0.61	13.9	1.00
% Ephemeroptera	0.12	na	na	0.118	0.34	286.0	0.56
% Tanyt./Chiro.	13.5	83.5	58.0	15.885	3.99	29.5	6.54
Beck's Biotic Index	7.9	40.6	36.5	4.625	2.15	27.2	3.53
Scraper Taxa	0.4	na	na	0.125	0.35	88.4	0.58
% clingers	28.3	31.6	31.6	96.827	9.84	34.8	16.14
2005 Index							
B-IBI	2.5	16.8	10.1	0.184	0.43	17.1	0.70
Total Taxa	25.3	19.4	17.1	15.750	3.97	15.7	6.51
EPT Tax	4.4	16.5	18.8	0.375	0.61	13.9	1.00
Ephemeroptera Taxa	0.13	na	na	0.125	0.35	272.0	0.58
% Intolerants-Urban	13.5	75.1	36.0	18.878	4.34	32.2	7.13
% Ephemeroptera	0.12	na	na	0.118	0.34	286.0	0.56
Scraper Taxa	0.4	na	na	0.125	0.35	88.4	0.58
% climbers	7.1	34.4	35.8	3.994	2.00	28.1	3.28

The number of samples for all analyses is 8 (4 repeat sample pairs). mRPD is mean relative percent difference. MSE is mean square error. RMSE is root MSE. CV is coefficient of variability. CI90 is the 90% confidence interval. "na" is not applicable, and in this application indicates that the value for one of two samples was zero (0).

Laboratory sorting and subsampling bias was tested by an external laboratory for four sort residue samples (**Table D-2**). Their initial checks for missed specimens found large numbers of organisms, and resulted in failed percent sorting efficiency (PSE), that is,

<90%. However, in discussion with the sort QC laboratory, it was determined that dissecting microscopes were used (up to approximately 40x) for the first three samples. No magnification was used during the primary sorting, that is, it was done completely by the naked eye as called for in the Anne Arundel County SOP. By reviewing the vials of recheck recoveries, the QC laboratory estimated the number of organisms that would have been found without magnification. Using these values, all four samples passed, with PSE ranging from 90.7-95.9.

**Table D-2.** QC results from external laboratory sort residue re-checks.

Station ID	No. orgs (primary)	With magnification			Without magnification		
		No. recoveries	Total no.	PSE	No. recoveries	Total No.	PSE
05-04	118	31	149	79.2	12*	130	90.7
07-02	282	217	499	56.5	18*	300	94
07-08	146	33	179	81.6	8*	154	94.8
24-11A	116	na	na	na	5	121	95.9

Percent sorting efficiency (PSE) represents bias in the sorting/subsampling process. Asterisks (\*) indicate estimated number of recoveries that would have been found without magnification, based on review by external laboratory.

Taxonomic precision was tested by using an independent taxonomist (from a separate laboratory) to re-identify a randomly-selected subset of samples, and then quantifying differences. For this QC activity, we used samples collected and analyzed as part of the 2007 (year 4) sample lot. Since the taxonomist who performed the primary taxonomy for this phase of the monitoring (year 3) is the same, the QC results (**Table D-3**) are applicable. The most important result is that of PTD; the measurement quality objective (MQO) is 15%. All six sample comparisons fell well below the MQO, with an overall mean of 5.4 (s.d. 2.9), and PTD ranging from 1.0-8.7. There were very few straight disagreements, and the dominant error type with all comparisons was hierarchical and mostly arising from how worm (*Oligochaeta*) fragments were counted and recorded. No corrective actions were necessary. **Table D-4** provides a summary comparison of QC results with programmatic MQO.

**Table D-3.** QC results from taxonomic re-identification of randomly selected samples.

Sample ID*	PDE	PTD	PTC (absDIFF)	PDEm	PTDm
01-04	0.0	1.9	0.0	0.0	1.2
01-07	1.4	6.3	0.3	0.0	2.9
01-13a	3.5	8.7	1.0	1.0	3.8
02-19a	0.5	1.0	6.1	0.0	0.0
08-07	2.4	6.7	1.0	0.0	0.0
17-11a	3.4	7.6	0.6	0.0	1.9
mean	1.9	5.4	1.5	0.2	1.6
sd	1.4	2.9	2.1	0.4	1.4

Abbreviations: PDE, percent difference in enumeration; PTD, percent taxonomic disagreement; PTC (absDIFF), percent taxonomic completeness (absolute difference); PDEm, PDE midges only; PTDm, PTD midges only.

**Table D-4.** Summary of QC results and measurement quality objectives.

Activity	Performance indicator	Term	MQO	Result
Field sampling	Precision	Median relative pct. difference (mRPD)	<15	10.1
		Root mean square error (RMSE)	na	0.43
		Coefficient of variability (CV)	<10	17.1
		90% confidence interval (CI90)	<0.60	0.70
Sorting/subsampling	Bias	Pct. sorting efficiency (PSE)	>90	93.9
Taxonomic identification	Precision (consistency)	Pct. difference in enumeration (PDE)	<5	1.9
		Pct. taxonomic disagreement (PTD)	<15	5.4
MQO are taken from Hill et al. 2005; result values are from this dataset, with field sampling values based on the 2005 benthic index.				

Order	Family	Genus	FFG*	TV*	Habit
Amphipoda	Crangonyctidae	CRANGONYX	Collector	6.7	sp
Amphipoda	Crangonyctidae	STYGOBROMUS			
Amphipoda	Crangonyctidae	SYNURELLA		0.4	
Amphipoda	Gammaridae	GAMMARUS	Shredder	6.7	sp
Amphipoda	Hyalellidae	HYALELLA	Shredder	4.2	sp
Amphipoda		AMPHIPODA		6	sp
Basommatophora	Lymnaeidae	LYMNAEIDAE	Scraper	6.9	cb
Basommatophora	Physidae	PHYSELLA	Scraper	7	cb
Basommatophora	Planorbidae	PLANORBIDAE	Scraper	7.6	cb
Coleoptera	Dryopidae	HELICHUS	Scraper	6.4	cn
Coleoptera	Dytiscidae	AGABUS	Predator	5.4	sw, dv
Coleoptera	Dytiscidae	DYTISCIDAE	Predator	5.4	sw, dv
Coleoptera	Dytiscidae	NEOPORUS			
Coleoptera	Elmidae	ANCYRONYX	Scraper	7.8	cn, sp
Coleoptera	Elmidae	DUBIRAPHIA	Scraper	5.7	cn, cb
Coleoptera	Elmidae	MACRONYCHUS	Scraper	6.8	cn
Coleoptera	Elmidae	OPTIOSERVUS	Scraper	5.4	cn
Coleoptera	Elmidae	STENELMIS	Scraper	7.1	cn
Coleoptera	Gyrinidae	DINEUTUS	Predator	4	sw, dv
Coleoptera	Hydrophilidae	ENOCHRUS	Collector	4.1	bu, sp
Coleoptera	Hydrophilidae	HYDROBIUS	Collector	4.1	cb, cn, sp
Coleoptera	Hydrophilidae	Hydrochara			
Coleoptera	Ptilodactylidae	ANCHYTARSUS	Shredder	3.1	cn
Coleoptera	Scirtidae	CYPHON	Scraper	7	cb
Coleoptera	Scirtidae	PRIONOCYPHON			
Coleoptera		HYDROPORINAE			
Diptera	Ceratopogonidae	BEZZIA	Predator	3.3	bu
Diptera	Ceratopogonidae	CERATOPOGON	Predator	2.7	sp, bu
Diptera	Ceratopogonidae	CULICOIDES	Predator	5.9	bu
Diptera	Ceratopogonidae	PROBEZZIA	Predator	3	bu
Diptera	Chironomidae	CHAETOCLADIUS	Collector	7	sp
Diptera	Chironomidae	CORYNONEURA	Collector	4.1	sp
Diptera	Chironomidae	CRICOTOPUS	Shredder	9.6	cn, bu
Diptera	Chironomidae	CRICOTOPUS/ORTHOCLADIUS	Shredder	7.7	
Diptera	Chironomidae	CRYPTOCHIRONOMUS	Predator	7.6	sp, bu
Diptera	Chironomidae	DIAMESA	Collector	8.5	sp
Diptera	Chironomidae	DIPLOCLADIUS	Collector	5.9	sp
Diptera	Chironomidae	EUKIEFFERIELLA	Collector	6.1	sp
Diptera	Chironomidae	GEORTHOCLADIUS			
Diptera	Chironomidae	GLYPTOTENDIPES	Filterer	6.6	bu, cn
Diptera	Chironomidae	GYMNOMETRIOCNEMUS			sp
Diptera	Chironomidae	HETEROTRISSOCLADIUS	Collector	2	sp, bu
Diptera	Chironomidae	HYDROBAENUS	Scraper	7.2	sp
Diptera	Chironomidae	LIMNOPHYES	Collector	8.6	sp
Diptera	Chironomidae	MESOCRICOTOPUS		6.6	
Diptera	Chironomidae	MICROPSECTRA	Collector	2.1	cb, sp
Diptera	Chironomidae	MICROTENDIPES	Filterer	4.9	cn
Diptera	Chironomidae	NANOCLADIUS	Collector	7.6	sp
Diptera	Chironomidae	NATARSIA	Predator	6.6	sp
Diptera	Chironomidae	ODONTOMESA	Collector	6.6	sp
Diptera	Chironomidae	ORTHOCLADIINAE	Collector	7.6	
Diptera	Chironomidae	ORTHOCLADIUS	Collector	9.2	sp, bu

Order	Family	Genus	FFG*	TV*	Habit
Diptera	Chironomidae	PARACLADOPELMA	Collector	6.6	sp
Diptera	Chironomidae	PARACRICOTOPUS	Collector		
Diptera	Chironomidae	PARAKIEFFERIELLA	Collector	2.1	sp
Diptera	Chironomidae	PARALAUTERBORNIELLA	Collector	6.6	cn
Diptera	Chironomidae	PARAMETRIOCNEMUS	Collector	4.6	sp
Diptera	Chironomidae	PARAPHAENOCLADIUS	Collector	4	sp
Diptera	Chironomidae	PARATANYTARSUS	Collector	7.7	sp
Diptera	Chironomidae	PARATENDIPES	Collector	6.6	bu
Diptera	Chironomidae	PHAENOPSECTRA	Collector	8.7	cn
Diptera	Chironomidae	POLYPEDILUM	Shredder	6.3	cb, cn
Diptera	Chironomidae	PRODIAMESA	Collector	6.6	bu, sp
Diptera	Chironomidae	PSECTROTANYPUS	Predator	6.6	bu
Diptera	Chironomidae	PSEUDORTHOCCLADIUS	Collector	6	sp
Diptera	Chironomidae	PSEUDOSMITTIA			
Diptera	Chironomidae	RHEOCRICOTOPUS	Collector	6.2	sp
Diptera	Chironomidae	RHEOTANYTARSUS	Filterer	7.2	cn
Diptera	Chironomidae	STEMPELLINELLA	Collector	4.2	cb, sp, cn
Diptera	Chironomidae	STENOCHIRONOMUS	Shredder	7.9	bu
Diptera	Chironomidae	STILOCLADIUS	Collector	6.6	sp
Diptera	Chironomidae	TANYPODINAE	Predator	7.5	
Diptera	Chironomidae	TANYTARSUS	Filterer	4.9	cb, cn
Diptera	Chironomidae	THIENEMANNIELLA	Collector	5.1	sp
Diptera	Chironomidae	THIENEMANNIMYIA GROUP	Predator	8.2	sp
Diptera	Chironomidae	TVETENIA	Collector	5.1	sp
Diptera	Chironomidae	XYLOTOPUS	Shredder	6.6	bu
Diptera	Chironomidae	ZAVRELIMYIA	Predator	5.3	sp
Diptera	Culicidae	AEDES	Filterer	8	sw
Diptera	Empididae	CHELIFERA	Predator	7.1	sp, bu
Diptera	Empididae	EMPIDIDAE	Predator	7.5	sp, bu
Diptera	Empididae	HEMERODROMIA	Predator	7.9	sp, bu
Diptera	Empididae	NEOPLASTA	Predator		sp, bu
Diptera	Ptychopteridae	BITTACOMORPHA	Collector	4	bu
Diptera	Simuliidae	PROSIMULIUM	Filterer	2.4	cn
Diptera	Simuliidae	SIMULIUM	Filterer	5.7	cn
Diptera	Simuliidae	STEGOPTERNA	Filterer	2.4	cn
Diptera	Syrphidae	SYRPHIDAE	Collector		
Diptera	Tabanidae	CHRYSOPS	Predator	2.9	sp, bu
Diptera	Tabanidae	TABANIDAE	Predator	2.8	
Diptera	Tabanidae	TABANUS	Predator	2.8	sp, bu
Diptera	Tipulidae	ANTOCHA	Collector	8	cn
Diptera	Tipulidae	DICRANOTA	Predator	1.1	sp, bu
Diptera	Tipulidae	Epiphragma			
Diptera	Tipulidae	ERIOPTERA	Collector	4.8	bu
Diptera	Tipulidae	HEXATOMA	Predator	1.5	bu, sp
Diptera	Tipulidae	MOLOPHILUS		4.8	bu
Diptera	Tipulidae	ORMOSIA	Collector	6.3	bu
Diptera	Tipulidae	PEDICIA	Predator		bu
Diptera	Tipulidae	PILARIA	Predator	4.8	bu
Diptera	Tipulidae	PSEUDOLIMNOPHILA	Predator	2.8	bu
Diptera	Tipulidae	TIPULA	Shredder	6.7	bu
Diptera	Tipulidae	TIPULIDAE	Predator	4.8	bu, sp
Diptera	Tipulidae	TRIOGMA			bu,sp

Order	Family	Genus	FFG*	TV*	Habit
Diptera		ALLOGNOSTA			
Diptera		BRACHYCERA			
Ephemeroptera	Baetidae	ACERPENNA	Collector	2.6	sw, cn
Ephemeroptera	Ephemerellidae	EPHEMERELLA	Collector	2.3	cn, sw
Ephemeroptera	Heptageniidae	HEPTAGENIIDAE	Scraper	2.6	cn
Ephemeroptera	Heptageniidae	STENONEMA	Scraper	4.6	cn
Ephemeroptera	Leptophlebiidae	LEPTOPHLEBIA	Collector	1.8	sw, cn, sp
Ephemeroptera		PLAUDITUS			
Gastropoda		Micromenetus sp.			
Hemiptera	Corixidae	Sigara sp.	Predator		sw, cb
Hemiptera	Nepidae	Nepa			
Hemiptera	Veliidae	MICROVELIA	Predator	6	skater
Hoplonemertea	Tetrastemmatidae	PROSTOMA	Predator	7.3	
Isopoda	Asellidae	CAECIDOTEA	Collector	2.6	sp
Isopoda		ISOPODA	Collector	3.3	
Lepidoptera		LEPIDOPTERA		6.7	
Megaloptera	Corydalidae	CHAULIODES	Predator	1.4	cn, cb
Megaloptera	Corydalidae	NIGRONIA	Predator	1.4	cn, cb
Megaloptera	Sialidae	SIALIS	Predator	1.9	bu, cb, cn
Odonata	Aeshnidae	BOYERIA	Predator	6.3	cb, sp
Odonata	Calopterygidae	CALOPTERYX	Predator	8.3	cb
Odonata	Coenagrionidae	ARGIA	Predator	9.3	cn, cb, sp
Odonata	Coenagrionidae	ISCHNURA	Predator	9	cb
Odonata	Cordulegastridae	CORDULEGASTER	Predator	2.4	bu
Odonata	Corduliidae	CORDULIINAE	Predator		sp
Odonata	Gomphidae	STYLURUS	Predator		bu
Odonata	Libellulidae	ERYTHEMIS	Predator	7	sp
Odonata	Libellulidae	LIBELLULIDAE	Predator	9	
OLIGOCHAETA		OLIGOCHAETA	Collector	10	bu
OLIGOCHAETA	Naididae	Specaria			
OLIGOCHAETA	Tubificidae	Bothrioneurum			
OLIGOCHAETA	Tubificidae	Potamothrinx			
OLIGOCHAETA	Tubificidae	Tubificinae: bifid chaetae			
OLIGOCHAETA	Tubificidae	Tubificinae: hair+pectinate chaetae			
Plecoptera	Leuctridae	LEUCTRA	Shredder	0.4	cn
Plecoptera	Nemouridae	AMPHINEMURA	Shredder	3	sp, cn
Plecoptera	Nemouridae	NEMOURIDAE	Shredder	2.9	sp, cn
Plecoptera	Nemouridae	OSTROCERCA	Shredder	1.7	sp, cn
Plecoptera	Perlodidae	CLIOPERLA	Predator	1.7	cn
Plecoptera	Perlodidae	ISOPERLA	Predator	2.4	cn, sp
Plecoptera		PLECOPTERA		2.4	
Trichoptera	Dipseudopsidae	PHYLOCENTROPUS	Collector	5	bu
Trichoptera	Hydropsychidae	CHEUMATOPSYCHE	Filterer	6.5	cn
Trichoptera	Hydropsychidae	DIPLECTRONA	Filterer	2.7	cn
Trichoptera	Hydropsychidae	HYDROPSYCHE	Filterer	7.5	cn
Trichoptera	Leptoceridae	NECTOPSYCHE	Shredder	4.1	cb, sw
Trichoptera	Leptoceridae	OECETIS	Predator	4.7	cn, sp, cb
Trichoptera	Limnephilidae	HYDATOPHYLAX	Shredder	3.4	sp, cb
Trichoptera	Limnephilidae	IRONOQUIA	Shredder	4.9	sp
Trichoptera	Limnephilidae	LIMNEPHILIDAE	Shredder	3.4	cb, sp, cn
Trichoptera	Phryganeidae	PTILOSTOMIS	Shredder	4.3	cb
Trichoptera	Polycentropodidae	POLYCENTROPUS	Filterer	1.1	cn



Order	Family	Genus	FFG*	TV*	Habit
Trichoptera	Psychomyiidae	LYPE	Scraper	4.7	cn
Trichoptera	Sericostomatidae	AGARODES	Shredder	3	sp
Trichoptera	Uenoidae	NEOPHYLAX	Scraper	2.7	cn
Veneroida	Piscidiidae	PISIDIUM	Filterer	5.7	bu
		BIVALVIA			
		TURBELLARIA	Predator	4	sp

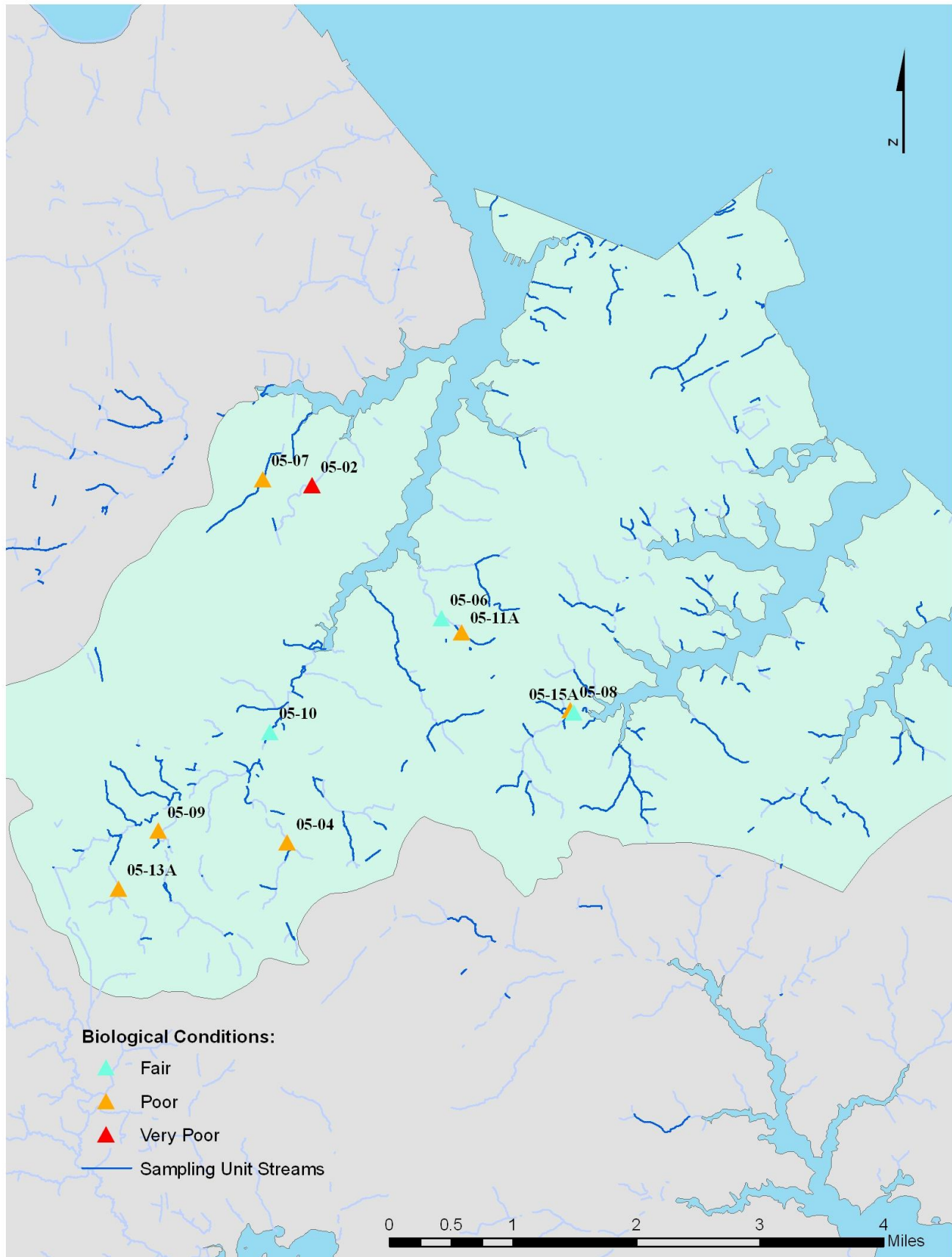
\* FFG = Function Feeding Group, TV = Tolerance Value

# **APPENDIX F: INDIVIDUAL SITE SUMMARIES**

Note: A map showing the location of the sample sites in each PSU precedes each collection of individual site summaries.

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# Marley Creek Sampling Unit



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Upstream



Downstream

**Location/Site Access:** Located approx. 150m US of Margate Road crossing  
**Latitude/Longitude:** 39.17098/-76.60197

### Land Use Analysis:

Land Use	Acres	% Area
Commercial	29.1	12%
Open Space	22.1	9%
Residential 1/2-acre	3.2	1%
Residential 1/4-acre	129.6	55%
Residential 1/8-acre	2.8	1%
Transportation	19.1	8%
Woods	31.5	13%
Grand Total	237.5	100%

Impervious (acres)	Total Area Above site	% Impervious
85.8	237.5	36.1

### **Results:**

- Biological condition – "Very Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Riparian vegetation and physical complexity of habitat scored high
- Dissolved oxygen concentration was low
- Sample dominated by worms (*Enchytraeidae*, *Limnodrilus*, *Lumbriculidae*, *Specaria* and unidentified *Tubificidae*)
- Stream type was identified as an E5, slope was 0.37 percent, and the median channel substrate was fine sand
- Typically, E channels are stable. However, the "Very Poor" biological ratings along with impaired habitat ratings may indicate that this reach is transitioning to an unstable form.
- Biological community is in worse condition than would be expected for available habitat quality.

### **Recommendations:**

- Maintain the protection of the riparian areas.

**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Very Poor</b>
<b>Overall Index</b>	<b>1.57</b>
Total Taxa Score	3
EPT Taxa Score	1
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	3

**Calculated Metric Values**

Total Taxa	19
EPT Taxa	0
Ephemeroptera Taxa	0
Intolerant Urban %	2.9
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	2.9

**Taxa List**

Cambaridae	2
Culicoides	2
Enchytraeidae	7
Fossaria	1
Kiefferulus	2
Limnodrilus	10
Lumbriculidae	2
Nanocladius	1
Nepa	1
Ormosia	6
Paraphaenocladus	1
Physa	3
Pisidium	1
Polypedilum	1
Pseudolimnophila	1
Ptychocheilus	1
Smittia	2
Specaria	11
Tubificidae	48

**Total Individuals**

103

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	7	Pool Variability	9
Bank Stability- Right Bank	7	Riparian Vegetative Zone Width- Left Bank	8
Channel Alteration	15	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	12	Sediment Deposition	8
Channel Sinuosity	8	Vegetative Protection (Left Bank)	6
Epifaunal Substrate/Available Cover	4	Vegetative Protection (Right Bank)	6
Pool Substrate Characterization	10		

**EPA Habitat Score** 110**EPA Narrative Ranking** PS**Maryland Biological Stream Survey PHI**

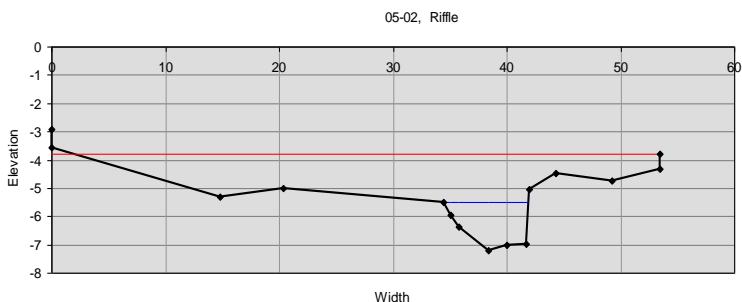
Drainage area (acres)	237.5	Instream Wood Debris	2
Remoteness	4	Bank Stability	12
Shading	80		
Epifaunal Substrate	5		
Instream Habitat	6		

**PHI Score** 58.50**PHI Narrative Ranking** D**Water Chemistry**

Dissolved Oxygen (mg/L)	3.43	Specific Conductance (mS/cm)	561
pH	6.88	Temperature (°C)	4.86

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.37	Cross Sectional Area (ft <sup>2</sup> )	9.4
Bankfull Width (ft)	7.5	Water Surface Slope (ft/ft)	0.37
Mean Bankfull Depth (ft)	1.3	Sinuosity	1.1
Floodprone Width (ft)	225	D50 (mm)	0.19
Entrenchment Ratio	30.1	Adjustments?	Sin
Width to Depth Ratio	6.0	<b>Rosgen Stream Type</b>	<b>E5</b>







Upstream



Downstream

**Location/Site Access:** Located approx. 260m SE from Foxwell Road  
**Latitude/Longitude:** 39.12896/-76.60593

### Land Use Analysis:

Land Use	Acres	% Area
Commercial	0.7	0%
Open Space	6.0	2%
Pasture/Hay	3.0	1%
Residential 1/2-acre	38.0	12%
Residential 1/4-acre	88.7	28%
Residential 1/8-acre	2.1	1%
Residential 1-acre	12.0	4%
Row Crops	27.1	9%
Transportation	8.9	3%
Woods	126.4	40%
Grand Total	312.9	100%

Impervious (acres)	Total Area Above site	% Impervious
43.1	312.9	13.8

### **Results:**

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Riparian vegetation scored high and bank stability scored low
- Sample lacking *Epemeroptera* and also scored poorly for Intolerant percent
- Stream type was identified as an G5c, slope was 1.13 percent, and the median channel substrate was very fine gravel
- Dissolved oxygen recorded value in error: possible corrected value 11.24 mg/L.
- Typically, G channels are unstable. Bank stability ratings indicate that this reach is also unstable.
- Habitat assessment results were mixed for this site, but biological community observed is trending toward more than expected impairment based on the observed habitat quality.

### **Recommendations:**

- Maintain and protect the riparian area.
- Investigate potential for BMP retrofits on residential lands upstream of site.



**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Poor</b>
<b>Overall Index</b>	<b>2.71</b>
Total Taxa Score	5
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	3
% Climbers	5

**Calculated Metric Values**

Total Taxa	39
EPT Taxa	4
Ephemeroptera Taxa	0
Intolerant Urban %	9.3
Ephemeroptera %	0
<del>Taxa List</del>	1
Aboloboma	15.3
Ancyronyx	2
Boyeria	4
Calopteryx	4
Chaetocladius	3
Cheumatopsyche	11
Chironomus	1
Corynoneura	4
Cricotopus	1
Cryptochironomus	2
Diplectrona	2
Enchytraeidae	3
Heterotrissocladius	2
Leuctra	1
Limnodrilus	2
Lumbriculidae	3
Macronychus	4
Menetus	1
Orthocladius	1
Parametriochnemus	7
Paraphaenocladius	2
Paratendipes	1
Phaenopsectra	2
Physa	1
Polycentropus	5
Polypedilum	9
Pseudorthocladius	3
Rheotanytarsus	6
Simulium	1
Stenelmis	3
Stenochironomus	4
Synurella	1
Tanytarsus	1
Thienemanniella	2
Thienemannimyia	5
Tribelos	6
Tubificidae	3
Tvetenia	2
Zavreliomyia	2

**Total Individuals** 118

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	2	Pool Variability	9
Bank Stability- Right Bank	2	Riparian Vegetative	10
		Zone Width- Left Bank	
Channel Alteration	19	Riparian Vegetative	9
		Zone Width- Right Bank	
Channel Flow Status	14	Sediment Deposition	8
Channel Sinuosity	10	Vegetative Protection (Left Bank)	4
Epifaunal Substrate/Available Cover	11	Vegetative Protection (Right Bank)	4
Pool Substrate Characterization	7		

**EPA Habitat Score** 70.74

**EPA Narrative Ranking** PS

**Maryland Biological Stream Survey PHI**

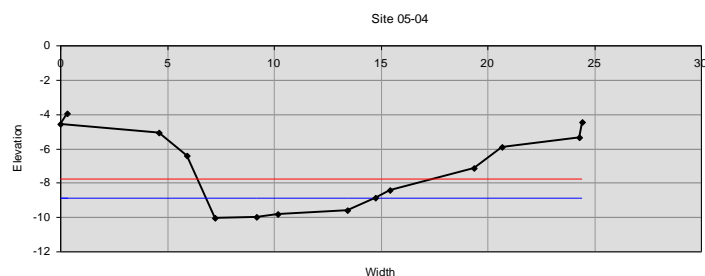
Drainage area (acres)	312.9	Instream Wood Debris	7
Remoteness	12	Bank Stability	5
Shading	80		
Epifaunal Substrate	11	<b>PHI Score</b>	70.86
Instream Habitat	9	<b>PHI Narrative Ranking</b>	PD

**Water Chemistry**

Dissolved Oxygen (mg/L)	112.4	Specific Conductance (mS/cm)	105
pH	6.75	Temperature (°C)	9.56

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.49	Cross Sectional Area (ft <sup>2</sup> )	6.7
Bankfull Width (ft)	8.0	Slope (%)	1.13
Mean Bankfull Depth (ft)	0.8	Sinuosity	1.14
Floodprone Width (ft)	11.2	D50 (mm)	2.82
Entrenchment Ratio	1.4	Adjustments?	ER ↓ 0.2
Width to Depth Ratio	9.5	<b>Rosgen Stream Type</b>	<b>G5c</b>





Upstream



Downstream

**Location/Site Access:** Located approx. 150 DS from Marley Neck Blvd Crossing  
**Latitude/Longitude:** 39.15529/-76.58248

#### Land Use Analysis:

Land Use	Acres	% Area
Commercial	8.4	3%
Industrial	0.8	0
Open Space	1.4	1%
Residential 1/2-acre	12.9	5%
Residential 1/4-acre	52.4	21%
Residential 1-acre	3.5	1%
Residential 2-acre	3.6	1%
Transportation	8.7	3%
Utility	11.3	4%
Woods	152.1	60%
Grand Total	255.1	100%

Impervious (acres)	Total Area Above site	% Impervious
35.4	255.1	13.9

#### **Results:**

- Biological condition – "Fair"
- Habitat scores "Partially Supporting" and "Degraded"
- Riparian zone width scored high and bank variables were marginal
- Dominant taxa are *Chironomidae*. EPT taxa scored high.
- Stream type was identified as an E5, slope was 0.28 percent, and the median channel substrate was very coarse sand
- Typically, E channels are stable. However, the poor bank stability may indicate that this reach is transitioning to an unstable form.
- Biological community is in better condition than expected for measured level of habitat quality.

#### **Recommendations:**

- Maintain and protect the riparian area.
- Investigate possible water quality impacts enriching community. Provide BMPs as necessary and appropriate.

**IBI and Metric Scores**

Narrative Rating	Fair
<b>Overall Index</b>	<b>3.29</b>
Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	3
Intolerant Urban % Score	3
Ephemeroptera % Score	3
Scraper Taxa Score	1
% Climbers	3

**Calculated Metric Values**

Total Taxa	34
EPT Taxa	5
Ephemeroptera Taxa	1
Intolerant Urban %	11.9
Ephemeroptera %	0.9
Scraper Taxa	0
% Climbers	2.8

**Taxa List**

Corynoneura	1
Culicoides	1
Diamesa	1
Diplocladius	12
Eurylophella	1
Fossaria	1
Gomphidae	1
Hydrobaenus	6
Ironoquia	1
Lepidoptera	1
Limnephilidae	3
Limnodrilus	1
Limnophyes	4
Mesocricotopus	9
Nemouridae	8
Neoporus	2
Ormosia	7
Orthocladius/Cricotopus	3
Parametriocnemus	5
Paraphaenocladius	2
Physa	6
Pisidium	4
Pseudorthocladius	4
Ptilostomis	1
Pyralidae	2
Rheocricotopus	2
Somatochlora	2
Stegopterna	1
Synurella	1
Tipula	1
Tribelos	1
Tubificidae	2
Tvetenia	11
Zavrelinyia	1

**Total Individuals** 109

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	3	Pool Variability	6
Bank Stability- Right Bank	3	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	18	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	13	Sediment Deposition	6
Channel Sinuosity	14	Vegetative Protection (Left Bank)	4
Epifaunal Substrate/Available Cover	6	Vegetative Protection (Right Bank)	4
Pool Substrate Characterization	8		

**EPA Habitat Score** 105

**EPA Narrative Ranking** PS

**Maryland Biological Stream Survey PHI**

Drainage area (acres)	255.1	Instream Wood Debris	1
Remoteness	9	Bank Stability	18
Shading	90		
Epifaunal Substrate	3		
Instream Habitat	6		

**PHI Score** 65.24

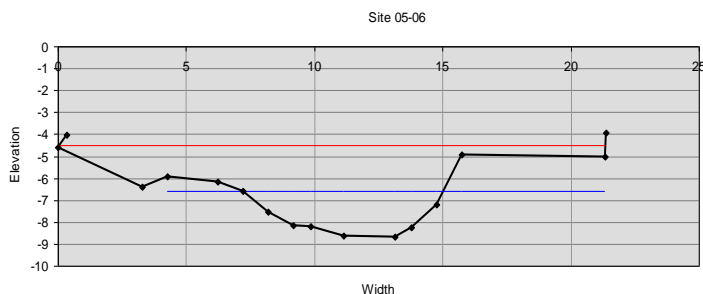
**PHI Narrative Ranking** D

**Water Chemistry**

Dissolved Oxygen (mg/L)	14.5	Specific Conductance (mS/cm)	217
pH	6.98	Temperature (°C)	5.62

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.4	Cross Sectional Area (ft <sup>2</sup> )	11.6
Bankfull Width (ft)	7.8	Slope (%)	0.279
Mean Bankfull Depth (ft)	1.5	Sinuosity	1.2
Floodprone Width (ft)	207	D50 (mm)	1.51
Entrenchment Ratio	26.5	Adjustments?	SI: ↑ 0.2
Width to Depth Ratio	5.3	<b>Rosgen Stream Type</b>	<b>E5</b>





Upstream



Downstream

**Location/Site Access:** Located approx. 160 m south of Rose Anne Road

Latitude/Longitude: 39.17176/-76.60943

#### **Land Use Analysis:**

Land Use	Acres	% Area
Commercial	126.8	19%
Open Space	60.1	9%
Residential 1/4-acre	403.0	61%
Residential 1/8-acre	7.8	1%
Transportation	35.8	5%
Woods	25.5	4%
Grand Total	659.0	100%

Impervious (acres)	Total Area Above site	% Impervious
312.0	659.0	47.3

#### **Results:**

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Most habitat variables scores are marginal
- Impervious percentage in the drainage area is very high (47.3%)
- Sample dominated by a dragonfly (*Argia*) and a midge (*Thienemannimyia*)
- Stream type was identified as an E5, slope was 0.31 percent, and the median channel substrate was fine sand
- Typically, E channels are stable. However, the very high imperviousness is probably affecting hydrologic patterns, which could in turn destabilize channel morphology.
- Habitat assessment results were mixed for this site, but biological community observed is trending toward more than expected impairment based on the observed habitat quality.

#### **Recommendations:**

- Protect the riparian area.
- Investigate opportunities for stormwater management on upstream commercial and residential lands.

05-07

## Marley Creek Sampling Unit

**IBI and Metric Scores**

Narrative Rating	Poor
Overall Index	2.14
Total Taxa Score	3
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

**Calculated Metric Values**

Total Taxa	19
EPT Taxa	3
Ephemeroptera Taxa	0
Intolerant Urban %	0
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	8.3

**Taxa List**

Argia	34
Calopteryx	1
Capniidae	1
Cheumatopsyche	1
Cricotopus	9
Enchytraeidae	2
Hydrobaenus	1
Hydropsyche	2
Limnodrilus	12
Lumbricidae	1
Lumbriculidae	2
Nais	1
Physa	7
Planorbidae	1
Polypedilum	9
Stenochironomus	2
Thienemannimyia	30
Tribelos	1
Tubificidae	3

**Total Individuals**

120

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Variability	12
Bank Stability- Right Bank	6	Riparian Vegetative	8
Channel Alteration	14	Zone Width- Left Bank	6
Channel Flow Status	13	Riparian Vegetative	6
Channel Sinuosity	9	Zone Width- Right Bank	7
Epifaunal Substrate/Available Cover	11	Sediment Deposition	6
Pool Substrate Characterization	9	Vegetative Protection (Left Bank)	6
		Vegetative Protection (Right Bank)	6

**EPA Habitat Score** 113**EPA Narrative Ranking** PS**Maryland Biological Stream Survey PHI**

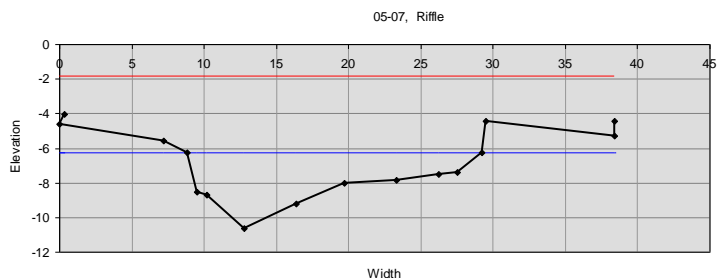
Drainage area (acres)	659.0	Instream Wood Debris	18
Remoteness	3	Bank Stability	13
Shading	100		
Epifaunal Substrate	10		
Instream Habitat	11		

**PHI Score** 74.02**PHI Narrative Ranking** PD**Water Chemistry**

Dissolved Oxygen (mg/L)	8.14	Specific Conductance (mS/cm)	467
pH	6.63	Temperature (°C)	8.14

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	1.0	Cross Sectional Area (ft <sup>2</sup> )	45.5
Bankfull Width (ft)	20.4	Slope (%)	0.31
Mean Bankfull Depth (ft)	2.2	Sinuosity	1.04
Floodprone Width (ft)	300.0	D50 (mm)	0.17
Entrenchment Ratio	14.7	Adjustments?	Sin.
Width to Depth Ratio	9.2	<b>Rosgen Stream Type</b>	<b>E5</b>







Upstream



Downstream

**Location/Site Access:** Located approx. 220m South of Park off Opel Drive  
**Latitude/Longitude:** 39.14437/-76.56306

### **Land Use Analysis:**

Land Use	Acres	% Area
Commercial	17.2	2%
Open Space	15.7	2%
Residential 1/2-acre	178.4	23%
Residential 1/4-acre	178.0	23%
Residential 1/8-acre	19.0	2%
Residential 1-acre	28.6	4%
Residential 2-acre	5.9	1%
Transportation	27.5	3%
Woods	317.5	40%
Grand Total	787.7	100%

Impervious (acres)	Total Area Above site	% Impervious
135.8	787.7	17.2

### **Results:**

- Biological condition – "Poor"
- Habitat scores "Supporting" and "Partially Degraded"
- All habitat variables scored in the sub-optimal to optimal range
- Sample dominated by midges (*Tvetenia* and *Rheotanytarsus*) and lacked mayflies
- Stream type was identified as an E5, slope was 0.985 percent, and the median channel substrate was very fine sand
- Typically, E channels are stable and the high habitat scores indicate potential for continued stability.
- Biological community is in worse condition than would be expected for available habitat quality.

### **Recommendations:**

- Maintain the protection of riparian areas.
- Investigate feasibility, necessity of retrofitting stormwater management to developed areas.

**IBI and Metric Scores**

Narrative Rating	Poor
<b>Overall Index</b>	<b>2.71</b>
Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	3
% Climbers	3

**Calculated Metric Values**

Total Taxa	29
EPT Taxa	5
Ephemeroptera Taxa	0
Intolerant Urban %	9.5
Ephemeroptera %	0
Scraper Taxa	1
% Climbers	6.0

**Taxa List**

Amphinemura	1
Ancyronyx	2
Caecidotea	2
Cheumatopsyche	2
Corynoneura	3
Cricotopus	1
Diplectrona	1
Gammarus	7
Gomphus	1
Helichus	1
Hemerodromia	1
Lepidostoma	2
Macronychus	2
Orthocladius/Cricotopus	10
Oulimnius	2
Parametriocnemus	9
Paratendipes	3
Phaenopsectra	1
Polycentropus	1
Polypedilum	5
Rheotanytarsus	17
Simulium	1
Stenelmis	3
Stenochironomus	2
Stilocladius	1
Synurella	1
Tanytarsus	1
Tipula	1
Trienodes	2
Tvetenia	30

**Total Individuals** 116

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	7	Pool Variability	10
Bank Stability- Right Bank	7	Riparian Vegetative	10
Channel Alteration	19	Zone Width- Left Bank	
Channel Flow Status	15	Riparian Vegetative	10
Channel Sinuosity	13	Zone Width- Right Bank	
Epifaunal Substrate/Available Cover	12	Sediment Deposition	10
Pool Substrate Characterization	11	Vegetative Protection (Left Bank)	7
		Vegetative Protection (Right Bank)	7

<b>EPA Habitat Score</b>	138
<b>EPA Narrative Ranking</b>	S

**Maryland Biological Stream Survey PHI**

Drainage area (acres)	765.7	Instream Wood Debris	6
Remoteness	13	Bank Stability	11
Shading	90		
Epifaunal Substrate	12		
Instream Habitat	9		

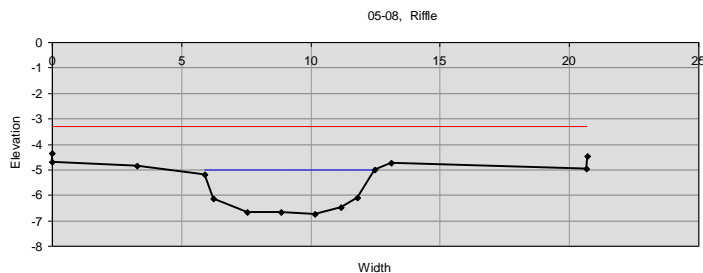
<b>PHI Score</b>	74.05
<b>PHI Narrative Ranking</b>	PD

**Water Chemistry**

Dissolved Oxygen (mg/L)	11.82	Specific Conductance (mS/cm)	220
pH	6.83	Temperature (°C)	10.79

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	1.2	Cross Sectional Area (ft <sup>2</sup> )	9.2
Bankfull Width (ft)	6.6	Slope (%)	0.985
Mean Bankfull Depth (ft)	1.4	Sinuosity	1.1
Floodprone Width (ft)	121	D50 (mm)	0.081
Entrenchment Ratio	18.4	Adjustments?	Sin.
Width to Depth Ratio	4.7	<b>Rosgen Stream Type</b>	<b>E5</b>





Upstream



Downstream

**Location/Site Access:** Located approx. 120 m SW of Apartments off Starwood Drive  
**Latitude/Longitude:** 39.1304/-76.62537

#### Land Use Analysis:

Land Use	Acres	% Area
Commercial	29.4	6%
Open Space	36.9	7%
Residential 1/4-acre	263.3	53%
Residential 1/8-acre	63.3	13%
Transportation	21.9	4%
Utility	2.5	1%
Woods	77.3	16%
Grand Total	496.6	100%

Impervious (acres)	Total Area Above site	% Impervious
155.6	496.6	31.3

#### **Results:**

- Biological condition – "Poor"
- Habitat scores "Non Supporting" and "Degraded"
- Bank stability and vegetative protection scored low
- Sample dominated by midges (*Polypedilum*, *Orthocladius/Cricotopus*, and *Thienemannimyia*)
- Stream type was identified as an B5c, slope was 0.263 percent, and the median channel substrate was fine sand
- Typically, B channels are stable. However, the low bank stability ratings may indicate that this reach is transitioning to an unstable form.
- Habitat assessment results were mixed for this site, but biological community observed is trending toward less than expected impairment based on the observed habitat quality.

#### **Recommendations:**

- Protect the riparian area.
- Investigate BMP retrofit potential on upstream residential and commercial land uses.



05-09

## Marley Creek Sampling Unit

**IBI and Metric Scores**

Narrative Rating	Poor
<b>Overall Index</b>	<b>2.14</b>
Total Taxa Score	5
EPT Taxa Score	1
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

**Calculated Metric Values**

Total Taxa	34
EPT Taxa	1
Ephemeroptera Taxa	0
Intolerant Urban %	0
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	27.8

**Taxa List**

Argia	3
Calopteryx	3
Cheumatopsyche	1
Chironomus	1
Copelatus	1
Cricotopus	1
Cryptochironomus	1
Culicoides	3
Dicrotendipes	6
Diplocladius	1
Enchytraeidae	2
Ferrissia	1
Hydrobaenus	1
Kiefferulus	3
Limnodrilus	3
Nanocladius	1
Natarsia	2
Orthocladius	2
Orthocladius/Cricotopus	14
Paracladopelma	2
Paraphaenocladius	1
Paratanytarsus	1
Phaenopsectra	6
Physa	1
Pisidium	1
Polypedilum	24
Pylalidae	1
Stenochironomus	1
Tanytarsus	4
Thienemanniella	2
Thienemannimyia	11
Tipula	4
Tubificidae	4
Xylotopus	2

**Total Individuals** 115

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	3	Pool Variability	6
Bank Stability- Right Bank	3	Riparian Vegetative Zone Width- Left Bank	7
Channel Alteration	16	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	8	Sediment Deposition	5
Channel Sinuosity	9	Vegetative Protection (Left Bank)	4
Epifaunal Substrate/Available Cover	6	Vegetative Protection (Right Bank)	4
Pool Substrate Characterization	6		

<b>EPA Habitat Score</b>	87
<b>EPA Narrative Ranking</b>	NS

**Maryland Biological Stream Survey PHI**

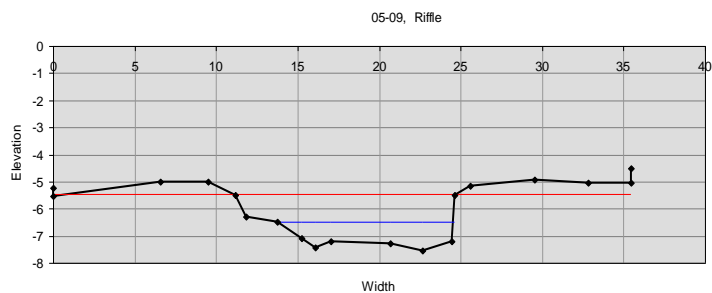
Drainage area (acres)	518.7	Instream Wood Debris	3
Remoteness	6	Bank Stability	6
Shading	95		
Epifaunal Substrate	6	<b>PHI Score</b>	57.14
Instream Habitat	5	<b>PHI Narrative Ranking</b>	D

**Water Chemistry**

Dissolved Oxygen (mg/L)	12.37	Specific Conductance (mS/cm)	267
pH	5.64	Temperature (°C)	6.42

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.81	Cross Sectional Area (ft <sup>2</sup> )	7.9
Bankfull Width (ft)	10.7	Water Surface Slope (ft/ft)	0.263
Mean Bankfull Depth (ft)	0.7	Sinuosity	1.2
Floodprone Width (ft)	15	D50 (mm)	0.18
Entrenchment Ratio	1.4	Adjustments?	None
Width to Depth Ratio	14.5	<b>Rosgen Stream Type</b>	<b>B5c</b>





Upstream



Downstream

**Location/Site Access:** Located approx. 100m West of Marley Station Mall parking lot  
**Latitude/Longitude:** 39.14198/-76.60844

#### Land Use Analysis:

Land Use	Acres	% Area
Commercial	260.7	10%
Open Space	144.4	5%
Residential 1/2-acre	71.2	3%
Residential 1/4-acre	895.1	33%
Residential 1/8-acre	567.2	21%
Residential 1-acre	15.1	1%
Row Crops	59.2	2%
Transportation	177.5	6%
Utility	18.9	1%
Woods	516.8	19%
Grand Total	2742.7	100%

Impervious (acres)	Total Area Above site	% Impervious
967.1	2742.7	35.3

#### **Results:**

- Biological condition – "Fair"
- Habitat scores "Supporting" and "Degraded"
- Riparian zone width scored optimally
- Dominant taxon is *Ancyronyx* (*Elmidae*, riffle beetle)
- Stream type was identified as an E5, slope was 0.029 percent, and the median channel substrate was very fine sand
- Typically, E channels are stable and the EPA habitat and biological scores indicate that continued stability is possible. PHI indicates habitat degradation.
- Habitat assessment results were mixed for this site, but biological community observed is trending toward less than expected impairment based on the observed habitat quality.

#### **Recommendations:**

- Maintain and protect the riparian area.
- Investigate feasibility, necessity of BMP implementation on developed areas.

**IBI and Metric Scores**

Narrative Rating	Fair
<b>Overall Index</b>	<b>3</b>
Total Taxa Score	5
EPT Taxa Score	3
Ephemeroptera Taxa Score	3
Intolerant Urban % Score	1
Ephemeroptera % Score	3
Scraper Taxa Score	1
% Climbers	5

**Calculated Metric Values**

Total Taxa	32
EPT Taxa	2
Ephemeroptera Taxa	1
Intolerant Urban %	0.9
Ephemeroptera %	5.5
Scraper Taxa	0
% Climbers	15.6

**Taxa List**

Ablabesmyia	3
Ancyronyx	14
Argia	2
Calopteryx	4
Cheumatopsyche	2
Cricotopus	6
Cryptochironomus	1
Cryptotendipes	1
Dicrotendipes	7
Dubiraphia	7
Enallagma	2
Eurylophella	6
Ferrissia	1
Gomphidae	1
Hydrobaenus	1
Limnodrilus	1
Macronychus	7
Mallochohelea	2
Nanocladius	1
Orthocladius	1
Orthocladius/Cricotopus	1
Paratanytarsus	2
Paratendipes	1
Polypedilum	3
Rheocricotopus	4
Rheotanytarsus	7
Smittia	1
Stenochironomus	3
Tanytarsus	8
Thienemannimyia	1
Tribelos	7
Tubificidae	1

**Total Individuals** 109

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Variability	11
Bank Stability- Right Bank	6	Riparian Vegetative Zone Width- Left Bank	9
Channel Alteration	16	Riparian Vegetative Zone Width- Right Bank	9
Channel Flow Status	19	Sediment Deposition	8
Channel Sinuosity	12	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	10	Vegetative Protection (Right Bank)	5
Pool Substrate Characterization	10		

<b>EPA Habitat Score</b>	126
<b>EPA Narrative Ranking</b>	S

**Maryland Biological Stream Survey PHI**

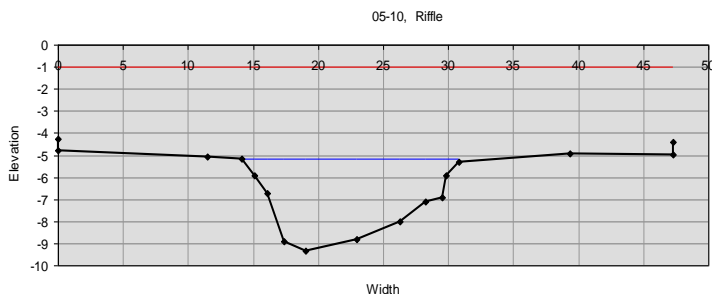
Drainage area (acres)	2742.7	Instream Wood Debris	8
Remoteness	5	Bank Stability	12
Shading	40		
Epifaunal Substrate	10	<b>PHI Score</b>	54.09
Instream Habitat	11	<b>PHI Narrative Ranking</b>	D

**Water Chemistry**

Dissolved Oxygen (mg/L)	15.22	Specific Conductance (mS/cm)	289
pH	6.13	Temperature (°C)	8.34

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	4.3	Cross Sectional Area (ft <sup>2</sup> )	45.8
Bankfull Width (ft)	16.7	Water Surface Slope (ft/ft)	0.029
Mean Bankfull Depth (ft)	2.7	Sinuosity	1.1
Floodprone Width (ft)	102	D50 (mm)	0.078
Entrenchment Ratio	6.1	Adjustments?	Sin.
Width to Depth Ratio	6.1	<b>Rosgen Stream Type</b>	<b>E5</b>





Upstream



Downstream

**Location/Site Access:** Located approx. 220m US of Marley Neck Blvd.  
**Latitude/Longitude:** 39.15361/-76.57944

#### **Land Use Analysis:**

Land Use	Acres	% Area
Commercial	6.5	4%
Open Space	1.5	1%
Residential 1/2-acre	5.0	3%
Residential 1/4-acre	45.9	26%
Residential 1-acre	3.5	2%
Residential 2-acre	3.6	2%
Transportation	4.0	2%
Utility	6.9	4%
Woods	102.1	57%
Grand Total	179.7	100%

Impervious (acres)	Total Area Above site	% Impervious
27.3	179.7	15.2

#### **Results:**

- Biological condition – "Poor"
- Habitat scores "Non -supporting" and "Degraded"
- Riparian zone width scored high, though bank stability and vegetative protection scored low.
- Dominant taxa include a clam (*Pisidium*) and a worm (*Aulodrilus*)
- Stream type was identified as an C6, slope was 0.245 percent, and the median channel substrate was silt
- Typically, C channels are stable. Habitat ratings related to bank stability ranked very low, indicating an unstable condition.
- Habitat assessment results were mixed for this site, but biological community observed is trending toward less than expected impairment based on the observed habitat quality.

#### **Recommendations:**

- Protect the riparian area.
- Investigate potential to control stormwater through the implantation of BMP retrofits.

**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Poor</b>
<b>Overall Index</b>	<b>2.43</b>
Total Taxa Score	5
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	3
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	3

**Calculated Metric Values**

Total Taxa	40
EPT Taxa	3
Ephemeroptera Taxa	0
Intolerant Urban %	17.2
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	5.1

**Taxa List**

Aulodrilus	10
Bezzia/Palpomyia	1
Ceratopogon	3
Chaetocladius	1
Chauliodes	1
Culicoides	9
Dasyhelea	1
Dubiraphia	1
Enchytraeidae	1
Gomphidae	2
Gonomyia	1
Helichus	1
Hydrobaenus	2
Ironoquia	1
Limnodrilus	1
Lumbricidae	1
Mesocricotopus	3
Nemouridae	4
Neoporus	2
Orthocladius	2
Parametricnemus	1
Paraphaenocladius	5
Phaenopsectra	2
Physa	8
Pisidium	11
Planorbidae	1
Polypedilum	2
Pseudolimnophila	2
Ptilostomis	3
Rheocricotopus	1
Smittia	1
Somatochlora	1
Stegopterna	2
Stygobromus	1
Synurella	2
Tanypodinae	1
Thienemannimyia	1
Tubificidae	3
Veliidae	2
Zavrelimyia	1

**Total Individuals** 99

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	1	Pool Variability	3
Bank Stability- Right Bank	1	Riparian Vegetative	
		Zone Width- Left Bank	10
Channel Alteration	19	Riparian Vegetative	10
Channel Flow Status	10	Zone Width- Right Bank	
Channel Sinuosity	9	Sediment Deposition	15
Epifaunal Substrate/Available Cover	4	Vegetative Protection (Left Bank)	1
Pool Substrate Characterization	3	Vegetative Protection (Right Bank)	1

<b>EPA Habitat Score</b>	87
<b>EPA Narrative Ranking</b>	NS

**Maryland Biological Stream Survey PHI**

Drainage area (acres)	197.6	Instream Wood Debris	2
Remoteness	15	Bank Stability	3
Shading	100		
Epifaunal Substrate	3		
Instream Habitat	3		

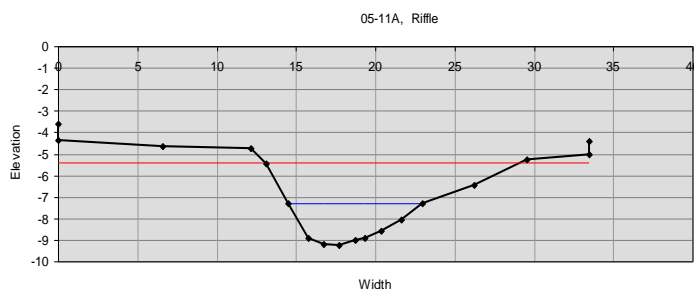
<b>PHI Score</b>	62.07
<b>PHI Narrative Ranking</b>	D

**Water Chemistry**

Dissolved Oxygen (mg/L)	11.49	Specific Conductance (mS/cm)	218
pH	6.43	Temperature (°C)	9.2

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.3	Cross Sectional Area (ft <sup>2</sup> )	10.5
Bankfull Width (ft)	8.5	Water Surface Slope (ft/ft)	0.245
Mean Bankfull Depth (ft)	1.2	Sinuosity	1.1
Floodprone Width (ft)	16.0	D50 (mm)	0.062
Entrenchment Ratio	1.9	Adjustments?	ER, Sin.
Width to Depth Ratio	6.8	<b>Rosgen Stream Type</b>	<b>C6</b>







Upstream



Downstream

**Location/Site Access:** Located approx. 75m NW of playground/powerline clearing off Phrine Road

Latitude/Longitude: 39.12361/-76.63149

#### Land Use Analysis:

Land Use	Acres	% Area
Commercial	53.9	19%
Industrial	10.6	4%
Open Space	27.5	9%
Residential 1/4-acre	31.8	11%
Residential 1/8-acre	71.9	25%
Row Crops	22.0	8%
Transportation	20.2	7%
Utility	2.0	1%
Woods	50.5	17%
<b>Grand Total</b>	<b>290.4</b>	<b>100%</b>

Impervious (acres)	Total Area Above site	% Impervious
106.9	290.4	36.8

#### **Results:**

- Biological condition – "Poor"
- Habitat scores "Non Supporting" and "Degraded"
- Bank stability scored low and the riparian zone width was marginal
- Dominant taxa are non-insects; a snail (*Physa*), a clam (*Pisidium*), and a worm (*Tubificidae*)
- Stream type was not classified, but was identified as disturbed.
- Habitat assessment results were mixed for this site, but biological community observed is trending toward less than expected impairment based on the observed habitat quality.

#### **Recommendations:**

- Protect riparian areas. Remove sources of disturbance, if possible.
- Investigate impact of developed lands on stream water quality and stability. Implement retrofits as necessary.

**IBI and Metric Scores**

Narrative Rating	Poor
Overall Index	2.43
Total Taxa Score	5
EPT Taxa Score	1
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	3
% Climbers	5

**Calculated Metric Values**

Total Taxa	24
EPT Taxa	0
Ephemeroptera Taxa	0
Intolerant Urban %	3.3
Ephemeroptera %	0
Scraper Taxa	1
% Climbers	10.9

**Taxa List**

Anax	2
Bittacomorpha	2
Bothrioneurum	7
Calopteryx	1
Culicoides	4
Enchytraeidae	2
Epiphragma	1
Fossaria	1
Hydrobaenus	1
Lumbricidae	6
Ormosia	1
Orthocladus/Cricotopus	2
Phaenopsectra	3
Physa	15
Pisidium	15
Polypedilum	7
Pseudolimnophila	1
Pseudosmittia	1
Somatoclora	2
Stygobromus	1
Thienemannimyia	1
Tipula	13
Tubificidae	2
Zavrelimyia	2

guitar

**Total Individuals** 92**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	3	Pool Variability	6
Bank Stability- Right Bank	3	Riparian Vegetative Zone Width- Left Bank	5
Channel Alteration	14	Riparian Vegetative Zone Width- Right Bank	5
Channel Flow Status	9	Sediment Deposition	6
Channel Sinuosity	9	Vegetative Protection (Left Bank)	4
Epifaunal Substrate/Available Cover	5	Vegetative Protection (Right Bank)	4
Pool Substrate Characterization	6		

**EPA Habitat Score** 79**EPA Narrative Ranking** NS**Maryland Biological Stream Survey PHI**

Drainage area (acres)	290.4	Instream Wood Debris	10
Remoteness	4	Bank Stability	6
Shading	80		
Epifaunal Substrate	5	<b>PHI Score</b>	55.87
Instream Habitat	4	<b>PHI Narrative Ranking</b>	D

**Water Chemistry**

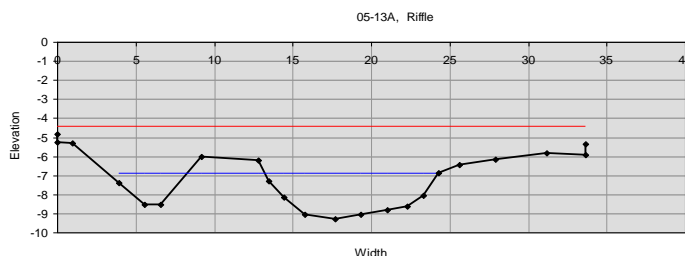
Dissolved Oxygen (mg/L)	8.83	Specific Conductance (mS/cm)	366
pH	6.08	Temperature (°C)	6.63

**Geomorphic Assessments**

Too disturbed for classification purposes. Classification not performed

**Rosen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.45	Cross Sectional Area (ft <sup>2</sup> )	14.5
Bankfull Width (ft)	9.8	Water Surface Slope (ft/ft)	—
Mean Bankfull Depth (ft)	1.49	Sinuosity	—
Floodprone Width (ft)	—	D50 (mm)	—
Entrenchment Ratio	—	Adjustments?	—
Width to Depth Ratio	6.6	<b>Rosen Stream Type</b>	—





Upstream



Downstream

**Location/Site Access:** Located approx. 230m SW of ballfield off Opel Drive  
**Latitude/Longitude:** 39.14408/-76.56256

### Land Use Analysis:

Land Use	Acres	% Area
Commercial	17.2	2%
Open Space	15.7	2%
Residential 1/2-acre	178.4	23%
Residential 1/4-acre	178.0	22%
Residential 1/8-acre	19.0	2%
Residential 1-acre	28.6	4%
Residential 2-acre	5.9	1%
Transportation	27.5	3%
Woods	321.0	41%
Grand Total	791.2	100%

Impervious (acres)	Total Area Above site	% Impervious
135.8	791.2	17.2

### **Results:**

- Biological condition – "Fair"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Riparian zone width scored high, but pool variability, bank stability, and vegetative protection scored low
- Sample dominated by midges (Tvetenia and Parametrioctenus)
- Stream type was identified as an E5, slope was 0.84 percent, and the median channel substrate was fine-medium sand
- Typically, E channels are stable. However, the impaired bank stability may indicate that this reach is transitioning to an unstable form.
- Habitat assessment results were mixed for this site, but biological community observed is trending toward less than expected impairment based on the observed habitat quality.

### **Recommendations:**

- Maintain and protect the riparian areas. Remove sources of disturbance, if possible.
- Investigate BMP retrofit potential on residential land uses upstream, to protect water quality.



**IBI and Metric Scores**

Narrative Rating	Fair
<b>Overall Index</b>	<b>3.29</b>
Total Taxa Score	5
EPT Taxa Score	3
Ephemeroptera Taxa Score	3
Intolerant Urban % Score	1
Ephemeroptera % Score	3
Scraper Taxa Score	3
% Climbers	5

**Calculated Metric Values**

Total Taxa	23
EPT Taxa	3
Ephemeroptera Taxa	1
Intolerant Urban %	8.1
Ephemeroptera %	2.0
Scraper Taxa	1
% Climbers	9.1

**Taxa List**

Acerpenna	2
Ancyronyx	1
Corynoneura	8
Cricotopus	1
Diplectrona	3
Gammarus	7
Helichus	2
Hydrobaenus	1
Lepidostoma	1
Macronychus	3
Orthocladius/Cricotopus	7
Oulimnius	2
Parametriocnemus	11
Paratanytarsus	3
Polypedilum	5
Rheosmittia	2
Rheotanytarsus	7
Stenelmis	2
Tanytarsus	3
Thienemannimyia	1
Tipula	2
Tubificidae	1
Tvetenia	24

**Total Individuals**

99

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	3	Pool Variability	0
Bank Stability- Right Bank	3	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	19	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	17	Sediment Deposition	9
Channel Sinuosity	10	Vegetative Protection (Left Bank)	3
Epifaunal Substrate/Available Cover	10	Vegetative Protection (Right Bank)	3
Pool Substrate Characterization	10		

<b>EPA Habitat Score</b>	116
<b>EPA Narrative Ranking</b>	PS

**Maryland Biological Stream Survey PHI**

Drainage area (acres)	791.2	Instream Wood Debris	5
Remoteness	13	Bank Stability	6
Shading	95		
Epifaunal Substrate	9		
Instream Habitat	7		

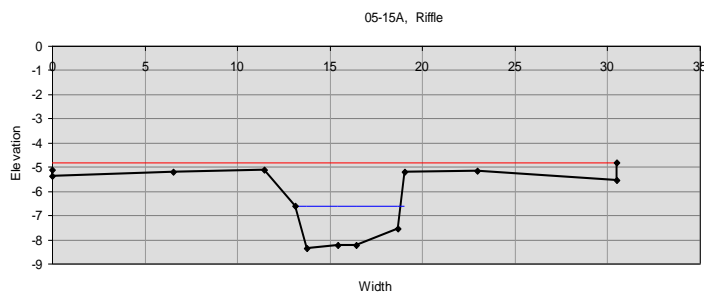
<b>PHI Score</b>	66.99
<b>PHI Narrative Ranking</b>	PD

**Water Chemistry**

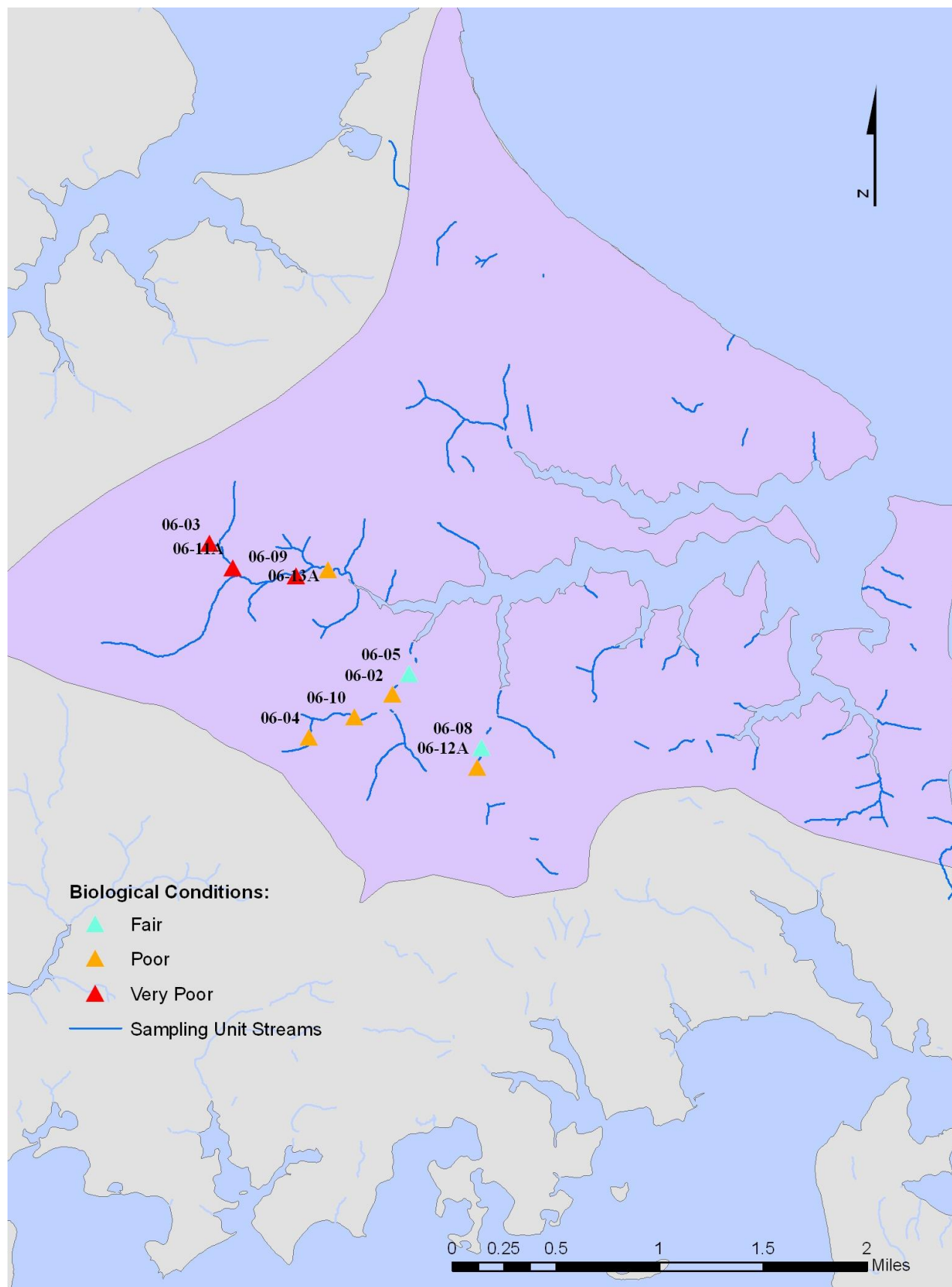
Dissolved Oxygen (mg/L)	10.54	Specific Conductance (mS/cm)	284
pH	6.67	Temperature (°C)	10.51

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	1.2	Cross Sectional Area (ft <sup>2</sup> )	8.0
Bankfull Width (ft)	5.7	Water Surface Slope (ft/ft)	0.84
Mean Bankfull Depth (ft)	1.41	Sinuosity	1.1
Floodprone Width (ft)	95.1	D50 (mm)	0.25
Entrenchment Ratio	16.7	Adjustments?	Sin.
Width to Depth Ratio	4.1	<b>Rosgen Stream Type</b>	<b>E5</b>



# Bodkin Creek Sampling Unit



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Upstream



Downstream

**Location/Site Access:** Located approx. 100m SE of house at 1243 Lorene Drive  
 Latitude/Longitude: 39.11848/-76.48314

#### **Land Use Analysis:**

Land Use	Acres	% Area
Airport	8.3	3%
Commercial	2.7	1%
Open Space	5.8	2%
Pasture/Hay	5.9	2%
Residential 1/2-acre	143.4	46%
Residential 1-acre	9.4	3%
Transportation	7.4	2%
Woods	128.2	41%
Grand Total	311.3	100%

Impervious (acres)	Total Area Above site	% Impervious
32.3	311.3	10.4

#### **Results:**

- Biological condition – "Poor"
- Habitat scores "Supporting" and "Partially Degraded"
- Riparian vegetation zone width scored high
- Sample dominated by midges: *Rheotanytarsus*, *Parametriocnemus*, and *Thienemannimyia*. No mayflies.
- Stream type was identified as an E5, slope was 0.22 percent, and the median channel substrate was fine sand.
- Typically, E channels are stable and this one has good potential for continued stability.
- Biological community is in worse condition than would be expected for available habitat quality.

#### **Recommendations:**

- Maintain and protect the riparian zone
- Determine water quality impacts of residential land uses, retrofit with BMPs as necessary.

**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Poor</b>
<b>Overall Index</b>	<b>2.71</b>
Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	3
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	3

**Calculated Metric Values**

Total Taxa	29
EPT Taxa	6
Ephemeroptera Taxa	0
Intolerant Urban %	20
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	7.8

**Taxa List**

Anchytarsus	3
Apsectrotanypus	8
Bezzia/Palpomyia	2
Calopteryx	3
Ceratopogon	1
Corynoneura	2
Gomphus	1
Heteroplectron	1
Heterotrissocladius	4
Lepidostoma	1
Leuctra	1
Mallochohelea	2
Molanna	1
Natarsia	3
Nigronia	1
Parametriocnemus	16
Paraphaenocladus	8
Phaenopsectra	2
Polycentropus	1
Polypedilum	2
Pseudolimnophila	6
Pycnopsycha	2
Rheocricotopus	1
Rheotanytarsus	15
Stegopterna	6
Stictochironomus	1
Tanytarsus	3
Thienemanniella	2
Thienemannimyia	16

**Total Individuals**

115

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	8	Pool Variability	6
Bank Stability- Right Bank	8	Riparian Vegetative	9
Channel Alteration	18	Zone Width- Left Bank	
Channel Flow Status	19	Riparian Vegetative	10
Channel Sinuosity	14	Zone Width- Right Bank	
Epifaunal Substrate/Available Cover	8	Sediment Deposition	8
Pool Substrate Characterization	11	Vegetative Protection (Left Bank)	8
		Vegetative Protection (Right Bank)	8

<b>EPA Habitat Score</b>	135
<b>EPA Narrative Ranking</b>	S

**Maryland Biological Stream Survey PHI**

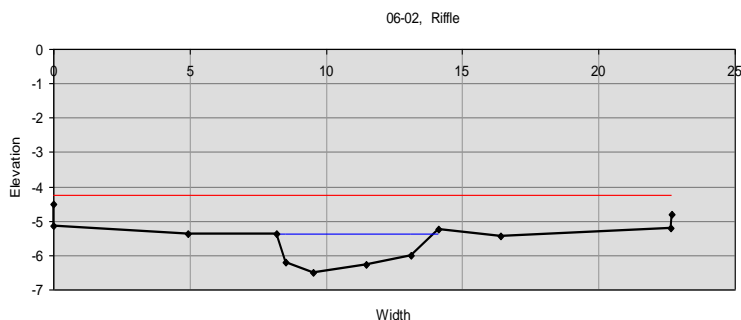
Drainage area (acres)	311.3	Instream Wood Debris	9
Remoteness	11	Bank Stability	16
Shading	90		
Epifaunal Substrate	8	<b>PHI Score</b>	75.83
Instream Habitat	8	<b>PHI Narrative Ranking</b>	PD

**Water Chemistry**

Dissolved Oxygen (mg/L)	9.7	Specific Conductance (mS/cm)	164
pH	5.93	Temperature (°C)	13.01

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.49	Cross Sectional Area (ft <sup>2</sup> )	4.6
Bankfull Width (ft)	5.8	Water Surface Slope (ft/ft)	0.22
Mean Bankfull Depth (ft)	0.6	Sinuosity	1.2
Floodprone Width (ft)	95	D50 (mm)	0.15
Entrenchment Ratio	16.5	Adjustments?	Sin
Width to Depth Ratio	7.1	<b>Rosgen Stream Type</b>	<b>E5</b>







Upstream



Downstream

**Location/Site Access:** Located approx. 150 DS from Braidhill Drive Crossing  
**Latitude/Longitude:** 39.1291/-76.49952

#### Land Use Analysis:

Land Use	Acres	% Area
Commercial	1.6	1%
Open Space	23.3	11%
Residential 1/2-acre	59.7	28%
Residential 1/4-acre	59.3	28%
Residential 1-acre	6.4	3%
Transportation	3.3	2%
Woods	59.5	28%
Grand Total	213.1	100%

Impervious (acres)	Total Area Above site	% Impervious
32.2	213.1	15.1

#### **Results:**

- Biological condition – "Very Poor"
- Habitat scores "Non Supporting" and "Degraded"
- Channel flow status and Epifaunal substrate scored very poorly
- Sample had no EPTs and was dominated by clams: *Sphaeriidae* and *Pisidium*
- Stream type was identified as an C6, slope was 0.83 percent, and the median channel substrate was silt
- The "Very Poor" biological ratings may be associated with fine substrates observed in this reach. The banks appear stable (and they should be in a C channel), so excess sediment may be coming from overland flow.
- Habitat assessment results were mixed for this site, but biological community observed is trending toward more than expected impairment based on the observed habitat quality.

#### **Recommendations:**

- Protect the riparian area and restore the habitat, if possible.
- Investigate necessity, feasibility of BMP retrofits on developed lands.

**IBI and Metric Scores**

Narrative Rating	Very Poor
<b>Overall Index</b>	<b>1.57</b>
Total Taxa Score	3
EPT Taxa Score	1
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	3

**Calculated Metric Values**

Total Taxa	14
EPT Taxa	0
Ephemeroptera Taxa	0
Intolerant Urban %	1.0
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	1.0

**Taxa List**

Alotanyus	1
Aulodrilus	8
Bittacomorpha	5
Chrysops	1
Culicoides	5
Limnodrilus	2
Lumbriculidae	7
Nais	1
Pisidium	45
Polypedilum	1
Sphaeriidae (Mollusca)	23
Tanypodinae	1
Tubificidae	3
Zavreliomyia	1

**Total Individuals**

104

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	8	Pool Variability	3
Bank Stability- Right Bank	8	Riparian Vegetative Zone Width- Left Bank	7
Channel Alteration	11	Riparian Vegetative Zone Width- Right Bank	6
Channel Flow Status	1	Sediment Deposition	13
Channel Sinuosity	6	Vegetative Protection (Left Bank)	8
Epifaunal Substrate/Available Cover	2	Vegetative Protection (Right Bank)	8
Pool Substrate Characterization	6		

<b>EPA Habitat Score</b>	87
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<b>EPA Narrative Ranking</b>	NS
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**Maryland Biological Stream Survey PHI**

Drainage area (acres)	213.1	Instream Wood Debris	1
Remoteness	7	Bank Stability	16
Shading	50		
Epifaunal Substrate	2		
Instream Habitat	2		

<b>PHI Score</b>	51.81
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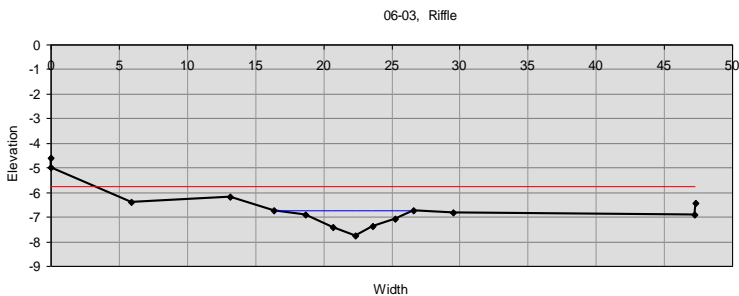
<b>PHI Narrative Ranking</b>	D
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**Water Chemistry**

Dissolved Oxygen (mg/L)	8.8	Specific Conductance (mS/cm)	162
pH	6.29	Temperature (°C)	11.45

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.3	Cross Sectional Area (ft <sup>2</sup> )	4.5
Bankfull Width (ft)	10.0	Water Surface Slope (ft/ft)	0.83
Mean Bankfull Depth (ft)	0.4	Sinuosity	1.0
Floodprone Width (ft)	115	D50 (mm)	0.062
Entrenchment Ratio	11.5	Adjustments?	Sin
Width to Depth Ratio	22	<b>Rosgen Stream Type</b>	<b>C6</b>





Upstream



Downstream

**Location/Site Access:** Located approx. 150 m SE of Fairwood Drive  
 Latitude/Longitude: 39.11554/-76.4907

### **Land Use Analysis:**

Land Use	Acres	% Area
Airport	5.3	4%
Commercial	1.8	1%
Open Space	4.1	3%
Residential 1/2-acre	53.8	42%
Residential 1-acre	5.3	4%
Transportation	4.0	3%
Woods	53.3	42%
Grand Total	127.4	100%

Impervious (acres)	Total Area Above site	% Impervious
12.3	127.4	9.6

### **Results:**

- Biological condition – "Poor"
- Habitat scores "Non Supporting" and "Degraded"
- Riparian vegetation zone width and epifaunal substrate scored low
- Sample dominated by biting flies, *Culicoides*
- Stream type was identified as an E6, slope was 0.30 percent, and the median channel substrate was silt
- Dissolved oxygen was very low.
- This channel, like typical E channels, appears stable. However, the very fine substrate indicates that excessive sediment may be a problem.
- Habitat assessment results were mixed for this site, but biological community observed is trending toward less than expected impairment based on the observed habitat quality.

### **Recommendations:**

- Protect the riparian area and restore the habitat, if possible.
- Investigate possible water quality impacts of upstream residential lands, correct as feasible and necessary.



**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Poor</b>
<b>Overall Index</b>	<b>2.71</b>
Total Taxa Score	3
EPT Taxa Score	1
Ephemeroptera Taxa Score	3
Intolerant Urban % Score	1
Ephemeroptera % Score	3
Scraper Taxa Score	3
% Climbers	5

**Calculated Metric Values**

Total Taxa	20
EPT Taxa	1
Ephemeroptera Taxa	1
Intolerant Urban %	0
Ephemeroptera %	1.0
Scraper Taxa	1
% Climbers	9.5

**Taxa List**

Agabus	1
Alotanypus	1
Bezzia/Palpomyia	5
Chironomini	1
Culicoides	68
Eurylophella	1
Helius	1
Hydrochara	1
Kiefferulus	2
Lumbriculidae	2
Nematoda	1
Ormosia	1
Orthocladus	2
Polypedilum	7
Prionocyphon	1
Rheotanytarsus	2
Tanytus	1
Tanytarsus	2
Tribelos	3
Tubificidae	2

**Total Individuals**

105

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Variability	6
Bank Stability- Right Bank	6	Riparian Vegetative	9
Channel Alteration	13	Zone Width- Left Bank	
Channel Flow Status	11	Riparian Vegetative	2
Channel Sinuosity	7	Zone Width- Right Bank	
Epifaunal Substrate/Available Cover	2	Sediment Deposition	6
Pool Substrate Characterization	6	Vegetative Protection (Left Bank)	6
		Vegetative Protection (Right Bank)	6

**EPA Habitat Score** 86**EPA Narrative Ranking** NS**Maryland Biological Stream Survey PHI**

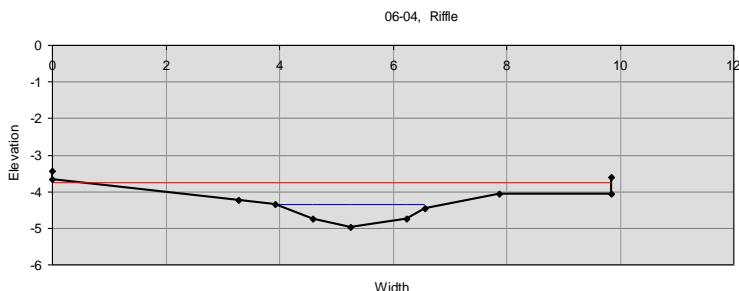
Drainage area (acres)	127.4	Instream Wood Debris	3
Remoteness	5	Bank Stability	15
Shading	85		
Epifaunal Substrate	2	<b>PHI Score</b>	58.71
Instream Habitat	2	<b>PHI Narrative Ranking</b>	D

**Water Chemistry**

Dissolved Oxygen (mg/L)	0.74	Specific Conductance (mS/cm)	129
pH	5.86	Temperature (°C)	16.61

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.2	Cross Sectional Area (ft <sup>2</sup> )	1.0
Bankfull Width (ft)	2.6	Water Surface Slope (ft/ft)	0.30
Mean Bankfull Depth (ft)	0.4	Sinuosity	1.1
Floodprone Width (ft)	17	D50 (mm)	0.062
Entrenchment Ratio	6.5	Adjustments?	Sin
Width to Depth Ratio	6.6	<b>Rosgen Stream Type</b>	<b>E6</b>





Upstream



Downstream

**Location/Site Access:** Located approx. 50m S of end of Silver Road  
**Latitude/Longitude:** 39.11993/-76.48164

#### Land Use Analysis:

Land Use	Acres	% Area
Airport	8.3	1%
Commercial	11.4	2%
Open Space	16.2	2%
Pasture/Hay	5.9	1%
Residential 1/2-acre	377.0	55%
Residential 1-acre	16.5	2%
Transportation	20.4	3%
Woods	229.5	33%
Grand Total	686.2	100%

Impervious (acres)	Total Area Above site	% Impervious
84.5	686.2	12.3

#### **Results:**

- Biological condition – "Fair"
- Habitat scores "Supporting" and "Partially Degraded"
- Most habitat variables were scored in the sub-optimal to optimal range
- Sample lacking mayflies and dominated by *Parametriocnemus*, *Polycentropus*, *Thienemannimyia*, and *Diplectrona*
- Stream type was identified as an E5, slope was 0.29 percent, and the median channel substrate was fine sand
- Habitat and water quality indicators are as expected for an E channel and agree with the "Fair" biological condition.
- Biological community is appropriate for observed habitat quality.

#### **Recommendations:**

- Protect the riparian area.
- Protect water quality and stream stability through increased control of stormwater on upstream residential lands.

06-05

## Bodkin Creek Sampling Unit

**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Fair</b>
<b>Overall Index</b>	<b>3.29</b>
Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	5
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

**Calculated Metric Values**

Total Taxa	23
EPT Taxa	6
Ephemeroptera Taxa	0
Intolerant Urban %	35.9
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	18.8

**Taxa List**

Anchytarsus	6
Boyeria	2
Calopteryx	3
Diplectrona	10
Heteroplectron	7
Heterotrissocladius	2
Lepidostoma	1
Microspectra	5
Orthocladius	2
Parametriocnemus	18
Phaenopsectra	2
Polycentropus	12
Polypedilum	7
Pseudolimnophila	4
Pseudorthocladius	1
Psilotreta	1
Rheotanytarsus	9
Simulium	5
Stenelmis	1
Tanytarsus	4
Thienemanniella	1
Thienemannimyia	12
Triaenodes	2

**Total Individuals**

117

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	8	Pool Variability	7
Bank Stability- Right Bank	8	Riparian Vegetative	8
Channel Alteration	18	Zone Width- Left Bank	
Channel Flow Status	18	Riparian Vegetative	10
Channel Sinuosity	18	Zone Width- Right Bank	
Epifaunal Substrate/Available Cover	11	Sediment Deposition	8
Pool Substrate Characterization	12	Vegetative Protection (Left Bank)	9
		Vegetative Protection (Right Bank)	9

**EPA Habitat Score** 144**EPA Narrative Ranking** S**Maryland Biological Stream Survey PHI**

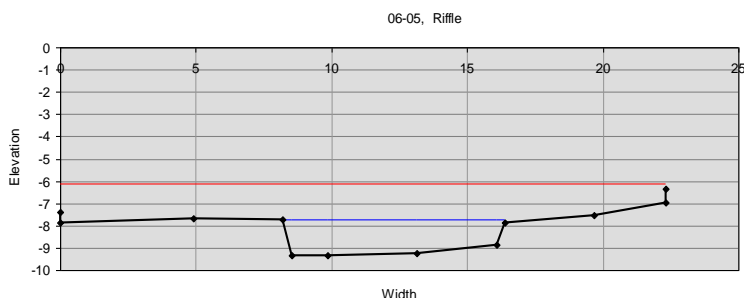
Drainage area (acres)	686.2	Instream Wood Debris	14
Remoteness	9	Bank Stability	14
Shading	80		
Epifaunal Substrate	11	<b>PHI Score</b>	75.41
Instream Habitat	11	<b>PHI Narrative Ranking</b>	PD

**Water Chemistry**

Dissolved Oxygen (mg/L)	9.13	Specific Conductance (mS/cm)	173
pH	5.56	Temperature (°C)	17.57

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	1.1	Cross Sectional Area (ft <sup>2</sup> )	11.6
Bankfull Width (ft)	8.2	Water Surface Slope (ft/ft)	0.29
Mean Bankfull Depth (ft)	1.4	Sinuosity	1.2
Floodprone Width (ft)	98	D50 (mm)	0.13
Entrenchment Ratio	11.9	Adjustments?	Sin
Width to Depth Ratio	5.8	<b>Rosgen Stream Type</b>	<b>E5</b>





Upstream



Downstream

**Location/Site Access:** Located approx. 150 m of Bodkin Park  
**Latitude/Longitude:** 39.11474/-76.47521

### Land Use Analysis:

Land Use	Acres	% Area
Commercial	8.8	3%
Open Space	8.2	2%
Open Wetland	14.3	4%
Residential 1/2-acre	177.9	51%
Transportation	12.4	4%
Utility		0%
Water	17.8	5%
Woods	107.0	31%
Grand Total	346.3	100%

Impervious (acres)	Total Area Above site	% Impervious
40.6	346.3	11.7

### **Results:**

- Biological condition – "Fair"
- Habitat scores "Supporting" and "Minimally Degraded"
- All habitat variables scored moderate to optimal
- Sample relatively diverse, but lacking mayflies and dominated by a midge (*Thienemannimyia*)
- Stream type was identified as an E5, slope was 0.19 percent, and the median channel substrate was fine sand
- Habitat and water quality indicators are as expected for an E channel and agree with the "Fair" biological condition. Lack of mayflies may be due to excessive fine sediments.
- Habitat assessment results were mixed for this site, but biological community observed is trending toward more than expected impairment based on the observed habitat quality.

### **Recommendations:**

- Maintain the protection of the riparian area
- Protect water quality through BMP implementation on residential lands upstream.

06-08

## Bodkin Creek Sampling Unit

**IBI and Metric Scores**

Narrative Rating	Fair
Overall Index	3.00

Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	3
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

**Calculated Metric Values**

Total Taxa	37
EPT Taxa	5
Ephemeroptera Taxa	0
Intolerant Urban %	17.3
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	8.7

**Taxa List**

Apsectrotanypus	5
Bethbilbeckia	2
Bezzia/Palpomysia	5
Ceratopogon	6
Chrysops	1
Corethrella	1
Corynoneura	1
Enallagma	1
Heteroplectron	1
Heterotrissocladius	2
Ischnura	1
Lepidostoma	1
Limnophyes	4
Micropsectra	2
Microtendipes	1
Nanocladius	1
Neoporus	3
Orthocladius	1
Parametriocnemus	1
Paraphaenocladius	6
Paratendipes	1
Polycentropus	1
Polypedilum	1
Pseudolimnophila	1
Pseudorthocladius	2
Pseudosmittia	2
Ptilostomis	3
Pycnopsyche	2
Sialis	1
Sphaeriidae (Mollusca)	2
Stegopterna	2
Stenochironomus	2
Tanypodinae	2
Thienemannimyia	19
Tipula	1
Tribelos	8
Zavrelimyia	8

**Total Individuals** 104

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	8	Pool Variability	9
Bank Stability- Right Bank	8	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	18	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	18	Sediment Deposition	10
Channel Sinuosity	11	Vegetative Protection (Left Bank)	8
Epifaunal Substrate/Available Cover	12	Vegetative Protection (Right Bank)	8
Pool Substrate Characterization	10		

**EPA Habitat Score** 140

**EPA Narrative Ranking** S

**Maryland Biological Stream Survey PHI**

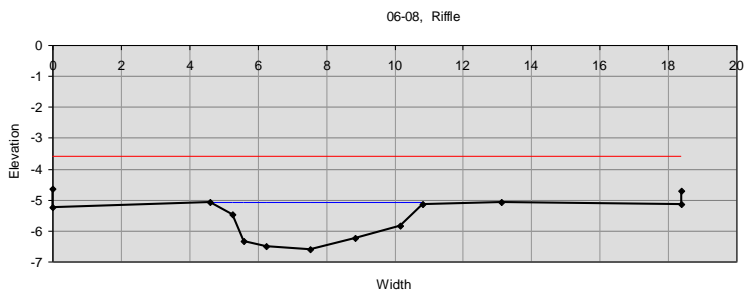
Drainage area (acres)	346.3	Instream Wood Debris	9
Remoteness	12	Bank Stability	16
Shading	95		
Epifaunal Substrate	12	<b>PHI Score</b>	82.46
Instream Habitat	9	<b>PHI Narrative Ranking</b>	MD

**Water Chemistry**

Dissolved Oxygen (mg/L)	9.31	Specific Conductance (mS/cm)	207
pH	5.8	Temperature (°C)	10.65

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.54	Cross Sectional Area (ft <sup>2</sup> )	6.4
Bankfull Width (ft)	6.2	Water Surface Slope (ft/ft)	0.19
Mean Bankfull Depth (ft)	1.03	Sinuosity	1.1
Floodprone Width (ft)	131	D50 (mm)	0.16
Entrenchment Ratio	21	Adjustments?	Sin
Width to Depth Ratio	6	<b>Rosgen Stream Type</b>	<b>E5</b>







Upstream



Downstream

**Location/Site Access:** Located South of Crosse Point Golf Course off Wiageo Foot Drive  
**Latitude/Longitude:** 39.12679/-76.49176

#### **Land Use Analysis:**

Land Use	Acres	% Area
Commercial	35.7	5%
Open Space	121.3	17%
Pasture/Hay	3.8	1%
Residential 1/2-acre	121.5	17%
Residential 1/4-acre	94.2	13%
Residential 1-acre	17.0	2%
Transportation	8.0	1%
Water	3.7	1%
Woods	317.7	44%
Grand Total	723.1	100%

Impervious (acres)	Total Area Above site	% Impervious
87.6	723.1	12.1

#### **Results:**

- Biological condition – "Very Poor"
- Habitat scores "Comparable" and "Minimally Degraded"
- All scores were near optimal except for epifaunal substrate and pool substrate characterization
- Sample lacking mayflies and dominated by a midge (*Paratendipes*)
- Stream type was identified as an E5, slope was 0.91 percent, and the median channel substrate was fine to medium sand
- This E channel appears stable, habitat and measured water quality indicators are normal, though pH is somewhat low.
- Biological community is in worse condition than would be expected for available habitat quality.

#### **Recommendations:**

- Because habitat is minimally degraded and biological condition is very poor, look for problems with water quality and correct, if possible.

06-09

## Bodkin Creek Sampling Unit

**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Very Poor</b>
<b>Overall Index</b>	<b>1.86</b>
Total Taxa Score	3
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	3

**Calculated Metric Values**

Total Taxa	21
EPT Taxa	3
Ephemeroptera Taxa	0
Intolerant Urban %	8.3
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	4.6

**Taxa List**

Ablabesmyia	6
Apsectrotanypus	2
Cryptochironomus	4
Dineutus	1
Diplectrona	1
Diplocladius	2
Heteroplectron	2
Natarsia	5
Nigronia	2
Paracladopelma	2
Parametrioctenus	3
Paraphaenocladus	4
Paratendipes	42
Phaenopsectra	7
Polycentropus	1
Polypedilum	5
Rheotanytarsus	8
Sialis	3
Thienemannimyia	6
Tribelos	2
Zavreliomyia	1

**Total Individuals**

109

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	9	Pool Variability	10
Bank Stability- Right Bank	9	Riparian Vegetative Zone Width- Left Bank	9
Channel Alteration	19	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	19	Sediment Deposition	10
Channel Sinuosity	17	Vegetative Protection (Left Bank)	9
Epifaunal Substrate/Available Cover	15	Vegetative Protection (Right Bank)	9
Pool Substrate Characterization	11		

<b>EPA Habitat Score</b>	156
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<b>EPA Narrative Ranking</b>	C
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**Maryland Biological Stream Survey PHI**

Drainage area (acres)	723.1	Instream Wood Debris	10
Remoteness	16	Bank Stability	17
Shading	95		
Epifaunal Substrate	15		
Instream Habitat	15		

<b>PHI Score</b>	91.93
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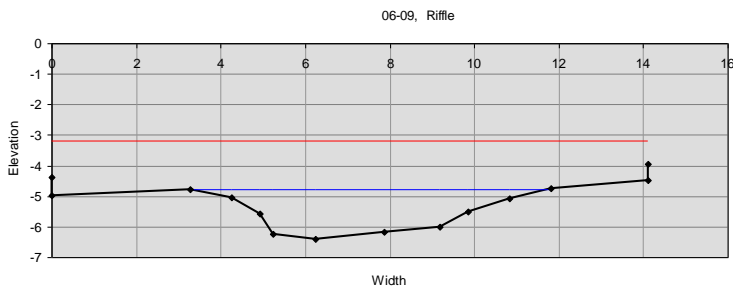
<b>PHI Narrative Ranking</b>	MD
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**Water Chemistry**

Dissolved Oxygen (mg/L)	9.94	Specific Conductance (mS/cm)	172
pH	5.16	Temperature (°C)	12.78

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	1.1	Cross Sectional Area (ft <sup>2</sup> )	7.7
Bankfull Width (ft)	8.4	Water Surface Slope (ft/ft)	0.91
Mean Bankfull Depth (ft)	0.92	Sinuosity	1.1
Floodprone Width (ft)	98	D50 (mm)	0.25
Entrenchment Ratio	11.6	Adjustments?	Sin
Width to Depth Ratio	9.2	<b>Rosgen Stream Type</b>	<b>E5</b>





Upstream



Downstream

**Location/Site Access:** Located approx. 80 m behind house at 1227 Lorene Drive  
**Latitude/Longitude:** 39.11694/-76.48657

### **Land Use Analysis:**

Land Use	Acres	% Area
Airport	8.3	3%
Commercial	2.7	1%
Open Space	5.8	2%
Pasture/Hay	5.9	2%
Residential 1/2-acre	104.6	42%
Residential 1-acre	8.0	3%
Transportation	6.7	3%
Woods	107.8	43%
Grand Total	250.0	100%

Impervious (acres)	Total Area Above site	% Impervious
23.8	250.0	9.5

### **Results:**

- Biological condition – "Poor"
- Habitat scores "Partially Supported" and "Partially Degraded"
- Riparian vegetation zone width scored high
- Sample lacking mayflies and dominated by a midge (*Thienemannimyia*)
- Stream type was identified as an C5, slope was 0.67 percent, and the median channel substrate was fine sand
- Typically, C channels are stable. This channel has sub-optimal bank indicators and marginal substrate indicators.
- Habitat assessment results were mixed for this site, but biological community observed is trending toward more than expected impairment based on the observed habitat quality.

### **Recommendations:**

- Protect the riparian area
- Investigate BMP retrofit possibilities in upstream watershed.



**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Poor</b>
<b>Overall Index</b>	<b>2.71</b>

Total Taxa Score	5
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	3
Ephemeroptera % Score	1
Scraper Taxa Score	3
% Climbers	3

**Calculated Metric Values**

Total Taxa	32
EPT Taxa	4
Ephemeroptera Taxa	0
Intolerant Urban %	24.3
Ephemeroptera %	0
Scraper Taxa	1
% Climbers	7.8

**Taxa List**

Ablabesmyia	2
Apsectrotanytus	7
Bethbilbeckia	2
Bezzia/Palpomysia	3
Caecidotea	1
Calopteryx	4
Ceratopogon	1
Cryptochironomus	3
Diplectrona	2
Heteroplectron	7
Heterotrissocladius	2
Lype	1
Mallochohelea	2
Micropsectra	1
Natarsia	4
Orthocladius	1
Parametrioconemus	9
Paraphaenocladius	7
Paratendipes	1
Pilaria	2
Polycentropus	7
Polypedilum	3
Prionocyphon	1
Pseudolimnophila	1
Rheocricotopus	1
Rheotanytarsus	4
Stegopterna	1
Synurella	5
Thienemannimyia	19
Tipula	1
Tubificidae	5
Zavrelimyia	5

**Total Individuals** 115

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	7	Pool Variability	6
Bank Stability- Right Bank	7	Riparian Vegetative	9
Channel Alteration	19	Zone Width- Left Bank	
Channel Flow Status	15	Riparian Vegetative	10
Channel Sinuosity	12	Zone Width- Right Bank	
Epifaunal Substrate/Available Cover	7	Sediment Deposition	8
Pool Substrate Characterization	7	Vegetative Protection (Left Bank)	7
		Vegetative Protection (Right Bank)	7

**EPA Habitat Score** 121

**EPA Narrative Ranking** PS

**Maryland Biological Stream Survey PHI**

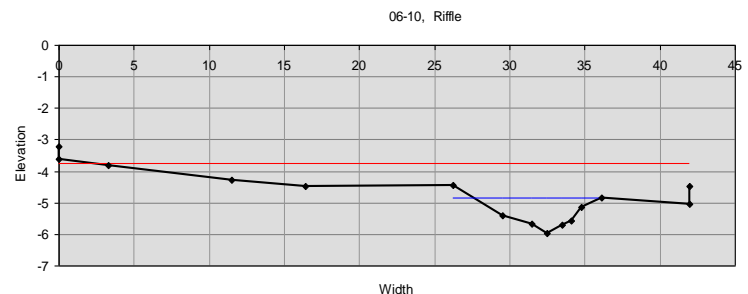
Drainage area (acres)	250.0	Instream Wood Debris	1
Remoteness	8	Bank Stability	17
Shading	95		
Epifaunal Substrate	5	<b>PHI Score</b>	67.36
Instream Habitat	6	<b>PHI Narrative Ranking</b>	PD

**Water Chemistry**

Dissolved Oxygen (mg/L)	9.31	Specific Conductance (mS/cm)	79
pH	5.36	Temperature (°C)	14.04

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.4	Cross Sectional Area (ft <sup>2</sup> )	4.8
Bankfull Width (ft)	8.4	Water Surface Slope (ft/ft)	0.67
Mean Bankfull Depth (ft)	0.6	Sinuosity	1.3
Floodprone Width (ft)	69.0	D50 (mm)	0.13
Entrenchment Ratio	8.2	Adjustments?	
Width to Depth Ratio	14.7	<b>Rosgen Stream Type</b>	<b>C5</b>





Upstream



Downstream

**Location/Site Access:** Located approx. 100 m from Old Nikemissle Site Road  
**Latitude/Longitude:** 39.12738/-76.49744

### Land Use Analysis:

Land Use	Acres	% Area
Commercial	24.6	6%
Open Space	88.3	23%
Residential 1/2-acre	90.7	23%
Residential 1/4-acre	59.7	15%
Residential 1-acre	6.3	2%
Transportation	5.4	1%
Water	2.9	1%
Woods	109.9	28%
Grand Total	387.9	100%

Impervious (acres)	Total Area Above site	% Impervious
59.8	387.9	15.4

### **Results:**

- Biological condition – "Very Poor"
- Habitat scores "Partially Supported" and "Partially Degraded"
- Riparian vegetation protection scored relatively low
- Sample lacking mayflies and dominated by midges (*Tribelos* and *Phaenopsectra*)
- Dissolved oxygen recorded value in error: possible corrected value 12.96 mg/L
- Stream type was identified as an C5, slope was 0.37 percent, and the median channel substrate was very fine sand
- Habitat and water quality conditions are better than might be expected for the "Very Poor" biological ratings in this reach.
- Biological community is in worse condition than would be expected for available habitat quality.

### **Recommendations:**

- Maintain protection of riparian areas. Investigate possible water quality stressors, likely found in upstream residential and commercial lands.

**IBI and Metric Scores**

Narrative Rating	Very Poor
<b>Overall Index</b>	<b>1.57</b>
Total Taxa Score	3
EPT Taxa Score	1
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	3

**Calculated Metric Values**

Total Taxa	19
EPT Taxa	1
Ephemeroptera Taxa	0
Intolerant Urban %	2.0
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	3.0

**Taxa List**

Apsectrotanypus	1
Cheumatopsyche	1
Chironomus	1
Chrysops	1
Cordulegaster	1
Helius	1
Hydrobaenus	1
Limnophyes	2
Ormosia	1
Orthocladius	1
Paraphaenocladus	1
Paratanytarsus	1
Phaenopsectra	11
Pisidium	4
Polypedilum	3
Thienemannimyia	8
Tribelos	58
Xylotopus	1
Zavrelimyia	3

**Total Individuals** 101

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	7	Pool Variability	7
Bank Stability- Right Bank	7	Riparian Vegetative Zone Width- Left Bank	8
Channel Alteration	19	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	15	Sediment Deposition	9
Channel Sinuosity	8	Vegetative Protection (Left Bank)	6
Epifaunal Substrate/Available Cover	11	Vegetative Protection (Right Bank)	6
Pool Substrate Characterization	8		

**EPA Habitat Score** 121

**EPA Narrative Ranking** PS

**Maryland Biological Stream Survey PHI**

Drainage area (acres)	387.9	Instream Wood Debris	5
Remoteness	11	Bank Stability	14
Shading	80		
Epifaunal Substrate	11		
Instream Habitat	10		

**PHI Score** 74.51

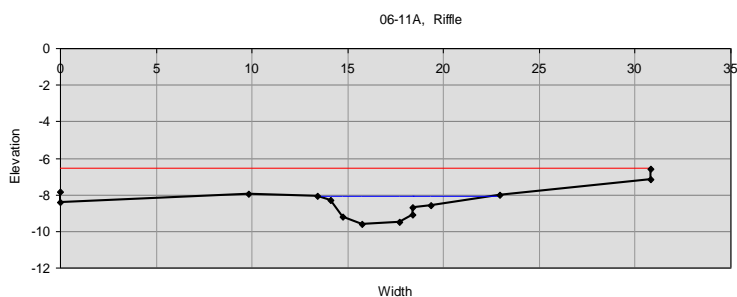
**PHI Narrative Ranking** PD

**Water Chemistry**

Dissolved Oxygen (mg/L)	129.6	Specific Conductance (mS/cm)	161
pH	5.82	Temperature (°C)	14.67

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.6	Cross Sectional Area (ft <sup>2</sup> )	7.0
Bankfull Width (ft)	9.1	Water Surface Slope (ft/ft)	0.37
Mean Bankfull Depth (ft)	0.8	Sinuosity	1.1
Floodprone Width (ft)	>246	D50 (mm)	0.12
Entrenchment Ratio	27	Adjustments?	Sin
Width to Depth Ratio	11.9	<b>Rosgen Stream Type</b>	<b>C5</b>





Upstream



Downstream

**Location/Site Access:** Located approx. 50 m DS of Fresh Pond  
**Latitude/Longitude:** 39.11336/-76.47557

#### **Land Use Analysis:**

Land Use	Acres	% Area
Commercial	7.8	3%
Open Space	7.2	3%
Open Wetland	14.3	5%
Residential 1/2-acre	130.8	49%
Transportation	9.2	3%
Water	17.8	7%
Woods	80.3	30%
Grand Total	267.3	100%

Impervious (acres)	Total Area Above site	% Impervious
29.0	267.3	10.9

#### **Results:**

- Biological condition – "Poor"
- Habitat scores "Supporting" and "Partially Degraded"
- All EPA habitat variables scored moderate or near optimal
- Sample lacking mayflies and dominated by *Stegopterna* (blackflies)
- Stream type was identified as an E5, slope was 1.1 percent, and the median channel substrate was fine sand
- High dominance of blackflies may have been a temporary biological condition coinciding with the blackfly life cycle. Habitat and water quality indicators suggest that "Fair" or better biological conditions should be possible.
- Biological community is in worse condition than would be expected for available habitat quality.

#### **Recommendations:**

- Maintain the protection of the riparian area.
- Investigate water quality degradation associated with upstream residential and commercial lands. Correct as necessary and feasible.

**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Poor</b>
<b>Overall Index</b>	<b>2.71</b>
Total Taxa Score	5
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	5
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	3

**Calculated Metric Values**

Total Taxa	22
EPT Taxa	4
Ephemeroptera Taxa	0
Intolerant Urban %	46
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	3

**Taxa List**

Caecidotea	1
Cheumatopsyche	1
Culicoides	4
Dasyhelea	1
Enallagma	1
Ironoquia	2
Libellula	1
Micropsectra	1
Neoporos	1
Orthocladius/Cricotopus	1
Orthotrichia	2
Parametriocnemus	2
Paraphaenocladius	1
Paratendipes	1
Ptilostomis	1
Rheotanytarsus	1
Simulium	11
Stegopterna	44
Thienemannimyia	16
Tipula	1
Tubificidae	1
Zavreliomyia	5

**Total Individuals**

100

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	9	Pool Variability	8
Bank Stability- Right Bank	9	Riparian Vegetative	9
Channel Alteration	18	Zone Width- Left Bank	9
Channel Flow Status	14	Riparian Vegetative	9
Channel Sinuosity	13	Zone Width- Right Bank	7
Epifaunal Substrate/Available Cover	10	Sediment Deposition	9
Pool Substrate Characterization	11	Vegetative Protection (Left Bank)	9
		Vegetative Protection (Right Bank)	9

<b>EPA Habitat Score</b>	135
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<b>EPA Narrative Ranking</b>	S
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**Maryland Biological Stream Survey PHI**

Drainage area (acres)	267.3	Instream Wood Debris	7
Remoteness	10	Bank Stability	16
Shading	85		
Epifaunal Substrate	10		
Instream Habitat	10		

<b>PHI Score</b>	77.32
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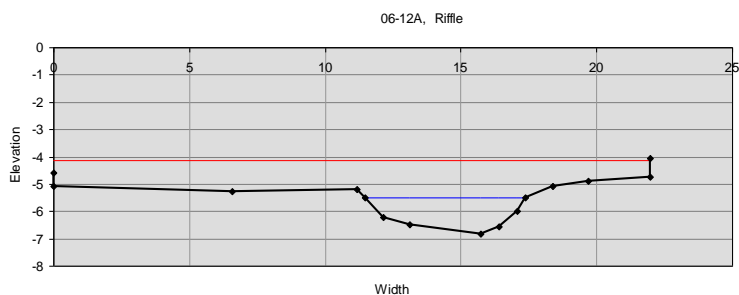
<b>PHI Narrative Ranking</b>	PD
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**Water Chemistry**

Dissolved Oxygen (mg/L)	9.72	Specific Conductance (mS/cm)	290
pH	6.04	Temperature (°C)	12.97

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.4	Cross Sectional Area (ft <sup>2</sup> )	5.6
Bankfull Width (ft)	5.9	Water Surface Slope (ft/ft)	1.1
Mean Bankfull Depth (ft)	1.0	Sinuosity	1.2
Floodprone Width (ft)	148	D50 (mm)	0.13
Entrenchment Ratio	25.1	Adjustments?	Sin
Width to Depth Ratio	6.2	<b>Rosgen Stream Type</b>	<b>E5</b>







Upstream



Downstream

**Location/Site Access:** Located near Compass Pointe Golf Course

Latitude/Longitude: 39.12722/-76.48889

#### Land Use Analysis:

Land Use	Acres	% Area
Commercial	35.7	4%
Open Space	137.9	17%
Residential 1/2-acre	121.5	15%
Residential 1/4-acre	94.2	12%
Residential 1-acre	17.0	2%
Transportation	8.0	1%
Water	5.3	1%
Woods	382.6	47%
Grand Total	806.2	100%

Impervious (acres)	Total Area Above site	% Impervious
87.6	806.2	10.9

#### **Results:**

- Biological condition – "Poor"
- Habitat scores "Comparable" and incomplete
- All EPA habitat variables scored near optimal
- Sample lacking mayflies and dominated by a midge, *Rheotanytarsus*
- Stream type was identified as an E5, slope was 0.28 percent, and the median channel substrate was fine sand
- This E channel is stable, has good habitat, and normal water quality (though pH is somewhat low).
- Biological community is in worse condition than would be expected for available habitat quality.

#### **Recommendations:**

- Maintain the protection of the riparian areas. Investigate other, previously unmeasured water quality stressors.

**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Poor</b>
<b>Overall Index</b>	<b>2.14</b>
Total Taxa Score	3
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	3
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	3

**Calculated Metric Values**

Total Taxa	19
EPT Taxa	4
Ephemeroptera Taxa	0
Intolerant Urban %	19.0
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	4.8

**Taxa List**

Ablabesmyia	6
Apsectrotanypus	1
Calopteryx	1
Cryptochironomus	1
Diplectrona	8
Heteroplectron	1
Mallochohelea	1
Nigronia	1
Parametriocnemus	16
Phylocentropus	3
Polycentropus	4
Polypedilum	4
Rheotanytarsus	43
Sialis	2
Stegopterna	3
Synurella	1
Thienemannimyia	7
Tribelos	1
Xylotopus	1

**Total Individuals**

105

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	9	Pool Variability	10
Bank Stability- Right Bank	9	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	19	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	19	Sediment Deposition	12
Channel Sinuosity	20	Vegetative Protection (Left Bank)	9
Epifaunal Substrate/Available Cover	15	Vegetative Protection (Right Bank)	9
Pool Substrate Characterization	13		

<b>EPA Habitat Score</b>	164
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<b>EPA Narrative Ranking</b>	C
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**Maryland Biological Stream Survey PHI**

Drainage area (acres)	806.2	Instream Wood Debris	—
Remoteness	—	Bank Stability	—
Shading	95		
Epifaunal Substrate	16		
Instream Habitat	16		

<b>PHI Score</b>	—
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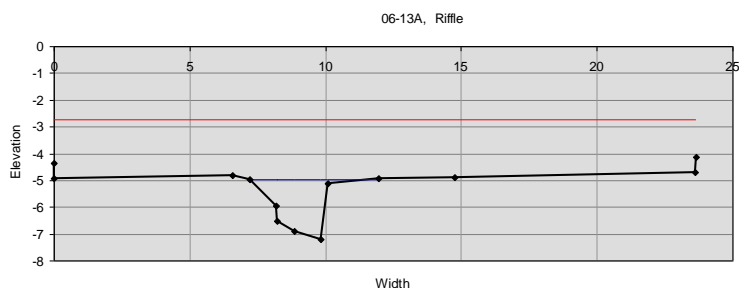
<b>PHI Narrative Ranking</b>	—
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**Water Chemistry**

Dissolved Oxygen (mg/L)	10.14	Specific Conductance (mS/cm)	122
pH	5.37	Temperature (°C)	10.63

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	1.3	Cross Sectional Area (ft <sup>2</sup> )	4.1
Bankfull Width (ft)	4.5	Water Surface Slope (ft/ft)	0.28
Mean Bankfull Depth (ft)	0.9	Sinuosity	1.1
Floodprone Width (ft)	141	D50 (mm)	0.21
Entrenchment Ratio	31.6	Adjustments?	Sin
Width to Depth Ratio	4.8	<b>Rosgen Stream Type</b>	<b>E5</b>





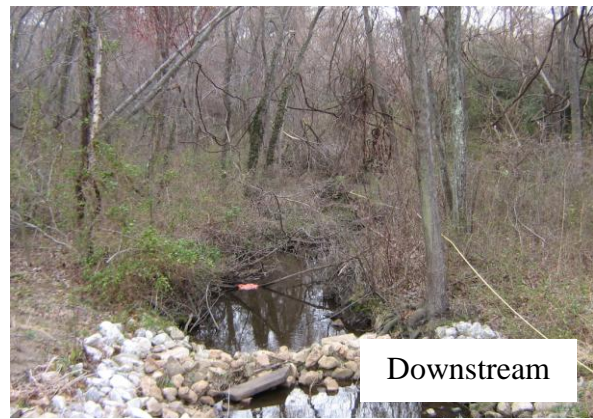
# Upper Magothy Sampling Unit



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Upstream



Downstream

**Location/Site Access:** Located near Balsom Drive Crossing below pond  
**Latitude/Longitude:** 39.08295/-76.5591

### Land Use Analysis:

Land Use	Acres	% Area
Commercial	51.3	7%
Open Space	32.9	4%
Residential 1/2-acre	63.0	8%
Residential 1/4-acre	403.5	52%
Residential 1-acre	26.4	3%
Residential 2-acre	6.0	1%
Transportation	21.0	3%
Woods	167.2	22%
Grand Total	772.9	100%

Impervious (acres)	Total Area Above site	% Impervious
151.8	772.9	19.6

### **Results:**

- Biological condition – "Fair"
- Habitat scores "Non Supporting" and "Degraded"
- Most EPA habitat variables scored poorly to marginally
- Sample dominated by *Orthocladus*, *Dubiraphia*, *Simulium*, and *Tanytarsus*
- Geomorphic assessment incomplete because pond and culvert comprise approximately half of the assessment reach.
- Association of this reach with the upstream pond affects the hydrology and morphology.
- Biological community is in better condition than expected for measured level of habitat quality.

### **Recommendations:**

- Protect the riparian area. Restore the habitat, if possible.
- Check impact of pond and residential land uses on stream stability and water quality.

**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Fair</b>
<b>Overall Index</b>	<b>3.00</b>
Total Taxa Score	5
EPT Taxa Score	3
Ephemeroptera Taxa Score	3
Intolerant Urban % Score	1
Ephemeroptera % Score	3
Scraper Taxa Score	1
% Climbers	5

**Calculated Metric Values**

Total Taxa	29
EPT Taxa	3
Ephemeroptera Taxa	1
Intolerant Urban %	2.6
Ephemeroptera %	0.9
Scraper Taxa	0
% Climbers	13.2

**Taxa List**

Argia	1
Caecidotea	1
Chaetocladius	2
Cheumatopsyche	2
Cryptotendipes	1
Dero	1
Dicrotendipes	2
Dubiraphia	16
Eurylophella	1
Gammarus	2
Isonychia	3
Limnodrilus	1
Nanocladius	2
Orthocladius	15
Orthocladius/Cricotopus	5
Parametrioicnemus	1
Paratendipes	2
Phaenopsectra	1
Physa	1
Polypedilum	5
Rheotanytarsus	3
Simulium	16
Stegopterna	2
Stenelmis	9
Stenochironomus	5
Tanytarsus	10
Thienemannimyia	2
Tribelos	1
Tubificidae	1

**Total Individuals**

114

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	4	Pool Variability	8
Bank Stability- Right Bank	4	Riparian Vegetative	4
Channel Alteration	6	Zone Width- Left Bank	4
Channel Flow Status	10	Riparian Vegetative	4
Channel Sinuosity	8	Zone Width- Right Bank	4
Epifaunal Substrate/Available Cover	13	Sediment Deposition	8
Pool Substrate Characterization	8	Vegetative Protection (Left Bank)	5
		Vegetative Protection (Right Bank)	5

**EPA Habitat Score** 87**EPA Narrative Ranking** NS**Maryland Biological Stream Survey PHI**

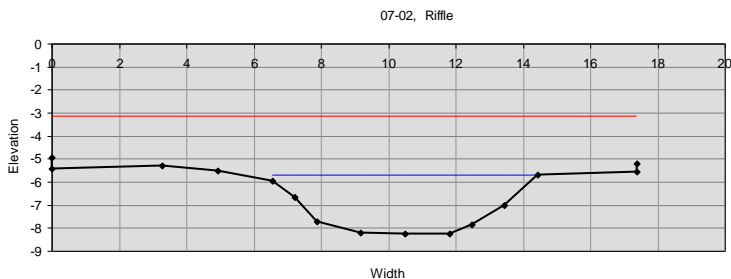
Drainage area (acres)	772.9	Instream Wood Debris	2
Remoteness	0	Bank Stability	6
Shading	60		
Epifaunal Substrate	13		
Instream Habitat	14		

**PHI Score** 57.46**PHI Narrative Ranking** D**Water Chemistry**

Dissolved Oxygen (mg/L)	7.1	Specific Conductance (mS/cm)	173
pH	6.17	Temperature (°C)	9.46

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	1.2	Cross Sectional Area (ft <sup>2</sup> )	14.9
Bankfull Width (ft)	7.9	Water Surface Slope (ft/ft)	--
Mean Bankfull Depth (ft)	1.9	Sinuosity	--
Floodprone Width (ft)	--	D50 (mm)	--
Entrenchment Ratio	--	Adjustments?	--
Width to Depth Ratio	4.2	<b>Rosgen Stream Type</b>	





Upstream



Downstream

**Location/Site Access:** Located at Balsom Drive Crossing below pond  
**Latitude/Longitude:** 39.08295/-76.5591

#### **Land Use Analysis:**

Land Use	Acres	% Area
Commercial	9.7	4%
Open Space	6.2	3%
Residential 1/2-acre	62.4	26%
Residential 1/4-acre	35.9	15%
Residential 1-acre	14.0	6%
Residential 2-acre	2.3	1%
Transportation	14.0	6%
Woods	91.6	39%
Grand Total	236.0	100%

Impervious (acres)	Total Area Above site	% Impervious
42.4	236.0	18.0

#### **Results:**

- Biological condition – "Fair"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Bank stability and vegetative protection scored poorly.
- Sample dominated by *Parametriocnemus Diplectrona*
- Stream type was identified as an E5, slope was 1.04 percent, and the median channel substrate was fine sand
- Typically, E channels are stable. However, the marginal bank-related habitat ratings may indicate that this reach is transitioning to an unstable form.
- Habitat assessment results were mixed for this site, but biological community observed is trending toward less than expected impairment based on the observed habitat quality.

#### **Recommendations:**

- Maintain the protection of the riparian area.
- Perform BMP retrofits on residential and commercial lands as necessary to improve and protect water quality.



**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Fair</b>
<b>Overall Index</b>	<b>3.57</b>

Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	3
Intolerant Urban % Score	5
Ephemeroptera % Score	3
Scraper Taxa Score	1
% Climbers	3

**Calculated Metric Values**

Total Taxa	27
EPT Taxa	5
Ephemeroptera Taxa	1
Intolerant Urban %	30.9
Ephemeroptera %	0.9
Scraper Taxa	0
% Climbers	6.4

**Taxa List**

Amphinemura	4
Anchytarsus	2
Apsectrotanypus	1
Bethbilbeckia	1
Calopteryx	2
Ceratopogon	1
Corynoneura	2
Culicoides	1
Diplectrona	18
Eurylophella	1
Helichus	1
Heteroplectron	1
Heterotrissocladius	3
Libellulidae	1
Lype	1
Micropsectra	2
Parametriocnemus	35
Paratendipes	1
Polypedilum	2
Procladius	1
Pseudolimnophila	4
Rheotanytarsus	9
Simulium	6
Stenelmis	2
Synurella	1
Tanytarsus	1
Thienemannimyia	6

**Total Individuals**

110

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	5	Pool Variability	7
Bank Stability- Right Bank	5	Riparian Vegetative Zone Width- Left Bank	9
Channel Alteration	12	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	12	Sediment Deposition	11
Channel Sinuosity	9	Vegetative Protection (Left Bank)	6
Epifaunal Substrate/Available Cover	10	Vegetative Protection (Right Bank)	6
Pool Substrate Characterization	9		

**EPA Habitat Score** 111**EPA Narrative Ranking** PS**Maryland Biological Stream Survey PHI**

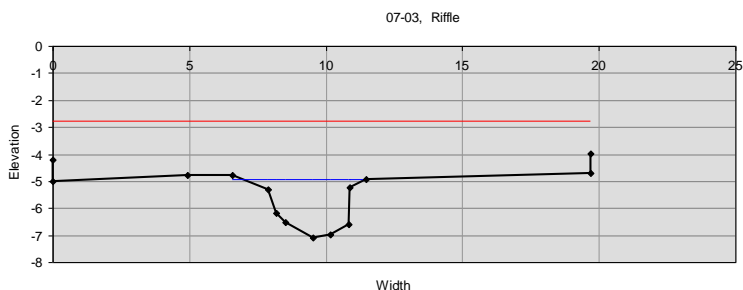
Drainage area (acres)	236.0	Instream Wood Debris	8
Remoteness	6	Bank Stability	10
Shading	95		
Epifaunal Substrate	10		
Instream Habitat	6		

**PHI Score** 70.54**PHI Narrative Ranking** PD**Water Chemistry**

Dissolved Oxygen (mg/L)	8.75	Specific Conductance (mS/cm)	243
pH	6.14	Temperature (°C)	5.87

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.4	Cross Sectional Area (ft <sup>2</sup> )	5.5
Bankfull Width (ft)	4.6	Water Surface Slope (ft/ft)	1.04
Mean Bankfull Depth (ft)	1.2	Sinuosity	1.2
Floodprone Width (ft)	115	D50 (mm)	0.13
Entrenchment Ratio	25	Adjustments?	Sin
Width to Depth Ratio	3.8	<b>Rosgen Stream Type</b>	<b>E5</b>





**Location/Site Access:** Located approx. 120m behind 256 Poplar Road  
**Latitude/Longitude:** 39.11271/-76.59679

#### **Land Use Analysis:**

Land Use	Acres	% Area
Commercial	8.0	2%
Open Space	28.0	6%
Residential 1/2-acre	131.1	28%
Residential 1/4-acre	107.0	23%
Residential 1-acre	28.3	6%
Transportation	21.4	5%
Woods	147.5	31%
Grand Total	472.6	100%

Impervious (acres)	Total Area Above site	% Impervious
72.0	472.6	15.2

#### **Results:**

- Biological condition – "Fair"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Channel alteration and channel flow status scored high
- Sample dominated by *Parametriocnemus* and *Polypedilum*
- Stream type was identified as an E5, slope was 0.54 percent, and the median channel substrate was fine to medium sand
- Typically, E channels are stable. However, the marginal bank and substrate-related habitat ratings may indicate that this reach is transitioning to an unstable form.
- Habitat assessment results were mixed for this site, but biological community observed is trending toward less than expected impairment based on the observed habitat quality.

#### **Recommendations:**

- Maintain the protection of the riparian area.
- Retrofit BMPs on residential and commercial lands as necessary and feasible.



**IBI and Metric Scores**

Narrative Rating	Fair
<b>Overall Index</b>	<b>3</b>

Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	3
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

**Calculated Metric Values**

Total Taxa	36
EPT Taxa	7
Ephemeroptera Taxa	0
Intolerant Urban %	13.4
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	13.4

**Taxa List**

Ablabesmyia	1
Ancyronyx	1
Brillia	1
Calopteryx	1
Ceratopogon	1
Cheumatopsyche	1
Corynoneura	1
Enchytraeidae	1
Hemerodromia	1
Heteroplectron	1
Hydropsyche	1
Lepidostoma	1
Limnephilidae	1
Lype	1
Macronychus	4
Natarsia	3
Orthocladius	3
Parametriocnemus	33
Paratendipes	2
Phaenopsectra	1
Polycentropus	1
Polypedilum	10
Rheocricotopus	2
Rheotanytarsus	4
Simulium	3
Stegopterna	9
Stenelmis	2
Stenochironomus	3
Synurella	2
Tanypodinae	1
Tanytarsus	3
Thienemanniella	1
Thienemannimyia	8
Tipula	1
Tvetenia	1
Zavrelimyia	1

**Total Individuals** 112

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Variability	10
Bank Stability- Right Bank	6	Riparian Vegetative	9
Channel Alteration	19	Zone Width- Left Bank	
Channel Flow Status	14	Riparian Vegetative	7
Channel Sinuosity	9	Zone Width- Right Bank	
Epifaunal Substrate/Available Cover	11	Sediment Deposition	8
Pool Substrate Characterization	11	Vegetative Protection (Left Bank)	6
		Vegetative Protection (Right Bank)	6

**EPA Habitat Score** 122

**EPA Narrative Ranking** PS

**Maryland Biological Stream Survey PHI**

Drainage area (acres)	472.6	Instream Wood Debris	9
Remoteness	6	Bank Stability	12
Shading	95		
Epifaunal Substrate	12		
Instream Habitat	11		

**PHI Score** 75.47

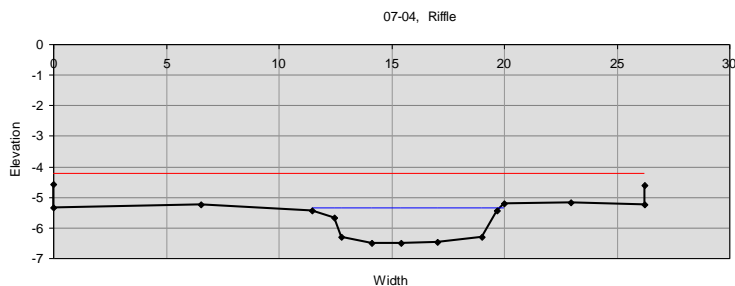
**PHI Narrative Ranking** PD

**Water Chemistry**

Dissolved Oxygen (mg/L)	8.65	Specific Conductance (mS/cm)	204
pH	6.09	Temperature (°C)	9.84

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.7	Cross Sectional Area (ft <sup>2</sup> )	7.5
Bankfull Width (ft)	8.3	Water Surface Slope (ft/ft)	0.54
Mean Bankfull Depth (ft)	0.9	Sinuosity	1.1
Floodprone Width (ft)	85	D50 (mm)	0.25
Entrenchment Ratio	10.2	Adjustments?	Sin
Width to Depth Ratio	9.2	<b>Rosgen Stream Type</b>	<b>E5</b>





Upstream



Downstream

**Location/Site Access:** Located approx. 60m N of Kent Drive  
 Latitude/Longitude: 39.11321/-76.5683

#### Land Use Analysis:

Land Use	Acres	% Area
Commercial	14.2	2%
Open Space	63.8	11%
Residential 1/2-acre	85.8	14%
Residential 1/4-acre	171.8	29%
Residential 1-acre	14.4	2%
Transportation	32.6	5%
Woods	215.3	36%
Grand Total	599.4	100%

Impervious (acres)	Total Area Above site	% Impervious
85.3	599.4	14.2

#### **Results:**

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Bank stability and vegetative protection scored moderately
- Sample lacking mayflies and dominated by midges (*Parametriocnemus* and *Orthocladius/Cricotopus*)
- Stream type was identified as an E5, slope was 0.69 percent, and the median channel substrate was medium sand
- Typically, E channels are stable. However, the "Poor" biological ratings along with sub-optimal and marginal habitat ratings may indicate that this reach is transitioning to an unstable form.
- Biological community is appropriate for observed habitat quality.

#### **Recommendations:**

- Protect the riparian area, including reintroduction of woody debris, if possible.
- Look for water quality impacts associated with residential land uses, correct as necessary and feasible.

07-05

## Upper Magothy R. Sampling Unit

**IBI and Metric Scores**

Narrative Rating	Poor
<b>Overall Index</b>	<b>2.14</b>
Total Taxa Score	3
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

**Calculated Metric Values**

Total Taxa	21
EPT Taxa	3
Ephemeroptera Taxa	0
Intolerant Urban %	1.9
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	15.9

**Taxa List**

Calopteryx	1
Cheumatopsyche	6
Hydropsyche	2
Lype	4
Micropsectra	2
Nanocladius	3
Orthocladius	2
Orthocladius/Cricotopus	13
Paracladopelma	1
Parametrioctenus	36
Paraphaenocladius	2
Phaenopsectra	2
Pisidium	1
Polypedilum	9
Rheocricotopus	1
Rheotanytarsus	4
Sciaridae	1
Stenelmis	1
Tanytarsus	5
Thienemannimyia	9
Tubificidae	2

**Total Individuals**

107

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Variability	8
Bank Stability- Right Bank	6	Riparian Vegetative	8
Channel Alteration	13	Zone Width- Left Bank	8
Channel Flow Status	14	Riparian Vegetative	8
Channel Sinuosity	9	Zone Width- Right Bank	10
Epifaunal Substrate/Available Cover	9	Sediment Deposition	6
Pool Substrate Characterization	10	Vegetative Protection (Left Bank)	6
		Vegetative Protection (Right Bank)	6

<b>EPA Habitat Score</b>	113
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<b>EPA Narrative Ranking</b>	PS
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**Maryland Biological Stream Survey PHI**

Drainage area (acres)	599.4	Instream Wood Debris	2
Remoteness	5	Bank Stability	12
Shading	95		
Epifaunal Substrate	9		
Instream Habitat	7		

<b>PHI Score</b>	63.41
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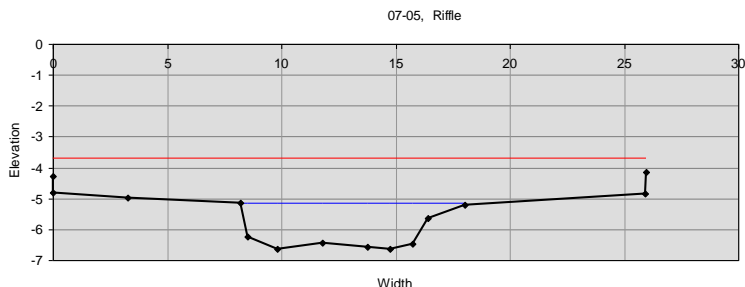
<b>PHI Narrative Ranking</b>	D
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**Water Chemistry**

Dissolved Oxygen (mg/L)	9.85	Specific Conductance (mS/cm)	104
pH	6.72	Temperature (°C)	6.31

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.9	Cross Sectional Area (ft <sup>2</sup> )	10.0
Bankfull Width (ft)	7.5	Water Surface Slope (ft/ft)	0.69
Mean Bankfull Depth (ft)	1.3	Sinuosity	1.0
Floodprone Width (ft)	59	D50 (mm)	0.34
Entrenchment Ratio	7.8	Adjustments?	Sin
Width to Depth Ratio	5.7	<b>Rosgen Stream Type</b>	<b>E5</b>





**Location/Site Access:** Located approx. 100m NE of house at 106 Silverrock Court  
**Latitude/Longitude:** 39.0984/-76.57635

#### Land Use Analysis:

Land Use	Acres	% Area
Commercial	12.1	8%
Open Space	44.4	31%
Residential 1/2-acre	6.3	4%
Residential 1/4-acre	28.6	20%
Residential 1-acre	6.8	5%
Transportation	11.3	8%
Woods	33.9	24%
Grand Total	143.4	100%

Impervious (acres)	Total Area Above site	% Impervious
27.5	143.4	19.2

#### **Results:**

- Biological condition – "Poor"
- Habitat scores "Supporting" and "Partially Degraded"
- Habitat variables related to substrate and pool variability scored lowest of all
- Sample lacking mayflies and dominated by *Stegopterna*, *Rheocricotopus*, and *Orthocladus/Cricotopus*
- Stream type was identified as an E5, slope was 0.7 percent, and the median channel substrate was fine sand
- This E channel may be stable; however, poor substrate conditions may be limiting the biological potential.
- Biological community is in worse condition than would be expected for available habitat quality.

#### **Recommendations:**

- Maintain the protection of the riparian area.
- Execute BMP retrofits to correct any water quality problems depressing biological community health.

07-07

## Upper Magothy R. Sampling Unit

**IBI and Metric Scores**

Narrative Rating	Poor
<b>Overall Index</b>	<b>2.71</b>
Total Taxa Score	5
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	5
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	3

**Calculated Metric Values**

Total Taxa	26
EPT Taxa	2
Ephemeroptera Taxa	0
Intolerant Urban %	37.9
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	4.3

**Taxa List**

Agrypnia	1
Caecidotea	2
Culicoides	1
Cyphon	3
Enchytraeidae	1
Gymnometriocnemus	1
Hydrobaenus	2
Ischnura	1
Lumbriculidae	1
Nemoura	5
Neoporus	4
Orthocladius	3
Orthocladius/Cricotopus	16
Parametriocnemus	2
Paraphaenocladius	1
Paratendipes	2
Phaenopsectra	1
Pisidium	2
Polypedilum	1
Rheocricotopus	24
Spirosperma	1
Stegopterna	35
Stenochironomus	1
Synurella	2
Thienemannimyia	1
Tubificidae	2

**Total Individuals**

116

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	8	Pool Variability	10
Bank Stability- Right Bank	8	Riparian Vegetative Zone Width- Left Bank	8
Channel Alteration	17	Riparian Vegetative Zone Width- Right Bank	9
Channel Flow Status	14	Sediment Deposition	10
Channel Sinuosity	14	Vegetative Protection (Left Bank)	7
Epifaunal Substrate/Available Cover	10	Vegetative Protection (Right Bank)	7
Pool Substrate Characterization	12		

**EPA Habitat Score** 134**EPA Narrative Ranking** S**Maryland Biological Stream Survey PHI**

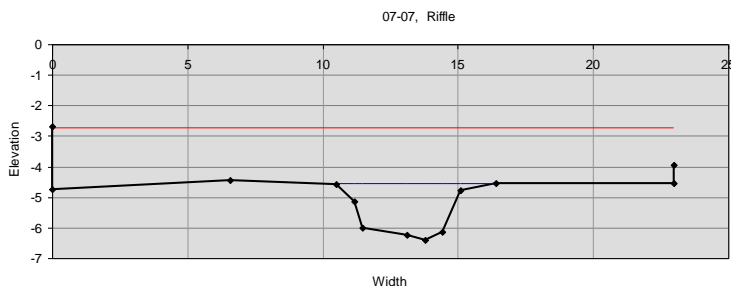
Drainage area (acres)	143.4	Instream Wood Debris	4
Remoteness	9	Bank Stability	14
Shading	60		
Epifaunal Substrate	10	<b>PHI Score</b>	71.69
Instream Habitat	9	<b>PHI Narrative Ranking</b>	PD

**Water Chemistry**

Dissolved Oxygen (mg/L)	6.05	Specific Conductance (mS/cm)	312
pH	6.17	Temperature (°C)	4.18

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.2	Cross Sectional Area (ft <sup>2</sup> )	6.1
Bankfull Width (ft)	5.9	Water Surface Slope (ft/ft)	0.7
Mean Bankfull Depth (ft)	1.0	Sinuosity	1.2
Floodprone Width (ft)	75	D50 (mm)	0.19
Entrenchment Ratio	12.7	Adjustments?	Sin
Width to Depth Ratio	5.7	<b>Rosgen Stream Type</b>	<b>E5</b>







Upstream



Downstream

**Location/Site Access:** Located approx. 70m behind house at 419 Fernwood Drive  
**Latitude/Longitude:** 39.08356/-76.56319

#### Land Use Analysis:

Land Use	Acres	% Area
Commercial	51.3	7%
Open Space	32.9	5%
Residential 1/2-acre	61.4	9%
Residential 1/4-acre	374.5	54%
Residential 1-acre	20.5	3%
Residential 2-acre	3.3	0.5%
Transportation	18.9	3%
Woods	126.8	18%
Grand Total	691.2	100%

Impervious (acres)	Total Area Above site	% Impervious
140.1	691.2	20.3

#### **Results:**

- Biological condition – "Fair"
- Habitat score "Non Supporting" and "Degraded"
- Riparian vegetation and physical complexity of habitat scored high
- Sample dominated by *Ancyronyx* and *Parametriocnemus*
- Stream type was identified as an E5, slope was 0.17 percent, and the median channel substrate was very fine sand
- Typically, E channels are stable. However, the marginal bank and substrate habitat ratings may indicate that this reach is transitioning to an unstable form.
- Biological community is in better condition than expected for measured level of habitat quality.

#### **Recommendations:**

- Maintain the protection of the riparian area.
- Investigate impacts of runoff on stream habitat quality, retrofit BMPs on developed lands upstream as necessary.

07-08

## Upper Magothy R. Sampling Unit

## IBI and Metric Scores

Narrative Rating	Fair
<b>Overall Index</b>	<b>3.29</b>
Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	3
Intolerant Urban % Score	1
Ephemeroptera % Score	3
Scraper Taxa Score	3
% Climbers	3

## Calculated Metric Values

Total Taxa	38
EPT Taxa	5
Ephemeroptera Taxa	1
Intolerant Urban %	2.8
Ephemeroptera %	6.5
Scraper Taxa	1
% Climbers	3.7

## Taxa List

Ablabesmyia	5
Alluaudomyia	1
Ancyronyx	12
Argia	2
Caecidotea	1
Corynoneura	2
Cryptochironomus	1
Diplocladius	1
Dubiraphia	8
Eurylophella	7
Helichus	5
Hydrobaenus	1
Limnephilidae	1
Macronychus	1
Menetus	2
Natarsia	4
Orthocladius	3
Orthocladius/Cricotopus	1
Parametriocnemus	10
Paraphaenocladus	1
Paratanytarsus	3
Paratendipes	2
Phaenopsectra	4
Phylocentropus	1
Physa	1
Polycentropus	1
Polypedilum	3
Procladius	1
Pseudorthocladius	1
Ptilostomis	1
Stenelmis	1
Stenochironomus	2
Tanypodinae	3
Thienemannimyia	1
Tribelos	5
Tubificidae	3
Xylotopus	1
Zavrelimyia	4

Total Individuals 107

## Physical Habitat

## EPA Rapid Bioassessment

Bank Stability- Left Bank	4	Pool Variability	6
Bank Stability- Right Bank	4	Riparian Vegetative Zone Width- Left Bank	8
Channel Alteration	16	Riparian Vegetative Zone Width- Right Bank	5
Channel Flow Status	14	Sediment Deposition	5
Channel Sinuosity	8	Vegetative Protection (Left Bank)	4
Epifaunal Substrate/Available Cover	6	Vegetative Protection (Right Bank)	4
Pool Substrate Characterization	8		

EPA Habitat Score 92

EPA Narrative Ranking NS

## Maryland Biological Stream Survey PHI

Drainage area (acres)	691.2	Instream Wood Debris	2
Remoteness	6	Bank Stability	7
Shading	90		
Epifaunal Substrate	5		
Instream Habitat	5		

PHI Score 53.4

PHI Narrative Ranking D

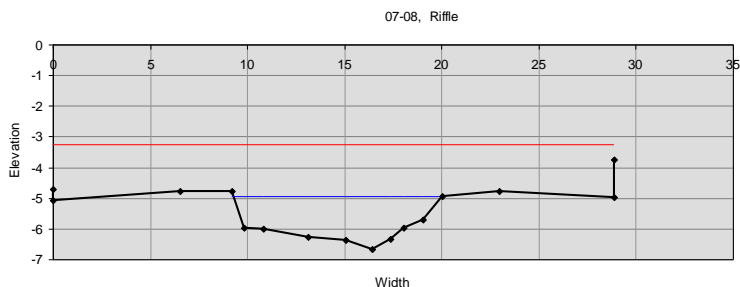
## Water Chemistry

Dissolved Oxygen (mg/L)	9.93	Specific Conductance (mS/cm)	146
pH	5.89	Temperature (°C)	8.42

## Geomorphic Assessments

## Rosgen Level II Classification Data

Drainage Area (mi <sup>2</sup> )	1.1	Cross Sectional Area (ft <sup>2</sup> )	12.3
Bankfull Width (ft)	10.7	Water Surface Slope (ft/ft)	0.17
Mean Bankfull Depth (ft)	1.1	Sinuosity	1.2
Floodprone Width (ft)	121	D50 (mm)	0.094
Entrenchment Ratio	11.3	Adjustments?	Sin
Width to Depth Ratio	9.4	<b>Rosgen Stream Type</b>	<b>E5</b>







Upstream



Downstream

**Location/Site Access:** Located approx. 80m NE of Drum Avenue N behind house 222  
**Latitude/Longitude:** 39.11543/-76.56751

#### Land Use Analysis:

Land Use	Acres	% Area
Commercial	144.5	9%
Industrial	6.5	0%
Open Space	39.6	2%
Residential 1/2-acre	389.1	24%
Residential 1/4-acre	131.3	8%
Residential 1-acre	93.3	6%
Residential 2-acre	2.8	0%
Transportation	97.8	6%
Water	3.7	0%
Woods	709.7	44%
Grand Total	1618.2	100%

Impervious (acres)	Total Area Above site	% Impervious
294.6	1618.2	18.2

#### **Results:**

- Biological condition – "Fair"
- Habitat scores in "Supporting" and "Partially Degraded" ranges
- All EPA habitat variables scored in the moderate to optimal range
- Sample dominated by *Tanytarsus*, *Parametriocnemus*, and *Polycentropus*
- Stream type was identified as an E5, slope was 0.46 percent, and the median channel substrate was fine sand
- "Fair" biological conditions and "Supporting" habitat assessments are in agreement, though biological potential may be limited by fine substrates.
- Biological community is appropriate for observed habitat quality.

#### **Recommendations:**

- Maintain the protection of the riparian area.
- Determine feasibility, necessity of BMP implementation on developed lands to enhance stream water quality.

07-09

## Upper Magothy R. Sampling Unit

**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Fair</b>
<b>Overall Index</b>	<b>3.86</b>
Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	3
Intolerant Urban % Score	3
Ephemeroptera % Score	3
Scraper Taxa Score	3
% Climbers	5

**Calculated Metric Values**

Total Taxa	26
EPT Taxa	5
Ephemeroptera Taxa	1
Intolerant Urban %	25.9
Ephemeroptera %	4.6
Scraper Taxa	1
% Climbers	34.3

**Taxa List**

Acerpenna	5
Ancyronyx	1
Caecidotea	1
Calopteryx	5
Corynoneura	1
Diplectrona	2
Gomphus	1
Macronychus	2
Nigronia	2
Oecetis	2
Orthocladius/Cricotopus	2
Oulimnius	2
Parametriocnemus	11
Paratendipes	1
Polycentropus	10
Polypedilum	1
Rheocricotopus	7
Rheotanytarsus	3
Simulium	2
Stenelmis	1
Synurella	5
Tanytarsus	31
Thienemannimyia	7
Tipula	1
Triaenodes	1
Zavrelimyia	1

Total Individuals 108

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Variability	10
Bank Stability- Right Bank	6	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	20	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	14	Sediment Deposition	10
Channel Sinuosity	15	Vegetative Protection (Left Bank)	6
Epifaunal Substrate/Available Cover	12	Vegetative Protection (Right Bank)	6
Pool Substrate Characterization	12		

EPA Habitat Score 137

EPA Narrative Ranking S

**Maryland Biological Stream Survey PHI**

Drainage area (acres)	1618.2	Instream Wood Debris	5
Remoteness	12	Bank Stability	12
Shading	85		
Epifaunal Substrate	12		
Instream Habitat	10		

PHI Score 69.64

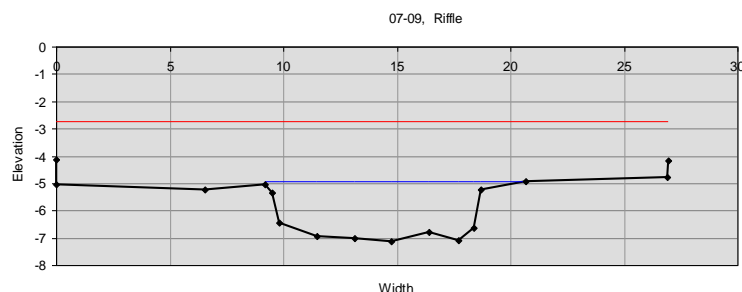
PHI Narrative Ranking PD

**Water Chemistry**

Dissolved Oxygen (mg/L)	9.35	Specific Conductance (mS/cm)	237
pH	6.13	Temperature (°C)	9.89

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	2.5	Cross Sectional Area (ft <sup>2</sup> )	18.2
Bankfull Width (ft)	11.5	Water Surface Slope (ft/ft)	0.46
Mean Bankfull Depth (ft)	1.6	Sinuosity	1.3
Floodprone Width (ft)	144.4	D50 (mm)	0.14
Entrenchment Ratio	12.6	Adjustments?	Sin
Width to Depth Ratio	7.3	<b>Rosgen Stream Type</b>	<b>E5</b>





Upstream



Downstream

**Location/Site Access:** Located approx. 30m SE of Old Mill Road DS of Lake Waterford Dam

**Latitude/Longitude:** 39.11561/-76.55666

### Land Use Analysis:

Land Use	Acres	% Area
Commercial	222.7	7%
Open Space	166.4	6%
Residential 1/2-acre	635.5	21%
Residential 1/4-acre	458.8	15%
Residential 1-acre	128.0	4%
Transportation	169.8	6%
Water	15.0	1%
Woods	1167.9	39%
Grand Total	2976.6	100%

Impervious (acres)	Total Area Above site	% Impervious
525.5	2976.6	17.7

### **Results:**

- Biological condition – "Fair"
- Habitat scores "Supporting" and "Partially Degraded"
- Channel sinuosity scored poorly
- Sample dominated by non-midge insects (*Simulium*, *Cheumatopsyche*, and *Stenelmis*)
- Stream type was identified as an E5, slope was 0.37 percent, and the median channel substrate was coarse sand
- Typically, E channels are stable. However, the bank-related habitat ratings are suboptimal and may indicate that this reach is transitioning to an unstable form.
- Biological community is appropriate for observed habitat quality.

### **Recommendations:**

- Maintain the protection of the riparian area.
- Determine necessity, feasibility of BMP retrofits on developed lands in watershed.

**IBI and Metric Scores**

Narrative Rating	Fair
<b>Overall Index</b>	<b>3.00</b>
Total Taxa Score	5
EPT Taxa Score	3
Ephemeroptera Taxa Score	3
Intolerant Urban % Score	1
Ephemeroptera % Score	3
Scraper Taxa Score	3
% Climbers	3

**Calculated Metric Values**

Total Taxa	26
EPT Taxa	3
Ephemeroptera Taxa	1
Intolerant Urban %	4.9
Ephemeroptera %	1.0
Scraper Taxa	1
% Climbers	6.8

**Taxa List**

Ablabesmyia	1
Amnicola	6
Amphipoda	1
Boyeria	1
Calopteryx	1
Cheumatopsyche	12
Crangonyx	5
Cricotopus	3
Limnodrilus	2
Macronychus	1
Microcylloepus	2
Nais	1
Oecetis	6
Orthocladius/Cricotopus	5
Oulimnius	3
Polypedium	3
Potthastia	2
Ranatra	1
Simulium	21
Sphaeriidae (Mollusca)	1
Stenelmis	16
Stenonema	1
Tanytarsus	1
Thienemannimyia	4
Tribelos	1
Tubificidae	2

**Total Individuals**

103

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Variability	9
Bank Stability- Right Bank	6	Riparian Vegetative	7
Channel Alteration	16	Zone Width- Left Bank	
Channel Flow Status	16	Riparian Vegetative	10
Channel Sinuosity	6	Zone Width- Right Bank	
Epifaunal Substrate/Available Cover	14	Sediment Deposition	12
Pool Substrate Characterization	13	Vegetative Protection (Left Bank)	6
		Vegetative Protection (Right Bank)	6

<b>EPA Habitat Score</b>	127
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<b>EPA Narrative Ranking</b>	S
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**Maryland Biological Stream Survey PHI**

Drainage area (acres)	2976.6	Instream Wood Debris	12
Remoteness	6	Bank Stability	12
Shading	95		
Epifaunal Substrate	14		
Instream Habitat	15		

<b>PHI Score</b>	73.98
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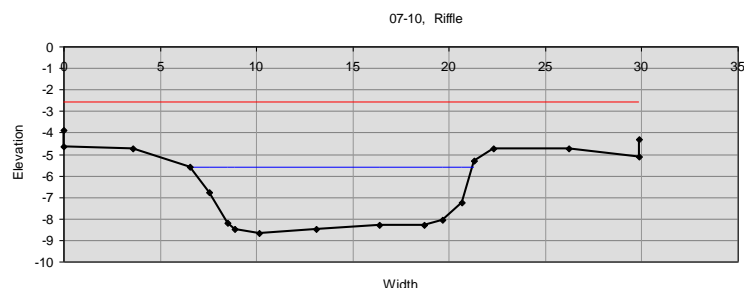
<b>PHI Narrative Ranking</b>	PD
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**Water Chemistry**

Dissolved Oxygen (mg/L)	8.29	Specific Conductance (mS/cm)	306
pH	6.43	Temperature (°C)	9.21

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	4.6	Cross Sectional Area (ft <sup>2</sup> )	36.3
Bankfull Width (ft)	14.7	Water Surface Slope (ft/ft)	0.43
Mean Bankfull Depth (ft)	2.48	Sinuosity	1.1
Floodprone Width (ft)	190.0	D50 (mm)	0.71
Entrenchment Ratio	13	Adjustments?	Sin
Width to Depth Ratio	5.9	<b>Rosgen Stream Type</b>	<b>E5</b>







Upstream



Downstream

**Location/Site Access:** Located approx. 120m N of Retention Pond at end of Dales Way Drive

Latitude/Longitude: 39.10508/-76.56816

### Land Use Analysis:

Land Use	Acres	% Area
Commercial	24.9	6.7
Industrial	0.9	0.2
Open Space	48.9	13.3
Residential 1-acre	20.5	5.6
Residential 1/2-acre	21.8	5.9
Residential 1/4-acre	118.2	32.1
Residential 2-acre	1.1	0.3
Transportation	22.3	6.1
Water	0.7	0.2
Woods	109.3	29.6
Grand Total	368.6	100.0

Impervious (acres)	Total Area Above site	% Impervious
73.0	368.6	19.8

### **Results:**

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Substrate and pool variability variables scored poorly
- Sample lacking mayflies and dominated by worms (*Tubificidae*)
- Stream type was identified as an C5, slope was 0.78 percent, and the median channel substrate was fine sand
- Typically, C channels are stable. However, the habitat ratings related to bank stability and substrate indicate that this reach is transitioning to an unstable form
- Biological community is appropriate for observed habitat quality.

### **Recommendations:**

- Maintain the protection of the riparian area.
- Investigate need for BMP retrofits to alleviate likely water quality inputs depressing biological community.

**IBI and Metric Scores**

Narrative Rating	Poor
<b>Overall Index</b>	<b>2.14</b>
Total Taxa Score	5
EPT Taxa Score	1
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	3
% Climbers	3

**Calculated Metric Values**

Total Taxa	25
EPT Taxa	1
Ephemeroptera Taxa	0
Intolerant Urban %	9.17
Ephemeroptera %	0
Scraper Taxa	1
% Climbers	2.8

**Taxa List**

Aulodrilus	1
Caecidotea	10
Chaetocladius	1
Chaulioides	1
Culicoides	3
Cyphon	3
Diplocladius	1
Dytiscidae	1
Helichus	1
Hydrobaenus	3
Ironoquia	1
Libellula	1
Limnophyes	1
Lumbricidae	1
Lumbriculidae	1
Menetus	1
Neoporus	6
Ormosia	3
Orthocladius/Cricotopus	5
Parametriocnemus	1
Pisidium	2
Pseudosmittia	1
Spirosperma	2
Tipula	1
Tubificidae	57

**Total Individuals**

109

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Variability	5
Bank Stability- Right Bank	6	Riparian Vegetative Zone Width- Left Bank	9
Channel Alteration	19	Riparian Vegetative Zone Width- Right Bank	9
Channel Flow Status	14	Sediment Deposition	9
Channel Sinuosity	8	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	5	Vegetative Protection (Right Bank)	5
Pool Substrate Characterization	6		

**EPA Habitat Score** 106**EPA Narrative Ranking** PS**Maryland Biological Stream Survey PHI**

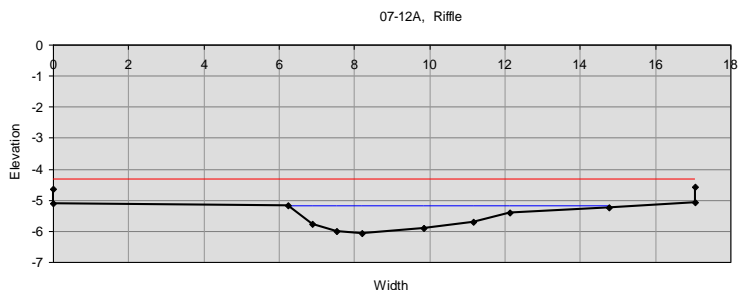
Drainage area (acres)	368.6	Instream Wood Debris	1
Remoteness	7	Bank Stability	12
Shading	75		
Epifaunal Substrate	5		
Instream Habitat	4		

**PHI Score** 55.90**PHI Narrative Ranking** D**Water Chemistry**

Dissolved Oxygen (mg/L)	5.48	Specific Conductance (mS/cm)	470
pH	6.41	Temperature (°C)	3.52

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.62 <sup>1</sup>	Cross Sectional Area (ft <sup>2</sup> )	4.1
Bankfull Width (ft)	8.5	Water Surface Slope (ft/ft)	0.78
Mean Bankfull Depth (ft)	0.5	Sinuosity	1.0
Floodprone Width (ft)	92	D50 (mm)	0.16
Entrenchment Ratio	10.8	Adjustments?	Sin
Width to Depth Ratio	17.7	<b>Rosgen Stream Type</b>	<b>C5</b>







Upstream



Downstream

**Location/Site Access:** Located approx. 120 m NW of Circle on Holly Drive  
**Latitude/Longitude:** 39.11186/-76.54421

### Land Use Analysis:

Land Use	Acres	% Area
Commercial	4.8	2%
Industrial	0.1	0%
Open Space	14.1	5%
Residential 1/2-acre	155.4	51%
Residential 1-acre	7.7	3%
Residential 2-acre	2.2	1%
Transportation	4.1	1%
Woods	116.4	38%
Grand Total	305.0	100%

Impervious (acres)	Total Area Above site	% Impervious
38.5	305.0	12.6

### Results:

- Biological condition – "Very Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Riparian variables scored marginally
- Sample lacking mayflies and dominated by midges (*Parametriocnemus*)
- Stream type was identified as an E5, slope was 0.77 percent, and the median channel substrate was clay
- Typically, E channels are stable. However, the "Very Poor" biological ratings along with impaired habitat ratings may indicate that this reach is transitioning to an unstable form.
- Biological community is in worse condition than would be expected for available habitat quality.

### Recommendations:

- Protect the riparian area and restore the habitat, if possible.
- Investigate need for BMP retrofits on upstream residential lands.
- Consider trash cleanup for this reach.

07-14A

## Upper Magothy R. Sampling Unit

**IBI and Metric Scores**

Narrative Rating	Very Poor
<b>Overall Index</b>	<b>1.86</b>
Total Taxa Score	1
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

**Calculated Metric Values**

Total Taxa	12
EPT Taxa	3
Ephemeroptera Taxa	0
Intolerant Urban %	4.2
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	8.5

**Taxa List**

Agarodes	1
Apsectrotanytus	2
Bittacomorpha	1
Brillia	3
Corynoneura	21
Diplectrona	3
Lepidostoma	1
Parametriocnemus	61
Polypedilum	9
Thienemanniella	10
Thienemannimyia	2
Tribelos	4

**Total Individuals**

118

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	5	Pool Variability	8
Bank Stability- Right Bank	5	Riparian Vegetative Zone Width- Left Bank	2
Channel Alteration	18	Riparian Vegetative Zone Width- Right Bank	9
Channel Flow Status	14	Sediment Deposition	11
Channel Sinuosity	6	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	8	Vegetative Protection (Right Bank)	5
Pool Substrate Characterization	8		

**EPA Habitat Score** 104**EPA Narrative Ranking** PS**Maryland Biological Stream Survey PHI**

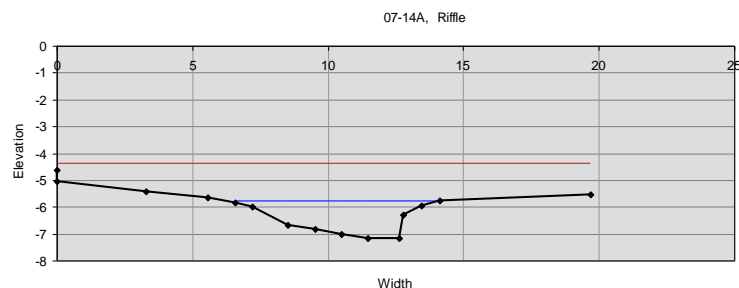
Drainage area (acres)	321.1	Instream Wood Debris	7
Remoteness	4	Bank Stability	10
Shading	80		
Epifaunal Substrate	8		
Instream Habitat	5		

**PHI Score** 60.65**PHI Narrative Ranking** D**Water Chemistry**

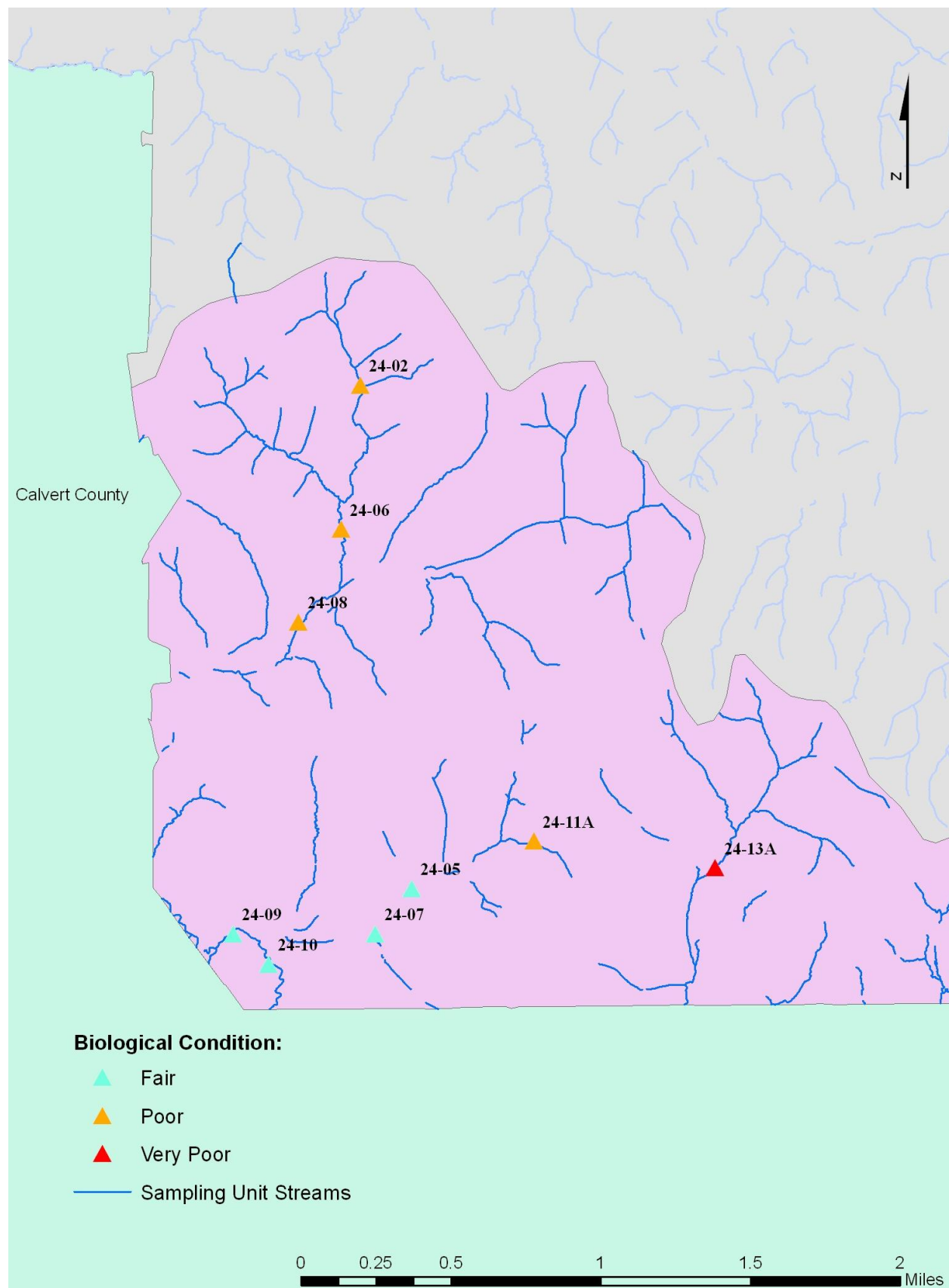
Dissolved Oxygen (mg/L)	7.59	Specific Conductance (mS/cm)	115
pH	6.24	Temperature (°C)	6.62

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.5	Cross Sectional Area (ft <sup>2</sup> )	6.4
Bankfull Width (ft)	7.5	Water Surface Slope (ft/ft)	0.77
Mean Bankfull Depth (ft)	0.8	Sinuosity	1.1
Floodprone Width (ft)	36.1	D50 (mm)	0.01
Entrenchment Ratio	4.8	Adjustments?	Sin
Width to Depth Ratio	8.9	<b>Rosgen Stream Type</b>	<b>E5</b>



# Hall Creek Sampling Unit



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Upstream



Downstream

**Location/Site Access:** Located approx. 200m NW of Circle on Chickadee Drive  
**Latitude/Longitude:** 38.75146/-76.60991

### Land Use Analysis:

Land Use	Acres	% Area
Commercial	0.8	1%
Pasture/Hay	9.0	6%
Residential 1/2-acre	45.5	28%
Residential 1-acre	11.5	7%
Row Crops	23.9	15%
Transportation	2.9	2%
Woods	66.6	42%
Grand Total	160.3	100%

Impervious (acres)	Total Area Above site	% Impervious
9.5	160.3	5.9

### **Results:**

- Biological condition – "Poor"
- Habitat scores "Non Supporting" and "Degraded"
- Bank stability and vegetative protection scored very poorly
- Sample lacking mayflies and dominated by *Rheocricotopus*, *Amphinemura*, and *Diplocadius*
- Stream type was identified as an B5, slope was 3.28 percent, and the median channel substrate was fine sand
- Typically, B channels are stable. However, secure headcuts observed downstream with an extremely narrow width to depth ratio. Observation may indicate this reach is downcutting further below its surrounding valley.
- Habitat assessment results were mixed for this site, but biological community observed is trending toward less than expected impairment based on the observed habitat quality.

### **Recommendations:**

- Maintain the protection of the riparian area.
- Determine causes of instability observed in this reach and develop appropriate restoration approach.
- Determine necessity, feasibility of retrofitting stormwater BMPs in upstream drainage.



**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Poor</b>
<b>Overall Index</b>	<b>2.14</b>
Total Taxa Score	3
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	5
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	1

**Calculated Metric Values**

Total Taxa	15
EPT Taxa	4
Ephemeroptera Taxa	0
Intolerant Urban %	30.9
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	0

**Taxa List**

Amphinemura	19
Diplocladius	16
Enchytraeidae	1
Gammarus	6
Heterotrissocladius	1
Isonychia	3
Lype	1
Nemoura	8
Nigronia	1
Orthocladius	2
Orthocladius/Cricotopus	6
Parametrioctonus	6
Paraphaenocladius	3
Rheocricotopus	32
Stegopterna	5

**Total Individuals** 110

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	1	Pool Variability	5
Bank Stability- Right Bank	1	Riparian Vegetative	10
Channel Alteration	16	Zone Width- Left Bank	
Channel Flow Status	13	Riparian Vegetative	10
Channel Sinuosity	9	Zone Width- Right Bank	
Epifaunal Substrate/Available Cover	6	Sediment Deposition	6
Pool Substrate Characterization	6	Vegetative Protection (Left Bank)	2
		Vegetative Protection (Right Bank)	2

**EPA Habitat Score** 87

**EPA Narrative Ranking** NS

**Maryland Biological Stream Survey PHI**

Drainage area (acres)	160.3	Instream Wood Debris	3
Remoteness	14	Bank Stability	2
Shading	95		
Epifaunal Substrate	6		
Instream Habitat	4		

**PHI Score** 64.83

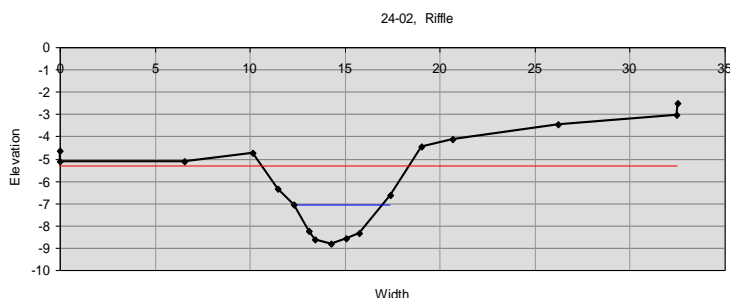
**PHI Narrative Ranking** D

**Water Chemistry**

Dissolved Oxygen (mg/L)	6.88	Specific Conductance (mS/cm)	73
pH	6.21	Temperature (°C)	10.34

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.3	Cross Sectional Area (ft <sup>2</sup> )	5.3
Bankfull Width (ft)	4.7	Water Surface Slope (ft/ft)	3.28
Mean Bankfull Depth (ft)	1.1	Sinuosity	<1.2
Floodprone Width (ft)	4.6	D50 (mm)	0.13
Entrenchment Ratio	1.7	Adjustments?	Sin., WD
Width to Depth Ratio	4.1	<b>Rosgen Stream Type</b>	<b>B5</b>







Upstream



Downstream

**Location/Site Access:** Located approx. 130 m behind house at 95 Hummingbird Drive  
**Latitude/Longitude:** 38.74418/-76.60009

### **Land Use Analysis:**

Land Use	Acres	% Area
Commercial	4.0	1%
Open Space	3.0	1%
Pasture/Hay	17.7	6%
Residential 1/2-acre	92.4	31%
Residential 1-acre	10.5	3%
Residential 2-acre	3.2	1%
Row Crops	10.8	4%
Transportation	10.3	3%
Woods	150.8	50%
Grand Total	302.8	100%

Impervious (acres)	Total Area Above site	% Impervious
21.3	302.8	7.1

### **Results:**

- Biological condition – "Very Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Bank stability and vegetative protection scored moderate
- Sample lacking mayflies and dominated by Midges (*Diplocladius*, *Rheocricotopus*, and *Orthocladius/Cricotopus*)
- Stream type was identified as an C6, slope was 0.927 percent, and the median channel substrate was silt to very fine sand
- Typically, C channels are stable. However, the "Very Poor" biological ratings along with marginal habitat ratings related to bank and substrate variables indicate that this reach is transitioning to an unstable form.
- Biological community is in worse condition than would be expected for available habitat quality.

### **Recommendations:**

- Maintain the protection of the riparian area.
- Determine feasibility of BMP retrofits for residential lands upstream or in other areas possibly impacting reach water quality.

**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Very Poor</b>
<b>Overall Index</b>	<b>1.86</b>
Total Taxa Score	3
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	3
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	1

**Calculated Metric Values**

Total Taxa	20
EPT Taxa	3
Ephemeroptera Taxa	0
Intolerant Urban %	15.0
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	0.9

**Taxa List**

Agrypnia	1
Amphinemura	5
Chaetocladius	4
Cricotopus	1
Culicoides	2
Diplocladius	43
Macronychus	1
Nemoura	6
Ormosia	1
Orthocladius	2
Orthocladius/Cricotopus	14
Parametriocnemus	2
Pisidium	1
Polypedilum	1
Pseudosmittia	1
Rheocricotopus	19
Stegopterna	6
Stilocladius	1
Tanypodinae	1
Zavreliomyia	2

**Total Individuals**

114

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Variability	8
Bank Stability- Right Bank	6	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	19	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	18	Sediment Deposition	9
Channel Sinuosity	7	Vegetative Protection (Left Bank)	6
Epifaunal Substrate/Available Cover	11	Vegetative Protection (Right Bank)	6
Pool Substrate Characterization	8		

**EPA Habitat Score** 124**EPA Narrative Ranking** PS**Maryland Biological Stream Survey PHI**

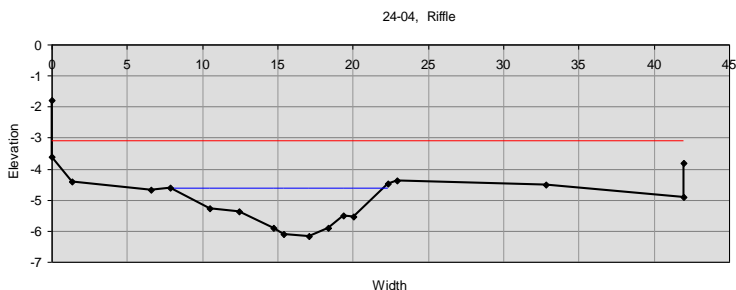
Drainage area (acres)	302.8	Instream Wood Debris	6
Remoteness	12	Bank Stability	12
Shading	35		
Epifaunal Substrate	10	<b>PHI Score</b>	68.00
Instream Habitat	10	<b>PHI Narrative Ranking</b>	PD

**Water Chemistry**

Dissolved Oxygen (mg/L)	7.6	Specific Conductance (mS/cm)	175
pH	6.79	Temperature (°C)	8.69

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.5	Cross Sectional Area (ft <sup>2</sup> )	12.4
Bankfull Width (ft)	14.1	Water Surface Slope (ft/ft)	0.927
Mean Bankfull Depth (ft)	0.9	Sinuosity	1.1
Floodprone Width (ft)	131	D50 (mm)	0.062
Entrenchment Ratio	9.3	Adjustments?	Sin
Width to Depth Ratio	16.1	<b>Rosgen Stream Type</b>	<b>C6</b>





Upstream



Downstream

**Location/Site Access:** Located approx. ~300m NE of (incomplete)  
**Latitude/Longitude:** 38.72709/-76.60685

#### Land Use Analysis:

Land Use	Acres	% Area
Commercial	7.2	2%
Open Space	7.7	2%
Pasture/Hay	69.3	18%
Residential 1-acre	9.9	3%
Residential 2-acre	24.5	7%
Row Crops	95.7	25%
Transportation	8.8	2%
Water	0.8	0%
Woods	151.6	40%
Grand Total	375.5	100%

Impervious (acres)	Total Area Above site	% Impervious
13.5	375.5	3.6

#### **Results:**

- Biological condition – "Fair"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Pool and bank habitat variables scored marginally
- Sample dominated by midges (*Micropsectra* and *Polypedilum*) and amphipods (*Gammarus*)
- Stream type was identified as an G5c, slope was 0.35 percent, and the median channel substrate was fine sand
- Typically, G channels are not stable. This reach has marginal habitat ratings for variables related to bank stability and substrate, but the biological community is not totally degraded.
- Habitat assessment results were mixed for this site, but biological community observed is trending toward less than expected impairment based on the observed habitat quality.

#### **Recommendations:**

- Maintain the protection of the riparian area.
- Biological community possibly artificially enriched by nutrient inputs for agricultural operations upstream of site. Determine if nutrient enrichment is possibly occurring here.

**IBI and Metric Scores**

Narrative Rating	Fair
Overall Index	3.57

Total Taxa Score	5
EPT Taxa Score	3
Ephemeroptera Taxa Score	3
Intolerant Urban % Score	5
Ephemeroptera % Score	3
Scraper Taxa Score	1
% Climbers	5

**Calculated Metric Values**

Total Taxa	22
EPT Taxa	3
Ephemeroptera Taxa	1
Intolerant Urban %	28.4
Ephemeroptera %	4.6
Scraper Taxa	0
% Climbers	45.0

**Taxa List**

Bezzia/Palpomysia	1
Ceratopogon	1
Chrysops	1
Corynoneura	4
Dixa	2
Gammarus	18
Isonychia	1
Limnephilidae	5
Limnodrilus	1
Micropsectra	25
Orthocladus	1
Orthocladus/Cricotopus	4
Parametriocnemus	5
Pilaria	1
Polypedilum	22
Pseudolimnophila	4
Rheocricotopus	2
Rheotanytarsus	1
Stenonema	5
Tanytarsus	2
Thienemannimyia	1
Zavrelimyia	2

**Total Individuals**

109

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	5	Pool Variability	6
Bank Stability- Right Bank	5	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	19	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	11	Sediment Deposition	8
Channel Sinuosity	10	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	11	Vegetative Protection (Right Bank)	5
Pool Substrate Characterization	8		

<b>EPA Habitat Score</b>	113
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<b>EPA Narrative Ranking</b>	PS
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**Maryland Biological Stream Survey PHI**

Drainage area (acres)	375.5	Instream Wood Debris	2
Remoteness	15	Bank Stability	10
Shading	100		
Epifaunal Substrate	11		
Instream Habitat	8		

<b>PHI Score</b>	76.32
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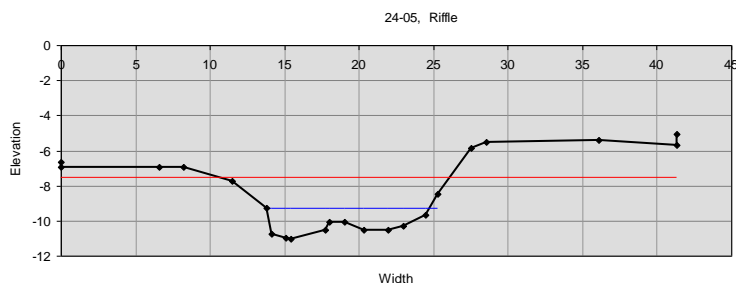
<b>PHI Narrative Ranking</b>	PD
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**Water Chemistry**

Dissolved Oxygen (mg/L)	7.67	Specific Conductance (mS/cm)	170
pH	6.7	Temperature (°C)	6.63

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.6	Cross Sectional Area (ft <sup>2</sup> )	12.7
Bankfull Width (ft)	11.0	Water Surface Slope (ft/ft)	0.35
Mean Bankfull Depth (ft)	1.2	Sinuosity	1.2
Floodprone Width (ft)	15.7	D50 (mm)	0.18
Entrenchment Ratio	1.4	Adjustments?	Sin
Width to Depth Ratio	9.5	<b>Rosgen Stream Type</b>	<b>G5c</b>







Upstream



Downstream

**Location/Site Access:** Located approx. 380m SW of Woodside View Dr  
 Latitude/Longitude: 38.7445/-76.61112

### **Land Use Analysis:**

Land Use	Acres	% Area
Commercial	0.8	0.2%
Open Space	5.5	1%
Pasture/Hay	11.9	3%
Residential 1/2-acre	70.5	16%
Residential 1-acre	86.9	19%
Residential 2-acre	1.2	0.3%
Row Crops	30.0	7%
Transportation	10.1	2%
Woods	229.2	51%
Grand Total	445.9	100%

Impervious (acres)	Total Area Above site	% Impervious
30.7	445.9	6.9

### **Results:**

- Biological condition – "Poor"
- Habitat scores "Non Supporting" and "Partially Degraded"
- Several habitat variables scored marginally and poorly
- Sample lacking mayflies and dominated by midges (*Diplocladius*) and worms (*Limnodrilus* and unidentified *Tubificidae*)
- Stream type was identified as an C5, slope was 0.23 percent, and the median channel substrate was very fine sand
- Typically, C channels are stable. However, the marginal habitat ratings related to bank and substrate variables indicate that this reach is transitioning to an unstable form.
- Habitat conditions are mixed for this site, with one assessment method indicating impairment and one indicating some kind of enrichment.

### **Recommendations:**

- Maintain the protection of the riparian area.
- Determine if residential lands upstream of site are adversely impacting water quality. Remediate as necessary.

**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Poor</b>
<b>Overall Index</b>	<b>2.43</b>
Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	3

**Calculated Metric Values**

Total Taxa	28
EPT Taxa	6
Ephemeroptera Taxa	0
Intolerant Urban %	9.3
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	3.7

**Taxa List**

Agrypnia	4
Amphinemura	2
Bezzia/Palpomysia	3
Corynoneura	1
Diplocladius	19
Dixella	1
Enchytraeidae	5
Gammarus	1
Helichus	1
Heterotrissocladius	1
Isonychia	9
Isoperla	3
Limnodrilus	10
Limnophila	1
Limnophyes	1
Mallochochelea	1
Nais	1
Nemoura	3
Orthocladius	2
Orthocladius/Cricotopus	4
Parametrioctonus	5
Perlodidae	1
Pisidium	1
Polypedilum	4
Rheocricotopus	7
Simuliidae	1
Tubificidae	11
Zavrelimyia	4

**Total Individuals**

107

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	5	Pool Variability	8
Bank Stability- Right Bank	5	Riparian Vegetative Zone Width- Left Bank	8
Channel Alteration	14	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	10	Sediment Deposition	3
Channel Sinuosity	8	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	7	Vegetative Protection (Right Bank)	5
Pool Substrate Characterization	8		

<b>EPA Habitat Score</b>	96
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<b>EPA Narrative Ranking</b>	NS
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**Maryland Biological Stream Survey PHI**

Drainage area (acres)	445.9	Instream Wood Debris	6
Remoteness	11	Bank Stability	10
Shading	95		
Epifaunal Substrate	7		
Instream Habitat	7		

<b>PHI Score</b>	69.09
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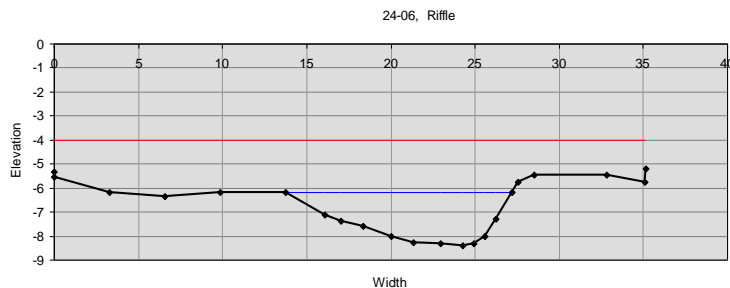
<b>PHI Narrative Ranking</b>	PD
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**Water Chemistry**

Dissolved Oxygen (mg/L)	5.77	Specific Conductance (mS/cm)	234
pH	6.77	Temperature (°C)	5.75

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.7	Cross Sectional Area (ft <sup>2</sup> )	8.5
Bankfull Width (ft)	10.2	Water Surface Slope (ft/ft)	0.23
Mean Bankfull Depth (ft)	0.84	Sinuosity	1.1
Floodprone Width (ft)	25.3	D50 (mm)	0.094
Entrenchment Ratio	2.5	Adjustments?	--
Width to Depth Ratio	12.1	<b>Rosgen Stream Type</b>	<b>C5</b>







Upstream



Downstream

**Location/Site Access:** Located approx. 70m W of house @ (incomplete)  
**Latitude/Longitude:** 38.72491/-76.6091

### Land Use Analysis:

Land Use	Acres	% Area
Commercial	7.5	2%
Open Space	7.7	2%
Pasture/Hay	74.5	19%
Residential 1-acre	11.3	3%
Residential 2-acre	24.5	6%
Row Crops	97.2	24%
Transportation	8.8	2%
Water	0.8	0.2%
Woods	166.4	42%
Grand Total	398.8	100%

Impervious (acres)	Total Area Above site	% Impervious
13.9	398.8	3.5

### **Results:**

- Biological condition – "Fair"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Bank stability and vegetative protection scored poorly
- Sample dominated by midges (*Polypedilum*, *Micropsectra*, and *Parametriocnemus*)
- Stream type was identified as an B5c, slope was 0.413 percent, and the median channel substrate was fine to medium sand
- Typically, B channels are stable. However, the marginal habitat ratings related to bank conditions indicate that this reach is transitioning to an unstable form.
- Habitat assessment results were mixed for this site, but biological community observed is trending toward less than expected impairment based on the observed habitat quality.

### **Recommendations:**

- Maintain the protection of the riparian areas and the well-forested drainage area.
- Possible artificial enrichment of site due to agricultural inputs. Determine if problem exacerbated by inputs and remediate as necessary.

**IBI and Metric Scores**

Narrative Rating	Fair
Overall Index	3.86
Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	5
Intolerant Urban % Score	3
Ephemeroptera % Score	3
Scraper Taxa Score	1
% Climbers	5

**Calculated Metric Values**

Total Taxa	26
EPT Taxa	6
Ephemeroptera Taxa	2
Intolerant Urban %	25
Ephemeroptera %	5.2
Scraper Taxa	0
% Climbers	55.2

**Taxa List**

Bezzia/Palpomysia	2
Boyeria	2
Calopteryx	1
Diplocladius	2
Gammarus	5
Heptageniidae	1
Hydrobaenus	1
Isoperla	1
Limnephilidae	2
Limnodrilus	3
Lype	1
Mallochocheila	1
Microspectra	22
Nigronia	1
Orthocladius/Cricotopus	2
Paralauterborniella	2
Parametriocnemus	10
Paraphaenocladus	2
Pisidium	2
Polypedilum	39
Pseudolimnophila	4
Pycnopsycha	1
Stenonema	5
Thienemannimyia	1
Tribelos	1
Zavrelimyia	2

**Total Individuals**

116

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	4	Pool Variability	8
Bank Stability- Right Bank	4	Riparian Vegetative	10
Channel Alteration	19	Zone Width- Left Bank	
Channel Flow Status	11	Riparian Vegetative	10
Channel Sinuosity	13	Zone Width- Right Bank	
Epifaunal Substrate/Available Cover	11	Sediment Deposition	9
Pool Substrate Characterization	12	Vegetative Protection (Left Bank)	4
		Vegetative Protection (Right Bank)	4

**EPA Habitat Score** 119**EPA Narrative Ranking** PS**Maryland Biological Stream Survey PHI**

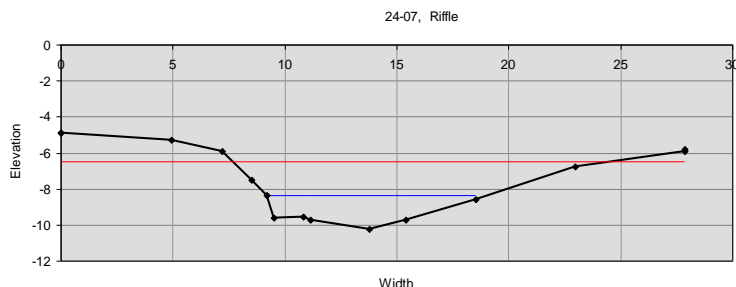
Drainage area (acres)	398.8	Instream Wood Debris	1
Remoteness	8	Bank Stability	8
Shading	95		
Epifaunal Substrate	11		
Instream Habitat	9		

**PHI Score** 68.93**PHI Narrative Ranking** PD**Water Chemistry**

Dissolved Oxygen (mg/L)	8.09	Specific Conductance (mS/cm)	97
pH	6.8	Temperature (°C)	3.99

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.6	Cross Sectional Area (ft <sup>2</sup> )	11.7
Bankfull Width (ft)	9.4	Water Surface Slope (ft/ft)	0.413
Mean Bankfull Depth (ft)	1.3	Sinuosity	1.5
Floodprone Width (ft)	17.4	D50 (mm)	0.25
Entrenchment Ratio	1.9	Adjustments?	W/D
Width to Depth Ratio	0.6	<b>Rosgen Stream Type</b>	<b>B5c</b>





Upstream



Downstream

**Location/Site Access:** Located approx. 220m DS from Wilson Rd crossing  
**Latitude/Longitude:** 38.74002/-76.61377

### Land Use Analysis:

Land Use	Acres	% Area
Commercial	7.0	1%
Open Space	32.3	3%
Pasture/Hay	56.8	5%
Residential 1/2-acre	220.4	19%
Residential 1-acre	116.2	10%
Residential 2-acre	20.6	2%
Row Crops	66.7	6%
Transportation	27.7	2%
Woods	619.7	53%
Grand Total	1167.4	100%

Impervious (acres)	Total Area Above site	% Impervious
70.2	1167.4	6.0

### **Results:**

- Biological condition – "Poor"
- Habitat scores "Non Supporting" and "Severely Degraded"
- Several habitat variables scored poorly
- Sample lacking mayflies and dominated by worms (unidentified *Tubificidae* and *Ilyodrilus*) and midges (*Orthocladius*)
- Geomorphic assessment was not completed
- Biological community is in better condition than expected for measured level of habitat quality.

### **Recommendations:**

- Maintain the protection of the riparian areas. Restore habitat if possible.
- Provide for BMP retrofits on residential lands as necessary to improve water quality.

**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Poor</b>
<b>Overall Index</b>	<b>2.43</b>
Total Taxa Score	5
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	3
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	3

**Calculated Metric Values**

Total Taxa	26
EPT Taxa	2
Ephemeroptera Taxa	0
Intolerant Urban %	13.0
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	2.6

**Taxa List**

Aulodrilus	2
Bezzia/Palpomyia	3
Caecidotea	8
Chaetocladius	6
Chrysops	2
Culicoides	1
Diplocladius	7
Enchytraeidae	3
Hydrobaenus	5
Ilyodrilus	11
Ironoquia	1
Limnephilidae	7
Limnodrilus	6
Natarsia	2
Neoporus	2
Ormosia	3
Orthocladius	14
Orthocladius/Cricotopus	1
Pelodytes	1
Pisidium	1
Polypedilum	1
Rheocricotopus	4
Stegopterna	1
Synurella	4
Tanytarsus	1
Tubificidae	18

**Total Individuals**

115

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	5	Pool Variability	6
Bank Stability- Right Bank	5	Riparian Vegetative	10
		Zone Width- Left Bank	
Channel Alteration	15	Riparian Vegetative	8
		Zone Width- Right Bank	
Channel Flow Status	15	Sediment Deposition	5
Channel Sinuosity	10	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	5	Vegetative Protection (Right Bank)	5
Pool Substrate Characterization	6		

<b>EPA Habitat Score</b>	100
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<b>EPA Narrative Ranking</b>	NS
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**Maryland Biological Stream Survey PHI**

Drainage area (acres)	1167.4	Instream Wood Debris	3
Remoteness	10	Bank Stability	10
Shading	60		
Epifaunal Substrate	5		
Instream Habitat	4		

<b>PHI Score</b>	50.69
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<b>PHI Narrative Ranking</b>	SD
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**Water Chemistry**

Dissolved Oxygen (mg/L)	2.48	Specific Conductance (mS/cm)	253
pH	6.25	Temperature (°C)	11.34

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	Cross Sectional Area (ft <sup>2</sup> )
Bankfull Width (ft)	Water Surface Slope (ft/ft)
Mean Bankfull Depth (ft)	Sinuosity
Floodprone Width (ft)	D50 (mm)
Entrenchment Ratio	Adjustments?
Width to Depth Ratio	<b>Rosgen Stream Type</b>

Data missing - not collected or not recorded





Upstream



Downstream

**Location/Site Access:** Located approx. 600m SW of house @ end of Kidwell Ln (312)  
 Latitude/Longitude: 38.72494/-76.6179

### Land Use Analysis:

**Note: Data incomplete. Breakdown does not include areas in Calvert County.**

Land Use	Acres	% Area
Commercial	24.0	--
Open Space	73.2	--
Pasture/Hay	160.8	--
Residential 1/2-acre	40.4	--
Residential 1-acre	155.2	--
Residential 2-acre	65.6	--
Row Crops	302.6	--
Transportation	35.3	--
Utility	32.9	--
Woods	643.0	--
Grand Total	3845.0	--

Impervious (acres)	Total Area Above site	% Impervious
73.4	3845.0	--

### **Results:**

- Biological condition – "Fair"
- Habitat scores "Partially Supporting" and "Degraded"
- Riparian zone width scored high but bank variables scored marginally
- Sample dominated by midges (*Tanytarsus* and *Polypedilum*)
- Stream type was identified as an G5c, slope was 0.193 percent, and the median channel substrate was very fine sand
- Typically, G channels are not stable and this reach shows marginal habitat ratings for variables related to banks and substrates.
- Biological community is in better condition than expected for measured level of habitat quality.

### **Recommendations:**

- Maintain the protection of the riparian area.
- Determine if agricultural and residential land uses are impairing water quality in this reach, correct as necessary.

**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Fair</b>
<b>Overall Index</b>	<b>3.57</b>

Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	3
Intolerant Urban % Score	3
Ephemeroptera % Score	3
Scraper Taxa Score	1
% Climbers	5

**Calculated Metric Values**

Total Taxa	34
EPT Taxa	5
Ephemeroptera Taxa	1
Intolerant Urban %	10.9
Ephemeroptera %	0.9
Scraper Taxa	0
% Climbers	34.5

**Taxa List**

Ablabesmyia	2
Ancyronyx	1
Chaetocladius	1
Chironominae	1
Cricotopus	1
Cryptochironomus	1
Diplocladius	2
Dubiraphia	1
Gammarus	2
Heptageniidae	1
Hydrobaenus	2
Isonychia	3
Limnephilidae	2
Lype	1
Mallochocheila	1
Micropsectra	1
Nais	1
Nigronia	2
Orthocladius	4
Orthocladius/Cricotopus	7
Paralauterborniella	1
Parametrioctonus	6
Paratanytarsus	2
Perlidae	2
Pisidium	2
Planorbidae	1
Polypedium	17
Prosimulium	4
Rheocricotopus	3
Rheotanytarsus	5
Sphaerium	1
Stegopterna	2
Tanytarsus	20
Thienemannimyia	7

**Total Individuals** 110

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	4	Pool Variability	12
Bank Stability- Right Bank	4	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	18	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	13	Sediment Deposition	8
Channel Sinuosity	10	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	8	Vegetative Protection (Right Bank)	5
Pool Substrate Characterization	8		

<b>EPA Habitat Score</b>	115
<b>EPA Narrative Ranking</b>	PS

**Maryland Biological Stream Survey PHI**

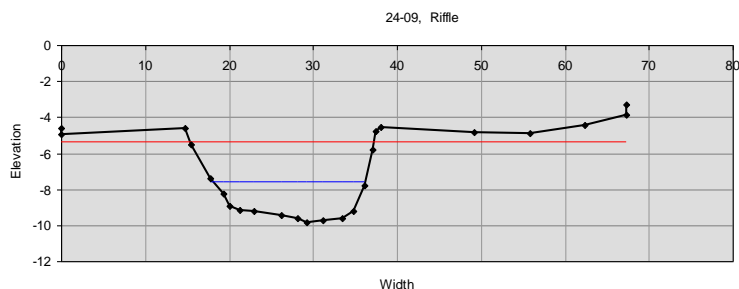
Drainage area (acres)	3845.0	Instream Wood Debris	8
Remoteness	17	Bank Stability	8
Shading	70		
Epifaunal Substrate	8	<b>PHI Score</b>	63.53
Instream Habitat	11	<b>PHI Narrative Ranking</b>	D

**Water Chemistry**

Dissolved Oxygen (mg/L)	9.02	Specific Conductance (mS/cm)	258
pH	6.78	Temperature (°C)	7.86

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	6.0	Cross Sectional Area (ft <sup>2</sup> )	30.2
Bankfull Width (ft)	18.0	Water Surface Slope (ft/ft)	0.193
Mean Bankfull Depth (ft)	1.7	Sinuosity	1.2
Floodprone Width (ft)	21.4	D50 (mm)	0.09
Entrenchment Ratio	1.2	Adjustments?	None
Width to Depth Ratio	10.7	<b>Rosgen Stream Type</b>	<b>G5c</b>







Upstream



Downstream

**Location/Site Access:** Located approx. 300m Behind House (312) @ end of Kidwell Ln.  
 Latitude/Longitude: 38.72346/-76.6157

### Land Use Analysis:

**Note: Data incomplete. Breakdown does not include areas in Calvert County.**

Land Use	Acres	% Area
Commercial	21.4	--
Open Space	71.4	--
Pasture/Hay	126.3	--
Residential 1/2-acre	40.4	--
Residential 1-acre	153.8	--
Residential 2-acre	41.9	--
Row Crops	288.4	--
Transportation	32.2	--
Utility	32.9	--
Woods	582.2	--
Grand Total	3702.9	--

Impervious (acres)	Total Area Above site	% Impervious
67.8	3702.9	--

### **Results:**

- Biological condition – "Fair"
- Habitat scores "Supporting" and "Partially Degraded"
- Bank stability and vegetative protection scored marginally
- Sample dominated by midges (*Tanytarsus*)
- Stream type was identified as an G5c, slope was 0.139 percent, and the median channel substrate was fine sand
- Typically, G channels are not stable and this reach shows marginal habitat ratings for variables related to banks and substrates.
- Biological community is appropriate for observed habitat quality.

### **Recommendations:**

- Maintain the protection of the riparian areas.
- Investigate potential water quality impacts from agricultural and residential land uses. Retrofit BMPs as necessary.

**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Fair</b>
<b>Overall Index</b>	<b>3.29</b>

Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	3
Intolerant Urban % Score	1
Ephemeroptera % Score	3
Scraper Taxa Score	1
% Climbers	5

**Calculated Metric Values**

Total Taxa	33
EPT Taxa	5
Ephemeroptera Taxa	1
Intolerant Urban %	6.8
Ephemeroptera %	1.9
Scraper Taxa	0
% Climbers	42.7

**Taxa List**

Ablabesmyia	6
Ancyronyx	6
Bezzia/Palpomysia	1
Chaetocladius	1
Chrysops	1
Culicoides	1
Diplocladius	1
Dubiraphia	1
Helichus	3
Heptageniidae	2
Hyaella	1
Ironoquia	2
Labrundinia	2
Leptoceridae	2
Lype	4
Micropsectra	2
Microtendipes	2
Nanocladius	2
Nigronia	1
Orthocladius	2
Paralauterborniella	1
Parametriocnemus	1
Perlidae	1
Phaenopsectra	2
Physa	2
Pisidium	1
Polypedilum	6
Rheotanytarsus	2
Sphaerium	1
Stenochironomus	1
Tanytarsus	34
Thienemannimyia	7
Tribelos	1

**Total Individuals** 103

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	3	Pool Variability	13
Bank Stability- Right Bank	3	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	19	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	13	Sediment Deposition	10
Channel Sinuosity	11	Vegetative Protection (Left Bank)	4
Epifaunal Substrate/Available Cover	15	Vegetative Protection (Right Bank)	4
Pool Substrate Characterization	13		

**EPA Habitat Score** 128

**EPA Narrative Ranking** S

**Maryland Biological Stream Survey PHI**

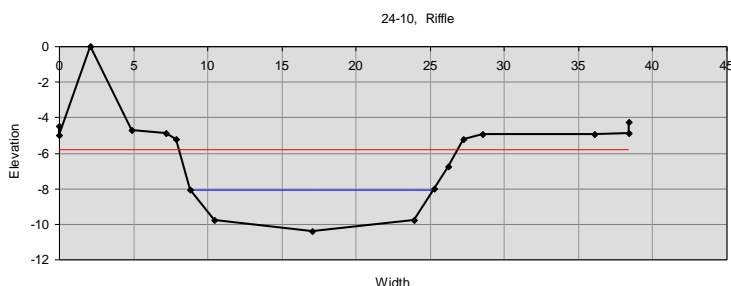
Drainage area (acres)	3702.9	Instream Wood Debris	14
Remoteness	16	Bank Stability	6
Shading	90		
Epifaunal Substrate	15	<b>PHI Score</b>	78.67
Instream Habitat	15	<b>PHI Narrative Ranking</b>	PD

**Water Chemistry**

Dissolved Oxygen (mg/L)	9.14	Specific Conductance (mS/cm)	146
pH	6.85	Temperature (°C)	8.56

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	5.8	Cross Sectional Area (ft <sup>2</sup> )	29.1
Bankfull Width (ft)	16.4	Water Surface Slope (ft/ft)	0.139
Mean Bankfull Depth (ft)	1.8	Sinuosity	2.4
Floodprone Width (ft)	17.8	D50 (mm)	0.11
Entrenchment Ratio	1.1	Adjustments?	None
Width to Depth Ratio	9.2	<b>Rosgen Stream Type</b>	<b>G5c</b>





Upstream



Downstream

**Location/Site Access:** Located approx. 30m DS of Rt. 2 Crossing  
**Latitude/Longitude:** 38.72936/-76.59927

### Land Use Analysis:

Land Use	Acres	% Area
Commercial	0.2	0.3%
Open Space	2.2	3%
Pasture/Hay	8.3	11%
Residential 1-acre	4.5	6%
Row Crops	36.9	49%
Transportation	3.1	4%
Water	0.3	0.4%
Woods	20.1	27%
Grand Total	75.5	100%

Impervious (acres)	Total Area Above site	% Impervious
3.4	75.5	4.5

### **Results:**

- Biological condition – "Poor"
- Habitat score "Non Supporting" and "Partially Degraded."
- Riparian vegetation and physical complexity of habitat scored high
- Sample dominated by amphipods (*Gammarus*) and midges (*Diplocladius*, *Polypedilum*, and *Orthocladius/Cricotopus*)
- Stream type was identified as an G5c, slope was 0.76 percent, and the median channel substrate was very fine sand
- Typically, G channels are not stable and this reach shows marginal habitat ratings for variables related to banks and substrates.
- Habitat conditions are mixed for this site, with one assessment method indicating impairment and one indicating some kind of enrichment.

### **Recommendations:**

- Maintain the protection of the riparian areas. Restore banks if possible.
- Determine what impacts might be due to the extensive agricultural land use upstream of site, correct as feasible and necessary.

**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Poor</b>
<b>Overall Index</b>	<b>2.71</b>
Total Taxa Score	5
EPT Taxa Score	1
Ephemeroptera Taxa Score	3
Intolerant Urban % Score	1
Ephemeroptera % Score	3
Scraper Taxa Score	1
% Climbers	5

**Calculated Metric Values**

Total Taxa	31
EPT Taxa	1
Ephemeroptera Taxa	1
Intolerant Urban %	5.1
Ephemeroptera %	1.7
Scraper Taxa	0
% Climbers	18.0

**Taxa List**

Bezzia/Palpomyia	1
Chaetocladius	2
Coenagrionidae	1
Corynoneura	3
Cryptochironomus	1
Culicoides	3
Curculionidae	1
Diplocladius	18
Gammarus	24
Hemerodromia	1
Limnodrilus	2
Mallochohelea	1
Microspectra	3
Nigronia	1
Orthocladius	1
Orthocladius/Cricotopus	12
Parametriocnemus	3
Paraphaenocladius	3
Paratanytarsus	1
Paratendipes	1
Polypedilum	15
Potamothenax	1
Pseudolimnophila	2
Rheocricotopus	4
Rheotanytarsus	1
Stenonema	2
Stilocladius	1
Tanytarsus	2
Thienemannimyia	4
Tipula	1
Zavrelimyia	1

**Total Individuals** 117

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	4	Pool Variability	6
Bank Stability- Right Bank	4	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	14	Riparian Vegetative Zone Width- Right Bank	8
Channel Flow Status	13	Sediment Deposition	8
Channel Sinuosity	7	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	7	Vegetative Protection (Right Bank)	5
Pool Substrate Characterization	7		

**EPA Habitat Score** 98

**EPA Narrative Ranking** NS

**Maryland Biological Stream Survey PHI**

Drainage area (acres)	75.5	Instream Wood Debris	6
Remoteness	14	Bank Stability	8
Shading	95		
Epifaunal Substrate	7		
Instream Habitat	5		

**PHI Score** 76.99

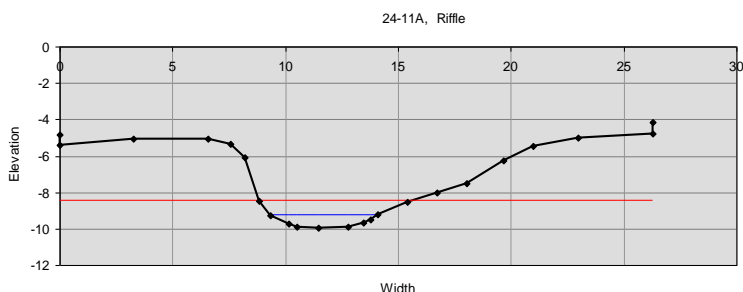
**PHI Narrative Ranking** PD

**Water Chemistry**

Dissolved Oxygen (mg/L)	5.01	Specific Conductance (mS/cm)	207
pH	6.53	Temperature (°C)	7.8

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.1	Cross Sectional Area (ft <sup>2</sup> )	2.7
Bankfull Width (ft)	4.8	Water Surface Slope (ft/ft)	0.76
Mean Bankfull Depth (ft)	0.6	Sinuosity	1.1
Floodprone Width (ft)	6.9	D50 (mm)	0.077
Entrenchment Ratio	1.5	Adjustments?	↑Sin, ↓ER
Width to Depth Ratio	8.4	<b>Rosgen Stream Type</b>	<b>G5c</b>







Upstream



Downstream

**Location/Site Access:** Located behind Crowe's Nest Horse Farm off Tucker Ct.  
**Latitude/Longitude:** 38.72803/-76.5881

#### Land Use Analysis:

Land Use	Acres	% Area
Commercial	6.8	3%
Open Space	24.9	9%
Pasture/Hay	41.2	16%
Residential 1/2-acre	26.6	10%
Residential 1-acre	27.0	10%
Residential 2-acre	2.7	1%
Row Crops	48.3	18%
Transportation	6.6	3%
Utility	17.3	7%
Woods	62.0	24%
Grand Total	263.9	100%

Impervious (acres)	Total Area Above site	% Impervious
17.4	263.9	6.6

#### **Results:**

- Biological condition – "Very Poor"
- Habitat scores "Non Supporting" and "Degraded"
- Several habitat variables, including bank stability and vegetative protection scored poorly
- Dissolved oxygen concentration very low
- Sample dominated by midges (*Orthocladius/Cricotopus*)
- Stream type was identified as an G5c, slope was 0.347 percent, and the median channel substrate was very fine sand
- Typically, G channels are not stable and this reach shows poor or marginal habitat ratings for variables related to banks and substrates.
- Habitat assessment results were mixed for this site, but biological community observed is trending toward more than expected impairment based on the observed habitat quality.

#### **Recommendations:**

- Protect the riparian areas. Restore banks if possible.
- Investigate impacts from residential and agricultural land uses and correct as necessary.

**IBI and Metric Scores**

<b>Narrative Rating</b>	<b>Very Poor</b>
<b>Overall Index</b>	<b>1.86</b>
Total Taxa Score	3
EPT Taxa Score	1
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

**Calculated Metric Values**

Total Taxa	15
EPT Taxa	1
Ephemeroptera Taxa	0
Intolerant Urban %	0.9
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	9.8

**Taxa List**

Chaetocladius	2
Corynoneura	3
Diplocladius	5
Gammarus	6
Limnephilidae	3
Orthocladius	1
Orthocladius/Cricotopus	59
Parametriocnemus	2
Polypedilum	11
Rheocricotopus	12
Simulium	4
Stegopterna	1
Stilocladius	1
Tubificidae	1
Zavrelimyia	1

**Total Individuals**

112

**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	2	Pool Variability	5
Bank Stability- Right Bank	2	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	16	Riparian Vegetative Zone Width- Right Bank	5
Channel Flow Status	10	Sediment Deposition	5
Channel Sinuosity	10	Vegetative Protection (Left Bank)	2
Epifaunal Substrate/Available Cover	5	Vegetative Protection (Right Bank)	2
Pool Substrate Characterization	6		

<b>EPA Habitat Score</b>	80
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<b>EPA Narrative Ranking</b>	NS
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**Maryland Biological Stream Survey PHI**

Drainage area (acres)	263.9	Instream Wood Debris	1
Remoteness	10	Bank Stability	4
Shading	85		
Epifaunal Substrate	5		
Instream Habitat	3		

<b>PHI Score</b>	55.65
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<b>PHI Narrative Ranking</b>	D
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**Water Chemistry**

Dissolved Oxygen (mg/L)	2.3	Specific Conductance (mS/cm)	219
pH	6.73	Temperature (°C)	9.58

**Geomorphic Assessments****Rosgen Level II Classification Data**

Drainage Area (mi <sup>2</sup> )	0.4	Cross Sectional Area (ft <sup>2</sup> )	5.0
Bankfull Width (ft)	6.5	Water Surface Slope (ft/ft)	0.347
Mean Bankfull Depth (ft)	0.8	Sinuosity	1.2
Floodprone Width (ft)	9.1	D50 (mm)	0.071
Entrenchment Ratio	1.4	Adjustments?	None
Width to Depth Ratio	8.5	<b>Rosgen Stream Type</b>	<b>G5c</b>

