HOWARD COUNTY BIOLOGICAL MONITORING AND ASSESSMENT SOUTH BRANCH PATAPSCO, PATAPSCO RIVER LOWER BRANCH A, and PATAPSCO RIVER LOWER BRANCH B WATERSHEDS 2015

NPDES Permit Number 00-DP-3318 MD0068322

December 31, 2015
Report

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Prepared for

Department of Public Works
Bureau of Environmental Services
Stormwater Management Division
NPDES Watershed Management Programs

Prepared by

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December 31, 2015
Report

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EXECUTIVE SUMMARY

The Howard County Department of Public Works, Stormwater Management Division, initiated the Howard County Biological Monitoring and Assessment Program in the spring of 2001. The County initiated the monitoring program to establish a baseline ecological stream condition for all of the County's watersheds. The program involves monitoring the biological and physical condition of the County's water resources and is designed on a five-year rotating basis such that each of the County's 15 watersheds, or primary sampling units (PSUs), is sampled once every five years.

To allow for paired site comparisons with both Rounds 1 and 2, 30 sites from Round 1 and 30 sites from Round 2 were randomly selected for repeat sampling in Round 3. The remaining 90 sites in Round 3 are new random sites. More specifically, 2 sites in each Round 3 watershed were randomly chosen from the 10 Round 1 sites and 2 sites were randomly chosen from the 10 Round 2 sites; the remaining 6 sites are new random sites. In 2015, ten sites were chosen for sampling in each of three subwatersheds: South Branch Patapsco, Patapsco River Lower Branch A, and Patapsco River Lower Branch B. These subwatersheds were also sampled in Round 1 (2003) and Round 2 (2008) of the countywide assessment. The monitoring involved sampling instream water quality, collection and analysis of the biological community (benthic macroinvertebrates) using Maryland Biological Stream Sampling (MBSS) protocols, cross sectional analysis, particle size distribution, and assessment of the physical habitat using the United States Environmental Protection Agency's (EPA) Rapid Bioassessment Protocols (RBP) and the MBSS's Physical Habitat Index (PHI). The sampling methods used are compatible with those used in the first two rounds of the assessment, with updates where applicable.

All biological data collection occurred between March 12 and April 9, 2015, well within the benthic sampling period defined by the MBSS protocols. The positions of the sites were collected using a GPS unit accurate to within 2 meters.

Biological results for 2015 in the South Branch Patapsco, Patapsco River Lower Branch A, and Patapsco River Lower Branch B watersheds indicate streams that are in good to very poor condition. Nine of the sites sampled received overall BIBI ratings of "Good". Seven sites received ratings of "Fair" and seven sites received ratings of "Poor". Six sites ranked in the "Very Poor" range, one in the South Branch Patapsco, one in the Patapsco River Lower Branch A, and four sites in the Patapsco River Lower Branch B subwatershed.

RBP habitat assessment results indicate average subwatershed physical habitat conditions that are "Partially Supporting" in all three subwatersheds. None of the sites sampled in any of the three subwatersheds were "Comparable to Reference" (as defined as > 90% of the maximum score). Eight sites were "Supporting", five of which were in the South Branch Patapsco subwatershed. Seventeen sites were "Partially Supporting" and five were "Non-Supporting." The PHI results indicate average subwatershed physical habitat conditions are "Degraded" in the Patapsco River Lower Branch A and B subwatersheds, and "Partially Degraded" in the South Branch Patapsco River subwatershed. No sites were "Minimally Degraded", but four sites were "Severely Degraded."

The geomorphic assessment indicates that a range of systems are present in the Patapsco River watershed. Some of the channels sampled throughout the subwatersheds were classified as stable type C and E channels; however, the majority of the sites sampled were incised and entrenched F channels. Gravel is the dominant substrate type in almost all of the sampled reaches; however, the dominant substrate is sand at four of the sites.

The amount of impervious surface in the Patapsco River watershed increases with distance downstream, and as the benthic community in a freshwater stream can be adversely affected by impervious cover and associated runoff at values below 10% (CWP 2003), so does stream health, generally. The average percentage of impervious surface area in the South Branch Patapsco, the furthest upstream, is only 5.5%. The average percentage of impervious area in the Patapsco River Lower Branches A and B (moving downstream), is 15.8% and 23%, respectively. Percentage of impervious area in site drainage area ranges from only 0.7% to 30% (see Appendix A for impervious values).

The relationships between the BIBI and both the RBP habitat assessment score and the PHI score were not significant ($R^2 = 0.19$, $p = .42$, $R^2 = 0.09$, $p = .84$, respectively). As the habitat scores increase, so does the BIBI (see Figure 4-2). This suggests that physical habitat conditions directly affect the biological condition of a stream.

Comparisons to Rounds 1 and 2 of the assessment indicates change in conditions in the Patapsco River watershed, namely in the South Branch Patapsco subwatershed. The South Branch Patapsco subwatershed was in "Poor" biological condition in the first two rounds, but improved to "Good" in the third round of sampling. The Patapsco River Lower Branch A was in "Poor" biological condition in all three rounds, and the Patapsco River Lower Branch B was in "Poor" condition in rounds 1 and 3, but was in "Very Poor" biological condition in Round 2 of sampling. The South Branch Patapsco and Patapsco River Lower Branch A subwatersheds were "Partially Supporting" in all three rounds of sampling. The Patapsco River Lower Branch B subwatershed improved from "Non-supporting" in Rounds 1 and 2, to "Partially Supporting" in Round 3 of sampling.

TABLE OF CONTENTS

Page

LIST OF TABLES

Table No. **Page**

LIST OF FIGURES

Figure No. **Page**

1 BACKGROUND AND OBJECTIVES

The Howard County Department of Public Works, Stormwater Management Division, initiated the Howard County Biological Monitoring and Assessment Program in the spring of 2001. The program involves monitoring the biological and physical condition of the county's water resources to monitor status and detect trends at the stream level, the watershed level, and ultimately the county level. The Department of Public Works initiated the program to establish a baseline ecological stream condition for all of the county's watersheds. The program is designed on a 5-year, rotating basis such that each of the county's 15 watersheds, or primary sampling units (PSU), is sampled once every 5 years. In general three PSUs are sampled each year, and 10 sites are sampled in each PSU.

The first sampling rotation (Round 1) was completed in only 3 years (2001 to 2003; Table 1-1). Sampling conducted in PSUs 2, 5, and 3 in 2001 addressed requirements of the Patuxent Reservoir Watershed Group in addition to sampling conducted in the Little Patuxent watersheds (PSUs 11, 12, and 13) under a Watershed Restoration Action Strategy (WRAS) grant. In 2002, only the Middle Patuxent sites (PSUs 6, 7, and 8) were sampled. Additional WRAS funding in 2003 allowed sampling to be completed in the Patapsco River tributaries (PSUs 1, 4, and 10) in addition to Rocky Gorge, Hammond Branch, and Dorsey Run, which were sampled to supplement the data collected in 2001 for the Little Patuxent. Round 1 (2001-2003) was sampled and assessed by Tetra Tech.

Round 2 (2005 to 2009) focused on Upper and Lower Brighton Dam (PSUs 2 and 5, respectively) and Cattail Creek (PSU 3) during the first year of sampling. The Little Patuxent River subwatersheds (PSUs 11, 12, and 13) were sampled in 2006. The Middle Patuxent subwatersheds (PSUs 6, 7, and 8) and the Patapsco River subwatersheds (PSUs 1, 4, and 10) were re-sampled in 2007 and 2008, respectively. In 2009, 30 newly selected sites were sampled in the Rocky Gorge Dam (PSU 9), Hammond Branch (PSU 14), and Dorsey Run (PSU 15) subwatersheds to fulfill sampling requirements. Tetra Tech completed the first year of Round 2 sampling and assessment (2005), while KCI was responsible for the remainder of the second Round (2006-2009).

Round 3 (2012 to 2016) of county-wide sampling began with sampling at Upper Brighton Dam (PSU 2), Lower Brighton Dam (PSU 5), and Cattail Creek (PSU 3) during 2012 and with the Little Patuxent River watersheds in 2013 (PSUs 11, 12, and 13). During 2014, Round 3 sampling continued with the sampling of the Middle Patuxent River subwatersheds (PSUs 6, 7, and 8). In 2015, the South Branch Patapsco, Patapsco River Lower Branch A, and Patapsco River Lower Branch B subwatersheds were sampled (PSUs 10, 1, and 4). Round 3 sampling will continue through 2016 and PSUs will be sampled in the same order as in Round 2. Round 3 sampling includes a combination of repeat site samples and new random site samples to improve trend detection. Figure 1-1 illustrates the progress made to date on the county-wide biological monitoring program.

Assessment methods follow those developed by Maryland Department of Natural Resources' (DNR) Maryland Biological Stream Survey (MBSS) and the standard operating procedures (SOPs) found in the Quality Assurance Project Plan (QAPP) for the Howard County Biological Monitoring and Assessment Program (Howard County 2001). The sampling methods

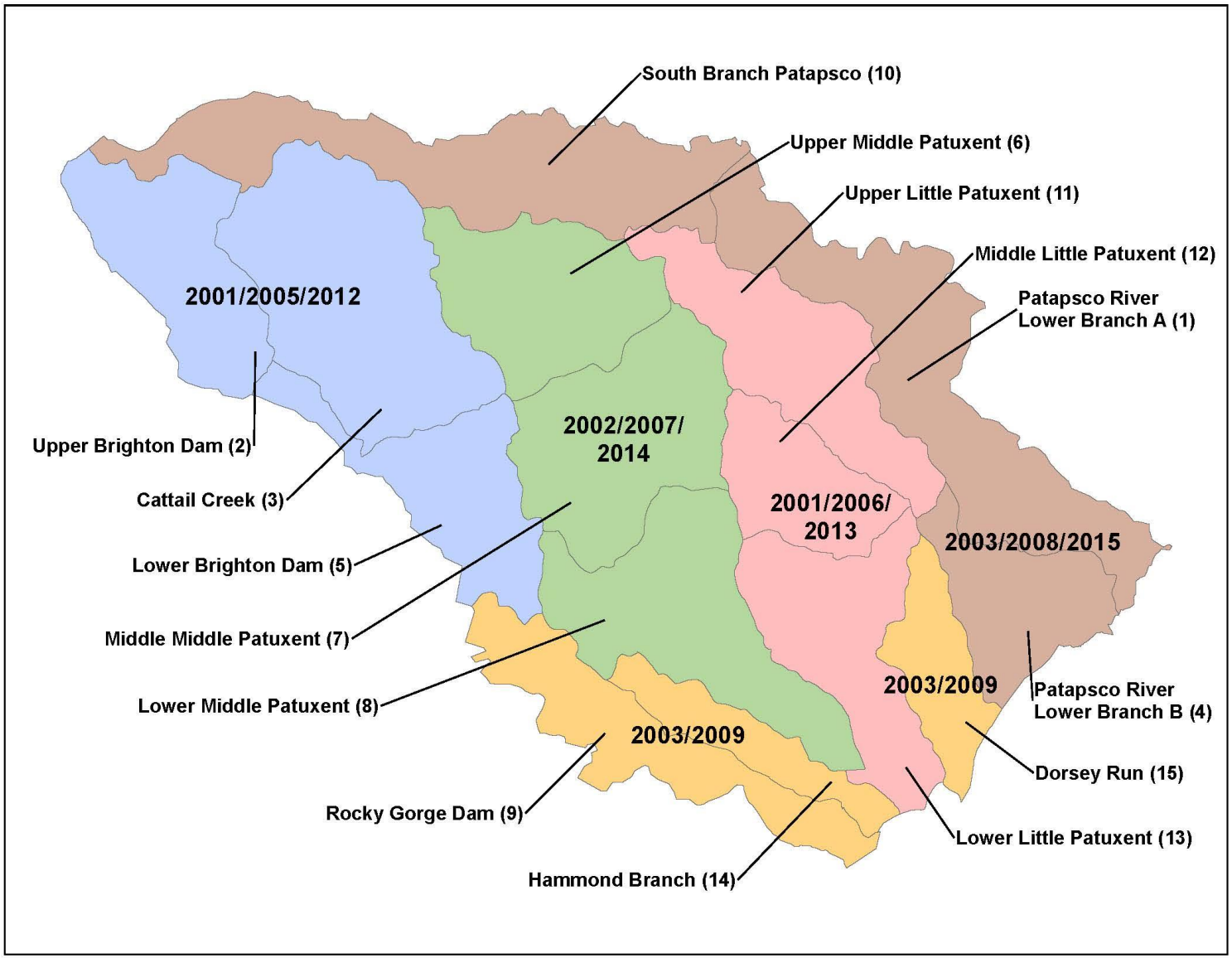

Figure 1-1. Summary of Howard County bioassessment progress (2001-2015)

used in Round 3 are compatible with those used in Rounds 1 and 2 and have been updated where applicable.

Table 1-1. Howard County bioassessment subwatersheds and schedule

Year	Number of Sites	Primary Sampling Unit (Code and Name)
Round 1		
2001	60	11 – Upper Little Patuxent 12 – Middle Little Patuxent 13 – Lower Little Patuxent 2 – Upper Brighton Dam 5 – Lower Brighton Dam 3 – Cattail Creek
2002	30	6 – Upper Middle Patuxent 7 – Middle Middle Patuxent 8 – Lower Middle Patuxent
2003	60	9 – Rocky Gorge Dam 14 – Hammond Branch 15 – Dorsey Run 10 – S Branch Patapsco River Tributaries 1 – Patapsco River L Branch A 4 – Patapsco River L Branch B
Round 2		
2005	30	2 – Upper Brighton Dam 5 – Lower Brighton Dam 3 – Cattail Creek
2006	30	11 – Upper Little Patuxent 12 – Middle Little Patuxent 13 – Lower Little Patuxent
2007	30	6 – Upper Middle Patuxent 7 – Middle Middle Patuxent 8 – Lower Middle Patuxent
2008	30	10 – S Branch Patapsco River Tributaries 1 – Patapsco River L Branch A 4 – Patapsco River L Branch B
2009	30	9 – Rocky Gorge Dam 14 – Hammond Branch 15 – Dorsey Run
Round 3		
2012	30	2 – Upper Brighton Dam 5 – Lower Brighton Dam 3 – Cattail Creek
2013	30	11 – Upper Little Patuxent 12 – Middle Little Patuxent 13 – Lower Little Patuxent
2014	30	6 – Upper Middle Patuxent 7 – Middle Middle Patuxent 8 – Lower Middle Patuxent

Table 1-1. (Continued)

Year	Number of Sites	Primary Sampling Unit (Code and Name)
2015	30	10 – S Branch Patapsco River Tributaries 1 – Patapsco River L Branch A 4 – Patapsco River L Branch B
2016	30	9 – Rocky Gorge Dam 14 – Hammond Branch 15 – Dorsey Run

The three subwatersheds sampled in 2015 are located along the northern edge of the county, bordering Frederick County, Carroll County, Baltimore County, and Anne Arundel County. The Patapsco River watershed is crossed by several major transportation routes (Figure 1-2). Routes 32 and 97 run roughly north-south through the South Branch Patapsco subwatershed. Interstate 70 and Frederick Road (Route 40) run roughly east-west through the South Branch Patapsco and Patapsco River Lower Branch A subwatersheds. The Patapsco River Lower Branch B is traversed by a number of major roads, but most notable Route 100 and Interstate 95. Along with major interstates crossing these three subwatersheds, waterways in the Patapsco River watershed have also been intersected by railroad routes since the 1800s. The B&O railroad's *Main Line* directly borders the mainstem Patapsco River throughout the entire length of these three subwatersheds. Numerous sites sampled border, receive runoff from, or flow under active railroad lines in the Patapsco Valley. Contaminants from railroad activity have been found in higher concentrations downstream of crossings than in the sediments above, and in some streams exceeded probable effect thresholds for risks to aquatic life (Levengood et al. 2015).

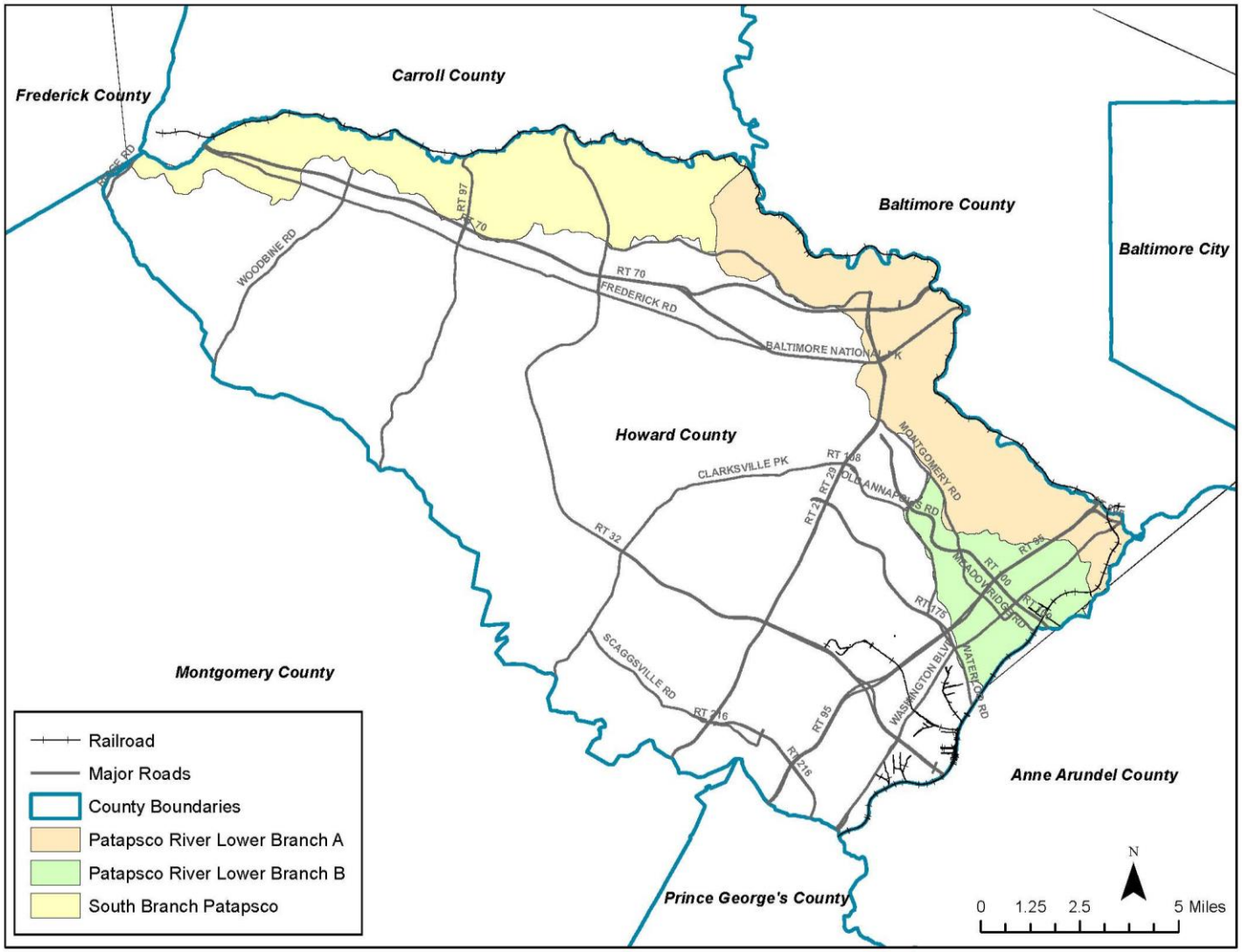

Figure 1-2. Location map of the South Branch Patapsco, and Patapsco River Lower Branches A and B subwatersheds

2 METHODS

Stream monitoring conducted throughout the watershed includes measuring instream water quality, sampling and assessing the biological community (benthic macroinvertebrates), visually assessing the instream and riparian physical habitat, performing cross sectional analysis, and measuring substrate particle size. During 2015, 10 sites were selected for sampling in each of the 3 PSU's – South Branch Patapsco, Patapsco River Lower Branch A, and Patapsco River Lower Branch B. The assessment methods followed the current MBSS protocols (DNR 2014) and the SOPs described in the county's QAPP (Howard County 2001). All biological data were collected between March 12 and April 9, 2015, within the spring index period as required by MBSS sampling protocols. The location of each site was identified using a global positioning system (GPS) unit that is accurate to within 2 meters. All data were entered into a customized geodatabase created by Versar for Howard County's countywide biological monitoring program. Photographs were taken to document conditions at the time of data collection.

2.1 SELECTION OF SAMPLING SITES

A total of 150 sampling sites were selected at random per round of sampling for Rounds 1 and 2 to provide robust assessments of stream condition for the county and its 15 watersheds (or PSUs). Rounds 1 and 2 provide two unbiased assessments of stream condition with the ability to compare changes in the area-wide mean condition between rounds. Round 3 will provide a third unbiased assessment of stream condition while improving the ability to detect change over time (i.e., trends) by incorporating fixed sites (i.e., repeated sampling of sites selected at random for Rounds 1 and 2). New randomly selected sites also will be sampled during Round 3. This "partial replacement" design meets the objective of improved trend detection, while continually improving the accuracy of the status assessment.

To allow for paired site comparisons, 30 sites from Round 1 and 30 sites from Round 2 were randomly selected for repeat sampling in Round 3. The remaining 90 sites in Round 3 are new, randomly selected sites. This is consistent with the recommendation of standard statistical texts (e.g., Cochran 1977) to fix between 25% and 50% of the sites. More specifically, 2 sites in each Round 3 watershed were randomly chosen from the 10 Round 1 sites, and 2 sites were randomly chosen from the 10 Round 2 sites; the remaining 6 sites in each watershed are new, randomly selected sites.

The randomly selected sites are distributed in proportion to the length of stream in each stream order within each watershed to ensure adequate coverage of stream sizes. To select primary and alternate sampling sites, stream lengths were summed by stream order within each subwatershed. The length of stream by stream order and its percentage of the total length within the subwatershed determined the number of sites selected on that order stream.

A random number generator was used to select sampling reaches for 2015. Both primary and alternate sites were selected in case the primary site was ephemeral (dry), inaccessible, or unsafe to sample. Site codes contain the PSU code and initials of the watershed (10PT), stream order (1), a two-digit sequential number (01), either an "R" or an "F" indicating that the site is a

randomly selected site or a fixed "revisit" site, the year sampled (2015), and a letter used in the field to differentiate sampling sites (A).

One duplicate site will be monitored in each PSU for a total of 3 duplicate sites per year (15 QC duplicate sites over the course of Round 3). Only the biological assessment will be conducted at the duplicate sites. These sites were selected using aerial photography and then verified in the field. Duplicate sites (including alternates) will be immediately upstream of a sampling site, will have similar habitat characteristics, and will not be affected by road crossings or confluences.

2.2 LAND USE ANALYSIS

The acreage and percentage of various land use categories were calculated for the drainage area to each site using county GIS data. Drainage areas to each sampling site were first delineated using 2-foot contours. Land use was derived from Maryland Department of Planning (MDP) 2010 land use for Howard County. Since the Patapsco River is a large watershed draining and bordering several counties, additional GIS data from Carroll, Frederick, Baltimore, and Anne Arundel counties were used to delineate drainage areas and calculate land use percentages. Impervious values were derived using Howard County's 2004 planimetric layers, including roads, buildings, parking lots, driveways and sidewalks.

A table with the percentage of land use, including impervious surface, in each subwatershed is included in Appendix A.

2.3 WATER QUALITY SAMPLING

To supplement the macroinvertebrate sampling and physical habitat assessment, water quality is measured in the field at all monitoring stations. All parameters are measured *in situ* with a YSI® multi-probe data storage device. A calibration log is kept to ensure that the equipment is working properly during field visits. Field-tested parameters include:

- pH (standard pH units)
- Temperature (degrees Celsius, °C)
- Dissolved oxygen (milligrams per liter, mg/L)
- Conductivity (microSiemans per centimeter, µS/cm)
- Turbidity (NTU)

The Maryland Department of the Environment (MDE) has established acceptable standards for several water quality parameters for each designated Stream Use Classification. These standards are listed in the *Code of Maryland Regulations (COMAR) 26.08.02.03-03 - Water Quality* (MDE, 1994). The South Branch Patapsco has drainages classified as I, III, and IV. The Patapsco River Lower Branch A also has drainages classified as I, III, and IV, however only types I and IV are present in Howard County. The South Branch Patapsco subwatershed is the only drainage capable of supporting a trout fishery. This subwatershed, as well as the Patapsco River Lower Branch A

subwatershed, have waterways capable of supporting "put and take" trout fisheries. The Patapsco River Lower Branch B is classified as only I, meaning it supports only "non-trout" fisheries and water is for industrial or agriculture use. The acceptable standards for Use I, III, and IV are listed in Tables 2-1, 2-2, and 2-3. Data collected at each station are compared with these standards in the site summaries in Section 3.0.

Table 2-1. Water quality sampling and COMAR standards, use I

Parameter	Units	Acceptable COMAR Standard
pH	standard pH units	6.5 to 8.5
Temperature	degrees Celsius, °C	maximum of 90 °F (32 °C) or ambient temperature of the surface water, whichever is greater
Dissolved Oxygen (DO)	milligrams per liter, mg/L	may not be less than 5 mg/L at any time
Conductivity	microSiemans per centimeter, µS/cm	no COMAR standard set
Turbidity	Nephelometer Turbidity Units, NTU	maximum of 150 NTUs and maximum monthly average of 50 NTUs

Table 2-2. Water quality sampling and COMAR standards, use III

Parameter	Units	Acceptable COMAR Standard
pH	standard pH units	6.5 to 8.5
Temperature	degrees Celsius, °C	maximum of 68 °F (20 °C) or ambient temperature of the surface water, whichever is greater
Dissolved Oxygen (DO)	milligrams per liter, mg/L	may not be less than 5 mg/L at any time, minimum daily average no less than 6 mg/L
Conductivity	microSiemans per centimeter, µS/cm	no COMAR standard set
Turbidity	Nephelometer Turbidity Units, NTU	maximum of 150 NTUs and maximum monthly average of 50 NTUs

Table 2-3. Water quality sampling and COMAR standards, use IV		
Parameter	**Units**	**Acceptable COMAR Standard**
pH	standard pH units	6.5 to 8.5
Temperature	degrees Celsius, °C	maximum of 75 °F (23.9 °C) or ambient temperature of the surface water, whichever is greater
Dissolved Oxygen (DO)	milligrams per liter, mg/L	may not be less than 5 mg/L at any time
Conductivity	microSiemans per centimeter, µS/cm	no COMAR standard set
Turbidity	Nephelometer Turbidity Units, NTU	maximum of 150 NTUs and maximum monthly average of 50 NTUs

2.4 BIOLOGICAL SAMPLING

Biological monitoring was conducted throughout the South Branch Patapsco, Patapsco River Lower Branch A, and Patapsco River Lower Branch B subwatersheds following methods detailed in the county's QAPP (Howard County 2001). Biological assessment methods within Howard County are designed to be consistent and comparable with the methods used by Maryland DNR in its MBSS. The county adopted the MBSS methodology to be consistent with statewide monitoring programs and programs adopted by other Maryland counties. The methods were developed locally and are calibrated to Maryland's physiographic regions and stream types. To maintain comparability with prior years of sampling, physical habitat condition was assessed using the EPA's Rapid Bioassessment Protocol (RBP; Barbour et al. 1999) habitat assessment for high-gradient streams. The MBSS habitat parameters required to calculate the MBSS Physical Habitat Index (PHI) were also collected (Paul et al. 2002). Many of the MBSS habitat parameters included in the PHI are usually sampled during the summer index period. For example, percent shading is often misrepresented during the spring index period when leaves typically have not yet opened. Therefore, the PHI score should be used with that particular caveat. Figure 2-1 shows the locations of the bioassessment sites on the Howard County stream layer.

2.4.1 Benthic Macroinvertebrate Sampling

Benthic macroinvertebrate collection followed the QAPP, which closely mirrors MBSS procedures (DNR 2014). Benthic macroinvertebrate sampling is conducted during the spring index period (March 1 to April 30) along a 75-meter reach. Systematic field collections of the benthic macroinvertebrate community provide a measure of the biological health of the stream. The multi-habitat, D-frame net approach was used to sample a range of the most productive habitat types within the reach. In this sampling approach, 20 square feet distributed among the best available

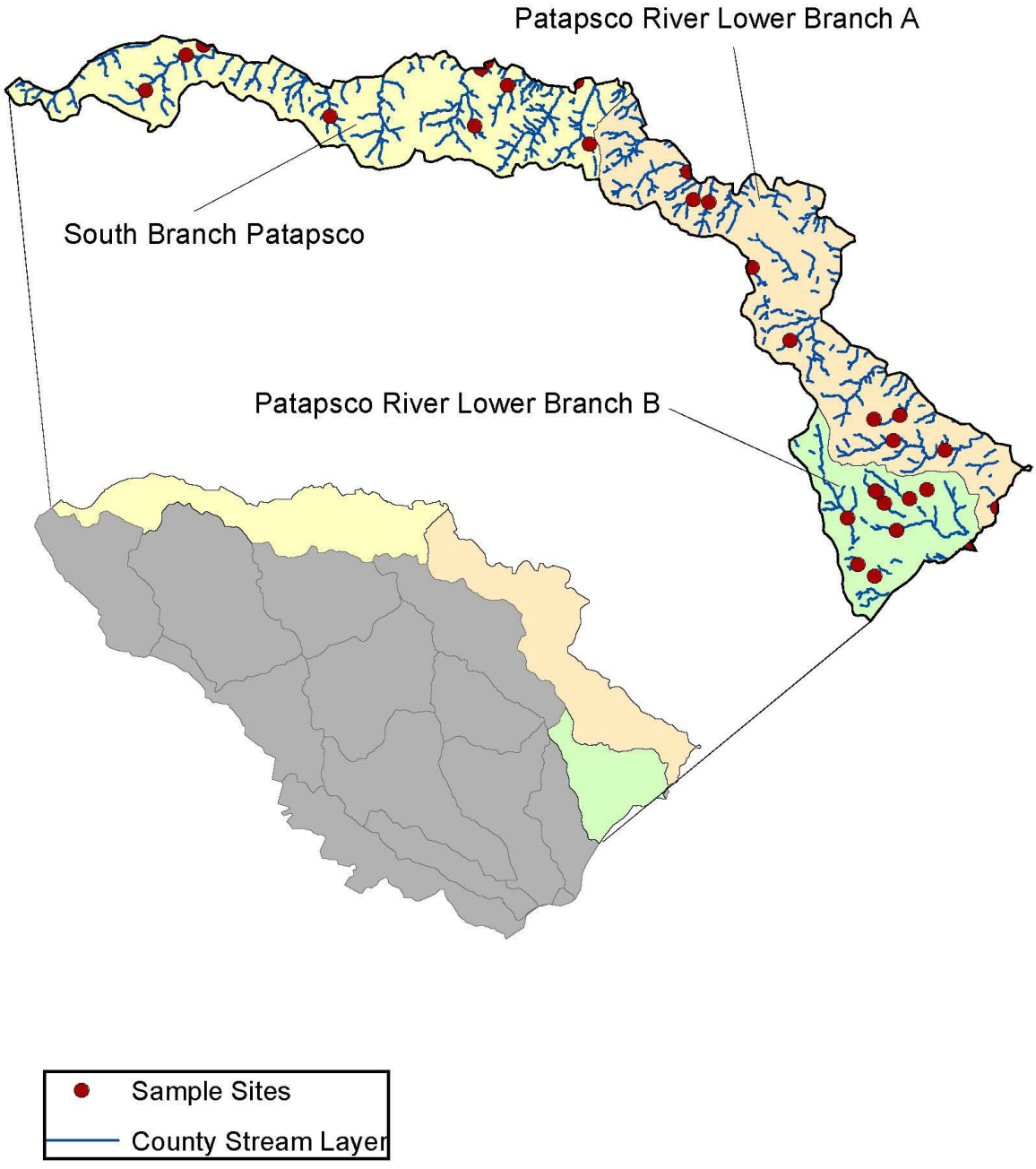

Figure 2-1. Patapsco South Branch, Patapsco River Lower Branch A, and Patapsco River Lower Branch B bioassessment sampling locations

habitats within the stream system are sampled and combined into one composite sample. Sampled habitats include riffles, rootwads, rootmats and woody debris, leaf packs, submerged aquatic vegetation, and undercut banks.

2.4.2 Sample Processing and Laboratory Identification

Benthic macroinvertebrate samples are processed and subsampled according to methods described in the MBSS Laboratory Methods for Benthic Macroinvertebrate Processing and Taxonomy (Boward and Friedman 2000). Subsampling is conducted to standardize the sample size and reduce variation caused by samples of different size. In this method, the sample is spread evenly across a gridded tray and a randomly selected grid is picked clean (sorted) of organisms. Grids are selected and sorted until a count of 120 is reached. The last grid selected is sorted entirely even if the count of 120 is reached (i.e., if 2 grids contain only 110 organisms an additional grid is selected and sorted completely). The 120 target allows for proper identification of specimens that are missing parts or are early instars that cannot be identified easily.

Organisms were identified by Versar's benthic taxonomist, who is certified by the Society for Freshwater Science (formerly North American Benthological Society) for all macroinvertebrate identifications for East Coast specimens. Most organisms are identified to the genus level, including Chironomidae and Oligochaeta when possible. Individuals of early instars or those that may be damaged were identified to the lowest possible level with certainty. Most taxa are identified using a stereoscope, but permanent slide mounts were used to identify Chironomidae and Oligochaeta to genus level. Results were recorded on a bench sheet and entered into an Access database for analysis.

2.4.3 Biological Data Analysis

Data were analyzed using methods developed by MBSS as outlined in the *New Biological Indicators to Better Assess the Condition of Maryland Streams* (Southerland et al. 2005). The Benthic Index of Biotic Integrity (BIBI) approach involves statistical analysis using metrics that have a predictable response to water quality and habitat impairment. The metrics selected fall into five major groups, including taxa richness, taxa composition, tolerance to perturbation, trophic (feeding) classification, and habit.

Raw values for each metric are given a score of 1, 3, or 5 based on ranges of values developed for each metric. The results are combined into a scaled BIBI score ranging from 1.0 to 5.0, and a corresponding narrative rating is applied. Three sets of metric calculations have been developed for Maryland streams based on broad physiographic regions. These include the Coastal Plain, Eastern Piedmont, and Combined Highlands ecoregions. The South Branch Patapsco sites are all located in the Eastern Piedmont region. Nine sites in each of the Patapsco River Lower Branch A and Patapsco River Lower Branch B are also located in the Eastern Piedmont region. For these 28 sites the Piedmont formulation of the BIBI was used. One site in each of Patapsco River Lower Branch A and Patapsco River Lower Branch B subwatersheds, however, is located in the Coastal Plain region. The Coastal Plain formulation of the BIBI was used for these two sites.

DNR updated the benthic metrics, scoring criteria, and individual species tolerance in 2005. The data collected during Round 1 sampling of the South Branch Patapsco, Patapsco River Lower Branch A, and Patapsco River Lower Branch B subwatersheds were originally analyzed using the old metrics (Stribling et al. 1998); consequently, those results are not directly comparable to the current sampling data. All data from the 2003 sampling were recalculated using the updated metrics to allow for direct comparison with the Round 2 and Round 3 data. For this report, any mention of 2003 BIBI scores refer to these recalculated values.

The following metrics and BIBI scoring were used for data analysis:

Eastern Piedmont BIBI Metrics:

- *Number of Ephemeroptera Taxa* – Equals the total number Ephemeroptera Taxa in the sample. Ephemeroptera (mayflies) are generally considered pollution sensitive, thus communities dominated by Ephemeroptera usually indicate better water quality.
- *Total Number of Taxa* – Equals the richness of the community in terms of the total number of taxa at the genus level or higher. A large variety of genera typically indicate better overall water quality, habitat diversity and/or suitability, and community health.
- *Number of EPT Taxa* – Equals the richness of genera within the Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). EPT taxa are generally considered pollution sensitive, thus higher numbers of EPT taxa would be indicative of better water quality.
- *Percent Intolerant Urban* – Equals the percentage of individuals in the sample that are considered intolerant to urbanization (tolerance values [TV] = 0 – 3). The percent of intolerant urban is expected to decrease with decreasing water quality.
- *Percent Chironomidae* – Equals the percentage of individuals in the sample that are in the Chironomidae (nonbiting midge) family. An increase in the percentage of Chironomidae is generally an indicator of decreasing water quality.
- *Percent Clingers* – Equals the percentage of the total number of individuals who are adapted to attaching to surfaces in stream riffles. Higher percentages of clingers are representative of a decrease in stressors and better water quality.

Coastal Plain BIBI Metrics:

- *Total Number of Taxa* – Equals the richness of the community in terms of the total number of taxa at the genus level or higher. A large variety of genera typically indicate better overall water quality, habitat diversity and/or suitability, and community health.
- *Number of EPT Taxa* – Equals the richness of genera within the Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). EPT taxa are generally considered pollution sensitive, thus higher numbers of EPT taxa would be indicative of better water quality.

- *Number of Ephemeroptera Taxa* – Equals the total number Ephemeroptera Taxa in the sample. Ephemeroptera (mayflies) are generally considered pollution sensitive, thus communities dominated by Ephemeroptera usually indicate better water quality.
- *Percent Intolerant Urban* – Equals the percentage of individuals in the sample that are considered intolerant to urbanization (tolerance values [TV] = 0 – 3). The percent of intolerant urban is expected to decrease with decreasing water quality.
- *Percent Ephemeroptera* – Equals the percent of Ephemeroptera individuals in the sample. Ephemeroptera are generally considered pollution sensitive, thus communities dominated by Ephemeroptera usually indicate lower disturbances in water quality.
- *Number Scraper Taxa* – Equals the number of Scraper taxa in the sample, those taxa that scrape food from the substrate. As the levels of stressors or pollution rise there is an expected decrease in the numbers of Scraper taxa.
- *Percent Climbers* – Equals the percentage of the total number of individuals who are adapted to living on stem surfaces. Higher percentages of climbers typically represent a decrease in stressors and overall better water quality.

Information on trophic or functional feeding group and habit were based heavily on information compiled by DNR and from Merritt and Cummins (1996). Scoring criteria for the Piedmont BIBI are shown in Table 2-4. Coastal Plain BIBI scoring criteria are shown in Table 2-5. The raw metric value ranges are given with the corresponding scores of 1, 3, or 5. Table 2-6 provides the BIBI scoring ranges and corresponding biological condition ratings.

Table 2-4. Biological index scoring for Piedmont benthic macroinvertebrates

Metric	Score		
	1	**3**	**5**
Total Number of Taxa	< 15	15 – 24	≥ 25
Number of EPT Taxa	< 5	5 – 10	≥ 11
Number of Ephemeroptera Taxa	< 2	2 – 3	≥ 4
Percent Intolerant Urban	< 12	12 – 50	≥ 51
Percent Chironomidae	> 63	24 – 63	≤ 24
Percent Clingers	< 31	31 – 73	≥ 74

Table 2-5. Biological index scoring for Coastal Plain benthic macroinvertebrates			
Metric	**Score**		
	1	**3**	**5**
Total Number of Taxa	< 14	14 – 21	≥ 22
Number of EPT Taxa	< 2	2 - 4	≥ 5
Number of Ephemeroptera Taxa	< 1.0	1.9 – 1.0	≥ 2
Percent Intolerant Urban	< 10	10 - 27	≥ 28
Percent Ephemeroptera	< 0.8	0.8 – 10.9	≥ 11
Number of Scraper Taxa	> 1.0	1.9 – 1.0	≥ 2
Percent Climbers	< 0.9	0.9 – 7.9	≥ 8.0

Table 2-6. BIBI scoring and rating	
BIBI Score	**Narrative Rating**
4.0 – 5.0	Good
3.0 – 3.9	Fair
2.0 – 2.9	Poor
1.0 – 1.9	Very Poor

2.5 PHYSICAL HABITAT ASSESSMENT

Each biological monitoring site is characterized based on physical characteristics and various habitat parameters following the Environmental Protection Agency's Rapid Bioassessment Protocol (RBP) habitat assessment for high gradient streams (Barbour et al 1999). The RBP habitat assessment consists of visually assessing 10 biologically significant habitat parameters that evaluate a stream's ability to support an acceptable level of biological condition. Each parameter is given a numerical score from 0 to 20 and a categorical rating of optimal, suboptimal, marginal or poor. Overall habitat quality typically increases as the total score for each site increases. The parameters assessed for high gradient streams are listed in Table 2-7.

Table 2-7. RBP habitat parameters for high gradient streams	
Parameters Assessed	
Epifaunal substrate/available cover	Channel alteration
Embeddedness	Frequency of riffles/bends
Velocity/depth regime	Bank stability
Sediment deposition	Vegetative protection
Channel flow status	Riparian vegetative zone width

The above parameters for each site were summed to obtain a total habitat score. Since local reference conditions were not available for comparison, the percent comparability was calculated based on the highest attainable score (200). The percent comparability score is then used to place each site into corresponding narrative rating categories as shown in Table 2-8.

Table 2-8. RBP habitat score and ratings

Percent of Reference	Narrative Rating
> 90.0	Comparable to Reference
75.1 – 89.9	Supporting
60.1 – 75.0	Partially Supporting
< 60.0	Non-supporting

MBSS stream habitat assessment methods (Paul et al. 2002) were used to assess the physical habitat at each site using the Piedmont Physical Habitat Index (PHI). In developing the PHI, MBSS identified eight parameters that have the most discriminatory power for Piedmont streams. These parameters were evaluated on a 0 to 20 scale at each sampling site and used to calculate the PHI (Table 2-9, Table 2-10).

Table 2-9. Parameters assessed in MBSS's habitat assessment procedure (Physical Habitat Index or PHI) for Piedmont streams

Parameter	Rating Scale
Remoteness	0 to 20
Shading	0% to 100%
Epibenthic Substrate	0 to 20
Instream Habitat	0 to 20
Woody Debris and Rootwads	Total count
Bank Stability	0 to 20
Riffle Quality	0 to 20
Embeddedness	0 to 20

Table 2-10. Parameters assessed in MBSS's habitat assessment procedure (Physical Habitat Index or PHI) for Coastal Plains streams

Parameter	Rating Scale
Remoteness	0 to 20
Shading	0% to 100%
Epibenthic Substrate	0 to 20
Instream Habitat	0 to 20
Woody Debris and Rootwads	Total count
Bank Stability	0 to 20

PHI is scored based on Table 2-11.

Table 2-11. MBSS Physical Habitat Index (PHI) score and rankings	
> 81	Minimally Degraded
66-81	Partially Degraded
51-65	Degraded
< 51	Severely Degraded

2.6 GEOMORPHIC ANALYSIS

A stream geomorphic assessment was conducted to foster a better understanding of the physical processes and features shaping the storm channels in these subwatersheds and to support strategic decisions on how to best protect, manage, and restore watershed resources. Assessment techniques include the cross sectional survey, substrate particle size analysis, and measurement of channel slope.

2.6.1 Cross Section Analysis

Cross sections at each monitoring station were surveyed according to Howard County's SOP to characterize the channel and measure cross sectional area and discharge. Each cross section was located on a representative riffle whenever possible and was surveyed with a laser level and stadia rod.

The cross sections include survey of the floodplain and all pertinent channel features including:

- Top of bank
- Bankfull elevation
- Edge of water
- Limits of point and instream depositional features
- Thalweg
- Floodprone elevation

Sinuosity was calculated using GIS based on the stream length and straight line valley length, including the selected reach of stream sampled. The floodprone width was estimated at an elevation two times the bankfull depth.

Additional survey points were taken near the upstream and downstream ends of the sampling reach to estimate the slope through the reach in order to estimate discharge. Survey points for slope calculations typically were taken at the top of like features (e.g., top of riffle to top of riffle), although this was not always possible.

2.6.2 Particle Size Analysis

The channel bed and bank materials were characterized at each cross section using pebble count analysis. One modified Wolman pebble count (Wolman 1954) was conducted in each reach to determine the composition of channel materials and the median particle size for each site. The pebble count procedure was adapted from *Stream Channel Reference Sites: An Illustrated Guide to Field Technique* (Harrelson et al. 1994). Pebble counts were conducted at 10 transects across the entire assessment reach. Transects were positioned based on the proportion of riffles, pools, runs, and glides in the assessment reach as estimated by visual inspection. The count was conducted within the entire bankfull channel. The pebble counts provide roughness values necessary for calculations of velocity and discharge.

2.6.3 Rosgen Classification

The stream cross section, bed and bank material data, and slope were analyzed using the Ohio Department of Natural Resources Reference Reach Spreadsheet Version 4.3L (ODNR 2012). The following values and ratios were calculated:

Sinuosity	Entrenchment ratio	Bankfull cross section area
Slope	Bankfull height	Velocity
Floodprone width	Bankfull width	Discharge
Width / depth ratio	Mean depth	

A Rosgen Level II characterization (Rosgen 1996) was assigned to each stream reach based on field-collected data. Table 2-12 includes general descriptions for each channel type classification based on the Rosgen classification system for natural rivers. The types are determined by a combination of factors including entrenchment, width-to-depth ratio, planform, and slope. Soil types, basin relief, and valley morphology also contribute to the channel type.

Table 2-12. Rosgen Level II channel type description

Channel Type	General Description (from Rosgen 1996)
Aa+	Very steep, deeply entrenched, debris transport, torrent streams.
A	Steep, entrenched, confined, cascading, step/pool streams. High energy/ debris transport associated with depositional soils. Very stable if bedrock or boulder dominated channel.
B	Moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools. Moderate width/depth ratio. Narrow, gently sloping valleys. Very stable plan and profile. Stable banks.
C	Low gradient, meandering, slightly entrenched, point-bar, riffle/pool, alluvial channels with broad, well-defined floodplains.
D	Braided channel with longitudinal and transverse bars. Very wide channel with eroding banks. Active lateral adjustment, high bedload and bank erosion.

Table 2-12. (Continued)

Channel Type	General Description (from Rosgen 1996)
DA	Anastomosing (multiple channels) narrow and deep with extensive, well-vegetated floodplains and associated wetlands. Very gentle relief with highly variable sinuosities and width/depth ratios. Very stable streambanks.
E	Low gradient, Highly sinuous, riffle/pool stream with low width/depth ratio and little deposition. Very efficient and stable. High meander/width ratio.
F	Entrenched, meandering riffle/pool channel on low gradients with high width/ depth ratio and high bank erosion rates.
G	Entrenched “gully” step/pool and low width/depth ratio on moderate gradients. Narrow valleys. Unstable, with grade control problems and high bank erosion rates.

3 RESULTS

A total of 30 sites were sampled in the South Branch Patapsco, Patapsco River Lower Branch A, and Patapsco River Lower Branch B subwatersheds, 10 in each subwatershed. Site coordinates are provided in Appendix A. One biological QA/QC sample was collected in each subwatershed at stations where upstream habitat was considered to be similar. The summary results of the habitat assessment, biological assessment, land use, and Rosgen characterization (Rosgen 1996) are divided among the three subwatersheds and presented in detail in this section. A map of each subwatershed displaying the results of the RBP habitat assessment and BIBI is also presented. Full data results are displayed in Appendices A through F.

3.1 SOUTH BRANCH PATAPSCO

In 2015, 5 of the 10 sampling sites in the South Branch Patapsco subwatershed were on first-order streams, two were on second-order streams, and three were on fourth order streams. The field QC sample was collected at site 10PT-401-R-2015A. The subwatershed had an average BIBI score of 3.50 and a "Fair" condition rating; scores ranged from 1.33 to 4.67. The average RBP habitat assessment comparability score was 73 or " Partially Supporting," and scores ranged from 56 ("Non-supporting") to 80 ("Supporting"). The average PHI score was 65.39 ("Degraded"). The South Branch Patapsco had five stream channels classified as Rosgen type F, four as B, and one as G. Channel substrate at eight of the sites was predominantly gravel. The remaining two sites had sand as the dominant particle size class. Table 3-1 summarizes the results for the South Branch Patapsco subwatershed and Figure 3-1 shows the sites with BIBI and RBP comparability scores on a map.

Table 3-1. South Branch Patapsco Sampling Results

Site ID	Drainage Area (acres)	% Impervious	BIBI Score	BIBI Rating	RBP Score	RBP Rating	PHI Score	PHI Rating
10PT-401-R-2015A*	40,550.44	1.67	4	Good	75	Partially Supporting	65.94	Degraded
10PT-404-R-2015B	36,559.76	1.55	4.33	Good	80	Supporting	75.74	Partially Degraded
10PT-107-R-2015C	257.38	7.27	4	Good	64	Partially Supporting	57.09	Degraded
10PT-110-R-2015D	240.63	6.88	1.33	Very Poor	56	Non-supporting	49.24	Severely Degraded
10PT-114-R-2015E	657.24	9.76	2.67	Poor	79	Supporting	61.41	Degraded
10PT-216-R-2015F	4,562.72	1.49	2.33	Poor	72	Partially Supporting	73.81	Partially Degraded
10PT-419-F-2015G	36,748.72	1.56	3.33	Fair	70	Partially Supporting	69.82	Partially Degraded
10PT-122-F-2015H	427.54	7.45	4.33	Good	80	Supporting	74.79	Partially Degraded
10PT-124-F-2015I	127.51	9.42	4.67	Good	76	Supporting	68.61	Partially Degraded
10PT-225-F-2015J	1,936.55	7.63	4	Good	78	Supporting	57.46	Degraded
Minimum	127.51	1.49	1.33	Very Poor	56	Non-supporting	49.24	Severely Degraded
Maximum	40550.44	9.76	4.67	Good	80	Supporting	75.74	Partially Degraded
Mean	12206.85	5.47	3.5	Fair	73	Partially Supporting	65.39	Degraded
Standard Deviation	17847.11	3.48	1.07		7.83		8.85	

* QC sampling was conducted at this site

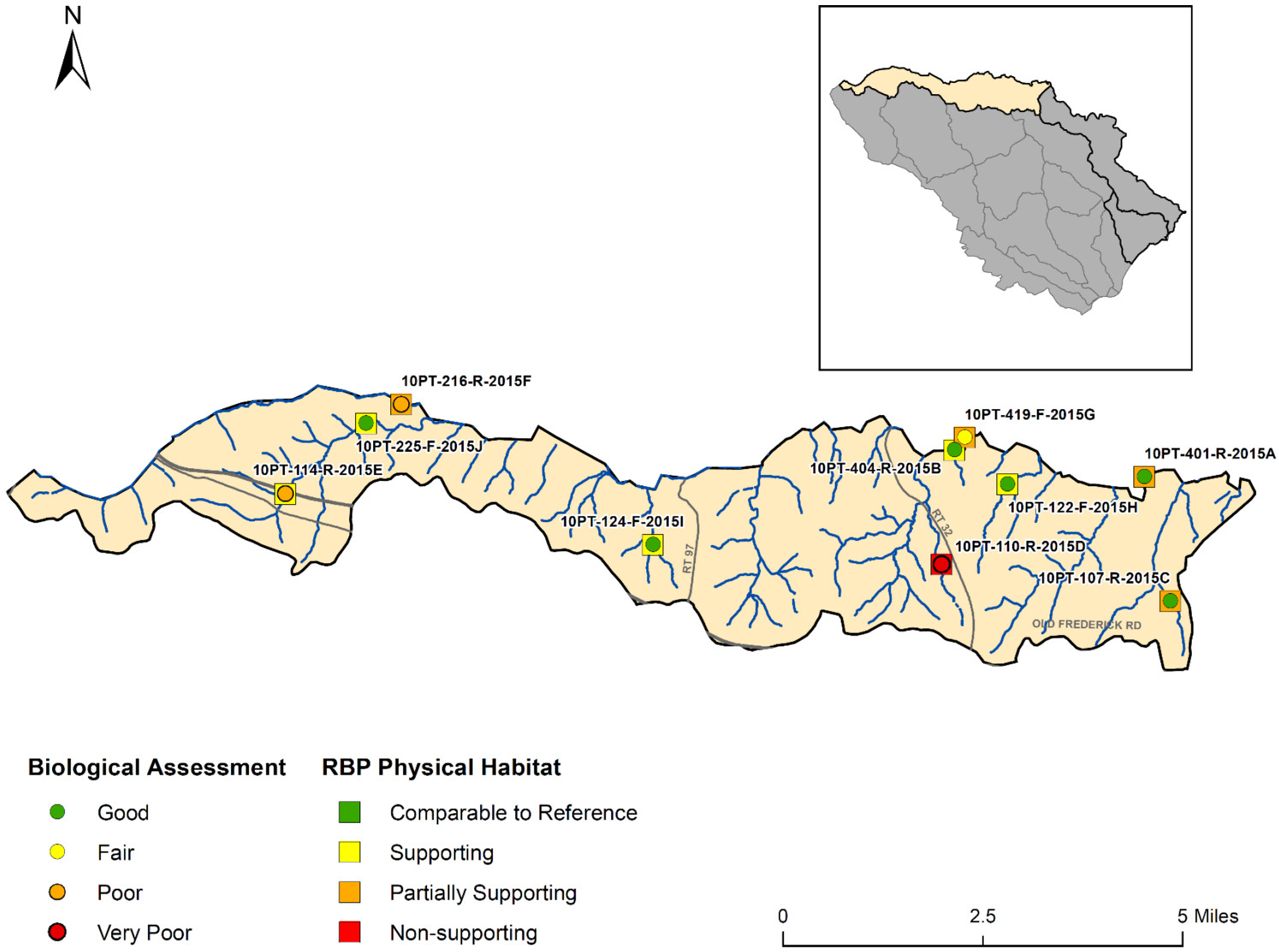

Figure 3-1. South Branch Patapsco sampling results

10PT-401-R-2015A – This is a well forested portion of the mainstem South Branch Patapsco running along a railroad track. The site is closest to Henryton Road. Both banks are high with dewatered root wads and woody debris. Stream width is approximately 20 meters with gravel as the dominant substrate type. This site has the largest drainage area of any site sampled in 2015, at 40,550 acres. Land use is mainly agriculture (41%), forest (33%), and low-density residential (21%). Impervious surface is low in the drainage, at only 1.67%. The RBP habitat assessment yielded a score of 75 ("Partially Supporting") and the PHI score was 65.9 ("Degraded"). Despite less than ideal habitat conditions, a total of 24 taxa were present in the sample, including 12 Ephemeroptera, Plecoptera, and Tricoptera (EPT) taxa. Seventy-five percent of the individuals were tolerant of urban stressors. The site's overall BIBI score of 4.00 and "Good" biological classification are mainly attributed to only having 6.5% chironomidae and to having a high number of EPT taxa. All water quality parameters were within acceptable COMAR standards. Geomorphically, the stream was classified as an F4 channel, meaning it had a high width-depth ratio and was moderately entrenched. Gravel was the dominant particle class.

10PT-404-R-2015B – This mainstem South Branch Patapsco site is near River Road. At the lower end of the reach there is a 35 meter long bar which splits the flow. The bar has become vegetated with trees. A railroad track runs parallel to the site and the right bank is steep and covered with railroad gravel. This site has a large drainage as well, at 36,560 acres. Land use in the drainage is mainly agriculture (43%), forest (30%), and low-density residential (21%). Impervious surface is low, at only 1.55%. The habitat at this site was rated highest out of all the sites sampled in this subwatershed, and had a RBP habitat assessment score of 80 ("Supporting") and a PHI score of 75.7 ("Partially Degraded"). A total of 33 taxa were present in the sample, including 16 EPT taxa. The high number of total taxa, EPT taxa, and low percentage of chironomidae caused the site's overall BIBI score (4.33) and biological classification (Good) to score so well. All water quality parameters were within acceptable COMAR standards. The stream was classified as having a B4c channel type and a dominant particle class of gravel. This channel type indicates that the stream was moderate in terms of entrenchment, width-depth ratio, and sinuosity.

10PT-107-R-2015C – This first order stream is off of Marriottsville Road. The streambed is dominated by sandy material with silt/clay banks. The site's riparian buffer consists of both young and mature trees, but the banks are still moderately eroded. The site drainage is 257 acres. Of that area, 46% of the land use is agriculture, 34% is forest, and 20% is low-density residential. Impervious cover accounts for 7.27% of the site catchment. The RBP habitat assessment resulted in a score of 64 ("Partially Supporting") and the PHI score a 57.1 ("Degraded"). A total of 25 taxa were present in the sample, including 10 EPT taxa, despite having somewhat degraded habitat. Seventy-four percent of individuals were tolerant of urban stressors. The site's overall BIBI score of 4.00 corresponds to a "Good" biological classification, and is likely attributed to the high number of taxa and the low percentage of chironomidae (0%). All water quality parameters were within acceptable COMAR standards. This stream had a channel type of B5c, meaning it was moderately entrenched and sinuous, and had a dominant channel material of sand.

10PT-110-R-2015D – This site is off of Route 32 and runs through a pasture. No cattle were present at the time of sampling, but site was very silty with almost no riparian buffer. The right bank is eroded more than the left bank but the stream is still connected to the flood plain.

The site drainage is 241 acres. The land uses in this area are mainly agriculture (63%), forest (11%), low-density residential (24%), and institutional (2%). Impervious cover accounts for 6.88% of the drainage. The RBP habitat assessment resulted in a low score of 56 ("Non-supporting") and the PHI score was a 49.2 ("Severely Degraded"). A total of 15 taxa were present in the sample, including only one EPT taxa. Ninety six percent of individuals were tolerant of urban stressors. These two factors, plus having 88.2% chironomidae in the sample, caused the site's overall BIBI score to be 1.33, and correspond to a "Very Poor" biological classification. This site had the most degraded habitat out of any site in the subwatershed, and unsurprisingly, had the lowest BIBI score as well. All water quality parameters were, however, within acceptable COMAR standards. This stream had an F4 channel type, meaning the substrate was mainly gravel, and the channel was moderately entrenched and had a high width-depth ratio.

10PT-114-R-2015E – This first order stream is located off of Beetz Road, and flows under I-70 just downstream of the site. The drainage for this site is 657 acres. Land use is comprised of agriculture (39%), forest (10%), and low-density housing (46%). The remaining area is transportation, wetland, and commercial/industrial. The drainage is 9.76% impervious surface. The RBP habitat assessment resulted in a score of 79 ("Supporting") and the PHI score a 61.4 ("Degraded"). A total of 28 taxa were present in the sample, including nine EPT taxa. Since ninety-one percent of individuals were tolerant of urban stressors and there were no Ephemeroptera taxa present, the site's overall BIBI score (2.67) corresponded to a "Poor" biological classification. All water quality parameters were within acceptable COMAR standards. This stream was classified as having an F4 channel type, meaning the substrate was mainly gravel, and the channel was moderately entrenched, with a high width-depth ratio.

10PT-216-R-2015F – This site runs parallel to a railroad track near Blooms Lane. The right bank is highly eroded due to the railroad and there is no riparian buffer along half of the site. The drainage is 4,563 acres, and of this area, land use is made up of primarily agriculture (35%), forest (34%), commercial/industrial (7%), low-density residential (13%), medium-density residential (5%), and high-density residential (2%). The remaining land is institutional, transportation, open urban land, and open water. This drainage is only 1.49% impervious cover, however, the lowest in this subwatershed. The RBP habitat assessment resulted in a score of 72 ("Partially Supporting") and the PHI score was 73.8 ("Partially Degraded"). A total of 18 taxa were present in the sample, including seven EPT taxa. Since ninety-three percent of individuals were tolerant of urban stressors and there were no Ephemeroptera taxa present, the site's overall BIBI score (2.33) corresponded to a "Poor" biological classification. All water quality parameters were within acceptable COMAR standards. This stream had a channel type of C4, meaning it was only slightly entrenched and the dominant substrate particle class was gravel.

10PT-419-F-2015G – This site is located on the South Branch Patapsco River and runs parallel to a railroad track off of River Road. Along the railroad track, the right bank is channelized by a stone retaining wall. There is a large mid-channel bar comprised of sand and gravel. Due to the river's width, the site is only about 15% shaded. This site on the South Branch Patapsco has a drainage of 36,749 acres. Land use is comprised mainly of agriculture (43%), forest (30%), and low-density residential (22%). This drainage has only 1.56% impervious surface. The RBP habitat assessment resulted in a score of 70 ("Partially Supporting") and the PHI score was 69.8 ("Partially Degraded"). A total of 30 taxa were present in the sample, including 10 EPT taxa. Eighty-five

percent of individuals found were tolerant of urban stressors. The site's overall BIBI score of 3.33 corresponds to a "Fair" biological classification. All water quality parameters were within acceptable COMAR standards. This stream's channel type was classified as a B4c, meaning it was moderately sinuous and entrenched, and the dominant bed material was gravel.

10PT-122-F-2015H – This site is on a first order stream off of River Road. It is fairly embedded due to large amounts of silt from eroded banks (greater than 2.5 meters in height in some areas). The drainage for this site is 428 acres. Of this area, 14% of the land use is agricultural, 40% is forest, and 46% is low-density residential. 7.45% of this catchment is impervious cover. The RBP habitat assessment resulted in a score of 80 ("Supporting"), one of the highest in the subwatershed, and the PHI score was 74.8 ("Partially Degraded"). A total of 29 taxa were present in the sample, including 13 EPT taxa. Sixty-one percent of individuals were tolerant of urban stressors. The site's overall BIBI score of 4.33 corresponds to a "Good" biological classification. This stream would have scored higher had there been more than one Ephemeroptera taxa present in the sample. All water quality parameters were within acceptable COMAR standards. This stream's channel was classified as an E4, meaning it was only slightly entrenched and had a very low width-depth ratio.

10PT-124-R-2015I – This site is located on a first order stream off of Old Frederick Road. Although this site is well forested, there are areas of high erosion and bare soil, mainly on the right bank. The drainage at this site is only 128 acres, the smallest in the subwatershed. Land use consists mainly of agricultural (24%), forest (47%), and low-density residential (25%). Impervious surface in this drainage is 9.42%. The RBP habitat assessment resulted in a score of 76 ("Supporting") and the PHI score was 68.6 ("Partially Degraded"). A total of 31 taxa were present in the sample, including 18 EPT taxa. Fifty-six percent of individuals were tolerant of urban stressors. The site's overall BIBI score was 4.67 and corresponded to a "Good" biological classification because of the high number of total taxa, high number of EPT taxa, and low percentage of chironomidae (12.7%). All water quality parameters were within acceptable COMAR standards. This stream's channel type was classified as an F4b, meaning the dominant particle class was gravel, it had a high width-depth ratio, and was entrenched.

10PT-225-F-2015J – This site, located off of Blooms Lane, runs between an old field on the right bank and a dirt driveway on the left bank. The driveway runs uphill, making the left stream bank high. The site is only about 30% shaded with little woody debris. The drainage area for this second order stream is 1,937 acres. Land use consists of agricultural (54%), forest (14%), and low-density residential (28%). The remaining land use is a mix of transportation, commercial/ industrial, and institutional. Impervious cover accounts for 7.63% of this drainage area. The RBP habitat assessment resulted in a score of 78 ("Supporting") and the PHI assessment resulted in a score of 57.5 ("Degraded"). Since a total of 28 taxa were present in the sample, including 11 EPT, the site's overall BIBI score was 4.00 and corresponded to a "Good" biological classification. All water quality parameters were within acceptable COMAR standards. This stream had a channel type of C4, meaning it was only slightly entrenched and had a dominant particle class of gravel.

3.2 PATAPSCO RIVER LOWER BRANCH A

In 2015, 8 of the 10 sampling sites in the Patapsco River Lower Branch A were on first-order streams, one was on a second-order, and one was on a third-order stream. The field QC sample was collected at site 01PA-317-R-2015F. The subwatershed had an average BIBI score of 2.90 and a "Poor" condition rating; scores ranged from 1.67 to 4.00. The average RBP habitat assessment comparability score was 68.1 or "Partially Supporting," and scores ranged from 49 ("Non-Supporting") to 79 ("Supporting"). The average PHI score was 62.85 ("Degraded"). Seven of the stream channels assessed in the Patapsco River Lower Branch A were classified as Rosgen type F. Two of the remaining channels were classified as C, and one as a type G. Substrates were predominantly gravel at nine of the sites. One site had a sandy substrate. Table 3-2 summarizes the results for the Patapsco River Lower Branch A subwatershed and Figure 3-2 shows the sites with BIBI and RBP comparability scores on a map.

Table 3-2. Patapsco River Lower Branch A sampling results

Site ID	Drainage Area (acres)	% Imper-vious	BIBI Score	BIBI Rating	RBP Score	RBP Rating	PHI Score	PHI Rating
01PA-102-R-2015A	868.07	14.60	2.67	Poor	73	Partially Supporting	71.03	Partially Degraded
01PA-104-R-2015B	320.60	17.04	4.00	Good	76	Supporting	77.35	Partially Degraded
01PA-107-R-2015C	33.37	0.65	3.67	Fair	75	Partially Supporting	70.17	Partially Degraded
01PA-110-R-2015D	57.59	15.23	2.33	Poor	58	Non-supporting	39.27	Severely Degraded
01PA-213-R-2015E	1,917.07	9.64	3.00	Fair	79	Supporting	75.86	Partially Degraded
01PA-317-R-2015F*	12,123.86	17.88	3.00	Fair	60	Non-supporting	54.72	Degraded
01PA-119-F-2015G	323.43	19.82	1.67	Very Poor	71	Partially Supporting	72.89	Partially Degraded
01PA-121-F-2015H	288.92	18.12	2.67	Poor	49	Non-supporting	50.75	Severely Degraded
01PA-123-F-2015I	29.12	23.35	2.67	Poor	70	Partially Supporting	51.72	Degraded
01PA-126-F-2015J	195.97	21.25	3.33	Fair	70	Partially Supporting	68.34	Partially Degraded
Minimum	29.12	0.65	1.67	Very Poor	49	Non-supporting	39.27	Severely Degraded
Maximum	12123.86	23.35	4.00	Good	79	Supporting	77.35	Partially Degraded
Mean	1615.8	15.76	2.90	Poor	68.1	Partially Supporting	62.85	Degraded
Standard Deviation	3736.35	6.53	0.67		9.433392226		13.31	

* QC sampling was conducted at this site and PHI Score calculated using coastal PHI metrics

01PA-102-2015A – This first order stream is located in Rockburn Branch Park, near Milbury Court, and is in a designated forest retention zone. Erosion throughout the site is moderate. The site's drainage area is 868 acres. Land use is comprised mainly of agriculture (4%), forest (20%), low-density residential (26%), and medium-density residential (46%). The drainage is 14.6% impervious cover. The RBP habitat assessment resulted in a score of 73 ("Partially Supporting") and the PHI score was 71 ("Partially Degraded"). A total of 20 taxa were present in the sample, including 7 EPT taxa. Ninety-six percent of individuals, however, were tolerant of urban stressors. The site's overall BIBI score of 2.67 corresponds to a "Poor" biological classification. The site's poor BIBI score is likely attributed to the high percentage of chironomidae (52.8% of the sample). All water quality parameters were within acceptable COMAR standards. This stream was classified as a B4c, meaning the dominant substrate was gravel, and the channel was moderately entrenched and sinuous.

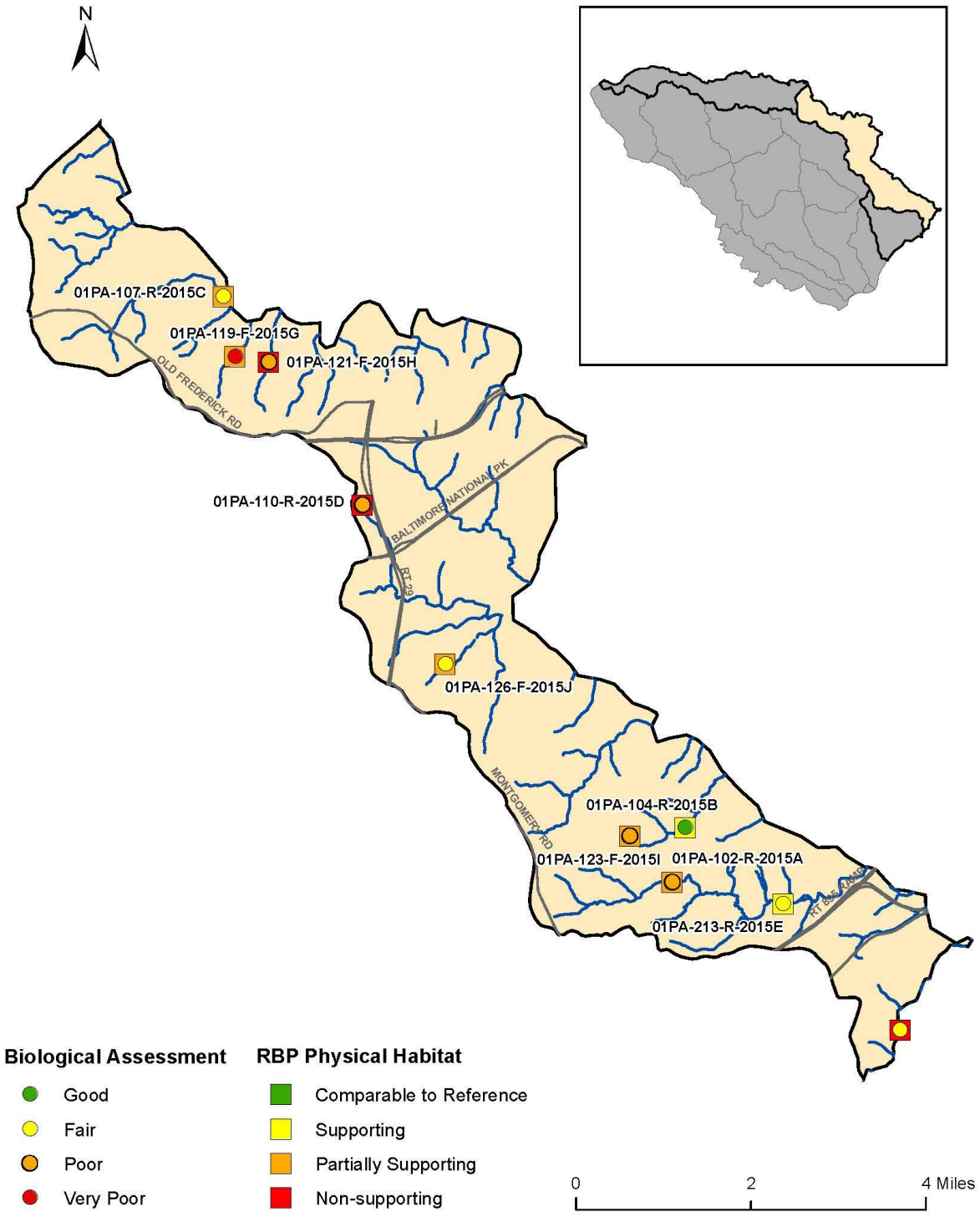

Figure 3-2. Patapsco River Lower Branch A sampling results

01PA-104-R-2015B – This is a steep first order stream with wooded buffers located in Patapsco Valley State Park near Landing Road. The riparian buffers extend well beyond 50 meters. The drainage area for this site is 321 acres. Land use in this area is agricultural (5%), bare ground (9%), forest (28%), institutional (15%), low-density residential (21%), and medium-density residential (22%). Impervious cover is at 17% in this site's drainage area. The RBP habitat assessment resulted in a score of 76 ("Supporting") and the PHI score was 77.4 ("Partially Degraded"). A total of 22 taxa were present in the sample, including 12 EPT taxa. Fifty-five percent of individuals in the sample were tolerant of urban stressors. The site's overall BIBI score of 4.00 was the highest in this subwatershed, and the only one which corresponds to a "Good" biological classification. The sites high BIBI score is attributed to the high percentage of clingers and scrapers, 86.4% and 39.2%, respectively (benthic macroinvertebrates can fall under both of these categories). These two categories of benthic macroinvertebrates live in the interstitial space of the substrate, thus higher percentages of them reflect lower embeddedness and overall better stream health. This site had a pH of 5.98, which is in violation of COMAR water quality parameters, which requires this stream's pH to be between 6.5 and 8.5. This stream was classified as an F4, meaning it had a high width-depth ratio, was entrenched, and had a gravelly stream bed.

01PA-107-R-2015C – This site is on Davis Branch, a first order stream located deep in the Patapsco Valley closest to Cavey Lane. This site has a large riparian buffer overall, but is channelized at the bottom of the site when it passes under an active railroad line. The site drainage is small, at only 33 acres. Land use is overwhelming forest, at 98%. The other 2% is agricultural, and unsurprisingly, impervious cover accounts for under 1% in the drainage. The RBP habitat assessment resulted in a score of 75 ("Partially Supporting") and the PHI score was 70.2 ("Partially Degraded"). A total of 33 taxa were present in the sample, including 11 EPT taxa. Seventy-one percent of individuals in the sample were tolerant of urban stressors. The site's overall BIBI score of 3.67 corresponds to a "Fair" biological classification. This site's BIBI score was good compared to other sites in the subwatershed, but lacked a large number of Ephemeroptera which would have raised its score to the "Good" category. This site had a pH of 5.87, which is in violation of COMAR water quality parameters, which state that pH must be between 6.5 and 8.5. Water quality violations are discussed further in section 4.1, but it is noteworthy to say that percent impervious cover is likely not the cause in this case. The pH violation at this site may be attributed to its proximity to an active railroad line, as urban activities affect in stream water quality. (Chester 1996) This stream's channel type was classified as an F4, meaning it had a gravelly bed, was entrenched, and had a high width-depth ratio.

01PA-110-R-2015D – This site, located off of St. Johns Lane, is a first order stream which runs through a natural grassy area in an open patch of woods. The site is at the top end of the drainage in a medium density residential area. The site has a drainage of 58 acres, and of that area, medium-density residential is the predominant land use at 54%. The remaining land use is made up mainly of agricultural (20%), forest (7%), open urban land (9%), and transportation (7%). 15.23% of the drainage is impervious surface. The RBP habitat assessment resulted in a score of 58 ("Non-supporting") and the PHI score was 39.3 ("Severely Degraded"), the lowest in the subwatershed. A total of 22 taxa were present in the sample, including only 1 EPT taxa. Sixty-six percent of individuals in the sample were tolerant of urban stressors. The site's overall BIBI score

of 2.33 corresponds to a "Poor" biological classification. This poor BIBI score is likely attributed to the low number of EPT taxa. All water quality parameters were within acceptable COMAR standards. This stream was classified as a B5a, meaning it has a steep slope for a type "B" stream, and is moderately entrenched. This stream's dominant particle class was sand.

01PA-213-R-2015E – This site, posted as Environmental Trust land, is located on private property off of Belmont Woods Road. The drainage area for this site is 1,917 acres. Of that area, 10% is agricultural, 42% is forest, 25% is low-density residential, and 16% is low-density residential. The remaining land usage is made up of open urban land and institutional. The drainage is 9.64% impervious surface. The RBP habitat assessment resulted in the highest score in this subwatershed, 79 ("Supporting"), and the PHI assessment yielded a score of 75.9 ("Partially Degraded"). A total of 25 taxa were present in the sample, including 10 EPT taxa. Eighty-nine percent of individuals in the sample were tolerant of urban stressors, lowering the BIBI score to 3.00, and a rating of "Fair". All water quality parameters were within acceptable COMAR standards. This stream's channel type was classified as an F4, meaning it had a gravelly bed, was entrenched, and had a high width-depth ratio.

01PA-317-R-2015F – This third order stream is located off of Race Road. The site is one of two "coastal plain" sites sampled in 2015, and its dominant substrate is sand. This site is located in an industrial area and had large amounts of waste and refuse. Of the 12,124 acre drainage, agriculture accounts for only 4% of the land use, forest for 33%, and commercial/ industrial for 22%. The remaining land use is diverse, but mainly consist of high, medium, and low-density residential, at 8%, 12%, and 9%, respectively. Impervious surface is high in this drainage, at 17.88%. The RBP habitat assessment resulted in a score of 60 ("Non-supporting") and the PHI score was 51.1 ("Degraded"). A total of 23 taxa were present in the sample, including 7 EPT taxa. Ninety-two percent of individuals in the sample were tolerant of urban stressors. The site's overall BIBI score of 3.00 corresponds to a "Fair" biological classification. This score is attributed to the low number of Ephemeroptera taxa and high percent of pollution tolerant individuals. All water quality parameters were within acceptable COMAR standards. This stream's channel type was classified as an F4, meaning it had a gravelly bed, was entrenched, and had a high width-depth ratio.

01PA-119-F-2015G – This first order stream is surrounded by a medium density residential housing development near Green Clover Drive. There is a considerable amount of erosion and dry, overhanging rootwads on the stream banks. The drainage area for this site is 323 acres. Medium and low-density residential areas are the main land use in this drainage, at 39% and 40%, respectively. The remaining land uses are forest (17%), institutional (1%), and agriculture (3%). Nearly twenty percent of this site's drainage area is impervious surface. The RBP habitat assessment resulted in a score of 71 ("Partially Supporting") and the PHI score was 72.9 ("Partially Degraded"). A total of 24 taxa were present in the sample, including 7 EPT taxa. Ninety-seven percent of individuals in the sample were tolerant of urban stressors, indicating that the benthic community can tolerate degraded conditions. The site's overall BIBI score of 1.67 corresponds to a "Very Poor" biological classification, and was the lowest score in the Patapsco River Lower Branch A subwatershed. This low score is attributed to a high percentage of

chironomidae (63.37%) and a low percentage of clingers (29.8%). This site had a pH of 6.47, which is just outside of the COMAR water quality parameters which require a stream's pH to be between 6.5 and 8.5. The stream was a type B4c at this site, meaning that it was moderately entrenched, had a gravelly bed, and had a gentle slope for a "B" channel type.

01PA-121-F-2015H – This is a first order stream in a well-wooded corridor between two medium-density housing areas near Thornbrook Road. The channel here is very unstable with tall, deeply incised banks, and bar formation. In this 289-acre drainage, the land usage consists of agriculture (3%), forest (26%), medium-density residential (58%), and low-density residential (13%). This drainage is 18% impervious surface. The RBP habitat assessment resulted in a score of 49 ("Non-supporting") and the PHI score a 50.8 ("Severely Degraded"). A total of 25 taxa were present in the sample, including 6 EPT taxa. Ninety-three percent of individuals in the sample were tolerant of urban stressors, lowering this site's overall BIBI score to 2.67, corresponding to a "Poor" biological classification. Like numerous other sites in this subwatershed, this site's pH (6.46) did not meet the COMAR water quality parameters which require a pH between 6.5 and 8.5. The stream was classified as a type B4c at this site, meaning that it was moderately entrenched, had a sandy bed, and a gentle slope for a "B" channel type.

01PA-123-F-2015I – This first order stream is located in a medium-density residential neighborhood off of Ilchester Road. The site and surrounding wooded area is marked as "forest retention zone"; consequently there are decent buffers. Of this small 29-acre drainage, the land use consists of forest (15%), institutional (46%), medium-density housing (37%), and low-density housing (2%). Impervious surface accounts for 23% of this site's catchment, the highest percentage of impervious surface in this subwatershed. The RBP habitat assessment resulted in a score of 70 ("Partially Supporting"), while the PHI score was 51.7 and indicated degraded habitat conditions. A total of 19 taxa were present in the sample, including 8 EPT taxa. Seventy-nine percent of individuals in the sample were tolerant of urban stressors. The site's overall BIBI score of 2.67 corresponds to a "Poor" biological classification. This low score is likely due to having no individuals from the Ephemeroptera taxa present. This site had a pH of 6.26, which is in violation of COMAR water quality parameters which require a pH of between 6.5 and 8.5. This stream was classified as a G4, meaning it was entrenched, moderately sinuous, and had a steep slope. The dominant particle class at this site was gravel.

01PA-126-F-2105J – This is a small first order stream which runs through a large medium density housing development off of Brittany Drive. As the riparian buffers are poor, this site's banks are eroding. The drainage area for this site is 196 acres. Land uses in that area are agriculture (4%), commercial/industrial (3%), forest (4%), institutional (25%), medium-density residential (42%), and low-density residential (23%). The site's drainage contains 21% impervious surface. The RBP habitat assessment resulted in a score of 70 ("Partially Supporting") and a PHI score of 68.3 ("Partially Degraded"). A total of 23 taxa were present in the sample, including 6 EPT taxa. Seventy-eight percent of individuals in the sample were tolerant of urban stressors. The site's overall BIBI score of 3.33 corresponds to a "Fair" biological classification. All water quality parameters were within acceptable COMAR standards. The channel type at this site was classified as an F4, meaning it had a gravelly bottom, a high width-depth ratio, and was entrenched.

3.3 PATAPSCO RIVER LOWER BRANCH B

In 2015, six of the ten sampling sites in the Patapsco River Lower Branch B subwatershed were on first-order streams, three were on second-order streams, and one was on a third-order stream. The field QC sample was collected at site 04PB-103-R-2015A. The subwatershed had an average BIBI score of 2.17 and a "Poor" condition rating; scores ranged from 1.33 to 3.0; with the two best sites only scoring in the "Fair" category. The average RBP habitat assessment comparability score was 66.6 or "Partially Supporting," and scores ranged from 55 ("Non-Supporting") to 76 ("Supporting"). The average PHI score was 62.03 ("Degraded"). Four streams were classified as Rosgen type F channels, three were classified as type B channels, two were type C channels, and one channel was classified as a type E. Gravel was the dominant channel substrate at nine of the ten sites, except for one stream which had a sandy bottom. Table 3-3 summarizes the results for the Patapsco River Lower Branch B subwatershed and Figure 3-3 shows the sites with BIBI and RBP comparability scores on a map.

Table 3-3. Patapsco River Lower Branch B sampling results

Site ID	Drainage Area (acres)	% Impervious	BIBI Score	BIBI Rating	RBP Score	RBP Rating	PHI Score	PHI Rating
04PB-103-R-2015A*	184.63	17.62	2	Poor	65	Partially Supporting	46.89	Severely Degraded
04PB-104-R-2015B	125.44	19.9	2.67	Poor	70	Partially Supporting	72.97	Partially Degraded
04PB-208-R-2015C	2,223.01	25.5	1.33	Very Poor	75	Partially Supporting	72.18	Partially Degraded
04PB-210-R-2015D	2,065.40	25.08	1.67	Very Poor	69	Partially Supporting	62.88	Degraded
04PB-214-R-2015E	1,489.18	23.36	1.67	Very Poor	76	Supporting	69.24	Partially Degraded
04PB-318-R-2015F**	5,452.28	21.81	3	Fair	67	Partially Supporting	51.22	Degraded
04PB-119-F-2015G	368.08	18.61	3	Fair	62	Partially Supporting	73.78	Partially Degraded
04PB-122-F-2015H	105.24	20.95	2.67	Poor	65	Partially Supporting	59.22	Degraded
04PB-123-F-2015I	83.38	26.47	2	Poor	55	Non-supporting	49.42	Severely Degraded
04PB-125-F-2015J	570.67	30.03	1.67	Very Poor	62	Partially Supporting	62.55	Degraded
Minimum	83.38	17.62	1.33	Very Poor	55	Non-supporting	46.89	Severely Degraded
Maximum	5452.28	30.03	3	Fair	76	Supporting	73.78	Partially Degraded
Mean	1266.731	22.93	2.17	Poor	66.6	Partially Supporting	62.03	Degraded
Standard Deviation	1687.71999	3.88	0.61		6.31		10.15	

* QC sampling was conducted at this site
** PHI Score calculated using coastal PHI metrics

Figure 3-3. Patapsco River Lower Branch B sampling results

04PB-103-R-2015A – This stream runs through the Timbers at Troy golf course off of Marshalee Drive near route 100. The drainage area for the site is 185 acres. The land use consists of agriculture (1%), commercial/industrial (11%), open urban land (64%), and medium-density residential (20%). The remaining area consists of high-density residential and forest. This drainage is 17.62% impervious cover. The RBP habitat assessment resulted in a score of 65 ("Partially Supporting") and a PHI score of 46.9 ("Severely Degraded"). A total of 25 taxa were present in the sample, including 5 Ephemeroptera, Plecoptera, and Tricoptera (EPT) taxa. Ninety-seven percent of individuals in the sample were tolerant of urban stressors and seventy-seven percent of the sample was made up of chironomidae, resulting in a BIBI score of 2.00 and a biological classification of "Poor". All water quality parameters were within acceptable COMAR standards. The stream was classified as a type B4c at this site, meaning that it was moderately entrenched, had a sandy bed, and a gentle slope for a "B" channel type.

04PB-104-R-2015B – This first order stream is located on a golf course bordering Marshalee Drive. The golf course is surround by medium density housing. This site has a 125 acre drainage area. The land uses are mainly commercial/industrial (16%), medium-density residential (23%), and open urban land (56%). 19.9% of this site's drainage area is impervious surface. The RBP habitat assessment resulted in a score of 70 ("Partially Supporting") and the PHI score was 73 ("Partially Degraded"). A total of 21 taxa were present in the sample, including 8 EPT taxa. Eighty-two percent of individuals in the sample were tolerant of urban stressors. The site's overall BIBI score of 2.67 corresponds to a "Poor" biological classification. This low scoring is likely attributed to having no Ephemeroptera taxa present in the sample. All water quality parameters were within acceptable COMAR standards. The stream was classified as a type B4c at this site, meaning that it was moderately entrenched, had a sandy bed, and a gentle slope for a "B" channel type.

04PB-208-R-2015C – This second order stream is located behind a construction company off of Kit Kat Road and is littered with trash and debris. The drainage area for this site is 2,223 acres. Land uses include agriculture (12%), commercial/industrial (8%), forest (18%), low-density residential (10%), medium-density residential (19%), high-density residential (21%), open urban land (3%), transportation (5%), and institutional (4%). This site's drainage is 25% impervious cover. The RBP habitat assessment resulted in a score of 75 ("Partially Supporting") and the PHI score was 72.2 ("Partially Degraded"). A total of 20 taxa were present in the sample, including 3 EPT taxa. As ninety-nine percent of individuals in the sample were tolerant of urban stressors, it is clear that this site's benthic community has been affected by urbanization in the drainage. The site's overall BIBI score of 1.33 is the lowest in the Patapsco River Lower Branch B subwatershed and corresponds to a "Very Poor" biological classification. This degraded stream's score is so low because there are no Ephemeroptera taxa, a high percentage of chironomidae (73%), and only 26% of clingers present in the sample. All water quality parameters were within acceptable COMAR standards. The channel type at this site was classified as an F4, meaning it had a gravelly bottom, a high width-depth ratio, and was entrenched.

04PB-210-R-2015D – In a residential area, this stream runs between two rows of housing off of Water Oak Road. It has steep, eroded banks, reaching 3-4 meters in height in some places. The drainage area is 2,065 acres. Land use is comprised of agriculture (13%), commercial/ industrial (~4%), forest (17%), high-density residential (22%), institutional (~3%), low-density residential (10%), medium-density residential (24%), transportation (5%), and open urban land (~2%). This drainage is 25.1% impervious cover. The RBP habitat assessment resulted in a score of 69 ("Partially Supporting") and a PHI score of 62.9 ("Degraded"). A total of 16 taxa were present in the sample, including 4 EPT taxa. Ninety-eight percent of individuals in the sample were intolerant of urban stressors, again indicating that the majority of the benthic community can tolerate degraded conditions. The site's overall BIBI score of 1.67 corresponds to a "Very Poor" biological classification. All water quality parameters were within acceptable COMAR standards. The channel type at this site was classified as an F4, meaning it had a gravelly bottom, a high width-depth ratio, and was entrenched.

04PB-214-R-2015E – This site is on a second order stream in a residential area off of Grassy Garth. This site has a drainage area of 1,489 acres. Of this area, the land use consists of agriculture (17%), industrial/commercial (4%), forest (14%), high-density residential (16%), institutional (3%), medium-density residential (24%), low-density residential (14%), transportation (5%), and open urban land (3%). This site's drainage has 23.36% impervious cover. The RBP habitat assessment resulted in a score of 76 ("Supporting"), which was the highest of this subwatershed. The PHI score of 69.2 indicated that habitat conditions are partially degraded. A total of 21 taxa were present in the sample, including 5 EPT taxa. Again, ninety-nine percent of individuals in the sample were intolerant of urban stressors, indicating that most of the benthic community is tolerant of generally poor conditions. The site's overall BIBI score of 1.67 corresponds to a "Very Poor" biological classification. All water quality parameters were within acceptable COMAR standards. The channel type at this site was classified as an F4, meaning it had a gravelly bottom, a high width-depth ratio, and was entrenched.

04PB-318-R-2015F – Located near an industrial park off of Coca Cola Drive, this site is highly embedded and runs parallel to a paved road. This third order stream is in the "Coastal Plain" physiographic region and has a drainage area of 5,452 acres. Of this area, the land uses are agriculture (6%), bare ground (3%), commercial/industrial (22%), forest (30%), institutional (4%), low-density residential (11%), medium-density residential (10%), and high-density residential (9%). The remaining area has mixed land uses of transportation and open urban land. This drainage is 21.81% impervious surface. The RBP habitat assessment resulted in a score of 67 ("Partially Supporting") and the PHI score was 51.2 ("Degraded"). A total of 20 taxa were present in the sample, including 4 EPT taxa. Despite a large amount of impervious surface and highly developed land uses, fifty-one percent of individuals in the sample were intolerant of urban stressors. The site's overall BIBI score of 3.00 corresponds to a "Fair" biological classification, and is one of only two sites in this subwatershed to do so. This comparatively good biological classification is likely attributed to having a fair number of EPT taxa present in the sample for a coastal plain site (4), as well as having roughly half the sample intolerant of urban stressors. All water quality parameters were within acceptable COMAR standards. The channel type at this site

was classified as an F4, meaning it had a gravelly bottom, a high width-depth ratio, and was entrenched.

04PB-119-F-2015G – This is an incised first order stream. It runs through a narrow patch of woods between a medium density residential area and a commercial area off of Troy Hill Drive. The drainage area for this site is 368 acres. Land uses are mainly agriculture (10%), forest (18%), low-density residential (19%), and medium-density residential (30%). The remaining drainage area is composed of a mix of land uses, namely commercial/industrial, institutional, and high-density residential. The drainage area is 18.6% impervious surface. The RBP habitat assessment resulted in a score of 62 ("Partially Supporting") and the PHI score was 73.8 ("Partially Degraded"). A total of 28 taxa were present in the sample, including 9 EPT taxa. This higher number of EPT taxa, as well as having 39% of individuals in the sample intolerant of urban stressors, lead to this sites "Fair" biological classification and BIBI score of 3.00. All water quality parameters were within acceptable COMAR standards. The channel type at this site was classified as an F4, meaning it had a gravelly bottom, a high width-depth ratio, and was entrenched.

04PB-122-F-2015H – This site is located on a first order stream that runs through Timbers at Troy Golf Course off of Marshalee Drive. Land usage for the 105-acre drainage consist mainly of commercial/industrial (19%), medium-density residential (18%), and open urban land (57%). This site's drainage area is 21% impervious surface. The RBP habitat assessment resulted in a score of 65 ("Partially Supporting") and the PHI score was 59.2 ("Degraded"). A total of 24 taxa were present in the sample, including 7 EPT taxa. Eighty percent of individuals in the sample were tolerant of urban stressors. The site's overall BIBI score of 2.67 corresponds to a "Poor" biological classification, and is likely due to the absence of Ephemeroptera taxa. All water quality parameters were within acceptable COMAR standards. The channel type at this site was classified as an F4, meaning it had a gravelly bottom, a high width-depth ratio, and was entrenched.

04PB-123-2015I – This is a small first order stream in a narrow patch of woods between two medium density housing lots off of Hunter Road. This site is highly impacted, with extensive erosion on both banks and a large amount of silt and sand deposition. The site has an 83-acre drainage, and land uses consist mainly of forest (14%), transportation (9%), and medium-density housing (71%). The remaining 6% is a mix of low-density residential and institutional land uses. This small catchment is 26.47% impervious cover. The RBP habitat assessment resulted in a score of 55 ("Non-supporting") which was the lowest RBP habitat score received in this subwatershed. The PHI score of 49.4 indicated Severely Degraded habitat conditions. A total of 19 taxa were present in the sample, including 4 EPT taxa. All of the individuals in the sample were tolerant of urban stressors, meaning that this system is highly affected by urbanization, causing the site's overall BIBI score (2.00) and biological classification (Poor) to score so low. All water quality parameters were within acceptable COMAR standards. This stream's channel type was classified as a G5c, meaning it was entrenched and had a sandy bottom.

04PB-125-F-2015J – This is a larger first order stream that flows through a patch of woods upstream of Route 100. This site is highly eroded and embedded. Adjacent to the site there is a

large floodplain vernal pool. The site's drainage area is 571 acres. Thirty percent of this drainage is impervious surface, the highest percentage for a site this year in the whole Patapsco River watershed. This large percentage of impervious surface likely attributes to the erosion and marginal conditions in the stream. The land use consists of commercial/industrial (31%), forest (24%), open urban land (21%), transportation (6%), medium-density residential (10%), and high-density residential (~8%). The RBP habitat assessment resulted in a score of 62 ("Partially Supporting") and the PHI score was 62.5 ("Degraded"). A total of 13 taxa were present in the sample, including only 3 EPT taxa. Unsurprisingly, ninety-nine percent of individuals in the sample were tolerant of the urban stressors which stem from the large amounts of development and impervious cover. The site's overall BIBI score of 1.67 corresponds to a "Very Poor" biological classification. This site had a pH of 5.89, which is in violation of COMAR water quality parameters, which require this stream's pH to be between 6.5 and 8.5. The stream was classified as a type B4c at this site, meaning that it was moderately entrenched, had a sandy bed, and a gentle slope for a "B" channel type.

4 DISCUSSION AND COMPARISON

4.1 DISCUSSION OF 2015 ASSESSMENT RESULTS

Regression Relationships – Regression analysis is a statistical technique for estimating the relationships among variables. It helps one to understand how the typical value of the one variable changes when another variable is varied. It allows a user to use measured data to predict future results. The result of a regression analysis is an R-squared value that ranges from 0 to 1.0. A higher number is indicative of a stronger relationship between the variables.

Land use, habitat, and water chemistry parameters were regressed against the benthic macroinvertebrate IBI scores for each site in order to examine the relationship of those parameters to the biological health of the stream. For the purposes of this analysis and because they were all significantly correlated with each other, percentage impervious was used as a proxy for all of the other land use types.

The relationship of BIBI scores to impervious surface in the catchments upstream of the sample site was significant (Figure 4-1; R^2= 0.35, $p < 0.001$). Generally, as impervious surface increased, the BIBI scores decreased. These results are consistent with the notion that overall biological condition is likely being affected by the amount of development (i.e., imperviousness) in the watershed.

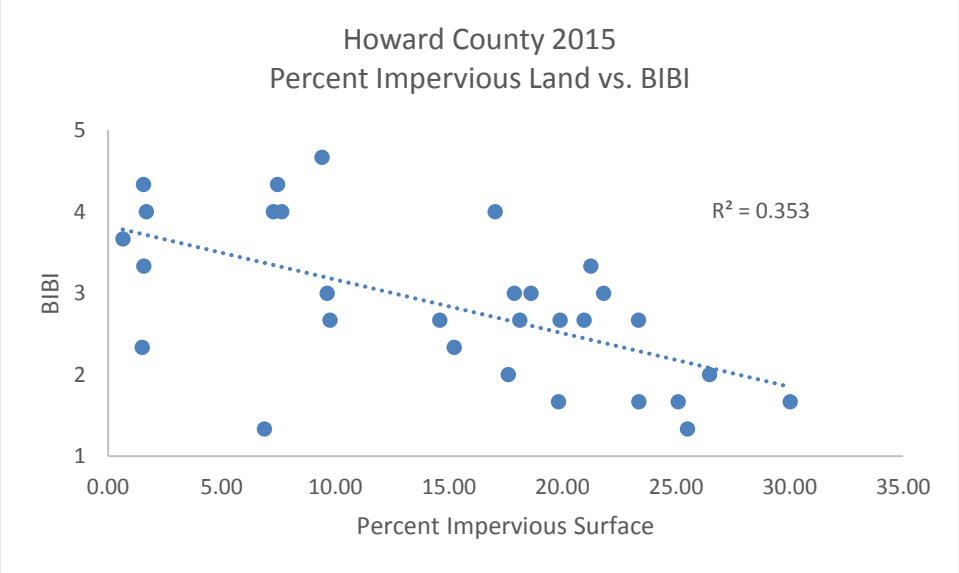

Figure 4-1. Regression relationships between the Benthic Index of Biotic Integrity (BIBI) and impervious surface in upstream catchments during 2015 Howard County Biological Monitoring

The relationships between the BIBI and both the RBP habitat assessment score and the PHI score were not significant (R^2= 0.19, p =.42, R^2 = 0.11, p=.79, respectively). However, as the habitat scores increase, so does the BIBI (see Figure 4-2). This suggests that physical habitat conditions directly affect the biological condition of a stream.

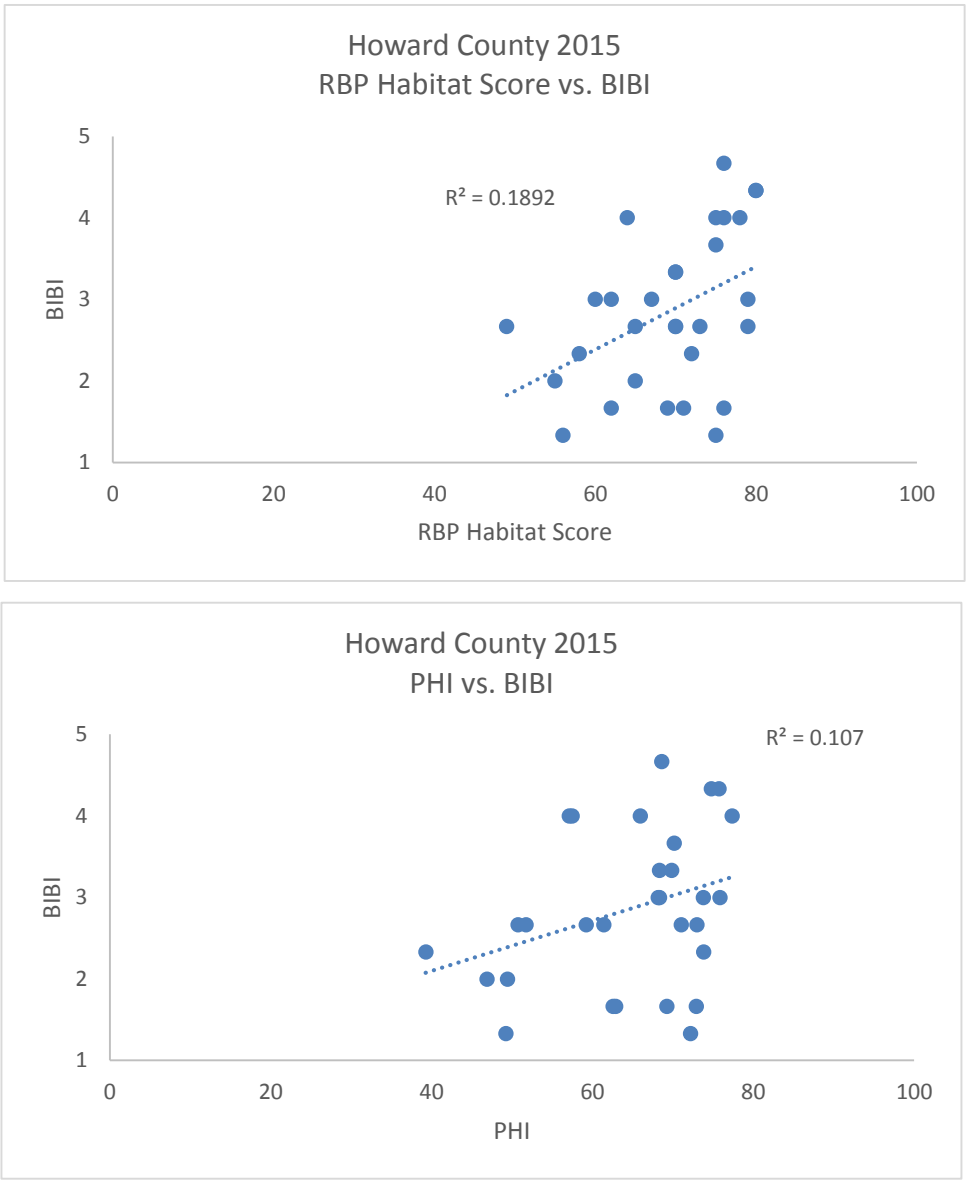

Figure 4-2. Regression relationships between the Benthic Index of Biotic Integrity (BIBI) and both RBP Habitat Assessment Score and Physical Habitat Indicator (PHI) for sites sampled in the 2015 Howard County Biological Monitoring

Water quality parameters (temperature, dissolved oxygen, pH, conductivity, and turbidity) were also regressed against the BIBI score. None of the results showed significant relationships,

although a general trend showed that as dissolved oxygen increased and conductivity decreased, the BIBI scores improved.

In an attempt to determine why sites were in violation of the COMAR standards, water quality parameters were regressed against percent impervious surface in each catchment. While percent impervious cover and pH didn't prove to be statistically significant, the regression of percent impervious cover and conductivity was significant (Figure 4-3).

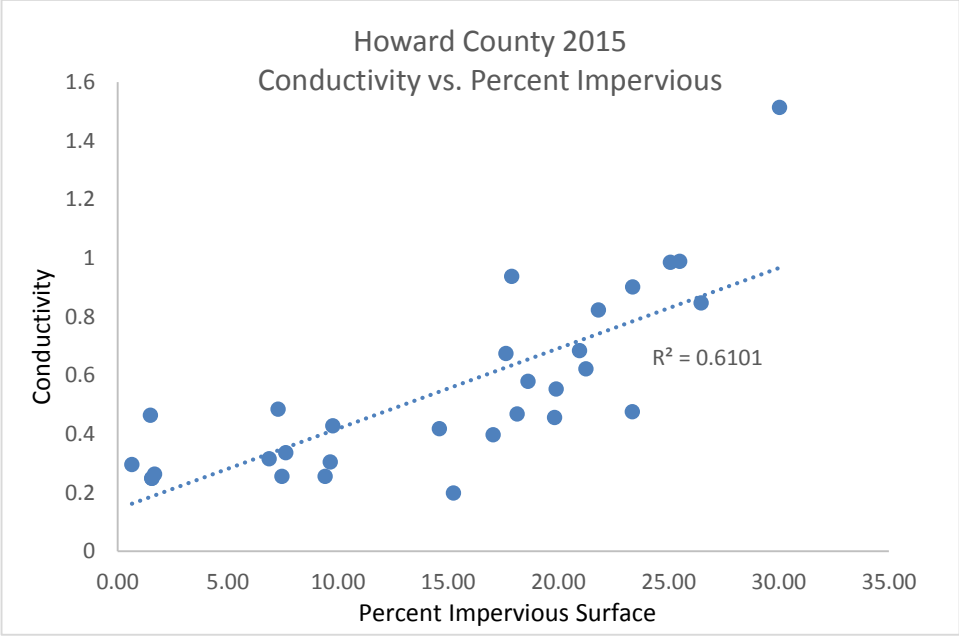

Figure 4-3. Regression relationship between the percent impervious surface and conductivity for sites sampled in the 2015 Howard County Biological Monitoring

While the violations in pH were not completely described by their relation to percent impervious cover, there is a known relationship between water quality and percent impervious surface in urbanizing areas (Chester 1996). This relationship between water quality and impervious cover likely explains why the sites in violation of COMAR standards for pH had some of the higher percentages of impervious surface.

4.2 COMPARISON OF 2003, 2008, AND 2015 BIOASSESSMENT DATA

BIBI – Table 4-1 summarizes the 2003, 2008, and 2015 biological index data, and Figure 4-3 is a box plot comparing BIBI scores for each subwatershed (current BIBI calculations were used for all rounds).

Table 4-1. Comparison of 2003, 2008, and 2015 BIBI data

Sampling Year		Number of Sites Sampled	Min BIBI Score	Max BIBI Score	Median BIBI Score	Mean BIBI Score	Narrative Rating	Standard Deviation
2003	South Branch Patapsco	10	2.33	4	3.00	2.93	Poor	0.54
	Patapsco River Lower Branch A	10	2	4.33	2.67	2.67	Poor	0.77
	Patapsco River Lower Branch B	10	2	3.67	3.00	2.97	Poor	0.64
2008	South Branch Patapsco	10	1.33	4.67	2.83	2.73	Poor	1.09
	Patapsco River Lower Branch A	10	1.33	4	2.00	2.21	Poor	0.75
	Patapsco River Lower Branch B	10	1	2	1.33	1.40	Very Poor	0.31
2015	South Branch Patapsco	10	1.33	4.67	4.00	4.00	Good	1.07
	Patapsco River Lower Branch A	10	1.67	4	2.83	2.83	Poor	0.67
	Patapsco River Lower Branch B	10	1.33	3	2.00	2.17	Poor	0.61

In the South Branch Patapsco subwatershed, the biological condition was "Poor" in 2003 and 2008, but "Good" in 2015. The ANOVA test for differences amongst the years showed that the three Rounds were not significantly different from each other, likely due to one outlier site in the "Very Poor" category.

In the Patapsco River Lower Branch A, the assessments in all three Rounds indicated that the subwatershed was in "Poor" biological condition overall, according to the updated BIBI scores. The ANOVA test for differences amongst the years showed that the biological condition in the Patapsco River Lower Branch A was not significantly different over time.

The biological condition in the Patapsco River Lower Branch B was "Poor" in 2003 and 2015 and "Very Poor" in 2008. The ANOVA test for differences amongst the years showed that biological condition in 2008 was significantly less than that in either 2003 or 2015, but that 2003 and 2015 were not significantly different from each other.

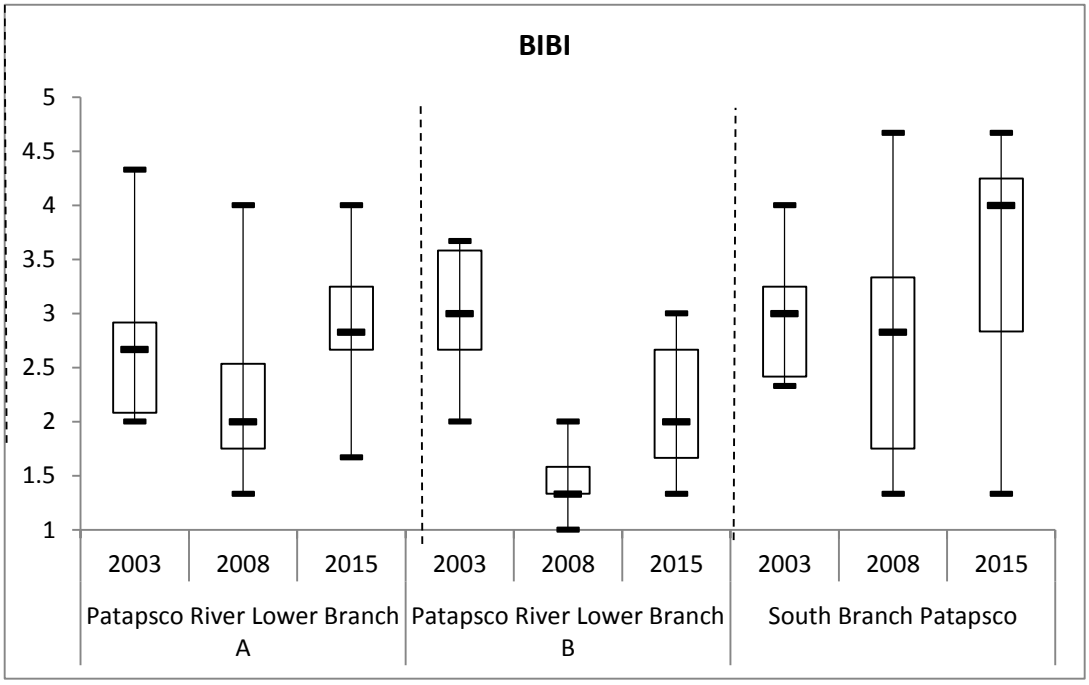

Figure 4-4. Comparison of 2003, 2008, and 2015 BIBI scores

RBP Physical Habitat Assessment – Table 4-2 summarizes the 2003, 2008, and 2015 RBP comparability scores, and Figure 4-4 is a box plot illustrating RBP comparability scores.

In both the Patapsco River Lower Branch A and the South Branch Patapsco subwatersheds, the RBP Habitat score was "Partially Supporting" in all three Rounds of the Survey. The ANOVA test for differences amongst the years showed that the habitat scores were not significantly different for both subwatersheds.

In the Patapsco River Lower Branch B subwatershed, the RBP habitat condition was "Non-Supporting" in 2003 and 2008, but increased slightly to "Partially Supporting" in 2015. The ANOVA test for differences amongst the years showed a significant difference in the year 2008 from both the year 2003 and 2015, but the increase from 2003 to 2015 was not significant.

Table 4-2. Comparison of 2003, 2008, and 2015 RBP assessment data

Sampling Year		Number of Sites Sampled	Min RBP Score	Max RBP Score	Median RBP Score	Mean RBP Score	Narrative Rating	Standard Deviation
2003	South Branch Patapsco	10	48	77	61.00	61.90	Partially Supporting	8.37
	Patapsco River Lower Branch A	10	39	78	65.50	62.00	Partially Supporting	11.78
	Patapsco River Lower Branch B	10	34	70	63.50	60.80	Non-Supporting	11.10
2008	South Branch Patapsco	10	41	86	62.00	62.00	Partially Supporting	12.22
	Patapsco River Lower Branch A	10	48	78	64.00	63.50	Partially Supporting	9.30
	Patapsco River Lower Branch B	10	34	62	50.00	50.10	Non-Supporting	7.92
2015	South Branch Patapsco	10	56	80	75.50	73.00	Partially Supporting	7.83
	Patapsco River Lower Branch A	10	49	76	70.50	68.10	Partially Supporting	9.43
	Patapsco River Lower Branch B	10	55	76	66.00	66.60	Partially Supporting	6.31

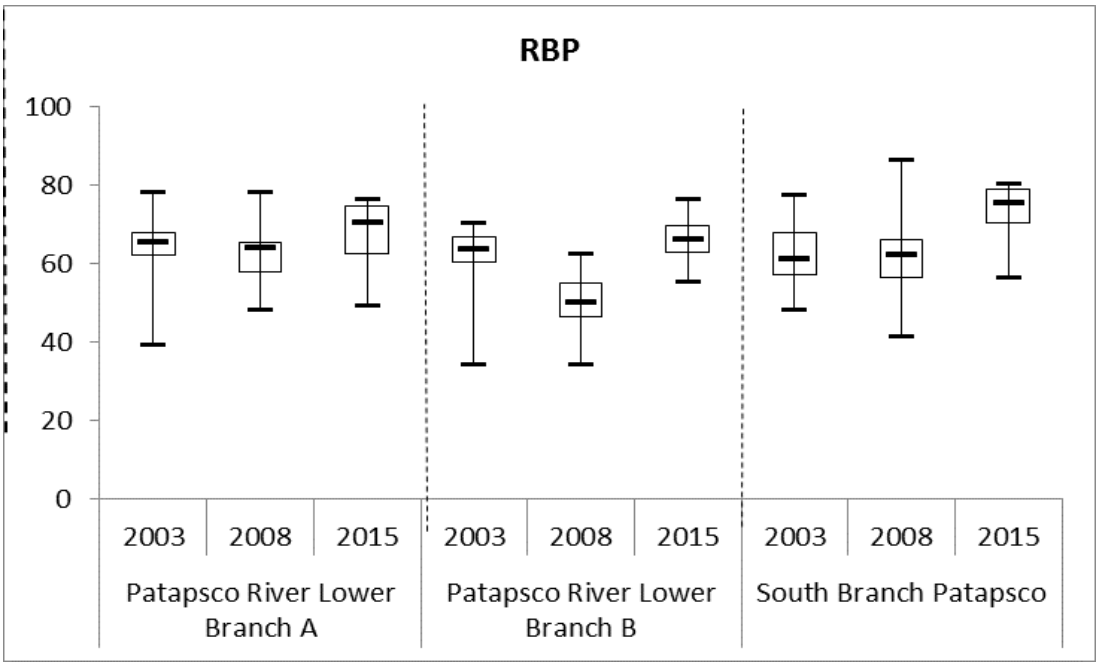

Figure 4-4. Comparison of 2003, 2008, and 2015 RBP scores

5 CONCLUSIONS AND RECOMMENDATIONS

This report is the fourth of five annual reports that describe Round 3 (2012-2016) of the Howard County Biological Monitoring and Assessment Program. More definitive Round 3 conclusions and comparisons with Rounds 1 and 2 will be provided at the completion of Round 3. These preliminary conclusions and recommendations provide context for interpreting results and identifying possible future revisions.

5.1 WATERSHED CONDITIONS

Additional Water Quality Sampling – Habitat conditions and BIBI scores are not always strongly correlated with each other, indicating that stressors other than habitat are affecting stream conditions. This can be an indication of degraded water quality conditions. Although most of the water quality parameters measured were within the acceptable COMAR standards, additional sampling, especially on those streams rated as "Poor" or "Very Poor" for biological condition, may identify other chemical stressors that are affecting the biota. Of the streams which were in violation of COMAR standards for pH, all except one stream had a high percentage of impervious cover. In the one stream which did not have a largely impervious catchment, the site passed under an active railroad bed, which may have contributed to the poor water quality.

Supplementary sampling could include **additional parameters** such as nutrients and metals, which may be of concern. It is also likely that high levels of these chemical stressors may only occur in the first flush of stormwater runoff. Because biological monitoring is usually conducted under baseflow conditions, concomitant chemical sampling may fail to identify the effects of pollutants associated with stormwater runoff, specifically in more urban portions of the watershed. **Wet weather monitoring** in these watersheds can be conducted to determine the presence of additional water quality stressors in stormwater runoff. The cost of wet weather monitoring is prohibitive for an extensive bioassessment, but wet weather monitoring could be incorporated into the design as representative downstream sampling in each subwatershed.

Expanded Physical Habitat Assessment – 2012 (beginning of Round 3) was the first year the bioassessment collected the metrics for the MBSS Physical Habitat Index (PHI) and calculated the PHI for comparison with the RBP scores collected in Round 3 and previous rounds. The PHI showed a strong significant relationship to the RBP physical habitat assessment ($R^2 = 0.43$ with a p-value of < 0.001), indicating that the PHI score did not improve the overall assessment of the subwatersheds or individual sites significantly. However, certain metrics that contribute to the overall PHI score did prove useful in site assessments (especially "shading" and "embeddedness"). In addition, collection of the PHI information allows full integration with the MBSS regional assessments. We recommend that the PHI collection be retained through Round 3 and reevaluated prior to Round 4.

Additional MBSS Parameters - Howard County adopted the Maryland DNR's MBSS methods in 2001. The MBSS program continues to evolve and refine its sampling design, field procedures, and data analysis protocols; the most recent field sampling protocols were updated in 2010 (MDNR 2010). Although the benthic macroinvertebrate collection methods implemented herein were not changed during that update, additional surveys were added to the MBSS data collection efforts (i.e., stream salamander sampling in the summer and a seasonal pool search in the spring) that may be of interest to the county. Round 4 of the MBSS includes collecting simple geomorphic parameters. We recommend that Howard County consider adding these additional salamander, seasonal pool, and geomorphic parameters, in addition to updating methods as needed to stay current with the latest MBSS sampling protocols. Certification by the MBSS is now being provided for both field and laboratory protocols and should be required for conducting this bioassessment. For the 2015 sampling conducted for this project, Versar's field crew leader, benthic sample processor/subsampler, and benthic taxonomist have all received MBSS certification for their respective tasks.

5.2 WATERSHED STUDIES

The Howard County Biological Monitoring and Assessment Program provides valuable information that supports countywide management of aquatic resources. For example, it serves as the most accurate indicator of watershed condition and supports assignment of preservation and restoration priorities. It is a spatial intensification of the statewide MBSS that leverages the regionwide condition assessment and stressor identification tools employed by both Maryland DNR and MDE. In addition, bioassessment results are an essential part of watershed assessments and restoration plans to support the Howard County MS4 permit and Watershed Implementation Plan (WIP) of the Chesapeake Bay TMDL.

In 2013, Howard County completed a draft Countywide Implementation Strategy (CIS) that identifies restoration projects and programs to meet MS4 permit requirements for treatment of impervious surfaces and reductions in loads of nutrients, sediments, and other pollutants to local waters and the Chesapeake Bay. Currently, the county is finalizing the CIS, updating the draft to include the most recent historical BMP information and adjusted models using the latest version of MAST loading rates. In addition, the county has begun preparation of watershed studies with recommendations for site-specific restoration. In 2015, the county has completed draft plans for Little and Middle Patuxent watersheds, incorporating biological monitoring data collected in previous years as part of the Howard County Biological Monitoring and Assessment Program. Additional watersheds will be addressed in the future. The results of the biological and physical monitoring in the South Branch Patapsco, Patapsco River Lower Branch A, and Patapsco River Lower Branch B subwatersheds (and other subwatersheds sampled in Round 3) will help target areas with the greatest restoration potential.

The updated CIS could include a proposed monitoring strategy to demonstrate compliance with the MS4 permit and Bay WIP. Both intensive local monitoring and extensive watershed-scale monitoring will be needed to monitor progress in a cost-effective manner. We recommend

that the Howard County Biological Monitoring and Assessment Program serve as the framework for assembling this integrated MS4 permit and WIP monitoring strategy.

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APPENDIX A

SITE COORDINATES, LAND USE AND IMPERVIOUSNESS

South Branch Patapsco, Patapsco River Lower Branch A,
and Patapsco River Lower Branch B Watersheds
Biological Monitoring and Assessment 2014
Summary Land Use and Percent Impervious

Howard County
2015

Site ID	Drainage Area (acres)	% Agriculture	% Bare Ground	% Commercial/ Industrial	% Extractive	% Forest	% High-density Residential	% Institutional	% Low-density Residential	% Medium-density Residential	% Open Urban Land	% Open Water	% Transportation	% Wetland	% Impervious
Patapsco River Lower Branch A															
01PA-102-R-2015A	868.07	4.04	0.00	0.00	0.00	20.85	0.08	0.62	25.86	46.22	2.33	0.00	0.00	0.00	14.60
01PA-104-R-2015B	320.60	4.84	8.65	0.00	0.00	28.04	0.00	15.03	20.67	22.32	0.44	0.00	0.00	0.00	17.04
01PA-107-R-2015C	33.37	1.79	0.00	0.00	0.00	98.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.65
01PA-110-R-2015D	57.59	20.13	0.00	2.86	0.00	6.89	0.00	0.00	0.00	53.86	8.90	0.00	7.36	0.00	15.23
01PA-213-R-2015E	1,917.07	9.96	0.00	0.00	0.00	42.06	0.32	1.57	16.08	25.36	4.64	0.00	0.00	0.00	9.64
01PA-317-R-2015F	12,123.86	3.59	2.19	21.67	0.00	33.11	7.51	2.49	9.18	12.36	3.74	0.05	4.11	0.00	17.88
01PA-119-F-2015G	323.43	2.94	0.00	0.00	0.00	16.64	0.00	1.39	38.74	40.28	0.00	0.00	0.00	0.00	19.82
01PA-121-F-2015H	288.92	2.94	0.00	0.00	0.00	26.30	0.00	0.00	13.23	57.52	0.00	0.00	0.00	0.00	18.12
01PA-123-F-2015I	29.12	0.00	0.00	0.00	0.00	15.30	0.00	45.94	2.18	36.57	0.00	0.00	0.00	0.00	23.35
01PA-126-F-2015J	195.97	3.82	0.00	3.36	0.00	3.59	0.00	24.74	22.91	41.58	0.00	0.00	0.00	0.00	21.25
Patapsco River Lower Branch B															
04PB-103-R-2015A	184.63	1.32	0.00	10.66	0.00	1.18	3.18	0.00	0.00	19.75	63.92	0.00	0.00	0.00	17.62
04PB-104-R-2015B	125.44	1.94	0.00	15.72	0.00	0.15	3.48	0.00	0.00	23.08	55.63	0.00	0.00	0.00	19.90
04PB-208-R-2015C	2,223.01	12.71	0.19	7.93	0.00	17.51	21.49	3.58	10.10	19.15	2.91	0.00	4.44	0.00	25.50
04PB-210-R-2015D	2,065.40	13.03	0.17	4.62	0.00	17.16	21.87	3.85	10.78	20.61	3.13	0.00	4.78	0.00	25.08
04PB-214-R-2015E	1,489.18	16.70	0.00	4.34	0.00	14.11	15.91	3.08	14.49	23.70	2.61	0.00	5.07	0.00	23.36
04PB-318-R-2015F	5,452.28	5.80	3.10	21.89	0.00	29.57	8.76	3.97	11.44	10.23	1.83	0.00	3.41	0.00	21.81
04PB-119-F-2015G	368.08	9.81	0.00	4.14	0.00	18.17	4.55	3.32	19.49	29.86	8.32	0.00	2.35	0.00	18.61
04PB-122-F-2015H	105.24	2.31	0.00	18.70	0.00	0.18	4.15	0.00	0.00	18.09	56.57	0.00	0.00	0.00	20.95
04PB-123-F-2015I	83.38	0.32	0.00	0.00	0.00	13.87	0.00	2.12	2.99	71.24	0.00	0.00	9.46	0.00	26.47
04PB-125-F-2015J	570.67	0.00	0.00	31.43	0.00	23.54	7.47	0.48	0.00	10.18	21.22	0.00	5.69	0.00	30.03
South Branch Patapsco															
10PT-401-R-2015A	40,550.44	40.57	0.12	1.69	0.00	32.69	0.42	0.62	21.04	1.52	0.82	0.20	0.29	0.01	1.67
10PT-404-R-2015B	36,559.76	42.69	0.13	1.87	0.00	29.70	0.47	0.49	21.49	1.68	0.91	0.22	0.32	0.02	1.55
10PT-107-R-2015C	257.38	46.38	0.00	0.00	0.00	33.71	0.00	0.00	19.90	0.00	0.00	0.00	0.00	0.00	7.27
10PT-110-R-2015D	240.63	62.58	0.00	0.00	0.00	10.97	0.00	2.84	23.61	0.00	0.00	0.00	0.00	0.00	6.88
10PT-114-R-2015E	657.24	39.01	0.00	0.68	0.00	10.43	0.00	0.00	46.26	0.05	0.00	0.00	2.66	0.91	9.76
10PT-216-R-2015F	4,562.72	34.79	0.64	6.80	0.00	33.65	2.18	1.10	12.87	5.38	0.96	0.26	1.34	0.00	1.49
10PT-419-F-2015G	36,748.72	42.63	0.13	1.86	0.00	29.76	0.46	0.48	21.53	1.67	0.91	0.22	0.32	0.02	1.56
10PT-122-F-2015H	427.54	13.76	0.00	0.00	0.00	39.77	0.00	0.07	46.40	0.00	0.00	0.00	0.00	0.00	7.45
10PT-124-F-2015I	127.51	24.45	0.00	0.00	0.00	46.50	0.00	0.00	25.14	0.00	0.00	0.00	3.91	0.00	9.42
10PT-225-F-2015J	1,936.55	53.82	0.00	0.28	0.00	14.10	0.00	1.91	27.76	0.02	0.00	0.00	1.80	0.31	7.63

Forest landuse category is a combination of deciduous forest, evergreen forest, mixed forest, and brush landuse categories
Agricultural landuse category is a combination of cropland, pasture, orchards, row crops, feeding operations, and agricultural buildings landuse categories
Landuse is based on 2010 MDP landuse GIS files.

APPENDIX B

WATER QUALITY DATA

VERSAR

South Branch Patapsco, Patapsco River Lower Branch A,
and Patapsco River Lower Branch B Watersheds
Biological Monitoring and Assessment
Summary Water Quality Data

Howard County
2015

Site ID	Sample Date	Water Temperature (C)	Dissolved Oxygen (mg/L)	pH	Conductivity mS/cm	Turbidity (NTU)
Patapsco River Lower Branch A						
01PA-102-R-2015A	17-Mar-15	11.9	13.7	7.26	0.418	1.3
01PA-104-R-2015B	12-Mar-15	4.2	12.6	5.98	0.397	5.6
01PA-107-R-2015C	17-Mar-15	5.6	11.9	5.87	0.296	2.3
01PA-110-R-2015D	13-Mar-15	2.9	7.1	7.06	0.199	6.7
01PA-213-R-2015E	06-Apr-15	12.1	12.9	8.14	0.305	14
01PA-317-R-2015F	24-Mar-15	5.9	11.4	7.09	0.938	8.3
01PA-119-F-2015G	13-Mar-15	3	12.9	6.47	0.456	1.4
01PA-121-F-2015H	13-Mar-15	8.4	12	6.46	0.468	7
01PA-123-F-2015I	12-Mar-15	7.4	11.1	6.51	0.476	14
01PA-126-F-2015J	17-Mar-15	9.8	12.2	6.26	0.622	1.7
Patapsco River Lower Branch B						
04PB-103-R-2015A	26-Mar-15	8.9	11.2	7.76	0.675	10
04PB-104-R-2015B	18-Mar-15	4.4	12.3	7.17	0.553	3.5
04PB-208-R-2015C	26-Mar-15	7.5	13.6	7.98	0.989	3.9
04PB-210-R-2015D	26-Mar-15	6.4	12.4	6.98	0.986	2.9
04PB-214-R-2015E	07-Apr-15	13.6	13.5	8.36	0.902	16.1
04PB-318-R-2015F	06-Apr-15	9.2	13.6	7.7	0.823	21.6
04PB-119-F-2015G	20-Mar-15	3.4	12.4	6.86	0.58	5.6
04PB-122-F-2015H	06-Apr-15	6.8	12.6	6.9	0.684	16
04PB-123-F-2015I	18-Mar-15	4.4	10.8	7.11	0.847	9
04PB-125-F-2015J	18-Mar-15	8.5	12.5	5.89	1.514	11.1
South Branch Patapsco						
10PT-401-R-2015A	24-Mar-15	5.6	12.6	7.42	0.263	2.2
10PT-404-R-2015B	25-Mar-15	3.5	13	7.46	0.249	2
10PT-107-R-2015C	07-Apr-15	11.5	10.8	7.6	0.485	17.4
10PT-110-R-2015D	19-Mar-15	7.9	12.3	6.73	0.316	29.2
10PT-114-R-2015E	09-Apr-15	8.7	12	7.24	0.428	13.9
10PT-216-R-2015F	25-Mar-15	5.8	14.9	7.46	0.464	2
10PT-419-F-2015G	24-Mar-15	5.7	13.4	7.52	0.249	1.5
10PT-122-F-2015H	19-Mar-15	2.9	12.5	6.67	0.255	4.6
10PT-124-F-2015I	19-Mar-15	4.8	12.5	6.88	0.256	2.7
10PT-225-F-2015J	07-Apr-15	12	12.9	7.92	0.336	13.7

APPENDIX C

BENTHIC MACROINVERTEBRATE DATA

South Branch Patapsco, Patapsco River Lower Branch A,
and Patapsco River Lower Branch B Watersheds
Biological Monitoring Assessment
Benthic Macroinvertebrate Metrics

Howard County
2015

Site ID	Region	Sample Date	Metrics														Scored Metrics						BIBI	BIBIRating
			# Taxa	# Ephemeroptera, Trichoptera, Plecoptera	# Ephemeroptera	# Scrapers	Total Abundance	% Ephemeroptera	% Climbers	% Chironomidae	% Clingers	% Tanytarsini	% Scrapers	% Swimmers	% Diptera	% Intolerant - Urban	# Taxa	# Ephemeroptera, Trichoptera, Plecoptera	# Ephemeroptera	% Intolerant - Urban	% Chironomidae	% Clingers		
Patapsco River Lower Branch A																							2.90	
01PA-102-R-2015A	Piedmont	17-Mar-15	20	7	0	7	125	0.00	0.80	52.80	76.00	0.80	8.00	0.00	54.40	4.07	3	3	1	1	3	5	2.7	Poor
01PA-104-R-2015B	Piedmont	12-Mar-15	22	12	2	4	125	13.60	1.60	13.60	86.40	0.00	39.20	1.60	18.40	45.16	3	5	3	3	5	5	4	Good
01PA-107-R-2015C	Piedmont	17-Mar-15	33	11	1	6	113	5.31	5.31	23.01	72.57	3.54	22.12	5.31	33.63	28.70	5	5	1	3	5	3	3.7	Fair
01PA-110-R-2015D	Piedmont	13-Mar-15	22	1	0	0	102	0.00	4.90	26.47	39.22	4.90	0.00	0.98	69.61	33.66	3	1	1	3	3	3	2.3	Poor
01PA-213-R-2015E	Piedmont	06-Apr-15	25	10	2	5	132	1.52	16.67	43.18	68.94	1.52	12.88	0.76	49.24	11.02	5	3	3	1	3	3	3	Fair
01PA-317-R-2015F	Coastal Plain	24-Mar-15	23	7	0	3	120	0.00	5.00	77.50	17.50	12.50	4.17	1.67	80.00	7.50	5	5	1	1			3	Fair
01PA-119-F-2015G	Piedmont	13-Mar-15	24	7	0	4	131	0.00	3.05	63.36	29.77	2.29	5.34	0.00	68.70	3.13	3	3	1	1	1	1	1.7	Very Poor
01PA-121-F-2015H	Piedmont	13-Mar-15	25	6	0	3	82	0.00	6.10	58.54	37.80	3.66	4.88	0.00	63.41	7.32	5	3	1	1	3	3	2.7	Poor
01PA-123-F-2015I	Piedmont	12-Mar-15	19	8	0	2	33	0.00	12.12	33.33	66.67	0.00	6.06	0.00	36.36	21.21	3	3	1	3	3	3	2.7	Poor
01PA-126-F-2015J	Piedmont	17-Mar-15	23	6	0	7	124	0.00	5.65	16.94	79.84	0.81	24.19	0.00	33.87	21.77	3	3	1	3	5	5	3.3	Fair
Patapsco River Lower Branch B																							2.17	
04PB-103-R-2015A	Piedmont	26-Mar-15	25	5	0	3	122	0.00	3.28	77.87	16.39	0.82	3.28	0.00	83.61	3.33	5	3	1	1	1	1	2	Poor
04PB-104-R-2015B	Piedmont	18-Mar-15	21	8	0	2	103	0.00	0.00	34.95	55.34	0.00	2.91	0.00	53.40	18.45	3	3	1	3	3	3	2.7	Poor
04PB-208-R-2015C	Piedmont	26-Mar-15	20	3	0	3	115	0.00	3.48	73.04	26.09	1.74	3.48	0.00	84.35	0.88	3	1	1	1	1	1	1.3	Very Poor
04PB-210-R-2015D	Piedmont	26-Mar-15	16	4	1	2	117	0.85	4.27	64.96	42.74	3.42	3.42	0.00	68.38	1.71	3	1	1	1	1	3	1.7	Very Poor
04PB-214-R-2015E	Piedmont	07-Apr-15	21	5	0	2	126	0.00	11.11	80.16	30.16	4.76	4.76	2.38	83.33	0.79	3	3	1	1	1	1	1.7	Very Poor
04PB-318-R-2015F	Coastal Plain	06-Apr-15	20	4	0	4	125	0.00	1.60	20.80	89.60	0.00	6.40	0.00	72.80	51.20	3	3	1	5			3	Fair
04PB-119-F-2015G	Piedmont	20-Mar-15	28	9	0	5	107	0.00	6.54	24.30	68.22	4.67	36.45	0.00	30.84	38.68	5	3	1	3	3	3	3	Fair
04PB-122-F-2015H	Piedmont	06-Apr-15	24	7	0	2	123	0.00	0.81	41.46	56.91	4.88	4.88	0.00	48.78	19.83	3	3	1	3	3	3	2.7	Poor
04PB-123-F-2015I	Piedmont	18-Mar-15	19	4	0	2	118	0.00	7.63	52.54	33.90	0.00	2.54	0.00	71.19	0.00	3	1	1	1	3	3	2	Poor
04PB-125-F-2015J	Piedmont	18-Mar-15	13	3	0	1	122	0.00	0.82	40.16	55.74	4.92	5.74	0.00	41.80	0.82	1	1	1	1	3	3	1.7	Very Poor
South Branch Patapsco																							3.50	
10PT-401-R-2015A	Piedmont	24-Mar-15	24	12	5	5	123	4.88	1.63	6.50	39.02	0.00	4.07	2.44	10.57	24.56	3	5	5	3	5	3	4	Good
10PT-404-R-2015B	Piedmont	25-Mar-15	33	16	4	2	127	5.51	3.15	20.47	48.03	0.00	3.94	3.15	29.13	20.00	5	5	5	3	5	3	4.3	Good
10PT-107-R-2015C	Piedmont	07-Apr-15	25	10	2	4	108	4.63	4.63	0.00	75.93	0.00	22.22	4.63	5.56	25.93	5	3	3	3	5	5	4	Good
10PT-110-R-2015D	Piedmont	19-Mar-15	15	1	0	2	119	0.00	9.24	88.24	21.01	1.68	5.04	0.00	88.24	4.20	3	1	1	1	1	1	1.3	Very Poor
10PT-114-R-2015E	Piedmont	09-Apr-15	28	9	0	4	125	0.00	15.20	54.40	56.00	2.40	5.60	0.00	63.20	9.09	5	3	1	1	3	3	2.7	Poor
10PT-216-R-2015F	Piedmont	25-Mar-15	18	7	0	1	122	0.00	0.00	40.16	45.90	1.64	0.82	0.00	43.44	7.14	3	3	1	1	3	3	2.3	Poor
10PT-419-F-2015G	Piedmont	24-Mar-15	30	10	1	4	126	0.79	4.76	19.05	49.21	2.38	3.17	0.79	33.33	15.29	5	3	1	3	5	3	3.3	Fair
10PT-122-F-2015H	Piedmont	19-Mar-15	29	13	3	6	126	18.25	0.79	14.29	81.75	0.00	7.14	16.67	23.02	39.02	5	5	3	3	5	5	4.3	Good
10PT-124-F-2015I	Piedmont	19-Mar-15	31	18	5	7	126	15.08	1.59	12.70	73.81	3.17	19.84	11.11	26.19	64.00	5	5	5	5	5	3	4.7	Good
10PT-225-F-2015J	Piedmont	07-Apr-15	28	11	4	6	134	6.72	3.73	31.34	50.00	0.00	12.69	6.72	44.78	19.42	5	5	5	3	3	3	4	Good

VERSAR

Site ID **01PA-102-R-2015A** Region **Piedmont** Sample Date **3/17/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	20	3	# Scrapers	7		% Tanytarsini	0.8	
Total Abundance	125		% Ephemeroptera	0.0		% Scrapers	8.0	
# Ephemeroptera	0	1	% Climbers	0.8		% Swimmers	0.0	
# Ephemeroptera, Trichoptera, Plecoptera	7	3	% Chironomidae	52.8	3	% Diptera	54.4	
			% Clingers	76.0	5	% Intolerant - Urban	4.1	1

BIBI Score **2.67 Poor**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Arthropoda / Insecta									
	Diptera	Tipulidae	Antocha	Antocha	L	1	Collector	cn	8
	Trichoptera	Hydropsychidae	Ceratopsyche	Ceratopsyche	L	2	Collector		
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	37	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	4	Filterer	cn	4.4
	Diptera	Chironomidae	Dicrotendipes	Dicrotendipes	L	5	Collector	bu	9
	Trichoptera	Glossosomatidae	Glossosoma	Glossosoma	L	1	Scraper	cn	0
	Trichoptera	Glossosomatidae		Glossosomatidae	P	1	Scraper	cn	1
	Diptera	Empididae	Hemerodromia	Hemerodromia	L	1	Predator	sp, bu	7.9
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	3	Filterer	cn	7.5
	Coleoptera	Elmidae	Macronychus	Macronychus	L	1	Scraper	cn	6.8
	Diptera	Chironomidae	Microtendipes	Microtendipes	L	40	Filterer	cn	4.9
	Trichoptera	Uenoidae	Neophylax	Neophylax	L	2	Scraper	cn	2.7
	Coleoptera	Elmidae	Optioservus	Optioservus	L	1	Scraper	cn	5.4
	Coleoptera	Elmidae	Optioservus	Optioservus	A	1	Scraper	cn	5.4
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	8	Collector	sp, bu	9.2
	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	1	Scraper	cn	2.7
	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	L	1	Collector	sp	7.7
	Plecoptera	Nemouridae	Prostoia	Prostoia	L	1	Shredder	sp, cn	4.5
	Coleoptera	Psephenidae	Psephenus	Psephenus	L	1	Scraper	cn	4.4
	Diptera	Chironomidae	Synorthocladius	Synorthocladius	L	4	Collector		6.6
	Diptera	Chironomidae	Tvetenia	Tvetenia	L	8	Collector	sp	5.1
Mollusca / Gastropoda									
	Basommatophora	Physidae	Physa	Physa		1	Scraper	cb	7

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **01PA-104-R-2015B** Region **Piedmont** Sample Date **3/12/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	22	3	# Scrapers	4		% Tanytarsini	0.0	
Total Abundance	125		% Ephemeroptera	13.6		% Scrapers	39.2	
# Ephemeroptera	2	3	% Climbers	1.6		% Swimmers	1.6	
# Ephemeroptera, Trichoptera, Plecoptera	12	5	% Chironomidae	13.6	5	% Diptera	18.4	
			% Clingers	86.4	5	% Intolerant - Urban	45.2	3

BIBI Score **4.00 Good**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Arthropoda / Insecta									
	Diptera	Tipulidae	Antocha	Antocha	L	1	Collector	cn	8
	Ephemeroptera	Baetidae	Baetis	Baetis	L	2	Collector	sw, cb, cn	3.9
	Trichoptera	Hydropsychidae	Ceratopsyche	Ceratopsyche	L	1	Collector		
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	15	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	17	Filterer	cn	4.4
	Diptera	Chironomidae	Diamesa	Diamesa	L	1	Collector	sp	8.5
	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	L	1	Filterer	cn	2.7
	Trichoptera	Glossosomatidae	Glossosoma	Glossosoma	L	5	Scraper	cn	0
	Trichoptera	Glossosomatidae	Glossosoma	Glossosoma	P	1	Scraper	cn	0
	Ephemeroptera	Heptageniidae		Heptageniidae	L	3	Scraper	cn	2.6
	Diptera	Chironomidae	Hydrobaenus	Hydrobaenus	L	1	Scraper	sp	7.2
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	2	Filterer	cn	7.5
	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	12	Scraper	cn	3
	Diptera	Chironomidae	Microtendipes	Microtendipes	L	2	Filterer	cn	4.9
	Trichoptera	Uenoidae	Neophylax	Neophylax	L	27	Scraper	cn	2.7
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	6	Collector	sp, bu	9.2
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	3	Collector	sp	4.6
	Plecoptera	Perlidae		Perlidae	L	1	Predator	cn	2.2
	Trichoptera	Polycentropodidae	Polycentropus	Polycentropus	L	1	Filterer	cn	1.1
	Diptera	Chironomidae	Potthastia	Potthastia	L	1	Collector	sp	0
	Diptera	Simuliidae	Prosimulium	Prosimulium	L	3	Filterer	cn	2.4
	Diptera	Simuliidae	Prosimulium	Prosimulium	P	1	Filterer	cn	2.4
	Plecoptera	Nemouridae	Prostoia	Prostoia	L	14	Shredder	sp, cn	4.5
	Diptera	Chironomidae	Sympotthastia	Sympotthastia	L	3	Collector	sp	8.2
	Diptera	Tipulidae	Tipula	Tipula	L	1	Shredder	bu	6.7

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **01PA-107-R-2015C** Region **Piedmont** Sample Date **3/17/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	33	5	# Scrapers	6		% Tanytarsini	3.5	
Total Abundance	113		% Ephemeroptera	5.3		% Scrapers	22.1	
# Ephemeroptera	1	1	% Climbers	5.3		% Swimmers	5.3	
# Ephemeroptera, Trichoptera, Plecoptera	11	5	% Chironomidae	23.0	5	% Diptera	33.6	
			% Clingers	72.6	3	% Intolerant - Urban	28.7	3

BIBI Score **3.67 Fair**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Annelida / Oligochaeta									
	Tubificida	Tubificidae		Tubificidae		1	Collector	cn	8.4
Arthropoda / Insecta									
	Diptera	Tipulidae	Antocha	Antocha	L	3	Collector	cn	8
	Trichoptera	Hydropsychidae	Ceratopsyche	Ceratopsyche	L	5	Collector		
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	18	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	9	Filterer	cn	4.4
	Diptera	Empididae	Clinocera	Clinocera	L	3	Predator	cn	7.4
	Diptera	Chironomidae	Diamesa	Diamesa	L	1	Collector	sp	8.5
	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	L	1	Filterer	cn	2.7
	Plecoptera	Perlidae	Eccoptura	Eccoptura	L	1	Predator	cn	0.6
	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	6	Collector	cn, sw	2.3
	Trichoptera	Glossosomatidae		Glossosomatidae	P	1	Scraper	cn	1
	Coleoptera	Dryopidae	Helichus	Helichus	A	1	Scraper	cn	6.4
	Diptera	Empididae	Hemerodromia	Hemerodromia	L	1	Predator	sp, bu	7.9
	Diptera	Chironomidae	Hydrobaenus	Hydrobaenus	L	1	Scraper	sp	7.2
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	6	Filterer	cn	7.5
	Diptera	Chironomidae	Limnophyes	Limnophyes	L	1	Collector	sp	8.6
	Diptera	Chironomidae	Microtendipes	Microtendipes	L	6	Filterer	cn	4.9
	Trichoptera	Uenoidae	Neophylax	Neophylax	L	16	Scraper	cn	2.7
	Coleoptera	Elmidae	Optioservus	Optioservus	L	1	Scraper	cn	5.4
	Diptera	Chironomidae	Orthocladius	Orthocladius	P	1	Collector	sp, bu	9.2
	Diptera	Chironomidae	Parakiefferiella	Parakiefferiella	L	1	Collector	sp	2.1
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	P	1	Collector	sp	4.6
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	5	Collector	sp	4.6
	Trichoptera	Polycentropodidae	Polycentropus	Polycentropus	L	2	Filterer	cn	1.1
	Diptera	Simuliidae	Prosimulium	Prosimulium	L	2	Filterer	cn	2.4
	Diptera	Tipulidae	Pseudolimnophila	Pseudolimnophila	L	1	Predator	bu	2.8
	Trichoptera	Limnephilidae	Pycnopsyche	Pycnopsyche	L	1	Shredder	sp, cb, cn	3.1
	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	4	Filterer	cn	7.2
	Diptera	Chironomidae	Sympotthastia	Sympotthastia	L	3	Collector	sp	8.2
	Diptera	Chironomidae	Synorthocladius	Synorthocladius	L	1	Collector		6.6
	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	1	Predator	sp	8.2
	Diptera	Tipulidae	Tipula	Tipula	L	2	Shredder	bu	6.7
Mollusca / Gastropoda									
	Basommatophora	Ancylidae	Ferrissia	Ferrissia		5	Scraper	cb	7
Platyhelminthes / Turbellaria									
	Tricladida	Dugesiidae	Girardia	Girardia		1	Predator	sp	9.3

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **01PA-110-R-2015D** Region **Piedmont** Sample Date **3/13/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	22	3	# Scrapers	0		% Tanytarsini	4.9	
Total Abundance	102		% Ephemeroptera	0.0		% Scrapers	0.0	
# Ephemeroptera	0	1	% Climbers	4.9		% Swimmers	1.0	
# Ephemeroptera, Trichoptera, Plecoptera	1	1	% Chironomidae	26.5	3	% Diptera	69.6	
			% Clingers	39.2	3	% Intolerant - Urban	33.7	3

BIBI Score **2.33 Poor**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Annelida / Oligochaeta									
	Haplotaxida	Enchytraeidae		Enchytraeidae		1	Collector	bu	9.1
	Lumbricina			Lumbricina		1	Collector	bu	
	Tubificida	Tubificidae		Tubificidae		5	Collector	cn	8.4
Arthropoda / Insecta									
	Coleoptera	Dytiscidae	Agabus	Agabus	A	1	Predator	sw, dv	5.4
	Diptera	Ceratopogonidae	Bezzia	Bezzia	L	4	Predator	bu	3.3
	Diptera	Ptychopteridae	Bittacomorpha	Bittacomorpha	L	2	Collector	bu	4
	Diptera	Chironomidae	Diamesa	Diamesa	L	2	Collector	sp	8.5
	Diptera			Diptera	L	1			6
	Diptera	Chironomidae	Eukiefferiella	Eukiefferiella	L	5	Collector	sp	6.1
	Diptera	Tipulidae	Hexatoma	Hexatoma	L	1	Predator	bu, sp	1.5
	Trichoptera	Limnephilidae	Ironoquia	Ironoquia	L	19	Shredder	sp	4.9
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	2	Collector	sp, bu	9.2
	Diptera	Psychodidae	Pericoma	Pericoma	L	1	Collector		4
	Diptera	Tipulidae	Pseudolimnophila	Pseudolimnophila	L	3	Predator	bu	2.8
	Diptera	Ptychopteridae	Ptychoptera	Ptychoptera	L	1	Collector		4
	Diptera	Chironomidae	Rheocricotopus	Rheocricotopus	L	10	Collector	sp	6.2
	Diptera	Simuliidae	Stegopterna	Stegopterna	L	30	Filterer	cn	2.4
	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	5	Filterer	cb, cn	4.9
	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	1	Predator	sp	8.2
	Diptera	Tipulidae	Tipula	Tipula	L	1	Shredder	bu	6.7
	Diptera	Chironomidae	Zavrelimyia	Zavrelimyia	L	2	Predator	sp	5.3
Mollusca / Bivalvia									
	Veneroida	Pisidiidae	Pisidium	Pisidium		4	Filterer	bu	5.7

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **01PA-213-R-2015E** Region **Piedmont** Sample Date **4/6/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	25	5	# Scrapers	5		% Tanytarsini	1.5	
Total Abundance	132		% Ephemeroptera	1.5		% Scrapers	12.9	
# Ephemeroptera	2	3	% Climbers	16.7		% Swimmers	0.8	
# Ephemeroptera, Trichoptera, Plecoptera	10	3	% Chironomidae	43.2	3	% Diptera	49.2	
			% Clingers	68.9	3	% Intolerant - Urban	11.0	1

BIBI Score **3.00 Fair**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Arthropoda / Insecta									
	Diptera	Chironomidae	Ablabesmyia	Ablabesmyia	L	2	Predator	sp	8.1
	Plecoptera	Perlidae	Acroneuria	Acroneuria	L	1	Predator	cn	2.5
	Diptera	Tipulidae	Antocha	Antocha	L	2	Collector	cn	8
	Ephemeroptera	Baetidae	Baetis	Baetis	L	1	Collector	sw, cb, cn	3.9
	Trichoptera	Hydropsychidae	Ceratopsyche	Ceratopsyche	L	5	Collector		
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	P	1	Filterer	cn	6.5
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	28	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	18	Filterer	cn	4.4
	Diptera	Empididae	Clinocera	Clinocera	L	6	Predator	cn	7.4
	Megaloptera	Corydalidae	Corydalus	Corydalus	L	2	Predator	cn, cb	1.4
	Diptera	Chironomidae	Cricotopus	Cricotopus	L	1	Shredder	cn, bu	9.6
	Diptera	Chironomidae	Diamesa	Diamesa	L	1	Collector	sp	8.5
	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	L	1	Filterer	cn	2.7
	Diptera	Chironomidae	Eukiefferiella	Eukiefferiella	L	5	Collector	sp	6.1
	Trichoptera	Glossosomatidae	Glossosoma	Glossosoma	L	3	Scraper	cn	0
	Odonata	Gomphidae		Gomphidae	L	1	Predator	bu	2.2
	Diptera	Chironomidae	Hydrobaenus	Hydrobaenus	L	9	Scraper	sp	7.2
	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	1	Scraper	cn	3
	Trichoptera	Uenoidae	Neophylax	Neophylax	L	1	Scraper	cn	2.7
	Trichoptera	Uenoidae	Neophylax	Neophylax	L	2	Scraper	cn	2.7
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	8	Collector	sp, bu	9.2
	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	1	Scraper	cn	2.7
	Trichoptera	Polycentropodidae	Polycentropus	Polycentropus	L	1	Filterer	cn	1.1
	Diptera	Chironomidae	Polypedilum	Polypedilum	L	19	Shredder	cb, cn	6.3
	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	2	Filterer	cn	7.2
	Diptera	Chironomidae	Thienemanniella	Thienemanniella	L	5	Collector	sp	5.1
	Diptera	Chironomidae	Tvetenia	Tvetenia	L	5	Collector	sp	5.1

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **01PA-317-R-2015F** Region **Coastal Plain** Sample Date **3/24/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	23	5	# Scrapers	3		% Tanytarsini	12.5	
Total Abundance	120		% Ephemeroptera	0.0		% Scrapers	4.2	
# Ephemeroptera	0	1	% Climbers	5.0		% Swimmers	1.7	
# Ephemeroptera, Trichoptera, Plecoptera	7	5	% Chironomidae	77.5		% Diptera	80.0	
			% Clingers	17.5		% Intolerant - Urban	7.5	1

BIBI Score **3.00 Fair**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Annelida / Oligochaeta									
	Tubificida	Tubificidae		Tubificidae		1	Collector	cn	8.4
Arthropoda / Insecta									
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	2	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	1	Filterer	cn	4.4
	Diptera	Chironomidae	Conchapelopia	Conchapelopia	L	5	Predator	sp	6.1
	Diptera	Chironomidae	Cricotopus	Cricotopus	P	1	Shredder	cn, bu	9.6
	Coleoptera	Elmidae	Dubiraphia	Dubiraphia	L	1	Scraper	cn, cb	5.7
	Diptera	Empididae	Hemerodromia	Hemerodromia	L	2	Predator	sp, bu	7.9
	Coleoptera	Elmidae	Macronychus	Macronychus	L	2	Scraper	cn	6.8
	Diptera	Chironomidae	Microtendipes	Microtendipes	L	1	Filterer	cn	4.9
	Trichoptera	Leptoceridae	Oecetis	Oecetis	L	2	Predator	cn, sp, cb	4.7
	Diptera	Chironomidae	Orthocladius	Orthocladius	P	1	Collector	sp, bu	9.2
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	34	Collector	sp, bu	9.2
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	P	2	Collector	sp	4.6
	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	L	15	Collector	sp	7.7
	Trichoptera	Polycentropodidae	Polycentropus	Polycentropus	L	7	Filterer	cn	1.1
	Diptera	Chironomidae	Potthastia	Potthastia	L	1	Collector	sp	0
	Diptera	Ceratopogonidae	Probezzia	Probezzia	L	1	Predator	bu	3
	Trichoptera	Phryganeidae	Ptilostomis	Ptilostomis	L	1	Shredder	cb	4.3
	Diptera	Chironomidae	Rheocricotopus	Rheocricotopus	L	5	Collector	sp	6.2
	Coleoptera	Elmidae	Stenelmis	Stenelmis	L	2	Scraper	cn	7.1
	Plecoptera	Taeniopterygidae	Taeniopteryx	Taeniopteryx	L	1	Shredder	sp, cn	4.8
	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	23	Predator	sp	8.2
	Trichoptera	Leptoceridae	Triaenodes	Triaenodes	L	2	Shredder	sw, cb	5
	Diptera	Chironomidae	Xylotopus	Xylotopus	L	5	Shredder	bu	6.6
Mollusca / Bivalvia									
	Veneroida	Corbiculidae	Corbicula	Corbicula		2	Filterer	bu	6

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **01PA-119-F-2015G** Region **Piedmont** Sample Date **3/13/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	24	3	# Scrapers	4		% Tanytarsini	2.3	
Total Abundance	131		% Ephemeroptera	0.0		% Scrapers	5.3	
# Ephemeroptera	0	1	% Climbers	3.1		% Swimmers	0.0	
# Ephemeroptera, Trichoptera, Plecoptera	7	3	% Chironomidae	63.4	1	% Diptera	68.7	
			% Clingers	29.8	1	% Intolerant - Urban	3.1	1

BIBI Score **1.67 Very Poor**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Annelida / Oligochaeta									
	Haplotaxida	Enchytraeidae		Enchytraeidae		1	Collector	bu	9.1
	Lumbricina			Lumbricina		3	Collector	bu	
Arthropoda / Insecta									
	Diptera	Tipulidae	Antocha	Antocha	L	2	Collector	cn	8
	Diptera	Chironomidae	Chaetocladius	Chaetocladius	L	15	Collector	sp	7
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	18	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	2	Filterer	cn	4.4
	Diptera	Chironomidae	Diamesa	Diamesa	L	4	Collector	sp	8.5
	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	L	2	Filterer	cn	2.7
	Trichoptera	Glossosomatidae	Glossosoma	Glossosoma	L	2	Scraper	cn	0
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	6	Filterer	cn	7.5
	Trichoptera	Limnephilidae		Limnephilidae	L	1	Shredder	cb, sp, cn	3.4
	Diptera	Tipulidae	Limonia	Limonia	L	1	Shredder	bu, sp	4.8
	Trichoptera	Psychomyiidae	Lype	Lype	L	1	Scraper	cn	4.7
	Coleoptera	Elmidae	Macronychus	Macronychus	L	2	Scraper	cn	6.8
	Diptera	Chironomidae	Orthocladius	Orthocladius	P	3	Collector	sp, bu	9.2
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	53	Collector	sp, bu	9.2
	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	2	Filterer	cn	7.2
	Diptera	Chironomidae	Stenochironomus	Stenochironomus	L	1	Shredder	bu	7.9
	Diptera	Chironomidae	Sympotthastia	Sympotthastia	L	2	Collector	sp	8.2
	Diptera	Chironomidae	Synorthocladius	Synorthocladius	L	1	Collector		6.6
	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	1	Filterer	cb, cn	4.9
	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	1	Predator	sp	8.2
	Diptera	Tipulidae	Tipula	Tipula	L	4	Shredder	bu	6.7
Arthropoda / Malacostraca									
	Amphipoda	Crangonyctidae	Crangonyx	Crangonyx		1	Collector	sp	6.7
Mollusca / Gastropoda									
	Basommatophora	Physidae	Physa	Physa		2	Scraper	cb	7

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **01PA-121-F-2015H** Region **Piedmont** Sample Date **3/13/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	25	5	# Scrapers	3		% Tanytarsini	3.7	
Total Abundance	82		% Ephemeroptera	0.0		% Scrapers	4.9	
# Ephemeroptera	0	1	% Climbers	6.1		% Swimmers	0.0	
# Ephemeroptera, Trichoptera, Plecoptera	6	3	% Chironomidae	58.5	3	% Diptera	63.4	
			% Clingers	37.8	3	% Intolerant - Urban	7.3	1

BIBI Score **2.67 Poor**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Annelida / Oligochaeta									
	Tubificida	Tubificidae		Tubificidae		1	Collector	cn	8.4
Arthropoda / Insecta									
	Odonata	Calopterygidae	Calopteryx	Calopteryx	L	1	Predator	cb	8.3
	Diptera	Chironomidae	Chaetocladius	Chaetocladius	L	15	Collector	sp	7
	Diptera	Chironomidae	Chaetocladius	Chaetocladius	P	1	Collector	sp	7
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	11	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	2	Filterer	cn	4.4
	Diptera	Empididae	Clinocera	Clinocera	L	1	Predator	cn	7.4
	Diptera	Chironomidae	Corynoneura	Corynoneura	L	15	Collector	sp	4.1
	Diptera	Chironomidae	Diamesa	Diamesa	L	5	Collector	sp	8.5
	Diptera	Tipulidae	Dicranota	Dicranota	L	1	Predator	sp, bu	1.1
	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	L	2	Filterer	cn	2.7
	Coleoptera	Dryopidae	Helichus	Helichus	A	2	Scraper	cn	6.4
	Coleoptera	Hydrophilidae	Hydrobius	Hydrobius	A	1	Collector	cb, cn, sp	4.1
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	5	Filterer	cn	7.5
	Diptera	Chironomidae	Microtendipes	Microtendipes	L	1	Filterer	cn	4.9
	Trichoptera	Uenoidae	Neophylax	Neophylax	L	1	Scraper	cn	2.7
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	5	Collector	sp	4.6
	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	L	2	Collector	sp	7.7
	Trichoptera	Philopotamidae		Philopotamidae	P	1	Filterer	cn	2.6
	Diptera	Chironomidae	Polypedilum	Polypedilum	L	1	Shredder	cb, cn	6.3
	Plecoptera	Nemouridae	Soyedina	Soyedina	L	1	Shredder	sp, cn	2.9
	Diptera	Chironomidae	Tanytarsus	Tanytarsus	P	1	Filterer	cb, cn	4.9
	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	1	Predator	sp	8.2
	Diptera	Tipulidae	Tipula	Tipula	L	2	Shredder	bu	6.7
	Diptera	Chironomidae	Zavrelimyia	Zavrelimyia	L	1	Predator	sp	5.3
Arthropoda / Malacostraca									
	Amphipoda	Crangonyctidae	Stygonectes	Stygonectes		1	Collector		8
Mollusca / Gastropoda									
	Basommatophora	Physidae	Physa	Physa		1	Scraper	cb	7

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **01PA-123-F-2015I** Region **Piedmont** Sample Date **3/12/2015**

BIBI Metrics and Scores

	Value	Score
# Taxa	19	3
Total Abundance	33	
# Ephemeroptera	0	1
# Ephemeroptera, Trichoptera, Plecoptera	8	3

	Value	Score
# Scrapers	2	
% Ephemeroptera	0.0	
% Climbers	12.1	
% Chironomidae	33.3	3
% Clingers	66.7	3

	Value	Score
% Tanytarsini	0.0	
% Scrapers	6.1	
% Swimmers	0.0	
% Diptera	36.4	
% Intolerant - Urban	21.2	3

BIBI Score **2.67 Poor**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Arthropoda / Insecta									
	Plecoptera	Capniidae	Allocapnia	Allocapnia	L	1	Shredder	cn	4.2
	Coleoptera	Ptilodactylidae	Anchytarsus	Anchytarsus	L	3	Shredder	cn	3.1
	Diptera	Ceratopogonidae		Ceratopogonidae	L	1	Predator	sp, bu	3.6
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	2	Filterer	cn	4.4
	Diptera	Chironomidae	Conchapelopia	Conchapelopia	L	2	Predator	sp	6.1
	Diptera	Chironomidae	Cricotopus	Cricotopus	L	1	Shredder	cn, bu	9.6
	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	L	3	Filterer	cn	2.7
	Plecoptera	Perlidae	Eccoptura	Eccoptura	L	1	Predator	cn	0.6
	Coleoptera	Hydrophilidae	Hydrobius	Hydrobius	A	1	Collector	cb, cn, sp	4.1
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	3	Filterer	cn	7.5
	Plecoptera	Leuctridae	Leuctra	Leuctra	L	1	Shredder	cn	0.4
	Trichoptera	Limnephilidae		Limnephilidae	L	2	Shredder	cb, sp, cn	3.4
	Diptera	Chironomidae	Microtendipes	Microtendipes	L	1	Filterer	cn	4.9
	Hemiptera	Veliidae	Microvelia	Microvelia	A	1	Predator	sk	6
	Trichoptera	Uenoidae	Neophylax	Neophylax	L	1	Scraper	cn	2.7
	Megaloptera	Corydalidae	Nigronia	Nigronia	L	1	Predator	cn, cb	1.4
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	5	Collector	sp, bu	9.2
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	2	Collector	sp	4.6
	Coleoptera	Elmidae	Stenelmis	Stenelmis	A	1	Scraper	cn	7.1

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **01PA-126-F-2015J** Region **Piedmont** Sample Date **3/17/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	23	3	# Scrapers	7		% Tanytarsini	0.8	
Total Abundance	124		% Ephemeroptera	0.0		% Scrapers	24.2	
# Ephemeroptera	0	1	% Climbers	5.6		% Swimmers	0.0	
# Ephemeroptera, Trichoptera, Plecoptera	6	3	% Chironomidae	16.9	5	% Diptera	33.9	
			% Clingers	79.8	5	% Intolerant - Urban	21.8	3

BIBI Score **3.33 Fair**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Arthropoda / Insecta									
	Diptera	Tipulidae	Antocha	Antocha	L	15	Collector	cn	8
	Odonata	Calopterygidae	Calopteryx	Calopteryx	L	1	Predator	cb	8.3
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	24	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	16	Filterer	cn	4.4
	Diptera	Chironomidae	Conchapelopia	Conchapelopia	L	3	Predator	sp	6.1
	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	L	10	Filterer	cn	2.7
	Diptera	Empididae		Empididae	L	1	Predator	sp, bu	7.5
	Trichoptera	Glossosomatidae	Glossosoma	Glossosoma	P	1	Scraper	cn	0
	Trichoptera	Glossosomatidae	Glossosoma	Glossosoma	L	3	Scraper	cn	0
	Diptera	Empididae	Hemerodromia	Hemerodromia	L	1	Predator	sp, bu	7.9
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	1	Filterer	cn	7.5
	Diptera	Chironomidae	Microtendipes	Microtendipes	L	8	Filterer	cn	4.9
	Trichoptera	Uenoidae	Neophylax	Neophylax	L	12	Scraper	cn	2.7
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	5	Collector	sp	4.6
	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	L	1	Collector	sp	7.7
	Coleoptera	Psephenidae	Psephenus	Psephenus	L	6	Scraper	cn	4.4
	Diptera	Tipulidae	Pseudolimnophila	Pseudolimnophila	L	1	Predator	bu	2.8
	Diptera	Simuliidae	Simulium	Simulium	L	1	Filterer	cn	5.7
	Coleoptera	Elmidae	Stenelmis	Stenelmis	L	1	Scraper	cn	7.1
	Coleoptera	Elmidae	Stenelmis	Stenelmis	A	1	Scraper	cn	7.1
	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	1	Predator	sp	8.2
	Diptera	Tipulidae	Tipula	Tipula	L	2	Shredder	bu	6.7
	Diptera	Chironomidae	Zavrelimyia	Zavrelimyia	L	3	Predator	sp	5.3
Mollusca / Gastropoda									
	Basommatophora	Ancylidae	Ferrissia	Ferrissia		3	Scraper	cb	7
	Basommatophora	Lymnaeidae		Lymnaeidae		1	Scraper	cb	6.9
	Basommatophora	Physidae	Physa	Physa		2	Scraper	cb	7

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **04PB-103-R-2015A** Region **Piedmont** Sample Date **3/26/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	25	5	# Scrapers	3		% Tanytarsini	0.8	
Total Abundance	122		% Ephemeroptera	0.0		% Scrapers	3.3	
# Ephemeroptera	0	1	% Climbers	3.3		% Swimmers	0.0	
# Ephemeroptera, Trichoptera, Plecoptera	5	3	% Chironomidae	77.9	1	% Diptera	83.6	
			% Clingers	16.4	1	% Intolerant - Urban	3.3	1

BIBI Score **2.00 Poor**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Annelida / Oligochaeta									
	Tubificida	Tubificidae		Tubificidae		4	Collector	cn	8.4
Arthropoda / Insecta									
	Odonata	Coenagrionidae	Argia	Argia	L	1	Predator	cn, cb, sp	9.3
	Diptera	Chironomidae	Chaetocladius	Chaetocladius	L	5	Collector	sp	7
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	5	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	1	Filterer	cn	4.4
	Diptera	Empididae	Clinocera	Clinocera	L	2	Predator	cn	7.4
	Diptera	Chironomidae	Conchapelopia	Conchapelopia	L	3	Predator	sp	6.1
	Diptera	Chironomidae	Diamesa	Diamesa	L	5	Collector	sp	8.5
	Diptera	Chironomidae	Diamesa	Diamesa	P	2	Collector	sp	8.5
	Diptera	Tipulidae	Dicranota	Dicranota	L	1	Predator	sp, bu	1.1
	Odonata	Gomphidae		Gomphidae	L	1	Predator	bu	2.2
	Plecoptera	Chloroperlidae	Haploperla	Haploperla	L	1	Predator	cn	1.6
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	2	Filterer	cn	7.5
	Trichoptera	Limnephilidae		Limnephilidae	L	1	Shredder	cb, sp, cn	3.4
	Diptera	Empididae	Neoplasta	Neoplasta	L	2	Predator		
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	10	Collector	sp, bu	9.2
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	P	3	Collector	sp	4.6
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	5	Collector	sp	4.6
	Diptera	Ceratopogonidae	Probezzia	Probezzia	L	1	Predator	bu	3
	Coleoptera	Psephenidae	Psephenus	Psephenus	L	1	Scraper	cn	4.4
	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	1	Filterer	cn	7.2
	Coleoptera	Elmidae	Stenelmis	Stenelmis	A	1	Scraper	cn	7.1
	Diptera	Chironomidae	Sympotthastia	Sympotthastia	P	2	Collector	sp	8.2
	Diptera	Chironomidae	Sympotthastia	Sympotthastia	L	36	Collector	sp	8.2
	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	3	Predator	sp	8.2
	Diptera	Tipulidae	Tipula	Tipula	L	1	Shredder	bu	6.7
	Diptera	Chironomidae	Tvetenia	Tvetenia	L	19	Collector	sp	5.1
	Diptera	Chironomidae	Zavrelimyia	Zavrelimyia	L	1	Predator	sp	5.3
Mollusca / Gastropoda									
	Basommatophora	Physidae	Physa	Physa		2	Scraper	cb	7

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **04PB-104-R-2015B** Region **Piedmont** Sample Date **3/18/2015**

BIBI Metrics and Scores

	Value	Score
# Taxa	21	3
Total Abundance	103	
# Ephemeroptera	0	1
# Ephemeroptera, Trichoptera, Plecoptera	8	3

	Value	Score
# Scrapers	2	
% Ephemeroptera	0.0	
% Climbers	0.0	
% Chironomidae	35.0	3
% Clingers	55.3	3

	Value	Score
% Tanytarsini	0.0	
% Scrapers	2.9	
% Swimmers	0.0	
% Diptera	53.4	
% Intolerant - Urban	18.4	3

BIBI Score **2.67 Poor**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Arthropoda / Insecta									
	Plecoptera	Capniidae	Allocapnia	Allocapnia	L	2	Shredder	cn	4.2
	Coleoptera	Ptilodactylidae	Anchytarsus	Anchytarsus	L	7	Shredder	cn	3.1
	Diptera	Tipulidae	Antocha	Antocha	L	7	Collector	cn	8
	Diptera	Ceratopogonidae		Ceratopogonidae	L	2	Predator	sp, bu	3.6
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	4	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	4	Filterer	cn	4.4
	Diptera	Chironomidae	Diamesa	Diamesa	L	3	Collector	sp	8.5
	Diptera	Chironomidae	Diamesa	Diamesa	P	2	Collector	sp	8.5
	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	L	8	Filterer	cn	2.7
	Diptera	Chironomidae	Eukiefferiella	Eukiefferiella	L	9	Collector	sp	6.1
	Plecoptera	Chloroperlidae	Haploperla	Haploperla	L	8	Predator	cn	1.6
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	11	Filterer	cn	7.5
	Diptera	Chironomidae	Microtendipes	Microtendipes	L	2	Filterer	cn	4.9
	Trichoptera	Uenoidae	Neophylax	Neophylax	L	2	Scraper	cn	2.7
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	4	Collector	sp, bu	9.2
	Trichoptera	Rhyacophilidae	Rhyacophila	Rhyacophila	L	1	Predator	cn	2.1
	Coleoptera	Elmidae	Stenelmis	Stenelmis	L	1	Scraper	cn	7.1
	Diptera	Chironomidae	Sympotthastia	Sympotthastia	L	3	Collector	sp	8.2
	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	3	Predator	sp	8.2
	Diptera	Tipulidae	Tipula	Tipula	L	10	Shredder	bu	6.7
	Diptera	Chironomidae	Tvetenia	Tvetenia	L	9	Collector	sp	5.1
	Diptera	Chironomidae	Zavrelimyia	Zavrelimyia	L	1	Predator	sp	5.3

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **04PB-208-R-2015C** Region **Piedmont** Sample Date **3/26/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	20	3	# Scrapers	3		% Tanytarsini	1.7	
Total Abundance	115		% Ephemeroptera	0.0		% Scrapers	3.5	
# Ephemeroptera	0	1	% Climbers	3.5		% Swimmers	0.0	
# Ephemeroptera, Trichoptera, Plecoptera	3	1	% Chironomidae	73.0	1	% Diptera	84.3	
			% Clingers	26.1	1	% Intolerant - Urban	0.9	1

BIBI Score **1.33 Very Poor**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Arthropoda / Insecta									
	Coleoptera	Elmidae	Ancyronyx	Ancyronyx	L	1	Scraper	cn, sp	7.8
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	10	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	2	Filterer	cn	4.4
	Diptera	Empididae	Clinocera	Clinocera	L	1	Predator	cn	7.4
	Diptera	Chironomidae	Cricotopus	Cricotopus	L	5	Shredder	cn, bu	9.6
	Diptera	Chironomidae	Diamesa	Diamesa	L	2	Collector	sp	8.5
	Diptera	Empididae	Hemerodromia	Hemerodromia	L	11	Predator	sp, bu	7.9
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	2	Filterer	cn	7.5
	Diptera	Chironomidae	Microtendipes	Microtendipes	L	2	Filterer	cn	4.9
	Diptera	Empididae	Neoplasta	Neoplasta	L	1	Predator		
	Coleoptera	Elmidae	Optioservus	Optioservus	L	1	Scraper	cn	5.4
	Diptera	Chironomidae	Orthocladius	Orthocladius	P	3	Collector	sp, bu	9.2
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	47	Collector	sp, bu	9.2
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	P	1	Collector	sp	4.6
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	5	Collector	sp	4.6
	Diptera	Chironomidae	Polypedilum	Polypedilum	L	2	Shredder	cb, cn	6.3
	Diptera	Chironomidae	Potthastia	Potthastia	L	1	Collector	sp	0
	Coleoptera	Elmidae	Stenelmis	Stenelmis	L	2	Scraper	cn	7.1
	Diptera	Chironomidae	Sympotthastia	Sympotthastia	P	2	Collector	sp	8.2
	Diptera	Chironomidae	Sympotthastia	Sympotthastia	L	5	Collector	sp	8.2
	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	2	Filterer	cb, cn	4.9
	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	2	Predator	sp	8.2
	Diptera	Chironomidae	Tvetenia	Tvetenia	L	5	Collector	sp	5.1

Site ID **04PB-210-R-2015D** Region **Piedmont** Sample Date **3/26/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	16	3	# Scrapers	2		% Tanytarsini	3.4	
Total Abundance	117		% Ephemeroptera	0.9		% Scrapers	3.4	
# Ephemeroptera	1	1	% Climbers	4.3		% Swimmers	0.0	
# Ephemeroptera, Trichoptera, Plecoptera	4	1	% Chironomidae	65.0	1	% Diptera	68.4	
			% Clingers	42.7	3	% Intolerant - Urban	1.7	1

BIBI Score **1.67 Very Poor**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Arthropoda / Insecta									
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	26	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	5	Filterer	cn	4.4
	Diptera	Empididae	Clinocera	Clinocera	L	1	Predator	cn	7.4
	Odonata	Cordulegastridae	Cordulegaster	Cordulegaster	L	1	Predator	bu	2.4
	Diptera	Empididae	Hemerodromia	Hemerodromia	L	1	Predator	sp, bu	7.9
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	1	Filterer	cn	7.5
	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	1	Scraper	cn	3
	Diptera	Chironomidae	Microtendipes	Microtendipes	L	8	Filterer	cn	4.9
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	42	Collector	sp, bu	9.2
	Diptera	Chironomidae	Orthocladius	Orthocladius	P	4	Collector	sp, bu	9.2
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	9	Collector	sp	4.6
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	P	2	Collector	sp	4.6
	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	L	3	Collector	sp	7.7
	Diptera	Chironomidae	Polypedilum	Polypedilum	L	4	Shredder	cb, cn	6.3
	Coleoptera	Elmidae	Stenelmis	Stenelmis	A	1	Scraper	cn	7.1
	Coleoptera	Elmidae	Stenelmis	Stenelmis	L	2	Scraper	cn	7.1
	Diptera	Chironomidae	Sympotthastia	Sympotthastia	L	3	Collector	sp	8.2
	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	1	Filterer	cb, cn	4.9
	Diptera	Tipulidae	Tipula	Tipula	L	2	Shredder	bu	6.7

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **04PB-214-R-2015E** Region **Piedmont** Sample Date **4/7/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	21	3	# Scrapers	2		% Tanytarsini	4.8	
Total Abundance	126		% Ephemeroptera	0.0		% Scrapers	4.8	
# Ephemeroptera	0	1	% Climbers	11.1		% Swimmers	2.4	
# Ephemeroptera, Trichoptera, Plecoptera	5	3	% Chironomidae	80.2	1	% Diptera	83.3	
			% Clingers	30.2	1	% Intolerant - Urban	0.8	1

BIBI Score **1.67 Very Poor**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Arthropoda / Insecta									
	Diptera	Tipulidae	Antocha	Antocha	L	2	Collector	cn	8
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	8	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	1	Filterer	cn	4.4
	Diptera	Chironomidae	Chironomini	Chironomini	L	1			5.9
	Diptera	Empididae	Clinocera	Clinocera	L	1	Predator	cn	7.4
	Diptera	Chironomidae	Conchapelopia	Conchapelopia	P	1	Predator	sp	6.1
	Diptera	Chironomidae	Conchapelopia	Conchapelopia	L	1	Predator	sp	6.1
	Diptera	Chironomidae	Cricotopus	Cricotopus	L	5	Shredder	cn, bu	9.6
	Coleoptera	Elmidae	Dubiraphia	Dubiraphia	A	1	Scraper	cn, cb	5.7
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	1	Filterer	cn	7.5
	Diptera	Chironomidae	Microtendipes	Microtendipes	L	1	Filterer	cn	4.9
	Diptera	Chironomidae	Orthocladius	Orthocladius	P	4	Collector	sp, bu	9.2
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	68	Collector	sp, bu	9.2
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	5	Collector	sp	4.6
	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	L	1	Collector	sp	7.7
	Trichoptera	Polycentropodidae	Polycentropus	Polycentropus	L	1	Filterer	cn	1.1
	Diptera	Chironomidae	Polypedilum	Polypedilum	L	7	Shredder	cb, cn	6.3
	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	2	Filterer	cn	7.2
	Coleoptera	Elmidae	Stenelmis	Stenelmis	L	4	Scraper	cn	7.1
	Coleoptera	Elmidae	Stenelmis	Stenelmis	A	1	Scraper	cn	7.1
	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	3	Filterer	cb, cn	4.9
	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	2	Predator	sp	8.2
	Diptera	Tipulidae	Tipula	Tipula	L	1	Shredder	bu	6.7
	Trichoptera	Leptoceridae	Triaenodes	Triaenodes	L	3	Shredder	sw, cb	5
Arthropoda / Malacostraca									
	Amphipoda	Crangonyctidae	Crangonyx	Crangonyx		1	Collector	sp	6.7

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **04PB-318-R-2015F** Region **Coastal Plain** Sample Date **4/6/2015**

BIBI Metrics and Scores

	Value	Score
# Taxa	20	3
Total Abundance	125	
# Ephemeroptera	0	1
# Ephemeroptera, Trichoptera, Plecoptera	4	3

	Value	Score
# Scrapers	4	
% Ephemeroptera	0.0	
% Climbers	1.6	
% Chironomidae	20.8	
% Clingers	89.6	

	Value	Score
% Tanytarsini	0.0	
% Scrapers	6.4	
% Swimmers	0.0	
% Diptera	72.8	
% Intolerant - Urban	51.2	5

BIBI Score **3.00 Fair**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Arthropoda / Insecta									
	Diptera	Tipulidae	Antocha	Antocha	L	1	Collector	cn	8
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	8	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	10	Filterer	cn	4.4
	Diptera	Chironomidae	Diamesa	Diamesa	L	2	Collector	sp	8.5
	Coleoptera	Dryopidae	Helichus	Helichus	A	1	Scraper	cn	6.4
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	7	Filterer	cn	7.5
	Diptera	Chironomidae	Microtendipes	Microtendipes	L	17	Filterer	cn	4.9
	Trichoptera	Uenoidae	Neophylax	Neophylax	L	2	Scraper	cn	2.7
	Megaloptera	Corydalidae	Nigronia	Nigronia	L	1	Predator	cn, cb	1.4
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	1	Collector	sp, bu	9.2
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	1	Collector	sp	4.6
	Diptera	Simuliidae	Prosimulium	Prosimulium	L	51	Filterer	cn	2.4
	Diptera	Simuliidae	Prosimulium	Prosimulium	P	2	Filterer	cn	2.4
	Diptera	Tipulidae	Pseudolimnophila	Pseudolimnophila	L	2	Predator	bu	2.8
	Diptera	Simuliidae	Simulium	Simulium	L	2	Filterer	cn	5.7
	Diptera	Simuliidae	Stegopterna	Stegopterna	L	6	Filterer	cn	2.4
	Coleoptera	Elmidae	Stenelmis	Stenelmis	L	2	Scraper	cn	7.1
	Coleoptera	Elmidae	Stenelmis	Stenelmis	A	2	Scraper	cn	7.1
	Diptera	Chironomidae	Stictochironomus	Stictochironomus	L	4	Collector	bu	9.2
	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	1	Predator	sp	8.2
	Diptera	Tipulidae	Tipula	Tipula	L	1	Shredder	bu	6.7
Mollusca / Gastropoda									
	Basommatophora	Physidae	Physa	Physa		1	Scraper	cb	7

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **04PB-119-F-2015G** Region **Piedmont** Sample Date **3/20/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	28	5	# Scrapers	5		% Tanytarsini	4.7	
Total Abundance	107		% Ephemeroptera	0.0		% Scrapers	36.4	
# Ephemeroptera	0	1	% Climbers	6.5		% Swimmers	0.0	
# Ephemeroptera, Trichoptera, Plecoptera	9	3	% Chironomidae	24.3	3	% Diptera	30.8	
			% Clingers	68.2	3	% Intolerant - Urban	38.7	3

BIBI Score **3.00 Fair**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Arthropoda / Insecta									
	Plecoptera	Nemouridae	Amphinemura	Amphinemura	L	1	Shredder	sp, cn	3
	Diptera	Tipulidae	Antocha	Antocha	L	1	Collector	cn	8
	Odonata	Calopterygidae	Calopteryx	Calopteryx	L	1	Predator	cb	8.3
	Trichoptera	Hydropsychidae	Ceratopsyche	Ceratopsyche	L	1	Collector		
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	10	Filterer	cn	4.4
	Diptera	Chironomidae	Conchapelopia	Conchapelopia	L	2	Predator	sp	6.1
	Diptera	Chironomidae	Diamesa	Diamesa	L	3	Collector	sp	8.5
	Trichoptera	Philopotamidae	Dolophilodes	Dolophilodes	L	2	Filterer	cn	1.7
	Plecoptera	Perlidae	Eccoptura	Eccoptura	L	1	Predator	cn	0.6
	Trichoptera	Glossosomatidae	Glossosoma	Glossosoma	L	4	Scraper	cn	0
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	15	Filterer	cn	7.5
	Coleoptera	Elmidae	Macronychus	Macronychus	L	1	Scraper	cn	6.8
	Diptera	Chironomidae	Microtendipes	Microtendipes	L	1	Filterer	cn	4.9
	Trichoptera	Uenoidae	Neophylax	Neophylax	L	28	Scraper	cn	2.7
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	1	Collector	sp, bu	9.2
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	5	Collector	sp	4.6
	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	L	2	Collector	sp	7.7
	Coleoptera	Haliplidae	Peltodytes	Peltodytes	L	1	Shredder	cb, cn	8.9
	Diptera	Chironomidae	Potthastia	Potthastia	L	3	Collector	sp	0
	Diptera	Simuliidae	Prosimulium	Prosimulium	L	2	Filterer	cn	2.4
	Plecoptera	Nemouridae	Prostoia	Prostoia	L	3	Shredder	sp, cn	4.5
	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	2	Filterer	cn	7.2
	Coleoptera	Elmidae	Stenelmis	Stenelmis	L	1	Scraper	cn	7.1
	Diptera	Chironomidae	Sympotthastia	Sympotthastia	L	4	Collector	sp	8.2
	Diptera	Chironomidae		Tanytarsini	L	1	Collector		3.5
	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	1	Predator	sp	8.2
	Diptera	Tipulidae	Tipula	Tipula	L	4	Shredder	bu	6.7
	Diptera	Chironomidae	Tvetenia	Tvetenia	L	1	Collector	sp	5.1
Mollusca / Gastropoda									
	Basommatophora	Physidae	Physa	Physa		5	Scraper	cb	7

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **04PB-122-F-2015H** Region **Piedmont** Sample Date **4/6/2015**

BIBI Metrics and Scores

	Value	Score
# Taxa	24	3
Total Abundance	123	
# Ephemeroptera	0	1
# Ephemeroptera, Trichoptera, Plecoptera	7	3

	Value	Score
# Scrapers	2	
% Ephemeroptera	0.0	
% Climbers	0.8	
% Chironomidae	41.5	3
% Clingers	56.9	3

	Value	Score
% Tanytarsini	4.9	
% Scrapers	4.9	
% Swimmers	0.0	
% Diptera	48.8	
% Intolerant - Urban	19.8	3

BIBI Score **2.67 Poor**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Annelida / Oligochaeta									
	Lumbricina			Lumbricina		1	Collector	bu	
Arthropoda / Insecta									
	Coleoptera	Ptilodactylidae	Anchytarsus	Anchytarsus	L	28	Shredder	cn	3.1
	Diptera	Ceratopogonidae		Ceratopogonidae	L	3	Predator	sp, bu	3.6
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	1	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	1	Filterer	cn	4.4
	Diptera	Chironomidae	Conchapelopia	Conchapelopia	L	5	Predator	sp	6.1
	Odonata	Cordulegastridae	Cordulegaster	Cordulegaster	L	1	Predator	bu	2.4
	Diptera	Chironomidae	Corynoneura	Corynoneura	L	5	Collector	sp	4.1
	Diptera	Chironomidae	Cricotopus	Cricotopus	L	5	Shredder	cn, bu	9.6
	Diptera	Chironomidae	Diamesa	Diamesa	P	1	Collector	sp	8.5
	Diptera	Chironomidae	Diamesa	Diamesa	L	1	Collector	sp	8.5
	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	L	9	Filterer	cn	2.7
	Diptera	Chironomidae	Eukiefferiella	Eukiefferiella	L	5	Collector	sp	6.1
	Plecoptera	Chloroperlidae	Haploperla	Haploperla	L	9	Predator	cn	1.6
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	6	Filterer	cn	7.5
	Trichoptera	Limnephilidae	Ironoquia	Ironoquia	L	1	Shredder	sp	4.9
	Diptera	Chironomidae	Micropsectra	Micropsectra	L	1	Collector	cb, sp	2.1
	Trichoptera	Uenoidae	Neophylax	Neophylax	L	4	Scraper	cn	2.7
	Diptera	Empididae	Neoplasta	Neoplasta	L	1	Predator		
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	5	Collector	sp, bu	9.2
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	15	Collector	sp	4.6
	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	5	Filterer	cn	7.2
	Coleoptera	Elmidae	Stenelmis	Stenelmis	L	2	Scraper	cn	7.1
	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	2	Predator	sp	8.2
	Diptera	Tipulidae	Tipula	Tipula	L	5	Shredder	bu	6.7
	Diptera	Chironomidae	Zavrelimyia	Zavrelimyia	L	1	Predator	sp	5.3

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **04PB-123-F-2015I** Region **Piedmont** Sample Date **3/18/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	19	3	# Scrapers	2		% Tanytarsini	0.0	
Total Abundance	118		% Ephemeroptera	0.0		% Scrapers	2.5	
# Ephemeroptera	0	1	% Climbers	7.6		% Swimmers	0.0	
# Ephemeroptera, Trichoptera, Plecoptera	4	1	% Chironomidae	52.5	3	% Diptera	71.2	
			% Clingers	33.9	3	% Intolerant - Urban	0.0	1

BIBI Score **2.00 Poor**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Annelida / Oligochaeta									
	Haplotaxida	Enchytraeidae		Enchytraeidae	L	2	Collector	bu	9.1
	Tubificida	Tubificidae		Tubificidae	L	9	Collector	cn	8.4
Arthropoda / Insecta									
	Trichoptera	Hydropsychidae	Ceratopsyche	Ceratopsyche	L	3	Collector		
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	9	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	3	Filterer	cn	4.4
	Diptera	Chironomidae	Cricotopus	Cricotopus	L	5	Shredder	cn, bu	9.6
	Diptera	Chironomidae	Diamesa	Diamesa	L	1	Collector	sp	8.5
	Diptera	Chironomidae	Eukiefferiella	Eukiefferiella	L	5	Collector	sp	6.1
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	5	Filterer	cn	7.5
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	25	Collector	sp, bu	9.2
	Diptera	Chironomidae	Orthocladius	Orthocladius	P	2	Collector	sp, bu	9.2
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	10	Collector	sp	4.6
	Diptera	Chironomidae	Phaenopsectra	Phaenopsectra	L	2	Collector	cn	8.7
	Diptera	Chironomidae	Polypedilum	Polypedilum	L	6	Shredder	cb, cn	6.3
	Diptera	Simuliidae	Simulium	Simulium	L	1	Filterer	cn	5.7
	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	1	Predator	sp	8.2
	Diptera	Tipulidae	Tipula	Tipula	L	21	Shredder	bu	6.7
	Diptera	Chironomidae	Tvetenia	Tvetenia	L	5	Collector	sp	5.1
Mollusca / Gastropoda									
	Basommatophora	Lymnaeidae	Fossaria	Fossaria		1	Scraper	cb	6.9
	Basommatophora	Physidae	Physa	Physa		2	Scraper	cb	7

Site ID **04PB-125-F-2015J** Region **Piedmont** Sample Date **3/18/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	13	1	# Scrapers	1		% Tanytarsini	4.9	
Total Abundance	122		% Ephemeroptera	0.0		% Scrapers	5.7	
# Ephemeroptera	0	1	% Climbers	0.8		% Swimmers	0.0	
# Ephemeroptera, Trichoptera, Plecoptera	3	1	% Chironomidae	40.2	3	% Diptera	41.8	
			% Clingers	55.7	3	% Intolerant - Urban	0.8	1

BIBI Score **1.67 Very Poor**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Arthropoda / Insecta									
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	25	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	23	Filterer	cn	4.4
	Diptera	Chironomidae	Conchapelopia	Conchapelopia	L	5	Predator	sp	6.1
	Diptera	Chironomidae	Diamesa	Diamesa	P	1	Collector	sp	8.5
	Diptera	Chironomidae	Diamesa	Diamesa	L	2	Collector	sp	8.5
	Diptera	Empididae	Hemerodromia	Hemerodromia	L	2	Predator	sp, bu	7.9
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	6	Filterer	cn	7.5
	Megaloptera	Corydalidae	Nigronia	Nigronia	L	1	Predator	cn, cb	1.4
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	25	Collector	sp, bu	9.2
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	10	Collector	sp	4.6
	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	6	Filterer	cn	7.2
	Coleoptera	Elmidae	Stenelmis	Stenelmis	L	7	Scraper	cn	7.1
Arthropoda / Malacostraca									
	Amphipoda	Crangonyctidae	Crangonyx	Crangonyx		8	Collector	sp	6.7
Mollusca / Bivalvia									
	Veneroida	Corbiculidae	Corbicula	Corbicula		1	Filterer	bu	6

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **10PT-401-R-2015A** Region **Piedmont** Sample Date **3/24/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	24	3	# Scrapers	5		% Tanytarsini	0.0	
Total Abundance	123		% Ephemeroptera	4.9		% Scrapers	4.1	
# Ephemeroptera	5	5	% Climbers	1.6		% Swimmers	2.4	
# Ephemeroptera, Trichoptera, Plecoptera	12	5	% Chironomidae	6.5	5	% Diptera	10.6	
			% Clingers	39.0	3	% Intolerant - Urban	24.6	3

BIBI Score **4.00 Good**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Annelida / Oligochaeta									
	Haplotaxida	Enchytraeidae		Enchytraeidae	L	1	Collector	bu	9.1
	Haplotaxida	Naididae		Naididae	L	1	Collector	bu	8.5
Arthropoda / Insecta									
	Diptera	Tipulidae	Antocha	Antocha	L	3	Collector	cn	8
	Trichoptera	Hydropsychidae	Ceratopsyche	Ceratopsyche	L	66	Collector		
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	17	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	3	Filterer	cn	4.4
	Diptera	Chironomidae	Chironomus	Chironomus	L	1	Collector	bu	4.6
	Ephemeroptera	Heptageniidae	Epeorus	Epeorus	L	1	Scraper	cn	1.7
	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	2	Collector	cn, sw	2.3
	Diptera	Chironomidae	Eukiefferiella	Eukiefferiella	L	1	Collector	sp	6.1
	Ephemeroptera	Ephemerellidae	Eurylophella	Eurylophella	L	1	Scraper	cn, sp	4.5
	Coleoptera	Dryopidae	Helichus	Helichus	A	1	Scraper	cn	6.4
	Ephemeroptera	Heptageniidae		Heptageniidae	L	1	Scraper	cn	2.6
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	7	Filterer	cn	7.5
	Trichoptera	Lepidostomatidae	Lepidostoma	Lepidostoma	L	2	Shredder	cb, sp, cn	0
	Ephemeroptera	Leptophlebiidae		Leptophlebiidae	L	1	Collector	sw, cn	1.7
	Coleoptera	Elmidae	Macronychus	Macronychus	L	1	Scraper	cn	6.8
	Diptera	Chironomidae	Microtendipes	Microtendipes	L	2	Filterer	cn	4.9
	Trichoptera	Polycentropodidae	Neureclipsis	Neureclipsis	L	2	Filterer	cn	0.2
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	3	Collector	sp, bu	9.2
	Diptera	Chironomidae	Parakiefferiella	Parakiefferiella	L	1	Collector	sp	2.1
	Trichoptera	Polycentropodidae	Polycentropus	Polycentropus	L	3	Filterer	cn	1.1
	Diptera	Simuliidae	Prosimulium	Prosimulium	L	1	Filterer	cn	2.4
	Diptera	Tipulidae	Tipula	Tipula	L	1	Shredder	bu	6.7

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **10PT-404-R-2015B** Region **Piedmont** Sample Date **3/25/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	33	5	# Scrapers	2		% Tanytarsini	0.0	
Total Abundance	127		% Ephemeroptera	5.5		% Scrapers	3.9	
# Ephemeroptera	4	5	% Climbers	3.1		% Swimmers	3.1	
# Ephemeroptera, Trichoptera, Plecoptera	16	5	% Chironomidae	20.5	5	% Diptera	29.1	
			% Clingers	48.0	3	% Intolerant - Urban	20.0	3

BIBI Score **4.33 Good**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Arthropoda / Insecta									
	Diptera	Tipulidae	Antocha	Antocha	L	1	Collector	cn	8
	Ephemeroptera	Baetidae	Baetis	Baetis	L	1	Collector	sw, cb, cn	3.9
	Odonata	Aeshnidae	Boyeria	Boyeria	L	1	Predator	cb, sp	6.3
	Trichoptera	Hydropsychidae	Ceratopsyche	Ceratopsyche	L	37	Collector		
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	17	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	8	Filterer	cn	4.4
	Diptera	Empididae	Clinocera	Clinocera	L	9	Predator	cn	7.4
	Diptera	Chironomidae	Conchapelopia	Conchapelopia	L	2	Predator	sp	6.1
	Diptera	Chironomidae	Diamesa	Diamesa	P	1	Collector	sp	8.5
	Diptera	Chironomidae	Diamesa	Diamesa	L	2	Collector	sp	8.5
	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	L	2	Filterer	cn	2.7
	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	2	Collector	cn, sw	2.3
	Ephemeroptera	Heptageniidae		Heptageniidae	L	1	Scraper	cn	2.6
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	5	Filterer	cn	7.5
	Ephemeroptera	Isonychiidae	Isonychia	Isonychia	L	1	Filterer	sw, cn	2.5
	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	2	Scraper	cn	3
	Trichoptera	Brachycentridae	Micrasema	Micrasema	L	1	Shredder	cn, sp	2.3
	Diptera	Chironomidae	Microtendipes	Microtendipes	L	1	Filterer	cn	4.9
	Trichoptera	Uenoidae	Neophylax	Neophylax	L	2	Scraper	cn	2.7
	Megaloptera	Corydalidae	Nigronia	Nigronia	L	1	Predator	cn, cb	1.4
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	4	Collector	sp, bu	9.2
	Diptera	Chironomidae	Parakiefferiella	Parakiefferiella	L	1	Collector	sp	2.1
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	5	Collector	sp	4.6
	Plecoptera	Perlidae		Perlidae	L	1	Predator	cn	2.2
	Trichoptera	Polycentropodidae	Polycentropus	Polycentropus	L	2	Filterer	cn	1.1
	Diptera	Chironomidae	Potthastia	Potthastia	L	1	Collector	sp	0
	Plecoptera	Nemouridae	Prostoia	Prostoia	L	2	Shredder	sp, cn	4.5
	Trichoptera	Limnephilidae	Pycnopsyche	Pycnopsyche	L	1	Shredder	sp, cb, cn	3.1
	Diptera	Simuliidae	Simulium	Simulium	L	1	Filterer	cn	5.7
	Diptera	Chironomidae	Sympotthastia	Sympotthastia	L	2	Collector	sp	8.2
	Diptera	Chironomidae	Synorthocladius	Synorthocladius	L	1	Collector		6.6
	Plecoptera	Taeniopterygidae		Taeniopterygidae	L	1	Shredder		3.1
	Diptera	Chironomidae	Tvetenia	Tvetenia	P	1	Collector	sp	5.1
	Diptera	Chironomidae	Tvetenia	Tvetenia	L	5	Collector	sp	5.1
Arthropoda / Malacostraca									
	Isopoda	Asellidae	Caecidotea	Caecidotea		1	Collector	sp	2.6
Mollusca / Bivalvia									
	Veneroida	Corbiculidae	Corbicula	Corbicula		1	Filterer	bu	6

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **10PT-107-R-2015C** Region **Piedmont** Sample Date **4/7/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	25	5	# Scrapers	4		% Tanytarsini	0.0	
Total Abundance	108		% Ephemeroptera	4.6		% Scrapers	22.2	
# Ephemeroptera	2	3	% Climbers	4.6		% Swimmers	4.6	
# Ephemeroptera, Trichoptera, Plecoptera	10	3	% Chironomidae	0.0	5	% Diptera	5.6	
			% Clingers	75.9	5	% Intolerant - Urban	25.9	3

BIBI Score **4.00 Good**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Arthropoda / Insecta									
	Plecoptera	Nemouridae	Amphinemura	Amphinemura	L	2	Shredder	sp, cn	3
	Coleoptera	Ptilodactylidae	Anchytarsus	Anchytarsus	L	16	Shredder	cn	3.1
	Diptera	Tipulidae	Antocha	Antocha	L	2	Collector	cn	8
	Odonata	Aeshnidae	Boyeria	Boyeria	L	1	Predator	cb, sp	6.3
	Ephemeroptera	Baetidae	Centroptilum	Centroptilum	L	1	Collector	sw, cn	2.3
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	7	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	13	Filterer	cn	4.4
	Odonata	Cordulegastridae	Cordulegaster	Cordulegaster	L	1	Predator	bu	2.4
	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	L	1	Filterer	cn	2.7
	Coleoptera	Elmidae	Dubiraphia	Dubiraphia	A	1	Scraper	cn, cb	5.7
	Coleoptera	Elmidae	Dubiraphia	Dubiraphia	L	1	Scraper	cn, cb	5.7
	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	4	Collector	cn, sw	2.3
	Coleoptera	Hydrophilidae	Hydrobius	Hydrobius	L	1	Collector	cb, cn, sp	4.1
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	6	Filterer	cn	7.5
	Trichoptera	Uenoidae	Neophylax	Neophylax	L	14	Scraper	cn	2.7
	Coleoptera	Elmidae	Optioservus	Optioservus	L	3	Scraper	cn	5.4
	Plecoptera			Plecoptera	L	1			2.4
	Diptera	Simuliidae	Prosimulium	Prosimulium	L	1	Filterer	cn	2.4
	Trichoptera	Rhyacophilidae	Rhyacophila	Rhyacophila	L	1	Predator	cn	2.1
	Megaloptera	Sialidae	Sialis	Sialis	L	1	Predator	bu, cb, cn	1.9
	Diptera	Simuliidae	Simulium	Simulium	L	1	Filterer	cn	5.7
	Diptera	Simuliidae	Stegopterna	Stegopterna	L	1	Filterer	cn	2.4
	Coleoptera	Elmidae	Stenelmis	Stenelmis	L	4	Scraper	cn	7.1
	Coleoptera	Elmidae	Stenelmis	Stenelmis	A	1	Scraper	cn	7.1
	Diptera	Tipulidae	Tipula	Tipula	L	1	Shredder	bu	6.7
Arthropoda / Malacostraca									
	Amphipoda	Gammaridae	Gammarus	Gammarus		18	Shredder	sp	6.7
Mollusca / Bivalvia									
	Veneroida	Pisidiidae	Pisidium	Pisidium		4	Filterer	bu	5.7

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **10PT-110-R-2015D** Region **Piedmont** Sample Date **3/19/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	15	3	# Scrapers	2		% Tanytarsini	1.7	
Total Abundance	119		% Ephemeroptera	0.0		% Scrapers	5.0	
# Ephemeroptera	0	1	% Climbers	9.2		% Swimmers	0.0	
# Ephemeroptera, Trichoptera, Plecoptera	1	1	% Chironomidae	88.2	1	% Diptera	88.2	
			% Clingers	21.0	1	% Intolerant - Urban	4.2	1

BIBI Score **1.33** **Very Poor**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Annelida / Oligochaeta									
	Lumbricida	Lumbricidae		Lumbricidae		1	Collector		10
	Tubificida	Tubificidae		Tubificidae		1	Collector	cn	8.4
Arthropoda / Insecta									
	Diptera	Chironomidae	Ablabesmyia	Ablabesmyia	L	22	Predator	sp	8.1
	Odonata	Coenagrionidae	Argia	Argia	L	4	Predator	cn, cb, sp	9.3
	Odonata	Calopterygidae	Calopteryx	Calopteryx	L	1	Predator	cb	8.3
	Diptera	Chironomidae	Conchapelopia	Conchapelopia	L	4	Predator	sp	6.1
	Diptera	Chironomidae	Cricotopus	Cricotopus	L	10	Shredder	cn, bu	9.6
	Coleoptera	Elmidae	Dubiraphia	Dubiraphia	L	1	Scraper	cn, cb	5.7
	Odonata	Coenagrionidae	Enallagma	Enallagma	L	1	Predator	cb	9
	Diptera	Chironomidae	Hydrobaenus	Hydrobaenus	L	5	Scraper	sp	7.2
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	50	Collector	sp, bu	9.2
	Trichoptera	Polycentropodidae	Polycentropus	Polycentropus	L	5	Filterer	cn	1.1
	Diptera	Chironomidae	Polypedilum	Polypedilum	L	2	Shredder	cb, cn	6.3
	Diptera	Chironomidae	Rheocricotopus	Rheocricotopus	L	10	Collector	sp	6.2
	Diptera	Chironomidae	Tanytarsus	Tanytarsus	L	2	Filterer	cb, cn	4.9

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **10PT-114-R-2015E** Region **Piedmont** Sample Date **4/9/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	28	5	# Scrapers	4		% Tanytarsini	2.4	
Total Abundance	125		% Ephemeroptera	0.0		% Scrapers	5.6	
# Ephemeroptera	0	1	% Climbers	15.2		% Swimmers	0.0	
# Ephemeroptera, Trichoptera, Plecoptera	9	3	% Chironomidae	54.4	3	% Diptera	63.2	
			% Clingers	56.0	3	% Intolerant - Urban	9.1	1

BIBI Score **2.67 Poor**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Arthropoda / Insecta									
	Coleoptera	Ptilodactylidae	Anchytarsus	Anchytarsus	L	8	Shredder	cn	3.1
	Diptera	Tipulidae	Antocha	Antocha	L	5	Collector	cn	8
	Trichoptera	Hydropsychidae	Ceratopsyche	Ceratopsyche	L	1	Collector		
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	11	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	P	2	Filterer	cn	4.4
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	2	Filterer	cn	4.4
	Diptera	Empididae	Clinocera	Clinocera	L	3	Predator	cn	7.4
	Diptera	Chironomidae	Conchapelopia	Conchapelopia	P	1	Predator	sp	6.1
	Diptera	Chironomidae	Conchapelopia	Conchapelopia	L	13	Predator	sp	6.1
	Diptera	Chironomidae	Cricotopus	Cricotopus	L	5	Shredder	cn, bu	9.6
	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	L	3	Filterer	cn	2.7
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	5	Filterer	cn	7.5
	Trichoptera	Leptoceridae	Mystacides	Mystacides	L	1	Collector	sp, cb	4.1
	Trichoptera	Uenoidae	Neophylax	Neophylax	L	1	Scraper	cn	2.7
	Diptera	Empididae	Neoplasta	Neoplasta	L	3	Predator		
	Coleoptera	Elmidae	Optioservus	Optioservus	L	1	Scraper	cn	5.4
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	14	Collector	sp, bu	9.2
	Coleoptera	Elmidae	Oulimnius	Oulimnius	A	1	Scraper	cn	2.7
	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	2	Scraper	cn	2.7
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	5	Collector	sp	4.6
	Trichoptera	Polycentropodidae	Polycentropus	Polycentropus	L	2	Filterer	cn	1.1
	Diptera	Chironomidae	Polypedilum	Polypedilum	L	16	Shredder	cb, cn	6.3
	Diptera	Chironomidae	Potthastia	Potthastia	L	1	Collector	sp	0
	Diptera	Chironomidae	Rheocricotopus	Rheocricotopus	L	5	Collector	sp	6.2
	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	2	Filterer	cn	7.2
	Trichoptera	Rhyacophilidae	Rhyacophila	Rhyacophila	L	1	Predator	cn	2.1
	Diptera	Chironomidae		Tanytarsini	L	1	Collector		3.5
	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	4	Predator	sp	8.2
	Diptera	Chironomidae	Zavrelimyia	Zavrelimyia	P	1	Predator	sp	5.3
Arthropoda / Malacostraca									
	Amphipoda	Hyalellidae	Hyalella	Hyalella		1	Shredder	sp	4.2
Mollusca / Bivalvia									
	Veneroida	Pisidiidae	Pisidium	Pisidium		2	Filterer	bu	5.7
Mollusca / Gastropoda									
	Basommatophora	Physidae	Physa	Physa		2	Scraper	cb	7

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **10PT-216-R-2015F** Region **Piedmont** Sample Date **3/25/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	18	3	# Scrapers	1		% Tanytarsini	1.6	
Total Abundance	122		% Ephemeroptera	0.0		% Scrapers	0.8	
# Ephemeroptera	0	1	% Climbers	0.0		% Swimmers	0.0	
# Ephemeroptera, Trichoptera, Plecoptera	7	3	% Chironomidae	40.2	3	% Diptera	43.4	
			% Clingers	45.9	3	% Intolerant - Urban	7.1	1

BIBI Score **2.33 Poor**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Annelida / Oligochaeta									
	Lumbriculida	Lumbriculidae		Lumbriculidae		1	Collector	bu	6.6
Arthropoda / Insecta									
	Plecoptera	Perlidae	Acroneuria	Acroneuria	L	2	Predator	cn	2.5
	Diptera	Tipulidae	Antocha	Antocha	L	1	Collector	cn	8
	Trichoptera	Hydropsychidae	Ceratopsyche	Ceratopsyche	L	24	Collector		
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	27	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	9	Filterer	cn	4.4
	Diptera	Empididae	Clinocera	Clinocera	L	2	Predator	cn	7.4
	Diptera	Chironomidae	Diamesa	Diamesa	L	1	Collector	sp	8.5
	Diptera	Chironomidae	Dicrotendipes	Dicrotendipes	L	19	Collector	bu	9
	Diptera	Chironomidae	Eukiefferiella	Eukiefferiella	L	2	Collector	sp	6.1
	Trichoptera	Glossosomatidae	Glossosoma	Glossosoma	L	1	Scraper	cn	0
	Diptera	Empididae	Hemerodromia	Hemerodromia	L	1	Predator	sp, bu	7.9
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	1	Filterer	cn	7.5
	Diptera	Chironomidae	Microtendipes	Microtendipes	L	9	Filterer	cn	4.9
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	16	Collector	sp, bu	9.2
	Diptera	Chironomidae	Paratanytarsus	Paratanytarsus	L	1	Collector	sp	7.7
	Trichoptera	Polycentropodidae	Polycentropus	Polycentropus	L	4	Filterer	cn	1.1
	Diptera	Chironomidae		Tanytarsini	L	1	Collector		3.5

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **10PT-419-F-2015G** Region **Piedmont** Sample Date **3/24/2015**

BIBI Metrics and Scores

	Value	Score		Value	Score		Value	Score
# Taxa	30	5	# Scrapers	4		% Tanytarsini	2.4	
Total Abundance	126		% Ephemeroptera	0.8		% Scrapers	3.2	
# Ephemeroptera	1	1	% Climbers	4.8		% Swimmers	0.8	
# Ephemeroptera, Trichoptera, Plecoptera	10	3	% Chironomidae	19.0	5	% Diptera	33.3	
			% Clingers	49.2	3	% Intolerant - Urban	15.3	3

BIBI Score **3.33 Fair**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Arthropoda / Insecta									
	Plecoptera	Perlidae	Acroneuria	Acroneuria	L	1	Predator	cn	2.5
	Diptera	Tipulidae	Antocha	Antocha	L	1	Collector	cn	8
	Odonata	Aeshnidae	Boyeria	Boyeria	L	1	Predator	cb, sp	6.3
	Diptera	Chironomidae	Brillia	Brillia	L	1	Shredder	bu, sp	7.4
	Trichoptera	Hydropsychidae	Ceratopsyche	Ceratopsyche	L	41	Collector		
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	17	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	6	Filterer	cn	4.4
	Diptera	Empididae	Clinocera	Clinocera	L	8	Predator	cn	7.4
	Diptera	Chironomidae	Diamesa	Diamesa	P	1	Collector	sp	8.5
	Diptera	Chironomidae	Diamesa	Diamesa	L	3	Collector	sp	8.5
	Diptera	Chironomidae	Eukiefferiella	Eukiefferiella	L	1	Collector	sp	6.1
	Diptera	Empididae	Hemerodromia	Hemerodromia	L	1	Predator	sp, bu	7.9
	Diptera	Chironomidae	Heterotrissocladius	Heterotrissocladius	L	1	Collector	sp, bu	2
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	9	Filterer	cn	7.5
	Trichoptera	Lepidostomatidae	Lepidostoma	Lepidostoma	L	1	Shredder	cb, sp, cn	0
	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	1	Scraper	cn	3
	Diptera	Chironomidae	Microtendipes	Microtendipes	L	2	Filterer	cn	4.9
	Coleoptera	Elmidae	Optioservus	Optioservus	L	1	Scraper	cn	5.4
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	7	Collector	sp, bu	9.2
	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	1	Scraper	cn	2.7
	Trichoptera	Polycentropodidae	Polycentropus	Polycentropus	L	1	Filterer	cn	1.1
	Diptera	Chironomidae	Polypedilum	Polypedilum	L	2	Shredder	cb, cn	6.3
	Diptera	Simuliidae	Prosimulium	Prosimulium	L	7	Filterer	cn	2.4
	Diptera	Chironomidae	Rheotanytarsus	Rheotanytarsus	L	3	Filterer	cn	7.2
	Diptera	Chironomidae	Stilocladius	Stilocladius	L	1	Collector	sp	6.6
	Plecoptera	Taeniopterygidae	Strophopteryx	Strophopteryx	L	1	Shredder	sp, cn	3.3
	Diptera	Tipulidae	Tipula	Tipula	L	1	Shredder	bu	6.7
	Trichoptera	Leptoceridae	Triaenodes	Triaenodes	L	1	Shredder	sw, cb	5
	Diptera	Chironomidae	Tvetenia	Tvetenia	L	2	Collector	sp	5.1
Arthropoda / Malacostraca									
	Amphipoda	Crangonyctidae	Crangonyx	Crangonyx		1	Collector	sp	6.7
Mollusca / Gastropoda									
	Basommatophora	Lymnaeidae		Lymnaeidae		1	Scraper	cb	6.9

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **10PT-122-F-2015H** Region **Piedmont** Sample Date **3/19/2015**

BIBI Metrics and Scores

	Value	Score
# Taxa	29	5
Total Abundance	126	
# Ephemeroptera	3	3
# Ephemeroptera, Trichoptera, Plecoptera	13	5

	Value	Score
# Scrapers	6	
% Ephemeroptera	18.3	
% Climbers	0.8	
% Chironomidae	14.3	5
% Clingers	81.7	5

	Value	Score
% Tanytarsini	0.0	
% Scrapers	7.1	
% Swimmers	16.7	
% Diptera	23.0	
% Intolerant - Urban	39.0	3

BIBI Score **4.33 Good**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Annelida / Oligochaeta									
	Tubificida	Tubificidae		Tubificidae	L	1	Collector	cn	8.4
Arthropoda / Insecta									
	Plecoptera	Perlidae	Acroneuria	Acroneuria	L	4	Predator	cn	2.5
	Coleoptera	Ptilodactylidae	Anchytarsus	Anchytarsus	L	1	Shredder	cn	3.1
	Diptera	Tipulidae	Antocha	Antocha	L	2	Collector	cn	8
	Trichoptera	Hydropsychidae	Ceratopsyche	Ceratopsyche	L	2	Collector		
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	23	Filterer	cn	6.5
	Trichoptera	Philopotamidae	Chimarra	Chimarra	L	14	Filterer	cn	4.4
	Diptera	Empididae	Clinocera	Clinocera	L	1	Predator	cn	7.4
	Diptera	Chironomidae	Conchapelopia	Conchapelopia	L	1	Predator	sp	6.1
	Diptera	Chironomidae	Diamesa	Diamesa	L	1	Collector	sp	8.5
	Trichoptera	Philopotamidae	Dolophilodes	Dolophilodes	L	1	Filterer	cn	1.7
	Coleoptera	Psephenidae	Ectopria	Ectopria	L	1	Scraper	cn	2.2
	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	20	Collector	cn, sw	2.3
	Ephemeroptera	Ephemerellidae		Ephemerellidae	L	1		cn, sp, sw	2.6
	Diptera	Chironomidae	Eukiefferiella	Eukiefferiella	L	2	Collector	sp	6.1
	Ephemeroptera	Ephemerellidae	Eurylophella	Eurylophella	L	1	Scraper	cn, sp	4.5
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	4	Filterer	cn	7.5
	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	1	Scraper	cn	3
	Trichoptera	Uenoidae	Neophylax	Neophylax	L	4	Scraper	cn	2.7
	Diptera	Empididae	Neoplasta	Neoplasta	L	1	Predator		
	Megaloptera	Corydalidae	Nigronia	Nigronia	L	1	Predator	cn, cb	1.4
	Trichoptera	Polycentropodidae	Nyctiophylax	Nyctiophylax	L	1	Filterer	cn	0.2
	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	1	Scraper	cn	2.7
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	2	Collector	sp	4.6
	Plecoptera	Perlidae		Perlidae	L	5	Predator	cn	2.2
	Diptera	Simuliidae	Prosimulium	Prosimulium	L	5	Filterer	cn	2.4
	Plecoptera	Nemouridae	Prostoia	Prostoia	L	7	Shredder	sp, cn	4.5
	Trichoptera	Rhyacophilidae	Rhyacophila	Rhyacophila	L	3	Predator	cn	2.1
	Coleoptera	Elmidae	Stenelmis	Stenelmis	L	1	Scraper	cn	7.1
	Diptera	Chironomidae	Sympotthastia	Sympotthastia	L	12	Collector	sp	8.2
	Diptera	Tipulidae	Tipula	Tipula	L	2	Shredder	bu	6.7

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **10PT-124-F-2015I** Region **Piedmont** Sample Date **3/19/2015**

BIBI Metrics and Scores

	Value	Score
# Taxa	31	5
Total Abundance	126	
# Ephemeroptera	5	5
# Ephemeroptera, Trichoptera, Plecoptera	18	5
# Scrapers	7	
% Ephemeroptera	15.1	
% Climbers	1.6	
% Chironomidae	12.7	5
% Clingers	73.8	3
% Tanytarsini	3.2	
% Scrapers	19.8	
% Swimmers	11.1	
% Diptera	26.2	
% Intolerant - Urban	64.0	5

BIBI Score **4.67 Good**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Arthropoda / Insecta									
	Plecoptera	Capniidae	Allocapnia	Allocapnia	L	1	Shredder	cn	4.2
	Plecoptera	Nemouridae	Amphinemura	Amphinemura	L	1	Shredder	sp, cn	3
	Coleoptera	Ptilodactylidae	Anchytarsus	Anchytarsus	L	1	Shredder	cn	3.1
	Diptera	Tipulidae	Antocha	Antocha	L	2	Collector	cn	8
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	6	Filterer	cn	6.5
	Ephemeroptera	Baetidae	Diphetor	Diphetor	L	6	Collector	sw, cn	2.3
	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona	L	20	Filterer	cn	2.7
	Trichoptera	Philopotamidae	Dolophilodes	Dolophilodes	L	2	Filterer	cn	1.7
	Plecoptera	Perlidae	Eccoptura	Eccoptura	L	2	Predator	cn	0.6
	Coleoptera	Psephenidae	Ectopria	Ectopria	L	2	Scraper	cn	2.2
	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	5	Collector	cn, sw	2.3
	Ephemeroptera	Ephemerellidae	Eurylophella	Eurylophella	L	2	Scraper	cn, sp	4.5
	Trichoptera	Glossosomatidae	Glossosoma	Glossosoma	P	3	Scraper	cn	0
	Trichoptera	Glossosomatidae	Glossosoma	Glossosoma	L	2	Scraper	cn	0
	Ephemeroptera	Leptophlebiidae	Habrophlebiodes	Habrophlebiodes	L	3	Collector	sw	2
	Diptera	Tipulidae	Hexatoma	Hexatoma	L	6	Predator	bu, sp	1.5
	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche	L	2	Filterer	cn	7.5
	Plecoptera	Perlodidae	Isoperla	Isoperla	L	12	Predator	cn, sp	2.4
	Ephemeroptera	Heptageniidae	Maccaffertium	Maccaffertium	L	3	Scraper	cn	3
	Trichoptera	Uenoidae	Neophylax	Neophylax	L	8	Scraper	cn	2.7
	Diptera	Empididae	Neoplasta	Neoplasta	L	1	Predator		
	Coleoptera	Elmidae	Optioservus	Optioservus	L	3	Scraper	cn	5.4
	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus	L	6	Collector	sp	4.6
	Diptera	Simuliidae	Prosimulium	Prosimulium	P	1	Filterer	cn	2.4
	Diptera	Simuliidae	Prosimulium	Prosimulium	L	2	Filterer	cn	2.4
	Plecoptera	Nemouridae	Prostoia	Prostoia	L	5	Shredder	sp, cn	4.5
	Trichoptera	Odontoceridae	Psilotreta	Psilotreta	L	2	Scraper	sp	0.9
	Trichoptera	Limnephilidae	Pycnopsyche	Pycnopsyche	L	2	Shredder	sp, cb, cn	3.1
	Diptera	Chironomidae	Sublettea	Sublettea	L	1	Collector		10
	Diptera	Chironomidae		Tanytarsini	L	3	Collector		3.5
	Diptera	Chironomidae	Thienemannimyia group	Thienemannimyia group	L	1	Predator	sp	8.2
	Diptera	Tipulidae	Tipula	Tipula	L	5	Shredder	bu	6.7
	Diptera	Chironomidae	Trissopelopia	Trissopelopia	L	5	Predator	sp	4.1

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

VERSAR

Site ID **10PT-225-F-2015J** Region **Piedmont** Sample Date **4/7/2015**

BIBI Metrics and Scores

	Value	Score
# Taxa	28	5
Total Abundance	134	
# Ephemeroptera	4	5
# Ephemeroptera, Trichoptera, Plecoptera	11	5

	Value	Score
# Scrapers	6	
% Ephemeroptera	6.7	
% Climbers	3.7	
% Chironomidae	31.3	3
% Clingers	50.0	3

	Value	Score
% Tanytarsini	0.0	
% Scrapers	12.7	
% Swimmers	6.7	
% Diptera	44.8	
% Intolerant - Urban	19.4	3

BIBI Score **4.00 Good**

Benthic Data

Phylum / Class	Order	Family	Genus	Taxon	LifeStage	Count	Functional Feeding Group	Habit	Tolerance Value
Arthropoda / Insecta									
	Plecoptera	Perlidae	Acroneuria	Acroneuria	L	2	Predator	cn	2.5
	Plecoptera	Nemouridae	Amphinemura	Amphinemura	L	1	Shredder	sp, cn	3
	Diptera	Tipulidae	Antocha	Antocha	L	13	Collector	cn	8
	Ephemeroptera	Baetidae	Baetis	Baetis	L	2	Collector	sw, cb, cn	3.9
	Odonata	Calopterygidae	Calopteryx	Calopteryx	L	1	Predator	cb	8.3
	Trichoptera	Hydropsychidae	Ceratopsyche	Ceratopsyche	L	31	Collector		
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	L	17	Filterer	cn	6.5
	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	P	1	Filterer	cn	6.5
	Diptera	Empididae	Clinocera	Clinocera	L	1	Predator	cn	7.4
	Diptera	Chironomidae	Conchapelopia	Conchapelopia	L	6	Predator	sp	6.1
	Coleoptera	Gyrinidae	Dineutus	Dineutus	A	1	Predator	sw, dv	4
	Ephemeroptera	Baetidae	Diphetor	Diphetor	L	3	Collector	sw, cn	2.3
	Coleoptera	Elmidae	Dubiraphia	Dubiraphia	A	1	Scraper	cn, cb	5.7
	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	L	3	Collector	cn, sw	2.3
	Ephemeroptera	Ephemerellidae	Eurylophella	Eurylophella	L	1	Scraper	cn, sp	4.5
	Odonata	Gomphidae		Gomphidae	L	1	Predator	bu	2.2
	Diptera	Chironomidae	Hydrobaenus	Hydrobaenus	L	10	Scraper	sp	7.2
	Plecoptera	Perlodidae	Isoperla	Isoperla	L	1	Predator	cn, sp	2.4
	Diptera	Chironomidae	Microtendipes	Microtendipes	L	11	Filterer	cn	4.9
	Trichoptera	Uenoidae	Neophylax	Neophylax	L	3	Scraper	cn	2.7
	Megaloptera	Corydalidae	Nigronia	Nigronia	L	1	Predator	cn, cb	1.4
	Coleoptera	Elmidae	Optioservus	Optioservus	L	1	Scraper	cn	5.4
	Diptera	Chironomidae	Orthocladius	Orthocladius	L	10	Collector	sp, bu	9.2
	Coleoptera	Elmidae	Oulimnius	Oulimnius	L	1	Scraper	cn	2.7
	Plecoptera	Perlidae		Perlidae	L	1	Predator	cn	2.2
	Diptera	Simuliidae	Prosimulium	Prosimulium	L	1	Filterer	cn	2.4
	Diptera	Simuliidae	Prosimulium	Prosimulium	P	1	Filterer	cn	2.4
	Trichoptera	Rhyacophilidae	Rhyacophila	Rhyacophila	L	1	Predator	cn	2.1
	Diptera	Chironomidae	Sympotthastia	Sympotthastia	L	3	Collector	sp	8.2
	Diptera	Tipulidae	Tipula	Tipula	L	2	Shredder	bu	6.7
	Diptera	Chironomidae	Trissopelopia	Trissopelopia	L	2	Predator	sp	4.1

Life Stage, I - Immature, P- Pupa, A - Adult, U - Undetermined; Primary habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler, sw - swimmer; Tolerance Values, based on Hilsenhoff, modified for Maryland; na idicates information for the particular taxa was not available.

APPENDIX D

HABITAT ASSESSMENT DATA

South Branch Patapsco, Patapsco River Lower Branch A,
and Patapsco River Lower Branch B Watersheds
Biological Monitoring and Assessment
Summary RBP Habitat Assessment Data

Howard County
2015

Site ID	Sample Date	Total RBP Habitat Score	RBP Score	RBP Rating	Epifaunal Substrate / Cover	Embedded-ness	Velocity / Depth Regime	Sediment Deposition	Channel Flow Status	Channel Alteration	Frequency of Riffles	Bank Stability - Left	Bank Stability - Right	Vegetative Protection - Left	Vegetative Protection - Right	Riparian Vegetative Zone Width - Left	Riparian Vegetative Zone Width - Right
Patapsco River Lower Branch A																	
01PA-102-R-2015A	3/17/2015	133	73	Partially Supporting	13	13	10	10	15	20	15	4	5	7	5	7	9
01PA-104-R-2015B	3/12/2015	138	76	Supporting	14	13	10	15	11	20	17	5	4	6	5	10	8
01PA-107-R-2015C	3/17/2015	136	75	Partially Supporting	13	12	14	10	15	13	17	8	6	7	7	7	7
01PA-110-R-2015D	3/13/2015	105	58	Non-supporting	5	4	4	2	17	19	2	10	10	9	9	7	7
01PA-213-R-2015E	4/6/2015	143	79	Supporting	15	14	13	13	11	13	16	6	6	9	9	9	9
01PA-317-R-2015F	3/24/2015	108	60	Non-supporting	4	3	13	4	12	18	14	2	3	8	9	9	9
01PA-119-F-2015G	3/13/2015	128	71	Partially Supporting	11	11	8	12	9	19	16	6	5	7	6	9	9
01PA-121-F-2015H	3/13/2015	89	49	Non-supporting	5	7	6	4	8	18	13	2	2	3	3	9	9
01PA-123-F-2015I	3/12/2015	127	70	Partially Supporting	7	11	7	18	17	15	13	7	7	5	5	6	9
01PA-126-F-2015J	3/17/2015	127	70	Partially Supporting	12	13	8	12	14	20	17	6	5	5	5	5	5
Patapsco River Lower Branch B																	
04PB-103-R-2015A	3/26/2015	118	65	Partially Supporting	7	7	8	7	11	18	16	3	5	9	9	9	9
04PB-104-R-2015B	3/18/2015	126	70	Partially Supporting	13	11	10	10	13	19	17	7	4	8	3	9	2
04PB-208-R-2015C	3/26/2015	135	75	Partially Supporting	14	11	13	10	10	18	16	6	6	8	8	6	9
04PB-210-R-2015D	3/26/2015	125	69	Partially Supporting	12	12	10	12	13	14	17	8	5	7	4	7	4
04PB-214-R-2015E	4/7/2015	137	76	Supporting	16	14	13	10	15	18	16	7	2	8	4	9	5
04PB-318-R-2015F	4/6/2015	122	67	Partially Supporting	8	8	13	8	14	18	11	6	6	7	7	9	7
04PB-119-F-2015G	3/20/2015	112	62	Partially Supporting	11	12	11	8	10	18	13	3	2	4	4	8	8
04PB-122-F-2015H	4/6/2015	118	65	Partially Supporting	9	10	8	9	11	15	16	7	7	6	6	7	7
04PB-123-F-2015I	3/18/2015	100	55	Non-supporting	9	8	8	5	10	20	9	2	2	6	6	6	9
04PB-125-F-2015J	3/18/2015	113	62	Partially Supporting	9	11	12	10	11	16	15	4	2	3	6	7	7
South Branch Patapsco																	
10PT-401-R-2015A	3/24/2015	135	75	Partially Supporting	8	9	16	10	12	18	16	5	6	9	8	9	9
10PT-404-R-2015B	3/25/2015	145	80	Supporting	16	17	13	14	11	18	17	6	9	3	9	3	9
10PT-107-R-2015C	4/7/2015	115	64	Partially Supporting	9	9	8	9	15	18	13	4	4	5	5	8	8
10PT-110-R-2015D	3/19/2015	102	56	Non-supporting	9	12	8	11	14	18	14	5	7	1	1	1	1
10PT-114-R-2015E	4/9/2015	143	79	Supporting	16	13	13	10	16	15	16	6	5	7	9	8	9
10PT-216-R-2015F	3/25/2015	131	72	Partially Supporting	16	14	14	12	13	18	17	2	9	2	6	2	6
10PT-419-F-2015G	3/24/2015	127	70	Partially Supporting	13	15	13	9	10	10	16	9	8	2	9	4	9
10PT-122-F-2015H	3/19/2015	145	80	Supporting	15	13	13	10	15	18	16	4	5	9	9	9	9
10PT-124-F-2015I	3/19/2015	138	76	Supporting	12	13	10	12	15	18	18	6	4	6	6	9	9
10PT-225-F-2015J	4/7/2015	142	78	Supporting	14	13	13	14	15	18	16	6	7	3	7	7	9

South Branch Patapsco, Patapsco River Lower Branch A,
and Patapsco River Lower Branch B Watersheds
Biological Monitoring and Assessment
Summary RBP Habitat Assessment Data

Howard County
2015

SiteID	Drainage Area (acres)	Distance to Road	Remoteness Score	% Shading	Shading Score	EpiSub-strate Value	EpiSub-strate Score	Instream Habitat Value	Instream Habitat Score	# Pieces of Instream Woody Debris	Woody Debris Score
Patapsco River Lower Branch A											
01PA-102-R-2015A	868.0686829	70	42.1732375	55	57.61239	15	82.35294	15	84.27877861	9	75
01PA-104-R-2015B	320.6026394	325	86.4334089	70	62.56541	16	88.23529	12	69.47707416	9	75
01PA-107-R-2015C	33.36620481	750	100	65	44.84573	13	70.58824	12	79.13579155	2	16.666667
01PA-110-R-2015D	57.59048472	90	47.3053036	30	22.71527	3	11.76471	4	25.99606989	4	33.333333
01PA-213-R-2015E	1917.07	400	95.46875	60	66.08698	15	82.35294	16	87.2479484	4	33.333333
01PA-317-R-2015F	12123.86362	45	34.5757093	65	81.10954	5	23.52941	11	47.61865432	19	100
01PA-119-F-2015G	323.42732	225	72.5625	85	75.56886	13	70.58824	10	56.73718371	8	66.666667
01PA-121-F-2015H	288.9197799	800	100	70	61.92536	4	17.64706	6	31.81391609	2	16.666667
01PA-123-F-2015I	29.12309623	75	43.5185388	45	29.60126	5	23.52941	4	28.90661146	5	41.666667
01PA-126-F-2015J	195.9715944	0	3.84375	85	72.48707	13	70.58824	12	71.578291	11	91.666667
Patapsco River Lower Branch B											
04PB-103-R-2015A	184.6339336	100	49.65625	75	63.15968	7	35.29412	8	46.42779478	3	25
04PB-104-R-2015B	125.4420799	50	36.2380794	55	45.71332	14	76.47059	15	92.53635587	16	100
04PB-208-R-2015C	2223.01	450	100	50	59.83199	11	58.82353	13	67.56223223	10	83.333333
04PB-210-R-2015D	2065.4	70	42.1732375	75	78.01305	13	70.58824	16	86.92981608	0	0
04PB-214-R-2015E	1489.18	40	32.8181191	60	64.53335	15	82.35294	16	88.32611573	8	66.666667
04PB-318-R-2015F	5452.28	25	26.75	60	72.51645	9	47.05882	12	57.38121089	6	50
04PB-119-F-2015G	368.0826559	40	32.8181191	90	81.77003	13	70.58824	16	94.29242915	11	91.666667
04PB-122-F-2015H	105.2416654	75	43.5185388	75	59.70199	9	47.05882	11	67.88099268	5	41.666667
04PB-123-F-2015I	83.37618241	50	36.2380794	40	32.47022	6	29.41176	6	37.11905615	18	100
04PB-125-F-2015J	570.6665935	10	18.3309345	75	70.1009	11	58.82353	11	60.66448092	8	66.666667
South Branch Patapsco											
10PT-401-R-2015A	40550.44	600	100	55	81.25786	7	35.29412	15	67.86958434	3	25
10PT-404-R-2015B	36559.76	450	100	55	80.62061	16	88.23529	16	74.66304247	0	0
10PT-107-R-2015C	257.3769956	125	55.0636821	45	43.00483	7	35.29412	10	57.71230416	8	66.666667
10PT-110-R-2015D	240.6254236	300	83.1933276	15	18.56131	9	47.05882	6	32.5947023	0	0
10PT-114-R-2015E	657.2431074	10	18.3309345	75	70.96975	16	88.23529	14	79.11519327	2	16.666667
10PT-216-R-2015F	4562.72	300	83.1933276	65	75.09822	16	88.23529	17	89.89765144	3	25
10PT-419-F-2015G	36748.72	700	100	15	49.49342	11	58.82353	12	49.23614573	5	41.666667
10PT-122-F-2015H	427.5408236	500	100	65	60.53445	14	76.47059	16	93.65321742	3	25
10PT-124-F-2015I	127.5050356	700	100	70	56.8937	12	64.70588	14	86.11550266	2	16.666667
10PT-225-F-2015J	1936.55	50	36.2380794	30	44.33868	14	76.47059	14	74.5023459	0	0

South Branch Patapsco, Patapsco River Lower Branch A,
and Patapsco River Lower Branch B Watersheds
Biological Monitoring and Assessment
Summary RBP Habitat Assessment Data

Howard County
2015

SiteID	Left Bank Erosion Extent	Left Bank Erosion Severity	Right Bank Erosion Extent	Right Bank Erosion Severity	Bank Stability Score	Riffle Quality Value	Riffle Quality Score	Embedded-ness (%)	Embedded-ness Score	PHI Score	PHI Rating
Patapsco River Lower Branch A										63.21	
01PA-102-R-2015A	40	2	48	2	72.36016	15	93.34792	45	61.1111111	71.02957	Partially Degraded
01PA-104-R-2015B	55	2	23	2	76.86864	14	93.559017	40	66.6666667	77.35069	Partially Degraded
01PA-107-R-2015C	28	2	21	2	88.98772	15	100	45	61.1111111	70.16691	Partially Degraded
01PA-110-R-2015D	3	1	3	1	100	6	61.960868	90	11.1111111	39.27333	Severely Degraded
01PA-213-R-2015E	20	1	30	2	91.21536	13	78.94459	35	72.2222222	75.85902	Partially Degraded
01PA-317-R-2015F	70	2	75	2	41.48035	12	64.031849	85	16.6666667	54.71895	Degraded
01PA-119-F-2015G	45	2	25	2	80.34386	13	88.419884	35	72.2222222	72.88868	Partially Degraded
01PA-121-F-2015H	42	2	36	2	76.86864	11	78.835763	80	22.2222222	50.74745	Severely Degraded
01PA-123-F-2015I	21	1	13	1	99.01623	9	80.868504	40	66.6666667	51.72174	Degraded
01PA-126-F-2015J	50	2	36	2	73.27748	13	91.087463	35	72.2222222	68.3439	Partially Degraded
Patapsco River Lower Branch B										62.03	
04PB-103-R-2015A	60	2	70	2	50.7478	8	65.942634	65	38.8888889	46.88965	Severely Degraded
04PB-104-R-2015B	31	2	45	2	77.74787	12	88.370412	40	66.6666667	72.96791	Partially Degraded
04PB-208-R-2015C	55	2	40	2	69.08327	14	83.248656	50	55.5555556	72.17982	Partially Degraded
04PB-210-R-2015D	45	2	20	1	85.22551	12	73.455352	40	66.6666667	62.88148	Degraded
04PB-214-R-2015E	45	3	40	2	66.67523	13	80.289401	35	72.2222222	69.23551	Partially Degraded
04PB-318-R-2015F	65	2	60	2	53.61125	10	58.101992	60	44.4444444	51.21962	Degraded
04PB-119-F-2015G	55	2	50	2	64.2062	12	82.638828	35	72.2222222	73.77534	Partially Degraded
04PB-122-F-2015H	55	2	40	2	69.08327	12	89.305307	50	55.5555556	59.22139	Degraded
04PB-123-F-2015I	58	2	52	2	61.67129	7	65.083217	70	33.3333333	49.41587	Severely Degraded
04PB-125-F-2015J	50	2	35	2	73.73312	13	85.396493	40	66.6666667	62.54785	Degraded
South Branch Patapsco										65.39	
10PT-401-R-2015A	35	2	25	2	84.54078	16	77.972963	50	55.5555556	65.93636	Degraded
10PT-404-R-2015B	10	1	40	2	89.90996	17	83.616996	20	88.8888889	75.74185	Partially Degraded
10PT-107-R-2015C	60	2	35	2	69.08327	10	74.358881	50	55.5555556	57.09241	Degraded
10PT-110-R-2015D	20	1	65	2	76.7214	10	74.717219	45	61.1111111	49.24474	Severely Degraded
10PT-114-R-2015E	45	2	56	2	66.18645	12	79.551991	35	72.2222222	61.40981	Degraded
10PT-216-R-2015F	15	1	75	3	61.67129	16	89.604923	30	77.7777778	73.80981	Partially Degraded
10PT-419-F-2015G	40	1	0	0	97.54339	16	78.49712	25	83.3333333	69.8242	Partially Degraded
10PT-122-F-2015H	50	2	37	2	72.81984	14	92.026386	30	77.7777778	74.78528	Partially Degraded
10PT-124-F-2015I	40	2	55	2	69.08327	11	83.191134	35	72.2222222	68.6098	Partially Degraded
10PT-225-F-2015J	35	2	55	2	71.43462	13	78.890759	30	77.7777778	57.45661	Degraded

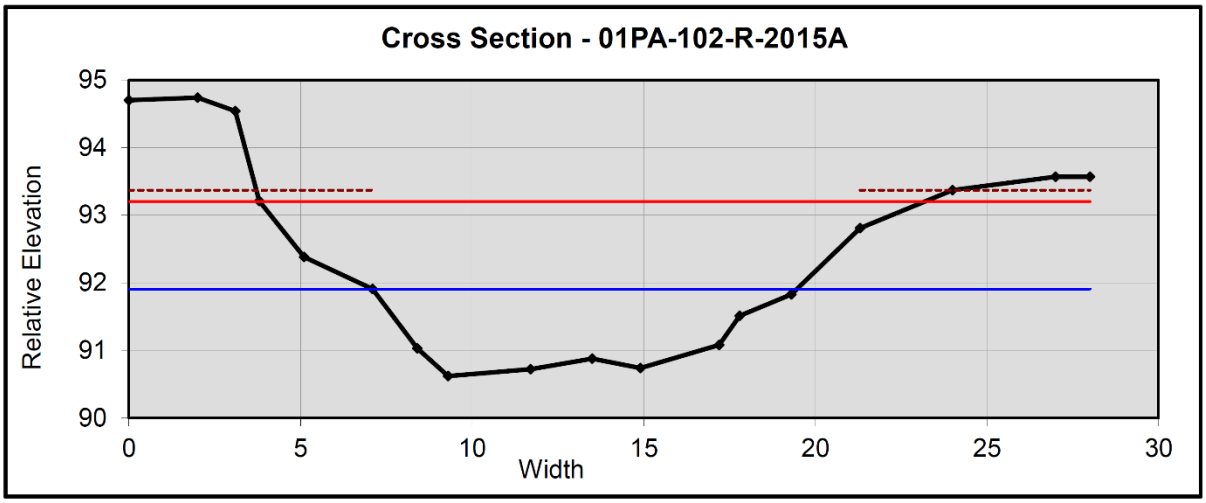
APPENDIX E

GEOMORPHOLOGIC DATA

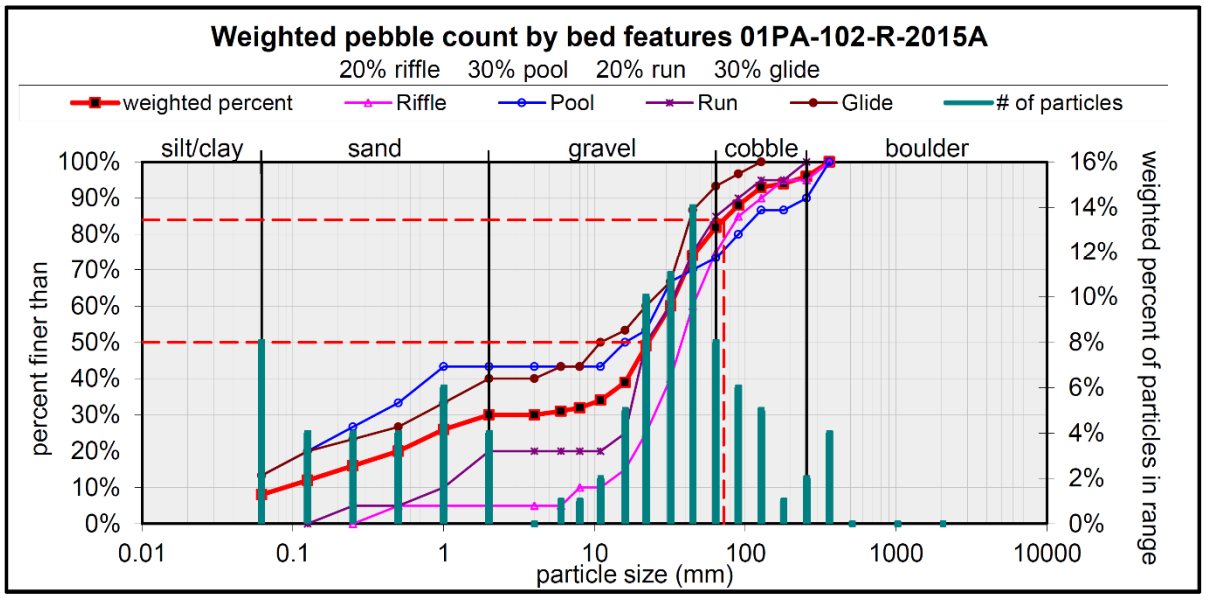
South Branch Patapsco, Patapsco River Lower Branch A,
and Patapsco River Lower Branch B Watersheds
Biological Monitoring and Assessment
Summary Geomorphological Data

Howard County
2015

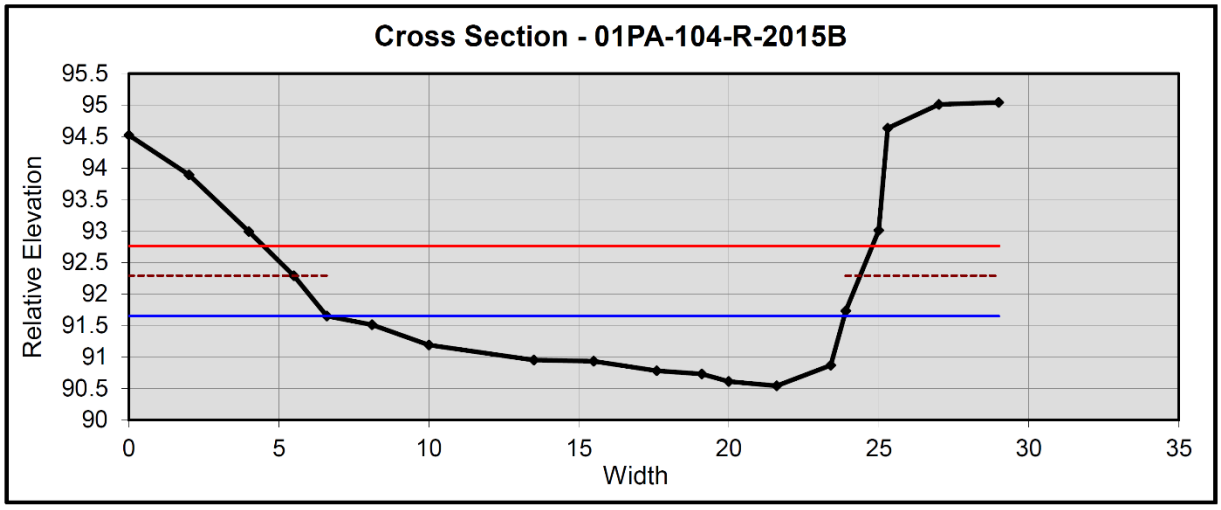
Site ID	Mean depth (dbkf) (ft)	Bankfull width (Wbkf) (ft)	Bankfull cross-sectional area (Abkf) (ft2)	Width/Depth ratio (Wbkf/dbkf)	Width of flood-prone area (Wfpa) (ft)	Entrenchment Ratio (Wfpa/ Wbkf)	Slope (water surface, percent)	Valley Length (feet)	Sinuosity (stream length/valley length)	Median particle size, reach (D50) (mm)	Dominant particle size class	Percent dominant particle size	Channel Type
01PA-102-R-2015A	0.9	12.4	11.1	13.8	19.4	1.6	0.756	670.64	1.34	23.00	gravel	52%	B4c
01PA-104-R-2015B	0.7	17.3	11.6	25.6	20.3	1.2	1.321	904.33	1.47	23.00	gravel	62%	F4
01PA-107-R-2015C	1.2	27.0	33.1	22.0	35.7	1.3	1.548	890.03	1.07	34.00	gravel	48%	F4
01PA-110-R-2015D	0.2	17.3	3.6	82.8	34.9	2.0	4.308	503.74	1.14	0.42	sand	58%	B5a
01PA-213-R-2015E	0.7	25.3	17.6	36.3	29.1	1.2	0.764	1380.61	1.07	34.00	gravel	47%	F4
01PA-317-R-2015F	1.6	39.0	63.4	24.0	43.8	1.1	0.252	1217.09	1.31	6.70	gravel	53%	F4
01PA-119-F-2015G	0.8	29.8	23.4	38.1	51.3	1.7	1.345	1020.41	1.30	16.00	gravel	37%	B4c
01PA-121-F-2015H	1.3	25.4	32.4	19.9	37.5	1.5	1.105	1100.79	1.20	0.50	sand	60%	B5c
01PA-123-F-2015I	0.6	4.0	2.4	6.9	6.1	1.5	3.796	437.57	1.45	16.00	gravel	57%	G4
01PA-126-F-2015J	0.7	17.5	11.7	26.0	23	1.3	1.528	864.76	1.31	30.00	gravel	44%	F4
04PB-103-R-2015A	1.0	11.9	12.4	11.4	16.6	1.4	0.752	377.95	1.15	16.00	gravel	58%	F4
04PB-104-R-2015B	0.6	5.6	3.4	9.4	8.8	1.6	1.536	659.88	1.38	17.00	gravel	95%	B4c
04PB-208-R-2015C	1.1	27.9	31.8	24.5	35.1	1.3	0.589	776.54	1.51	12.00	gravel	51%	F4
04PB-210-R-2015D	1.2	17.9	21.3	15.0	23.6	1.3	0.923	573.43	1.30	35.00	gravel	60%	F4
04PB-214-R-2015E	0.8	20.5	10.3	40.5	22.3	1.1	0.658	554.40	1.46	33.00	gravel	57%	F4
04PB-318-R-2015F	1.8	30.9	55.2	17.3	34.6	1.1	0.028	1504.46	1.07	12.00	gravel	48%	F4
04PB-119-F-2015G	0.9	11.7	10.8	12.7	15.8	1.3	2.190	631.89	1.07	23.00	gravel	51%	F4
04PB-122-F-2015H	0.6	9.4	5.5	16.1	12.5	1.3	1.179	464.30	1.13	19.00	gravel	67%	F4
04PB-123-F-2015I	0.6	4.5	2.9	7.0	6.2	1.4	1.528	384.35	1.13	0.40	sand	44%	G5c
04PB-125-F-2015J	0.9	15.1	12.9	17.6	28	1.9	1.069	581.59	1.06	9.40	gravel	47%	B4c
10PT-401-R-2015A	2.5	60.9	155.2	23.9	80.4	1.3	0.244	3800.82	1.79	32.00	gravel	34%	F4
10PT-404-R-2015B	1.6	70.7	113.2	44.1	143.7	2.0	0.780	2765.42	1.39	69.00	gravel	44%	B4c
10PT-107-R-2015C	0.8	7.1	5.5	9.1	13.2	1.9	0.821	549.05	1.37	0.45	sand	54%	B5c
10PT-110-R-2015D	0.6	6.3	3.9	10.1	12.8	2.0	0.792	664.50	1.42	23.00	gravel	59%	F4
10PT-114-R-2015E	1.2	15.8	19.6	12.7	20.4	1.3	0.829	706.04	1.21	33.00	gravel	49%	F4
10PT-216-R-2015F	1.4	14.7	20.4	10.6	59.3	4.0	0.695	1965.39	1.17	39.00	gravel	55%	C4
10PT-419-F-2015G	2.4	63.0	148.8	26.7	86.9	1.4	0.528	2654.00	1.47	44.00	gravel	59%	B4c
10PT-122-F-2015H	1.1	8.2	8.9	7.5	17.5	2.1	1.443	567.36	1.62	33.00	gravel	38%	E4
10PT-124-F-2015I	0.6	10.8	6.5	17.9	14	1.3	3.365	577.62	1.60	34.00	gravel	53%	F4b
10PT-225-F-2015J	1.2	18.8	23.5	15.0	41.6	2.2	0.662	1811.02	1.50	18.00	gravel	50%	C4



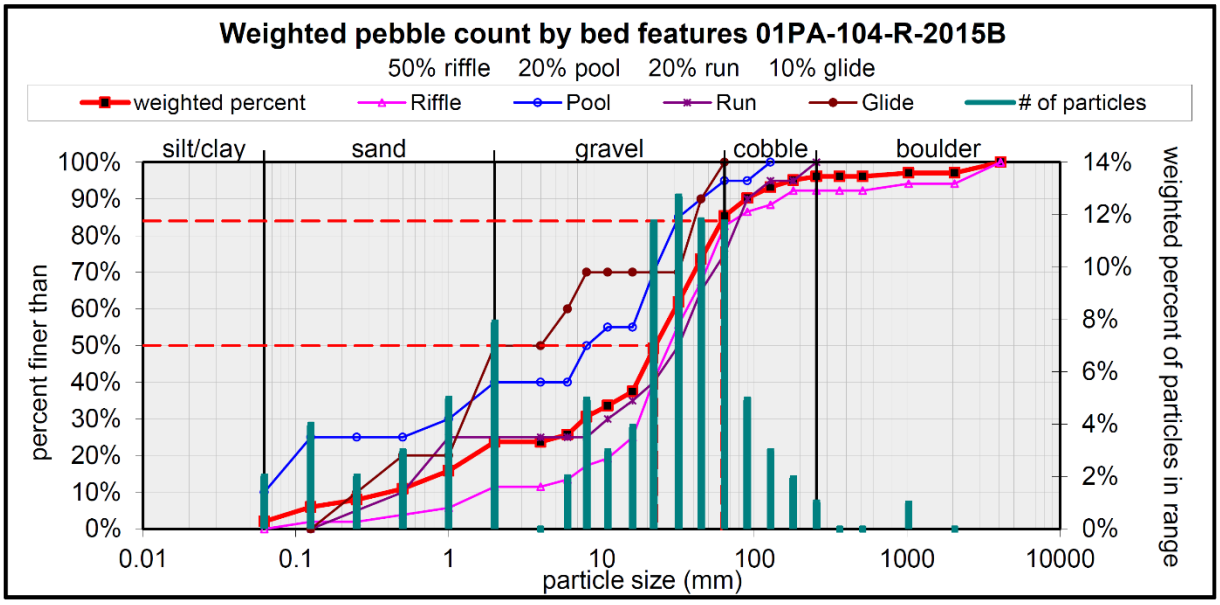
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
11.1	x-section area (ft.sq.)	19.4	W flood prone area (ft)	2.7	velocity (ft/s)
12.4	width (ft)	1.6	entrenchment ratio	30.2	discharge rate (cfs)
0.9	mean depth (ft)	2.8	low bank height (ft)	0.76	channel slope (%)
1.3	max depth (ft)	2.1	low bank height ratio		
13.0	wetted parimeter (ft)				
0.9	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
13.8	width-depth ratio	0.043	Manning's roughness	1.31	**F4**



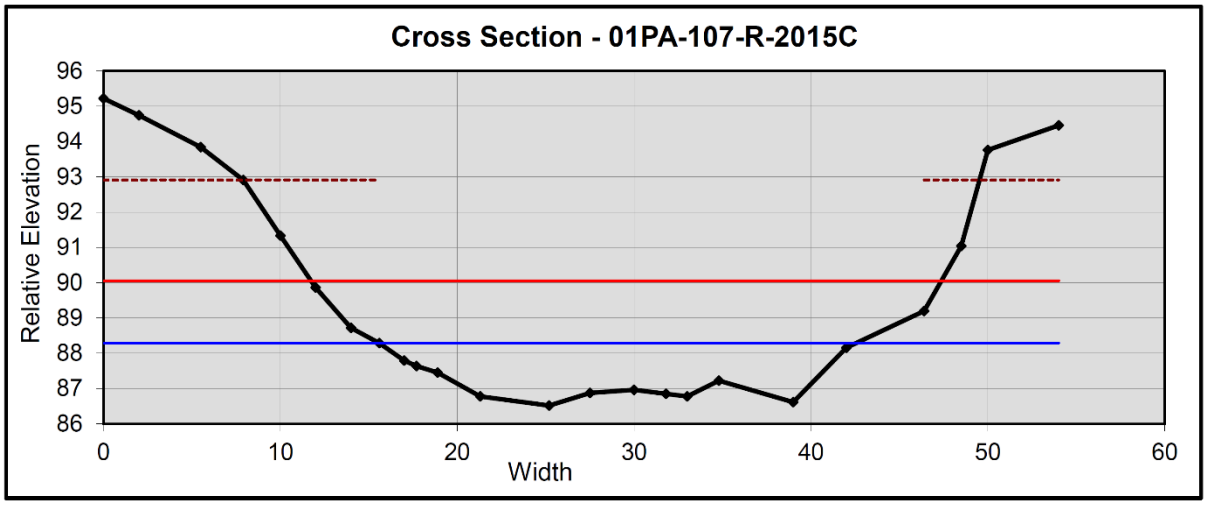
Size (mm)		Size Distribution		Type	
D16	0.25	mean	4.2	silt/clay	8%
D35	12	dispersion	47.6	sand	22%
D50	23	skewness	-0.47	gravel	52%
D65	36			cobble	14%
D84	72			boulder	4%
D95	210				



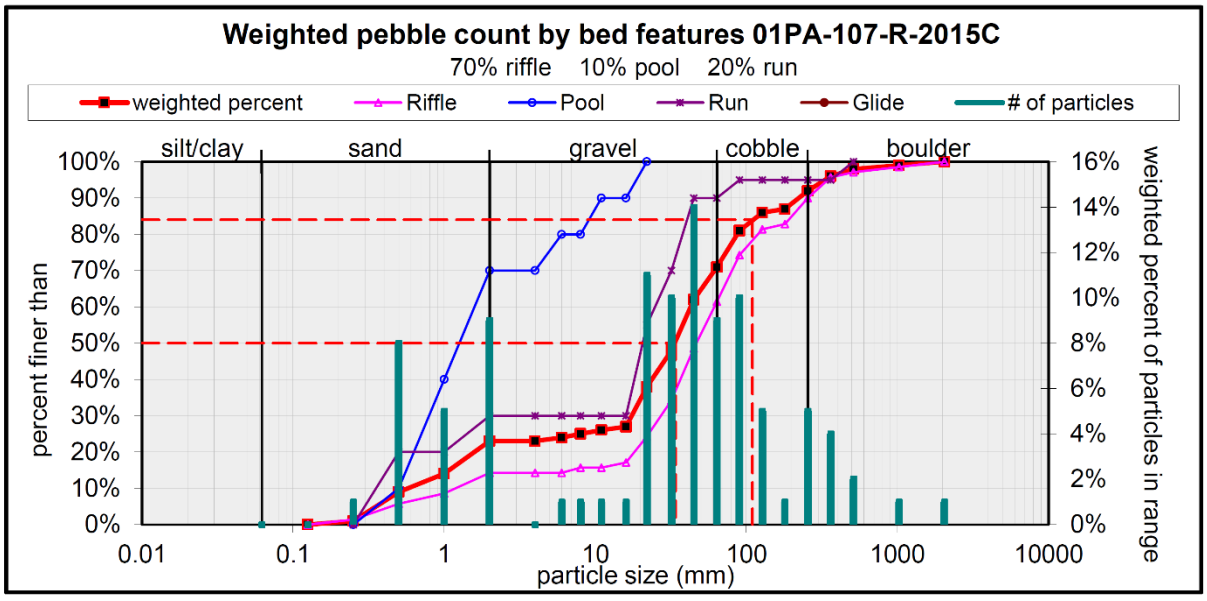
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
11.6	x-section area (ft.sq.)	20.3	W flood prone area (ft)	3.1	velocity (ft/s)
17.3	width (ft)	1.2	entrenchment ratio	35.8	discharge rate (cfs)
0.7	mean depth (ft)	1.8	low bank height (ft)	1.32	channel slope (%)
1.1	max depth (ft)	1.6	low bank height ratio		
17.8	wetted parimeter (ft)				
0.7	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
25.6	width-depth ratio	0.042	Manning's roughness	1.47	**F4**



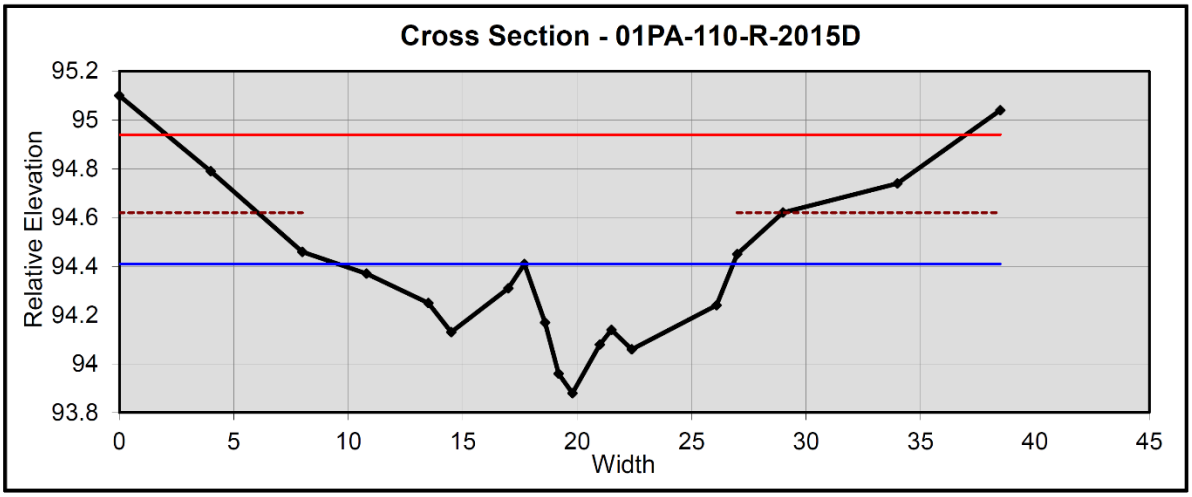
Size (mm)		Size Distribution		Type	
D16	1	mean	7.8	silt/clay	2%
D35	13	dispersion	12.8	sand	22%
D50	23	skewness	-0.35	gravel	62%
D65	35			cobble	11%
D84	61			boulder	4%
D95	180				



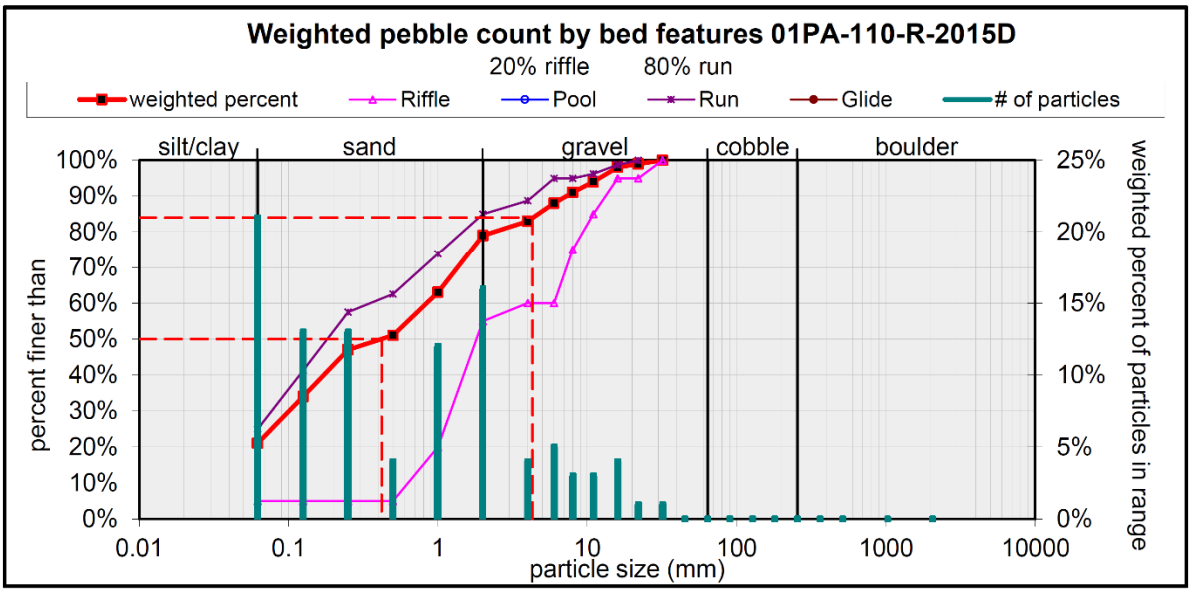
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
33.1	x-section area (ft.sq.)	35.7	W flood prone area (ft)	3.7	velocity (ft/s)
27.0	width (ft)	1.3	entrenchment ratio	122.9	discharge rate (cfs)
1.2	mean depth (ft)	6.4	low bank height (ft)	1.55	channel slope (%)
1.8	max depth (ft)	3.6	low bank height ratio		
27.7	wetted parimeter (ft)				
1.2	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
22.0	width-depth ratio	0.056	Manning's roughness	1.07	**F4**



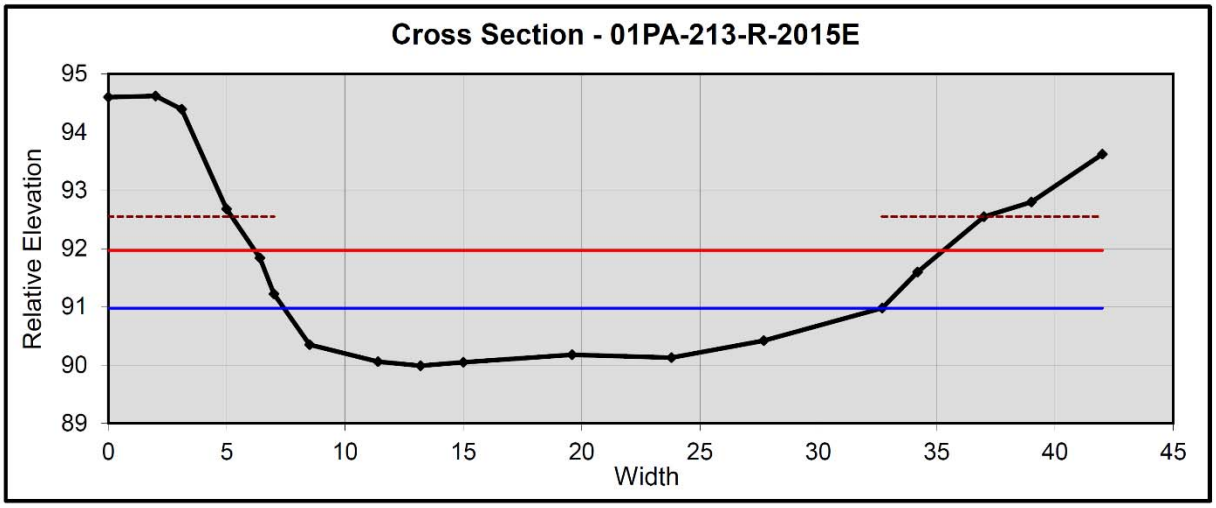
Size (mm)		Size Distribution		Type	
D16	1.2	mean	11.5	silt/clay	0%
D35	20	dispersion	15.8	sand	23%
D50	34	skewness	-0.34	gravel	48%
D65	51			cobble	21%
D84	110			boulder	8%
D95	330				



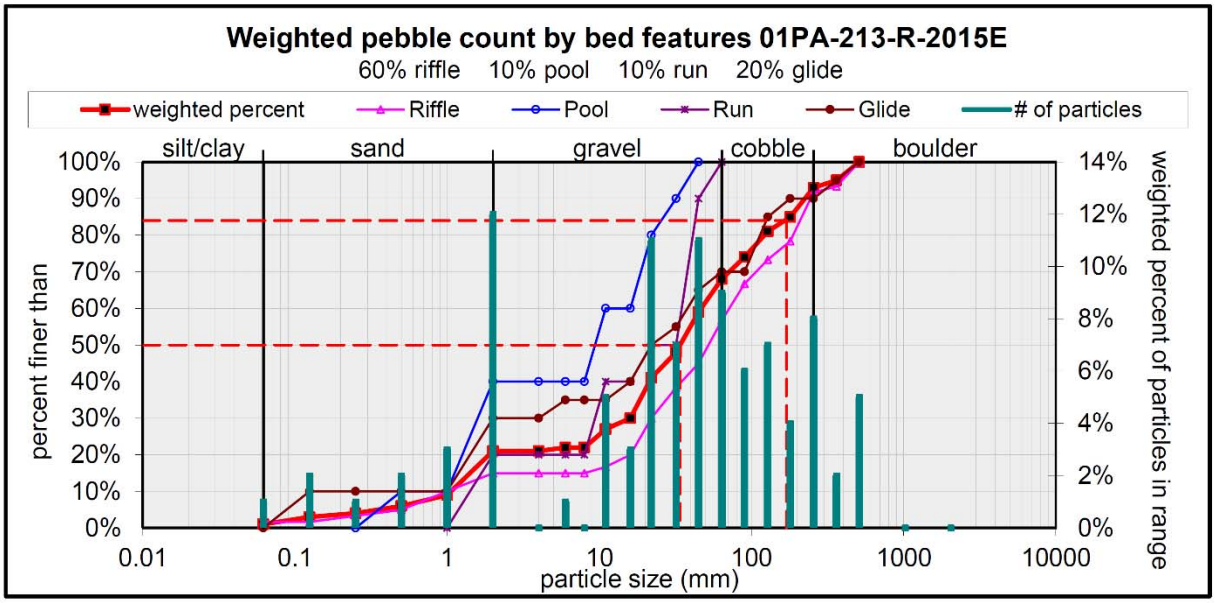
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
3.6	x-section area (ft.sq.)	34.9	W flood prone area (ft)	4.3	velocity (ft/s)
17.3	width (ft)	2.0	entrenchment ratio	15.4	discharge rate (cfs)
0.2	mean depth (ft)	0.7	low bank height (ft)	4.31	channel slope (%)
0.5	max depth (ft)	1.4	low bank height ratio		
17.4	wetted parimeter (ft)				
0.2	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
82.8	width-depth ratio	0.025	Manning's roughness	1.14	**B4a**



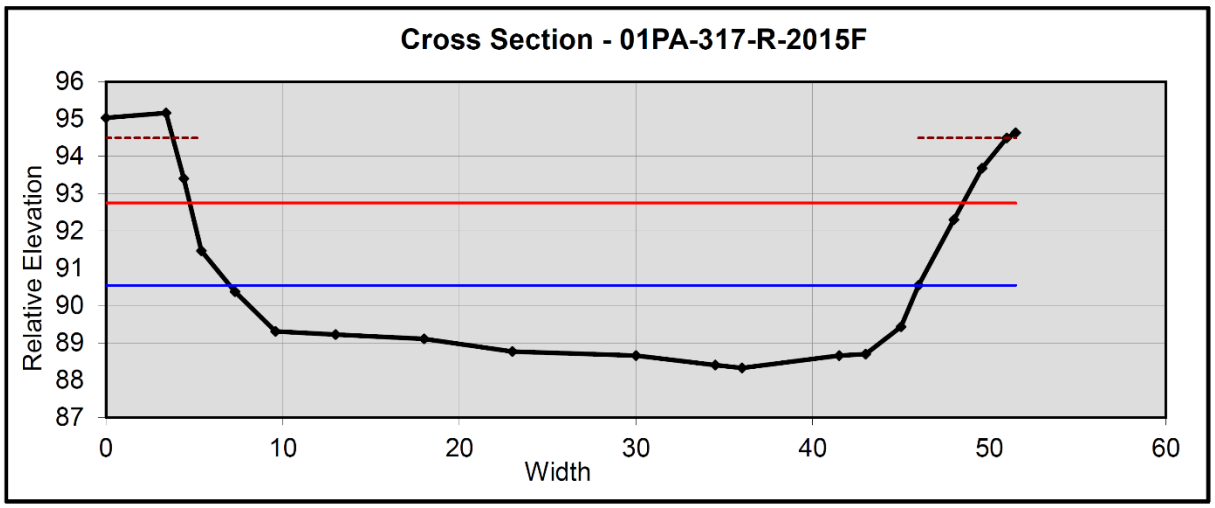
Size (mm)		Size Distribution		Type	
D16	0.062	mean	0.5	silt/clay	21%
D35	0.13	dispersion	8.5	sand	58%
D50	0.42	skewness	0.07	gravel	21%
D65	1.1			cobble	0%
D84	4.3			boulder	0%
D95	12				



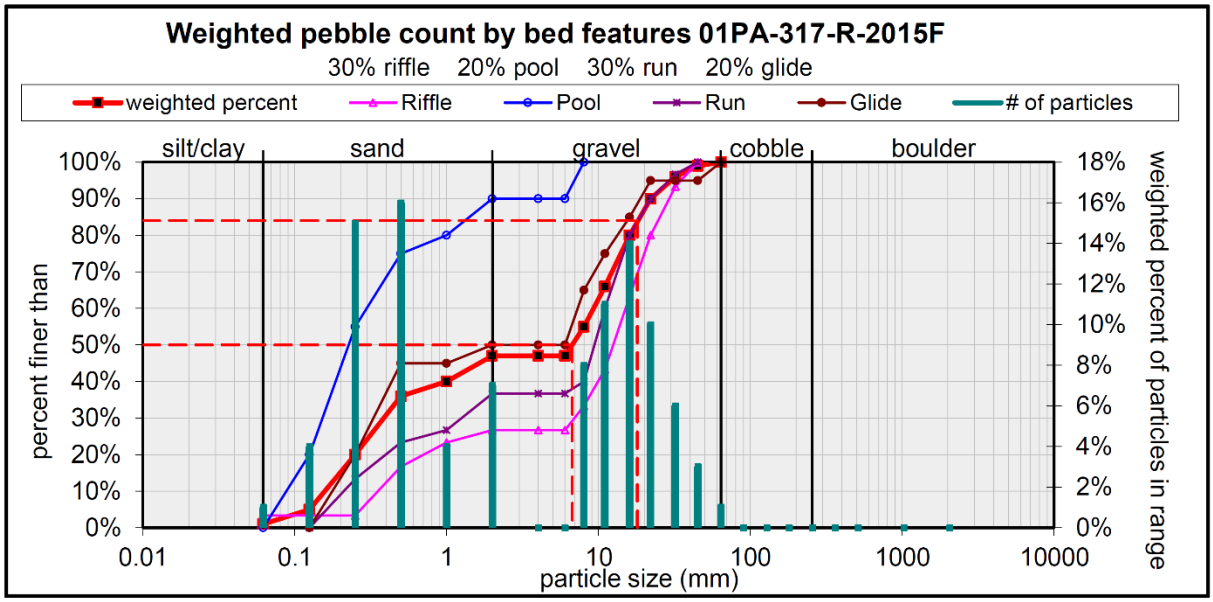
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
17.6	x-section area (ft.sq.)	29.1	W flood prone area (ft)	1.3	velocity (ft/s)
25.3	width (ft)	1.2	entrenchment ratio	23.1	discharge rate (cfs)
0.7	mean depth (ft)	2.6	low bank height (ft)	0.76	channel slope (%)
1.0	max depth (ft)	2.6	low bank height ratio		
25.5	wetted parimeter (ft)				
0.7	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
36.3	width-depth ratio	0.078	Manning's roughness	1.07	**F4**



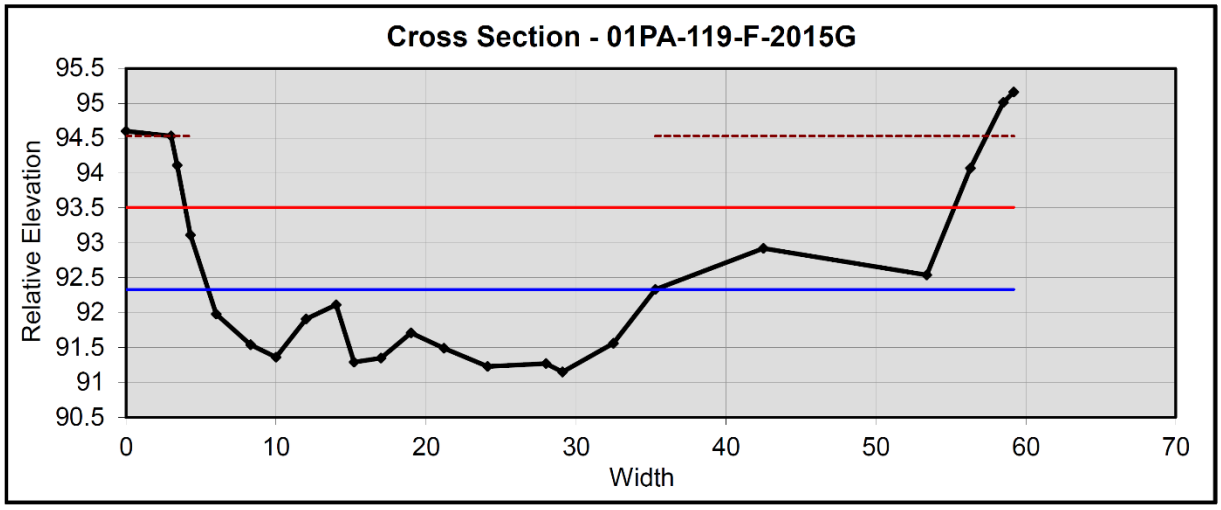
Size (mm)		Size Distribution		Type	
D16	1.5	mean	16.0	silt/clay	1%
D35	18	dispersion	13.8	sand	20%
D50	34	skewness	-0.23	gravel	47%
D65	57			cobble	25%
D84	170			boulder	7%
D95	360				



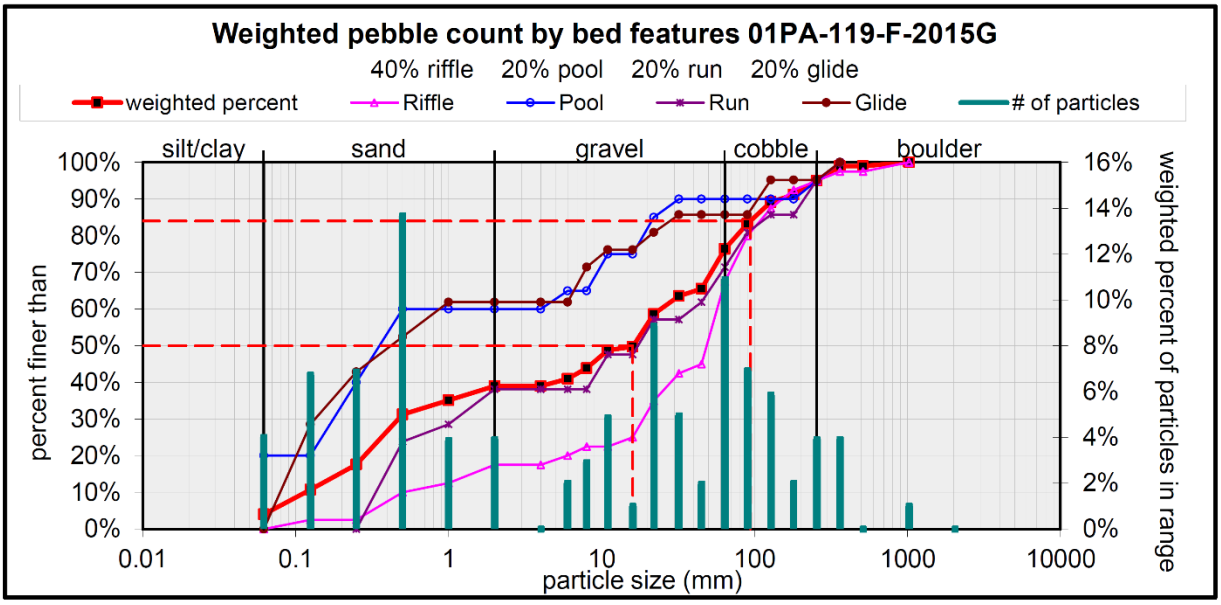
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
63.4	x-section area (ft.sq.)	43.8	W flood prone area (ft)	3.8	velocity (ft/s)
39.0	width (ft)	1.1	entrenchment ratio	240.1	discharge rate (cfs)
1.6	mean depth (ft)	6.2	low bank height (ft)	0.25	channel slope (%)
2.2	max depth (ft)	2.8	low bank height ratio		
39.9	wetted parimeter (ft)				
1.6	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
24.0	width-depth ratio	0.027	Manning's roughness	1.31	**F4**



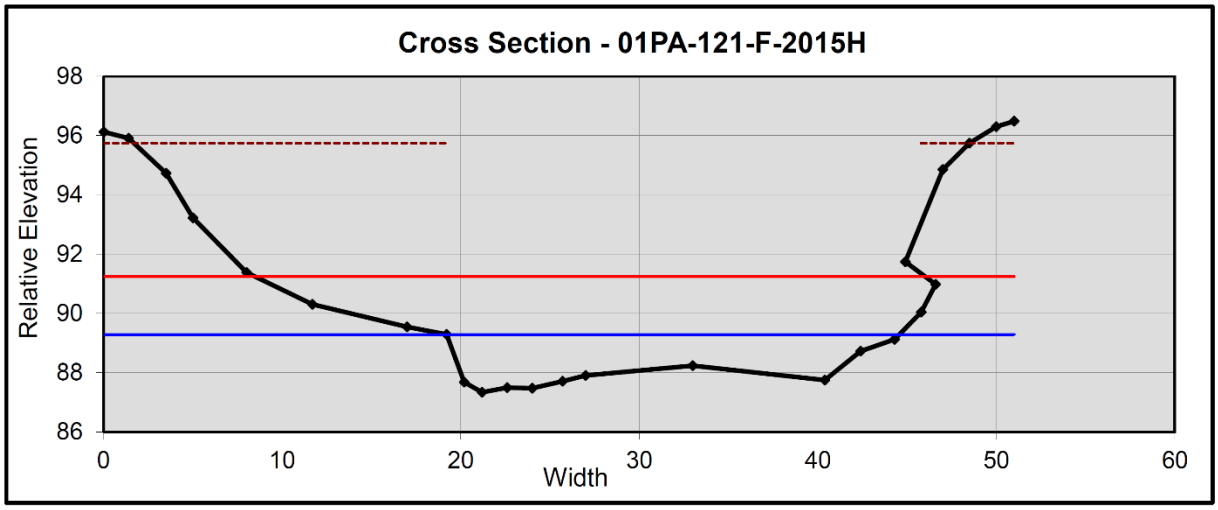
Size (mm)		Size Distribution		Type	
D16	0.21	mean	1.9	silt/clay	1%
D35	0.48	dispersion	17.3	sand	46%
D50	6.7	skewness	-0.39	gravel	53%
D65	11			cobble	0%
D84	18			boulder	0%
D95	30				



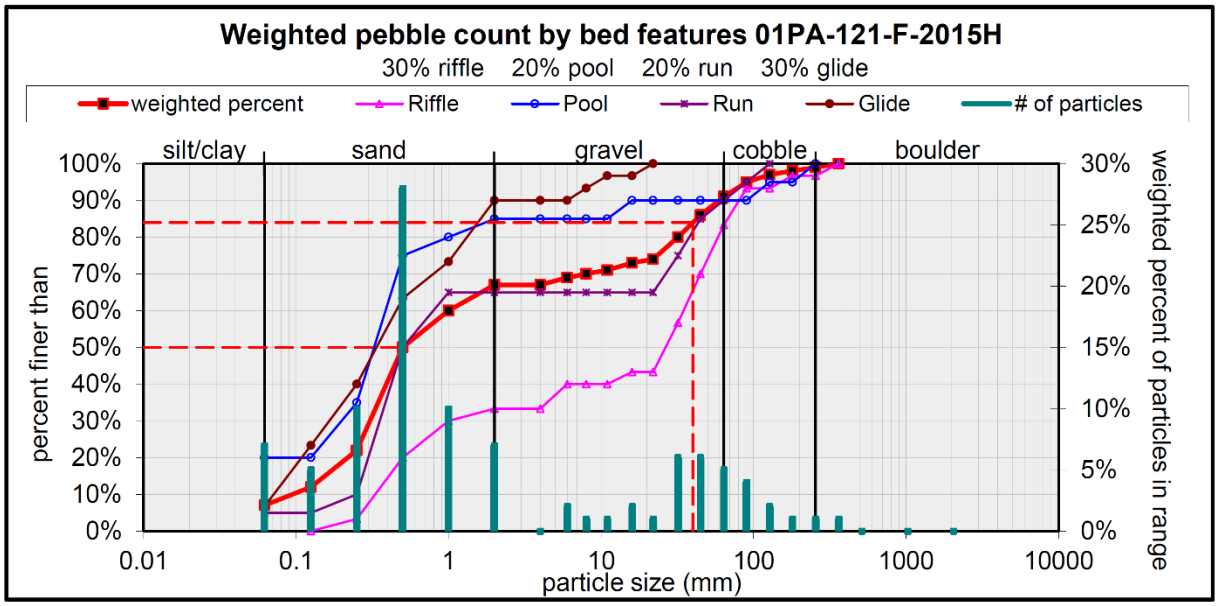
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
23.4	x-section area (ft.sq.)	51.3	W flood prone area (ft)	2.9	velocity (ft/s)
29.8	width (ft)	1.7	entrenchment ratio	68.6	discharge rate (cfs)
0.8	mean depth (ft)	3.4	low bank height (ft)	1.35	channel slope (%)
1.2	max depth (ft)	2.9	low bank height ratio		
30.5	wetted parimeter (ft)				
0.8	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
38.1	width-depth ratio	0.049	Manning's roughness	1.30	**B4c**



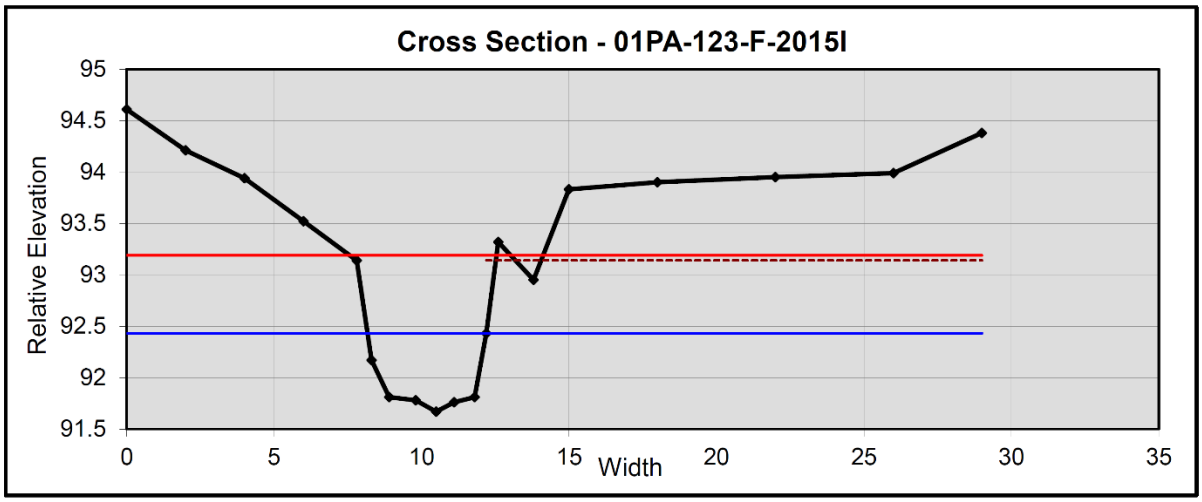
Size (mm)		Size Distribution		Type	
D16	0.21	mean	4.4	silt/clay	4%
D35	0.98	dispersion	41.0	sand	35%
D50	16	skewness	-0.34	gravel	37%
D65	41			cobble	19%
D84	94			boulder	5%
D95	250				



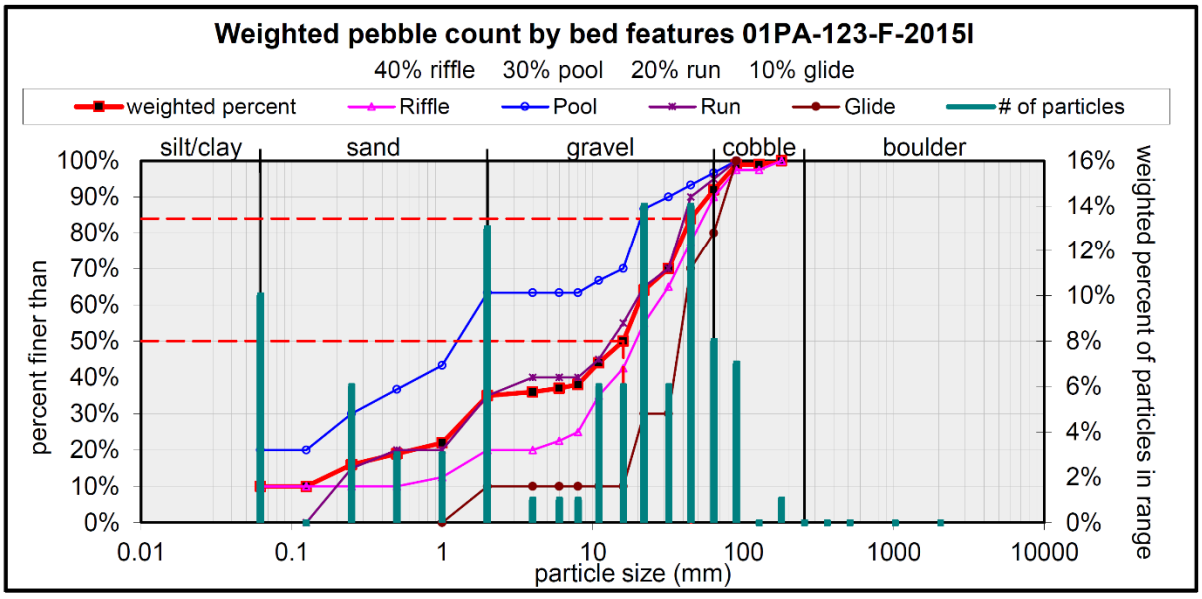
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
32.4	x-section area (ft.sq.)	37.5	W flood prone area (ft)	5.0	velocity (ft/s)
25.4	width (ft)	1.5	entrenchment ratio	161.4	discharge rate (cfs)
1.3	mean depth (ft)	8.4	low bank height (ft)	1.11	channel slope (%)
1.9	max depth (ft)	4.3	low bank height ratio		
26.7	wetted parimeter (ft)				
1.2	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
19.9	width-depth ratio	0.036	Manning's roughness	1.20	**B5c**



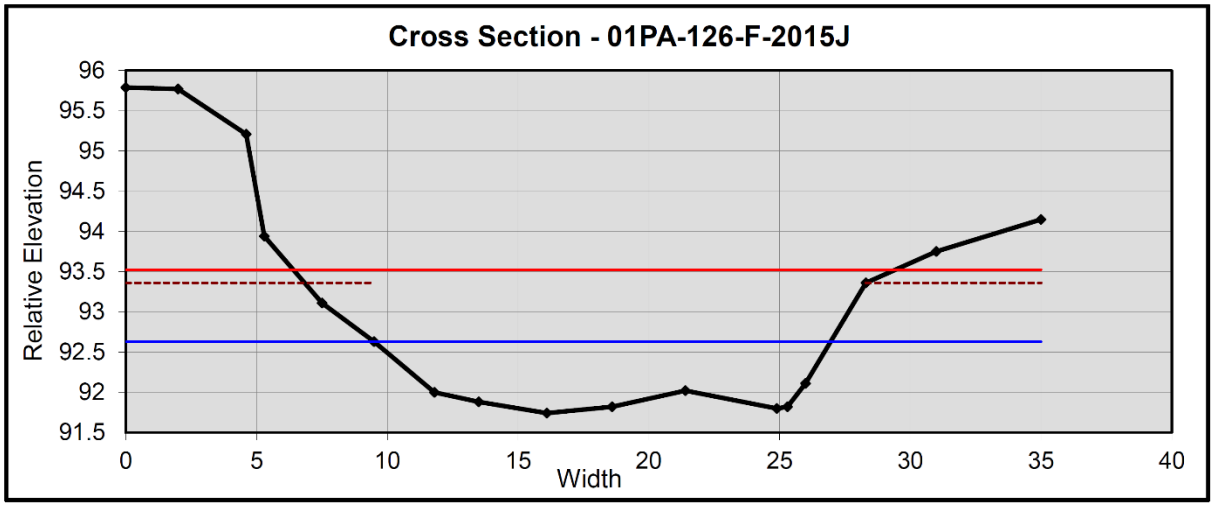
Size (mm)		Size Distribution		Type	
D16	0.16	mean	2.5	silt/clay	7%
D35	0.34	dispersion	41.6	sand	60%
D50	0.5	skewness	0.45	gravel	24%
D65	1.6			cobble	8%
D84	40			boulder	1%
D95	90				



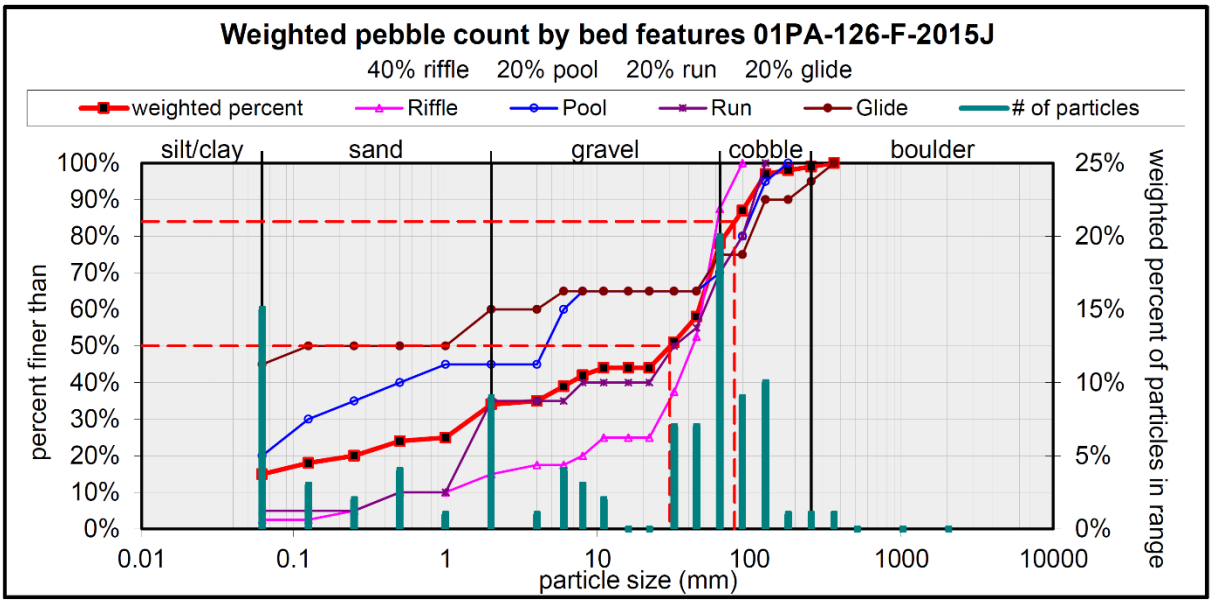
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
2.4	x-section area (ft.sq.)	6.1	W flood prone area (ft)	4.6	velocity (ft/s)
4.0	width (ft)	1.5	entrenchment ratio	10.8	discharge rate (cfs)
0.6	mean depth (ft)	1.5	low bank height (ft)	3.80	channel slope (%)
0.8	max depth (ft)	1.9	low bank height ratio		
4.6	wetted parimeter (ft)				
0.5	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
6.9	width-depth ratio	0.040	Manning's roughness	1.45	**G4**



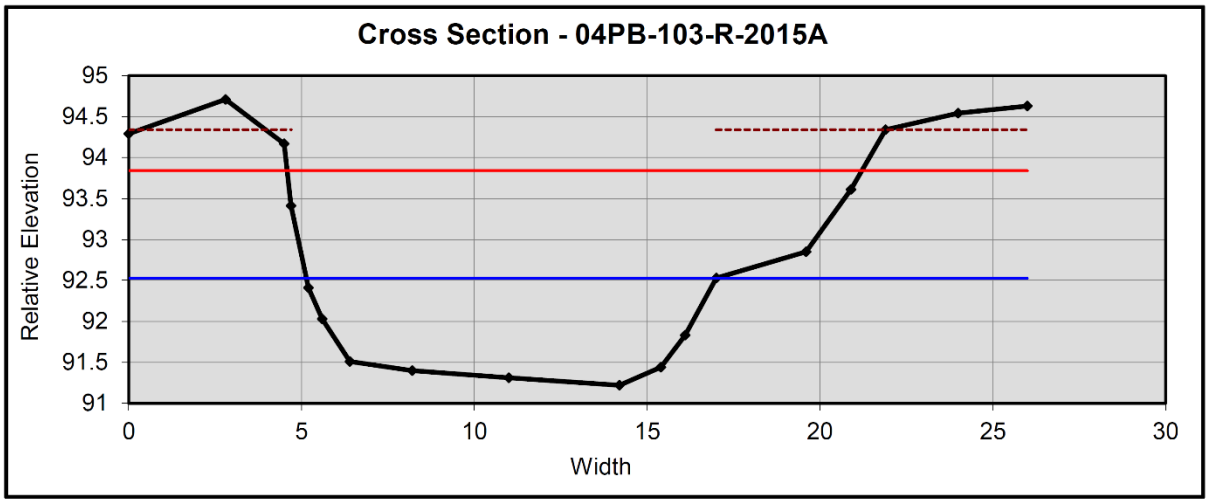
Size (mm)		Size Distribution		Type	
D16	0.25	mean	3.4	silt/clay	10%
D35	2	dispersion	33.4	sand	25%
D50	16	skewness	-0.45	gravel	57%
D65	23			cobble	8%
D84	45			boulder	0%
D95	74				



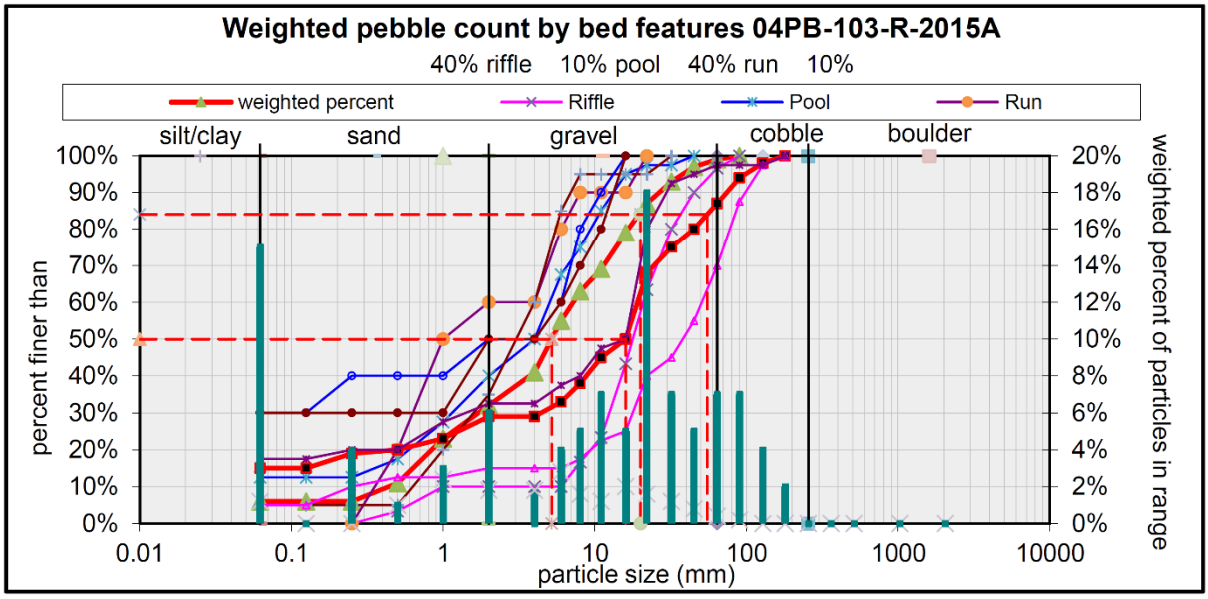
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
11.7	x-section area (ft.sq.)	23.0	W flood prone area (ft)	3.4	velocity (ft/s)
17.5	width (ft)	1.3	entrenchment ratio	40.4	discharge rate (cfs)
0.7	mean depth (ft)	1.6	low bank height (ft)	1.53	channel slope (%)
0.9	max depth (ft)	1.8	low bank height ratio		
17.8	wetted parimeter (ft)				
0.7	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
26.0	width-depth ratio	0.040	Manning's roughness	1.31	**F4**



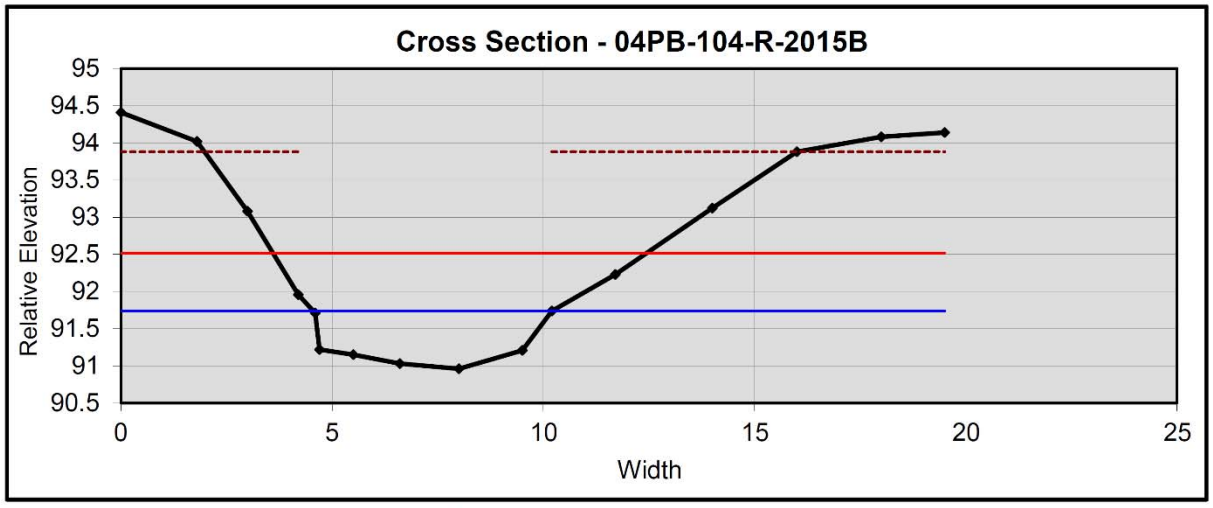
Size (mm)		Size Distribution		Type	
D16	0.078	mean	2.5	silt/clay	15%
D35	4	dispersion	193.6	sand	19%
D50	30	skewness	-0.62	gravel	44%
D65	51			cobble	21%
D84	80			boulder	1%
D95	120				



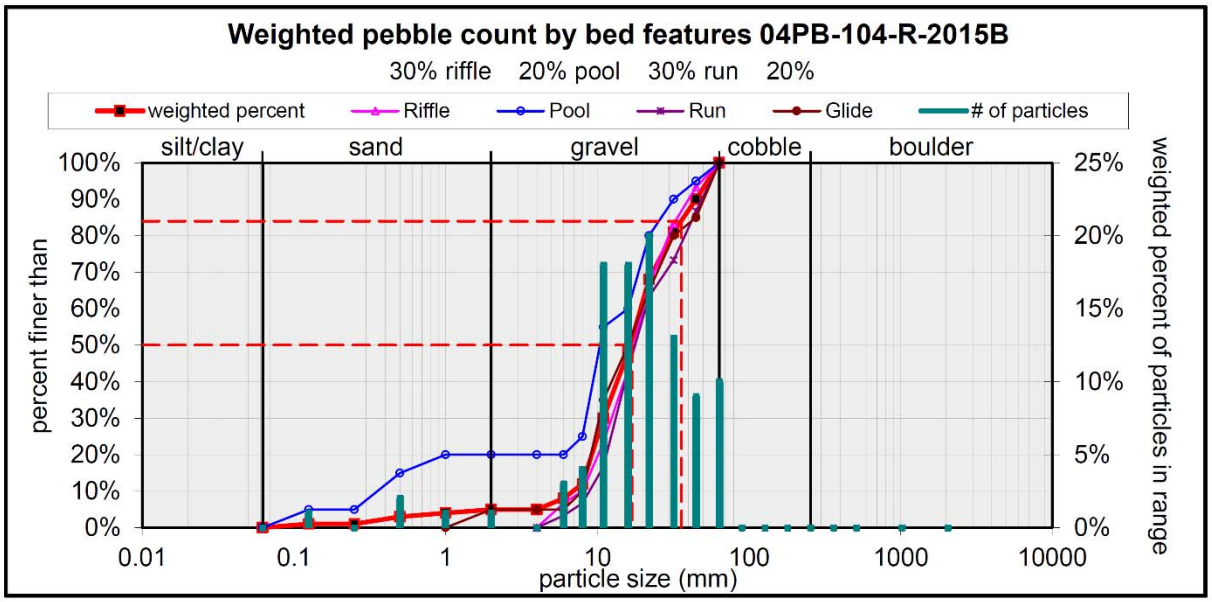
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
12.4	x-section area (ft.sq.)	16.6	W flood prone area (ft)	0.3	velocity (ft/s)
11.9	width (ft)	1.4	entrenchment ratio	3.9	discharge rate (cfs)
1.0	mean depth (ft)	3.1	low bank height (ft)	0.75	channel slope (%)
1.3	max depth (ft)	2.4	low bank height ratio		
12.6	wetted parimeter (ft)				
1.0	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
11.4	width-depth ratio	0.042	Manning's roughness	1.15	F4



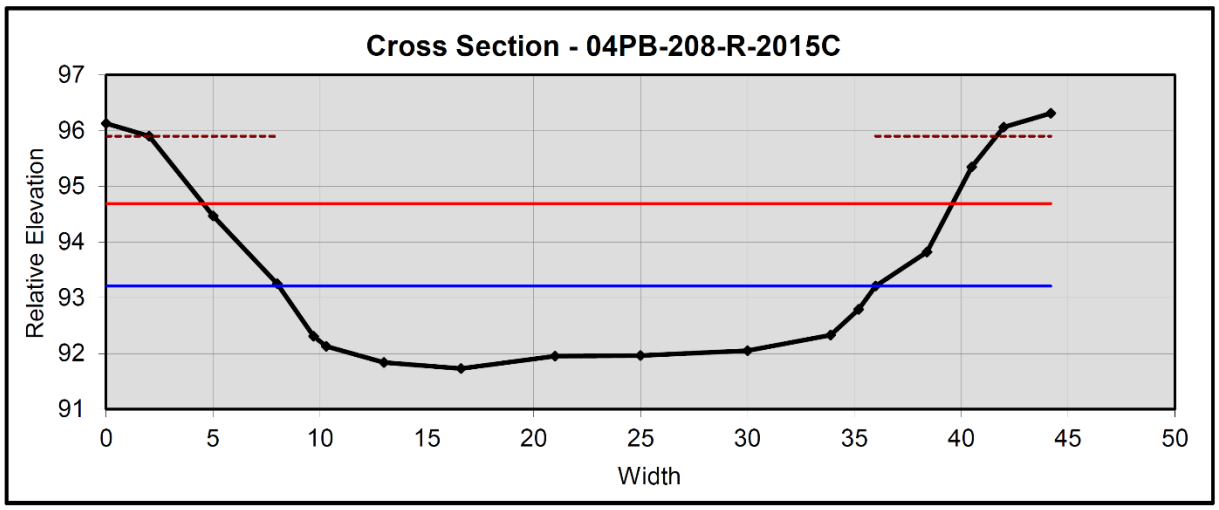
Size (mm)		Size Distribution		Type	
D16	0.15	mean	2.9	silt/clay	15%
D35	6.7	dispersion	55.1	sand	14%
D50	16	skewness	-0.47	gravel	58%
D65	21			cobble	13%
D84	55			boulder	0%
D95	98				



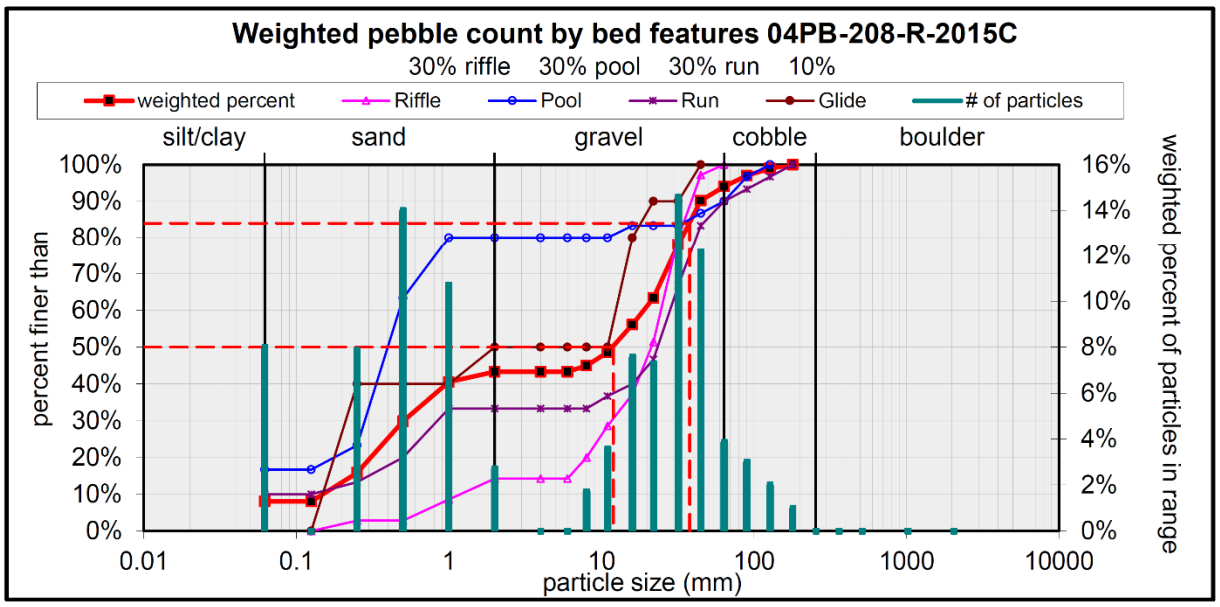
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
3.4	x-section area (ft.sq.)	8.8	W flood prone area (ft)	3.7	velocity (ft/s)
5.6	width (ft)	1.6	entrenchment ratio	12.7	discharge rate (cfs)
0.6	mean depth (ft)	2.9	low bank height (ft)	1.54	channel slope (%)
0.8	max depth (ft)	3.7	low bank height ratio		
6.3	wetted parimeter (ft)				
0.5	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
9.4	width-depth ratio	0.033	Manning's roughness	1..38	B4



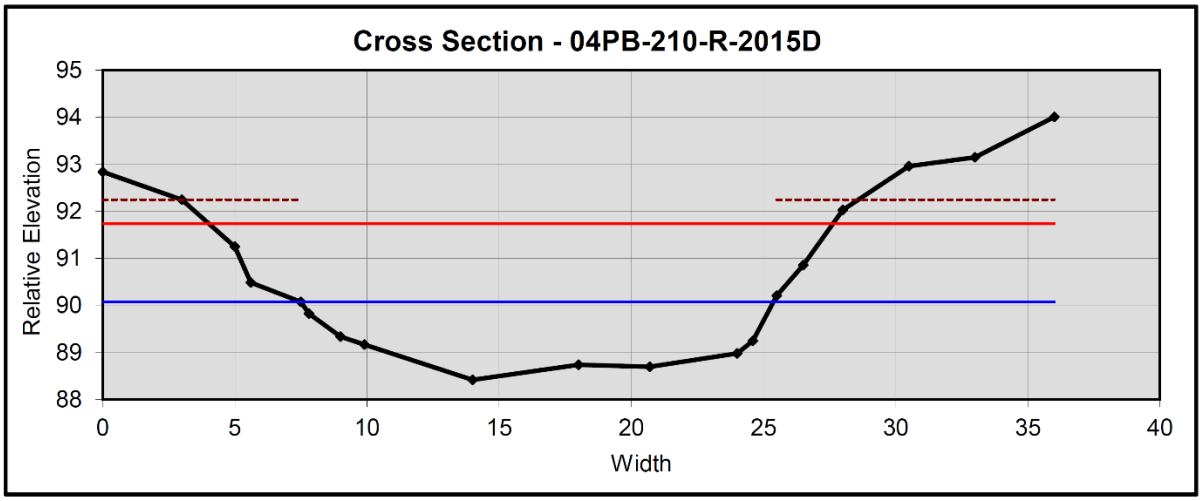
Size (mm)		Size Distribution		Type	
D16	8.6	mean	17.6	silt/clay	0%
D35	12	dispersion	2.0	sand	5%
D50	17	skewness	0.02	gravel	95%
D65	21			cobble	0%
D84	36			boulder	0%
D95	54				



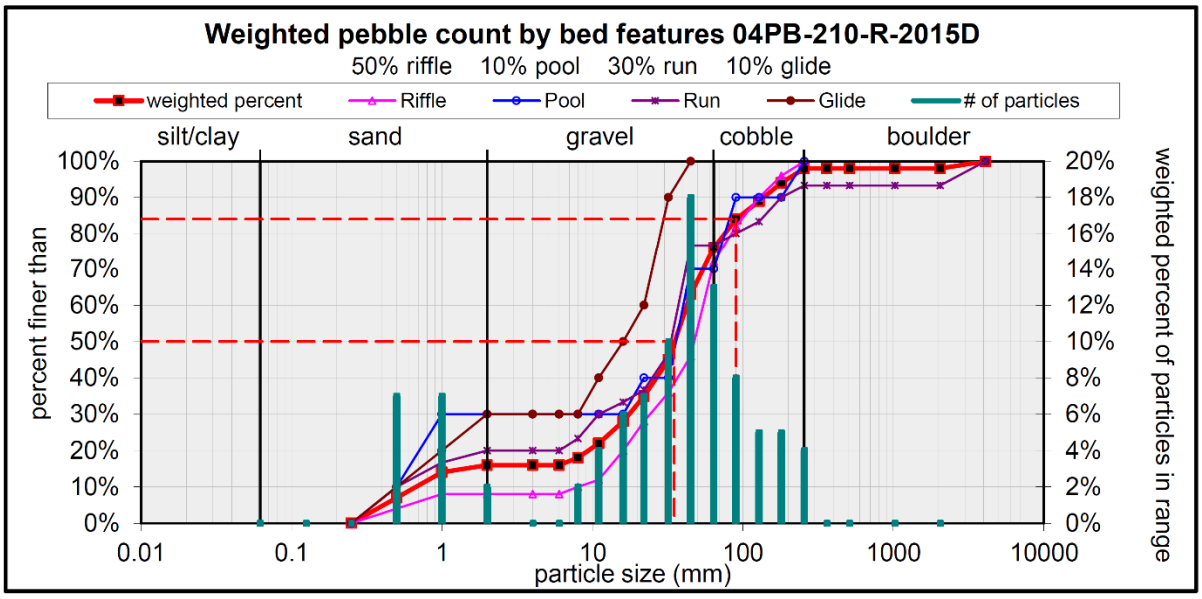
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
31.8	x-section area (ft.sq.)	35.1	W flood prone area (ft)	4.1	velocity (ft/s)
27.9	width (ft)	1.3	entrenchment ratio	129.0	discharge rate (cfs)
1.1	mean depth (ft)	4.2	low bank height (ft)	0.59	channel slope (%)
1.5	max depth (ft)	2.8	low bank height ratio		
28.4	wetted parimeter (ft)				
1.1	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
24.5	width-depth ratio	0.030	Manning's roughness	1.51	F4



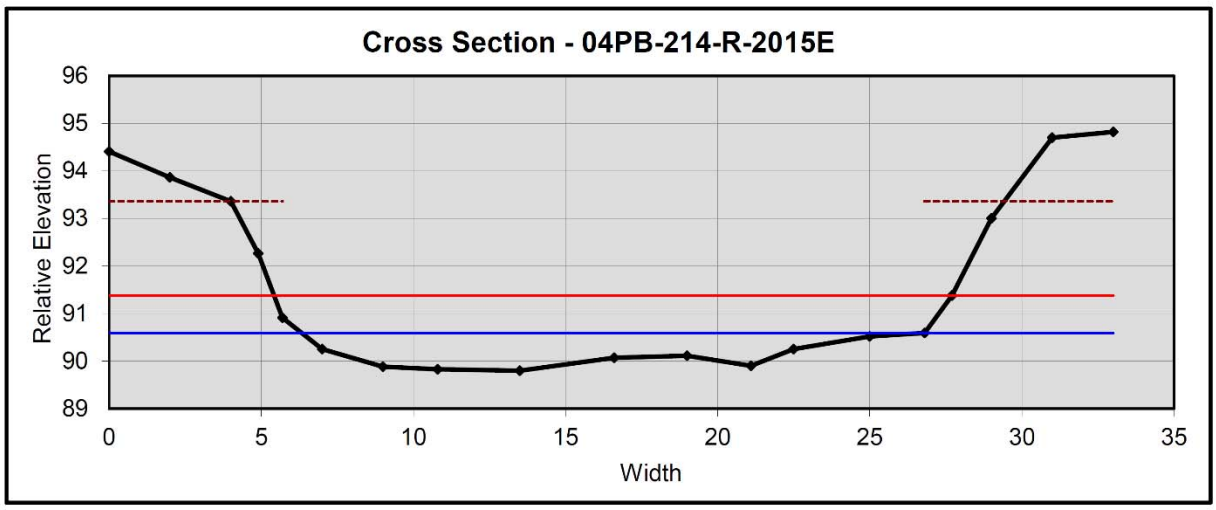
Size (mm)		Size Distribution		Type	
D16	0.25	mean	3.1	silt/clay	8%
D35	0.7	dispersion	25.6	sand	35%
D50	12	skewness	-0.40	gravel	51%
D65	23			cobble	6%
D84	38			boulder	0%
D95	72				



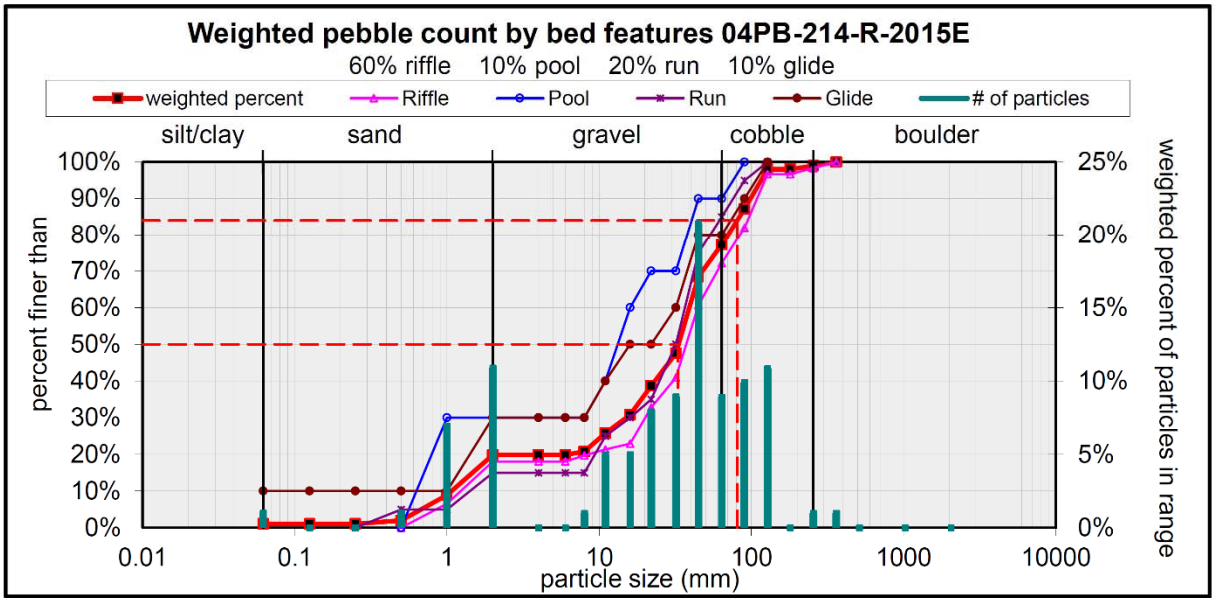
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
21.3	x-section area (ft.sq.)	23.6	W flood prone area (ft)	3.7	velocity (ft/s)
17.9	width (ft)	1.3	entrenchment ratio	78.9	discharge rate (cfs)
1.2	mean depth (ft)	3.8	low bank height (ft)	0.92	channel slope (%)
1.7	max depth (ft)	2.3	low bank height ratio		
18.6	wetted parimeter (ft)				
1.1	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
15.0	width-depth ratio	0.042	Manning's roughness	1.30	F4



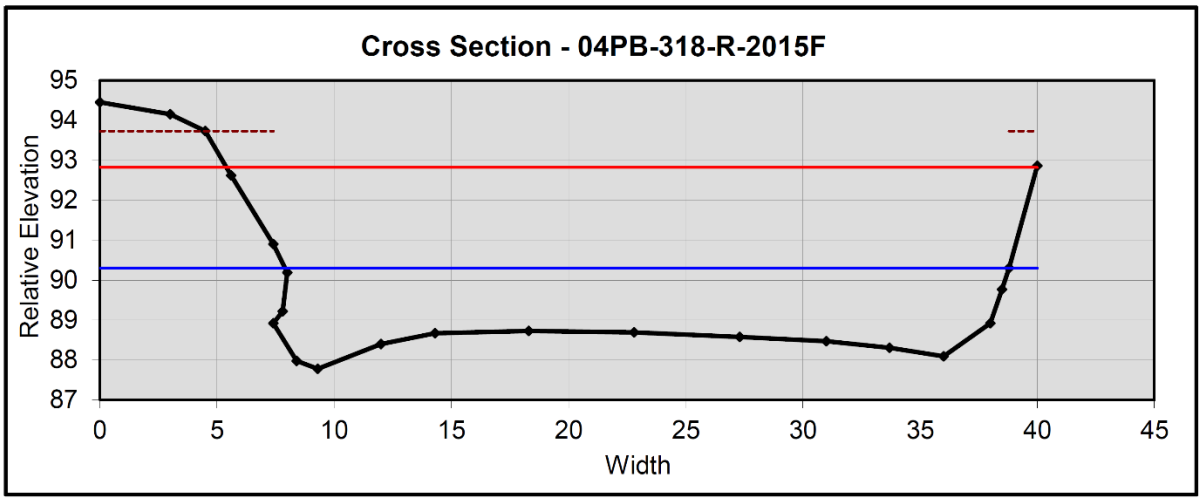
Size (mm)		Size Distribution		Type	
D16	6	mean	23.2	silt/clay	0%
D35	22	dispersion	4.2	sand	16%
D50	35	skewness	-0.16	gravel	60%
D65	48			cobble	22%
D84	90			boulder	2%
D95	200				



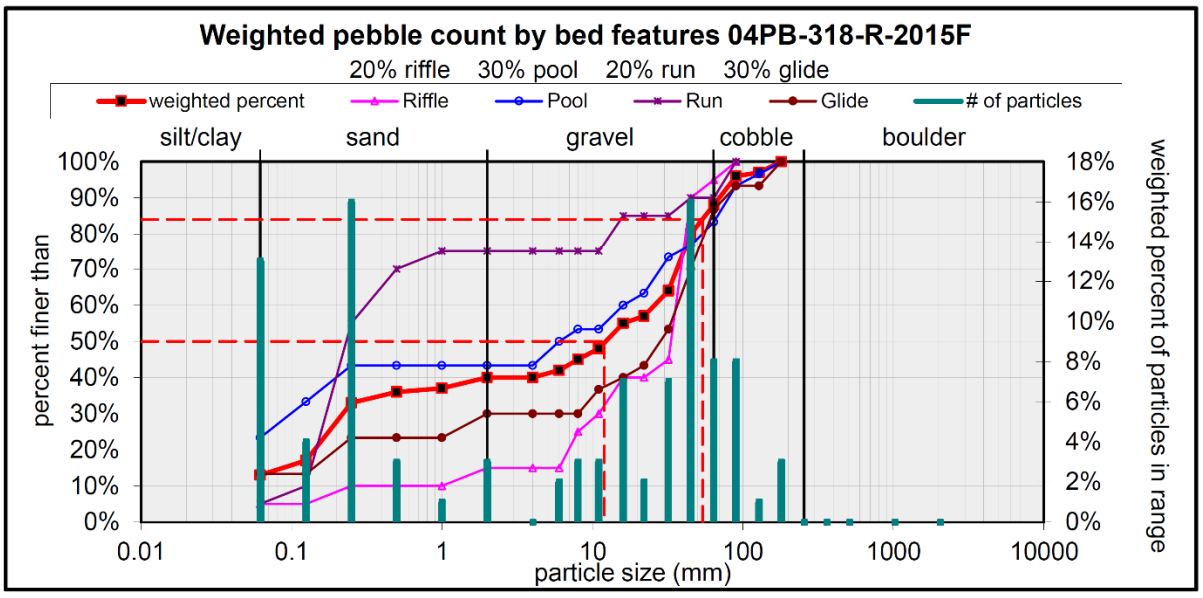
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
10.3	x-section area (ft.sq.)	22.3	W flood prone area (ft)	1.4	velocity (ft/s)
20.5	width (ft)	1.1	entrenchment ratio	15.0	discharge rate (cfs)
0.5	mean depth (ft)	3.6	low bank height (ft)	0.66	channel slope (%)
0.8	max depth (ft)	4.5	low bank height ratio		
20.7	wetted parimeter (ft)				
0.5	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
40.5	width-depth ratio	0.053	Manning's roughness	1.46	F4



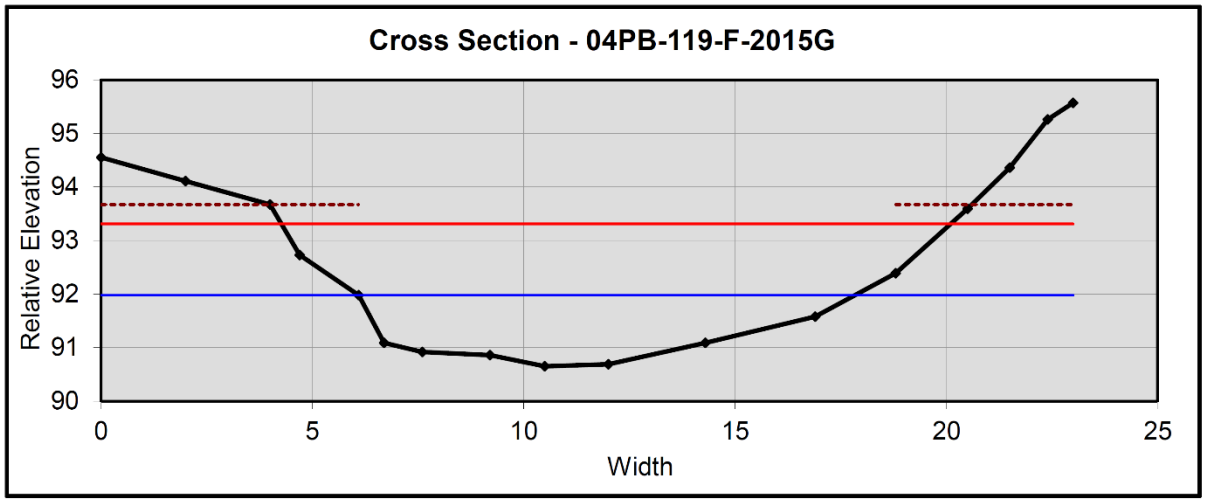
Size (mm)		Size Distribution		Type	
D16	1.6	mean	11.4	silt/clay	1%
D35	19	dispersion	11.5	sand	19%
D50	33	skewness	-0.35	gravel	57%
D65	43			cobble	22%
D84	81			boulder	1%
D95	120				



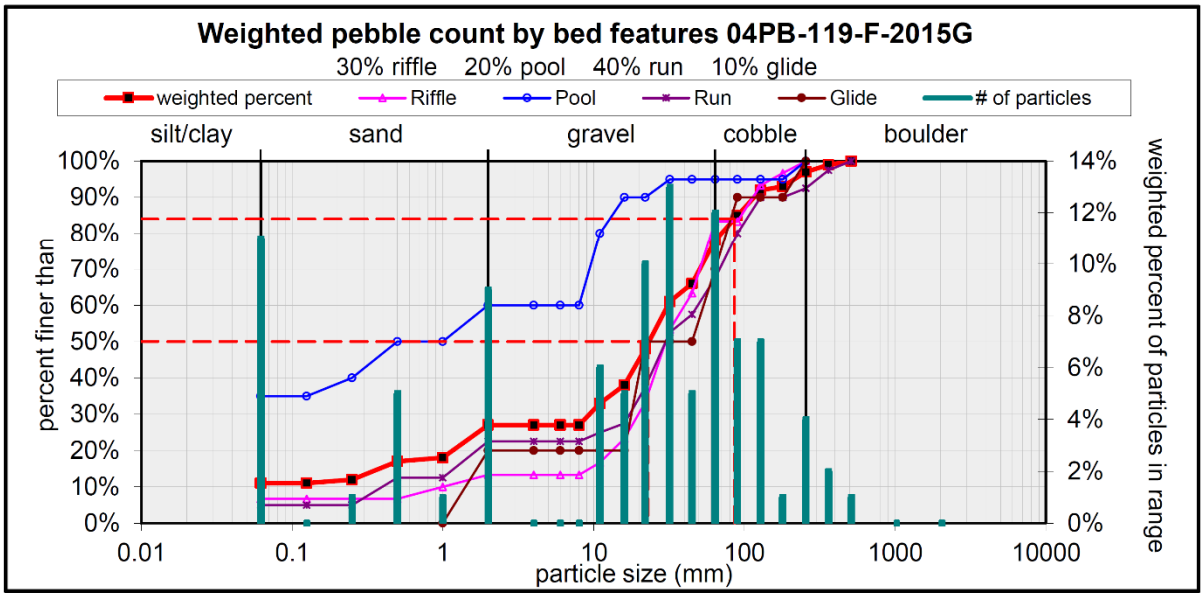
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
55.2	x-section area (ft.sq.)	34.6	W flood prone area (ft)	1.1	velocity (ft/s)
30.9	width (ft)	1.1	entrenchment ratio	61.7	discharge rate (cfs)
1.8	mean depth (ft)	6.0	low bank height (ft)	0.03	channel slope (%)
2.5	max depth (ft)	2.4	low bank height ratio		
34.5	wetted parimeter (ft)				
1.6	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
17.3	width-depth ratio	0.031	Manning's roughness	1.07	F4



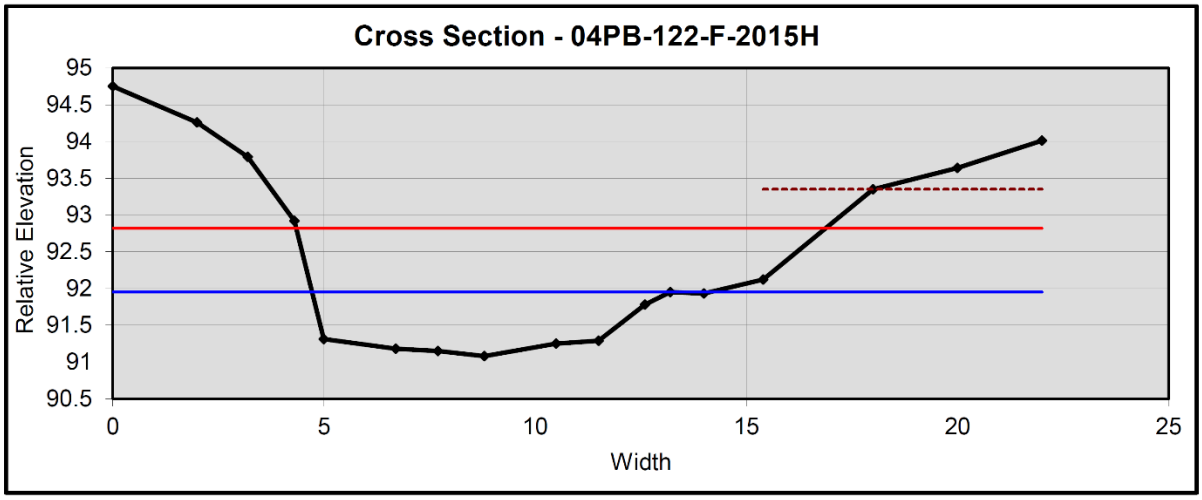
Size (mm)		Size Distribution		Type	
D16	0.1	mean	2.3	silt/clay	13%
D35	0.4	dispersion	62.3	sand	27%
D50	12	skewness	-0.43	gravel	48%
D65	33			cobble	12%
D84	54			boulder	0%
D95	86				



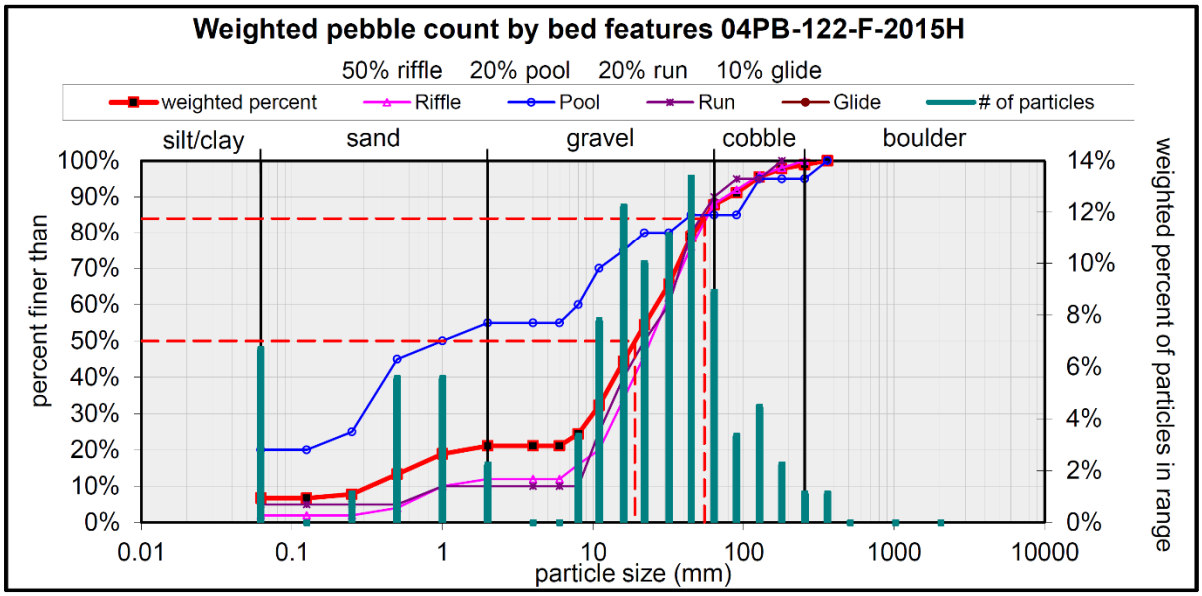
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
10.8	x-section area (ft.sq.)	15.8	W flood prone area (ft)	4.6	velocity (ft/s)
11.7	width (ft)	1.3	entrenchment ratio	49.7	discharge rate (cfs)
0.9	mean depth (ft)	3.0	low bank height (ft)	2.19	channel slope (%)
1.3	max depth (ft)	2.3	low bank height ratio		
12.4	wetted parimeter (ft)				
0.9	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
12.7	width-depth ratio	0.044	Manning's roughness	1.04	F4



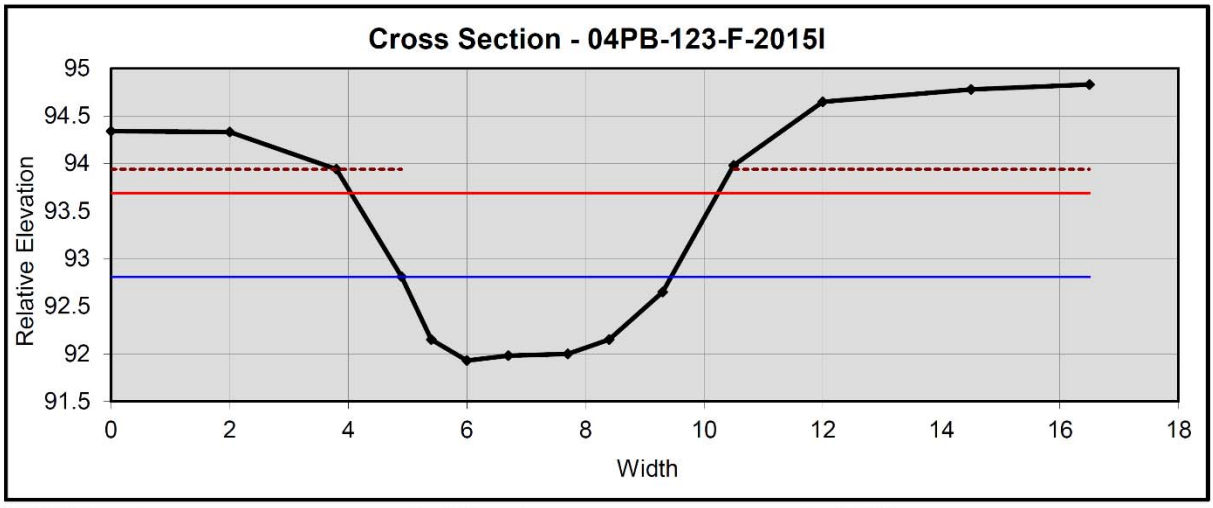
Size (mm)		Size Distribution		Type	
D16	0.44	mean	6.2	silt/clay	11%
D35	13	dispersion	28.0	sand	16%
D50	23	skewness	-0.38	gravel	51%
D65	42			cobble	19%
D84	86			boulder	3%
D95	210				



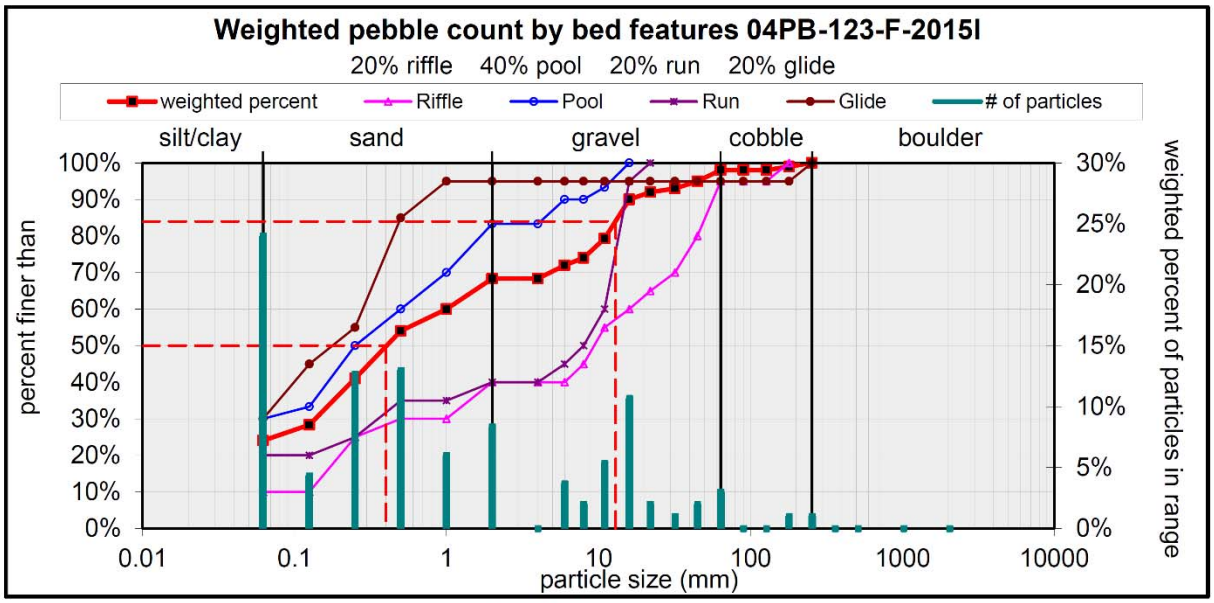
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
5.5	x-section area (ft.sq.)	12.5	W flood prone area (ft)	2.7	velocity (ft/s)
9.4	width (ft)	1.3	entrenchment ratio	15.0	discharge rate (cfs)
0.6	mean depth (ft)	2.3	low bank height (ft)	1.18	channel slope (%)
0.9	max depth (ft)	2.6	low bank height ratio		
10.0	wetted parimeter (ft)				
0.6	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
16.1	width-depth ratio	0.040	Manning's roughness	1.13	F4



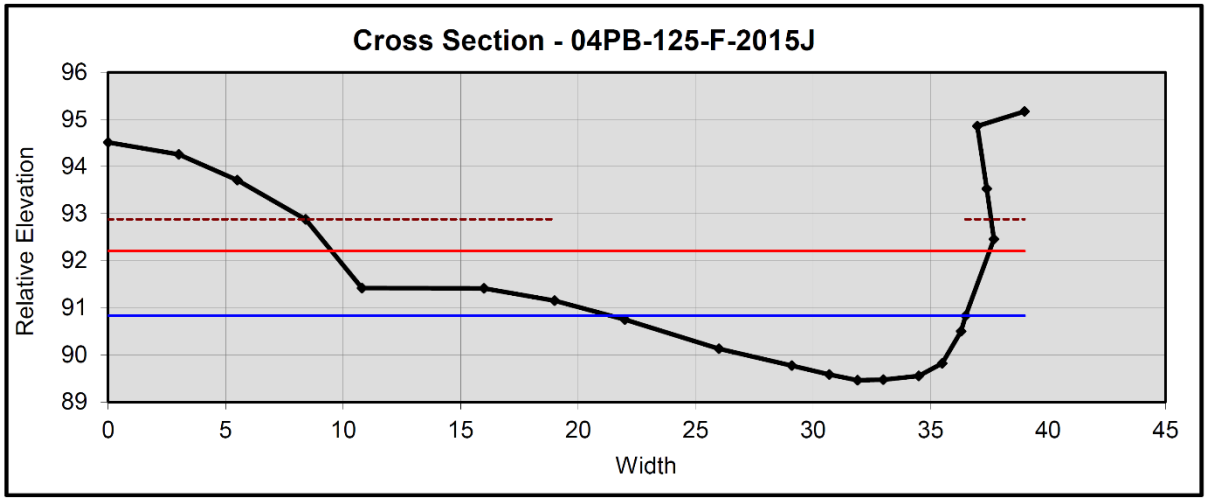
Size (mm)		Size Distribution		Type	
D16	0.7	mean	6.2	silt/clay	7%
D35	12	dispersion	15.0	sand	14%
D50	19	skewness	-0.35	gravel	67%
D65	31			cobble	11%
D84	55			boulder	1%
D95	120				



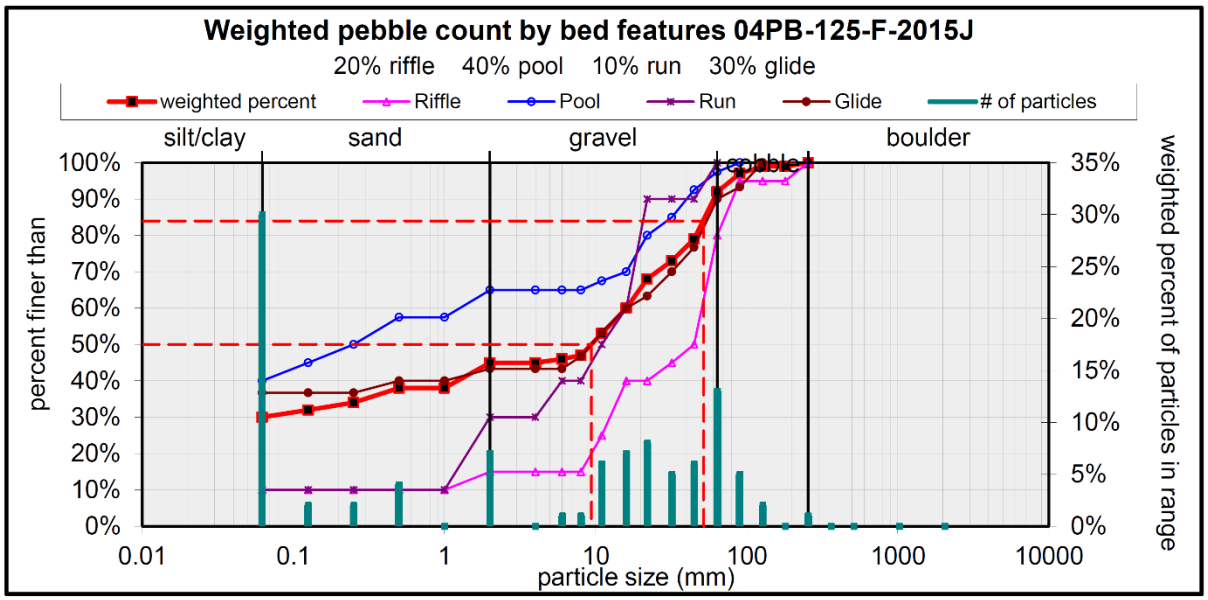
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
2.9	x-section area (ft.sq.)	6.2	W flood prone area (ft)	3.4	velocity (ft/s)
4.5	width (ft)	1.4	entrenchment ratio	10.0	discharge rate (cfs)
0.6	mean depth (ft)	2.0	low bank height (ft)	1.53	channel slope (%)
0.9	max depth (ft)	2.3	low bank height ratio		
5.1	wetted parimeter (ft)				
0.6	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
7.0	width-depth ratio	0.037	Manning's roughness	1.13	G5



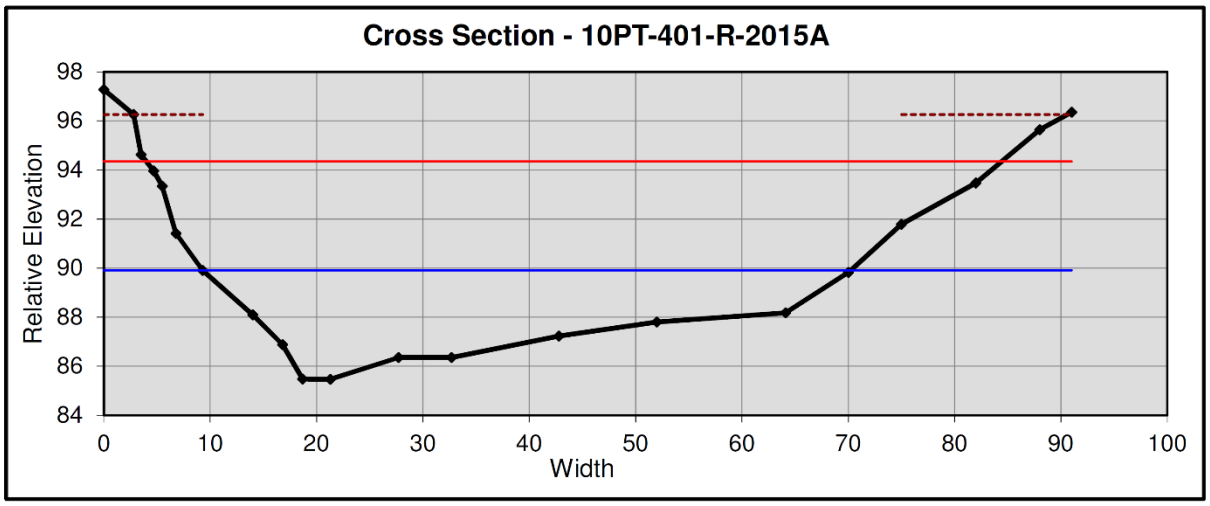
Size (mm)		Size Distribution		Type	
D16	0.062	mean	0.9	silt/clay	24%
D35	0.18	dispersion	19.5	sand	44%
D50	0.4	skewness	0.23	gravel	30%
D65	1.5			cobble	2%
D84	13			boulder	0%
D95	45				



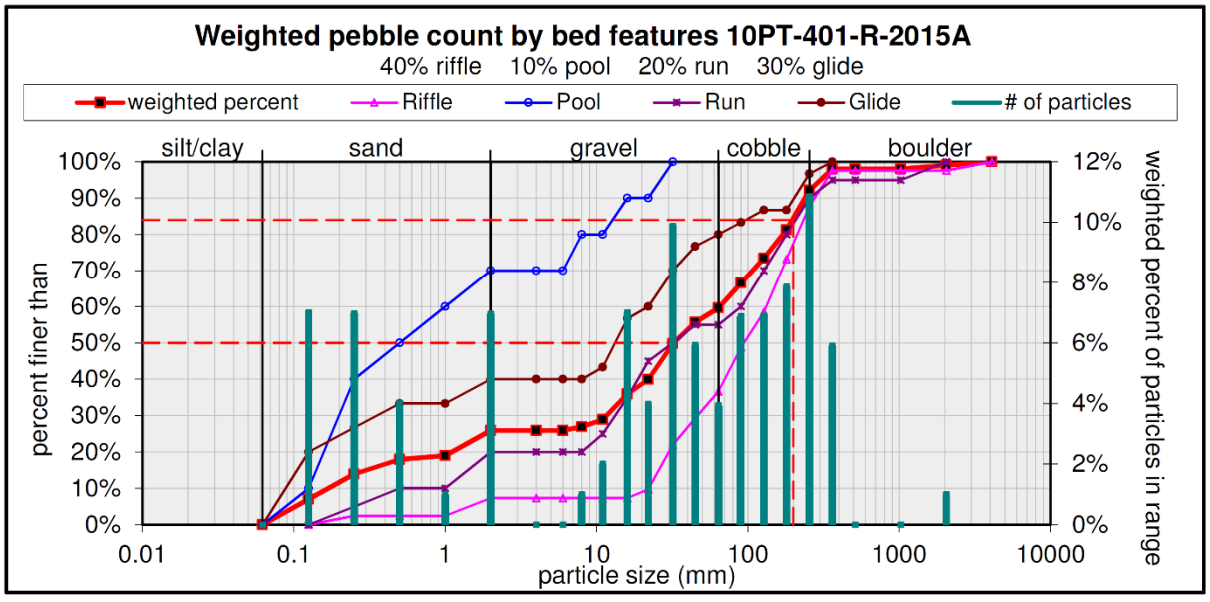
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
12.9	x-section area (ft.sq.)	28.0	W flood prone area (ft)	3.5	velocity (ft/s)
15.1	width (ft)	1.9	entrenchment ratio	44.6	discharge rate (cfs)
0.9	mean depth (ft)	3.4	low bank height (ft)	1.07	channel slope (%)
1.4	max depth (ft)	2.5	low bank height ratio		
15.7	wetted parimeter (ft)				
0.8	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
17.6	width-depth ratio	0.039	Manning's roughness	1.06	B4



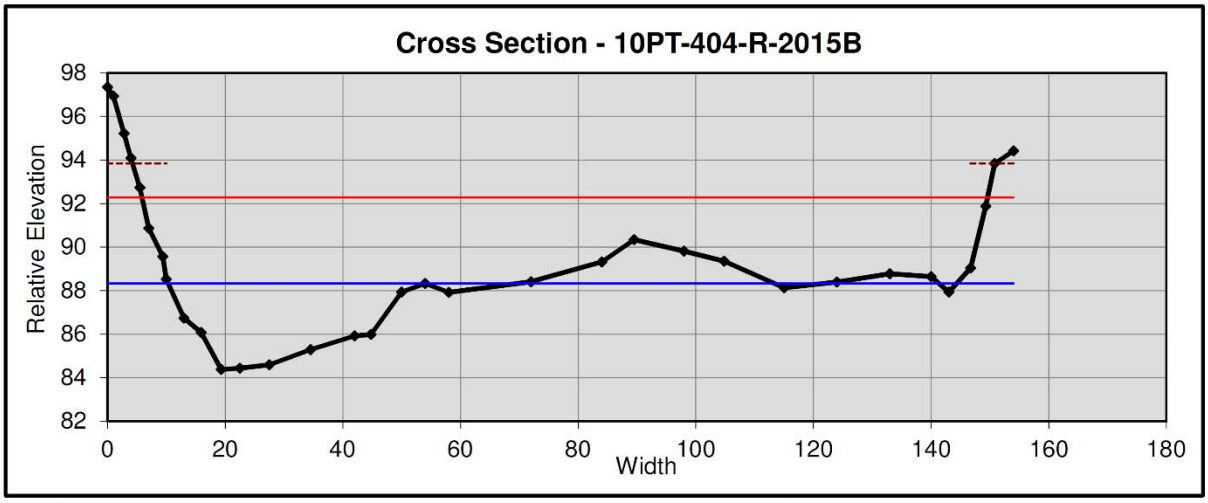
Size (mm)		Size Distribution		Type	
D16	0.062	mean	1.8	silt/clay	30%
D35	0.3	dispersion	78.6	sand	15%
D50	9.4	skewness	-0.42	gravel	47%
D65	20			cobble	8%
D84	52			boulder	0%
D95	79				



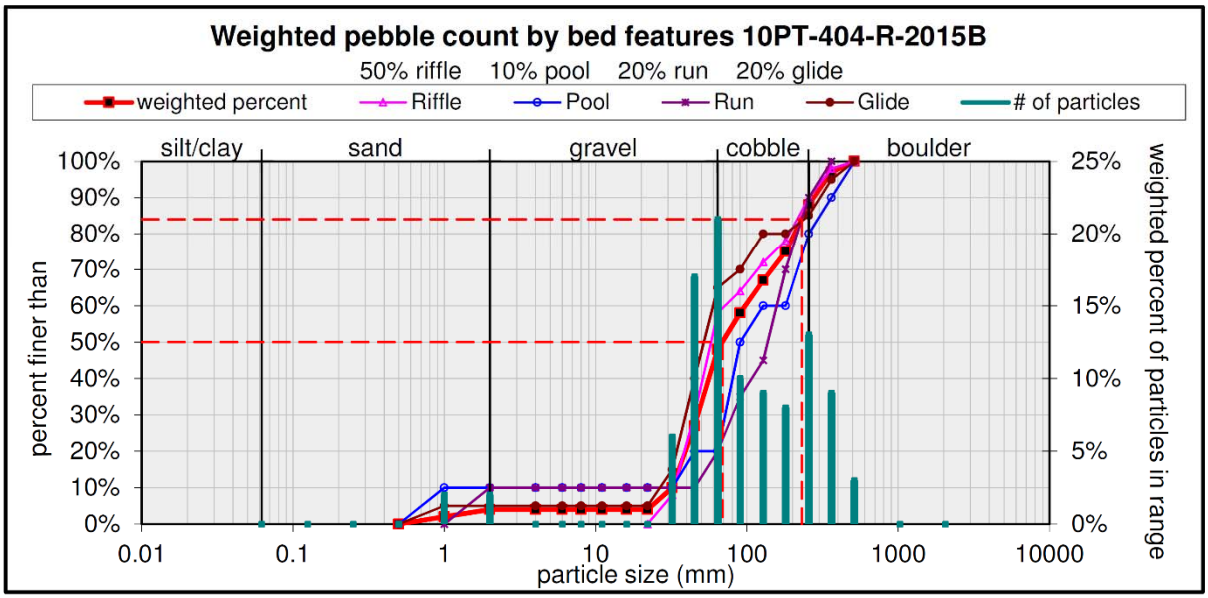
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
155.2	x-section area (ft.sq.)	80.4	W flood prone area (ft)	2.9	velocity (ft/s)
60.9	width (ft)	1.3	entrenchment ratio	457.2	discharge rate (cfs)
2.5	mean depth (ft)	10.8	low bank height (ft)	0.24	channel slope (%)
4.4	max depth (ft)	2.4	low bank height ratio		
62.3	wetted parimeter (ft)				
2.5	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
23.9	width-depth ratio	0.046	Manning's roughness	1.79	**F4**



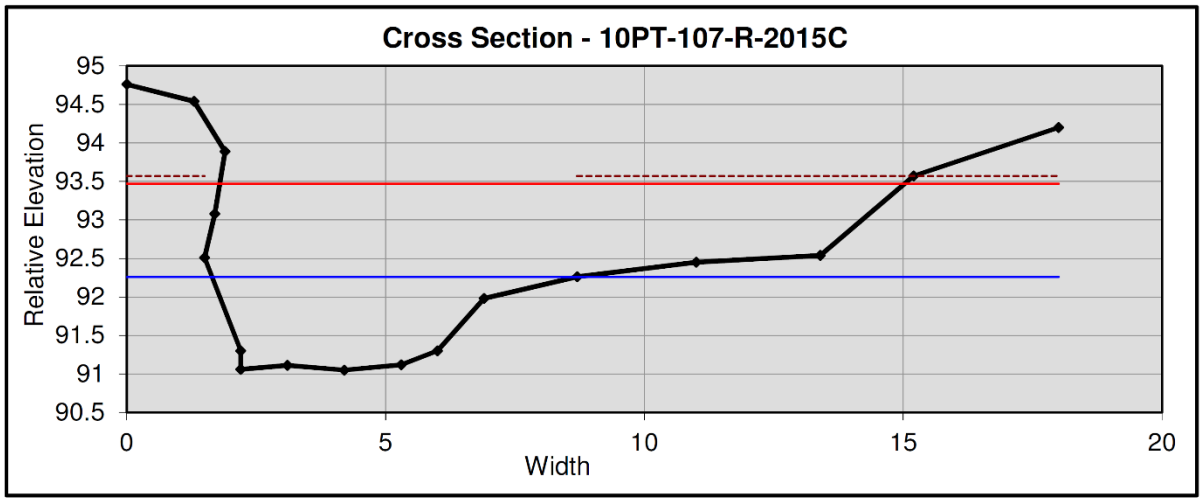
Size (mm)		Size Distribution		Type	
D16	0.36	mean	8.5	silt/clay	0%
D35	15	dispersion	47.6	sand	26%
D50	32	skewness	-0.35	gravel	34%
D65	84			cobble	32%
D84	200			boulder	8%
D95	300				



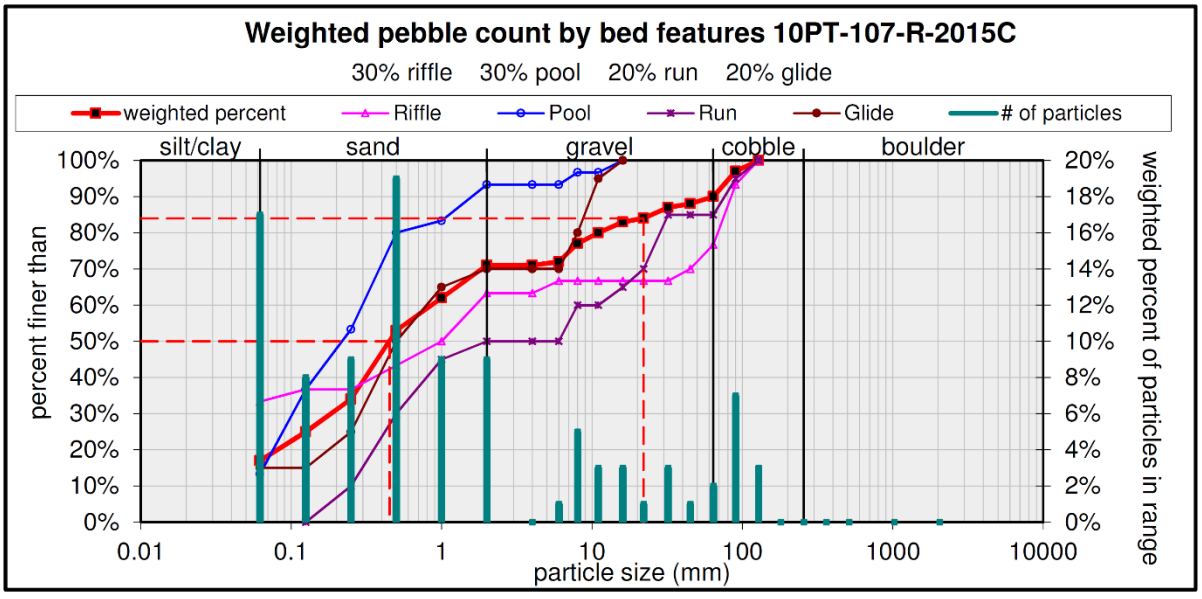
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
113.2	x-section area (ft.sq.)	143.7	W flood prone area (ft)	3.6	velocity (ft/s)
70.7	width (ft)	2.0	entrenchment ratio	402.3	discharge rate (cfs)
1.6	mean depth (ft)	9.5	low bank height (ft)	0.78	channel slope (%)
4.0	max depth (ft)	2.4	low bank height ratio		
72.2	wetted parimeter (ft)				
1.6	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
44.1	width-depth ratio	0.050	Manning's roughness	1.37	**B4c**



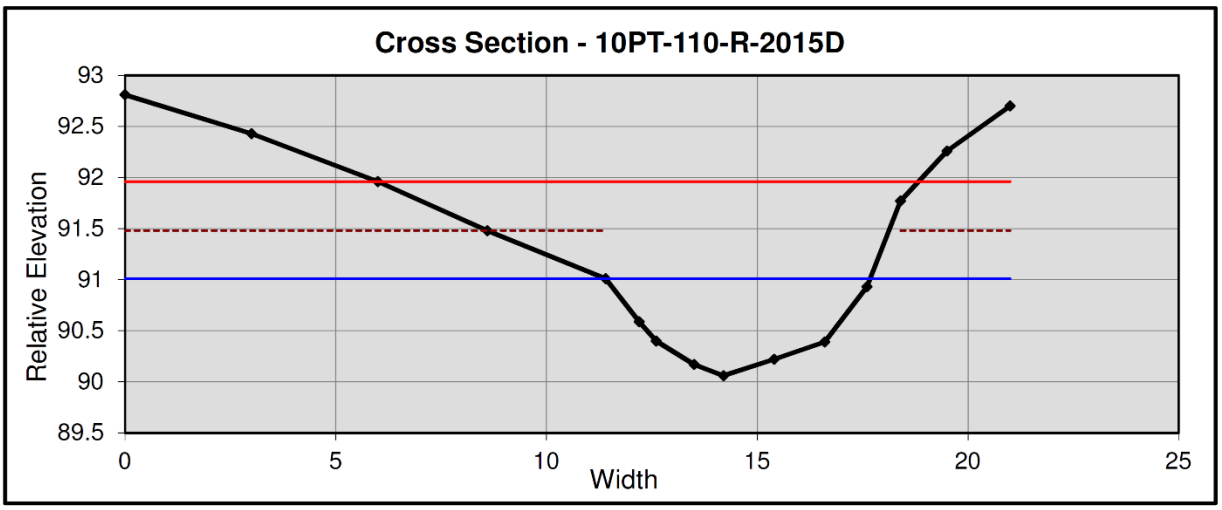
Size (mm)		Size Distribution		Type	
D16	36	mean	91.0	silt/clay	0%
D35	51	dispersion	2.6	sand	4%
D50	69	skewness	0.13	gravel	44%
D65	120			cobble	40%
D84	230			boulder	12%
D95	340				



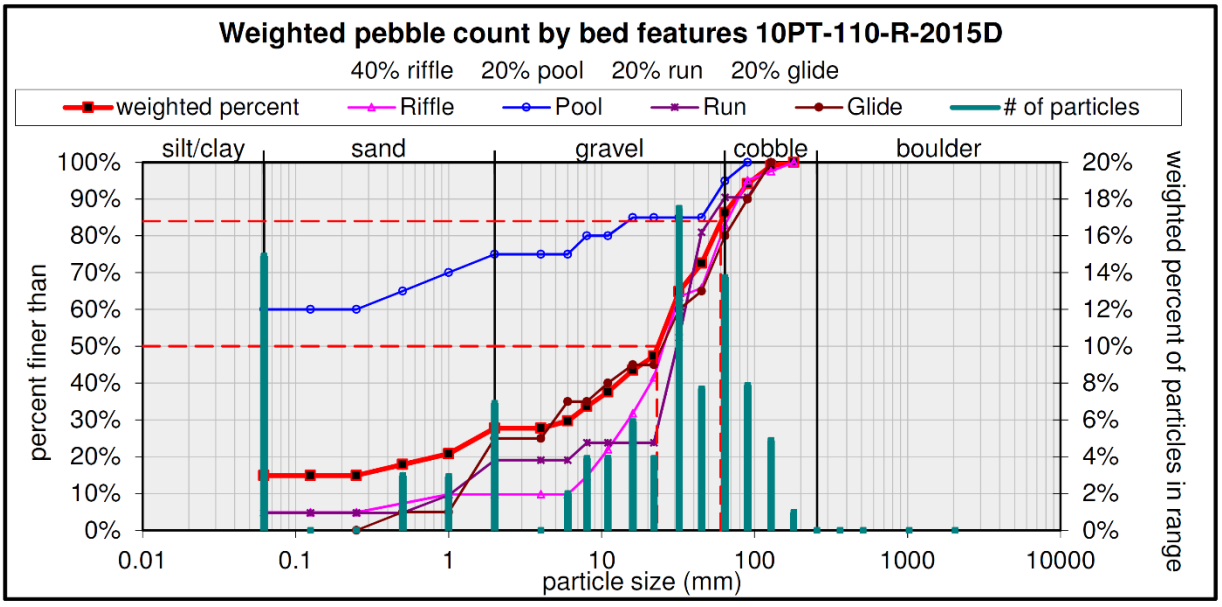
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
5.5	x-section area (ft.sq.)	13.2	W flood prone area (ft)	2.5	velocity (ft/s)
7.1	width (ft)	1.9	entrenchment ratio	13.5	discharge rate (cfs)
0.8	mean depth (ft)	2.5	low bank height (ft)	0.82	channel slope (%)
1.2	max depth (ft)	2.1	low bank height ratio		
8.1	wetted parimeter (ft)				
0.7	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
9.1	width-depth ratio	0.042	Manning's roughness	1.37	**B5c**



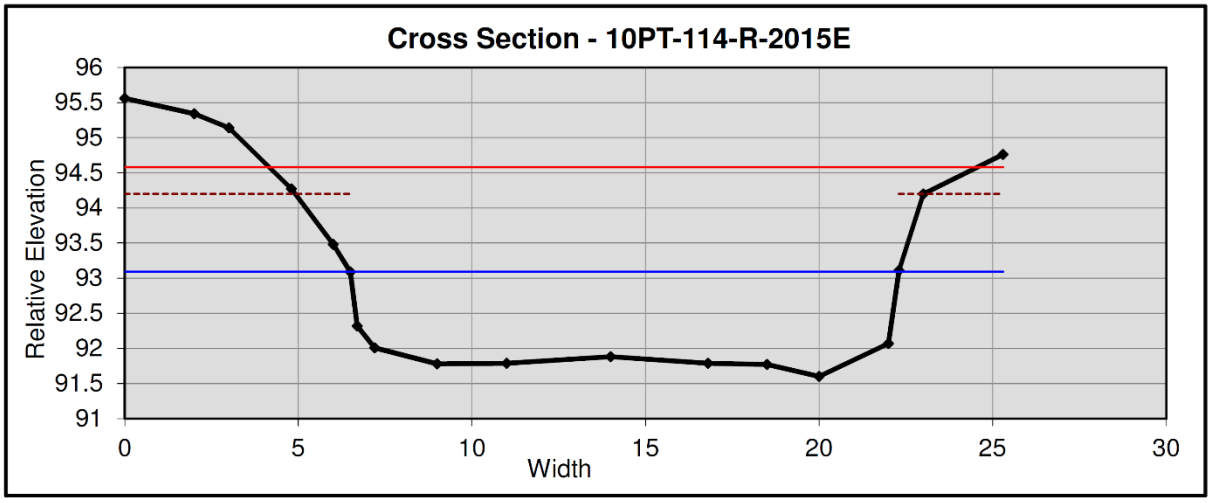
Size (mm)		Size Distribution		Type	
D16	0.062	mean	1.2	silt/clay	17%
D35	0.26	dispersion	28.1	sand	54%
D50	0.45	skewness	0.26	gravel	19%
D65	1.3			cobble	10%
D84	22			boulder	0%
D95	82				



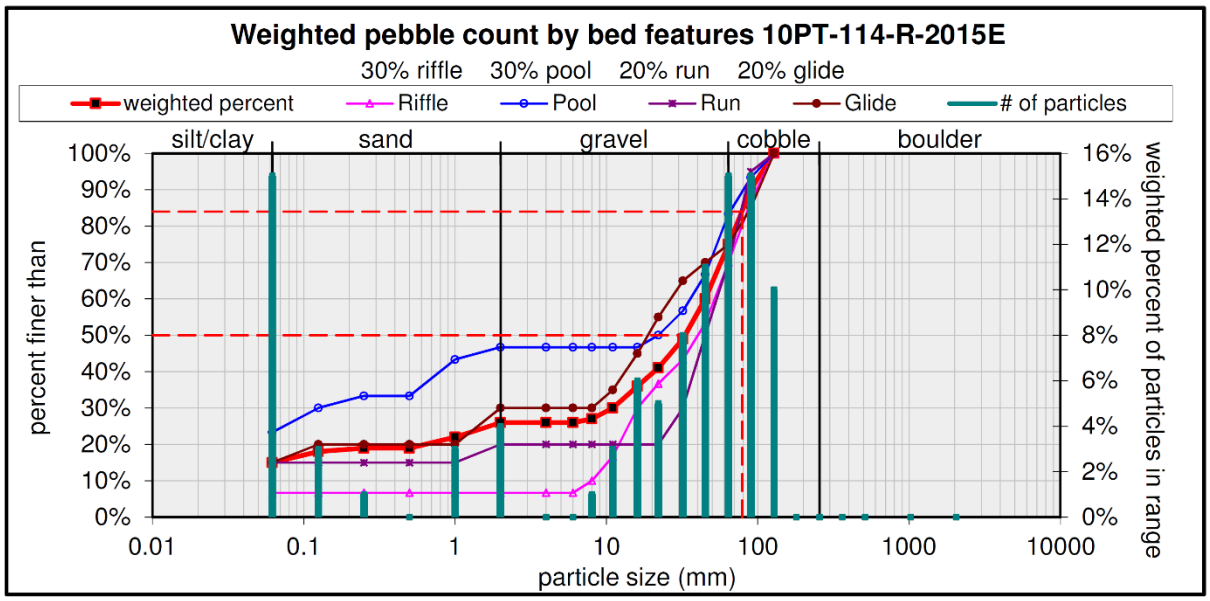
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
3.9	x-section area (ft.sq.)	12.8	W flood prone area (ft)	2.2	velocity (ft/s)
6.3	width (ft)	2.0	entrenchment ratio	8.7	discharge rate (cfs)
0.6	mean depth (ft)	1.4	low bank height (ft)	0.79	channel slope (%)
1.0	max depth (ft)	1.5	low bank height ratio		
6.7	wetted parimeter (ft)				
0.6	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
10.1	width-depth ratio	0.042	Manning's roughness	1.42	**F4**



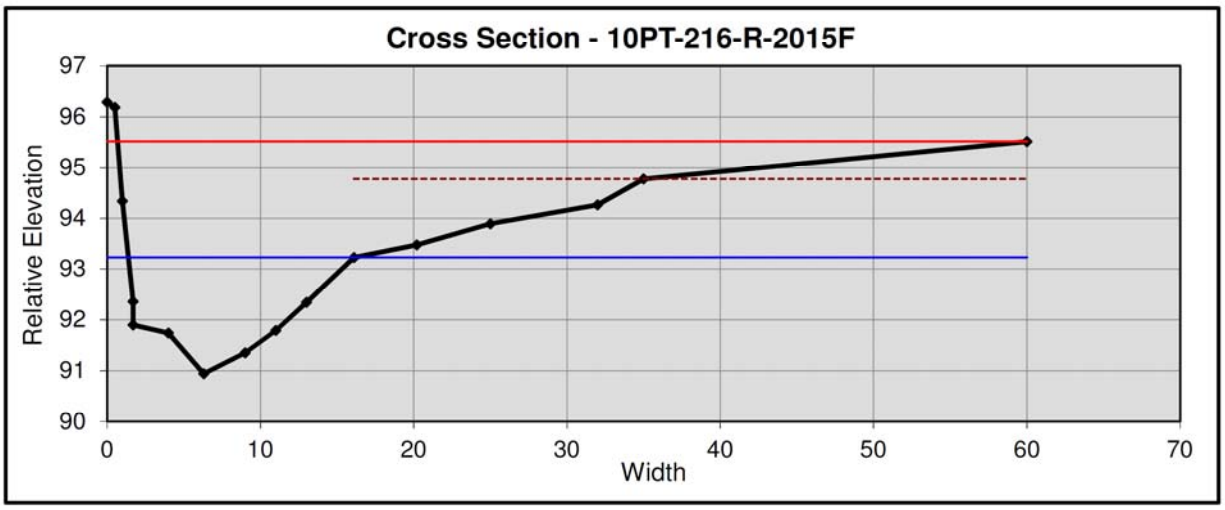
Size (mm)		Size Distribution		Type	
D16	0.32	mean	4.4	silt/clay	15%
D35	9	dispersion	37.2	sand	13%
D50	23	skewness	-0.48	gravel	59%
D65	32			cobble	14%
D84	60			boulder	0%
D95	96				



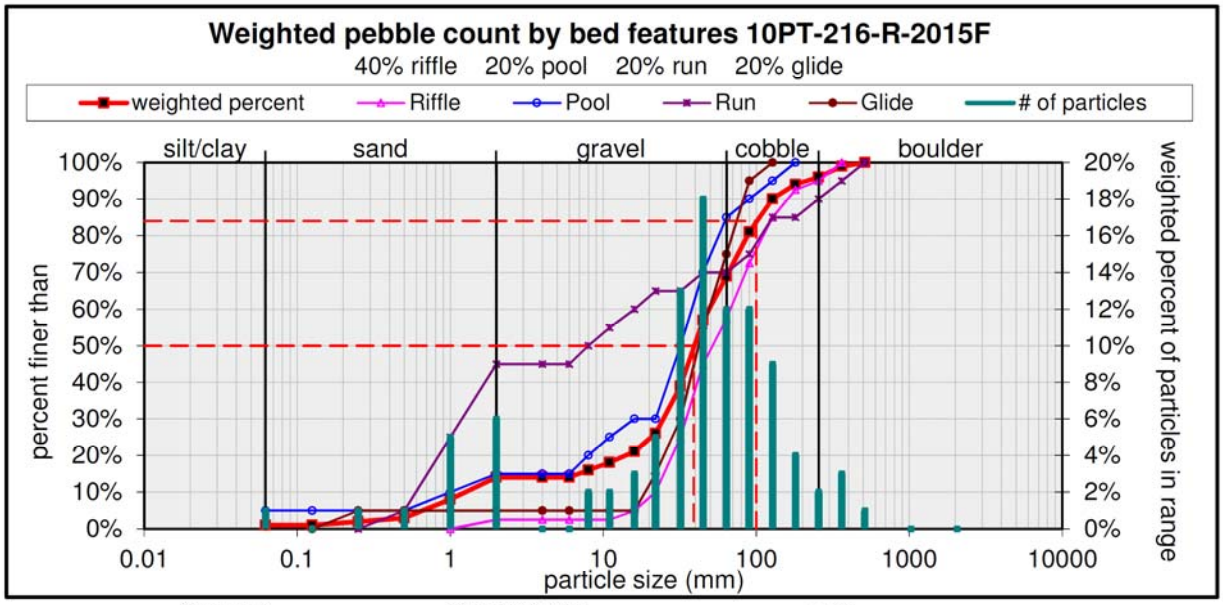
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
19.6	x-section area (ft.sq.)	20.4	W flood prone area (ft)	3.6	velocity (ft/s)
15.8	width (ft)	1.3	entrenchment ratio	70.9	discharge rate (cfs)
1.2	mean depth (ft)	2.6	low bank height (ft)	0.83	channel slope (%)
1.5	max depth (ft)	1.7	low bank height ratio		
17.3	wetted parimeter (ft)				
1.1	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
12.7	width-depth ratio	0.041	Manning's roughness	1.21	**F4**



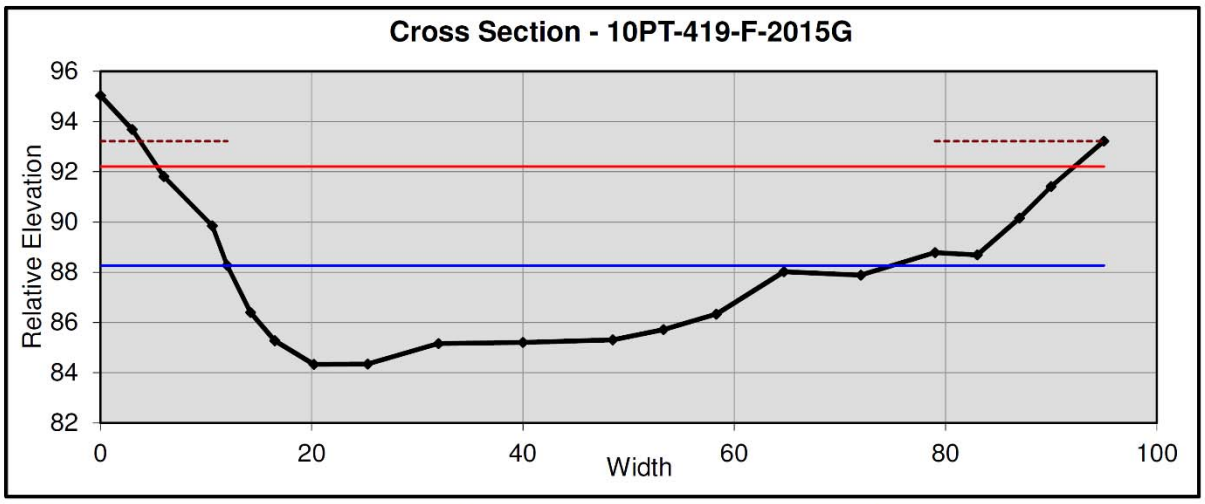
Size (mm)		Size Distribution		Type	
D16	0.078	mean	2.5	silt/clay	15%
D35	15	dispersion	212.7	sand	11%
D50	33	skewness	-0.65	gravel	49%
D65	51			cobble	25%
D84	79			boulder	0%
D95	110				



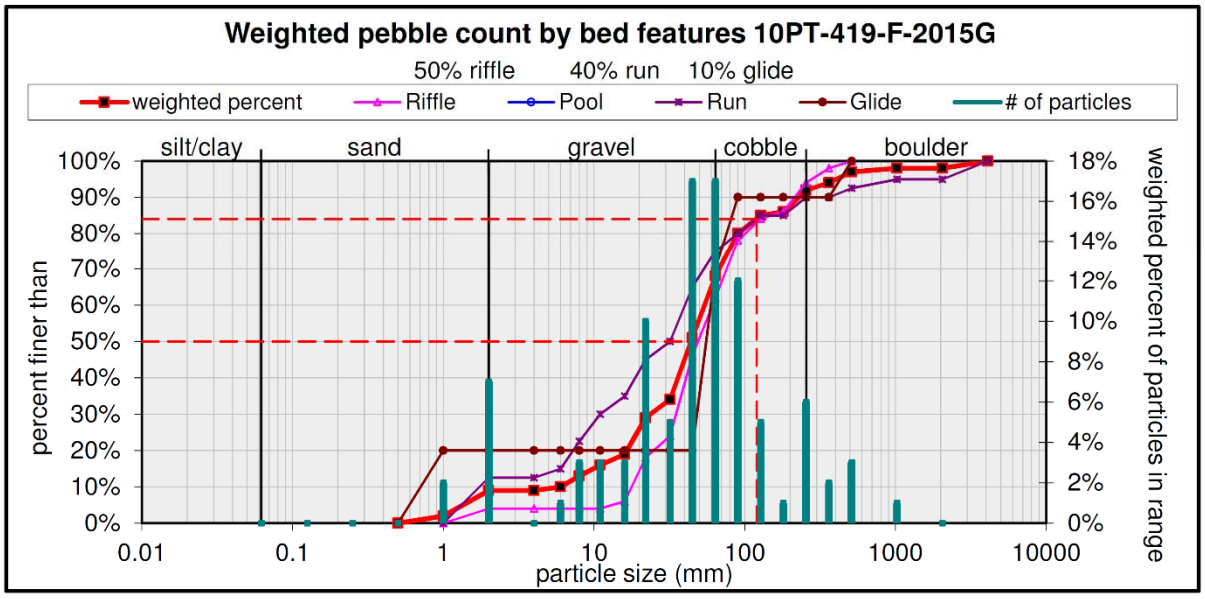
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
20.4	x-section area (ft.sq.)	59.3	W flood prone area (ft)	3.3	velocity (ft/s)
14.7	width (ft)	4.0	entrenchment ratio	67.6	discharge rate (cfs)
1.4	mean depth (ft)	3.8	low bank height (ft)	0.70	channel slope (%)
2.3	max depth (ft)	1.7	low bank height ratio		
16.2	wetted parimeter (ft)				
1.3	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
10.6	width-depth ratio	0.044	Manning's roughness	1.17	**C4**



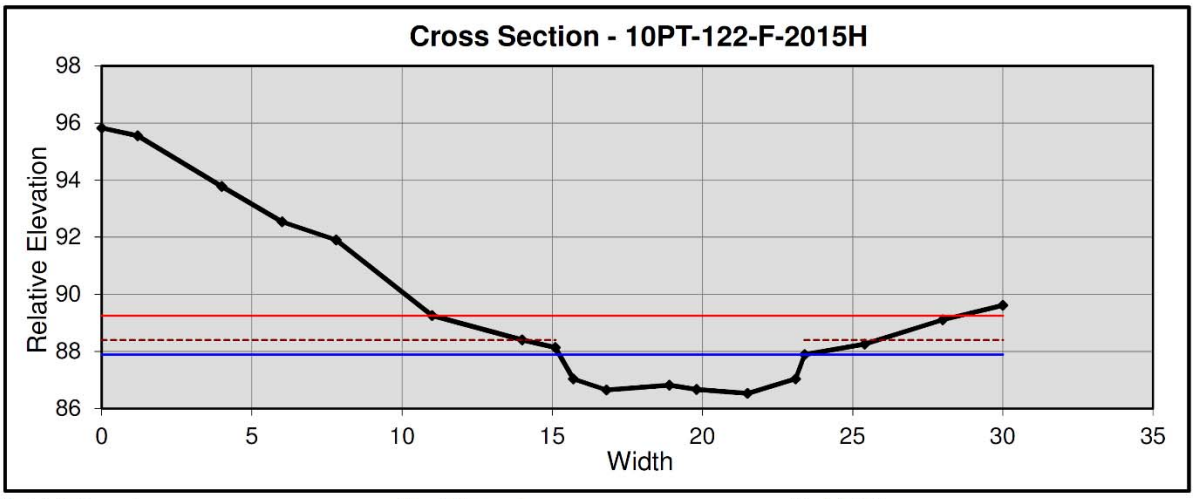
Size (mm)		Size Distribution		Type	
D16	8	mean	28.3	silt/clay	1%
D35	29	dispersion	3.7	sand	13%
D50	39	skewness	-0.13	gravel	55%
D65	57			cobble	27%
D84	100			boulder	4%
D95	210				



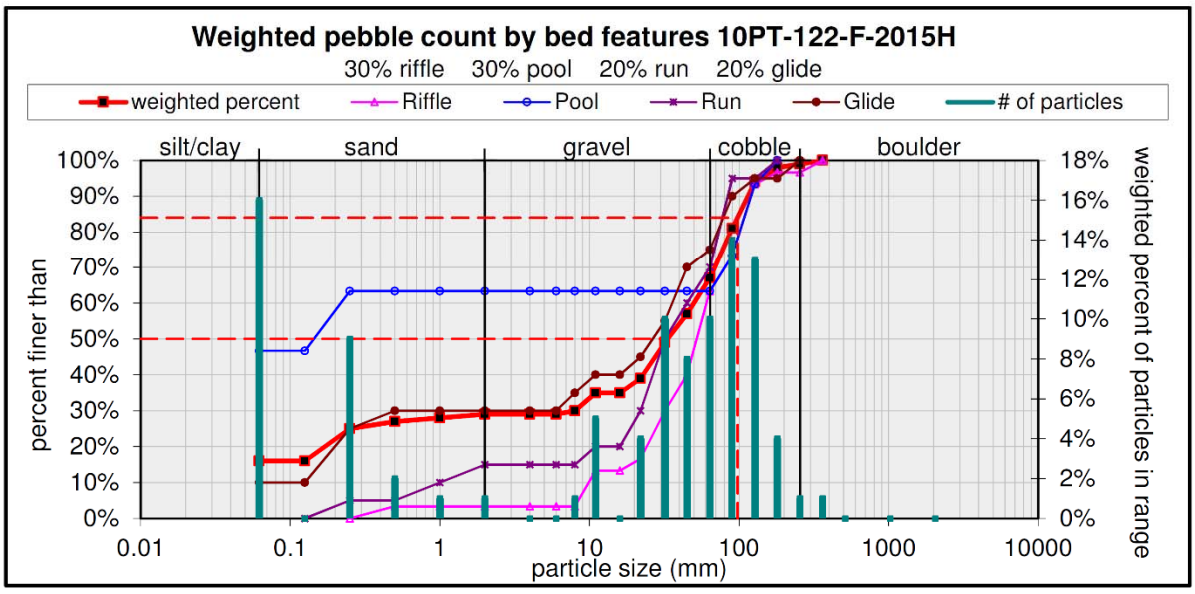
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
148.8	x-section area (ft.sq.)	86.9	W flood prone area (ft)	4.7	velocity (ft/s)
63.0	width (ft)	1.4	entrenchment ratio	700.6	discharge rate (cfs)
2.4	mean depth (ft)	8.9	low bank height (ft)	0.53	channel slope (%)
3.9	max depth (ft)	2.3	low bank height ratio		
64.5	wetted parimeter (ft)				
2.3	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
26.7	width-depth ratio	0.040	Manning's roughness	1.47	**B4c**



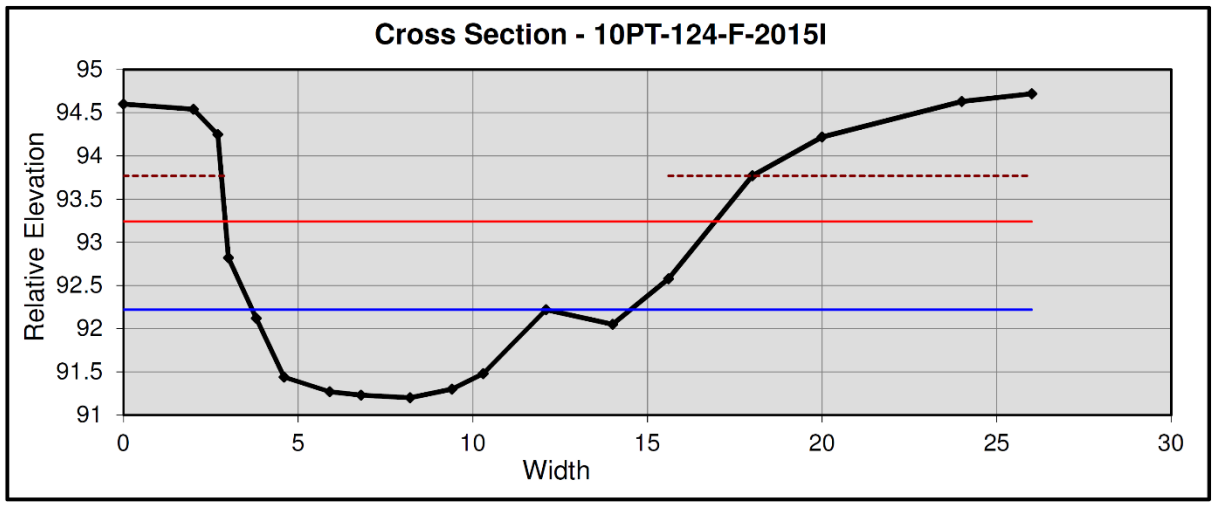
Size (mm)		Size Distribution		Type	
D16	11	mean	36.3	silt/clay	0%
D35	33	dispersion	3.4	sand	9%
D50	44	skewness	-0.08	gravel	59%
D65	60			cobble	24%
D84	120			boulder	8%
D95	410				



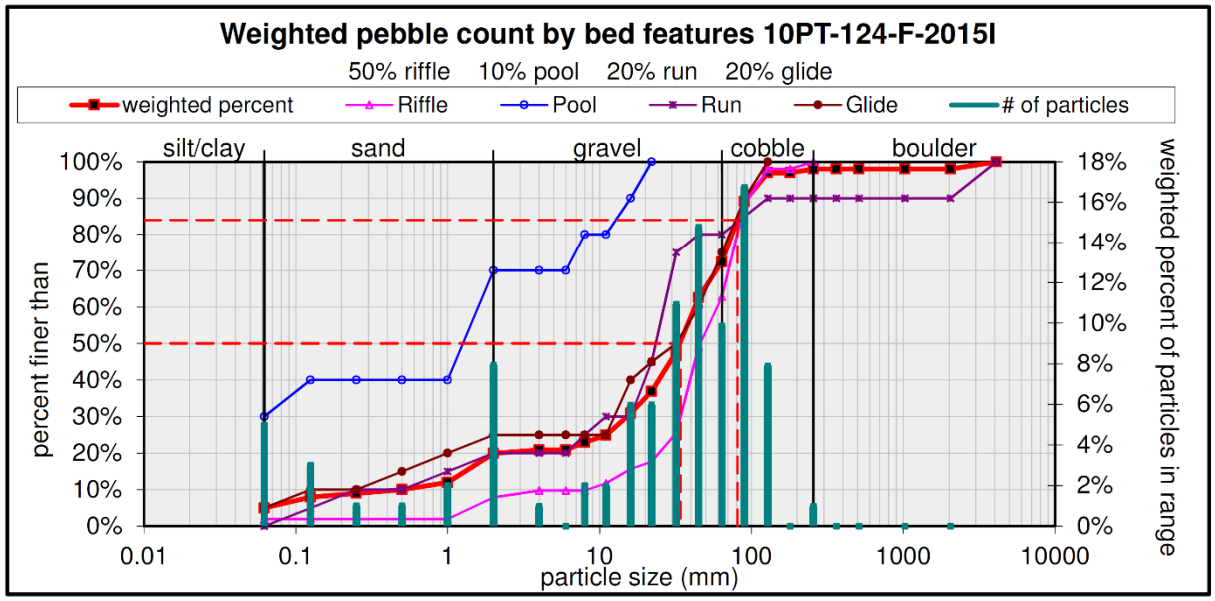
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
8.9	x-section area (ft.sq.)	17.5	W flood prone area (ft)	3.7	velocity (ft/s)
8.2	width (ft)	2.1	entrenchment ratio	32.7	discharge rate (cfs)
1.1	mean depth (ft)	1.9	low bank height (ft)	1.44	channel slope (%)
1.4	max depth (ft)	1.4	low bank height ratio		
9.4	wetted parimeter (ft)				
0.9	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
7.5	width-depth ratio	0.047	Manning's roughness	1.62	**E4**



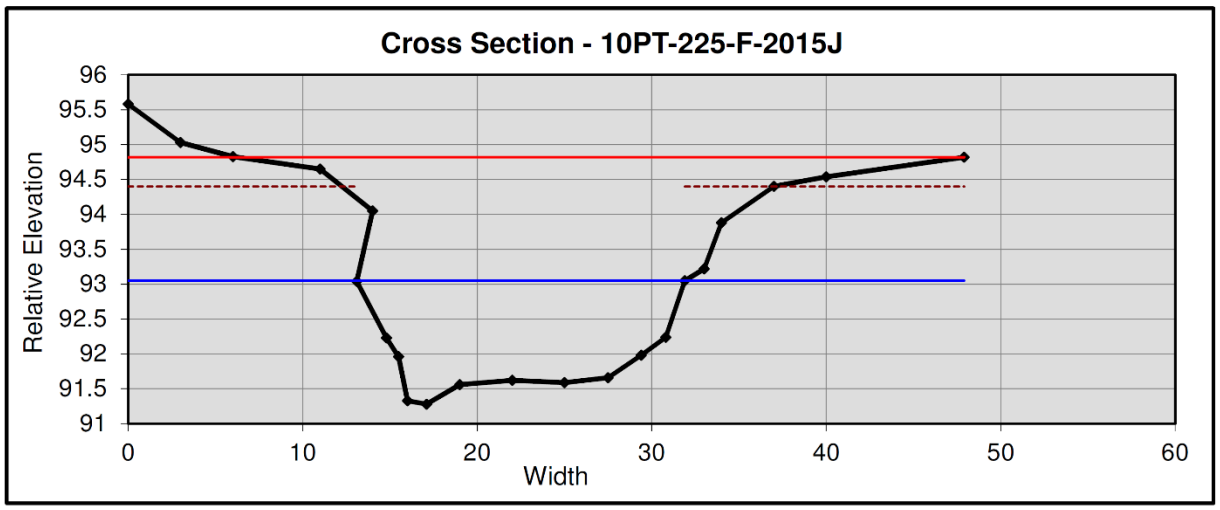
Size (mm)		Size Distribution		Type	
D16	0.062	mean	2.5	silt/clay	16%
D35	11	dispersion	267.6	sand	13%
D50	33	skewness	-0.63	gravel	38%
D65	60			cobble	32%
D84	98			boulder	1%
D95	140				



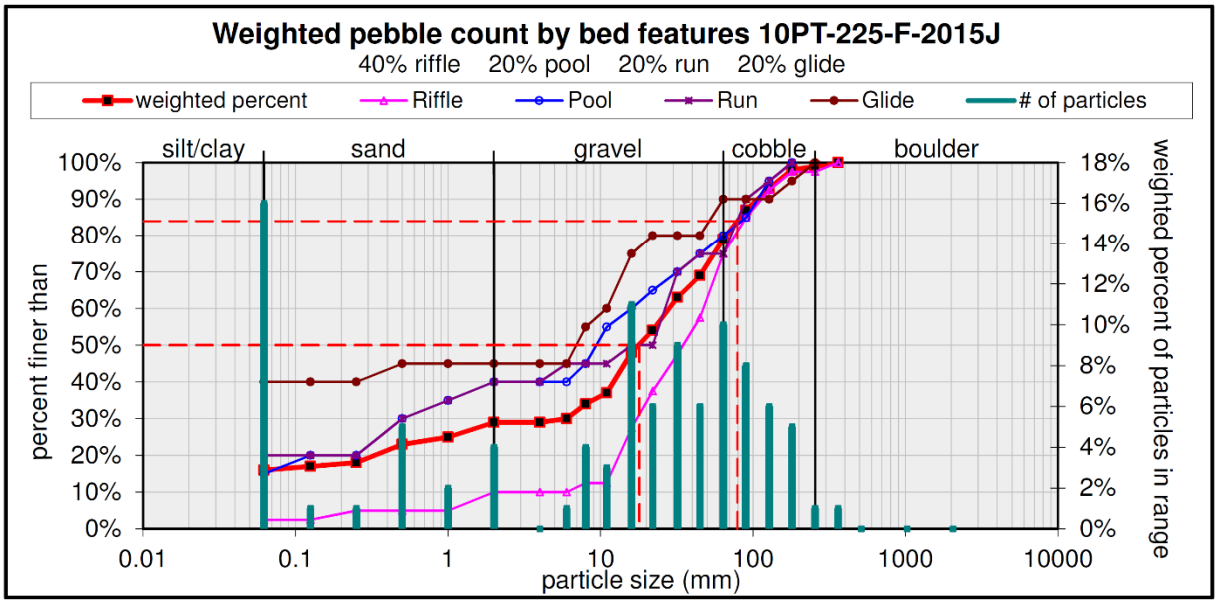
Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
6.5	x-section area (ft.sq.)	14.0	W flood prone area (ft)	4.1	velocity (ft/s)
10.8	width (ft)	1.3	entrenchment ratio	26.7	discharge rate (cfs)
0.6	mean depth (ft)	2.6	low bank height (ft)	3.37	channel slope (%)
1.0	max depth (ft)	2.5	low bank height ratio		
11.3	wetted parimeter (ft)				
0.6	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
17.9	width-depth ratio	0.047	Manning's roughness	1.60	**F4b**



Size (mm)		Size Distribution		Type	
D16	1.4	mean	10.6	silt/clay	5%
D35	20	dispersion	13.3	sand	15%
D50	34	skewness	-0.38	gravel	52%
D65	49			cobble	26%
D84	81			boulder	2%
D95	120				



Bankfull Dimensions		Flood Dimensions		Bankfull Flow	
23.5	x-section area (ft.sq.)	41.6	W flood prone area (ft)	3.4	velocity (ft/s)
18.8	width (ft)	2.2	entrenchment ratio	80.0	discharge rate (cfs)
1.2	mean depth (ft)	3.1	low bank height (ft)	0.66	channel slope (%)
1.8	max depth (ft)	1.8	low bank height ratio		
19.7	wetted parimeter (ft)				
1.2	hyd radi (ft)	Flow Resistance		Sinuosity	Channel Type
15.0	width-depth ratio	0.040	Manning's roughness	1.50	**C4**



Size (mm)		Size Distribution		Type	
D16	0.062	mean	2.2	silt/clay	16%
D35	8.9	dispersion	147.4	sand	13%
D50	18	skewness	-0.52	gravel	50%
D65	36			cobble	20%
D84	79			boulder	1%
D95	150				

APPENDIX F

QUALITY ASSURANCE/QUALITY CONTROL

QUALITY ASSURANCE/QUALITY CONTROL

The biological monitoring program for the Patapsco River Lower Branch A, Patapsco River Lower Branch B, and South Branch Patapsco River subwatersheds includes chemical, physical, and biological assessments conducted throughout the selected PSUs. The sampling methods used are compatible with the Design of the Biological Monitoring and Assessment Program for Howard County Maryland (Tetra Tech, 2001) and the Quality Assurance Project Plan (QAPP) for Howard County Department of Public Works (Tetra Tech, 2001). A summary of the Quality Assurance/Quality Control (QA/QC) procedures and results are presented in this Appendix.

A quality assurance and quality control analysis was completed for the assessment work conducted in the Patapsco River Lower Branch A, Patapsco River Lower Branch B, and South Branch Patapsco River subwatersheds. This analysis included performance characteristics of precision, accuracy, bias and completeness. Performance measures include:

- Precision (consistency) of field sampling and overall site assessments using intra-teamsite duplication
  - median relative percent difference (mRPD)
  - coefficient of variability (CV)
  - 90% confidence interval (CI)
- Bias of sample sorting and subsampling
  - percent sorting efficiency (PSE)
- Completeness
  - number of valid data points obtained as a proportion of those planned (QAPP, 2001).

Data that does not meet performance or acceptable criteria are re-evaluated to correct any problems or investigated further to determine the cause of any discrepancies.

Field Sampling

All field crew members were recently trained in MBSS Spring Sampling protocols prior to the start of field sampling. The field crew leader has received certification in MBSS benthic field protocols. All subjective scoring was completed with the input of all team members at the sampling site to reduce individual sampler bias.

Field water quality measurements were collected *in situ* at all monitoring sites. All *in-situ* parameters were measured with a YSI® multi-probe data storage device. Water quality equipment was regularly inspected, maintained, and calibrated to ensure proper usage and accuracy of the readings. Calibration logs were kept by field crew leaders and checked by the project manager regularly.

Sample jars contained both internal and external labels. All chain-of-custody procedures were followed for transfer of the samples between the field and the identification lab.

Replicate (duplicate) samples were collected at ten percent of the sites (one site for each PSU, three total for the 2013 sampling year). These QC samples were collected to determine the consistency and precision of the sampling procedures and the intra-team adherence to those protocols. QC sites were field-selected rather than randomly selected to ensure that the QC sites maintained similar habitat conditions to the original site. Benthic macroinvertebrate sampling was performed at the duplicate sites.

Duplicate samples were collected at sites 01PA-317-D-2015F, 04PB-103-D-2015A, and 10PT-401-D-2015A. These sites represent varying drainage areas and impervious surface covers. Table 1 identifies the drainage areas and imperviousness for each site.

Table 1. Drainage area and percent imperviousness for sites at which duplicate samples were collected

Site	Drainage Area	Impervious Percent
01PA-317-D-2015F	12,124	17.9
04PB-103-D-2015A	185	17.6
10PT-401-D-2015A	40,550	1.7

Precision

Measures of precision calculated for the consistency of field sampling using intra-team site duplication were:

- Median relative percent difference (mRPD) and relative percent difference (RPD)
- Coefficient of variability (CV)
- 90% confidence interval (CI)

Acceptable measurement quality objectives (MQO) are listed in Table 2. DNR's MBSS protocols were used for the collection and analysis of macroinvertebrate data. In 2005, DNR updated their Benthic Index of Biotic Integrity (BIBI; Southerland et al. 2005). These new metrics were used to calculate the BIBI presented in this report.

Table 2. Measurement quality objectives (QAPP, 2001)			
Metric or Index	**Precision**	**Accuracy**	**Completeness (%)**
GPS		± 25m	100
Macroinvertebrate taxa			100
Metric Scores	RPD ≤ 5%		
Bioassessment Scores	RPD ≤ 5%		
Sorting Efficiency	SE ≥ 90%		

GPS

All GPS points were collected with a Trimble ProXT GPS unit capable of accuracy of within 2 meters. Thus, the accuracy requirement of ± 25 meters was met. A GPS point was collected at all 30 sites, therefore the data meets the 100 percent MQO for completeness.

Biological Assessment

Table 3 includes the results of the QC analysis for the biological metrics and BIBI scores.

Table 3. RPD values for scored BIBI metrics and final BIBI score at sites at which duplicate samples were taken

	Scored Metrics						
	# Taxa	**# Ephemeroptera, Trichoptera, Plecoptera**	**# Ephemeroptera**	**% Intolerant Urban**	**% Chiron-omidae**	**% Clingers**	**BIBI**
01PA-317-R-2015F	5	5	1	1	0	0	3.29
01PA-317-D-2015FDUP	5	5	1	1	0	0	3.00
RPD	0	0	0	0	0	0	9.20
04PB-103-R-2015A	5	3	1	1	1	1	1.67
04PB-103-D-2015ADUP	3	3	1	1	1	1	2.00
RPD	50	0	0	0	0	0	17.90
10PT-401-R-2015A	3	5	5	3	5	3	4.00
10PT-401-D-2015ADUP	3	3	1	3	5	3	3.00
RPD	1	50	50	0	0	0	28.60

A few metric scores fell outside the acceptable range for precision, especially at the site in the South Branch Patapsco subwatershed. In this case, the difference for some metrics was only more than one scoring class (i.e., 1, 3, or 5), which resulted in a very large RPD. In fact, even the smallest incremental difference in metric scores would result in an exceedance of the RPD MQO. The overall BIBI score at this site was significantly higher in the original sample than in the duplicate. More Ephemeroptera, Plecoptera, and Tricoptera species were found in this sample, increasing the scores for two of the five metrics. Additional measures of precision were calculated among the combined QC dataset to evaluate the significance of the differences in individual metric values and scores, as well as in the overall BIBI score.

The BIBI is not scored on a continuous scale, but rather each metric is scored on an incremental scale and these values are averaged to yield the final BIBI score. Additionally, an individual metric value may differ by only one taxa or one percent for a sample pair, but if it falls on either side of a scoring threshold, the resulting difference in metric scores will differ by as much as 50 to 100 percent for RPD.

Due to the overall BIBI score consisting of scaled incremental metrics, the RPD does not reflect the precision well. Additional measures of precision (CV, CI, and mRPD) for the combined sample pair results indicate far better precision than does the RPD. None of the measures calculated deviated significantly from normal, acceptable levels of precision between duplicate sample pairs observed in similar studies (Hill et al. 2005; Gallardo et al. 2006).

All phases of the biological assessment were conducted for every site; therefore the 100 percent completeness MQO is met.

Laboratory Sorting and Subsampling

Only one highly qualified sorter with over 25 years of experience was used to sort the 30 countywide samples. After 10 samples were sorted, the laboratory QC officer randomly selected one sample to resort to check the sorting efficiency of the technician. The target sorting efficiency rate for this project was 90%. The sorting technician saved the sample debris that was originally sorted for each sample and stored it in a separate container for QC purposes. The QC officer resorted the sample portion that was originally sorted and removed, counted, and added any organisms originally missed to the sample vials for identification.

Three samples were resorted by the QC officer for this project since 30 samples were originally processed. All 3 samples passed the QC with a range between 98.44% and 100.00% (Table 4). The average for the 3 samples QC'ed was 98.98%, which was way above the sorting efficiency target of 90%.

SORTING PERCENT ERROR (Table 4)

Serial Number	# Errors	Original Count	Total Count	% Sorting Efficiency
10PT-110-R-2015D	0	119	119	0.00%
01PA-119-F-2015G	2	131	133	1.50%
04PB-214-R-2015E	2	126	128	1.56%
Final Average Error Rate				1.02%

Table 4. Precision calculations for the BIBI, individual metrics, and scores for sites at which duplicate samples were taken

SiteID	# Taxa	# Ephemeroptera, Plecoptera, Tricoptera	# Ephmeroptera	Percent Intolerant Urban	Percent Chironomidae	Percent Clingers	Percent Ephemeroptera	Percent Scrapers	Percent Climbers	BIBI
01PA-317-D-2015FDUP	5	5	1	1			1	5	5	3.29
01PA-317-R-2015F	5	5	1	1			1	5	3	3.00
RPD	0	0	0	0			0	0	50	9.20
04PB-103-D-2015ADUP	3	3	1	1	1	1				1.67
04PB-103-R-2015A	5	3	1	1	1	1				2.00
RPD	50	0	0	0	0	0				17.90
10PT-401-D-2015ADUP	3	3	1	3	5	3				3.00
10PT-401-R-2015A	3	5	5	3	5	3				4.00
RPD	1	50	50	0	0	0				28.60