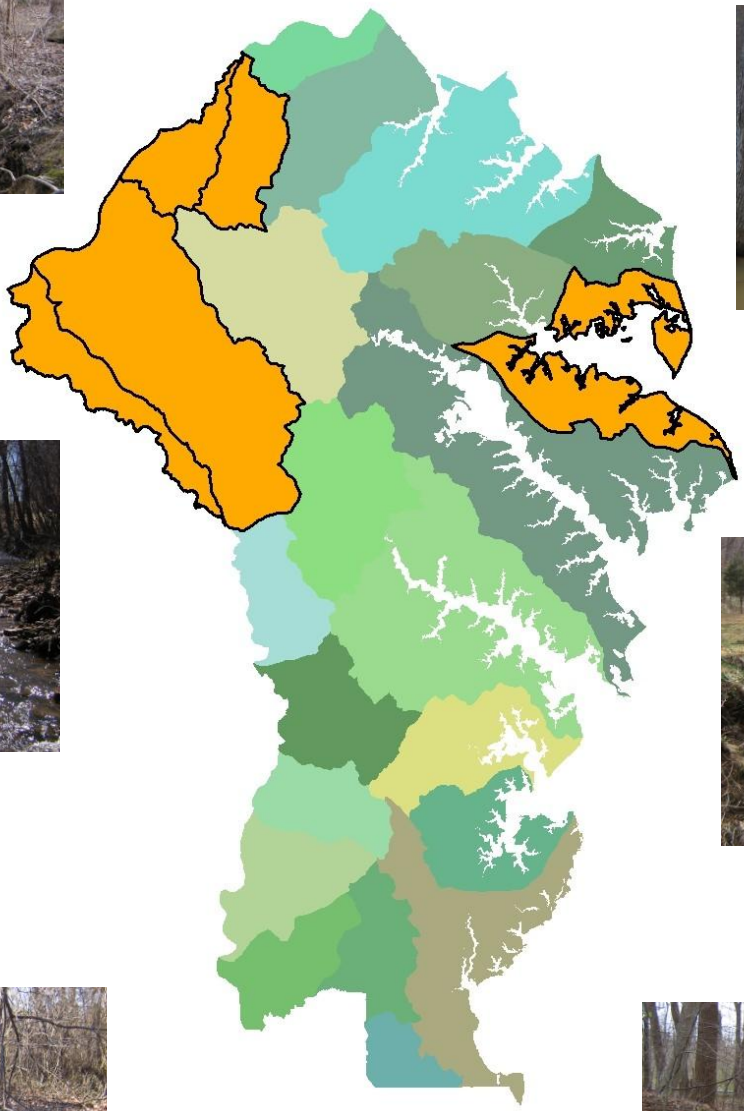
Anne Arundel County, Maryland
Department of Public Works
Watershed, Ecosystem, and Restoration Services

Aquatic Biological Assessment of the Watersheds of Anne Arundel County, Maryland: 2007



Aquatic Biological Assessment of the Watersheds of Anne Arundel County, Maryland: 2007

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Abstract

The Anne Arundel County Department of Public Works (DPW) 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 five primary sampling units (PSUs) in 2007 partially fulfills the goal of county-wide stream assessment. The PSUs include the Upper Patuxent River, the Little Patuxent River, Piney Run, Stony Run, and the Lower Magothy River. The indicators used to assess the support of aquatic life in streams include the Benthic Index of Biological Integrity (B-IBI), the Rapid Bioassessment Protocol (RBP) habitat score, the Physical Habitat Index (PHI), and four water quality measures (temperature, dissolved oxygen, specific conductance, and acidity). 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. For the five subwatersheds combined none of the B-IBI scores indicated "Good" biological conditions and 24% indicated "Fair" conditions, with the majority of sites having (76%) having "Poor" or "Very Poor" conditions. Habitat measures using the RBP method indicated Supporting and Partially Supporting conditions in 6% and 64% of sites, respectively. The PHI indicated Minimally Degraded and Partially Degraded conditions in 19% and 62% of sites, respectively. Water quality measurements did not show stressful conditions for temperature or dissolved oxygen, though the sampling period did not coincide with the most stressful summer months. Thresholds for specific conductivity have not been established. Other than one high outlier at 4,384 µS, conductivity levels were within normal ranges. The majority of stream reaches in the PSUs were low slope, sand bottomed channels. A mix of stable and unstable stream types were observed throughout the PSUs.

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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 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 citing, 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 subwatersheds were assessed (Victoria and Markusic 2007). In 2005, Herring Bay, South River (Upper and Lower), Lyons Creek and Stocketts Run subwatersheds were assessed (Roberts et al. 2006). The third year (2006) addressed the Marley Creek, Bodkin Creek, Upper Magothy River and Hall Creek subwatersheds (Stribling et al. 2008). The purpose of this report is to present assessment results for the fourth year of sampling (2007) in the Upper Patuxent River, Little Patuxent River, Piney Run, Stony Run, and Lower Magothy River subwatersheds.

Purpose of Biological and Physical Habitat Assessment

The use of benthic macroinvertebrates as the basis of biological assessments is advantageous because 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) can cause sedimentation, degradation of riparian vegetation, and bank instability, potentially 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 Upper Patuxent River, Little Patuxent River, Piney Run, Stony Run, and Lower 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. Final selection and placement of sampling segments was random; stratified by subwatershed and stream order at 1:100,000 scale.

For 2007, 10 randomly selected sites were chosen from each PSU (Upper Patuxent River [PSU #16], Little Patuxent River [17], Piney Run [1], Stony Run [2], and Lower Magothy River [8]) for a total of 50 sites. One site within each PSU was randomly-selected for replicate quality control (QC) sampling to address issues of measurement (systematic) error. The number of repeat samples collected was 10 percent of the total for this sampling event (5 sites); thus, there were a total of 55 samples collected at 50 sites. Only biology, chemistry, and physical habitat data were repeated.

Alternate Sites

In addition to the ten randomly selected primary sites, ten alternate sites were also selected. In the event that a primary site could not be sampled (e.g., due to access denial, non-wadeable, or impounded channel), the first alternate site of the same stream order was sampled in its place. This

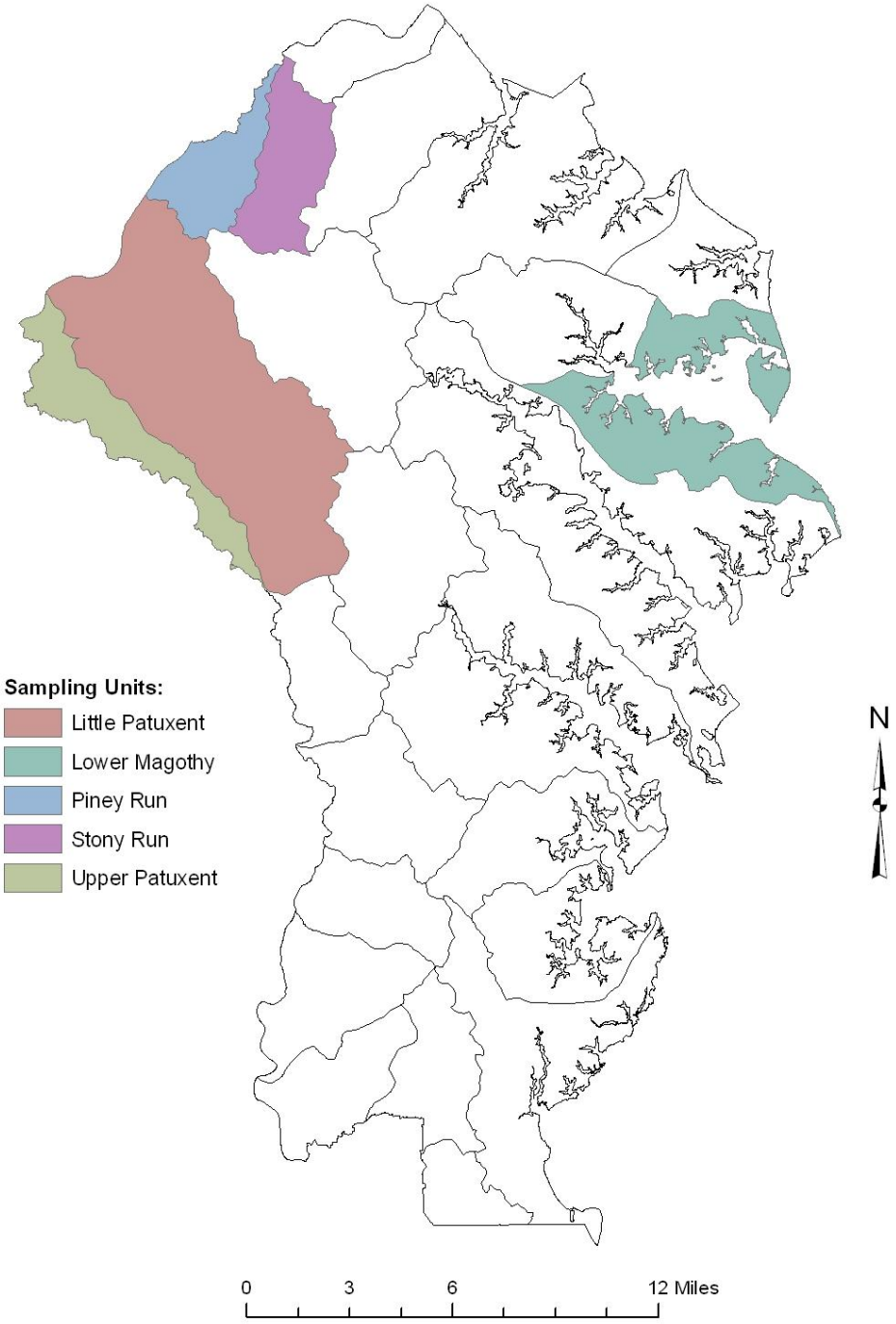

Figure 1 - Sampling units assessed for the fourth year of the County's biological monitoring program (2007).

maintains the randomness of the design, while incorporating the flexibility necessary to account for unforeseen circumstances in the field. During the 2007 sampling period, it was necessary to sample a total of 21 alternate sites (**Table 1**).

Table 1–Alternate sites sampled.

Original Site	Alternate Site	Reason
01-03	01-12a	Streambed dry
01-06	01-13a	Landowner access denied
02-02	02-11a	Streambed dry
02-08	02-18a	In large wetland
02-09	02-19a	In large wetland
02-10	02-20a	In large wetland
08-06	08-11a	No stream located at or near original coordinates
08-08	08-13a	No stream located at or near original coordinates
08-10	08-15a	Streambed dry
16-04	16-11a	Streambed dry
16-06	16-12a	Streambed dry
16-07	16-13a	No stream located at or near original coordinates
16-08	16-14a	Located in a wetland
16-09	16-16a	Located in a wetland
17-02	17-11a	Located within active gov't firing range
17-03	17-12a	No stream located at or near original coordinates
17-04	17-13a	Landowner access denied
17-06	17-14a	Located within active gov't firing range
17-07	17-15a	Landowner access denied
17-08	17-16a	No stream located at or near original coordinates
17-10	17-17a	Located near active gov't firing range within a wetland

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 ft² 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 ± 20%) was reached.

Benthic Taxonomy

Sample taxonomy using the methods of Boward and Friedman (2000) was performed by ARC. Specimens 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; Tetra Tech 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).

Physical Habitat Rating (Methods for Calculation and Scoring)

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 Maryland Biological Stream Survey (MBSS) Physical Habitat Index (PHI; Paul et al. 2003). The RBPs evaluate 10 variables that describe instream physical characteristics, channel morphology, and riparian vegetation and stream bank structure. Each variable 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 variables 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 EPA RBP method but has been revised to incorporate variables that better characterize the physical complexity of Maryland Coastal Plain streams. The PHI evaluates physical habitat quality based on the following variables:

- bank stability
- instream woody debris and rootwads
- instream habitat quality
- epibenthic substrate
- shading
- 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 at each site to determine the stream type of each reach as characterized by the Rosgen Stream Classification (Rosgen 1996). Measurements at each site included a pebble count, a cross sectional profile, and a simplified longitudinal profile.

Modified 100-particle Wolman Pebble Counts (Wolman 1954) were performed to determine the particle size distribution of the channel substrate. Ten transects were distributed throughout the 75-m reach in proportion to the feature types (pool, glide, run, riffle) present. For example, if a reach was 60% pools and 40% glides, six transects would be allocated to pools while four would be placed in glide features. Each transect begins on one bank at approximate bankfull level and

continues across the width of the active channel to the opposite bankfull width. A total of 10 particles per transect were selected by hand (each particle is defined as a size of geologic substrate material within various classes: silt/clay, sand, gravel, cobble, boulder, and bedrock). To reduce sampler bias, each particle was chosen without the sampler looking in the stream at what was being collected (Harrelson et al. 1994). Each particle was chosen, measured, and recorded at evenly spaced intervals across the channel. If a reach was composed entirely of soft sediment (sand, silt/clay) and exhibited no clear variation in material size, the pebble count was not performed and the percentage of sediment types was visually estimated. However, a pebble count was performed at every fifth site.

Channel cross-sectional surveys were performed to provide a coarse characterization of channel cross-sectional area and changes to channel dimensions over time. After a thorough visual assessment of the channel characteristics, a representative section of the channel (preferably a transitional zone between feature types) was selected for analysis as the cross-section area. A tape measure was drawn between permanent monuments (4-ft sections of ½ inch diameter rebar) that were installed on each side of stream to record the location of each measurement. A GPS reading was taken at the primary monument (typically on the left bank facing downstream) and recorded on the data sheet. Height measurements were taken using a laser-level and survey rod. Numerous measurements were taken across the entire width of the channel with the aim of characterizing the topographic variability of the channel while attempting to capture as many features along the bank and streambed as possible including:

- Elevation of monuments
- Topography changes
- Top of each channel bank
- Bankfull indicators
- Edges of water
- Thalweg
- Depositional and erosional features

Using the data collected during the cross-sectional survey, a number of additional measures based on bankfull indicators can be calculated, which allows for further measurements to be made. These measures include:

- Bankull Width (W_{bkf}) – the channel width at bankfull elevation
- Bankfull Mean Depth (d_{bkf}) – the mean depth of the bankfull channel
- Bankfull Cross-Sectional Area (A_{bkf}) – the product of bankfull depth and bankfull mean depth
- Maximum Depth (d_{mbkf}) – the maximum depth of the bankfull channel
- Width/Depth Ratio (W_{bkf}/d_{bkf}) – the ratio of bankfull width divided by bankfull mean depth

Several additional measurements are then made based on the bankfull measures, which are necessary for determining the stream type of each reach. These measures include:

- Width of Floodprone Area (W_{fpa}) – width of the channel at flood stage (two times maximum depth)
- Entrenchment Ratio (ER) – the ratio of floodprone width divided by bankfull width

Additionally, sinuosity, the ratio stream length to valley length, was determined by measuring the straight-line distance of the reach using a laser rangefinder or by running a measuring tape.

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 F: 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 B-IBI values.

Physical Habitat

The 10 RBP variable scores were summed to obtain a final habitat score. Site habitat condition was determined through comparison to a reference condition score. Because there were no RBP data for reference sites within Anne Arundel County, we compared to a reference condition based on similar studies from Prince George's County (Stribling et al. 1999). Narrative ratings that correspond to final RBP habitat scores **(Table 2)** express the potential of a stream or watershed to support a healthy biological community. These narrative ratings were adapted from Plafkin et al. (1989).

Table 2–EPA RBP Scoring (Stribling et al. 1999).

Score	Narrative
151 +	Comparable (to reference)
126 – 150	Supporting (aquatic life uses)
101 – 125	Partially Supporting
0 – 100	Non-Supporting

For the PHI, the variables measured in the field were scored on a 100-point scale. Some scores were adjusted for watershed size. The individual scores were then summed and divided by the total number of variables (six) to yield a final PHI score, which was associated with a narrative rating (**Table 3**). Composite scores or values for primary sampling units were presented as means plus/minus a single standard deviation ($\bar{x} \pm 1$ s.d.).

Table 3–MBSS PHI Scoring (Paul et al. 2003, Boward 2006).

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

Biological Index Rating

The biological indicator is based on the Index of Biological Integrity (IBI; Karr et al. 1986) and uses characteristics of the benthic macroinvertebrate assemblage structure and function to assess the overall water resource condition. Benthic IBIs (B-IBI) were developed by the MBSS and calibrated for different geographic areas of Maryland (Stribling et al. 1998). In 2005, MBSS revised the B-IBI (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 is indicative of stream degradation.
3. *Number of Ephemeroptera Taxa.* Mayflies are generally sensitive to pollution and the number of mayfly genera 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 for the 2005 index are listed in **Table 4**. IBI scores were calculated by summing the nine metric scores for each site, and dividing by the number of metrics (9). Using the format established by MBSS, the resulting value was then compared to the index scoring criteria for translation into narrative categories (**Table 5**; Southerland et al. 2005). 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. Composite scores for primary sampling units were presented as means plus/minus a single standard deviation ($\bar{x} \pm 1$ s.d.).

Table 4–MBSS BIBI Metrics.

Metric	**Scoring Thresholds**		
	1	3	5
Number of Taxa	< 14	≥ 14 < 22	≥ 22
Number of EPT Taxa	< 2	≥ 2 < 5	≥ 5
Number of Ephemeroptera Taxa	< 1	≥ 1 < 2	≥ 2
Percent Intolerant to Urban	<10	≥ 10 < 28	≥ 28
Percent Ephemeroptera	< 0.8	≥ 0.8 < 11	≥ 11
Number of Scraper Taxa	< 1	≥ 1 < 2	≥ 2
Percent Climbers	< 0.9	≥ 0.9 < 8	≥ 8

From: Southerland et al. 2005

Table 5–MBSS BIBI (2005) 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 percent 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 10th 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 10th 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.

Water quality standards for these streams have been established in the Code of Maryland (COMAR, **Table 6**). Composite values for

individual sampling units are means plus/minus a single standard deviation ($\bar{x}$ ± 1 s.d.).

Table 6–Code of Maryland (COMAR) Water Quality Standards.

Parameter	Standard
pH (S. U.)	6.5 to 8.5
Dissolved Oxygen (mg/L)	Minimum of 5 mg/L
Conductivity (µmhos/cm)	[No state standard]
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 (±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 B, 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^{th} 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 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

The following sections describe biological conditions, habitat quality, and geomorphologic results for selected subwatersheds. Because of the probabilistic (random) site selection process (Hill and Stribling 2004), average results in each sampling unit describe typical conditions for all streams within the subwatershed, even in those streams where no data were collected. While individual streams could certainly be found that assess as either better or worse than the typical conditions, probabilistic sampling is the best way to characterize all streams. **Table 7** summarizes biological and habitat conditions for each sampling unit.

Biological Assessment Summary

Overall, the BIBI scores throughout the sampling units were variable, with the largest portion of the sites (48%) falling within the "Poor" category (**Figure 2**). Twenty-four percent of the sites were rated as "Fair," and 28% rated "Very Poor." No sites were rated as "Good". All five sampling units had mean B-IBI values that put them in the overall "Poor" category (**Table 7**). Piney Run (PSU-1) had the highest mean B-IBI score (2.69±0.80), and Little Patuxent (PSU-17) had the lowest (2.09±0.79). At many of the sites, the benthic macroinvertebrate assemblage was dominated by midges (Diptera: Chironomidae). Blackflies (Diptera: Simuliidae), sowbugs (Isopoda: Asellidae), worms (Oligochaeta) and riffle beetles (Coleoptera: Elmidae) were also abundant at several of the sites.

Table 7–Summary of BIBI and habitat scores across sampling units. For each primary sampling unit, N = 10 sites.

Sampling unit	*Average BIBI Score ±SD / Condition Narrative*	*Average EPA RBP Habitat Score ±SD / Condition Narrative*	*Average MBSS PHI Score ±SD / Condition Narrative*
Upper Patuxent River	2.37 ±0.38 Poor	117.0 ±14.8 Partially Supporting	75.9 ±13.0 Partially Degraded
Little Patuxent River	2.09 ±0.79 Poor	105 ±10.7 Partially Supporting	62.9 ±7.8 Partially Degraded
Piney Run	2.69 ±0.80 Poor	109.1 ±10.0 Partially Supporting	58.7 ±14.0 Degraded
Stony Run	2.37 ±0.70 Poor	105.1 ±8.4 Partially Supporting	58.7 ±7.9 Degraded
Lower Magothy River	2.20 ±0.46 Poor	101.7 ±8.6 Partially Supporting	58.7 ±6.0 Degraded

Habitat Assessment Summary

Across the five sampling units, physical habitat quality generally assessed as somewhat degraded. RBP narratives for mean scores were "Partially Supporting" for all five units (**Table 7**) and 6% of the individual sites had habitat quality supportive of aquatic life uses. Judging from the mean of PHI values, 3 of the 5 units assessed as "Degraded," with the Upper Patuxent and Little Patuxent classified as "Partially Degraded" (**Table 7**). Over all PSUs, the PHI evaluation rated only 8% of the individual sites were assessed as having

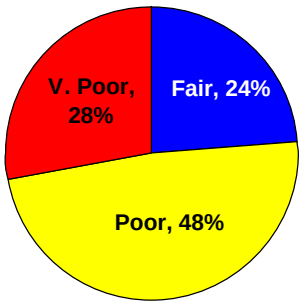

Figure 2 - Proportional distribution of B-IBI assessment results.

minimal physical habitat disturbance. None of the sites were rated as comparable to reference conditions by the RBP method (**Figure 3**).

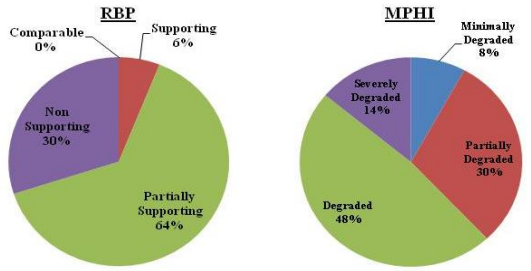

Figure 3 - Proportional distribution of physical habitat quality assessment scores.

Water Quality Assessment Summary

There were no violations of the COMAR temperature or dissolved oxygen standards, which is not surprising considering the sampling schedule. Temperature observations made in March and April are not likely to show high temperature stress. The highest temperature recorded was 15.7°C, in Stony Run. All dissolved oxygen readings were above 7.15 mg/L, which is safely above the 5 mg/L standard, but which could be expected to be higher in the late winter and early spring. There is no state standard for conductivity, but one site had a particularly high reading, at 4384 µS in the Lower Magothy. Eight other readings were greater than 1000 µS, five of which were in the Piney Run. All of the high conductivity readings in the Lower Magothy sampling unit were collected on March 8th, one day after a snow event and probable road salting. Samples in the Piney Run were collected before and several days after snow events.

Due to a technical problem with pH probe of the multimeter, encountered during a review of calibration records for the unit, the pH data were deemed unreliable and so are not reported.

Geomorphic Assessment Summary

The E type stream channel was the dominant stream type found within the sampling units. As shown in **Figure 4**, 32% of all sites assessed were classified as E channels. G and C channel types both occurred in 18 and 22% of sites, respectively, while B channels made up 10% of sites assessed.

The F type was observed at 10% of sites and 8% of the sites were excluded from analysis due to site conditions that violated basic requirements associated with applying the Rosgen classification system.

While the different channel types were observed in a fairly uniformly distribution across sampling units, only the C channel type was found in all sampling units, occurring most frequently in the Stony Run sampling unit. The F channel type was only found in the Stony Run and Little Patuxent sampling units.

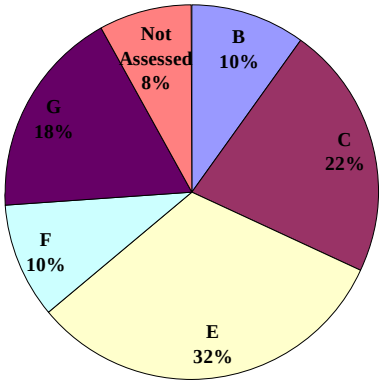

Figure 4 - Summary of Rosgen stream types.

The majority of channels had sand substrates. Approximately 86% of assessed reaches were found to have sand bottoms. The remainder (~14%) were dominated by gravel substrate. Within sand bottom channels, the average D50 observed was 0.33 mm. For gravelly reaches, the average D50 observed was 11.0 mm. No clay bottom channels were observed.

Stream slope was low in the assessment reaches. The average slopes for all reaches assessed were approximately 0.76%. Slopes were lowest in the Lower Magothy (0.44%) and highest in the Upper Patuxent (1.1%) sampling units. Excluding one reach, all B and G types were of the Bc and Gc type, meaning that these reaches had a slope of less than 2%.

Primary 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 subwatersheds are discussed. When site-specific data are not available for a particular subwatershed within a unit, the unit-wide results characterize basic conditions of all streams throughout the unit.

Upper Patuxent River

The Upper Patuxent sampling unit is located along the western border of the County (**Figure 1**), with site drainage areas ranging in size from 42 to 335 acres. The ten sample locations **(Figure 5**) are on tributaries to the Upper Patuxent mainstem.

Aquatic Habitat

Half of the Upper Patuxent streams were rated as "Partially Supporting" by the RBP method, 20% "Non Supporting", and 30% "Supporting" (**Figure 6**). The MBSS PHI results showed that 40% of the streams were "Minimally Degraded" or "Partially Degraded" and 10% were "Degraded" or "Severely Degraded." The mean RBP habitat score was 117 ± 15 (**Table 7**), with individual sites ranging from 89 to 135. Streams with the worst RBP scores had altered channels or unstable banks, as well as sedimentation and disturbed riparian zones. The mean PHI score was 75.9 ± 13.0, with individual sites ranging from 51 to 90. The site scoring lowest on the PHI had relatively low scores for remoteness, trash, and woody debris. The Upper Patuxent PSU had the best overall habitat conditions among the subwatersheds sampled in 2007.

Benthic Macroinvertebrates

Seventy percent of the sites in the Upper Patuxent River Sampling Unit rated as "Poor," 20% rated "Very Poor" and 10% rated "Fair" (**Figure 7**). The mean B-IBI score was 2.37 ± 0.38 (**Table 7**), and scores at individual sites ranged from 1.86 (Very Poor) to 3.00 (Fair). The lowest B-IBI scores occurred at two sites, 16-03 and 16-12a. At site 16-03, 75% of the organisms were midges, and 80% of the assemblage was comprised of stressor tolerant organisms. The most abundant taxa were Diptera: Chironomidae: *Zavrelimyia* and *Hydrobaenus*. Site 16-12a was also dominated by stressor tolerant organisms, with worms and midges comprising over ninety percent of the assemblage. The most dominant taxa were Oligochaeta: Naididae: *Nais* and Diptera: Chironomidae: *Hydrobaenus*. The site with the highest B-IBI score, 16-11a, also had an assemblage dominated by black-flies, worms and midges. However, several taxa that are intolerant to pollution, such as Plecoptera: Leuctridae and Megaloptera: Corydalidae, were present at this site For site-specific data and assessment results see ***Appendix F***.

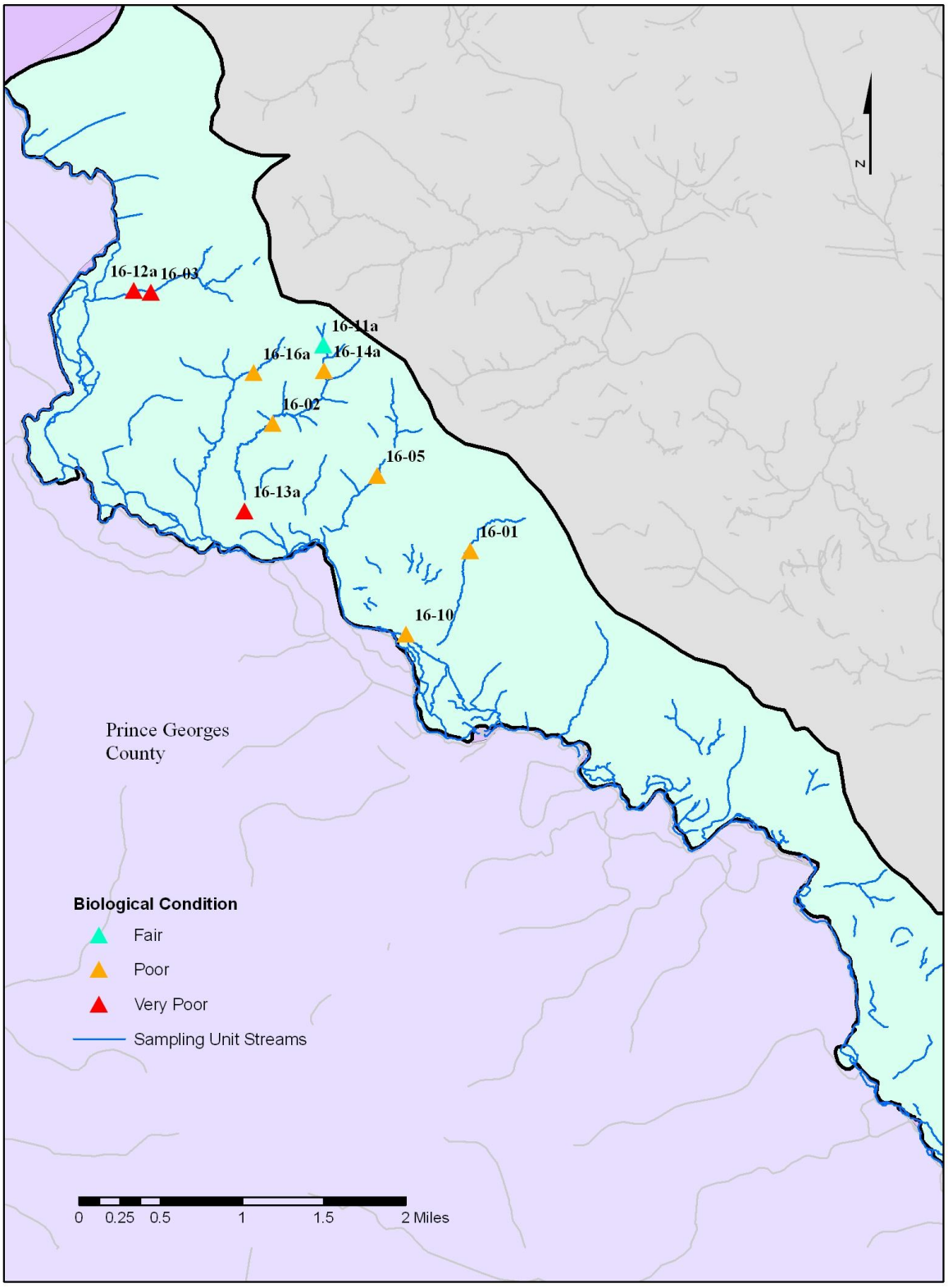

Figure 5 – Sampling locations in the Upper Patuxent sampling unit.

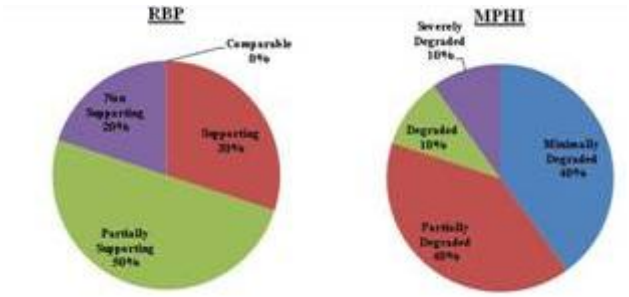

Figure 6. Summary of habitat conditions observed in the Upper Patuxent sampling unit.

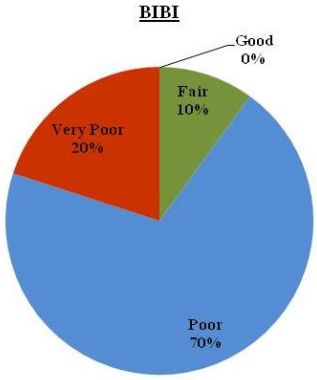

Figure 7- Summary of BIBI scores in the Upper Patuxent sampling unit.

Water Quality

All water quality variables were within acceptable ranges for individual site observations and for mean values (**Table 8).** However, more stressful temperature and dissolved oxygen conditions might be expected at other times than during the March - April sampling period. Water temperature ranged from 5.1-11.2°C; conductivity from 34-265 µmhos/cm; and DO from 7.2-12.7 mg/L.

Table 8–Average water quality values - Upper Patuxent.

Value ± Standard Deviation		
Temperature*	Conductivity*	D.O.*
7.9 ±2.2	97.7 ±72.4	9.4 ±1.4
**Units: Temp. (°C), Cond. (µmhos/cm), D.O. (mg/L)*		

Geomorphic Assessment

In this sampling unit, the B, C, E and G types were observed (**Figure 8**). In 30% (3 of 10) of cases, stream reaches were not classified because various impacts prevent a valid classification from being executed.

The assessment reaches had mostly sand-dominated bottoms. Only one of the seven reaches classified had a gravel substrate. The average D50 of the classified reaches was 1.48 mm or just below the gravel particle class. Slopes ranged from a high of just over 2 % to a low of 0.42%, with an average of 1.1% across all sites.

Excluding sinuosity, there were no significant differences between the E-type reaches found in the Upper Patuxent River versus the E reaches making up the reference reach database described in Secrist et al. (2006). In fact, the significant difference in entrenchment ratio observed between the reference reach E channels and all E channels measured across sampling units does not persist when evaluating only the E channels found in the Upper Patuxent sampling unit.

The other stream types observed were not present in a high enough frequency to make any direct comparisons to each other. However, nearly every assessed reach in this sampling unit, regardless of stream type, had a bankfull width much wider than expected given the low level of imperviousness (most less than 3%, excluding 16-12A at ~13%) found in the upstream drainage areas. These reaches had widths close to that predicted by a hydraulic geometry relationship developed Anne Arundel County for highly imperious watersheds (AAC 2002) instead of widths close to curves developed by McCandless (2003) in Coastal Plain watersheds with impervious surface levels less than 17%. For depth, dimensions better matched

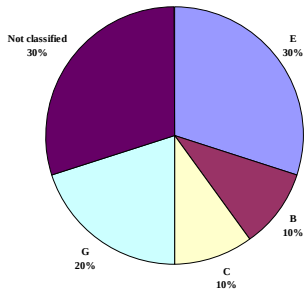

Figure 8 - Summary of Rosgen stream types in the Upper Patuxent sampling unit.

with McCandless (2003) than with the AAC (2002) urban curves.

The current trajectory for these reaches is unknown. The reaches in this sampling unit are likely in some state of recovery from past agricultural activities, which were likely on going up to the 1920s and 30s. However, since most of this sampling unit is contained within the Patuxent Wildlife Research Refuge and has very little development, the overall direction is likely toward increased equilibrium. Additional data collection will provide insight into the future conditions of streams within this sampling unit.

Little Patuxent River

The Little Patuxent River sampling unit is located in the northwestern part of the County (**Figure 1**), with site drainage areas ranging from 86 to 2,992 acres. The ten sample locations in the watershed **(Figure 9**) are located on tributaries to the Little Patuxent River.

Aquatic Habitat

None of the streams in the Little Patuxent PSU have physical habitat conditions that are comparable to reference (RBP) and none that are minimally degraded (PHI) (**Figure 10**). For the RBP assessment, 80% of the streams were rated "Partially Supporting" and 20% were "Non Supporting". The PHI further rated 40% "Partially Degraded," 50% as "Degraded," and 10% "Severely Degraded." The mean RBP habitat score was 105.0 ± 10.7, with individual sites ranging from 87 (Non-Supporting) - 118 (Partially Supporting). Of the two streams rated as "Non-Supporting", one had poor riparian conditions and the other had extremely poor pool substrates and variability (Sites 17-05 and 17-13a). The mean PHI rating was 62.9 ± 7.8, with individual sites ranging from around 49 (Severely Degraded) to 69 (Partially Degraded).

Benthic Macroinvertebrates

Fifty percent of the sites in the Little Patuxent River Sampling Unit rated as "Very Poor," 30% rated "Poor," and 20% rated "Fair" (**Figure 11**). The mean B-IBI score was 2.09 ± 0.79 (**Table 7**), with scores at individual sites ranging from 1.00 to 3.29. Site 17-05 received the lowest B-IBI score and had the lowest number of total taxa (12). Stressor tolerant organisms comprised 85% of the benthic macroinvertebrate assemblage at this site. The most dominant taxon, Diptera: Chironomidae: *Hydrobaenus*, made up 77% of the assemblage. Diptera: Chironomidae: *Hydrobaenus* was also the most abundant taxon at the two sites that received the highest B-IBI scores, 17-09 and 17-16a. However, these two sites had fewer stressor tolerant organisms and more diverse assemblages. Site 17-09 had thirty total taxa, which included several pollution intolerant taxa (Trichoptera: Psychomyiidae: *Lype*, Odonata: Gomphidae and Coleoptera: Elmidae: *Ancyronyx).* Six taxa from the environmentally sensitive orders Ephemeroptera, Plecoptera, Trichoptera were present at the other site, 17-16a, which had twenty-nine total taxa. For site-specific data and assessment results see ***Appendix F***

Water Quality

All water quality variables were within acceptable ranges for individual site observations and for mean values (**Table 9).** However, more stressful temperature and dissolved oxygen conditions might be expected at other times than during the March – April sampling period. Water temperature ranged from 5.8 – 15.1 °C; conductivity from 100 - 477 µmhos/cm; and DO from 7.2-11.5 mg/L.

Table 9– Average water quality values - Little Patuxent

Value ± Standard Deviation		
Temperature*	Conductivity*	D.O.*
9.9 ±2.7	275.3 ±122.0	10.2 ±1.7
**Units: Temp. (°C), Cond. (µmhos/cm), D.O. (mg/L)*		

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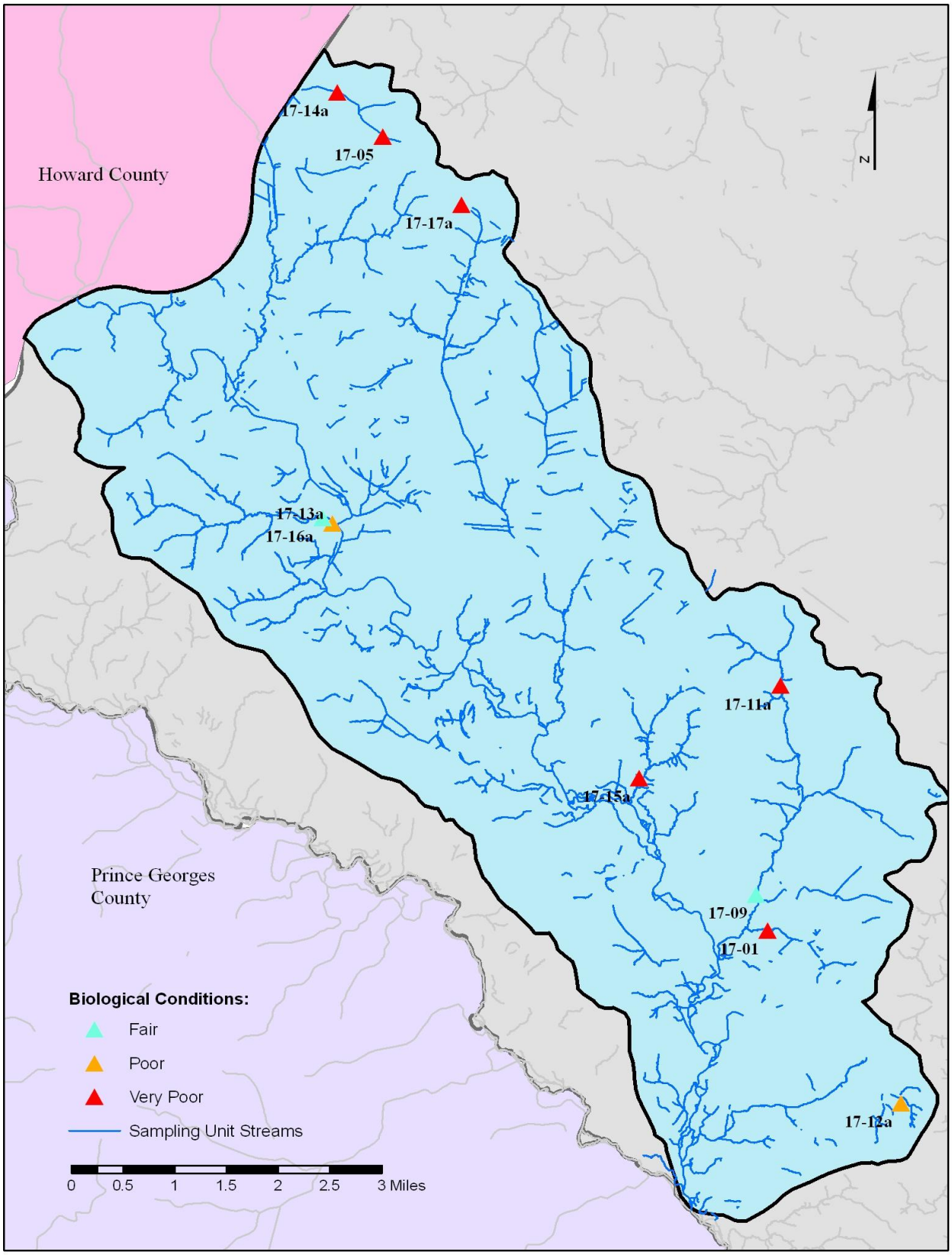

Figure 9 - Sampling locations in the Little Patuxent sampling unit.

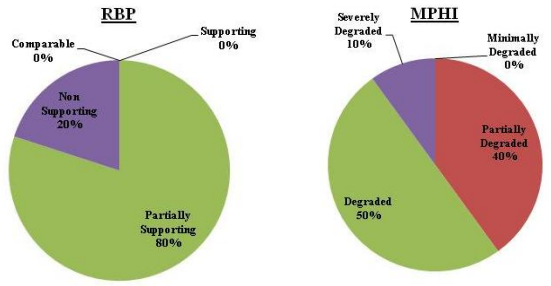

Figure 10 – Summary of habitat conditions in the Little Patuxent sampling unit.

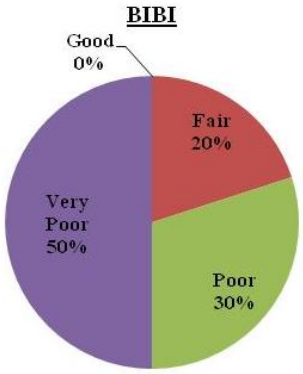

Figure 11 – Summary of BIBI scores in the Little Patuxent sampling unit.

Geomorphic Assessment

The B, F, C and G stream types were observed in this sampling unit in roughly equal proportions. As shown in **Figure 12**, the F and B types were slightly more prevalent at 30% occurrence versus 20% occurrence for the G and C types.

Eighty percent of reaches assessed in this sampling unit were sand bottom channels. The average D50 observed was 2.54 mm. Slopes ranged from a high of almost 2% to a low of 0.20%, with an average of 0.94% across all sites.

As in the other sampling units, regardless of stream type, streams here were straighter than expected for particular types. Sinuosities of between 1.0 and 1.2 dominated in the Little Patuxent. Only the two F types observed at 17-15A and 17-17A had sinuosities appropriate for their class.

In general, the reaches assessed here had lower width to depth ratios compared to average values for similar types. For example, the mean F4 W/D ratio is 28 (Rosgen 1998) while the F reaches measured in this sampling unit averaged around 14. For the C type, the average W/D ratio is 27 while the average C type assessed in the Little Patuxent had a W/D ration of 20. Overall, this condition may indicate that streams in this sampling unit are more entrenched and incised than expected. From the data collected here, it is unclear if the downcutting, which causes such entrenched conditions, has ceased. If so, then lateral adjustment would be expected for these reaches and the observed F and G types would possibly begin to evolve into C and E systems. Repeated measurements over time at these sites ultimately would provide insight into the evolutionary trajectory of these streams and the surrounding riparian areas.

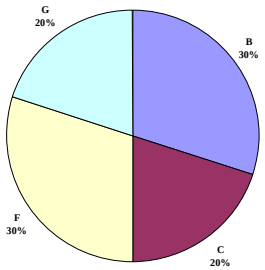

Figure 12 - Summary of Rosgen stream types in the Little Patuxent sampling unit.

Piney Run

The Piney Run sampling unit is located in the northwestern part of the County (**Figure 1**), with site drainage areas ranging from 122 – 12,770 acres. Ten sample locations in the watershed **(Figure 14)** are on the mainstem or tributaries of Piney Run

Aquatic Habitat

The RBP physical habitat assessments showed that 80 percent of the Piney Run streams are "Partially Supporting" and 20 percent are "Non Supporting" (**Figure 13**). The mean RBP score was 109.1 ± 10.0 (**Table 7**), with site-specific scores ranging from 94 (Non Supporting) to 125 (Partially Supporting). Of the two sites that rated lowest, one was rated low for bank stability and bank protection and the other had poor channel and pool variability.

The MBSS PHI characterized 30% of sites as either "Partially Degraded" or "Severely Degraded" (**Figure 14**), with the remainder classified as "Degraded." The mean PHI score was 58.7 ± 14.0, and the range of PHI scores was between 36 and 75.

Benthic Macroinvertebrates

Fifty percent of the sites in the Piney Run Sampling Unit rated as "Fair," 30% rated "Poor," and 20% rated "Very Poor" (**Figure 15**). The mean B-IBI score was 2.69 ± 0.80 (**Table 16**), with scores at individual sites ranging from 1.29 to 3.86. Site 01-13a had the lowest B-IBI score and the lowest number of total taxa (11). Two taxa, Oligochaeta: Naididae: *Nais* and Diptera: Chironomidae: *Eukiefferiella*, comprised 85% of the benthic macroinvertebrate assemblage at this site. Eighty-seven percent of the organisms at site 01-13a are considered to be stressor tolerant. Site 01-02 had the best B-IBI score and highest number of total taxa (33). Pollution intolerant organisms comprised a larger percentage of the assemblage at site 01-02 than stressor tolerant organisms (22% versus 13%). Coleoptera: Elmidae: *Oulimnius*, which is considered to be a pollution intolerant organism, was the most abundant taxon. Two species of Plecoptera and one species of Trichoptera were also present at this site. For site-specific data and assessment results see ***Appendix F***.

Water Quality

All water quality variables were within acceptable ranges for individual site observations and for mean values (**Table 10).** However, more stressful temperature and dissolved oxygen conditions might be expected at other times than during the March sampling period. Water temperature ranged from 0.5 – 12.0 °C; conductivity from 186 - 1774 µmhos/cm; and DO from 10.6 -14.8 mg/L.

Table 10– Average water quality values - Piney Run

Value ± Standard Deviation		
Temperature*	Conductivity*	D.O.*
6.3 ±3.7	1056.1 ±523.9	12.6 ±1.6
**Units: Temp. (°C), Cond. (µmhos/cm), D.O. (mg/L)*		

Geomorphic Assessment

The B, E, G, F and C types were observed in this sampling unit, with the G type being the dominant type observed (4 of 10 sites) (**Figure 16**). Generally, the G reaches and the single B type were found in the headwater areas of this sampling unit. The C type reaches were found furthest downstream along the mainstem while the E types were located between the two.

Streams in this sampling unit were a mix of sand and gravel 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.

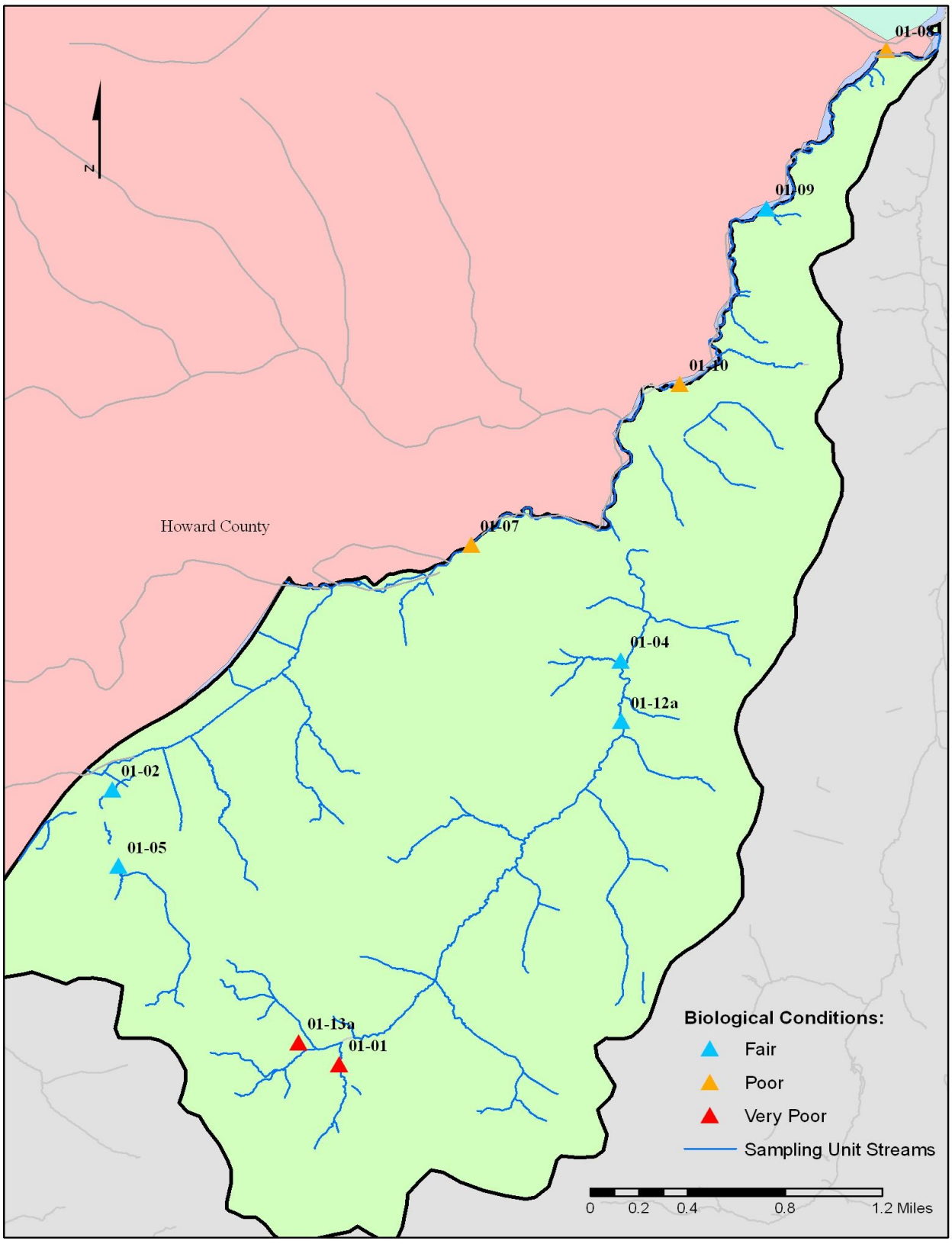

Figure 13 - Sampling locations in the Piney Run sampling unit.

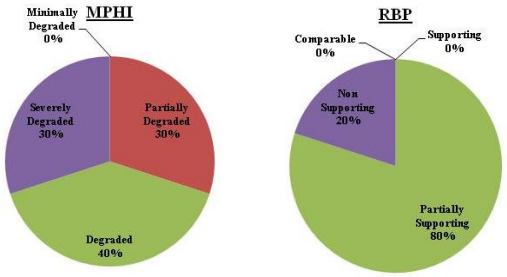

Figure 14 – Summary of habitat conditions observed in the Piney Run sampling unit.

These reaches occupy more of the valley floor than typical G streams. The average entrenchment ratio among all G types in the sampling unit was approximately 1.5 while Rosgen (1998) reports that the average G5 ER is around 1.2. Width to depth ratios are also larger for these G types than typically found for the stream type. G reaches in this sampling unit had an average width to depth of 8.9 while typical G5 streams have a W/D ratio

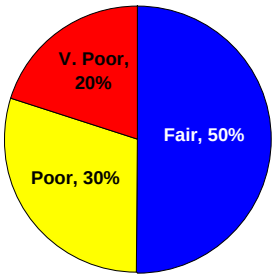

Figure 15 – Summary of BIBI scores in the Piney Run sampling unit.

of about 7.2.

Conversely, the C types are in Piney Run appear narrower that typical C types. Width to depth ratios for C5 streams average around 27. The average W/D ratio observed on C types in this sampling unit was around 17.

While this sampling unit appears to have unstable headwater reaches but somewhat stable mainstem reaches, it is unknown if the streams in this sampling unit have reached equilibrium. The larger than usual width to depth ratios for the headwater G channels may indicate that these reaches have finished incising into their valley floors and have begun lateral adjustments into more stable stream types. The delivery of sediment from these headwater systems might be causing aggradation and loss of channel capacity further down the river landscape, in line with the diminished width to depth ratios observed in the C type systems comprising the extreme downstream end of this sampling unit. Further narrowing and loss of depth in all the C types coupled with a conversion of the single gravel bed C type to a sand bed C stream would be indicative of continued headwater degradation. Additional measurements will be required to track the evolving geomorphic conditions within this sampling unit.

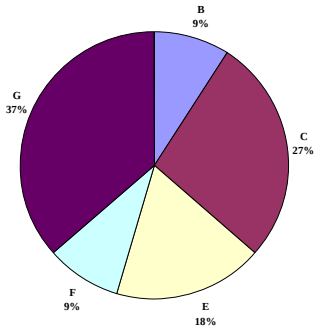

Figure 16 - Summary of Rosgen stream types in the Piney Run sampling unit.

Stony Run

The Stony Run sampling unit is the northernmost portion in the County (**Figure 1**). Sampling sites in Stony Run have individual drainage areas ranging from 59 to 6092 acres. The ten sample locations in the watershed **(Figure 17**) are on the mainstem or tributaries of Stony Run.

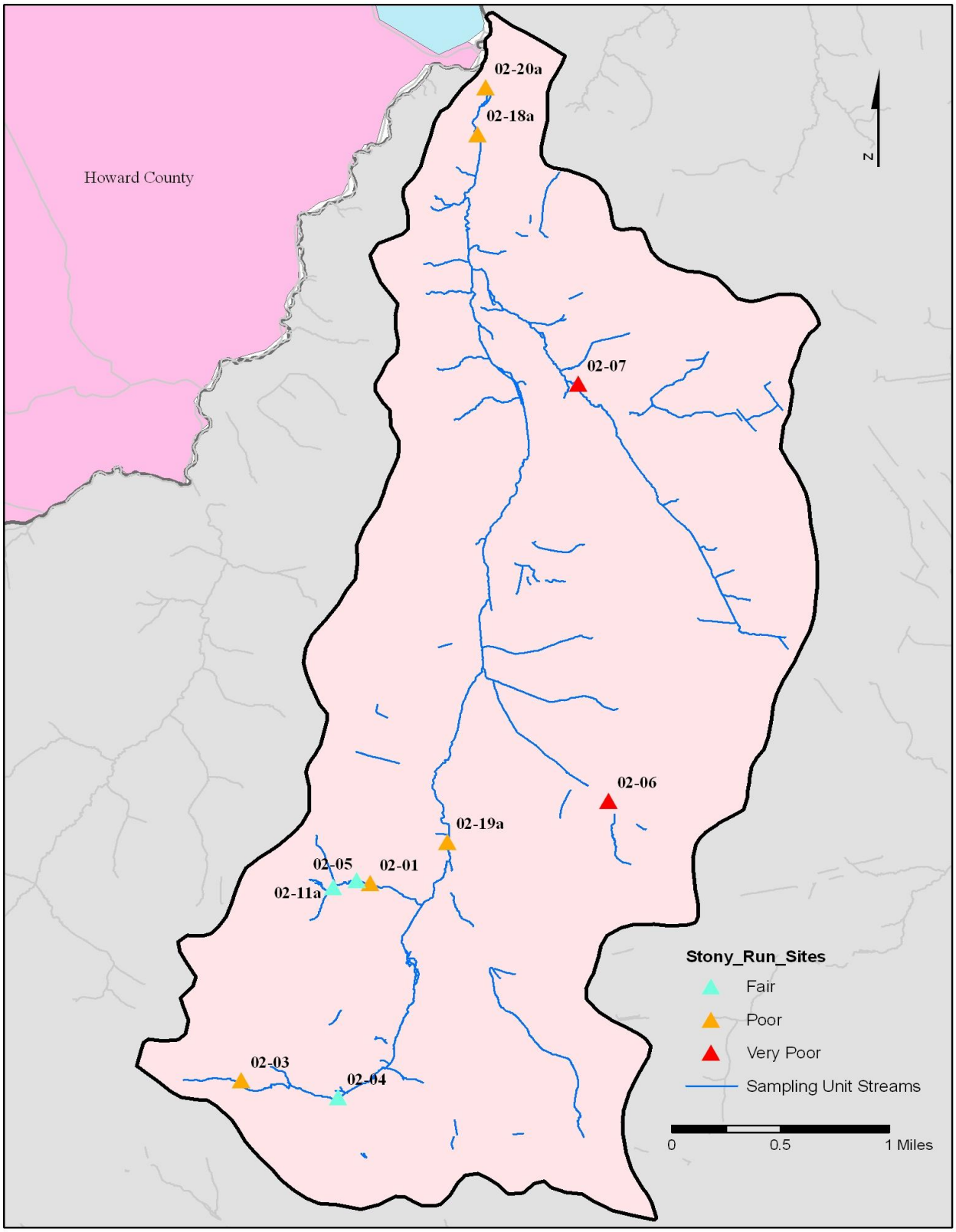

Figure 17 - Sampling locations in the Stony Run sampling unit.

Aquatic Habitat

The RBP physical habitat quality assessments show 70 percent of the streams in Stony Run as "Partially Supporting" and 30 percent as "Non Supporting" (**Figure 18**). The mean RBP value is 105.1 ± 8.4 (**Table 7**) with values ranging from 93 - 116. Of the three sites with "Non Supporting" habitat, site 02-19a had especially poor pool quality and sites 02-01 and 02-11a had poor bank conditions. The PHI indicated "Severely Degraded" conditions in 10% of sites, "Partially Degraded" in 20%, and "Degraded" in 70%. The mean PHI score was 68.8 ± 7.0, and the range was from 45 to 74.

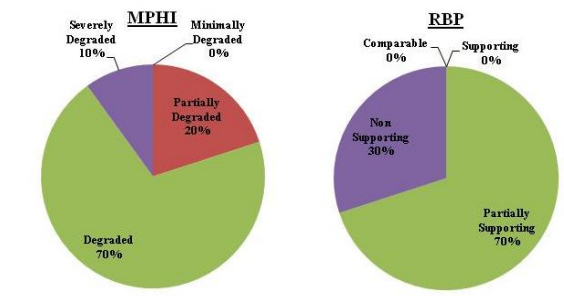

Figure 18 – Summary of habitat conditions in the Stony Run sampling unit.

Benthic Macroinvertebrates

Fifty percent of the sites in the Stony Run Sampling Unit rated as "Poor," 20% rated "Very Poor," and 30% rated "Fair" (**Figure 19**). The mean B-IBI score was 2.37 ± 0.70 (**Table 7**), with scores at individual sites ranging from 1.29 to 3.57. Mollusks were present at six of the ten sites in this sampling unit. Site 02-06 had the lowest B-IBI score (1.29) and the lowest number of total taxa (12). Mollusks comprised eighty-eight percent of the benthic macroinvertebrate assemblage at this site. At the site with the highest B-IBI score, 02-11a, Blackflies (Diptera: Simuliidae) and midges (Diptera: Chironomidae) were the most dominant taxa. This site had twenty-five total taxa, which included several pollution intolerant taxa (Trichoptera: Hydropsychidae: *Diplectrona* and Megaloptera: Corydalidae: *Nigronia*). For site-specific data and assessment results see ***Appendix F***.

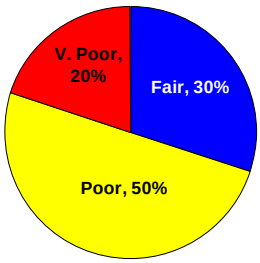

Figure 19 – Summary of BIBI scours in the Stony Run sampling unit.

Water Quality

In the Stony Run sub-watershed all water quality variables were within acceptable ranges for individual site observations and for mean values (**Table 11).** However, more stressful temperature and dissolved oxygen conditions might be expected at other times than during the March sampling period. Water temperature ranged from 1.1 – 15.7 °C; conductivity from 220 - 1199 µmhos/cm; and DO from 8.5 – 15.7 mg/L.

Table 11– Average water quality values - Stony Run

Value ± Standard Deviation		
Temperature*	Conductivity*	D.O.*
7.8 ±5.8	633.9 ±319.6	12.1 ±2.4
**Units: Temp. (°C), Cond. (µmhos/cm), D.O. (mg/L)*		

Geomorphic Assessment

In this sampling unit, the E and C types were the predominant types observed, making up 50 and 40 percent of reaches evaluated, respectively (**Figure 20**). A single F type was also found in the sampling unit.

Only one of ten assessment reaches had gravel-dominated bottoms while the remaining reaches were sand bottom channels. The average D50 observed was 2.53 mm or just into the gravel particle class. Slopes ranged from a high of just over 1% to a low of 0.1%, with an average of 0.68% across all sites.

Excluding sinuosity, there were no significant differences between the E-type reaches found in the Stony Run versus the E reaches making up the

reference reach database described in Secrist et al. (2006). In fact, the significant difference in entrenchment ratio observed between the reference reach E channels and all E channels measured across sampling units does not persist when evaluating only the E channels found in the Stony Run sampling unit.

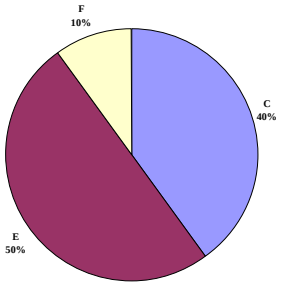

Figure 20 - Summary of Rosgen stream types in the Stony Run sampling unit.

For the C types observed, it appears that these reaches are deeper and occupy less of the floodprone area (Rosgen 1996) than typical C5 stream types. Rosgen (1998) reports that the average C5 entrenchment ratio is 2.96 while the average ER observed for Stony Run sites is 10.5. For the C type, Stony Run reaches have a fairly low width to depth ratio at 16 in comparison to the average of 27 reported in Rosgen (1998) for C5 stream types.

Overall, streams in the Stony Run sampling unit appear somewhat narrower and more entrenched in the floodplain than expected for their type. The current evolutionary trajectory for these reaches is unknown. An inspection of property records shows that a large portion of development in this sampling unit, approximately 56%, occurred during the 1980s and 1990s, meaning that runoff from these areas is likely being treated by some sort of stormwater management technology. What long term influence such approaches might have on stream geomorphology remains unknown, although evidence suggests (MDE 2000) that the management approaches applied during this time period are less effective at protecting receiving stream stability than current approaches mandated today. Additional data collection will help to answer this question.

Lower Magothy River

The Lower Magothy sampling unit is on the eastern border of the County (**Figure 1**). Sampling sites in the Lower Magothy have individual drainage areas ranging from 169 – 800 acres. The ten sample locations in the watershed **(Figure 21**) are all on tributaries of the Lower Magothy River.

Aquatic Habitat

The RBP physical habitat quality assessments show 60 percent of the streams in the Lower Magothy as "Non Supporting" and 40 percent as "Partially Supporting" (**Figure 22**). The mean RBP value is 101.7 ± 8.6 (**Table 7**) with values ranging from 91 - 118. Five of the six sites with "Non Supporting" habitat conditions had especially poor bank conditions. The other site (08-07) was severely channelized. The PHI indicated "Degraded" conditions in 70 percent of sites, "Partially Degraded" conditions at 20% of sites, and one site judged "Severely Degraded." The mean PHI score was 58.7 ± 6.0, with scores ranging from 49 to 70. A lack of epifaunal substrate and the low remoteness scores contributed to the observed impaired conditions.

Benthic Macroinvertebrates

Sixty percent of the sites in the Lower Magothy River Sampling Unit rated as "poor," 30% rated "very poor," and 10% rated "fair" (**Figure 23**). The mean B-IBI score was 2.20 ± 0.46 (**Table 7**), with scores at individual sites ranging from 1.57 to 3.00. The lowest B-IBI scores occurred at two sites, 08-09 and 08-03. Ninety-three percent of the organisms at site 08-09 were midges (Diptera: Chironomidae), and the most dominant taxon, Diptera: Chironomidae: *Parametriocnemus*, comprised 57% of the assemblage.

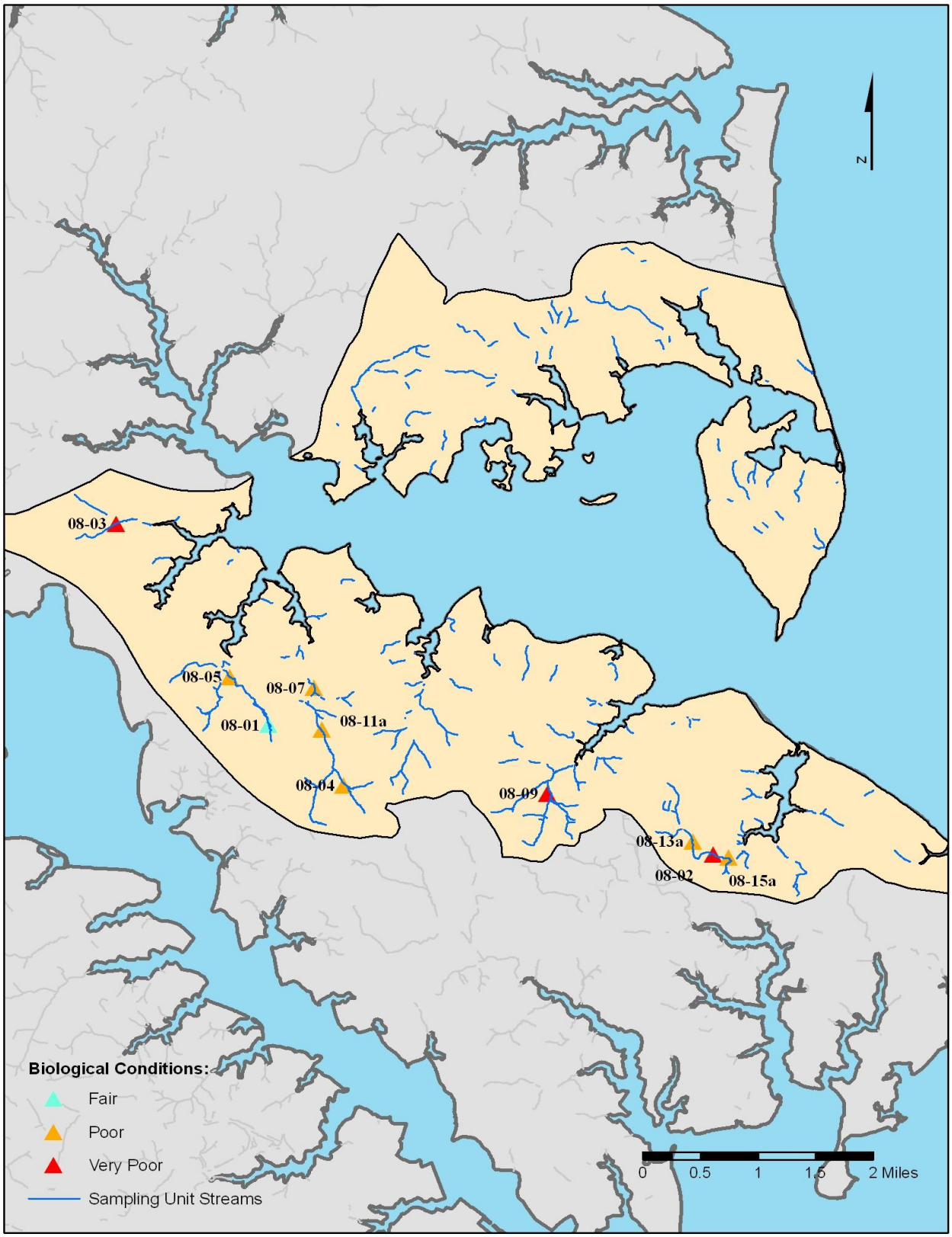

Figure 21 - Sampling locations in the Lower Magothy River sampling unit.

Of the sixteen total taxa at site 08-03, eight were worms (six Oligochaeta taxa, one Planariidae (flatworm), one Nemertea (ribbon worm)) and one was a leech (Hirudinea). One taxon, Oligochaeta: Tubificinae, comprised 60% of the assemblage. Tubificinae was also the most dominant taxon at site 08-01, which received the highest B-IBI score. However, several taxa that are intolerant to pollution, such as Trichoptera: Odontoceridae: *Psilotreta*, Trichoptera: Psychomyiidae: *Lype* and Coleoptera: Elmidae: *Oulimnius*, were present at this site. For site-specific data and assessment results see ***Appendix F***.

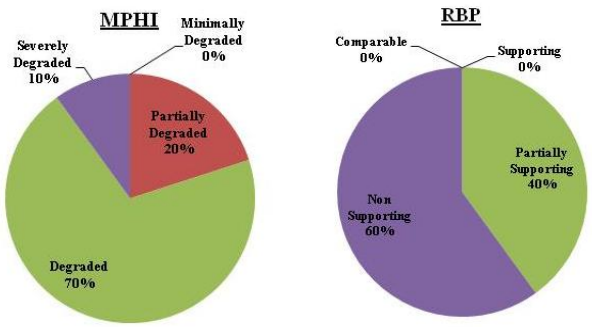

Figure 22 – Summary of habitat conditions in the Lower Magothy sampling unit.

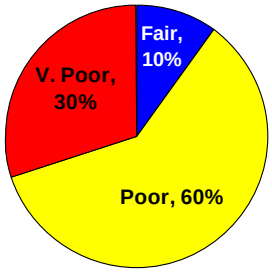

Figure 23 Summary of BIBI scores in the Lower Magothy sampling unit.

Water Quality

In the Lower Magothy PSU, all water quality variables were within acceptable ranges for individual site observations and for mean values (**Table 12).** However, more stressful temperature and dissolved oxygen conditions might be expected at other times than during the March sampling period. Water temperature ranged from 1.5 – 12.8 °C; conductivity from 358 - 4384 µmhos/cm; and DO from 9.9 – 12.6 mg/L. The values for specific conductance are higher in the Lower Magothy than in the other subwatersheds sampled in 2007. However, no standard has been established for determining stressful levels of specific conductance. Samples with the highest conductivity were collected one day after a snow event, when road salts may have drained into the sampled waters and elevated the conductivity reading.

Table 12– Average water quality values - Lower Magothy

Value ± Standard Deviation		
Temperature*	Conductivity*	D.O.*
6.3 ±3.1	1131.4 ±1194.5	11.2 ±0.9
**Units: Temp. (°C), Cond. (µmhos/cm), D.O. (mg/L)*		

Geomorphic Assessment

The E, G, and C types were observed in this sampling unit, with the E type being the dominant type observed (6 of 10 sites) (**Figure 24**). One site, 08-07, was excluded from analysis because approximately half the site was contained within a culvert crossing a nearby road. There were no obvious patterns in the distribution of stream types within the sampling unit.

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.

Excluding sinuosity, there were no significant differences between the E-type reaches found in the Lower Magothy versus the E reaches making up the reference reach database described in Secrist et al. (2006). In fact, the significant difference in entrenchment ratio observed between the reference reach E channels and all E channels measured across sampling units does not persist when evaluating only the E channels found in the Lower Magothy sampling unit.

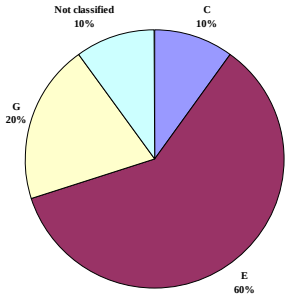

Figure 24 - Summary of Rosgen stream types in the Lower Magothy sampling unit.

The Lower Magothy sampling unit appears to have mostly stable E type systems. Despite the presence of these stable channel types, biological conditions are poor overall. Currently, the potential state of channel stability is unclear. Given the likely age of development in this sampling unit, these channels might be approaching equilibrium conditions. However, repeated measurements would be required to validate this assumption. Regardless, any habitat quality associated with stable channel conditions is not sufficient to overcome the known impacts to water quality linked with the large amounts of residential and commercial development found within this sampling unit (Stepenuck et al. 2002, Palmer et al. 2002).

Conclusions and Recommendations

As there are typically multiple stressors affecting stream biota, it is often difficult to isolate single stressors that are the direct cause of biological impairment (Norton et al. 2000, USEPA 2000). We do 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. For example, two sites in the Upper Patuxent were rated as "Poor" for biology (B-IBI) and "Supporting" for habitat (RBP) (**Table 13**). This is an indication that stressors unrelated to habitat are causing biological degradation in this sampling unit. **Table 14** similarly arranges biological assessment narratives against those for PHI. Stability and complexity of physical habitat are necessary for a healthy biota, among other factors. Poor water quality, availability of food resources, and invasive species can impair the ability of stream organisms to survive and reproduce. Assuming that physical habitat quality is the principal factor

Table 13–Site-by-site comparison of biological assessments (BIBI) to physical habitat quality assessments (EPA RBP).

EPA RBP Habitat Assessment Narratives	BIBI Narratives			
	Good	Fair	Poor	Very Poor
Comparable				
Supporting		16-11A	16-13A 16-14A	
Partially Supporting		01-02 01-09 01-12A 02-04 02-05 17-09 17-16A	01-07 01-08 01-10 02-03 02-18A 02-20A 08-11A 08-13A 08-15A 16-01 16-02 16-05 16-10 16-16A 17-12A 17-15A	01-01 01-13A 02-06 02-07 08-09 17-01 17-11A 17-14A 17-17A
Non-Supporting		**01-04** **01-05** **02-11A** **08-01**	02-01 02-19A 08-04 08-05 08-07 17-13A	08-02 08-03 16-03 16-12A 17-05

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.

Table 14–Site-by-site comparison of biological assessments (BIBI) to the physical habitat assessments (MBSS PHI).

MBSS PHI assessments	BIBI Narratives			
	Good	Fair	Poor	Very Poor
Minimally Degraded		16-11A	**16-13A** **16-14A** **16-16A**	
Partially Degraded		01-04 02-04 02-11A 08-01 17-16A	08-04 16-01 16-02 16-05 16-10 17-12A 17-15A	**01-01** **01-13A** **17-01** **17-17A**
Degraded		01-02 01-05 01-12A 02-05 17-09	01-07 02-01 02-03 02-18A 02-20A 08-05 08-11A 08-13A 08-15A 17-13A 17-15A	02-06 02-07 08-02 08-03 08-09 16-12A 17-05 17-14A
Severely Degraded		**01-09**	01-10 01-08 02-19A 08-07	16-03 17-11A

Refer to notes under **Table 13** regarding cell shading and bold type.

defining the biological potential of a stream, we can make inferences about streams in which the biological indicators are better or worse than expected. Biological signals that are better than expected may be due to something like nutrient enrichment while those that are worse than expected may be depressed by stressors such as water chemistry contaminants. **Table 15** shows those sites for which the B-IBI is higher or lower than expected for the habitat assessment. Only those sites for which the biology-habitat relationship was true for both habitat quality indicators are shown.

Table 15–Reaches for which the paired assessments of biological condition (BIBI) and physical habitat quality (RBP, PHI) indicate the potential stressor type affecting the stream biota.

Possible Water Quality Impairment	Possible Enrichment
01-01 01-13A 02-06 02-07 08-09 16-13A 16-14A 17-01 17-11A 17-14A 17-17A	01-02 01-05 01-09 01-12A 02-05 02-19A 08-07 17-09

Water quality impairments are most commonly observed within the Little Patuxent River PSU, with 4 of 10 sites exhibiting such conditions for both habitat assessments. Enrichment was judged to have occurred most frequently at sites in the Piney Run PSU.

Overall biological conditions are impaired for all five 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, our knowledge about the specific modes of action of most stressors may not be well-tested and 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), or both. 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.

There were no conclusive indications of adverse water quality conditions. Temperature and dissolved oxygen met COMAR standards. There is no state standard for conductivity. One site had a particularly high reading, at 4384 µmhos/cm in the Lower Magothy. Eight other readings were greater than 1000 µmhos/cm, five of which were in the Piney Run. All of the high conductivity readings in the Lower Magothy sampling unit were collected one day after a snow event and probable road salting. Samples in the Piney Run were collected before and several days after snow events. Due to calibration inconsistencies with the pH probe of the multimeter the pH data were deemed unreliable and were not reported.

Channel instability and excessive erosion are likely significant stressors impacting stream macroinvertebrate communities in these sampling units. Streams with typically unstable channels were fairly common, with 18% G channels and 10% F channels over the five sampling units. While additional assessment information is necessary in order to anticipate changes in channel form, these baseline results indicate that significant channel erosion will occur in several reaches, especially those indicating unstable banks and erosional or depositional features.

As illustrated in **Table 16**, E channels in the sampling units have two of three channel characteristics that are significantly different from Western Coastal Plain reference conditions (Secrist et al. 2006). In general, E channels in the sampling units are straighter than found in stable E reaches, having only 60% of the sinuosity associated with stable reaches. Entrenchment ratios were also relatively low, which means that the reaches found in this year's sampling units 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 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 over-widening, 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

Table 16–Comparison of average E channel dimensionless ratios found in this study to other sources.

Data Sources	Sinuosity	ER	W/D	Reference
General E5 stream type	2.35	39.5	5.78	Rosgen (1998)
E channel Western CP reference reaches	1.42	26.4	9.2	Secrist et al. (2006)
Field data from this assessment	1.13*	14.3*	7.86	–

* = Significant difference from E channel WCP reference reaches ($p < 0.05$)

Plain, and the responses of the County's streams are likely still occurring today.

The C, E and B stream types are typically considered evolutionary end points in the Rosgen classification system that perturbed systems tend to adjust toward over time (Rosgen 1996). These stable stream types dominated the Stony Run, Lower Magothy, and Upper Patuxent sampling units and were found in lesser amounts in the other units. Conversely, unstable types like the F and G types were found in significant percentages in the Piney Run and Little Patuxent sampling units.

One trend observed across sampling units and within all stream types is the prevalence of channels that are narrower, deeper, straighter, and occupy a smaller percentage of streamside land on to which out of bank flows occur. Conditions for the E type streams are discussed previously. **Table 17** show that similar patterns exist for other observed types, although statistical tests were not performed to determine if significant differences exist.

Table 17–Comparison of mean observed stream characteristics by type to mean values typical for the type.

Stream Type	Entrenchment Ratio		Width / Depth		Sinuosity	
	Obs.	Typ.	Obs.	Typ.	Obs.	Typ.
B[1]	1.74	1.63	12.2	16.6	1.02	1.38
C	9.85	2.96	20.5	27.0	1.11	3.45
F	1.32	1.14	16.3	21.3	1.36	1.43
G	1.47	1.17	7.5	7.2	1.07	1.25

[1]Typical values from Rosgen (1998). B4 type was used as no surveys exist for B5 types.

In order to place such departure from expected values into context, 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 (AADPW 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 25**.

As shown in **Figure 25**, nearly all values fall somewhere between the rural and urban bankfull channel regional cures. 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 and lower elevation than it was in the pre-disturbance phase.

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.

Based upon the results of this assessment, the following recommendations are made:

Continue Assessment Efforts. This first five year monitoring cycle provides a crucial baseline necessary to understand overall biological conditions within the County. To understand ecological trends and possible recovery associated with management activities, repeated sampling of this nature is necessary.

Address Water Quality Impairments. Given the depressed biological conditions related to available habitat, it seems likely that runoff from upstream land uses is impacting the water quality of these systems and adversely affecting the biological communities. To the extent feasible, best management practice installation and/or retrofits should be occur in these sampling units, particularly in the Little Patuxent, Upper Patuxent,

and Upper Magothy PSUs where several sites showed biological conditions depressed relative to observed habitat quality.

Geomorphic Assessments. The pervasive instream sedimentation observed is likely due to causative agents that act well outside the assessment reaches sampled here. For sites that have the most severe problems, additional assessments that look at the physical conditions of the stream channel and of contributing upstream reaches are necessary in order to understand the corrective measures necessary to enhance channel stability.

Build on Existing Assessments. As comprehensive watershed assessments are completed in these PSUs, the recommendations from those studies should be implemented to the extent feasible.

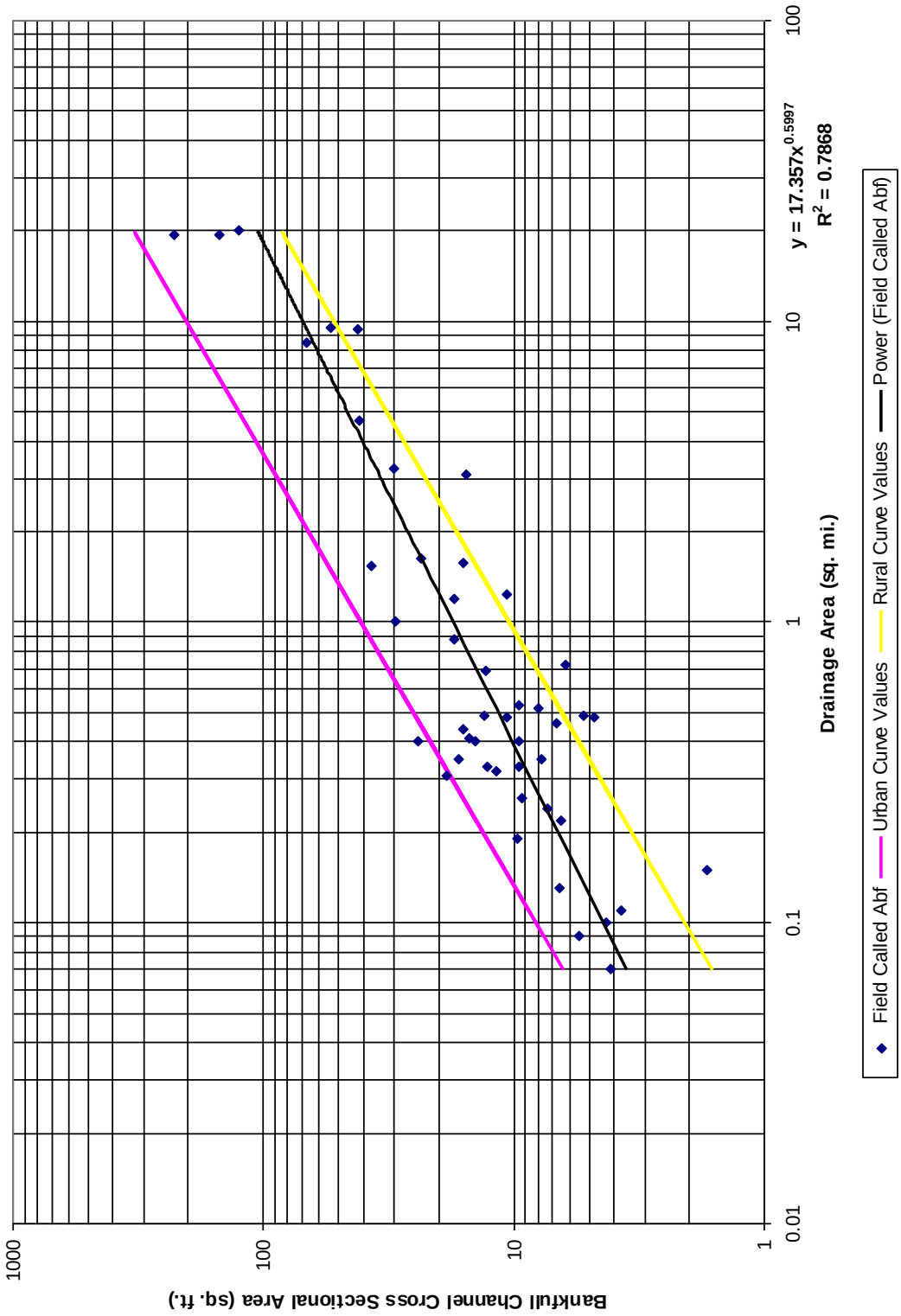

Figure 25. Comparison of field collected A) bankfull channel depth, B) bankfull channel area, and C) bankfull channel width with Coastal Plain regional relationships in rural and urban watersheds.

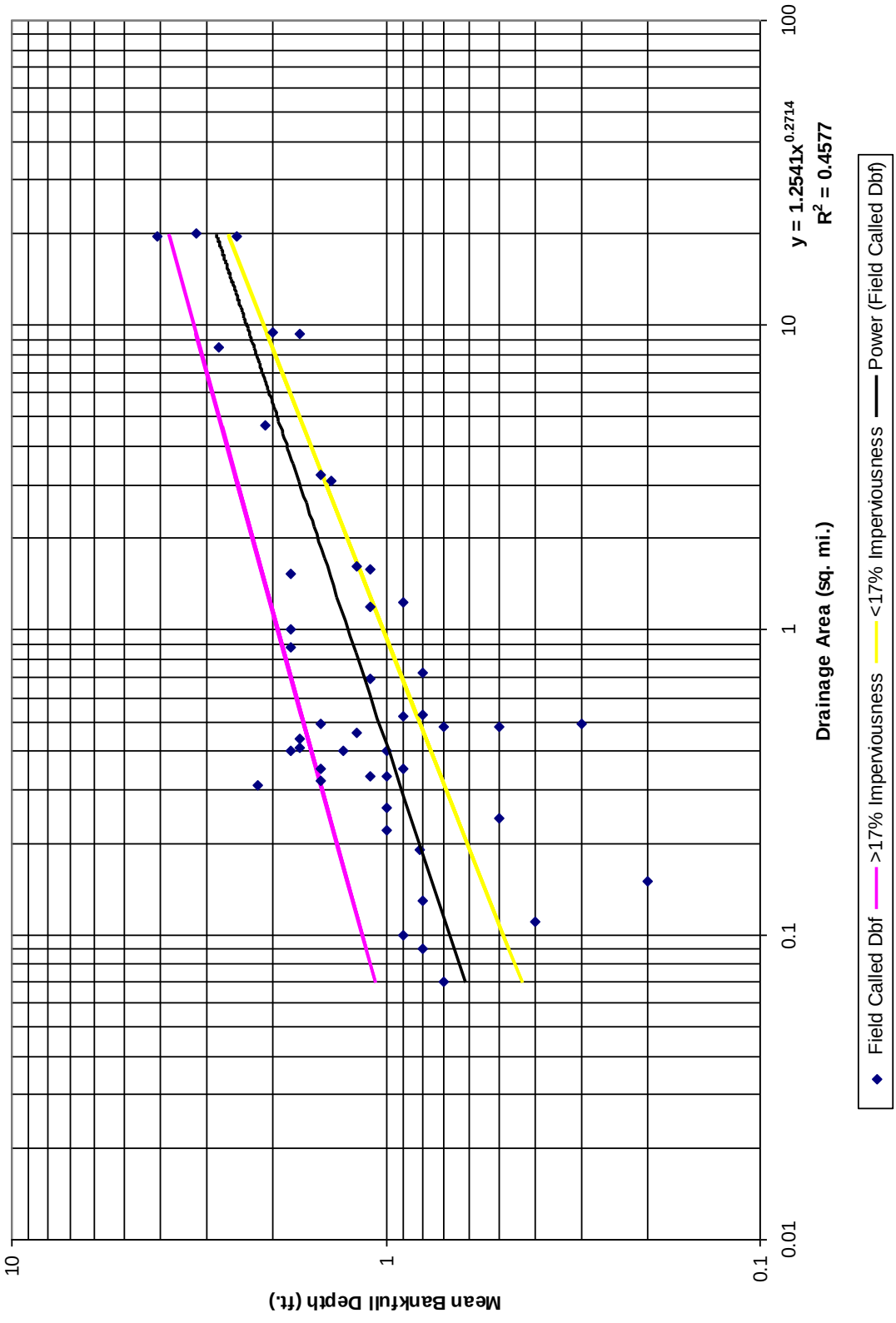
Mean Bankfull Depth (ft.)
10
1
0.1
0.01
0.1
1
10
100
Drainage Area (sq. mi.)
y = 1.2541x^0.2714
R² = 0.4577
Field Called Dbf
>17% Imperviousness
<17% Imperviousness
Power (Field Called Dbf)

Figure 25.b

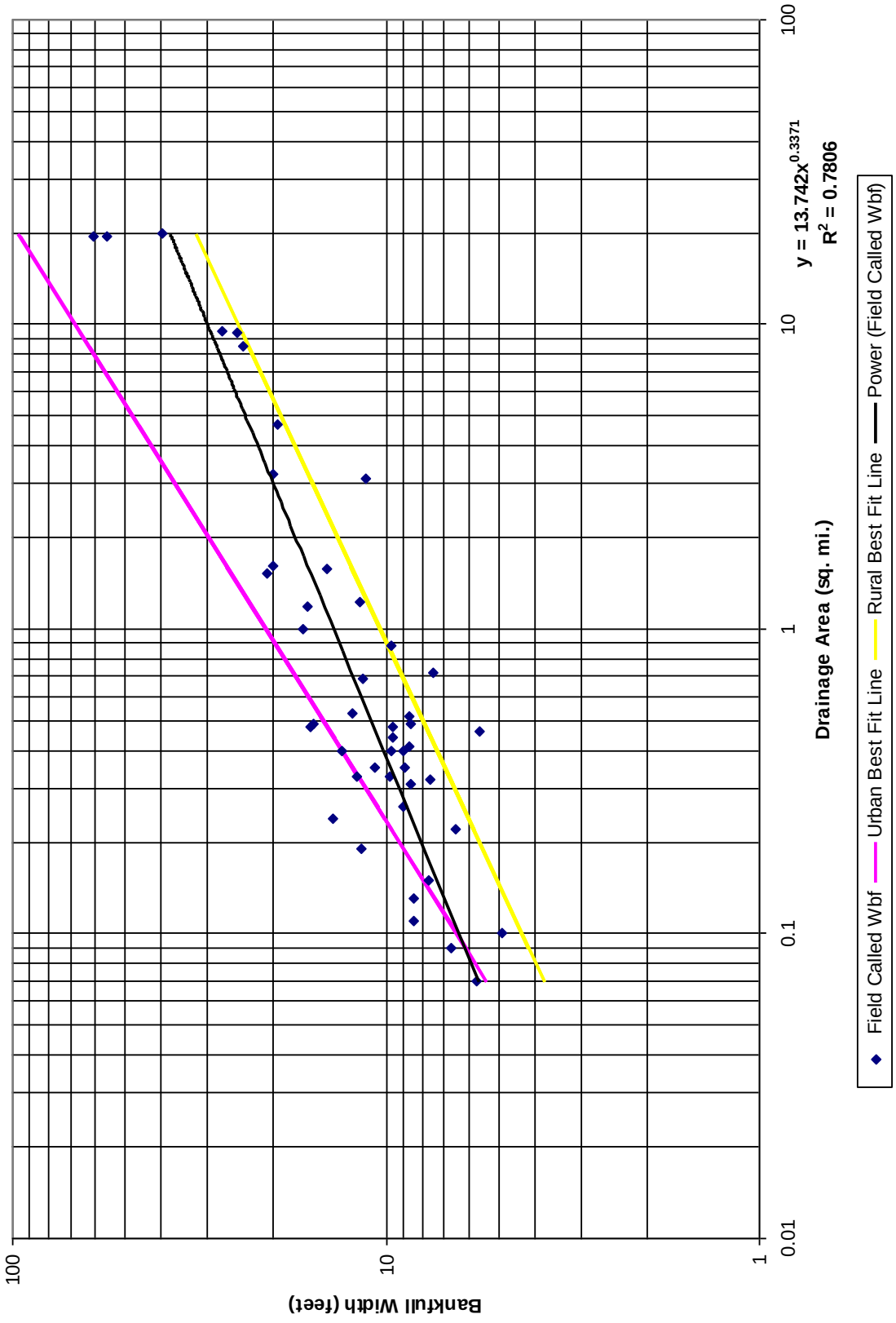
Bankfull Width (feet)
100
10
1
0.01
0.1
1
10
100
Drainage Area (sq. mi.)
y = 13.742x^0.3371
R² = 0.7806
Field Called Wbf
Urban Best Fit Line
Rural Best Fit Line
Power (Field Called Wbf)

Figure 25.c

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APPENDIX A

SAMPLE FIELD SHEETS

ANNE ARUNDEL COUNTY
MARYLAND
County Executive Janet S. Owens

Stream Channel Classification and Assessment Form
Rosgen Classification System
Level II

OECR

Watershed Name:_____ Stream/ReachID:_____
Drainage Area:_____mi^2/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:
_____

Thalwag 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.
Thalwag 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 Guage

(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 not new fall and not 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**
6. Channel Alteration	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.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	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.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	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
9. Vegetative Protection (score each bank) 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
10. Riparian Vegetative Zone Width (score each bank riparian zone)	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

SITE Watershed Code ____ Segment ____ Type ____ Year 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) ____

Remoteness ____

Bank Erosion

	Left Bank	Right Bank
Extent		
Severity		
1=min		
2=mod		
3=severe		
Eroded Area (m2 X 10)		
Bank Stability		

Benthic Habitat Sampled

(Square feet; Total = 20 square feet)

Riffle	
Rootwad/Woody Debris	
Leaf Pack	
Macrophytes	
Undercut Banks	
Other	

(Specify) _____

Stream Width (m)

0 m ____

75 m ____

LANDUSE (Y/N)

Old Field	
Deciduous Forest	
Coniferous Forest	
Wetland	
Surface Mine	
Landfill	
Residential	
Commercial/Industrial	
Cropland	
Pasture	
Orchard/Vineyard/Nursery	
Golf Course	

RIPARIAN VEGETATION (facing upstream)

	Left Bank	Right Bank
Width (50m max)		
Adjacent Land Cover		
Vegetation Type (see back)		
Buffer Breaks (Y/N)		

Buffer Break Types (M=minor; S=severe)

Storm Drain		
Tile Drain		
Impervious Drainage		
Gully		
Orchard		
Crop		
Pasture		
New Construction		
Dirt Road		
Gravel Road		
Raw Sewage		
Railroad		

CHANNELIZATION

Evidence of Channel Straightening or Dredging (Y/N) ____

TYPE	EXTENT (m) Left Bank	Bottom	Right Bank
Concrete			
Gabion			
Rip-rap			
Earthen Berm			
Drege Spoil off Channel			
Pipe Culvert			

HABITAT ASSESSMENT

Instream Habitat (0-20)	
Epifaunal Substrate (0-20)	
Velocity/Depth Diversity (0-20)	
Pool/Glide/Eddy Quality (0-20)	
Extent (0-20)	
Riffle/Run Quality (0-20)	
Extent (0-20)	
Embeddedness (%)	
Shading (%)	
Trash Rating	

WATER QUALITY PARAMETERS

Temperature © ____.____

DO (mg/L) ____.____

pH ____.____

Cond (ms/cm) ____.____

Turbidity (NTU) ____.____

Meter Calibrations by: _____

Sampleability

- ____ Benthos
- ____ Habitat Assessment
- ____ Water Quality

Road Culvert

- ____ Culvert in Segment? (y/n)
- ____ Sampleable? (y/n)
- ____ Length of Culvert (m)
- ____ Width of Culvert (m)

Maximum Depth (cm) ____

No. Instream Woody Debris	
No. of Dewatered Woody Debris	
No. of Instream Rootwads	
No. of Dewatered Rootwads	

PHOTODOCUMENTATION

Picture Number ____ Subject _____

Picture Number ____ Subject _____

Picture Number ____ Subject _____

Picture Number ____ Subject _____

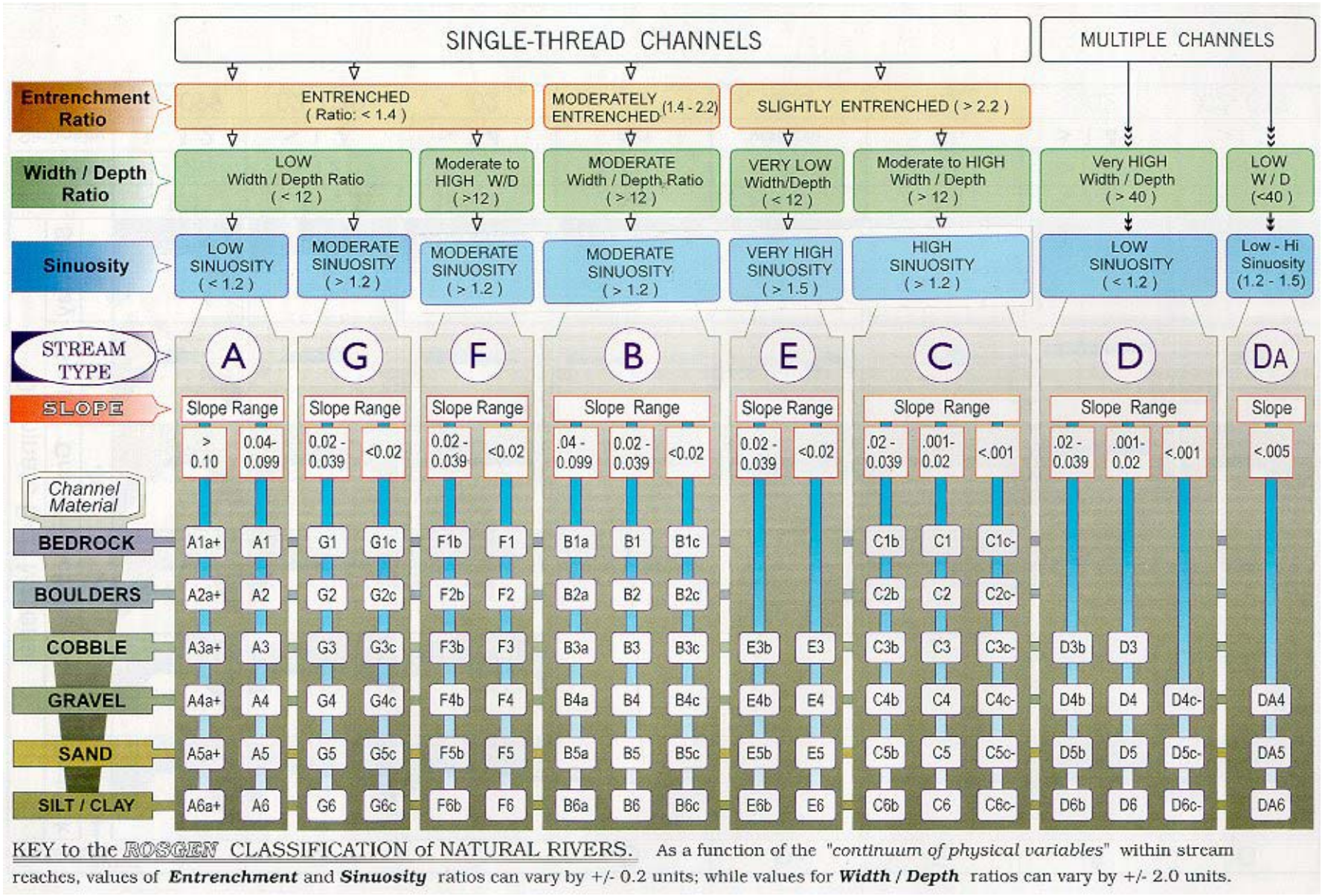
Site Acces Route _____

Sampling Consd (____num. Anodes) _____

Comments _____

APPENDIX B

ROSGEN STREAM CLASSIFICATION



KEY to the *ROSGEN* CLASSIFICATION of NATURAL RIVERS. As a function of the *"continuum of physical variables"* within stream reaches, values of ***Entrenchment*** and ***Sinuosity*** ratios can vary by +/- 0.2 units; while values for ***Width / Depth*** ratios can vary by +/- 2.0 units.

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

APPENDIX C

GEOMORPHIC ASSESSMENT RESULTS

Station	DA mi2	ER f/f	Wbf ft	Dbf ft	W/D f/f	Abf ft2	Slope %	Sinuosity f/f	Wfp ft	D50 mm	Adj?	Level II Stream Type
01-01	0.4	1.6	9.6	1.7	5.8	15.9	1.1	1.00	16	0.2	Sin, ER	G5c
01-02	0.7	1.4	7.5	0.8	9.2	6.2	0.94	1.10	10	0.2	Sin, ER	G5c
01-04	0.2	3.7	6.5	1	6.5	6.5	1.8	*1.10*	24	1.0	Sin	E5
01-05	0.4	1.5	9.7	1	9.9	9.5	0.85	*1.00*	14	0.5	Sin, W/D	B5c
01-07	7.8	*24.4*	24.2	2.8	8.8	66.9	0.27	1.00	*590*	6.0	Sin	E4
01-08	20.1	*9.0*	39.9	3.2	12.7	126.1	0.086	1.20	*361*	0.3	Sin	C5
01-09	19.0	*13.4*	56.1	4.1	13.8	228.8	0.17	*1.10*	*750*	0.5	Sin	C5
01-10	18.2	14.4	60.8	2.5	24.6	150.2	0.51	1.20	*876*	14.0	None	C4
01-12A	3.2	1.3	20.1	1.5	13.4	30.3	0.91	1.20	*26*	4.0	None	F4
01-13A	0.4	1.6	13.1	1.8	7.2	24	0.77	1.10	21	0.3	ER, Sin	G5c
02-01	0.4	10.9	10.7	1.5	6.9	16.5	0.47	1.00	116	0.3	Sin	E5
02-03	0.1	8.9	6.7	0.8	8.2	5.5	0.88	1.00	60	0.2	Sin	E5
02-04	0.5	10.9	9.6	0.5	19.3	4.8	0.67	*1.20*	105	0.3	Sin	C5
02-05	0.3	9.5	7.6	1.5	4.9	11.8	0.1	1.10	72	0.4	Sin	E5
02-06	0.5	*16.2*	12.3	0.8	15.8	9.6	0.28	1.00	*200*	0.3	Sin	C5
02-07	1.5	*4.7*	20.8	1.8	11.7	37.1	0.86	1.40	*98*	1.0	Sin	E5
02-11A	0.2	1.3	13.9	0.5	26.7	7.3	1.1	1.40	19	0.3	None	F5
02-18A	9.4	5.6	25.1	1.7	15.0	41.9	1.13	1.10	140	22.0	Sin	C4
02-20A	9.5	*9.4*	27.4	2	13.9	54	0.47	1.20	*257*	0.5	Sin	C5
08-01	0.3	8.9	8.6	2.2	4.0	18.6	0.2	1.00	77	0.2	Sin	E5
08-02	0.5	*3.7*	8.6	1.5	5.6	13.1	0.136	1.00	*32*	0.2	Sin	E5
08-03	0.5	1.5	5.6	1.2	4.6	6.8	1.02	1.00	8	0.2	ER, Sin	G5c
08-04	0.3	1.0	9.0	1	8.8	9.3	0.62	*1.00*	9	0.3	Sin	G5c
08-05	0.5	*8.5*	15.7	0.3	46.5	5.3	0.59	1.00	*133*	0.3	Sin	C5
08-09	0.3	10.0	9.8	1	10.2	9.5	0.59	1.30	98	*0.4*	Sin	E5
08-11A	0.9	*20.7*	9.7	1.8	5.4	17.3	0.04	*1.00*	*227*	0.4	Sin	E5
08-13A	0.4	*17.7*	8.7	1.7	5.1	15.1	0.55	1.10	*155*	0.2	Sin	E5
08-15A	0.5	*23.1*	8.7	0.9	9.3	8	0.21	1.10	*200*	0.1	Sin	E5
16-01	0.3	*23.0*	12.0	1.1	11.3	12.7	0.69	1.00	*276*	0.3	Sin	E5
16-02	0.4	*17.0*	9.0	1.3	9.0	14.2	0.47	1.50	*193*	0.5	None	E5

Station	DA mi2	ER f/f	Wbf ft	Dbf ft	W/D f/f	Abf ft2	Slope %	Sinuosity f/f	Wfp ft	D50 mm	Adj?	Level II Stream Type
16-05	0.4	1.7	8.9	0.9	10.1	7.8	0.42	1.10	15	0.3	W/D, Sin	B5c
16-11A	0.1	1.3	5.7	0.7	7.9	4.1	2.2	*1.10*	8	0.4	Sin	G5
16-12A	0.5	11.2	16.0	0.7	24.1	10.7	0.77	1.00	180	0.2	Sin	C5
16-14A	0.1	5.3	8.4	0.8	10.7	6.6	1.4	1.40	44	8.4	Sin	E4
16-16A	0.1	1.8	4.9	0.9	5.6	4.3	1.7	1.20	9	0.4	ER	G4c
17-01	1.0	1.7	16.7	1.8	9.3	29.8	1.33	1.13	28	0.4	ER	G5c
17-05	0.2	1.5	11.6	0.81	14.0	9.7	0.83	1.00	17	0.3	Sin	B5c
17-09	4.7	1.3	19.5	2.1	9.2	41.4	0.56	1.00	26	0.5	Sin	G5c
17-11A	1.2	1.3	11.8	0.9	13.1	10.7	0.23	1.20	15	0.2	None	F5
17-12A	0.2	*2.6*	7.7	0.2	20.4	1.7	1.20	1.20	20	0.2	Sin	C5
17-13A	1.6	1.7	20.1	1.2	17.0	23.6	0.82	1.00	34	9.7	Sin	B4c
17-14A	0.7	2.3	11.5	1.1	10.2	12.9	0.21	*1.00*	26	0.2	ER, Sin, W/D	B5c
17-15A	1.6	1.3	14.4	1.1	13.0	15.9	0.98	1.50	19	13.0	None	F4
17-16A	0.1	7.2	8.4	0.4	19.2	3.7	1.34	1.00	60	0.2	Sin	C5
17-17A	1.2	1.4	16.2	1.1	15.2	17.3	1.85	1.50	23	0.6	ER	F5

NOTES:
Values in italics are estimated, either in the field or using GIS databases.
DA = Drainage Area
ER = Entrenchment Ratio
Wbf = Width of the bankfull channel
Dbf = Mean depth of the bankfull channel
Abf = Area of the bankfull channel
Wfp= Width of the floodprone area
D50 = Size of median particle within the reach
Adj? = Any adjustments made to parameters as allowed in the Rosgen Classification System

APPENDIX D

QUALITY CONTROL SUMMARY

QUALITY CONTROL

Three aspects of data quality were addressed for the biological components of this dataset. They 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 5 sample pairs for both the original and revised B-IBI (Stribling et al. 1998, Southerland et al. 2005), including individual metrics **(Table D-1)**. Field sampling precision failed all MQOs presented by Hill et al. (2005) for the 1998 index and passed them all for the 2005 index. The MQO for the B-IBI is 15%, 10%, and ±0.5 for median relative percent difference (RPD), coefficient of variability (CV), and 90 percent confidence interval, respectively. Results for the 1998 index in this dataset were 37.5, 26.7, and ±0.83. The 2005 index was less variable with statistics of 7.9, 8.07, and ±0.26.

Table D-1. Precision statistics for field sampling (n = 10 [5 sample pairs]).

1998 Index	**mean**	**avgRPD**	**medRPD**	**MSE**	**RMSE**	**CV**	**CI90**
B-IBI	1.89	30.8	37.5	0.25	0.50	26.7	0.83
Total Taxa	21.60	10.9	12.8	14.8	3.85	17.81	6.33
EPT Taxa	1.30	93.3	66.7	1.70	1.30	100.30	2.14
% Ephemeroptera	0.0	0.0	0.0	0.0	0.00	na	0.00
% Tanyt./Chiro.	6.6	113.0	105.9	66.8	8.2	123.5	13.4
Beck's Biotic Index	2.9	88.7	111.1	9.1	3.0	104.0	5.0
Scraper Taxa	0.10	40.0	0.0	0.1	0.32	316.23	0.52
% clingers	16.73	132.2	175.8	137.8	11.74	70.17	19.31
2005 Index							
B-IBI	1.94	7.9	12.5	0.0245	0.16	8.07	0.26
Total Taxa	21.60	10.9	12.8	14.8	3.85	17.81	6.33
EPT Taxa	1.30	93.3	66.7	1.70	1.30	100.30	2.14
Ephemeroptera Taxa	0.0	0.0	0.0	0.0	0.00	na	0.00
% Intolerant-Urban	15.87	130.3	136.4	88.5	9.41	59.28	15.48
% Ephemeroptera	0.0	0.0	0.0	0.0	0.00	na	0.00
Scraper Taxa	1.20	40.0	0.0	0.1	0.32	26.35	0.52
% climbers	3.55	79.2	64.0	3.23	1.80	50.63	2.96

mRPD is mean relative percent difference, MSE is mean square error, RMSE is root MSE, CV is coefficient of variability, and CI90 is the 90% confidence interval. "na" is not applicable, and in this application indicates that the value for the denominator was zero (0).

Laboratory sorting and subsampling bias was tested by an external laboratory for five sort residue samples (**Table D-2**). All five samples passed the measurement quality objective of PSE > 90%. For these samples, PSE ranged from 98.2 to 100%.

Table D2. QC results from external laboratory sort residue re-checks.

Station ID	No. orgs (primary)	No. recoveries	Total No.	PSE
01-12a	103	0	103	100
02-01	102	0	102	100
02-05	110	2	112	98.2
08-13a	115	0	115	100
17-12a	103	1	104	99.04

Taxonomic precision was tested by using an independent taxonomist (from a separate laboratory) to re-identify a randomly-selected subset of six samples, and then quantifying differences. The most important result is that of PTD, for which 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 (**Table D-3**). 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. 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.

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

Table D-4. Summary of QC results and measurement quality objectives. MQO are taken from Hill et al. 2005; result values are from this dataset, with field sampling values based on the 2005 benthic index.

Activity	Performance indicator	Term	MQO	Result
Field sampling	Precision	Median relative pct. difference (mRPD)	<15	12.5
		Root mean square error (RMSE)	na	0.16
		Coefficient of variability (CV)	<10	8.07
		90% confidence interval (CI90)	<0.60	0.26
Sorting/subsampling	Bias	Pct. sorting efficiency (PSE)	>90	99.4
Taxonomic identification	Precision (consistency)	Pct. difference in enumeration (PDE)	<5	1.9
		Pct. taxonomic disagreement (PTD)	<15	5.4

APPENDIX E

MASTER TAXA LIST

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	PSEUDORTHOCLADIUS	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	Potamothrix			
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

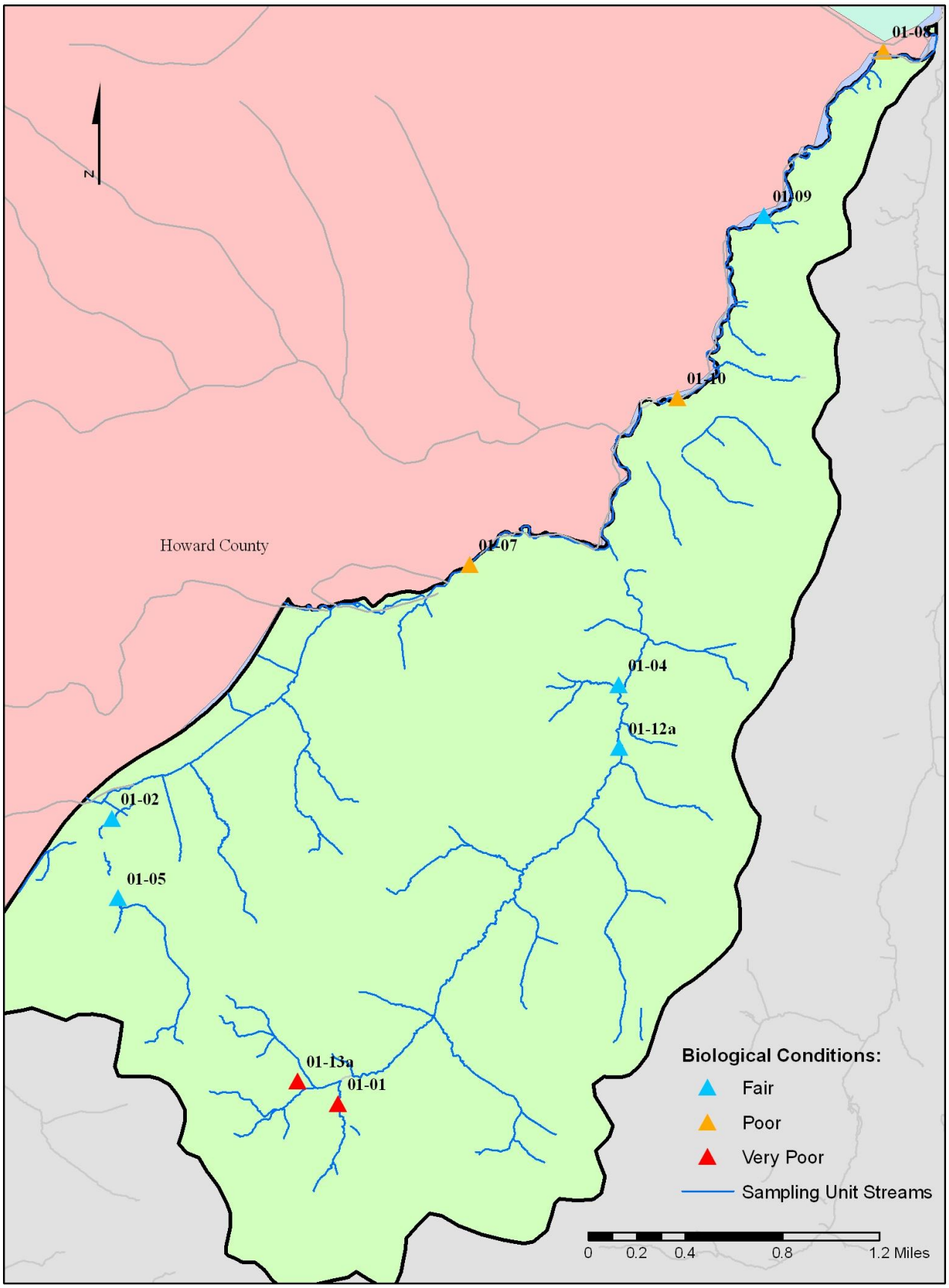
Order	Family	Genus	FFG*	TV*	Habit
Trichoptera	Psychomyiidae	LYPE	Scraper	4.7	cn
Trichoptera	Sericostomatidae	AGARODES	Shredder	3	sp
Trichoptera	Uenoidae	NEOPHYLAX	Scraper	2.7	cn
Veneroida	Piscidiidae	PISIDIUM	Filterer	5.7	bu
		BIVALVIA			
		TURBELLARIA	Predator	4	sp

* FFG = Function Feeding Group, TV = Tolerance Value

APPENDIX F

INDIVIDUAL SITE SUMMARIES

Piney Run Sampling Unit



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01-01 Piney Run Sampling Unit


Upstream


Downstream

Location/Site Access: Located at 7789 Rotherman Drive 120m south
Latitude/Longitude: 39.14969/-76.74251

Land Use Analysis:

Land Use	Acres	% Area
Commercial	0.1	0.0
Open Space	16.0	5.6
Residential 1/2-acre	5.0	1.8
Residential 1/4-acre	108.3	38.1
Residential 1-acre	1.9	0.7
Residential 2-acre	1.7	0.6
Transportation	6.6	2.3
Woods	144.5	50.9
Grand Total	284.1	100.0

Impervious (acres)	Total Area Above site	% Impervious
48.5	284.1	17.1

Results:

- Biological condition – "Very Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Adequate substrate/available cover, optimal riparian zone, limited pool habitat, moderately unstable banks, moderate sediment deposition
- Sample dominated by midges (Eukiefferiella) and worms (Nais)
- Stream type was identified as an unstable G5c, slope was 1.1 percent, and the median channel substrate was fine sand
- Habitat assessment results were mixed for this site, but biological community observed is trending toward somewhat less than expected impairment based on the observed habitat quality.

Recommendations:

- Maintain the protection of the riparian area.
- Investigate need, feasibility of BMP retrofit opportunities on residential lands.

01-01 Piney Run Sampling Unit

IBI and Metric Scores

Narrative Rating	**Very Poor**
Overall Index	**1.57**
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	1
Ephemeroptera Taxa	0
Intolerant Urban %	0
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	2.7

Taxa List

Nais	28
Enchytraeidae	1
Tubificinae	2
Aulodrilus	1
Stenelmis	1
Chironomus	4
Eukiefferiella	61
Limnophyes	1
Orthocladius/Cricotopus	5
Paraphaenocladius	1
Polypedilum	3
Thienemanniella	2
Doithrix	1
Cheumatopsyche	1
Total Individuals	112

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	4	Pool Variability	5
Bank Stability- Right Bank	4	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	19	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	8	Sediment Deposition	6
Channel Sinuosity	14	Vegetative Protection (Left Bank)	4
Epifaunal Substrate/Available Cover	11	Vegetative Protection (Right Bank)	4
Pool Substrate Characterization	8		

EPA Habitat Score	107
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	284.1	Instream Wood Debris	3
Remoteness	9	Bank Stability	6
Shading	90		
Epifaunal Substrate	11		
Instream Habitat	11		

PHI Score	71.41
PHI Narrative Ranking	PD

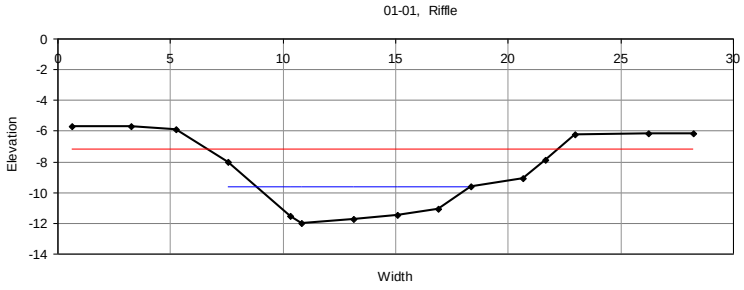
Water Chemistry

Dissolved Oxygen (mg/L)	12.19	Specific Conductance (mS/cm)	917
pH	–	Temperature (°C)	5.93

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.44	Cross Sectional Area (ft^2)	15.9
Bankfull Width (ft)	9.6	Water Surface Slope (ft/ft)	1.1
Mean Bankfull Depth (ft)	1.7	Sinuosity	1.0
Floodprone Width (ft)	15.7	D50 (mm)	0.19
Entrenchment Ratio	1.6	Adjustments?	↑ Sin, ↓ER
Width to Depth Ratio	5.8	**Rosgen Stream Type**	**G5c**



01-02 Piney Run Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Farest Rd.
Latitude/Longitude: 39.16676/-76.75985

Land Use Analysis:

Note: Land use incomplete due to partial location in Howard County.		
Land Use	**Acres**	**% Area**
Industrial	15.7	3.4
Open Space	20.1	4.4
Pasture/Hay	0.9	0.2
Residential 1/2-acre	125.6	27.4
Residential 1-acre	14.5	3.2
Transportation	21.6	4.7
Woods	260.1	56.7
Grand Total	458.4	100.0

Impervious (acres)	Total Area Above site	% Impervious
50.3	458.4	11.0

Results:

- Biological condition – "Fair"
- Habitat scores "Partially Supporting" and "Degraded"
- Marginal substrate/available cover, unstable banks, minimally impacted riparian zone, fairly straight channel
- Diverse assemblage with 5 EPT taxa. The most abundant taxon is *Oulimnius*, a riffle beetle. 62% of the assemblage is comprised of midges.
- Stream type was identified as an G5c, slope was 0.94 percent, and the median channel substrate was fine sand
- 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 areas.

01-02 Piney Run Sampling Unit

IBI and Metric Scores

Narrative Rating	**Fair**
Overall Index	**3.86**
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	33
EPT Taxa	5
Ephemeroptera Taxa	1
Intolerant Urban %	27.5
Ephemeroptera %	2.9
Scraper Taxa	1
% Climbers	8.8

Taxa List

Nais	5
Helichus	1
Dubiraphia	1
Oulimnius	13
Stenelmis	2
Chaetocladius	7
Corynoneura	1
Diplocladius	1
Eukiefferiella	2
Hydrobaenus	1
Odontomesa	1
Orthocladius/Cricotopus	9
Paracladopelma	1
Parakiefferiella	4
Parametriocnemus	3
Paratendipes	1
Polypedilum	2
Potthastia	1
Rheocricotopus	2
Thienemanniella	3
Thienemannimyia	8
Tvetenia	2
Rheotanytarsus	7
Tanytarsus	7
Stegopterna	1
Antocha	1
Acerpenna	3
Maccaffertium	1
Allocapnia	3
Amphinemura	3
Diplectrona	3
Limnephilidae	1
Nematoda	1
Total Individuals	102

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	3	Pool Variability	9
Bank Stability- Right Bank	3	Riparian Vegetative Zone Width- Left Bank	8
Channel Alteration	17	Riparian Vegetative Zone Width- Right Bank	8
Channel Flow Status	16	Sediment Deposition	11
Channel Sinuosity	6	Vegetative Protection (Left Bank)	3
Epifaunal Substrate/Available Cover	9	Vegetative Protection (Right Bank)	3
Pool Substrate Characterization	8		

EPA Habitat Score	104
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	561.5	Instream Wood Debris	3
Remoteness	8	Bank Stability	6
Shading	65		
Epifaunal Substrate	7		
Instream Habitat	9		

PHI Score	57.97
PHI Narrative Ranking	D

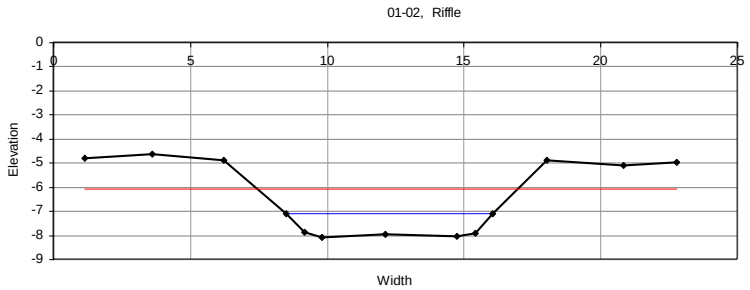
Water Chemistry

Dissolved Oxygen (mg/L)	11.62	Specific Conductance (mS/cm)	294
pH	–	Temperature (°C)	7.84

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.88	Cross Sectional Area (ft^2)	6.2
Bankfull Width (ft)	7.5	Water Surface Slope (ft/ft)	0.94
Mean Bankfull Depth (ft)	0.8	Sinuosity	1.1
Floodprone Width (ft)	10.2	D50 (mm)	0.19
Entrenchment Ratio	1.4	Adjustments?	↑ Sin
Width to Depth Ratio	9.2	**Rosgen Stream Type**	**G5c**



01-04 Piney Run Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Dorsey Rd. Crossing 500m east
Latitude/Longitude: 39.17465/-76.72089

Land Use Analysis:

Land Use	Acres	% Area
Industrial	45.3	30.8
Open Space	50.1	34.1
Residential 1-acre	1.2	0.8
Transportation	24.0	16.3
Water	0.8	0.6
Woods	25.5	17.4
Grand Total	147.0	100.0

Impervious (acres)	Total Area Above site	% Impervious
54.7	147.0	37.2

Results:

- Biological condition – "Fair"
- Habitat scores "Non Supporting" and "Degraded"
- Adequate substrate/available cover, unstable banks, moderate sediment deposition, optimal riparian zone
- Good taxa richness with 6 EPT taxa. Midges comprise 79% of the assemblage. *Thienemannimyia* is the most abundant taxon.
- Stream type was identified as an E5, slope was 1.8 percent, and the median channel substrate was coarse to very coarse sand
- Typically, E channels are stable. However, the poor habitat ratings related to 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 the protection of the riparian area.
- Investigate necessity, feasibility of BMP retrofits on developed lands upstream.

01-04 Piney Run Sampling Unit

IBI and Metric Scores

Narrative Rating	Fair
Overall Index	**3.00**
Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	3
Intolerant Urban % Score	1
Ephemeroptera % Score	3
Scraper Taxa Score	1
% Climbers	3

Calculated Metric Values

Total Taxa	27
EPT Taxa	6
Ephemeroptera Taxa	1
Intolerant Urban %	3.8
Ephemeroptera %	1.0
Scraper Taxa	0
% Climbers	4.8

Taxa List

Lumbricidae	1
Limnodrilus	2
Agabus	1
Neoporus	1
Ablabesmyia	1
Chaetocladius	4
Cryptochironomus	1
Eukiefferiella	3
Limnophyes	1
Orthocladius/Cricotopus	10
Parametriocnemus	15
Phaenopsectra	2
Polypedilum	2
Thienemannimyia	29
Tvetenia	2
Xenochironomus	1
Zavrelimyia	12
Chrysops	1
Pilaria	1
Tipula	1
Caenis	1
Calopteryx	2
Allocapnia	2
Cheumatopsyche	1
Diplectrona	2
Limnephilidae	5
Ptilostomis	1
Total Individuals	105

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	3	Pool Variability	8
Bank Stability- Right Bank	3	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	17	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	8	Sediment Deposition	6
Channel Sinuosity	8	Vegetative Protection (Left Bank)	3
Epifaunal Substrate/Available Cover	11	Vegetative Protection (Right Bank)	3
Pool Substrate Characterization	9		

EPA Habitat Score	99
EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	147.0	Instream Wood Debris	3
Remoteness	8	Bank Stability	7
Shading	95		
Epifaunal Substrate	11		
Instream Habitat	11		

PHI Score	75.75
PHI Narrative Ranking	PD

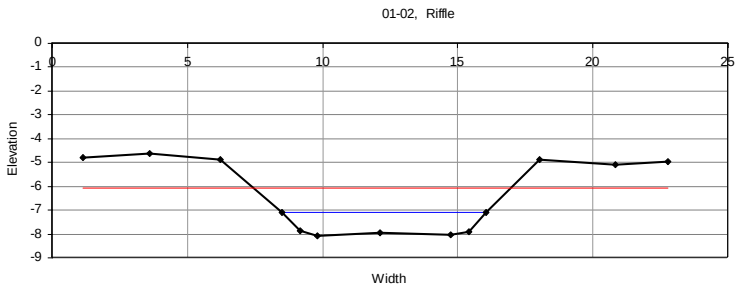
Water Chemistry

Dissolved Oxygen (mg/L)	11.33	Specific Conductance (mS/cm)	1774
pH	–	Temperature (°C)	3.61

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.22	Cross Sectional Area (ft^2)	6.5
Bankfull Width (ft)	6.5	Water Surface Slope (ft/ft)	1.8
Mean Bankfull Depth (ft)	1.0	Sinuosity	1.1*
Floodprone Width (ft)	23.9	D50 (mm)	1
Entrenchment Ratio	3.7	Adjustments?	↑ Sin
Width to Depth Ratio	6.5	**Rosgen Stream Type**	**E5**



01-05 Piney Run Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Forest Ave. crossing, 120ft. D.S.
Latitude/Longitude: 39.16201/-76.75938

Land Use Analysis:

Land Use	Acres	% Area
Open Space	19.4	7.6
Residential 1/2-acre	78.9	31.2
Residential 1-acre	10.7	4.2
Transportation	12.7	5.0
Woods	131.6	51.9
Grand Total	253.3	100.0

Impervious (acres)	Total Area Above site	% Impervious
19.4	253.3	7.6

Results:

- Biological condition – "Fair"
- Habitat scores "Non Supporting" and "Degraded"
- Adequate substrate/available cover, moderately unstable banks, straight channel, marginal riparian zone (right bank)
- Diverse assemblage with 6 EPT taxa. *Oulimnius*, a riffle beetle, is the most abundant taxon and comprises 36% of the sample.
- Stream type was identified as an B5c, slope was 0.85 percent, and the median channel substrate was medium to coarse sand
- Biological community is in better condition than expected for measured level of habitat quality.

Recommendations:

- Protect the riparian area. Restore channel forms if possible.
- Determine necessity, feasibility of stormwater BMP retrofits on developed lands upstream.

01-05 Piney Run Sampling Unit

IBI and Metric Scores

Narrative Rating	**Fair**
Overall Index	**3.30**
Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	5
Ephemeroptera % Score	1
Scraper Taxa Score	3
% Climbers	3

Calculated Metric Values

Total Taxa	24
EPT Taxa	6
Ephemeroptera Taxa	0
Intolerant Urban %	43.6
Ephemeroptera %	0
Scraper Taxa	1
% Climbers	5.5

Taxa List

Nais	1
Lumbricidae	2
Tubificinae	1
Oulimnius	40
Corynoneura	1
Orthocladiinae	1
Orthocladius/Cricotopus	4
Polypedilum	4
Rheocricotopus	2
Thienemanniella	14
Thienemannimyia	6
Bethbilbeckia	1
Rheotanytarsus	10
Tanytarsus	2
Dicranota	2
Limnophila	2
Pseudolimnophila	2
Capniidae	4
Amphinemura	1
Diplectrona	3
Limnephilidae	2
Molanna	1
Lype	3
Pisidium	1
Total Individuals	110

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	5	Pool Variability	5
Bank Stability- Right Bank	5	Riparian Vegetative Zone Width- Left Bank	9
Channel Alteration	16	Riparian Vegetative Zone Width- Right Bank	3
Channel Flow Status	8	Sediment Deposition	8
Channel Sinuosity	4	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	11	Vegetative Protection (Right Bank)	5
Pool Substrate Characterization	10		

EPA Habitat Score	94
EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	253.3	Instream Wood Debris	4
Remoteness	4	Bank Stability	10
Shading	60		
Epifaunal Substrate	11		
Instream Habitat	11		

PHI Score	65.20
PHI Narrative Ranking	D

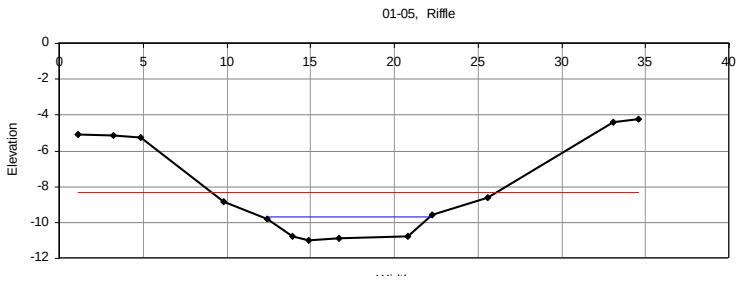
Water Chemistry

Dissolved Oxygen (mg/L)	10.64	Specific Conductance (mS/cm)	186
pH	–	Temperature (°C)	9.57

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.40	Cross Sectional Area (ft^2)	9.5
Bankfull Width (ft)	9.7	Water Surface Slope (ft/ft)	0.85
Mean Bankfull Depth (ft)	1.0	Sinuosity	1.0*
Floodprone Width (ft)	14.4	D50 (mm)	0.5
Entrenchment Ratio	1.5	Adjustments?	↑ Sin, ↑ W/D
Width to Depth Ratio	9.9	**Rosgen Stream Type**	**B5c**



01-08 Piney Run Sampling Unit


Upstream


Downstream

Location/Site Access: Located at 200m DS from Race Rd.
Latitude/Longitude: 39.21243/-76.70044

Land Use Analysis:

Note: Data Incomplete—does not include areas in Howard Co.		
Land Use	**Acres**	**% Area**
Commercial	236.1	--
Forested Wetland	5.7	--
Industrial	335.0	--
Open Space	471.3	--
Pasture/Hay	0.9	--
Residential 1/2-acre	298.4	--
Residential 1/4-acre	276.1	--
Residential 1-acre	250.5	--
Residential 2-acre	61.5	--
Transportation	337.3	--
Utility	5.7	--
Water	12.3	--
Woods	2622.3	--
Grand Total	4913.0	--

Impervious (acres)	Total Area Above site	% Impervious
933.7	4913.0	--

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Severely Degraded"
- Marginal substrate/available cover, moderately unstable banks, heavy sediment deposition, optimal riparian zone
- 75% of the assemblage is comprised of midges. The most dominant taxon, *Hydrobaenus*, makes up 39% of the sample. No EPT taxa.
- Stream type was identified as an C5, slope was 0.086 percent, and the median channel substrate was medium sand
- Typically, C channels are stable. However, the marginal habitat ratings related to bank stability and substrate 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.
- Investigate need for additional stormwater management on developed lands upstream

01-08 Piney Run Sampling Unit

IBI and Metric Scores

Narrative Rating	**Poor**
Overall Index	**2.14**
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	23
EPT Taxa	0
Ephemeroptera Taxa	0
Intolerant Urban %	0.9
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	13.0

Taxa List

Nais	4
Lumbricidae	1
Tubificinae	2
Stenelmis	1
Ablabesmyia	1
Dicrotendipes	2
Hydrobaenus	42
Limnophyes	1
Orthocladius/Cricotopus	9
Paratendipes	1
Polypedilum	11
Rheosmittia	2
Saetheria	4
Zavrelimyia	1
Paratanytarsus	1
Rheotanytarsus	1
Sublettea	1
Tanytarsus	3
Hemerodromia	1
Tipula	1
Progomphus	1
Fossaria	1
Corbicula	16
Total Individuals	108

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	4	Pool Variability	10
Bank Stability- Right Bank	4	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	13	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	16	Sediment Deposition	5
Channel Sinuosity	9	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	7	Vegetative Protection (Right Bank)	5
Pool Substrate Characterization	8		

EPA Habitat Score	106
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	12770.1	Instream Wood Debris	4
Remoteness	3	Bank Stability	9
Shading	95		
Epifaunal Substrate	7		
Instream Habitat	11		

PHI Score	48.32
PHI Narrative Ranking	SD

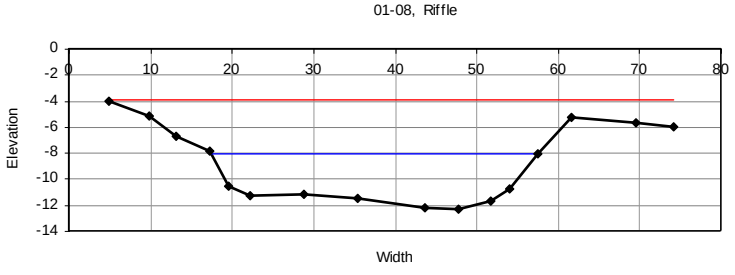
Water Chemistry

Dissolved Oxygen (mg/L)	10.87	Specific Conductance (mS/cm)	777
pH	–	Temperature (°C)	12.04

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	20.0	Cross Sectional Area (ft^2)	126.1
Bankfull Width (ft)	39.9	Water Surface Slope (ft/ft)	0.086
Mean Bankfull Depth (ft)	3.2	Sinuosity	1.2
Floodprone Width (ft)	361*	D50 (mm)	0.27
Entrenchment Ratio	9*	Adjustments?	↑ Sin
Width to Depth Ratio	12.7	**Rosgen Stream Type**	**C5**



01-09 Piney Run Sampling Unit


Upstream


Downstream

Location/Site Access: Located at 130m S of Race Rd.
Latitude/Longitude: 39.20263/-76.70966

Land Use Analysis:

Note: Data Incomplete—does not include areas in Howard Co.		
Land Use	**Acres**	**% Area**
Commercial	236.1	--
Industrial	335.0	--
Open Space	471.3	--
Pasture/Hay	0.9	--
Residential 1/2-acre	298.4	--
Residential 1/4-acre	276.1	--
Residential 1-acre	218.1	--
Residential 2-acre	61.5	--
Transportation	332.0	--
Water	12.3	--
Woods	2535.8	--
Grand Total	4777.4	--

Impervious (acres)	Total Area Above site	% Impervious
927.7	4777.4	--

Results:

- Biological condition – "Fair"
- Habitat scores "Partially Supporting" and "Severely Degraded"
- Marginal substrate/available cover, moderately unstable banks, optimal riparian zone
- Assemblage is dominated by midges. The most dominant taxon, *Hydrobaenus*, comprises 32% of the sample.
- Stream type was identified as an C5, slope was 0.17 percent, and the median channel substrate was medium sand
- Typically, C channels are stable. However, the habitat ratings related to banks and substrates 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. Restore habitat features, if possible
- Investigate need, feasibility of BMP installation on developed lands upstream.

01-09 Piney Run Sampling Unit

IBI and Metric Scores

Narrative Rating	**Fair**
Overall Index	**3.29**
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	31
EPT Taxa	4
Ephemeroptera Taxa	1
Intolerant Urban %	1.9
Ephemeroptera %	1.0
Scraper Taxa	1
% Climbers	9.6

Taxa List

Nais	3
Tubificinae	1
Helichus	1
Ancyronyx	4
Macronychus	6
Oulimnius	1
Stenelmis	2
Chaetocladius	1
Dicrotendipes	1
Hydrobaenus	33
Odontomesa	1
Orthocladius/Cricotopus	17
Parametriocnemus	2
Polypedilum	5
Rheocricotopus	1
Saetheria	2
Sympotthastia	1
Thienemanniella	1
Zavrelimyia	1
Paratanytarsus	1
Rheotanytarsus	3
Tanytarsus	2
Limonia	1
Heptageniidae	1
Boyeria	1
Calopteryx	2
Argia	1
Taeniopteryx	1
Cheumatopsyche	4
Hydropsyche	1
Corbicula	2
Total Individuals	104

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	3	Pool Variability	13
Bank Stability- Right Bank	5	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	18	Riparian Vegetative Zone Width- Right Bank	9
Channel Flow Status	16	Sediment Deposition	8
Channel Sinuosity	13	Vegetative Protection (Left Bank)	3
Epifaunal Substrate/Available Cover	10	Vegetative Protection (Right Bank)	6
Pool Substrate Characterization	8		

EPA Habitat Score	122
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	12452.0	Instream Wood Debris	4
Remoteness	8	Bank Stability	6
Shading	40		
Epifaunal Substrate	3		
Instream Habitat	10		

PHI Score	36.25
PHI Narrative Ranking	SD

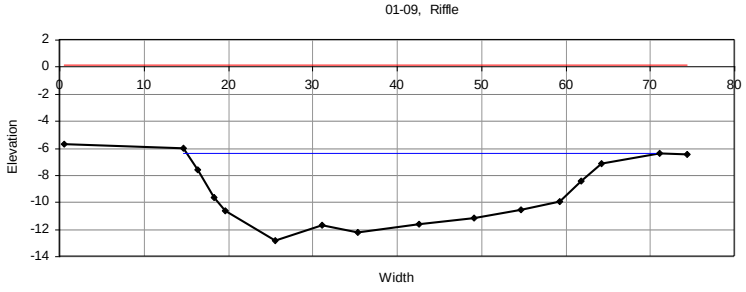
Water Chemistry

Dissolved Oxygen (mg/L)	13.28	Specific Conductance (mS/cm)	1340
pH	–	Temperature (°C)	5.97

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	19.5	Cross Sectional Area (ft^2)	228.8
Bankfull Width (ft)	56.1	Water Surface Slope (ft/ft)	0.17
Mean Bankfull Depth (ft)	4.1	Sinuosity	1.1*
Floodprone Width (ft)	750*	D50 (mm)	0.45
Entrenchment Ratio	13.4*	Adjustments?	↑ Sin
Width to Depth Ratio	13.8	**Rosgen Stream Type**	**C5**



01-10 Piney Run Sampling Unit


Upstream


Downstream

Location/Site Access: Located at 100m from Race rd. (south)
Latitude/Longitude: 39.19177/-76.71631

Land Use Analysis:

Note: Data Incomplete—does not include areas in Howard Co.		
Land Use	**Acres**	**% Area**
Commercial	234.8	--
Industrial	333.7	--
Open Space	463.0	--
Pasture/Hay	1.2	--
Residential 1/2-acre	300.0	--
Residential 1/4-acre	271.3	--
Residential 1-acre	194.6	--
Residential 2-acre	47.2	--
Transportation	316.9	--
Water	12.3	--
Woods	2289.2	--
Grand Total	4464.2	--

Impervious (acres)	Total Area Above site	% Impervious
911.6	4464.2	--

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Severely Degraded"
- Adequate substrate/available cover, moderately unstable banks, moderate sediment deposition, minimally impacted riparian zone
- Good taxa richness. Midges (*Hydrobaenus*, *Orthocladius/Cricotopus*) are the most abundant organisms (63%), followed by worms (12%).
- Stream type was identified as an C4, slope was 0.51 percent, and the median channel substrate was medium gravel
- Typically, C channels are stable. However, the marginal habitat ratings related to banks and substrate 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.
- Determine need, feasibility of stormwater management in upstream watershed

01-10 Piney Run Sampling Unit

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	**2.71**
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	30
EPT Taxa	5
Ephemeroptera Taxa	0
Intolerant Urban %	3
Ephemeroptera %	0
Scraper Taxa	1
% Climbers	2

Taxa List

Nais	7
Lumbricidae	1
Tubificinae	3
Limnodrilus	1
Ancyronyx	2
Macronychus	1
Optioservus	1
Oulimnius	1
Stenelmis	2
Brillia	1
Corynoneura	1
Diplocladius	1
Hydrobaenus	19
Orthocladius/Cricotopus	19
Parametriocnemus	3
Polypedilum	1
Sympotthastia	5
Thienemannimyia	1
Paratanytarsus	1
Rheotanytarsus	10
Tanytarsus	1
Maccaffertium	3
Argia	2
Taeniopteryx	2
Cheumatopsyche	4
Diplectrona	1
Hydropsyche	2
Polycentropus	1
Crangonyx	2
Corbicula	1
Total Individuals	100

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	5	Pool Variability	13
Bank Stability- Right Bank	4	Riparian Vegetative Zone Width- Left Bank	6
Channel Alteration	18	Riparian Vegetative Zone Width- Right Bank	9
Channel Flow Status	9	Sediment Deposition	7
Channel Sinuosity	7	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	11	Vegetative Protection (Right Bank)	4
Pool Substrate Characterization	9		

EPA Habitat Score	107
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	11738.3	Instream Wood Debris	3
Remoteness	5	Bank Stability	8
Shading	15		
Epifaunal Substrate	10		
Instream Habitat	11		

PHI Score	38.18
PHI Narrative Ranking	SD

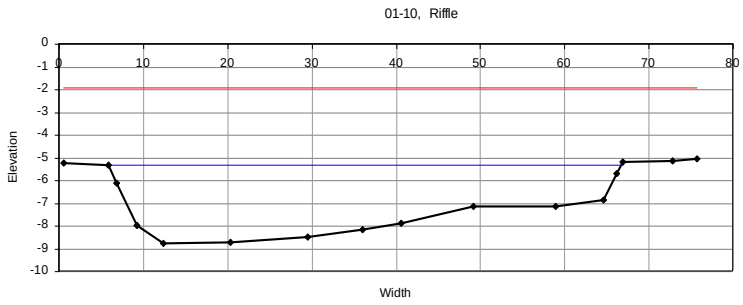
Water Chemistry

Dissolved Oxygen (mg/L)	14.63	Specific Conductance (mS/cm)	1453
pH	–	Temperature (°C)	0.48

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	19.5	Cross Sectional Area (ft^2)	150.2
Bankfull Width (ft)	60.8	Water Surface Slope (ft/ft)	0.51
Mean Bankfull Depth (ft)	2.5	Sinuosity	1.2
Floodprone Width (ft)	876*	D50 (mm)	14
Entrenchment Ratio	14.4*	Adjustments?	None
Width to Depth Ratio	24.6	**Rosgen Stream Type**	**C4**



01-12A Piney Run Sampling Unit

Location/Site Access: Located at Park in back lot of Oceaneering, on airport 100way Rd.
Latitude/Longitude: 39.17089/-76.72085

Land Use Analysis:

Land Use	Acres	% Area
Commercial	213.0	10.2
Industrial	46.3	2.2
Open Space	223.8	10.7
Residential 1/2-acre	7.9	0.4
Residential 1/4-acre	271.0	12.9
Residential 1-acre	62.5	3.0
Residential 2-acre	20.2	1.0
Transportation	170.5	8.1
Water	9.6	0.5
Woods	1069.7	51.1
Grand Total	2094.5	100.0

Impervious (acres)	Total Area Above site	% Impervious
493.0	2094.5	23.5

Results:

- Biological condition – "Fair"
- Habitat scores "Partially Supporting" and "Degraded"
- Adequate substrate/available cover, moderately unstable banks, moderate sediment deposition, minimally impacted riparian zone
- Midges dominate the assemblage (62%), followed by worms (16%). The two most abundant taxa are *Orthocladius/Cricotopus* and *Hydrobaenus*.
- Stream type was identified as an F4, slope was 0.91 percent, and the median channel substrate was very fine to fine gravel
- Typically, F channels are not stable. The bank stability ratings indicate marginal conditions.
- Biological community is in better condition than expected for measured level of habitat quality.

Recommendations:

- Maintain the protection of the riparian area.
- Determine need, feasibility of stormwater management on upstream developed lands to preserve current biological conditions.

01-12A Piney Run Sampling Unit

IBI and Metric Scores

Narrative Rating	**Fair**
Overall Index	**3.00**
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	30
EPT Taxa	3
Ephemeroptera Taxa	1
Intolerant Urban %	7.7
Ephemeroptera %	1.0
Scraper Taxa	1
% Climbers	2.9

Taxa List

Nais	12
Lumbriculidae	1
Tubificinae	1
Limnodrilus	3
Ancyronyx	2
Macronychus	2
Oulimnius	5
Corynoneura	1
Cryptochironomus	1
Dicrotendipes	1
Hydrobaenus	17
Orthocladius/Cricotopus	21
Parametriocnemus	1
Paraphaenocladius	3
Sympotthastia	1
Thienemanniella	4
Thienemannimyia	4
Microtendipes	1
Paratanytarsus	2
Rheotanytarsus	4
Tanytarsus	3
Chelifera	1
Hemerodromia	2
Caenis	1
Nigronia	1
Argia	1
Somatochlora	1
Cheumatopsyche	5
Hydropsyche	1
Fossaria	1
Total Individuals	104

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	4	Pool Variability	14
Bank Stability- Right Bank	5	Riparian Vegetative Zone Width- Left Bank	8
Channel Alteration	17	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	15	Sediment Deposition	9
Channel Sinuosity	10	Vegetative Protection (Left Bank)	4
Epifaunal Substrate/Available Cover	14	Vegetative Protection (Right Bank)	5
Pool Substrate Characterization	10		

EPA Habitat Score	125
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	2094.5	Instream Wood Debris	5
Remoteness	8	Bank Stability	8
Shading	75		
Epifaunal Substrate	12		
Instream Habitat	14		

PHI Score	64.30
PHI Narrative Ranking	D

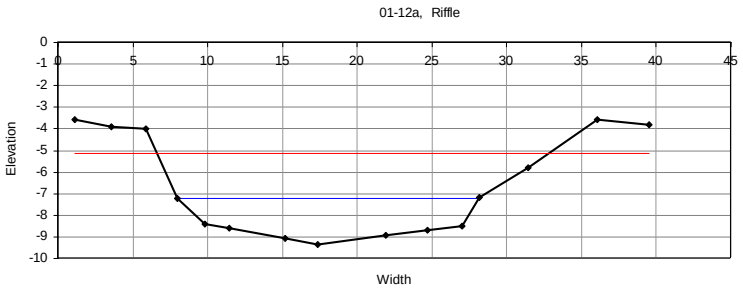
Water Chemistry

Dissolved Oxygen (mg/L)	14.19	Specific Conductance (mS/cm)	971
pH	–	Temperature (°C)	9.54

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	3.24	Cross Sectional Area (ft^2)	30.3
Bankfull Width (ft)	20.1	Water Surface Slope (ft/ft)	0.91
Mean Bankfull Depth (ft)	1.5	Sinuosity	1.2
Floodprone Width (ft)	26.2	D50 (mm)	4
Entrenchment Ratio	1.3	Adjustments?	None
Width to Depth Ratio	13.4	**Rosgen Stream Type**	**F4**



01-13A Piney Run Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Milestone parkway development SE
Latitude/Longitude: 39.15106/-76.74563

Land Use Analysis:

Land Use	Acres	% Area
Industrial	0.8	0.6
Open Space	26.2	21.5
Residential 1/2-acre	0.8	0.7
Residential 2-acre	10.2	8.3
Transportation	18.0	14.7
Water	0.5	0.4
Woods	65.6	53.8
Grand Total	122.1	100.0

Impervious (acres)	Total Area Above site	% Impervious
19.1	122.1	15.6

Results:

- Biological condition – "Very Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Adequate substrate/available cover, unstable banks, moderate sediment deposition, optimal riparian zone
- Poor taxa richness. Sample dominated by midges and worms. Two taxa, *Nais* and *Eukiefferiella*, comprise 85% of the sample.
- Specific conductance is relatively high
- Stream type was identified as an G5c, slope was 0.77 percent, and the median channel substrate was fine sand
- Typically, G channels are not stable and this reach is true to form
- Biological community is in worse condition than would be expected for available habitat quality.

Recommendations:

- Maintain the protection of the riparian area.
- Investigate necessity, feasibility of retrofitting BMPs on extensive transportation land cover found in drainage area.

01-13A Piney Run Sampling Unit

IBI and Metric Scores

Narrative Rating	**Very Poor**
Overall Index	**1.29**
Total Taxa Score	1
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	11
EPT Taxa	1
Ephemeroptera Taxa	0
Intolerant Urban %	0.0
Ephemeroptera %	0.0
Scraper Taxa	0
% Climbers	1.9

Taxa List

Nais	46
Tubificinae	1
Limnodrilus	1
Chironomus	1
Eukiefferiella	43
Orthocladius/Cricotopus	6
Polypedilum	2
Thienemanniella	1
Chelifera	1
Cheumatopsyche	1
Physa	1

Total Individuals	104

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	3	Pool Variability	9
Bank Stability- Right Bank	3	Riparian Vegetative Zone Width- Left Bank	9
Channel Alteration	18	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	14	Sediment Deposition	6
Channel Sinuosity	8	Vegetative Protection (Left Bank)	3
Epifaunal Substrate/Available Cover	12	Vegetative Protection (Right Bank)	3
Pool Substrate Characterization	10		

EPA Habitat Score	108
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	122.1	Instream Wood Debris	5
Remoteness	8	Bank Stability	6
Shading	100		
Epifaunal Substrate	6		
Instream Habitat	12		

PHI Score	72.97
PHI Narrative Ranking	PD

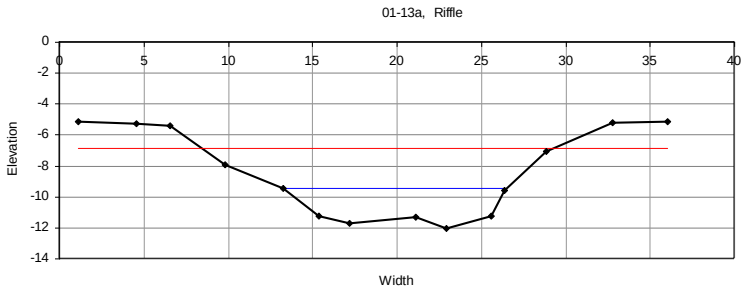
Water Chemistry

Dissolved Oxygen (mg/L)	12.12	Specific Conductance (mS/cm)	1385
pH	–	Temperature (°C)	6.51

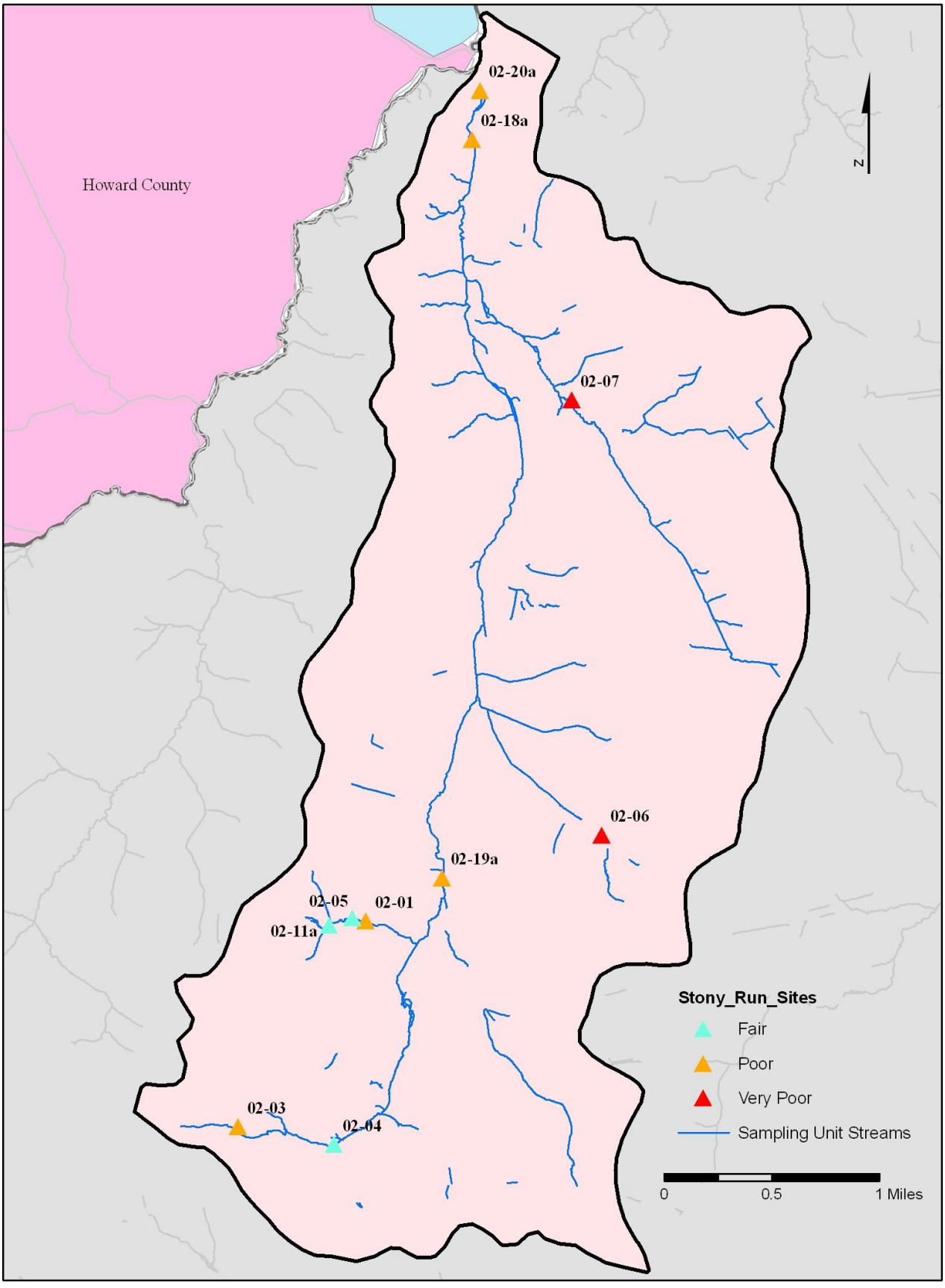
Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.2	Cross Sectional Area (ft^2)	24.0
Bankfull Width (ft)	13.1	Water Surface Slope (ft/ft)	0.77
Mean Bankfull Depth (ft)	1.8	Sinuosity	1.1
Floodprone Width (ft)	20.6	D50 (mm)	0.34
Entrenchment Ratio	1.6	Adjustments?	↓ER, ↑Sin
Width to Depth Ratio	7.2	**Rosgen Stream Type**	**G5c**



Stony Run Sampling Unit



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02-03 Stony Run Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Cedar Dr. crossing, 100m U.S.
Latitude/Longitude: 39.14103/-76.71756

Land Use Analysis:

Land Use	Acres	% Area
Residential 1/4-acre	39.8	67.2
Residential 1-acre	1.5	2.5
Transportation	0.1	0.1
Woods	17.8	30.1
Grand Total	59.2	100.0

Impervious (acres)	Total Area Above site	% Impervious
10.6	59.2	17.9

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Adequate substrate/available cover, moderately unstable banks, minimally impacted riparian zone
- The most abundant taxa are amphipods (*Gammarus*), midges (*Corynoneura*), and stoneflies (*Amphinemura*).
- Stream type was identified as an E5, slope was 0.88 percent, and the median channel substrate was fine sand and marginal bank stability indicating possible transition to an unstable condition
- 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 and restore the riparian area.

02-03 Stony Run Sampling Unit

IBI and Metric Scores

Narrative Rating	**Poor**
Overall Index	**2.14**
Total Taxa Score	5
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	25
EPT Taxa	4
Ephemeroptera Taxa	0
Intolerant Urban %	19.6
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	0

Taxa List

Nais	2
Lumbriculidae	1
Enchytraeidae	1
Tubificinae	3
Branchiura	2
Culicoides	1
Dasyhelea	1
Chaetocladius	1
Corynoneura	23
Eukiefferiella	1
Limnophyes	1
Nanocladius	1
Orthocladius/Cricotopus	3
Phaenopsectra	1
Pseudorthocladius	1
Thienemanniella	1
Tvetenia	2
Amphinemura	18
Diplectrona	2
Limnephilidae	1
Pycnopsyche	1
Gammarus	28
Physidae	1
Planorbidae	1
Prostoma	4
Total Individuals	102

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	5	Pool Variability	7
Bank Stability- Right Bank	5	Riparian Vegetative Zone Width- Left Bank	7
Channel Alteration	17	Riparian Vegetative Zone Width- Right Bank	7
Channel Flow Status	15	Sediment Deposition	9
Channel Sinuosity	7	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	11	Vegetative Protection (Right Bank)	5
Pool Substrate Characterization	10		

EPA Habitat Score	110
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	59.2	Instream Wood Debris	4
Remoteness	4	Bank Stability	10
Shading	40		
Epifaunal Substrate	5		
Instream Habitat	11		

PHI Score	63.20
PHI Narrative Ranking	D

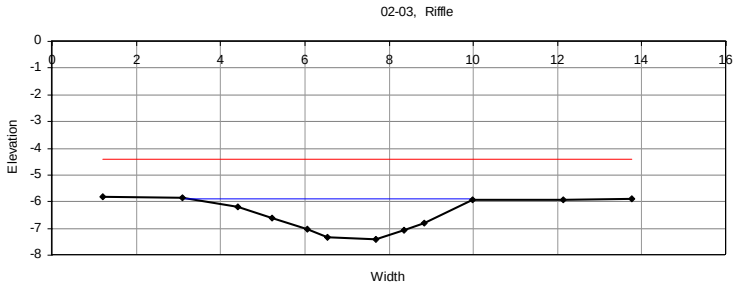
Water Chemistry

Dissolved Oxygen (mg/L)	8.93	Specific Conductance (mS/cm)	343
pH	–	Temperature (°C)	14.55

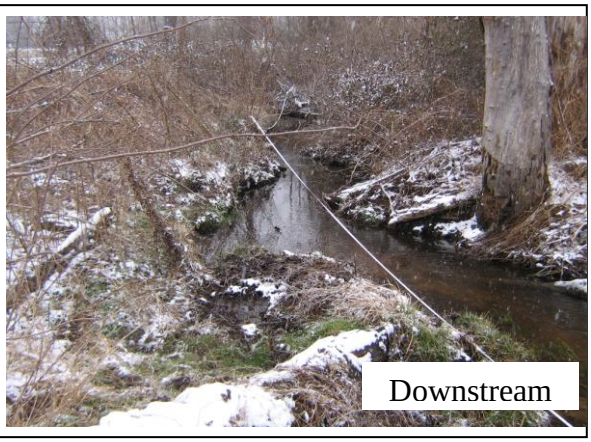
Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.09	Cross Sectional Area (ft^2)	5.5
Bankfull Width (ft)	6.7	Water Surface Slope (ft/ft)	0.88
Mean Bankfull Depth (ft)	0.8	Sinuosity	1.0
Floodprone Width (ft)	59.7	D50 (mm)	0.18
Entrenchment Ratio	8.9	Adjustments?	↑Sin
Width to Depth Ratio	8.2	**Rosgen Stream Type**	**E5**



02-04 Stony Run Sampling Unit



Location/Site Access: Located at end of Macedonia Drive (south end) 530 ft. SW
Latitude/Longitude: 39.13982/-76.7093

Land Use Analysis:

Land Use	Acres	% Area
Commercial	8.2	2.7
Open Space	6.6	2.2
Residential 1/4-acre	198.9	65.4
Residential 1-acre	1.5	0.5
Row Crops	26.0	8.5
Transportation	6.2	2.0
Woods	56.7	18.7
Grand Total	304.1	100.0

Impervious (acres)	Total Area Above site	% Impervious
68.4	304.1	22.5

Results:

- Biological condition – "Fair"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Adequate substrate/available cover, no pools, minimally impacted riparian zone
- Assemblage is dominated by one species of riffle beetle (*Oulimnius*).
- Stream type was identified as a C5, slope was 0.67 percent, and the median channel substrate was medium sand
- Typically, C channels are stable and habitat indicators show that the reach is in relatively good 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 necessity, feasibility of BMP retrofits on developed lands.

02-04 Stony Run Sampling Unit

IBI and Metric Scores

Narrative Rating	**Fair**
Overall Index	**3.00**
Total Taxa Score	3
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	5
Ephemeroptera % Score	1
Scraper Taxa Score	5
% Climbers	3

Calculated Metric Values

Total Taxa	18
EPT Taxa	3
Ephemeroptera Taxa	0
Intolerant Urban %	76.2
Ephemeroptera %	0
Scraper Taxa	2
% Climbers	1.0

Taxa List

Spirosperma	1
Oulimnius	67
Ablabesmyia	1
Corynoneura	5
Hydrobaenus	1
Orthocladius/Cricotopus	1
Parametriocnemus	1
Pseudosmittia	1
Thienemanniella	4
Simulium	1
Boyeria	1
Amphinemura	6
Cheumatopsyche	1
Diplectrona	4
Gammaridae	1
Physa	1
Menetus	1
Sphaeriidae (Mollusca)	3
Total Individuals	101

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	8	Pool Variability	0
Bank Stability- Right Bank	8	Riparian Vegetative Zone Width- Left Bank	8
Channel Alteration	16	Riparian Vegetative Zone Width- Right Bank	6
Channel Flow Status	18	Sediment Deposition	11
Channel Sinuosity	8	Vegetative Protection (Left Bank)	8
Epifaunal Substrate/Available Cover	12	Vegetative Protection (Right Bank)	8
Pool Substrate Characterization	0		

EPA Habitat Score	111
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	304.1	Instream Wood Debris	7
Remoteness	9	Bank Stability	14
Shading	55		
Epifaunal Substrate	12		
Instream Habitat	12		

PHI Score	73.61
PHI Narrative Ranking	PD

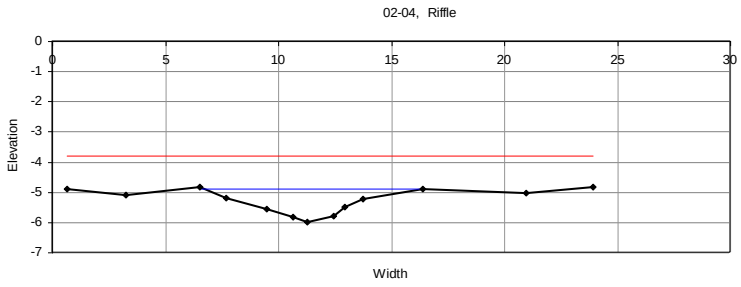
Water Chemistry

Dissolved Oxygen (mg/L)	12.4	Specific Conductance (mS/cm)	842
pH	–	Temperature (°C)	4.07

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.48	Cross Sectional Area (ft^2)	4.8
Bankfull Width (ft)	9.6	Water Surface Slope (ft/ft)	0.67
Mean Bankfull Depth (ft)	0.5	Sinuosity	1.2*
Floodprone Width (ft)	105*	D50 (mm)	0.32
Entrenchment Ratio	10.9*	Adjustments?	↑Sin
Width to Depth Ratio	19.3	**Rosgen Stream Type**	**C5**



02-05 Stony Run Sampling Unit

Location/Site Access: Located at Farm Pond Ct.
Latitude/Longitude: 39.15509/-76.70765

Land Use Analysis:

Land Use	Acres	% Area
Commercial	14.1	6.9
Industrial	0.5	0.3
Open Space	17.2	8.5
Residential 1/2-acre	3.2	1.6
Residential 1/4-acre	69.9	34.3
Residential 1/8-acre	14.8	7.3
Residential 1-acre	0.1	0.1
Transportation	9.6	4.7
Woods	74.2	36.4
Grand Total	203.8	100.0

Impervious (acres)	Total Area Above site	% Impervious
49.9	203.8	24.5

Results:

- Biological condition – "Fair"
- Habitat scores “Partially Supporting” and "Degraded"
- Marginal substrate/available cover, lack of woody debris, moderate sediment deposition, poor riparian zone (left bank)
- The most abundant taxa are amphipods (*Gammarus*), black flies (*Stegopterna*) and worms (*Tubificinae, Limnodrilus*).
- Stream type was identified as an E5, slope was 0.10 percent, and the median channel substrate was medium sand
- This reach has a modified riparian area and poor substrate characteristics
- Biological community is in better condition than expected for measured level of habitat quality.

Recommendations:

- Protect the riparian area. Restore habitat features, if possible.
- Investigate potential for retrofitting BMPs within residential and commercial areas.

02-05 Stony Run Sampling Unit

IBI and Metric Scores

Narrative Rating	**Fair**
Overall Index	**3.00**
Total Taxa Score	5
EPT Taxa Score	3
Ephemeroptera Taxa Score	3
Intolerant Urban % Score	3
Ephemeroptera % Score	3
Scraper Taxa Score	1
% Climbers	3

Calculated Metric Values

Total Taxa	31
EPT Taxa	3
Ephemeroptera Taxa	1
Intolerant Urban %	13.9
Ephemeroptera %	0.9
Scraper Taxa	0
% Climbers	7.4

Taxa List

Lumbricidae	1
Tubificinae	12
Aulodrilus	1
Limnodrilus	11
Neoporus	2
Peltodytes	1
Culicoides	7
Chaetocladius	1
Corynoneura	1
Hydrobaenus	1
Natarsia	1
Orthocladius/Cricotopus	4
Parametriocnemus	1
Polypedilum	6
Pseudorthocladius	1
Rheosmittia	2
Thienemannimyia	4
Zavrelimyia	6
Rheotanytarsus	1
Rhaphium	1
Stegopterna	12
Pseudolimnophila	1
Tipula	1
Leptophlebiidae	1
Coenagrionidae	1
Cordulegaster	1
Limnephilidae	1
Pycnopsyche	2
Gammarus	17
Fossaria	1
Sphaeriidae (Mollusca)	5
Total Individuals	108

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	8	Pool Variability	8
Bank Stability- Right Bank	8	Riparian Vegetative Zone Width- Left Bank	2
Channel Alteration	13	Riparian Vegetative Zone Width- Right Bank	6
Channel Flow Status	17	Sediment Deposition	6
Channel Sinuosity	7	Vegetative Protection (Left Bank)	7
Epifaunal Substrate/Available Cover	6	Vegetative Protection (Right Bank)	7
Pool Substrate Characterization	8		

EPA Habitat Score	103
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	203.8	Instream Wood Debris	1
Remoteness	3	Bank Stability	14
Shading	60		
Epifaunal Substrate	4		
Instream Habitat	6		

PHI Score	54.60
PHI Narrative Ranking	D

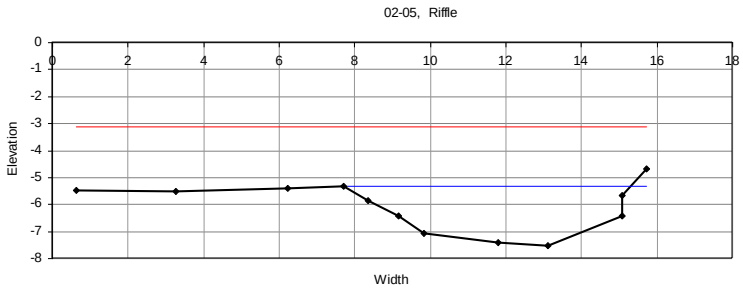
Water Chemistry

Dissolved Oxygen (mg/L)	15.7	Specific Conductance (mS/cm)	436
pH	–	Temperature (°C)	1.34

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.32	Cross Sectional Area (ft^2)	11.8
Bankfull Width (ft)	7.6	Water Surface Slope (ft/ft)	0.1
Mean Bankfull Depth (ft)	1.5	Sinuosity	1.1*
Floodprone Width (ft)	72	D50 (mm)	0.35
Entrenchment Ratio	9.5	Adjustments?	↑Sin
Width to Depth Ratio	4.9	**Rosgen Stream Type**	**E5**



02-06 Stony Run Sampling Unit


Upstream


Downstream

Location/Site Access: Located at BWI airport
Latitude/Longitude: 39.16058/-76.68603

Land Use Analysis:

Land Use	Acres	% Area
Commercial	18.8	5.5
Industrial	75.1	22.1
Open Space	63.4	18.7
Residential 1/2-acre	65.4	19.3
Residential 1/8-acre	1.0	0.3
Transportation	15.1	4.5
Woods	100.9	29.7
Grand Total	339.7	100.0

Impervious (acres)	Total Area Above site	% Impervious
110.1	339.7	32.4

Results:

- Biological condition – "Very Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Poor substrate/available cover, moderately unstable banks, straight channel, optimal riparian zone
- Poor taxa richness. Mollusks comprise 88% of the assemblage.
- Stream type was identified as a C5, slope was 0.28 percent, and the median channel substrate was fine to medium sand
- Biological community is in worse condition than would be expected for available habitat quality.

Recommendations:

- Maintain the protection of the riparian area.
- Investigate BMP retrofit opportunities on residential and commercial land use areas upstream of site.

02-06 Stony Run Sampling Unit

IBI and Metric Scores

Narrative Rating	**Very Poor**
Overall Index	**1.29**
Total Taxa Score	1
EPT Taxa Score	1
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	3
% Climbers	1

Calculated Metric Values

Total Taxa	12
EPT Taxa	0
Ephemeroptera Taxa	0
Intolerant Urban %	0.0
Ephemeroptera %	0.0
Scraper Taxa	1
% Climbers	0.0

Taxa List

Tubificinae	4
Coleoptera	1
Culicoides	2
Chaetocladius	1
Pseudorthocladius	2
Thienemannimyia	1
Fossaria	1
Physa	8
Menetus	5
Pisidium	36
Sphaeriidae (Mollusca)	42
Nematoda	1
Total Individuals	104

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	4	Pool Variability	7
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	16	Sediment Deposition	7
Channel Sinuosity	6	Vegetative Protection (Left Bank)	4
Epifaunal Substrate/Available Cover	5	Vegetative Protection (Right Bank)	4
Pool Substrate Characterization	12		

EPA Habitat Score	107
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	339.7	Instream Wood Debris	3
Remoteness	8	Bank Stability	8
Shading	70		
Epifaunal Substrate	5		
Instream Habitat	5		

PHI Score	55.89
PHI Narrative Ranking	D

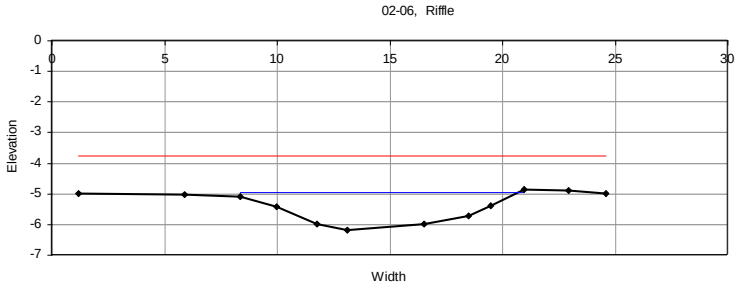
Water Chemistry

Dissolved Oxygen (mg/L)	12.89	Specific Conductance (mS/cm)	1199
pH	–	Temperature (°C)	15.25

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.53	Cross Sectional Area (ft^2)	9.6
Bankfull Width (ft)	12.3	Water Surface Slope (ft/ft)	0.28
Mean Bankfull Depth (ft)	0.8	Sinuosity	1.0*
Floodprone Width (ft)	200*	D50 (mm)	0.25
Entrenchment Ratio	16.2*	Adjustments?	↑Sin
Width to Depth Ratio	15.8	**Rosgen Stream Type**	**C5**



** estimated*

02-07 Stony Run Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Northrop Grunnan parking lot off of Rt. 170
Latitude/Longitude: 39.18985/-76.68848

Land Use Analysis:

Land Use	Acres	% Area
Airport	433.9	44.2
Commercial	18.3	1.9
Industrial	15.6	1.6
Open Space	285.5	29.1
Residential 1/2-acre	3.3	0.3
Residential 1/4-acre	8.8	0.9
Residential 1-acre	23.0	2.3
Transportation	47.7	4.9
Woods	145.9	14.9
Grand Total	981.9	100.0

Impervious (acres)	Total Area Above site	% Impervious
439.9	981.9	44.8

Results:

- Biological condition – "Very Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Adequate substrate/available cover, unstable banks, moderate sediment deposition, marginal riparian zone (right bank).
- Midges comprise 78% of the assemblage (*Orthocladius/Cricotopus*, *Eukiefferiella*, and *Thienemannimyia* are most abundant)
- Stream type was identified as an E5, slope was 0.86 percent, and the median channel substrate was coarse to very coarse sand
- Biological community is in worse condition than would be expected for available habitat quality.

Recommendations:

- Protect the riparian area.
- Determine necessity, feasibility of BMP implementation to capture drainage from BWI airport and other impervious areas.

02-07 Stony Run Sampling Unit

IBI and Metric Scores

Narrative Rating	Very Poor
Overall Index	**1.57**
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	20
EPT Taxa	1
Ephemeroptera Taxa	0
Intolerant Urban %	1.9
Ephemeroptera %	0.0
Scraper Taxa	0
% Climbers	5.7

Taxa List

Enchytraeidae	1
Tubificinae	6
Limnodrilus	1
Brillia	6
Eukiefferiella	15
Hydrobaenus	1
Orthocladius/Cricotopus	37
Parametriocnemus	1
Phaenopsectra	3
Polypedilum	4
Stictochironomus	1
Thienemannimyia	13
Zavrelimyia	2
Tipula	2
Boyeria	1
Coenagrionidae	1
Argia	1
Cheumatopsyche	6
Stygobromus	2
Caecidotea	2
Total Individuals	106

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	2	Pool Variability	12
Bank Stability- Right Bank	4	Riparian Vegetative Zone Width- Left Bank	8
Channel Alteration	17	Riparian Vegetative Zone Width- Right Bank	4
Channel Flow Status	14	Sediment Deposition	7
Channel Sinuosity	10	Vegetative Protection (Left Bank)	2
Epifaunal Substrate/Available Cover	11	Vegetative Protection (Right Bank)	4
Pool Substrate Characterization	9		

EPA Habitat Score	104
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	981.9	Instream Wood Debris	7
Remoteness	7	Bank Stability	6
Shading	60		
Epifaunal Substrate	11		
Instream Habitat	11		

PHI Score	60.38
PHI Narrative Ranking	D

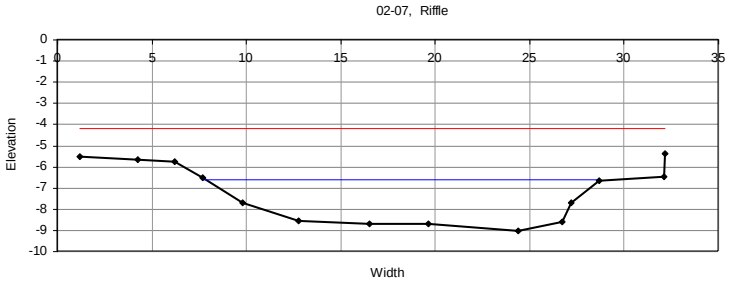
Water Chemistry

Dissolved Oxygen (mg/L)	8.5	Specific Conductance (mS/cm)	930
pH	–	Temperature (°C)	8.78

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	1.53	Cross Sectional Area (ft^2)	37.1
Bankfull Width (ft)	20.8	Water Surface Slope (ft/ft)	0.86
Mean Bankfull Depth (ft)	1.8	Sinuosity	1.4
Floodprone Width (ft)	98*	D50 (mm)	1.0
Entrenchment Ratio	4.7*	Adjustments?	↑Sin
Width to Depth Ratio	11.7	**Rosgen Stream Type**	**E5**



02-11A Stony Run Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Terrain Court. 400ft. S.
Latitude/Longitude: 39.15459/-76.70966

Land Use Analysis:

Land Use	Acres	% Area
Commercial	7.5	4.8
Industrial	0.5	0.3
Open Space	13.3	8.5
Residential 1/2-acre	3.2	2.0
Residential 1/4-acre	53.3	34.2
Residential 1/8-acre	1.6	1.0
Residential 1-acre	0.2	0.1
Transportation	8.1	5.2
Woods	68.4	43.8
Grand Total	156.2	100.0

Impervious (acres)	Total Area Above site	% Impervious
33.5	156.2	21.5

Results:

- Biological condition – "Fair"
- Habitat scores “Non Supporting” and "Partially Degraded"
- Marginal substrate/available cover, unstable banks, evidence of channelization, moderate sediment deposition, optimal riparian zone
- Black flies (*Stegopterna*) and midges (*Parametriocnemus, Polypedilum*) dominate the assemblage.
- Stream type was identified as an F5, slope was 1.1 percent, and the median channel substrate was medium sand
- 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 necessity, feasibility of BMP retrofit installation on developed lands.

02-11A Stony Run Sampling Unit

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	25
EPT Taxa	3
Ephemeroptera Taxa	1
Intolerant Urban %	33.3
Ephemeroptera %	0.9
Scraper Taxa	0
% Climbers	12.0

Taxa List

Tubificinae	2
Limnodrilus	2
Stenelmis	1
Culicoides	1
Chaetocladius	1
Corynoneura	1
Diplocladius	1
Hydrobaenus	1
Orthocladius/Cricotopus	2
Parametriocnemus	28
Polypedilum	12
Pseudorthocladius	1
Rheocricotopus	1
Thienemanniella	1
Thienemannimyia	4
Micropsectra	1
Rheotanytarsus	1
Stegopterna	30
Leptophlebiidae	1
Nigronia	1
Diplectrona	3
Limnephilidae	2
Gammarus	8
Physidae	1
Sphaeriidae (Mollusca)	1
Total Individuals	108

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	3	Pool Variability	9
Bank Stability- Right Bank	3	Riparian Vegetative Zone Width- Left Bank	9
Channel Alteration	12	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	14	Sediment Deposition	6
Channel Sinuosity	8	Vegetative Protection (Left Bank)	3
Epifaunal Substrate/Available Cover	8	Vegetative Protection (Right Bank)	3
Pool Substrate Characterization	8		

EPA Habitat Score	96
EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	156.2	Instream Wood Debris	3
Remoteness	8	Bank Stability	6
Shading	95		
Epifaunal Substrate	6		
Instream Habitat	8		

PHI Score	67.12
PHI Narrative Ranking	PD

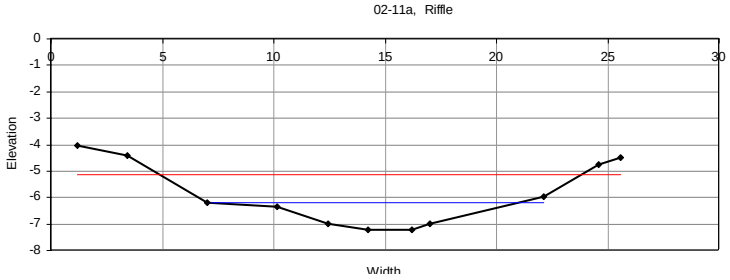
Water Chemistry

Dissolved Oxygen (mg/L)	11.17	Specific Conductance (mS/cm)	323
pH	–	Temperature (°C)	9.76

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.24	Cross Sectional Area (ft^2)	7.3
Bankfull Width (ft)	13.9	Water Surface Slope (ft/ft)	1.1
Mean Bankfull Depth (ft)	0.5	Sinuosity	1.4
Floodprone Width (ft)	18.7	D50 (mm)	0.3
Entrenchment Ratio	1.3	Adjustments?	None
Width to Depth Ratio	26.7	**Rosgen Stream Type**	**F5**



02-18A Stony Run Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Ridge Rd., park at closed road park entrance
Latitude/Longitude: 39.20741/-76.69706

Land Use Analysis:

Land Use	Acres	% Area
Airport	530.7	8.8
Commercial	359.4	6.0
Forested Wetland	2.0	0.0
Industrial	564.8	9.4
Open Space	883.9	14.7
Open Wetland	5.9	0.1
Residential 1/2-acre	298.1	4.9
Residential 1/4-acre	818.5	13.6
Residential 1/8-acre	34.4	0.6
Residential 1-acre	64.2	1.1
Residential 2-acre	31.7	0.5
Row Crops	33.7	0.6
Transportation	387.4	6.4
Utility	1.4	0.0
Water	8.0	0.1
Woods	2006.5	33.3
Grand Total	6030.6	100.0

Impervious (acres)	Total Area Above site	% Impervious
1845.5	6030.6	30.6

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Adequate substrate/available cover, moderately unstable banks, evidence of channelization, marginal riparian zone (right bank).
- Good taxa richness with 6 EPT taxa. The most abundant taxa are midges (*Hydrobaenus, Orthocladius/Cricotopus*).
- Stream type was identified as an C4, slope was 1.13 percent, and the median channel substrate was coarse gravel
- Typically, C channels are stable. However, the habitat appears to be stressed and channel stability is threatened
- Biological community is appropriate for observed habitat quality.

Recommendations:

- Protect the riparian area.
- Investigate retrofit opportunities for storm water management for developed areas in this basin.

02-18A Stony Run Sampling Unit

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	**2.71**
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	26
EPT Taxa	6
Ephemeroptera Taxa	0
Intolerant Urban %	6.7
Ephemeroptera %	0.0
Scraper Taxa	1
% Climbers	4.8

Taxa List

Nais	3
Macronychus	2
Microcylloepus	4
Optioservus	1
Oulimnius	2
Stenelmis	13
Brillia	1
Eukiefferiella	1
Hydrobaenus	19
Orthocladius/Cricotopus	17
Polypedilum	1
Pseudorthocladius	1
Sympotthastia	1
Rheotanytarsus	3
Tanytarsus	3
Simulium	1
Stegopterna	4
Boyeria	1
Capniidae/Leuctridae	1
Cheumatopsyche	10
Hydropsyche	6
Chimarra	1
Lype	1
Neophylax	1
Gammarus	5
Nematoda	1
Total Individuals	104

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	5	Pool Variability	12
Bank Stability- Right Bank	7	Riparian Vegetative Zone Width- Left Bank	8
Channel Alteration	10	Riparian Vegetative Zone Width- Right Bank	5
Channel Flow Status	18	Sediment Deposition	11
Channel Sinuosity	8	Vegetative Protection (Left Bank)	4
Epifaunal Substrate/Available Cover	14	Vegetative Protection (Right Bank)	5
Pool Substrate Characterization	9		

EPA Habitat Score	116
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	6030.6	Instream Wood Debris	3
Remoteness	8	Bank Stability	12
Shading	45		
Epifaunal Substrate	9		
Instream Habitat	14		

PHI Score	53.19
PHI Narrative Ranking	D

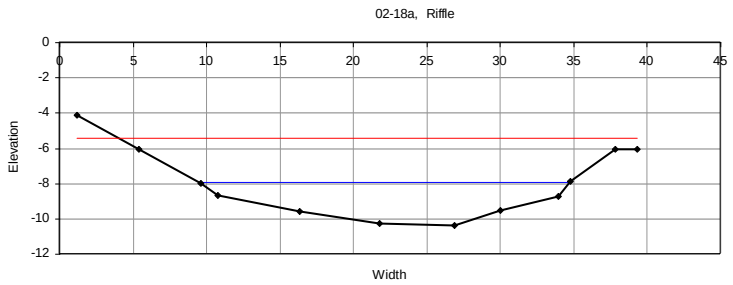
Water Chemistry

Dissolved Oxygen (mg/L)	13.6	Specific Conductance (mS/cm)	570
pH	–	Temperature (°C)	4.61

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	9.42	Cross Sectional Area (ft^2)	41.9
Bankfull Width (ft)	25.1	Water Surface Slope (ft/ft)	1.13
Mean Bankfull Depth (ft)	1.7	Sinuosity	1.1
Floodprone Width (ft)	140	D50 (mm)	22
Entrenchment Ratio	5.6	Adjustments?	↑ Sin
Width to Depth Ratio	15	**Rosgen Stream Type**	**C4**



02-19A Stony Run Sampling Unit

Location/Site Access: Located at Old Dorsey Rd. Crossing
Latitude/Longitude: 39.15775/-76.69986

Land Use Analysis:

Land Use	Acres	% Area
Commercial	59.2	3.0
Forested Wetland	2.0	0.1
Industrial	66.7	3.4
Open Space	158.2	8.0
Residential 1/2-acre	187.2	9.5
Residential 1/4-acre	764.9	38.9
Residential 1/8-acre	33.4	1.7
Residential 1-acre	16.2	0.8
Residential 2-acre	1.5	0.1
Row Crops	33.7	1.7
Transportation	110.7	5.6
Water	8.0	0.4
Woods	523.8	26.6
Grand Total	1965.5	100.0

Impervious (acres)	Total Area Above site	% Impervious
464.6	1965.5	23.6

Results:

- Biological condition – "Poor"
- Habitat scores “Non Supporting” and "Severely Degraded"
- Adequate substrate/available cover, moderately unstable banks, no pools, evidence of channelization, minimally impacted riparian zone
- Assemblage is dominated by beetles and midges. The most abundant species are *Stenelmis* and *Orthocladius/Cricotopus*.
- Stream type was not evaluated
- Biological community is in better condition than expected for measured level of habitat quality.

Recommendations:

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

02-19A Stony Run 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	3
% Climbers	3

Calculated Metric Values

Total Taxa	19
EPT Taxa	2
Ephemeroptera Taxa	0
Intolerant Urban %	5.7
Ephemeroptera %	0.0
Scraper Taxa	1
% Climbers	1.0

Taxa List

Nais	5
Tubificinae	3
Macronychus	1
Optioservus	2
Oulimnius	6
Stenelmis	32
Corynoneura	2
Cryptochironomus	1
Hydrobaenus	1
Orthocladius/Cricotopus	22
Thienemanniella	2
Thienemannimyia	1
Rheotanytarsus	3
Calopteryx	1
Cheumatopsyche	4
Hydropsyche	7
Gammarus	9
Fossaria	1
Pisidium	2
Total Individuals	105

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	4	Pool Variability	0
Bank Stability- Right Bank	4	Riparian Vegetative Zone Width- Left Bank	7
Channel Alteration	13	Riparian Vegetative Zone Width- Right Bank	7
Channel Flow Status	18	Sediment Deposition	11
Channel Sinuosity	6	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	13	Vegetative Protection (Right Bank)	5
Pool Substrate Characterization	0		

EPA Habitat Score	93
EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	1965.5	Instream Wood Debris	4
Remoteness	1	Bank Stability	8
Shading	10		
Epifaunal Substrate	11		
Instream Habitat	13		

PHI Score	45.13
PHI Narrative Ranking	SD

Water Chemistry

Dissolved Oxygen (mg/L)	10.23	Specific Conductance (mS/cm)	220
pH	–	Temperature (°C)	15.67

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	Cross Sectional Area (ft^2)
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	**Rosgen Stream Type**

(Missing data – not evaluated)

02-20A Stony Run Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Furnace Ave. park at train tracks, walk east
Latitude/Longitude: 39.21069/-76.69633

Land Use Analysis:

Land Use	Acres	% Area
Airport	530.7	8.7
Commercial	360.3	5.9
Forested Wetland	2.0	0.0
Industrial	564.8	9.3
Open Space	884.1	14.5
Open Wetland	5.9	0.1
Residential 1/2-acre	298.1	4.9
Residential 1/4-acre	818.5	13.4
Residential 1/8-acre	34.4	0.6
Residential 1-acre	70.4	1.2
Residential 2-acre	33.1	0.5
Row Crops	33.7	0.6
Transportation	394.0	6.5
Utility	5.3	0.1
Water	8.0	0.1
Woods	2049.7	33.6
Grand Total	6092.9	100.0

Impervious (acres)	Total Area Above site	% Impervious
1853.0	6092.9	30.4

Results:

- Biological condition – "Poor"
- Habitat scores “Partially Supporting” and "Degraded"
- Adequate substrate/available cover, moderately unstable banks, fairly straight channel, optimal riparian zone
- Assemblage dominated by midges. The most abundant taxon, *Hydrobaenus*, comprises 46% of the sample.
- Stream type was identified as an C5, slope was 0.47 percent, and the median channel substrate was coarse to medium sand
- Typically, C channels are stable. However, the marginal habitat ratings related to bank conditions 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.
- Investigate necessity, feasibility of BMP retrofits on developed lands upstream.

02-20A Stony Run Sampling Unit

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	**2.14**
Total Taxa Score	5
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	25
EPT Taxa	3
Ephemeroptera Taxa	0
Intolerant Urban %	2.8
Ephemeroptera %	0.0
Scraper Taxa	0
% Climbers	3.7

Taxa List

Unionicola	1
Nais	2
Enchytraeidae	1
Tubificinae	2
Ancyronyx	1
Macronychus	3
Microcylloepus	1
Stenelmis	2
Bezzia/Palpomyia	1
Diplocladius	1
Hydrobaenus	50
Nanocladius	1
Orthocladius/Cricotopus	8
Parametriocnemus	1
Polypedilum	2
Paratanytarsus	1
Rheotanytarsus	4
Tanytarsus	2
Ephydridae	1
Stegopterna	3
Tipulidae	1
Cheumatopsyche	9
Hydropsyche	2
Pycnopsyche	2
Gammarus	7

Total Individuals	109

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	4	Pool Variability	10
Bank Stability- Right Bank	4	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	17	Riparian Vegetative Zone Width- Right Bank	9
Channel Flow Status	18	Sediment Deposition	9
Channel Sinuosity	6	Vegetative Protection (Left Bank)	4
Epifaunal Substrate/Available Cover	12	Vegetative Protection (Right Bank)	4
Pool Substrate Characterization	9		

EPA Habitat Score	116
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	6092.9	Instream Wood Debris	4
Remoteness	7	Bank Stability	8
Shading	85		
Epifaunal Substrate	10		
Instream Habitat	12		

PHI Score	56.00
PHI Narrative Ranking	D

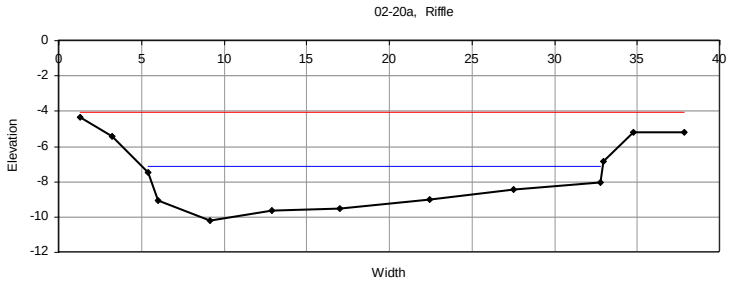
Water Chemistry

Dissolved Oxygen (mg/L)	13.39	Specific Conductance (mS/cm)	578
pH	–	Temperature (°C)	3.17

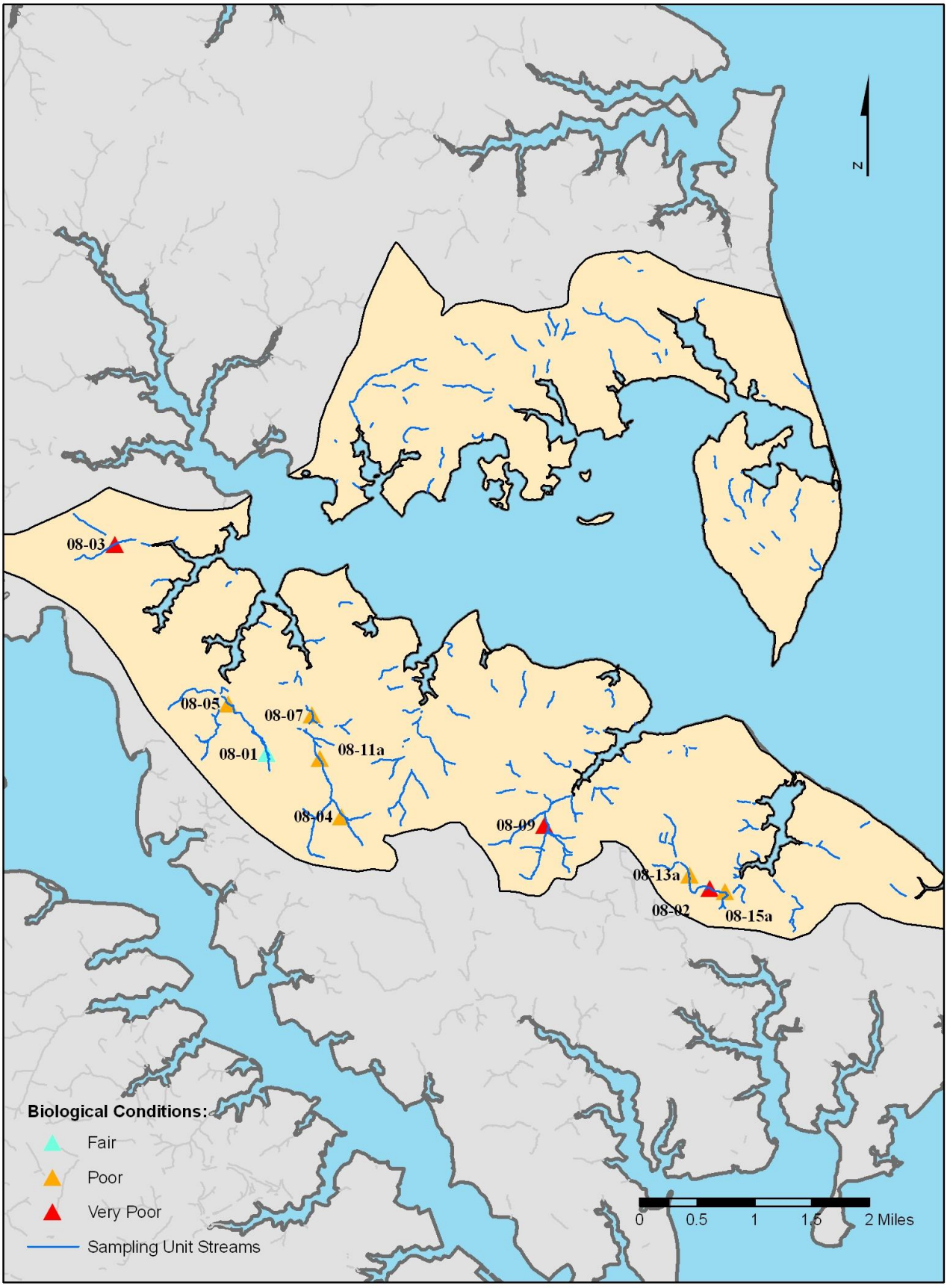
Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	9.52	Cross Sectional Area (ft^2)	54.0
Bankfull Width (ft)	27.4	Water Surface Slope (ft/ft)	0.47
Mean Bankfull Depth (ft)	2.0	Sinuosity	1.2
Floodprone Width (ft)	257*	D50 (mm)	0.5
Entrenchment Ratio	9.4*	Adjustments?	↑ Sin
Width to Depth Ratio	13.9	**Rosgen Stream Type**	**C5**



Lower Magothy Sampling Unit



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08-01 Lower Magothy Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Anne Arundel Community College
Latitude/Longitude: 39.04887/-76.5148

Land Use Analysis:

Land Use	Acres	% Area
Commercial	32.6	16.4
Industrial	6.9	3.5
Open Space	18.2	9.2
Residential 1/2-acre	82.5	41.6
Transportation	9.6	4.9
Woods	48.4	24.4
Grand Total	198.2	100.0

Impervious (acres)	Total Area Above site	% Impervious
57.9	198.2	29.2

Results:

- Biological condition – "Fair"
- Habitat scores "Non Supporting" and "Partially Degraded"
- Marginal substrate/available cover, moderately unstable banks, evidence of channelization, minimally impacted riparian zone
- Assemblage is dominated by worms (46%) and midges (36%). The most abundant taxon is Tubificinae.
- Stream type was identified as an E5, slope was 0.20 percent, and the median channel substrate was fine sand
- 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 need, feasibility of BMP retrofits on extensive developed lands upstream.

08-01 Lower Magothy Sampling Unit

IBI and Metric Scores

Narrative Rating	**Fair**
Overall Index	**3.00**
Total Taxa Score	5
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	5
% Climbers	5

Calculated Metric Values

Total Taxa	23
EPT Taxa	2
Ephemeroptera Taxa	0
Intolerant Urban %	3.8
Ephemeroptera %	0.0
Scraper Taxa	2
% Climbers	14.2

Taxa List

Enchytraeidae	1
Tubificinae	33
Aulodrilus	3
Limnodrilus	12
Oulimnius	1
Dineutus	1
Diplocladius	4
Natarsia	1
Odontomesa	5
Paracladopelma	1
Parametriocnemus	1
Paratendipes	6
Phaenopsectra	2
Polypedilum	15
Prodiamesa	2
Rheocricotopus	1
Sciaridae	1
Pseudolimnophila	1
Psilotreta	2
Lype	1
Physa	6
Menetus	1
Pisidium	5
Total Individuals	106

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	4	Pool Variability	9
Bank Stability- Right Bank	5	Riparian Vegetative Zone Width- Left Bank	6
Channel Alteration	11	Riparian Vegetative Zone Width- Right Bank	8
Channel Flow Status	15	Sediment Deposition	6
Channel Sinuosity	7	Vegetative Protection (Left Bank)	4
Epifaunal Substrate/Available Cover	8	Vegetative Protection (Right Bank)	5
Pool Substrate Characterization	8		

EPA Habitat Score	96
EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	198.2	Instream Wood Debris	7
Remoteness	7	Bank Stability	8
Shading	100		
Epifaunal Substrate	8		
Instream Habitat	8		

PHI Score	70.44
PHI Narrative Ranking	PD

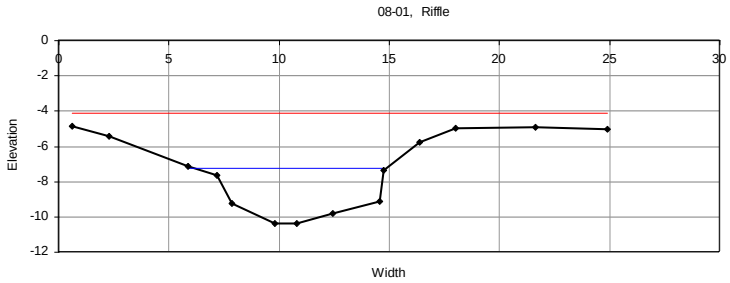
Water Chemistry

Dissolved Oxygen (mg/L)	11.06	Specific Conductance (mS/cm)	1338
pH	–	Temperature (°C)	3.77

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.31	Cross Sectional Area (ft^2)	18.6
Bankfull Width (ft)	8.6	Water Surface Slope (ft/ft)	0.20
Mean Bankfull Depth (ft)	2.2	Sinuosity	1.0
Floodprone Width (ft)	77.0	D50 (mm)	0.18
Entrenchment Ratio	8.9	Adjustments?	↑Sin
Width to Depth Ratio	4.0	**Rosgen Stream Type**	**E5**



08-02 Lower Magothy Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Cape Saint Rd. Crossing
Latitude/Longitude: 39.0316/-76.44326

Land Use Analysis:

Land Use	Acres	% Area
Commercial	33.1	10.5
Industrial	0.8	0.2
Open Space	32.6	10.4
Residential 1/4-acre	114.1	36.2
Residential 1/8-acre	50.2	15.9
Residential 2-acre	1.1	0.4
Transportation	8.3	2.6
Woods	75.0	23.8
Grand Total	315.3	100.0

Impervious (acres)	Total Area Above site	% Impervious
92.4	315.3	29.3

Results:

- Biological condition – "Very Poor"
- Habitat scores "Non Supporting" and "Degraded"
- Adequate substrate/available cover, moderately unstable banks, evidence of channelization, marginal riparian zone
- The most abundant taxon, Sphaeriidae (Mollusca), comprises 31% of the sample. The other taxa are mostly worms, midges and amphipods.
- Stream type was identified as an E5, slope was 0.136 percent, and the median channel substrate was fine sand
- 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 features, if possible.
- Determine need, feasibility of BMP installation to control stormwater from developed lands.

08-02 Lower Magothy Sampling Unit

IBI and Metric Scores

Narrative Rating	**Very Poor**
Overall Index	**1.86**
Total Taxa Score	5
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	26
EPT Taxa	0
Ephemeroptera Taxa	0
Intolerant Urban %	4.7
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	**3.8**

Taxa List

Nais	**3**
Ilyodrilus	**1**
Lumbriculidae	**1**
Tubificinae	**12**
Aulodrilus	**1**
Chrysomelidae	**1**
Neoporus	**1**
Stenelmis	**1**
Bezzia/Palpomyia	**1**
Cryptochironomus	**1**
Orthocladiinae	**1**
Orthocladius/Cricotopus	**8**
Parametriocnemus	**3**
Paratendipes	**1**
Polypedilum	**4**
Thienemannimyia	**9**
Rheotanytarsus	**1**
Gomphus	**1**
Crangonyx	**1**
Gammarus	**11**
Caecidotea	**4**
Physa	**3**
Sphaeriidae (Mollusca)	**30**
Nematoda	**3**
Prostoma	**2**
Planariidae	**1**
Total Individuals	**106**

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	4	Pool Variability	9
Bank Stability- Right Bank	4	Riparian Vegetative Zone Width- Left Bank	5
Channel Alteration	13	Riparian Vegetative Zone Width- Right Bank	6
Channel Flow Status	16	Sediment Deposition	8
Channel Sinuosity	6	Vegetative Protection (Left Bank)	4
Epifaunal Substrate/Available Cover	11	Vegetative Protection (Right Bank)	4
Pool Substrate Characterization	8		

EPA Habitat Score	98
EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	315.3	Instream Wood Debris	2
Remoteness	4	Bank Stability	8
Shading	65		
Epifaunal Substrate	5		
Instream Habitat	11		

PHI Score	56.91
PHI Narrative Ranking	D

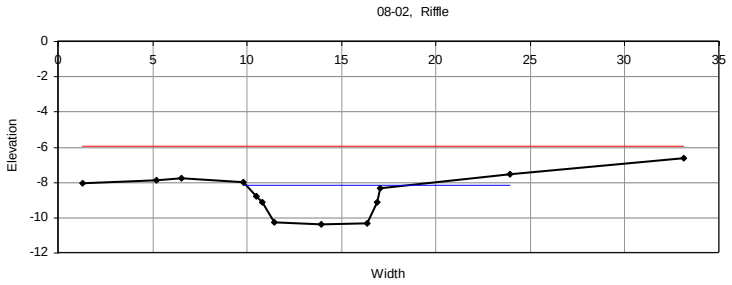
Water Chemistry

Dissolved Oxygen (mg/L)	11.8	Specific Conductance (mS/cm)	694
pH	–	Temperature (°C)	8.65

Geomorphic Assessments

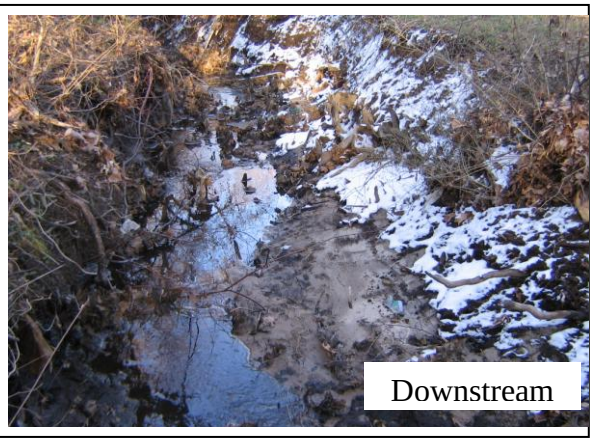
Rosgen Level II Classification Data

Drainage Area (mi^2)	0.49	Cross Sectional Area (ft^2)	13.1
Bankfull Width (ft)	8.6	Water Surface Slope (ft/ft)	0.136
Mean Bankfull Depth (ft)	1.5	Sinuosity	1.00*
Floodprone Width (ft)	32.0*	D50 (mm)	0.16
Entrenchment Ratio	3.7*	Adjustments?	↑Sin
Width to Depth Ratio	5.6	**Rosgen Stream Type**	**E5**



08-03 Lower Magothy Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Park at intersection of McKinsry Rd. at Leelyn Dr. - walk 0.1 miles S.E.
Latitude/Longitude: 39.07533/-76.53922

Land Use Analysis:

Land Use	Acres	% Area
Commercial	100.7	34.0
Open Space	19.2	6.5
Residential 1/2-acre	23.5	7.9
Residential 1/4-acre	93.4	31.6
Residential 1/8-acre	17.1	5.8
Transportation	19.2	6.5
Woods	22.8	7.7
Grand Total	295.8	100.0

Impervious (acres)	Total Area Above site	% Impervious
133.7	295.8	45.2

Results:

- Biological condition – "Very Poor"
- Habitat scores "Non Supporting" and "Degraded"
- Marginal substrate/available cover, moderately unstable banks, optimal riparian zone
- Assemblage is dominated by worms. One taxon, Tubificinae, comprises 60% of the sample. No EPT taxa.
- Specific conductance relatively high.
- Stream type was identified as an G5c, slope was 1.02 percent, and the median channel substrate was fine sand
- 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 and restore habitat features, if possible.
- Determine feasibility of stormwater management on developed lands upstream.

08-03 Lower Magothy Sampling Unit

IBI and Metric Scores

Narrative Rating	Very Poor
Overall Index	**1.57**
Total Taxa Score	3
EPT Taxa Score	1
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	3
% Climbers	1

Calculated Metric Values

Total Taxa	16
EPT Taxa	0
Ephemeroptera Taxa	0
Intolerant Urban %	0.0
Ephemeroptera %	0
Scraper Taxa	1
% Climbers	0.0

Taxa List

Mooreobdella	5
Nais	1
Enchytraeidae	1
Lumbricidae	1
Tubificinae	60
Bothrioneurum	1
Limnodrilus	3
Orthocladius/Cricotopus	5
Stenochironomus	1
Thienemannimyia	1
Tipula	2
Fossaria	1
Physa	9
Pisidium	1
Prostoma	2
Planariidae	6
Total Individuals	100

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	3	Pool Variability	8
Bank Stability- Right Bank	3	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	17	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	10	Sediment Deposition	10
Channel Sinuosity	7	Vegetative Protection (Left Bank)	4
Epifaunal Substrate/Available Cover	7	Vegetative Protection (Right Bank)	4
Pool Substrate Characterization	7		

EPA Habitat Score	100
EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	295.8	Instream Wood Debris	4
Remoteness	8	Bank Stability	7
Shading	60		
Epifaunal Substrate	7		
Instream Habitat	7		

PHI Score	58.57
PHI Narrative Ranking	D

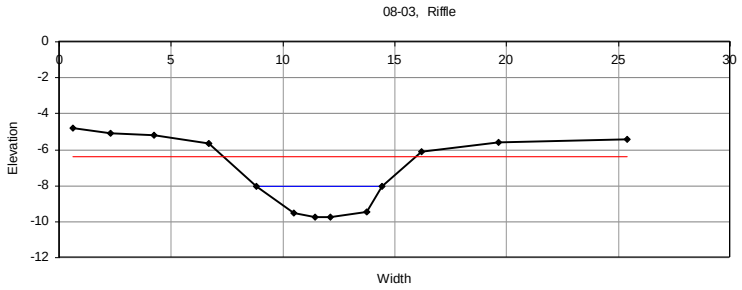
Water Chemistry

Dissolved Oxygen (mg/L)	9.86	Specific Conductance (mS/cm)	4384
pH	–	Temperature (°C)	6.17

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.46	Cross Sectional Area (ft^2)	6.8
Bankfull Width (ft)	5.6	Water Surface Slope (ft/ft)	1.02
Mean Bankfull Depth (ft)	1.2	Sinuosity	1.00*
Floodprone Width (ft)	8.1	D50 (mm)	0.16
Entrenchment Ratio	1.5	Adjustments?	↓ER,↑Sin
Width to Depth Ratio	4.6	**Rosgen Stream Type**	**G5c**



08-04 Lower Magothy Sampling Unit


Upstream


Downstream

Location/Site Access: Located at 224 Waycross Rd., 200m S.W.
Latitude/Longitude: 39.04091/-76.50277

Land Use Analysis:

Land Use	Acres	% Area
Commercial	5.0	3.0
Open Space	2.3	1.4
Residential 1/2-acre	95.1	56.3
Residential 1/4-acre	9.8	5.8
Residential 1-acre	7.1	4.2
Transportation	2.0	1.2
Woods	47.7	28.2
Grand Total	169.1	100.0

Impervious (acres)	Total Area Above site	% Impervious
30.2	169.1	17.9

Results:

- Biological condition – "Poor"
- Habitat scores "Non Supporting" and "Partially Degraded"
- Marginal substrate/available cover, moderately unstable banks, moderate sediment deposition, minimally impacted riparian zone
- 15 midge taxa comprise 67% of the assemblage. The most abundant taxa are *Polypedilum* and *Diplocladius.*
- Stream type was identified as an G5c, slope was 0.62 percent, and the median channel substrate was fine to medium sand
- 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 necessity, feasibility of installing stormwater management practices on upstream developed lands.

08-04 Lower Magothy Sampling Unit

IBI and Metric Scores

Narrative Rating	**Poor**
Overall Index	**2.43**
Total Taxa Score	5
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	32
EPT Taxa	4
Ephemeroptera Taxa	0
Intolerant Urban %	3.4
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	25.0

Taxa List

Lumbriculidae	2
Eclipidrilus	2
Enchytraeidae	1
Tubificinae	6
Aulodrilus	7
Limnodrilus	1
Spirosperma	1
Promoresia	1
Chironomini	1
Corynoneura	5
Diplocladius	11
Eukiefferiella	3
Natarsia	5
Odontomesa	3
Orthocladius/Cricotopus	1
Parachaetocladius	1
Parametriocnemus	7
Polypedilum	27
Rheocricotopus	1
Thienemannimyia	4
Zavrelimyia	4
Rheotanytarsus	3
Tanytarsus	2
Ormosia	1
Pseudolimnophila	2
Tipula	5
Allocapnia	1
Limnephilidae	1
Psilotreta	1
Lype	2
Pisidium	3
Nematoda	1
Total Individuals	116

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	4	Pool Variability	8
Bank Stability- Right Bank	4	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	18	Riparian Vegetative Zone Width- Right Bank	8
Channel Flow Status	9	Sediment Deposition	6
Channel Sinuosity	7	Vegetative Protection (Left Bank)	4
Epifaunal Substrate/Available Cover	8	Vegetative Protection (Right Bank)	4
Pool Substrate Characterization	9		

EPA Habitat Score	99
EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	169.1	Instream Wood Debris	3
Remoteness	6	Bank Stability	8
Shading	100		
Epifaunal Substrate	6		
Instream Habitat	8		

PHI Score	66.38
PHI Narrative Ranking	PD

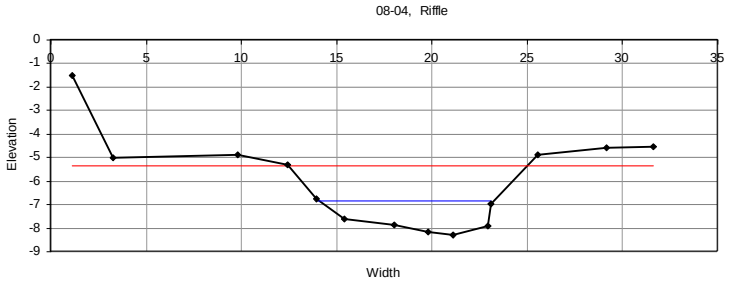
Water Chemistry

Dissolved Oxygen (mg/L)	10.03	Specific Conductance (mS/cm)	358
pH	–	Temperature (°C)	5.72

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.26	Cross Sectional Area (ft^2)	9.3
Bankfull Width (ft)	9.0	Water Surface Slope (ft/ft)	0.62
Mean Bankfull Depth (ft)	1.0	Sinuosity	1.00*
Floodprone Width (ft)	9	D50 (mm)	0.25
Entrenchment Ratio	1.0	Adjustments?	↑ Sin
Width to Depth Ratio	8.8	**Rosgen Stream Type**	**G5c**



08-05 Lower Magothy Sampling Unit


Upstream


Downstream

Location/Site Access: Located at 939 Blue Fox way, walk east 340ft.
Latitude/Longitude: 39.05521/-76.52098

Land Use Analysis:

Land Use	Acres	% Area
Commercial	62.7	20.5
Open Space	6.9	2.2
Residential 1/2-acre	36.6	12.0
Residential 1/4-acre	93.8	30.7
Residential 1-acre	7.6	2.5
Transportation	18.7	6.1
Woods	79.6	26.0
Grand Total	305.9	100.0

Impervious (acres)	Total Area Above site	% Impervious
94.7	305.9	31.0

Results:

- Biological condition – "Poor"
- Habitat scores "Non Supporting" and "Degraded"
- Marginal substrate/available cover, moderately unstable banks, heavy sediment deposition, marginal riparian zone (right bank)
- Assemblage dominated by mollusks (49%) and midges (32%). The most abundant taxa are *Physa* and *Thienemannimyia*.
- Stream type was identified as an C5, slope was 0.59 percent, and the median channel substrate was fine to medium sand
- Habitat conditions are mixed for this site, with one assessment method indicating impairment and one indicating some kind of enrichment.

Recommendations:

- Protect the riparian area.
- Determine need, feasibility of BMP installation on upstream developed lands.

08-05 Lower Magothy 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	3
Ephemeroptera % Score	1
Scraper Taxa Score	3
% Climbers	1

Calculated Metric Values

Total Taxa	18
EPT Taxa	3
Ephemeroptera Taxa	0
Intolerant Urban %	11.0
Ephemeroptera %	0
Scraper Taxa	1
% Climbers	0.8

Taxa List

Tubificinae	4
Spirosperma	1
Corynoneura	1
Diplocladius	4
Orthocladius/Cricotopus	1
Stenochironomus	1
Thienemanniella	2
Thienemannimyia	27
Paratanytarsus	2
Boyeria	1
Diplectrona	1
Psilotreta	1
Lype	1
Caecidotea	11
Physa	35
Menetus	1
Pisidium	22
Prostoma	2
Total Individuals	118

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	4	Pool Variability	8
Bank Stability- Right Bank	4	Riparian Vegetative Zone Width- Left Bank	9
Channel Alteration	17	Riparian Vegetative Zone Width- Right Bank	3
Channel Flow Status	16	Sediment Deposition	3
Channel Sinuosity	6	Vegetative Protection (Left Bank)	3
Epifaunal Substrate/Available Cover	6	Vegetative Protection (Right Bank)	3
Pool Substrate Characterization	9		

EPA Habitat Score	91
EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	305.9	Instream Wood Debris	10
Remoteness	4	Bank Stability	6
Shading	80		
Epifaunal Substrate	5		
Instream Habitat	6		

PHI Score	57.48
PHI Narrative Ranking	D

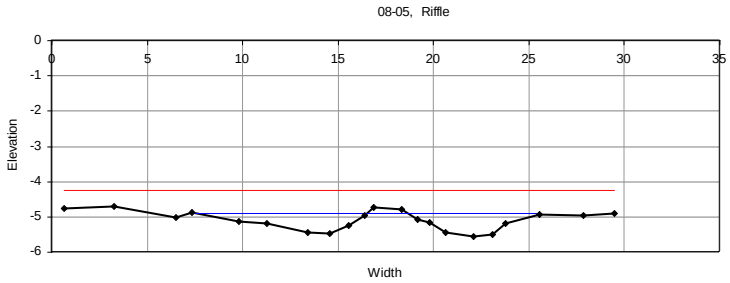
Water Chemistry

Dissolved Oxygen (mg/L)	10.3	Specific Conductance (mS/cm)	1383
pH	–	Temperature (°C)	3.96

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.49	Cross Sectional Area (ft^2)	5.3
Bankfull Width (ft)	15.7	Water Surface Slope (ft/ft)	0.59
Mean Bankfull Depth (ft)	0.3	Sinuosity	1.00*
Floodprone Width (ft)	133*	D50 (mm)	0.25
Entrenchment Ratio	8.5*	Adjustments?	↑ Sin
Width to Depth Ratio	46.5	**Rosgen Stream Type**	**C5**



08-07 Lower Magothy Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Jones Road crossing
Latitude/Longitude: 39.0537/-76.5074

Land Use Analysis:

Land Use	Acres	% Area
Commercial	70.0	8.7
Industrial	1.2	0.1
Open Space	24.0	3.0
Pasture/Hay	5.2	0.6
Residential 1/2-acre	209.1	26.1
Residential 1/4-acre	176.0	22.0
Residential 1/8-acre	15.7	2.0
Residential 1-acre	29.8	3.7
Transportation	33.2	4.1
Water	1.9	0.2
Woods	234.9	29.3
Grand Total	800.9	100.0

Impervious (acres)	Total Area Above site	% Impervious
204.2	800.9	25.5

Results:

- Biological condition – "Poor"
- Habitat scores "Non Supporting" and "Severely Degraded"
- Poor substrate conditions, obvious channelization, heavy sediment deposition, marginal riparian zone (left bank)
- Assemblage dominated by worms (47%). *Nais* and *Tubificinae* are the most abundant taxa. Many of the other organisms are midges (18%) and Mollusks (9%).
- Stream type was identified as an E5, slope was 0.013 percent, and the median channel substrate was silt
- While impaired, biological community is in better condition than expected for measured level of habitat quality.

Recommendations:

- Protect the riparian area and restore habitat features, if possible
- Look for BMP retrofit opportunities in residential and commercial areas upstream of site.

08-07 Lower Magothy Sampling Unit

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	**2.14**
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	27
EPT Taxa	1
Ephemeroptera Taxa	0
Intolerant Urban %	1.0
Ephemeroptera %	0
Scraper Taxa	1
% Climbers	1.9

Taxa List

Nais	19
Enchytraeidae	4
Slavina	4
Tubificinae	16
Aulodrilus	2
Limnodrilus	3
Spirosperma	1
Neoporus	1
Bezzia/Palpomyia	1
Diplocladius	1
Paraphaenocladius	1
Pseudorthocladius	11
Pseudosmittia	1
Stenochironomus	1
Thienemanniella	2
Micropsectra	1
Rheotanytarsus	1
Tipulidae	1
Ischnura	1
Cheumatopsyche	1
Crangonyx	14
Fossaria	4
Physa	2
Menetus	1
Pisidium	3
Nematoda	1
Prostoma	7
Total Individuals	105

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	7	Pool Variability	11
Bank Stability- Right Bank	8	Riparian Vegetative Zone Width- Left Bank	4
Channel Alteration	9	Riparian Vegetative Zone Width- Right Bank	6
Channel Flow Status	16	Sediment Deposition	3
Channel Sinuosity	5	Vegetative Protection (Left Bank)	6
Epifaunal Substrate/Available Cover	6	Vegetative Protection (Right Bank)	6
Pool Substrate Characterization	8		

EPA Habitat Score	95
EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	800.9	Instream Wood Debris	3
Remoteness	2	Bank Stability	14
Shading	75		
Epifaunal Substrate	2		
Instream Habitat	6		

PHI Score	48.75
PHI Narrative Ranking	SD

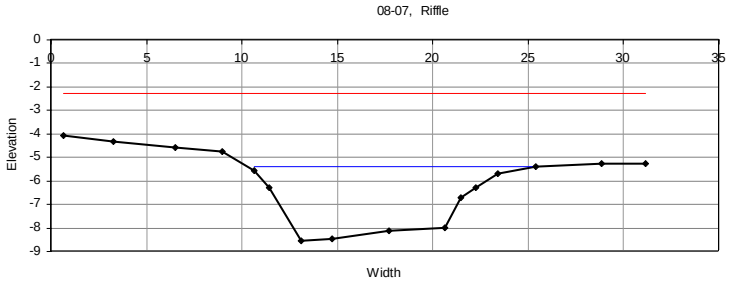
Water Chemistry

Dissolved Oxygen (mg/L)	12.55	Specific Conductance (mS/cm)	873
pH	–	Temperature (°C)	1.52

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	1.25	Cross Sectional Area (ft^2)	28.6
Bankfull Width (ft)	14.8	Water Surface Slope (ft/ft)	0.013
Mean Bankfull Depth (ft)	1.9	Sinuosity	1.00*
Floodprone Width (ft)	62*	D50 (mm)	0.13
Entrenchment Ratio	4.2*	Adjustments?	↑ Sin
Width to Depth Ratio	7.6	**Rosgen Stream Type**	**E5**



** estimated*

08-09 Lower Magothy Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Ridge Dr.
Latitude/Longitude: 39.03968/-76.46996

Land Use Analysis:

Land Use	Acres	% Area
Commercial	7.5	3.6
Open Space	10.3	4.9
Residential 1/2-acre	6.7	3.2
Residential 1/4-acre	29.3	13.8
Residential 1/8-acre	37.2	17.6
Residential 1-acre	4.8	2.3
Residential 2-acre	4.9	2.3
Row Crops	10.8	5.1
Transportation	9.3	4.4
Woods	90.6	42.8
Grand Total	211.4	100.0

Impervious (acres)	Total Area Above site	% Impervious
37.4	211.4	17.7

Results:

- Biological condition – "Very Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Marginal bank and substrate habitat features
- Sample dominated by midges (*Parametriocnemus*)
- Stream type was identified as an E5, slope was 0.59 percent, and the median channel substrate was medium sand
- Biological community is in worse condition than would be expected for available habitat quality.

Recommendations:

- Protect the riparian area.
- Look for opportunities to improve water quality via BMP installation or retrofits on existing developed land.

08-09 Lower Magothy Sampling Unit

IBI and Metric Scores

Narrative Rating	**Very Poor**
Overall Index	**1.57**
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	1
Ephemeroptera Taxa	0
Intolerant Urban %	0
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	2.68

Taxa List

Slavina	1
Tubificinae	1
Aulodrilus	1
Corynoneura	7
Diplocladius	4
Heterotrissocladius	1
Odontomesa	3
Parametriocnemus	61
Paraphaenocladius	1
Phaenopsectra	1
Thienemanniella	5
Thienemannimyia	4
Zavrelimyia	2
Rheotanytarsus	10
Tanytarsus	1
Tipula	2
Psilotreta	1
Prostoma	1
Total Individuals	107

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	4	Pool Variability	7
Bank Stability- Right Bank	4	Riparian Vegetative Zone Width- Left Bank	7
Channel Alteration	13	Riparian Vegetative Zone Width- Right Bank	8
Channel Flow Status	16	Sediment Deposition	8
Channel Sinuosity	9	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	9	Vegetative Protection (Right Bank)	5
Pool Substrate Characterization	8		

EPA Habitat Score	103
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	211.4	Instream Wood Debris	6
Remoteness	4	Bank Stability	7
Shading	70		
Epifaunal Substrate	4		
Instream Habitat	9		

PHI Score	58.05
PHI Narrative Ranking	D

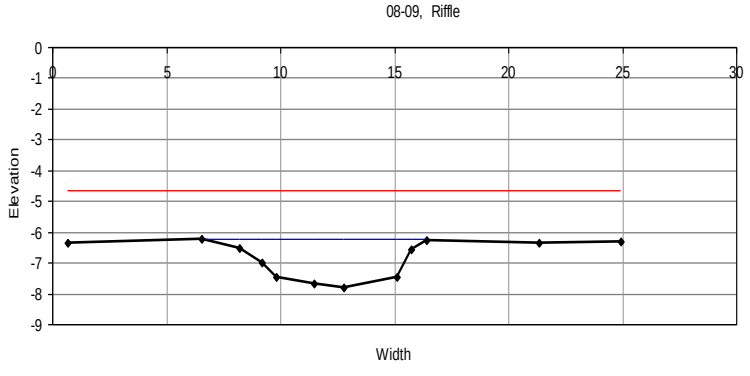
Water Chemistry

Dissolved Oxygen (mg/L)	11.65	Specific Conductance (mS/cm)	465
pH	–	Temperature (°C)	7.45

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.33	Cross Sectional Area (ft^2)	9.5
Bankfull Width (ft)	9.8	Water Surface Slope (ft/ft)	0.59
Mean Bankfull Depth (ft)	1.0	Sinuosity	1.3
Floodprone Width (ft)	98	D50 (mm)	0.35*
Entrenchment Ratio	10	Adjustments?	↑ Sin
Width to Depth Ratio	10.2	**Rosgen Stream Type**	**E5**



08-11A Lower Magothy Sampling Unit


Upstream


Downstream

Location/Site Access: Located at end of kings college re. playground; walk 500m N.E.
Latitude/Longitude: 39.04823/-76.50617

Land Use Analysis:

Land Use	Acres	% Area
Commercial	27.4	4.9
Industrial	0.3	0.1
Open Space	5.5	1.0
Pasture/Hay	5.2	0.9
Residential 1/2-acre	198.2	35.2
Residential 1/4-acre	94.1	16.7
Residential 1-acre	29.8	5.3
Transportation	21.8	3.9
Woods	180.2	32.0
Grand Total	562.5	100.0

Impervious (acres)	Total Area Above site	% Impervious
115.7	562.5	20.6

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Marginal substrate/available cover, straight channel, limited instream woody debris, marginal riparian zone (right bank)
- Assemblage dominated by worms (53%) and mollusks (34%). The most abundant taxa are Tubificinae and *Pisidium*.
- pH relatively high
- Stream type was identified as an E5, slope was 0.04 percent, and the median channel substrate was medium sand
- Biological community is appropriate for observed habitat quality.

Recommendations:

- Protect the riparian area.
- Determine need, feasibility of stormwater management BMP implementation on developed lands upstream of site.

08-11A Lower Magothy Sampling Unit

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	5
% Climbers	3

Calculated Metric Values

Total Taxa	23
EPT Taxa	0
Ephemeroptera Taxa	0
Intolerant Urban %	0.8
Ephemeroptera %	0
Scraper Taxa	2
% Climbers	1.7

Taxa List

Ilyodrilus	8
Lumbriculidae	3
Tubificinae	26
Aulodrilus	11
Bothrioneurum	1
Limnodrilus	13
Spirosperma	1
Dytiscidae	1
Odontomesa	1
Parametriocnemus	1
Phaenopsectra	3
Polypedilum	1
Prodiamesa	1
Pseudorthocladius	1
Zavrelimyia	1
Micropsectra	1
Tipulidae	1
Crangonyx	1
Gammarus	1
Physa	10
Menetus	2
Pisidium	28
Planariidae	1
Total Individuals	118

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	7	Pool Variability	14
Bank Stability- Right Bank	7	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	16	Riparian Vegetative Zone Width- Right Bank	5
Channel Flow Status	19	Sediment Deposition	7
Channel Sinuosity	4	Vegetative Protection (Left Bank)	6
Epifaunal Substrate/Available Cover	9	Vegetative Protection (Right Bank)	6
Pool Substrate Characterization	8		

EPA Habitat Score	118
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	562.5	Instream Wood Debris	1
Remoteness	4	Bank Stability	12
Shading	80		
Epifaunal Substrate	3		
Instream Habitat	10		

PHI Score	55.73
PHI Narrative Ranking	D

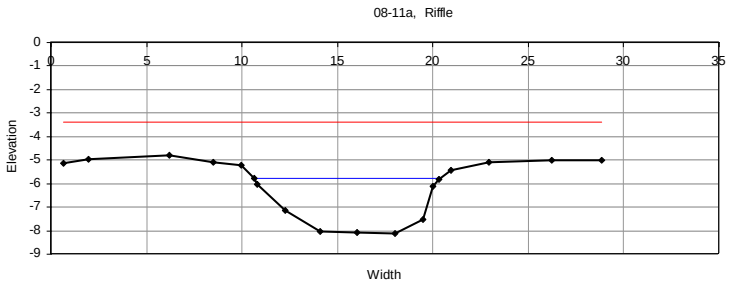
Water Chemistry

Dissolved Oxygen (mg/L)	11.52	Specific Conductance (mS/cm)	570
pH	10.04	Temperature (°C)	4.98

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.88	Cross Sectional Area (ft^2)	17.3
Bankfull Width (ft)	9.7	Water Surface Slope (ft/ft)	0.04
Mean Bankfull Depth (ft)	1.8	Sinuosity	1.0*
Floodprone Width (ft)	227*	D50 (mm)	0.35
Entrenchment Ratio	23.5*	Adjustments?	↑ Sin
Width to Depth Ratio	5.4	**Rosgen Stream Type**	**E5**



08-13A Lower Magothy Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Almond Drive, walk S.E. ~480m
Latitude/Longitude: 39.03334/-76.44658

Land Use Analysis:

Land Use	Acres	% Area
Commercial	28.2	10.7
Open Space	32.1	12.2
Residential 1/4-acre	110.6	41.9
Residential 1/8-acre	37.5	14.2
Transportation	3.3	1.2
Woods	52.3	19.8
Grand Total	264.0	100.0

Impervious (acres)	Total Area Above site	% Impervious
77.3	264.0	29.3

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Marginal substrate/available cover , moderately unstable banks, minimally impacted riparian zone
- Assemblage dominated by midges (67%). The most abundant taxa are *Parametriocnemus* and *Polypedilum*.
- Stream type was identified as an E5, slope was 0.55 percent, and the median channel substrate was fine sand
- Typically, E channels are stable. However, the marginal habitat ratings related to bank and substrate features may indicate that this reach is transitioning to an unstable form
- Biological community is appropriate for observed habitat quality.

Recommendations:

- Protect the riparian areas and restore habitat features, if possible.
- Look for stormwater management opportunities on developed lands in the upstream watershed.

08-13A Lower Magothy Sampling Unit

IBI and Metric Scores

Narrative Rating	**Poor**
Overall Index	**2.71**
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	27
EPT Taxa	3
Ephemeroptera Taxa	0
Intolerant Urban %	3.5
Ephemeroptera %	0
Scraper Taxa	1
% Climbers	19.3

Taxa List

Tubificinae	1
Bothrioneurum	1
Culicoides	1
Diplocladius	1
Georthocladius	1
Natarsia	1
Paracladopelma	2
Parametriocnemus	33
Paraphaenocladius	1
Phaenopsectra	1
Polypedilum	19
Pseudorthocladius	2
Thienemanniella	3
Thienemannimyia	9
Tribelos	1
Rheotanytarsus	2
Hemerodromia	1
Stegopterna	1
Ormosia	1
Cheumatopsyche	1
Ptilostomis	3
Lype	2
Crangonyx	4
Gammarus	4
Caecidotea	3
Physidae	4
Sphaeriidae (Mollusca)	11
Total Individuals	114

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	3	Pool Variability	8
Bank Stability- Right Bank	3	Riparian Vegetative Zone Width- Left Bank	8
Channel Alteration	18	Riparian Vegetative Zone Width- Right Bank	6
Channel Flow Status	15	Sediment Deposition	8
Channel Sinuosity	9	Vegetative Protection (Left Bank)	3
Epifaunal Substrate/Available Cover	8	Vegetative Protection (Right Bank)	3
Pool Substrate Characterization	10		

EPA Habitat Score	102
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	264.0	Instream Wood Debris	3
Remoteness	4	Bank Stability	6
Shading	70		
Epifaunal Substrate	5		
Instream Habitat	8		

PHI Score	54.84
PHI Narrative Ranking	D

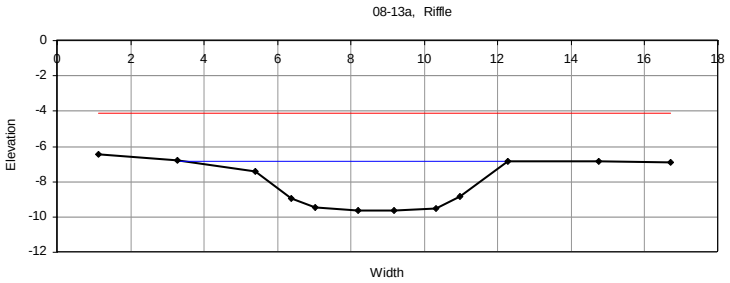
Water Chemistry

Dissolved Oxygen (mg/L)	12.38	Specific Conductance (mS/cm)	511
pH	–	Temperature (°C)	7.99

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.41	Cross Sectional Area (ft^2)	15.1
Bankfull Width (ft)	8.7	Water Surface Slope (ft/ft)	0.55
Mean Bankfull Depth (ft)	1.7	Sinuosity	1.1
Floodprone Width (ft)	155*	D50 (mm)	0.16
Entrenchment Ratio	17.7*	Adjustments?	↑ Sin
Width to Depth Ratio	5.1	**Rosgen Stream Type**	**E5**



08-15A Lower Magothy Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Woodland circle
Latitude/Longitude: 39.0312/-76.44086

Land Use Analysis:

Land Use	Acres	% Area
Commercial	33.1	9.9
Industrial	0.8	0.2
Open Space	32.6	9.7
Residential 1/4-acre	127.0	37.9
Residential 1/8-acre	51.0	15.2
Residential 2-acre	1.1	0.3
Transportation	9.1	2.7
Woods	80.4	24.0
Grand Total	335.2	100.0

Impervious (acres)	Total Area Above site	% Impervious
96.7	335.2	28.9

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Adequate substrate/available cover, moderate sediment deposition, marginal riparian zone (left bank)
- Good taxa richness. The most abundant organisms are worms (27%), isopods (15%), amphipods (14%) and midges (15%).
- Stream type was identified as an E5, slope was 0.21 percent, and the median channel substrate was fine sand
- Typically, E channels are stable. This reach could become unstable with any additional disturbance in the riparian area
- Biological community is appropriate for observed habitat quality.

Recommendations:

- Protect the riparian area.
- Look for water quality improvement opportunities via BMP installation in the upstream drainage area.

08-15A Lower Magothy Sampling Unit

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	31
EPT Taxa	1
Ephemeroptera Taxa	0
Intolerant Urban %	15.9
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	2.8

Taxa List

Thyadinae	1
Helobdella	1
Enchytraeidae	5
Tubificinae	21
Aulodrilus	2
Limnodrilus	1
Ancyronyx	3
Macronychus	2
Bezzia/Palpomyia	1
Ablabesmyia	1
Clinotanypus	1
Corynoneura	1
Cryptochironomus	2
Parametriocnemus	1
Polypedilum	3
Rheocricotopus	1
Stenochironomus	1
Thienemannimyia	3
Paratanytarsus	1
Rheotanytarsus	1
Gomphus	1
Lype	1
Crangonyx	3
Gammarus	12
Caecidotea	16
Lymnaeidae	1
Physidae	2
Sphaeriidae (Mollusca)	9
Nematoda	1
Prostoma	1
Planariidae	7
Total Individuals	107

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	6	Pool Variability	7
Bank Stability- Right Bank	6	Riparian Vegetative Zone Width- Left Bank	4
Channel Alteration	18	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	18	Sediment Deposition	9
Channel Sinuosity	7	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	10	Vegetative Protection (Right Bank)	5
Pool Substrate Characterization	10		

EPA Habitat Score	115
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	335.2	Instream Wood Debris	2
Remoteness	5	Bank Stability	10
Shading	70		
Epifaunal Substrate	6		
Instream Habitat	10		

PHI Score	59.60
PHI Narrative Ranking	D

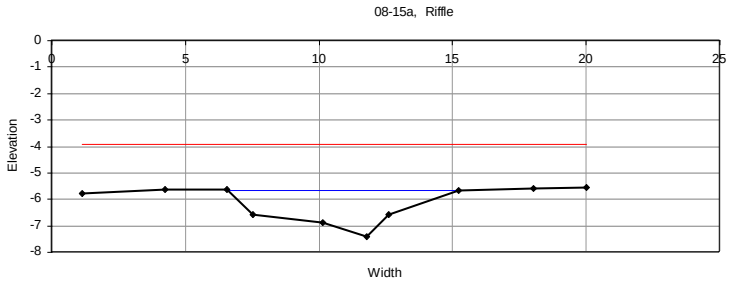
Water Chemistry

Dissolved Oxygen (mg/L)	11.17	Specific Conductance (mS/cm)	738
pH	–	Temperature (°C)	12.84

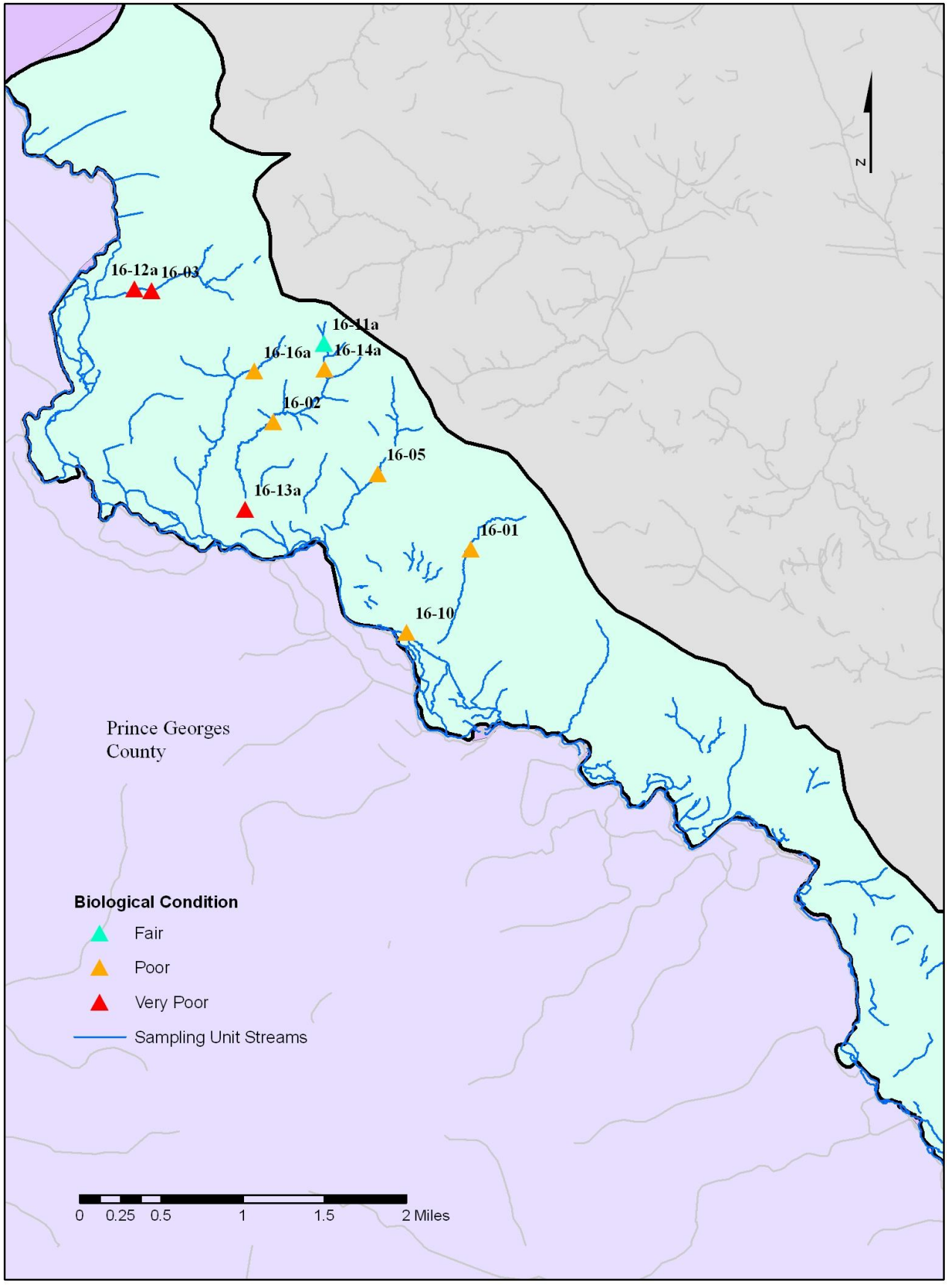
Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.52	Cross Sectional Area (ft^2)	8.0
Bankfull Width (ft)	8.7	Water Surface Slope (ft/ft)	0.21
Mean Bankfull Depth (ft)	0.9	Sinuosity	1.1
Floodprone Width (ft)	>200*	D50 (mm)	0.13
Entrenchment Ratio	23.1*	Adjustments?	↑ Sin
Width to Depth Ratio	9.3	**Rosgen Stream Type**	**E5**



Upper Patuxent Sampling Unit



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16-01 Upper Patuxent Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Wildlife Loop rd. 0.27 miles west
Latitude/Longitude: 39.06184/- 76.78703

Land Use Analysis:

Land Use	Acres	% Area
Open Space	1.3	0.6
Transportation	7.8	3.7
Woods	202.1	95.7
Grand Total	211.3	100.0

Impervious (acres)	Total Area Above site	% Impervious
5.3	211.3	2.5

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Adequate substrate/available cover, moderately unstable banks, straight channel, optimal riparian zone
- Assemblage dominated by midges (40%) and isopods (31%). *Caecidotea*, an isopod, is the most abundant organism.
- Stream type was identified as an E5, slope was 0.69 percent, and the median channel substrate was fine to medium sand
- 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.
- Work with Patuxent Research Refuge staff to pinpoint possible water quality impacts in upstream drainage area.

16-01 Upper Patuxent Sampling Unit

IBI and Metric Scores

Narrative Rating	**Poor**
Overall Index	**2.71**
Total Taxa Score	3
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	5
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	18
EPT Taxa	3
Ephemeroptera Taxa	0
Intolerant Urban %	35.3
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	8.4

Taxa List

Enchytraeidae	18
Dero	1
Cyphon	8
Apsectrotanypus	1
Corynoneura	1
Guttipelopia guttipennis	1
Larsia	3
Psectrocladius	22
Thienemannimyia	16
Micropsectra	1
Zavrelia	3
Simulium	1
Stegopterna	1
Hexatoma	1
Leuctra	2
Pycnopsyche	1
Ptilostomis	1
Caecidotea	37
Total Individuals	119

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	20	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	17	Sediment Deposition	12
Channel Sinuosity	5	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	11	Vegetative Protection (Right Bank)	5
Pool Substrate Characterization	8		

EPA Habitat Score	110
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	211.3	Instream Wood Debris	8
Remoteness	14	Bank Stability	10
Shading	100		
Epifaunal Substrate	6		
Instream Habitat	11		

PHI Score	79.00
PHI Narrative Ranking	PD

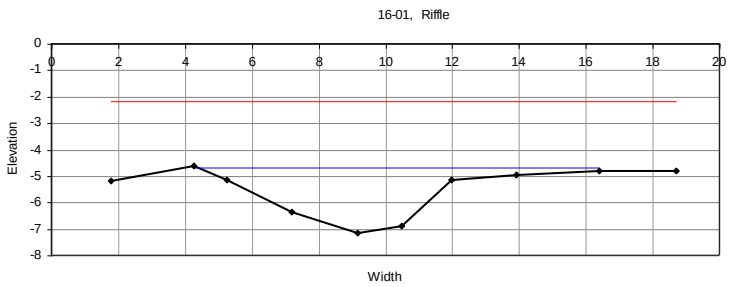
Water Chemistry

Dissolved Oxygen (mg/L)	9.26	Specific Conductance (mS/cm)	69
pH	–	Temperature (°C)	5.45

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.33	Cross Sectional Area (ft^2)	12.7
Bankfull Width (ft)	12.0	Water Surface Slope (ft/ft)	0.69
Mean Bankfull Depth (ft)	1.1	Sinuosity	1.0
Floodprone Width (ft)	276*	D50 (mm)	0.25
Entrenchment Ratio	23*	Adjustments?	↑ Sin
Width to Depth Ratio	11.3	**Rosgen Stream Type**	**E5**



16-02 Upper Patuxent Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Wild Turkey way, 0.29 miles south
Latitude/Longitude: 39.07319/-76.80952

Land Use Analysis:

Land Use	Acres	% Area
Open Space	3.3	1.3
Transportation	10.2	4.0
Utility	18.1	7.1
Woods	223.3	87.6
Grand Total	254.8	100.0

Impervious (acres)	Total Area Above site	% Impervious
6.4	254.8	2.5

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Adequate substrate/available cover, moderately unstable banks, optimal riparian zone
- One species of black fly (*Stegopterna*) comprises 50% of the assemblage. Midges and worms make up 39%. No EPT taxa.
- Stream type was identified as an E5, slope was 0.47 percent, and the median channel substrate was medium sand
- 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.
- Work with Patuxent Research Refuge staff to pinpoint possible water quality impacts in upstream drainage area.

16-02 Upper Patuxent Sampling Unit

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	21
EPT Taxa	0
Ephemeroptera Taxa	0
Intolerant Urban %	50.6
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	3.5

Taxa List

Lumbriculidae	2
Enchytraeidae	5
Tubificinae	3
Limnodrilus	1
Alluaudomyia	1
Culicoides	1
Ablabesmyia	3
Corynoneura	1
Limnophyes	2
Paratendipes	1
Polypedilum	1
Rheocricotopus	3
Rheosmittia	8
Stenochironomus	1
Thienemannimyia	1
Tribelos	1
Zavrelimyia	3
Tanytarsus	2
Simulium	1
Stegopterna	43
Tipula	1
Total Individuals	85

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	4	Pool Variability	8
Bank Stability- Right Bank	4	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	20	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	16	Sediment Deposition	11
Channel Sinuosity	12	Vegetative Protection (Left Bank)	4
Epifaunal Substrate/Available Cover	11	Vegetative Protection (Right Bank)	4
Pool Substrate Characterization	8		

EPA Habitat Score	122
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	254.8	Instream Wood Debris	6
Remoteness	14	Bank Stability	8
Shading	100		
Epifaunal Substrate	8		
Instream Habitat	11		

PHI Score	77.83
PHI Narrative Ranking	PD

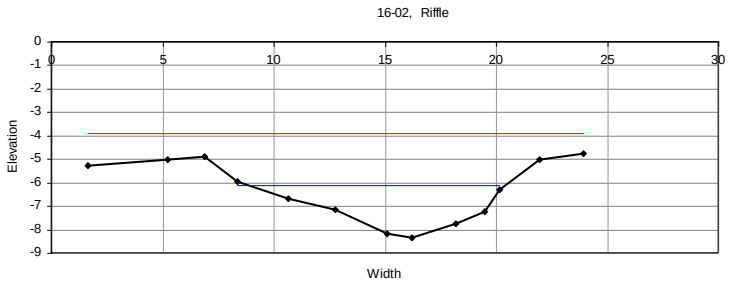
Water Chemistry

Dissolved Oxygen (mg/L)	9.55	Specific Conductance (mS/cm)	34
pH	–	Temperature (°C)	7

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.40	Cross Sectional Area (ft^2)	14.2
Bankfull Width (ft)	11.3	Water Surface Slope (ft/ft)	0.47
Mean Bankfull Depth (ft)	1.3	Sinuosity	1.5
Floodprone Width (ft)	193*	D50 (mm)	0.47
Entrenchment Ratio	17*	Adjustments?	None
Width to Depth Ratio	9	**Rosgen Stream Type**	**E5**



16-03 Upper Patuxent Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Brock Bridge rd crossing
Latitude/Longitude: 39.0848/-76.82336

Land Use Analysis:

Land Use	Acres	% Area
Commercial	10.7	3.5
Industrial	0.5	0.2
Open Space	18.6	6.1
Residential 1/4-acre	56.5	18.7
Residential 1/8-acre	1.2	0.4
Residential 1-acre	1.5	0.5
Transportation	19.9	6.6
Utility	3.1	1.0
Woods	190.4	63.0
Grand Total	302.2	100.0

Impervious (acres)	Total Area Above site	% Impervious
41.0	302.2	13.6

Results:

- Biological condition – "Very Poor"
- Habitat scores “Non Supporting” and "Severely Degraded"
- Marginal substrate/available cover, obvious channel alteration, marginal riparian zone
- Assemblage dominated by midges (75%). The most abundant taxa are *Zavrelimyia* and *Hydrobaenus*.
- Stream type was not evaluated.
- Biological community is appropriate for observed habitat quality.

Recommendations:

- Protect the riparian areas and restore habitat features, if possible.
- Look for stormwater management opportunities on developed lands in upstream drainage area.

16-03 Upper Patuxent Sampling Unit

IBI and Metric Scores

Narrative Rating	**Very Poor**
Overall Index	**1.86**
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	17
EPT Taxa	2
Ephemeroptera Taxa	0
Intolerant Urban %	3.8
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	1.0

Taxa List

Nais	3
Eiseniella	1
Tubificinae	8
Limnodrilus	3
Neoporus	4
Dicrotendipes	5
Diplocladius	2
Hydrobaenus	28
Phaenopsectra	2
Polypedilum	1
Rheocricotopus	3
Zavrelimyia	37
Stegopterna	1
Nemoura	2
Limnephilidae	2
Cambaridae	1
Physa	1
Total Individuals	104

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	6	Pool Variability	10
Bank Stability- Right Bank	6	Riparian Vegetative Zone Width- Left Bank	5
Channel Alteration	8	Riparian Vegetative Zone Width- Right Bank	4
Channel Flow Status	15	Sediment Deposition	7
Channel Sinuosity	7	Vegetative Protection (Left Bank)	3
Epifaunal Substrate/Available Cover	7	Vegetative Protection (Right Bank)	3
Pool Substrate Characterization	8		

EPA Habitat Score	89
EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	302.2	Instream Wood Debris	2
Remoteness	0	Bank Stability	12
Shading	50		
Epifaunal Substrate	6		
Instream Habitat	7		

PHI Score	50.89
PHI Narrative Ranking	SD

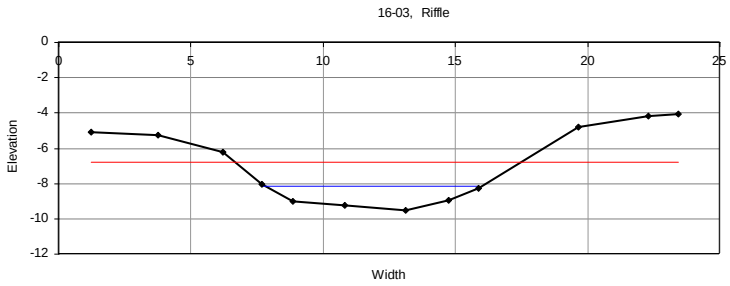
Water Chemistry

Dissolved Oxygen (mg/L)	12.74	Specific Conductance (mS/cm)	265
pH	–	Temperature (°C)	5.67

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	Cross Sectional Area (ft^2)
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	**Rosgen Stream Type** **Not classified**



16-05 Upper Patuxent Sampling Unit


Upstream


Downstream

Location/Site Access: Located at South road crossing
Latitude/Longitude: 39.06854/-76.79765

Land Use Analysis:

Land Use	Acres	% Area
Transportation	5.1	2.2
Utility	2.2	1.0
Woods	219.8	96.8
Grand Total	227.1	100.0

Impervious (acres)	Total Area Above site	% Impervious
3.6	227.1	1.6

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Adequate substrate/available cover, evidence of channelization, minimally impacted riparian zone
- Midges are the most abundant organisms, comprising 45% of the assemblage, followed by black flies (23%). Four EPT taxa were also found.
- Stream type was identified as an B5c, slope was 0.42 percent, and the median channel substrate was medium sand.
- 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 high quality riparian area.
- Work with Patuxent Research Refuge staff to pinpoint possible water quality impacts in upstream drainage area.

16-05 Upper Patuxent Sampling Unit

IBI and Metric Scores

Narrative Rating	**Poor**
Overall Index	**2.71**
Total Taxa Score	3
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	5
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	19
EPT Taxa	4
Ephemeroptera Taxa	0
Intolerant Urban %	40.2
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	13.1

Taxa List

Enchytraeidae	9
Bezzia/Palpomyia	3
Ceratopogon	2
Apsectrotanypus	3
Limnophyes	2
Parachaetocladius	2
Polypedilum	9
Tribelos	24
Zavrelimyia	3
Micropsectra	4
Stempellinella	1
Simulium	2
Stegopterna	23
Tipula	1
Leuctra	10
Nemoura	1
Limnephilidae	1
Polycentropus	3
Crangonyx	4
Total Individuals	107

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	6	Pool Variability	10
Bank Stability- Right Bank	6	Riparian Vegetative Zone Width- Left Bank	8
Channel Alteration	13	Riparian Vegetative Zone Width- Right Bank	8
Channel Flow Status	16	Sediment Deposition	14
Channel Sinuosity	7	Vegetative Protection (Left Bank)	6
Epifaunal Substrate/Available Cover	14	Vegetative Protection (Right Bank)	6
Pool Substrate Characterization	9		

EPA Habitat Score	123
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	227.1	Instream Wood Debris	6
Remoteness	5	Bank Stability	12
Shading	80		
Epifaunal Substrate	12		
Instream Habitat	14		

PHI Score	75.28
PHI Narrative Ranking	PD

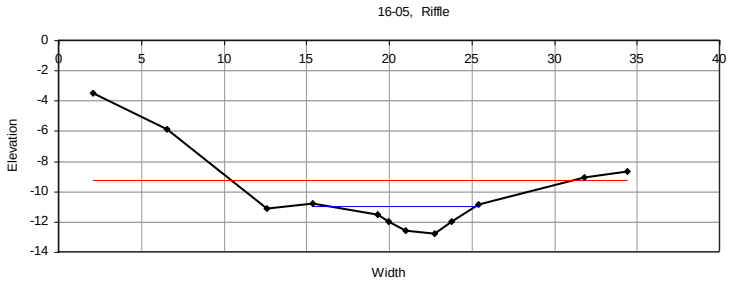
Water Chemistry

Dissolved Oxygen (mg/L)	9.8	Specific Conductance (mS/cm)	36
pH	–	Temperature (°C)	5.05

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.35	Cross Sectional Area (ft^2)	7.8
Bankfull Width (ft)	8.9	Water Surface Slope (ft/ft)	0.42
Mean Bankfull Depth (ft)	0.9	Sinuosity	1.1
Floodprone Width (ft)	15.4	D50 (mm)	0.3
Entrenchment Ratio	1.7	Adjustments?	↑W/D, ↑Sin
Width to Depth Ratio	10.1	**Rosgen Stream Type**	**B5c**



16-10 Upper Patuxent Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Knowles rd. : 450 meters NW
Latitude/Longitude: 39.05445/-76.79442

Land Use Analysis:

Land Use	Acres	% Area
Forested Wetland	41.2	18.7
Transportation	2.1	1.0
Utility	21.4	9.7
Woods	155.9	70.6
Grand Total	220.6	100.0

Impervious (acres)	Total Area Above site	% Impervious
1.3	220.6	0.6

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Marginal substrate/available cover, moderately unstable banks, optimal riparian zone
- Assemblage dominated by worms (32%). Most of the remaining organisms are midges, isopods and amphipods. No EPT taxa.
- Stream type was not evaluated
- 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 riparian area.
- Work with PRR staff, others to mitigate possible water quality impacts from unknown sources upstream.

16-10 Upper Patuxent Sampling Unit

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	27
EPT Taxa	0
Ephemeroptera Taxa	0
Intolerant Urban %	15.0
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	1.8

Taxa List

Nais	2
Lumbriculidae	21
Enchytraeidae	1
Tubificinae	3
Aulodrilus	2
Limnodrilus	2
Spirosperma	5
Matus	1
Ceratopogonidae	1
Alluaudomyia	1
Bezzia/Palpomyia	2
Culicoides	6
Clinotanypus	1
Limnophyes	1
Natarsia	3
Paraphaenocladius	1
Paratendipes	1
Pseudorthocladius	8
Pseudosmittia	1
Tribelos	5
Tanytarsus	2
Tipulidae	1
Ormosia	2
Crangonyx	14
Caecidotea	17
Pisidium	9
Nematoda	1
Total Individuals	114

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	5	Pool Variability	9
Bank Stability- Right Bank	5	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	15	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	18	Sediment Deposition	9
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	113
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	220.6	Instream Wood Debris	13
Remoteness	15	Bank Stability	10
Shading	100		
Epifaunal Substrate	4		
Instream Habitat	8		

PHI Score	77.45
PHI Narrative Ranking	PD

Water Chemistry

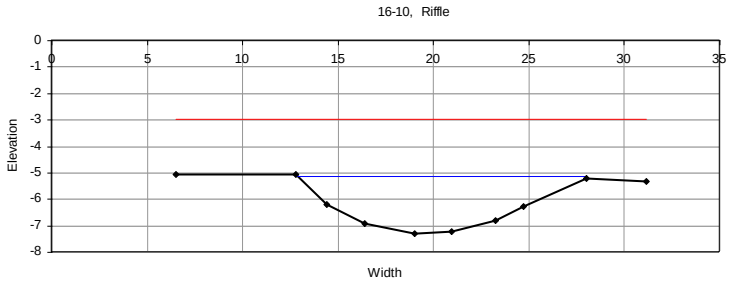
Dissolved Oxygen (mg/L)	7.92	Specific Conductance (mS/cm)	64
pH	–	Temperature (°C)	9.72

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	Cross Sectional Area (ft^2)
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	**Rosgen Stream Type**

Not classified



16-11A Upper Patuxent Sampling Unit


Upstream


Downstream

Location/Site Access: Located at South road, 0.11 miles northeast
Latitude/Longitude: 39.08014/-76.80376

Land Use Analysis:

Land Use	Acres	% Area
Open Space	3.2	7.6
Transportation	2.4	5.7
Woods	36.7	86.7
Grand Total	42.3	100.0

Impervious (acres)	Total Area Above site	% Impervious
1.5	42.3	3.6

Results:

- Biological condition – "Fair"
- Habitat scores "Supporting" and "Minimally
- Degraded"
- Adequate substrate/available cover, moderately stable banks, optimal riparian zone
- One species of black fly (*Stegopterna*) comprises 34% of the assemblage. Midges and worms are also abundant.
- Stream type was identified as an G5, slope was 2.2 percent, and the median channel substrate was medium sand
- 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.
- Work with PRR staff, others to mitigate possible water quality impacts from unknown sources upstream

16-11A Upper Patuxent Sampling Unit

IBI and Metric Scores

Narrative Rating	Fair
Overall Index	**3.00**
Total Taxa Score	5
EPT Taxa Score	3
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	2
Ephemeroptera Taxa	0
Intolerant Urban %	49.6
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	10.6

Taxa List

Enchytraeidae	16
Lumbricidae	1
Tubificinae	1
Neoporus	2
Stenelmis	1
Hydrobius	1
Cyphon	1
Bezzia/Palpomyia	2
Culicoides	2
Limnophyes	6
Orthocladius/Cricotopus	1
Parametriocnemus	1
Polypedilum	7
Thienemannimyia	7
Zavrelimyia	4
Micropsectra	2
Stegopterna	39
Chrysops	1
Ormosia	2
Tipula	1
Nigronia	1
Leuctra	13
Ptilostomis	1

Total Individuals 113

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	6	Pool Variability	9
Bank Stability- Right Bank	5	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	20	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	16	Sediment Deposition	9
Channel Sinuosity	9	Vegetative Protection (Left Bank)	6
Epifaunal Substrate/Available Cover	12	Vegetative Protection (Right Bank)	6
Pool Substrate Characterization	8		

EPA Habitat Score	126
EPA Narrative Ranking	S

Maryland Biological Stream Survey PHI

Drainage area (acres)	42.3	Instream Wood Debris	9
Remoteness	15	Bank Stability	11
Shading	100		
Epifaunal Substrate	9		
Instream Habitat	12		

PHI Score	89.84
PHI Narrative Ranking	MD

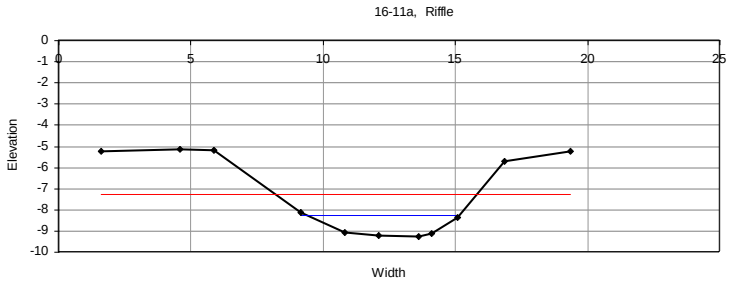
Water Chemistry

Dissolved Oxygen (mg/L)	9.49	Specific Conductance (mS/cm)	52
pH	–	Temperature (°C)	8.78

Geomorphic Assessments

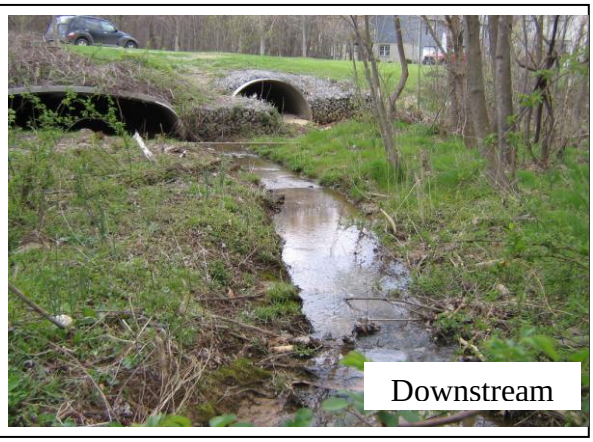
Rosgen Level II Classification Data

Drainage Area (mi^2)	0.07	Cross Sectional Area (ft^2)	4.1
Bankfull Width (ft)	5.7	Water Surface Slope (ft/ft)	2.2
Mean Bankfull Depth (ft)	0.7	Sinuosity	1.1*
Floodprone Width (ft)	7.6	D50 (mm)	0.36
Entrenchment Ratio	1.3	Adjustments?	None
Width to Depth Ratio	7.9	**Rosgen Stream Type**	**G5**



16-12A Upper Patuxent Sampling Unit


Upstream


Downstream

Location/Site Access: Located at River bridge way crossing, D.S.
Latitude/Longitude: 39.085/-76.82536

Land Use Analysis:

Land Use	Acres	% Area
Commercial	10.7	3.5
Industrial	0.5	0.2
Open Space	18.8	6.1
Residential 1/4-acre	60.0	19.4
Residential 1/8-acre	1.2	0.4
Residential 1-acre	1.5	0.5
Transportation	20.5	6.6
Utility	3.1	1.0
Woods	193.1	62.4
Grand Total	309.3	100.0

Impervious (acres)	Total Area Above site	% Impervious
43.1	309.3	13.9

Results:

- Biological condition – "Very Poor"
- Habitat scores "Supporting" and "Degraded"
- Marginal substrate/available cover, unstable banks, fairly straight channel, marginal riparian zone (left bank)
- Assemblage dominated by worms and midges. *Nais* and *Hydrobaenus* are the most abundant organisms.
- Stream type was identified as an C5, slope was 0.77 percent, and the median channel substrate was fine sand
- 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 habitat features, if possible.
- Look for opportunities, as necessary, to provide stormwater management on developed lands.

16-12A Upper Patuxent Sampling Unit

IBI and Metric Scores

Narrative Rating	Very Poor
Overall Index	**1.86**
Total Taxa Score	5
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	22
EPT Taxa	0
Ephemeroptera Taxa	0
Intolerant Urban %	0
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	5.4

Taxa List

Nais	34
Enchytraeidae	5
Dero	1
Tubificinae	6
Limnodrilus	1
Spirosperma	1
Culicoides	2
Ablabesmyia	1
Chironomus	3
Cryptochironomus	1
Dicrotendipes	2
Diplocladius	3
Hydrobaenus	19
Orthocladius/Cricotopus	4
Polypedilum	5
Rheocricotopus	7
Thienemannimyia	1
Zavrelimyia	5
Tanytarsus	1
Corduliidae/Libellulidae	1
Physa	6
Pisidium	2
Total Individuals	111

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	3	Pool Variability	10
Bank Stability- Right Bank	3	Riparian Vegetative Zone Width- Left Bank	5
Channel Alteration	15	Riparian Vegetative Zone Width- Right Bank	8
Channel Flow Status	18	Sediment Deposition	8
Channel Sinuosity	6	Vegetative Protection (Left Bank)	3
Epifaunal Substrate/Available Cover	7	Vegetative Protection (Right Bank)	3
Pool Substrate Characterization	8		

EPA Habitat Score	97
EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	309.3	Instream Wood Debris	5
Remoteness	2	Bank Stability	6
Shading	85		
Epifaunal Substrate	5		
Instream Habitat	7		

PHI Score	55.07
PHI Narrative Ranking	D

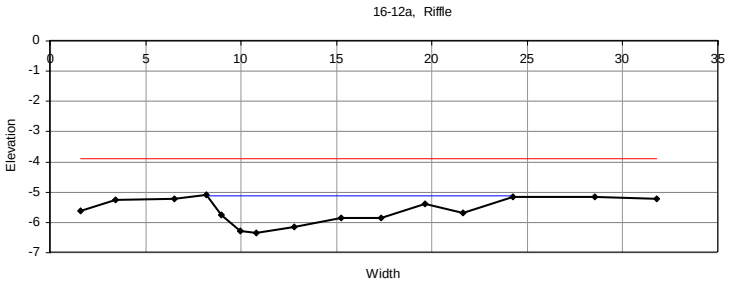
Water Chemistry

Dissolved Oxygen (mg/L)	9.1	Specific Conductance (mS/cm)	174
pH	6.36	Temperature (°C)	8.51

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.48	Cross Sectional Area (ft^2)	10.7
Bankfull Width (ft)	16.0	Water Surface Slope (ft/ft)	0.77
Mean Bankfull Depth (ft)	0.7	Sinuosity	1.0
Floodprone Width (ft)	180	D50 (mm)	0.19
Entrenchment Ratio	11.2	Adjustments?	↑Sin
Width to Depth Ratio	24.1	**Rosgen Stream Type**	**C5**



16-13A Upper Patuxent Sampling Unit

Picture unavailable

Upstream

Picture unavailable

Downstream

Location/Site Access: Located at Knowles Rd. - 0.25 miles southeast
Latitude/Longitude: 39.06541/-76.81277

Land Use Analysis:

Land Use	Acres	% Area
Open Space	3.3	0.8
Transportation	11.2	2.8
Utility	18.1	4.6
Woods	360.7	91.7
Grand Total	393.2	100.0

Impervious (acres)	Total Area Above site	% Impervious
6.8	393.2	1.7

Results:

- Biological condition – "Poor"
- Habitat scores "Supporting" and "Minimally Degraded"
- Adequate substrate/available cover, straight channel, optimal riparian zone
- Isopods (*Caecidotea*) comprise 43% of the assemblage. The other organisms are mostly mollusks (*Pisidium*), worms and midges. No EPTs.
- Stream type was not evaluated
- 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 conditions to determine if unknown impairment exists. Correct with BMP installation/retrofits as necessary and feasible.

16-13A Upper Patuxent Sampling Unit

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	16
EPT Taxa	0
Ephemeroptera Taxa	0
Intolerant Urban %	43.6
Ephemeroptera %	0
Scraper Taxa	1
% Climbers	6.8

Taxa List

Lumbriculidae	5
Enchytraeidae	2
Chaetogaster	1
Spirosperma	7
Omisus	6
Hydrobaenus	2
Natarsia	7
Orthocladius/Cricotopus	5
Polypedilum	2
Tanytarsus	6
Hexatoma	1
Crangonyx	1
Caecidotea	50
Menetus	1
Pisidium	20
Nematoda	1
Total Individuals	117

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	8	Pool Variability	7
Bank Stability- Right Bank	8	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	20	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	20	Sediment Deposition	9
Channel Sinuosity	5	Vegetative Protection (Left Bank)	8
Epifaunal Substrate/Available Cover	14	Vegetative Protection (Right Bank)	8
Pool Substrate Characterization	8		

EPA Habitat Score	135
EPA Narrative Ranking	S

Maryland Biological Stream Survey PHI

Drainage area (acres)	393.2	Instream Wood Debris	10
Remoteness	16	Bank Stability	16
Shading	100		
Epifaunal Substrate	3		
Instream Habitat	14		

PHI Score	81.87
PHI Narrative Ranking	MD

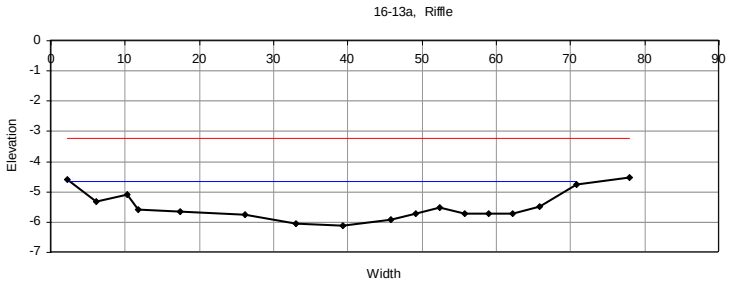
Water Chemistry

Dissolved Oxygen (mg/L)	9.72	Specific Conductance (mS/cm)	110
pH	–	Temperature (°C)	11.17

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	Cross Sectional Area (ft^2)
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	**Rosgen Stream Type** **Not classified**



16-14A Upper Patuxent Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Wild turkey way, 0.15 miles north
Latitude/Longitude: 39.07784/-76.80366

Land Use Analysis:

Land Use	Acres	% Area
Open Space	3.2	3.7
Transportation	3.4	4.0
Woods	79.1	92.3
Grand Total	85.7	100.0

Impervious (acres)	Total Area Above site	% Impervious
2.5	85.7	3.0

Results:

- Biological condition – "Poor"
- Habitat scores "Supporting" and "Minimally Degraded"
- Adequate substrate/available cover, moderately unstable (left) bank, optimal riparian zone
- Black flies (*Stegopterna*) comprise 42% of the assemblage. Most of the other organisms are midges, stoneflies and worms.
- pH is relatively low
- Stream type was identified as an E4, slope was 1.4 percent, and the median channel substrate was medium gravel
- Biological community is in worse condition than would be expected for available habitat quality.

Recommendations:

- Maintain the protection of the riparian area.
- Investigate possible water quality impact from somewhere in the upstream watershed.

16-14A

Upper Patuxent Sampling Unit

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	**2.43**
Total Taxa Score	3
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	20
EPT Taxa	4
Ephemeroptera Taxa	0
Intolerant Urban %	62.5
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	1.9

Taxa List

Enchytraeidae	9
Hydroporinae	1
Bezzia/Palpomyia	6
Ceratopogon	1
Corynoneura	1
Limnophyes	1
Orthocladius/Cricotopus	1
Polypedilum	2
Pseudorthocladius	5
Rheocricotopus	2
Thienemannimyia	3
Zavrelimyia	3
Simulium	2
Stegopterna	44
Limnophila	1
Tipula	1
Leuctra	13
Nemoura	4
Limnephilidae	1
Wormaldia	3
Total Individuals	104

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	5	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	16	Sediment Deposition	11
Channel Sinuosity	11	Vegetative Protection (Left Bank)	6
Epifaunal Substrate/Available Cover	14	Vegetative Protection (Right Bank)	6
Pool Substrate Characterization	9		

EPA Habitat Score	134
EPA Narrative Ranking	S

Maryland Biological Stream Survey PHI

Drainage area (acres)	85.7	Instream Wood Debris	4
Remoteness	15	Bank Stability	11
Shading	100		
Epifaunal Substrate	11		
Instream Habitat	14		

PHI Score	88.20
PHI Narrative Ranking	MD

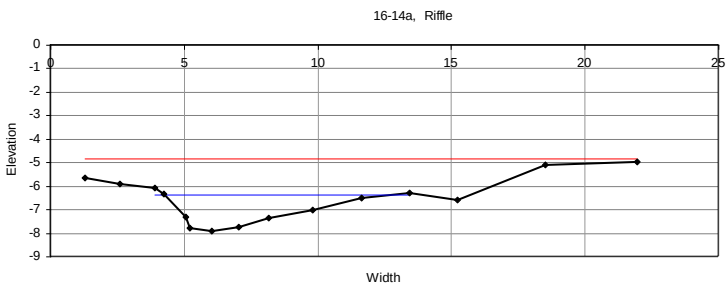
Water Chemistry

Dissolved Oxygen (mg/L)	7.15	Specific Conductance (mS/cm)	63
pH	–	Temperature (°C)	7.48

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.13	Cross Sectional Area (ft^2)	6.6
Bankfull Width (ft)	8.4	Water Surface Slope (ft/ft)	1.4
Mean Bankfull Depth (ft)	0.8	Sinuosity	1.4
Floodprone Width (ft)	44.3	D50 (mm)	8.4
Entrenchment Ratio	5.3	Adjustments?	↑Sin
Width to Depth Ratio	10.7	**Rosgen Stream Type**	**E4**



16-16A Upper Patuxent Sampling Unit

Upstream

Downstream

Location/Site Access: Located at Wild turkey way, 0.18 miles north
Latitude/Longitude: 39.07768/-76.81168

Land Use Analysis:

Land Use	Acres	% Area
Open Space	2.1	3.3
Transportation	0.4	0.7
Utility	13.1	20.2
Woods	49.1	75.9
Grand Total	64.7	100.0

Impervious (acres)	Total Area Above site	% Impervious
0.4	64.7	0.7

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Minimally Degraded"
- Adequate substrate/available cover, moderately unstable banks, optimal riparian zone
- Good taxa richness. Assemblage is dominated by midges (49%). The most abundant taxon is *Parametriocnemus.*
- Difficult classification. Stream type was identified as an G4c, but has E type characteristics. Slope was 1.7 percent, and the median channel substrate was medium sand
- 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.
- Determine if water quality impacts associated with the utility land uses exist. Remediate as necessary.

16-16A Upper Patuxent Sampling Unit

IBI and Metric Scores

Narrative Rating	**Poor**
Overall Index	**2.43**
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	31
EPT Taxa	4
Ephemeroptera Taxa	0
Intolerant Urban %	27.8
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	6.5

Taxa List

Lumbriculidae	3
Enchytraeidae	1
Tubificinae	1
Limnodrilus	1
Bezzia/Palpomyia	2
Ceratopogon	1
Ablabesmyia	3
Heterotrissocladius	1
Natarsia	3
Parametriocnemus	22
Paratendipes	1
Phaenopsectra	1
Polypedilum	5
Pseudorthocladius	1
Rheocricotopus	5
Thienemannimyia	11
Zavrelimyia	3
Dixella	3
Prosimulium	1
Simulium	3
Stegopterna	11
Tipula	2
Boyeria	1
Calopteryx	1
Cordulegaster	2
Leuctra	13
Diplectrona	1
Ironoquia	1
Pycnopsyche	1
Crangonyx	2
Pisidium	1
Total Individuals	108

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	3	Pool Variability	7
Bank Stability- Right Bank	3	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	20	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	14	Sediment Deposition	7
Channel Sinuosity	10	Vegetative Protection (Left Bank)	4
Epifaunal Substrate/Available Cover	12	Vegetative Protection (Right Bank)	4
Pool Substrate Characterization	8		

EPA Habitat Score	112
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	64.7	Instream Wood Debris	7
Remoteness	15	Bank Stability	6
Shading	100		
Epifaunal Substrate	7		
Instream Habitat	12		

PHI Score	83.41
PHI Narrative Ranking	MD

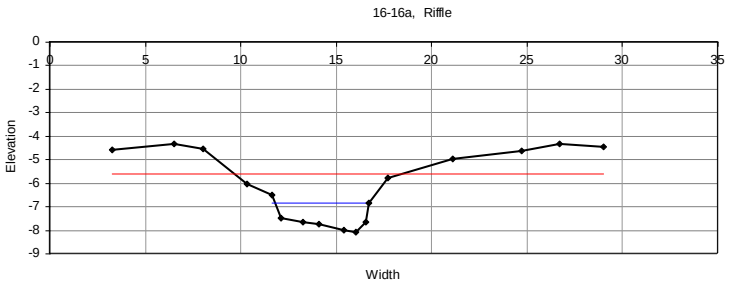
Water Chemistry

Dissolved Oxygen (mg/L)	9.67	Specific Conductance (mS/cm)	110
pH	–	Temperature (°C)	10.5

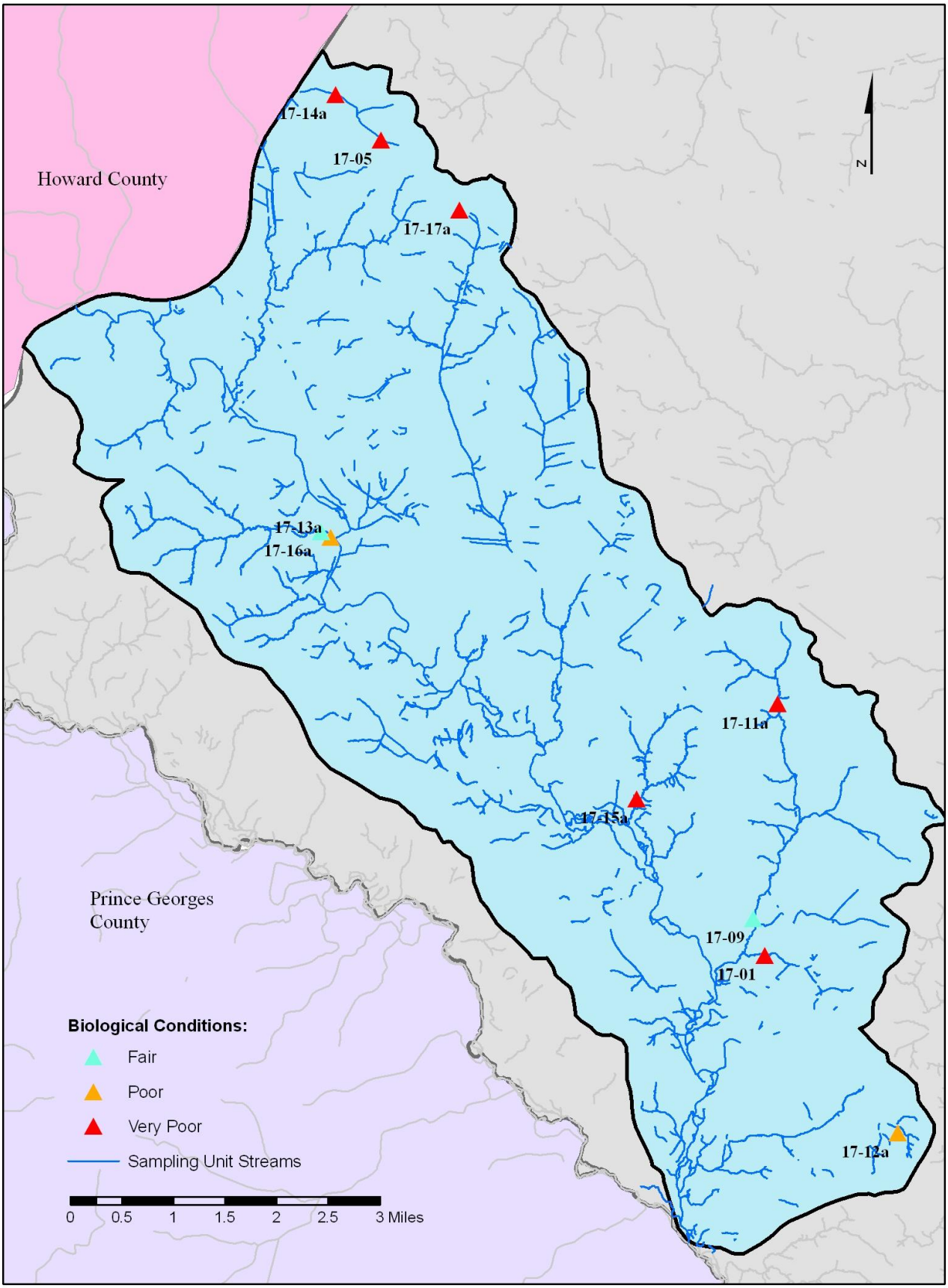
Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.10	Cross Sectional Area (ft^2)	4.3
Bankfull Width (ft)	4.9	Water Surface Slope (ft/ft)	1.7
Mean Bankfull Depth (ft)	0.9	Sinuosity	1.2
Floodprone Width (ft)	8.9	D50 (mm)	0.42
Entrenchment Ratio	1.8	Adjustments?	↓ER
Width to Depth Ratio	5.6	**Rosgen Stream Type**	**G4c**



Little Patuxent Sampling Unit



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17-05 Little Patuxent Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Route 175, park at produce market, 0.16m north
Latitude/Longitude: 39.14465/-76.76095

Land Use Analysis:

Land Use	Acres	% Area
Commercial	5.2	4.2
Open Space	4.4	3.6
Residential 1/2-acre	17.8	14.5
Residential 1-acre	0.1	0.0
Transportation	12.9	10.5
Woods	82.6	67.2
Grand Total	122.9	100.0

Impervious (acres)	Total Area Above site	% Impervious
18.9	122.9	15.3

Results:

- Biological condition – "Very Poor"
- Habitat scores "Non Supporting" and "Degraded"
- Marginal substrate/available cover, moderately unstable banks, limited pool habitat, marginal riparian zone (right bank)
- Poor taxa richness. One species, *Hydrobaenus* (a midge), comprises 77% of the assemblage.
- Stream type was identified as an B5c, slope was 0.83 percent, and the median channel substrate was fine to medium sand
- 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 and restore habitat features, if possible
- Determine impact of developed lands on water quality, correct with BMPs as necessary and appropriate.

17-05 Little Patuxent Sampling Unit

IBI and Metric Scores

Narrative Rating	Very Poor
Overall Index	**1.00**
Total Taxa Score	1
EPT Taxa Score	1
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	1

Calculated Metric Values

Total Taxa	12
EPT Taxa	1
Ephemeroptera Taxa	0
Intolerant Urban %	3.8
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	0.0

Taxa List

Enchytraeidae	1
Tubificinae	2
Chaetocladius	2
Diamesa	1
Diplocladius	6
Hydrobaenus	81
Orthocladiinae	1
Orthocladius/Cricotopus	2
Stegopterna	2
Paranemoura	2
Physa	4
Nematoda	1

Total Individuals 105

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	3	Pool Variability	5
Bank Stability- Right Bank	3	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	18	Riparian Vegetative Zone Width- Right Bank	4
Channel Flow Status	10	Sediment Deposition	10
Channel Sinuosity	6	Vegetative Protection (Left Bank)	3
Epifaunal Substrate/Available Cover	7	Vegetative Protection (Right Bank)	3
Pool Substrate Characterization	9		

EPA Habitat Score	91
EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	122.9	Instream Wood Debris	3
Remoteness	5	Bank Stability	6
Shading	80		
Epifaunal Substrate	6		
Instream Habitat	7		

PHI Score	61.08
PHI Narrative Ranking	D

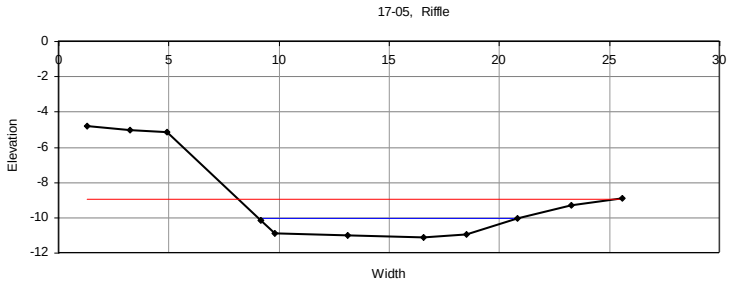
Water Chemistry

Dissolved Oxygen (mg/L)	11.05	Specific Conductance (mS/cm)	396
pH	–	Temperature (°C)	11.69

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.19	Cross Sectional Area (ft^2)	9.7
Bankfull Width (ft)	11.6	Water Surface Slope (ft/ft)	0.83
Mean Bankfull Depth (ft)	0.81	Sinuosity	1.00
Floodprone Width (ft)	17.1	D50 (mm)	0.25
Entrenchment Ratio	1.5	Adjustments?	Sin ↑
Width to Depth Ratio	14	**Rosgen Stream Type**	**B5c**



17-09 Little Patuxent Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Evergreen road crossing. 500m U.S
Latitude/Longitude: 39.03509/-76.69408

Land Use Analysis:

Land Use	Acres	% Area
Commercial	71.2	2.4
Industrial	250.9	8.4
Open Space	207.7	6.9
Pasture/Hay	167.6	5.6
Residential 1/2-acre	45.7	1.5
Residential 1/4-acre	792.2	26.5
Residential 1/8-acre	93.5	3.1
Residential 1-acre	44.6	1.5
Residential 2-acre	4.6	0.2
Row Crops	480.7	16.1
Transportation	67.4	2.3
Utility	82.9	2.8
Water	4.0	0.1
Woods	678.6	22.7
Grand Total	2991.6	100.0

Impervious (acres)	Total Area Above site	% Impervious
666.6	2991.6	22.3

Results:

- Biological condition – "Fair"
- Habitat scores "Partially Supporting" and "Degraded"
- Marginal substrate/available cover, moderately unstable banks, minimally impacted riparian zone
- Good taxa richness. 12 midge taxa comprise 52% of the assemblage. 5 EPT taxa. *Hydrobaenus* is the most abundant taxon.
- pH is relatively high
- Stream type was identified as an G5c, slope was 0.56 percent, and the median channel substrate was medium sand
- Biological community is in better condition than expected for measured level of habitat quality..

Recommendations:

- Protect the riparian area.
- Determine if stormwater management is necessary for upstream developed areas.

17-09 Little Patuxent Sampling Unit

IBI and Metric Scores

Narrative Rating	Fair
Overall Index	**3.29**
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	30
EPT Taxa	6
Ephemeroptera Taxa	1
Intolerant Urban %	10.2
Ephemeroptera %	4.6
Scraper Taxa	0
% Climbers	4.6

Taxa List

Nais	5
Enchytraeidae	1
Ancyronyx	3
Stenelmis	7
Peltodytes	1
Ablabesmyia	1
Diamesa	3
Hydrobaenus	29
Orthocladius/Cricotopus	3
Polypedilum	3
Potthastia	1
Stenochironomus	3
Thienemanniella	1
Thienemannimyia	2
Tvetenia	1
Paratanytarsus	2
Rheotanytarsus	7
Prosimulium	1
Simulium	4
Stegopterna	1
Antocha	2
Caenis	5
Coenagrionidae	1
Gomphidae	1
Cheumatopsyche	13
Hydropsyche	3
Limnephilidae	1
Polycentropus	1
Lype	1
Caecidotea	1
Total Individuals	108

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	4	Pool Variability	12
Bank Stability- Right Bank	4	Riparian Vegetative Zone Width- Left Bank	6
Channel Alteration	19	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	15	Sediment Deposition	8
Channel Sinuosity	8	Vegetative Protection (Left Bank)	4
Epifaunal Substrate/Available Cover	10	Vegetative Protection (Right Bank)	4
Pool Substrate Characterization	9		

EPA Habitat Score	113
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	2991.6	Instream Wood Debris	6
Remoteness	7	Bank Stability	8
Shading	85		
Epifaunal Substrate	9		
Instream Habitat	10		

PHI Score	57.50
PHI Narrative Ranking	D

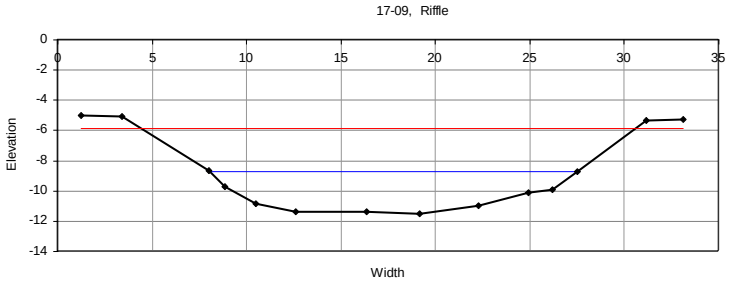
Water Chemistry

Dissolved Oxygen (mg/L)	11.11	Specific Conductance (mS/cm)	298
pH	–	Temperature (°C)	10.6

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	4.67	Cross Sectional Area (ft^2)	41.4
Bankfull Width (ft)	19.5	Water Surface Slope (ft/ft)	0.56
Mean Bankfull Depth (ft)	2.1	Sinuosity	1.0
Floodprone Width (ft)	26.2	D50 (mm)	0.46
Entrenchment Ratio	1.3	Adjustments?	Sin ↑
Width to Depth Ratio	9.2	**Rosgen Stream Type**	**G5c**



17-11A Little Patuxent Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Harvest moon drive- park in culvert, take paved trail to park, 0.31m
Latitude/Longitude: 39.06521/-76.68956

Land Use Analysis:

Land Use	Acres	% Area
Commercial	23.2	3.0
Open Space	26.8	3.4
Pasture/Hay	0.1	0.0
Residential 1/2-acre	12.6	1.6
Residential 1/4-acre	367.4	46.7
Residential 1/8-acre	93.5	11.9
Residential 1-acre	11.8	1.5
Residential 2-acre	0.8	0.1
Transportation	10.1	1.3
Utility	17.5	2.2
Woods	222.5	28.3
Grand Total	786.1	100.0

Impervious (acres)	Total Area Above site	% Impervious
187.1	786.1	23.8

Results:

- Biological condition – "Very Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Adequate substrate/available cover, poor (left) bank stability, moderate sediment deposition, poor riparian zone (left bank)
- Assemblage dominated by worms (42%) and midges (50%). The most abundant taxa are *Hydrobaenus* and *Nais*.
- pH is relatively high
- Stream type was identified as an F5, slope was 0.23 percent, and the median channel substrate was fine sand
- Biological community is in worse condition than would be expected for available habitat quality.

Recommendations:

- Protect the riparian area and restore habitat features, if possible.
- Determine necessity, feasibility of implementing stormwater management on developed lands upstream of site.

17-11A Little Patuxent Sampling Unit

IBI and Metric Scores

Narrative Rating	Very Poor
Overall Index	**1.57**
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	18
EPT Taxa	1
Ephemeroptera Taxa	0
Intolerant Urban %	0
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	2.9

Taxa List

Nais	33
Enchytraeidae	3
Slavina	1
Tubificinae	3
Spirosperma	4
Ancyronyx	5
Ablabesmyia	1
Dicrotendipes	1
Hydrobaenus	43
Nanocladius	1
Paracladopelma	1
Polypedilum	1
Thienemannimyia	1
Tvetenia	1
Paratanytarsus	1
Tanytarsus	2
Cheumatopsyche	2
Crangonyx	1
Total Individuals	105

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	2	Pool Variability	6
Bank Stability- Right Bank	6	Riparian Vegetative Zone Width- Left Bank	2
Channel Alteration	17	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	17	Sediment Deposition	7
Channel Sinuosity	9	Vegetative Protection (Left Bank)	2
Epifaunal Substrate/Available Cover	11	Vegetative Protection (Right Bank)	6
Pool Substrate Characterization	8		

EPA Habitat Score	103
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	786.1	Instream Wood Debris	3
Remoteness	8	Bank Stability	8
Shading	15		
Epifaunal Substrate	5		
Instream Habitat	11		

PHI Score	48.68
PHI Narrative Ranking	D

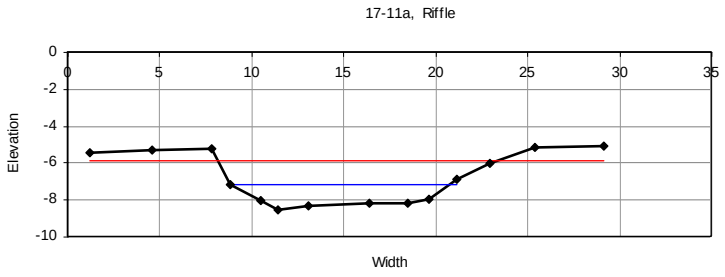
Water Chemistry

Dissolved Oxygen (mg/L)	11.45	Specific Conductance (mS/cm)	231
pH	–	Temperature (°C)	8.12

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	1.23	Cross Sectional Area (ft^2)	10.7
Bankfull Width (ft)	11.8	Water Surface Slope (ft/ft)	0.23
Mean Bankfull Depth (ft)	0.9	Sinuosity	1.2
Floodprone Width (ft)	15.2	D50 (mm)	0.23
Entrenchment Ratio	1.3	Adjustments?	None
Width to Depth Ratio	13.1	**Rosgen Stream Type**	**F5**



17-12A Little Patuxent Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Crofton park, 0.23 miles east
Latitude/Longitude: 39.00487/-76.66808

Land Use Analysis:

Land Use	Acres	% Area
Commercial	0.0	0.0
Open Space	14.6	16.9
Residential 1/2-acre	3.6	4.2
Residential 1/4-acre	27.4	31.8
Residential 1-acre	1.4	1.6
Row Crops	2.4	2.8
Transportation	3.3	3.8
Woods	33.6	39.0
Grand Total	86.2	100.0

Impervious (acres)	Total Area Above site	% Impervious
11.4	86.2	13.2

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Marginal substrate/available cover, limited pool habitat, minimally impacted riparian zone
- Half of the assemblage is comprised of isopods (*Caecidotea*) and mollusks (*Pisidium*). Most of the other organisms are midges, worms and amphipods.
- Stream type was identified as an C5, slope was 1.2 percent, and the median channel substrate was fine sand
- 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.
- Determine need, feasibility of BMP installation on developed lands.

17-12A Little Patuxent Sampling Unit

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	20
EPT Taxa	1
Ephemeroptera Taxa	0
Intolerant Urban %	31.4
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	2.0

Taxa List

Tubificinae	6
Isochaetides	1
Limnodrilus	2
Spirosperma	6
Bezzia/Palpomyia	2
Culicoides	1
Corynoneura	1
Diplocladius	1
Hydrobaenus	4
Paraphaenocladius	1
Polypedilum	1
Rheocricotopus	3
Paratanytarsus	1
Rheotanytarsus	3
Stempellinella	1
Libellulidae	1
Nemouridae	1
Crangonyx	13
Caecidotea	31
Pisidium	22
Total Individuals	102

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	6	Pool Variability	5
Bank Stability- Right Bank	6	Riparian Vegetative Zone Width- Left Bank	7
Channel Alteration	16	Riparian Vegetative Zone Width- Right Bank	8
Channel Flow Status	12	Sediment Deposition	8
Channel Sinuosity	7	Vegetative Protection (Left Bank)	6
Epifaunal Substrate/Available Cover	7	Vegetative Protection (Right Bank)	6
Pool Substrate Characterization	8		

EPA Habitat Score	102
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	86.2	Instream Wood Debris	7
Remoteness	5	Bank Stability	12
Shading	95		
Epifaunal Substrate	3		
Instream Habitat	7		

PHI Score	69.14
PHI Narrative Ranking	PD

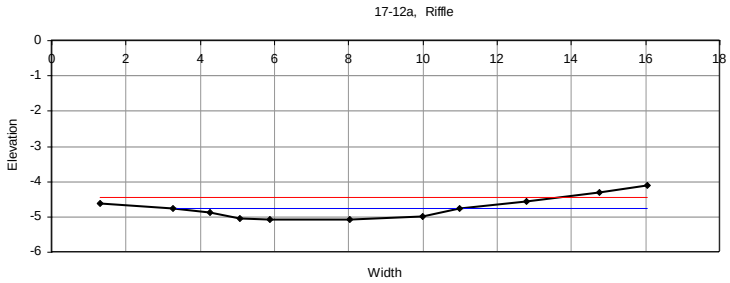
Water Chemistry

Dissolved Oxygen (mg/L)	9.59	Specific Conductance (mS/cm)	100
pH	–	Temperature (°C)	5.81

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.15	Cross Sectional Area (ft^2)	1.7
Bankfull Width (ft)	7.7	Water Surface Slope (ft/ft)	1.2
Mean Bankfull Depth (ft)	0.2	Sinuosity	1.2
Floodprone Width (ft)	20*	D50 (mm)	0.22
Entrenchment Ratio	2.6*	Adjustments?	Sin ↑
Width to Depth Ratio	20.4	**Rosgen Stream Type**	**C5**



17-13A Little Patuxent Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Bald eagle rd. crossing, 0.11 miles D.S.
Latitude/Longitude: 39.08881/-76.77016

Land Use Analysis:

Land Use	Acres	% Area
Commercial	72.2	7.0
Industrial	2.4	0.2
Open Space	54.8	5.3
Open Wetland	3.7	0.4
Residential 1/2-acre	1.3	0.1
Residential 1/8-acre	28.5	2.7
Residential 1-acre	1.2	0.1
Transportation	47.7	4.6
Utility	33.0	3.2
Water	1.8	0.2
Woods	791.5	76.2
Grand Total	1038.2	100.0

Impervious (acres)	Total Area Above site	% Impervious
118.8	1038.2	11.4

Results:

- Biological condition – "Poor"
- Habitat scores "Non Supporting" and "Degraded"
- Adequate substrate/available cover, moderately unstable (right) bank, straight channel, no pools, minimally impacted riparian zone
- Assemblage dominated by midges (79%). *Pseudorthocladius* and *Hydrobaenus* are the most abundant taxa.
- Stream type was identified as an B4c, slope was 0.82 percent, and the median channel substrate was medium gravel
- 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.
- Focus on eliminating water quality impacts associated with developed lands upstream.

17-13A Little Patuxent Sampling Unit

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	**2.71**
Total Taxa Score	5
EPT Taxa Score	3
Ephemeroptera Taxa Score	3
Intolerant Urban % Score	1
Ephemeroptera % Score	3
Scraper Taxa Score	1
% Climbers	3

Calculated Metric Values

Total Taxa	23
EPT Taxa	3
Ephemeroptera Taxa	1
Intolerant Urban %	3.7
Ephemeroptera %	2.8
Scraper Taxa	0
% Climbers	5.5

Taxa List

Nais	5
Enchytraeidae	7
Spirosperma	1
Helichus	1
Stenelmis	2
Cryptochironomus	2
Diplocladius	1
Eukiefferiella	4
Hydrobaenus	20
Orthocladius/Cricotopus	4
Parametriocnemus	2
Phaenopsectra	1
Polypedilum	5
Pseudorthocladius	33
Thienemannimyia	6
Tvetenia	2
Rheotanytarsus	5
Tanytarsus	1
Hemerodromia	1
Centroptilum	3
Nigronia	1
Capniidae/Leuctridae	1
Ironoquia	1
Total Individuals	109

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	6	Pool Variability	0
Bank Stability- Right Bank	4	Riparian Vegetative Zone Width- Left Bank	7
Channel Alteration	16	Riparian Vegetative Zone Width- Right Bank	8
Channel Flow Status	14	Sediment Deposition	8
Channel Sinuosity	3	Vegetative Protection (Left Bank)	6
Epifaunal Substrate/Available Cover	11	Vegetative Protection (Right Bank)	4
Pool Substrate Characterization	0		

EPA Habitat Score	87
EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	1038.2	Instream Wood Debris	3
Remoteness	5	Bank Stability	10
Shading	70		
Epifaunal Substrate	9		
Instream Habitat	11		

PHI Score	58.63
PHI Narrative Ranking	D

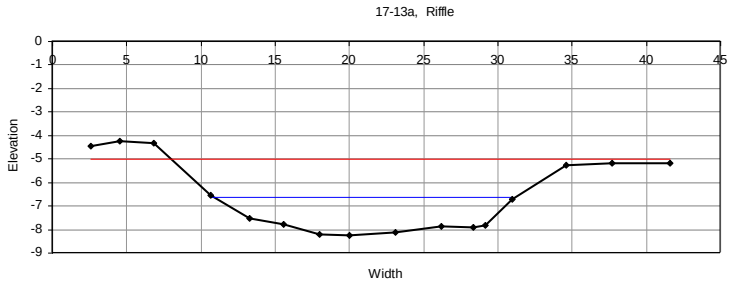
Water Chemistry

Dissolved Oxygen (mg/L)	7.44	Specific Conductance (mS/cm)	201
pH	–	Temperature (°C)	8.09

Geomorphic Assessments

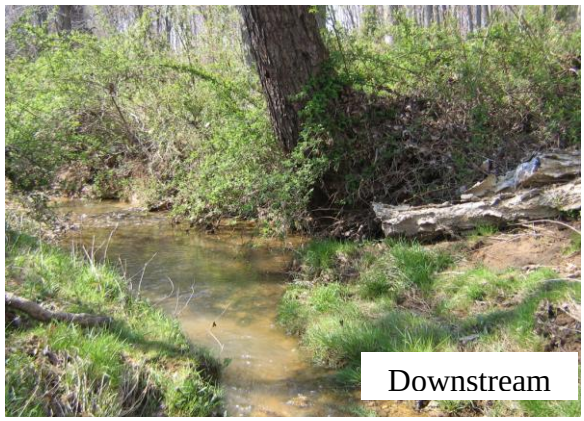
Rosgen Level II Classification Data

Drainage Area (mi^2)	1.62	Cross Sectional Area (ft^2)	23.6
Bankfull Width (ft)	20.1	Water Surface Slope (ft/ft)	0.82
Mean Bankfull Depth (ft)	1.2	Sinuosity	1.0
Floodprone Width (ft)	33.7	D50 (mm)	9.7
Entrenchment Ratio	1.7	Adjustments?	Sin ↑
Width to Depth Ratio	17	**Rosgen Stream Type**	**B4c**



17-14A Little Patuxent Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Wigley Rd crossing, D.S. 0.10 miles
Latitude/Longitude: 39.15105/-76.76909

Land Use Analysis:

Land Use	Acres	% Area
Commercial	15.4	3.5
Open Space	23.4	5.3
Pasture/Hay	12.7	2.9
Residential 1/2-acre	159.5	36.3
Residential 1-acre	18.1	4.1
Transportation	22.2	5.1
Woods	188.3	42.8
Grand Total	439.7	100.0

Impervious (acres)	Total Area Above site	% Impervious
66.6	439.7	15.1

Results:

- Biological condition – "Very Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Adequate substrate/available cover, moderately unstable (left) bank, fairly straight channel, poor (left) riparian zone
- Assemblage dominated by midges. One taxon, *Hydrobaenus*, makes up 52% of the sample.
- Difficult classification disturbed reach. Stream type was identified as an B5c, slope was 0.21 percent, and the median channel substrate was fine sand
- Biological community is in worse condition than would be expected for available habitat quality.

Recommendations:

- Protect the riparian area and restore it, if possible.
- Investigate need, feasibility of BMP implementation on developed lands upstream.

17-14A Little Patuxent Sampling Unit

IBI and Metric Scores

Narrative Rating	**Very Poor**
Overall Index	**1.29**
Total Taxa Score	3
EPT Taxa Score	1
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	1

Calculated Metric Values

Total Taxa	19
EPT Taxa	1
Ephemeroptera Taxa	0
Intolerant Urban %	0.0
Ephemeroptera %	0.0
Scraper Taxa	0
% Climbers	0.9

Taxa List

Nais	6
Enchytraeidae	1
Tubificinae	12
Neoporus	1
Dubiraphia	2
Ablabesmyia	1
Diamesa	9
Dicrotendipes	2
Hydrobaenus	59
Orthocladius/Cricotopus	6
Paratendipes	3
Polypedilum	1
Paratanytarsus	1
Ormosia	2
Tipula	1
Argia	1
Perithemis	1
Ironoquia	1
Physa	3
Total Individuals	113

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	4	Pool Variability	9
Bank Stability- Right Bank	6	Riparian Vegetative Zone Width- Left Bank	2
Channel Alteration	17	Riparian Vegetative Zone Width- Right Bank	4
Channel Flow Status	15	Sediment Deposition	8
Channel Sinuosity	6	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	11	Vegetative Protection (Right Bank)	6
Pool Substrate Characterization	9		

EPA Habitat Score	102
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	439.7	Instream Wood Debris	3
Remoteness	5	Bank Stability	10
Shading	40		
Epifaunal Substrate	12		
Instream Habitat	11		

PHI Score	61.00
PHI Narrative Ranking	D

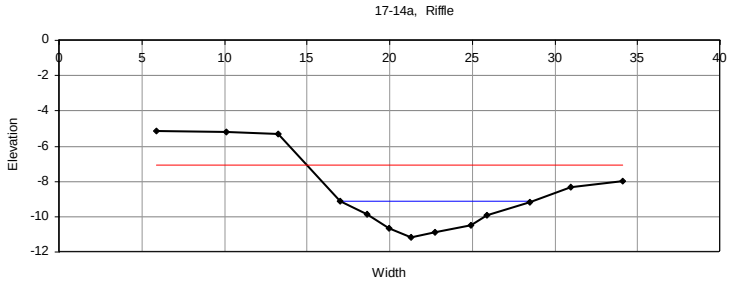
Water Chemistry

Dissolved Oxygen (mg/L)	11.77	Specific Conductance (mS/cm)	384
pH	–	Temperature (°C)	8.18

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	0.69	Cross Sectional Area (ft^2)	12.9
Bankfull Width (ft)	11.5	Water Surface Slope (ft/ft)	0.21
Mean Bankfull Depth (ft)	1.1	Sinuosity	1.00*
Floodprone Width (ft)	26	D50 (mm)	0.24
Entrenchment Ratio	2.3	Adjustments?	ER↓, WD↑, Sin ↑
Width to Depth Ratio	10.2	**Rosgen Stream Type**	**B5c**



17-15A Little Patuxent Sampling Unit


Upstream


Downstream

Location/Site Access: Located at Strawberry way crossing, southwest 0.18 miles
Latitude/Longitude: 39.05195/-76.71503

Land Use Analysis:

Land Use	Acres	% Area
Commercial	4.5	0.6
Industrial	29.8	4.2
Open Space	39.0	5.5
Residential 1-acre	3.8	0.5
Residential 1/2-acre	2.1	0.3
Residential 1/4-acre	178.7	25.1
Residential 1/8-acre	207.0	29.1
Residential 2-acre	4.2	0.6
Transportation	31.0	4.4
Water	0.4	0.1
Woods	210.1	29.6
Grand Total	710.6	100.0

Impervious (acres)	Total Area Above site	% Impervious
234.0	710.6	33.0

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Adequate substrate/available cover, moderately unstable (right) bank, obvious channel alteration, marginal riparian zone
- Assemblage dominated by midges (56%) and worms (35%). *Nais* and *Hydrobaenus* are the most abundant taxa.
- Stream type was identified as an F5, slope was 1.85 percent, and the median channel substrate was coarse sand
- Typically, F channels are not stable. This channel is not stable and the riparian zone is disturbed – making recovery to a stable channel form difficult
- Biological community is appropriate for observed habitat quality.

Recommendations:

- Restore riparian area and habitat features, if possible
- Determine necessity, feasibility of BMP installation on developed lands upstream.

17-15A Little Patuxent Sampling Unit

IBI and Metric Scores

Narrative Rating	**Poor**
Overall Index	**2.14**
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	24
EPT Taxa	1
Ephemeroptera Taxa	0
Intolerant Urban %	0.0
Ephemeroptera %	0.0
Scraper Taxa	0
% Climbers	9.9

Taxa List

Nais	33
Enchytraeidae	1
Isochaetides	1
Chaetocladius	1
Chironomus	1
Corynoneura	1
Cryptochironomus	1
Diamesa	2
Eukiefferiella	2
Hydrobaenus	24
Orthocladius/Cricotopus	1
Parametriocnemus	1
Polypedilum	5
Rheocricotopus	4
Thienemannimyia	6
Zavrelimyia	1
Rheotanytarsus	2
Tanytarsus	5
Aedes	2
Simulium	1
Tipula	1
Ironoquia	1
Stygobromus	1
Physa	3
Total Individuals	101

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	6	Pool Variability	10
Bank Stability- Right Bank	3	Riparian Vegetative Zone Width- Left Bank	5
Channel Alteration	10	Riparian Vegetative Zone Width- Right Bank	3
Channel Flow Status	20	Sediment Deposition	10
Channel Sinuosity	9	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	11	Vegetative Protection (Right Bank)	2
Pool Substrate Characterization	8		

EPA Habitat Score	102
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	710.6	Instream Wood Debris	7
Remoteness	4	Bank Stability	9
Shading	55		
Epifaunal Substrate	11		
Instream Habitat	11		

PHI Score	60.50
PHI Narrative Ranking	D

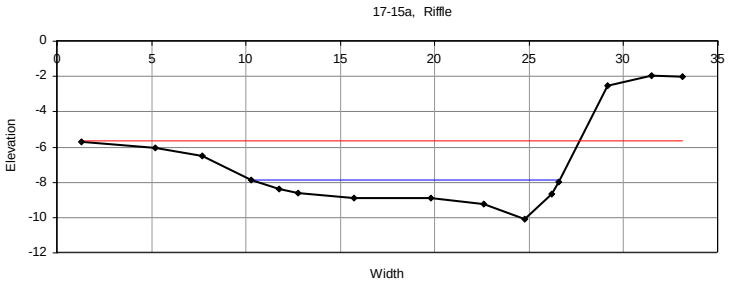
Water Chemistry

Dissolved Oxygen (mg/L)	7.2	Specific Conductance (mS/cm)	157
pH	–	Temperature (°C)	8.88

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	1.19	Cross Sectional Area (ft^2)	17.3
Bankfull Width (ft)	16.2	Water Surface Slope (ft/ft)	1.85
Mean Bankfull Depth (ft)	1.1	Sinuosity	1.5
Floodprone Width (ft)	23.2	D50 (mm)	0.59
Entrenchment Ratio	1.4	Adjustments?	ER ↓
Width to Depth Ratio	15.2	**Rosgen Stream Type**	**F5**



17-16A Little Patuxent Sampling Unit


Upstream


Downstream

Location/Site Access:
Latitude/Longitude: 39.08963/-76.77199

Land Use Analysis:

Land Use	Acres	% Area
Commercial	69.6	6.9
Industrial	2.4	0.2
Open Space	47.4	4.7
Open Wetland	3.7	0.4
Residential 1/2-acre	1.3	0.1
Residential 1/8-acre	28.5	2.8
Residential 1-acre	1.2	0.1
Transportation	44.9	4.5
Utility	33.0	3.3
Water	1.8	0.2
Woods	775.0	76.8
Grand Total	1008.8	100.0

Impervious (acres)	Total Area Above site	% Impervious
114.1	1008.8	11.3

Results:

- Biological condition – "Fair"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Adequate substrate/available cover, moderately unstable banks, marginal riparian zone (left bank)
- Good taxa richness. Midges comprise 56% of the sample. *Hydrobaenus* is the most abundant taxon. 6 EPT taxa.
- Stream type was identified as an F4, slope was 0.98 percent, and the median channel substrate was medium gravel
- 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:

- Restore the riparian areas and channel habitat.
- Determine need, feasibility of BMP implementation on developed lands.

17-16A Little Patuxent Sampling Unit

IBI and Metric Scores

Narrative Rating	**Fair**
Overall Index	**3.29**
Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	5
Intolerant Urban % Score	1
Ephemeroptera % Score	3
Scraper Taxa Score	1
% Climbers	3

Calculated Metric Values

Total Taxa	29
EPT Taxa	6
Ephemeroptera Taxa	3
Intolerant Urban %	5.5
Ephemeroptera %	6.4
Scraper Taxa	0
% Climbers	2.7

Taxa List

Nais	3
Lumbriculidae	1
Enchytraeidae	1
Lumbricidae	1
Tubificinae	1
Spirosperma	5
Lioporeus	1
Ancyronyx	6
Sperchopsis	1
Ablabesmyia	2
Diplocladius	1
Hydrobaenus	36
Limnophyes	1
Orthocladius/Cricotopus	10
Tanypodinae	3
Thienemannimyia	8
Zavrelimyia	1
Simulium	5
Ormosia	1
Baetidae	1
Centroptilum	3
Eurylophella	3
Calopteryx	3
Leuctra	1
Cheumatopsyche	1
Ironoquia	7
Stygobromus	1
Caecidotea	1
Prostoma	1
Total Individuals	110

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	5	Pool Variability	10
Bank Stability- Right Bank	3	Riparian Vegetative Zone Width- Left Bank	5
Channel Alteration	18	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	16	Sediment Deposition	7
Channel Sinuosity	11	Vegetative Protection (Left Bank)	6
Epifaunal Substrate/Available Cover	14	Vegetative Protection (Right Bank)	4
Pool Substrate Characterization	8		

EPA Habitat Score	117
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	1008.8	Instream Wood Debris	4
Remoteness	6	Bank Stability	8
Shading	85		
Epifaunal Substrate	12		
Instream Habitat	14		

PHI Score	67.30
PHI Narrative Ranking	PD

Water Chemistry

Dissolved Oxygen (mg/L)	10.86	Specific Conductance (mS/cm)	173
pH	6.76	Temperature (°C)	12.27

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi^2)	1.58	Cross Sectional Area (ft^2)	15.9
Bankfull Width (ft)	14.4	Water Surface Slope (ft/ft)	0.98
Mean Bankfull Depth (ft)	1.1	Sinuosity	1.5
Floodprone Width (ft)	18.6	D50 (mm)	13
Entrenchment Ratio	1.3	Adjustments?	None
Width to Depth Ratio	13	**Rosgen Stream Type**	**F4**