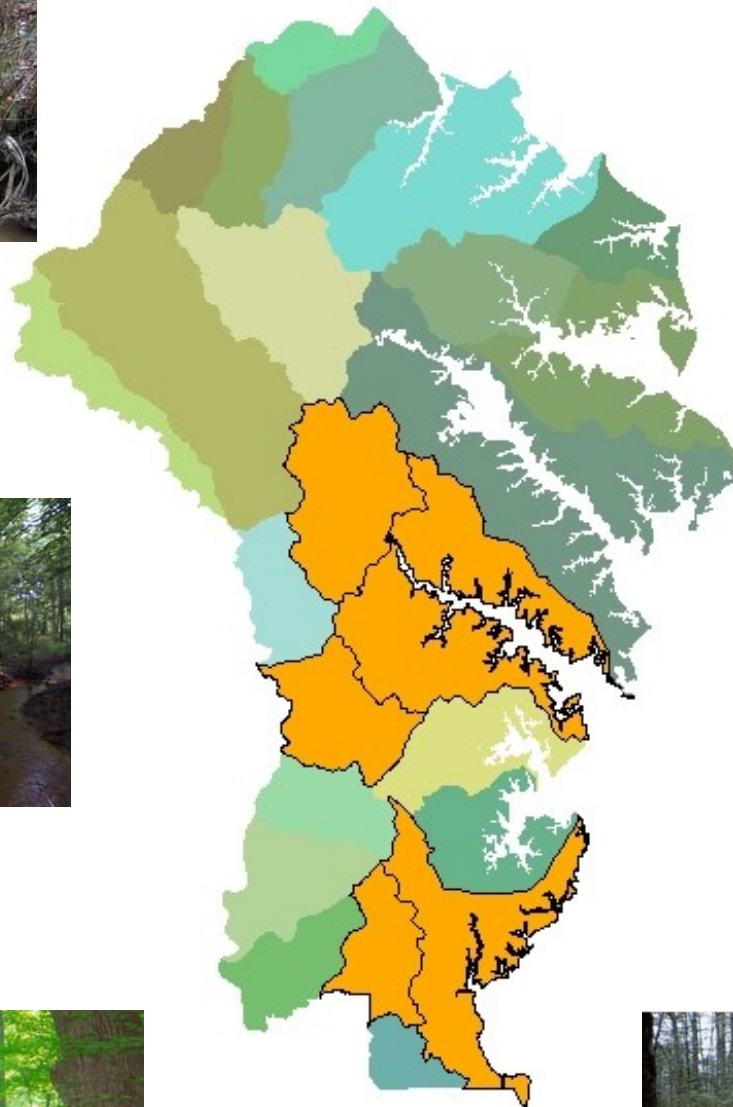
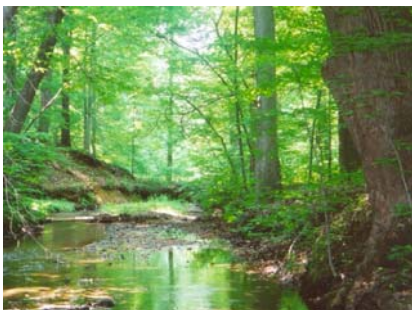


Aquatic Biological Assessment of the Watersheds of Anne Arundel County, Maryland: 2005



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Introduction

The Chesapeake Bay is the largest estuary in North America (USEPA 2004). It has a drainage area of over 64,000 square miles and is located in six states. Many important plant and animal species inhabit the Bay and millions of people live, work, and play along its waters. However, this kind of intense usage can have undesirable impacts on the ecological health of the Bay ecosystem. The conversion of forests and fields to developed land, the filling and draining of wetlands and streams, and the replacement of natural shoreline with shores hardened with stone or piers are just a handful of examples illustrating the impacts of human activities on the Bay.

Despite its large size, the health of the Chesapeake Bay is directly related to the water and habitat quality of the thousands of streams and rivers that provide fresh water to this system (Staver et al. 1996). Healthy streams and rivers are necessary for healthy coastal areas (Growth and James 2005, Batel et al. 2002). Additionally, since Anne Arundel County's attractiveness as a place to live and work is partially related to its coastal resources, the protection of streams and rivers is vital to maintain the high quality of life and economic growth enjoyed by its citizens. For example, it is estimated that approximately \$1.7 billion was spent in Anne Arundel County on heritage tourism in 2004, of which natural resources related tourism is considered to be a primary component (AAC 2005), underscoring the economic importance of the Chesapeake Bay to the County.

Anne Arundel County has approximately 1,500 miles of streams and rivers within its borders. Protecting these resources first requires having basic information about their overall conditions.

To collect this information, the County has implemented a Countywide Biological Monitoring Program to characterize the biological and habitat conditions of the major watersheds of the County. A five-year sampling cycle, begun in 2004, will result in complete coverage of the County by 2008. This report summarizes the results of sampling performed in 2005, or the second year of this cycle. Following this introductory section, this report is organized as follows:

Methods - A description of the methods used to evaluate biological community health and habitat conditions in and near the stream channel.

Results and Discussion of Stream Monitoring – Comparisons of conditions are made between sampling units. Next, overall results are presented for each individual sampling unit and the conditions of selected subwatersheds found within each sampling unit are discussed. Detailed data summaries of each station sampled are found in Appendix B. Discussions are held in the context provided by reference conditions developed in past work done by the Maryland Department of Natural Resources, which are used to evaluate reach and sampling unit health. General recommendations to correct the causes of any observed impairment are made.

Conclusions and Recommendations - A list of recommendations generated by the study.

Appendices - Quality Assurance/Quality Control information, detailed condition summaries of each site, a master taxa list showing all organisms found, geomorphic condition summaries and Rosgen Stream classifications along with examples of all field sheets used are found in several appendices at the end of this report.

Methods

Site Selection

Sampling locations for the implementation of the Anne Arundel County Biological Monitoring and Assessment Program were developed as part of the overall *Sampling and Analysis Plan for Anne Arundel County Biological Monitoring and Assessment Program* (Tetra Tech 2005). Sites were randomly selected from a 1:100,000 scale map of the county's streams. The county was separated into 24 monitoring sampling units and ten sites were selected at random in each sampling unit. Ten additional alternate sites were selected in each sampling unit to serve as replacement sites should any of the primary sites prove unsuitable for sampling. Both primary and alternate sites were identified in a latitude/longitude (lat/long) coordinate format. All sample site reaches were 75 m in length. For the 2005 sampling season, five sampling units were assessed: Upper North River, Lower North River, Stocketts Run, Lyons Creek, and Herring Bay (see **Figure 1**).

Alternate Site Selection

During field sampling, sites that were not considered suitable for sampling were removed from the study. Reasons for removal of sites included a lack of a defined channel, a dry channel, a beaver pond or other form of impoundment, or an overlap with another site. An alternate site was then selected from a list provided by the County. The reason for elimination was noted on a field sheet along with the selected alternate site. **Table 1** lists the alternate site selection and reasoning.

Field Methods

Sites were located in the field using a handheld Global Positioning System (GPS) to navigate to the predetermined lat/long coordinates for each site. The lat/long coordinate represents the mid-point of the 75-meter sampling segment.

Table 1- Field Sampling- Alternate Sites Chosen

Original Site	Alternate Site	Reason
11-1	11-13A	Dry swale
11-3	11-17A	No defined channel/ expansive wetland
11-8	11-14A	Backwatered by beaver
11-9	11-11A	Site overlapped with site 11-6
11-10	11-15A	Backwatered by beaver
15-2	15-11A	Impounded
15-8	15-19A	Backwatered by beaver
15-9	15-20A	Backwatered by beaver
15-10	15-12A	Backwatered by beaver
22-7	22-17A	Impounded
22-8	22-11A	Backwatered by beaver
22-10	22-16A	Backwatered by beaver

Each site was marked in the field, at the upstream and downstream limits, with tree tags and flagging. All field data collection was conducted in accordance with the *Sampling and Analysis Plan for Anne Arundel County Biological Monitoring and Assessment Program* (Tetra Tech 2005). These methods are summarized below.

Aquatic Habitat

Aquatic habitat was visually evaluated in each 75-meter segment utilizing both the United States Environmental Protection Agency's (EPA) Rapid Bioassessment Protocol (RBP) (Barbour 1999) and the Maryland Biological Stream Survey (MBSS) Physical Habitat Index (PHI) (Paul et al. 2002). The EPA protocol is based on the quality of the velocity depth regime, epifaunal substrate, embeddedness, sediment deposition, frequency of riffles, channel alteration, channel flow status, bank vegetative protection, bank stability, and riparian vegetative zones.

The MBSS PHI is partly based on the EPA protocol but it incorporates other parameters also found to be indicative of habitat quality in other Maryland streams. These additional parameters include shading, distance to the nearest road, instream habitat, bank erosion, and instream woody debris and rootwads. These parameters are shown on an example field sheet in **Appendix F: Sample Field Sheets**.

Anne Arundel County Spring 2005 Monitoring

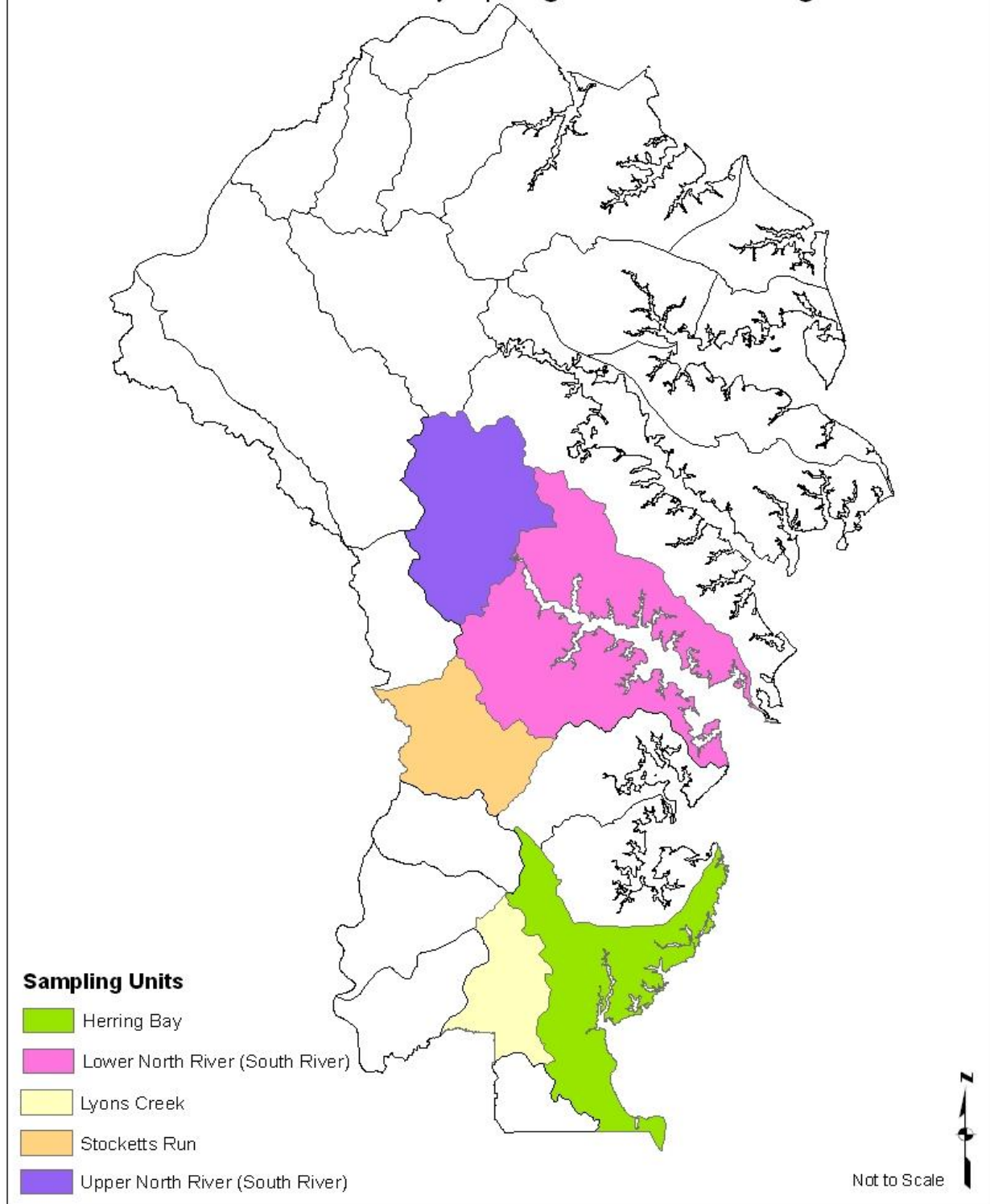


Figure 1 - 2005 Sampling Units

Benthic Macroinvertebrates

Benthic macroinvertebrate collection was conducted using the MBSS Spring index period protocols. This method emphasizes the community composition and relative abundance of organisms in the most favorable habitats. The most favorable habitat is a riffle area followed by, in order, 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, submerged aquatic vegetation (SAV) and associated bottom substrate in moving water, and detrital/sand areas in moving water. The most favorable habitats were sampled in proportion to their dominance in the segment.

Starting at the downstream end of the 75-meter segment, the various habitats are sampled for organisms using a D-net. In riffles and runs, the D-net is firmly placed in the substrate while the organisms are dislodged from any rocks and gravel by gently agitating a one square-foot patch directly upstream of the net opening. Any large rocks and cobbles present in the one square foot patch are gently placed within the net and cleaned to remove organisms. To sample undercut banks, the net is used to gently agitate one square-foot of roots and other substrate making up the bank. For logs and snags, the surface of the log is gently rubbed with the net and/or by the sampler. These procedures are repeated until a total of 20 square feet is sampled within the 75-meter segment.

Once collected, the sample is placed into 1 L plastic sampling containers and preserved with ethanol before being transferred to the laboratory for further processing.

Water quality

Water quality data were collected in-situ using a Hydrolab Quanta multi-probe meter with an SD-12 transmitter. Temperature, turbidity, pH, conductivity, and dissolved oxygen parameters were measured.

Geomorphic Assessment

Geomorphic surveys were conducted within the 75-meter segments at each site identified in the five sampling units. Geomorphic assessment measurements included a simplified longitudinal profile survey, a cross section survey, and pebble counts. Data from these measurements were used to determine the stream type of each reach as categorized by the Rosgen Stream Classification (Rosgen 1996). Data were recorded on field forms and with Pocket RIVERMorph software (Pocket RIVERMorph 2005) on handheld Personal Digital Assistants (PDAs).

Many studies have shown that strong relationships exist between the independent variable of basin drainage area and the dependent variables of average bankfull channel geometry (width, depth, and cross-sectional area) for stable streams in a physiographic region with a similar hydrologic regime (Dunne and Leopold 1978). Thus, if the drainage area to a particular point of interest is known, these regional relationships provide predictive estimates of bankfull channel parameters.

Regional relationships developed by the U.S. Fish and Wildlife Service (USFWS) for streams in the Maryland Coastal Plain (McCandless 2003) were used to estimate the bankfull channel parameters of the sampling sites. First, prior to initiating the field assessment, drainage areas for each assessment site were determined using the Geographic Information System (GIS) application GISHydro2000 (GISHydro2000 2004). The drainage areas and the USFWS regional relationships (McCandless 2003) were then used to estimate the bankfull channel geometry parameters at each site. This information was used in the field as a first estimate for identifying bankfull channel geometry characteristics.

The simplified longitudinal profile was performed throughout the 75-meter reach length of each site. The purpose of the longitudinal profile was to

identify indicators and elevations of the bankfull discharge (bankfull indicators) and to determine the bankfull water surface slope throughout the reach. Once the bankfull indicators were identified, elevation data on the channel thalweg, water surface, and bankfull indicator were collected, at a minimum, at the upstream and downstream ends of the representative reach on the same bed feature.

The cross section surveys were performed at channel transects that were installed in riffles as close to the midpoint of the 75-meter reach as possible. If no riffles existed within the reach, cross sections were installed in a nearby run or glide within a straight transitional reach (i.e., not in a meander bend pool). Cross section monuments, placed on each bank, consisted of four-foot iron reinforcement bars hammered to within six inches of the ground surface and topped with yellow caps. The monuments were field identified with orange flagging labeled with the site name and wrapped around the rebar and on nearby trees. Photos were taken of upstream, downstream, left bank, and right bank views at each cross section, and each cross section monument was located using the GPS. (Please note, the *left* and *right* bank descriptions and the location of station zero on the longitudinal profile for this assessment are consistent with the conventions used by MBSS, where left and right are oriented facing upstream and station zero on the longitudinal profile is at the downstream end of the reach. These conventions are contrary to those typically used for geomorphic assessments, which is left and right bank facing downstream and station zero on the longitudinal profile at the upstream end of the reach.) Each cross section survey consisted of measuring the topographic variability of the associated stream bed, floodplains, and terraces, including:

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

- depositional and erosional features within the channel.

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

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

To determine the size of channel substrate within the 75-meter reach segments, a Wolman Pebble Count (Wolman 1954) was performed, which consists of stratifying the reach based on its frequency of pools, riffles, runs, and glides. The goal of the pebble count is to measure the intermediate axis of 100 particles across ten transects, or ten particles in each of ten transects across the bankfull width and calculate the median particle size, the D_{50} , of the reach. This value was then used for categorizing the sites into the

Rosgen Stream Classification (Rosgen 1996). The number of transects performed in each bed feature was determined by measuring or visually estimating the percentage of reach length for each type of bed feature. For example, if riffles covered 20 percent of the reach length, then 20 percent of the pebble count, or two transects, were performed in riffles. If a channel was clearly a sand or silt bed channel with no distinct variation in material size, the pebble count was not performed, and the D₅₀ was visually estimated. However, if the channel did have changes in bed material size from feature to feature, a full pebble count was performed.

Data Analysis

Land Use and Impervious Surface Evaluation

The County has an extensive Geographic Information System geodatabase, which was used to characterize land use and impervious surface distributions 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 B: 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.

Aquatic Habitat

Each individual metric of the EPA RBP is scored from zero to 20 and all are totaled to calculate the final score (see example field sheet in **Appendix F: Sample Field Sheets**). The maximum total of the standard EPA RBP is 200 points. In some cases this 200-point total is used to represent the reference condition. However, a total of 168 points was used to represent the reference

conditions of Anne Arundel County, based on an assumption of similar conditions found in Prince George's County streams by Stribling et al. (1999). **Table 2** shows the narrative rankings for the EPA protocols based on this 168-point reference condition.

Table 2-EPA RBP Scoring

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

Source: Stribling et al. 1999

The MBSS PHI in Coastal Plain streams is calculated using the following parameters: distance to the nearest road (remoteness), instream habitat, epifaunal substrate, instream woody debris and rootwads, shading, and bank erosion, all adjusted for watershed size as described in Paul et al. (2002). Narrative condition descriptions and scoring ranges come from Boward (per. comm.). **Table 3** summarizes the scoring ranges and associated narrative rankings for the MBSS PHI protocols.

Table 3- MBSS PHI Scoring

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

Source: Paul et al. (2002), Boward (per.comm.)

Benthic Macroinvertebrates

In the laboratory, the samples were transferred to a subsampling tray that displayed 60 five-centimeter (cm) grids on the bottom of the tray. A random number between one and 60 was chosen to determine which grid would be picked for a total of 120 organisms. If the total number of organisms removed from the first grid was equal to or greater than 120, subsampling was complete for the sample. If the number of organisms is less, then another grid was randomly selected. The last grid chosen was picked in its entirety.

Subsamples (including Chironomidae) from each monitoring segment were identified to genus, or the lowest taxonomic level possible, using

common taxonomic references. The final classification and abundance of each organism was entered into a database. The database contained information on the tolerance value, functional feeding group, and habit (characteristic behavior) of each taxonomic group. This database information has been updated since the initial development of the MBSS Benthic Index of Biotic Integrity (BIBI). The tolerance values in particular have been updated using a new urban stressor index (Bressler 2005). These data were exported along with the specific data from each sample into a spreadsheet for calculation of community metrics. A list of all taxa identified is provided in *Appendix C: Master Taxa List*.

DNR has developed a BIBI that compares the macroinvertebrate community within a given stream to reference macroinvertebrate communities in the least-impaired streams. The DNR BIBI is based on statewide reference streams in each physiographic province. The BIBI for the Coastal Plain uses seven community metrics found to characterize macroinvertebrate community health in Maryland's Coastal Plain streams. The metrics calculated for Coastal Plain streams are as follows:

Total Number of Taxa- This metric reflects the health of the community through a measurement of the total number of unique taxa in a sample. An increase in taxa is directly related to the increase in water quality, habitat diversity, and/or habitat suitability.

Number of EPT Taxa- The richness of the generally intolerant insect orders of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). This value summarizes taxa richness with macroinvertebrates that are generally considered to be intolerant of pollution. Therefore, a higher number of taxa within the sample suggest better water quality conditions.

Percent Ephemeroptera- The percentage of insects from the Ephemeroptera order that make up the total sample. The degree to which mayflies dominate the community can indicate the relative

success of these generally pollution intolerant individuals in sustaining reproduction.

Number of Ephemeroptera Taxa- The total number of taxa from the Ephemeroptera order. This metric generally increases with better water and habitat quality.

Percent Intolerant to Urban- The percentage of insects making up the sample that have a tolerance value less than or equal to three. This metric generally increases without urban stressors.

Number of Scraper Taxa- The number of taxa that feed on periphyton and associated microfauna. This metric generally increases without perturbation.

Percent Climbers- The percentage of individuals in the sample that live primarily on stem type surfaces. This metric generally increases without stressors.

Each metric is scored a five, three, or one using the thresholds listed in **Table 4**.

Table 4-MBSS BIBI Metrics

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

Source: Southerland et al. (2005)

Each of the metric scores is added together and the resulting average is the BIBI score. **Table 5** shows the scores and narrative rankings of the MBSS BIBI.

Classification (Rosgen 1996). In this classification methodology, streams are categorized based on

Table 5-MBSS BIBI Scoring

BIBI Score	Narrative Ranking	Characteristics
4.0 – 5.0	Good	Comparable to reference streams considered to be minimally impacted, biological metrics fall within the upper 50 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 10 th percentile of reference site values.
1.0 – 1.9	Very Poor	Strong deviation from reference conditions, with most aspects of biological integrity not resembling the qualities of minimally impacted streams, indicating severe degradation. On average, most or all metrics fall below the 10 th percentile of reference site values.

Water Quality

Water quality data from each site was compiled and, when available, compared to Maryland water quality standards for Use I streams. **Table 6** shows the standards for these streams.

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.

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

Table 6-Maryland COMAR Standards

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

Source: COMAR 26.08.02.03-3

their measured field values of entrenchment ratio, width/depth ratio, sinuosity, water surface slope, and channel materials according to the table in **Appendix D: Rosgen Stream Classification**. As shown in Appendix D, the Rosgen Stream Classification categorizes streams into broad stream types, which are identified by the letters, A, G, F, B, E, C, D, and DA.

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. Type D streams are braided channels with unstable eroding banks and a large sediment supply, causing longitudinal and transverse bars and active lateral adjustment. These streams are very wide with moderate to gentle gradients. Type DA streams are very narrow and deep anastomosing (braided, diverging, and converging) channels with wide, well vegetated floodplains and wetlands. These streams occur in broad gentle-gradient valleys and have very stable stream banks and highly variable sinuosities (Rosgen 1994; Rosgen 1996).

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

To facilitate the data analyses, a GIS database and an engineering software tool called RIVERMorph (RIVERMorph 2005) was used. This software was used to compile, manipulate, and plot field data and to analyze geometry, profile, and channel material characteristics of each assessment site.

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:

- Stream classifications, slopes, and channel materials are only representative of the 75-meter reach in which they were evaluated. In some cases, these data are representative of shorter reaches, depending on site conditions.
- 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.
- 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 84th 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.

Results and Discussion

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

Comparisons Between Sampling Units

This section compares results among sampling units. Biological conditions, habitat quality, and geomorphologic results are discussed. Conditions within selected subwatersheds are also discussed when the data allow such discussions. However, because of the random nature of the site selection process, it should be noted that averaged results for each sampling unit describe typical conditions within all subwatersheds in a given sampling unit,

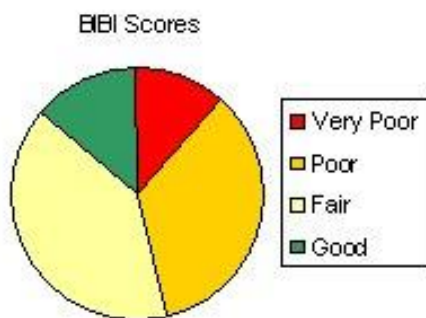
even in areas where no data were directly collected. For details, see Hill and Stribling (2004). **Table 7** summarizes overall biological and habitat conditions for each sampling unit.

Biological Assessment Summary

Overall, the BIBI scores throughout the sampling units were variable, with the largest portion of the sites (40 percent) falling within the “Fair” range (**Figure 2**). Thirty-four percent of the sites fell into the “Poor” range, 14 percent fell into the “Good” range, and 12 percent fell into the “Very Poor” range.

As shown in **Table 7**, three of five units (Lower North River, Lyon’s Creek, and Herring Bay) had aggregate BIBI scores in the “Poor” range while two of five (Upper North River and Stocketts Run) had combined scores of “Fair.” The Stocketts Run sampling unit had the highest average BIBI score (3.53 ± 0.87), and the highest number of sites scoring in the “Good” range. The Lower North River sampling unit, which makes up the southeastern half of the South River watershed, had the lowest average planning unit BIBI score (2.63 ± 0.54), with the majority of sites (60 percent) scored in the “Poor” range. One site also scored as “Very Poor”. Of note is an apparent gradient of biological condition within the South River watershed. Overall biological conditions tended to be healthier in the northwest half (Upper North River unit) compared to the southeast portion (Lower North River unit) of the watershed.

Figure 2 – Summary of Year 2 BIBI Scores



The benthic communities of the sampling units were generally comprised of several genera of amphipods, isopods, midges (Chironomidae),

aquatic worms, and some EPT taxa. Sites scoring in the “Good” range generally had a higher overall taxa richness and better representation from sensitive EPT taxa. The stonefly genera *Isoperla* sp., *Leuctra* sp., and *Amphinemeura* sp. were most commonly found at less impaired sites. Either one of two amphipod genera *Gammarus* sp. and *Synurella* sp. were found at almost every site sampled. The isopod genera *Caecidotea* sp. was found at the majority of sites as well. Aquatic worms and a very diverse midge population made up the majority of the remainder of the communities.

Habitat Assessment Summary

Aggregate habitat scores indicate degraded conditions throughout the sampling units (**Table 7 and Figure 3**). As shown in Table 7, habitat conditions as evaluated using the MBSS PHI showed either “Degraded” (3 of 5 units) or “Partially Degraded” (2 of 5) conditions, with all values near the cutoff between these two categories (see **Table 3**). The Stocketts Run sampling unit had the highest combined MBSS PHI score at 69.0 ± 10.0 while the Herring Bay sampling unit had the lowest (60.2 ± 9.4). Using the EPA RBP habitat assessment information, habitat was uniformly classified as “Partially Supporting”, the next to lowest category in this method. The Lower North River sampling unit had the highest score at 119.2 ± 19.3 while the Lyon’s Creek sampling unit had the lowest score (103.9 ± 15.1).

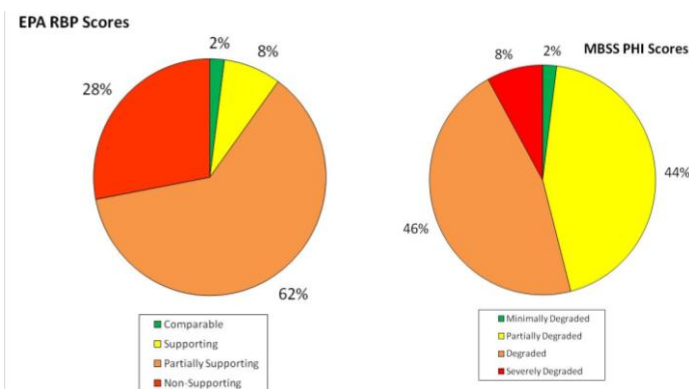
The higher quality benthic communities tended to be located on larger streams within the sampling units that had substantial forested riparian buffers. Such buffers allow for plenty of influx of instream woody debris and rootwads, as well as a high amount of shading. The size of these larger streams may allow for the development of more complex niches for benthic macroinvertebrates. The common location of the small headwater streams within these sampling units was situated closer to residential and commercial land uses and usually resulted in a more impacted benthic community. In addition, some of the sites in the smaller headwater tributaries may experience very low, or even subterranean, flows seasonally that could limit biological communities.

Generally, habitat and biological community conditions tend to be related. The quality of reach habitat conditions dictates the level of potential biological health that a particular site can achieve, all other factors being equal. In essence, this means that sites with “Good” BIBI scores tend to be associated with “Minimally Degraded” or “Comparable” habitat, those with “Fair” BIBI scores tend to have “Partially Degraded” or “Supporting” habitat, and so on. When biological community health and habitat conditions do not correlate well, it is a possible indicator of human impacts, which tend to manifest themselves in two basic ways. First, when biological conditions are better than expected for the habitat quality observed (i.e. - a BIBI of “Good” and a habitat rating of “Degraded” or “Severely Degraded”), nutrient enrichment from agricultural activities or other sources is often suspected. Conversely, when biological conditions are worse than expected for the observed habitat quality (i.e.- a BIBI of “Poor” and a habitat rating of “Minimally Degraded” or “Comparable”), then pollutant impacts, excessive high flow conditions, geomorphic instability, or some other stressor might be the causative agent.

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

Sampling Unit	Average BIBI Score \pm SD / Condition Narrative	Average MBSS PHI Score \pm SD / Condition Narrative	Average EPA RBP Habitat Score \pm SD / Condition Narrative
Upper North River	3.34 \pm 0.46 Fair	66.7 \pm 10.0 Partially Degraded	107.8 \pm 10.2 Partially Supporting
Lower North River	2.63 \pm 0.54 Poor	65.0 \pm 8.5 Degraded	119.2 \pm 19.3 Partially Supporting
Stocketts Run	3.53 \pm 0.87 Fair	69.0 \pm 10.1 Partially Degraded	114.2 \pm 17.6 Partially Supporting
Lyon’s Creek	2.77 \pm 0.78 Poor	62.3 \pm 12.1 Degraded	103.9 \pm 15.1 Partially Supporting
Herring Bay	2.80 \pm 1.07 Poor	60.2 \pm 9.4 Degraded	105.2 \pm 12.9 Partially Supporting

Figure 3 – Summary of Year 2 Habitat Scores



In these sampling units, the two habitat methods gave scores that tended not to be well correlated with BIBI scores. As illustrated in **Table 8**, the EPA RBP habitat scores showed a slightly broader distribution among the different habitat categories, but rated most sites as having “Partially Supporting” habitat and rated many sites (~62%) as having less impaired biological communities in comparison to available habitat. In contrast, the MBSS PHI showed mixed results in that approximately 25% of sites were judged more impaired biologically in comparison to available habitat while around a third were judged to have less impaired insect communities in comparison to available habitat (**Table 9**). The exact cause of this difference between the two methods is not known. However, the overarching conclusion is that factors other than in-stream habitat conditions are impacting biological health in the 2005 sampling units.

Table 8- Comparison of biological scores to EPA RBP habitat condition.

EPA RBP Habitat Scores	BIBI Score			
	Good	Fair	Poor	Very Poor
Comparable				12-10
Supporting	19-09	19-07	12-09, 12-02	15-01
Partially Supporting	19-01, 19-10, 15-19a, 22-01, 11-05	19-03, 19-06, 19-08, 15-12a, 12-08, 22-04, 22-17a, 22-09, 11-02, 11-04, 11-05, 11-14a, 12-01, 11-11a, 22-11a	19-02, 19-04, 15-03, 15-07, 12-03, 12-05, 12-06, 11-06, 22-02	15-11a, 22-06
Non- Supporting	15-20a	12-04, 11-13a 11-07 11-15a 11-17a	19-05, 15-04, 15-06, 22-05, 22-16a 12-07	15-05, 22-03

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.

Table 9. Comparison of biological scores to MBSS PHI habitat condition.

MBSS PHI Score	BIBI Score			
	Good	Fair	Poor	Very Poor
Minimally Degraded		19-07		
Partially Degraded	19-09, 22-01, 19-01	22-04, 12-01, 12-08, 19-08, 11-02, 11-04, 11-07, 11-11a, 11-13a, 11-15a	19-05, 15-04, 22-16a, 15-03, 19-02	15-01, 12-10, 22-06
Degraded	19-10, 11-05	15-12a, 22-11a, 22-17a, 12-04, 19-03, 19-06, 11-14a, 11-17a	22-05, 22-02, 15-06, 15-07, 12-03, 12-05, 12-06, 12-07, 12-09, 19-04	15-05, 15-11a, 22-03
Severely Degraded	15-19a, 15-20a	22-09	11-06	

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 were more impaired than the habitat scores would predict

Because of the uncertainty between the two methods, a conservative approach for categorizing the impacts to the stream biota beyond habitat factors is necessary. Sites characterized by both methods as either potentially impacted by water quality degradation or possibly enriched by excessive nutrient concentrations are listed in **Table 10**.

Table 10- Reaches in which habitat and biological conditions are somewhat mismatched, as similarly characterized by both habitat assessment methods.

Possible Water Quality Impairment	Possible Enrichment
12-10, 15-01, 15-11a, 22-06	11-05, 11-14a, 11-17a, 12-04, 15-12a, 15-19a, 15-20a, 19-01, 19-03, 19-06, 19-09, 19-10, 22-01, 22-09, 22-11a, 22-17a,

Basic water quality parameters measured within all of the sampling units were generally consistent and within Maryland State standards. One consistent exception was lower than expected pH values. Each sampling unit had at least three and as many as eight out of ten sites with pH values of less than 6.5. This may be due to natural causes such as low pH groundwater flows, such as those from glauconitic soils, to smaller tributary streams.

Of the sites listed in **Table 10** as having potential water quality impairment, only 22-06 was outside the standard for the parameters measured, having a pH at the time of sampling of 5.88. Sites 12-10 and 15-11a had dissolved oxygen concentrations of 5.52 mg/L and 5.73 mg/L, respectively, which are near the impairment level of <5 mg/L. In addition, site 15-01 had a pH value of 6.81, which is near the lower limit of the State standard described in **Table 6**. These sites should be considered potential candidates for future water quality investigations.

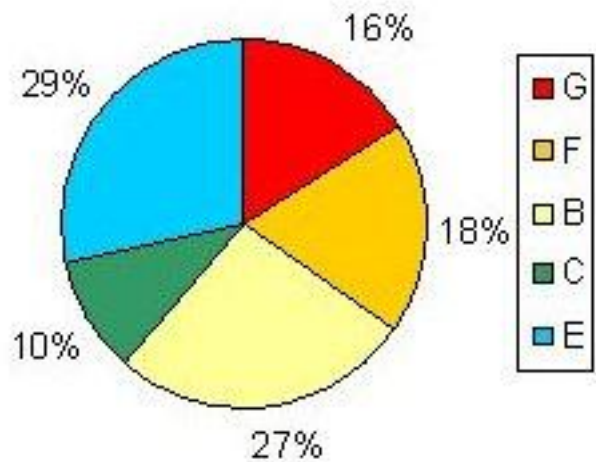
Geomorphic Assessment Summary

The stream types throughout the sampling units were variable, with the largest portion of the sites (29 percent) being E channels (**Figure 4**). Twenty-seven percent of the sites were classified as B channels, although the majority of these channels had width depth ratios within the range of the G type channel. This may indicate that these streams are in transition to more unstable G channels. The Lower North River sampling unit had the greatest number of sites (four) with these types of B channels. Sixteen percent of the sites classified as G channels, 18 percent were F channels, and 10 percent were C channels. The Herring Bay sampling unit had the highest number

of sites (seven) that classified as the most stable C and E channels, and the Stocketts Run sampling unit had the highest number of sites (seven) that classified as unstable G and F channels.

Eight percent of the sites sampled in 2005 had sand channel substrates. All of the sites within the Upper North River sampling unit had sand beds, while only four sites within the Lyons Creek sampling unit consisted of sand channels. Twelve percent of the sites had gravel beds. These sites were located in the Stocketts Run (two sites) and Lyons Creek (four sites) sampling units. Eight percent of the sites had silt/clay channel substrates.

Figure 4 – Summary of Year 2 Rosgen Stream Types



These silt/clay sites were located in the Lower North River (one site), Herring Bay (two sites), and Lyons Creek sampling units. Five sites within the Stocketts Run sampling unit also had a very hard clay layer in the banks and stream beds, identified as the IIC3g horizon of the Bibb silt loam soil (USDA 1973), that appears to provide bed and bank stabilization and grade control, similar to bedrock, in the streams where it is present. However, the permanence of this feature is unknown, so stability associated with it should be considered temporary, lasting years or perhaps decades once exposed.

Overall, slopes throughout the sampling units were low. Channel slopes ranged from a minimum of 0.003 feet/foot in the Upper North River sampling unit to a maximum of 0.015 feet/foot in the Herring Bay sampling unit.

The streams within the sampling units appear to be adjusting. Over geologic time, streams have constantly adjusted to the climatic changes in the volumes of water and sediment they carry; they are not stationary. Streams have adjusted to continents moving, land masses uplifting, and mountains weathering from wind, precipitation, and ice. In response to these changes, rivers have natural tendencies to alter and stabilize their shapes, slopes, and patterns. This stabilization that began in the geologic past is still occurring today (Dunne and Leopold 1978).

This stabilization process is an evolutionary development that occurs throughout drainage network systems. The fundamental geomorphic process that occurs is rejuvenation in response to downstream base level lowering, the cause of which can vary (Shumm et al. 1984). This process is understood to occur as headward (downstream to upstream) incision. The headward incision is characterized by nickpoint migration (see **Figure 5**) and

Figure 5. Example of headward erosion in the Patuxent River watershed.



Source: J. Thompson, MD DNR.

increased sediment yield due to stream bank and bed erosion. Typically, the stream bed and bank erosion follows the process of degradation, followed by widening and stabilization to a new form at a lower elevation. These evolutionary stages of channel adjustment can be described in terms of stream type succession scenarios (Rosgen 1996). For example, pre-disturbance stable B channels could be affected by some impact in the watershed that initiates degradation and base level lowering to a G channel, followed by rejuvenation in the upstream drainage network by widening to an F channel and stabilizing to a new stable B channel at the lower base elevation.

This process of base level lowering and network response can occur over the course of many years

and can have various causes (Shumm et al. 1984). However, some causes, such as the effects of human activities, can accelerate the natural geomorphic processes and stream channel adjustments. The effects of human activities cause alterations in the flow regime, including runoff volumes and patterns, which initiate further stream channel alterations. Forest clearing, agricultural practices, urban and suburban development, and commercial and industrial development are all examples of human activities that have resulted in increased impervious surfaces, decreased riparian cover, increased stormwater runoff, and increased sedimentation. These activities often accelerate stream channel adjustments.

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 Plain, and the responses of the county's streams are likely still occurring today. For example, in the Stocketts Run sampling unit, stream stability appears to improve in the larger mainstem streams of Stocketts Run and Davidsonville Branch subwatersheds that are closer to the Patuxent River. This is consistent with the evolutionary development of drainage network rejuvenation in response to downstream base level lowering proceeding from downstream to upstream (Shumm et al. 1984). In this case,

Stocketts Run has likely adjusted to a new lower base level due to historic disturbances in its watershed, such as forest clearing, agricultural practices, and suburbanization. The drainage networks in the Stocketts Run and Davidsonville Branch subwatersheds appear to be in the process of adjusting to this reduction in base level. This is supported by the stream types identified in these subwatersheds. In the lower mainstem streams, F channels were identified that appear to have gone through the process of degrading and widening and now appear to be adjusting to more stable forms (C channels). In the headwater and tributary streams to the mainstem and in upper reaches of the mainstem, unstable G channels and B channels that appear to be transitioning to more unstable forms (F and G channels) were identified.

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

In the meantime, these baseline geomorphic assessment field data can be compared to the Maryland Coastal Plain regional relationships of bankfull channel geometry (McCandless 2003) in order to determine whether bankfull characteristics observed in the field depart from these more stable reference conditions. This comparison is shown in **Figures 6, 7 and 8**. Although it appears that many of the data are not consistent with the regional relationships, it should be noted that these relationships were developed on streams with drainage areas ranging from 0.3 to 89.7 square miles, with 93% of the data collected in watersheds greater than one square-mile, and 64% of the data collected in watersheds with zero to 3% imperviousness. Therefore, stream channels with smaller drainage areas, such as those studied in this assessment (ranging from 0.1 to 7.2 square miles with 62% of the data collected in watersheds

less than one square-mile), appear to show greater variability in channel dimensions when compared to the regional relationships. This may be due to the natural variability of streams, the ranges of land use, the greater amounts of imperviousness, and the adjustment scenarios within the assessed watersheds. In effect, these regional relationships can apply to the streams studied in this assessment, and they were effectively used as estimates of field indicators of bankfull channel geometry.

Figure 6 - Bankfull Cross-Sectional Area Field Data vs. Regional Relationship for Maryland Coastal Plain Streams (McCandless 2003)

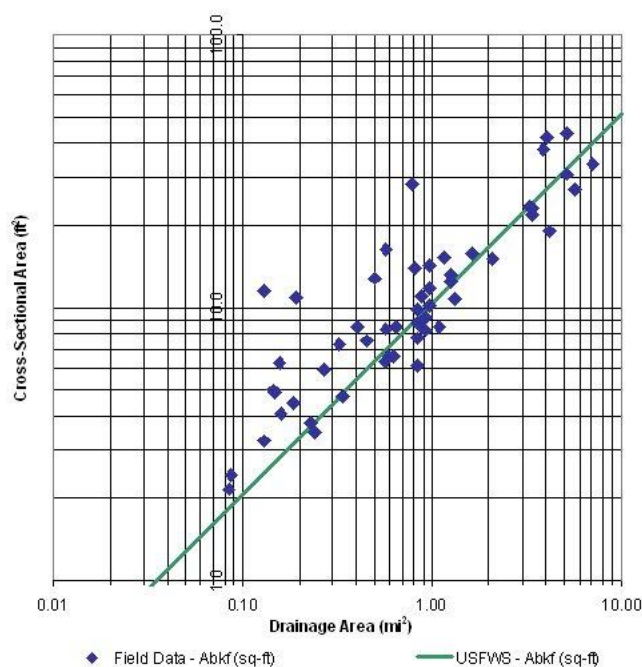


Figure 7 - Bankfull Width Field Data vs. Regional Relationship for Maryland Coastal Plain Streams (McCandless 2003)

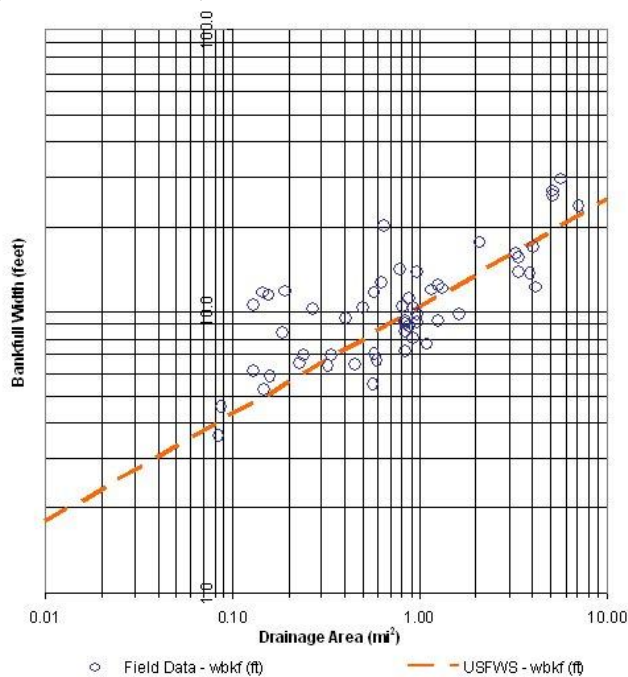
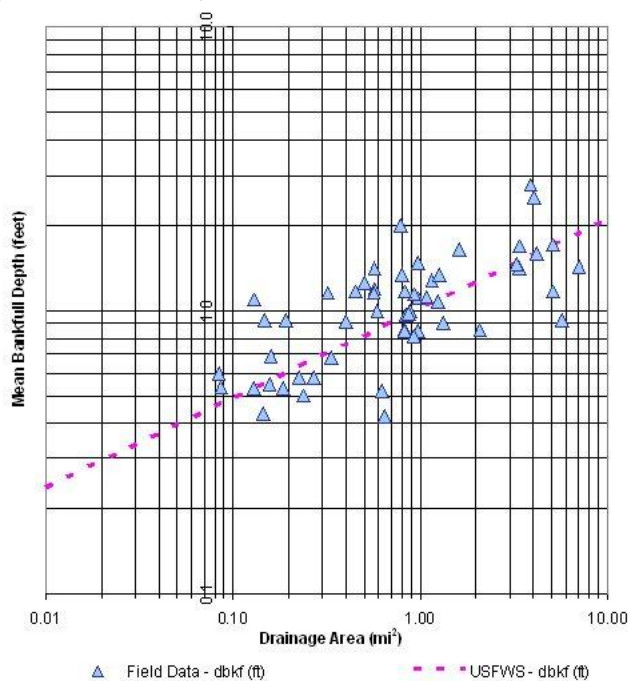


Figure 8 - Mean Bankfull Depth Field Data vs. Regional Relationship for Maryland Coastal Plain Streams (McCandless 2003)



While there appears to be a disparity between the field data and the regional relationships, field indicators of the bankfull discharge were consistent throughout the 75-meter reaches and

were, therefore, considered appropriate. The bankfull indicators observed in the field included tops of point bars, flat bankfull benches, floodplain breaks, slope breaks, and scour lines.

Individual Sampling Unit Discussions

This section summarizes conditions found within each sampling unit. Discussions of potential impacts to observed habitat and biological conditions are discussed here. For detailed site descriptions, please see *Appendix B: Individual Site Summaries*.

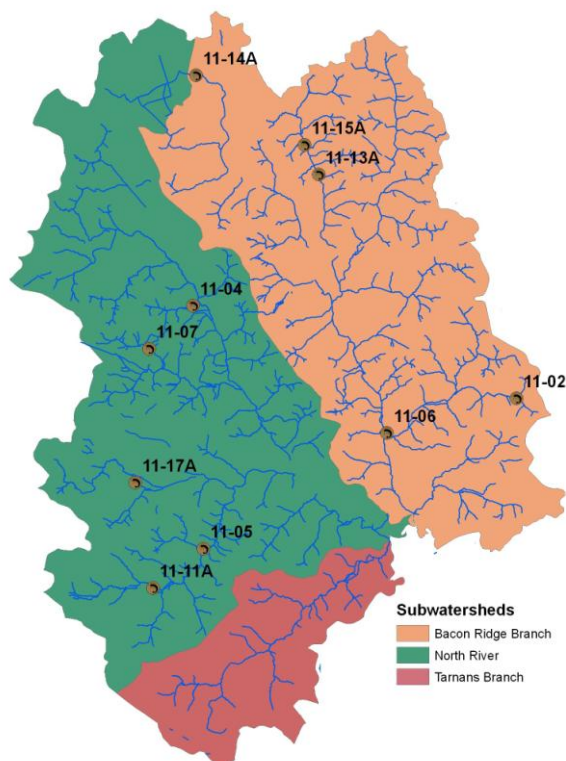
When appropriate, conditions within individual subwatershed are discussed. However, it should be noted that even when site-specific data are not available for a particular subwatershed within a unit, the unit wide results characterize basic conditions of streams throughout the unit.

Upper North River

Comprising the northern half of the South River watershed, the Upper North River sampling unit is approximately 12,797 acres and is located in the middle portion of the County (**Figure 1**). The sampling unit is primarily comprised of the Bacon Ridge Branch, North River, and Tarnans Branch subwatersheds. As no sampling stations were located within Tarnans Branch, no further discussion of the subwatershed will be included. The land use of the Upper North River sampling unit is approximately 61 percent forested, nine percent agricultural, and 1.4 percent urban land, including industrial, commercial, and transportation. Approximately 22 percent of the sampling unit is residential land use. Impervious surfaces comprise 8.2 percent of the overall Upper North River sampling unit. In both Bacon Ridge Branch and North River (**Figure 9**) the greatest concentration of residential land use occurs in the upper portions of the subwatershed. Some agricultural areas are also concentrated in these upper portions, while large forested areas occur along the stream valleys of tributaries and the mainstem of the North River and Bacon Ridge Branch. Most of the urban land cover occurs in the Bacon Ridge Branch subwatershed and is located near the former Crownsville Hospital site.

Ten primary sites and one replicate site were sampled within the Upper North River sampling unit (**Figure 9**). Five of the sites (11-11A, 11-05, 11-17A, 11-07, and 11-04) were located within the North River subwatershed. The other five sites (11-02, 11-06, 11-13A, 11-15A, and 11-14A) were located within the Bacon Ridge Branch subwatershed. Three of these sites were located on the mainstem of Bacon Ridge Branch.

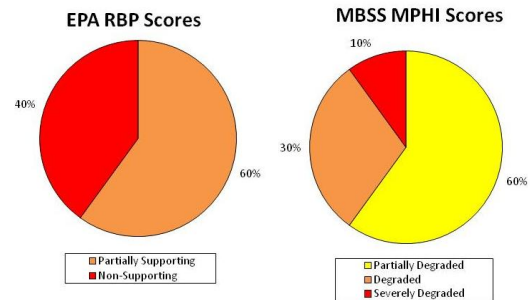
Figure 9 - Upper North River Sampling Locations



Aquatic Habitat

The MBSS PHI rated 60 percent of the streams within the Upper North River sampling unit as “Partially Degraded”, 30 percent of streams were rated as “Degraded”, and 10 percent were rated “Severely Degraded” (**Figure 10**). The average PHI score was 66.7 ± 10.0 , or “Partially Degraded” overall. Sixty percent of streams were rated as “Partially Supporting” and forty percent were rated as “Non-Supporting” by the EPA RBP habitat assessment. The average EPA RBP score was 107.8 ± 10.2 , or “Partially Supporting” overall. Generally, the sites showed a good amount of shading around the stream while instream habitat was poor or marginal at all sites.

Figure 10 - Upper North River Habitat Scores

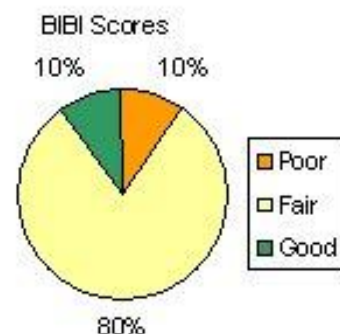


No obvious pattern was observed within the individual subwatersheds of the North River and Bacon Ridge Branch. Both subwatersheds had MBSS PHI habitat scores that were relatively well distributed between “Partially Degraded” and “Degraded”. Bank erosion, woody debris, and remoteness were all variable within each subwatershed. EPA RBP habitat scores were equally variable with only pool substrate characterization and channel alteration scoring consistently high throughout the sampling unit.

Benthic Macroinvertebrates

As shown in **Figure 11**, the MBSS BIBI rated ten percent of the streams within the Upper North River sampling unit as “Good”, 80 percent as “Fair”, and ten percent as “Poor”. The average BIBI score was 3.34 ± 0.46 , which is within the “Fair” range. Generally, these sites showed good taxa richness and the presence of sensitive EPT taxa. The one site scoring in the “Poor” range (11-06) had lower taxa richness and was devoid of the sensitive mayflies or stoneflies that were present at other sites.

Figure 11 - Upper North River BIBI Scores



The sites sampled within the North River subwatershed generally scored in the lower end of the “Fair” range with the exception of one site (11-05) that scored in the “Good” range. This site had seven EPT taxa present, one of the highest values of all sites sampled during 2005. In addition, the benthic community at this site had low overall tolerance values and a high number of climber taxa. The other sites within this subwatershed (11-04, 11-07, 11-17A, and 11-11A) all had the presence of sensitive EPT taxa, including mayflies and stoneflies, and had a low overall tolerance value. However, these sites also had lower overall taxa richness than the site scoring in the “Good” range.

Sites sampled within the Bacon Ridge Branch subwatershed generally fell within the mid to upper range of “Fair” for the MBSS BIBI, with the exception of one site (11-06) that scored in the “Poor” range. This site lacked many sensitive EPT taxa and was heavily dominated by the blackfly genus *Stegopterna* sp. The other sites within this subwatershed (11-14A, 11-15A, 11-13A, and 11-02) generally had similar composition with a combination of sensitive EPT taxa and tolerant midge, aquatic worm, and amphipod taxa.

Detailed data on each site can be found in **Appendix B: Individual Site Summaries**.

Water Quality

Temperature and turbidity values sampled in the Upper North River sampling unit were within Maryland’s Use I stream standards. Dissolved oxygen values were within state standards with the exception of one stream within the Bacon Ridge Branch subwatershed. Overall, pH values in Upper North River were lower than would be expected and values at 80 percent of the sampling locations were below what is considered acceptable for Use I streams. Conductivity values ranged from very low in streams with large forested buffers and a large distance to the nearest roadway to relatively high in sites that were situated near roadways. **Table 11** shows the average water quality values and their standard deviations.

Table 11- Average water quality values- Upper North River

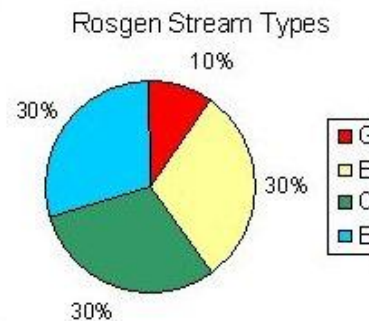
Value/Standard Deviation				
Temp. *	D.O.*	pH	Cond.*	Turb.*
9.9 ± 2.3	6.0 ± 0.9	5.8 ± 0.5	0.137 ± 0.072	20.9 ± 7.6

*units- Temp. (°C), D.O. (mg/L), Cond. (mS/cm), Turb. (NTU)

Geomorphic Assessment

As shown in **Figure 12**, one of the Upper North River sites is a G channel, three are B channels, three are C channels, and three are E channels. Channel slopes range from 0.0002 ft/ft to 0.008 ft/ft. All of the sites sampled have sand channel substrates.

Figure 12 - Upper North River Rosgen Stream Types



All of the B channels identified in the Upper North River sampling unit have width/depth ratios more like G channels (well below 12), but were classified as B channels because their entrenchment ratios were within the moderately entrenched range. This may indicate that these channels are in transition to more unstable G channels. These stream types, like the G, C, and E channels identified, are located throughout the Upper North River sampling unit. Thus, this sampling unit is likely in various stages of adjustment.

More detailed summaries of the geomorphic data and stream types identified in Upper North River are included in the appendices.

Summary

Overall, biological conditions within the Upper North River sampling unit generally show enriched biological community conditions in comparison to available habitat. Aquatic habitat scores for the MBSS PHI ranged from “Partially

Degraded” to “Minimally Degraded” with EPA RBP scores showing slightly worse conditions (Partially Supporting). Average biological conditions within the sampling unit were rated as “Fair.” The large amount of forested land uses within the sampling unit, especially along the stream valleys has allowed for adequate shading, woody debris, and only localized moderate erosion. The low amount of urban land use and impervious areas has allowed a fair benthic community to thrive. The North River and Bacon Ridge Branch subwatersheds have similar aquatic habitat, benthic, and water quality conditions.

Previous biological sampling data exist for the Upper North River sampling unit. These data show impaired conditions in this portion of the South River sampling unit. Data collected during 2002 and in 1997 as part of the Maryland Biological Stream Survey are summarized in **Table 12**.

Biological health as described by previous sampling in this sampling unit is “Poor”. Only one of 16 samples was measured as “Fair”. The others were measured as “Poor”. However, it should be noted that a severe precipitation shortfall occurred in the last half of 2001 and through the first half of 2002, resulting in one of the worst droughts ever recorded in Maryland (MDSCO 2006). This event may explain the depressed biological community observed in 2002. This does not explain the results observed in 1997, which was a more normal precipitation year. Results obtained during this study seem to indicate biological community improvement since 1997. However, all discussions about the impacts of drought on biological response must be considered provisional and subject to revision as more data are collected in subsequent sampling rounds.

The geomorphic conditions within the Upper North River sampling unit are also fair. Sites with “Poor” benthic communities and those with a combination of “Fair” benthic communities and “Degraded” habitat conditions may indicate that the channels are in transition to more unstable forms.

The width depth ratios of the B channels indicate that they may be transitioning to more unstable G streams.

Table 12- Summary of past biological assessment activities in the Upper North River sampling unit. Habitat data not available for MBSS sites.

Sampling Year	Sampling Unit Biological Conditions		Notes
	MBSS	MBSS Streamwaders	
2002	Poor to Good	Poor ¹	Two samples for MBSS: One Poor, one Good 10 samples for Streamwaders: all Poor
1997	Poor	ND	Four MBSS samples: all Poor No data (ND) collected by Streamwaders

¹Targeted sampling

Lower North River

The Lower North River sampling unit, which is approximately 23,981 acres and is located in the middle portion of the County (**Figure 1**), comprises the southeastern half of the South River watershed. The sampling unit is primarily comprised of the Beards Creek, Broad Creek, Flat Creek, and Glebe Creek subwatersheds. Many other unnamed tributary subwatersheds comprise the remainder of the Lower North River sampling unit, but only one contained a sampling station. As a result, only this subwatershed, referred to as Unnamed Tributary, will be discussed in addition to the primary subwatersheds. The land use of the Lower North River sampling unit is approximately 43 percent forested, five percent agricultural, and 5.9 percent urban land, including industrial, commercial, and transportation. Approximately 38 percent of the sampling unit is residential land use. Impervious surfaces comprise 17.5 percent of the overall Lower North River sampling unit. The highest concentration of urban land use occurs in

the Broad Creek subwatershed (**Figure 13**) in the vicinity of I-97. Urban land uses are also concentrated in the Glebe Creek subwatershed in the vicinity of MD Route 2. Generally, the middle portion of all of the subwatersheds are dominated by forest along the main stream valleys with residential land uses concentrated in the lower portions, closer to the South River. Some agricultural areas also occur in the upper portions of the drainage, with the highest concentration occurring in the Flat Creek subwatershed

Ten primary sites and one replicate site were sampled within the Lower North River sampling unit (**Figure 13**). Three of the sites (12-01, 12-09, and 12-10) were located within the Broad Creek subwatershed. Two of the sites (12-08 and 12-06) were located within the Beards Creek subwatershed, three were located within the Flat Creek subwatershed, and one site (12-02) was located on the mainstem of Glebe Creek. The remaining site (12-07) was located on an unnamed tributary to the South River.

Aquatic Habitat

As shown in **Figure 14**, the MBSS PHI rated 40 percent of the streams within the Lower North River sampling unit as “Partially Degraded”, while the other 60 percent of streams were rated as “Degraded”. The average MBSS PHI score was 65.0 ± 8.5 . Ten percent of streams were rated as “Comparable”, 20 percent were rated as “Supporting”, 50 percent of streams were rated as “Partially Supporting”, and 20 percent were rated as “Non-Supporting” by the EPA RBP habitat assessment. The average score of 119.2 ± 19.3 (“Partially Supporting”) was the highest aggregate score observed using this method. Overall, the sites showed a wide variety of habitat scores and variable individual habitat metrics.

Figure 13 - Lower North River Sampling Sites

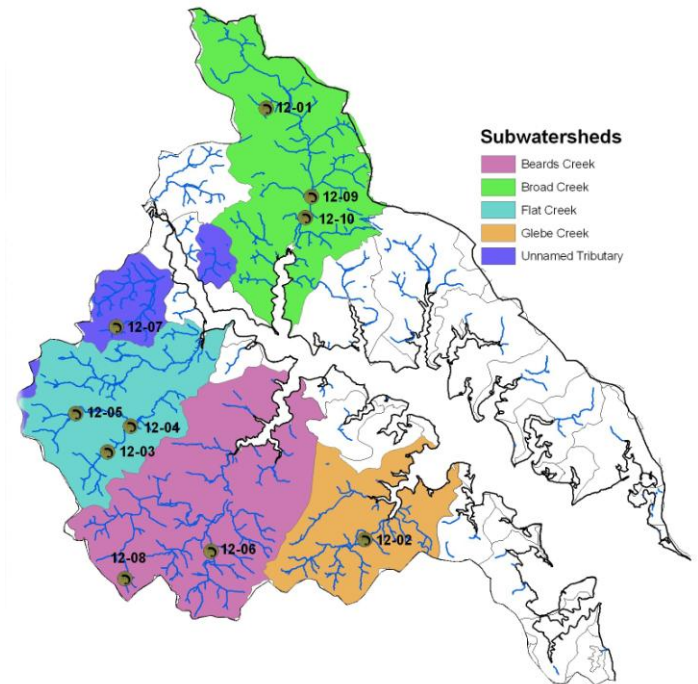
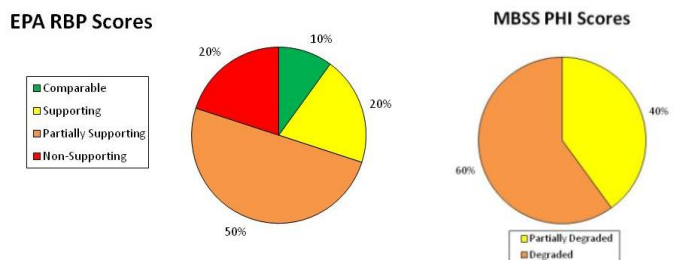


Figure 14 - Lower North River Habitat Scores



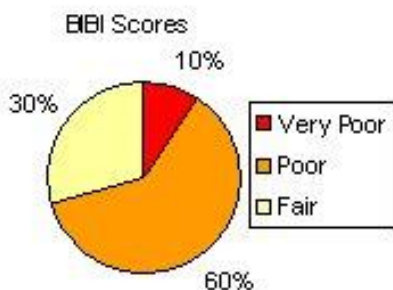
Sites within the mainstem of Broad Creek showed the best overall instream habitat and epifaunal substrate while the most instream woody debris and rootwads were present in the Glebe Creek subwatershed. Within the Beards Creek and Flat Creek subwatersheds high amounts of shading contrasted with low instream habitat and epifaunal substrate quality, resulting in overall “Degraded” habitat scores.

Benthic Macroinvertebrates

The MBSS BIBI rated 30 percent of the streams within the Lower North River sampling unit as “Fair”, 60 percent as “Poor”, and ten percent as “Very Poor” (**Figure 15**). The average BIBI score was 2.63 ± 0.54 , which is within the “Poor” range. Generally, sites scoring in the “Fair” range had

much higher taxa richness when compared with sites scoring in the “Poor” or “Very Poor” range. Only one site within the Lower North River sampling unit contained mayfly taxa. The three sites scoring in the “Fair” range were distributed within the Broad Creek, Flat Creek, and Beards Creeks subwatersheds. The one site scoring in the “Very Poor” range was located within the Beards Creek subwatershed. Overall, benthic conditions appear to be similar throughout the Lower North River sampling unit.

Figure 15 - Lower North River BIBI Scores



Sites located within the Broad Creek subwatershed range from “Very Poor” to “Fair” for the MBSS BIBI. The site scoring in the “Fair” range (12-01) had the highest taxa richness within the sampling unit. This site also had a good number of EPT taxa, all from the Trichoptera order, and a high number of climber taxa. The site scoring in the “Poor” range (12-09) was located on the mainstem of Broad Creek just downstream of Generals Highway. This site was highly channelized with some current beaver activity, and as a result was dominated by tolerant midge taxa and an amphipod taxon *Gammarus* sp. The site scoring in the “Very Poor” range was located just downstream in a braided channel obviously impacted by beaver activity. During the spring sampling period, benthic collection was focused on what appeared to be the main channel within this system. Upon a subsequent site visit by the geomorphic assessment team, it was noted that the channel sampled during the early spring was dry and another channel was currently active. The transient nature of these channels most likely had an effect on the impairment of the benthic community, which was dominated by common net

spinning caddisflies (*Cheumatopsyche* sp.) and a midge taxon (*Rheotanytarsus* sp.).

One site was sampled in an unnamed tributary subwatershed adjacent to Flat Creek. This site (12-07) scored in the “Poor” range and was heavily dominated by aquatic worms.

Sites sampled within the Flat Creek subwatershed ranged from “Poor” to “Fair” for the MBSS BIBI. Two of the sites (12-03 and 12-05) scored in the “Fair” range and were located on small, sandy bottom streams with relatively low spring flows. Site 12-03 was dominated by aquatic worms and an isopod taxon (*Caecidotea* sp.), while site 12-05 was dominated by a more diverse group of Diptera taxa as well as *Caecidotea* sp. The site scoring in the “Fair” range (12-04) had a high taxa richness that included a mayfly taxon (*Acerpenna* sp.) and a diverse group of Dipterans.

Two sites were sampled within Beards Creek. These sites scored in the “Fair” (12-08) and “Poor” (12-06) ranges. Site 12-08 had high taxa richness, low overall tolerance of those taxa, and a high number of scraper taxa. This site had a larger channel than site 12-06 and a much higher amount of instream woody debris and rootwads providing habitat. Site 12-06 was heavily dominated by an amphipod genus (*Gammarus* sp.) but also had a high number of climber taxa.

Only one site was sampled in the Glebe Creek subwatershed. This site (12-02) scored in the “Poor” range for the MBSS BIBI. This site was dominated by the blackfly taxon *Stegopterna* sp., but had a lower overall tolerance within the taxa present.

Detailed data on each site can be found in **Appendix B: Individual Site Summaries**.

Water Quality

Temperature and turbidity values sampled in the Lower North River sampling unit were within Maryland’s Use I stream standards. Dissolved oxygen values were within state standards with the exception of one stream within the Flat Creek subwatershed. Overall, dissolved oxygen values in Lower North River were lower than would be

expected during the spring sampling period. pH values at three of the sampling locations were below what is considered acceptable for Use I streams. Conductivity values ranged from very low in streams with large forested buffers and a large distance to the nearest roadway to relatively high in sites that were situated near roadways. **Table 13** shows the average water quality values and their standard deviations.

Table 13- Average water quality values – Lower North River

Value/Standard Deviation				
Temp.*	D.O.*	pH	Cond.*	Turb.*
8.3 ± 3.8	5.9 ± 1.2	6.6 ± 0.3	0.211 ± 0.084	9.4 ± 7.5

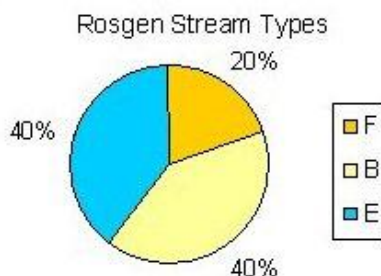
*units- Temp. (°C), D.O. (mg/L), Cond. (mS/cm), Turb. (NTU)

Geomorphic Assessment

Two of the Lower North River sites are F channels, four are B channels, and four are E channels (**Figure 16**). Channel slopes range from 0.002 ft/ft to 0.006 ft/ft. Nine of the sites sampled have sand channel substrates. One site (12-10) has a silt/clay channel substrate.

All of the B channels identified in the Lower North River sampling unit have width depth ratios more like G channels (well below 12), but were classified as B channels because their entrenchment ratios were within the moderately entrenched range. This may indicate that these channels are in transition to more unstable G channels. These channels, like the F and E channels identified, are scattered throughout the Lower North River sampling unit. Thus, this sampling unit is likely in various stages of adjustment.

Figure 16 - Lower North River Rosgen Stream Types



More detailed summaries of the geomorphic data and stream types identified in Lower North River are included in the appendices.

Summary

The Lower North River sampling unit contains variable benthic communities and aquatic habitat conditions, but biological scores generally tracked with available habitat conditions. Aquatic habitat scores throughout were relatively degraded with a few sites scoring higher than others. MBSS PHI scores were all in the “Degraded” or “Partially Degraded” range. EPA RBP scores were generally judged as “Partially Supporting” (Average score was 119.2, ± 19.3). As described above, benthic macroinvertebrate community scores were mostly in the “Poor” or “Very Poor” ranges. Water quality within the sampling unit was also variable with several sites not meeting the Use I standards for pH and one site not meeting the standard for dissolved oxygen.

Previous biological sampling data exist for the Lower North River sampling unit. These data show impaired conditions in this portion of the South River watershed. Data collected during 2002 as part of the Maryland Biological Stream Survey are summarized in **Table 14**.

Biological health as described by previous sampling in this sampling unit is “Poor”. Only three of 25 samples were measured as “Fair”. The others were listed as “Poor”. As stated previously, it should be noted that a severe precipitation shortfall occurred in the last half of 2001 and through the first half of 2002, resulting in one of the worst droughts ever recorded in Maryland (MDSCO 2006). This event may partially explain the depressed biological community observed in 2002. Unlike the Upper North River sampling unit, conditions within this unit did not appear to improve during recovery from this severe drought. However, all assumptions about the impacts of drought on biological response must be considered provisional and subject to revision as more data are collected in subsequent sampling rounds.

Table 14- Summary of past biological assessment activities in the Lower North River sampling unit collected in 2002.

Sampling Agency	Sampling Unit Biological Conditions	Notes
MBSS	Poor to Fair	Four samples: Two fair, two poor
MBSS Streamwaders	Mostly Poor ¹	21 samples: 1 fair, 20 poor

¹Targeted sampling.

The impaired benthic communities and stream habitat in the F channels may be due to the unstable nature of this type of channel. In the B and E channels, which are typically considered stable, impacted benthic communities and stream habitat may indicate that the channels are in transition to more unstable forms.

Stocketts Run

The Stocketts Run sampling unit is approximately 8,713 acres and is located in the southwestern portion of the County (**Figure 1**). The sampling unit is primarily comprised of the Kings Branch, Davidsonville Branch, and Stocketts Run subwatersheds. A small portion of the sampling unit also drains directly to the Patuxent River via a handful of unnamed tributaries. The land use of the sampling unit is approximately 57 percent forested, 13 percent agricultural, and 4.2 percent urban land, including industrial, commercial, and transportation. Approximately 17 percent of the sampling unit is residential land use. Impervious surfaces comprise 9.9 percent of the overall Stocketts Run sampling unit. The greatest density of residential land use occurs in the Kings Branch subwatershed (**Figure 17**), while the highest density of agricultural land occurs in the Davidsonville Branch subwatershed. The Stocketts Run subwatershed has a high concentration of forested land use, especially along the riparian buffer of the mainstem of Stocketts Run.

Figure 17 - Stocketts Run Sampling Sites



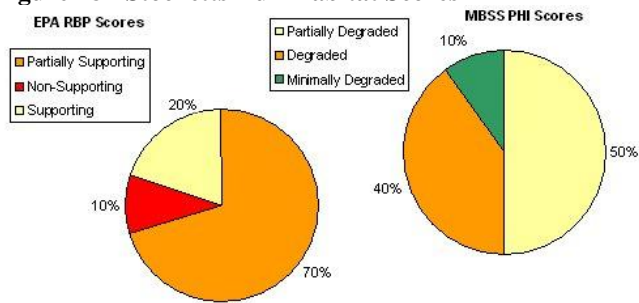
Ten primary sites and one replicate site were sampled within the Stocketts Run sampling unit (**Figure 17**). Three of the sites (19-09, 19-10, and 19-04) were located on the mainstem of Stocketts Run. Two of the sites (19-01 and 19-02) were located on the mainstem of Davidsonville Branch and one site (19-08) was located on the mainstem of Kings Branch. The remainder of the sites (19-03, 19-05, 19-06, and 19-07) were located on small unnamed tributary streams to Stocketts Run and Davidsonville Branch.

Aquatic Habitat

The MBSS PHI rated 50 percent of the streams within the Stocketts Run sampling unit as “Partially Degraded”, while 40 percent of streams were rated as “Degraded” (**Figure 18**). One sample reach was rated “Minimally Degraded”. The average PHI score was 69.0 ± 10.0 . Using the EPA RBP habitat assessment method, seventy percent of streams were rated as “Partially Supporting”, 20 percent were rated as “Supporting”, and ten percent were rated as “Non-Supporting”. An average score of 114.2 ± 17.6 (resulting in a unit-wide classification of “Partially Supporting”) was observed.

Generally, the sites were well shaded with a moderate amount of instream woody debris and rootwads as well as a moderate amount of streambank erosion. Epifaunal substrate, pool substrate, and instream habitat showed a wide range of scores throughout the sampling unit, while channel alteration scores were consistently high throughout.

Figure 18 - Stocketts Run Habitat Scores



Sites located in the Stocketts Run subwatershed generally scored in the “Degraded” or “Partially Supporting” ranges with one site (19-07) scored as “Minimally Degraded”. The remoteness metric scored low while instream habitat and epifaunal substrate quality varied between sites. Site 19-07, located in a well-forested tributary in the southernmost portion of the subwatershed, had the best overall habitat, with excellent epifaunal substrate and instream habitat.

Sites located within the Davidsonville Branch subwatershed ranged from “Partially Degraded” to “Degraded” and “Partially Supporting” to “Non-Supporting”. The sites scoring in the higher ranges were located on the larger mainstem portion of the stream. These sites scoring in the higher ranges generally had better epifaunal substrate and instream habitat.

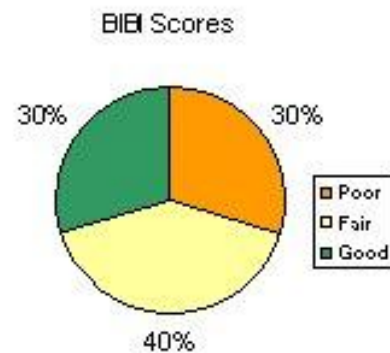
The one site sampled within King Branch was rated as “Partially Degraded” and “Partially Supporting”. This site had good bank stability and fair epifaunal substrate and instream habitat.

Benthic Macroinvertebrates

The MBSS BIBI rated 30 percent of the streams within the Stocketts Run sampling unit as “Good”, 40 percent as “Fair”, and 30 percent as “Poor” (Figure 19). The average BIBI score for Stocketts

Run was 3.53 ± 0.87 , which is within the “Fair” range. Generally, sites scoring in the “Good” range had a higher EPT taxa richness, with the Ephemeroptera or mayfly taxa being most notably absent from sites scoring less than “Good”. These “Good” sites were always located on a mainstem stream. Sites scoring in the “Fair” and “Poor” ranges all lacked mayfly taxa but varied with respect to all other metrics. These “Fair” and “Poor” sites were all located on tributary streams with the exception of the site located in Kings Branch.

Figure 19 - Stocketts Run BIBI Scores



Sites located within the Stocketts Run subwatershed ranged from “Poor” to “Good” for the MBSS BIBI. Generally, the sites scoring in the “Good” range (19-09 and 19-10) were located on the mainstem of Stocketts Run, closer to the Patuxent River. The site located farthest downstream, 19-09, was dominated by the sensitive stonefly taxon *Isoperla* sp. This site also had a very high percentage (53.68%) of organisms intolerant to urban stressors. Site 19-10, located farther upstream, had a more even distribution of taxa within the sample. Three taxa, *Ephemerella* sp. (a mayfly), *Paratanytarsus* sp. (a midge), and *Gammarus* sp. (a scud) dominated this sample. Two sites scored in the “Fair” range and were both located on tributary streams to Stocketts Run. One of these sites, 19-06, located closer to the mainstem, was dominated by two blackfly taxa, *Simulium* sp. and *Stegopterna* sp. The other site was located farther up in the sampling unit and was dominated by a midge taxon (*Polypedilum* sp.) and a scud taxon (*Gammarus* sp.). The site scoring in the “Poor” range (19-04) was located in a small headwater tributary in the eastern portion of the sampling unit. This site was dominated by

two midge taxa, *Micropsectra* sp. and *Rheotanytarsus* sp. and a scud taxon, *Gammarus* sp.

As with Stocketts Run, sites located on the lower mainstem of Davidsonville Branch scored higher than the remainder of the subwatershed. This site, 19-01, had a very high number of EPT taxa and a very high percentage (54.17%) of taxa intolerant to urban stressors. A sensitive mayfly taxon *Acerpenna* sp. and a sensitive scud taxon *Synurella* sp. dominated this site. One site, 19-03, scored in the “Fair” range and had high numbers of EPT taxa but was generally dominated by aquatic worms. Two sites scored in the “Poor” range within the Davidsonville Branch subwatershed. One site, 19-02, was located on the mainstem, while the other site, 19-05, was located on a tributary stream. Both sites were dominated by pollution tolerant bivalves and aquatic worms.

One site (19-08) was sampled in the Kings Branch subwatershed and scored in the high end of the “Fair” range. This site had a high overall taxa richness and a high EPT taxa richness. No mayfly taxa were found within this site and a relatively high number of aquatic worms and midges were also present in the sample.

Detailed data on each site can be found in **Appendix B: Individual Site Summaries**.

Water Quality

Temperature and turbidity values sampled in the Stocketts Run sampling unit were within Maryland’s Use I stream standards. Dissolved oxygen values were within state standards with the exception of one small tributary stream. Overall, dissolved oxygen values in Stocketts Run were lower than would be expected during the spring sampling period. pH values at 60 percent of the sampling locations were below what is considered acceptable for Use I streams. Several of these streams were small headwater tributaries with a large baseflow component from adjacent seeps, and may have a naturally lower pH value. Conductivity values were generally low, as expected in a sampling unit with low amounts of impervious surfaces and urban development.

Table 15 shows the average water quality values and their standard deviations.

Table 15- Average water quality values – Stocketts Run

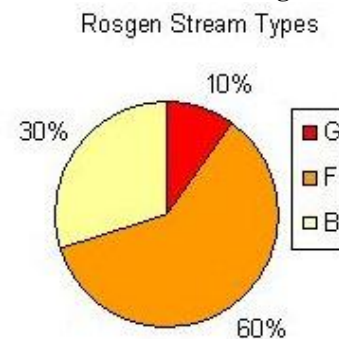
Value/Standard Deviation				
Temp.*	D.O.*	pH	Cond.*	Turb.*
12.8 ± 1.4	5.4 ± 0.5	6.0 ± 0.6	0.171 ± 0.045	16.2 ± 5.8

*units- Temp. (°C), D.O. (mg/L), Cond. (mS/cm), Turb. (NTU)

Geomorphic Assessment

Six of the Stocketts Run sites are F channels, three are B channels, and one is a G channel (**Figure 20**). The F channels occur throughout all of the Stocketts Run subwatersheds. The B channels occur on headwater tributaries to Davidsonville Branch (19-05) and Stocketts Run (19-06 and 19-07) subwatersheds. The G stream occurs on the mainstem of Davidsonville Branch (19-02). Channel slopes throughout the subwatersheds range from 0.0008 ft/ft to 0.011 ft/ft.

Figure 20 - Stocketts Run Rosgen Stream Types



Eight of the streams have sand bed channels, while the remaining two sites have gravel substrates. The gravel bed streams are 19-05 and 19-01, both located in the Davidsonville Branch subwatershed. Five of the sites possess a very hard clay layer in the banks and stream beds. This layer is identified as the IIC3g horizon of the Bibb silt loam soil according to the Anne Arundel County soil survey (USDA 1973), which is characterized as hard, firm, sticky and plastic with some coarse sand and fine gravel. This material appears to provide bed and bank stabilization and grade control, similar to bedrock, in the streams where it is present (noted with the channel substrate modifier /I in the channel classifications assigned to these sites in Appendix B). This clay layer appears at sites 19-02, 19-03, and 19-05 in the

Davidsonville Branch subwatershed and in sites 19-04 and 19-10 in the Stocketts Run subwatershed.

More detailed summaries of the geomorphic data and stream types identified in Stocketts Run are included in the appendices.

Summary

The Stocketts Run sampling unit appears to have varied overall stream conditions based on aquatic habitat, biological, water quality, and geomorphic conditions. In two of the subwatersheds, Stocketts Run and Davidsonville Branch, biological condition appears to improve in the larger, mainstem streams closer to the Patuxent River. This may be due to the greater potential for niches in a larger stream setting or perhaps a greater diversity due to the proximity to the Patuxent River. In addition, some of the sites in the smaller headwater tributaries with sandy substrates may experience very low flows seasonally that may limit biological communities. Stream stability also appears to improve in the larger mainstem streams of Stocketts Run and Davidsonville Branch subwatersheds that are closer to the Patuxent River. This is consistent with the evolutionary development of drainage network rejuvenation in response to downstream base level lowering (Shumm et al. 1984).

Previous biological sampling data exist for the Stocketts Run subwatershed (see **Table 16**). These data show improvement over time. What these data may illustrate is the recovery from impacts associated with the drought experienced in 2001 and 2002 over the entire state of Maryland (MDSCO 2006). In 2002, observed habitat conditions were comparable to those in 2005. Habitat data were not available for 2003 and 2004.

Based upon this information, it appears the Stocketts Run has the resiliency to recover from disturbance associated with natural stressors like drought. This is likely due to the extensive amounts of forested, undeveloped land found in this subwatershed. However, all assumptions about the impacts of drought on biological response must be considered provisional and

subject to revision as more data are collected in subsequent sampling rounds.

Table 16- Summary of past biological assessment activities in the Stocketts Run subwatershed.

Sampling Year	Sampling Unit Biological Condition	Sampling Unit Habitat Conditions		Sampling Agency
		EPA RBP	MBSS PHI	
2002	Mostly Poor ¹	Partially Supporting	NA	AA County 13 Samples: 7 V. Poor 4 Poor 2 Fair
2004	Fair to Poor ²	NA ³	Not reported	MBSS Stream-waders Six Samples: 1 Fair 5 Poor MBSS Two Samples: Both Fair

¹Targeted sampling.

² Targeted sampling for Streamwaders sites.

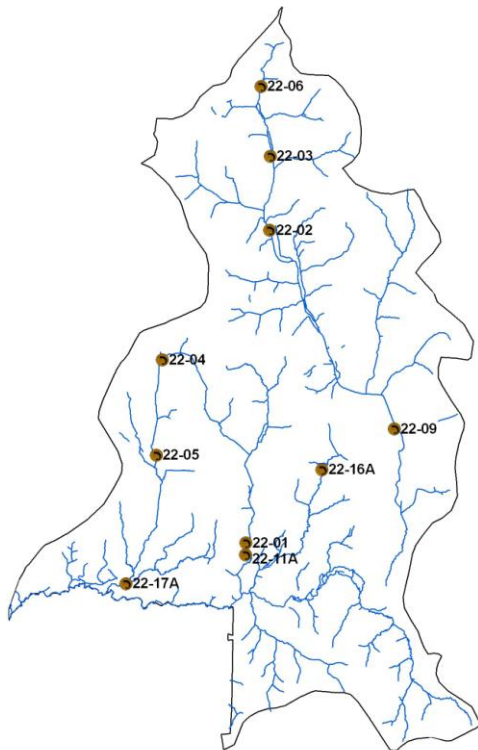
³ EPA RBP Habitat assessment is not part of MBSS sampling activities.

The amount of large forested riparian buffer areas is much higher in the mainstem streams when compared with the smaller headwater tributaries, and this may also help account for the differences in BIBI scores. Agricultural land uses within the sampling unit appear to have a negative effect on the aquatic habitat and stability of the streams, especially within Davidsonville Branch, which has the greatest concentration of agricultural land uses. Land use may also be having an effect on the in situ water quality. Nutrients, sediments, and other non point source contaminants from agricultural and residential areas may be contributing to the lower than expected dissolved oxygen readings throughout the sampling unit. pH values were also lower than expected in the small tributary streams with a large groundwater baseflow component. The cause of this is not known but it may be due to naturally lower pH values, which could be explained by the presence of glauconitic sediments found in the Nanjemoy and Aquia Formations within this subwatershed.

Lyons Creek

The Lyons Creek sampling unit is approximately 6,153 acres and is located in the southern portion of the county (**Figure 1**). This sampling unit is not divided into subwatersheds (**Figure 21**). The land use of the Lyons Creek sampling unit is approximately 41 percent forested, 31 percent agricultural, and 1.3 percent urban land, including industrial, commercial, and transportation. Approximately 18 percent of the sampling unit is residential land use. Impervious surfaces comprise 5.3 percent of the overall Lyons Creek sampling unit. The overall land use of Lyons Creek is variable with most of the forested areas occurring along tributary stream valleys and the mainstem of Lyons Creek. A large portion of the sampling unit is currently in agricultural use and increased development has concentrated residential land uses close to main roadways within the sampling unit.

Figure 21 - Lyons Creek Sampling Sites



Ten primary sites and one replicate site were sampled within the Lyons Creek sampling unit (**Figure 21**). Four sites (22-09, 22-02, 22-03, and 22-06) were located on the mainstem of Lyons Creek. The remaining sites (22-17A, 22-05, 22-

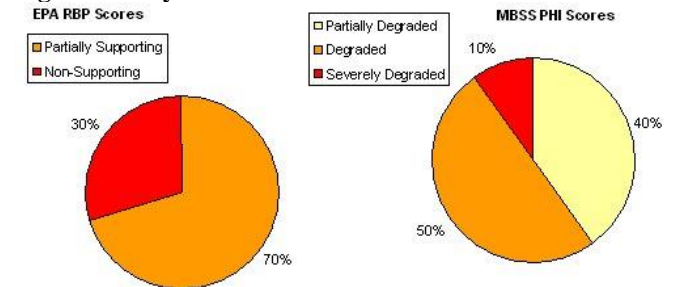
04, 22-01, 22-11A, and 22-16A) were located on tributary streams within the sampling unit.

Aquatic Habitat

The MBSS PHI rated 50 percent of the streams within the Lyons Creek sampling unit as “Degraded”, 40 percent of streams were rated as “Partially Degraded”, and the other ten percent as “Severely Degraded” (**Figure 22**). The average PHI score was 62.3 ± 12.1 , which is in the “Degraded” range. Seventy percent of streams were rated as “Partially Supporting” and 30 percent were rated as “Non-Supporting” by the EPA RBP habitat assessment. The average EPA RBP score was resulted in a “Partially Supporting” rating at 103.9 ± 15.1 .

Throughout the sampling unit, instream habitat and epifaunal substrate were in the poor and very poor ranges while shading remained high. Localized areas of high erosion were noted within the sampling unit. A lack of instream woody debris and rootwads was prevalent throughout Lyons Creek. Habitat scores did not appear to vary greatly between larger mainstem sites and smaller tributary streams.

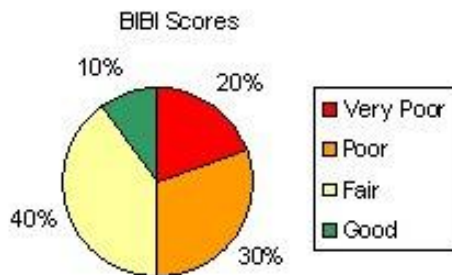
Figure 22 - Lyons Creek Habitat Scores



Benthic Macroinvertebrates

The MBSS BIBI rated ten percent of the streams within Lyons Creek as “Good”, 40 percent as “Fair”, 30 percent as “Poor”, and 20 percent as “Very Poor” (**Figure 23**). The average BIBI score for Lyons Creek was 2.77 ± 0.78 , which is within the “Poor” range. Sites scoring in the “Good” and “Fair” range were generally located lower in the sampling unit with the exception of one site located on a small tributary stream.

Figure 23 - Lyons Creek BIBI Scores



Four sites were located on the mainstem of Lyons Creek. One site (22-09), located on the middle portion of the mainstem scored in the “Fair” range for the MBSS BIBI. This site had low overall tolerance values and a high number of climber taxa. Other sites located on the mainstem of Lyons Creek, farther up in the sampling unit, scored in the “Poor” and “Very Poor” range. The site scoring “Poor” (22-02) was generally dominated by tolerant midge taxa but also had a high number of climber taxa. The sites scoring in the “Very Poor” range (22-03 and 22-06) were dominated by midge taxa, aquatic worms, and amphipods.

The remaining sites were located on tributary streams to Lyons Creek. Scores at these sites ranged from “Poor” to “Good” with sites situated closer to the mainstem of Lyons Creek generally scoring “Fair” or “Good”. The site scoring in the “Good” range (22-01) had high taxa richness, good EPT diversity, and many scraper and climber taxa. Another site (22-11A), located just downstream of this site, scored in the “Fair” range. This site had slightly less diversity overall as well as less diversity of EPT taxa. Sites 22-04 and 22-17A both scored in the “Fair” range and were located on a tributary stream in the western portion of the sampling unit. Mayfly and stonefly taxa were present at these sites but these taxa combined with an abundance of tolerant midge and aquatic worm taxa resulted in the overall “Fair” score. Site 22-05 scored in the “Poor” range and was heavily dominated by the amphipod taxon *Gammarus*.

Detailed data on each site can be found in **Appendix B: Individual Site Summaries**.

Water Quality

Temperature, turbidity, and dissolved oxygen values within the Lyons Creek sampling unit were within Maryland’s Use I stream standards. pH values at 70 percent of the sampling locations were below what is considered acceptable for Use I streams. Several of these streams were small, headwater tributaries and some were blackwater in nature, which may contribute to the lower than expected pH values. Conductivity values were generally low, as would be expected in a sampling unit with low amounts of impervious surfaces and urban development. **Table 17** shows the average water quality values and their standard deviations.

Table 17- Average water quality values – Lyons Creek

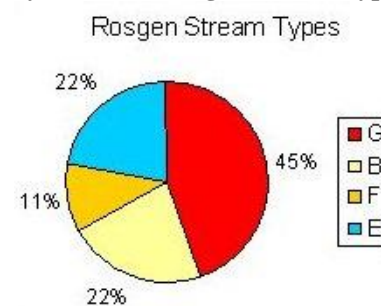
Value/Standard Deviation				
Temp.*	D.O.*	pH	Cond.*	Turb.*
13.4 ± 3.8	7.6 ± 2.4	6.4 ± 0.4	0.167 ± 0.018	14.6 ± 11.1

*units- Temp. (°C), D.O. (mg/L), Cond. (mS/cm), Turb. (NTU)

Geomorphic Assessment

Four of the Lyons Creek sites are G channels, two are B channels, one is an F channel, and two are E channels (**Figure 24**). Channel slopes range from 0.0004 ft/ft to 0.011 ft/ft. Four of the sites sampled have a sand channel substrate, and four sites have a gravel substrate. One site (22-09) has a silt/clay channel substrate.

Figure 24 - Lyons Creek Rosgen Stream Types



One of the B channels identified in the Lyons Creek sampling unit has a width depth ratio more like a G channel (well below 12), but was classified as a B channel because its entrenchment ratio was within the moderately entrenched range. This may indicate that this channel is in transition to an unstable G channel.

The geomorphic assessment at site 22-02 was not completed because the property owner denied access to the site.

More detailed summaries of the geomorphic data and stream types identified in Lyons Creek are included in the appendices.

Summary

A wide range of conditions was observed within the Lyons Creek sampling unit. Aquatic habitat conditions suffered from poor instream habitat and epifaunal substrate as well as localized areas of erosion that reduces overall habitat quality. Benthic IBI scores reflect these differences of habitat quality and ranged from “Very Poor” to “Good”. Generally, the best quality benthic communities were found lower in the sampling unit, closer to the Patuxent River. These larger streams may be able to provide greater habitat and consequently greater taxa diversity within the benthic community. Water quality within the Lyons Creek sampling unit was generally within parameters set for Use I waters in Maryland with the exception of pH values, which were slightly less than expected. Overall, biological conditions within the sampling unit seemed correlated with observed habitat quality.

Previous biological sampling data exist for the Lyons Creek sampling unit. The data collected during 2002 and in 1997 as part of the Maryland Biological Stream Survey are summarized in **Table 18**.

These data seem to show a downward trend in conditions in this sampling unit from 1997 to 2005, although only a handful of samples were collected before the sampling performed by the County in 2005. Samples collected in 2001 characterize the conditions in Lyons Creek as highly impaired. However, the small number of samples and the fact that no samples were collected in 2002 or 2003 after the impacts of the 2001-2002 drought described previously make it difficult to understand the ultimate trajectory of biological conditions within this sampling unit. All assumptions about the impacts of drought on biological response must be considered

provisional and subject to revision as more data are collected in subsequent sampling rounds.

Stream types also varied throughout the sampling unit. Generally, more stable B and E channels were located in the headwater channels and tributaries to Lyons Creek. However, impaired aquatic conditions in these reaches may indicate that these channels are evolving to more unstable channels.

Table 18- Summary of past biological assessment activities in the Lyons Creek sampling unit.

Sampling Year	Sampling Unit Biological Conditions		Notes
	MBSS	MBSS Streamwaders	
2001	Poor	Mostly Poor ¹	One sample by MBSS Five samples for Streamwaders: One Fair, four Poor
1997	Good	NA	One sample by MBSS No data collected by Streamwaders

¹Targeted sampling

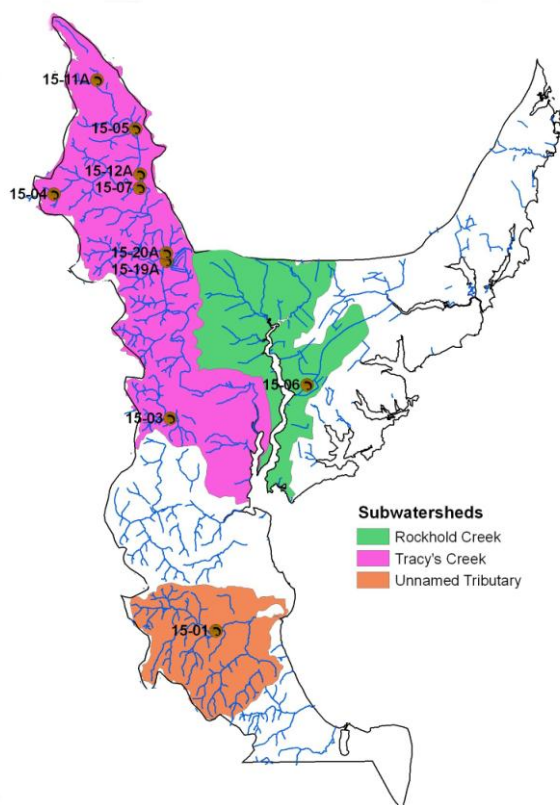
Overall, the aquatic community and geomorphic conditions within Lyons Creek appear to reflect the impacts associated with a sampling unit having a large percentage of agricultural land uses. Increased erosion and sedimentation from these current and historic land uses has reduced the overall availability of high quality aquatic habitat. These processes may also be altering the channels into more unstable stream types.

Herring Bay

The Herring Bay sampling unit is approximately 14,594 acres and is located in the southern portion of the county along the Chesapeake Bay (**Figure 1**). The sampling unit is comprised of the Rockhold Creek, Tracy’s Creek, Trotts Branch, and numerous unnamed tributary subwatersheds. As no sampling stations were located within Trotts Branch, no further discussion of the subwatershed will be included. One sampling site was located on a particularly large unnamed tributary. This

subwatershed will be discussed in detail and referred to as Unnamed Tributary. The land use of the Herring Bay sampling unit is approximately 52 percent forested, ten percent agricultural, and two percent urban land, including industrial, commercial, and transportation. Approximately 21 percent of the sampling unit is residential land use. Impervious surfaces comprise 7.3 percent of the overall Herring Bay sampling unit. Both the Tracy's Creek and Unnamed Tributary subwatersheds (**Figure 25**) are primarily forested with some residential areas concentrated along the edges of the subwatersheds. Agricultural land uses are most highly concentrated within the Rockhold Creek subwatershed.

Figure 25 - Herring Bay Sampling Sites



Ten primary sites and one replicate site were sampled within the Herring Bay sampling unit (**Figure 24**). One of the sites (15-06) was located within the Rockhold Creek subwatershed. One of the sites (15-01) was located within the subwatershed of an unnamed tributary. The remainder of the sites (15-03, 15-19A, 15-20A, 15-04, 15-07, 15-12A, 15-05, and 15-11A) were located within the Tracy's Creek subwatershed.

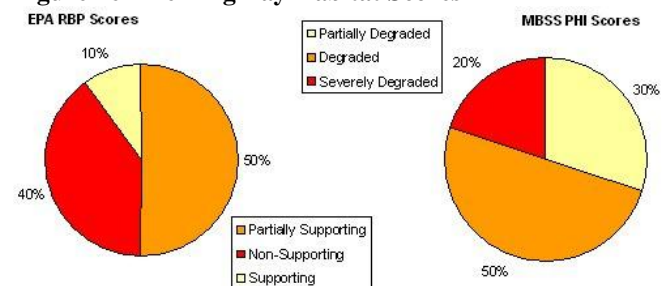
The majority of these sites were located on the mainstem of Tracy's Creek.

Aquatic Habitat

The MBSS PHI rated 50 percent of the streams within the Herring Bay sampling unit as "Degraded", 30 percent of streams were rated as "Partially Degraded", and 20 percent as "Severely Degraded" (**Figure 26**). The average PHI score was 60.2 ± 17.3 , giving this sampling unit an overall habitat condition of "Degraded." Fifty percent of streams were rated as "Partially Supporting", 40 percent were rated as "Non-Supporting", and ten percent were rated as "Supporting" by the EPA RBP habitat assessment. The average EPA RBP score was 105.2 ± 12.9 , giving this sampling unit an overall condition rating of "Partially Supporting". For this sampling unit, habitat conditions were judged approximately equivalent using the two methods.

Generally, the sites were well shaded with a moderate amount of instream woody debris and rootwads and localized severe erosion. Epifaunal substrate was poor while instream habitat was generally marginal. Levels of channel alteration were low throughout the sampling unit while pool substrate characterization was marginal. Other habitat metrics were quite variable throughout the sampling unit.

Figure 26 - Herring Bay Habitat Scores



Aquatic habitat conditions within Tracy's Creek subwatershed were generally "Degraded" with two sampling sites each in the subwatershed scoring in the "Partially Degraded" and "Severely Degraded" ranges. EPA RBP scores showed similar conditions with a combination of "Non-supporting" and "Partially Supporting" aquatic habitat. Most sites scoring lower for the habitat

evaluation were located at a higher position in the subwatershed. Within the Tracy's Creek subwatershed the sites were generally well shaded but contained only moderate amounts of woody debris and localized areas of severe erosion.

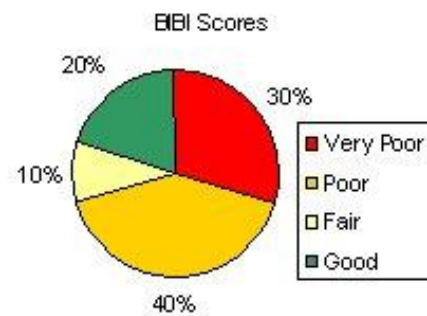
Only one site was sampled within the Rockhold Creek subwatershed. This site scored in the "Degraded" range for the MBSS PHI while the EPA RBP scored it in the "Non-Supporting" range. This site had a high amount of woody debris and no erosion, but scored low on the instream habitat and epifaunal substrate metrics. This site was a very small blackwater stream with a limited amount of suitable habitat.

One site was sampled within an Unnamed Tributary subwatershed draining to Herring Bay. This site scored in the "Partially Degraded" range for the MBSS PHI and the "Supporting" range for the EPA RBP. This site was part of a large stable floodplain wetland system that had lots of woody debris and very little bank erosion. Despite stability and woody debris this site lacked high quality instream habitat and epifaunal substrate adequate for full colonization by benthic macroinvertebrates.

Benthic Macroinvertebrates

The MBSS BIBI rated 20 percent of the streams within Herring Bay as "Good", ten percent as "Fair", 40 percent as "Poor", and 30 percent as "Very Poor" (**Figure 27**). The average BIBI score for Herring Bay sampling unit was 2.80 ± 1.07 , which is within the "Poor" range. Generally, sites within the Herring Bay sampling unit that scored within the "Good" range were the larger streams that were characterized by good overall taxa richness as well as good EPT taxa richness. Sites scoring in the "Fair" range had similar taxa composition with slightly higher overall tolerance values. Sites scoring in the "Poor" and "Very Poor" ranges contained generally a very tolerant benthic community and were dominated by midges, aquatic worms, and amphipods.

Figure 27 - Herring Bay BIBI Scores



Sites sampled within the Tracy's Creek subwatershed ranged from "Very Poor" to "Good" for the MBSS PHI. The sites scoring in the "Good" range (15-19A and 15-20A) were located in a lower position in the subwatershed and were generally in larger streams than at other sites sampled. These sites, located on the mainstem of Tracy's Creek, had very high EPT taxa richness and a good distribution of taxa abundances. One site (15-12A), located on a tributary stream to Tracy's Creek, scored in the "Fair" range for the MBSS BIBI. This site had good EPT taxa richness, but an overall tolerant community composition. Three sites (15-03, 15-04, and 15-07) scored in the "Poor" range. These sites were generally located higher in the subwatershed on smaller streams and were comprised of a benthic community dominated by midges and amphipods. Two sites (15-05 and 15-11A) scored in the "Very Poor" range. These sites were heavily dominated by midges or amphipod taxa.

One site (15-06) was sampled in the Rockhold Creek subwatershed. This site scored in the "Poor" range. Although this small blackwater stream had a low overall community tolerance value, the sample was mainly dominated by two taxa, an isopod (*Caecidotea* sp.) and aquatic worms.

One site (15-01) was sampled in an Unnamed Tributary subwatershed that drains to Herring Bay. Although aquatic habitat was good at this site, a lack of instream habitat resulted in a "Very Poor" BIBI score. This site was heavily dominated by members of the tolerant midge group *Cricotopus/Orthocladius* sp.

Detailed data on each site can be found in **Appendix B: Individual Site Summaries**.

Water Quality

Temperature and turbidity values sampled in the Herring Bay sampling unit were within Maryland's Use I stream standards. Dissolved oxygen values were within state standards with the exception of one small tributary stream within the Rockhold Creek subwatershed. This site was a very small blackwater drainage ditch that would be expected to have lower than normal dissolved oxygen values. pH values at two of the sampling locations were below what is considered acceptable for Use I streams. Several of these streams were blackwater in nature and may have a naturally lower pH value. Conductivity values were generally low, as expected in a sampling unit with low amounts of impervious surfaces and urban development. **Table 19** shows the average water quality values and their standard deviations.

Table 19- Average water quality values – Herring Bay

Value/Standard Deviation				
Temp.*	D.O.*	pH	Cond.*	Turb.*
12.8 ± 2.8	7.5 ± 3.0	6.3 ± 0.7	0.195 ± 0.109	29.7 ± 21.1

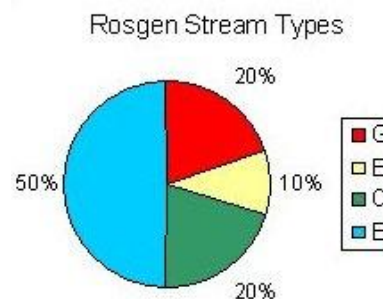
*units- Temp. (°C), D.O. (mg/L), Cond. (mS/cm), Turb. (NTU)

Geomorphic Assessment

Two of the Herring Bay sites are G channels, one is a B channel, two are C channels, and five are E channels (**Figure 28**). Channel slopes range from 0.001 ft/ft to 0.015 ft/ft. Eight of the sites sampled have a sand channel substrate, and two sites have a silt/clay channel substrate.

The one B channel identified in the Herring Bay sampling unit has a width depth ratio more like a G channel (well below 12), but was classified as a B channel because its entrenchment ratio was within the moderately entrenched range. This may indicate that this channel is in transition to the unstable G channel type.

Figure 28 - Herring Bay Rosgen Stream Types



More detailed summaries of the geomorphic data and stream types identified in Herring Bay River are included in the appendices.

Summary

Aquatic health within the Herring Bay sampling unit was variable, but showed mostly degraded conditions (see **Figures 26, 27**). The MBSS PHI rated the sites in the “Partially Degraded”, “Degraded”, or “Severely Degraded” range. The EPA RBP habitat scores point toward a somewhat more impacted community. The MBSS PHI emphasis on streambank erosion and woody debris tended to give higher scores to the many streams within this sampling unit that were similar to drainage ditches, despite poor instream habitat and epifaunal substrate.

Three sites (15-19A, 15-20A, and 15-12A) had biological communities in better health than expected for the habitat observed using either habitat assessment method. It is possible that these sites are in some way enriched or enhanced, perhaps by high nutrient inputs from upstream residential and agricultural land.

Conversely, two sites (15-01, 15-11A) show depressed biological communities in comparison to available habitat. Typically, this outcome is the result of poor water quality conditions that occur at a particular site. As described in Appendix B, Site 15-11A has almost 30% of its upstream land in developed uses (residential, commercial, utility right-of-way). However, some other, less obvious water quality impact is operating at Site 15-01 as no significant amounts of developed or agricultural land exist upstream of the sample site. Additional water quality investigations would be

necessary to identify the cause of the observed impairment.

For most parameters, water quality within the Herring Bay sampling unit was generally within State standards. An exception was pH, where 80% of sites sampled in this sampling unit had values less than 6.5. The cause of these low pH values is unknown, but is likely related to blackwater conditions from high levels of organic matter observed at many of these sites during this assessment. Blackwater streams typically have lower pH than streams without high inputs of leaves and other organic materials.

No previous biological sampling data are known to exist for the Herring Bay sampling unit. Consequently, it is not possible to attempt an evaluation of the potential impact that the drought of 2001-2002 may have had on the biological communities of the streams in this sampling unit, as was done in previous discussions.

Stream types within the Herring Bay drainage varied across the sampling unit. However, based on the aquatic conditions present, it is likely that most of the channels are transitioning to more unstable forms. Generally, reaches in headwater areas and in small tributaries were classified as unstable types (G type) in contrast to sites located on mainstem reaches (E, C types).

Conclusions and Recommendations

Year 2 sampling for the Aquatic Biological Assessment of the Watersheds of Anne Arundel County, Maryland revealed highly variable stream conditions. These conditions correlate with the diversity and transitional nature of the surrounding sampling units. However, some general statements about overall conditions can be made.

Of the sampling units investigated in 2005, Stocketts Run had the least overall biological impairment and least degraded habitat, while Lower North River had the most impaired biological conditions. The Lyon's Creek and Herring Bay sampling units were also judged impaired from a biological and habitat standpoint.

Sampling in two units, the Upper North River (UNR) and the Lower North River (LNR), allowed for complete coverage of the South River watershed during 2005. Overall, biological conditions tended to be healthier in the UNR (northwest portion) compared to the LNR (southeast portion) of the South River watershed. Habitat conditions did not show a similar gradient and were degraded in both units.

At this level of assessment, it is not possible to pinpoint the exact causes of the observed impairments. However, it is likely that a number of sites have some type of water quality impairment. As noted in the sampling unit summaries, a considerable number of sites were found to have low pH and/or low dissolved oxygen. While causes of this are likely natural, the County may want to consider further investigations. Additionally, subwatershed areas upstream of the sites listed in **Table 10** should be closely examined during deployment of the Watershed Management Tool as OECR's Watershed Management Program evaluates the larger watersheds where these stations are located.

More data on vertical and lateral stability would help verify trends in channel evolution sequences. The type of data could range from a rapid geomorphic assessment using qualitative indicators of stability to the detailed channel stability evolution used in Rosgen assessment levels III and IV. Depending on time and budgets, the more data available would yield the best results. At a minimum, it is recommended that cross sections be resurveyed. These assessments would be particularly useful in determining the transition direction of those streams that classified as B channels, but that had the width depth ratio of G channels. Understanding the stage of transition of the assessed reaches could in turn provide strong guidance to County staff make when making decisions about which streams are restored first, given the limited stream restoration funds currently available.

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Appendix A:

Quality Assurance/Quality Control

Quality Assurance/Quality Control

Quality Assurance/Quality Control (QA/QC) procedures for benthic macroinvertebrate field sampling, laboratory sorting and subsampling, taxonomy, data entry, metric calculation, and final IBI calculation were implemented for this project. QA/QC procedures also were practiced for the geomorphic assessment portion of this project, including field sampling, data entry, and identification of stream types.

Field Sampling

Initial QA/QC procedures for benthic macroinvertebrate field sampling included formal training for field crew leaders in MBSS Sampling Protocols. All field crew leaders attended MBSS Spring Index Period Training from 2002-2004. Field crew leaders conducted a field orientation for crew members before the start of the sampling period (March 1). At least one person extensively trained in MBSS protocols was present for each field sampling day.

Geomorphic assessment field crew leaders had been formally trained in Levels I through IV of the Rosgen Stream Classification Methodology between 2000 and 2004. Field crew leaders conducted a field calibration for crew members before the geomorphic assessment portion of the study began (May 31), and at least one field crew leader was present for each field sampling day.

Water quality QA/QC procedures included recalibration of the Hydrolab Quanta multi-probe meter at a minimum of one time each week during the sampling season. Dissolved oxygen probe membranes were replaced when dirty or damaged.

Chain-of-custody forms were initiated during field visits and maintained as samples were transferred to the laboratory. Also during field sampling, each data sheet was double checked for completeness and sample bucket labels were double checked for accuracy.

Geomorphic assessment survey equipment is calibrated annually and had been calibrated in Spring 2005. Also prior to initiating field work, the drainage area of each site was delineated using GISHydro2000 (GISHydro2000, 2004), and channel parameters of bankfull width, depth, and cross sectional area were estimated using the regional relationships for streams in the Maryland Coastal Plain (McCandless, 2003). These data were used in the field as a QA/QC of the field-identified bankfull channel geometry parameters. Survey data input into the handheld PDAs were also reviewed in the field for QA/QC. Cross section data were digitally plotted and analyzed for accuracy. Values of Width Depth Ratio and Entrenchment Ratio automatically calculated by Pocket RIVERMorph also were calculated by hand for QA/QC at five to ten percent of the sites.

A field audit of the benthic macroinvertebrate sampling crew was performed by Anne Arundel County and MBSS personnel on April 20, 2005. Anne Arundel County personnel completed a field audit of the geomorphic assessment crew on June 30, 2005.

All field protocols were evaluated and considered acceptable to meet project QA/QC objectives.

Replicate samples were taken at ten percent of the sites (five sites). One replicate site, located adjacent to pre-selected random sites, was assigned to each sampling unit. These samples were taken to determine the Relative Percent Difference (RPD) and Relative Standard Deviation (RSD) between the original and replicate sites. During field sampling it was noted that overall habitat and conditions of the randomly selected replicate sites were not always similar to those of the original site. RPD for the BIBI for three of the five sites was greater than the MQO (measurement quality objective) of the project (15%). These three sites were all relatively small (< 2m in width) and had limited optimal benthic habitat. The replicate and original sites that scored lower than the MQO for RPD had similar taxa composition with most variation coming from the overall taxa richness and the genera of Chironomidae represented. Some of this variation regarding Chironomidae may be a result of the identification of a twenty percent subsample as opposed to a complete identification of all individuals. This subsampling procedure is part of the overall MBSS procedure (Boward, 2000). RSD for the BIBI for three of the five sites was greater than the MQO (measurement quality objective) of the project (15%). The RSD MQO was not met for two of the five sites.

Laboratory Sorting and Subsampling

Sorting and subsampling QA/QC procedures included requiring new sorters to have the first ten samples QA/QCed by an experienced sorter. The results of the QA/QC were noted on the lab sorting sheet for the particular sample. Ninety percent efficiency was required to be reached on the first 10 samples. If any of the samples did not reach ninety percent efficiency, problems in technique or identification were noted and remedied, and QA/QC continued until the 10 sample requirement was met. After the 10 sample requirement was met, 10% of all samples sorted were QA/QCed and met the ninety percent efficiency. Efficiencies, problems noted, and solutions were recorded on the lab sorting sheet.

During data analysis it was noted that six of the samples had a count of organisms far under what was expected. The original sorting data sheets were referenced and a large discrepancy was noted between the number of organisms recorded on this data sheet and the number of organisms identified. The most likely reason is sorter error, as the QA/QC protocols did not include verifying the number of organisms sub-sampled by the sorter, but only what may have been missed in the sortate. The original sortate for each sample was examined for any possible problems. None were noted and additional organisms were sorted and identified from the original sample bucket to obtain the targeted number of organisms.

Taxonomy

Macroinvertebrates were identified by an outside laboratory, EcoAnalysts, Inc. The QA/QC procedures utilized by this lab are described below.

An extensive library of taxonomic literature, as well as a reference collection of specimens verified by nationally known taxonomists is used to determine the identity of invertebrates. Common taxonomic references used for identification can be found within the References section.

Two methods of quality control were employed to ensure taxonomic accuracy and consistency. A synoptic voucher collection was retained, consisting of at least one good specimen (preferably 3-5 specimens) of each taxon encountered within the project. If multiple taxonomists were involved, they each maintained their own collections. Upon completion, this collection was reviewed by a second taxonomist or by an outside laboratory. If an unfamiliar specimen was encountered it was sent to an outside specialist for verification. These verified specimens were retained in the laboratory reference collection.

Ten percent of the samples identified by EcoAnalysts were re-identified by Coastal Resources, Inc in house for taxonomic agreement. The Percent Taxonomic Difference or PTD was calculated for each sample. The goal for the PTD is 15 percent or less. All samples re-identified met this goal. Average PTD for the five samples was nine percent.

To determine the difference in number of organisms identified by the original taxonomist and the number of organisms identified by the QA/QC taxonomist the Percent Difference in Enumeration (PDE) was calculated. The MQO for the PDE is five percent. The final PDE for the five QA/QC samples is 2.9 percent.

Data Entry

All data entered was double checked by an independent person. Any errors found during QA/QC were corrected.

Metric and IBI Calculations

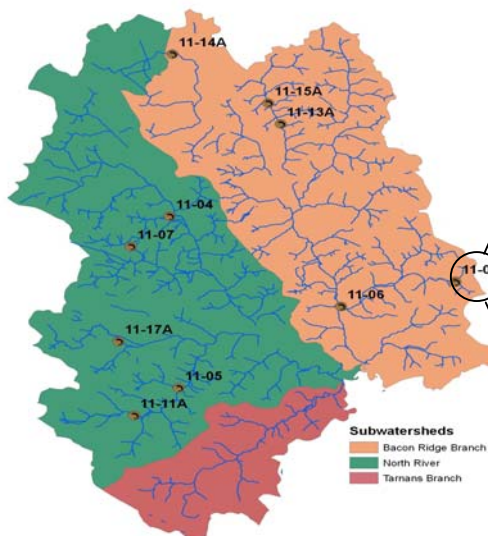
Ten percent of metric and IBI calculations were checked by hand using a pocket calculator to ensure correct calculation by the Excel spreadsheet. Any discrepancies were addressed at that time.

Identification of Stream Types

RIVERMorph automatically assigns a stream type to each assessment site based on the methods of the Rosgen Stream Classification (Rosgen, 1996). However, due to the natural variability, or continuum, of streams, adjustments in the values of Width Depth Ratio (+/- 2.0) and Entrenchment Ratio (+/- 0.2) are allowed, which may result in assigning a different stream type. Therefore, all stream types assigned by RIVERMorph were checked by hand and any necessary adjustments were made.

Appendix B:

Individual Site Summaries



Location/Site Access: Located within Bacon Ridge Branch subwatershed. Access from Crownsville Road. ADC Map 19 E-6 Latitude/Longitude: 39.00109031/-76.59137162

Land Use Analysis:

Land Use	Acres	% Area
Commercial	6.2	7.2
Open Space	11.0	13.2
Residential 1-acre	10.2	12.2
Residential ½-acre	1.6	1.9
Residential 2-acre	2.6	3.1
Row Crops	15.2	18.3
Transportation	7.8	9.4
Woods	28.7	72.1
Total	83.3	100.0

Impervious (acres)	Total Area Above site	% Impervious
15.3	82.7	18.5

Results:

- Biological condition - “Fair”
- Habitat scores in the “Partially Supporting” and “Partially Degraded” ranges
- Shading and erosion were all considered optimal
- Dominant taxa group were amphipods (*Synurella* sp.) and midges (Chironomidae) with several genera of caddisflies
- Stream type was identified as an E5, the water surface slope was 0.006 ft/ft, and the median channel substrate was medium sand

Recommendations:

- Maintain protection of forested land use with drainage area.

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	28
EPT Taxa	6
% Ephemeroptera	3.1
Number of Ephemeroptera	1
% Intolerant to Urban	60.8
Scraper Taxa	0
% Climbers	22.7

Taxa List

MOLOPHILUS	1
LEPTOPHLEBIA	3
CORDULEGASTER	5
LEUCTRA	1
ANCHYTARSUS	2
HYDROBIUS	1
NIGRONIA	4
SIALIS	2
MICROPSECTRA	5
NATARSIA	5
ODONTOMESA	1
PARAMETRIOCNEMUS	1
POLYPEDILUM	5
THIENEMANNIMYIA GROUP	7
CERATOPOGON	1
DICRANOTA	1
HEMERODROMIA	1
HEXATOMA	1
PSEUDOLIMNOPHILA	9
SYRPHIDAE	1
TIPULA	2
DIPLECTRONA	5
IRONOQUIA	2
LIMNAPHILIDAE	5
POLYCENTROPUS	6
OLIGOCHAETA	5
CAECIDOTEA	4
SYNURELLA	11

Total Individuals

97

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Substrate Characterization	6
Bank Stability- Right Bank	8	Pool Variability	1
Vegetative Protection- Left Bank	9	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	9	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	15	Sediment Deposition	12
Channel Alteration	17	Epifaunal Substrate	3
Channel Sinuosity	11	EPA Habitat Score	117
		EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

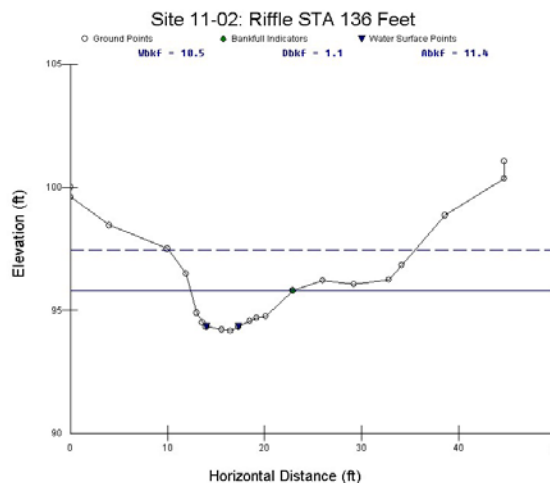
Drainage area (acres)	82.7	Instream Wood Debris	0
Distance from Road	250	Bank Erosion Extent- Left	10
Percent Shading	90	Bank Erosion Extent- Right	0
Epifaunal Substrate	3	Bank Erosion Severity- Left	1
Instream Habitat	7	Bank Erosion Severity- Right	0
		PHI Score	74.4
		PHI Narrative Ranking	PD

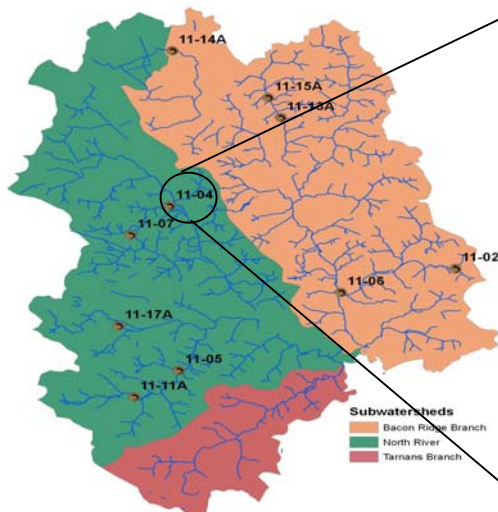
Water Chemistry

Dissolved Oxygen (mg/L)	7.59	Temperature (°C)	8.25
pH	5.62	Turbidity (NTU)	6.7
Specific Conductance (mS/cm)	0.171		

Geomorphic Assessments

Drainage area (acres)	82.7	Entrenchment Ratio:	2.41
Bankfull Width (ft):	10.52	Width:Depth Ratio:	9.67
Mean Depth (ft):	1.09	Sinuosity:	1.1
Bankfull X-Sec Area (sq ft):	11.44	Water Surface Slope (ft/ft):	0.006
Flood-Prone Width (ft):	25.35	Reach D50 (mm):	0.46

Rosgen Channel Classification: E 5



Location/Site Access: Located within North River subwatershed. Access from St. Stephens Chapel Road.

ADC Map 18 G-6 Latitude/Longitude: 39.01335775/-76.64536352

Land Use Analysis:

Land Use	Acres	% Area
Pasture/Hay	15.7	19.0
Row Crops	7.3	8.9
Woods	59.7	72.1
Total	82.7	100.0

Impervious (acres)	Total Area Above site	% Impervious
0.3	82.7	0.3

Results:

- Biological condition - "Fair"
- Habitat scores in the "Partially Supporting" and "Partially Degraded" ranges
- Very poor instream habitat and epifaunal substrate with low amounts of bank erosion
- Dominant taxa group were amphipods (*Gammarus* sp. and *Synurella* sp.) with several midge taxa
- The stream type was identified as a B5c, the water surface slope was 0.007 ft/ft, and the median channel substrate was medium sand

Recommendations:

- Maintain protection of forested land use within drainage area.

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	16
EPT Taxa	4
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	61.5
Scraper Taxa	1
% Climbers	8.6

Taxa List

CORDULEGASTER	1
LEUCTRA	9
CORYNONEURA	1
LIMNOPHYES	1
ORTHOCLADIINAE	1
PARAMETRIOCNEMUS	9
POLYPEDILUM	8
STEMPELLINELLA	1
DICRANOTA	4
TIPULA	5
DIPLECTRONA	9
IRONOQUIA	4
LYPE	1
OLIGOCHAETA	9
CAECIDOTEA	19
SYNURELLA	22

Total Individuals

104

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	8	Pool Substrate Characterization	7
Bank Stability- Right Bank	7	Pool Variability	4
Vegetative Protection- Left Bank	9	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	9	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	13	Sediment Deposition	3
Channel Alteration	18	Epifaunal Substrate	3
Channel Sinuosity	14		

EPA Habitat Score 115**EPA Narrative Ranking** PS**Maryland Biological Stream Survey PHI**

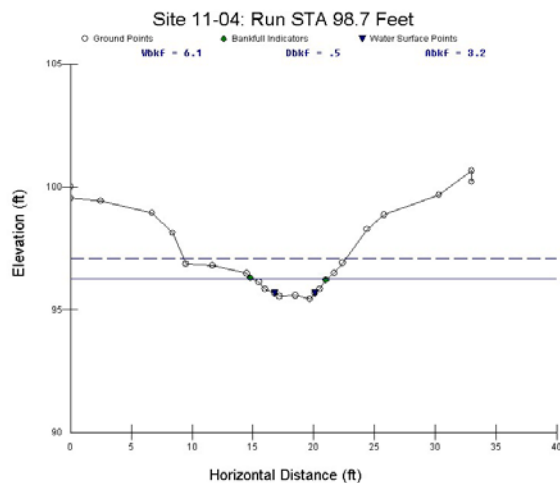
Drainage area (acres)	82.7	Instream Wood Debris	3
Distance from Road	850	Bank Erosion Extent- Left	3
Percent Shading	90	Bank Erosion Extent- Right	3
Epifaunal Substrate	3	Bank Erosion Severity- Left	1
Instream Habitat	3	Bank Erosion Severity- Right	1.5

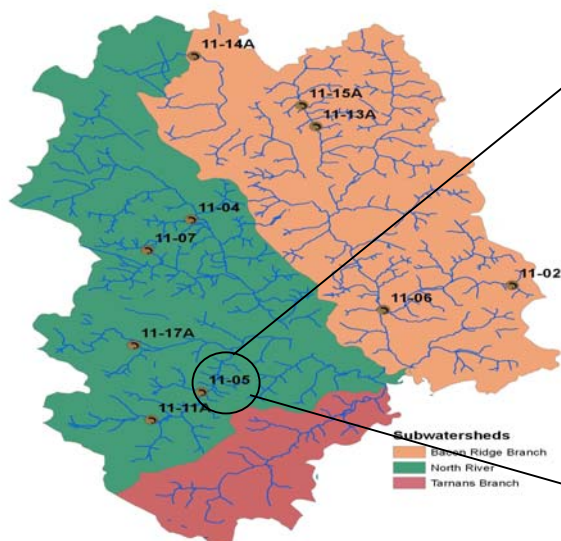
PHI Score 79.2**PHI Narrative Ranking** PD**Water Chemistry**

Dissolved Oxygen (mg/L)	5.1	Temperature (°C)	13.78
pH	5.23	Turbidity (NTU)	17.2
Specific Conductance (mS/cm)	0.073		

Geomorphic Assessments

Drainage area (acres)	82.7	Entrenchment Ratio:	2.18
Bankfull Width (ft):	6.14	Width:Depth Ratio:	11.58
Mean Depth (ft):	0.53	Sinuosity:	1.07
Bankfull X-Sec Area (sq ft):	3.24	Water Surface Slope (ft/ft):	0.007
Flood-Prone Width (ft):	13.36	Reach D50 (mm):	0.38

Rosgen Channel Classification: B5c



Location/Site Access: Located within North River subwatershed. Access from Branchwood Terrace.

ADC Map 18 G-9 Latitude/Longitude: 38.98161818/-76.64381349

Land Use Analysis:

Land Use	Acres	% Area
Commercial	1.9	0.2
Open Space	9.7	0.9
Pasture/Hay	56.9	5.5
Residential 1/2-acre	189.9	18.3
Residential 1-acre	23.6	2.3
Residential 2-acre	14.6	1.4
Row Crops	189.9	18.3
Transportation	17.2	1.7
Water	1.6	0.2
Woods	532.4	51.3
Total	1037.6	100.0

Impervious (acres)	Total Area Above site	% Impervious
49.2	1037.6	4.7

Results:

- Biological condition - “Good”
- Habitat scores in the “Partially Supporting” and “Degraded” ranges
- Very poor epifaunal substrate and instream habitat with good instream woody debris and vegetative protection
- Dominant taxa group were net spinning caddisflies (*Diplectrona* sp.) with other EPT taxa
- The stream type was identified as a B5c, the water surface slope was 0.005 ft/ft, and the median channel substrate was medium sand

Recommendations:

- Investigate possible sources of instability and sedimentation.

11-05

Upper North River Sampling Unit

IBI and Metric Scores

Narrative Rating	Good
Overall Index	4.14
Total Taxa Score	5
EPT Taxa Score	5
% Ephemeroptera	3
Number of Ephemeroptera Score	3
% Intolerant to Urban Score	5
Scraper Taxa Score	3
% Climbers	5

Calculated Metric Values

Total Taxa	31
EPT Taxa	7
% Ephemeroptera	1.0
Number of Ephemeroptera	1
% Intolerant to Urban	48.5
Scraper Taxa	1
% Climbers	8.2

Taxa List

LEPTOPHLEBIA	1
CALOPTERYX	2
ANCHYTARSUS	2
NIGRONIA	2
DIPLOCLADIUS	1
LIMNOPHYES	2
NATARSIA	1
PARAKIEFFERIELLA	1
PARAMETRIOCNEMUS	7
POLYPEDILUM	1
PSEUDORTHOCCLADIUS	3
RHEOCRICOTOPUS	1
RHEOTANYTARSUS	1
THIENEMANNIMYIA	2
XYLOTOPUS	1
BEZZIA	1
HEMERODROMIA	2
PILARIA	1
PROBEZZIA	1
PSEUDOLIMNOPHILA	1
TIPULA	6
DIPLECTRONA	29
HYDROPSYCHE	2
LIMNPHILIDAE	2
LYPE	1
POLYCENTROPUS	1
PTILOSTOMIS	1
OLIGOCHAETA	9
CAECIDOTEA	6
SYNURELLA	5
PEDICIA	1

Total Individuals 97**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	2	Pool Substrate Characterization	7
Bank Stability- Right Bank	2	Pool Variability	11
Vegetative Protection- Left Bank	7	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	7	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	16	Sediment Deposition	2
Channel Alteration	18	Epifaunal Substrate	3
Channel Sinuosity	6		

EPA Habitat Score 101**EPA Narrative Ranking** PS**Maryland Biological Stream Survey PHI**

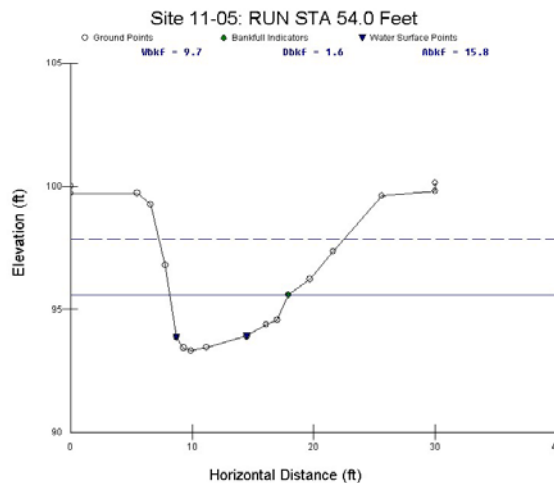
Drainage area (acres)	1037.6	Instream Wood Debris	11
Distance from Road	300	Bank Erosion Extent- Left	65
Percent Shading	80	Bank Erosion Extent- Right	60
Epifaunal Substrate	3	Bank Erosion Severity- Left	2
Instream Habitat	5	Bank Erosion Severity- Right	2

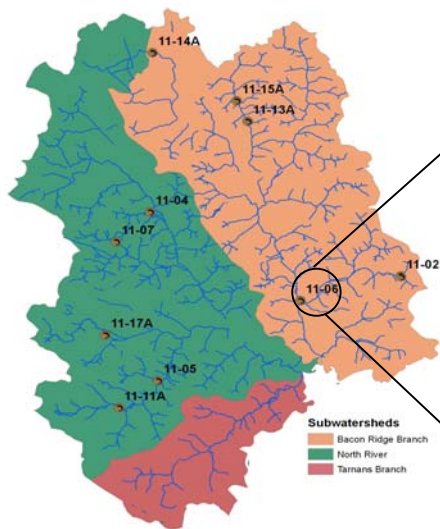
PHI Score 58.8**PHI Narrative Ranking** D**Water Chemistry**

Dissolved Oxygen (mg/L)	5.41	Temperature (°C)	10.43
pH	5.8	Turbidity (NTU)	47.9
Specific Conductance (mS/cm)	0.113		

Geomorphic Assessments

Drainage area (acres)	1037.6	Entrenchment Ratio:	1.56
Bankfull Width (ft):	9.73	Width:Depth Ratio:	5.98
Mean Depth (ft):	1.63	Sinuosity:	1.05
Bankfull X-Sec Area (sq ft):	15.82	Water Surface Slope (ft/ft):	0.005
Flood-Prone Width (ft):	15.2	Reach D50 (mm):	0.3

Rosgen Channel Classification: B5c



Location/Site Access: Located within Bacon Ridge Branch subwatershed. Access from Haverford Circle.

ADC Map 19 B-7 Latitude/Longitude: 38.99664/-76.61304

Land Use Analysis:

Land Use	Acres	% Area
Commercial	94.6	2.1
Industrial	8.6	0.2
Open Space	171.8	3.8
Open Wetland	14.2	0.3
Pasture/Hay	239.4	5.3
Residential 1/2-acre	499.8	11.1
Residential 1-acre	268.5	6.0
Residential 2-acre	21.4	0.5
Row Crops	204.4	4.5
Transportation	108.1	2.4
Water	20.5	0.5
Woods	2845.9	63.3
Total	4497.2	100.0

Impervious (acres)	Total Area Above site	% Impervious
303.7	4497.2	6.8

Results:

- Biological condition - "Poor"
- Habitat scores in the "Partially Supporting" and "Severely Degraded" ranges
- Very poor epifaunal substrate with high bank erosion and moderate shading and instream woody debris
- Dominant taxa group were blackflies (*Stegopterna* sp.) with amphipods
- The stream type was identified as a C5c-, the water surface slope was 0.0007 ft/ft, and the median channel substrate was fine sand
- Typically, C channels are stable. However, the "Poor" biological ratings and impaired habitat conditions may indicate that this reach is transitioning to an unstable form

Recommendations:

- Investigate the possible recent beaver activity effect on the biological community.
- Protection/restoration of this reach should be encouraged, especially due to the yellow perch spawning that was observed during the field visit.

11-06

Upper North River Sampling Unit

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	17
EPT Taxa	3
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	72.6
Scraper Taxa	1
% Climbers	2.8

Taxa List

NECTOPSYCHE	1
POLYCENTROPUS	2
OLIGOCHAETA	1
GAMMARUS	11
BOYERIA	1
NIGRONIA	1
DIPLOCLADIUS	1
HYDROBAENUS	1
ORTHOCLADIUS	2
PARAPHAENOCLADIUS	1
STENOCHIRONOMUS	1
THIENEMANNIMYIA GROUP	7
HEMERODROMIA	1
STEGOPTERNA	72
CHEUMATOPSYCHE	1
CORDULIINAE	1
STYLURUS	1

Total Individuals

106

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	3	Pool Substrate Characterization	7
Bank Stability- Right Bank	2	Pool Variability	12
Vegetative Protection- Left Bank	5	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	5	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	17	Sediment Deposition	6
Channel Alteration	16	Epifaunal Substrate	4
Channel Sinuosity	13		

EPA Habitat Score 110

EPA Narrative Ranking PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	4497.2	Instream Wood Debris	8
Distance from Road	280	Bank Erosion Extent- Left	75
Percent Shading	40	Bank Erosion Extent- Right	75
Epifaunal Substrate	4	Bank Erosion Severity- Left	1.5
Instream Habitat	9	Bank Erosion Severity- Right	1.5

PHI Score 46.6

PHI Narrative Ranking SD

Water Chemistry

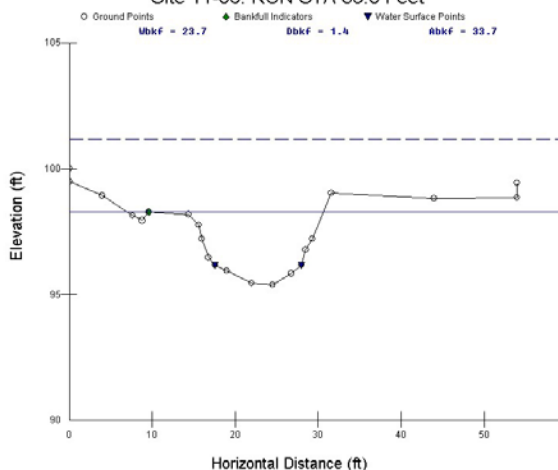
Dissolved Oxygen (mg/L)	7.59	Temperature (°C)	6.06
pH	6.58	Turbidity (NTU)	15.8
Specific Conductance (mS/cm)	0.194		

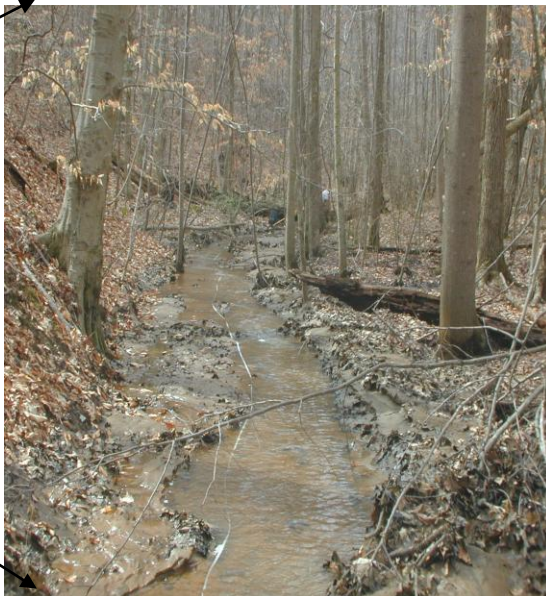
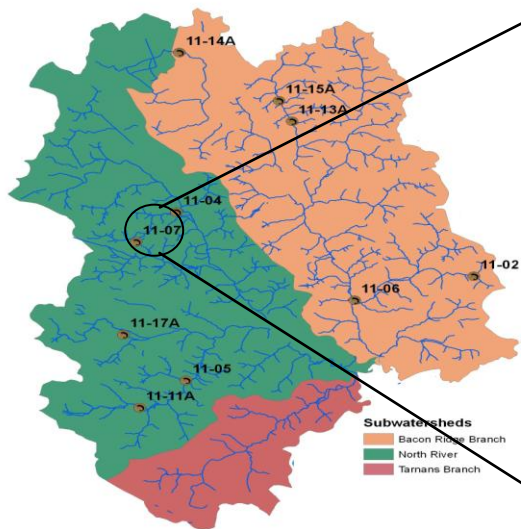
Geomorphic Assessments

Drainage area (acres)	4497.2	Entrenchment Ratio:	6.3
Bankfull Width (ft):	23.68	Width:Depth Ratio:	16.68
Mean Depth (ft):	1.42	Sinuosity:	1.2
Bankfull X-Sec Area (sq ft):	33.71	Water Surface Slope (ft/ft):	0.0007
Flood-Prone Width (ft):	150	Reach D50 (mm):	0.17

Rosgen Channel Classification: C5c-

Site 11-06: RUN STA 83.0 Feet





Location/Site Access: Located within North River subwatershed. Located behind sod farm.
ADC Map 18 F-4 Latitude/Longitude: 39.00775722/-76.65274649

Land Use Analysis:

Land Use	Acres	% Area
Pasture/Hay	27.9	30.3
Residential 1-acre	11.8	12.9
Residential 2-acre	4.2	4.5
Row Crops	0.1	0.1
Woods	48.0	52.3
Total	92.0	100.0

Impervious (acres)	Total Area Above site	% Impervious
15.3	92.0	16.6

Results:

- Biological condition - "Fair"
- Habitat scores in the "Non-Supporting" and "Partially Degraded" ranges
- Very poor instream habitat and epifaunal substrate with good instream woody debris and low bank erosion
- Dominant taxa group were midge taxa and blackflies (*Stegopterna* sp.)
- The stream type was identified as a C5, the water surface slope was 0.005 ft/ft, and the median channel substrate was medium sand

Recommendations:

- Investigate the potential impacts of nearby active agriculture.

11-07

Upper North River Sampling Unit

IBI and Metric Scores

Narrative Rating	Fair
Overall Index	3.0
Total Taxa Score	5
EPT Taxa Score	3
% Ephemeroptera	1
Number of Ephemeroptera Score	1
% Intolerant to Urban Score	5
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	23
EPT Taxa	4
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	33.0
Scraper Taxa	0
% Climbers	12.6

Taxa List

CORDULEGASTER	1
LEUCTRA	12
HYDROBIUS	2
DIPLOCLADIUS	15
HETEROTRISOCLADIUS	2
MICROPSECTRA	2
NATARSIA	1
ODONTOMESA	1
ORTHOCLADIINAE	3
PARAMETRIOCNEMUS	28
POLYPEDILUM	1
ZAVRELIMYIA	1
MOLOPHILUS	1
PROBEZZIA	1
PSEUDOLIMNOPHILA	1
STEGOPTERNA	10
TIPULA	3
DIPLECTRONA	3
HYDATOPHYLAX	3
LIMNephilidae	5
OLIGOCHAETA	5
SYGOBROMUS	1
BRACHYCERA	1

Total Individuals 103

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	9	Pool Substrate Characterization	6
Bank Stability- Right Bank	9	Pool Variability	2
Vegetative Protection- Left Bank	9	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	9	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	7	Sediment Deposition	2
Channel Alteration	16	Epifaunal Substrate	1
Channel Sinuosity	10		

EPA Habitat Score 100

EPA Narrative Ranking NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	92.0	Instream Wood Debris	10
Distance from Road	1000	Bank Erosion Extent- Left	20
Percent Shading	60	Bank Erosion Extent- Right	5
Epifaunal Substrate	1	Bank Erosion Severity- Left	1
Instream Habitat	4	Bank Erosion Severity- Right	1

PHI Score 74.0

PHI Narrative Ranking PD

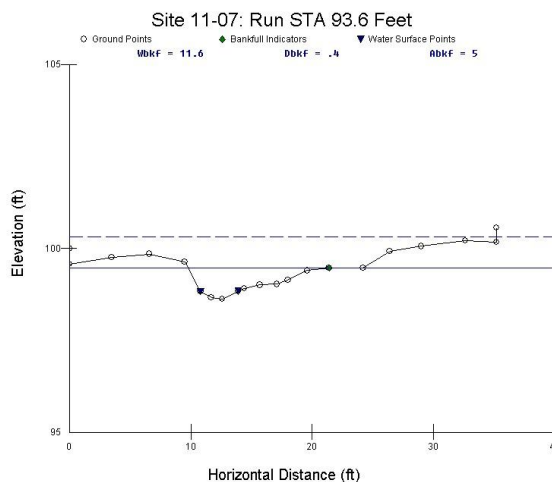
Water Chemistry

Dissolved Oxygen (mg/L)	5.9	Temperature (°C)	11.7
pH	5.88	Turbidity (NTU)	42.5
Specific Conductance (mS/cm)	0.076		

Geomorphic Assessments

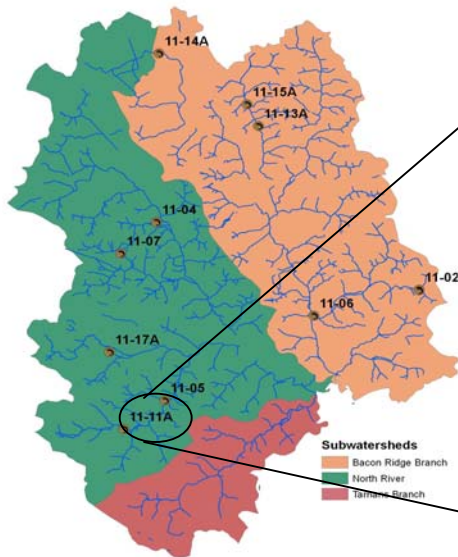
Drainage area (acres)	92.0	Entrenchment Ratio:	8.59
Bankfull Width (ft):	11.64	Width:Depth Ratio:	27.07
Mean Depth (ft):	0.43	Sinuosity:	1.2
Bankfull X-Sec Area (sq ft):	4.99	Water Surface Slope (ft/ft):	0.005
Flood-Prone Width (ft):	100	Reach D50 (mm):	0.38

Rosgen Channel Classification: C5



11-11a

Upper North River Sampling Unit



Location/Site Access: Located within North River subwatershed. Access from Owl Tree Lane and Bell Branch Road.
ADC Map 18 F-10 Latitude/Longitude: 38.97655108/-76.65228691

Land Use Analysis:

Land Use	Acres	% Area
Residential 1/2-acre	25.5	6.7
Residential 1-acre	16.4	4.3
Residential 2-acre	3.0	0.8
Row Crops	101.7	26.8
Transportation	3.8	1.0
Woods	229.7	60.4
Total	380.0	100.0

Impervious (acres)	Total Area Above site	% Impervious
7.7	380.0	2.0

Results:

- Biological condition - “Fair”
- Habitat scores in the “Partially Supporting” and “Partially Degraded” ranges
- Very poor epifaunal substrate with good instream woody debris and shading
- Dominant taxa group were several midge taxa with several EPT taxa
- The stream type was identified as a B5c, the water surface slope was 0.008 ft/ft, and the median channel substrate was fine sand. W/D ratio is low for this stream type, indicating potential transition to another, less stable type underway.
- Typically, B channels are stable. However, the moderately impaired biological and habitat ratings may indicate that this reach is transitioning to an unstable form

Recommendations:

- Investigate upstream sources of instability and sedimentation.

11-11a

Upper North River Sampling Unit

IBI and Metric Scores

Narrative Rating	Fair
Overall Index	3.0
Total Taxa Score	5
EPT Taxa Score	5
% Ephemeroptera	1
Number of Ephemeroptera Score	1
% Intolerant to Urban Score	5
Scraper Taxa Score	1
% Climbers	3

Calculated Metric Values

Total Taxa	24
EPT Taxa	6
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	48.0
Scraper Taxa	0
% Climbers	7.8

Taxa List

CORDULEGASTER	2
AMPHINEMURA	1
LEUCTRA	14
ANCHYTARSUS	1
NIGRONIA	2
SIALIS	2
HETEROTRISOCLADIUS	1
PARAMETRIOCNEMUS	17
POLYPEDILUM	2
PSEUDORTHOCCLADIUS	12
RHEOTANYTARSUS	1
STILOCLADIUS	1
HEMERODROMIA	4
HEXATOMA	2
TIPULA	5
TIPULIDAE	1
AGARODES	1
DIPLECTRONA	10
HYDATOPHYLAX	2
POLYCENTROPUS	1
OLIGOCHAETA	7
CAECIDOTEA	1
SYNURELLA	11
SYGOBROMUS	1

Total Individuals 102

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	3	Pool Substrate Characterization	9
Bank Stability- Right Bank	7	Pool Variability	10
Vegetative Protection- Left Bank	8	Riparian Vegetative	10
Vegetative Protection- Right Bank	8	Zone Width- Left Bank	10
Channel Flow Status	16	Riparian Vegetative	10
Channel Alteration	19	Zone Width- Right Bank	10
Channel Sinuosity	13	Sediment Deposition	7
		Epifaunal Substrate	4

EPA Habitat Score 124

EPA Narrative Ranking PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	380.0	Instream Wood Debris	11
Distance from Road	130	Bank Erosion Extent- Left	60
Percent Shading	85	Bank Erosion Extent- Right	20
Epifaunal Substrate	4	Bank Erosion Severity- Left	1.5
Instream Habitat	11	Bank Erosion Severity- Right	1

PHI Score 70.2

PHI Narrative Ranking PD

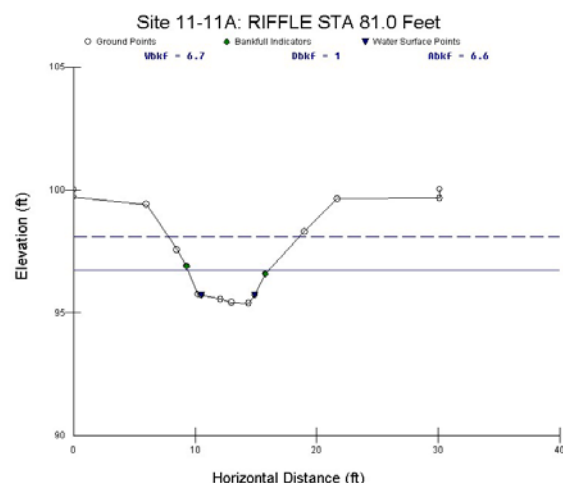
Water Chemistry

Dissolved Oxygen (mg/L)	6.2	Temperature (°C)	9.1
pH	5.62	Turbidity (NTU)	20.2
Specific Conductance (mS/cm)	0.104		

Geomorphic Assessments

Drainage area (acres)	380.0	Entrenchment Ratio:	1.62
Bankfull Width (ft):	6.66	Width:Depth Ratio:	6.73
Mean Depth (ft):	0.99	Sinuosity:	1.08
Bankfull X-Sec Area (sq ft):	6.6	Water Surface Slope (ft/ft):	0.008
Flood-Prone Width (ft):	10.82	Reach D50 (mm):	0.2

Rosgen Channel Classification: B5c



11-13a

Upper North River Sampling Unit



Location/Site Access: Located within Bacon Ridge Branch subwatershed. Access from Bacon Ridge Road.

ADC Map 18 K-1 Latitude/Longitude: 39.03040686/-76.62428553

Land Use Analysis:

Land Use	Acres	% Area
Commercial	2.5	0.6
Open Space	14.0	3.4
Residential 1/2-acre	37.0	8.9
Residential 1-acre	15.5	3.7
Residential 2-acre	0.3	0.1
Row Crops	10.5	2.5
Transportation	3.3	0.8
Woods	330.6	79.9
Total	413.5	100.0

Impervious (acres)	Total Area Above site	% Impervious
13.1	413.5	3.2

Results:

- Biological condition - “Fair”
- Habitat scores in the “Non-Supporting” and “Partially Degraded” ranges
- Very poor epifaunal substrate with good shading, bank erosion, and instream woody debris
- Dominant taxa group were stoneflies (*Leuctra* sp.) and aquatic worms
- The stream type was identified as a C5, the water surface slope was 0.005 ft/ft, and the median channel substrate was fine sand

Recommendations:

- Maintain protection of this highly forested drainage area to preserve the benthic community.

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	19
EPT Taxa	6
% Ephemeroptera	2.0
Number of Ephemeroptera	1
% Intolerant to Urban	33.7
Scraper Taxa	1
% Climbers	13.9

Taxa List

LEPTOPHLEBIA	2
LEUCTRA	21
DIAMESA	1
CRICOTOPUS/ORTHOCLADIUS	15
PARAMETRIOCNEMUS	6
PHAENOPSECTRA	1
POLYPEDILUM	5
THIENEMANNIMYIA GROUP	1
STEGOPTERNA	4
TIPULA	5
DIPLECTRONA	1
HYDATOPHYLAX	8
LIMNephilidae	1
LYPE	1
PISIDIUM	1
OLIGOCHAETA	20
CAECIDOTEA	1
CRANGONYX	2
SYNURELLA	5

Total Individuals

101

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Substrate Characterization	4
Bank Stability- Right Bank	6	Pool Variability	5
Vegetative Protection- Left Bank	8	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	8	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	11	Sediment Deposition	5
Channel Alteration	16	Epifaunal Substrate	3
Channel Sinuosity	4		

EPA Habitat Score 96**EPA Narrative Ranking** NS**Maryland Biological Stream Survey PHI**

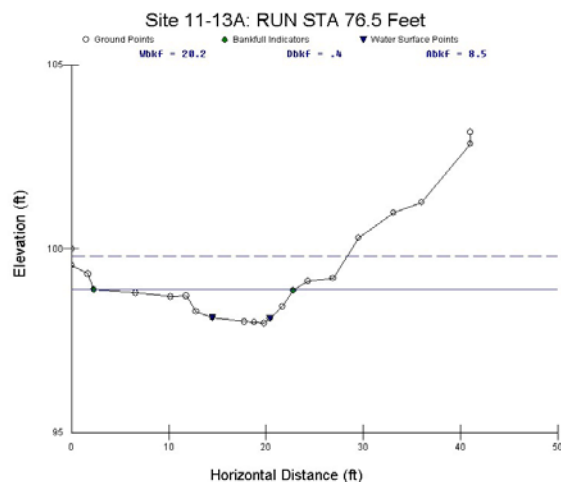
Drainage area (acres)	413.5	Instream Wood Debris	9
Distance from Road	740	Bank Erosion Extent- Left	10
Percent Shading	90	Bank Erosion Extent- Right	0
Epifaunal Substrate	3	Bank Erosion Severity- Left	1
Instream Habitat	6	Bank Erosion Severity- Right	0

PHI Score 76.1**PHI Narrative Ranking** PD**Water Chemistry**

Dissolved Oxygen (mg/L)	5.37	Temperature (°C)	8.7
pH	5.53	Turbidity (NTU)	9.4
Specific Conductance (mS/cm)	0.071		

Geomorphic Assessments

Drainage area (acres)	413.5	Entrenchment Ratio:	9.9
Bankfull Width (ft):	20.19	Width:Depth Ratio:	48.07
Mean Depth (ft):	0.42	Sinuosity:	1.05
Bankfull X-Sec Area (sq ft):	8.53	Water Surface Slope (ft/ft):	0.005
Flood-Prone Width (ft):	200	Reach D50 (mm):	0.19

Rosgen Channel Classification: C5

11-14a

Upper North River Sampling Unit



Location/Site Access: Located in the Bacon Ridge Branch subwatershed, access from Thrush Court.

ADC Map 13 H-11 Latitude/Longitude: 39.04340/-76.64470

Land Use Analysis:

Land Use	Acres	% Area
Commercial	22.1	4.1
Industrial	13.2	2.5
Open Space	37.7	7.1
Pasture/Hay	118.3	22.2
Residential 1/2-acre	151.8	28.5
Residential 1-acre	39.4	7.4
Residential 2-acre	16.1	3.0
Row Crops	17.5	3.3
Transportation	16.3	3.1
Water	7.7	1.5
Woods	92.0	17.3
Total	532.1	100.0

Impervious (acres)	Total Area Above site	% Impervious
57.1	532.1	10.7

Results:

- Biological condition - “Fair”
- Habitat scores in the “Partially Supporting” and “Degraded” ranges
- Very poor epifaunal substrate with good instream woody debris and shading
- Dominant taxa group were aquatic worms with several amphipod taxa
- The stream type was identified as an E5, the water surface slope was 0.0002 ft/ft, and the median channel substrate was medium sand
- Typically, E channels are stable. However, the “Fair” biological and habitat ratings may indicate that this reach is transitioning to an unstable form

Recommendations:

- Investigate the stormwater management techniques of nearby residential community.

11-14a

Upper North River Sampling Unit

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	21
EPT Taxa	1
% Ephemeroptera	3.0
Number of Ephemeroptera	1
% Intolerant to Urban	23.2
Scraper Taxa	4
% Climbers	8.1

Taxa List

HEPTAGENIIDAE	3
AGABUS	3
LIMNOPHYES	5
MICROPSECTRA	3
MICROTENDIPES	1
CRICOTOPUS/ORTHOCLADIUS	8
PARAPHAENOCLADIUS	1
PHAENOPSECTRA	2
POLYPEDILUM	1
RHEOCRICOTOPUS	3
RHEOTANYTARSUS	2
CHELIFERA	1
CHRYSOPTERUS	1
STEGOPTERUS	6
LYMNAEIDAE	2
PLANORBIDAE	1
PISIDIUM	1
OLIGOCHAETA	30
CRANGONYX	14
SYNURELLA	10
PHYSELLA	1

Total Individuals 99

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	5	Pool Substrate Characterization	9
Bank Stability- Right Bank	6	Pool Variability	8
Vegetative Protection- Left Bank	8	Riparian Vegetative	9
Vegetative Protection- Right Bank	7	Zone Width- Left Bank	8
Channel Flow Status	14	Riparian Vegetative	8
Channel Alteration	18	Zone Width- Right Bank	8
Channel Sinuosity	8	Sediment Deposition	8
		Epifaunal Substrate	10
EPA Habitat Score			118
EPA Narrative Ranking			PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	532.1	Instream Wood Debris	10
Distance from Road	50	Bank Erosion Extent- Left	30
Percent Shading	80	Bank Erosion Extent- Right	10
Epifaunal Substrate	4	Bank Erosion Severity- Left	1
Instream Habitat	10	Bank Erosion Severity- Right	1
PHI Score			65.6
PHI Narrative Ranking			D

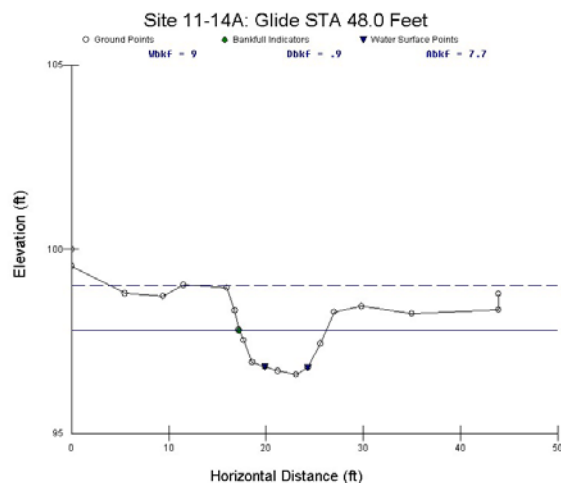
Water Chemistry

Dissolved Oxygen (mg/L)	6.34	Temperature (°C)	8.43
pH	6.72	Turbidity (NTU)	19
Specific Conductance (mS/cm)	0.264		

Geomorphic Assessments

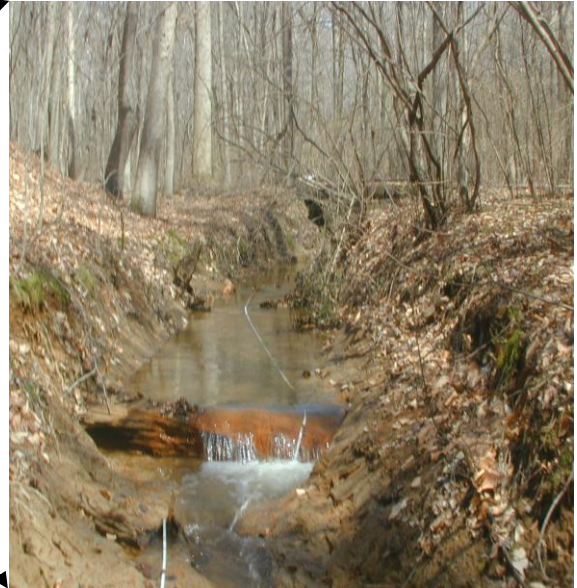
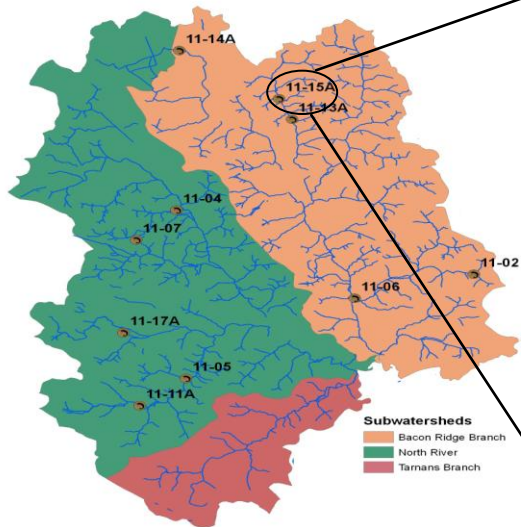
Drainage area (acres)	532.1	Entrenchment Ratio:	24.42
Bankfull Width (ft):	9.01	Width:Depth Ratio:	10.48
Mean Depth (ft):	0.86	Sinuosity:	1.07
Bankfull X-Sec Area (sq ft):	7.74	Water Surface Slope (ft/ft):	0.0002
Flood-Prone Width (ft):	220	Reach D50 (mm):	0.29

Rosgen Channel Classification: E5



11-15a

Upper North River Sampling Unit



Location/Site Access: Located in the Bacon Ridge Branch subwatershed. Access from Bacon Ridge Road.

ADC Map 13 K-12 Latitude/Longitude: 36.03428/-76.62663

Land Use Analysis:

Land Use	Acres	% Area
Commercial	2.5	0.9
Open Space	12.6	4.4
Residential 1/2-acre	36.9	12.9
Residential 1-acre	5.5	1.9
Residential 2-acre	0.3	0.1
Row Crops	8.7	3.0
Transportation	2.0	0.7
Woods	218.4	76.1
Total	286.9	100.0

Impervious (acres)	Total Area Above site	% Impervious
11.1	286.9	3.9

Results:

- Biological condition - "Fair"
- Habitat scores in the "Non-Supporting" and "Partially Degraded" ranges
- Very poor instream habitat and epifaunal substrate and woody debris
- Dominant taxa group were amphipods (*Synurella* sp.) and isopods (*Caecidotea* sp.)
- The stream type was identified as a G5c, the water surface slope was 0.008 ft/ft, and the median channel substrate was fine sand
- The moderately impaired biological and habitat ratings may be due to the unstable nature of the G channel

Recommendations:

- Maintain protection of the highly forested drainage area to preserve the benthic community.

11-15a

Upper North River Sampling Unit

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	18
EPT Taxa	3
% Ephemeroptera	3
Number of Ephemeroptera	1
% Intolerant to Urban	63.0
Scraper Taxa	0
% Climbers	13.0

Taxa List

LEPTOPHLEBIA	3
CALOPTERYX	3
LEUCTRA	7
CORYNONEURA	1
PARAMETRIOCNEMUS	7
PHAENOPSECTRA	1
POLYPEDILUM	3
THIENEMANNIMYIA GROUP	1
XYLOTOPUS	1
STEGOPTERNA	6
TIPULA	2
HYDATOPHYLAX	7
LEPIDOPTERA	1
PISIDIUM	1
OLIGOCHAETA	9
CAECIDOTEA	14
SYNURELLA	30
SYGOBROMUS	3

Total Individuals 100

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	2	Pool Substrate Characterization	6
Bank Stability- Right Bank	2	Pool Variability	6
Vegetative Protection- Left Bank	8	Riparian Vegetative Zone Width- Left Bank	8
Vegetative Protection- Right Bank	8	Riparian Vegetative Zone Width- Right Bank	9
Channel Flow Status	18	Sediment Deposition	6
Channel Alteration	15	Epifaunal Substrate	5
Channel Sinuosity	5		

EPA Habitat Score 98

EPA Narrative Ranking NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	286.9	Instream Wood Debris	1
Distance from Road	740	Bank Erosion Extent- Left	55
Percent Shading	75	Bank Erosion Extent- Right	75
Epifaunal Substrate	5	Bank Erosion Severity- Left	1.5
Instream Habitat	5	Bank Erosion Severity- Right	1

PHI Score 67.0

PHI Narrative Ranking PD

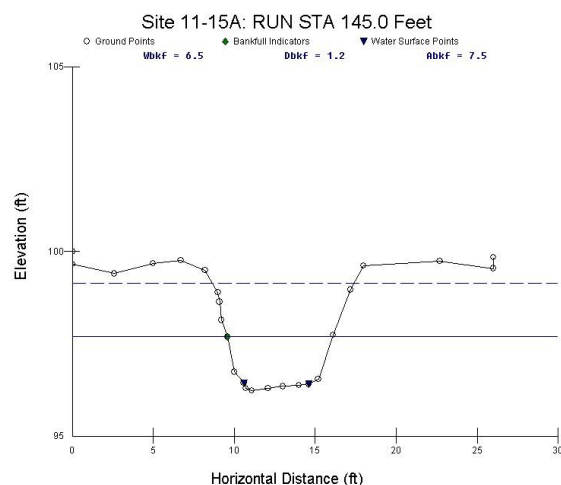
Water Chemistry

Dissolved Oxygen (mg/L)	4.98	Temperature (°C)	12.46
pH	5.49	Turbidity (NTU)	11.7
Specific Conductance (mS/cm)	0.072		

Geomorphic Assessments

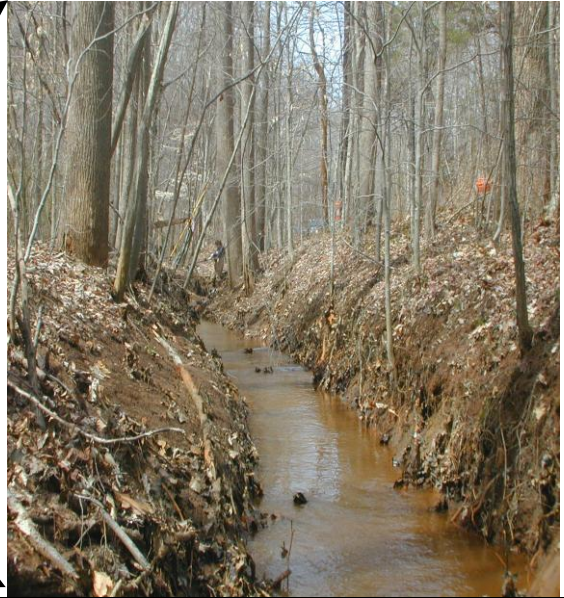
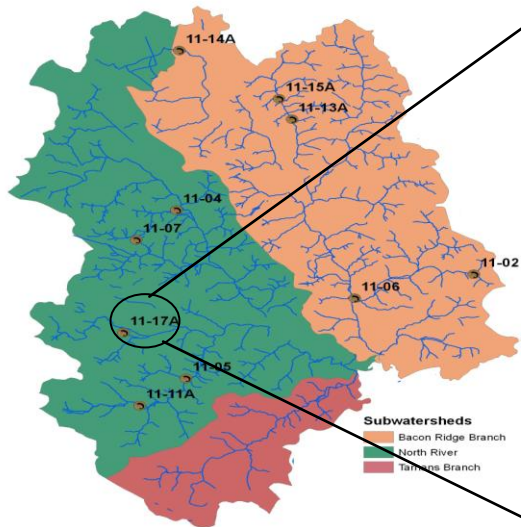
Drainage area (acres)	286.9	Entrenchment Ratio:	1.35
Bankfull Width (ft):	6.46	Width:Depth Ratio:	5.57
Mean Depth (ft):	1.16	Sinuosity:	1.11
Bankfull X-Sec Area (sq ft):	7.53	Water Surface Slope (ft/ft):	0.008
Flood-Prone Width (ft):	8.75	Reach D50 (mm):	0.2

Rosgen Channel Classification: G5c



11-17a

Upper North River Sampling Unit



Location/Site Access: Located in the North River subwatershed, access from MD 450 east of Hermitage Hills Drive.

ADC Map 18 E-7 Latitude/Longitude: 38.99028468/-76.65514804

Land Use Analysis:

Land Use	Acres	% Area
Commercial	15.2	4.1
Industrial	0.2	0.1
Open Space	9.6	2.6
Residential 1/2-acre	59.8	16.2
Residential 1/8-acre	0.2	0.0
Residential 1-acre	61.8	16.8
Residential 2-acre	1.5	0.4
Transportation	15.1	4.1
Woods	205.2	55.7
Total	368.5	100.0

Impervious (acres)	Total Area Above site	% Impervious
32.8	368.5	8.9

Results:

- Biological condition - "Fair"
- Habitat scores in the "Non-Supporting" and "Degraded" ranges
- Very poor epifaunal substrate and shading with optimal instream woody debris and low erosion
- Dominant taxa group were aquatic worms with crane flies (*Tipula* sp.) and several midge taxa
- The stream type was identified as an E5, the water surface slope was 0.006 ft/ft, and the median channel substrate was medium sand
- Typically, E channels are stable. However, the "moderately impaired biological and habitat ratings may indicate that this reach is transitioning to an unstable form"

Recommendations:

- Evaluate upstream area for sources of sedimentation.

IBI and Metric Scores

Narrative Rating	Fair
Overall Index	3.29
Total Taxa Score	5
EPT Taxa Score	3
% Ephemeroptera	1
Number of Ephemeroptera Score	1
% Intolerant to Urban Score	5
Scraper Taxa Score	3
% Climbers	5
Calculated Metric Values	
Total Taxa	24
EPT Taxa	4
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	35.4
Scraper Taxa	1
% Climbers	18.8

Taxa List

CORDULEGASTER	3
ANCHYTARSUS	2
SIALIS	9
HETEROTRISOCLADIUS	1
LIMNOPHYES	1
PARAMETRIOCNEMUS	3
PARAPHAENOCLADIUS	1
PARATANYTARSUS	1
PHAENOPSECTRA	1
POLYPEDILUM	2
PSEUDORTHOCCLADIUS	3
BEZZIA	1
ERIOPTERA	1
HEMERODROMIA	2
TIPULA	15
DIPLECTRONA	5
HYDATOPHYLAX	6
LYPE	4
PTILOSTOMIS	1
OLIGOCHAETA	18
CAECIDOTEA	9
SYNURELLA	5
BRACHYCERA	1
TRIOGMA	1

Total Individuals 96

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	7	Pool Substrate Characterization	8
Bank Stability- Right Bank	4	Pool Variability	7
Vegetative Protection- Left Bank	9	Riparian Vegetative Zone Width- Left Bank	9
Vegetative Protection- Right Bank	4	Riparian Vegetative Zone Width- Right Bank	2
Channel Flow Status	16	Sediment Deposition	7
Channel Alteration	13	Epifaunal Substrate	5
Channel Sinuosity	8	EPA Habitat Score	99
		EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

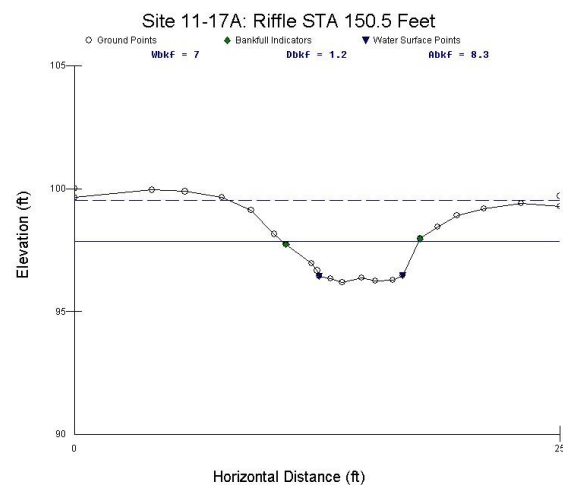
Drainage area (acres)	368.5	Instream Wood Debris	13
Distance from Road	10	Bank Erosion Extent- Left	6
Percent Shading	30	Bank Erosion Extent- Right	16
Epifaunal Substrate	5	Bank Erosion Severity- Left	1
Instream Habitat	7	Bank Erosion Severity- Right	1.5
		PHI Score	56.9
		PHI Narrative Ranking	D

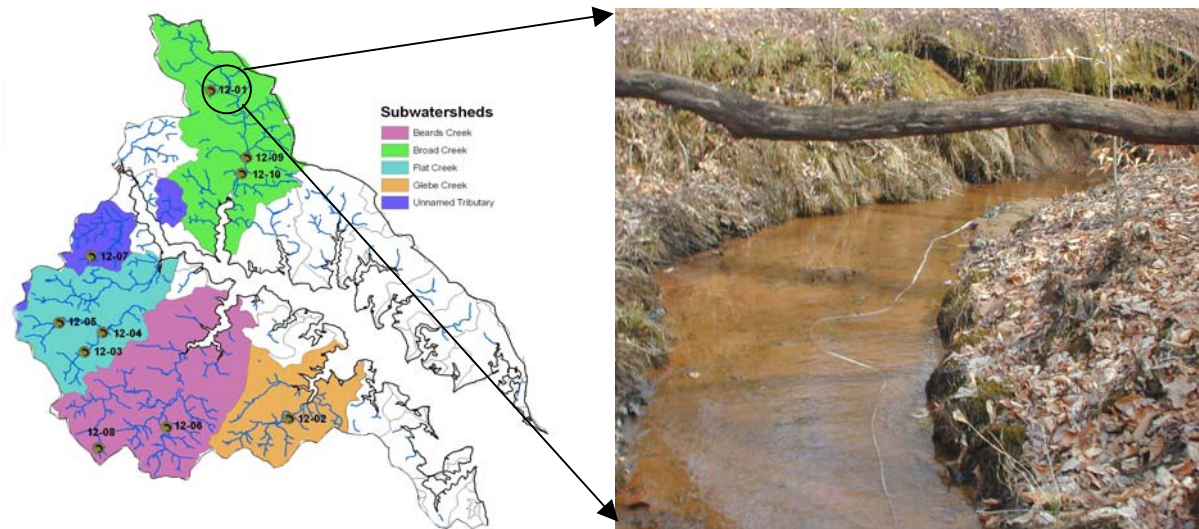
Water Chemistry

Dissolved Oxygen (mg/L)	5.62	Temperature (°C)	10.23
pH	6	Turbidity (NTU)	18.3
Specific Conductance (mS/cm)	0.228		

Geomorphic Assessments

Drainage area (acres)	368.5	Entrenchment Ratio:	2.43
Bankfull Width (ft):	7.00	Width:Depth Ratio:	5.89
Mean Depth (ft):	1.19	Sinuosity:	1.12
Bankfull X-Sec Area (sq ft):	8.32	Water Surface Slope (ft/ft):	0.006
Flood-Prone Width (ft):	17.01	Reach D50 (mm):	0.31

Rosgen Channel Classification: E5



Location/Site Access: Located in the Broad Creek subwatershed, access from the end of Gomoljak Road behind the last house then follow the swale approximately 0.25 miles down. ADC Map 19 G-5 Latitude/Longitude: 39.0045737/ 76.57951101

Land Use Analysis:

Land Use	Acres	% Area
Commercial	5.7	3.3
Residential 1/4-acre	0.5	0.3
Residential 1-acre	4.5	2.6
Residential 2-acre	6.0	3.5
Row Crops	57.4	33.3
Transportation	0.8	0.5
Woods	97.4	56.6
Total	172.2	100.0

Impervious (acres)	Total Area Above site	% Impervious
7.1	172.2	4.1

Results:

- Biological condition - “Fair”
- Habitat scores in the “Partially Supporting” and “Partially Degraded” ranges
- Optimal channel alteration and riparian vegetative width, marginal instream and epifaunal habitat quality
- Dominant taxa group were midges (Chironomidae) with several genera of beetles
- Stream type was identified as an F5, the water surface slope was 0.004 ft/ft, and the median channel substrate was medium sand

Recommendations:

- Investigate upstream area for sources of sedimentation and instability.

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	27
EPT Taxa	4
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	15.5
Scraper Taxa	1
% Climbers	15.5

Taxa List

MICROPSECTRA	3
CALOPTERYX	1
CORDULEGASTER	1
AGABUS	1
HYDROBIUS	1
CHAETOCLADIUS	3
CORYNONEURA	2
DIPLOCLADIUS	8
NATARSIA	2
ORTHOCLADIUS	7
PARAMETRIOCNEMUS	29
PARAPHAENOCLADIUS	5
POLYPEDILUM	2
RHEOTANYTARSUS	3
THIENEMANNIELLA	1
THIENEMANNIMYIA	5
CHELIFERA	1
ORMOSIA	1
PROBEZZIA	1
PSEUDOLIMNOPHILA	2
SIMULIUM	1
HYDATOPHYLAX	9
LYPE	2
PHYLOCENTROPUS	3
POLYCENTROPUS	1
CAECIDOTEA	1
SYNURELLA	7

Total Individuals 103

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Substrate Characterization	6
Bank Stability- Right Bank	8	Pool Variability	0
Vegetative Protection- Left Bank	9	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	9	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	9	Sediment Deposition	14
Channel Alteration	19	Epifaunal Substrate	6
Channel Sinuosity	15	EPA Habitat Score	121
		EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	172.2	Instream Wood Debris	8
Distance from Road (m)	650	Bank Erosion Extent- Left	40
Percent Shading	90	Bank Erosion Extent- Right	10
Epifaunal Substrate	6	Bank Erosion Severity -Left	1.5
Instream Habitat	6	Bank Erosion Severity -Right	1

PHI Score 80.3

PHI Narrative Ranking PD

Water Chemistry

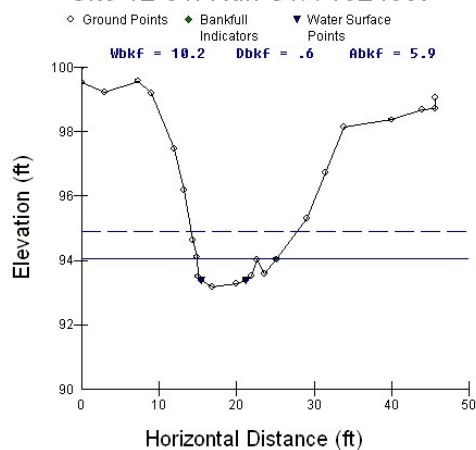
Dissolved Oxygen (mg/L)	6.04	Temperature (°C)	6.83
pH	6.65	Turbidity (NTU)	17.7
Specific Conductance (mS/cm)	0.07		

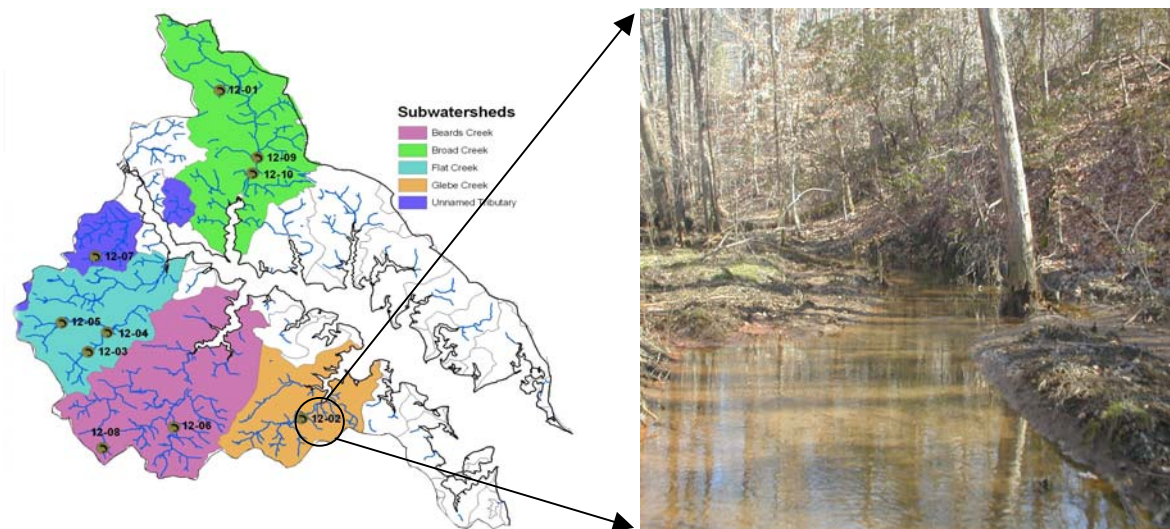
Geomorphic Assessments

Drainage area (acres)	172.2	Entrenchment Ratio:	1.34
Bankfull Width (ft):	10.19	Width:Depth Ratio:	17.57
Mean Depth (ft):	0.58	Sinuosity:	1.2
Bankfull X-Sec Area (sq ft):	5.92	Water Surface Slope (ft/ft):	0.004
Flood-Prone Width (ft):	13.64	Reach D50 (mm):	0.38

Rosgen Channel Classification: F5

Site 12-01: Run STA 132 feet





Location/Site Access: Located south of Rt. 214 and west of Muddy Creek Road. ADC Map 25 A-8 Latitude/Longitude: 38.91712724/76.5543625

Land Use Analysis:

Land Use	Acres	% Area
Commercial	18.1	2.4
Industrial	0.3	0.0
Open Space	68.9	9.3
Residential 1/2-acre	62.5	8.4
Residential 1/4-acre	68.3	9.2
Residential 1/8-acre	0.3	0.0
Residential 1-acre	80.0	10.8
Row Crops	73.2	9.9
Transportation	25.6	3.5
Water	1.3	0.2
Woods	344.0	46.3
Total	742.3	100.0

Impervious (acres)	Total Area Above site	% Impervious
81.3	742.3	11.0

Results:

- Biological condition - "Poor"
- Habitat scores in the "Supporting" and "Degraded" ranges
- High amount of woody debris, low erosion, and good channel alteration
- Dominant taxa group were blackflies (*Stegopterna* sp.) and midges
- Stream type was identified as an E5, the water surface slope was 0.004 ft/ft, and the median channel substrate was fine sand
- Typically, E channels are stable. However, the "Poor" biological rating and "Fair" habitat rating may indicate that this reach is transitioning to an unstable form, which may also explain the amount of bank erosion observed

Recommendations:

- Evaluate the impact of new upstream development and stormwater management.
- Investigate the impact of the culvert at Muddy Creek Road.

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	2.43

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

Calculated Metric Values

Total Taxa	17
EPT Taxa	3
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	48.5
Scraper Taxa	0
% Climbers	3.9

Taxa List

DIPLOCLADIUS	16
CRICOTOPUS/ORTHOCLADIUS	7
PARAMETRIOCNEMUS	8
POLYPEDILUM	1
PSEUDORTHOCLADIUS	1
RHEOTANYTARSUS	4
THIENEMANNIELLA	1
SIMULIUM	3
STEGOPTERNA	44
TIPULA	1
CHEUMATOPSYCHE	2
LIMNephilidae	2
OECETIS	1
PISIDIUM	4
OLIGOCHAETA	1
SYNURELLA	6
PROSTOMA	1

Total Individuals 103

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	9	Pool Substrate Characterization	7
Bank Stability- Right Bank	9	Pool Variability	8
Vegetative Protection- Left Bank	10	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	9	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	17	Sediment Deposition	6
Channel Alteration	18	Epifaunal Substrate	3
Channel Sinuosity	15	EPA Habitat Score	131
		EPA Narrative Ranking	S

Maryland Biological Stream Survey PHI

Drainage area (acres)	742.3	Instream Wood Debris	13
Distance from Road (m)	200	Bank Erosion Extent- Left	50
Percent Shading	70	Bank Erosion Extent- Right	50
Epifaunal Substrate	3	Bank Erosion Severity -Left	1
Instream Habitat	6	Bank Erosion Severity -Right	1

PHI Score 61.7

PHI Narrative Ranking D

Water Chemistry

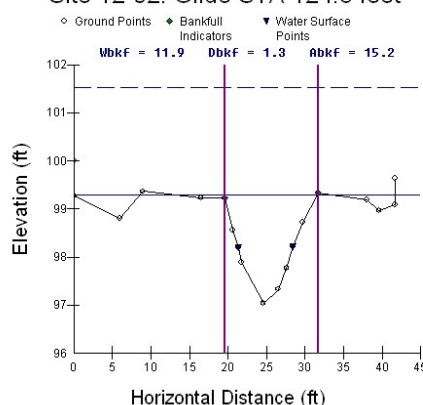
Dissolved Oxygen (mg/L)	6.58	Temperature (°C)	3.21
pH	6.49	Turbidity (NTU)	2.4
Specific Conductance (mS/cm)	0.17		

Geomorphic Assessments

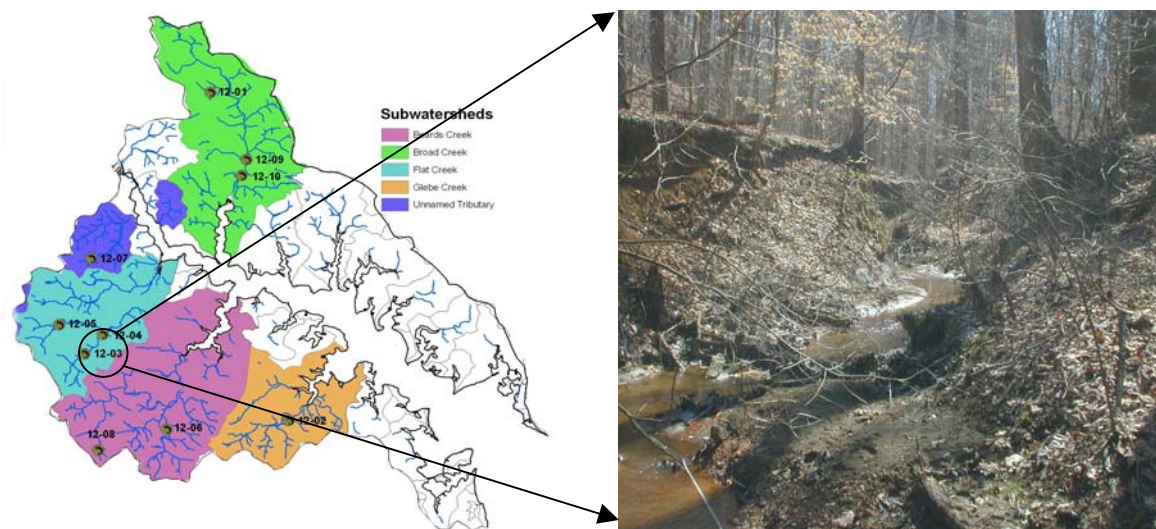
Drainage area (acres)	742.3	Entrenchment Ratio:	8.38
Bankfull Width (ft):	11.94	Width:Depth Ratio:	9.33
Mean Depth (ft):	1.28	Sinuosity:	1.2
Bankfull X-Sec Area (sq ft):	15.24	Water Surface Slope (ft/ft):	0.004
Flood-Prone Width (ft):	100	Reach D50 (mm):	0.19

Rosgen Channel Classification: E5

Site 12-02: Glide STA 124.3 feet



Note: The purple lines indicate that only the portions of the cross section between the lines are hydraulically connected to the bankfull channel.



Location/Site Access: Located in the Flat Creek subwatershed at the end of Shiloh Court.
Map 24 A-5 Latitude/Longitude: 38.93506007/76.62112791

Land Use Analysis:

Land Use	Acres	% Area
Commercial	9.8	2.7
Industrial	0.2	0.1
Open Space	20.3	5.6
Pasture/Hay	64.7	17.8
Residential 1/2-acre	40.0	11.0
Residential 1-acre	72.5	19.9
Row Crops	52.7	14.5
Transportation	6.7	1.8
Water	1.0	0.3
Woods	96.0	26.4
Total	363.8	100.0

Impervious (acres)	Total Area Above site	% Impervious
31.7	363.8	8.7

Results:

- Biological condition - “Poor”
- Habitat scores in the “Partially Supporting” and “Degraded” ranges
- Optimal channel alteration and riparian vegetative width but poor instream habitat
- Dominant taxa group were aquatic worms with crane flies (*Tipula* sp.) and isopods (*Caecidotea* sp.)
- Stream type was identified as a B5c, the water surface slope was 0.006 ft/ft, and the median channel substrate was fine sand.
- Typically, B channels are stable. However, the “Poor” biological rating and the impaired habitat ratings may indicate that this reach is transitioning to an unstable form, which may also explain the amount of bank erosion observed.

Recommendations:

- Investigate influence of runoff from nearby upstream housing development.

12-03

Lower North River Sampling Unit

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	2.71

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

Calculated Metric Values

Total Taxa	14
EPT Taxa	3
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	25.3
Scraper Taxa	2
% Climbers	4.2

Taxa List

CORDULEGASTER	2
DINEUTUS	2
NIGRONIA	2
DIPLOCLADIUS	2
HYDROBAENUS	2
PARAMETRIOCNEMUS	3
CHRYSOPS	2
TIPULA	17
DIPLECTRONA	2
HYDATOPHYLAX	2
LYPE	2
OLIGOCHAETA	41
CAECIDOTEA	10
SYNURELLA	6

Total Individuals	95
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Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	1	Pool Substrate Characterization	8
Bank Stability- Right Bank	2	Pool Variability	6
Vegetative Protection- Left Bank	7	Riparian Vegetative	10
Vegetative Protection- Right Bank	7	Zone Width- Left Bank	10
Channel Flow Status	15	Riparian Vegetative	10
Channel Alteration	18	Zone Width- Right Bank	6
Channel Sinuosity	14	Sediment Deposition	8
		Epifaunal Substrate	112

EPA Habitat Score	112
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EPA Narrative Ranking	PS
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Maryland Biological Stream Survey PHI

Drainage area (acres)	363.8	Instream Wood Debris	5
Distance from Road (m)	130	Bank Erosion Extent- Left	75
Percent Shading	70	Bank Erosion Extent- Right	60
Epifaunal Substrate	8	Bank Erosion Severity -Left	2
Instream Habitat	4	Bank Erosion Severity -Right	2

PHI Score	58.4
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PHI Narrative Ranking	D
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Water Chemistry

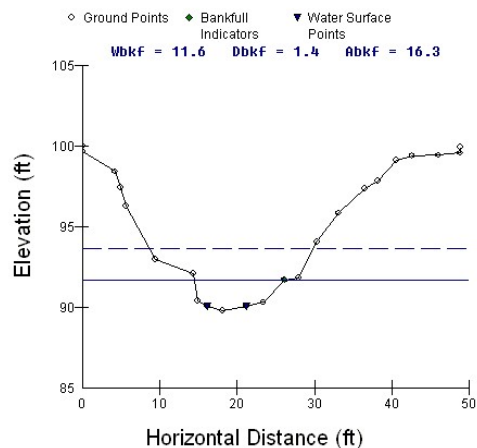
Dissolved Oxygen (mg/L)	5.47	Temperature (°C)	8.95
pH	6.31	Turbidity (NTU)	0
Specific Conductance (mS/cm)	0.204		

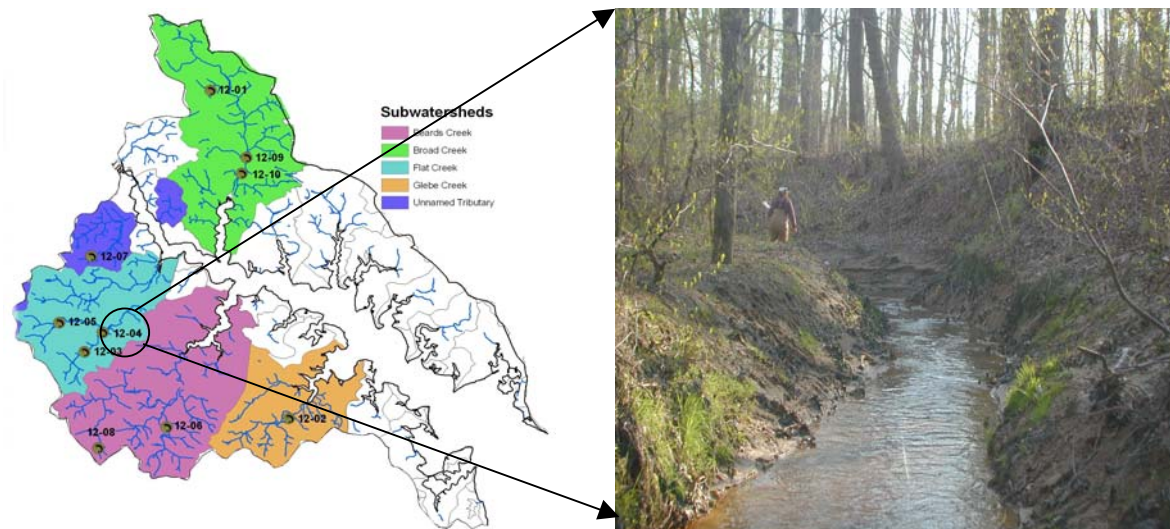
Geomorphic Assessments

Drainage area (acres)	363.8	Entrenchment Ratio:	1.83
Bankfull Width (ft):	11.59	Width:Depth Ratio:	8.22
Mean Depth (ft):	1.41	Sinuosity:	1.2
Bankfull X-Sec Area (sq ft):	16.3	Water Surface Slope (ft/ft):	0.006
Flood-Prone Width (ft):	21.16	Reach D50 (mm):	0.17

Rosgen Channel Classification: B5c

Site 12-03: Glide STA 100 feet





Location/Site Access: Located in the Flat Creek subwatershed, access from the end of Chickamauga Drive and follow the ravine next to mailbox made to look like a house.
 Map 24 B-4 Latitude/Longitude: 38.94027232/76.61510151

Land Use Analysis:

Land Use	Acres	% Area
Commercial	9.8	1.6
Industrial	0.2	0.0
Open Space	24.3	3.9
Pasture/Hay	64.7	10.5
Residential 1/2-acre	131.6	21.4
Residential 1-acre	76.4	12.4
Row Crops	72.0	11.7
Transportation	6.7	1.1
Water	1.0	0.2
Woods	228.5	37.1
Total	615.1	100.0

Impervious (acres)	Total Area Above site	% Impervious
50.2	615.1	8.2

Results:

- Biological condition - “Fair”
- Habitat scores in the “Non-Supporting” and “Degraded” ranges
- Very poor instream habitat and epifaunal substrate but good riparian vegetative width
- Dominant taxa group were midges with crane flies (*Tipula* sp.) and isopods (*Caecidota* sp.)
- Stream type was identified as an E5, the water surface slope was 0.004 ft/ft, and the median channel substrate was medium sand
- Typically, E channels are stable. However, the “Fair” biological and impaired habitat ratings may indicate that this reach is transitioning to an unstable form, which may also explain the amount of bank erosion observed

Recommendations:

- Investigate possible sources of runoff and sedimentation including the nearby residential development.

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	23
EPT Taxa	3
% Ephemeroptera	1
Number of Ephemeroptera	1
% Intolerant to Urban	22.7
Scraper Taxa	0
% Climbers	33

Taxa List

THIENEMANNIMYIA GROUP	1
BEZZIA	1
CERATOPOGON	1
HEMERODROMIA	1
MOLOPHILUS	2
TABANUS	3
TIPULA	10
HYDATOPHYLAX	2
IRONOQUIA	1
OLIGOCHAETA	4
CAECIDOTEA	13
SYNURELLA	4
ACERPENNA	1
HYDROBIUS	1
CHAETOCLADIUS	1
CRYPTOCHIRONOMUS	1
CRICOTOPUS/ORTHOCLADIUS	3
PARACLADOPELMA	1
PARAMETRIOCNEMUS	13
PARATANYTARSUS	1
POLYPEDILUM	29
RHEOTANYTARSUS	2

Total Individuals 97

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	1	Pool Substrate Characterization	6
Bank Stability- Right Bank	3	Pool Variability	2
Vegetative Protection- Left Bank	5	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	5	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	16	Sediment Deposition	4
Channel Alteration	18	Epifaunal Substrate	2
Channel Sinuosity	14	EPA Habitat Score	96
		EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	615.1	Instream Wood Debris	2
Distance from Road (m)	190	Bank Erosion Extent- Left	70
Percent Shading	90	Bank Erosion Extent- Right	65
Epifaunal Substrate	2	Bank Erosion Severity -Left	1.5
Instream Habitat	3	Bank Erosion Severity -Right	1.5

PHI Score 53.1

PHI Narrative Ranking D

Water Chemistry

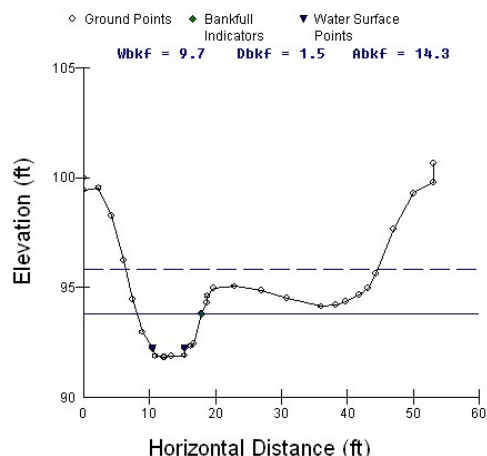
Dissolved Oxygen (mg/L)	5.82	Temperature (°C)	9.34
pH	6.23	Turbidity (NTU)	12.6
Specific Conductance (mS/cm)	0.173		

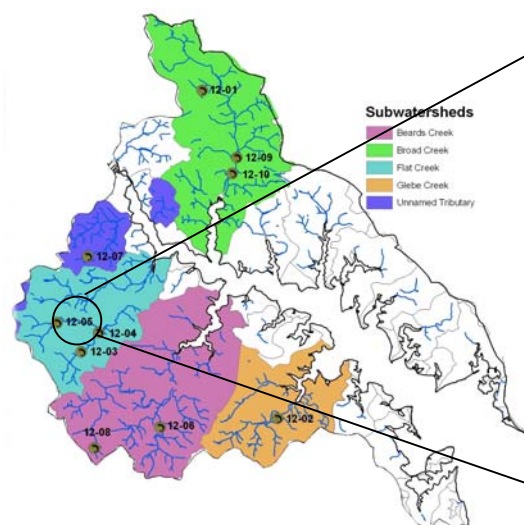
Geomorphic Assessments

Drainage area (acres)	615.1	Entrenchment Ratio:	3.91
Bankfull Width (ft):	9.74	Width:Depth Ratio:	6.63
Mean Depth (ft):	1.47	Sinuosity:	1.2
Bankfull X-Sec Area (sq ft):	14.34	Water Surface Slope (ft/ft):	0.004
Flood-Prone Width (ft):	38.12	Reach D50 (mm):	0.33

Rosgen Channel Classification: E5

Site 12-04: Riffle STA 121 feet





Location/Site Access: Located in the Flat Creek subwatershed, access from Governor Bridge Road.

ADC Map 23 J-3 Latitude/Longitude: 38.94291549/76.6293026

Land Use Analysis:

Land Use	Acres	% Area
Open Space	16.4	5.1
Pasture/Hay	6.8	2.1
Residential 1/2-acre	5.1	1.6
Residential 1-acre	41.0	12.8
Residential 2-acre	13.3	4.2
Row Crops	137.0	42.8
Transportation	6.3	2.0
Water	1.3	0.4
Woods	92.7	29.0
Total	320.0	100.0

Impervious (acres)	Total Area Above site	% Impervious
12.3	320.0	3.9

Results:

- Biological condition - "Poor"
- Habitat scores in the "Partially Supporting" and "Partially Degraded" ranges
- Optimal channel alteration and riparian vegetative width with marginal instream habitat and epifaunal substrate
- Dominant taxa group were isopods (*Caecidotea* sp.) with several midge taxa
- Stream type was identified as a B5c, the water surface slope was 0.003 ft/ft, and the median channel substrate was very coarse sand
- Typically, B channels are stable. However, the "Poor" biological rating may indicate that this reach is transitioning to an unstable form

Recommendations:

- Investigate reforestation of large fallow field, within the drainage area, located at the intersection of MD 424 and Governor's Bridge Road.

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	20
EPT Taxa	2
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	53.4
Scraper Taxa	0
% Climbers	6.7

Taxa List

CALOPTERYX	1
DIPLOCLADIUS	1
MICROTENDIPES	1
NATARSIA	1
PARAMETRIOCNEMUS	4
PHAENOPSECTRA	1
POLYPEDILUM	4
RHEOTANYTARSUS	18
TANYTARSUS	2
THIENEMANNIMYIA	4
HEMERODROMIA	1
PSEUDOLIMNOPHILA	1
STEGOPTERNA	1
TIPULA	2
CHEUMATOPSYCHE	1
IRONOQUIA	1
OLIGOCHAETA	6
CAECIDOTEA	50
SYNURELLA	1
NEOPORUS	2

Total Individuals 103

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	2	Pool Substrate Characterization	10
Bank Stability- Right Bank	2	Pool Variability	9
Vegetative Protection- Left Bank	8	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	8	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	11	Sediment Deposition	5
Channel Alteration	19	Epifaunal Substrate	6
Channel Sinuosity	10	EPA Habitat Score	110
		EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	320.0	Instream Wood Debris	8
Distance from Road (m)	350	Bank Erosion Extent- Left	45
Percent Shading	85	Bank Erosion Extent- Right	50
Epifaunal Substrate	6	Bank Erosion Severity -Left	1.5
Instream Habitat	8	Bank Erosion Severity -Right	1.5

PHI Score 72.3

PHI Narrative Ranking PD

Water Chemistry

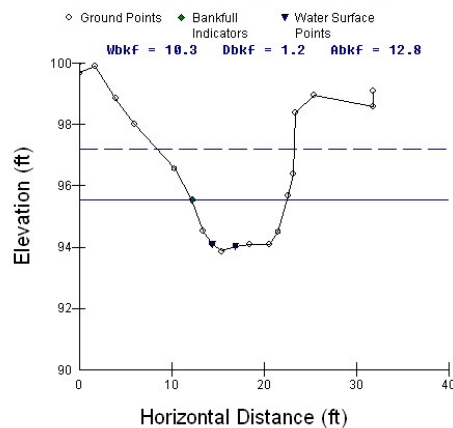
Dissolved Oxygen (mg/L)	4.59	Temperature (°C)	17.04
pH	6.09	Turbidity (NTU)	17
Specific Conductance (mS/cm)	0.205		

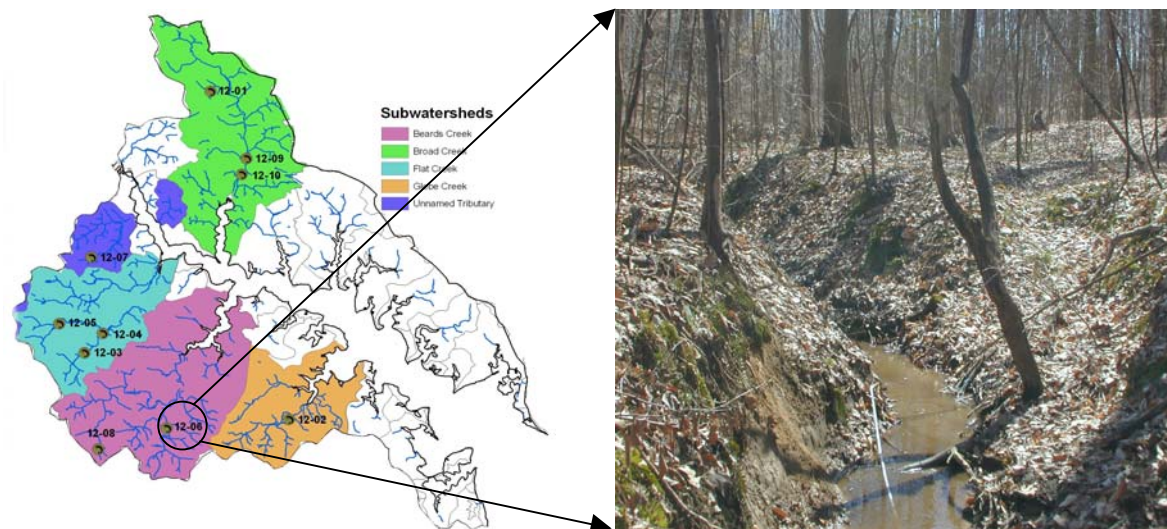
Geomorphic Assessments

Drainage area (acres)	320.0	Entrenchment Ratio:	1.44
Bankfull Width (ft):	10.28	Width:Depth Ratio:	8.22
Mean Depth (ft):	1.25	Sinuosity:	1.4
Bankfull X-Sec Area (sq ft):	12.83	Water Surface Slope (ft/ft):	0.003
Flood-Prone Width (ft):	14.82	Reach D50 (mm):	1.5

Rosgen Channel Classification: B5c

Site 12-05: Riffle STA 76 feet





Location/Site Access: Located in the Beards Creek subwatershed downstream of Avila Drive.

Map 24 A-9 Latitude/Longitude: 38.90935565/76.61678746

Land Use Analysis:

Land Use	Acres	% Area
Open Space	5.2	9.6
Pasture/Hay	5.3	9.8
Residential 1/2-acre	0.9	1.6
Residential 1/4-acre	3.9	7.1
Residential 1-acre	5.6	10.4
Residential 2-acre	4.2	7.8
Transportation	2.9	5.3
Woods	26.2	48.4
Total	54.1	100.0

Impervious (acres)	Total Area Above site	% Impervious
4.7	54.1	8.7

Results:

- Biological condition - “Poor”
- Habitat scores in the “Partially Supporting” and “Degraded” ranges
- Optimal channel alteration and riparian vegetative width with poor instream habitat and epifaunal substrate
- Dominant taxa group were amphipods (*Gammarus* sp.) with several midge taxa
- Stream type was identified as a B5c, the water surface slope was 0.004 ft/ft, and the median channel substrate was very coarse sand
- Typically, B channels are stable. However, the “Poor” biological rating and impaired habitat ratings may indicate that this reach is transitioning to an unstable form

Recommendations:

- Investigate effects of upstream residential development and culvert.
- Evaluate reach for possible historic retaining wall or dam structures that may be altering the hydrology within the reach.

12-06

Lower North River Sampling Unit

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	2.14
Total Taxa Score	3
EPT Taxa Score	3
% Ephemeroptera	1
Number of Ephemeroptera Score	0
% Intolerant to Urban Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	19
EPT Taxa	3
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	8.91
Scraper Taxa	0
% Climbers	10

Taxa List

CORDULEGASTER	1
AMPHINEMURA	1
OSTROCERCA	1
DIPLOCLADIUS	4
CRICOTOPUS/ORTHOCLADIUS	2
PARAMETRIOCNEMUS	1
PARAPHAENOCLADIUS	1
POLYPEDILUM	1
RHEOCRICOTOPUS	1
ZAVRELIMYIA	1
CERATOPOGON	1
LIMNEPHILIDAE	9
PISIDIUM	3
OLIGOCHAETA	5
CAECIDOTEA	2
GAMMARUS	63
SYNURELLA	2
TURBELLARIA	1
SYGOBROMUS	1

Total Individuals 101**Physical Habitat****EPA Rapid Bioassessment**

Bank Stability- Left Bank	4	Pool Substrate Characterization	6
Bank Stability- Right Bank	4	Pool Variability	7
Vegetative Protection- Left Bank	7	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	7	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	12	Sediment Deposition	5
Channel Alteration	18	Epifaunal Substrate	5
Channel Sinuosity	12		

EPA Habitat Score 107**EPA Narrative Ranking** PS**Maryland Biological Stream Survey PHI**

Drainage area (acres)	54.1	Instream Wood Debris	1
Distance from Road (m)	170	Bank Erosion Extent- Left	35
Percent Shading	60	Bank Erosion Extent- Right	35
Epifaunal Substrate	5	Bank Erosion Severity -Left	1.5
Instream Habitat	4	Bank Erosion Severity -Right	1.5

PHI Score 65.9**PHI Narrative Ranking** D**Water Chemistry**

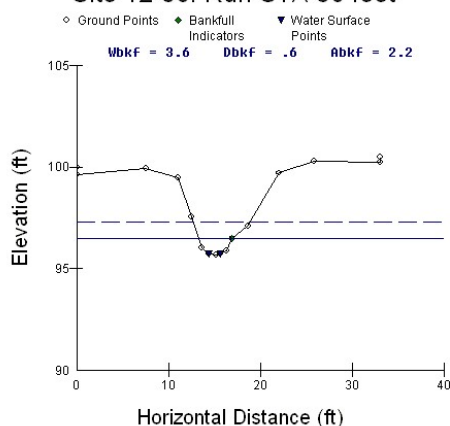
Dissolved Oxygen (mg/L)	5.82	Temperature (°C)	8.8
pH	7.17	Turbidity (NTU)	22
Specific Conductance (mS/cm)	0.28		

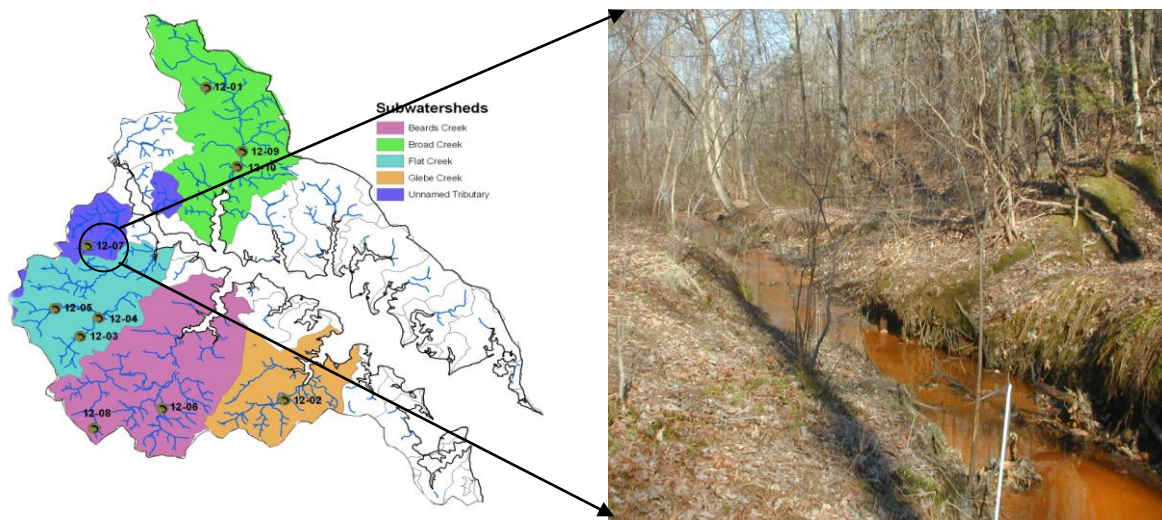
Geomorphic Assessments

Drainage area (acres)	54.1	Entrenchment Ratio:	1.71
Bankfull Width (ft):	3.63	Width:Depth Ratio:	6.05
Mean Depth (ft):	0.6	Sinuosity:	1.2
Bankfull X-Sec Area (sq ft):	2.17	Water Surface Slope (ft/ft):	0.004
Flood-Prone Width (ft):	6.2	Reach D50 (mm):	1.5

Rosen Channel Classification: B5c

Site 12-06: Run STA 56 feet





Location/Site Access: Located in the subwatershed of an unnamed tributary behind the houses on South Lake Drive.

ADC Map 19 A-13 Latitude/Longitude: 38.96037847/76.61876794

Land Use Analysis:

Land Use	Acres	% Area
Open Space	2.4	2.4
Residential 1/2-acre	39.1	39.1
Residential 1-acre	12.5	12.5
Residential 2-acre	3.0	3.0
Transportation	5.5	5.6
Woods	37.3	37.4
Total	99.9	100.0

Impervious (acres)	Total Area Above site	% Impervious
10.0	99.9	10.0

Results:

- Biological condition - "Poor"
- Habitat scores in the "Non-Supporting" and "Degraded" ranges
- Optimal channel alteration and riparian vegetative width with poor instream habitat and epifaunal substrate
- Dominant taxa group were aquatic worms with amphipods (*Synurella* sp.) and beetles (*Cyphon* sp.)
- Stream type was identified as an F5, the water surface slope was 0.005 ft/ft, and the median channel substrate was fine sand
- Impaired benthic communities and habitat conditions may be due to the unstable nature of the F stream type
- **Recommendations:**
- Investigate possible sources of sediment and instability including out dated stormwater management techniques in nearby residential community.

12-07

Lower North River Sampling Unit

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	18
EPT Taxa	2
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	20.8
Scraper Taxa	1
% Climbers	14.1

Taxa List

IRONOQUIA	1
LIMNEPHILIDAE	2
CAECIDOTEA	3
PROSTOMA	5
CRICOTOPUS	2
DIPLOCLADIUS	2
PARATENDIPES	3
POLYPEDILUM	2
STENOCHIRONOMUS	3
BITTACOMORPHA	2
HEXATOMA	2
PILARIA	2
TIPULA	1
HYDROBIUS	1
CYPHON	10
PRIONOCYPHON	1
SYNURELLA	15
OLIGOCHAETA	49

Total Individuals

106

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	8	Pool Substrate Characterization	6
Bank Stability- Right Bank	9	Pool Variability	1
Vegetative Protection- Left Bank	8	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	8	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	13	Sediment Deposition	4
Channel Alteration	17	Epifaunal Substrate	3
Channel Sinuosity	2		

EPA Habitat Score 99**EPA Narrative Ranking** NS**Maryland Biological Stream Survey PHI**

Drainage area (acres)	99.9	Instream Wood Debris	7
Distance from Road (m)	50	Bank Erosion Extent- Left	20
Percent Shading	60	Bank Erosion Extent- Right	20
Epifaunal Substrate	3	Bank Erosion Severity -Left	1
Instream Habitat	3	Bank Erosion Severity -Right	1

PHI Score 61.2**PHI Narrative Ranking** D**Water Chemistry**

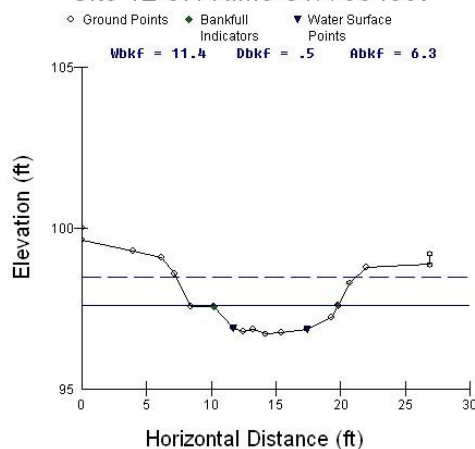
Dissolved Oxygen (mg/L)	5.04	Temperature (°C)	10.46
pH	6.46	Turbidity (NTU)	2.6
Specific Conductance (mS/cm)	0.356		

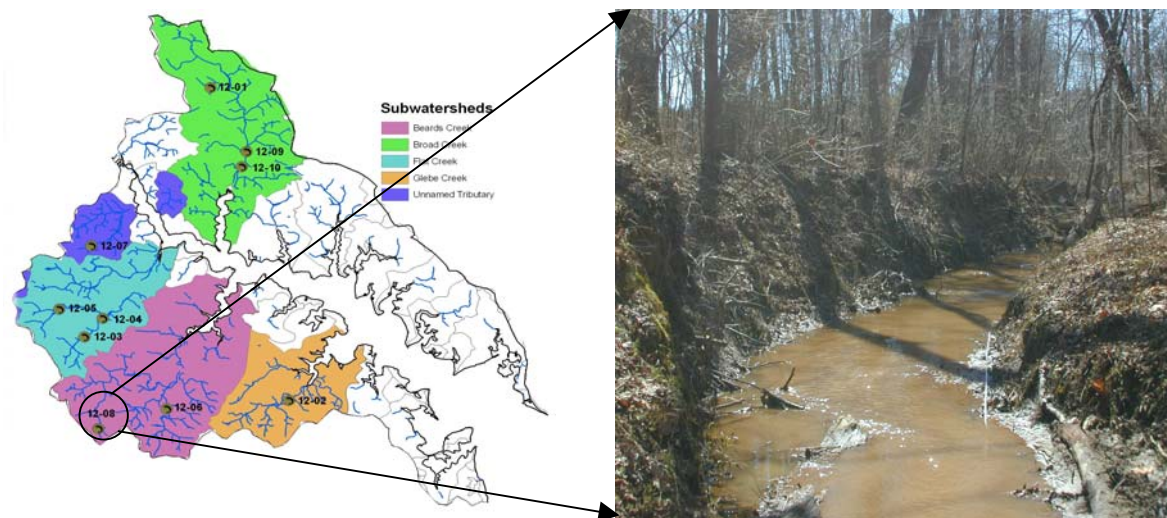
Geomorphic Assessments

Drainage area (acres)	99.9	Entrenchment Ratio:	1.22
Bankfull Width (ft):	11.42	Width:Depth Ratio:	20.76
Mean Depth (ft):	0.55	Sinuosity:	1.05
Bankfull X-Sec Area (sq ft):	6.27	Water Surface Slope (ft/ft):	0.005
Flood-Prone Width (ft):	13.9	Reach D50 (mm):	0.17

Rosgen Channel Classification: F5

Site 12-07: Riffle STA 80 feet





Location/Site Access: Located in the Beards Creek subwatershed off the dirt road which forks from Brick Church Road approximately 0.25 miles upstream of the road crossing.
ADC Map 24 E-8 Latitude/Longitude: 38.9148731/76.59431617

Land Use Analysis:

Land Use	Acres	% Area
Open Space	45.3	9.0
Pasture/Hay	4.0	0.8
Residential 1/2-acre	52.0	10.3
Residential 1-acre	29.2	5.8
Residential 2-acre	2.2	0.4
Row Crops	53.0	10.5
Transportation	4.9	1.0
Utility	5.0	1.0
Water	0.3	0.1
Woods	307.4	61.1
Total	503.3	100.0

Impervious (acres)	Total Area Above site	% Impervious
13.5	503.3	2.7

Results:

- Biological condition - “Fair”
- Habitat scores in the “Partially Supporting” and “Partially Degraded” ranges
- Optimal channel alteration and riparian vegetative width with moderate instream habitat and erosion
- Dominant taxa group were blackflies (*Prosimulium* sp.) with several amphipod taxa
- Stream type was identified as an E5, the water surface slope was 0.004 ft/ft, and the median channel substrate was fine sand
- Typically, E channels are stable. However, the “Fair” biological and degraded habitat ratings may indicate that this reach is transitioning to an unstable form, which may also explain the amount of bank erosion observed

Recommendations:

- Investigate reforestation of large farmed tracts in upstream riparian areas of reach.

IBI and Metric Scores

Narrative Rating	Fair
Overall Index	3.57
Total Taxa Score	5
EPT Taxa Score	5
% Ephemeroptera	1
Number of Ephemeroptera Score	1
% Intolerant to Urban Score	5
Scraper Taxa Score	5
% Climbers	3

Calculated Metric Values

Total Taxa	23
EPT Taxa	5
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	47.9
Scraper Taxa	2
% Climbers	7.1

Taxa List

HELICHUS	1
HYDROBIUS	2
NIGRONIA	1
DIPLOCLADIUS	4
CRICOTOPUS/ORTHOCLADIUS	1
PARAMETRIOCNEMUS	3
THIENEMANNIELLA	2
THIENEMANNIMYIA GROUP	2
ZAVRELIMYIA	4
HEMERODROMIA	1
PROSIMILIUM	17
SIMILIUM	2
STEGOPTERNA	9
TIPULA	1
CHEUMATOPSYCHE	2
HYDATOPHYLAX	1
IRONOQUIA	2
LIMNephilidae	3
LYPE	2
OLIGOCHAETA	3
CAECIDOTEA	9
GAMMARUS	15
SYNURELLA	11

Total Individuals 98

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	7	Pool Substrate Characterization	8
Bank Stability- Right Bank	7	Pool Variability	7
Vegetative Protection- Left Bank	8	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	8	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	15	Sediment Deposition	7
Channel Alteration	19	Epifaunal Substrate	4
Channel Sinuosity	15	EPA Habitat Score	125
		EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	503.3	Instream Wood Debris	8
Distance from Road (m)	350	Bank Erosion Extent- Left	50
Percent Shading	85	Bank Erosion Extent- Right	60
Epifaunal Substrate	4	Bank Erosion Severity -Left	1.5
Instream Habitat	8	Bank Erosion Severity -Right	1.5

PHI Score 68.5

PHI Narrative Ranking PD

Water Chemistry

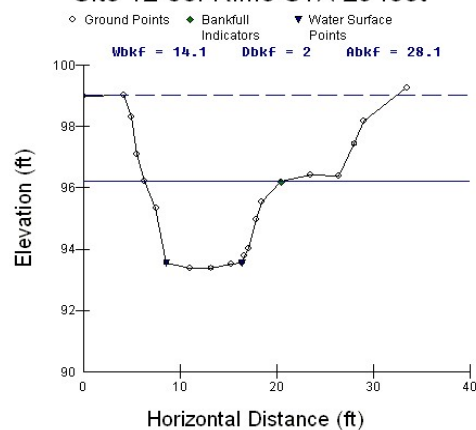
Dissolved Oxygen (mg/L)	9.09	Temperature (°C)	4.97
pH	6.62	Turbidity (NTU)	6.8
Specific Conductance (mS/cm)	0.145		

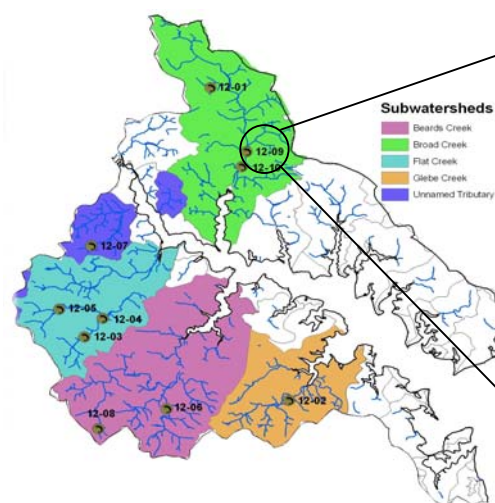
Geomorphic Assessments

Drainage area (acres)	503.3	Entrenchment Ratio:	2.31
Bankfull Width (ft):	14.07	Width:Depth Ratio:	7.04
Mean Depth (ft):	2	Sinuosity:	1.2
Bankfull X-Sec Area (sq ft):	28.1	Water Surface Slope (ft/ft):	0.004
Flood-Prone Width (ft):	32.5	Reach D50 (mm):	0.18

Rosgen Channel Classification: E5

Site 12-08: Riffle STA 29 feet





Location/Site Access: Located in the Broad Creek subwatershed downstream of Defense Highway stream crossing.

ADC Map 19 J-8 Latitude/Longitude: 38.986632/76.567804

Land Use Analysis:

Land Use	Acres	% Area
Commercial	85.8	3.3
Industrial	137.6	5.3
Open Space	187.7	7.2
Open Wetland	8.7	0.3
Pasture/Hay	17.1	0.7
Residential 1/2-acre	394.4	15.2
Residential 1/4-acre	17.2	0.7
Residential 1-acre	31.5	1.2
Residential 2-acre	40.2	1.6
Row Crops	96.4	3.7
Transportation	82.0	3.2
Water	17.7	0.7
Woods	1477.3	57.0
Total	2593.7	100.0

Impervious (acres)	Total Area Above site	% Impervious
286.7	2593.7	11.1

Results:

- Biological condition - “Very Poor”
- Habitat scores in the “Supporting” and “Degraded” ranges
- Optimal riparian vegetative width and woody debris with suboptimal instream habitat and epifaunal substrate
- Dominant taxa groups were several midge taxa and amphipods (*Gammarus* sp.)
- Stream type was identified as a B5c, the water surface slope was 0.003 ft/ft, and the median channel substrate was medium sand
- Typically, B channels are stable. However, the “Very Poor” biological rating and “Fair” habitat rating may indicate that this reach is transitioning to an unstable form

Recommendations:

- Investigate effects of current road widening efforts including culvert stability and maintenance.

12-09

Lower North River Sampling Unit

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	14
EPT Taxa	3
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	1.94
Scraper Taxa	1
% Climbers	6.8

Taxa List

ARGIA	1
NANOCLADIUS	5
CRICOTOPUS/ORTHOCLADIUS	3
RHEOTANYTARSUS	33
THIENEMANNIELLA	1
CHEUMATOPSYCHE	18
HYDROPSYCHE	3
OECETIS	1
PHYSELLA	3
OLIGOCHAETA	4
CAECIDOTEA	2
GAMMARUS	23
TURBELLARIA	4
POLYPEDILUM	2

Total Individuals

101

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	7	Pool Substrate Characterization	12
Bank Stability- Right Bank	6	Pool Variability	14
Vegetative Protection- Left Bank	7	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	7	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	19	Sediment Deposition	13
Channel Alteration	12	Epifaunal Substrate	11
Channel Sinuosity	1	EPA Habitat Score	129
		EPA Narrative Ranking	S

Maryland Biological Stream Survey PHI

Drainage area (acres)	2593.7	Instream Wood Debris	12
Distance from Road (m)	0	Bank Erosion Extent- Left	40
Percent Shading	45	Bank Erosion Extent- Right	50
Epifaunal Substrate	11	Bank Erosion Severity -Left	1
Instream Habitat	12	Bank Erosion Severity -Right	1

PHI Score 56.1**PHI Narrative Ranking** D**Water Chemistry**

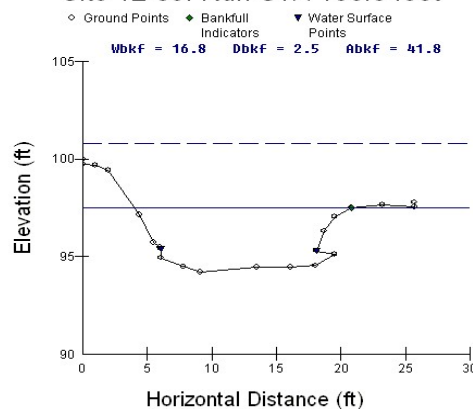
Dissolved Oxygen (mg/L)	5.42	Temperature (°C)	6.26
pH	6.74	Turbidity (NTU)	7.4
Specific Conductance (mS/cm)	0.2		

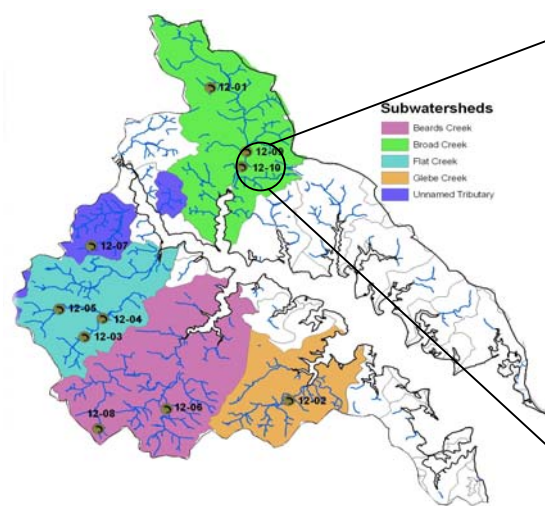
Geomorphic Assessments

Drainage area (acres)	2593.7	Entrenchment Ratio:	1.53
Bankfull Width (ft):	16.8	Width:Depth Ratio:	6.75
Mean Depth (ft):	2.49	Sinuosity:	1.07
Bankfull X-Sec Area (sq ft):	41.76	Water Surface Slope (ft/ft):	0.003
Flood-Prone Width (ft):	25.7	Reach D50 (mm):	0.38

Rosgen Channel Classification: B5c

Site 12-09: Run STA 156.5 feet





Location/Site Access: Located in the Broad Creek subwatershed on Harry Truman Parkway just downstream of RT. 50.

ADC Map 19 H-9 Latitude/Longitude: 38.98237549/76.56945253

Land Use Analysis:

Land Use	Acres	% Area
Commercial	96.0	3.6
Industrial	147.7	5.5
Open Space	191.9	7.2
Open Wetland	8.7	0.3
Pasture/Hay	17.1	0.6
Residential 1/2-acre	394.2	14.7
Residential 1/4-acre	17.1	0.6
Residential 1-acre	33.1	1.2
Residential 2-acre	40.2	1.5
Row Crops	96.3	3.6
Transportation	102.1	3.8
Water	17.7	0.7
Woods	1519.3	56.7
Total	2681.5	100.0

Impervious (acres)	Total Area Above site	% Impervious
321.4	2681.5	12.0

Results:

- Biological condition - “Poor”
- Habitat scores in the “Comparable” and “Partially Degraded” ranges
- Suboptimal instream habitat and epifaunal substrate with low erosion and optimal vegetative cover
- Dominant taxa group were net spinning caddisflies (*Cheumatopsyche* sp.) with midge and amphipod taxa
- Stream type was identified as an E6, the water surface slope was 0.002 ft/ft, and the median channel substrate was silt/clay
- Typically, E channels are stable. However, the “Poor” and “Fair” biological ratings may indicate that this reach is transitioning to an unstable form

Recommendations:

- Maintain protection of this beaver impounded area and its unique habitat within the sampling unit.

IBI and Metric Scores

Narrative Rating	Very Poor
Overall Index	1.86
Total Taxa Score	1
EPT Taxa Score	3
% Ephemeroptera	1
Number of Ephemeroptera Score	1
% Intolerant to Urban Score	1
Scraper Taxa Score	5
% Climbers	1

Calculated Metric Values

Total Taxa	11
EPT Taxa	2
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	1.05
Scraper Taxa	2
% Climbers	0.03

Taxa List

POLYPEDILUM	1
DUBIRAPHIA	1
RHEOTANYTARSUS	22
THIENEMANNIMYIA	1
SIMULIUM	1
CHEUMATOPSYCHE	47
HYDROPSYCHE	2
PHYSELLA	1
OLIGOCHAETA	1
CAECIDOTEA	1
GAMMARUS	17

Total Individuals 95

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	7	Pool Substrate Characterization	15
Bank Stability- Right Bank	6	Pool Variability	16
Vegetative Protection- Left Bank	10	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	10	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	18	Sediment Deposition	9
Channel Alteration	19	Epifaunal Substrate	15
Channel Sinuosity	17	EPA Habitat Score	162
		EPA Narrative Ranking	C

Maryland Biological Stream Survey PHI

Drainage area (acres)	2681.5	Instream Wood Debris	4
Distance from Road (m)	110	Bank Erosion Extent- Left	5
Percent Shading	70	Bank Erosion Extent- Right	10
Epifaunal Substrate	15	Bank Erosion Severity -Left	1
Instream Habitat	15	Bank Erosion Severity -Right	1

PHI Score	71.6
PHI Narrative Ranking	PD

Water Chemistry

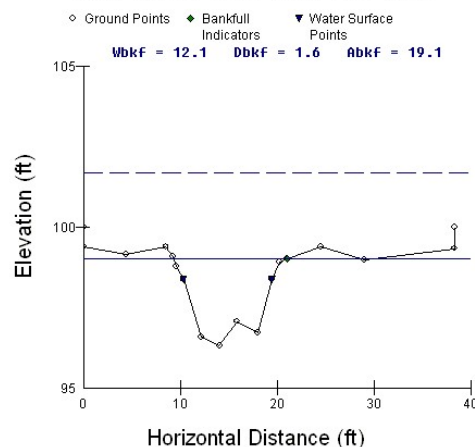
Dissolved Oxygen (mg/L)	5.73	Temperature (°C)	6.8
pH	6.84	Turbidity (NTU)	5
Specific Conductance (mS/cm)	0.308		

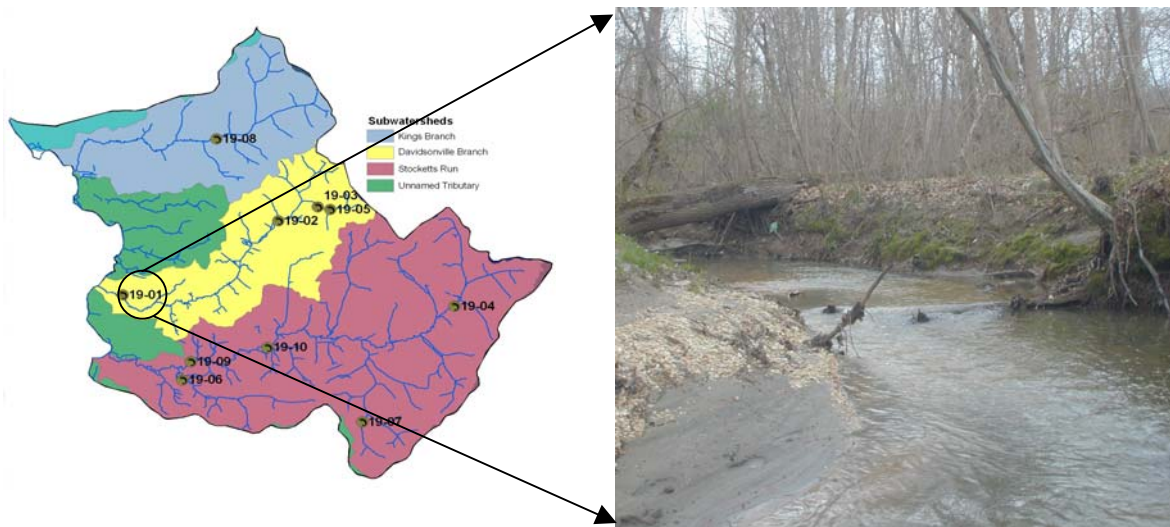
Geomorphic Assessments

Drainage area (acres)	2681.5	Entrenchment Ratio:	6.62
Bankfull Width (ft):	12.09	Width:Depth Ratio:	7.65
Mean Depth (ft):	1.58	Sinuosity:	1.2
Bankfull X-Sec Area (sq ft):	19.06	Water Surface Slope (ft/ft):	0.002
Flood-Prone Width (ft):	80	Reach D50 (mm):	0.03

Rosgen Channel Classification: E6

Site 12-10: Run STA 124 feet





Location/Site Access: Located in the Davidsonville Branch subwatershed approximately 500 ft upstream of Patuxent River Road next to the trailer park. ADC Map 23 C-12
 Latitude/Longitude: 38.89588/-76.66947

Land Use Analysis:

Land Use	Acres	% Area
Commercial	15.4	1.1
Residential 1-acre	66.2	4.9
Residential 2-acre	90.0	6.7
Row Crops	189.6	14.1
Transportation	19.5	1.5
Woods	473.3	35.2
Pasture/Hay	228.0	17.0
Open Space	70.3	5.2
Residential 1/2-acre	187.8	14.0
Water	4.1	0.3
Total	1344.2	100.0

Impervious (acres)	Total Area Above site	% Impervious
82.5	1344.2	6.1

Results:

- Biological condition - “Good”
- Habitat scores in the “Partially Supporting” and “Partially Degraded” ranges
- Instream woody debris and epifaunal substrate were all considered optimal
- Dominant taxa group were mayflies (*Acerpenna* sp.) and scuds (*Synurella* sp.)
- The stream type was identified as an F4, the water surface slope was 0.0008 ft/ft, and the median channel substrate was very fine gravel
- Typically, F stream types are considered unstable. However, The “Good” biological ratings for this reach may imply that the stream is in transition to a more stable form

Recommendations:

- Investigate the recent construction activities, which occurred between the biological and geomorphic site visits, within the stream channel and riparian buffer.
- Remove the new stream crossings and culvert blockages caused by this construction.
- Reforest the disturbed riparian buffer.

IBI and Metric Scores

Narrative Rating	Good
Overall Index	4.71
Total Taxa Score	5
EPT Taxa Score	5
% Ephemeroptera	5
Number of Ephemeroptera Score	5
% Intolerant to Urban Score	5
Scraper Taxa Score	5
% Climbers	3

Calculated Metric Values

Total Taxa	23
EPT Taxa	9
% Ephemeroptera	16.7
Number of Ephemeroptera	2
% Intolerant to Urban	54.2
Scraper Taxa	2
% Climbers	4.1

Taxa List

ACERPENNA	15
LEPTOPHLEBIA	1
AMPHINEMURA	4
ISOPERLA	2
LEUCTRA	2
DUBIRAPHIA	2
CRICOTOPUS/ORTHOCLADIUS	3
PARAKIEFFERIELLA	2
PARAMETRIOCNEMUS	2
PARAPHAENOCLADIUS	1
PARATANYTARSUS	4
PHAENOPSECTRA	1
RHEOTANYTARSUS	2
THIENEMANNIMYIA GROUP	7
HEMERODROMIA	3
CHEUMATOPSYCHE	8
HYDATOPHYLAX	1
HYDROPSYCHE	2
NEOPHYLAX	9
OLIGOCHAETA	7
CAECIDOTEA	2
SYNURELLA	15
PROSTOMA	1

Total Individuals

96

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	4	Pool Substrate Characterization	7
Bank Stability- Right Bank	4	Pool Variability	13
Vegetative Protection- Left Bank	6	Riparian Vegetative	9
Vegetative Protection- Right Bank	6	Zone Width- Left Bank	3
Channel Flow Status	8	Riparian Vegetative	9
Channel Alteration	17	Zone Width- Right Bank	13
Channel Sinuosity	14	Sediment Deposition	13
		Epifaunal Substrate	13
		EPA Habitat Score	113
		EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

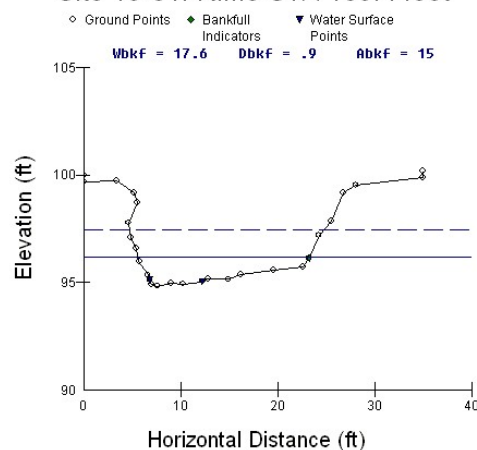
Drainage area (acres)	1344.2	Instream Wood Debris	11
Distance from Road (m)	98	Bank Erosion Extent(m)- Left	30
Percent Shading	80	Bank Erosion Extent(m)- Right	50
Epifaunal Substrate	13	Bank Erosion Severity -Left	1.5
Instream Habitat	13	Bank Erosion Severity -Right	1.5

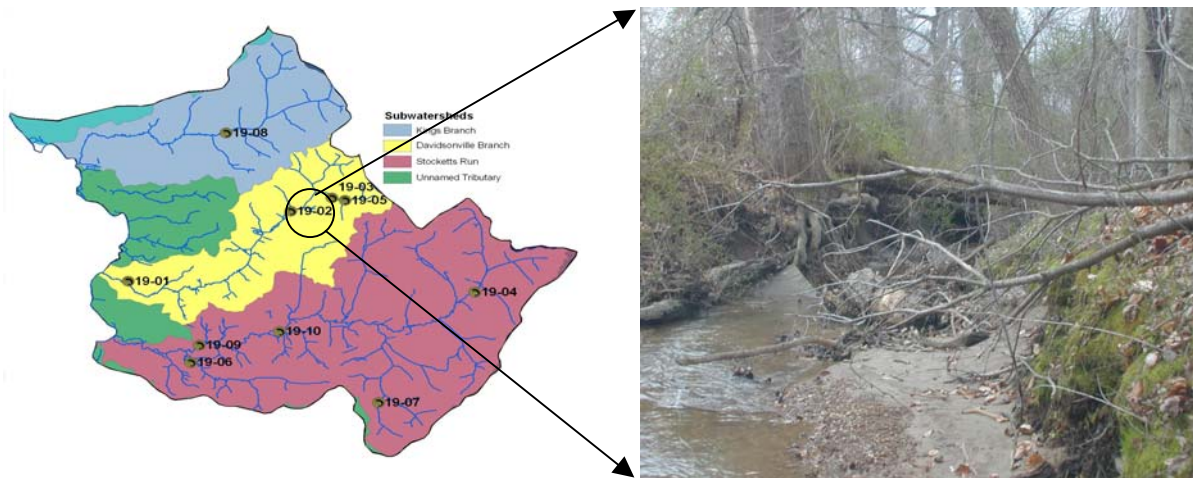
PHI Score 72.5**PHI Narrative Ranking** PD**Water Chemistry**

Dissolved Oxygen (mg/L)	6.13	Temperature (°C)	14.2
pH	6.37	Turbidity (NTU)	12.8
Specific Conductance (mS/cm)	0.178		

Geomorphic Assessments

Drainage area (acres)	1344.2	Entrenchment Ratio:	1.14
Bankfull Width (ft):	17.59	Width:Depth Ratio:	20.45
Mean Depth (ft):	0.86	Sinuosity:	1.21
Bankfull X-Sec Area (sq ft):	15.04	Water Surface Slope (ft/ft):	0.0008
Flood-Prone Width (ft):	20.02	Reach D50 (mm):	3.33

Rosgen Channel Classification: F4**Site 19-01: Riffle STA 159.4 feet**



Location/Site Access: Located in the Davidsonville Branch subwatershed at the end of Horseman Way, walk approximately 400m to site. ADC Map 23 H-9 Latitude/Longitude: 38.9077148 /76.63991717

Land Use Analysis:

Land Use	Acres	% Area
Commercial	3.98	0.7
Open Space	48.43	8.7
Residential 1/2-acre	166.08	29.8
Residential 1-acre	24.40	4.4
Row Crops	72.71	13.1
Transportation	8.79	1.6
Water	3.25	0.6
Woods	150.88	27.1
Pasture/Hay	62.09	11.2
Residential 2-acre	16.24	2.9
Total	556.86	100.0

Impervious (acres)	Total Area Above site	% Impervious
49.6	556.9	8.9

Results:

- Biological condition - "Poor"
- Habitat scores in the "Partially Supporting" and "Partially Degraded" ranges
- Epifaunal substrate and bank stability were considered in the good range
- Dominant taxa group were bivalves *Pisidium* sp. and aquatic worms with several genera of midges and caddisflies
- The stream type was identified as a G5/1c, the water surface slope was 0.005 ft/ft, and the median channel substrate was coarse sand
- Impaired benthic communities may be due to the unstable nature of the G stream type

Recommendations:

- Investigate the reforestation of surrounding cropland within the riparian buffer.
- Investigate feasibility of removing the many farm culverts within the stream channel.

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	21
EPT Taxa	4
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	23.5
Scraper Taxa	2
% Climbers	7.8

Taxa List

NIGRONIA	1
DIPLOCLADIUS	1
CRICOTOPUS/ORTHOCLADIUS	2
PARAMETRIOCNEMUS	11
POLYPEDILUM	6
RHEOTANYTARSUS	9
THIENEMANNIMYIA GROUP	2
ANTOCHA	1
BEZZIA	1
HEMERODROMIA	3
STEGOPTERNA	3
CHEUMATOPSYCHE	7
DIPLECTRONA	1
HYDROPSYCHE	1
NEOPHYLAX	5
PHYSELLA	1
PISIDIUM	13
OLIGOCHAETA	19
CAECIDOTEA	9
SYNURELLA	5
TURBELLARIA	1

Total Individuals

102

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	8	Pool Substrate Characterization	13
Bank Stability- Right Bank	5	Pool Variability	6
Vegetative Protection- Left Bank	4	Riparian Vegetative Zone Width- Left Bank	4
Vegetative Protection- Right Bank	5	Riparian Vegetative Zone Width- Right Bank	4
Channel Flow Status	14	Sediment Deposition	10
Channel Alteration	17	Epifaunal Substrate	12
Channel Sinuosity	11	EPA Habitat Score	113

EPA Narrative Ranking

PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	556.9	Instream Wood Debris	8
Distance from Road (m)	378	Bank Erosion Extent (m)- Left	20
Percent Shading	65	Bank Erosion Extent (m)- Right	50
Epifaunal Substrate	12	Bank Erosion Severity - Left	1
Instream Habitat	11	Bank Erosion Severity -Right	1.5

PHI Score

77.0

PHI Narrative Ranking

PD

Water Chemistry

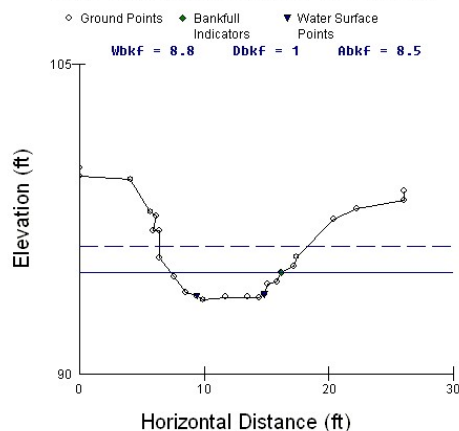
Dissolved Oxygen (mg/L)	5.18	Temperature (°C)	13.29
pH	6.02	Turbidity (NTU)	17.7
Specific Conductance (mS/cm)	0.239		

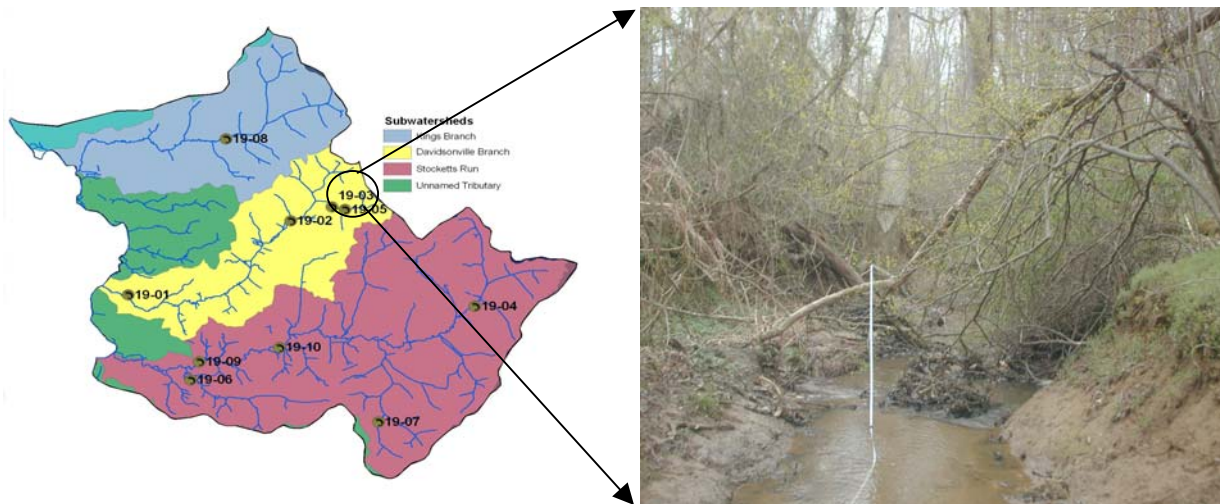
Geomorphic Assessments

Drainage area (acres)	556.9	Entrenchment Ratio:	1.34
Bankfull Width (ft):	8.83	Width:Depth Ratio:	9.1
Mean Depth (ft):	0.97	Sinuosity:	1.09
Bankfull X-Sec Area (sq ft):	8.54	Water Surface Slope (ft/ft):	0.005
Flood-Prone Width (ft):	11.82	Reach D50 (mm):	0.75

Rosgen Channel Classification: G 5/1 c

Site 19-02: Riffle STA 101.2 feet





Location/Site Access: Located in the Davidsonville Branch subwatershed upstream of Foxhall Road stream crossing.

ADC Map 23 J-9 Latitude/Longitude: 38.90996187/76.63239613

Land Use Analysis:

Land Use	Acres	% Area
Commercial	1.17	0.8
Open Space	5.56	3.6
Pasture/Hay	28.55	18.7
Residential 1/2-acre	21.04	13.8
Residential 1-acre	7.51	4.9
Row Crops	47.13	30.8
Transportation	1.89	1.2
Water	3.25	2.1
Woods	27.22	17.8
Residential 2-acre	9.56	6.3
Total	152.9	100.0

Impervious (acres)	Total Area Above site	% Impervious
7.6	152.9	5.0

Results:

- Biological condition - “Fair”
- Habitat scores in the “Partially Supporting” and “Degraded” ranges
- Low epifaunal substrate and instream habitat scores, high amounts of woody debris
- Dominant taxa group were aquatic worms and scuds (*Synurella* sp.) with several genera of midges and caddisflies
- The stream type was identified as F5/1, the water surface slope was 0.01 ft/ft, and the median channel substrate was fine sand
- Impaired benthic communities and stream habitat may be due to the unstable nature of the F stream type

Recommendations:

- Investigate possible sources of instability and sedimentation in the watershed.

IBI and Metric Scores

Narrative Rating	Fair
Overall Index	3.57

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

Calculated Metric Values

Total Taxa	17
EPT Taxa	6
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	29.7
Scraper Taxa	2
% Climbers	10.9

Taxa List

AMPHINEMURA	1
NEMOURIDAE	1
DIPLOCLADIUS	1
CRICOTOPUS/ORTHOCLADIUS	4
PARAMETRIOCNEMUS	11
POLYPEDILUM	3
CHRYSOPS	1
SIMULIUM	1
CHEUMATOPSYCHE	5
DIPLECTRONA	2
IRONOQUIA	1
NEOPHYLAX	1
PHYSELLA	7
PISIDIUM	13
OLIGOCHAETA	25
CAECIDOTEA	7
SYNURELLA	17

Total Individuals 101

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	7	Pool Substrate Characterization	7
Bank Stability- Right Bank	4	Pool Variability	12
Vegetative Protection- Left Bank	7	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	7	Riparian Vegetative Zone Width- Right Bank	7
Channel Flow Status	14	Sediment Deposition	6
Channel Alteration	18	Epifaunal Substrate	3
Channel Sinuosity	7	EPA Habitat Score	109
		EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	152.9	Instream Wood Debris	14
Distance from Road (m)	116	Bank Erosion Extent (m)- Left	65
Percent Shading	50	Bank Erosion Extent (m)- Right	20
Epifaunal Substrate	3	Bank Erosion Severity -Left	1.5
Instream Habitat	3	Bank Erosion Severity -Right	1
		PHI Score	60.1
		PHI Narrative Ranking	D

Water Chemistry

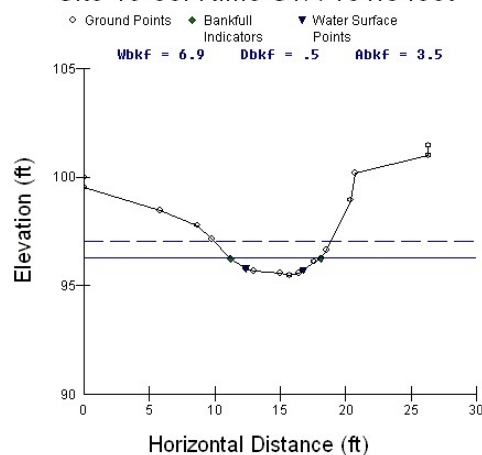
Dissolved Oxygen (mg/L)	5.12	Temperature (°C)	11.27
pH	5.92	Turbidity (NTU)	14.4
Specific Conductance (mS/cm)	0.154		

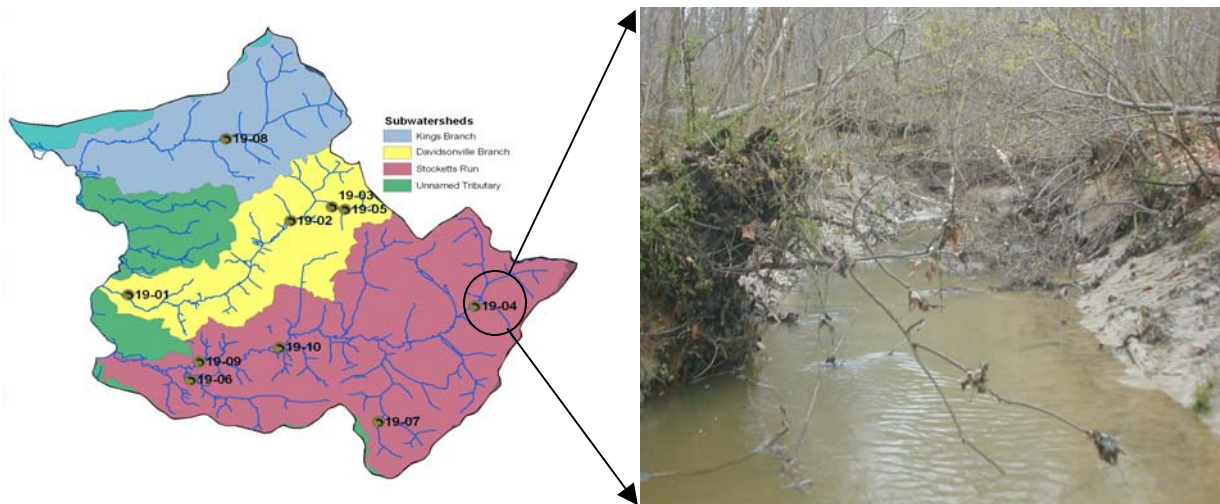
Geomorphic Assessments

Drainage area (acres)	152.9	Entrenchment Ratio:	1.29
Bankfull Width (ft):	6.92	Width:Depth Ratio:	13.84
Mean Depth (ft):	0.5	Sinuosity:	1.05
Bankfull X-Sec Area (sq ft):	3.49	Water Surface Slope (ft/ft):	0.01
Flood-Prone Width (ft):	8.9	Reach D50 (mm):	0.2

Rosgen Channel Classification: F 5/1

Site 19-03: Riffle STA 151.0 feet





Location/Site Access: Located in the Srocketts Run subwatershed downstream of Birdsville Road stream crossing.

ADC Map 24 C-12 Latitude/Longitude: 38.89383361/76.60650364

Land Use Analysis:

Land Use	Acres	% Area
Commercial	15.8	2.5
Open Space	75.4	12.1
Pasture/Hay	72.1	11.6
Residential 1/2-acre	98.3	15.8
Residential 1-acre	51.4	8.3
Row Crops	49.3	7.9
Transportation	19.9	3.2
Woods	180.0	29.0
Utility	30.9	5.0
Residential 2-acre	28.4	4.6
Total	621.4	100.0

Impervious (acres)	Total Area Above site	% Impervious
56.2	621.4	9.0

Results:

- Biological condition - "Poor"
- Habitat scores in the "Partially Supporting" and "Degraded" ranges
- Low instream habitat and epifaunal substrate and high amounts of woody debris
- Dominant taxa group were midges (Chironomidae) and scuds (*Gammarus* sp.) with several genera of stoneflies
- The stream type was identified as F5/1, the water surface slope was 0.002 ft/ft, and the median channel substrate was medium sand
- Low dissolved oxygen and high turbidity may indicate agricultural impacts or excess nutrients that may impact benthos. Impaired benthic communities and stream habitat may be due to the unstable nature of the F stream type

Recommendations:

- Investigate the possibility of nutrient contamination from the upstream wastewater treatment plant or agricultural non-point sources.

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	2.71

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

Calculated Metric Values

Total Taxa	21
EPT Taxa	4
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	24.5
Scraper Taxa	1
% Climbers	24.5

Taxa List

CALOPTERYX	1
HYDROBIUS	1
CRYPTOCHIRONOMUS	2
MICROPSECTRA	17
CRICOTOPUS/ORTHOCLADIUS	6
PARAMETRIOCNEMUS	1
PARATANYTARSUS	2
POLYPEDILUM	4
RHEOCRICOTOPUS	3
RHEOTANYTARSUS	15
THIENEMANNIMYIA GROUP	4
HEMERODROMIA	5
MOLOPHILUS	1
IRONOQUIA	6
DIPLECTRONA	1
LYPE	1
PTILOSTOMIS	2
CAECIDOTEA	5
GAMMARUS	23
SYNURELLA	1
MICROMENETUS SP.	1

Total Individuals 102

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	5	Pool Substrate Characterization	7
Bank Stability- Right Bank	3	Pool Variability	14
Vegetative Protection- Left Bank	4	Riparian Vegetative	9
Vegetative Protection- Right Bank	4	Zone Width- Left Bank	9
Channel Flow Status	14	Riparian Vegetative	9
Channel Alteration	13	Zone Width- Right Bank	9
Channel Sinuosity	7	Sediment Deposition	9
		Epifaunal Substrate	3
EPA Habitat Score			101
EPA Narrative Ranking			PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	621.4	Instream Wood Debris	16
Distance from Road (m)	200	Bank Erosion Extent (m)- Left	25
Percent Shading	80	Bank Erosion Extent (m)- Right	50
Epifaunal Substrate	3	Bank Erosion Severity – Left	1.5
Instream Habitat	3	Bank Erosion Severity- Right	1.5

PHI Score 62.7

PHI Narrative Ranking D

Water Chemistry

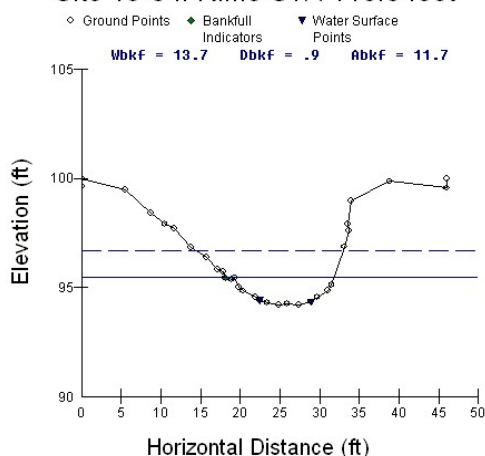
Dissolved Oxygen (mg/L)	4.99	Temperature (°C)	12.36
pH	6.24	Turbidity (NTU)	31.2
Specific Conductance (mS/cm)	0.221		

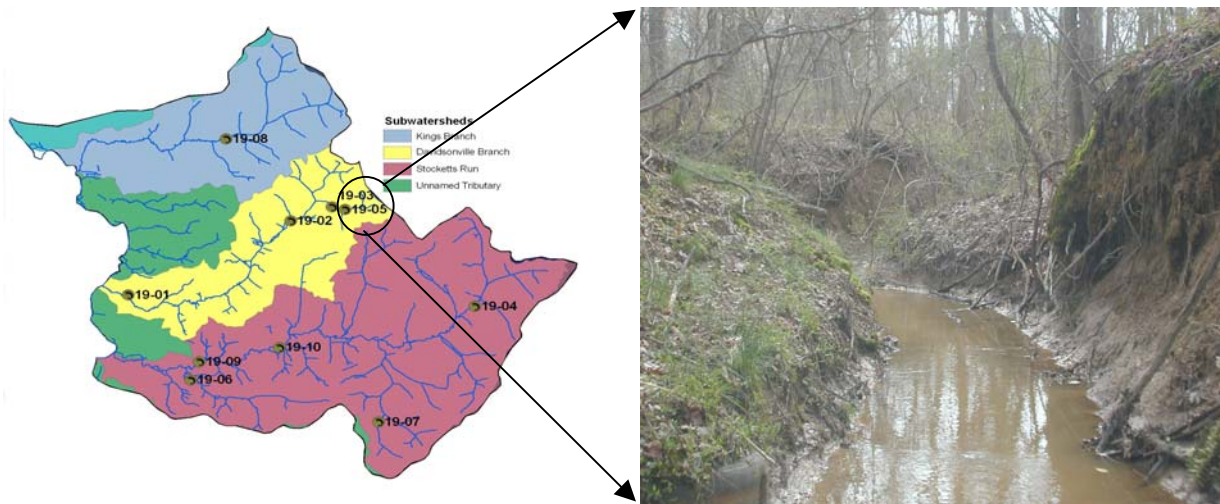
Geomorphic Assessments

Drainage area (acres)	621.4	Entrenchment Ratio:	1.35
Bankfull Width (ft):	13.72	Width:Depth Ratio:	16.14
Mean Depth (ft):	0.85	Sinuosity:	1.07
Bankfull X-Sec Area (sq ft):	11.71	Water Surface Slope (ft/ft):	0.002
Flood-Prone Width (ft):	18.53	Reach D50 (mm):	0.34

Rosgen Channel Classification: F 5/1

Site 19-04: Riffle STA 113.5 feet





Location/Site Access: Located in the Davidsonville Branch subwatershed upstream of the Foxhall Road stream crossing and approximately 500 ft upstream of site 19-03.
ADC Map 23 J-9 Latitude/Longitude: 38.9095284/76.63004121

Land Use Analysis:

Land Use	Acres	% Area
Open Space	4.8	3.3
Pasture/Hay	28.6	19.6
Residential 1/2-acre	20.8	14.3
Residential 1-acre	7.5	5.2
Residential 2-acre	9.6	6.6
Row Crops	44.2	30.4
Transportation	1.9	1.3
Water	3.3	2.2
Woods	23.8	16.3
Commercial	1.2	0.8
Grand Total	145.5	100.0

Impervious (acres)	Total Area Above site	% Impervious
7.6	145.5	5.2

Results:

- Biological condition - "Poor"
- Habitat scores in the "Non-Supporting" and "Partially Degraded" ranges
- Low instream habitat and epifaunal substrate scores combined with good bank stability resulted in the overall fair habitat scores
- Dominant taxa group were bivalves (*Pisidium* sp.) and midges (Chironomidae) with several genera of beetles and caddisflies
- The stream type was identified as B4/1c, the water surface slope was 0.011 ft/ft, and the median channel substrate was very fine gravel
- While classified as a stable B channel, the poor biological rating and mixed habitat conditions support the assumption that this stream is transitioning to an unstable G or F type channel.

Recommendations:

- Investigate the possible sources of sediment within the watershed.

19-05

Stocketts Run Sampling Unit

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	2.43

Total Taxa Score	3
EPT Taxa Score	3
% Ephemeroptera	1
Number of Ephemeroptera Score	1
% Intolerant to Urban Score	3
Scraper Taxa Score	3
% Climbers	3

Calculated Metric Values

Total Taxa	15
EPT Taxa	2
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	10.1
Scraper Taxa	1
% Climbers	5.05

Taxa List

ERYTHEMIS	1
HYDROBIUS	1
SIALIS	1
DIPLOCLADIUS	3
CRICOTOPUS/ORTHOCLADIUS	6
PARAMETRIOCNEMUS	13
HEMERODROMIA	1
CHEUMATOPSYCHE	2
IRONOQUIA	3
PHYSELLA	3
PISIDIUM	38
OLIGOCHAETA	18
CAECIDOTEA	2
SYNURELLA	6
PRIONCYPHON	1

Total Individuals 99

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Substrate Characterization	0
Bank Stability- Right Bank	3	Pool Variability	0
Vegetative Protection- Left Bank	8	Riparian Vegetative Zone Width- Left Bank	9
Vegetative Protection- Right Bank	8	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	13	Sediment Deposition	1
Channel Alteration	19	Epifaunal Substrate	4
Channel Sinuosity	7	EPA Habitat Score	88
		EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	145.5	Instream Wood Debris	10
Distance from Road (m)	320	Bank Erosion Extent (m)- Left	15
Percent Shading	70	Bank Erosion Extent (m)- Right	60
Epifaunal Substrate	4	Bank Erosion Severity – Right	1
Instream Habitat	3	Bank Erosion Severity- Left	2
		PHI Score	68.5
		PHI Narrative Ranking	PD

Water Chemistry

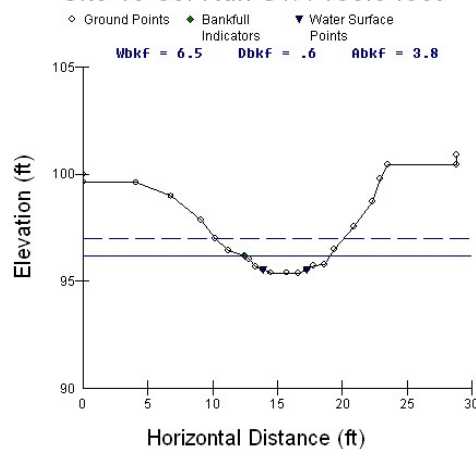
Dissolved Oxygen (mg/L)	5.21	Temperature (°C)	12.66
pH	5.97	Turbidity (NTU)	18.2
Specific Conductance (mS/cm)	0.131		

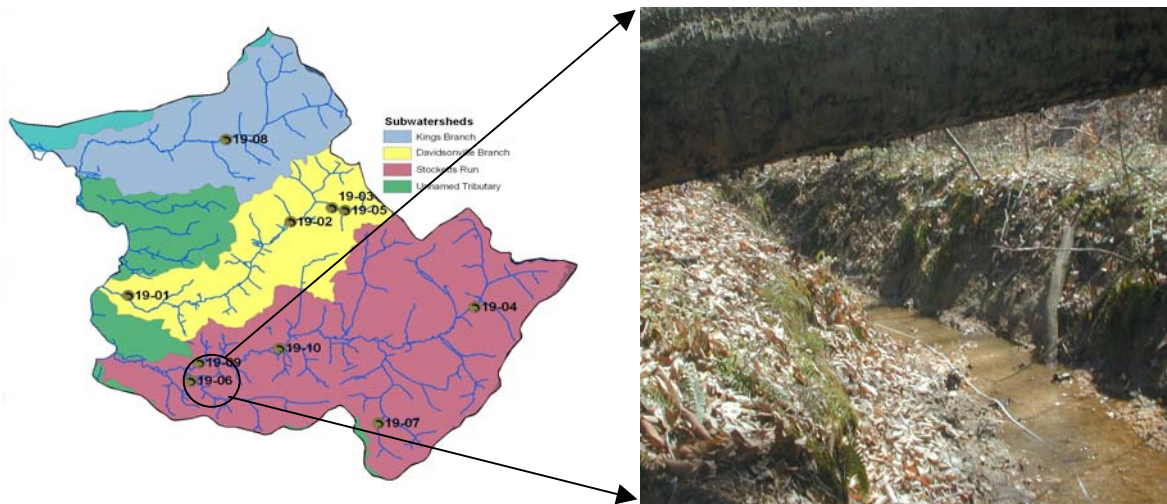
Geomorphic Assessments

Drainage area (acres)	145.5	Entrenchment Ratio:	1.51
Bankfull Width (ft):	6.54	Width:Depth Ratio:	12.08
Mean Depth (ft):	0.58	Sinuosity:	1.07
Bankfull X-Sec Area (sq ft):	3.79	Water Surface Slope (ft/ft):	0.011
Flood-Prone Width (ft):	9.89	Reach D50 (mm):	2.75

Rosgen Channel Classification: B 4/1 c

Site 19-05: Run STA 105.9 feet





Location/Site Access: Located in the Stocketts Run subwatershed, access from Sands Road by parking at the constructed house upstream of Stocketts Run. ADC Map 28 E-1
Latitude/Longitude: 38.882014/76.65818

Land Use Analysis:

Land Use	Acres	% Area
Open Space	43.4	12.0
Pasture/Hay	64.0	17.7
Residential 1/2-acre	6.8	1.9
Residential 1-acre	60.5	16.7
Residential 2-acre	6.6	1.8
Transportation	2.3	0.6
Woods	155.3	42.9
Row Crops	23.4	6.5
Total	362.4	100.0

Impervious (acres)	Total Area Above site	% Impervious
12.6	362.4	3.5

Results:

- Biological condition - "Fair"
- Habitat scores in the "Partially Supporting" and "Degraded" ranges
- Instream habitat was very poor while good ratings for channel alteration and remoteness resulted in the overall fair habitat ranking
- Dominant taxa group were blackflies (Simuliidae) with several genera of beetles and midges
- The stream type was identified as B5c, the water surface slope was 0.011 ft/ft, and the median channel substrate was very coarse sand
- Moderately impaired benthic community and stream habitat might be due to possible transition underway from B to G stream type

Recommendations:

- Investigate the watershed for uncontrolled stormwater runoff, possibly from new development.
- Implement additional SWM control if possible to control erosion and headcutting.

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	23
EPT Taxa	3
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	31.96
Scraper Taxa	1
% Climbers	6.2

Taxa List

AMPHINEMURA	5
LEUCTRA	1
CYPHON	1
CORYNONEURA	1
CRICOTOPUS	1
DIPLOCLADIUS	1
HETEROTRISOCLADIUS	1
MICROPSECTRA	1
CRICOTOPUS/ORTHOCLADIUS	5
PARAMETRIOCNEMUS	7
PHAENOPSECTRA	1
POLYPEDILUM	4
PSEUDORTHOCLADIUS	2
RHEOTANYTARSUS	1
THIENEMANNIMYIA GROUP	1
ZAVRELIMYIA	1
CULICOIDES	2
MOLOPHILUS	4
SIMULIUM	21
STEGOPTERNA	16
DIPLECTRONA	6
OLIGOCHAETA	13
PEDICIA	1

Total Individuals 97

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	4	Pool Substrate Characterization	8
Bank Stability- Right Bank	4	Pool Variability	1
Vegetative Protection- Left Bank	5	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	5	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	9	Sediment Deposition	10
Channel Alteration	19	Epifaunal Substrate	7
Channel Sinuosity	11		

EPA Habitat Score 103

EPA Narrative Ranking PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	362.4	Instream Wood Debris	3
Distance from Road (m)	390	Bank Erosion Extent (m)- Left	50
Percent Shading	80	Bank Erosion Extent (m)- Right	50
Epifaunal Substrate	7	Bank Erosion Severity - Left	1.5
Instream Habitat	2	Bank Erosion Severity- Right	1.5

PHI Score 64.1

PHI Narrative Ranking D

Water Chemistry

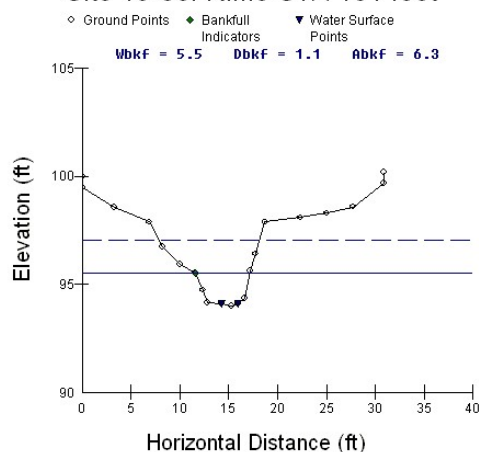
Dissolved Oxygen (mg/L)	4.68	Temperature (°C)	14.8
pH	4.52	Turbidity (NTU)	16
Specific Conductance (mS/cm)	0.097		

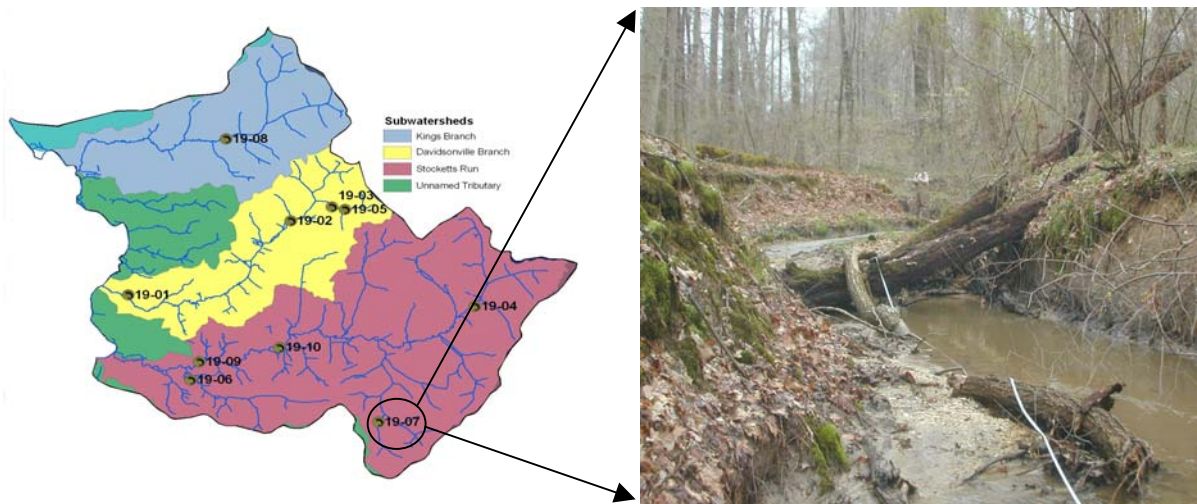
Geomorphic Assessments

Drainage area (acres)	362.4	Entrenchment Ratio:	1.86
Bankfull Width (ft):	5.54	Width:Depth Ratio:	4.82
Mean Depth (ft):	1.15	Sinuosity:	1
Bankfull X-Sec Area (sq ft):	6.35	Water Surface Slope (ft/ft):	0.011
Flood-Prone Width (ft):	10.29	Reach D50 (mm):	1

Rosgen Channel Classification: B 5c

Site 19-06: Riffle STA 131 feet





Location/Site Access: Located in the Stocketts Run subwatershed, access by parking at Glenwood Farm located off Harwood Road, long walk behind main house. ADC Map 28 C-3 Latitude/Longitude: 38.87506869/76.62414569

Land Use Analysis:

Land Use	Acres	% Area
Open Space	29.1	23.6
Residential 1-acre	9.8	8.0
Residential 2-acre	1.6	1.3
Transportation	4.4	3.5
Woods	52.7	42.8
Commercial	13.6	11.1
Pasture/Hay	1.8	1.5
Row Crops	10.1	8.2
Total	123.1	100.0

Impervious (acres)	Total Area Above site	% Impervious
12.9	123.1	10.4

Results:

- Biological condition - “Fair”
- Habitat scores in the “Supporting” and “Minimally Degraded” ranges
- Excellent instream habitat, epifaunal substrate, and instream woody debris resulted in the overall good habitat conditions
- Dominant taxa group were midges with several genera of bivalves, scuds, and aquatic worms
- The stream type was identified as B5c, the water surface slope was 0.01 ft/ft, and the median channel substrate was medium sand

Recommendations:

- Investigate possible nutrient impacts from surrounding agricultural land use.

19-07

Stocketts Run Sampling Unit

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	17
EPT Taxa	4
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	11.3
Scraper Taxa	2
% Climbers	38.1

Taxa List

DIAMESA	2
MICROTENDIPES	1
CRICOTOPUS/ORTHOCLADIUS	2
ORTHOCLADIUS	2
PARAMETRIOCNEMUS	4
POLYPEDILUM	29
ANTOCHA	1
DIPLECTRONA	1
IRONOQUIA	2
LYPE	2
POLYCENTROPUS	2
PHYSELLA	8
PISIDIUM	1
OLIGOCHAETA	4
CAECIDOTEA	1
GAMMARUS	28
MICROMENETUS	7

Total Individuals 97

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	7	Pool Substrate Characterization	13
Bank Stability- Right Bank	7	Pool Variability	14
Vegetative Protection- Left Bank	8	Riparian Vegetative	9
Vegetative Protection- Right Bank	8	Zone Width- Left Bank	9
Channel Flow Status	13	Riparian Vegetative	9
Channel Alteration	19	Zone Width- Right Bank	13
Channel Sinuosity	13	Sediment Deposition	13
		Epifaunal Substrate	16
		EPA Habitat Score	149
		EPA Narrative Ranking	S

Maryland Biological Stream Survey PHI

Drainage area (acres)	123.1	Instream Wood Debris	11
Distance from Road (m)	300	Bank Erosion Extent (m)- Left	13
Percent Shading	85	Bank Erosion Extent (m)- Right	8
Epifaunal Substrate	13	Bank Erosion Severity - Left	1.5
Instream Habitat	16	Bank Erosion Severity - Right	1

PHI Score 91.9

PHI Narrative Ranking MD

Water Chemistry

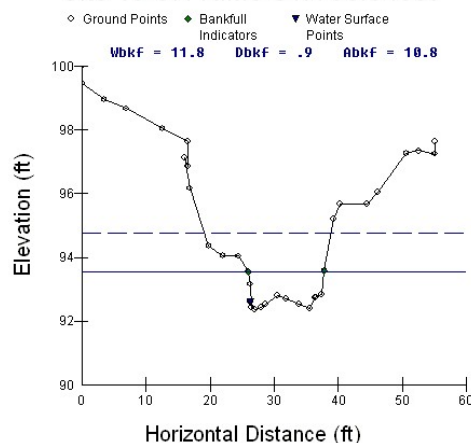
Dissolved Oxygen (mg/L)	5.25	Temperature (°C)	12.13
pH	6.21	Turbidity (NTU)	12.1
Specific Conductance (mS/cm)	0.17		

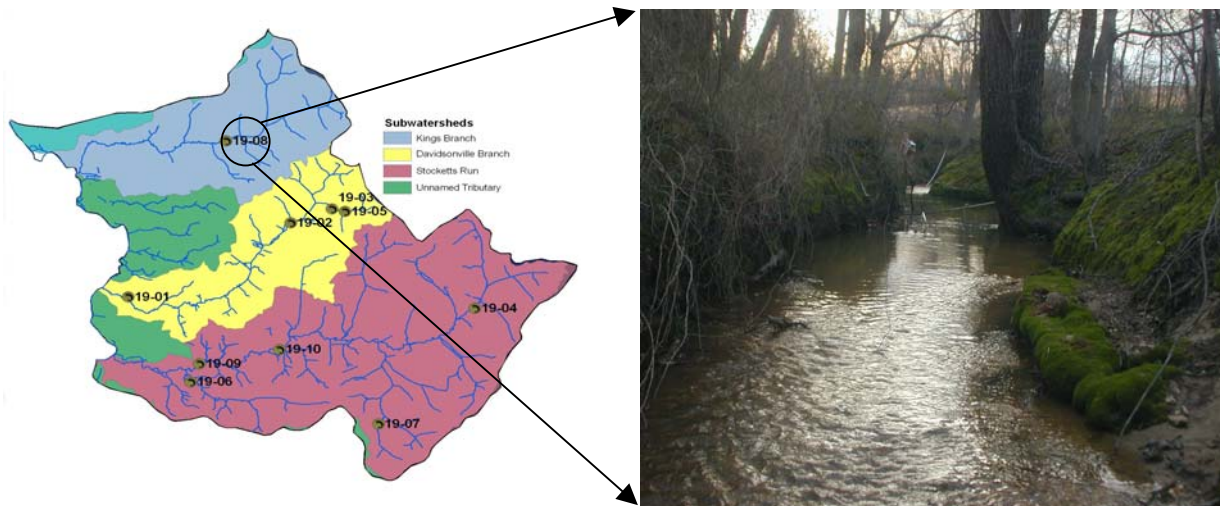
Geomorphic Assessments

Drainage area (acres)	123.1	Entrenchment Ratio:	1.68
Bankfull Width (ft):	11.79	Width:Depth Ratio:	12.82
Mean Depth (ft):	0.92	Sinuosity:	1.2
Bankfull X-Sec Area (sq ft):	10.8	Water Surface Slope (ft/ft):	0.01
Flood-Prone Width (ft):	19.76	Reach D50 (mm):	0.44

Rosgen Channel Classification: B 5c

Site 19-07: Riffle STA 90.5 feet





Location/Site Access: Located in the King Branch subwatershed behind blue house at the end of Royale Glen Avenue.

ADC Map 23 F-7 Latitude/Longitude: 38.92106717/76.65157443

Land Use Analysis:

Land Use	Acres	% Area
Open Space	97.7	11.5
Pasture/Hay	45.6	5.3
Residential 1/2-acre	242.2	28.4
Residential 1-acre	105.0	12.3
Residential 2-acre	32.9	3.9
Row Crops	108.3	12.7
Transportation	16.9	2.0
Water	1.3	0.2
Woods	183.8	21.6
Commercial	18.4	2.2
Industrial	0.7	0.1
Total	852.7	100.0

Impervious (acres)	Total Area Above site	% Impervious
89.5	852.7	10.5

Results:

- Biological condition - "Fair"
- Habitat scores in the "Partially Supporting" and "Partially Degraded" ranges
- Most habitat parameters scored within the fair range with bank stability being slightly better than others
- Dominant taxa group were aquatic worms and scuds (*Gammarus* sp.) with several genera of midges
- The stream type was identified as F5, the water surface slope was 0.002 ft/ft, and the median channel substrate was very coarse sand
- Impaired benthic communities and stream habitat may be due to the unstable nature of the F stream type

Recommendations:

- Investigate possible riparian buffer enhancement opportunities.
- Implement new SWM controls in older neighborhoods in the surrounding watershed

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	26
EPT Taxa	5
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	32.7
Scraper Taxa	2
% Climbers	13.9

Taxa List

AMPHINEMURA	4
NIGRONIA	1
MICROPSECTRA	10
MICROTENDIPES	6
CRICOTOPUS/ORTHOCLADIUS	2
PARAMETRIOCNEMUS	2
PARATANYTARSUS	3
PHAENOPSECTRA	3
POLYPEDILUM	2
RHEOTANYTARSUS	1
THIENEMANNIMYIA GROUP	1
ANTOCHA	2
CERATOPOGON	1
HEMERODROMIA	2
TABANUS	1
CHEUMATOPSYCHE	9
HYDROPSYCHE	1
IRONOQUIA	2
NEOPHYLAX	9
PHYSELLA	1
PISIDIUM	2
OLIGOCHAETA	15
CAECIDOTEA	5
GAMMARUS	13
SYNURELLA	2
TURBELLARIA	1

Total Individuals 101

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	3	Pool Substrate Characterization	11
Bank Stability- Right Bank	7	Pool Variability	11
Vegetative Protection- Left Bank	9	Riparian Vegetative Zone Width- Left Bank	8
Vegetative Protection- Right Bank	3	Riparian Vegetative Zone Width- Right Bank	3
Channel Flow Status	16	Sediment Deposition	9
Channel Alteration	18	Epifaunal Substrate	11
Channel Sinuosity	12		
		EPA Habitat Score	121
		EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	852.7	Instream Wood Debris	5
Distance from Road (m)	200	Bank Erosion Extent (m)- Left	50
Percent Shading	70	Bank Erosion Extent (m)- Right	10
Epifaunal Substrate	11	Bank Erosion Severity- Left	1.5
Instream Habitat	11	Bank Erosion Severity- Right	1

PHI Score	70.2
PHI Narrative Ranking	PD

Water Chemistry

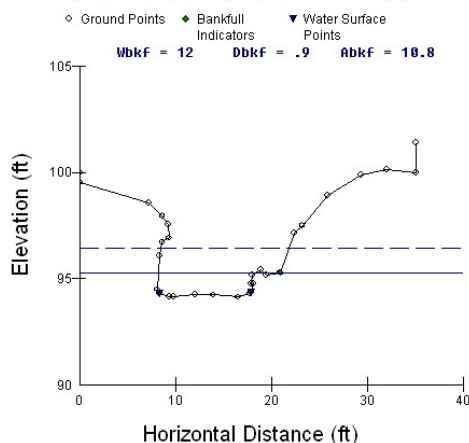
Dissolved Oxygen (mg/L)	5.6	Temperature (°C)	10.84
pH	5.78	Turbidity (NTU)	12.4
Specific Conductance (mS/cm)	0.224		

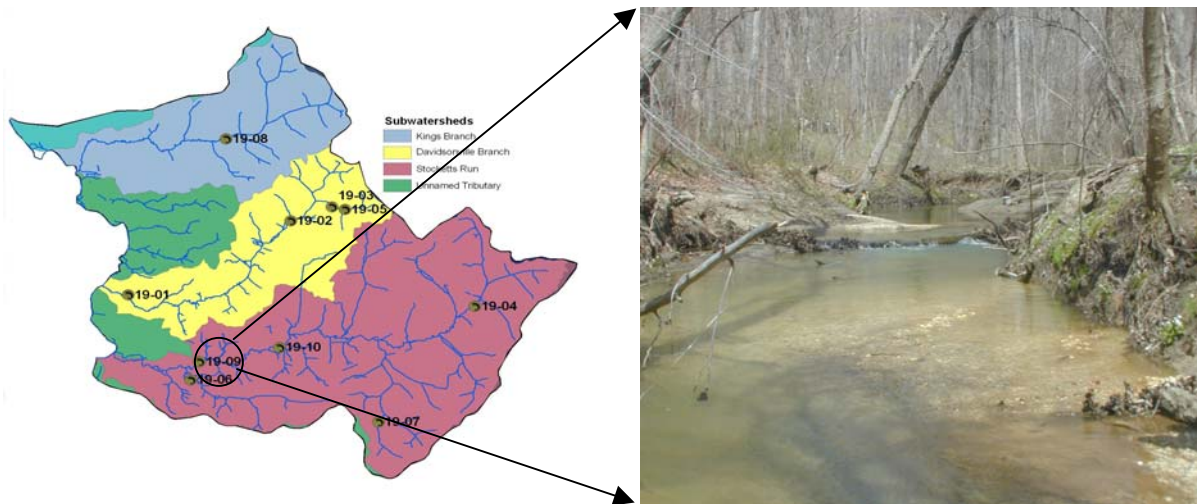
Geomorphic Assessments

Drainage area (acres)	852.7	Entrenchment Ratio:	1.11
Bankfull Width (ft):	11.97	Width:Depth Ratio:	13.3
Mean Depth (ft):	0.9	Sinuosity:	1.17
Bankfull X-Sec Area (sq ft):	10.79	Water Surface Slope (ft/ft):	0.002
Flood-Prone Width (ft):	13.31	Reach D50 (mm):	1.43

Rosgen Channel Classification: F 5

Site 19-08: Riffle STA 31 feet





Location/Site Access: Located in the Stocketts Run subwatershed, access near last house at the end of Ivy Lane then walk through ATV trails.

ADC Map 28 E-1 Latitude/Longitude: 38.88496/76.65659

Land Use Analysis:

Land Use	Acres	% Area
Commercial	32.6	0.9
Open Space	195.8	5.4
Pasture/Hay	278.3	7.6
Residential 1/2-acre	258.6	7.1
Residential 1-acre	260.4	7.2
Residential 2-acre	131.4	3.6
Row Crops	396.0	10.9
Transportation	57.4	1.6
Water	3.0	0.1
Woods	1929.5	53.0
Utility	98.2	2.7
Total	3641.1	100.0

Impervious (acres)	Total Area Above site	% Impervious
164.5	3641.1	4.5

Results:

- Biological condition - “Good”
- Habitat scores in the “Supporting” and “Partially Degraded” ranges
- Low remoteness scores and high bank stability scores combined with other metrics scoring fair resulted in the overall fair habitat condition
- Dominant taxa group was a stonefly taxa (*Isoperla* sp.) with several genera of caddisflies, midges, and mayflies
- The stream type was identified as F5, the water surface slope was 0.001 ft/ft, and the median channel substrate was very coarse sand
- Typically, F stream types are considered unstable. However, The “Good” biological rating and “Fair” habitat rating for this reach may imply that the stream is in transition to a more stable form

Recommendations:

- Implement watershed protection strategies to maintain high biological conditions.

19-09

Stocketts Run Sampling Unit

IBI and Metric Scores

Narrative Rating	Good
Overall Index	4.71
Total Taxa Score	5
EPT Taxa Score	5
% Ephemeroptera	5
Number of Ephemeroptera Score	5
% Intolerant to Urban Score	5
Scraper Taxa Score	3
% Climbers	5

Calculated Metric Values

Total Taxa	27
EPT Taxa	9
% Ephemeroptera	12.6
Number of Ephemeroptera	2
% Intolerant to Urban	53.7
Scraper Taxa	1
% Climbers	12.6

Taxa List

ACERPENNA	7
EPHEMERELLA	5
AMPHINEMURA	3
CLIOPERLA	1
ISOPERLA	23
ENOCHRUS	1
HELICHUS	1
DIPLOCLADIUS	2
NANOCLADIUS	1
PARAKIEFFERIELLA	6
PARATANYTARSUS	7
POLYPEDILUM	6
TANYTARSUS	5
THIENEMANNIMYIA GROUP	3
TVETENIA	1
HEMERODROMIA	2
HEXATOMA	1
SIMULIUM	2
TABANUS	1
CHEUMATOPSYCHE	1
HYDATOPHYLAX	1
IRONOQUIA	7
POLYCENTROPUS	1
OLIGOCHAETA	2
CAECIDOTEA	1
GAMMARUS	2
SYNURELLA	2

Total Individuals 95

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Substrate Characterization	11
Bank Stability- Right Bank	6	Pool Variability	15
Vegetative Protection- Left Bank	7	Riparian Vegetative	10
Vegetative Protection- Right Bank	7	Zone Width- Left Bank	10
Channel Flow Status	12	Riparian Vegetative	10
Channel Alteration	19	Zone Width- Right Bank	10
Channel Sinuosity	14	Sediment Deposition	8
		Epifaunal Substrate	11

EPA Habitat Score 136

EPA Narrative Ranking S

Maryland Biological Stream Survey PHI

Drainage area (acres)	3641.1	Instream Wood Debris	11
Distance from Road (m)	75	Bank Erosion Extent (m)- Left	30
Percent Shading	80	Bank Erosion Extent (m)- Right	30
Epifaunal Substrate	11	Bank Erosion Severity- Left	1
Instream Habitat	13	Bank Erosion Severity- Right	1

PHI Score 67.1

PHI Narrative Ranking PD

Water Chemistry

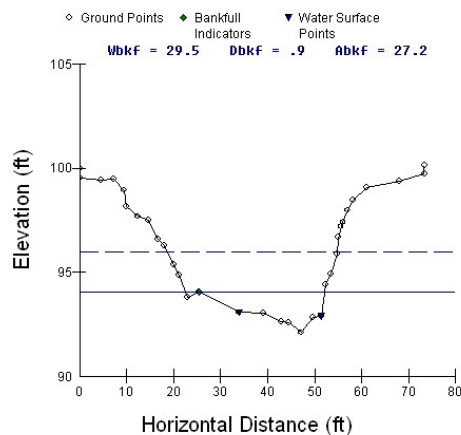
Dissolved Oxygen (mg/L)	6.15	Temperature (°C)	12.51
pH	6.79	Turbidity (NTU)	11.4
Specific Conductance (mS/cm)	0.149		

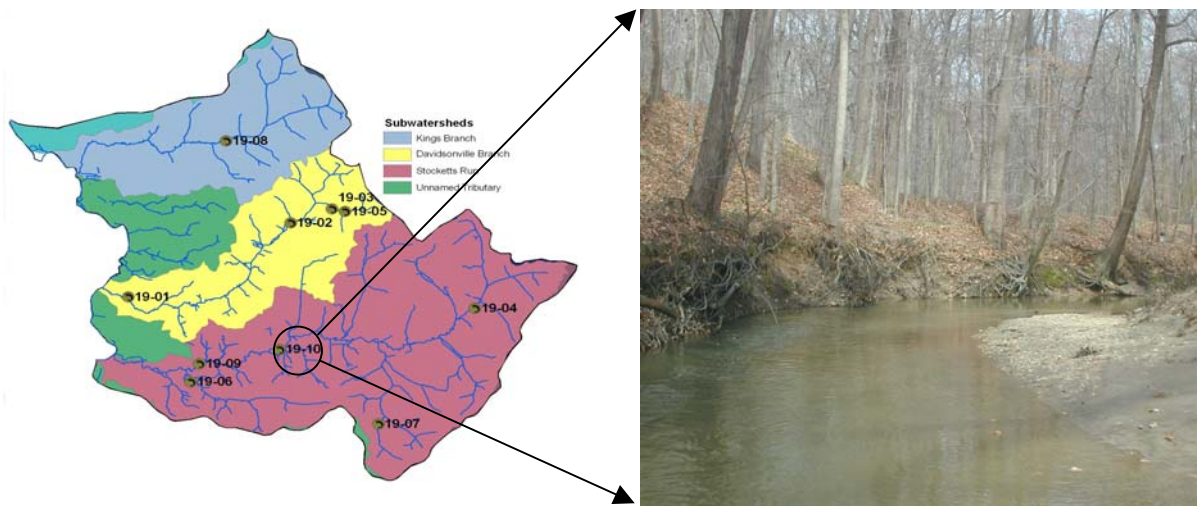
Geomorphic Assessments

Drainage area (acres)	3641.1	Entrenchment Ratio:	1.22
Bankfull Width (ft):	29.48	Width:Depth Ratio:	32.04
Mean Depth (ft):	0.92	Sinuosity:	1.2
Bankfull X-Sec Area (sq ft):	27.18	Water Surface Slope (ft/ft):	0.001
Flood-Prone Width (ft):	36.09	Reach D50 (mm):	1.25

Rosgen Channel Classification: F 5

Site 19-09: Run STA 110 feet





Location/Site Access: Located in the Srocketts Run subwatershed just downstream of the Harwood Road stream crossing.

ADC Map 23 H-13 Latitude/Longitude: 38.88725148/76.64205829

Land Use Analysis:

Land Use	Acres	% Area
Commercial	32.6	1.0
Open Space	184.5	5.6
Pasture/Hay	224.6	6.8
Residential 1/2-acre	241.3	7.3
Residential 1-acre	230.0	7.0
Residential 2-acre	115.0	3.5
Row Crops	396.0	12.0
Transportation	49.2	1.5
Water	3.0	0.1
Woods	1713.6	52.1
Utility	98.2	3.0
Total	3288.1	100.0

Impervious (acres)	Total Area Above site	% Impervious
150.9	3288.1	4.6

Results:

- Biological condition - “Good”
- Habitat scores in the “Partially Supporting” and “Degraded” ranges
- Low remoteness scores combined with good instream habitat and bank stability scores resulted in the overall fair habitat conditions
- Dominant taxa group was mayflies (*Ephemerella* sp.) with several genera of midges and scuds
- The stream type was identified as F5/1, the water surface slope was 0.003 ft/ft, and the median channel substrate was very coarse sand
- Typically, F stream types are considered unstable but the “Good” biological rating and moderate habitat ratings suggest that the stream is in transition to a more stable form

Recommendations:

- Reforest the riparian buffer next to Harwood Rd.
- Investigate potential impact of the culvert just upstream of the site.

19-10

Stocketts Run Sampling Unit

IBI and Metric Scores

Narrative Rating	Good
Overall Index	4.43

Total Taxa Score	5
EPT Taxa Score	5
% Ephemeroptera	5
Number of Ephemeroptera Score	5
% Intolerant to Urban Score	5
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	26
EPT Taxa	9
% Ephemeroptera	20.4
Number of Ephemeroptera	3
% Intolerant to Urban	28.6
Scraper Taxa	0
% Climbers	8.2

Taxa List

EPHEMERELLA	15
ACERPENNA	4
LEPTOPHLEBIA	1
CALOPTERYX	1
AMPHINEMURA	1
ISOPERLA	2
DINEUTUS	1
NIGRONIA	1
DIPLOCLADIUS	1
MICROTENDIPES	4
CRICOTOPUS/ORTHOCLADIUS	6
PARAMETRIOCNEMUS	1
PARAPHAENOCLADIUS	1
PARATANYTARSUS	12
POLYPEDILUM	2
RHEOTANYTARSUS	1
THIENEMANNIMYIA GROUP	9
HEMERODROMIA	2
MOLOPHILUS	1
CHEUMATOPSYCHE	9
HYDATOPHYLAX	1
HYDROPSYCHE	1
PTILOSTOMIS	3
CAECIDOTEA	1
GAMMARUS	14
SYNURELLA	3

Total Individuals 98

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	3	Pool Substrate Characterization	8
Bank Stability- Right Bank	4	Pool Variability	13
Vegetative Protection- Left Bank	7	Riparian Vegetative Zone Width- Left Bank	4
Vegetative Protection- Right Bank	7	Riparian Vegetative Zone Width- Right Bank	9
Channel Flow Status	9	Sediment Deposition	6
Channel Alteration	19	Epifaunal Substrate	7
Channel Sinuosity	13		

EPA Habitat Score 109

EPA Narrative Ranking PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	3288.1	Instream Wood Debris	7
Distance from Road (m)	40	Bank Erosion Extent (m)- Left	60
Percent Shading	60	Bank Erosion Extent (m)- Right	20
Epifaunal Substrate	7	Bank Erosion Severity- Left	2
Instream Habitat	14	Bank Erosion Severity- Right	1.5

PHI Score 55.8

PHI Narrative Ranking D

Water Chemistry

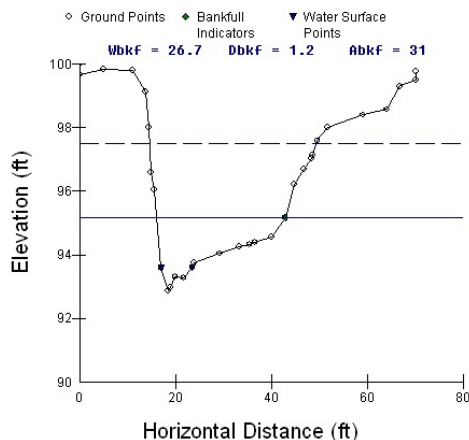
Dissolved Oxygen (mg/L)	5.33	Temperature (°C)	14.71
pH	6.54	Turbidity (NTU)	15.6
Specific Conductance (mS/cm)	0.151		

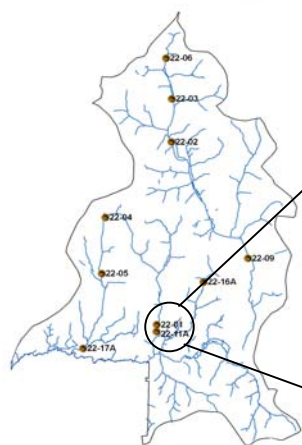
Geomorphic Assessments

Drainage area (acres)	3288.1	Entrenchment Ratio:	1.3
Bankfull Width (ft):	26.7	Width:Depth Ratio:	23.02
Mean Depth (ft):	1.16	Sinuosity:	2.05
Bankfull X-Sec Area (sq ft):	30.95	Water Surface Slope (ft/ft):	0.003
Flood-Prone Width (ft):	34.76	Reach D50 (mm):	2

Rosgen Channel Classification: F 5/1

Site 19-10: Riffle STA 80 feet





Location/Site Access: Located within the Lyons Creek subwatershed, access from behind the school bus lot on McKendree Road.

ADC Map 33 A-8 Latitude/Longitude: 38.77354105/-76.62080208

Land Use Analysis:

Land Use	Acres	% Area
Commercial	6.0	1.2
Residential 1-acre	36.5	7.1
Residential 2-acre	5.7	1.1
Row Crops	162.8	31.6
Transportation	10.3	2.0
Woods	196.8	38.2
Pasture/Hay	26.6	5.2
Open Space	42.9	8.3
Residential 1/2-acre	27.4	5.3
Total	515.0	100.0

Impervious (acres)	Total Area Above site	% Impervious
23.1	515.0	4.5

Results:

- Biological condition - “Good”
- Habitat scores in the “Partially Supporting” and “Partially Degraded” ranges
- Good vegetative protection and instream woody debris and rootwads
- Dominant taxa group were several midge taxa with aquatic worms and amphipods
- Stream type was identified as a G4c, the water surface slope was 0.004 ft/ft, and the median channel substrate was very fine gravel
- Typically, G stream types are considered unstable. However, the “Good” biological rating and adequate habitat rating for this reach may imply that the stream is in transition to a more stable form

Recommendations:

- Evaluate possibility of upstream reforestation in former agricultural tracts as well as residential areas.

IBI and Metric Scores

Narrative Rating	Good
Overall Index	4.14

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

Calculated Metric Values

Total Taxa	22
EPT Taxa	6
% Ephemeroptera	6.1
Number of Ephemeroptera	2
% Intolerant to Urban	9.1
Scraper Taxa	5
% Climbers	26.3

Taxa List

ACERPENNA	1
STENONEMA	5
AMPHINEMURA	1
PLECOPTERA	4
DUBIRAPHIA	1
HELICHUS	2
OPTIOSERVUS	1
DIPLOCLADIUS	1
CRICOTOPUS/ORTHOCLADIUS	4
PARALAUTERBORNIELLA	1
PARAMETRIOCNEMUS	2
POLYPEDILUM	19
PSEUDORTHOCLADIUS	2
RHEOTANYTARSUS	17
TANYTARSUS	6
THIENEMANNIMYIA GROUP	1
TABANIDAE	1
TIPULA	1
DIPLECTRONA	1
NEOPHYLAX	1
OLIGOCHAETA	15
GAMMARUS	12

Total Individuals 99

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	2	Pool Substrate Characterization	7
Bank Stability- Right Bank	6	Pool Variability	12
Vegetative Protection- Left Bank	8	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	8	Riparian Vegetative Zone Width- Right Bank	9
Channel Flow Status	14	Sediment Deposition	7
Channel Alteration	16	Epifaunal Substrate	8
Channel Sinuosity	14	EPA Habitat Score	121

EPA Narrative Ranking PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	515.0	Instream Wood Debris	11
Distance from Road (m)	260	Bank Erosion Extent- Left	70
Percent Shading	60	Bank Erosion Extent- Right	5
Epifaunal Substrate	8	Bank Erosion Severity -Left	1.5
Instream Habitat	10	Bank Erosion Severity -Right	1

PHI Score 70.6

PHI Narrative Ranking PD

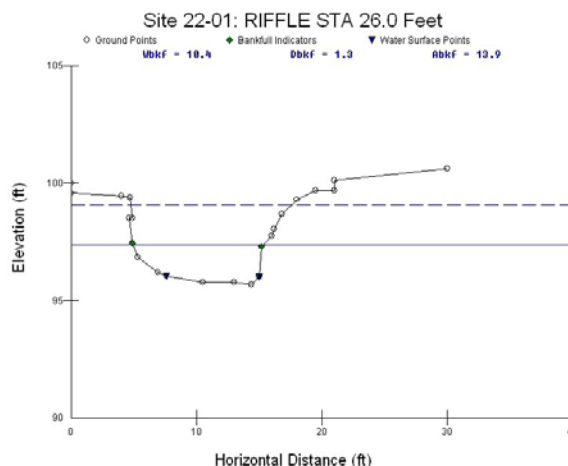
Water Chemistry

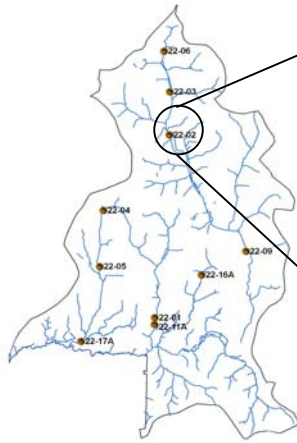
Dissolved Oxygen (mg/L)	5.88	Temperature (°C)	11.65
pH	6.29	Turbidity (NTU)	13.6
Specific Conductance (mS/cm)	0.152		

Geomorphic Assessments

Drainage area (acres)	515.0	Entrenchment Ratio:	1.23
Bankfull Width (ft):	10.39	Width:Depth Ratio:	7.75
Mean Depth (ft):	1.34	Sinuosity:	1.14
Bankfull X-Sec Area (sq ft):	13.91	Water Surface Slope (ft/ft):	0.004
Flood-Prone Width (ft):	12.82	Reach D50 (mm):	2.22

Rosgen Channel Classification: G4c





Location/Site Access: Located within the Lyons Creek subwatershed, access from Brooks Wood Road.

ADC Map 33 A-2 Latitude/Longitude: 38.80706/-76.61736

Land Use Analysis:

Land Use	Acres	% Area
Commercial	16.2	1.6
Open Space	50.8	5.1
Residential 1/2-acre	53.8	5.4
Residential 1-acre	71.5	7.2
Row Crops	388.7	39.3
Transportation	14.9	1.5
Water	1.9	0.2
Woods	314.5	31.8
Pasture/Hay	57.6	5.8
Residential 2-acre	19.0	1.9
Grand Total	988.9	100.0

Impervious (acres)	Total Area Above site	% Impervious
41.1	988.9	4.2

Results:

- Biological condition - "Poor"
- Habitat scores in the "Partially Supporting" and "Degraded" ranges
- Optimal channel alteration and riparian vegetative width with marginal instream habitat and poor epifaunal substrate
- Dominant taxa group were several midge taxa with amphipods and aquatic worms
- No geomorphic assessment was completed due to property access denial

Recommendations:

- Evaluate the impacts of current agricultural activities.
- Remove livestock access from stream to reduce localized stream bank erosion.

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	19
EPT Taxa	3
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	1.0
Scraper Taxa	1
% Climbers	41.3

Taxa List

CALOPTERYX	1
NEMOURIDAE	1
MICROTENDIPES	1
CRICOTOPUS/ORTHOCLADIUS	5
PARALAUTERBORNIELLA	3
PARAMETRIOCNEMUS	3
PARATENDIPES	1
POLYPEDILUM	35
RHEOCRICOTOPUS	4
RHEOTANYTARSUS	16
TANYTARSUS	6
THIENEMANNIMYIA GROUP	12
EMPIDIDAE	1
HEMERODROMIA	2
PILARIA	1
HYDATOPHYLAX	1
LYPE	1
OLIGOCHAETA	4
GAMMARUS	6

Total Individuals 104

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	4	Pool Substrate Characterization	7
Bank Stability- Right Bank	4	Pool Variability	8
Vegetative Protection- Left Bank	3	Riparian Vegetative Zone Width- Left Bank	9
Vegetative Protection- Right Bank	3	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	17	Sediment Deposition	8
Channel Alteration	19	Epifaunal Substrate	3
Channel Sinuosity	10	EPA Habitat Score	105
		EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	988.9	Instream Wood Debris	4
Distance from Road (m)	670	Bank Erosion Extent- Left	75
Percent Shading	70	Bank Erosion Extent- Right	75
Epifaunal Substrate	3	Bank Erosion Severity -Left	1
Instream Habitat	7	Bank Erosion Severity -Right	1

PHI Score	62.0
PHI Narrative Ranking	D

Water Chemistry

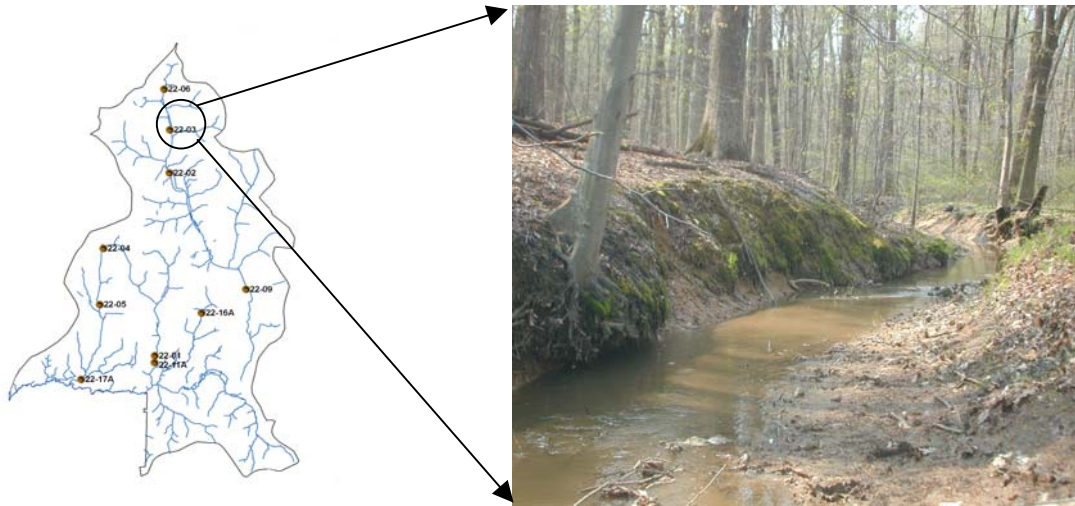
Dissolved Oxygen (mg/L)	9.68	Temperature (°C)	19.49
pH	6.55	Turbidity (NTU)	41.3
Specific Conductance (mS/cm)	0.18		

Geomorphic Assessments

Drainage Area (mi ²):	Entrenchment Ratio:
Bankfull Width (ft):	Width:Depth Ratio:
Mean Depth (ft):	Sinuosity:
Bankfull X-Sec Area (sq ft):	Water Surface Slope (ft/ft):
Flood-Prone Width (ft):	Reach D50 (mm):

Rosgen Channel Classification:

**The geomorphic assessment
was not completed
due to property access denial.**



Location/Site Access: Located within the Lyons Creek subwatershed, access from Frank Moreland Road.

ADC Map 29 A-13 Latitude/Longitude: 38.77122/-76.62080

Land Use Analysis:

Land Use	Acres	% Area
Commercial	16.3	2.8
Open Space	30.7	5.2
Pasture/Hay	22.5	3.8
Residential 1/2-acre	4.9	0.8
Residential 1-acre	47.9	8.2
Row Crops	260.5	44.4
Transportation	8.4	1.4
Water	1.9	0.3
Woods	182.7	31.1
Residential 2-acre	11.3	1.9
Total	586.9	100.0

Impervious (acres)	Total Area Above site	% Impervious
28.3	586.9	4.8

Results:

- Biological condition - “Very Poor”
- Habitat scores in the “Non-Supporting” and “Degraded” ranges
- Very poor instream woody debris and rootwads and poor instream habitat and epifaunal substrate
- Dominant taxa group were aquatic worms with several midge taxa
- Stream type was identified as a B5c, the water surface slope was 0.001 ft/ft, and the median channel substrate was very fine sand
- Typically, B channels are stable. However, the “Very Poor” biological ratings and impaired habitat conditions may indicate that this reach is transitioning to an unstable form

Recommendations:

- Investigate upstream sources of sedimentation and instability, especially current agriculture.
- Investigate removal of frequent farm culverts upstream of the reach.

IBI and Metric Scores

Narrative Rating	Very Poor
Overall Index	1.57

Total Taxa Score	1
EPT Taxa Score	1
% Ephemeroptera	1
Number of Ephemeroptera Score	1
% Intolerant to Urban Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	12
EPT Taxa	0
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	1.0
Scraper Taxa	0
% Climbers	24.0

Taxa List

DIPLOCLADIUS	2
CRICOTOPUS/ORTHOCLADIUS	7
PARAKIEFFERIELLA	1
PARALAUTERBORNIELLA	11
POLYPEDILUM	22
PSECTROTANYPUS	1
RHEOCRICOTOPUS	1
RHEOTANYTARSUS	1
TANYTARSUS	2
PISIDIUM	12
OLIGOCHAETA	39
GAMMARUS	1

Total Individuals 100

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	4	Pool Substrate Characterization	6
Bank Stability- Right Bank	5	Pool Variability	6
Vegetative Protection- Left Bank	3	Riparian Vegetative Zone Width- Left Bank	9
Vegetative Protection- Right Bank	4	Riparian Vegetative Zone Width- Right Bank	9
Channel Flow Status	9	Sediment Deposition	2
Channel Alteration	16	Epifaunal Substrate	2
Channel Sinuosity	6	EPA Habitat Score	81
		EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	586.9	Instream Wood Debris	0
Distance from Road (m)	975	Bank Erosion Extent- Left	60
Percent Shading	90	Bank Erosion Extent- Right	25
Epifaunal Substrate	1	Bank Erosion Severity -Left	1
Instream Habitat	2	Bank Erosion Severity -Right	1.5

PHI Score 61.7

PHI Narrative Ranking D

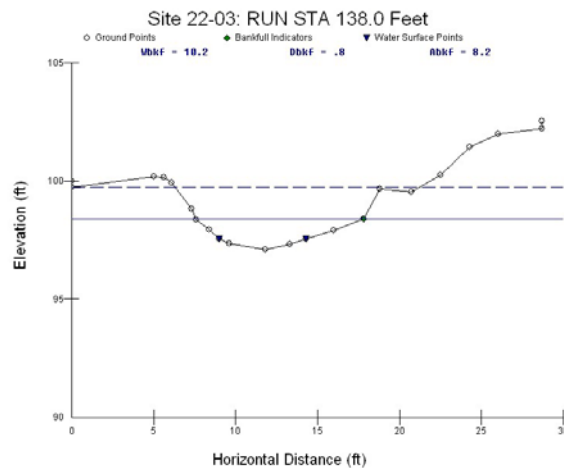
Water Chemistry

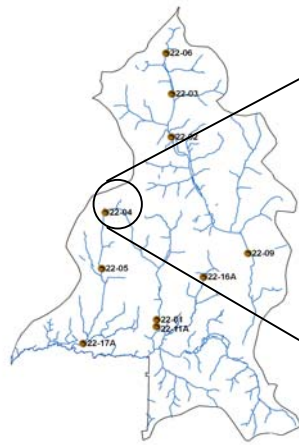
Dissolved Oxygen (mg/L)	5.63	Temperature (°C)	12.8
pH	6.2	Turbidity (NTU)	13.9
Specific Conductance (mS/cm)	0.187		

Geomorphic Assessments

Drainage area (acres)	586.9	Entrenchment Ratio:	1.48
Bankfull Width (ft):	10.22	Width:Depth Ratio:	12.62
Mean Depth (ft):	0.81	Sinuosity:	1.07
Bankfull X-Sec Area (sq ft):	8.23	Water Surface Slope (ft/ft):	0.001
Flood-Prone Width (ft):	15.11	Reach D50 (mm):	0.1

Rosgen Channel Classification: B5c





Location/Site Access: Located within the Lyons Creek subwatershed, access from behind the big grey barn on Little Road.

ADC Map 32 J-5 Latitude/Longitude: 38.79320231/-76.63217698

Land Use Analysis:

Land Use	Acres	% Area
Pasture/Hay	1.3	1.3
Residential 1-acre	15.8	16.8
Row Crops	49.8	53.1
Transportation	0.8	0.9
Woods	26.1	27.9
Total	93.7	100.0

Impervious (acres)	Total Area Above site	% Impervious
2.8	93.7	3.0

Results:

- Biological condition - "Fair"
- Habitat scores in the "Partially Supporting" and "Partially Degraded" ranges
- Optimal channel alteration with good shading and bank erosion
- Dominant taxa group were several midge and amphipod taxa with aquatic worms
- Stream type was identified as a B4c, the water surface slope was 0.012 ft/ft, and the median channel substrate was fine gravel

Recommendations:

- Reforest riparian buffer that is currently mowed up to stream bank on left side.
- Investigate direct sediment inputs from very nearby farm fields.

22-04

Lyons Creek Sampling Unit

IBI and Metric Scores

Narrative Rating	Fair
Overall Index	3.00

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

Calculated Metric Values

Total Taxa	19
EPT Taxa	4
% Ephemeroptera	0.9
Number of Ephemeroptera	1
% Intolerant to Urban	23.2
Scraper Taxa	0
% Climbers	13.0

Taxa List

LEPTOPHLEBIA	1
CALOPTERYX	2
PARAMETRIOCNEMUS	9
PHAENOPSECTRA	2
POLYPEDILUM	9
RHEOTANYTARSUS	23
TANYTARSUS	1
THIENEMANNIMYIA GROUP	7
CHRYSOPS	1
PSEUDOLIMNOPHILA	1
STEGOPTERNA	1
TIPULA	1
CHEUMATOPSYCHE	2
HYDATOPHYLAX	2
IRONOQUIA	6
OLIGOCHAETA	19
CAECIDOTEA	13
SYNURELLA	6
NEOPORUS	2

Total Individuals 108

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	8	Pool Substrate Characterization	6
Bank Stability- Right Bank	8	Pool Variability	1
Vegetative Protection- Left Bank	7	Riparian Vegetative	9
Vegetative Protection- Right Bank	7	Zone Width- Left Bank	
		Riparian Vegetative	2
		Zone Width- Right Bank	
Channel Flow Status	16	Sediment Deposition	14
Channel Alteration	16	Epifaunal Substrate	7
Channel Sinuosity	6	EPA Habitat Score	107
		EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	93.7	Instream Wood Debris	6
Distance from Road (m)	370	Bank Erosion Extent- Left	25
Percent Shading	70	Bank Erosion Extent- Right	25
Epifaunal Substrate	7	Bank Erosion Severity -Left	1
Instream Habitat	4	Bank Erosion Severity -Right	1

PHI Score 75.1

PHI Narrative Ranking PD

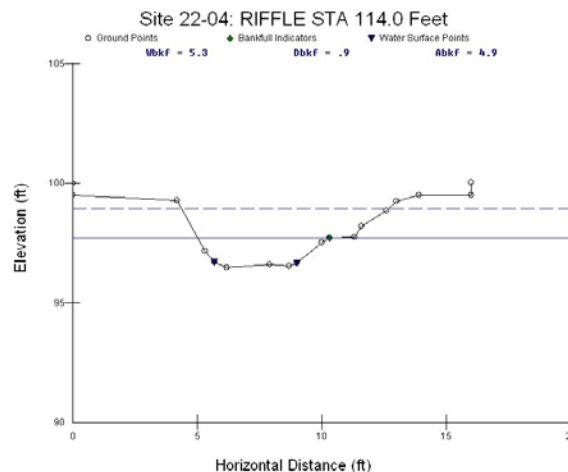
Water Chemistry

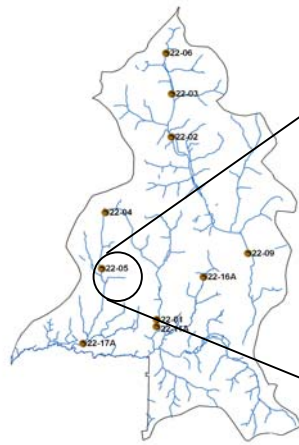
Dissolved Oxygen (mg/L)	8.24	Temperature (°C)	14.58
pH	6.01	Turbidity (NTU)	8.8
Specific Conductance (mS/cm)	0.159		

Geomorphic Assessments

Drainage area (acres)	93.7	Entrenchment Ratio:	1.57
Bankfull Width (ft):	5.29	Width:Depth Ratio:	5.75
Mean Depth (ft):	0.92	Sinuosity:	1.12
Bankfull X-Sec Area (sq ft):	4.87	Water Surface Slope (ft/ft):	0.012
Flood-Prone Width (ft):	8.33	Reach D50 (mm):	4.57

Rosgen Channel Classification: B4c





Location/Site Access: Located within the Lyons Creek subwatershed, access from Route 258.

ADC Map 32 J-6 Latitude/Longitude: 38.7829957/-76.63304944

Land Use Analysis:

Land Use	Acres	% Area
Open Space	3.1	1.2
Pasture/Hay	33.5	13.0
Residential 1-acre	26.5	10.3
Residential 2-acre	3.2	1.2
Row Crops	100.7	39.0
Transportation	0.9	0.3
Woods	90.6	35.1
Total	258.3	100.0

Impervious (acres)	Total Area Above site	% Impervious
6.0	258.3	2.3

Results:

- Biological condition - "Fair"
- Habitat scores in the "Non-Supporting" and "Degraded" ranges
- Optimal channel alteration and shading with poor instream woody debris and epifaunal substrate
- Dominant taxa group were amphipods (*Gammarus* sp.) and several midge taxa
- Stream type was identified as a G4c, the water surface slope was 0.004 ft/ft, and the median channel substrate was very fine gravel
- Impaired benthic communities and stream habitat may be due to the unstable nature of the G stream type

Recommendations:

- Investigate upstream for sources of instability and sediment.

22-05

Lyons Creek Sampling Unit

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	17
EPT Taxa	4
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	8.2
Scraper Taxa	1
% Climbers	16.3

Taxa List

AMPHINEMURA	1
HELICHUS	1
NIGRONIA	1
MICROPSECTRA	2
PARAKIEFFERIELLA	1
PARAMETRIOCNEMUS	1
POLYPEDILUM	12
RHEOTANYTARSUS	4
TVETENIA	1
CERATOPOGON	1
CHRYSOPS	1
TIPULA	2
DIPLECTRONA	1
HYDATOPHYLAX	1
IRONOQUIA	3
OLIGOCHAETA	2
GAMMARUS	63

Total Individuals 98

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	3	Pool Substrate Characterization	6
Bank Stability- Right Bank	3	Pool Variability	1
Vegetative Protection- Left Bank	5	Riparian Vegetative Zone Width- Left Bank	8
Vegetative Protection- Right Bank	5	Riparian Vegetative Zone Width- Right Bank	8
Channel Flow Status	11	Sediment Deposition	5
Channel Alteration	16	Epifaunal Substrate	2
Channel Sinuosity	9	EPA Habitat Score	82
		EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	258.3	Instream Wood Debris	8
Distance from Road (m)	85	Bank Erosion Extent- Left	50
Percent Shading	90	Bank Erosion Extent- Right	40
Epifaunal Substrate	5	Bank Erosion Severity -Left	1.5
Instream Habitat	2	Bank Erosion Severity -Right	1.5

PHI Score 62

PHI Narrative Ranking D

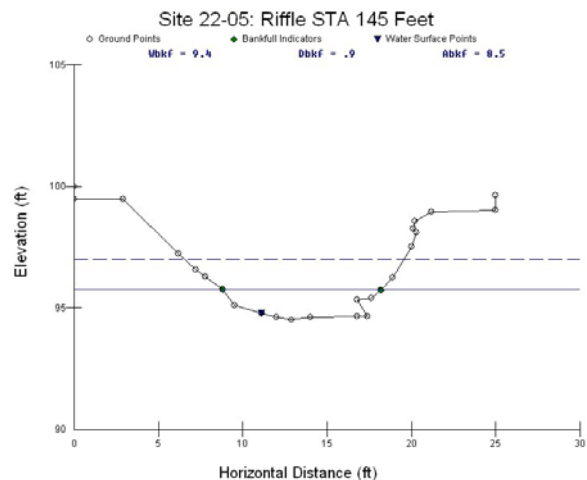
Water Chemistry

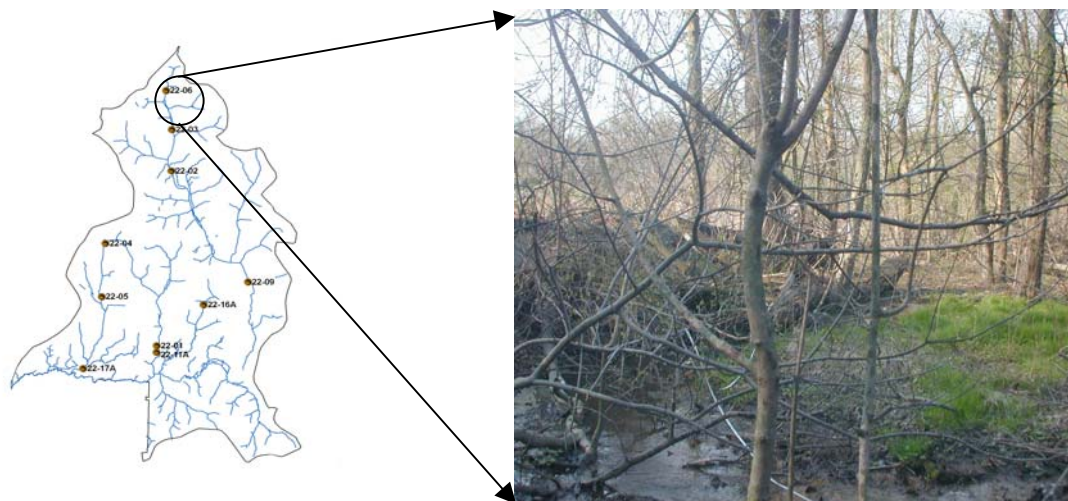
Dissolved Oxygen (mg/L)	5.6	Temperature (°C)	15.1
pH	6.35	Turbidity (NTU)	19.7
Specific Conductance (mS/cm)	0.139		

Geomorphic Assessments

Drainage area (acres)	258.3	Entrenchment Ratio:	1.38
Bankfull Width (ft):	9.4	Width:Depth Ratio:	10.33
Mean Depth (ft):	0.91	Sinuosity:	1.1
Bankfull X-Sec Area (sq ft):	8.54	Water Surface Slope (ft/ft):	0.004
Flood-Prone Width (ft):	12.98	Reach D50 (mm):	2.67

Rosgen Channel Classification: G4c





Location/Site Access: Located within the Lyons Creek subwatershed, access from Bella Place off of Old Solomons Island Road.

ADC Map 29 A-12 Latitude/Longitude: 8.82250262/-76.61849809

Land Use Analysis:

Land Use	Acres	% Area
Open Space	11.1	10.9
Pasture/Hay	0.6	0.6
Residential 1/2-acre	4.9	4.8
Residential 1-acre	16.9	16.5
Residential 2-acre	0.9	0.9
Transportation	1.1	1.1
Woods	39.4	38.6
Row Crops	27.1	26.5
Commercial	0.1	0.1
Total	102.3	100.0

Impervious (acres)	Total Area Above site	% Impervious
3.8	102.3	3.7

Results:

- Biological condition - “Very Poor”
- Habitat scores in the “Partially Supporting” and “Partially Degraded” ranges
- Optimal channel alteration and bank stability with poor epifaunal substrate quality
- Dominant taxa group were amphipods (*Caecidotea* sp.) and aquatic worms
- The stream type was identified as an E5, the water surface slope was 0.011 ft/ft, and the median channel substrate was fine sand
- Biological conditions appear somewhat depressed in comparison to habitat quality observed, so an unknown water quality

Recommendations:

- Explore reforestation of large, active agricultural tracts close to riparian area
- Perform additional assessments necessary to determine if water quality problem exists here

22-06

Lyons Creek Sampling Unit

IBI and Metric Scores

Narrative Rating	Very Poor
Overall Index	1.86
Total Taxa Score	1
EPT Taxa Score	3
% Ephemeroptera	1
Number of Ephemeroptera Score	1
% Intolerant to Urban Score	5
Scraper Taxa Score	1
% Climbers	1

Calculated Metric Values

Total Taxa	13
EPT Taxa	2
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	56.7
Scraper Taxa	0
% Climbers	0

Taxa List

LIBELLULIDAE	1
AMPHINEMURA	1
DIPLOCLADIUS	8
CRICOTOPUS/ORTHOCLADIUS	6
RHEOCRICOTOPUS	5
STENOCHIRONOMUS	1
THIENEMANNIMYIA GROUP	1
ZAVRELIMYIA	1
IRONOQUIA	2
OLIGOCHAETA	17
CAECIDOTEA	43
BIVALVIA	1
SYNURELLA	10

Total Individuals 97

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	10	Pool Substrate Characterization	7
Bank Stability- Right Bank	10	Pool Variability	2
Vegetative Protection- Left Bank	9	Riparian Vegetative Zone Width- Left Bank	9
Vegetative Protection- Right Bank	9	Riparian Vegetative Zone Width- Right Bank	7
Channel Flow Status	18	Sediment Deposition	3
Channel Alteration	19	Epifaunal Substrate	3
Channel Sinuosity	14		

EPA Habitat Score 120

EPA Narrative Ranking PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	102.3	Instream Wood Debris	8
Distance from Road (m)	3	Bank Erosion Extent- Left	0
Percent Shading	75	Bank Erosion Extent- Right	0
Epifaunal Substrate	3	Bank Erosion Severity -Left	0
Instream Habitat	8	Bank Erosion Severity -Right	0

PHI Score 66.3

PHI Narrative Ranking PD

Water Chemistry

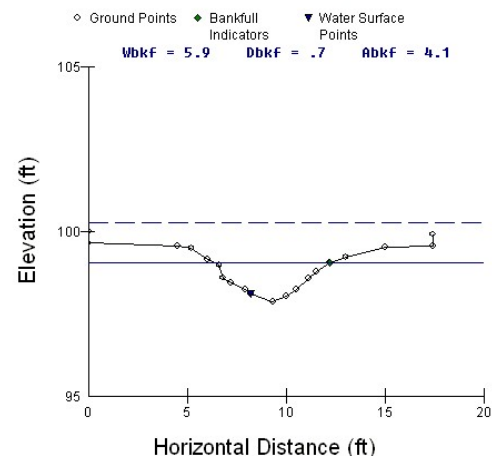
Dissolved Oxygen (mg/L)	6.04	Temperature (°C)	11.82
pH	5.88	Turbidity (NTU)	13.8
Specific Conductance (mS/cm)	0.183		

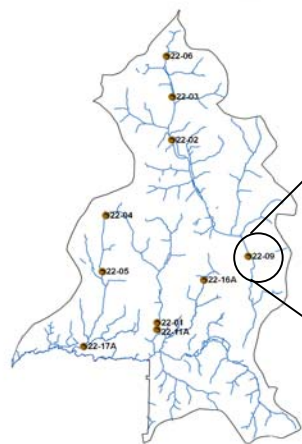
Geomorphic Assessments

Drainage area (acres)	102.3	Entrenchment Ratio:	17.01
Bankfull Width (ft):	5.88	Width:Depth Ratio:	8.52
Mean Depth (ft):	0.69	Sinuosity:	1.45
Bankfull X-Sec Area (sq ft):	4.08	Water Surface Slope (ft/ft):	0.011
Flood-Prone Width (ft):	100	Reach D50 (mm):	0.19

Rosgen Channel Classification: E5

Site 22-06: Run STA 14 feet





Location/Site Access: Located within the Lyons Creek subwatershed, access from behind SHA facility on Route 258.

ADC Map 33 D-6 Latitude/Longitude: 38.78570461/-76.6004207

Land Use Analysis:

Land Use	Acres	% Area
Open Space	122.1	4.9
Residential 1/2-acre	150.2	6.1
Residential 1-acre	166.4	6.7
Residential 2-acre	87.9	3.5
Transportation	40.7	1.6
Woods	862.5	34.8
Commercial	34.4	1.4
Pasture/Hay	198.6	8.0
Row Crops	804.6	32.5
Open Wetland	4.0	0.2
Water	7.4	0.3
Total	2478.9	100.0

Impervious (acres)	Total Area Above site	% Impervious
107.7	2478.9	4.3

Results:

- Biological condition - “Fair”
- Habitat scores in the “Partially Supporting” and “Severely Degraded” ranges
- Very poor instream habitat, epifaunal substrate, and shading
- Dominant taxa groups were blackflies (*Simulium* sp.), aquatic worms, and amphipods
- The stream type was identified as an E6, the water surface slope was 0.0004 ft/ft, and the median channel substrate was silt/clay
- Typically, E channels are stable, but habitat conditions show signs of degradation. However, biological community condition is enhanced compared to observed habitat conditions. This reach might be transitioning to an unstable form

Recommendations:

- Investigate effects of straightening and channelization throughout reach.
- Consider additional reforestation of floodplain and riparian zone.

22-09

Lyons Creek Sampling Unit

IBI and Metric Scores

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

Calculated Metric Values

Total Taxa	19
EPT Taxa	3
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	30.5
Scraper Taxa	1
% Climbers	9.5

Taxa List

DIPLOCLADIUS	9
CRICOTOPUS/ORTHOCLADIUS	13
PARAKIEFFERIELLA	1
POLYPEDILUM	4
STENOCHIRONOMUS	1
THIENEMANNIMYIA GROUP	2
HEMERODROMIA	1
SIMULIUM	19
CHEUMATOPSYCHE	1
IRONOQUIA	2
LYPE	2
OLIGOCHAETA	10
CAECIDOTEA	8
HYALELLA	2
SYNURELLA	12
NEOPORUS	1
GEORTHOCLADIUS	1
MICROPSECTRA	5
ALLOGNOSTA	1

Total Individuals 95

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	5	Pool Substrate Characterization	11
Bank Stability- Right Bank	6	Pool Variability	14
Vegetative Protection- Left Bank	2	Riparian Vegetative Zone Width- Left Bank	9
Vegetative Protection- Right Bank	3	Riparian Vegetative Zone Width- Right Bank	9
Channel Flow Status	17	Sediment Deposition	11
Channel Alteration	12	Epifaunal Substrate	1
Channel Sinuosity	1		

EPA Habitat Score 101

EPA Narrative Ranking PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	2478.9	Instream Wood Debris	8
Distance from Road (m)	85	Bank Erosion Extent- Left	60
Percent Shading	5	Bank Erosion Extent- Right	20
Epifaunal Substrate	0	Bank Erosion Severity -Left	1.5
Instream Habitat	1	Bank Erosion Severity -Right	1

PHI Score 31.3

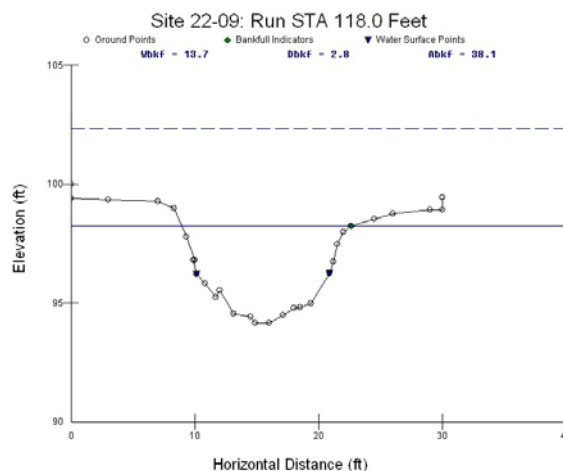
PHI Narrative Ranking SD

Water Chemistry

Dissolved Oxygen (mg/L)	6.45	Temperature (°C)	19.64
pH	7.37	Turbidity (NTU)	16.7
Specific Conductance (mS/cm)	0.163		

Geomorphic Assessments

Drainage area (acres)	2478.9	Entrenchment Ratio:	21.91
Bankfull Width (ft):	13.69	Width:Depth Ratio:	4.91
Mean Depth (ft):	2.79	Sinuosity:	1.05
Bankfull X-Sec Area (sq ft):	38.14	Water Surface Slope (ft/ft):	0.0004
Flood-Prone Width (ft):	300	Reach D50 (mm):	0.03

Rosgen Channel Classification: E6



Location/Site Access: Located within the Lyons Creek subwatershed, access from behind school bus lot on McKendree Road.

ADC Map 33 A-8 Latitude/Longitude: 38.77226727/-76.62088793

Land Use Analysis:

Land Use	Acres	% Area
Open Space	44.4	8.4
Pasture/Hay	26.7	5.0
Residential 1/2-acre	27.4	5.2
Residential 1-acre	36.9	6.9
Residential 2-acre	5.8	1.1
Row Crops	162.9	30.7
Transportation	10.2	1.9
Woods	210.9	39.7
Commercial	6.1	1.1
Total	531.3	100.0

Impervious (acres)	Total Area Above site	% Impervious
23.2	531.3	4.4

Results:

- Biological condition - "Fair"
- Habitat scores in the "Partially Supporting" and "Degraded" ranges
- Very poor epifaunal substrate with good vegetative protection
- Dominant taxa group were several midge taxa with aquatic worms and amphipods
- The stream type was identified as a G5c, the water surface slope was 0.002 ft/ft, and the median channel substrate was medium sand
- Moderately impaired benthic communities and stream habitat may be due to the unstable nature of the G stream type

Recommendations:

- Evaluate possibility of upstream reforestation in former agricultural tracts as well as residential areas.

IBI and Metric Scores

Narrative Rating	Fair
Overall Index	3.57

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

Calculated Metric Values

Total Taxa	23
EPT Taxa	3
% Ephemeroptera	2.9
Number of Ephemeroptera	1
% Intolerant to Urban	1.9
Scraper Taxa	3
% Climbers	16.5

Taxa List

STENONEMA	3
CALOPTERYX	3
HELICHUS	1
STENELMIS	1
NIGRONIA	1
DIPLOCLADIUS	1
MICROTENDIPES	1
NANOCLADIUS	1
CRICOTOPUS/ORTHOCLADIUS	1
PARAMETRIOCNEMUS	1
PARATANYTARSUS	41
POLYPEDILUM	5
RHEOTANYTARSUS	4
TANYTARSUS	8
THIENEMANNIMYIA GROUP	2
TVETENIA	1
BEZZIA	1
CHRYSOPS	1
HEMERODROMIA	1
CHEUMATOPSYCHE	1
HYDROPSYCHE	2
OLIGOCHAETA	11
GAMMARUS	11

Total Individuals 103

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	4	Pool Substrate Characterization	12
Bank Stability- Right Bank	4	Pool Variability	8
Vegetative Protection- Left Bank	9	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	9	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	14	Sediment Deposition	6
Channel Alteration	19	Epifaunal Substrate	4
Channel Sinuosity	15	EPA Habitat Score	124
		EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	531.3	Instream Wood Debris	9
Distance from Road (m)	230	Bank Erosion Extent- Left	30
Percent Shading	50	Bank Erosion Extent- Right	30
Epifaunal Substrate	4	Bank Erosion Severity -Left	1.5
Instream Habitat	10	Bank Erosion Severity -Right	1.5

PHI Score 64.1

PHI Narrative Ranking D

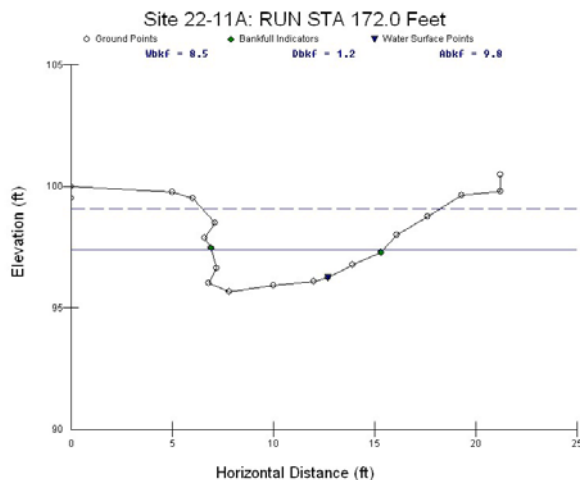
Water Chemistry

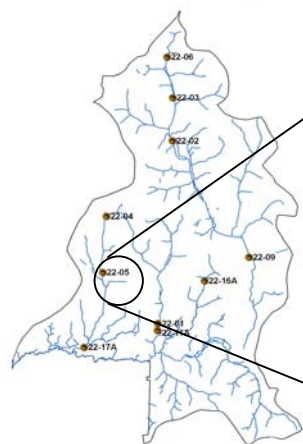
Dissolved Oxygen (mg/L)	6.03	Temperature (°C)	9.97
pH	6.37	Turbidity (NTU)	14.7
Specific Conductance (mS/cm)	0.149		

Geomorphic Assessments

Drainage area (acres)	531.3	Entrenchment Ratio:	1.39
Bankfull Width (ft):	8.47	Width:Depth Ratio:	7.3
Mean Depth (ft):	1.16	Sinuosity:	1.17
Bankfull X-Sec Area (sq ft):	9.82	Water Surface Slope (ft/ft):	0.002
Flood-Prone Width (ft):	11.79	Reach D50 (mm):	0.4

Rosgen Channel Classification: G5c





Location/Site Access: Located within the Lyons Creek subwatershed, access from Route 258.

ADC Map 33 B-6 Latitude/Longitude: 38.78136439/-76.61035946

Land Use Analysis:

Land Use	Acres	% Area
Commercial	0.9	0.8
Open Space	17.9	15.0
Pasture/Hay	5.5	4.6
Residential 1/2-acre	12.0	10.0
Residential 1-acre	10.4	8.7
Row Crops	9.1	7.6
Transportation	5.9	4.9
Woods	57.7	48.3
Total	119.4	100.0

Impervious (acres)	Total Area Above site	% Impervious
7.7	119.4	6.5

Results:

- Biological condition - "Poor"
- Habitat scores in the "Non-Supporting" and "Partially Degraded" ranges
- High bank erosion and poor epifaunal substrate with good shading
- Dominant taxa group were amphipods (*Gammarus* sp.) with several midge taxa
- The stream type was identified as an F5, the water surface slope was 0.008 ft/ft, and the median channel substrate was medium sand
- Impaired benthic communities and stream habitat may be due to the unstable nature of the F stream type

Recommendations:

- Reforest riparian buffer, which is currently being mowed and otherwise impacted by residential development.

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	2.43

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

Calculated Metric Values

Total Taxa	17
EPT Taxa	2
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	9.0
Scraper Taxa	1
% Climbers	8.0

Taxa List

MICROVELIA	1
CHAETOCLADIUS	3
DIPLOCLADIUS	3
CRICOTOPUS/ORTHOCLADIUS	19
PARATENDIPES	1
POLYPEDILUM	7
PSEUDORTHOCCLADIUS	1
RHEOCRICOTOPUS	8
XYLOTOPUS	1
HYDATOPHYLAX	1
LYPE	3
PISIDIUM	2
OLIGOCHAETA	5
CAECIDOTEA	7
GAMMARUS	36
SYNURELLA	1
HYDROPORINAE	1

Total Individuals 100

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	3	Pool Substrate Characterization	6
Bank Stability- Right Bank	3	Pool Variability	5
Vegetative Protection- Left Bank	8	Riparian Vegetative Zone Width- Left Bank	9
Vegetative Protection- Right Bank	8	Riparian Vegetative Zone Width- Right Bank	9
Channel Flow Status	9	Sediment Deposition	8
Channel Alteration	17	Epifaunal Substrate	4
Channel Sinuosity	6		

EPA Habitat Score 95

EPA Narrative Ranking NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	119.4	Instream Wood Debris	5
Distance from Road (m)	265	Bank Erosion Extent- Left	55
Percent Shading	95	Bank Erosion Extent- Right	60
Epifaunal Substrate	4	Bank Erosion Severity -Left	1.5
Instream Habitat	6	Bank Erosion Severity -Right	1.5

PHI Score 71.4

PHI Narrative Ranking PD

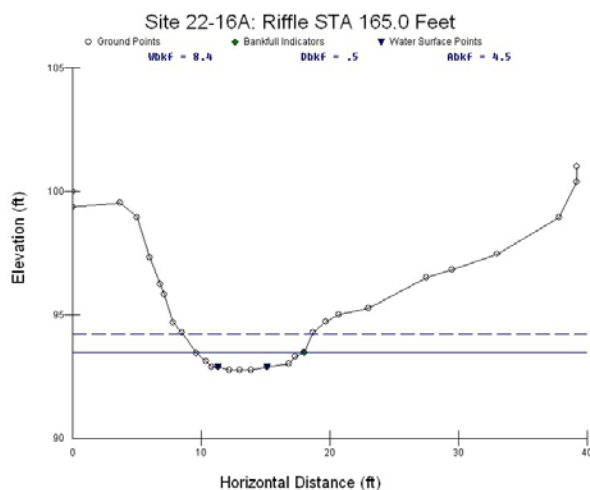
Water Chemistry

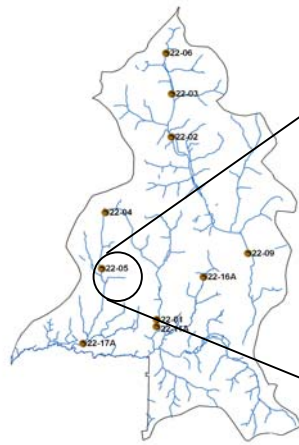
Dissolved Oxygen (mg/L)	11.25	Temperature (°C)	9.9
pH	6.41	Turbidity (NTU)	0
Specific Conductance (mS/cm)	0.191		

Geomorphic Assessments

Drainage area (acres)	119.4	Entrenchment Ratio:	1.19
Bankfull Width (ft):	8.44	Width:Depth Ratio:	15.92
Mean Depth (ft):	0.53	Sinuosity:	1.2
Bankfull X-Sec Area (sq ft):	4.46	Water Surface Slope (ft/ft):	0.008
Flood-Prone Width (ft):	10.06	Reach D50 (mm):	0.43

Rosgen Channel Classification: F5





Location/Site Access: Located within the Lyons Creek subwatershed, access from McKendree Road West.

ADC Map 32 H-9 Latitude/Longitude: 38.76923/-76.63726

Land Use Analysis:

Land Use	Acres	% Area
Commercial	14.7	1.8
Open Space	43.1	5.3
Pasture/Hay	194.6	24.1
Residential 1/2-acre	8.2	1.0
Residential 1-acre	68.5	8.5
Residential 2-acre	45.5	5.6
Row Crops	126.0	15.6
Transportation	14.8	1.8
Woods	292.8	36.2
Total	808.2	100.0

Impervious (acres)	Total Area Above site	% Impervious
38.9	808.2	4.8

Results:

- Biological condition - "Fair"
- Habitat scores in the "Partially Supporting" and "Degraded" ranges
- High bank erosion with poor epifaunal substrate and instream woody debris
- Dominant taxa group were several midge taxa and amphipods (*Gammarus* sp.)
- The stream type was identified as a G4c, the water surface slope was 0.008 ft/ft, and the median channel substrate was very fine gravel
- Impaired benthic communities and stream habitat may be due to the unstable nature of the G stream type

Recommendations:

- Reforest large fallow fields just adjacent to riparian buffer zone.

IBI and Metric Scores

Narrative Rating	Fair
Overall Index	3.29

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

Calculated Metric Values

Total Taxa	18
EPT Taxa	4
% Ephemeroptera	3.8
Number of Ephemeroptera	1
% Intolerant to Urban	7.7
Scraper Taxa	3
% Climbers	26.0

Taxa List

STENONEMA	4
CALOPTERYX	1
AMPHINEMURA	2
ANCYRONYX	1
HELICHUS	1
NIGRONIA	4
ORTHOCLADIINAE	3
CRICOTOPUS/ORTHOCLADIUS	8
POLYPEDILUM	22
RHEOTANYTARSUS	12
EMPIDIDAE	1
HEMERODROMIA	1
SIMULIUM	2
DIPLECTRONA	1
HYDROPSYCHE	1
OLIGOCHAETA	2
GAMMARUS	37
SYNURELLA	1

Total Individuals 104

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	3	Pool Substrate Characterization	9
Bank Stability- Right Bank	3	Pool Variability	7
Vegetative Protection- Left Bank	4	Riparian Vegetative Zone Width- Left Bank	9
Vegetative Protection- Right Bank	4	Riparian Vegetative Zone Width- Right Bank	9
Channel Flow Status	10	Sediment Deposition	15
Channel Alteration	19	Epifaunal Substrate	4
Channel Sinuosity	7		

EPA Habitat Score 103

EPA Narrative Ranking PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	808.2	Instream Wood Debris	3
Distance from Road (m)	290	Bank Erosion Extent- Left	68
Percent Shading	90	Bank Erosion Extent- Right	73
Epifaunal Substrate	4	Bank Erosion Severity -Left	1.5
Instream Habitat	6	Bank Erosion Severity -Right	1.5

PHI Score 58.7

PHI Narrative Ranking D

Water Chemistry

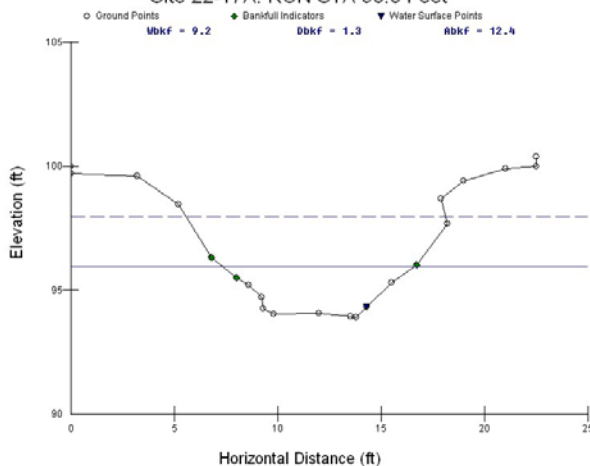
Dissolved Oxygen (mg/L)	11.65	Temperature (°C)	9.03
pH	6.71	Turbidity (NTU)	3.9
Specific Conductance (mS/cm)	0.155		

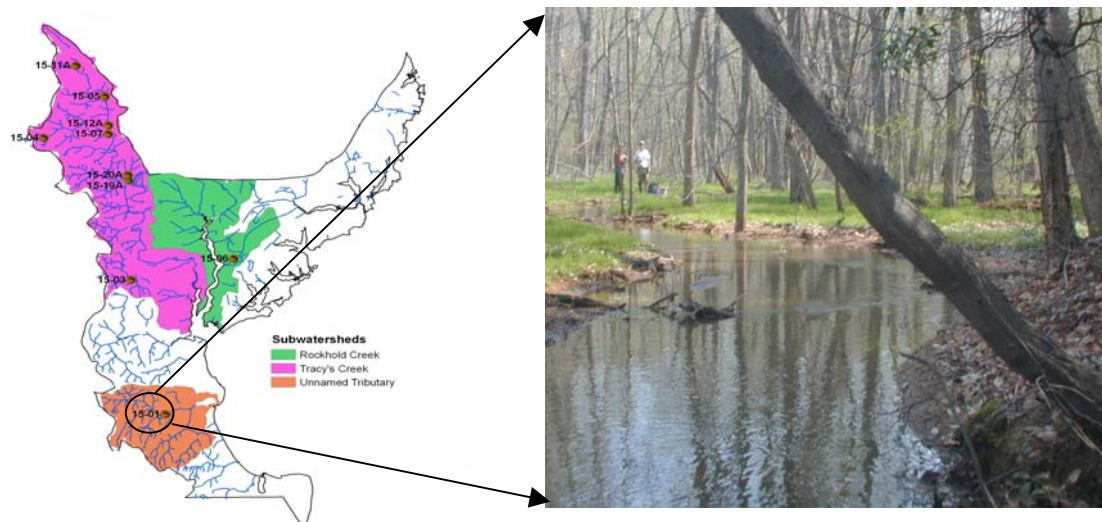
Geomorphic Assessments

Drainage area (acres)	808.2	Entrenchment Ratio:	1.36
Bankfull Width (ft):	9.21	Width:Depth Ratio:	6.87
Mean Depth (ft):	1.34	Sinuosity:	1.09
Bankfull X-Sec Area (sq ft):	12.36	Water Surface Slope (ft/ft):	0.008
Flood-Prone Width (ft):	12.53	Reach D50 (mm):	2.13

Rosgen Channel Classification: G4c

Site 22-17A: RUN STA 90.0 Feet





Location/Site Access: Located within a subwatershed of an unnamed tributary, access from Fairhaven Road.

ADC Map 33 G-13 Latitude/Longitude: 38.74594/-76.57281

Land Use Analysis:

Land Use	Acres	% Area
Commercial	4.8	0.7
Residential 1-acre	61.2	8.8
Residential 2-acre	5.5	0.8
Row Crops	10.4	1.5
Transportation	11.7	1.7
Woods	517.0	74.0
Open Space	17.7	2.5
Residential 1/2-acre	32.8	4.7
Utility	37.3	5.3
Grand Total	698.5	100.0

Impervious (acres)	Total Area Above site	% Impervious
17.4	698.5	2.5

Results:

- Biological condition - “Very Poor”
- Habitat scores in the “Supporting” and “Partially Degraded” ranges
- High amount of woody debris, low erosion, and good channel alteration
- Dominant taxa group were midges (Chironomidae) and stoneflies (*Amphinemura* sp.)
- Stream type was identified as an E6, the water surface slope was 0.003 ft/ft, and the median channel substrate was silt/clay
- Typically, E channels are stable. However, the “Very Poor” biological ratings along with impaired habitat ratings may indicate that this reach is transitioning to an unstable form

Recommendations:

- Maintain the protection of the well-forested drainage area.

IBI and Metric Scores

Narrative Rating	Very Poor
Overall Index	1.86
Total Taxa Score	1
EPT Taxa Score	3
% Ephemeroptera	1
Number of Ephemeroptera Score	1
% Intolerant to Urban Score	3
Scraper Taxa Score	1
% Climbers	3

Calculated Metric Values

Total Taxa	12
EPT Taxa	3
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	21.4
Scraper Taxa	0
% Climbers	2.0

Taxa List

AMPHINEMURA	16
ISOPERLA	1
AGABUS	1
CRICOTOPUS/ORTHOCLADIUS	59
POLYPEDILUM	2
RHEOCRICOTOPUS	2
IRONOQUIA	1
PISIDIUM	2
OLIGOCHAETA	9
CAECIDOTEA	2
GAMMARUS	1
SYNURELLA	2

Total Individuals 98

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	9	Pool Substrate Characterization	8
Bank Stability- Right Bank	10	Pool Variability	5
Vegetative Protection- Left Bank	9	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	9	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	18	Sediment Deposition	10
Channel Alteration	19	Epifaunal Substrate	3
Channel Sinuosity	9		

EPA Habitat Score 129

EPA Narrative Ranking S

Maryland Biological Stream Survey PHI

Drainage area (acres)	698.5	Instream Wood Debris	25
Distance from Road (m)	240	Bank Erosion Extent- Left	5
Percent Shading	70	Bank Erosion Extent- Right	5
Epifaunal Substrate	3	Bank Erosion Severity -Left	1
Instream Habitat	6	Bank Erosion Severity - Right	1

PHI Score 68.2

PHI Narrative Ranking PD

Water Chemistry

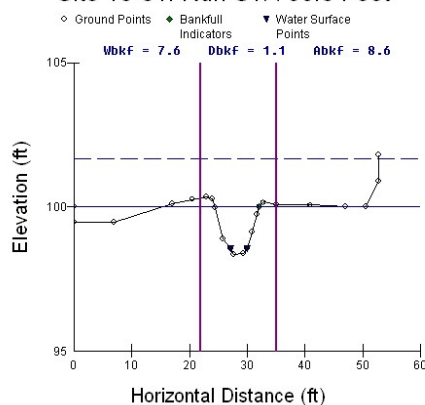
Dissolved Oxygen (mg/L)	11.27	Temperature (°C)	14.59
pH	6.81	Turbidity (NTU)	24.3
Specific Conductance (mS/cm)	0.155		

Geomorphic Assessments

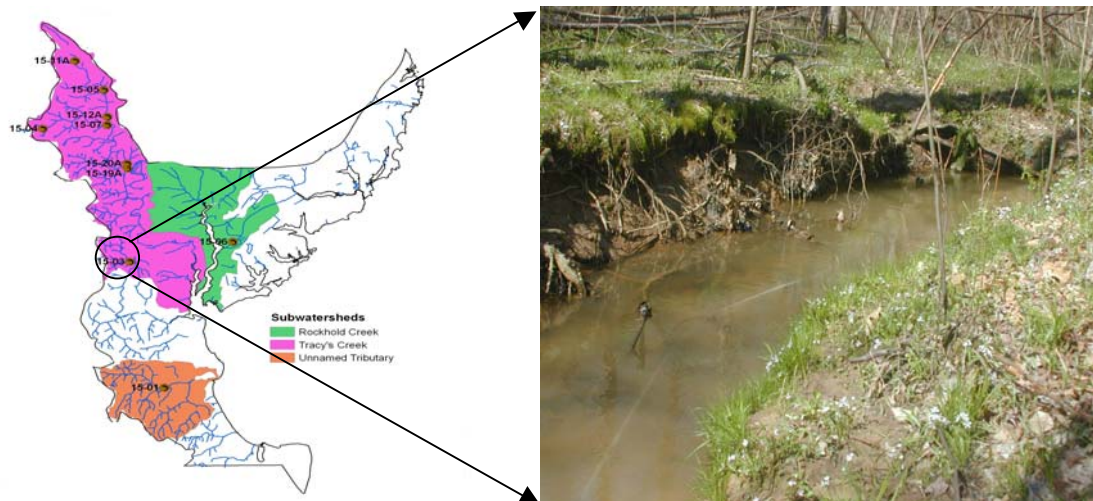
Drainage area (acres)	698.5	Entrenchment Ratio:	26.21
Bankfull Width (ft):	7.63	Width:Depth Ratio:	6.81
Mean Depth (ft):	1.12	Sinuosity:	1.1
Bankfull X-Sec Area (sq ft):	8.57	Water Surface Slope (ft/ft):	0.003
Flood-Prone Width (ft):	200	Reach D50 (mm):	0.03

Rosgen Channel Classification: E6

Site 15-01: Run STA 66.0 Feet



Note: The purple lines indicate that only the portions of the cross section between the lines are hydraulically connected to the bankfull channel.



Location/Site Access: Located within the Tracy's Creek subwatershed, access from powerline right-of-way or Fire Road along Route 256.

ADC Map 33 F-6 Latitude/Longitude: 38.78558/-76.58353

Land Use Analysis:

Land Use	Acres	% Area
Commercial	4.2	2.0
Open Space	2.9	1.4
Residential 1-acre	11.7	5.7
Row Crops	16.4	7.9
Transportation	2.6	1.3
Woods	136.7	66.2
Pasture/Hay	2.1	1.0
Residential 2-acre	6.2	3.0
Utility	23.7	11.5
Total	206.5	100.0

Impervious (acres)	Total Area Above site	% Impervious
5.2	206.5	2.5

Results:

- Biological condition - "Poor"
- Habitat scores in the "Partially Supporting" and "Partially Degraded" ranges
- Channel alteration and riparian vegetative width are considered optimal
- Dominant taxa group were amphipods (*Synurella* sp.) and midges (Chironomidae)
- Stream type was identified as an E5, the water surface slope was 0.005 ft/ft, and the median channel substrate was very fine sand
- Typically, E channels are stable. However, the "Poor" biological condition may indicate that this reach is transitioning to an unstable form

Recommendations:

- Investigate possible sources of upstream sedimentation and instability, including the powerline right-of-way and large culvert under Route 256.

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	2.71

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

Calculated Metric Values

Total Taxa	19
EPT Taxa	3
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	34.8
Scraper Taxa	1
% Climbers	3.5

Taxa List

AMPHINEMURA	1
OSTROCERCA	2
HELICHUS	3
DIPLOCLADIUS	19
HETEROTRISOCCLADIUS	4
CRICOTOPUS/ORTHOCLADIUS	9
PARAMETRIOCNEMUS	1
POLYPEDILUM	3
RHEOCRICOTOPUS	2
TANYTARSUS	1
IRONOQUIA	9
PISIDIUM	10
OLIGOCHAETA	8
CAECIDOTEA	5
GAMMARUS	8
SYNURELLA	19
TURBELLARIA	2
GEORHOCLADIUS	3
SYGOBROMUS1	6

Total Individuals

115

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	8	Pool Substrate Characterization	6
Bank Stability- Right Bank	7	Pool Variability	5
Vegetative Protection- Left Bank	9	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	9	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	14	Sediment Deposition	4
Channel Alteration	19	Epifaunal Substrate	4
Channel Sinuosity	15		

EPA Habitat Score 120**EPA Narrative Ranking** PS**Maryland Biological Stream Survey PHI**

Drainage area (acres)	206.5	Instream Wood Debris	3
Distance from Road (m)	435	Bank Erosion Extent- Left	40
Percent Shading	85	Bank Erosion Extent- Right	15
Epifaunal Substrate	4	Bank Erosion Severity -Left	1
Instream Habitat	6	Bank Erosion Severity -Right	1

PHI Score 72.5**PHI Narrative Ranking** PD**Water Chemistry**

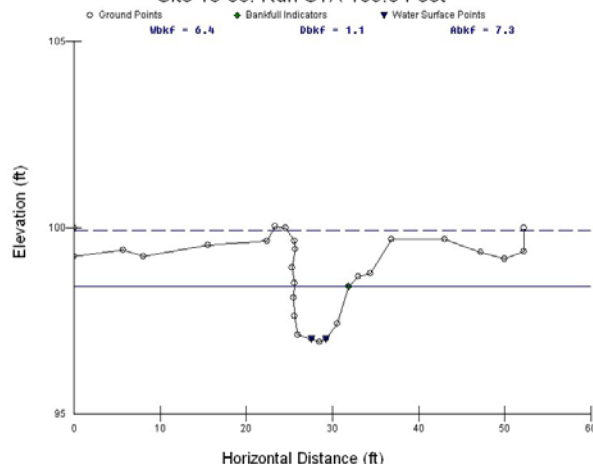
Dissolved Oxygen (mg/L)	6.2	Temperature (°C)	10.13
pH	6.51	Turbidity (NTU)	23
Specific Conductance (mS/cm)	0.165		

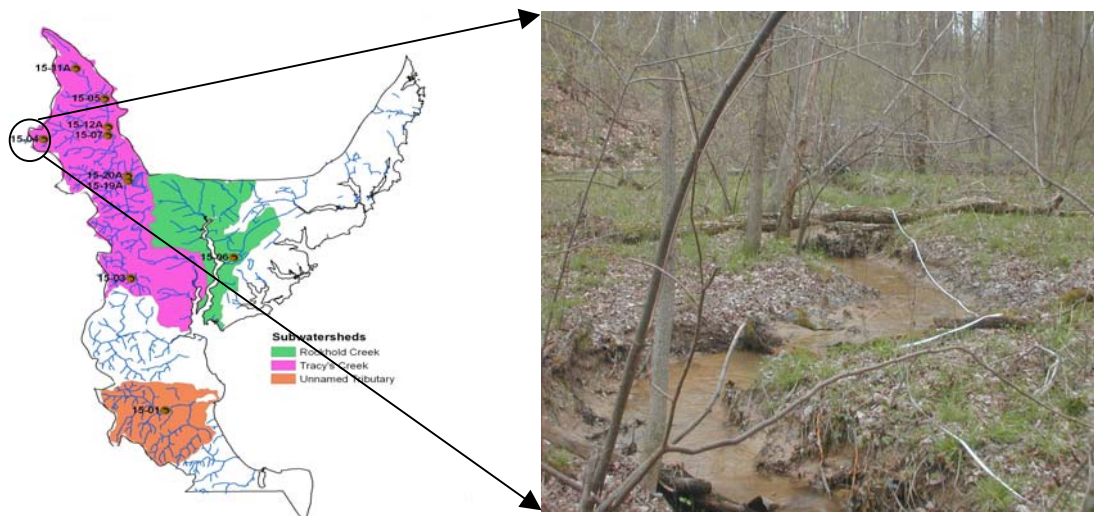
Geomorphic Assessments

Drainage area (acres)	206.5	Entrenchment Ratio:	23.55
Bankfull Width (ft):	6.37	Width:Depth Ratio:	5.54
Mean Depth (ft):	1.15	Sinuosity:	1.1
Bankfull X-Sec Area (sq ft):	7.3	Water Surface Slope (ft/ft):	0.005
Flood-Prone Width (ft):	150	Reach D50 (mm):	0.9

Rosgen Channel Classification: E5

Site 15-03: Run STA 109.0 Feet





Location/Site Access: Located within the Tracy's Creek subwatershed, access from behind Lothian Elementary School.
 ADC Map 29 B-11 Latitude/Longitude: 38.82748134/-76.61093818

Land Use Analysis:

Land Use	Acres	% Area
Commercial	6.0	10.8
Open Space	3.8	6.8
Pasture/Hay	1.8	3.2
Residential 1/2-acre	4.5	8.0
Residential 1-acre	3.1	5.5
Transportation	4.0	7.2
Woods	31.3	56.1
Residential 2-acre	1.4	2.4
Total	55.8	100.0

Impervious (acres)	Total Area Above site	% Impervious
5.2	55.8	9.4

Results:

- Biological condition - "Poor"
- Habitat scores in the "Non-Supporting" and "Partially Degraded" ranges
- Channel alteration, riparian vegetative width, and instream woody debris were all optimal
- Dominant taxa group were isopods (*Cacidotea* sp.) amphipods (*Synurella* sp.) and midges aquatic worms
- Stream type was identified as a B5c, the water surface slope was 0.015 ft/ft, and the median channel substrate was fine sand
- Typically, B channels are stable. However, the impaired biological and habitat ratings may indicate that this reach is transitioning to an unstable form

Recommendations:

- Suggest removal of large amounts of residential waste near Lothian Elementary.
- Investigate possible runoff treatment from school parking lot.

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	2.71

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

Calculated Metric Values

Total Taxa	18
EPT Taxa	2
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	71.9
Scraper Taxa	1
% Climbers	2

Taxa List

DYTISCIDAE	1
CRICOTOPUS	1
HETEROTRISSECLADIUS	1
HYDROBAENUS	5
MESOCRICOTOPUS	1
PARAKIEFFERIELLA	1
PARAMETRIOCNEMUS	1
PARAPHAENOCLADIUS	1
PRODIAMESA	1
RHEOCRICOTOPUS	1
THIENEMANNIMYIA GROUP	1
CHRYSOPTERNA	2
STEGOPTERNA	2
HYDATOPHYLAX	2
IRONOQUIA	5
OLIGOCHAETA	10
CAECIDOTEA	58
SYNURELLA1	13

Total Individuals 107

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	8	Pool Substrate Characterization	3
Bank Stability- Right Bank	9	Pool Variability	2
Vegetative Protection- Left Bank	8	Riparian Vegetative Zone Width- Left Bank	9
Vegetative Protection- Right Bank	8	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	6	Sediment Deposition	2
Channel Alteration	17	Epifaunal Substrate	1
Channel Sinuosity	11		

EPA Habitat Score 94

EPA Narrative Ranking NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	55.8	Instream Wood Debris	10
Distance from Road (m)	300	Bank Erosion Extent- Left	30
Percent Shading	85	Bank Erosion Extent- Right	30
Epifaunal Substrate	1	Bank Erosion Severity -Left	1
Instream Habitat	2	Bank Erosion Severity -Right	1

PHI Score 72.0

PHI Narrative Ranking PD

Water Chemistry

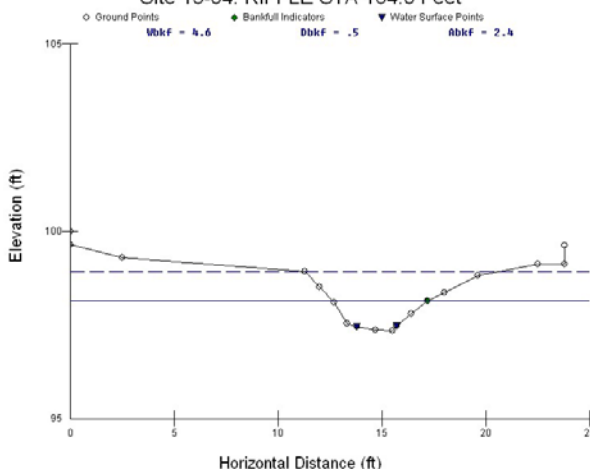
Dissolved Oxygen (mg/L)	5.15	Temperature (°C)	11.02
pH	5.88	Turbidity (NTU)	39.2
Specific Conductance (mS/cm)	0.497		

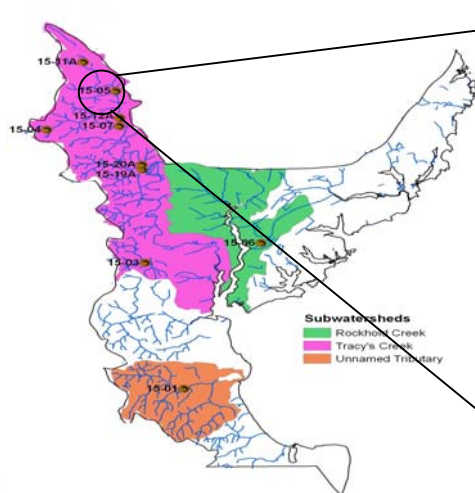
Geomorphic Assessments

Drainage area (acres)	55.8	Entrenchment Ratio:	2.06
Bankfull Width (ft):	4.55	Width:Depth Ratio:	8.43
Mean Depth (ft):	0.54	Sinuosity:	1.21
Bankfull X-Sec Area (sq ft):	2.44	Water Surface Slope (ft/ft):	0.015
Flood-Prone Width (ft):	9.36	Reach D50 (mm):	0.23

Rosgen Channel Classification: B5c

Site 15-04: RIFFLE STA 164.0 Feet





Location/Site Access: Located within the Tracy's Creek subwatershed, access from Sudley Road at Antioch farm.

ADC Map 29 E-9 Latitude/Longitude: 38.83966009/-76.59140477

Land Use Analysis:

Land Use	Acres	% Area
Commercial	1.1	0.2
Open Space	50.6	9.0
Pasture/Hay	21.3	3.8
Residential 1/2-acre	60.1	10.7
Residential 1-acre	83.9	14.9
Row Crops	44.5	7.9
Transportation	16.2	2.9
Water	3.6	0.6
Woods	258.6	45.9
Utility	19.8	3.5
Residential 2-acre	3.3	0.6
Residential 1/4-acre	0.0	0.0
Total	563.0	100.0

Impervious (acres)	Total Area Above site	% Impervious
37.7	563.0	6.7

Results:

- Biological condition - "Very Poor"
- Habitat scores in the "Non-Supporting" and "Degraded" ranges
- Channel alteration is considered optimal but bank erosion is very poor
- Dominant taxa group were amphipods (*Gammarus* sp.) and midges (Chironomidae)
- Stream type was identified as a G5c, the water surface slope was 0.003 ft/ft, and the median channel substrate was very fine sand
- Impaired benthic communities and stream habitat may be due to the unstable nature of the G stream type

Recommendations:

- Investigate possible sources of upstream sediment and instability

15-05

Herring Bay Sampling Unit

IBI and Metric Scores

Narrative Rating	Very Poor
Overall Index	1.86
Total Taxa Score	3
EPT Taxa Score	3
% Ephemeroptera	1
Number of Ephemeroptera Score	1
% Intolerant to Urban Score	1
Scraper Taxa Score	1
% Climbers	3

Calculated Metric Values

Total Taxa	15
EPT Taxa	3
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	6.9
Scraper Taxa	0
% Climbers	1

Taxa List

CHAETOCLADIUS	1
GLYPTOTENDIPES	1
PARATANYTARSUS	1
POLYPEDILUM	1
RHEOCRICOTOPUS	1
HEMERODROMIA	1
TIPULA	6
CHEUMATOPSYCHE	1
HYDROPSYCHIDAE	5
IRONOQUIA	1
PISIDIUM	3
CAECIDOTEA	3
GAMMARUS	72
SYNURELLA	2
SYGOBROMUS	2

Total Individuals

101

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	1	Pool Substrate Characterization	2
Bank Stability- Right Bank	3	Pool Variability	3
Vegetative Protection- Left Bank	7	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	7	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	14	Sediment Deposition	7
Channel Alteration	18	Epifaunal Substrate	2
Channel Sinuosity	7		

EPA Habitat Score 91**EPA Narrative Ranking** NS**Maryland Biological Stream Survey PHI**

Drainage area (acres)	563.0	Instream Wood Debris	5
Distance from Road (m)	300	Bank Erosion Extent- Left	75
Percent Shading	85	Bank Erosion Extent- Right	70
Epifaunal Substrate	2	Bank Erosion Severity -Left	2
Instream Habitat	3	Bank Erosion Severity -Right	1.5

PHI Score 55.4**PHI Narrative Ranking** D**Water Chemistry**

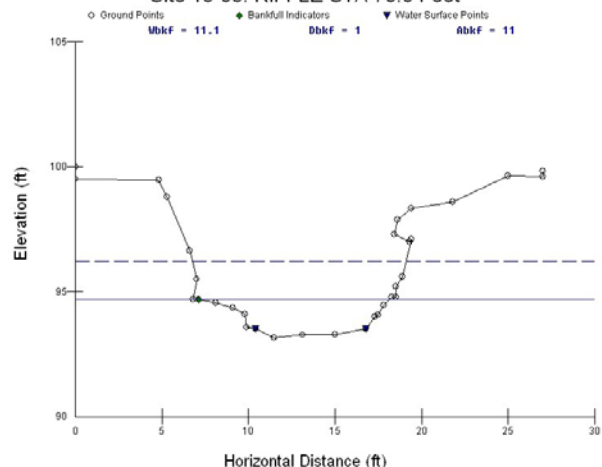
Dissolved Oxygen (mg/L)	6.15	Temperature (°C)	10.17
pH	6.48	Turbidity (NTU)	17.6
Specific Conductance (mS/cm)	0.181		

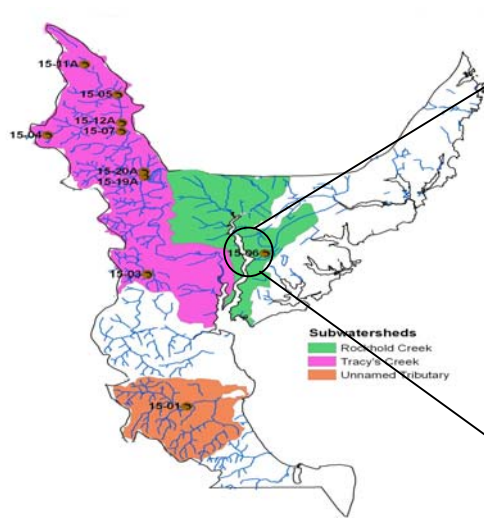
Geomorphic Assessments

Drainage area (acres)	563.0	Entrenchment Ratio:	1.12
Bankfull Width (ft):	11.05	Width:Depth Ratio:	11.16
Mean Depth (ft):	0.99	Sinuosity:	1.12
Bankfull X-Sec Area (sq ft):	10.97	Water Surface Slope (ft/ft):	0.003
Flood-Prone Width (ft):	12.37	Reach D50 (mm):	0.12

Rosgen Channel Classification: G5c

Site 15-05: RIFFLE STA 70.0 Feet





Location/Site Access: Located within the Rockhold Creek subwatershed, access from Swamp Circle Road but park at Mallard Drive.
ADC Map 34 A-5 Latitude/Longitude: 38.7917129/-76.55083255

Land Use Analysis:

Land Use	Acres	% Area
Open Space	2.0	0.5
Residential 2-acre	7.4	1.8
Row Crops	9.0	2.3
Transportation	12.9	3.2
Woods	292.4	73.2
Commercial	15.7	3.9
Residential 1/2-acre	59.0	14.8
Residential 1/4-acre	1.0	0.3
Grand Total	400.0	100.0

Impervious (acres)	Total Area Above site	% Impervious
31.2	400.0	7.8

Results:

- Biological condition - "Poor"
- Habitat scores in the "Non-Supporting" and "Degraded" ranges
- Instream woody debris, bank stability, and bank erosion are all optimal
- Dominant taxa group were isopods (*Cacidotea* sp.) and aquatic worms
- Stream type was identified as a C6, the water surface slope was 0.004 ft/ft, and the median channel substrate was silt/clay
- Typically, C channels are stable. However, the impaired biological and habitat ratings may be due to the blackwater nature of this stream. Low dissolved oxygen, pH values observed in this reach.

Recommendations:

- Investigate culvert at downstream end of segment at Swamp Circle Road for possible blockages and proper drainage

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	2.14

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

Calculated Metric Values

Total Taxa	15
EPT Taxa	0
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	38.4
Scraper Taxa	0
% Climbers	5.1

Taxa List

AGABUS	2
CHAULIODES	2
PHAENOPSECTRA	8
POLYPEDILUM	3
TANYPODINAE	1
AEDES	6
BEZZIA	1
MOLOPHILUS	2
TABANIDAE	2
OLIGOCHAETA	32
CAECIDOTEA	24
SYNURELLA	6
TURBELLARIA	6
HYDROPHORINAE	3

Total Individuals 99

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	10	Pool Substrate Characterization	6
Bank Stability- Right Bank	10	Pool Variability	2
Vegetative Protection- Left Bank	9	Riparian Vegetative Zone Width- Left Bank	2
Vegetative Protection- Right Bank	9	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	16	Sediment Deposition	3
Channel Alteration	12	Epifaunal Substrate	2
Channel Sinuosity	4	EPA Habitat Score	95
		EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	400.0	Instream Wood Debris	14
Distance from Road (m)	70	Bank Erosion Extent- Left	0
Percent Shading	65	Bank Erosion Extent- Right	0
Epifaunal Substrate	2	Bank Erosion Severity -Left	0
Instream Habitat	1	Bank Erosion Severity -Right	0

PHI Score 58.2

PHI Narrative Ranking D

Water Chemistry

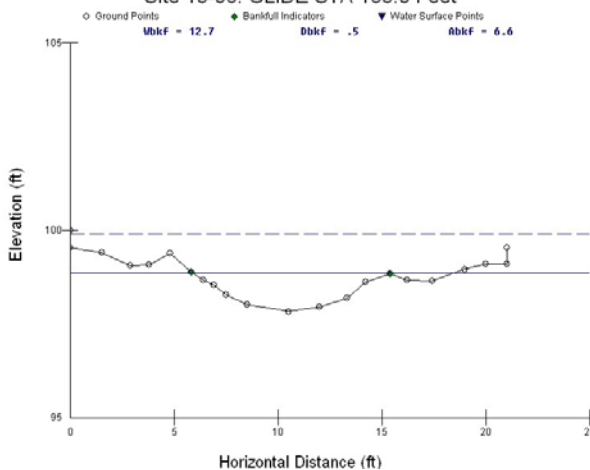
Dissolved Oxygen (mg/L)	2.98	Temperature (°C)	11.33
pH	4.29	Turbidity (NTU)	85.1
Specific Conductance (mS/cm)	0.138		

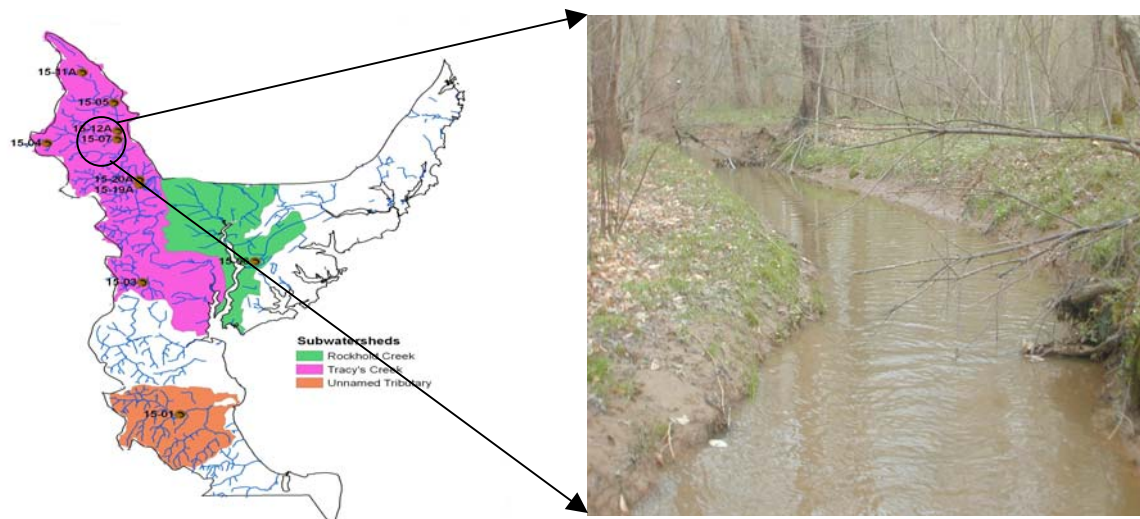
Geomorphic Assessments

Drainage area (acres)	400.0	Entrenchment Ratio:	3.94
Bankfull Width (ft):	12.68	Width:Depth Ratio:	24.38
Mean Depth (ft):	0.52	Sinuosity:	1.05
Bankfull X-Sec Area (sq ft):	6.64	Water Surface Slope (ft/ft):	0.004
Flood-Prone Width (ft):	50	Reach D50 (mm):	0.03

Rosgen Channel Classification: C6

Site 15-06: GLIDE STA 183.0 Feet





Location/Site Access: Located within the Tracy's Creek subwatershed, access from Sudley Road.

ADC Map 29 E-11 Latitude/Longitude: 38.8286/-76.59047

Land Use Analysis:

Land Use	Acres	% Area
Open Space	18.8	3.5
Pasture/Hay	10.8	2.0
Residential 1/2-acre	26.9	5.0
Residential 1-acre	18.7	3.5
Residential 2-acre	31.9	6.0
Transportation	8.4	1.6
Woods	316.4	59.0
Row Crops	60.3	11.2
Commercial	12.0	2.2
Utility	32.3	6.0
Total	536.5	100

Impervious (acres)	Total Area Above site	% Impervious
22.1	536.5	4.1

Results:

- Biological condition - "Poor"
- Habitat scores in the "Partially Supporting" and "Degraded" ranges
- Channel alteration and shading are considered optimal
- Dominant taxa group were amphipods and midges (Chironomidae)
- Stream type was identified as an E5, the water surface slope was 0.001 ft/ft, and the median channel substrate was medium sand
- Typically, E channels are stable. However, the impaired biological and habitat ratings may indicate that this reach is transitioning to an unstable form

Recommendations:

- Investigate possible sources of upstream sedimentation and instability.

15-07

Herring Bay Sampling Unit

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	2.43

Total Taxa Score	3
EPT Taxa Score	3
% Ephemeroptera	1
Number of Ephemeroptera	1
% Intolerant to Urban Score	3
Scraper Taxa Score	3
% Climbers	3

Calculated Metric Values

Total Taxa	19
EPT Taxa	3
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	16.2
Scraper Taxa	1
% Climbers	6.7

Taxa List

CALOPTERYX	2
AMPHINEMURA	1
CORYNONEURA	2
DIPLOCLADIUS	1
HYDROBAENUS	1
CRICOTOPUS/ORTHOCLADIUS	4
PARAMETRIOCNEMUS	2
POLYPEDILUM	4
PILARIA	2
STEGOPTERNA	1
IRONOQUIA	4
PTILOSTOMIS	1
OLIGOCHAETA	7
AMPHIPODA	41
CAECIDOTEA	8
GAMMARUS	12
HYALELLA	5
SYNURELLA	6
SYGOBROMUS	1

Total Individuals 105

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	9	Pool Substrate Characterization	6
Bank Stability- Right Bank	8	Pool Variability	3
Vegetative Protection- Left Bank	9	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	8	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	13	Sediment Deposition	4
Channel Alteration	18	Epifaunal Substrate	3
Channel Sinuosity	9	EPA Habitat Score	110
		EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	536.5	Instream Wood Debris	6
Distance from Road (m)	330	Bank Erosion Extent- Left	20
Percent Shading	90	Bank Erosion Extent- Right	50
Epifaunal Substrate	3	Bank Erosion Severity -Left	1
Instream Habitat	4	Bank Erosion Severity -Right	1.5

PHI Score 64.8

PHI Narrative Ranking D

Water Chemistry

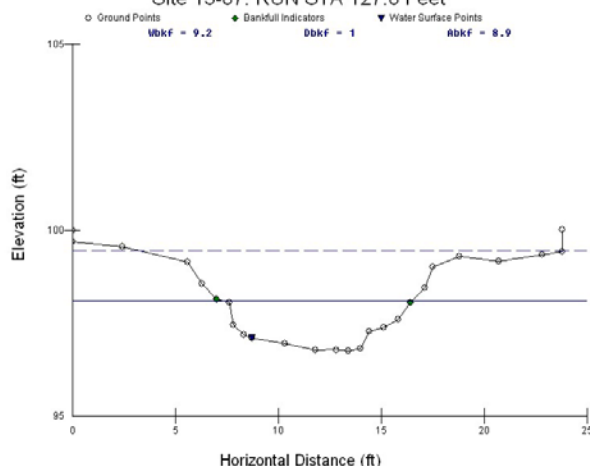
Dissolved Oxygen (mg/L)	5.96	Temperature (°C)	9.49
pH	6.23	Turbidity (NTU)	35
Specific Conductance (mS/cm)	0.107		

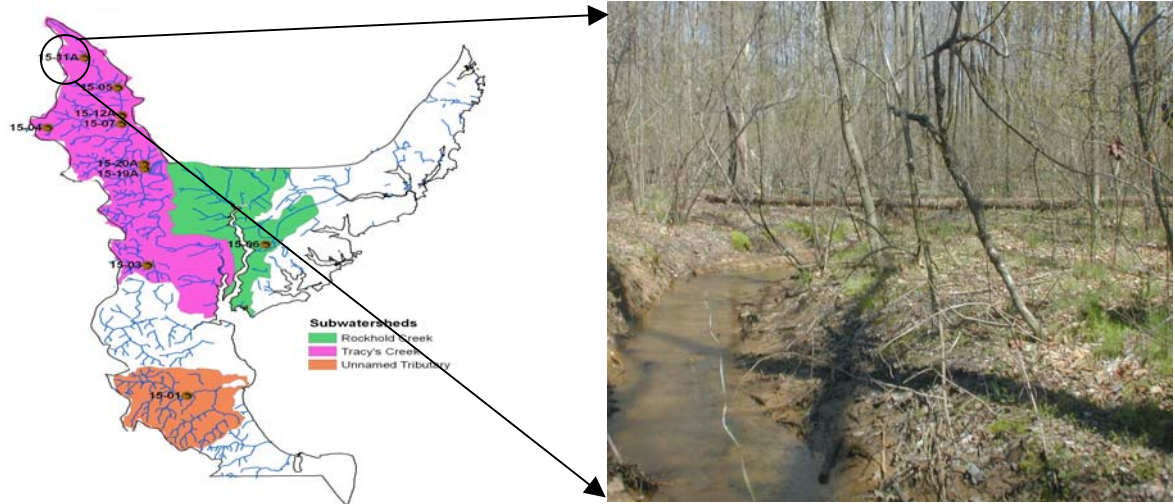
Geomorphic Assessments

Drainage area (acres)	536.5	Entrenchment Ratio:	10.87
Bankfull Width (ft):	9.2	Width:Depth Ratio:	9.58
Mean Depth (ft):	0.96	Sinuosity:	1.14
Bankfull X-Sec Area (sq ft):	8.86	Water Surface Slope (ft/ft):	0.001
Flood-Prone Width (ft):	100	Reach D50 (mm):	0.27

Rosgen Channel Classification: E5

Site 15-07: RUN STA 127.0 Feet





Location/Site Access: Located within the Tracy's Creek subwatershed, access from Route 255 and downstream of Tamarak Farm.
 ADC Map 29 D-7 Latitude/Longitude: 38.84878854/-76.60053944

Land Use Analysis:

Land Use	Acres	% Area
Commercial	1.1	0.5
Open Space	21.0	9.7
Pasture/Hay	4.8	2.2
Residential 1/2-acre	36.0	16.6
Residential 1-acre	25.3	11.7
Residential 2-acre	0.3	0.1
Row Crops	38.6	17.8
Transportation	6.0	2.7
Water	3.6	1.7
Woods	80.3	37.0
Total	217.0	100.0

Impervious (acres)	Total Area Above site	% Impervious
16.1	217.0	7.4

Results:

- Biological condition - "Very Poor"
- Habitat scores in the "Partially Supporting" and "Degraded" ranges
- Channel alteration and instream woody debris are considered optimal
- Dominant taxa group was a midge taxon (*Polypedilum* sp.)
- Stream type was identified as an E5, the water surface slope was 0.003 ft/ft, and the median channel substrate was medium sand
- Typically, E channels are stable. However, the "Very Poor" and "Fair" biological ratings may indicate that this reach is transitioning to an unstable form

Recommendations:

- Investigate Route 255 culvert stability and other sources of sedimentation or instability within the drainage area.

15-11a

Herring Bay Sampling Unit

IBI and Metric Scores

Narrative Rating	Very Poor
Overall Index	1.57

Total Taxa Score	1
EPT Taxa Score	1
% Ephemeroptera	1
Number of Ephemeroptera Score	1
% Intolerant to Urban Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	10
EPT Taxa	1
% Ephemeroptera	0
Number of Ephemeroptera	0
% Intolerant to Urban	1
Scraper Taxa	0
% Climbers	68

Taxa List

CALOPTERYX	1
DIPLOCLADIUS	1
POLYPEDILUM	67
STENOCHIRONOMUS	1
THIENEMANNIMYIA GROUP	4
HEMERODROMIA	1
STEGOPTERNA	1
CHEUMATOPSYCHE	1
PISIDIUM	12
OLIGOCHAETA	11

Total Individuals 100

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	8	Pool Substrate Characterization	6
Bank Stability- Right Bank	9	Pool Variability	4
Vegetative Protection- Left Bank	9	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	9	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	13	Sediment Deposition	3
Channel Alteration	19	Epifaunal Substrate	2
Channel Sinuosity	12	EPA Habitat Score	114
		EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	217.0	Instream Wood Debris	10
Distance from Road (m)	130	Bank Erosion Extent- Left	60
Percent Shading	80	Bank Erosion Extent- Right	70
Epifaunal Substrate	2	Bank Erosion Severity -Left	1
Instream Habitat	4	Bank Erosion Severity -Right	1

PHI Score 62.2

PHI Narrative Ranking D

Water Chemistry

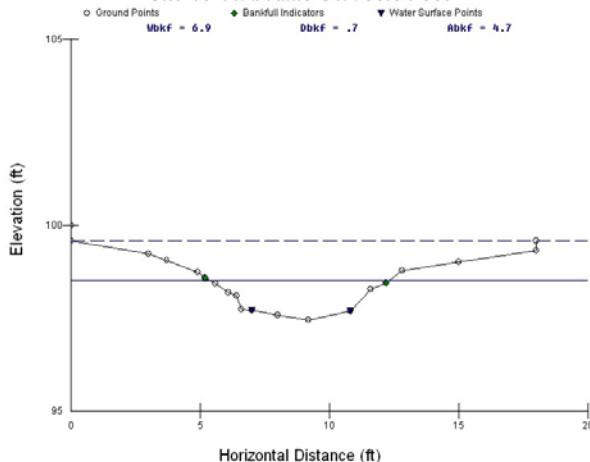
Dissolved Oxygen (mg/L)	5.52	Temperature (°C)	15.75
pH	6.66	Turbidity (NTU)	19.8
Specific Conductance (mS/cm)	0.213		

Geomorphic Assessments

Drainage area (acres)	217.0	Entrenchment Ratio:	14.45
Bankfull Width (ft):	6.92	Width:Depth Ratio:	10.18
Mean Depth (ft):	0.68	Sinuosity:	1.14
Bankfull X-Sec Area (sq ft):	4.71	Water Surface Slope (ft/ft):	0.003
Flood-Prone Width (ft):	100	Reach D50 (mm):	0.33

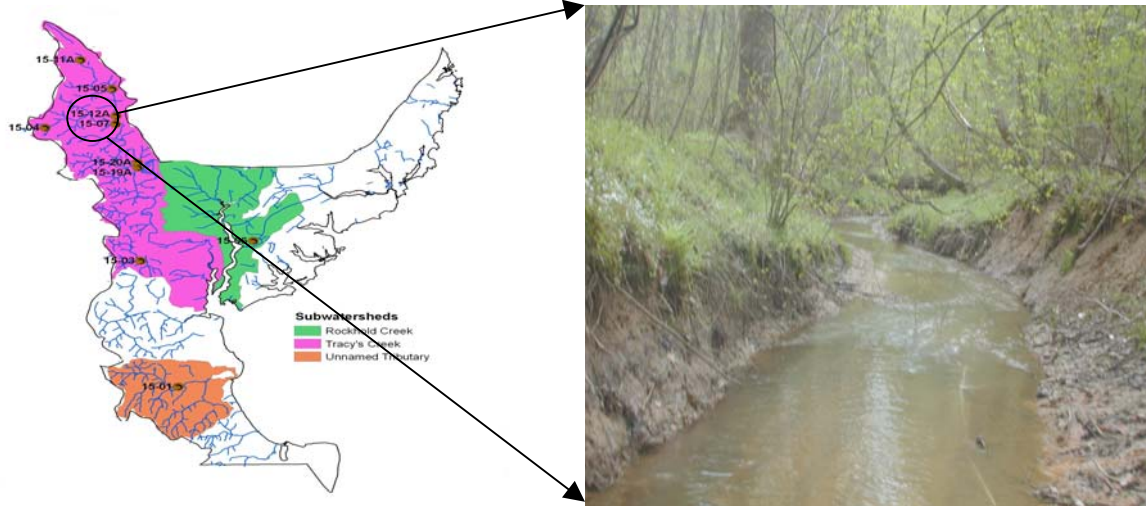
Rosgen Channel Classification: E5

Site 15-11A: Riffle STA 85.0 Feet



15-12a

Herring Bay Sampling Unit



Location/Site Access: Located within the Tracy's Creek subwatershed, access from Sudley Road and Nutwell Road.

ADC Map 29 E-10 Latitude/Longitude: 38.83115058/-76.59041798

Land Use Analysis:

Land Use	Acres	% Area
Open Space	67.7	8.4
Pasture/Hay	22.0	2.7
Residential 1/2-acre	64.0	8.0
Residential 1-acre	123.6	15.4
Residential 2-acre	8.0	1.0
Row Crops	46.0	5.7
Transportation	18.3	2.3
Utility	29.3	3.6
Water	3.6	0.4
Woods	420.8	52.3
Commercial	1.1	0.1
Residential 1/4-acre	0.0	0.0
Total	804.7	100.0

Impervious (acres)	Total Area Above site	% Impervious
47.4	804.7	5.9

Results:

- Biological condition - "Fair"
- Habitat scores in the "Partially Supporting" and "Degraded" ranges
- Channel alteration and riparian vegetative width are considered optimal
- Dominant taxa group were amphipods (*Gammarus* sp.) and midges (Chironomidae)
- Stream type was identified as a G5c, the water surface slope was 0.003 ft/ft, and the median channel substrate was medium sand. This stream appears to be in transition to an F5, resulting in accelerated bank erosion and increased downstream sedimentation.
- Impaired benthic communities and stream habitat may be due to the unstable nature of the G stream type

Recommendations:

- Investigate upstream sources of sedimentation and instability.

IBI and Metric Scores

Narrative Rating	Fair
Overall Index	3.86

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

Calculated Metric Values

Total Taxa	16
EPT Taxa	6
% Ephemeroptera	9
Number of Ephemeroptera	2
% Intolerant to Urban	5
Scraper Taxa	3
% Climbers	8

Taxa List

STENONEMA	7
CALOPTERYX	1
ISOPERLA	1
HELICHUS	1
DIAMESA	1
ORTHOCLADIINAE	1
CRICOTOPUS/ORTHOCLADIUS	51
POLYPEDILUM	7
DICRANOTA	1
CHEUMATOPSYCHE	1
IRONOQUIA	1
LYPE	1
OLIGOCHAETA	1
CAECIDOTEA	1
GAMMARUS	22
PLAUDITUS	2

Total Individuals	100
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Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	3	Pool Substrate Characterization	6
Bank Stability- Right Bank	3	Pool Variability	7
Vegetative Protection- Left Bank	3	Riparian Vegetative Zone Width- Left Bank	10
Vegetative Protection- Right Bank	3	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	12	Sediment Deposition	13
Channel Alteration	19	Epifaunal Substrate	4
Channel Sinuosity	11	EPA Habitat Score	104
		EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	804.7	Instream Wood Debris	1
Distance from Road (m)	300	Bank Erosion Extent- Left	40
Percent Shading	65	Bank Erosion Extent- Right	40
Epifaunal Substrate	4	Bank Erosion Severity -Left	2
Instream Habitat	3	Bank Erosion Severity -Right	2

PHI Score	54.4
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PHI Narrative Ranking	D
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Water Chemistry

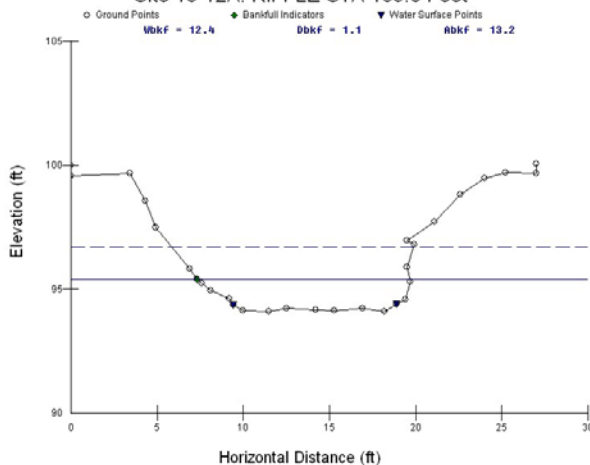
Dissolved Oxygen (mg/L)	12.07	Temperature (°C)	17.54
pH	6.78	Turbidity (NTU)	24.4
Specific Conductance (mS/cm)	0.182		

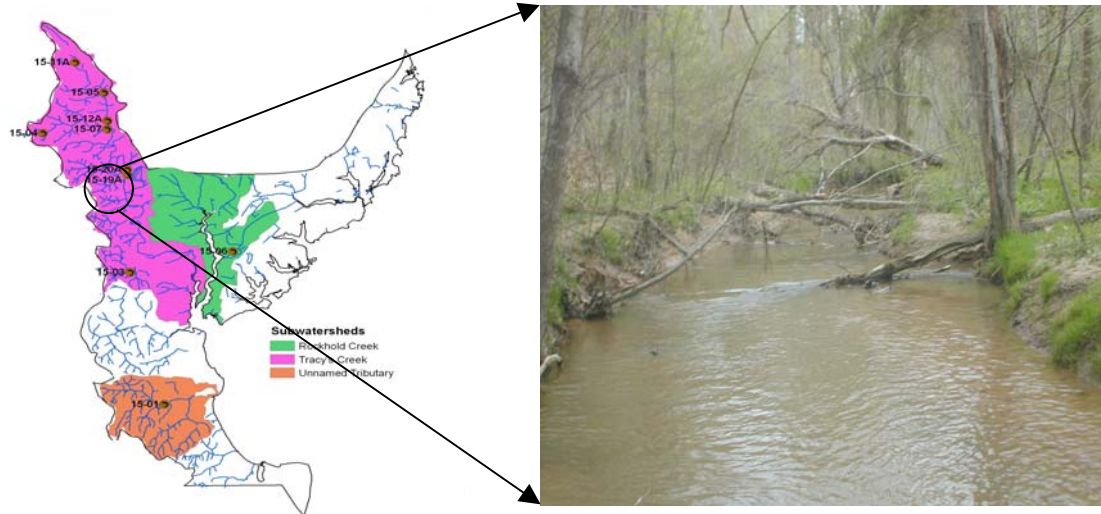
Geomorphic Assessments

Drainage area (acres)	804.7	Entrenchment Ratio:	1.13
Bankfull Width (ft):	12.37	Width:Depth Ratio:	11.56
Mean Depth (ft):	1.07	Sinuosity:	1.12
Bankfull X-Sec Area (sq ft):	13.25	Water Surface Slope (ft/ft):	0.003
Flood-Prone Width (ft):	14.01	Reach D50 (mm):	0.41

Rosgen Channel Classification: G5c

Site 15-12A: RIFFLE STA 189.0 Feet





Location/Site Access: Located within the Tracy's Creek subwatershed, access from behind Sudley County landfill. ADC Map 29 F-13 Latitude/Longitude: 38.81494782/-76.58413626

Land Use Analysis:

Land Use	Acres	% Area
Commercial	16.1	0.8
Industrial	21.3	1.0
Open Space	99.7	4.6
Pasture/Hay	54.8	2.6
Residential 1/2-acre	105.4	4.9
Residential 1/4-acre	0.0	0.0
Residential 1-acre	153.5	7.1
Residential 2-acre	88.2	4.1
Row Crops	166.8	7.8
Transportation	35.2	1.6
Water	3.6	0.2
Woods	1308.3	60.9
Utility	95.0	4.4
Total	2148.0	100.0

Impervious (acres)	Total Area Above site	% Impervious
99.9	2148.0	4.7

Results:

- Biological condition - "Good"
- Habitat scores in the "Partially Supporting" and "Severely Degraded" ranges
- Channel alteration is considered optimal while epifaunal substrate and erosion was poor
- Dominant taxa group were amphipods (*Gammarus* sp.) and midges (Chironomidae) with several genera of mayfly and stonefly
- Stream type was identified as an E5, the water surface slope was 0.004 ft/ft, and the median channel substrate was medium sand

Recommendations:

- Maintain protection of forested drainage area.
- Investigate large adjacent landfill for influences on biotic community and stream stability.

IBI and Metric Scores

Narrative Rating	Good
Overall Index	4.43
Total Taxa Score	5
EPT Taxa Score	5
% Ephemeroptera	5
Number of Ephemeroptera Score	3
% Intolerant to Urban Score	3
Scraper Taxa Score	5
% Climbers	5

Calculated Metric Values

Total Taxa	22
EPT Taxa	8
% Ephemeroptera	12.1
Number of Ephemeroptera	1
% Intolerant to Urban	20.2
Scraper Taxa	2
% Climbers	12.1

Taxa List

STENONEMA	12
AMPHINEMURA	13
ISOPERLA	3
CRICOTOPUS/ORTHOCLADIUS	16
PARALAUTERBORNIELLA	1
PARAMETRIOCNEMUS	1
POLYPEDILUM	9
RHEOCRICOTOPUS	1
RHEOTANYTARSUS	1
STENOCHIRONOMUS	1
TANYTARSUS	2
THIENEMANNIMYIA GROUP	1
HEMERODROMIA	1
CHEUMATOPSYCHE	6
HYDATOPHYLAX	1
HYDROPSYCHE	1
IRONOQUIA	2
LYPE	2
OLIGOCHAETA	1
CAECIDOTEIA	3
GAMMARUS	20
SYNURELLA	1

Total Individuals 99

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	3	Pool Substrate Characterization	7
Bank Stability- Right Bank	3	Pool Variability	12
Vegetative Protection- Left Bank	6	Riparian Vegetative	9
Vegetative Protection- Right Bank	6	Zone Width- Left Bank	9
Channel Flow Status	12	Riparian Vegetative	9
Channel Alteration	18	Zone Width- Right Bank	9
Channel Sinuosity	7	Sediment Deposition	8
		Epifaunal Substrate	3
EPA Habitat Score			103
EPA Narrative Ranking			PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	2148.0	Instream Wood Debris	5
Distance from Road (m)	190	Bank Erosion Extent- Left	75
Percent Shading	75	Bank Erosion Extent- Right	75
Epifaunal Substrate	3	Bank Erosion Severity -Left	1.5
Instream Habitat	7	Bank Erosion Severity -Right	1.5
PHI Score			49.2
PHI Narrative Ranking			SD

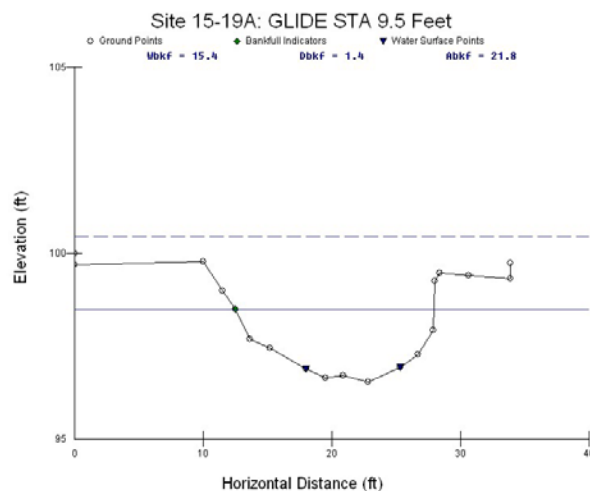
Water Chemistry

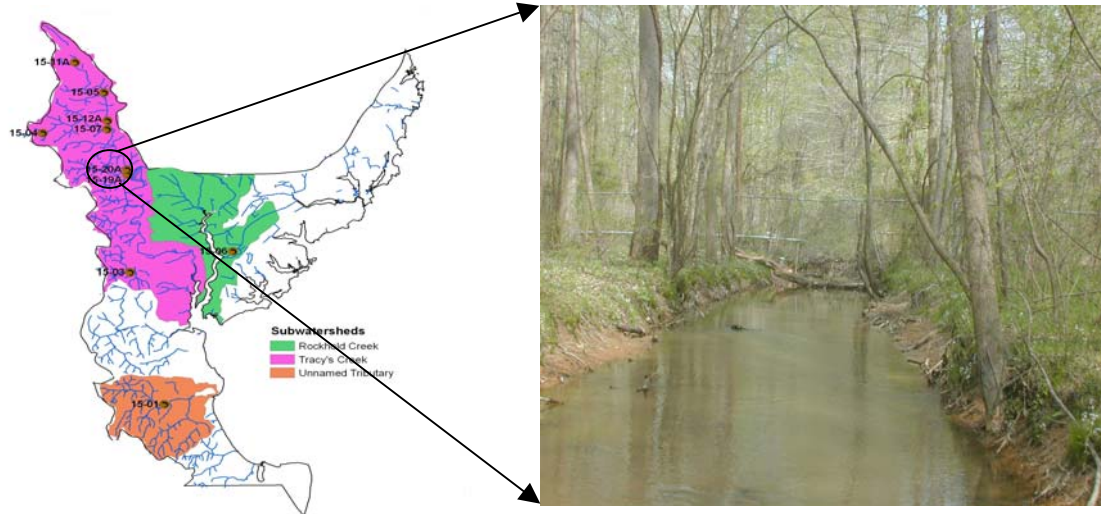
Dissolved Oxygen (mg/L)	9.81	Temperature (°C)	14.26
pH	6.45	Turbidity (NTU)	15
Specific Conductance (mS/cm)	0.161		

Geomorphic Assessments

Drainage area (acres)	2148.0	Entrenchment Ratio:	7.77
Bankfull Width (ft):	15.44	Width:Depth Ratio:	10.95
Mean Depth (ft):	1.41	Sinuosity:	1.07
Bankfull X-Sec Area (sq ft):	21.83	Water Surface Slope (ft/ft):	0.004
Flood-Prone Width (ft):	120	Reach D50 (mm):	0.38

Rosgen Channel Classification: E5





Location/Site Access: Located within the Tracy's Creek subwatershed, access from behind Sudley County landfill.

ADC Map 29 F-13 Latitude/Longitude: 38.816.46405/-76.58426224

Land Use Analysis:

Land Use	Acres	% Area
Commercial	16.1	0.8
Open Space	99.2	4.7
Pasture/Hay	54.8	2.6
Residential 1/2-acre	105.4	5.0
Residential 1/4-acre	0.0	0.0
Residential 1-acre	153.5	7.3
Residential 2-acre	87.6	4.2
Row Crops	165.8	7.9
Transportation	33.8	1.6
Water	3.6	0.2
Woods	1282.2	61.1
Utility	95.0	4.5
Total	2097.1	100.0

Impervious (acres)	Total Area Above site	% Impervious
79.6	2097.1	3.8

Results:

- Biological condition - "Good"
- Habitat scores in the "Non-Supporting" and "Severely Degraded" ranges
- Channel alteration is optimal while instream habitat and epifaunal substrate are poor
- Dominant taxa group were amphipods (*Gammarus* sp.) and mayflies (*Stenonema* sp.)
- Stream type was identified as a C5, the water surface slope was 0.001 ft/ft, and the median channel substrate was medium sand

Recommendations:

- Maintain forested drainage area protection.
- Investigate large adjacent landfill for influences on biotic community and stream stability.

15-20a

Herring Bay Sampling Unit

IBI and Metric Scores

Narrative Rating	Good
Overall Index	4.43
Total Taxa Score	5
EPT Taxa Score	5
% Ephemeroptera	5
Number of Ephemeroptera Score	3
% Intolerant to Urban Score	3
Scraper Taxa Score	5
% Climbers	5

Calculated Metric Values

Total Taxa	22
EPT Taxa	6
% Ephemeroptera	18.4
Number of Ephemeroptera	1
% Intolerant to Urban	21.1
Scraper Taxa	3
% Climbers	9.6

Taxa List

HETEROTRISOCLADIUS	1
STENONEMA	21
CALOPTERYX	1
AMPHINEMURA	10
ISOPERLA	4
HELICHUS	2
DIPLOCLADIUS	1
NANOCLADIUS	1
CRICOTOPUS/ORTHOCLADIUS	7
POLYPEDILUM	10
RHEOCRICOTOPUS	1
XYLOTOPUS	1
HEMERODROMIA	2
CHEUMATOPSYCHE	3
IRONOQUIA	8
LYPE	4
PISIDIUM	1
OLIGOCHAETA	9
CAECIDOTEA	7
GAMMARUS	18
SYNURELLA	1
NEOPLASTA	1

Total Individuals 114

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	6	Pool Substrate Characterization	7
Bank Stability- Right Bank	5	Pool Variability	11
Vegetative Protection- Left Bank	6	Riparian Vegetative Zone Width- Left Bank	3
Vegetative Protection- Right Bank	6	Riparian Vegetative Zone Width- Right Bank	3
Channel Flow Status	12	Sediment Deposition	8
Channel Alteration	16	Epifaunal Substrate	3
Channel Sinuosity	6	EPA Habitat Score	92
		EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	2097.1	Instream Wood Debris	7
Distance from Road (m)	30	Bank Erosion Extent- Left	75
Percent Shading	65	Bank Erosion Extent- Right	75
Epifaunal Substrate	3	Bank Erosion Severity -Left	1
Instream Habitat	5	Bank Erosion Severity -Right	1
		PHI Score	44.8
		PHI Narrative Ranking	SD

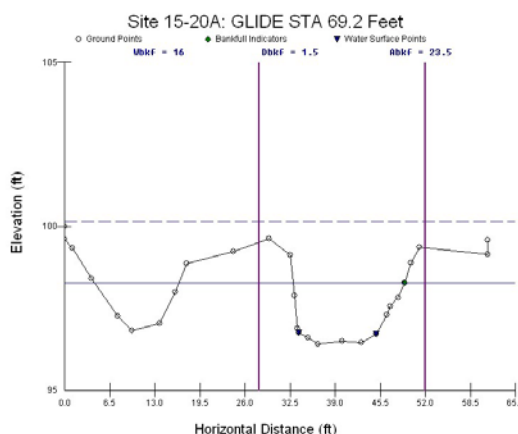
Water Chemistry

Dissolved Oxygen (mg/L)	10	Temperature (°C)	14.45
pH	6.52	Turbidity (NTU)	13.6
Specific Conductance (mS/cm)	0.16		

Geomorphic Assessments

Drainage area (acres)	2097.1	Entrenchment Ratio:	12.48
Bankfull Width (ft):	16.02	Width:Depth Ratio:	12.07
Mean Depth (ft):	1.46	Sinuosity:	1.05
Bankfull X-Sec Area (sq ft):	23.47	Water Surface Slope (ft/ft):	0.001
Flood-Prone Width (ft):	200	Reach D50 (mm):	0.38

Rosgen Channel Classification: C5



Note: The purple lines indicate that only the portions of the cross section between the lines are hydraulically connected to the bankfull channel.

Appendix C:

Master Taxa List

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

Order	Family	Genus	FFG*	TV*	Habit
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	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	
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
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			
		OLIGOCHAETA	Collector	10	bu
		TURBELLARIA	Predator	4	sp

* FFG = Function Feeding Group, TV = Tolerance Value

Appendix D:

Rosgen Classification

Appendix E:

Geomorphic Assessment Results

River	Reach	Drainage Area	Classification	Bankfull Width(ft)	Mean Depth(ft)	Bankfull X-Sec Area(sq ft)	Width:Depth Ratio	Flood-Prone Width(ft)	Entrenchment Ratio	D50(mm)	Water Surface Slope(ft/ft)	Sinuosity
Herring Bay	15-01	1.1	E 6	7.63	1.12	8.57	6.81	200	26.21	0.03	0.003	1.1
Herring Bay	15-03	0.3	E 5	6.37	1.15	7.3	5.54	150	23.55	0.09	0.005	1.1
Herring Bay	15-04	0.1	B 5c	4.55	0.54	2.44	8.43	9.36	2.06	0.23	0.015	1.21
Herring Bay	15-05	0.9	G 5c	11.05	0.99	10.97	11.16	12.37	1.12	0.12	0.003	1.12
Herring Bay	15-06	0.6	C 6	12.68	0.52	6.64	24.38	50	3.94	0.03	0.004	1.05
Herring Bay	15-07	0.8	E 5	9.2	0.96	8.86	9.58	100	10.87	0.27	0.001	1.14
Herring Bay	15-11A	0.3	E 5	6.92	0.68	4.71	10.18	100	14.45	0.33	0.003	1.14
Herring Bay	15-12A	1.3	G 5c	12.37	1.07	13.25	11.56	14.01	1.13	0.41	0.003	1.12
Herring Bay	15-19A	3.4	E 5	15.44	1.41	21.83	10.95	120	7.77	0.38	0.004	1.07
Herring Bay	15-20A	3.3	C 5	16.02	1.46	23.47	12.07	200	12.48	0.38	0.001	1.05
Lower North River	12-01	0.3	F 5	10.19	0.58	5.92	17.57	13.64	1.34	0.38	0.004	1.2
Lower North River	12-02	1.2	E 5	11.94	1.28	15.24	9.33	100	8.38	0.19	0.004	1.2
Lower North River	12-03	0.6	B 5c	11.59	1.41	16.3	8.22	21.16	1.83	0.17	0.006	1.2
Lower North River	12-04	1.0	E 5	9.74	1.47	14.34	6.63	38.12	3.91	0.33	0.004	1.2
Lower North River	12-05	0.5	B 5c	10.28	1.25	12.83	8.22	14.82	1.44	1.5	0.003	1.4
Lower North River	12-06	0.1	B 5c	3.63	0.6	2.17	6.05	6.2	1.71	1.5	0.004	1.2
Lower North River	12-07	0.2	F 5	11.42	0.55	6.27	20.76	13.9	1.22	0.17	0.005	1.05
Lower North River	12-08	0.8	E 5	14.07	2	28.1	7.04	32.5	2.31	0.18	0.004	1.2
Lower North River	12-09	4.1	B 5c	16.8	2.49	41.76	6.75	25.7	1.53	0.38	0.003	1.07
Lower North River	12-10	4.2	E 6	12.09	1.58	19.06	7.65	80	6.62	0.03	0.002	1.2
Lyons Creek	22-01	0.8	G 4c	10.39	1.34	13.91	7.75	12.82	1.23	2.22	0.004	1.14
Lyons Creek	22-02	1.5	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
Lyons Creek	22-03	0.9	B 5c	10.22	0.81	8.23	12.62	15.11	1.48	0.1	0.001	1.07
Lyons Creek	22-04	0.4	B 4c	5.29	0.92	4.87	5.75	8.33	1.57	4.57	0.012	1.12
Lyons Creek	22-05	0.4	G 4c	9.4	0.91	8.54	10.33	12.98	1.38	2.67	0.004	1.1
Lyons Creek	22-06	0.2	E 5	5.88	0.69	4.08	8.52	100	17.01	0.19	0.011	1.45
Lyons Creek	22-09	3.9	E 6	13.69	2.79	38.14	4.91	300	21.91	0.03	0.0004	1.05
Lyons Creek	22-11A	0.8	G 5c	8.47	1.16	9.82	7.3	11.79	1.39	0.4	0.002	1.17
Lyons Creek	22-16A	0.2	F 5	8.44	0.53	4.46	15.92	10.06	1.19	0.43	0.008	1.2
Lyons Creek	22-17A	1.3	G 4c	9.21	1.34	12.36	6.87	12.53	1.36	2.13	0.008	1.09
Stocketts Run	19-01	2.1	F 4	17.59	0.86	15.04	20.45	20.02	1.14	3.33	0.0008	1.21
Stocketts Run	19-02	0.9	G 5/1c	8.83	0.97	8.54	9.1	11.82	1.34	0.75	0.005	1.09
Stocketts Run	19-03	0.2	F 5/1	6.92	0.5	3.49	13.84	8.9	1.29	0.2	0.01	1.05
Stocketts Run	19-04	1.0	F 5/1	13.72	0.85	11.71	16.14	18.53	1.35	0.34	0.002	1.07
Stocketts Run	19-05	0.2	B 4/1c	6.54	0.58	3.79	12.08	9.89	1.51	2.75	0.011	1.07
Stocketts Run	19-06	0.6	B 5c	5.54	1.15	6.35	4.82	10.29	1.86	1	0.011	1
Stocketts Run	19-07	0.2	B 5c	11.79	0.92	10.8	12.82	19.76	1.68	0.44	0.01	1.2
Stocketts Run	19-08	1.3	F 5	11.97	0.9	10.79	13.3	13.31	1.11	1.43	0.002	1.17
Stocketts Run	19-09	5.7	F 5	29.48	0.92	27.18	32.04	36.09	1.22	1.25	0.001	1.2
Stocketts Run	19-10	5.1	F 5/1	26.7	1.16	30.95	23.02	34.76	1.3	2	0.003	2.05
Upper North River	11-02	0.1	E 5	10.52	1.09	11.44	9.65	25.35	2.41	0.46	0.006	1.1
Upper North River	11-04	0.1	B 5c	6.14	0.53	3.24	11.58	13.36	2.18	0.38	0.007	1.07
Upper North River	11-05	1.6	B 5c	9.73	1.63	15.82	5.97	15.2	1.56	0.3	0.005	1.05
Upper North River	11-06	7.2	C 5c-	23.68	1.42	33.71	16.68	54	2.28	0.17	0.0007	1.2
Upper North River	11-07	0.1	C 5	11.64	0.43	4.99	27.07	100	8.59	0.38	0.005	1.2
Upper North River	11-11A	0.6	B 5c	6.66	0.99	6.6	6.73	10.82	1.62	0.2	0.008	1.08
Upper North River	11-13A	0.7	C 5	20.19	0.42	8.53	48.07	200	9.91	0.19	0.005	1.05
Upper North River	11-14A	0.8	E 5	9.01	0.86	7.74	10.48	220	24.42	0.29	0.0003	1.07
Upper North River	11-15A	0.5	G 5c	6.46	1.16	7.53	5.57	8.75	1.35	0.2	0.008	1.11
Upper North River	11-17A	0.6	E 5	7	1.19	8.32	5.88	17.01	2.43	0.31	0.006	1.12

Appendix F: Sample Field Sheets



Stream Channel Classification and Assessment Form

Rosgen Classification System

Level II



Watershed Name: _____ Stream/ReachID: _____

Drainage Area: _____ mi²/acres/ha

Observers: _____ Date/Time: _____/_____/_____

Lat: _____

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

Lon: _____

Location Description: _____

Camera/Film No. _____

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

Photo Nos: US _____ DS _____ LB _____ RB _____

Bankfull Width (W): _____ ft.

Bankfull Mean Depth (D) : _____ ft.

W/D Ratio: _____

W and D checked on Regional Curve?

[] Y [] N

Describe feature(s) used:

Thalweg elv.(TE): _____ ft.

Bankfull elv.(BFE): _____ ft.

Max Bankfull Depth (TE-BFE): _____ ft.

2X Max Bankfull Depth (2XMBD): _____ ft.

Floodprone Area Elevation (TE-

2XMBD): _____ ft.

Floodprone Area Width (FPW): _____ ft.

Entrenchment Ratio(FPW/W): _____

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

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

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

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

Assessment Reach Length (ARL): _____ ft.

Valley Distance (VD): _____ ft.

WS Slope (WSE/ARL): _____ ft./ft.

Valley Slope (VE/VD): _____ ft./ft.

Sinuosity (ARD/VD): _____

Meander Length: _____ ft.

Belt Width: _____ ft.

CLASSIFICATION (USE ROSGEN KEY OF NATURAL RIVERS):

Channel Type:

Single Thread []

Multiple Channels []

Entrenchment Ratio:

<1.4 []

1.4-2.2 []

>2.2 []

Width/Depth Ratio:

<12 []

12-40 []

>40 []

Sinuosity:

<1.2 []

1.2-1.5 []

>1.5 []

D50: _____

Adjustments? _____

**Rosgen
Stream
Type: _____**

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

Vegetation Types

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

Riparian Buffer Zone/ Adjacent Land Cover Types

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

Sampleability Codes

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

Instream Blockage Codes

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

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

Other Notes:

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

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

Parameters to be evaluated in sampling reach	Habitat Parameter	Condition Category																				
		Optimal					Suboptimal					Marginal					Poor					
	1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).					30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).					10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.					Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.					
		SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
	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
	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
	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
	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

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 2 0 0 5	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 (m ² 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	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 Access Route _____

Sampling Consd (_____ num. Anodes) _____

Comments _____